# Messier Deep-Sky Catalog

A Field Guide to All 110 Objects

*Pavel Sem (pavel.sem@gmail.com) — Edition 2026-09-07 · c8fecba3*

# Charles Messier, 1730–1817

## BADONVILLER TO PARIS

Charles Messier was born on 26 June 1730 in Badonviller, in Lorraine, the tenth of the twelve children of Nicolas Messier, a court usher, and Françoise Grandblaise. Six of his brothers and sisters died young. His father died in 1741, when Charles was eleven, and the boy left school to help the household — the whole of his formal education was over before he had ever looked through a telescope.

Two events fixed his interest. In 1744 the great comet of that year appeared over Badonviller with six visible tails, an apparition that nobody who saw it forgot. Then on 25 July 1748 an annular solar eclipse was visible from his home town. A boy with no instruments and no teacher had seen two of the finest sights the eighteenth-century sky offered.

In October 1751 he went to Paris, and was hired by Joseph-Nicolas Delisle, astronomer of the French Navy — not for any astronomical training, which he did not have, but for his exceptionally fine handwriting. His first task was to copy a large map of China. He was lodged at the Hôtel de Cluny, where Delisle kept his observatory, and Delisle's secretary Libour introduced him to the instruments and taught him the habit that would make his career: to write down every observation carefully, with position and date. His first documented observation was the transit of Mercury on 6 May 1753. From 1754 he was permanently on the Navy's payroll as a clerk.

## LE FURET DES COMÈTES

In 1757 Messier began searching for the return of Halley's Comet. The prediction was still a hypothesis rather than a certainty, and Delisle had computed the comet's apparent track himself. Messier drew a beautiful chart of that track and swept it night after night — but Delisle's calculation was wrong, so he was looking in the wrong place. On 28 August 1758, still hunting, he found a small misty patch in Taurus which he first took for a comet. It did not move. It was the wreck of the supernova of 1054, and it became the first entry in his catalogue.

Halley's Comet was recovered by the German amateur Johann Georg Palitzsch on the night of 25–26 December 1758. Messier found it independently on 21 January 1759, four weeks later, having finally lost faith in his employer's numbers. Delisle refused to accept his own error and would not let the discovery be announced, and when Messier finally reported it — on 1 April 1759 — the astronomers of Paris did not take him seriously. Losing a comet to arithmetic and then to a date is an unpromising start to a career.

Delisle relented afterwards and set his assistant to observe on his own account. Messier went on to discover thirteen comets and co-discovered a fourteenth. He observed the transit of Venus of 6 June 1761. Honours followed: fellow of the Royal Society in 1764, foreign member of the Royal Swedish Academy of Sciences in 1769, and election to the French Academy of Sciences on 30 June 1770. Louis XV gave him the nickname by which he is still known — *le furet des comètes*, the ferret of comets.

## A LIST OF THINGS THAT ARE NOT COMETS

The catalogue was a by-product, and Messier said so. A comet hunter sweeping the same sky repeatedly keeps meeting small diffuse objects that look exactly like a distant comet and never move. Rather than re-examine each one, Messier wrote them down so that he and everyone else could ignore them. His friend and assistant Pierre Méchain, who may have found at least twenty of the objects, worked with him on the list.

He observed with a 100 mm refractor from the Hôtel de Cluny in central Paris — a modest instrument even by the standards of his day, and the reason his catalogue contains bright objects rather than difficult ones. He could only record what that telescope, from that latitude, could reach: the list runs from the north celestial pole down to declination −34.8°, and stops there. It is ordered neither by type nor by position, but by the order in which the objects turned up.

The first version, published in 1774 in the journal of the French Academy of Sciences, held 45 objects, only 17 of them his own discoveries. By 1780 it had grown to 80. The final version, published in 1781 in the 1784 issue of Connaissance des Temps, reached 103. Between 1921 and 1966 historians found evidence of seven more objects observed by Messier or Méchain shortly after publication; these, M104 to M110, are now accepted as part of the catalogue, the last of them added on Kenneth Glyn Jones's suggestion in 1967.

What the list actually contains, in modern terms, is 40 galaxies, 29 globular clusters, 26 open clusters, 7 diffuse nebulae, 4 planetary nebulae, a supernova remnant, a star cloud, an asterism and a double star — a taxonomy Messier had no way of suspecting. He did not know that M31 was another galaxy, or that M1 was the debris of an exploded star, or that M13 held hundreds of thousands of suns. He knew only that they were not comets, and that they stayed put.

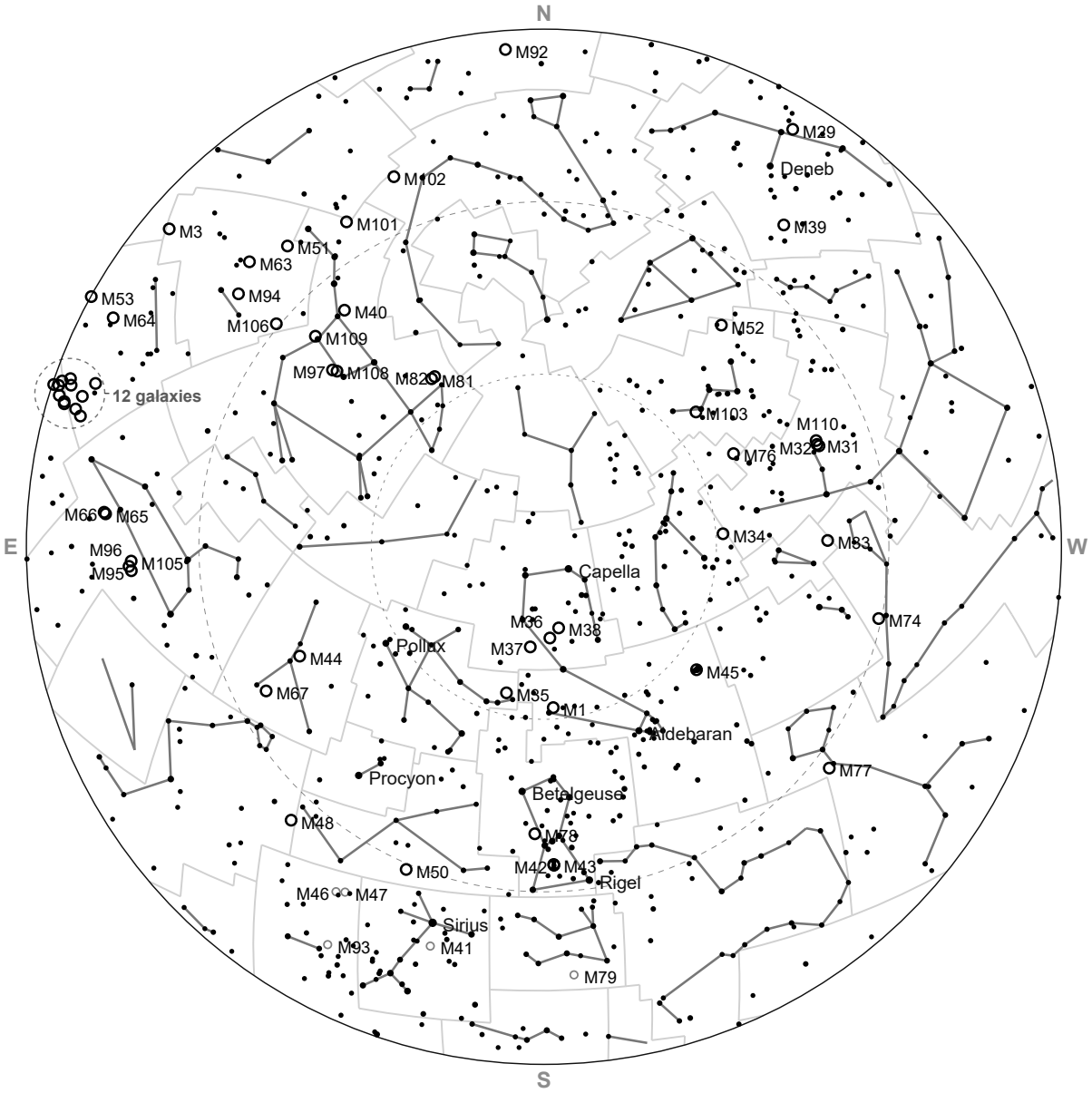
## AFTERWARDS

Messier's later years were less dignified. Near the end of his life he self-published a memoir connecting the great comet of 1769 to the birth of Napoleon, then in power — an exercise in flattery that stooped to astrology in the hope of attention and money. He died on 12 April 1817 and is buried in Père Lachaise cemetery in Paris. The lunar crater Messier and the asteroid 7359 Messier carry his name.

The catalogue has outlived everything else about him. Messier compiled it to save himself trouble; two and a half centuries later it is the standard first tour of the deep sky, the objects still called by his initial and their number, and a list of nuisances has become an itinerary. Almost every amateur astronomer alive has worked through part of it, and some spend a single March night trying to see all 110 before dawn. It is a strange kind of immortality: the man who spent his life chasing comets is remembered for the things that got in his way.

# January

*The sky from 50°N on the 15th at 22:00 CET*



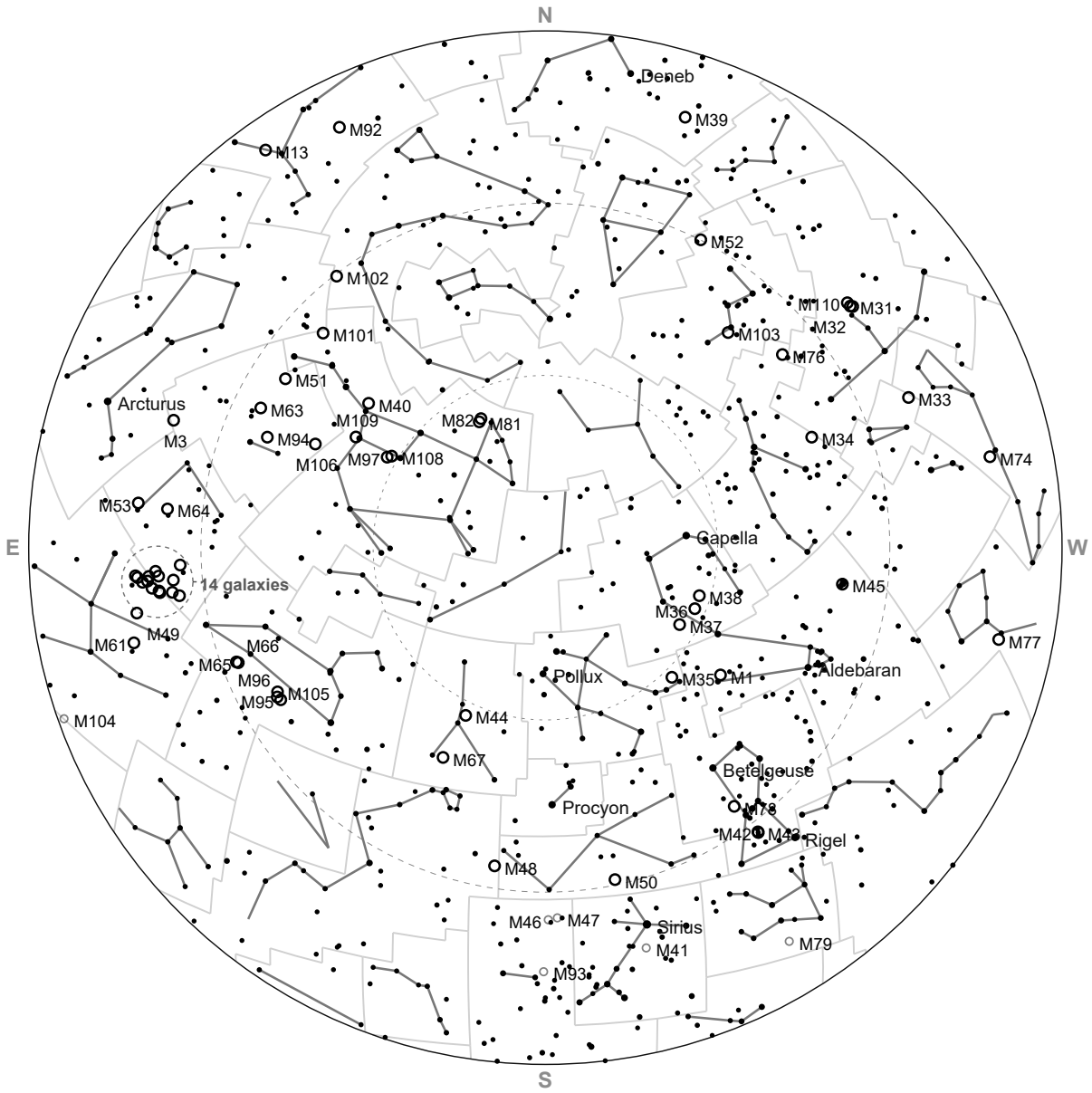

Sunset 16:28 Astronomical darkness 18:24–05:58 Sunrise 07:52

## OBJECTS OF THE NIGHT, BY CATALOGUE NUMBER

| | | | | |
|---|---|---|---|---|
| **M1** | *SNR* | *62° 21:50 S* | *Taurus* | |
| **M3** | *GC* | *68° 06:00 S* | *Canes Venatici* | |
| **M5** | *GC* | *40° 06:30 S* | *Serpens* | |
| **M13** | *GC* | *60° 06:30 E* | *Hercules* | |
| **M29** | *OC* | *36° 17:50 W* | *Cygnus* | |
| **M31** | *Glx* | *78° 17:50 SW* | *Andromeda* | |
| **M32** | *Glx* | *78° 17:50 SW* | *Andromeda* | |
| **M33** | *Glx* | *71° 17:50 S* | *Triangulum* | |
| **M34** | *OC* | **83°** *19:00 S* | *Perseus* | |
| **M35** | *OC* | *64° 22:30 S* | *Gemini* | |
| **M36** | *OC* | *74° 22:00 S* | *Auriga* | |
| **M37** | *OC* | *73° 22:10 S* | *Auriga* | |
| **M38** | *OC* | *76° 21:50 S* | *Auriga* | |
| **M39** | *OC* | *52° 17:50 W* | *Cygnus* | |
| **M40** | *DS* | *82° 04:40 N* | *Ursa Major* | |
| **M42** | *DN* | *35° 21:50 S* | *Orion* | |
| **M43** | *DN* | *35° 21:50 S* | *Orion* | |
| **M44** | *OC* | *60° 01:00 S* | *Cancer* | |
| **M45** | *OC* | *64° 20:10 S* | *Taurus* | |
| **M48** | *OC* | *34° 00:30 S* | *Hydra* | |
| **M49** | *Glx* | *48° 04:50 S* | *Virgo* | |
| **M50** | *OC* | *32° 23:20 S* | *Monoceros* | |
| **M51** | *Glx* | **87°** *05:50 S* | *Canes Venatici* | |
| **M52** | *OC* | *69° 17:50 NW* | *Cassiopeia* | |
| **M53** | *GC* | *58° 05:30 S* | *Coma Berenice* | |
| **M56** | *GC* | *31° 06:30 E* | *Lyra* | |
| **M57** | *PN* | *37° 06:30 E* | *Lyra* | |
| **M58** | *Glx* | *52° 05:00 S* | *Virgo* | |
| **M59** | *Glx* | *52° 05:00 S* | *Virgo* | |
| **M60** | *Glx* | *52° 05:00 S* | *Virgo* | |
| **M61** | *Glx* | *44° 04:40 S* | *Virgo* | |
| **M63** | *Glx* | *82° 05:30 S* | *Canes Venatici* | |
| **M64** | *Glx* | *62° 05:10 S* | *Coma Berenice* | |
| **M65** | *Glx* | *53° 03:40 S* | *Leo* | |
| **M66** | *Glx* | *53° 03:40 S* | *Leo* | |
| **M67** | *OC* | *52° 01:10 S* | *Cancer* | |
| **M74** | *Glx* | *56° 18:00 S* | *Pisces* | |
| **M76** | *PN* | **88°** *18:00 N* | *Perseus* | |
| **M77** | *Glx* | *40° 19:00 S* | *Cetus* | |
| **M78** | *DN* | *40° 22:10 S* | *Orion* | |
| **M81** | *Glx* | *71° 02:10 N* | *Ursa Major* | |
| **M82** | *Glx* | *70° 02:10 N* | *Ursa Major* | |
| **M84** | *Glx* | *53° 04:40 S* | *Virgo* | |
| **M85** | *Glx* | *58° 04:40 S* | *Coma Berenice* | |
| **M86** | *Glx* | *53° 04:40 S* | *Virgo* | |
| **M87** | *Glx* | *52° 04:50 S* | *Virgo* | |
| **M88** | *Glx* | *54° 04:50 S* | *Coma Berenice* | |
| **M89** | *Glx* | *53° 04:50 S* | *Virgo* | |
| **M90** | *Glx* | *53° 04:50 S* | *Virgo* | |
| **M91** | *Glx* | *54° 04:50 S* | *Coma Berenice* | |
| **M92** | *GC* | *58° 06:30 E* | *Hercules* | |
| **M94** | *Glx* | *81° 05:10 S* | *Canes Venatici* | |
| **M95** | *Glx* | *52° 03:00 S* | *Leo* | |
| **M96** | *Glx* | *52° 03:00 S* | *Leo* | |
| **M97** | *PN* | **85°** *03:30 N* | *Ursa Major* | |
| **M98** | *Glx* | *55° 04:30 S* | *Coma Berenice* | |
| **M99** | *Glx* | *54° 04:40 S* | *Coma Berenice* | |
| **M100** | *Glx* | *56° 04:40 S* | *Coma Berenice* | |
| **M101** | *Glx* | **86°** *06:20 N* | *Ursa Major* | |
| **M102** | *Glx* | *80° 06:30 NE* | *Draco* | |
| **M103** | *OC* | *79° 17:50 N* | *Cassiopeia* | |
| **M105** | *Glx* | *53° 03:10 S* | *Leo* | |
| **M106** | *Glx* | **87°** *04:40 S* | *Canes Venatici* | |
| **M108** | *Glx* | **84°** *03:30 N* | *Ursa Major* | |
| **M109** | *Glx* | **87°** *04:20 N* | *Ursa Major* | |
| **M110** | *Glx* | *78° 17:50 SW* | *Andromeda* | |

*Also up, low over the horizon: M2 GC 19° 17:50, M10 GC 25° 06:30, M12 GC 28° 06:30, M14 GC 21° 06:30, M15 GC 28° 17:50, M27 PN 22° 17:50, M41 OC 19° 23:00, M46 OC 25° 00:00, M47 OC 26° 23:50, M68 GC 13° 05:00, M71 GC 18° 17:50, M79 GC 15° 21:40, M93 OC 16° 00:00, M104 Glx 28° 05:00, M107 GC 20° 06:30*

*Altitude and time are the highest the object gets while the sun is below −12°; the chart shows where it stands at 22:00. Faint rings on the chart: objects that never reach 30° all night, listed in the line below. Dashed ring in the table: still below the horizon at 22:00, so not on the chart. DN diffuse nebula · DS double star · GC globular cluster · Glx galaxy · OC open cluster · PN planetary nebula · SNR supernova remnant*



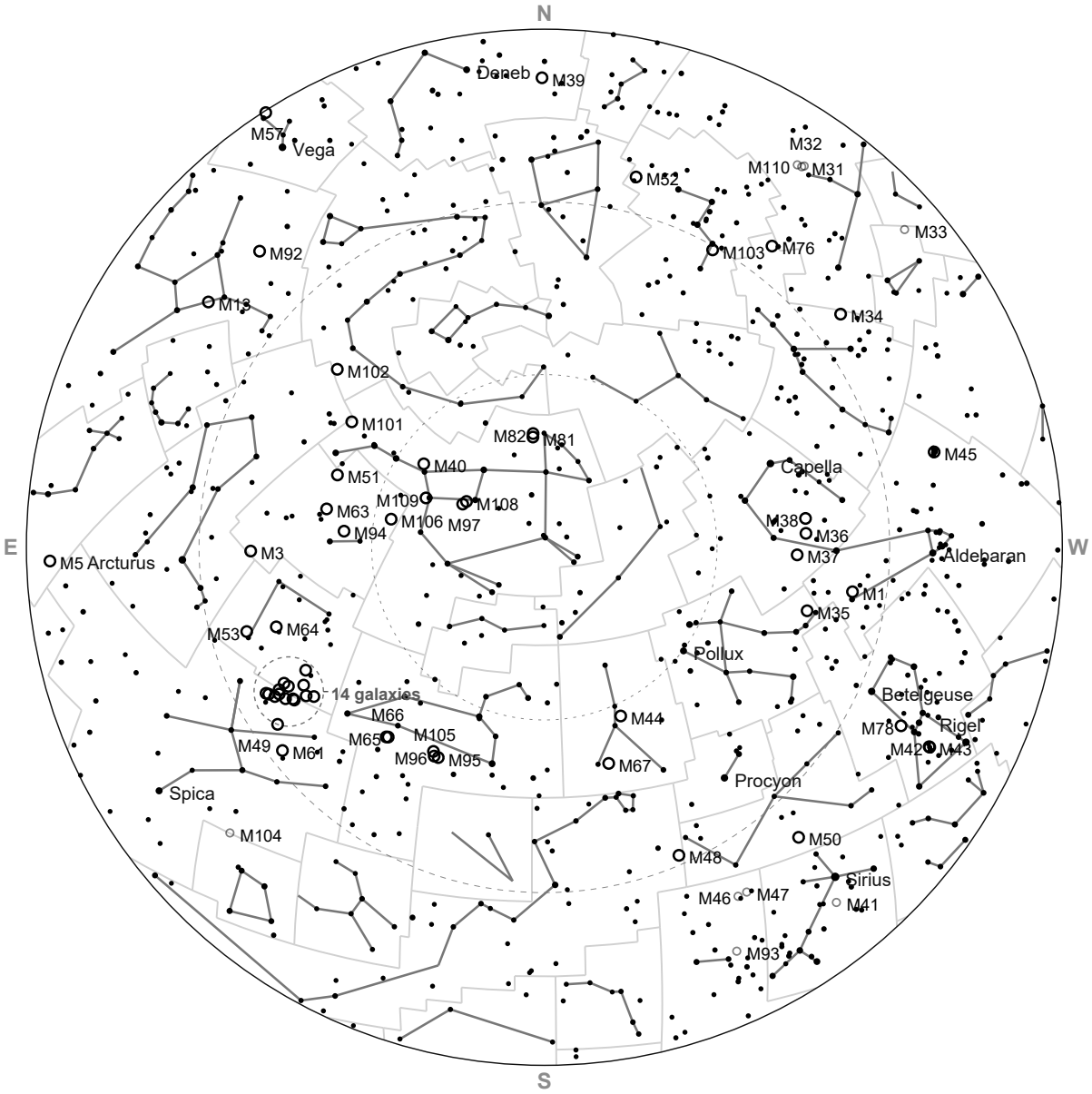

Sunset 17:20 Astronomical darkness 19:08–05:22 Sunrise 07:10

## OBJECTS OF THE NIGHT, BY CATALOGUE NUMBER

| | | | | | |
|---|---|---|---|---|---|
| **M1** | SNR | 62° 19:50 S | Taurus | | |
| **M3** | GC | 68° 04:00 S | Canes Venatici | | |
| **M5** | GC | 42° 05:30 S | Serpens | | |
| **M10** | GC | 33° 05:50 SE | Ophiuchus | | |
| **M12** | GC | 36° 05:50 SE | Ophiuchus | | |
| **M13** | GC | 72° 05:50 SE | Hercules | | |
| **M14** | GC | 31° 05:50 SE | Ophiuchus | | |
| **M27** | PN | 32° 05:50 E | Vulpecula | | |
| **M29** | OC | 39° 05:50 E | Cygnus | | |
| **M31** | Glx | 53° 18:30 W | Andromeda | | |
| **M32** | Glx | 53° 18:30 W | Andromeda | | |
| **M33** | Glx | 55° 18:30 W | Triangulum | | |
| **M34** | OC | 73° 18:30 W | Perseus | | |
| **M35** | OC | 64° 20:30 S | Gemini | | |
| **M36** | OC | 74° 19:50 S | Auriga | | |
| **M37** | OC | 73° 20:10 S | Auriga | | |
| **M38** | OC | 76° 19:50 S | Auriga | | |
| **M39** | OC | 35° 05:50 NE | Cygnus | | |
| **M40** | DS | **82°** 02:40 N | Ursa Major | | |
| **M42** | DN | 35° 19:50 S | Orion | | |
| **M43** | DN | 35° 19:50 S | Orion | | |
| **M44** | OC | 60° 23:00 S | Cancer | | |
| **M45** | OC | 64° 18:30 S | Taurus | | |
| **M48** | OC | 34° 22:30 S | Hydra | | |
| **M49** | Glx | 48° 02:50 S | Virgo | | |
| **M50** | OC | 32° 21:20 S | Monoceros | | |
| **M51** | Glx | **87°** 03:50 S | Canes Venatici | | |
| **M52** | OC | 50° 18:30 NW | Cassiopeia | | |
| **M53** | GC | 58° 03:30 S | Coma Berenice | | |
| **M56** | GC | 44° 05:50 E | Lyra | | |
| **M57** | PN | 50° 05:50 E | Lyra | | |
| **M58** | Glx | 52° 02:50 S | Virgo | | |
| **M59** | Glx | 52° 03:00 S | Virgo | | |
| **M60** | Glx | 52° 03:00 S | Virgo | | |
| **M61** | Glx | 44° 02:40 S | Virgo | | |
| **M63** | Glx | 82° 03:30 S | Canes Venatici | | |
| **M64** | Glx | 62° 03:10 S | Coma Berenice | | |
| **M65** | Glx | 53° 01:30 S | Leo | | |
| **M66** | Glx | 53° 01:40 S | Leo | | |
| **M67** | OC | 52° 23:10 S | Cancer | | |
| **M71** | GC | 30° 05:50 E | Sagitta | | |
| **M74** | Glx | 44° 18:30 SW | Pisces | | |
| **M76** | PN | 66° 18:30 W | Perseus | | |
| **M77** | Glx | 36° 18:30 SW | Cetus | | |
| **M78** | DN | 40° 20:00 S | Orion | | |
| **M81** | Glx | 71° 00:10 N | Ursa Major | | |
| **M82** | Glx | 70° 00:10 N | Ursa Major | | |
| **M84** | Glx | 53° 02:40 S | Virgo | | |
| **M85** | Glx | 58° 02:40 S | Coma Berenice | | |
| **M86** | Glx | 53° 02:40 S | Virgo | | |
| **M87** | Glx | 52° 02:50 S | Virgo | | |
| **M88** | Glx | 54° 02:50 S | Coma Berenice | | |
| **M89** | Glx | 53° 02:50 S | Virgo | | |
| **M90** | Glx | 53° 02:50 S | Virgo | | |
| **M91** | Glx | 54° 02:50 S | Coma Berenice | | |
| **M92** | GC | 71° 05:50 E | Hercules | | |
| **M94** | Glx | 81° 03:10 S | Canes Venatici | | |
| **M95** | Glx | 52° 01:00 S | Leo | | |
| **M96** | Glx | 52° 01:00 S | Leo | | |
| **M97** | PN | **85°** 01:30 N | Ursa Major | | |
| **M98** | Glx | 55° 02:30 S | Coma Berenice | | |
| **M99** | Glx | 54° 02:30 S | Coma Berenice | | |
| **M100** | Glx | 56° 02:40 S | Coma Berenice | | |
| **M101** | Glx | **86°** 04:20 N | Ursa Major | | |
| **M102** | Glx | **84°** 05:20 N | Draco | | |
| **M103** | OC | 65° 18:30 NW | Cassiopeia | | |
| **M105** | Glx | 53° 01:00 S | Leo | | |
| **M106** | Glx | **87°** 02:30 S | Canes Venatici | | |
| **M108** | Glx | **84°** 01:30 N | Ursa Major | | |
| **M109** | Glx | **87°** 02:10 N | Ursa Major | | |
| **M110** | Glx | 53° 18:30 W | Andromeda | | |

*Also up, low over the horizon: M9 GC 18° 05:50, M11 OC 20° 05:50, M16 DN 17° 05:50, M26 OC 18° 05:50, M41 OC 19° 21:00, M46 OC 25° 22:00, M47 OC 26° 21:50, M68 GC 13° 03:00, M79 GC 15° 19:40, M80 GC 16° 05:50, M93 OC 16° 22:00, M104 Glx 28° 03:00, M107 GC 26° 05:50*

*Altitude and time are the highest the object gets while the sun is below −12°; the chart shows where it stands at 22:00. Faint rings on the chart: objects that never reach 30° all night, listed in the line below. Dashed ring in the table: still below the horizon at 22:00, so not on the chart. DN diffuse nebula · DS double star · GC globular cluster · Glx galaxy · OC open cluster · PN planetary nebula · SNR supernova remnant*




Sunset 18:06 Astronomical darkness 19:54–04:24 Sunrise 06:12

## OBJECTS OF THE NIGHT, BY CATALOGUE NUMBER

| | | | | |
|---|---|---|---|---|
| **M1** | SNR | 58° | 19:20 | SW Taurus |
| **M3** | GC | 68° | 02:10 | S Canes Venatici |
| **M5** | GC | 42° | 03:40 | S Serpens |
| **M10** | GC | 36° | 05:00 | S Ophiuchus |
| **M12** | GC | 38° | 05:00 | S Ophiuchus |
| **M13** | GC | 76° | 05:00 | S Hercules |
| **M14** | GC | 35° | 05:00 | S Ophiuchus |
| **M27** | PN | 42° | 05:00 | E Vulpecula |
| **M29** | OC | 49° | 05:00 | E Cygnus |
| **M34** | OC | 47° | 19:20 | W Perseus |
| **M35** | OC | 63° | 19:20 | SW Gemini |
| **M36** | OC | 69° | 19:20 | SW Auriga |
| **M37** | OC | 69° | 19:20 | SW Auriga |
| **M38** | OC | 69° | 19:20 | SW Auriga |
| **M39** | OC | 44° | 05:00 | NE Cygnus |
| **M40** | DS | **82°** | 00:50 | N Ursa Major |
| **M42** | DN | 32° | 19:20 | SW Orion |
| **M43** | DN | 32° | 19:20 | SW Orion |
| **M44** | OC | 60° | 21:10 | S Cancer |
| **M45** | OC | 46° | 19:20 | W Taurus |
| **M48** | OC | 34° | 20:40 | S Hydra |
| **M49** | Glx | 48° | 01:00 | S Virgo |
| **M50** | OC | 32° | 19:30 | S Monoceros |
| **M51** | Glx | **87°** | 02:00 | S Canes Venatici |
| **M52** | OC | 37° | 05:00 | NE Cassiopeia |
| **M53** | GC | 58° | 01:40 | S Coma Berenice |
| **M56** | GC | 54° | 05:00 | E Lyra |
| **M57** | PN | 59° | 05:00 | E Lyra |
| **M58** | Glx | 52° | 01:00 | S Virgo |
| **M59** | Glx | 52° | 01:10 | S Virgo |
| **M60** | Glx | 52° | 01:10 | S Virgo |
| **M61** | Glx | 44° | 00:50 | S Virgo |
| **M63** | Glx | 82° | 01:40 | S Canes Venatici |
| **M64** | Glx | 62° | 01:20 | S Coma Berenice |
| **M65** | Glx | 53° | 23:40 | S Leo |
| **M66** | Glx | 53° | 23:50 | S Leo |
| **M67** | OC | 52° | 21:20 | S Cancer |
| **M71** | GC | 40° | 05:00 | E Sagitta |
| **M76** | PN | 43° | 19:20 | NW Perseus |
| **M78** | DN | 38° | 19:20 | S Orion |
| **M81** | Glx | 71° | 22:20 | N Ursa Major |
| **M82** | Glx | 70° | 22:20 | N Ursa Major |
| **M84** | Glx | 53° | 00:50 | S Virgo |
| **M85** | Glx | 58° | 00:50 | S Coma Berenice |
| **M86** | Glx | 53° | 00:50 | S Virgo |
| **M87** | Glx | 52° | 01:00 | S Virgo |
| **M88** | Glx | 54° | 01:00 | S Coma Berenice |
| **M89** | Glx | 53° | 01:00 | S Virgo |
| **M90** | Glx | 53° | 01:00 | S Virgo |
| **M91** | Glx | 54° | 01:00 | S Coma Berenice |
| **M92** | GC | 80° | 05:00 | SE Hercules |
| **M94** | Glx | 81° | 01:20 | S Canes Venatici |
| **M95** | Glx | 52° | 23:10 | S Leo |
| **M96** | Glx | 52° | 23:10 | S Leo |
| **M97** | PN | **85°** | 23:40 | N Ursa Major |
| **M98** | Glx | 55° | 00:40 | S Coma Berenice |
| **M99** | Glx | 54° | 00:40 | S Coma Berenice |
| **M100** | Glx | 56° | 00:50 | S Coma Berenice |
| **M101** | Glx | **86°** | 02:30 | N Ursa Major |
| **M102** | Glx | **84°** | 03:30 | N Draco |
| **M103** | OC | 46° | 19:20 | NW Cassiopeia |
| **M105** | Glx | 53° | 23:10 | S Leo |
| **M106** | Glx | **87°** | 00:40 | S Canes Venatici |
| **M108** | Glx | **84°** | 23:40 | N Ursa Major |
| **M109** | Glx | **87°** | 00:20 | N Ursa Major |

*Also up, low over the horizon: M9 GC 21° 05:00, M11 OC 26° 05:00, M15 GC 20° 05:00, M16 DN 22° 05:00, M17 DN 20° 05:00, M18 OC 19° 05:00, M23 OC 19° 05:00, M24 SC 18° 05:00, M25 OC 16° 05:00, M26 OC 24° 05:00, M31 Glx 29° 19:20, M32 Glx 29° 19:20, M33 Glx 29° 19:20, M41 OC 19° 19:20, M46 OC 25° 20:10, M47 OC 26° 20:00, M74 Glx 19° 19:20, M77 Glx 17° 19:20, M79 GC 13° 19:20, M80 GC 17° 04:40, M83 Glx 10° 02:00, M93 OC 16° 20:10, M104 Glx 28° 01:10, M107 GC 27° 05:00, M110 Glx 29° 19:20*

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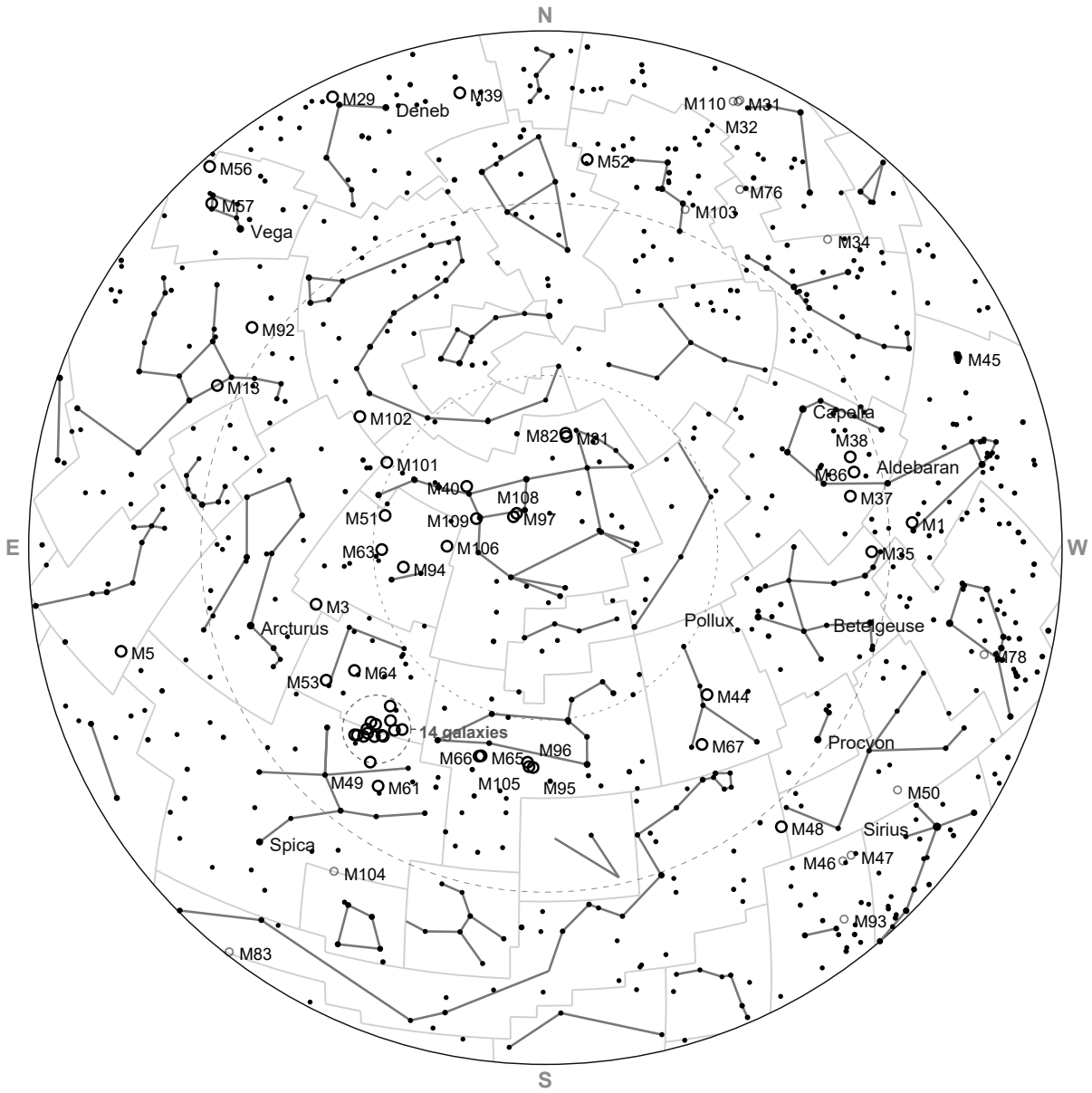


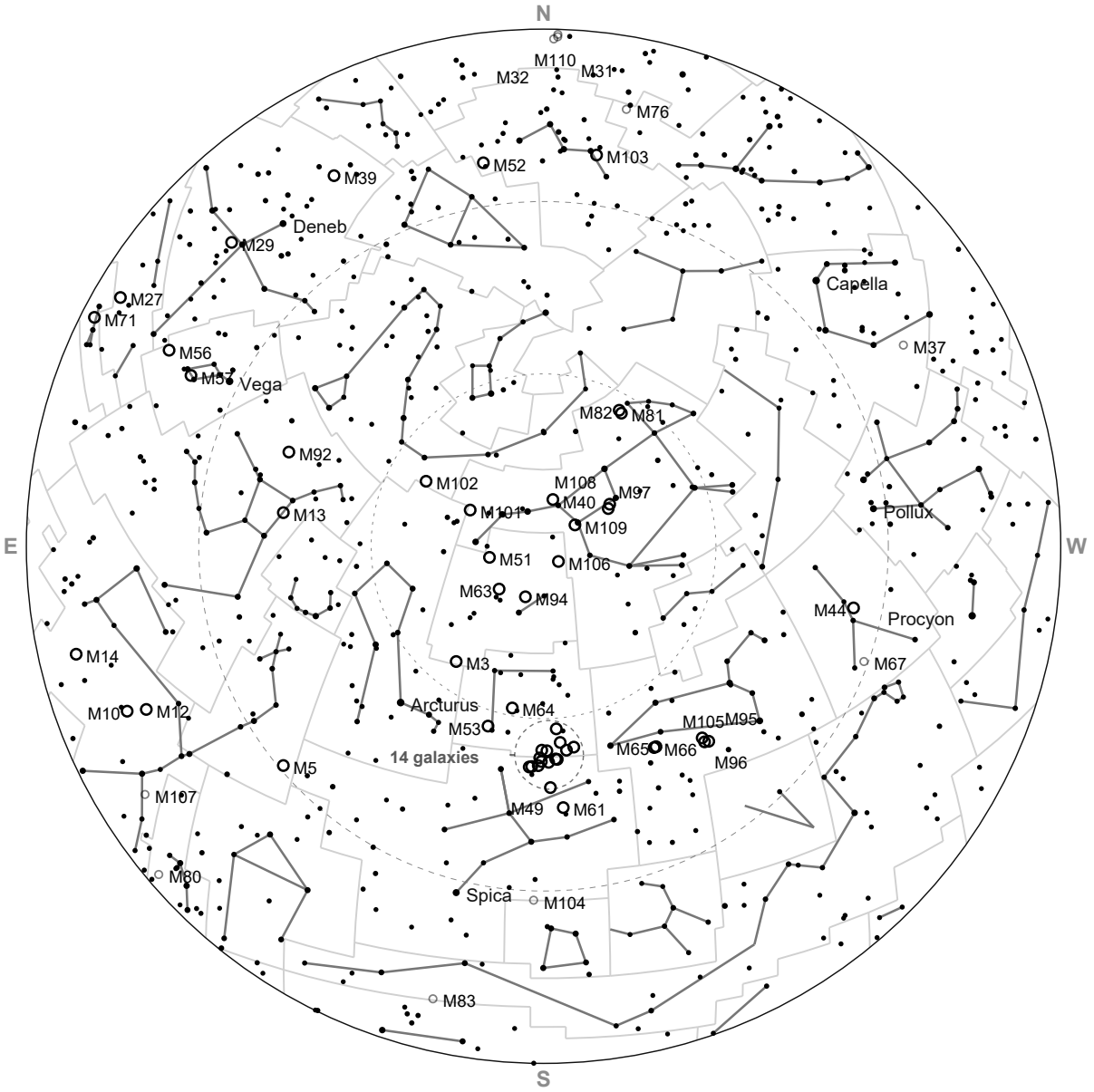

Sunset 19:54 Astronomical darkness 21:58–04:04 Sunrise 06:06

## OBJECTS OF THE NIGHT, BY CATALOGUE NUMBER

| | | | | |
|---|---|---|---|---|
| **M1** | *SNR* | *32° 21:20 W* | *Taurus* | |
| **M3** | *GC* | *68° 01:10 S* | *Canes Venatici* | |
| **M5** | *GC* | *42° 02:40 S* | *Serpens* | |
| **M10** | *GC* | *36° 04:20 S* | *Ophiuchus* | |
| **M11** | *OC* | *30° 04:40 SE* | *Scutum* | |
| **M12** | *GC* | *38° 04:10 S* | *Ophiuchus* | |
| **M13** | *GC* | *76° 04:00 S* | *Hercules* | |
| **M14** | *GC* | *37° 04:40 S* | *Ophiuchus* | |
| **M27** | *PN* | *48° 04:40 SE* | *Vulpecula* | |
| **M29** | *OC* | *55° 04:40 E* | *Cygnus* | |
| **M35** | *OC* | *40° 21:20 W* | *Gemini* | |
| **M36** | *OC* | *41° 21:20 W* | *Auriga* | |
| **M37** | *OC* | *43° 21:20 W* | *Auriga* | |
| **M38** | *OC* | *41° 21:20 W* | *Auriga* | |
| **M39** | *OC* | *50° 04:40 NE* | *Cygnus* | |
| **M40** | *DS* | *82° 23:50 N* | *Ursa Major* | |
| **M44** | *OC* | *56° 21:20 SW* | *Cancer* | |
| **M48** | *OC* | *30° 21:20 SW* | *Hydra* | |
| **M49** | *Glx* | *48° 23:50 S* | *Virgo* | |
| **M51** | *Glx* | **87°** *00:50 S* | *Canes Venatici* | |
| **M52** | *OC* | *42° 04:40 NE* | *Cassiopeia* | |
| **M53** | *GC* | *58° 00:40 S* | *Coma Berenice* | |
| **M56** | *GC* | *60° 04:40 SE* | *Lyra* | |
| **M57** | *PN* | *65° 04:40 SE* | *Lyra* | |
| **M58** | *Glx* | *52° 00:00 S* | *Virgo* | |
| **M59** | *Glx* | *52° 00:10 S* | *Virgo* | |
| **M60** | *Glx* | *52° 00:10 S* | *Virgo* | |
| **M61** | *Glx* | *44° 23:50 S* | *Virgo* | |
| **M63** | *Glx* | *82° 00:40 S* | *Canes Venatici* | |
| **M64** | *Glx* | *62° 00:20 S* | *Coma Berenice* | |
| **M65** | *Glx* | *53° 22:40 S* | *Leo* | |
| **M66** | *Glx* | *53° 22:40 S* | *Leo* | |
| **M67** | *OC* | *50° 21:20 SW* | *Cancer* | |
| **M71** | *GC* | *46° 04:40 SE* | *Sagitta* | |
| **M81** | *Glx* | *71° 21:20 N* | *Ursa Major* | |
| **M82** | *Glx* | *70° 21:20 N* | *Ursa Major* | |
| **M84** | *Glx* | *53° 23:50 S* | *Virgo* | |
| **M85** | *Glx* | *58° 23:50 S* | *Coma Berenice* | |
| **M86** | *Glx* | *53° 23:50 S* | *Virgo* | |
| **M87** | *Glx* | *52° 23:50 S* | *Virgo* | |
| **M88** | *Glx* | *54° 00:00 S* | *Coma Berenice* | |
| **M89** | *Glx* | *53° 00:00 S* | *Virgo* | |
| **M90** | *Glx* | *53° 00:00 S* | *Virgo* | |
| **M91** | *Glx* | *54° 00:00 S* | *Coma Berenice* | |
| **M92** | *GC* | **83°** *04:40 S* | *Hercules* | |
| **M94** | *Glx* | *81° 00:10 S* | *Canes Venatici* | |
| **M95** | *Glx* | *52° 22:10 S* | *Leo* | |
| **M96** | *Glx* | *52° 22:10 S* | *Leo* | |
| **M97** | *PN* | **85°** *22:40 N* | *Ursa Major* | |
| **M98** | *Glx* | *55° 23:40 S* | *Coma Berenice* | |
| **M99** | *Glx* | *54° 23:40 S* | *Coma Berenice* | |
| **M100** | *Glx* | *56° 23:50 S* | *Coma Berenice* | |
| **M101** | *Glx* | **86°** *01:30 N* | *Ursa Major* | |
| **M102** | *Glx* | **84°** *02:30 N* | *Draco* | |
| **M105** | *Glx* | *53° 22:10 S* | *Leo* | |
| **M106** | *Glx* | **87°** *23:40 S* | *Canes Venatici* | |
| **M108** | *Glx* | **84°** *22:40 N* | *Ursa Major* | |
| **M109** | *Glx* | **87°** *23:20 N* | *Ursa Major* | |

*Also up, low over the horizon: M2 GC 16° 04:40, M4 GC 13° 03:50, M9 GC 21° 04:40, M15 GC 26° 04:40, M16 DN 25° 04:40, M17 DN 22° 04:40, M18 OC 21° 04:40, M19 GC 14° 04:30, M20 DN 16° 04:40, M21 OC 17° 04:40, M23 OC 20° 04:40, M24 SC 20° 04:40, M25 OC 19° 04:40, M26 OC 28° 04:40, M31 Glx 19° 04:40, M32 Glx 19° 04:40, M34 OC 22° 21:20, M45 OC 17° 21:20, M46 OC 19° 21:20, M47 OC 19° 21:20, M50 OC 21° 21:20, M62 GC 10° 04:20, M76 PN 22° 21:20, M78 DN 17° 21:20, M80 GC 17° 03:40, M83 Glx 10° 01:00, M93 OC 11° 21:20, M103 OC 29° 04:40, M104 Glx 28° 00:00, M107 GC 27° 04:00, M110 Glx 20° 04:40*

*Altitude and time are the highest the object gets while the sun is below −12°; the chart shows where it stands at 22:00. Faint rings on the chart: objects that never reach 30° all night, listed in the line below. Dashed ring in the table: still below the horizon at 22:00, so not on the chart. DN diffuse nebula · DS double star · GC globular cluster · Glx galaxy · OC open cluster · PN planetary nebula · SC star cloud · SNR supernova remnant*



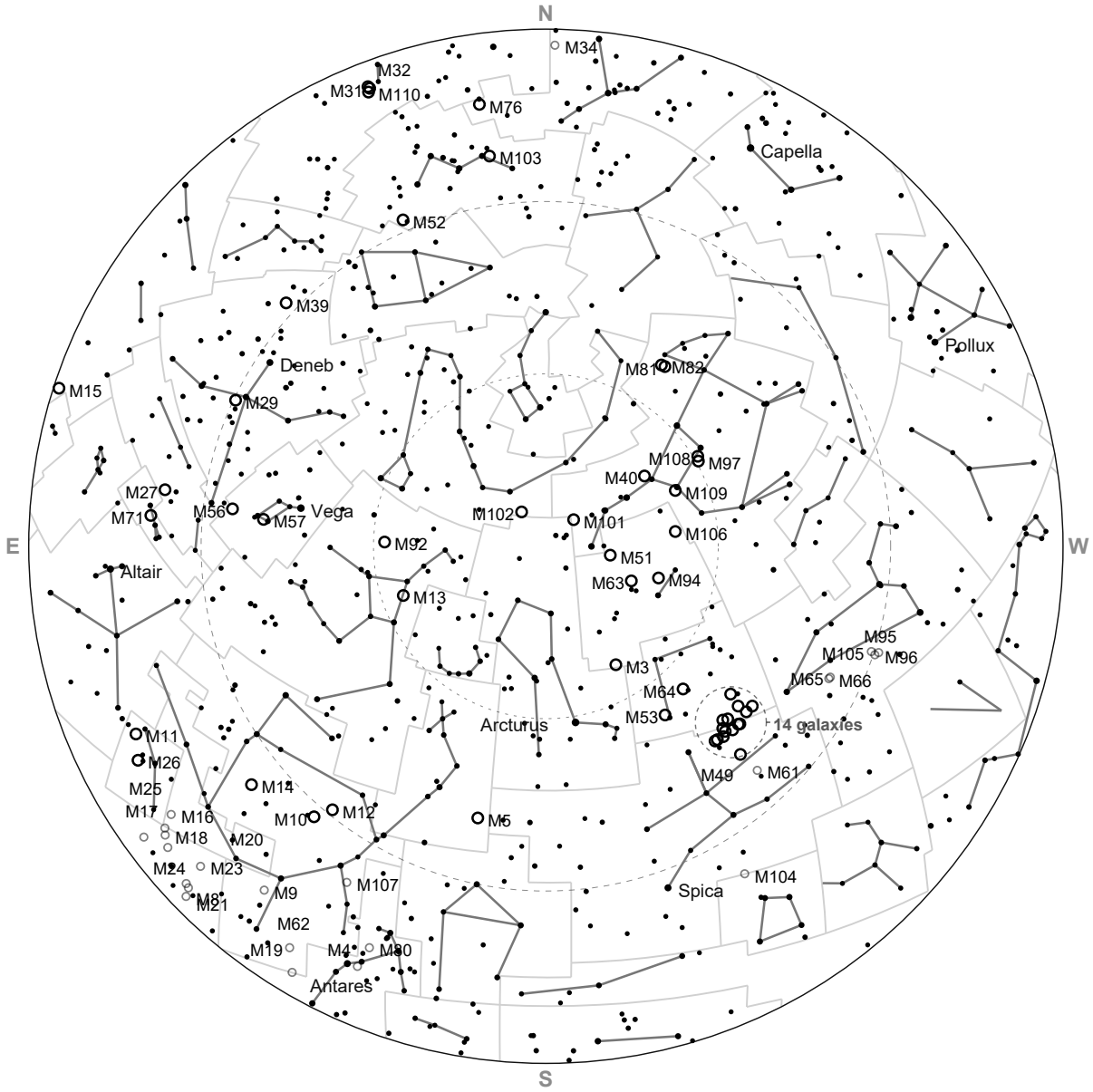

Sunset 20:40 Astronomical darkness 23:24–02:30 Sunrise 05:14

## OBJECTS OF THE NIGHT, BY CATALOGUE NUMBER

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ○ **M3** | *GC* | *68° 23:10 S Canes Venatici* | ○ **M56** | *GC* | *67° 03:40 SE Lyra* | ○ **M89** | *Glx* | *52° 22:20 S Virgo* |
| ○ **M5** | *GC* | *42° 00:40 S Serpens* | ○ **M57** | *PN* | *72° 03:40 SE Lyra* | ○ **M90** | *Glx* | *53° 22:20 S Virgo* |
| ○ **M10** | *GC* | *36° 02:20 S Ophiuchus* | ○ **M58** | *Glx* | *52° 22:20 S Virgo* | ○ **M91** | *Glx* | *54° 22:20 S Coma Berenice* |
| ◌ **M11** | *OC* | *33° 03:40 S Scutum* | ○ **M59** | *Glx* | *52° 22:20 S Virgo* | ○ **M92** | *GC* | **83°** *02:40 S Hercules* |
| ○ **M12** | *GC* | *38° 02:10 S Ophiuchus* | ○ **M60** | *Glx* | *51° 22:20 S Virgo* | ○ **M94** | *Glx* | **81°** *22:20 S Canes Venatici* |
| ○ **M13** | *GC* | *76° 02:10 S Hercules* | ○ **M61** | *Glx* | *44° 22:20 S Virgo* | ○ **M95** | *Glx* | *43° 22:20 SW Leo* |
| ○ **M14** | *GC* | *37° 03:00 S Ophiuchus* | ○ **M63** | *Glx* | **82°** *22:40 S Canes Venatici* | ○ **M96** | *Glx* | *44° 22:20 SW Leo* |
| ◌ **M15** | *GC* | *35° 03:40 SE Pegasus* | ○ **M64** | *Glx* | *62° 22:20 S Coma Berenice* | ○ **M97** | *PN* | *74° 22:20 NW Ursa Major* |
| ◌ **M26** | *OC* | *30° 03:40 S Scutum* | ○ **M65** | *Glx* | *48° 22:20 SW Leo* | ○ **M98** | *Glx* | *54° 22:20 S Coma Berenice* |
| ○ **M27** | *PN* | *56° 03:40 SE Vulpecula* | ○ **M66** | *Glx* | *48° 22:20 SW Leo* | ○ **M99** | *Glx* | *54° 22:20 S Coma Berenice* |
| ○ **M29** | *OC* | *65° 03:40 E Cygnus* | ○ **M71** | *GC* | *53° 03:40 SE Sagitta* | ○ **M100** | *Glx* | *55° 22:20 S Coma Berenice* |
| ○ **M39** | *OC* | *58° 03:40 E Cygnus* | ○ **M81** | *Glx* | *61° 22:20 NW Ursa Major* | ○ **M101** | *Glx* | **86°** *23:30 N Ursa Major* |
| ○ **M40** | *DS* | **81°** *22:20 NW Ursa Major* | ○ **M82** | *Glx* | *61° 22:20 NW Ursa Major* | ○ **M102** | *Glx* | **84°** *00:30 N Draco* |
| ○ **M44** | *OC* | *32° 22:20 W Cancer* | ○ **M84** | *Glx* | *52° 22:20 S Virgo* | ○ **M103** | *OC* | *34° 03:40 NE Cassiopeia* |
| ○ **M49** | *Glx* | *48° 22:20 S Virgo* | ○ **M85** | *Glx* | *58° 22:20 S Coma Berenice* | ○ **M105** | *Glx* | *45° 22:20 SW Leo* |
| ○ **M51** | *Glx* | **87°** *23:00 S Canes Venatici* | ○ **M86** | *Glx* | *53° 22:20 S Virgo* | ○ **M106** | *Glx* | **84°** *22:20 W Canes Venatici* |
| ○ **M52** | *OC* | *48° 03:40 NE Cassiopeia* | ○ **M87** | *Glx* | *52° 22:20 S Virgo* | ○ **M108** | *Glx* | *74° 22:20 NW Ursa Major* |
| ○ **M53** | *GC* | *58° 22:40 S Coma Berenice* | ○ **M88** | *Glx* | *54° 22:20 S Coma Berenice* | ○ **M109** | *Glx* | *81° 22:20 NW Ursa Major* |

*Also up, low over the horizon: M2 GC 24° 03:40, M4 GC 13° 01:50, M6 OC 8° 03:10, M8 DN 16° 03:30, M9 GC 21° 02:40, M16 DN 26° 03:40, M17 DN 24° 03:40, M18 OC 23° 03:40, M19 GC 14° 02:30, M20 DN 17° 03:30, M21 OC 18° 03:30, M22 GC 16° 03:40, M23 OC 21° 03:20, M24 SC 21° 03:40, M25 OC 21° 03:40, M28 GC 15° 03:40, M31 Glx 27° 03:40, M32 Glx 26° 03:40, M37 OC 16° 22:20, M62 GC 10° 02:30, M67 OC 28° 22:20, M72 GC 19° 03:40, M73 Ast 18° 03:40, M76 PN 27° 03:40, M80 GC 17° 01:40, M83 Glx 10° 23:00, M104 Glx 28° 22:20, M107 GC 27° 02:00, M110 Glx 27° 03:40*

*Altitude and time are the highest the object gets while the sun is below −12°; the chart shows where it stands at 22:00. Faint rings on the chart: objects that never reach 30° all night, listed in the line below. Dashed ring in the table: still below the horizon at 22:00, so not on the chart. Ast asterism · DN diffuse nebula · DS double star · GC globular cluster · Glx galaxy · OC open cluster · PN planetary nebula · SC star cloud*



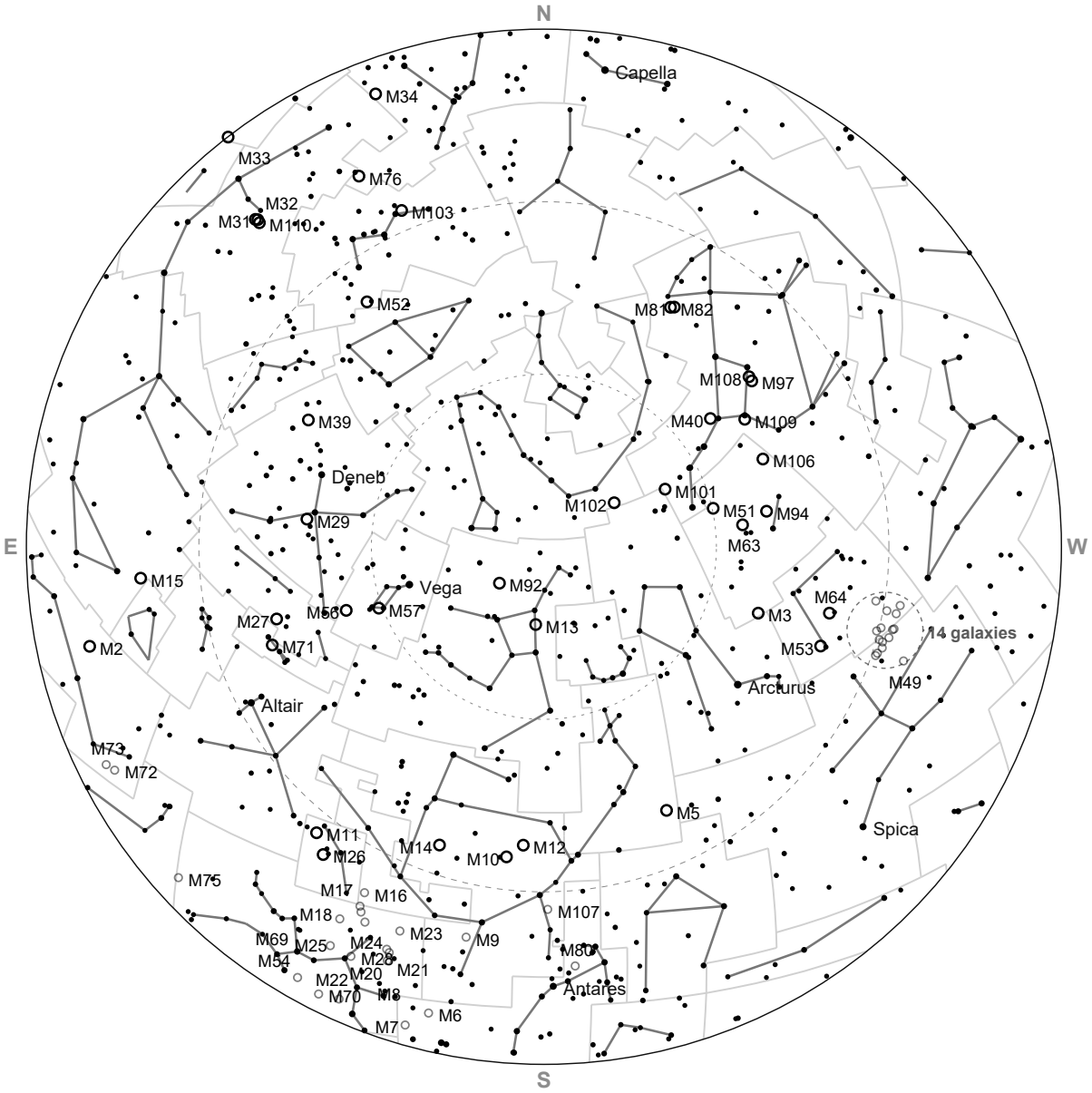

Sunset 21:12 Astronomical darkness none — bright summer nights Sunrise 04:52

## OBJECTS OF THE NIGHT, BY CATALOGUE NUMBER

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ◌ **M2** | *GC* | *33° 03:00 SE Aquarius* | ○ **M52** | *OC* | *57° 03:00 NE Cassiopeia* | ○ **M89** | *Glx* | *36° 23:10 SW Virgo* |
| ○ **M3** | *GC* | *58° 23:10 SW Canes Venati* | ○ **M53** | *GC* | *46° 23:10 SW Coma Berenic* | ○ **M90** | *Glx* | *37° 23:10 SW Virgo* |
| ○ **M5** | *GC* | *42° 23:10 S Serpens* | ○ **M56** | *GC* | **70°** *02:40 S Lyra* | ○ **M91** | *Glx* | *38° 23:10 SW Coma Berenic* |
| ○ **M10** | *GC* | *36° 00:20 S Ophiuchus* | ○ **M57** | *PN* | **73°** *02:20 S Lyra* | ○ **M92** | *GC* | **83°** *00:40 S Hercules* |
| ○ **M11** | *OC* | *34° 02:10 S Scutum* | ○ **M58** | *Glx* | *36° 23:10 SW Virgo* | ○ **M94** | *Glx* | *58° 23:10 W Canes Venatici* |
| ○ **M12** | *GC* | *38° 00:10 S Ophiuchus* | ○ **M59** | *Glx* | *36° 23:10 SW Virgo* | ○ **M97** | *PN* | *50° 23:10 NW Ursa Major* |
| ○ **M13** | *GC* | **76°** *00:00 S Hercules* | ○ **M60** | *Glx* | *36° 23:10 SW Virgo* | ○ **M98** | *Glx* | *35° 23:10 W Coma Berenice* |
| ○ **M14** | *GC* | *37° 01:00 S Ophiuchus* | ○ **M63** | *Glx* | *63° 23:10 W Canes Venatici* | ○ **M99** | *Glx* | *35° 23:10 W Coma Berenice* |
| ○ **M15** | *GC* | *46° 03:00 SE Pegasus* | ○ **M64** | *Glx* | *46° 23:10 SW Coma Berenic* | ○ **M100** | *Glx* | *37° 23:10 W Coma Berenice* |
| ○ **M26** | *OC* | *31° 02:10 S Scutum* | ○ **M71** | *GC* | *59° 03:00 S Sagitta* | ○ **M101** | *Glx* | **74°** *23:10 NW Ursa Major* |
| ○ **M27** | *PN* | *62° 03:00 S Vulpecula* | ○ **M76** | *PN* | *36° 03:00 NE Perseus* | ○ **M102** | *Glx* | **82°** *23:10 NW Draco* |
| ○ **M29** | *OC* | **76°** *03:00 SE Cygnus* | ○ **M81** | *Glx* | *46° 23:10 NW Ursa Major* | ○ **M103** | *OC* | *42° 03:00 NE Cassiopeia* |
| ○ **M31** | *Glx* | *38° 03:00 E Andromeda* | ○ **M82** | *Glx* | *47° 23:10 NW Ursa Major* | ○ **M106** | *Glx* | *56° 23:10 W Canes Venatici* |
| ○ **M32** | *Glx* | *38° 03:00 E Andromeda* | ○ **M84** | *Glx* | *35° 23:10 SW Virgo* | ○ **M108** | *Glx* | *50° 23:10 NW Ursa Major* |
| ○ **M39** | *OC* | **71°** *03:00 E Cygnus* | ○ **M85** | *Glx* | *39° 23:10 W Coma Berenice* | ○ **M109** | *Glx* | *55° 23:10 NW Ursa Major* |
| ○ **M40** | *DS* | *60° 23:10 NW Ursa Major* | ○ **M86** | *Glx* | *35° 23:10 SW Virgo* | ○ **M110** | *Glx* | *39° 03:00 E Andromeda* |
| ○ **M49** | *Glx* | *31° 23:10 SW Virgo* | ○ **M87** | *Glx* | *35° 23:10 SW Virgo* | | | |
| ○ **M51** | *Glx* | *67° 23:10 W Canes Venatici* | ○ **M88** | *Glx* | *37° 23:10 SW Coma Berenic* | | | |

*Also up, low over the horizon: M4 GC 13° 23:50, M6 OC 8° 01:00, M7 OC 5° 01:20, M8 DN 16° 01:30, M9 GC 21° 00:40, M16 DN 26° 01:40, M17 DN 24° 01:40, M18 OC 23° 01:40, M19 GC 14° 00:30, M20 DN 17° 01:30, M21 OC 18° 01:30, M22 GC 16° 02:00, M23 OC 21° 01:20, M24 SC 21° 01:40, M25 OC 21° 01:50, M28 GC 15° 01:50, M33 Glx 23° 03:00, M34 OC 23° 03:00, M54 GC 10° 02:20, M61 Glx 27° 23:10, M62 GC 10° 00:20, M65 Glx 25° 23:10, M66 Glx 25° 23:10, M69 GC 8° 01:50, M70 GC 8° 02:10, M72 GC 25° 03:00, M73 Ast 25° 03:00, M75 GC 18° 03:00, M80 GC 17° 23:40, M95 Glx 18° 23:10, M96 Glx 19° 23:10, M104 Glx 16° 23:10, M105 Glx 19° 23:10, M107 GC 27° 00:00*

*Altitude and time are the highest the object gets while the sun is below −12°; the chart shows where it stands at 22:00. Faint rings on the chart: objects that never reach 30° all night, listed in the line below. Dashed ring in the table: still below the horizon at 22:00, so not on the chart. Ast asterism · DN diffuse nebula · DS double star · GC globular cluster · Glx galaxy · OC open cluster · PN planetary nebula · SC star cloud*



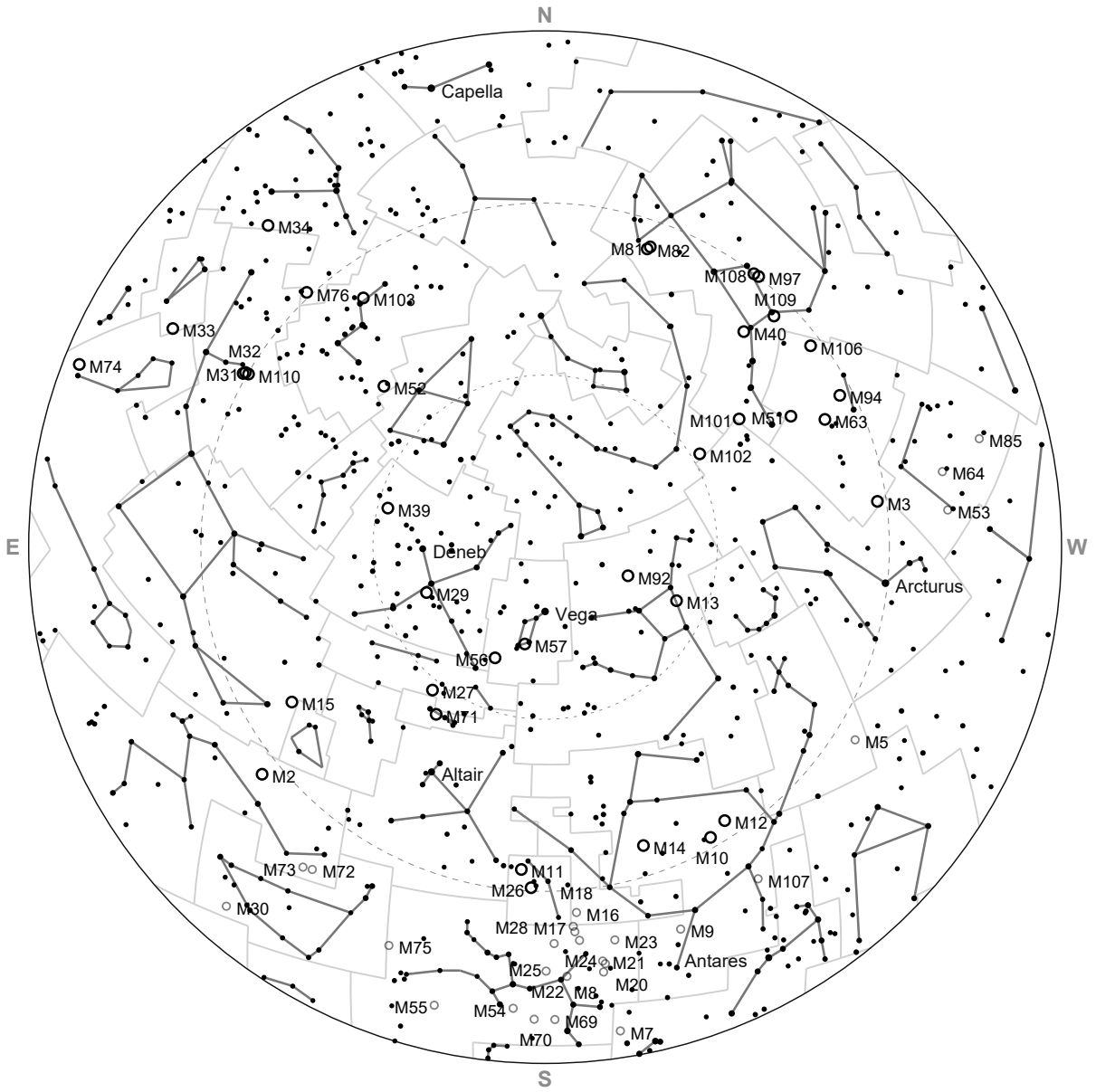

Sunset 21:04 Astronomical darkness 00:26–01:50 Sunrise 05:10

## OBJECTS OF THE NIGHT, BY CATALOGUE NUMBER

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ○ **M2** | *GC* | *39° 03:00 S Aquarius* | ○ **M33** | *Glx* | *45° 03:20 E Triangulum* | ○ **M81** | *Glx* | *39° 22:50 NW Ursa Major* |
| ○ **M3** | *GC* | *43° 22:50 W Canes Venatici* | ○ **M34** | *OC* | *42° 03:20 E Perseus* | ○ **M82** | *Glx* | *39° 22:50 NW Ursa Major* |
| ○ **M5** | *GC* | *35° 22:50 SW Serpens* | ○ **M39** | *OC* | **88°** *03:00 S Cygnus* | ○ **M92** | *GC* | **83°** *22:50 S Hercules* |
| ○ **M10** | *GC* | *36° 22:50 S Ophiuchus* | ○ **M40** | *DS* | *47° 22:50 NW Ursa Major* | ○ **M94** | *Glx* | *43° 22:50 W Canes Venatici* |
| ○ **M11** | *OC* | *34° 00:20 S Scutum* | ○ **M51** | *Glx* | *52° 22:50 W Canes Venatici* | ○ **M97** | *PN* | *38° 22:50 NW Ursa Major* |
| ○ **M12** | *GC* | *37° 22:50 S Ophiuchus* | ○ **M52** | *OC* | **73°** *03:20 NE Cassiopeia* | ○ **M101** | *Glx* | *59° 22:50 NW Ursa Major* |
| ○ **M13** | *GC* | **74°** *22:50 SW Hercules* | ○ **M53** | *GC* | *31° 22:50 W Coma Berenice* | ○ **M102** | *Glx* | **69°** *22:50 NW Draco* |
| ○ **M14** | *GC* | *37° 23:00 S Ophiuchus* | ○ **M56** | *GC* | **70°** *00:40 S Lyra* | ○ **M103** | *OC* | *58° 03:20 NE Cassiopeia* |
| ○ **M15** | *GC* | *52° 02:50 S Pegasus* | ○ **M57** | *PN* | **73°** *00:20 S Lyra* | ○ **M106** | *Glx* | *42° 22:50 NW Canes Venati* |
| ○ **M26** | *OC* | *31° 00:10 S Scutum* | ○ **M63** | *Glx* | *47° 22:50 W Canes Venatici* | ○ **M108** | *Glx* | *38° 22:50 NW Ursa Major* |
| ○ **M27** | *PN* | *63° 01:20 S Vulpecula* | ○ **M64** | *Glx* | *31° 22:50 W Coma Berenice* | ○ **M109** | *Glx* | *42° 22:50 NW Ursa Major* |
| ○ **M29** | *OC* | **79°** *01:50 S Cygnus* | ○ **M71** | *GC* | *59° 01:20 S Sagitta* | ○ **M110** | *Glx* | *61° 03:20 E Andromeda* |
| ○ **M31** | *Glx* | *60° 03:20 E Andromeda* | ◌ **M74** | *Glx* | *34° 03:20 E Pisces* | | | |
| ○ **M32** | *Glx* | *60° 03:20 E Andromeda* | ○ **M76** | *PN* | *55° 03:20 NE Perseus* | | | |

*Also up, low over the horizon: M6 OC 8° 23:10, M7 OC 5° 23:20, M8 DN 16° 23:30, M9 GC 21° 22:50, M16 DN 26° 23:40, M17 DN 24° 23:50, M18 OC 23° 23:40, M20 DN 17° 23:30, M21 OC 18° 23:30, M22 GC 16° 00:00, M23 OC 21° 23:20, M24 SC 21° 23:40, M25 OC 21° 00:00, M28 GC 15° 23:50, M30 GC 17° 03:00, M45 OC 20° 03:20, M49 Glx 17° 22:50, M54 GC 10° 00:20, M58 Glx 21° 22:50, M59 Glx 21° 22:50, M60 Glx 21° 22:50, M69 GC 8° 00:00, M70 GC 8° 00:10, M72 GC 27° 02:20, M73 Ast 27° 02:20, M75 GC 18° 01:30, M80 GC 15° 22:50, M84 Glx 19° 22:50, M85 Glx 23° 22:50, M86 Glx 20° 22:50, M87 Glx 20° 22:50, M88 Glx 22° 22:50, M89 Glx 21° 22:50, M90 Glx 22° 22:50, M91 Glx 22° 22:50, M98 Glx 19° 22:50, M99 Glx 20° 22:50, M100 Glx 21° 22:50, M107 GC 26° 22:50*

*Altitude and time are the highest the object gets while the sun is below −12°; the chart shows where it stands at 22:00. Faint rings on the chart: objects that never reach 30° all night, listed in the line below. Dashed ring in the table: still below the horizon at 22:00, so not on the chart. Ast asterism · DN diffuse nebula · DS double star · GC globular cluster · Glx galaxy · OC open cluster · PN planetary nebula · SC star cloud*




Sunset 20:20 Astronomical darkness 22:34–03:38 Sunrise 05:52

## OBJECTS OF THE NIGHT, BY CATALOGUE NUMBER

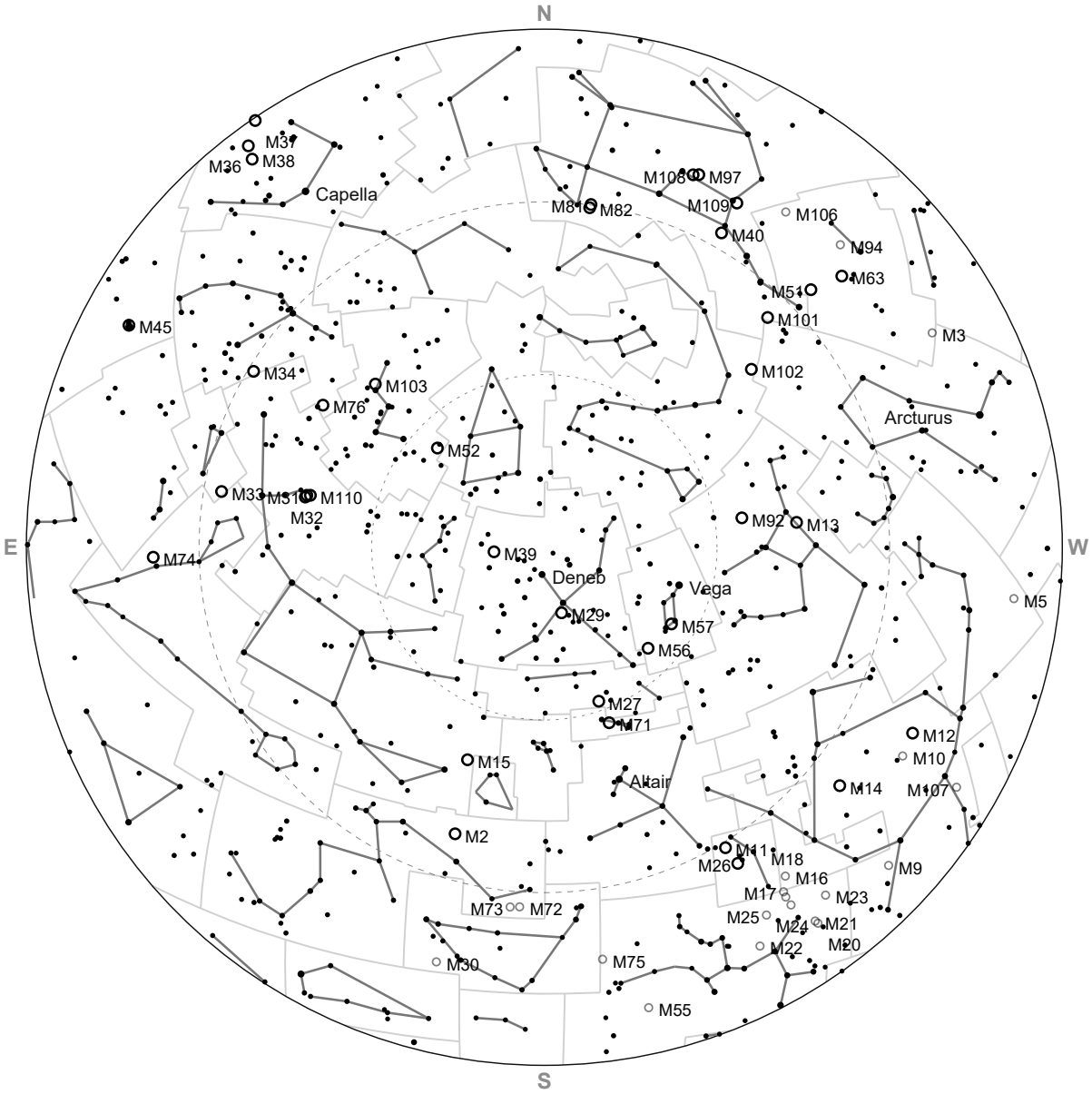
| | | | | |
|---|---|---|---|---|
| ◌ **M1** | *SNR* | *30° 04:20 E Taurus* | ○ **M34** | *OC* |
| ○ **M2** | *GC* | *39° 01:00 S Aquarius* | ◌ **M36** | *OC* |
| ○ **M3** | *GC* | *35° 21:40 W Canes Venatici* | ◌ **M37** | *OC* |
| ○ **M10** | *GC* | *33° 21:40 SW Ophiuchus* | ◌ **M38** | *OC* |
| ○ **M11** | *OC* | *34° 22:10 S Scutum* | ○ **M39** | *OC* |
| ○ **M12** | *GC* | *35° 21:40 SW Ophiuchus* | ○ **M40** | *DS* |
| ○ **M13** | *GC* | *68° 21:40 SW Hercules* | ◌ **M45** | *OC* |
| ○ **M14** | *GC* | *36° 21:40 S Ophiuchus* | ○ **M51** | *Glx* |
| ○ **M15** | *GC* | *52° 00:50 S Pegasus* | ○ **M52** | *OC* |
| ○ **M26** | *OC* | *31° 22:10 S Scutum* | ○ **M56** | *GC* |
| ○ **M27** | *PN* | *63° 23:20 S Vulpecula* | ○ **M57** | *PN* |
| ○ **M29** | *OC* | **79°** *23:50 S Cygnus* | ○ **M63** | *Glx* |
| ○ **M31** | *Glx* | **81°** *04:00 S Andromeda* | ○ **M71** | *GC* |
| ○ **M32** | *Glx* | **81°** *04:00 S Andromeda* | ○ **M74** | *Glx* |
| ○ **M33** | *Glx* | *70° 04:20 SE Triangulum* | ○ **M76** | *PN* |

| | | |
|---|---|---|
| *71° 04:20 E Perseus* | ◌ **M77** | *Glx* |
| *38° 04:20 E Auriga* | ○ **M81** | *Glx* |
| *34° 04:20 E Auriga* | ○ **M82** | *Glx* |
| *40° 04:20 E Auriga* | ○ **M92** | *GC* |
| **88°** *00:50 SE Cygnus* | ○ **M94** | *Glx* |
| *41° 21:40 NW Ursa Major* | ○ **M97** | *PN* |
| *48° 04:20 SE Taurus* | ○ **M101** | *Glx* |
| *44° 21:40 NW Canes Venati* | ○ **M102** | *Glx* |
| **78°** *02:50 N Cassiopeia* | ○ **M103** | *OC* |
| *70° 22:40 S Lyra* | ○ **M106** | *Glx* |
| *73° 22:20 S Lyra* | ○ **M108** | *Glx* |
| *39° 21:40 W Canes Venatici* | ○ **M109** | *Glx* |
| *59° 23:20 S Sagitta* | ○ **M110** | *Glx* |
| *55° 04:20 S Pisces* | | |
| **83°** *04:20 E Perseus* | | |

| | | |
|---|---|---|
| *35° 04:20 SE Cetus* | | |
| *36° 21:40 N Ursa Major* | | |
| *36° 21:40 N Ursa Major* | | |
| **78°** *21:40 SW Hercules* | | |
| *35° 21:40 NW Canes Venati* | | |
| *32° 21:40 NW Ursa Major* | | |
| *52° 21:40 NW Ursa Major* | | |
| *61° 21:40 NW Draco* | | |
| *78° 04:20 N Cassiopeia* | | |
| *35° 21:40 NW Canes Venati* | | |
| *32° 21:40 NW Ursa Major* | | |
| *36° 21:40 NW Ursa Major* | | |
| **82°** *04:00 S Andromeda* | | |

*Also up, low over the horizon: M5 GC 29° 21:40, M7 OC 5° 21:40, M8 DN 16° 21:40, M9 GC 20° 21:40, M16 DN 26° 21:40, M17 DN 24° 21:40, M18 OC 23° 21:40, M20 DN 17° 21:40, M21 OC 17° 21:40, M22 GC 16° 22:00, M23 OC 21° 21:40, M24 SC 21° 21:40, M25 OC 21° 21:50, M28 GC 15° 21:50, M30 GC 17° 01:00, M35 OC 26° 04:20, M53 GC 23° 21:40, M54 GC 10° 22:20, M55 GC 9° 23:00, M64 Glx 23° 21:40, M69 GC 8° 21:50, M70 GC 8° 22:10, M72 GC 27° 00:20, M73 Ast 27° 00:20, M75 GC 18° 23:30, M85 Glx 15° 21:40, M107 GC 23° 21:40*

*Altitude and time are the highest the object gets while the sun is below −12°; the chart shows where it stands at 22:00. Faint rings on the chart: objects that never reach 30° all night, listed in the line below. Dashed ring in the table: still below the horizon at 22:00, so not on the chart. Ast asterism · DN diffuse nebula · DS double star · GC globular cluster · Glx galaxy · OC open cluster · PN planetary nebula · SC star cloud · SNR supernova remnant*



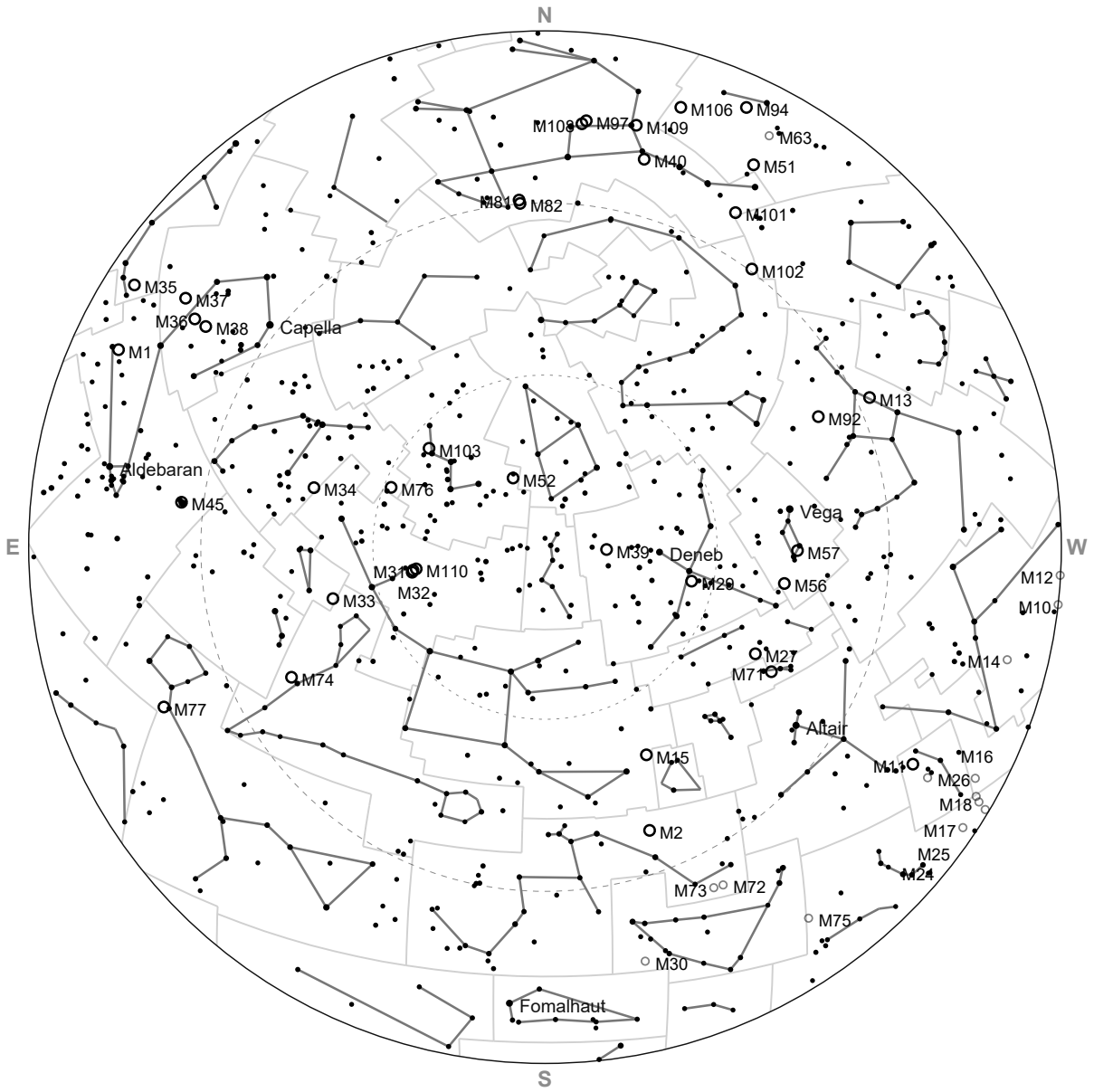

Sunset 19:14 Astronomical darkness 21:06–04:46 Sunrise 06:38

## OBJECTS OF THE NIGHT, BY CATALOGUE NUMBER

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ◌ **M1** | *SNR* | *56° 05:20 SE Taurus* | ○ **M36** | *OC* | *66° 05:20 SE Auriga* | ○ **M76** | *PN* | **88°** *03:00 N Perseus* |
| ○ **M2** | *GC* | *39° 22:50 S Aquarius* | ○ **M37** | *OC* | *63° 05:20 SE Auriga* | ◌ **M77** | *Glx* | *40° 04:00 S Cetus* |
| ○ **M11** | *OC* | *34° 20:30 S Scutum* | ○ **M38** | *OC* | *69° 05:20 SE Auriga* | ◌ **M78** | *DN* | *35° 05:20 SE Orion* |
| ○ **M12** | *GC* | *30° 20:30 SW Ophiuchus* | ○ **M39** | *OC* | **88°** *22:50 S Cygnus* | ○ **M81** | *Glx* | *46° 05:20 NE Ursa Major* |
| ○ **M13** | *GC* | *60° 20:30 W Hercules* | ○ **M40** | *DS* | *36° 20:30 NW Ursa Major* | ○ **M82** | *Glx* | *46° 05:20 NE Ursa Major* |
| ○ **M14** | *GC* | *33° 20:30 SW Ophiuchus* | ◌ **M42** | *DN* | *31° 05:20 SE Orion* | ○ **M92** | *GC* | *70° 20:30 W Hercules* |
| ○ **M15** | *GC* | *52° 22:50 S Pegasus* | ◌ **M43** | *DN* | *31° 05:20 SE Orion* | ○ **M97** | *PN* | *31° 05:20 NE Ursa Major* |
| ○ **M26** | *OC* | *30° 20:30 S Scutum* | ○ **M45** | *OC* | *64° 05:10 S Taurus* | ○ **M101** | *Glx* | *45° 20:30 NW Ursa Major* |
| ○ **M27** | *PN* | *63° 21:20 S Vulpecula* | ○ **M51** | *Glx* | *37° 20:30 NW Canes Venati* | ○ **M102** | *Glx* | *54° 20:30 NW Draco* |
| ○ **M29** | *OC* | **79°** *21:40 S Cygnus* | ○ **M52** | *OC* | *78° 00:40 N Cassiopeia* | ○ **M103** | *OC* | **79°** *02:50 N Cassiopeia* |
| ○ **M31** | *Glx* | **81°** *02:00 S Andromeda* | ○ **M56** | *GC* | *70° 20:40 S Lyra* | ○ **M108** | *Glx* | *31° 05:20 NE Ursa Major* |
| ○ **M32** | *Glx* | **81°** *02:00 S Andromeda* | ○ **M57** | *PN* | *73° 20:30 S Lyra* | ○ **M109** | *Glx* | *30° 20:30 NW Ursa Major* |
| ○ **M33** | *Glx* | *71° 02:50 S Triangulum* | ○ **M63** | *Glx* | *32° 20:30 NW Canes Venati* | ○ **M110** | *Glx* | **82°** *02:00 S Andromeda* |
| ○ **M34** | *OC* | **83°** *04:00 S Perseus* | ○ **M71** | *GC* | *59° 21:10 S Sagitta* | | | |
| ◌ **M35** | *OC* | *54° 05:20 SE Gemini* | ○ **M74** | *Glx* | *56° 03:00 S Pisces* | | | |

*Also up, low over the horizon: M3 GC 26° 20:30, M5 GC 22° 20:30, M9 GC 17° 20:30, M10 GC 29° 20:30, M16 DN 25° 20:30, M17 DN 23° 20:30, M18 OC 22° 20:30, M20 DN 16° 20:30, M21 OC 16° 20:30, M22 GC 16° 20:30, M23 OC 19° 20:30, M24 SC 20° 20:30, M25 OC 20° 20:30, M30 GC 17° 23:00, M44 OC 28° 05:20, M50 OC 19° 05:20, M55 GC 9° 21:00, M67 OC 20° 05:20, M72 GC 27° 22:10, M73 Ast 27° 22:20, M75 GC 18° 21:30, M94 Glx 28° 20:30, M106 Glx 28° 20:30, M107 GC 18° 20:30*

*Altitude and time are the highest the object gets while the sun is below −12°; the chart shows where it stands at 22:00. Faint rings on the chart: objects that never reach 30° all night, listed in the line below. Dashed ring in the table: still below the horizon at 22:00, so not on the chart. Ast asterism · DN diffuse nebula · DS double star · GC globular cluster · Glx galaxy · OC open cluster · PN planetary nebula · SC star cloud · SNR supernova remnant*




Sunset 18:10 Astronomical darkness 19:58–05:36 Sunrise 07:24

## OBJECTS OF THE NIGHT, BY CATALOGUE NUMBER

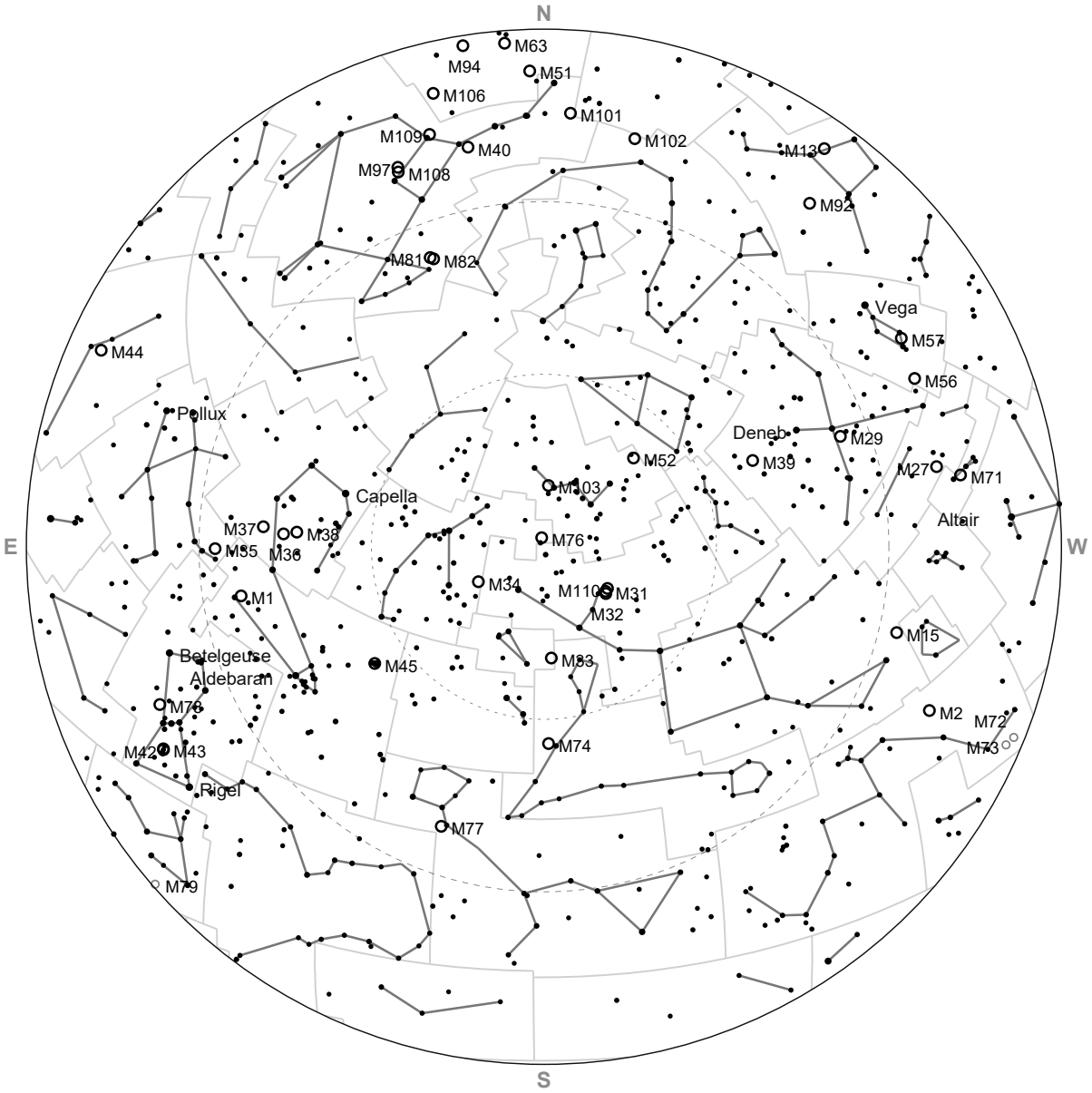
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ○ **M1** | *SNR* | *62° 05:00 S Taurus* | ○ **M39** | *OC* | **88°** | *20:50 SE Cygnus* | ○ **M76** | *PN* | **88°** | *01:00 NE Perseus* |
| ○ **M2** | *GC* | *39° 21:00 S Aquarius* | ○ **M40** | *DS* | *44° 06:10 NE Ursa Major* | | ○ **M77** | *Glx* | *40° 02:00 S Cetus* | |
| ○ **M11** | *OC* | *32° 19:20 S Scutum* | ◌ **M42** | *DN* | *35° 05:00 S Orion* | | ◌ **M78** | *DN* | *40° 05:10 S Orion* | |
| ○ **M13** | *GC* | *53° 19:20 W Hercules* | ◌ **M43** | *DN* | *35° 05:00 S Orion* | | ○ **M81** | *Glx* | *61° 06:10 NE Ursa Major* | |
| ○ **M15** | *GC* | *52° 20:50 S Pegasus* | ◌ **M44** | *OC* | *52° 06:10 SE Cancer* | | ○ **M82** | *Glx* | *61° 06:10 NE Ursa Major* | |
| ○ **M27** | *PN* | *63° 19:20 S Vulpecula* | ○ **M45** | *OC* | *64° 03:10 S Taurus* | | ○ **M92** | *GC* | *62° 19:20 W Hercules* | |
| ○ **M29** | *OC* | **79°** *19:50 S Cygnus* | ◌ **M48** | *OC* | *31° 06:10 SE Hydra* | | ○ **M94** | *Glx* | *30° 06:10 NE Canes Venatic* | |
| ○ **M31** | *Glx* | **81°** *00:00 S Andromeda* | ◌ **M50** | *OC* | *32° 06:10 S Monoceros* | | ○ **M97** | *PN* | *51° 06:10 NE Ursa Major* | |
| ○ **M32** | *Glx* | **81°** *00:00 S Andromeda* | ○ **M51** | *Glx* | *31° 19:20 NW Canes Venati* | | ○ **M101** | *Glx* | *39° 19:20 NW Ursa Major* | |
| ○ **M33** | *Glx* | *71° 01:00 S Triangulum* | ○ **M52** | *OC* | *78° 22:50 N Cassiopeia* | | ○ **M102** | *Glx* | *48° 19:20 NW Draco* | |
| ○ **M34** | *OC* | **83°** *02:00 S Perseus* | ○ **M56** | *GC* | *69° 19:20 SW Lyra* | | ○ **M103** | *OC* | **79°** *01:00 N Cassiopeia* | |
| ○ **M35** | *OC* | *64° 05:30 S Gemini* | ○ **M57** | *PN* | *69° 19:20 SW Lyra* | | ○ **M106** | *Glx* | *38° 06:10 NE Canes Venatic* | |
| ○ **M36** | *OC* | *74° 05:00 S Auriga* | ◌ **M67** | *OC* | *44° 06:10 SE Cancer* | | ○ **M108** | *Glx* | *51° 06:10 NE Ursa Major* | |
| ○ **M37** | *OC* | *73° 05:10 S Auriga* | ○ **M71** | *GC* | *59° 19:20 S Sagitta* | | ○ **M109** | *Glx* | *44° 06:10 NE Ursa Major* | |
| ○ **M38** | *OC* | *76° 04:50 S Auriga* | ○ **M74** | *Glx* | *56° 01:00 S Pisces* | | ○ **M110** | *Glx* | **82°** *00:00 S Andromeda* | |

*Also up, low over the horizon: M3 GC 19° 19:20, M10 GC 24° 19:20, M12 GC 24° 19:20, M14 GC 29° 19:20, M16 DN 23° 19:20, M17 DN 20° 19:20, M18 OC 20° 19:20, M23 OC 16° 19:20, M24 SC 18° 19:20, M25 OC 18° 19:20, M26 OC 29° 19:20, M30 GC 17° 21:00, M41 OC 19° 06:10, M46 OC 24° 06:10, M47 OC 25° 06:10, M55 GC 9° 19:20, M63 Glx 27° 06:10, M64 Glx 15° 06:10, M65 Glx 24° 06:10, M66 Glx 24° 06:10, M72 GC 27° 20:20, M73 Ast 27° 20:20, M75 GC 18° 19:30, M79 GC 15° 04:50, M85 Glx 18° 06:10, M93 OC 15° 06:10, M95 Glx 29° 06:10, M96 Glx 28° 06:10, M98 Glx 17° 06:10, M99 Glx 16° 06:10, M100 Glx 16° 06:10, M105 Glx 29° 06:10*

*Altitude and time are the highest the object gets while the sun is below −12°; the chart shows where it stands at 22:00. Faint rings on the chart: objects that never reach 30° all night, listed in the line below. Dashed ring in the table: still below the horizon at 22:00, so not on the chart. Ast asterism · DN diffuse nebula · DS double star · GC globular cluster · Glx galaxy · OC open cluster · PN planetary nebula · SC star cloud · SNR supernova remnant*

# November

*The sky from 50°N on the 15th at 22:00 CET*



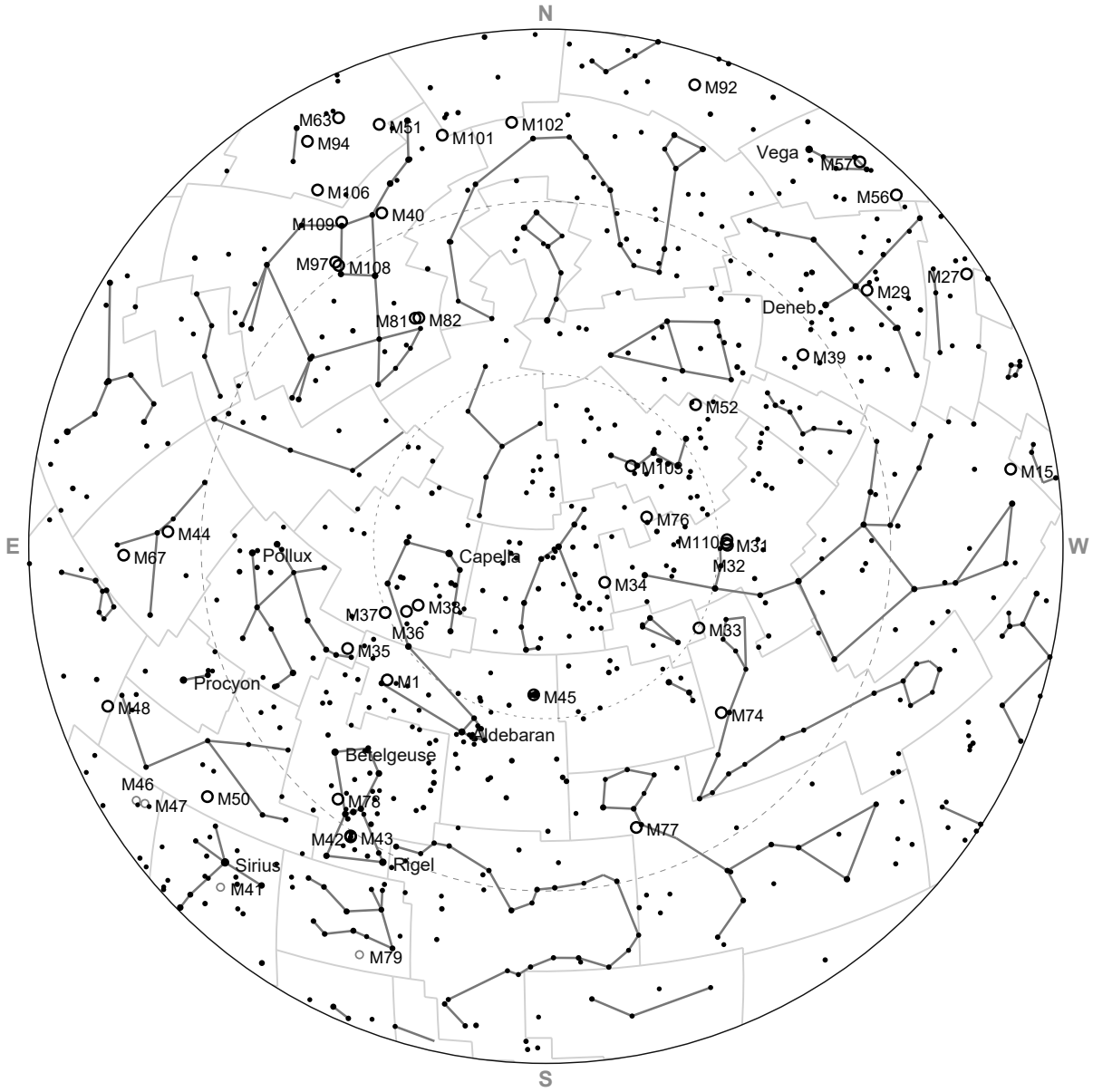

Sunset 16:18 Astronomical darkness 18:10–05:22 Sunrise 07:16

## OBJECTS OF THE NIGHT, BY CATALOGUE NUMBER

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **M1** | SNR | 62° | 01:50 S | Taurus | **M50** | OC | 32° | 03:20 S | Monoceros | **M85** | Glx | 43° | 05:50 SE | Coma Berenic |
| **M2** | GC | 39° | 17:50 S | Aquarius | **M51** | Glx | 51° | 05:50 E | Canes Venatici | **M86** | Glx | 39° | 05:50 SE | Virgo |
| **M3** | GC | 39° | 05:50 E | Canes Venatici | **M52** | OC | **78°** | 19:40 N | Cassiopeia | **M87** | Glx | 38° | 05:50 SE | Virgo |
| **M13** | GC | 40° | 17:40 W | Hercules | **M53** | GC | 36° | 05:50 E | Coma Berenice | **M88** | Glx | 39° | 05:50 SE | Coma Berenic |
| **M15** | GC | 52° | 17:50 S | Pegasus | **M56** | GC | 60° | 17:40 SW | Lyra | **M89** | Glx | 37° | 05:50 SE | Virgo |
| **M27** | PN | 59° | 17:40 SW | Vulpecula | **M57** | PN | 58° | 17:40 W | Lyra | **M90** | Glx | 37° | 05:50 SE | Virgo |
| **M29** | OC | 75° | 17:40 SW | Cygnus | **M58** | Glx | 36° | 05:50 SE | Virgo | **M91** | Glx | 39° | 05:50 SE | Coma Berenic |
| **M31** | Glx | **81°** | 21:00 S | Andromeda | **M59** | Glx | 35° | 05:50 SE | Virgo | **M92** | GC | 49° | 17:40 W | Hercules |
| **M32** | Glx | **81°** | 21:00 S | Andromeda | **M60** | Glx | 35° | 05:50 SE | Virgo | **M94** | Glx | 55° | 05:50 E | Canes Venatici |
| **M33** | Glx | 71° | 21:50 S | Triangulum | **M61** | Glx | 32° | 05:50 SE | Virgo | **M95** | Glx | 49° | 05:50 SE | Leo |
| **M34** | OC | **83°** | 23:00 S | Perseus | **M63** | Glx | 51° | 05:50 E | Canes Venatici | **M96** | Glx | 49° | 05:50 SE | Leo |
| **M35** | OC | 64° | 02:30 S | Gemini | **M64** | Glx | 41° | 05:50 E | Coma Berenice | **M97** | PN | 74° | 05:50 NE | Ursa Major |
| **M36** | OC | 74° | 02:00 S | Auriga | **M65** | Glx | 47° | 05:50 SE | Leo | **M98** | Glx | 42° | 05:50 SE | Coma Berenic |
| **M37** | OC | 73° | 02:10 S | Auriga | **M66** | Glx | 47° | 05:50 SE | Leo | **M99** | Glx | 41° | 05:50 SE | Coma Berenic |
| **M38** | OC | 76° | 01:50 S | Auriga | **M67** | OC | 52° | 05:10 S | Cancer | **M100** | Glx | 41° | 05:50 SE | Coma Berenic |
| **M39** | OC | **88°** | 17:50 S | Cygnus | **M71** | GC | 54° | 17:40 SW | Sagitta | **M101** | Glx | 50° | 05:50 NE | Ursa Major |
| **M40** | DS | 64° | 05:50 NE | Ursa Major | **M74** | Glx | 56° | 22:00 S | Pisces | **M102** | Glx | 42° | 05:50 NE | Draco |
| **M42** | DN | 35° | 01:50 S | Orion | **M76** | PN | **88°** | 22:00 N | Perseus | **M103** | OC | **79°** | 21:50 N | Cassiopeia |
| **M43** | DN | 35° | 02:00 S | Orion | **M77** | Glx | 40° | 23:00 S | Cetus | **M105** | Glx | 49° | 05:50 SE | Leo |
| **M44** | OC | 60° | 05:00 S | Cancer | **M78** | DN | 40° | 02:10 S | Orion | **M106** | Glx | 63° | 05:50 E | Canes Venatici |
| **M45** | OC | 64° | 00:10 S | Taurus | **M81** | Glx | 71° | 05:50 N | Ursa Major | **M108** | Glx | 74° | 05:50 NE | Ursa Major |
| **M48** | OC | 34° | 04:30 S | Hydra | **M82** | Glx | 70° | 05:50 N | Ursa Major | **M109** | Glx | 67° | 05:50 NE | Ursa Major |
| **M49** | Glx | 34° | 05:50 SE | Virgo | **M84** | Glx | 39° | 05:50 SE | Virgo | **M110** | Glx | **82°** | 21:00 S | Andromeda |

*Also up, low over the horizon: M11 OC 25° 17:40, M14 GC 19° 17:40, M26 OC 22° 17:40, M30 GC 17° 18:00, M41 OC 19° 03:10, M46 OC 25° 04:00, M47 OC 26° 04:00, M72 GC 27° 17:40, M73 Ast 27° 17:40, M75 GC 16° 17:40, M79 GC 15° 01:40, M93 OC 16° 04:00, M104 Glx 16° 05:50*

*Altitude and time are the highest the object gets while the sun is below −12°; the chart shows where it stands at 22:00. Faint rings on the chart: objects that never reach 30° all night, listed in the line below. Dashed ring in the table: still below the horizon at 22:00, so not on the chart. Ast asterism · DN diffuse nebula · DS double star · GC globular cluster · Glx galaxy · OC open cluster · PN planetary nebula · SNR supernova remnant*




Sunset 15:00 Astronomical darkness 17:58–05:54 Sunrise 07:54

## OBJECTS OF THE NIGHT, BY CATALOGUE NUMBER

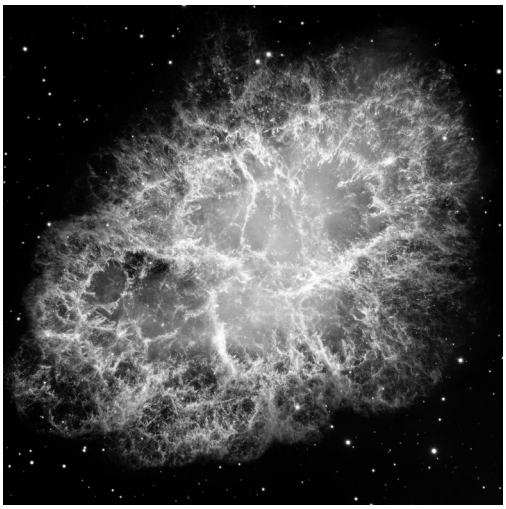
| | | | |
|---|---|---|---|
| **M1** | *SNR* | *62° 00:00 S Taurus* | |
| **M2** | *GC* | *36° 17:20 SW Aquarius* | |
| **M3** | *GC* | *62° 06:30 SE Canes Venatic* | |
| **M13** | *GC* | *40° 06:30 E Hercules* | |
| **M15** | *GC* | *48° 17:20 SW Pegasus* | |
| **M27** | *PN* | *46° 17:20 W Vulpecula* | |
| **M29** | *OC* | *61° 17:20 W Cygnus* | |
| **M31** | *Glx* | *81° 19:10 S Andromeda* | |
| **M32** | *Glx* | *81° 19:10 S Andromeda* | |
| **M33** | *Glx* | *71° 20:00 S Triangulum* | |
| **M34** | *OC* | **83°** *21:00 S Perseus* | |
| **M35** | *OC* | *64° 00:30 S Gemini* | |
| **M36** | *OC* | *74° 00:00 S Auriga* | |
| **M37** | *OC* | *73° 00:10 S Auriga* | |
| **M38** | *OC* | *76° 23:50 S Auriga* | |
| **M39** | *OC* | *76° 17:20 W Cygnus* | |
| **M40** | *DS* | **82°** *06:30 N Ursa Major* | |
| **M42** | *DN* | *35° 00:00 S Orion* | |
| **M43** | *DN* | *35° 00:00 S Orion* | |
| **M44** | *OC* | *60° 03:00 S Cancer* | |
| **M45** | *OC* | *64° 22:10 S Taurus* | |
| **M48** | *OC* | *34° 02:30 S Hydra* | |
| **M49** | *Glx* | *48° 06:30 S Virgo* | |
| **M50** | *OC* | *32° 01:20 S Monoceros* | |
| **M51** | *Glx* | *76° 06:30 E Canes Venatici* | |
| **M52** | *OC* | *78° 17:50 N Cassiopeia* | |
| **M53** | *GC* | *56° 06:30 SE Coma Berenic* | |
| **M56** | *GC* | *45° 17:20 W Lyra* | |
| **M57** | *PN* | *43° 17:20 W Lyra* | |
| **M58** | *Glx* | *51° 06:30 S Virgo* | |
| **M59** | *Glx* | *51° 06:30 S Virgo* | |
| **M60** | *Glx* | *51° 06:30 S Virgo* | |
| **M61** | *Glx* | *44° 06:30 S Virgo* | |
| **M63** | *Glx* | *76° 06:30 SE Canes Venatic* | |
| **M64** | *Glx* | *60° 06:30 S Coma Berenice* | |
| **M65** | *Glx* | *53° 05:40 S Leo* | |
| **M66** | *Glx* | *53° 05:40 S Leo* | |
| **M67** | *OC* | *52° 03:10 S Cancer* | |
| **M71** | *GC* | *42° 17:20 SW Sagitta* | |
| **M74** | *Glx* | *56° 20:00 S Pisces* | |
| **M76** | *PN* | **88°** *20:00 NE Perseus* | |
| **M77** | *Glx* | *40° 21:00 S Cetus* | |
| **M78** | *DN* | *40° 00:10 S Orion* | |
| **M81** | *Glx* | *71° 04:20 N Ursa Major* | |
| **M82** | *Glx* | *70° 04:20 N Ursa Major* | |
| **M84** | *Glx* | *53° 06:30 S Virgo* | |
| **M85** | *Glx* | *58° 06:30 S Coma Berenice* | |
| **M86** | *Glx* | *53° 06:30 S Virgo* | |
| **M87** | *Glx* | *52° 06:30 S Virgo* | |
| **M88** | *Glx* | *54° 06:30 S Coma Berenice* | |
| **M89** | *Glx* | *52° 06:30 S Virgo* | |
| **M90** | *Glx* | *53° 06:30 S Virgo* | |
| **M91** | *Glx* | *54° 06:30 S Coma Berenice* | |
| **M92** | *GC* | *39° 06:30 NE Hercules* | |
| **M94** | *Glx* | *79° 06:30 SE Canes Venatic* | |
| **M95** | *Glx* | *52° 05:00 S Leo* | |
| **M96** | *Glx* | *52° 05:10 S Leo* | |
| **M97** | *PN* | **85°** *05:40 N Ursa Major* | |
| **M98** | *Glx* | *55° 06:30 S Coma Berenice* | |
| **M99** | *Glx* | *54° 06:30 S Coma Berenice* | |
| **M100** | *Glx* | *56° 06:30 S Coma Berenice* | |
| **M101** | *Glx* | *72° 06:30 NE Ursa Major* | |
| **M102** | *Glx* | *63° 06:30 NE Draco* | |
| **M103** | *OC* | *79° 20:00 N Cassiopeia* | |
| **M105** | *Glx* | *53° 05:10 S Leo* | |
| **M106** | *Glx* | **87°** *06:30 SE Canes Venatic* | |
| **M108** | *Glx* | **84°** *05:30 N Ursa Major* | |
| **M109** | *Glx* | **87°** *06:20 N Ursa Major* | |
| **M110** | *Glx* | **82°** *19:00 S Andromeda* | |

*Also up, low over the horizon: M5 GC 28° 06:30, M41 OC 19° 01:10, M46 OC 25° 02:00, M47 OC 26° 02:00, M68 GC 13° 06:30, M72 GC 22° 17:20, M73 Ast 22° 17:20, M79 GC 15° 23:50, M93 OC 16° 02:10, M104 Glx 28° 06:30*

*Altitude and time are the highest the object gets while the sun is below −12°; the chart shows where it stands at 22:00. Faint rings on the chart: objects that never reach 30° all night, listed in the line below. Dashed ring in the table: still below the horizon at 22:00, so not on the chart. Ast asterism · DN diffuse nebula · DS double star · GC globular cluster · Glx galaxy · OC open cluster · PN planetary nebula · SNR supernova remnant*

# M1 Crab Nebula

SUPERNOVA REMNANT



| | |
|---|---|
| MESSIER | 1 |
| NGC | 1952 |
| OBJECT TYPE | Supernova Remnant |
| CONSTELLATION | Taurus |
| DISTANCE | 6,500 ly |
| APPARENT MAG. | +8.4 |
| RA (J2000) | 05h 34m 30s |
| DEC (J2000) | +22° 01′ |
| APPARENT SIZE | 6.0′ × 4.0′ |
| RADIUS (LY) | 6 |
| AGE (YEARS) | ~970 years (SN 1054) |

NOTABLE FEATURE

Expanding remnant of the supernova recorded by Chinese astronomers in 1054 AD; its pulsar rotates 30 times per second.

## DISCOVERY & HISTORY

John Bevis spotted the Crab Nebula in 1731. Charles Messier rediscovered it in 1758 while hunting for Comet Halley and was annoyed enough by the comet-like impostor to start the catalogue that bears his name — M1 is its first entry. In 1928 Edwin Hubble proposed linking the nebula to the "guest star" recorded by Chinese astronomers in 1054 CE; the idea stayed controversial until Nicholas Mayall settled it, making the Crab the first object tied to a recorded supernova. The neutron star at its centre, discovered as a radio pulsar in 1968, completes one of astronomy's tightest cause-and-effect chains.

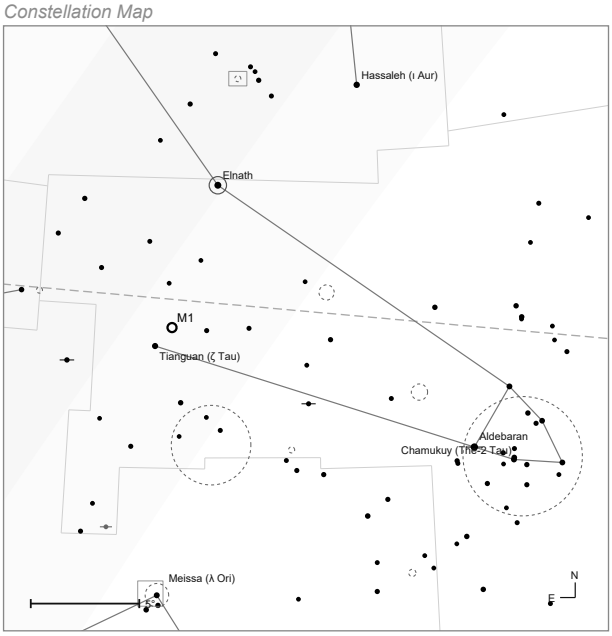
## AT THE EYEPIECE

In a 10″ Dobson under Bortle 4 skies, M1 sits 1° NW of ζ Tauri as an elongated oval about 6′ × 4′, soft and grey, brightening slightly toward the centre. No filaments are visible — those need long-exposure imaging. An OIII filter brings out the edges. The field is sparse; Aldebaran lies well outside, but the Hyades anchor the view to the west. Expect a faint, diffuse glow rather than the colourful image above.

## WHY IT MATTERS

The Crab is the closest, best-studied supernova remnant. Its central pulsar spins 30 times a second, powering the entire nebula through a wind of relativistic particles — making M1 a natural laboratory for high-energy astrophysics. Its X-ray brightness is so steady that it once served as the standard candle for hard-X-ray detectors. The expanding shell is still hot, still bright, and still being unpicked thread by thread.

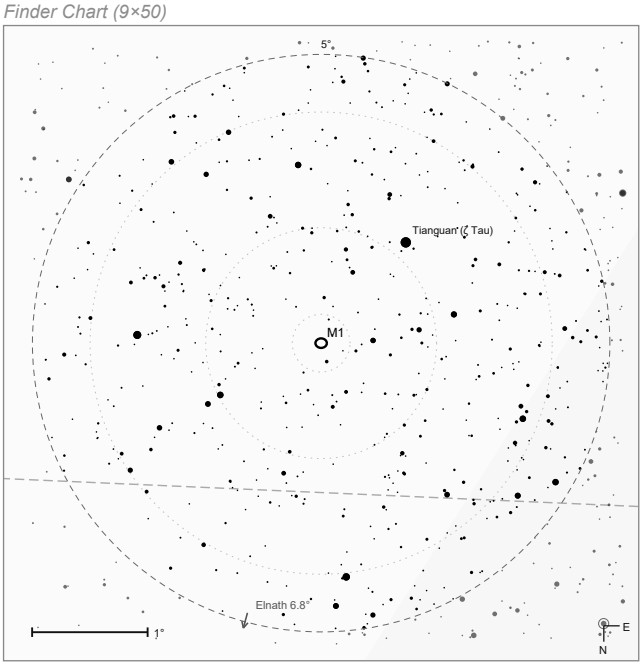
Constellation Map




Naked-eye view · mag 5.5 · field 28°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

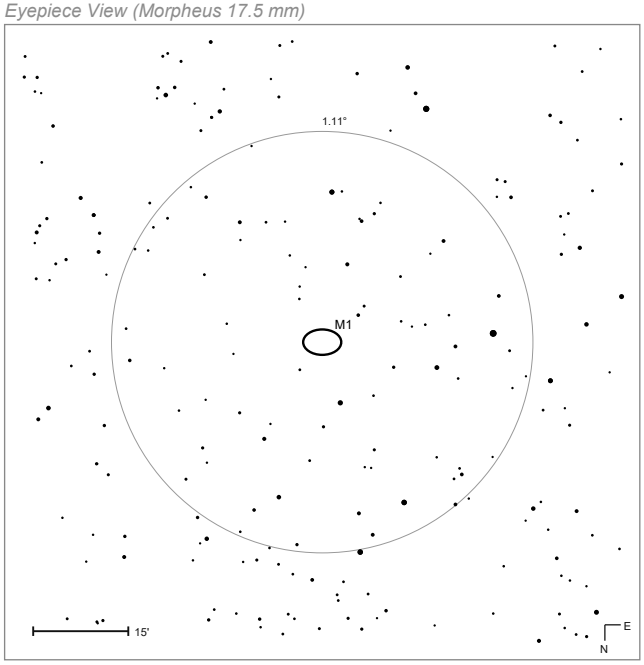
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 — ecliptic · · Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.6

mag ● 6 ● 8 ● 10 · 12

# M2

| | |
|---|---|
| MESSIER | 2 |
| NGC | 7089 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Aquarius |
| DISTANCE | 37.5 kly |
| APPARENT MAG. | +6.5 |
| RA (J2000) | 21h 33m 30s |
| DEC (J2000) | −00° 49′ |
| APPARENT SIZE | 16.0′ |
| RADIUS (LY) | 87 |
| AGE (YEARS) | 13 billion |
| NUMBER OF STARS | ~150,000 |

*NOTABLE FEATURE*

One of the largest and most distant globulars visible to the naked eye; richly resolved with any telescope.

## DISCOVERY & HISTORY

Jean-Dominique Maraldi discovered M2 in 1746 while tracking a comet with Jacques Cassini. Charles Messier independently rediscovered it in 1760 and catalogued it as a star-free nebula; William Herschel first resolved its individual stars in 1783. It lies 37,500 light-years away in Aquarius and contains roughly 150,000 stars. At 12.5–13 billion years old it is among the more ancient clusters in the Milky Way halo.

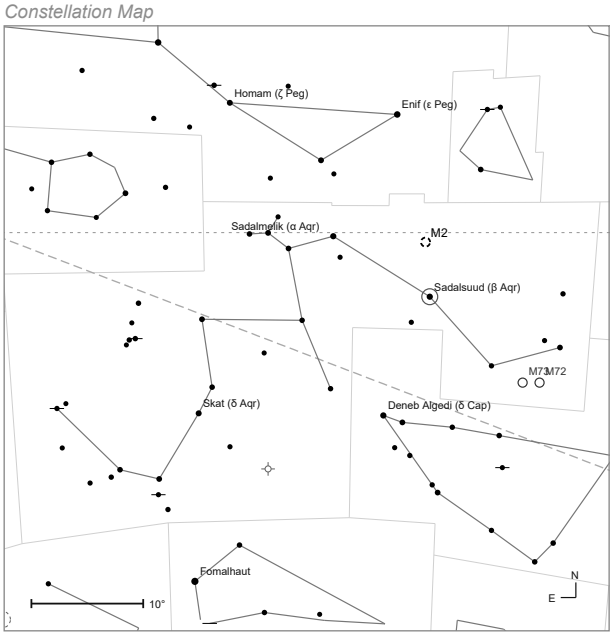
## AT THE EYEPIECE

M2 sits 5° north of Beta Aquarii. Through a 10″ Dobsonian under Bortle 4 skies it appears as a concentrated, slightly elliptical haze roughly 10′ across with a visibly brighter core. The outer halo granulates into individual stars at higher magnification. Its compact richness contrasts noticeably with the looser Ophiuchus globulars visible the same night.

## WHY IT MATTERS

Gaia proper-motion data links M2 to the Gaia Sausage — the kinematic debris of a dwarf galaxy the Milky Way absorbed early in its history. This makes it a fossil remnant of galactic assembly rather than a native cluster, and one of the best nearby tracers of the merger event that shaped the inner halo.

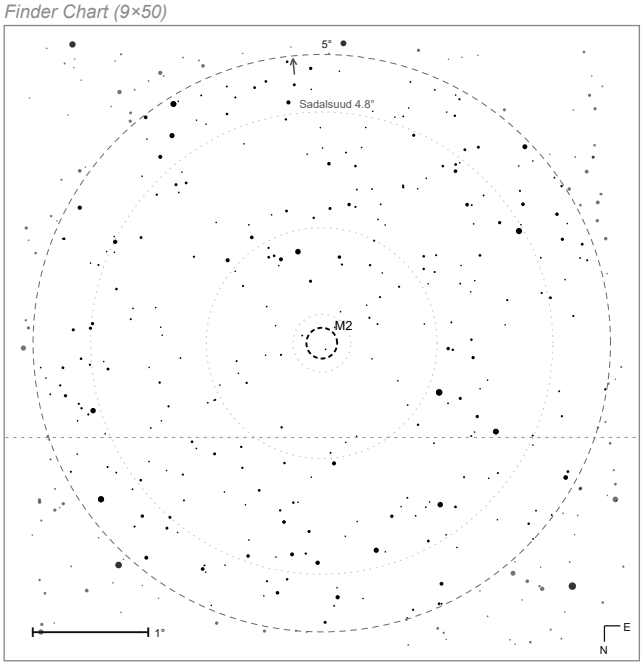
*Constellation Map*




*Naked-eye view · mag 5 · field 54°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

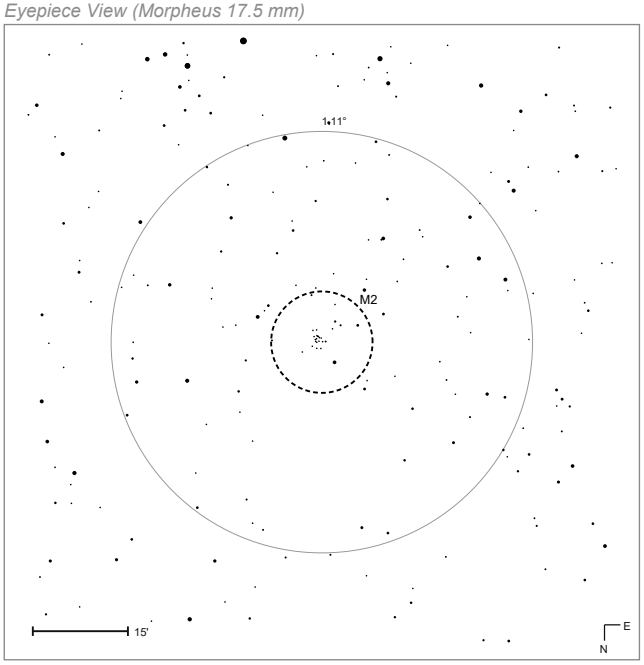
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - celestial equator - · Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

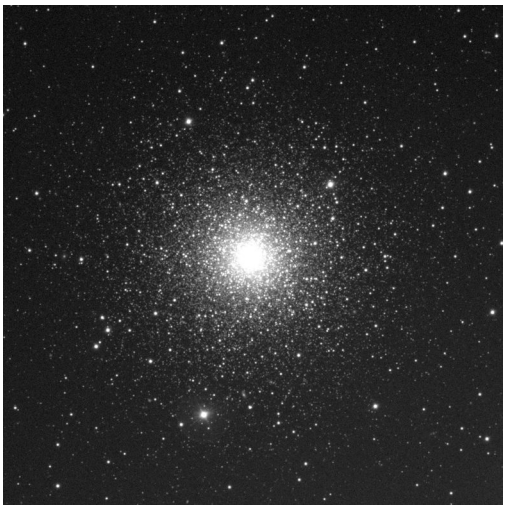



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.7*

mag ● 8 ● 10 · 12 · 14

# M3





| | |
|---|---|
| MESSIER | 3 |
| NGC | 5272 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Canes Venatici |
| DISTANCE | 32.6 kly |
| APPARENT MAG. | +6.3 |
| RA (J2000) | 13h 42m 12s |
| DEC (J2000) | +28° 23′ |
| APPARENT SIZE | 18.0′ |
| RADIUS (LY) | 85 |
| AGE (YEARS) | 11.4 billion |
| NUMBER OF STARS | ~500,000 |

NOTABLE FEATURE

Contains over 270 known variable stars — the highest count of any globular cluster.

## DISCOVERY & HISTORY

Messier 3 was the first object Charles Messier personally discovered, on 3 May 1764, cataloguing it as a star-free nebula. William Herschel resolved its stars around 1784. It lies about 32,600 light-years away in Canes Venatici and contains roughly 500,000 stars, making it one of the most populous globular clusters known. Its age is estimated at 11.4 billion years.

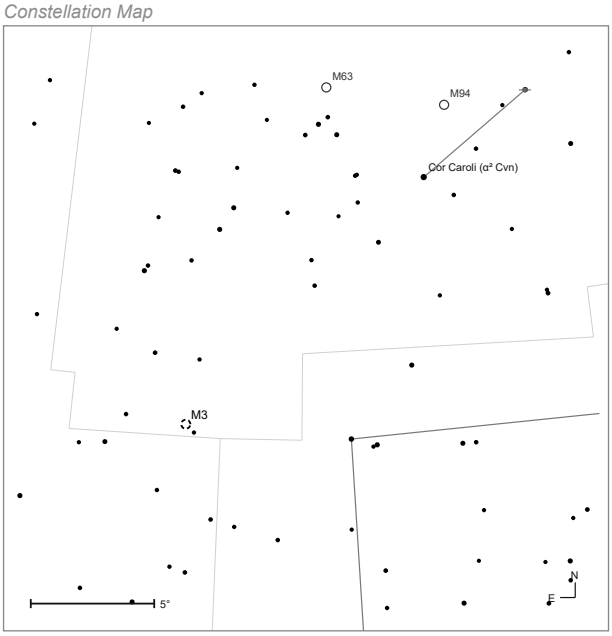
## AT THE EYEPIECE

Located almost exactly halfway between Arcturus and Cor Caroli (α CVn), M3 is arguably the finest northern globular after M13. Through a 10″ Dobsonian under Bortle 4 conditions it shows as a brilliant, well-resolved sphere roughly 12′ across with a rich, graduated core. Individual stars pepper the halo to the edges; the view rewards both low power for the full extent and higher magnification for core detail.

## WHY IT MATTERS

M3 hosts 274 confirmed variable stars — the largest collection in any known globular cluster, dominated by RR Lyrae pulsators. This rich population has made it a benchmark for stellar evolution studies; new members continue to be identified as recently as 2025. RR Lyrae period-luminosity relations derived here have been used to calibrate extragalactic distance measurements.

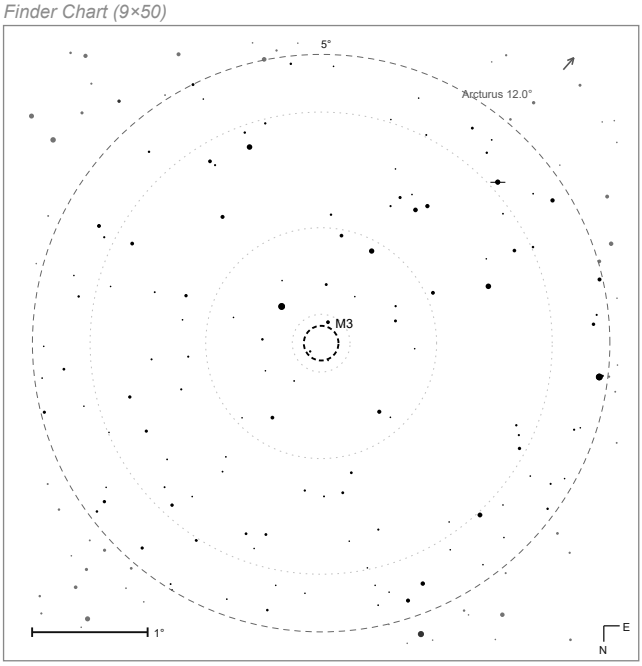
Constellation Map




Naked-eye view · mag 6.5 · field 24°

mag ● 1 ● 3 ● 5 ● 7

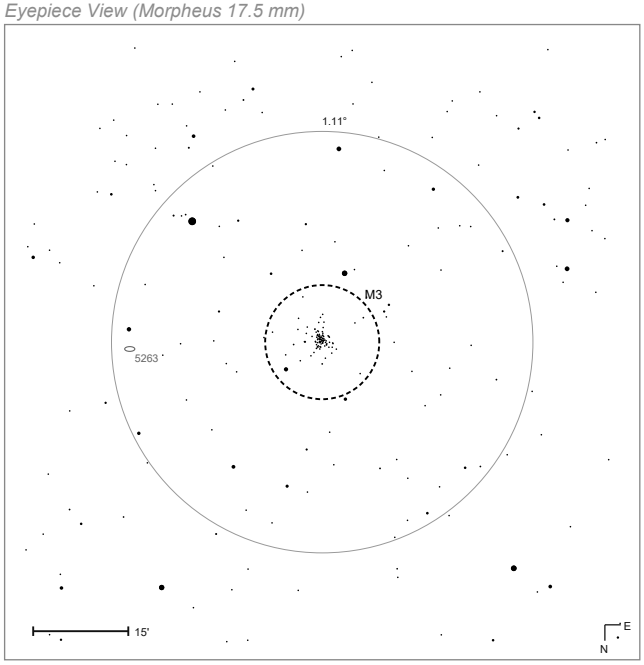
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5

mag ● 8 ● 10 · 12 · 14

# M4

| | |
|---|---|
| MESSIER | 4 |
| NGC | 6121 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Scorpius |
| DISTANCE | 6,000 ly |
| APPARENT MAG. | +5.4 |
| RA (J2000) | 16h 23m 36s |
| DEC (J2000) | −26° 32′ |
| APPARENT SIZE | 36.0′ |
| RADIUS (LY) | 31 |
| AGE (YEARS) | 12.2 billion |
| NUMBER OF STARS | ~100,000 |

NOTABLE FEATURE

The nearest globular cluster to Earth; harbours ancient white dwarfs estimated at 13 billion years old.

## DISCOVERY & HISTORY

Philippe Loys de Chéseaux found M4 in 1745; Charles Messier catalogued it in 1764. It holds the distinction of being the first globular cluster in which individual stars were resolved. At roughly 6,000 light-years it is the nearest globular cluster to the Solar System, and at 12.2 billion years one of the oldest. It lies in Scorpius, 1.3° west of Antares.

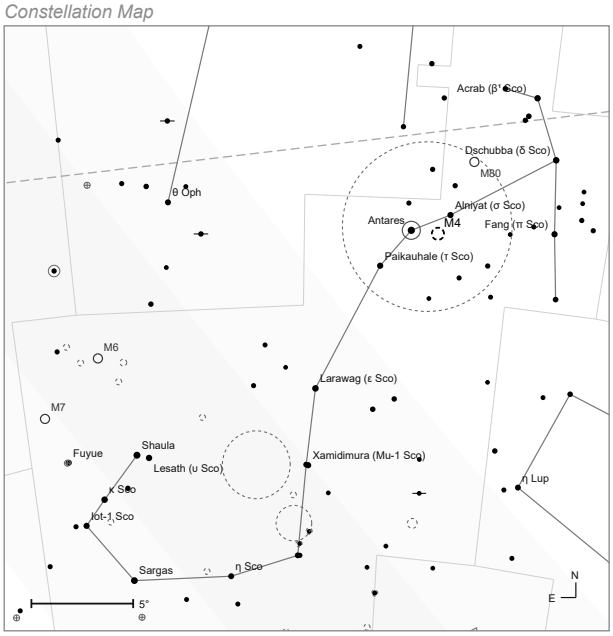
## AT THE EYEPIECE

M4 and Antares fit comfortably in the same wide-field view, making the cluster trivially easy to star-hop to. Through a 10″ Dobsonian under Bortle 4 it appears as a large, loosely concentrated sphere about 26′ across. The most distinctive feature is a short bar of 11th-magnitude stars roughly 2.5′ long across the core — clearly visible at moderate power — first noted by Herschel in 1783. The outer regions resolve well into chains of stars.

## WHY IT MATTERS

Hubble Space Telescope photometry of M4's ancient white dwarfs directly measured stellar ages of 12–13 billion years, providing early empirical support for the age of the universe. The cluster also shows evidence of two distinct stellar populations of different ages, suggesting multiple star-formation episodes — a phenomenon now thought to be common in massive globulars.

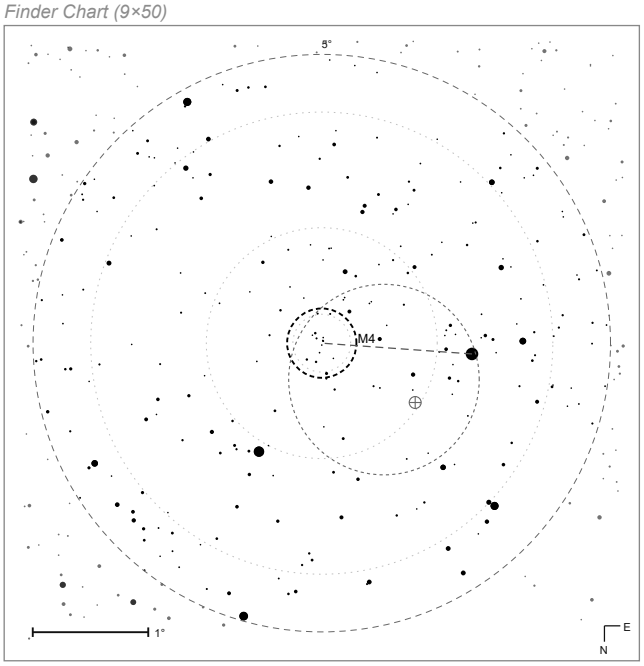
Constellation Map




Naked-eye view · mag 5.5 · field 3°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

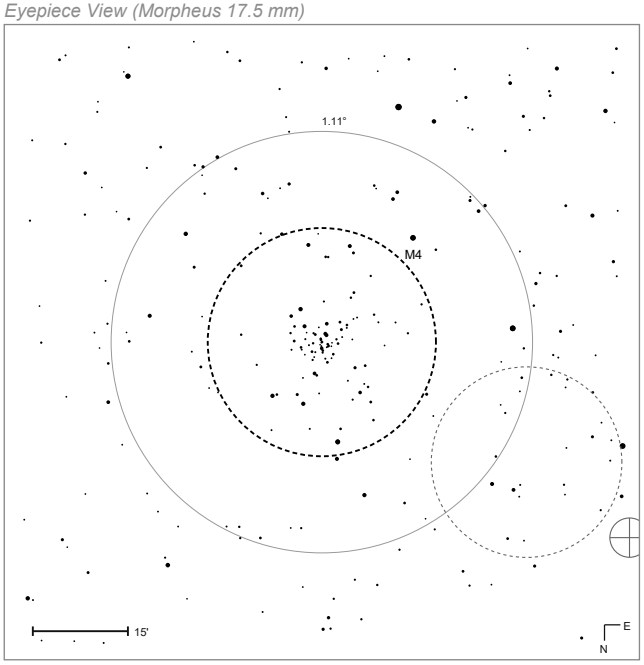
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

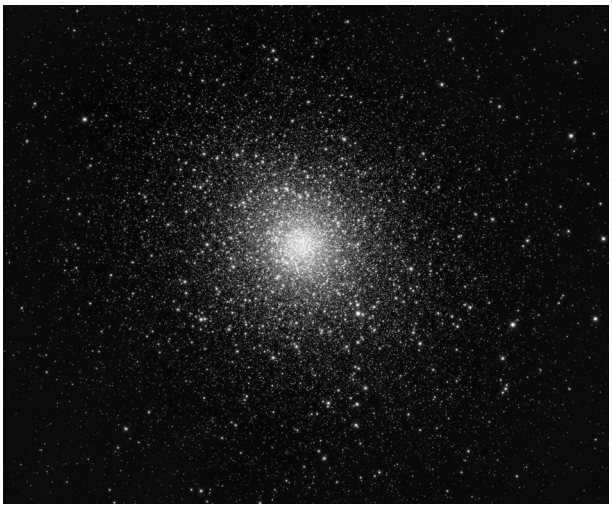



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.3 · outside the ring at 40 % opacity

mag ● 8 ● 10 · 12 · 14

# M5





| | |
|---|---|
| MESSIER | 5 |
| NGC | 5904 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Serpens |
| DISTANCE | 24.5 kly |
| APPARENT MAG. | +5.7 |
| RA (J2000) | 15h 18m 36s |
| DEC (J2000) | +02° 05′ |
| APPARENT SIZE | 23.0′ |
| RADIUS (LY) | 80 |
| AGE (YEARS) | 13 billion |
| NUMBER OF STARS | >500,000 |

NOTABLE FEATURE

One of the oldest and largest globulars; a dwarf nova has been observed in its halo.

## DISCOVERY & HISTORY

Gottfried Kirch discovered M5 in 1702 during a comet search, one of the earliest telescopic discoveries in the catalogue. Charles Messier catalogued it in 1764; William Herschel first resolved individual stars in 1791, counting roughly 200. M5 lies some 24,500 light-years away in Serpens and is estimated at 13 billion years old.

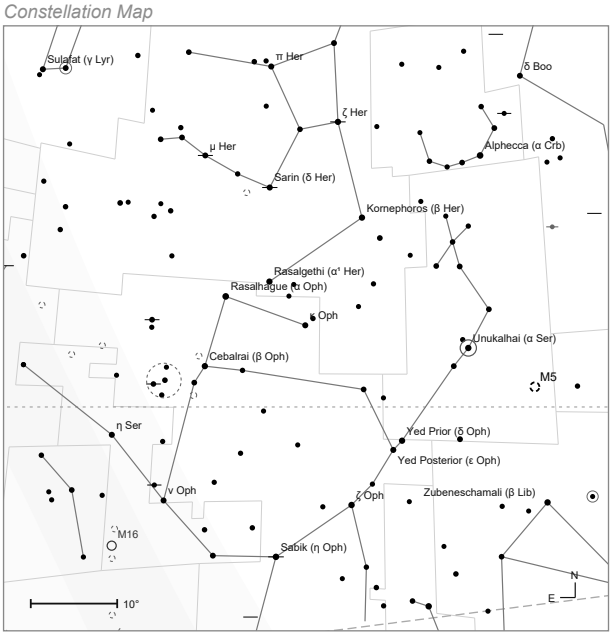
## AT THE EYEPIECE

Under excellent Bortle 4 conditions M5 is faintly visible to the naked eye near 5 Serpentis. Through a 10″ Dobsonian it ranks among the finest northern globulars — a rich, symmetrical sphere about 15′ across with a blazing, condensed core and a well-resolved outer halo. It appears distinctly brighter and more concentrated than neighbouring Ophiuchus globulars M10 and M12, and rewards prolonged scrutiny at 200× or more.

## WHY IT MATTERS

M5 contains 105 known variable stars, 97 of them RR Lyrae pulsators — key calibrators for the cosmic distance ladder. It also hosts two millisecond pulsars; one in a binary system allows precise measurement of the cluster's proper motion. The neutron-star mass derived from the binary constrains the equation of state of dense nuclear matter, giving M5 relevance to fundamental physics well beyond stellar astronomy.

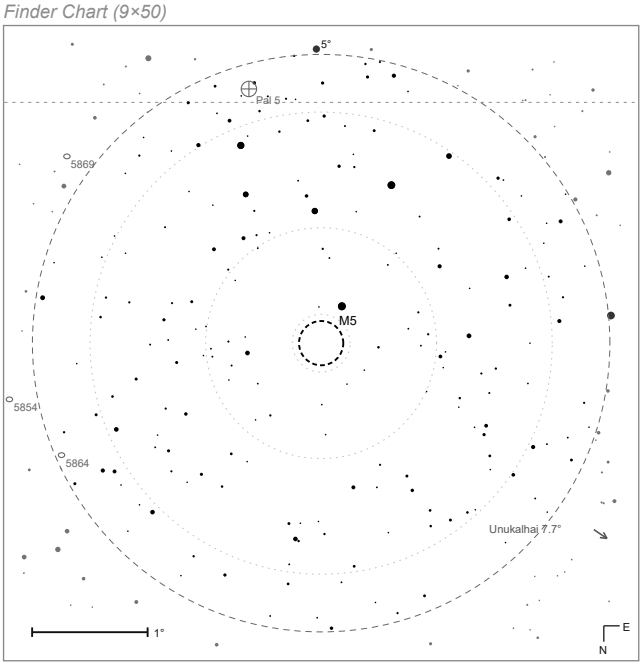
Constellation Map




Naked-eye view · mag 5 · field 7°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

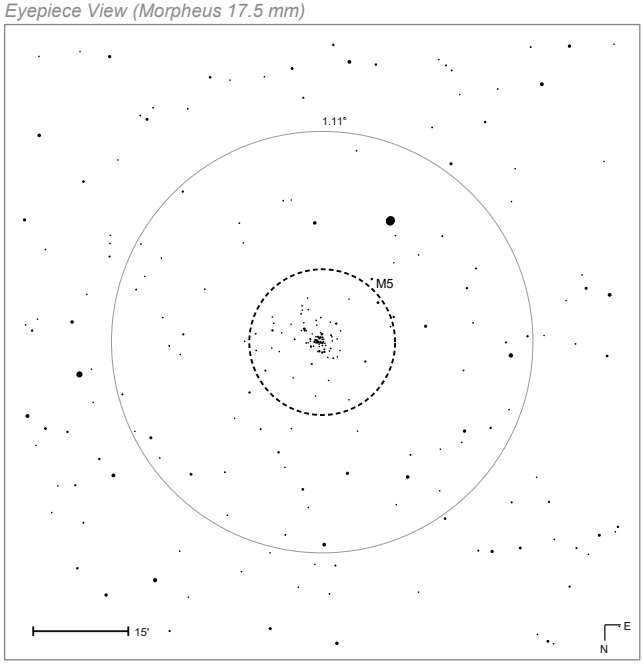
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - celestial equator · · Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13

mag ● 8 ● 10 · 12 · 14

# M6 Butterfly Cluster

| | |
|---|---|
| MESSIER | 6 |
| NGC | 6405 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Scorpius |
| DISTANCE | 1,600 ly |
| APPARENT MAG. | +4.2 |
| RA (J2000) | 17h 40m 18s |
| DEC (J2000) | −32° 15′ |
| APPARENT SIZE | 33.0′ |
| RADIUS (LY) | 8 |
| AGE (YEARS) | 100 million |
| NUMBER OF STARS | ~80 |

*NOTABLE FEATURE*

Named the Butterfly Cluster for its wing-like shape; the brightest member is a luminous orange giant.

## DISCOVERY & HISTORY

Giovanni Battista Hodierna recorded the Butterfly Cluster before 1654; formal credit is usually given to Jean-Philippe Loys de Chéseaux in 1746. Charles Messier catalogued it on 23 May 1764. It lies roughly 1,600 light-years away in southern Scorpius and is estimated at 94 million years old — a young cluster with 120 identified members.

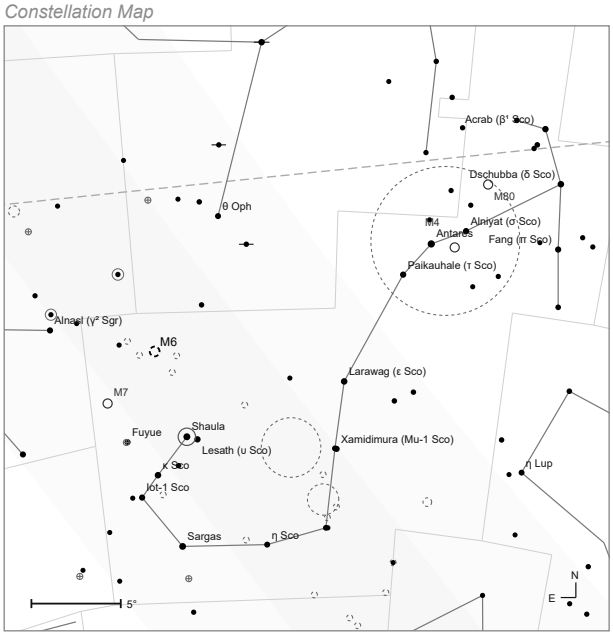
## AT THE EYEPIECE

From 50°N, M6 culminates only about 8° up, so a flat, haze-free southern horizon is essential. Through a 10″ Dobsonian at low power, about 80 stars are visible scattered across a 25′ field in a pattern that loosely recalls outstretched butterfly wings. The orange semi-regular variable BM Scorpii (mag 5.5–7.0) stands out conspicuously against the dominantly blue-white membership. The pair M6/M7 in the same wide-field sweep is one of the showpieces of the southern summer Milky Way.

## WHY IT MATTERS

M6 is a young open cluster in which most members are still blue B-type main-sequence stars. The presence of BM Scorpii — an evolved K-type orange giant — demonstrates that higher-mass stars have already left the main sequence while lower-mass stars have not, providing a direct snapshot of stellar evolution in progress. Its solar-like metallicity makes it a useful reference point for chemical abundance studies.

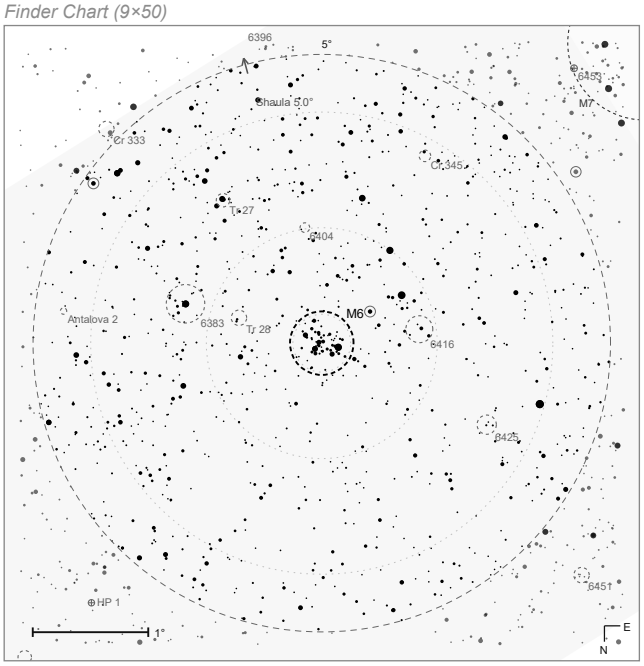
*Constellation Map*




*Naked-eye view · mag 5 · field 34°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

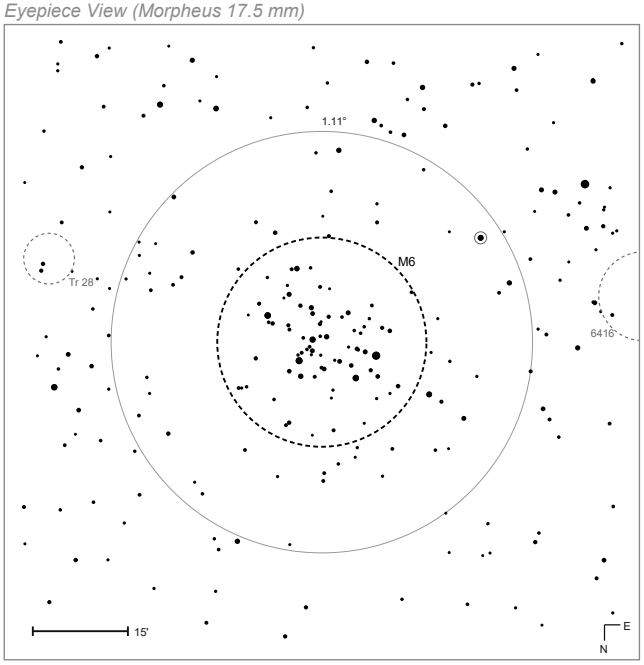
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

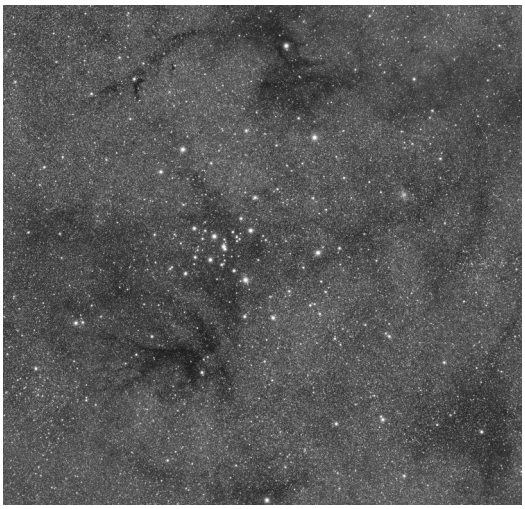



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 10.9 · outside the ring at 40 % opacity*

mag ● 6 ● 8 ● 10 · 12

# M7 Ptolemy's Cluster





| | |
|---|---|
| MESSIER | 7 |
| NGC | 6475 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Scorpius |
| DISTANCE | 1,000 ly |
| APPARENT MAG. | +3.3 |
| RA (J2000) | 17h 53m 54s |
| DEC (J2000) | −34° 48′ |
| APPARENT SIZE | 75.0′ |
| RADIUS (LY) | 11 |
| AGE (YEARS) | 220 million |
| NUMBER OF STARS | ~200 |

NOTABLE FEATURE

Catalogued by Ptolemy in 130 AD — one of the oldest recorded deep-sky objects; easily visible to the naked eye.

## DISCOVERY & HISTORY

Ptolemy described a "nebula" near the Scorpion's sting in 130 AD, giving M7 the longest documented observational history of any Messier object. Giovanni Battista Hodierna counted 30 stars in it before 1654; Charles Messier formally catalogued it in 1764. At declination −34.8° it is the southernmost Messier object. It lies ~980 light-years away and is roughly 200 million years old.

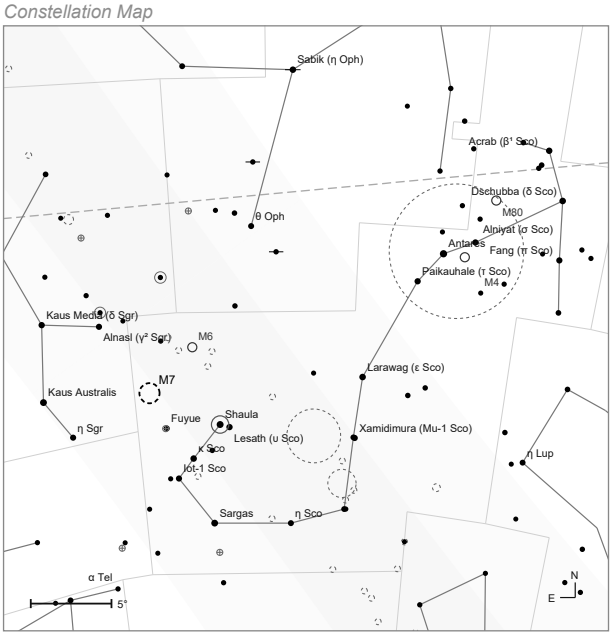
## AT THE EYEPIECE

M7 is an easy naked-eye cluster, appearing as a bright, misty patch near the Scorpion's tail. Through a 10″ Dobsonian it overflows any eyepiece much above 50× — some 80 scattered, mostly bright stars sprawl across more than 1° of sky. Best appreciated at the lowest available magnification, it sits against a spectacularly rich Milky Way background. From 50°N it culminates barely 5° above the horizon, so it needs a flat southern skyline and an exceptionally clear night.

## WHY IT MATTERS

M7 is one of the nearest and best-studied open clusters, used to calibrate the Hertzsprung-Russell diagram and model cluster dissolution rates. It has a solar-like metallicity and is dynamically young enough that the tidal radius still contains most of its original membership. On 29 August 2006 it served as the first-light target for the Long Range Reconnaissance Imager aboard the New Horizons spacecraft at the start of its journey to Pluto.

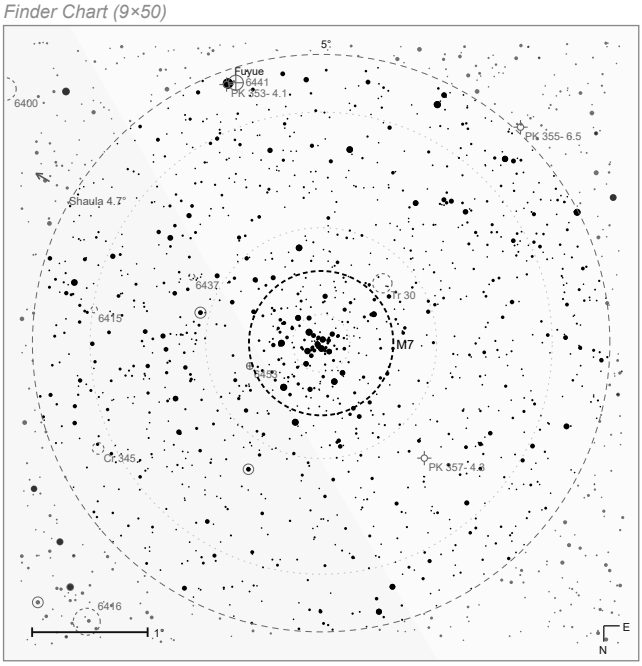
Constellation Map




Naked-eye view · mag 5 · field 38°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

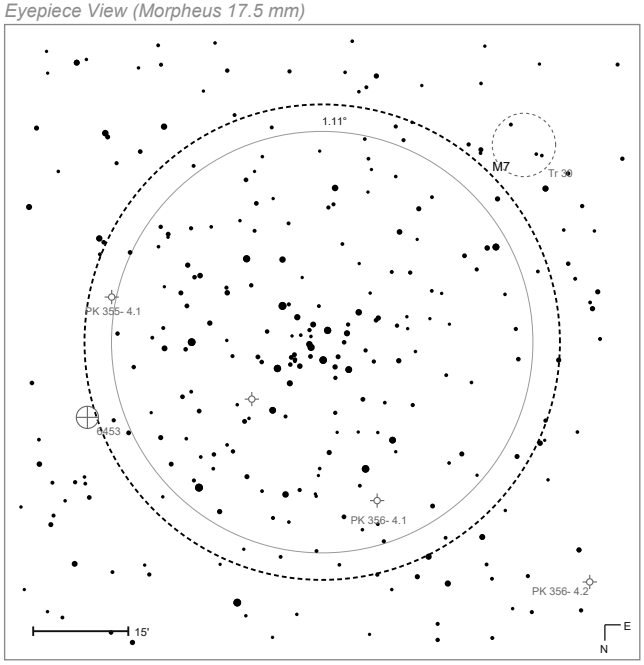
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 10.5 · outside the ring at 40 % opacity

mag ● 6 ● 8 ● 10 · 12

# M8 Lagoon Nebula

| | |
|---|---|
| MESSIER | 8 |
| NGC | 6523 |
| OBJECT TYPE | Diffuse Nebula |
| CONSTELLATION | Sagittarius |
| DISTANCE | 5,200 ly |
| APPARENT MAG. | +5.0 |
| RA (J2000) | 18h 03m 42s |
| DEC (J2000) | −24° 23′ |
| APPARENT SIZE | 45.0′ × 30.0′ |
| RADIUS (LY) | 34 |
| AGE (YEARS) | ~4 million |

NOTABLE FEATURE

Active stellar nursery; its 'Hourglass' sub-nebula marks a zone of current star formation driven by intense UV radiation.

## DISCOVERY & HISTORY

Giovanni Hodierna first noted the Lagoon Nebula in 1654; Guillaume Le Gentil observed it independently in 1747; Charles Messier catalogued it in 1764. It is one of only two star-forming nebulae visible to the naked eye from northern mid-latitudes — the other being M42 in Orion. The Lagoon lies 4,000–6,000 light-years away in Sagittarius and physically spans roughly 110 × 50 light-years.

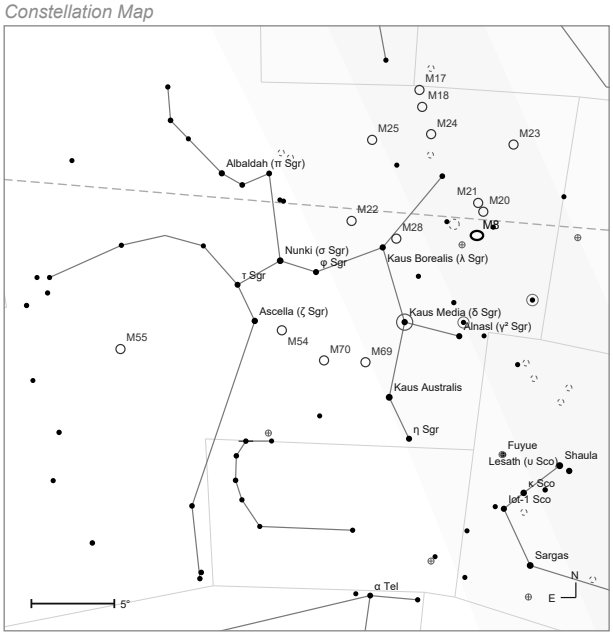
## AT THE EYEPIECE

Through a 10″ Dobsonian under Bortle 4 skies the Lagoon shows as a bright, elongated glow roughly 45′ × 30′ with a distinct dark lane — the eponymous lagoon — splitting the brighter northern lobe from the fainter southern region. The embedded open cluster NGC 6530 resolves into scattered blue-white stars. The tight Hourglass Nebula knot near the centre brightens with an OIII or H-beta filter. All structure appears grey visually; long-exposure images reveal pink hydrogen-alpha emission.

## WHY IT MATTERS

The Lagoon is an active H II region with ongoing star formation at multiple stages simultaneously: Herbig-Haro objects in the Hourglass structure (discovered 2006) show active accretion jets; Bok globules catalogued by E. E. Barnard mark collapsing pre-stellar cores; the young cluster NGC 6530 represents stars that recently emerged from the cloud. Few targets offer this complete a picture of stellar birth in a single eyepiece field.

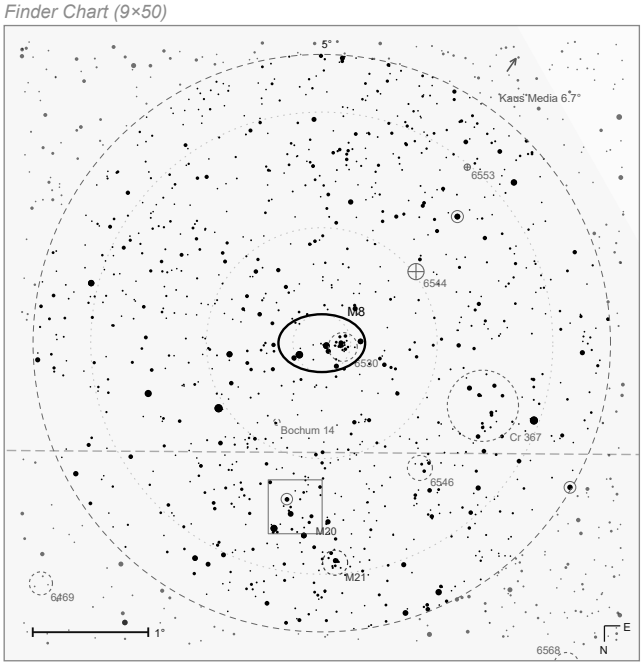
Constellation Map




Naked-eye view · mag 5 · field 36°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

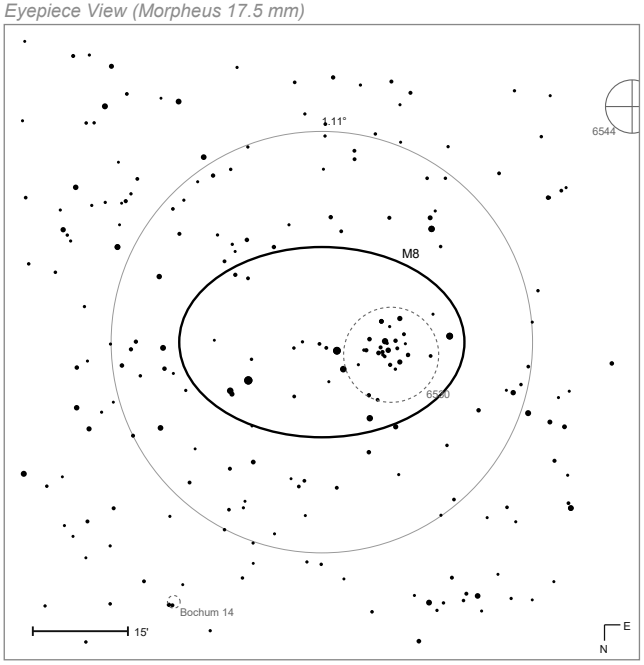
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 — ecliptic · · Telrad rings

Eyepiece View (Morpheus 17.5 mm)

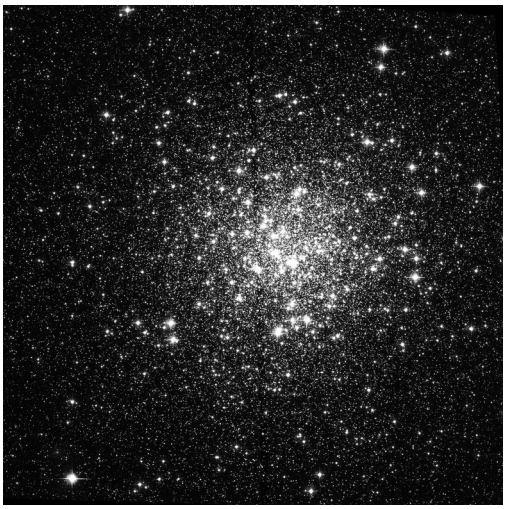



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 10.9 · outside the ring at 40 % opacity

mag ● 6 ● 8 ● 10 · 12

# M9

GLOBULAR CLUSTER



| | |
|---|---|
| MESSIER | 9 |
| NGC | 6333 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Ophiuchus |
| DISTANCE | 25.8 kly |
| APPARENT MAG. | +7.9 |
| RA (J2000) | 17h 19m 12s |
| DEC (J2000) | −18° 31′ |
| APPARENT SIZE | 12.0′ |
| RADIUS (LY) | 45 |
| AGE (YEARS) | 12 billion |
| NUMBER OF STARS | ~250,000 |

NOTABLE FEATURE

One of the closest globular clusters to the galactic centre, heavily reddened by intervening dust clouds.

## DISCOVERY & HISTORY

Charles Messier discovered M9 on 28 May 1764 and described it as a "nebula without stars." William Herschel resolved individual stars in 1783, estimating the cluster at 7–8′ across with a densely packed centre. M9 lies 25,800 light-years from Earth in Ophiuchus, only ~5,500 light-years from the Galactic Centre — placing it among the Messier globulars closest to the heart of the Milky Way.

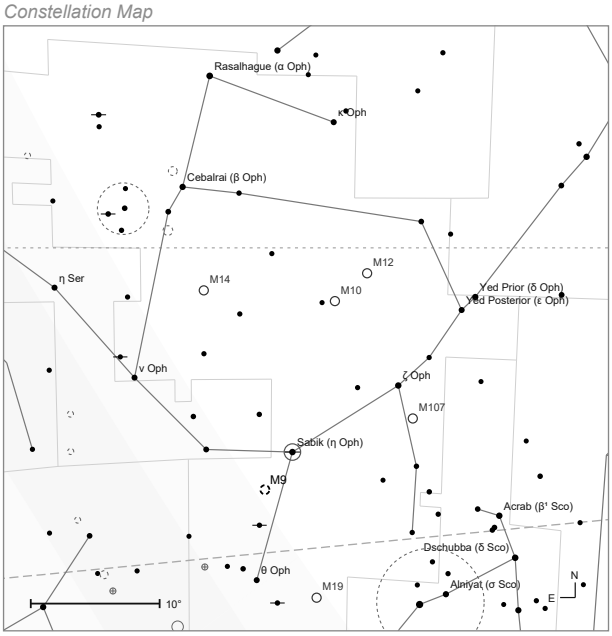
## AT THE EYEPIECE

At magnitude 7.9 M9 is fainter than its Ophiuchus neighbours M10 and M12. Through a 10″ Dobsonian under Bortle 4 conditions it appears as a small, round glow about 6′ across with a slightly condensed centre. Full resolution into individual stars requires averted vision. The dark nebula Barnard 64 reduces the background star density immediately west of the cluster, giving it an isolated appearance against an otherwise rich Milky Way field.

## WHY IT MATTERS

Its classification as an Oosterhoff type II globular — based on the periods of its RR Lyrae variables — implies an origin distinct from the Milky Way's disk population, pointing to accretion from a satellite galaxy. The absence of blue straggler stars is unusual among Messier globulars and has yet to be fully explained. Heavy dust extinction from its near-Galactic-Centre location means its true brightness is significantly higher than the observed magnitude suggests.

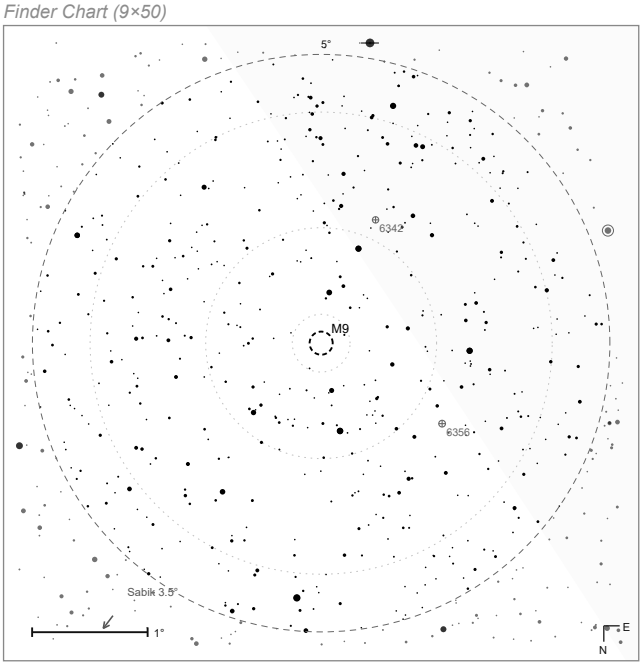
Constellation Map




Naked-eye view · mag 5 · field 47°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

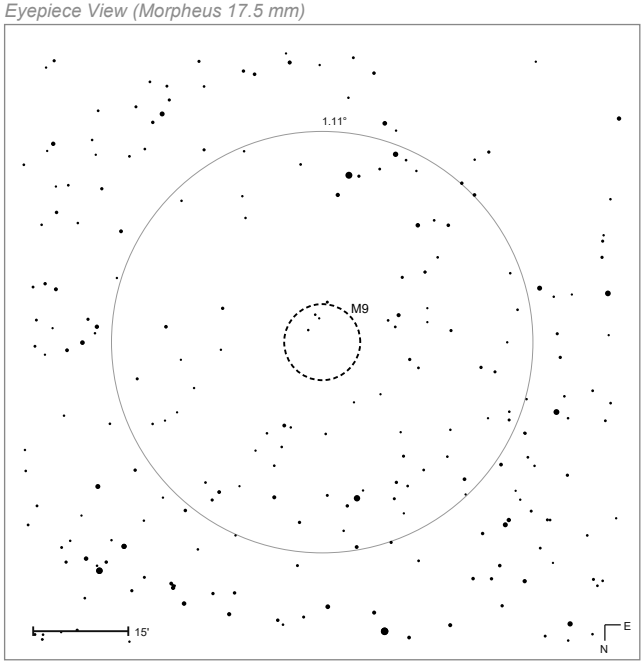
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 ● 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.6

mag ● 6 ● 8 ● 10 ● 12

# M10

GLOBULAR CLUSTER

| | |
|---|---|
| MESSIER | 10 |
| NGC | 6254 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Ophiuchus |
| DISTANCE | 14.3 kly |
| APPARENT MAG. | +6.6 |
| RA (J2000) | 16h 57m 06s |
| DEC (J2000) | −04° 06′ |
| APPARENT SIZE | 20.0′ |
| RADIUS (LY) | 42 |
| AGE (YEARS) | 11 billion |
| NUMBER OF STARS | ~100,000 |

NOTABLE FEATURE

A rich, compact globular that resolves readily into individual stars; forms a visual pair with the similar M12.

## DISCOVERY & HISTORY

Charles Messier discovered M10 on 29 May 1764 and catalogued it as a "nebula without stars." Johann Elert Bode independently described it in 1774 as "very pale." William Herschel resolved it with a larger reflector, calling it a "beautiful cluster of extremely compressed stars." Harlow Shapley made the first distance estimate but placed it at 33,000 light-years — more than twice the modern value of 14,300 light-years.

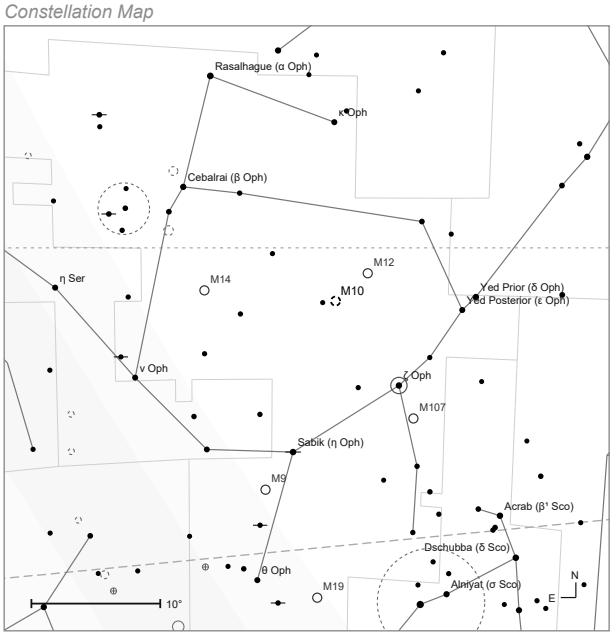
## AT THE EYEPIECE

M10 lies 1° west of the orange star 30 Ophiuchi, which provides a convenient colour contrast in the same field. Through a 10″ Dobsonian under Bortle 4 skies it appears as a moderately bright, well-rounded globular roughly 8–9′ across with a fairly condensed core. Comparing it to M12, 3.4° to the northwest, the two make a rewarding pair at low power: M10 is tighter and slightly brighter; M12 appears looser and more evenly resolved.

## WHY IT MATTERS

M10 shows chemical enrichment consistent with contributions from Type II supernovae but little evidence of Type Ia supernovae, indicating it formed rapidly in the earliest phases of galactic chemical evolution. It lies near the Galactic Equator, where differential interstellar reddening is measurable across its face — making it a useful probe of patchy dust distribution in the inner Milky Way.

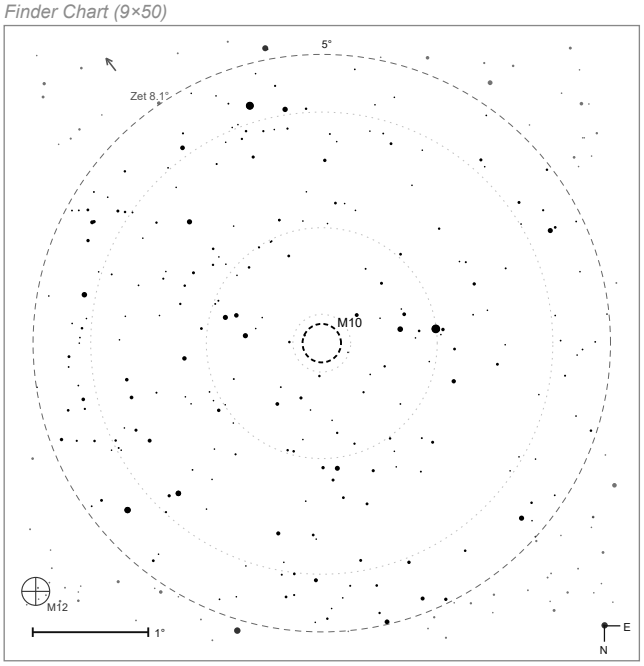
Constellation Map




Naked-eye view · mag 5 · field 47°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

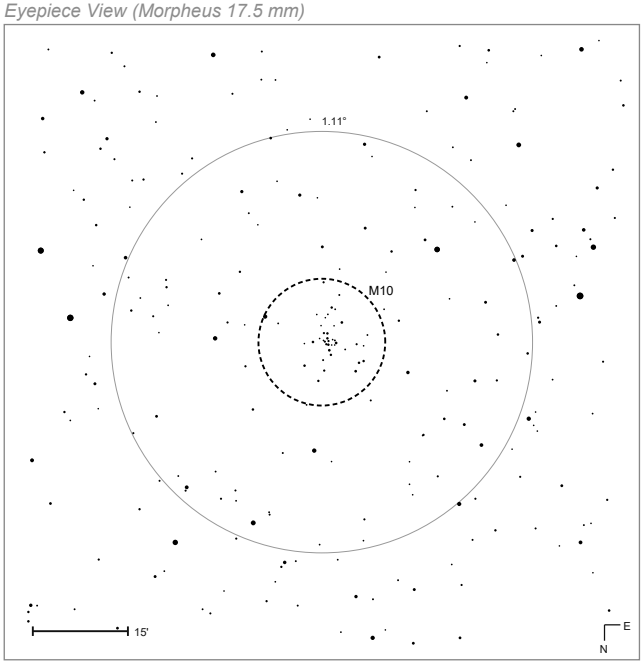
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.4

mag ● 8 ● 10 · 12 · 14

# M11 Wild Duck Cluster

| | |
|---|---|
| MESSIER | 11 |
| NGC | 6705 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Scutum |
| DISTANCE | 6,100 ly |
| APPARENT MAG. | +5.8 |
| RA (J2000) | 18h 51m 06s |
| DEC (J2000) | −06° 16′ |
| APPARENT SIZE | 11.0′ |
| RADIUS (LY) | 10 |
| AGE (YEARS) | 320 million |

## DISCOVERY & HISTORY

Gottfried Kirch found M11 in 1681 and described it as a small nebulous patch with a bright star at its centre. William Derham resolved it into stars in 1732 — one of the earliest clusters shown to be stellar rather than nebulous. Charles Messier added it on 30 May 1764. The popular name comes from the wedge of brighter members that suggests a flying flock of ducks, or, from another angle, a single swimming one. It lies about 6,100 light-years away, and modern work puts its age near 250–316 million years and its mass somewhere between 3,700 and 11,000 solar masses.

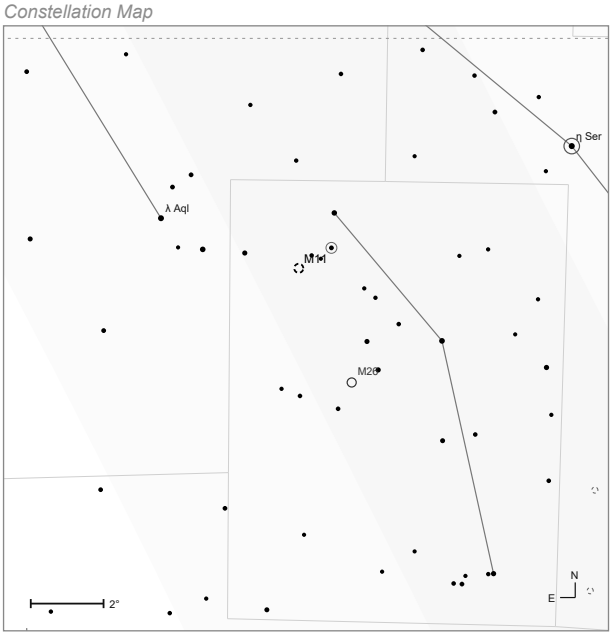
## AT THE EYEPIECE

M11 lies 1.5° south-east of β Scuti, right at the eastern edge of the Scutum Star Cloud, so the background field is already crowded before the cluster begins. From 50°N it culminates at 34°. Binoculars show a hazy knot that refuses to resolve. A 10″ Dobsonian under Bortle 4 skies breaks it into hundreds of stars from 9th to 13th magnitude packed into 11′ — so compact and rich that it reads as a globular until you notice the bright foreground star at the apex. Use 150× or more; the field rewards slow scanning. M26 sits 3.5° south-west.

## WHY IT MATTERS

M11 is among the richest and most massive open clusters known, with 870 members brighter than magnitude 16.5 — a population that lets astronomers test cluster dynamics on an object dense enough to behave almost like a globular. It is metal-rich, and unusually for its youth it shows enhanced alpha-process elements, suggesting its parent molecular cloud was seeded by a nearby Type II supernova before the stars formed. It still sits close to the galactic plane, not far from where it was born.

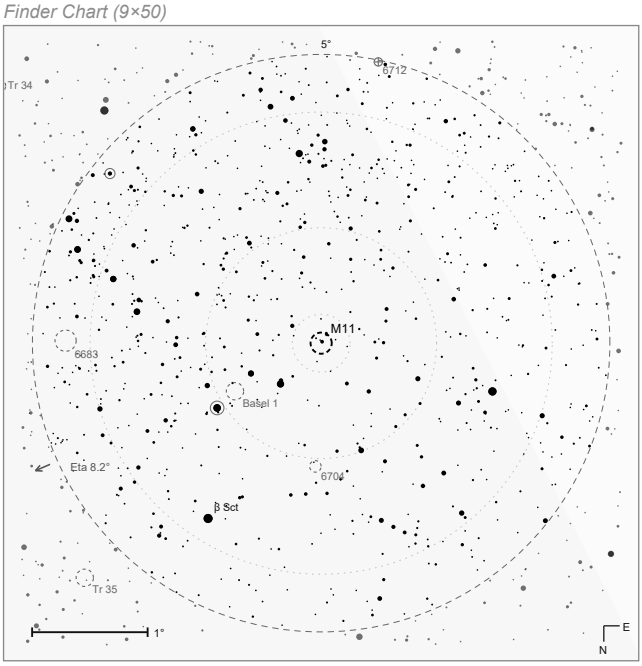
*Constellation Map*




*Naked-eye view · mag 6.5 · field 17°*

mag ● 1 ● 3 ● 5 ● 7 – – celestial equator

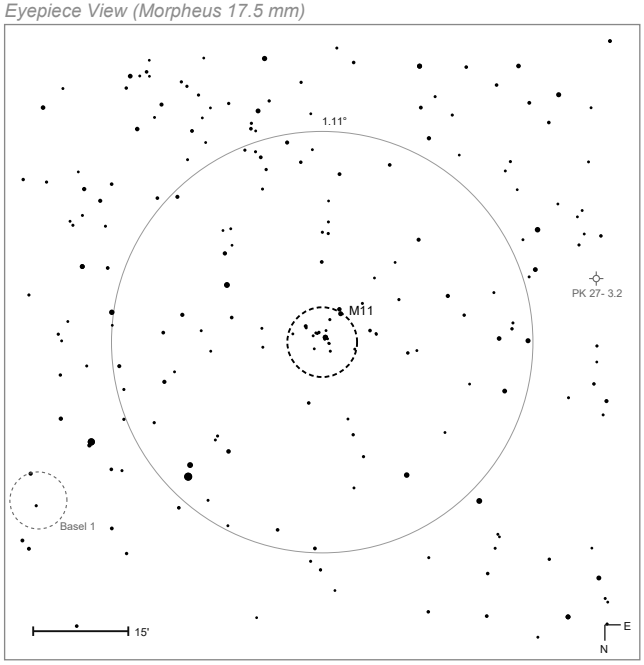
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

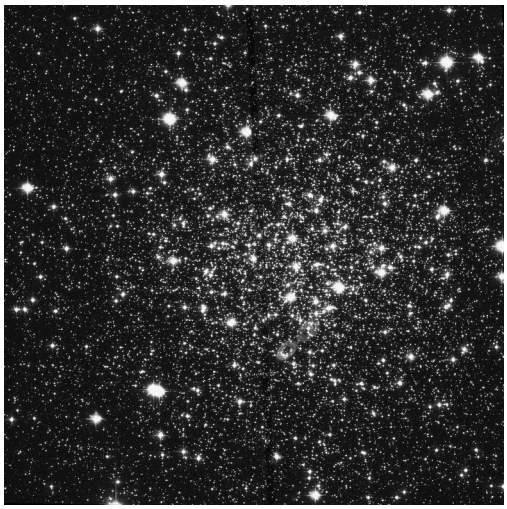



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.1*

mag ● 6 ● 8 ● 10 · 12

# M12





| | |
|---|---|
| MESSIER | 12 |
| NGC | 6218 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Ophiuchus |
| DISTANCE | 16.4 kly |
| APPARENT MAG. | +6.1 |
| RA (J2000) | 16h 47m 12s |
| DEC (J2000) | −01° 57′ |
| APPARENT SIZE | 16.0′ |
| RADIUS (LY) | 38 |
| AGE (YEARS) | 13.8 billion |

## DISCOVERY & HISTORY

Charles Messier discovered M12 on 30 May 1764 — the day before he found M10, 3° away — and logged it as a "nebula without stars". William Herschel recognised it as a globular cluster in 1783. Its loose structure fooled later observers too: with a Shapley–Sawyer concentration class of IX it is so sparsely packed that it was once catalogued as a tightly concentrated open cluster. It lies about 16,000 light-years away in Ophiuchus and spans roughly 75 light-years.

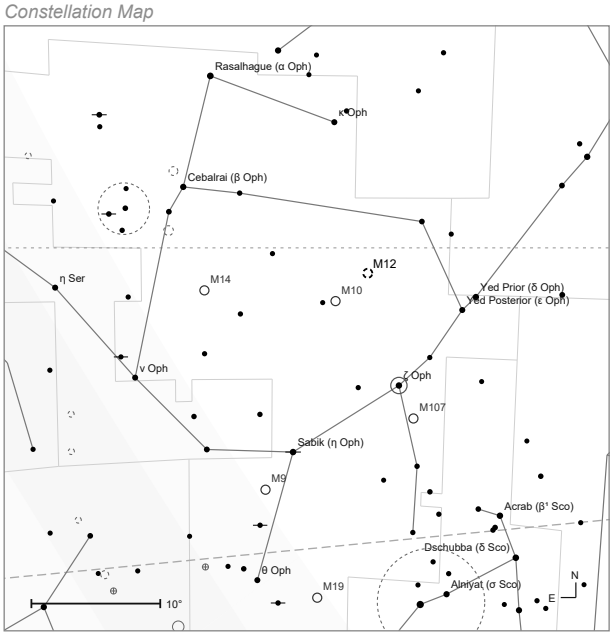
## AT THE EYEPIECE

M12 sits in an empty stretch of Ophiuchus, so the easiest approach is to find M10 first and move 3° north-west; alternatively it is 5.6° east-south-east of λ Ophiuchi. From 50°N it reaches 38°. Binoculars show a soft round glow. A 10″ Dobsonian under Bortle 4 skies gives a granular core about 3′ across inside a 10′ halo that resolves into individual stars of 12th magnitude and fainter. Compared with M10 in the same session, M12 is visibly looser and less centrally condensed — the two make an instructive pair.

## WHY IT MATTERS

A 2006 study found M12 unusually poor in low-mass stars. The likely explanation is tidal stripping: repeated passages through the matter-rich plane of the Milky Way have pulled its lightest members away, leaving a cluster gradually being dismantled by its host galaxy. That makes M12 a working example of how the galactic halo's globular population erodes over billions of years, and a calibration point for models of cluster destruction. Thirteen variable stars are known in it.

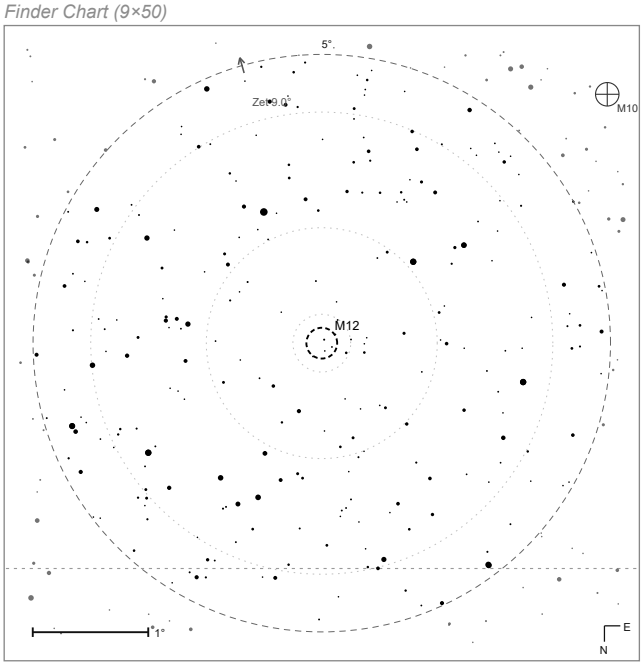
*Constellation Map*




*Naked-eye view · mag 5 · field 47°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

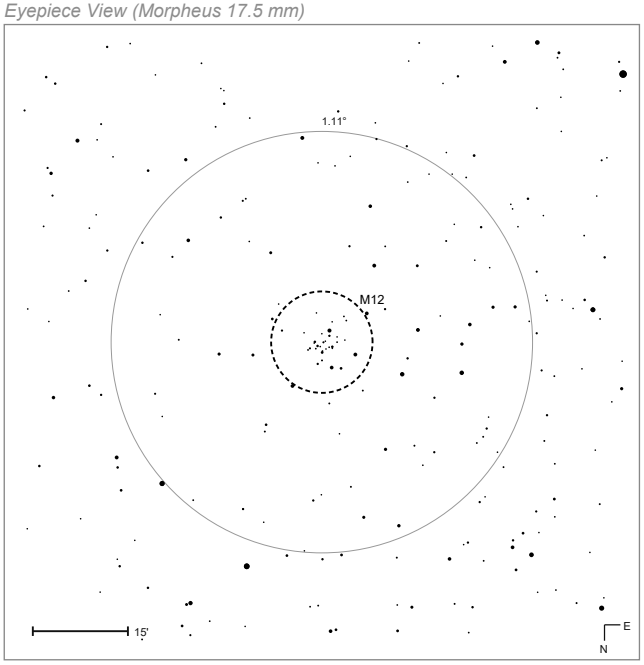
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - celestial equator - · Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

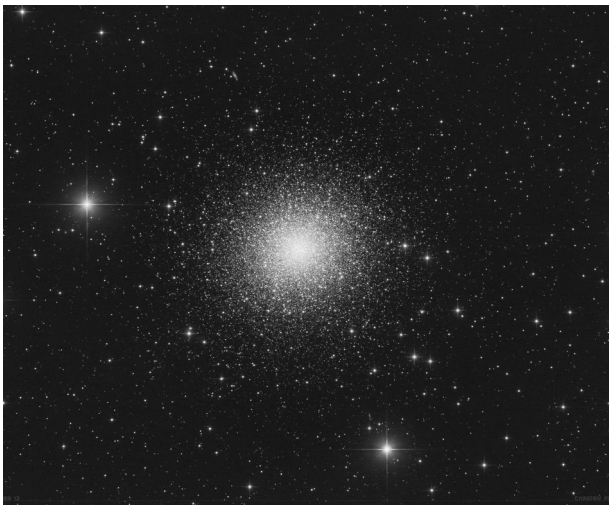



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.6*

mag ● 8 ● 10 · 12 · 14

# M13 Hercules Cluster

GLOBULAR CLUSTER



| | |
|---|---|
| MESSIER | 13 |
| NGC | 6205 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Hercules |
| DISTANCE | 25 kly |
| APPARENT MAG. | +5.8 |
| RA (J2000) | 16h 41m 42s |
| DEC (J2000) | +36° 28′ |
| APPARENT SIZE | 20.0′ |
| RADIUS (LY) | 73 |
| AGE (YEARS) | 11.7 billion |

## DISCOVERY & HISTORY

Edmond Halley noticed M13 in 1714 and described it as "a little Patch, but it shews it self to the naked Eye, when the Sky is serene and the Moon absent." Charles Messier catalogued it in 1764. William Herschel resolved it into stars with his 6.2-inch reflector in 1779, settling the question of what these "nebulous" objects really were. In 1974 the Arecibo radio telescope beamed a famous 1,679-bit message toward M13 — though by the time it arrives in 25,000 years, the cluster will have drifted out of the beam's path.

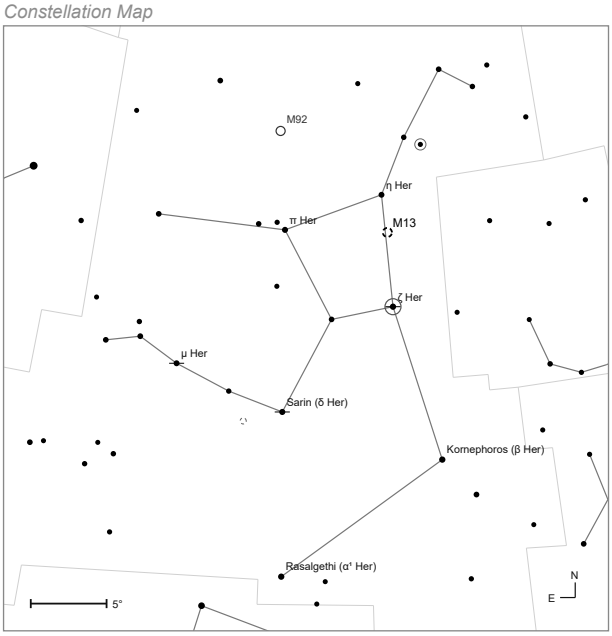
## AT THE EYEPIECE

M13 is the showpiece of the northern sky. Under Bortle 4 from 50°N it culminates above 75°, so atmospheric haze isn't an issue. In a 10″ Dobson the core blazes; the outer halo resolves into perhaps a hundred individual stars, with the famous "propeller" — three dark lanes radiating from the centre — visible to a patient eye at 100×–150×. Use η Herculis as a hop point: M13 sits 2.5° south of it, a third of the way from η to ζ, easy to find even with a finder.

## WHY IT MATTERS

M13 holds several hundred thousand stars in a sphere about 145 light-years across, 22,200 to 25,000 light-years away. Like all globular clusters, its stars are nearly as old as the galaxy itself — roughly 11.65 billion years — and metal-poor, formed before the Milky Way had been enriched by generations of supernovae. Spectroscopy of M13's stars helps calibrate the cosmic distance scale and constrains theories of stellar evolution in dense environments.

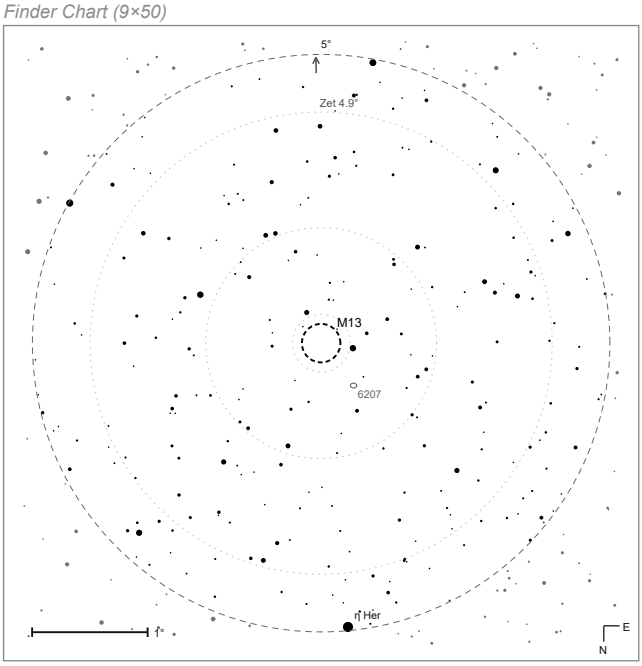
Constellation Map




Naked-eye view · mag 5 · field 4°

mag ● 1 ● 3 ● 5 ● 7

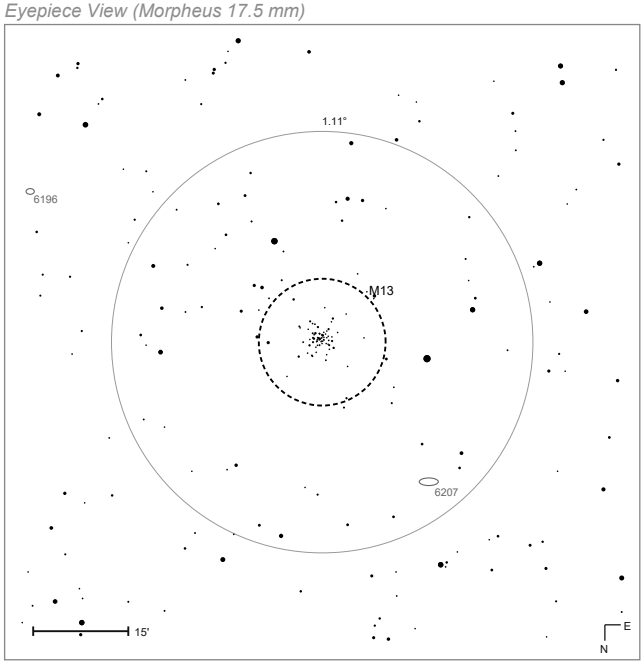
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.7

mag ● 8 ● 10 · 12 · 14

# M14

GLOBULAR CLUSTER

| | |
|---|---|
| MESSIER | 14 |
| NGC | 6402 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Ophiuchus |
| DISTANCE | 30.3 kly |
| APPARENT MAG. | +7.6 |
| RA (J2000) | 17h 37m 36s |
| DEC (J2000) | −03° 15′ |
| APPARENT SIZE | 11.0′ |
| RADIUS (LY) | 48 |

## DISCOVERY & HISTORY

Charles Messier discovered M14 on the night of 1–2 June 1764 and left an unusually full description: a round, faint nebula about 2′ across on the robe covering Ophiuchus's right shoulder, with a 9th-magnitude star just above it. He saw no stars in it and suspected a larger instrument might. He was right — the cluster holds several hundred thousand of them, at a distance of roughly 30,000 light-years, spanning about 100 light-years. Its total luminosity is some 400,000 Suns.

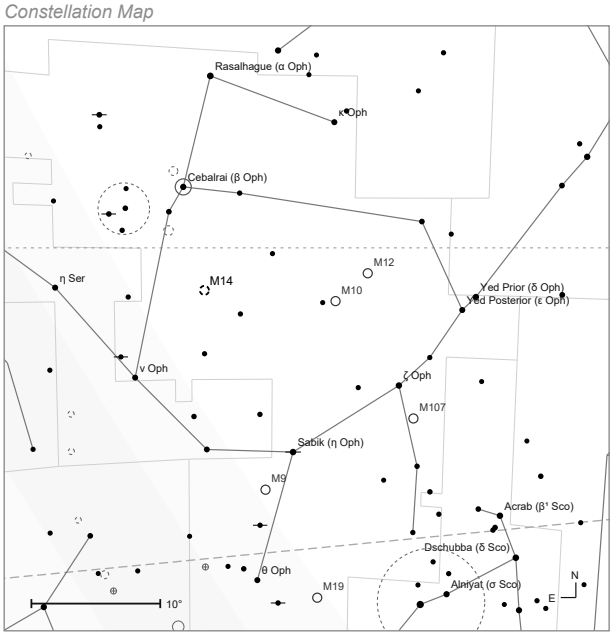
## AT THE EYEPIECE

M14 has no bright neighbour to guide on: work 10° east from M12 or 8° south from β Ophiuchi (Cebalrai). From 50°N it culminates at 37°. Binoculars pick it up easily as a small round glow. Its distance works against resolution, though — in a 10″ Dobsonian under Bortle 4 skies it stays milky and slightly oval, closer in texture to an elliptical galaxy than to M10 or M12, with only the faintest granulation at high power. The brightest members are 14th magnitude. NGC 6366, a much fainter globular, lies 3° south-west.

## WHY IT MATTERS

Seventy variable stars are known in M14, many of them W Virginis type — population II Cepheids whose period–luminosity relation anchors distance measurements to old stellar systems. The cluster also hosted a nova in 1938, missed at the time and only found in 1964 when archival photographic plates were re-examined. It peaked near magnitude 9.2, more than five times brighter than the cluster's brightest ordinary star, and remains one of very few novae ever recorded inside a globular cluster.

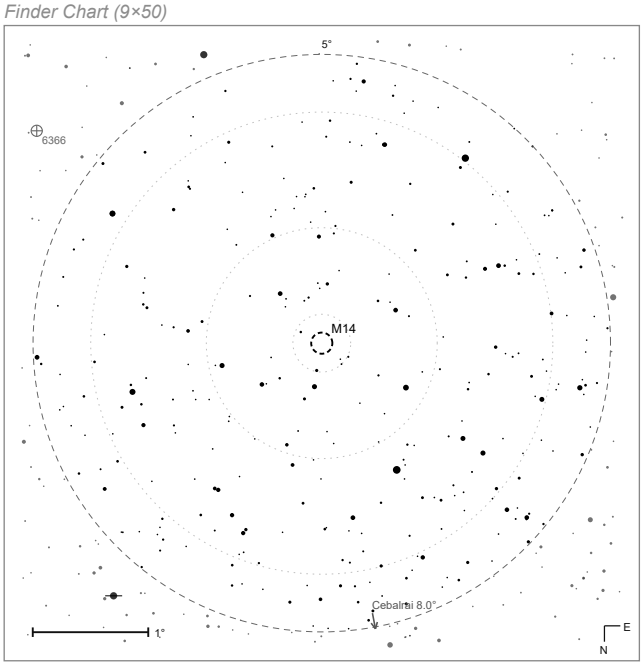
Constellation Map




Naked-eye view · mag 5 · field 47°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

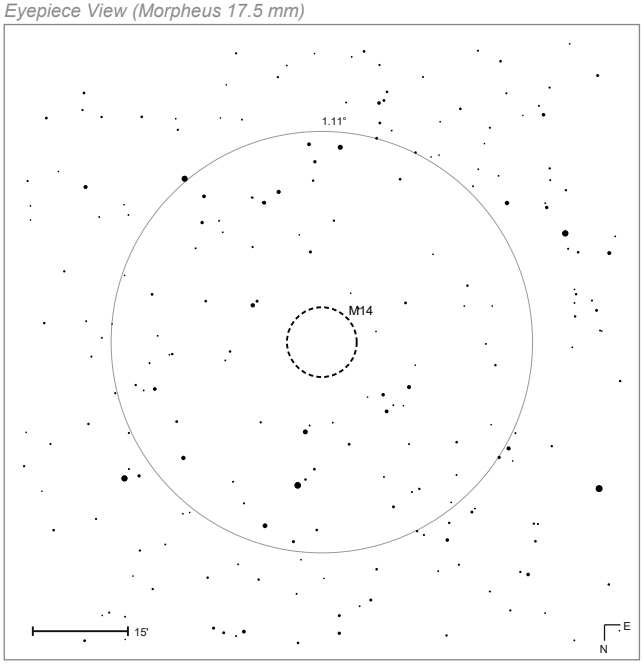
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

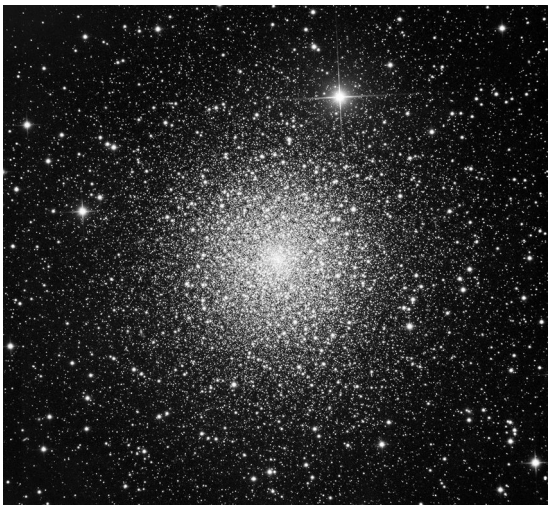



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.4

mag ● 8 ● 10 · 12 · 14

# M15

GLOBULAR CLUSTER



| | |
|---|---|
| MESSIER | 15 |
| NGC | 7078 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Pegasus |
| DISTANCE | 35.7 kly |
| APPARENT MAG. | +6.4 |
| RA (J2000) | 21h 30m 00s |
| DEC (J2000) | +12° 10′ |
| APPARENT SIZE | 18.0′ |
| RADIUS (LY) | 93 |
| AGE (YEARS) | 12 billion |

## DISCOVERY & HISTORY

Jean-Dominique Maraldi found M15 on 7 September 1746 while following a comet, and described it as a nebulous star made of many stars. Charles Messier logged it on 3 June 1764 as a nebula without stars; William Herschel resolved it in 1783. John Herschel and Heinrich d'Arrest both noticed the cluster looks lopsided, its centre displaced slightly east. At an estimated 12.5 ± 1.3 billion years, M15 is among the oldest globulars known, lying 35,700 light-years away and spanning 175 light-years.

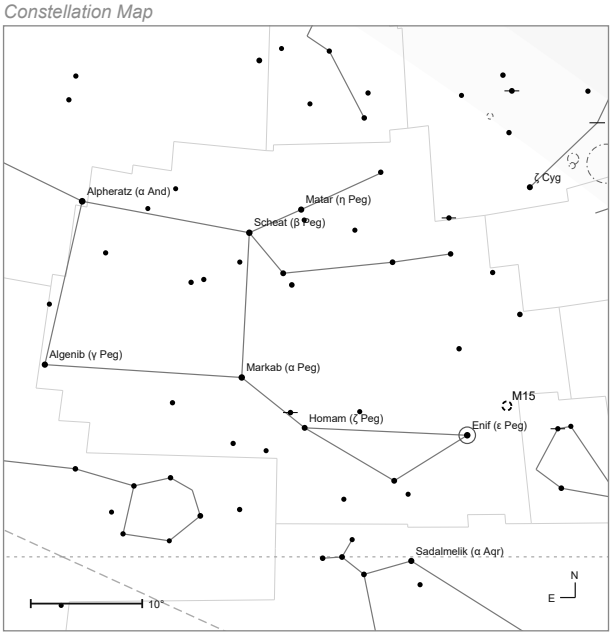
## AT THE EYEPIECE

Extend the line from θ Pegasi through Enif (ε Pegasi) about 4° north-west and M15 is there — an easy hop, and from 50°N it climbs to 52°. Binoculars show a fuzzy star; under a very dark sky it is on the edge of naked-eye visibility. Visually it spans about 7′, far less than the 18′ photographic figure. A 10″ Dobsonian under Bortle 4 skies resolves the outer regions into 12.6-magnitude stars but the core stays a blazing unresolved knot — this is one of the most concentrated globulars in the sky.

## WHY IT MATTERS

M15's core has undergone core collapse, leaving a central density cusp that may surround an intermediate-mass black hole. The cluster holds over 100,000 stars, 112 variables and 8 pulsars, including the double neutron star system M15-C. It also contains Pease 1, the first planetary nebula ever found inside a globular cluster, discovered by Francis Pease on Mount Wilson plates in 1928 — only three more have been found since. Two bright X-ray sources have been detected in it; one of them, M15 X-1, appears to be the first X-ray source ever recorded in Pegasus.

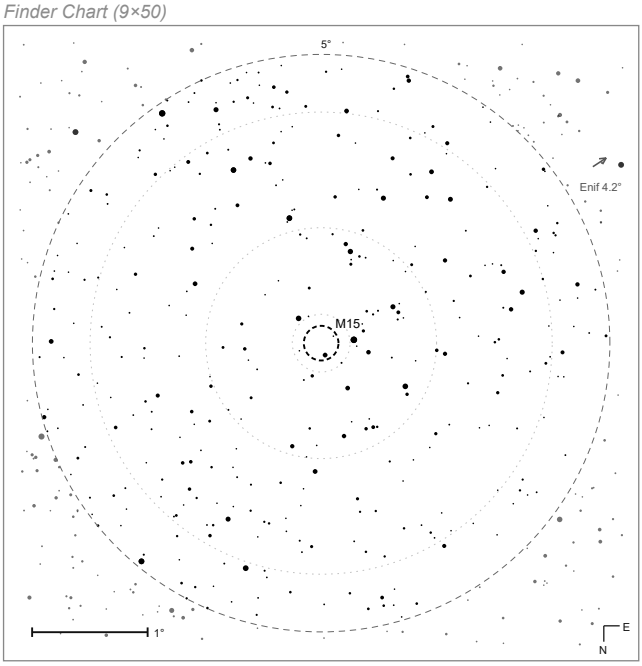
Constellation Map




Naked-eye view · mag 5 · field 54°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

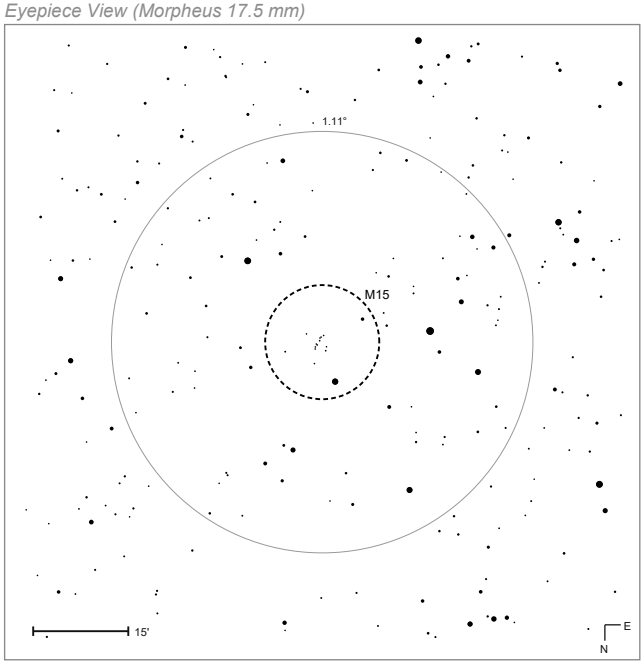
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.4

mag ● 8 ● 10 · 12 · 14

# M16 Eagle Nebula

| | |
|---|---|
| MESSIER | 16 |
| NGC | 6611 |
| OBJECT TYPE | Diffuse Nebula |
| CONSTELLATION | Serpens |
| DISTANCE | 5,700 ly |
| APPARENT MAG. | +6.0 |
| RA (J2000) | 18h 18m 48s |
| DEC (J2000) | −13° 47′ |
| APPARENT SIZE | 8.0′ |
| RADIUS (LY) | 7 |

## DISCOVERY & HISTORY

Jean-Philippe de Chéseaux found the cluster in 1745–46; Charles Messier catalogued the surrounding nebulosity in 1764. Both popular names describe the dark silhouette near the centre: an eagle with spread wings, or — in Robert Burnham Jr.'s reading — a Star Queen in profile. The same central pillar became one of the most reproduced astronomical images ever taken when Jeff Hester and Paul Scowen photographed it with the Hubble Space Telescope in 1995 and called it the Pillars of Creation. The nebula lies about 5,700 light-years away and the cluster in it is barely 1–2 million years old.

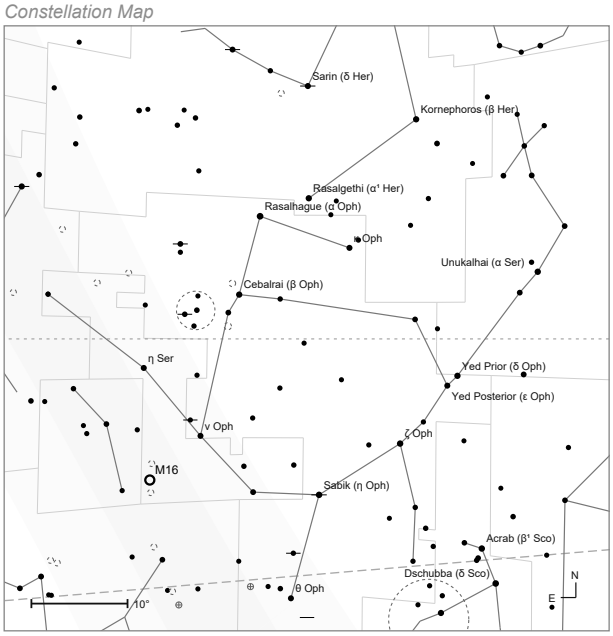
## AT THE EYEPIECE

M16 lies about 3° west of γ Scuti, in the Sagittarius Arm; from 50°N it culminates at only 26°, so a clear southern horizon matters. Binoculars show an elongated glow around a small knot of stars. In a 10″ Dobsonian under Bortle 4 skies the cluster dominates — some 40 stars from 8th to 12th magnitude — while the nebula reads as a soft, uneven wash around them; a UHC or OIII filter is what brings out the dark intrusion of the pillars. Do not expect the Hubble image. M17 lies 2.5° south.

## WHY IT MATTERS

M16 is one of the most closely studied star-forming regions in the galaxy, and the Pillars of Creation are the textbook case of photoevaporation: the winds and ultraviolet radiation of hot young stars eating away a molecular cloud while dense pockets inside it — Bok globules holding protostars — resist and are left standing as spires. Whether that radiation triggers or suppresses further collapse is still argued. The brightest member, HD 168076, is an 80-solar-mass O-type binary a million times more luminous than the Sun.

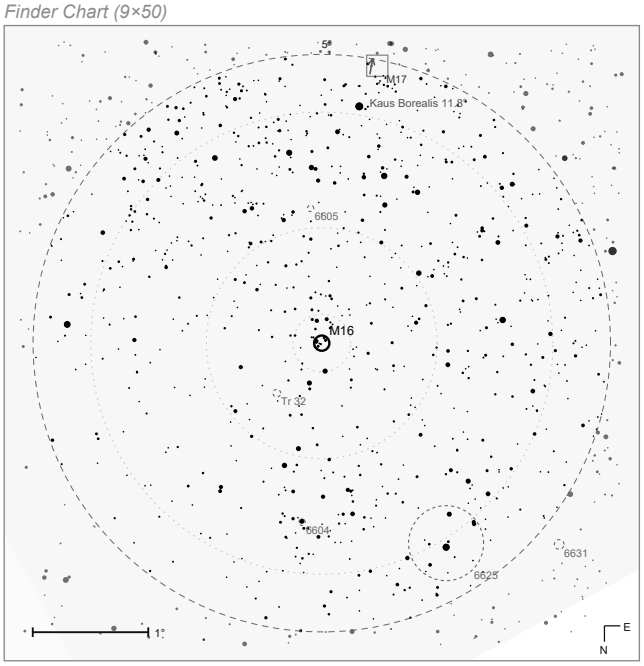
*Constellation Map*




*Naked-eye view · mag 5 · field 63°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

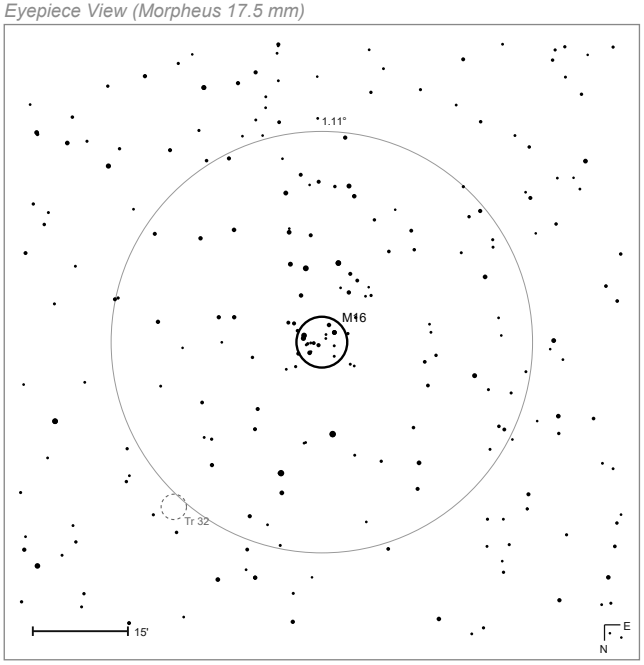
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.3*

mag ● 6 ● 8 ● 10 · 12

# M17 Omega Nebula

| | |
|---|---|
| MESSIER | 17 |
| NGC | 6618 |
| OBJECT TYPE | Diffuse Nebula |
| CONSTELLATION | Sagittarius |
| DISTANCE | 6,000 ly |
| APPARENT MAG. | +6.0 |
| RA (J2000) | 18h 20m 48s |
| DEC (J2000) | −16° 11′ |
| APPARENT SIZE | 20.0′ × 15.0′ |
| RADIUS (LY) | 17 |

## DISCOVERY & HISTORY

Philippe Loys de Chéseaux discovered the Omega Nebula in 1745, but his report went unnoticed and Charles Messier found it independently on 3 June 1764, comparing it to the Andromeda Nebula. John Herschel made the first careful drawing in 1833 and described its shape as a distorted Greek capital omega — Messier, he noted, had seen only the bright eastern branch. Admiral Smyth's names stuck: Omega and Horseshoe. Others followed — Swan, Checkmark, Lobster.

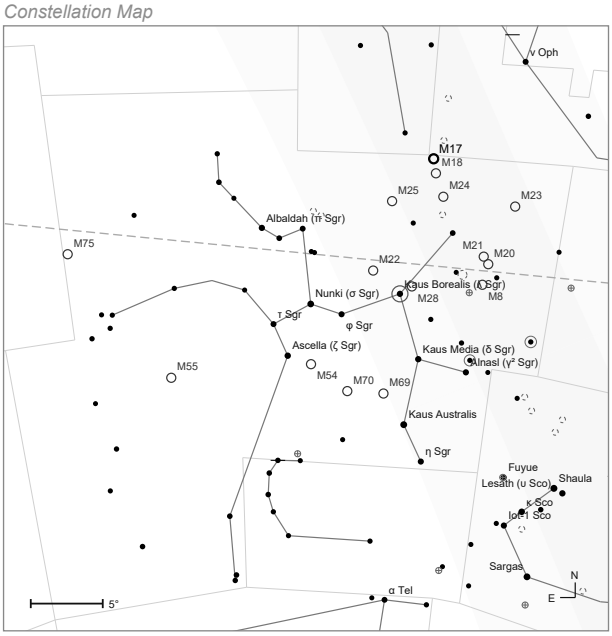
## AT THE EYEPIECE

M17 lies 2.5° south-west of γ Scuti, embedded in some of the richest star fields of Sagittarius; from 50°N it culminates at 24°, so pick a transparent night and a low southern horizon. Binoculars already show an elongated streak. A 10″ Dobsonian under Bortle 4 skies gives the nebula's best-known form: a bright bar with a hooked northern extension, the "swan" riding on water. A UHC filter adds several faint outer loops that are otherwise invisible. Unlike M42 the structure is seen edge-on, which is why it looks like a bar rather than a fan. M16 lies 2.5° north.

## WHY IT MATTERS

M17 lies 5,000–6,000 light-years away and is among the brightest and most massive star-forming regions in the galaxy: an H II region of some 800 solar masses inside a molecular cloud 40 light-years across and 30,000 solar masses in total. Its embedded cluster NGC 6618 holds up to 800 stars — 9 of spectral type O — plus more than a thousand still forming in the outer regions, at an age of just 1 million years. Because it is viewed edge-on rather than face-on like M42, it offers a complementary geometry for testing models of how H II regions break out of their parent clouds.

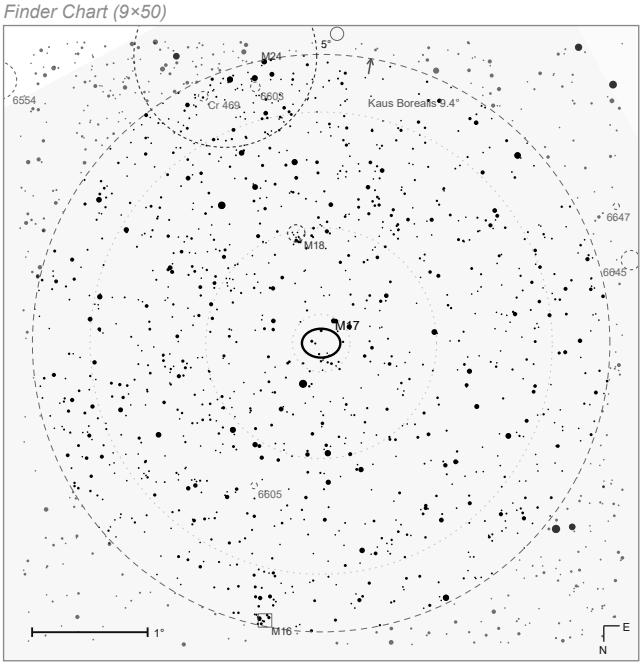
*Constellation Map*




*Naked-eye view · mag 5 · field 42°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

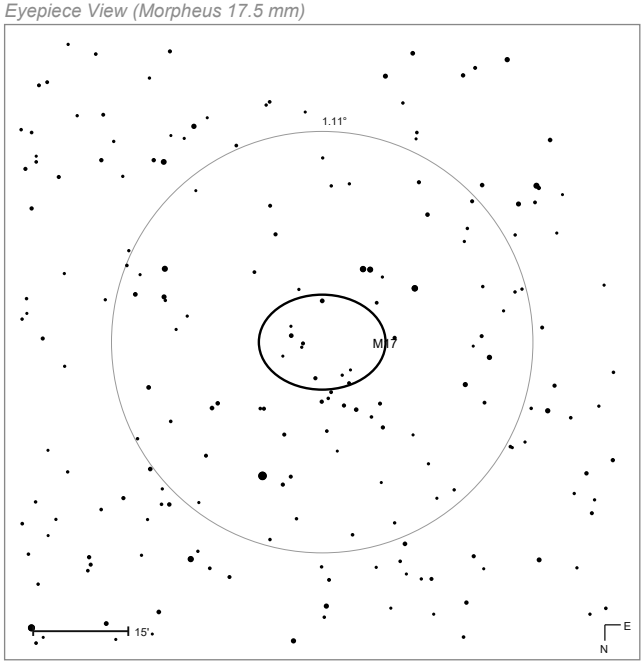
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

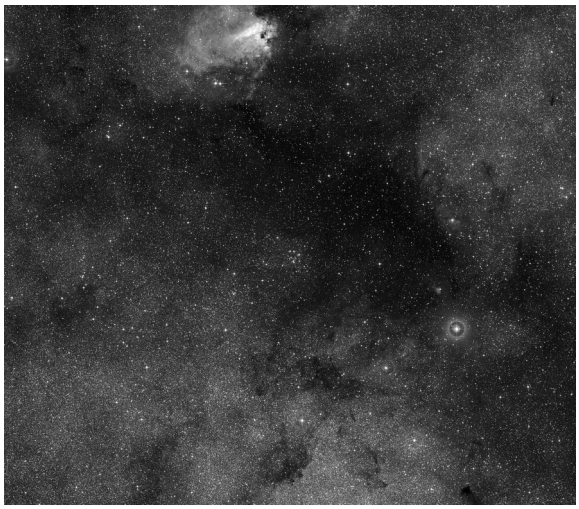



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 10.8*

mag ● 6 ● 8 ● 10 · 12

# M18





| | |
|---|---|
| MESSIER | 18 |
| NGC | 6613 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Sagittarius |
| DISTANCE | 4,200 ly |
| APPARENT MAG. | +6.9 |
| RA (J2000) | 18h 19m 54s |
| DEC (J2000) | −17° 08′ |
| APPARENT SIZE | 7.0′ |
| RADIUS (LY) | 4 |
| AGE (YEARS) | 33 million |

## DISCOVERY & HISTORY

Charles Messier found M18 on 3 June 1764 and described it as a cluster of small stars a little below M17, wrapped in faint nebulosity: through his 3.5-foot refractor it looked nebulous, in a larger instrument nothing but stars. John Herschel dismissed it as a loose, star-poor cluster. The verdict has not much changed — M18 is a sparse group whose main distinction is its position between two famous neighbours. It sits about 4,200 light-years away and is 17–33 million years old.

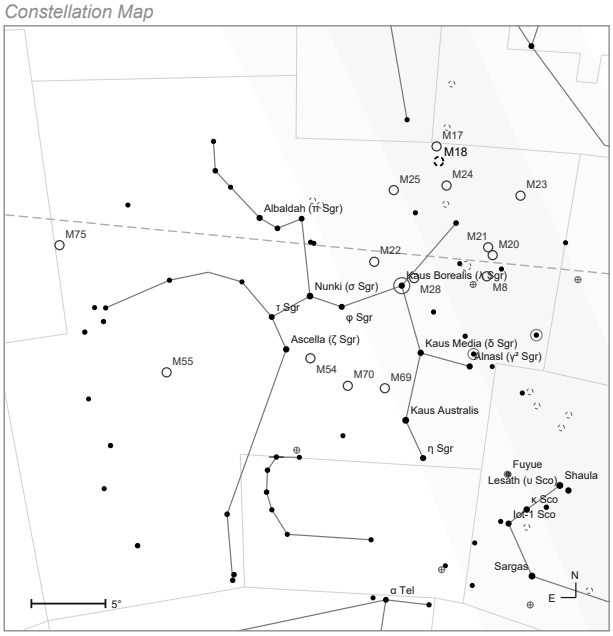
## AT THE EYEPIECE

M18 lies 1° south of M17 and 1.5° north-east of the M24 star cloud, roughly 4° north of μ Sagittarii; from 50°N it culminates at 23°. In 10×50 binoculars it is a faint unresolved haze, easy to sweep past. A 10″ Dobsonian under Bortle 4 skies resolves it completely — about a dozen whitish stars of 9th to 12th magnitude scattered across 7′ — and the nebulous look disappears entirely. The surrounding Milky Way field is so rich that the cluster barely stands out; the trick is to recognise it, not to see it.

## WHY IT MATTERS

M18's population is almost entirely B-type: 29 B stars, one definite Be star and three supergiants of class A or earlier, on a total mass of only about 190 Suns. That makes it a small, clean sample of coeval massive stars — useful precisely because it is simple. Its orbit is well determined too: it circles the galactic centre every 186.5 million years on a nearly circular path, crossing the galactic plane every 27.4 million years and never straying more than 80 pc from it.

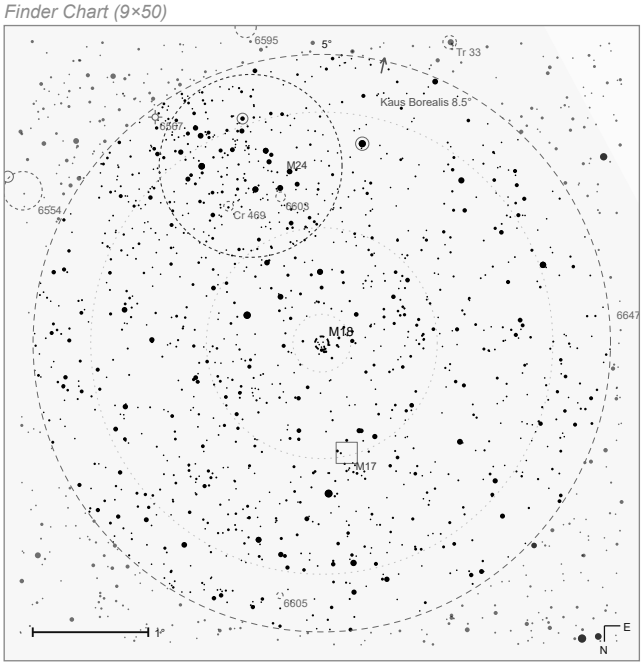
*Constellation Map*




*Naked-eye view · mag 5 · field 41°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

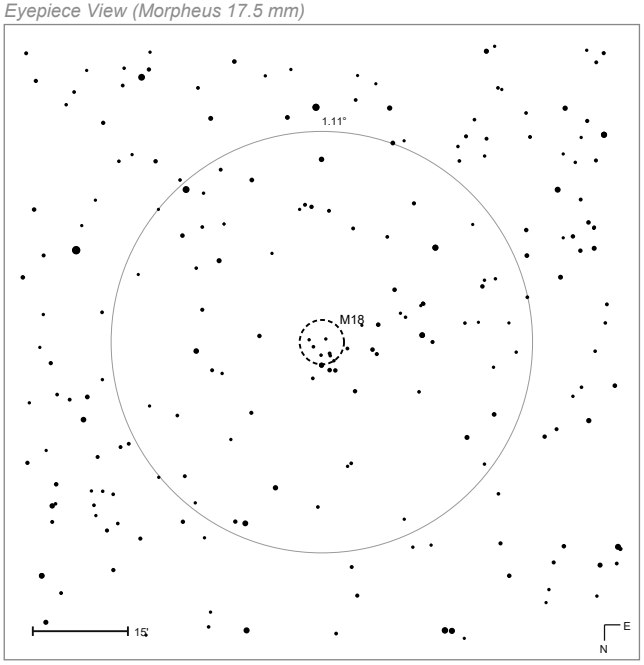
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 ● 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 10.6*

mag ● 6 ● 8 ● 10 ● 12

# M19

| | |
|---|---|
| MESSIER | 19 |
| NGC | 6273 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Ophiuchus |
| DISTANCE | 28.7 kly |
| APPARENT MAG. | +6.8 |
| RA (J2000) | 17h 02m 36s |
| DEC (J2000) | −26° 16′ |
| APPARENT SIZE | 17.0′ |
| RADIUS (LY) | 71 |
| AGE (YEARS) | 11.9 billion |

## DISCOVERY & HISTORY

Charles Messier discovered M19 on 5 June 1764 and placed it "between Scorpius and the right foot of Ophiuchus, on the same parallel as Antares". William Herschel resolved it into stars in 1784, and his son John called it "a superb cluster resolvable into countless stars". Admiral Smyth described it in detail; d'Arrest, oddly, left no notes at all. The cluster lies about 28,700 light-years away and only some 6,500 light-years from the galactic centre, holds around 1.1 million solar masses and is roughly 11.9 billion years old.

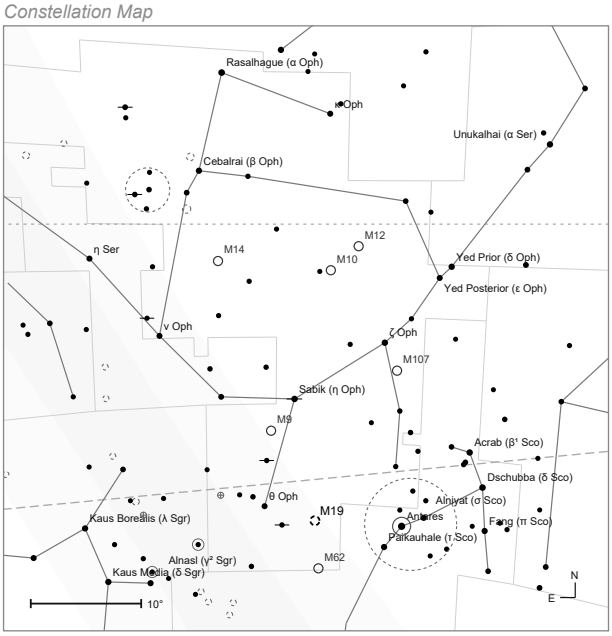
## AT THE EYEPIECE

M19 is easy to locate — about halfway along the line from Antares to θ Ophiuchi, 4.5° west-south-west of the latter. The problem is altitude: from 50°N it culminates at just 14°, so it wants a transparent night and a clear southern horizon. In 50 mm binoculars it is a small fuzzy point. A 10″ Dobsonian under Bortle 4 skies shows a distinctly oval object with a 3′ × 4′ core inside a 5′ × 7′ halo, resolving a few 13th-magnitude stars east and south of centre; at 150× it looks nearly fully resolved. M62 lies 4° south, M9 9° north-east.

## WHY IT MATTERS

M19 is one of the most oblate globular clusters known — but the flattening is largely an illusion. Intervening gas and dust absorb light strongly along its eastern edge, and in the infrared, where extinction matters far less, the cluster looks almost round. It is therefore a standing caution about inferring structure from optical images of objects seen through the galactic plane. Its variables include four Cepheids and RV Tauri stars plus at least one RR Lyrae with a known period.

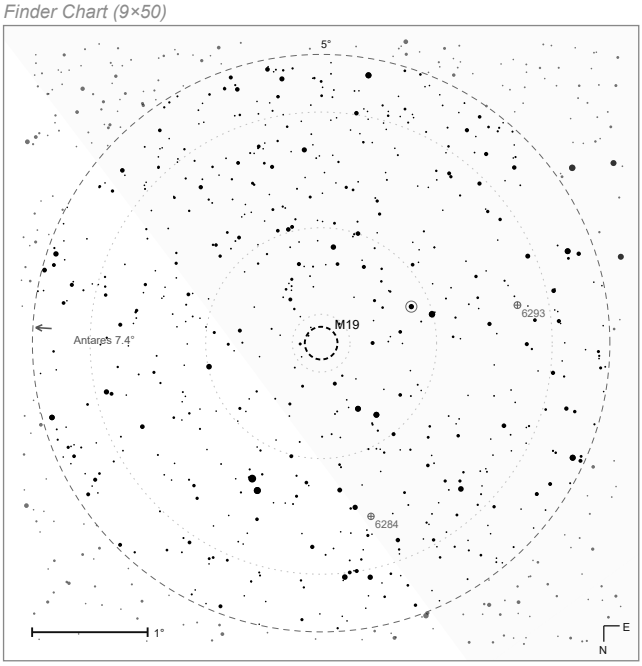
*Constellation Map*




*Naked-eye view · mag 5 · field 55°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

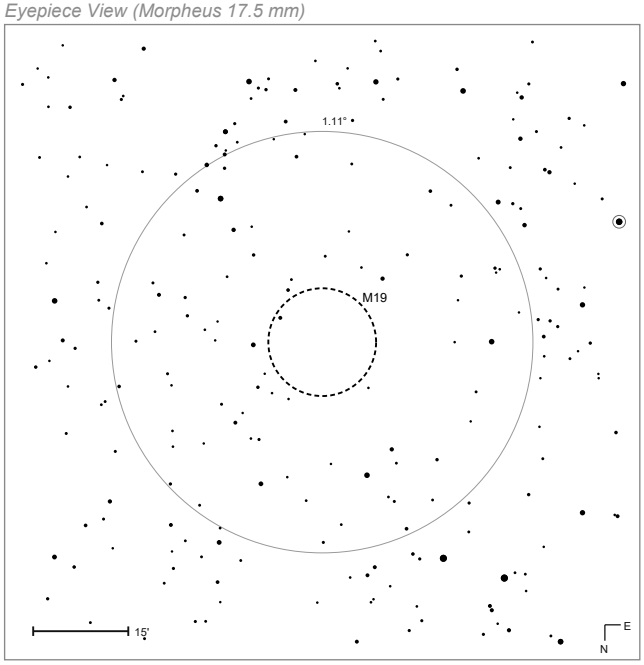
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.4*

mag ● 6 ● 8 ● 10 · 12

# M20 Trifid Nebula

*M20 is the nebula at centre; the loose cluster beside it is M21.*

| | |
|---|---|
| MESSIER | 20 |
| NGC | 6514 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Diffuse Nebula |
| CONSTELLATION | Sagittarius |
| DISTANCE | 4,100 ly |
| APPARENT MAG. | +6.3 |
| RA (J2000) | 18h 02m 42s |
| DEC (J2000) | −22° 58′ |
| APPARENT SIZE | 20.0′ |
| RADIUS (LY) | 12 |

## DISCOVERY & HISTORY

Charles Messier discovered the Trifid on 5 June 1764. Its name means three-lobed, after the dark dust lanes — catalogued separately as Barnard 85 — that appear to split the glowing gas into three parts. The object is an unusual combination of four things at once: an open cluster, an emission nebula in reddish pink, a reflection nebula in blue to the north-north-east, and the dark nebula that cuts across both. John Herschel's drawing fixed the trifid appearance in the literature, and it has been an amateur favourite ever since.

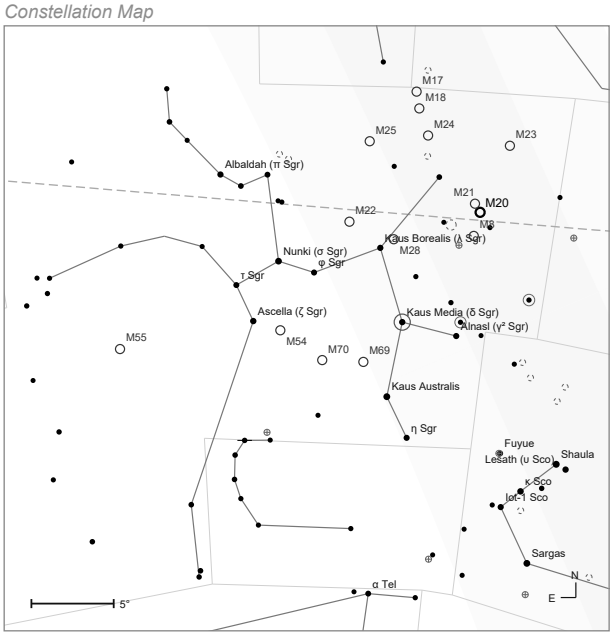
## AT THE EYEPIECE

M20 lies 1.5° north of M8 and about 8° north of Alnasl (γ Sgr); from 50°N it culminates at 17°, so it needs a good southern horizon. Binoculars show a dim round patch with a few stars. A 120–140 mm telescope adds the bright central multiple star and uneven patches of glow. In a 10″ Dobsonian under Bortle 4 skies the dark lanes finally appear — the whole point of the object — radiating from near the central star; the blue reflection portion is much harder and often invisible at low altitude. The nebula spans about 20′.

## WHY IT MATTERS

The Trifid lies about 4,100 light-years away, a young and active star-forming region in the Sagittarius Arm; its most massive star, HD 164492A, is an O7.5 giant of more than 20 solar masses surrounded by some 3,100 young stars, and Spitzer found 30 more still forming in 2005. Hubble imaging in 1997 caught the mechanics in detail: a stellar jet 0.75 light-years long emerging from a dense cloud 8 light-years from the central star, and a finger-like stalk pointing straight back at that star — photoevaporation caught in the act.

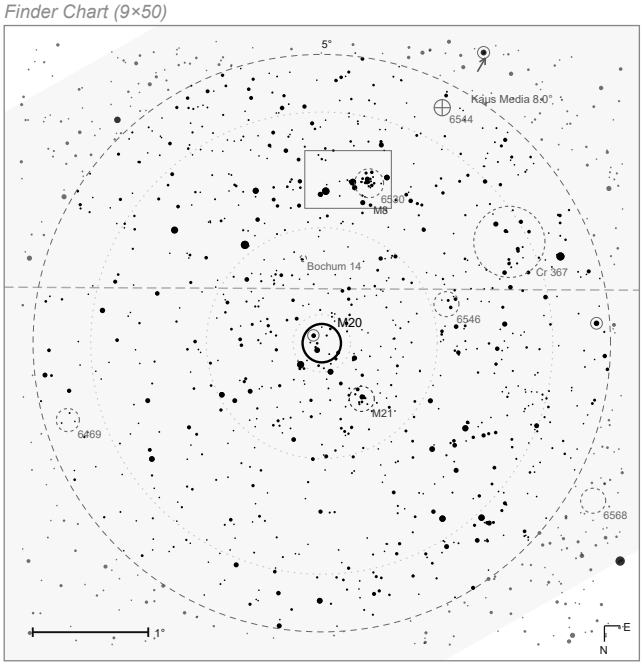
*Constellation Map*




*Naked-eye view · mag 5 · field 37°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

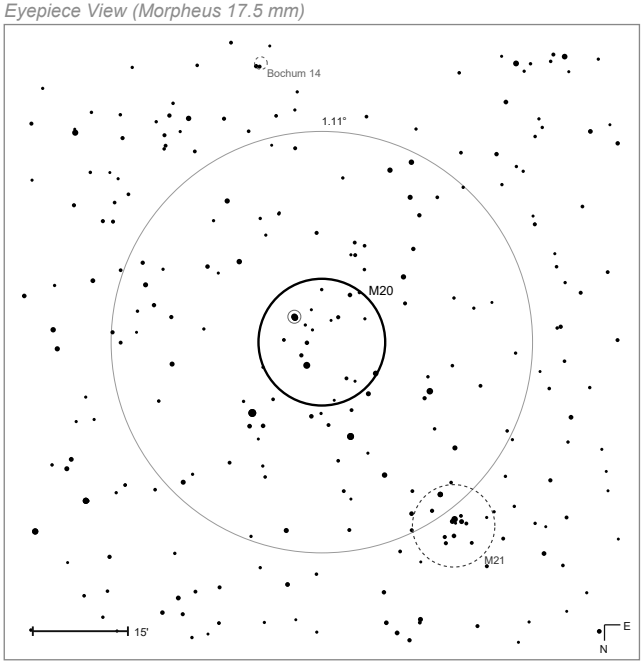
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 — ecliptic · · Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

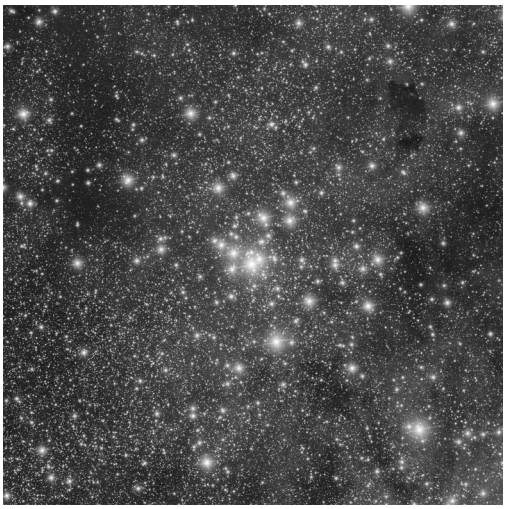



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 10.9*

mag ● 6 ● 8 ● 10 · 12

# M21





| | |
|---|---|
| MESSIER | 21 |
| NGC | 6531 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Sagittarius |
| DISTANCE | 3,900 ly |
| APPARENT MAG. | +5.9 |
| RA (J2000) | 18h 04m 12s |
| DEC (J2000) | −22° 29′ |
| APPARENT SIZE | 16.0′ |
| RADIUS (LY) | 9 |
| AGE (YEARS) | 7 million |

## DISCOVERY & HISTORY

Charles Messier found M21 on 5 June 1764 while sweeping for comets and logged it simply as a small cluster. Neither William nor John Herschel left any notes on it; Admiral Smyth described it as a cluster set in a very rich field. It also carries the name Webb's Cross. Despite lying less than 1° from the Trifid Nebula, M21 is not associated with that nebulosity — both belong to the Sagittarius OB1 association, but the cluster is a separate object about 3,900 light-years away and only 6.6 million years old.

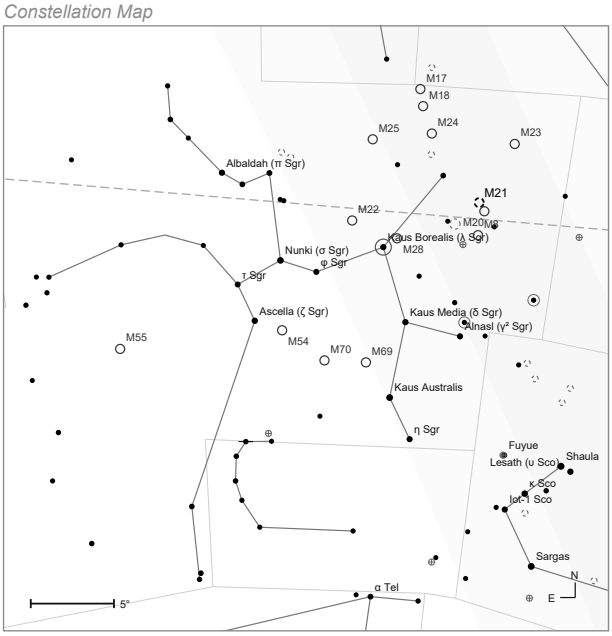
## AT THE EYEPIECE

M21 sits about 2° south-west of μ Sagittarii and just under 1° north-east of M20, which makes the two a natural pair in one sweep; from 50°N it culminates at 18°. Binoculars show it as a compact glow that barely resolves. A 114 mm telescope pulls out stars from 10th magnitude down; a 10″ Dobsonian under Bortle 4 skies resolves it fully across 16′, with strikingly ragged outer edges and a ring of about ten faint stars adorning the north-eastern side. Nothing here needs high power — the cluster is best at 60–100×.

## WHY IT MATTERS

M21 holds at least 105 members inside its coronal radius down to magnitude 15.5, including many early B stars, on a total mass of some 780 Suns. Between 40 and 60 of its low-mass members should still be pre-main-sequence objects; 26 candidates have been confirmed from hydrogen-alpha emission and lithium in their spectra. The stars show no significant spread in age, which argues that the whole cluster formed in a single triggered burst rather than over a drawn-out period — a clean test case for models of prompt star formation.

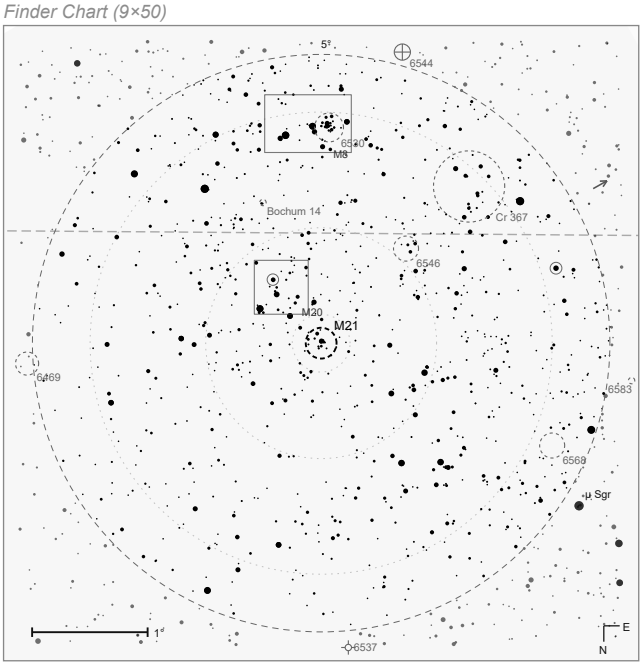
*Constellation Map*




*Naked-eye view · mag 5 · field 36°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

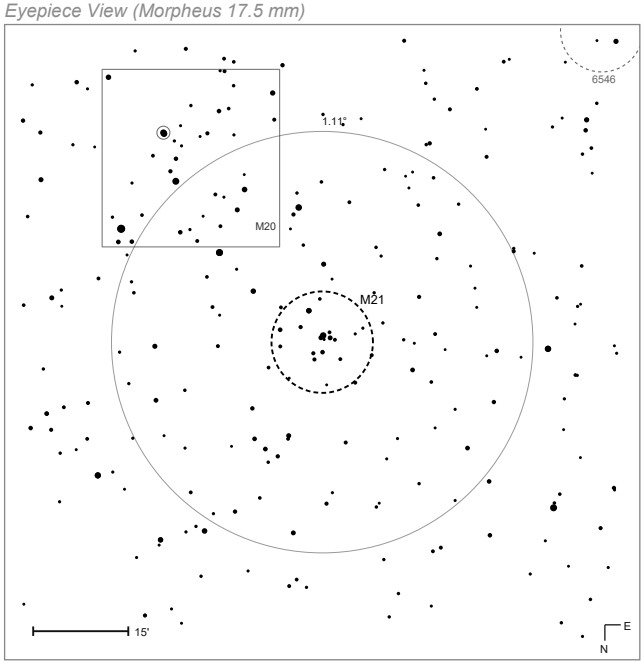
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 — ecliptic · · Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11*

mag ● 6 ● 8 ● 10 · 12

# M22

GLOBULAR CLUSTER

| | |
|---|---|
| MESSIER | 22 |
| NGC | 6656 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Sagittarius |
| DISTANCE | 10.6 kly |
| APPARENT MAG. | +5.2 |
| RA (J2000) | 18h 36m 24s |
| DEC (J2000) | −23° 54′ |
| APPARENT SIZE | 32.0′ |
| RADIUS (LY) | 49 |
| AGE (YEARS) | 12 billion |

## DISCOVERY & HISTORY

Abraham Ihle found M22 in 1665, making it one of the first globular clusters ever discovered; Charles Messier catalogued it in 1764. It was also among the first to be studied seriously — Harlow Shapley counted roughly 70,000 stars in it in 1930 and identified its dense core, with Halton Arp and William Melbourne following in 1959. From 1977 the cluster drew intense scrutiny because of the wide colour spread along its red giant branch, a feature otherwise seen in Omega Centauri and a sign of a chemically complex stellar population.

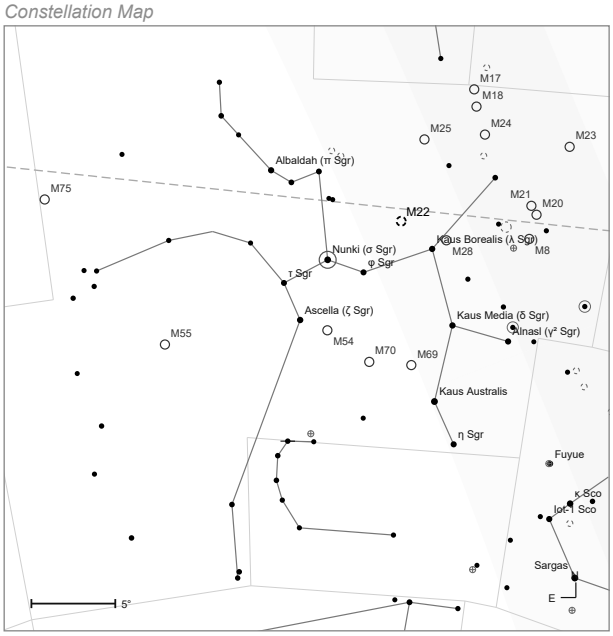
## AT THE EYEPIECE

M22 lies about 3° north-east of Kaus Borealis (λ Sgr), at the lid of the Teapot. From 50°N it culminates at only 16°, which is the sole reason this is not the most famous globular in the sky — intrinsically it outshines M13. On a transparent night it is a naked-eye smudge; 10×50 binoculars show a large round glow, brightening strongly to the centre. A 10″ Dobsonian under Bortle 4 skies resolves hundreds of 11th-magnitude stars across 32′ — the width of the full Moon — on a still-hazy background. M28 lies 3° west.

## WHY IT MATTERS

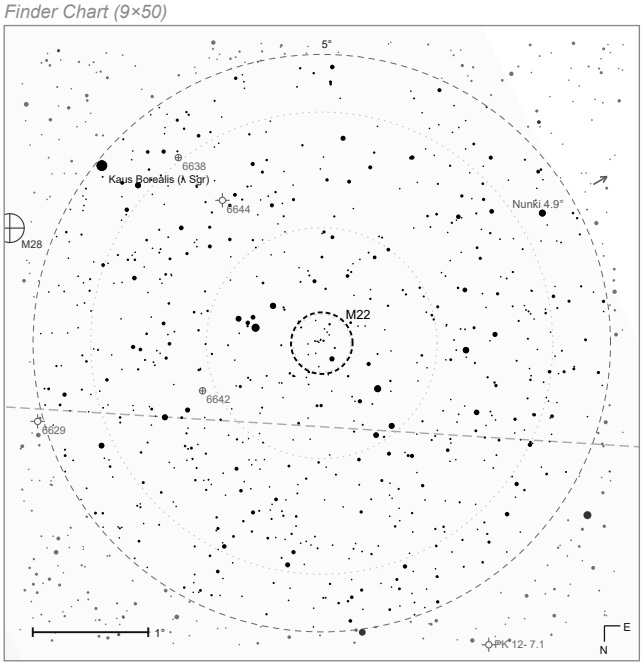
At about 10,600 light-years M22 is one of the nearest globulars, and it sits directly in front of the galactic bulge, so background bulge stars passing behind it can be gravitationally microlensed — a rare natural experiment used to search for faint compact objects inside the cluster. It is metal-poor, spans some 99 light-years, and contains 32 known variables. It is also one of only four globular clusters known to host a planetary nebula.

Constellation Map



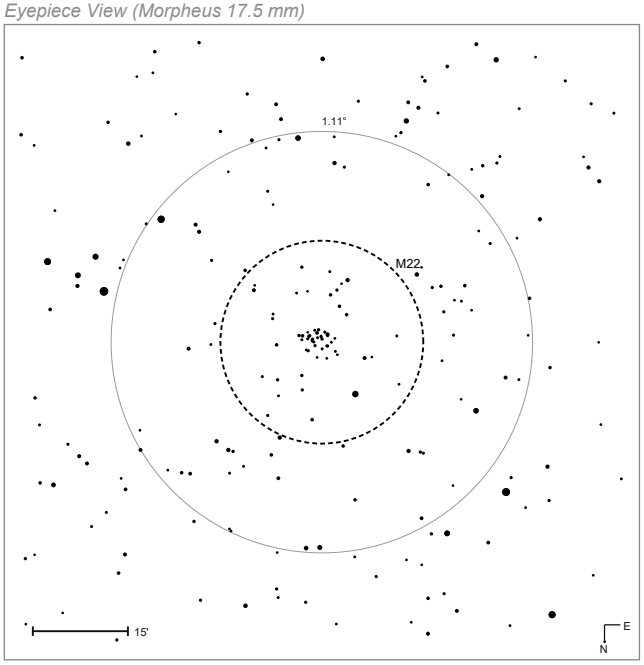

Naked-eye view · mag 5 · field 36°
mag ● 1 ● 3 ● 5 ● 7 — ecliptic

Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5
mag ● 2 ● 4 ● 6 ● 8 · 10 — ecliptic - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.2 · outside the ring at 40 % opacity
mag ● 6 ● 8 ● 10 · 12

# M23

| | |
|---|---|
| MESSIER | 23 |
| NGC | 6494 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Sagittarius |
| DISTANCE | 2,050 ly |
| APPARENT MAG. | +5.5 |
| RA (J2000) | 17h 57m 06s |
| DEC (J2000) | −18° 59′ |
| APPARENT SIZE | 25.0′ |
| RADIUS (LY) | 7 |
| AGE (YEARS) | 330 million |

## DISCOVERY & HISTORY

Charles Messier discovered M23 on 20 June 1764 and recorded it as a cluster near the star 65 Ophiuchi, 15′ across. John Herschel, observing from the Cape of Good Hope, counted about a hundred stars from 9th to 13th magnitude; Admiral Smyth noted how widely scattered they were. The cluster lies about 2,050 light-years away, is around 330 million years old, and has near-solar metallicity. Estimates of its membership range from 169 to 414 stars, giving a mass of roughly 1,200 solar masses.

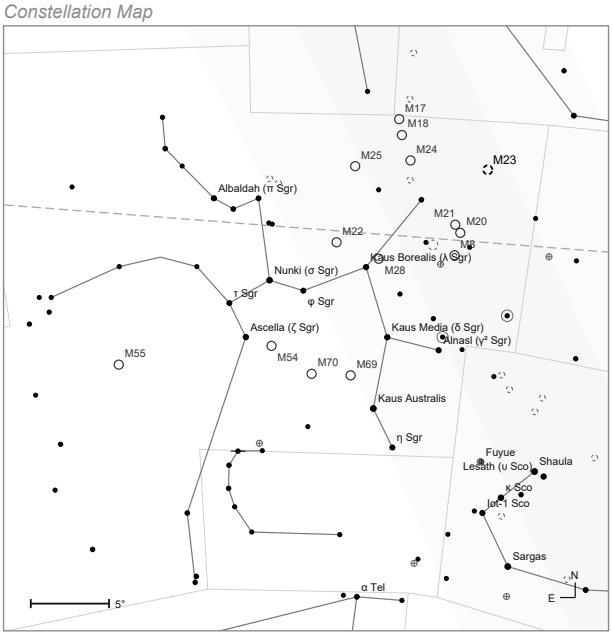
## AT THE EYEPIECE

M23 sits about 4.5° north-west of μ Sagittarii in a rich Milky Way field; from 50°N it culminates at 21°. It is visible in 10×50 binoculars, though individual stars are hard to pull out. A 114 mm telescope shows members from 10th magnitude down, and a 10″ Dobsonian under Bortle 4 skies resolves the full hundred across 25′ with markedly ragged, uneven borders — the cluster fades into the background field rather than ending. Keep the magnification low. A 6th-magnitude foreground star, HD 163245, marks the north-west corner but is not a member.

## WHY IT MATTERS

M23 lies in front of an extensive network of gas and dust with which it may have no physical connection, making it a useful line-of-sight probe of that obscuring material. Its own population includes five candidate red giants and the orange variable VV Sagittarii, a candidate asymptotic-giant-branch star. Because the cluster is middle-aged with solar composition, it serves as a reference point for the evolution of ordinary galactic-disc clusters — the kind that dominates the population but rarely gets photographed.

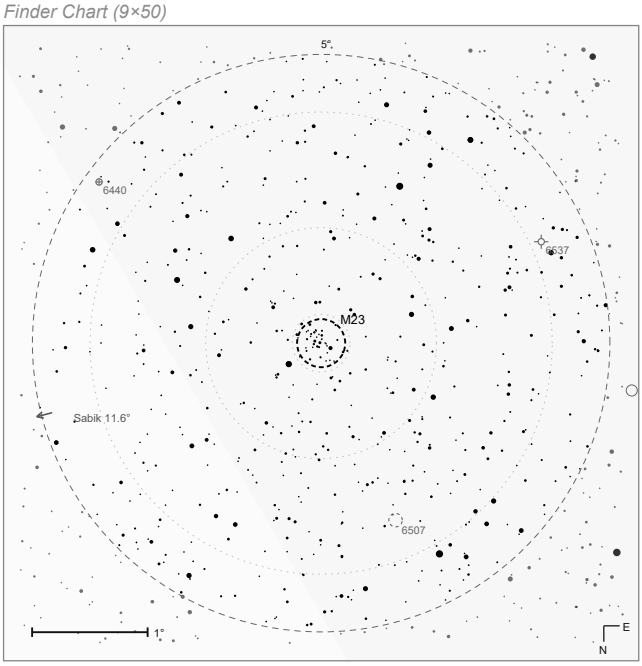
*Constellation Map*




*Naked-eye view · mag 5 · field 39°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

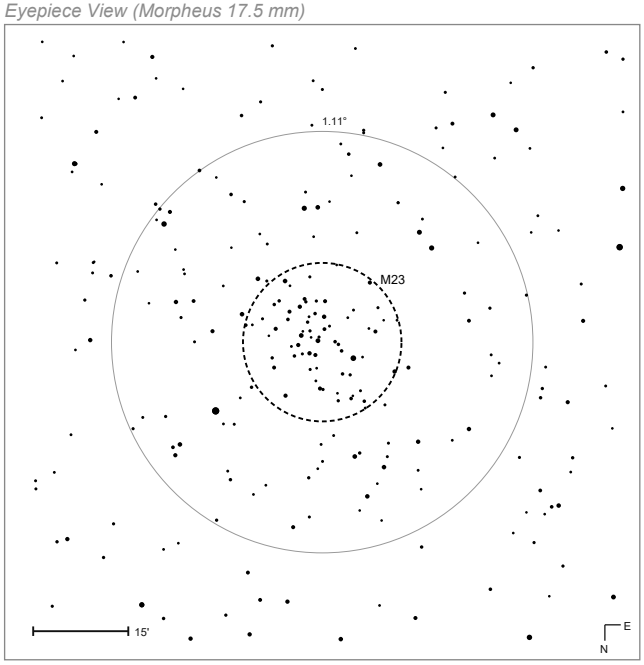
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 ● 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.3*

mag ● 6 ● 8 ● 10 ● 12

# M24 Sagittarius Star Cloud

*The whole field is M24 — a window onto the Sagittarius Arm, not a cluster; dark nebulae cross it.*

| | |
|---|---|
| MESSIER | 24 |
| IC | 4715 |
| OBJECT TYPE | Star Cloud |
| CONSTELLATION | Sagittarius |
| DISTANCE | 10 kly |
| APPARENT MAG. | +3.1 |
| RA (J2000) | 18h 17m 18s |
| DEC (J2000) | −18° 40′ |
| APPARENT SIZE | 90.0′ × 70.0′ |
| RADIUS (LY) | 131 |

## DISCOVERY & HISTORY

Charles Messier catalogued M24 in 1764 as "a large nebulosity in which there are many stars of different magnitudes", about 1.5° across. He was describing something no other entry in his catalogue is: not an object at all, but an opening. Some sources wrongly equate M24 with the small open cluster NGC 6603, which merely happens to lie in front of its north-eastern part. The star cloud spans roughly 600 light-years and is not gravitationally bound.

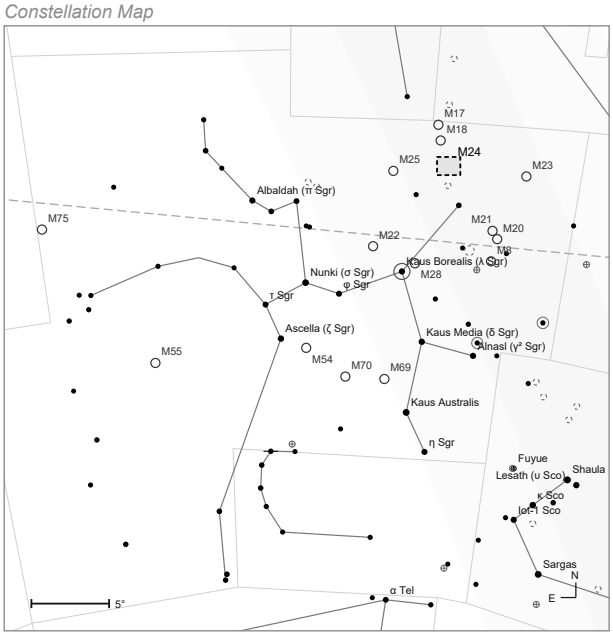
## AT THE EYEPIECE

M24 lies about 2° north of μ Sagittarii, between M23 to the west and M25 to the east, with M18 and M17 immediately north; from 50°N it culminates at 21°. To the naked eye it is a bright patch standing out even against the already-luminous Sagittarius Milky Way. Binoculars are the ideal instrument — around a thousand stars in one field, the densest concentration of individually visible stars anywhere in the sky. In a 10″ Dobsonian use the widest field you have, at least 2°: thousands of stars in strongly differing colours, with the western edge sharply bounded by dark nebulae and the eastern edge diffuse.

## WHY IT MATTERS

M24 is a window rather than an object — a gap in the Great Rift's dust that lets us look 10,000 to 15,000 light-years into the Scutum–Centaurus Arm, the major spiral arm between us and the galactic centre. Lines of sight like this one are how the structure of the inner galaxy was mapped optically before radio and infrared surveys existed. Its brightest star, HD 167356, is a white supergiant of magnitude 6.05. Because the light is spread so widely, its integrated magnitude is disputed: older references say 4.6, newer ones 2.5.

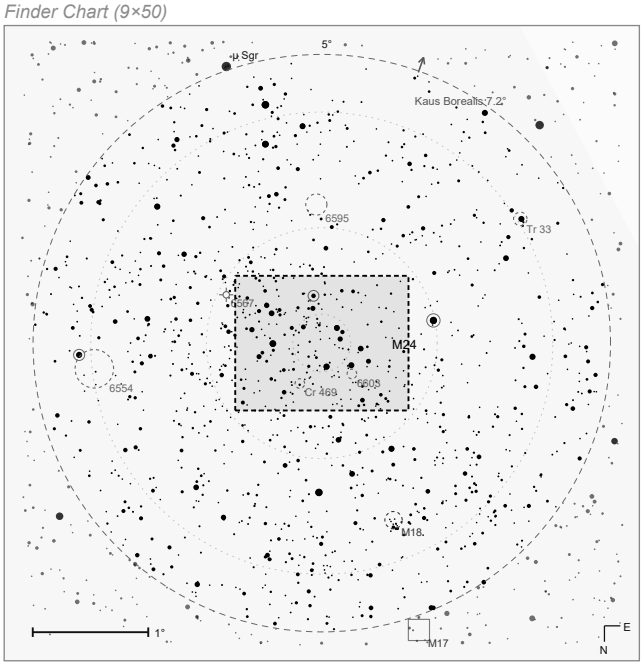
*Constellation Map*




*Naked-eye view · mag 5 · field 39°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

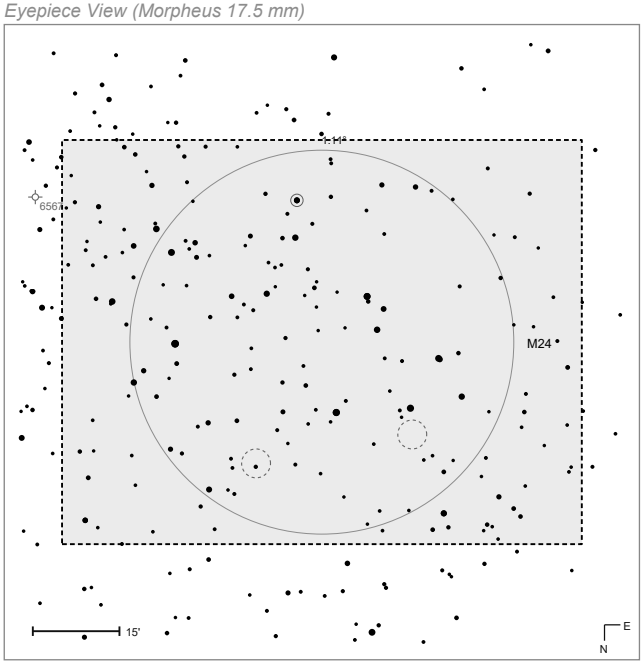
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 ● 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

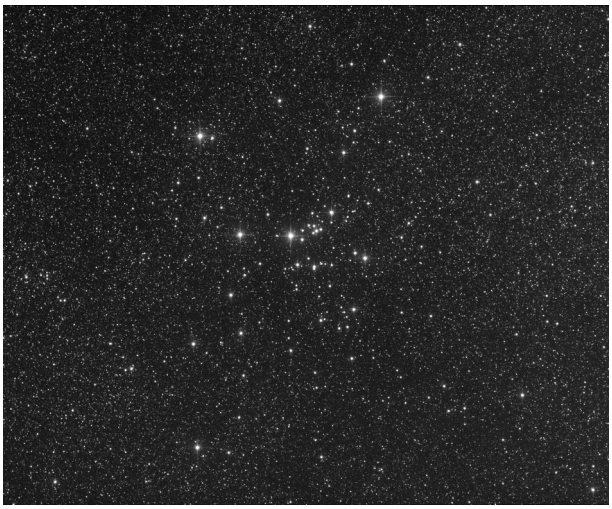



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 10.3 · outside the ring at 40 % opacity*

mag ● 6 ● 8 ● 10 ● 12

# M25





| | |
|---|---|
| MESSIER | 25 |
| IC | 4725 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Sagittarius |
| DISTANCE | 2,000 ly |
| APPARENT MAG. | +4.6 |
| RA (J2000) | 18h 31m 48s |
| DEC (J2000) | −19° 07′ |
| APPARENT SIZE | 26.0′ |
| RADIUS (LY) | 8 |
| AGE (YEARS) | 68 million |

## DISCOVERY & HISTORY

Philippe Loys de Chéseaux made the first recorded observation in 1745, describing a cluster of stars between the bow and the head of Sagittarius. Charles Messier added it to his list in 1764 with much the same wording. It went uncatalogued by Dreyer and only entered the Index Catalogue later as IC 4725 — an oddity for so bright an object. M25 lies about 2,000 light-years away, is 67.6 million years old and spans some 13 light-years, with an estimated mass of 1,937 solar masses, roughly a quarter of it still interstellar matter.

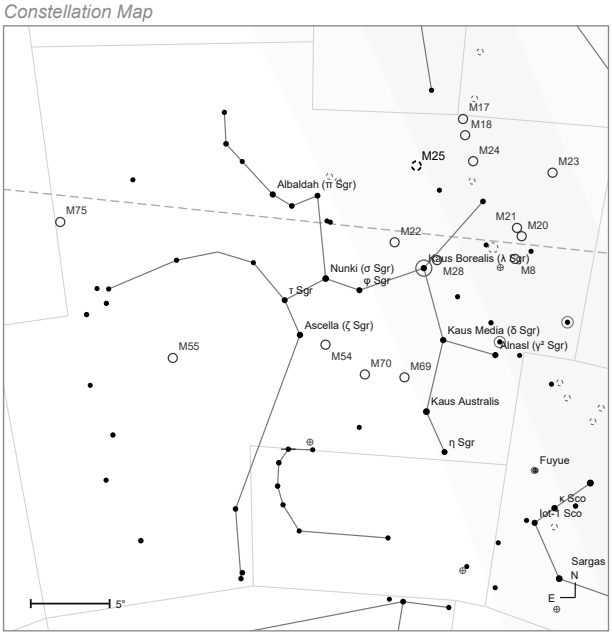
## AT THE EYEPIECE

M25 lies about 4.5° north-east of μ Sagittarii; from 50°N it culminates at 21°. Under a clear dark sky it is a naked-eye object, and 10×50 binoculars already separate some members. A 114 mm telescope resolves about a hundred stars from 6th to 10th magnitude. In a 10″ Dobsonian keep the power low — at 26′ the cluster overflows a high-power field and loses its shape. A dark lane passes close to the centre, and the brightest members form loose chains. M24 lies 3° west, M22 5° south.

## WHY IT MATTERS

M25 contains U Sagittarii, a classical Delta Cephei-type variable — a cluster membership that matters, because a Cepheid with an independently known distance calibrates the period–luminosity relation used to measure distances far beyond the Milky Way. Two red giants also belong to the cluster, one of them a binary. Recent work suggests M25 may form a ternary cluster system with NGC 6716 and Collinder 394, which would make it a rare example of clusters still gravitationally associated after tens of millions of years.

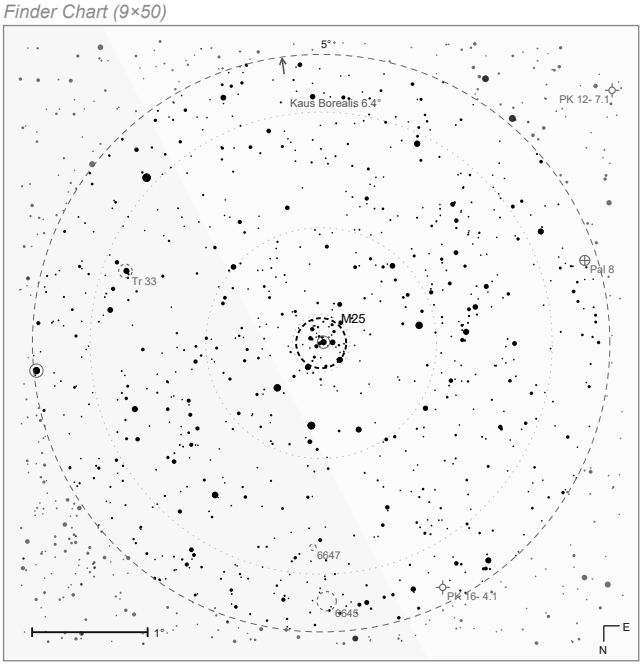
*Constellation Map*




*Naked-eye view · mag 5 · field 38°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

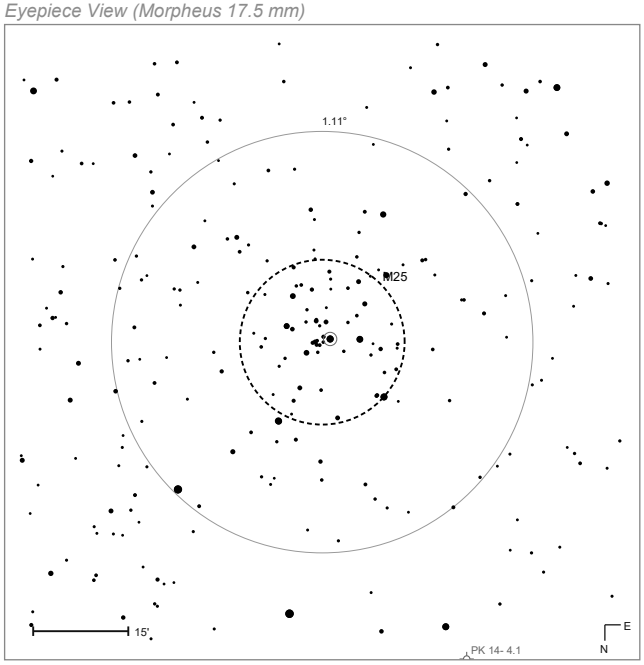
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

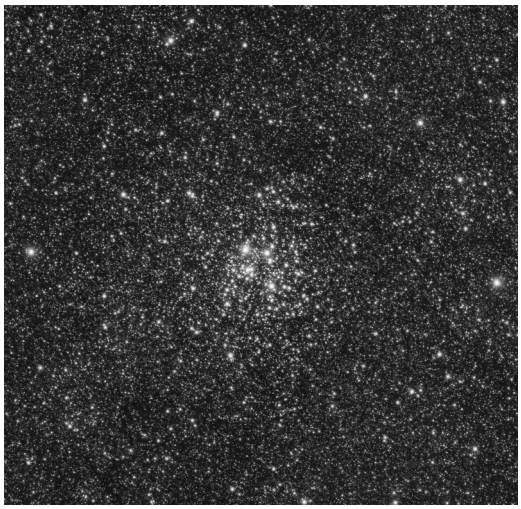



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.1*

mag ● 6 ● 8 ● 10 · 12

# M26





| | |
|---|---|
| MESSIER | 26 |
| NGC | 6694 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Scutum |
| DISTANCE | 5,160 ly |
| APPARENT MAG. | +8.0 |
| RA (J2000) | 18h 45m 12s |
| DEC (J2000) | −09° 24′ |
| APPARENT SIZE | 8.0′ |
| RADIUS (LY) | 6 |
| AGE (YEARS) | 85 million |

## DISCOVERY & HISTORY

Charles Messier discovered M26 on 20 July 1764, describing a cluster near the stars now called α and δ Scuti containing no nebulosity. It has stayed the least celebrated of Scutum's two Messier clusters ever since, permanently overshadowed by M11 a few degrees north. The cluster lies about 5,200 light-years away, spans 22 light-years, and estimates of its age range from 85 to 180 million years. Its brightest star is only 11th magnitude, which explains why Messier saw a patch rather than stars.

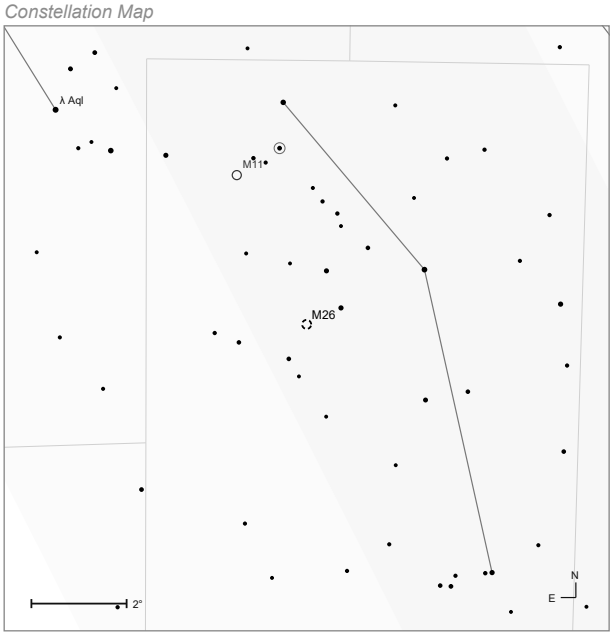
## AT THE EYEPIECE

M26 sits about 1° south-east of δ Scuti, 3.5° south-west of M11; from 50°N it culminates at 31°. In 10×50 binoculars it is a difficult, plain little smudge, easily lost in the surrounding Milky Way field. Even a 120–150 mm telescope barely resolves it. A 10″ Dobsonian under Bortle 4 skies pulls out a few dozen stars of 12th to 15th magnitude across 8′, and at 300 mm the count reaches about 50. Look through a finderscope first and you will understand why Messier included it — at low power the unresolved glow does look like a comet.

## WHY IT MATTERS

M26 has an oddity at its centre: a region of markedly low star density. The obvious explanation — an intervening dust cloud between us and the cluster — was ruled out by James Cuffey, who argued the gap is real, a genuine shell of low stellar space density. As of 2015 no clear explanation existed, which leaves this unremarkable cluster holding a small unsolved structural puzzle. It also contains one known spectroscopic binary system.

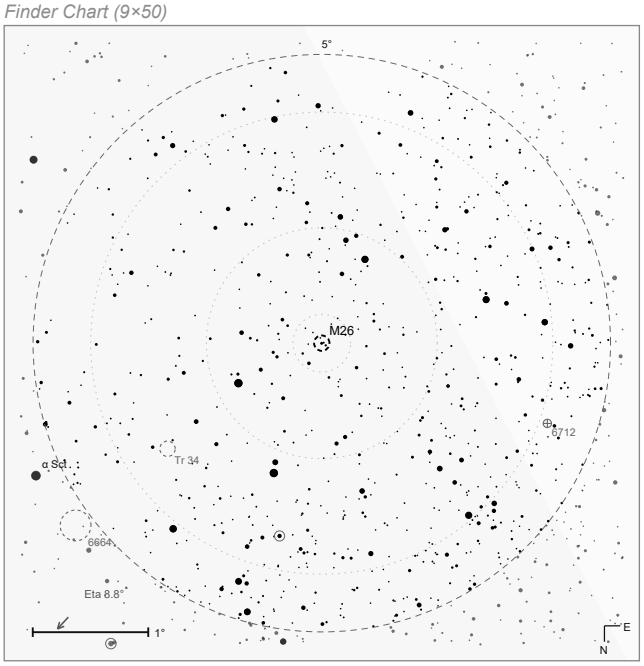
*Constellation Map*




*Naked-eye view · mag 7 · field 13°*

mag ● 1 ● 3 ● 5 ● 7

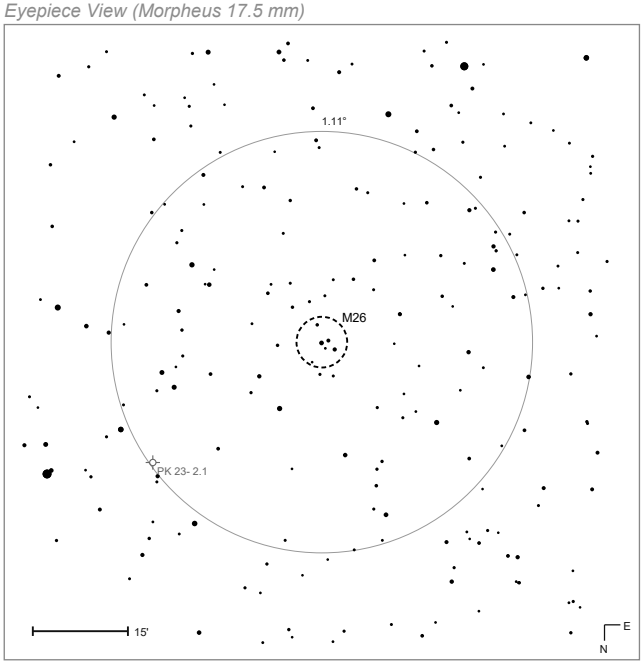
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 ● 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.2*

mag ● 6 ● 8 ● 10 ● 12

# M27 Dumbbell Nebula

| | |
|---|---|
| MESSIER | 27 |
| NGC | 6853 |
| OBJECT TYPE | Planetary Nebula |
| CONSTELLATION | Vulpecula |
| DISTANCE | 1,360 ly |
| APPARENT MAG. | +7.3 |
| RA (J2000) | 19h 59m 36s |
| DEC (J2000) | +22° 43′ |
| APPARENT SIZE | 6.7′ |
| RADIUS (LY) | 1 |

## DISCOVERY & HISTORY

Charles Messier found M27 on 12 June 1764 — the first planetary nebula ever discovered, decades before William Herschel coined the misleading name. Herschel himself failed to recognise its nature and tried to resolve it into stars; the field's star density persuaded him it was a cluster too distant to separate. John Herschel supplied the name Dumbbell from its two-lobed shape. It lies about 1,360 light-years away, and its expansion gives a kinematic age near 9,800 years, with an upper limit of about 14,600.

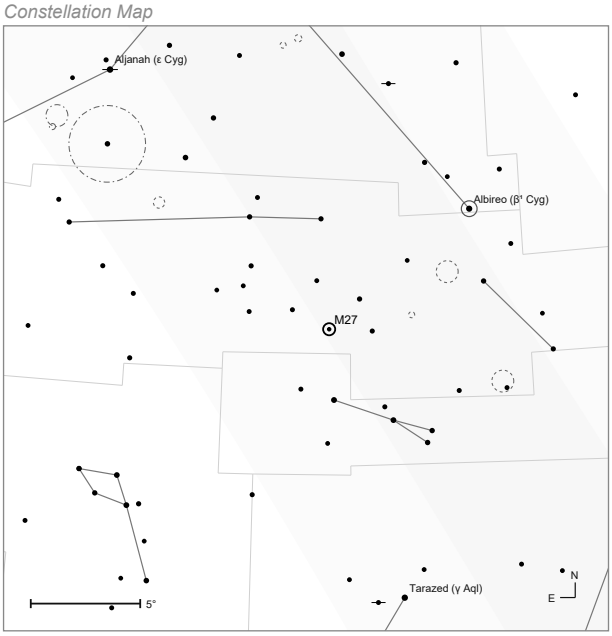
## AT THE EYEPIECE

M27 is easy to find, roughly 3° north of γ Sagittae; from 50°N it culminates at 63°, so nothing about it is hard. It shows in 10×50 binoculars and, under transparent skies, even in 8×30. A 114 mm telescope gives the basic double-lobed form. In a 10″ Dobsonian under Bortle 4 skies it is among the finest planetaries in the sky: a bright 7′ hourglass with the two lobes clearly unequal and the fainter "apple core" rim filling out the gaps at higher power. An OIII filter helps considerably. The 13.6-magnitude central star is a standard test of sky transparency in a 200 mm aperture.

## WHY IT MATTERS

The Dumbbell is a prolate spheroid seen along its equator, which is why we get such a clean view of its structure. Its central region carries a pattern of dark and bright cusped knots with trailing tails; as in the Helix and Eskimo nebulae, the knot heads are local photoionisation fronts — the ionising radiation of the central star eating into denser clumps of ejected gas. That central star is an unusually large white dwarf, about 0.055 solar radii and 0.56 solar masses.

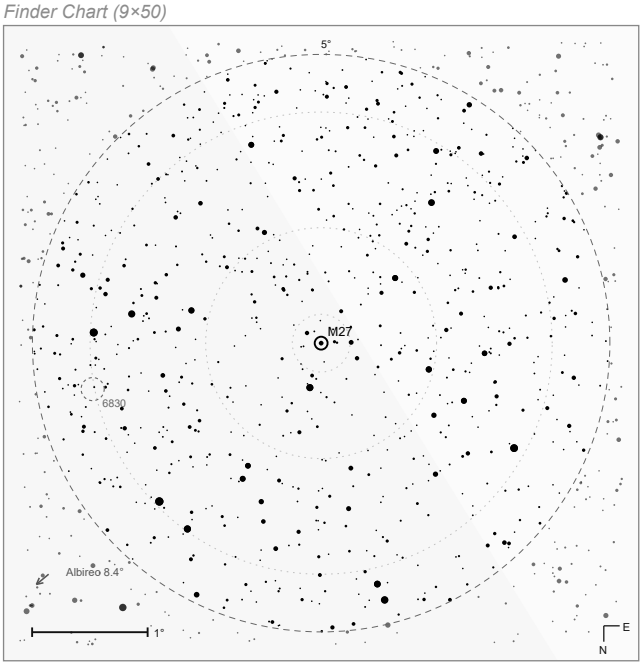
*Constellation Map*




*Naked-eye view · mag 5.5 · field 28°*

mag ● 1 ● 3 ● 5 ● 7

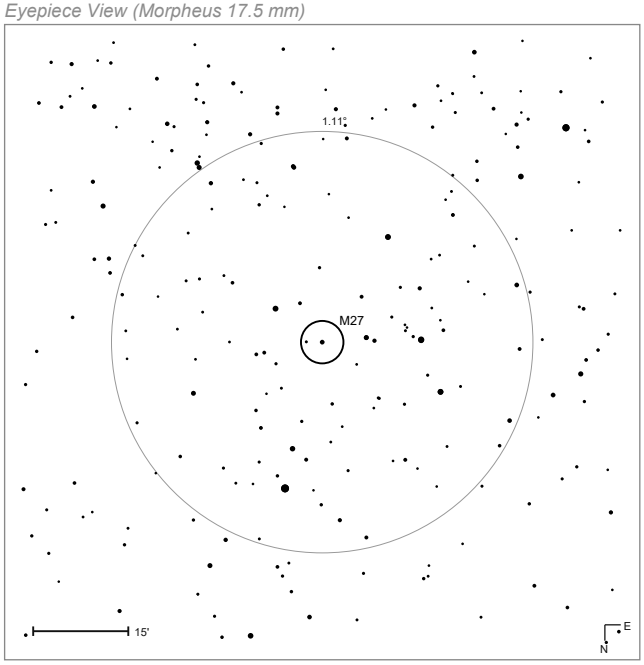
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 ● 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.3*

mag ● 6 ● 8 ● 10 ● 12

# M28

GLOBULAR CLUSTER

| | |
|---|---|
| MESSIER | 28 |
| NGC | 6626 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Sagittarius |
| DISTANCE | 18 kly |
| APPARENT MAG. | +6.9 |
| RA (J2000) | 18h 24m 30s |
| DEC (J2000) | −24° 52′ |
| APPARENT SIZE | 13.8′ |
| RADIUS (LY) | 36 |
| AGE (YEARS) | 12 billion |

## DISCOVERY & HISTORY

Charles Messier discovered M28 on 27 July 1764 and described it briefly: "nebula containing no star… round, seen with difficulty in 3½-foot telescope; Diam 2′." The cluster lies about 18,000 light-years away, holds some 550,000 solar masses, and its low metallicity — more than ten times poorer in metals than the Sun — together with its evolved stellar population places its age at roughly 12 billion years. Eighteen RR Lyrae variables have been found in it.

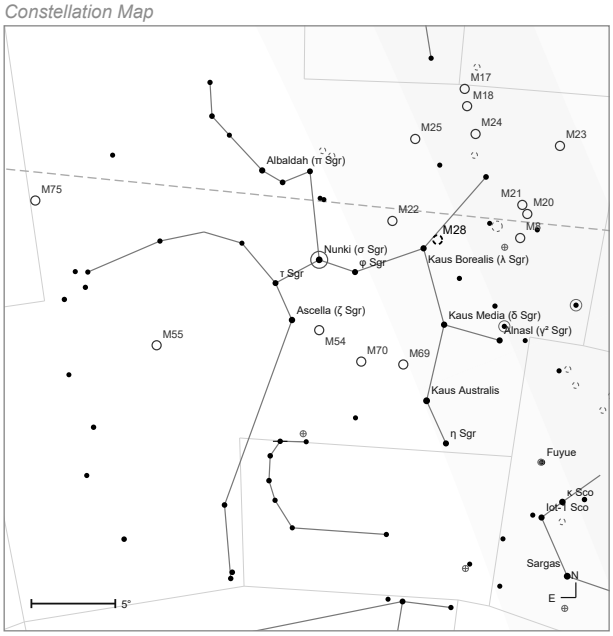
## AT THE EYEPIECE

M28 lies just under 1° north-west of Kaus Borealis (λ Sgr), the lid of the Teapot — close enough that the 3rd-magnitude star can intrude on the view. From 50°N it culminates at 15°, so transparency decides everything. In 10×50 binoculars it is a faint hazy dot. An 80 mm telescope shows a nebulous patch about 11′ across; 150 mm brings out the core and a few peripheral stars. A 10″ Dobsonian under Bortle 4 skies reveals a dense 2′ core with granulation inside it; the south-eastern edge looks noticeably poorer in stars. M22 lies 3° east.

## WHY IT MATTERS

M28 was where the first millisecond pulsar in a globular cluster was found — PSR B1821−24, detected with the Lovell Telescope at Jodrell Bank. Eleven more have since been identified with the Green Bank telescope, which as of 2011 made M28 the third-richest pulsar cluster associated with the Milky Way after Terzan 5 and 47 Tucanae. Dense cluster cores are pulsar factories: close stellar encounters transfer mass onto old neutron stars and spin them back up to millisecond periods.

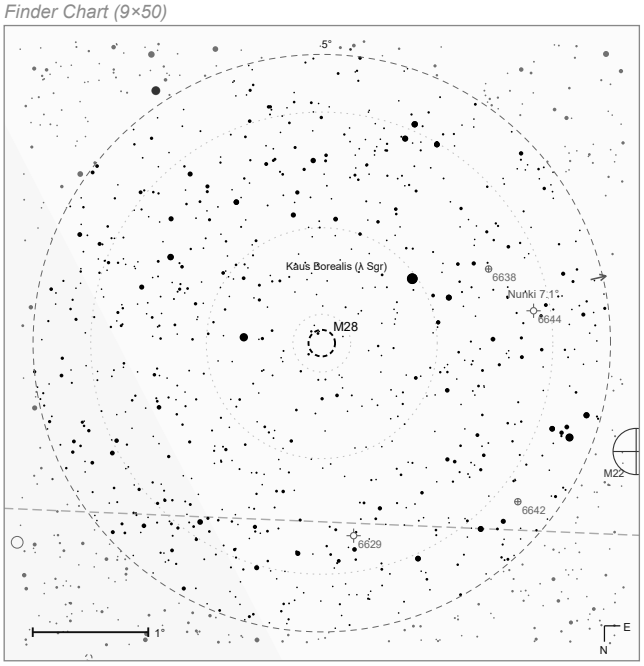
Constellation Map




Naked-eye view · mag 5 · field 36°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

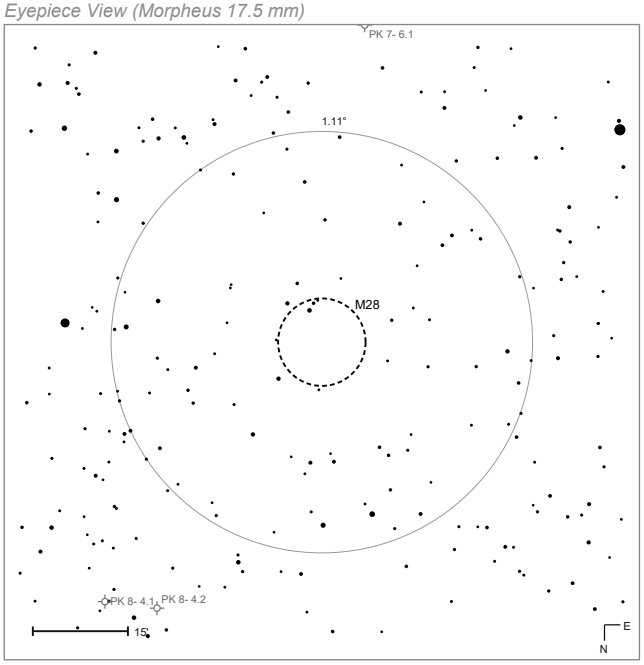
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 — ecliptic · · Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.2

mag ● 6 ● 8 ● 10 · 12

# M29

| | |
|---|---|
| MESSIER | 29 |
| NGC | 6913 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Cygnus |
| DISTANCE | 5,240 ly |
| APPARENT MAG. | +6.6 |
| RA (J2000) | 20h 23m 54s |
| DEC (J2000) | +38° 32′ |
| APPARENT SIZE | 10.0′ |
| RADIUS (LY) | 8 |
| AGE (YEARS) | 13 million |

## DISCOVERY & HISTORY

Charles Messier discovered M29 on 29 July 1764. It is a small, bright cluster just south of γ Cygni, sometimes called the Cooling Tower Cluster for the shape of its brightest members. Its distance has been awkward to pin down — quoted values run from 4,000 to 7,200 light-years, with Gaia EDR3 parallaxes giving about 5,240 — because the surrounding nebulosity and foreground dust of the local Orion–Cygnus Arm absorb its light unpredictably. Its age is around 10 million years; the five hottest members are all B0 giants.

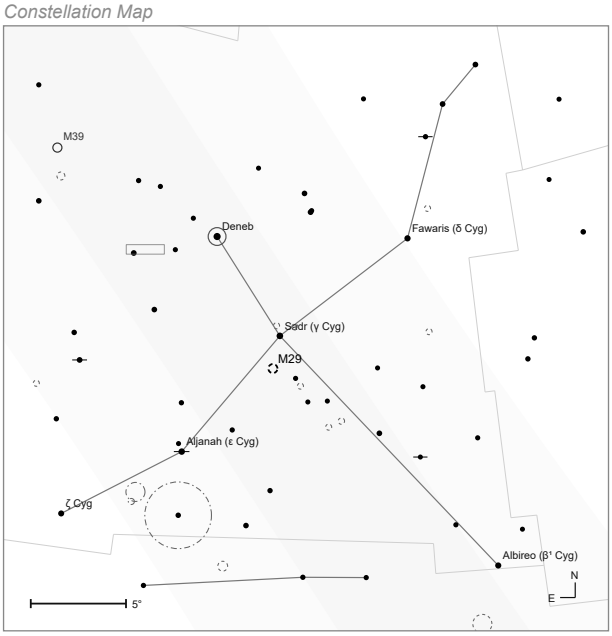
## AT THE EYEPIECE

M29 lies about 1.5° south of Sadr (γ Cygni), on the edge of the Cygnus Great Rift, and from 50°N it passes almost overhead at 79°. In 8×30 binoculars it is hard to pick out of the crowded field; 10×50 may just separate a star or two on a transparent night. A small refractor is the ideal instrument: at 100 mm all of its roughly twenty main stars resolve, six of them arranged in a pattern that mimics the shape of Pegasus in miniature. A 10″ Dobsonian pushes the count to about 30. The Crescent Nebula lies 2.5° west.

## WHY IT MATTERS

M29 belongs to the Cygnus OB1 association, so its stars are markers of a young star-forming complex in our own spiral arm rather than an isolated cluster. Its absolute magnitude of −8.2 corresponds to 160,000 solar luminosities packed into just 11 light-years, and its Trumpler class notes associated nebulosity — the gas it formed from has not yet dispersed. That heavy, patchy extinction is exactly what makes it a working test case for correcting cluster distances inside the galactic plane.

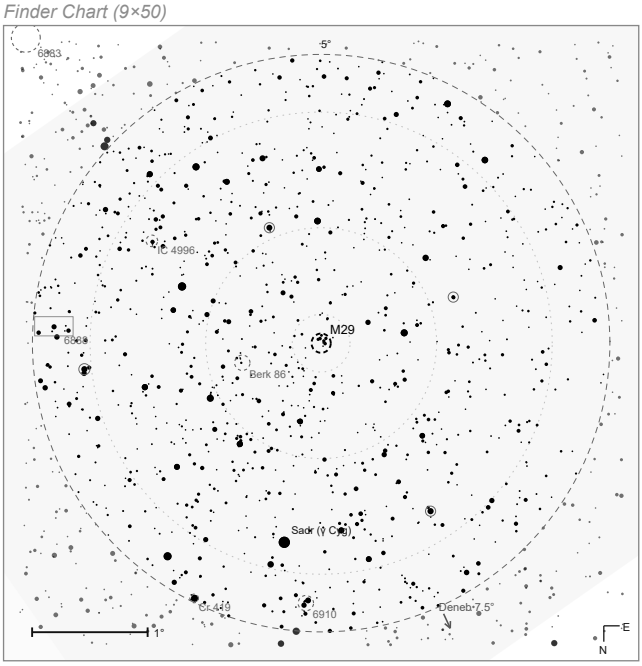
*Constellation Map*




*Naked-eye view · mag 5 · field 32°*

mag ● 1 ● 3 ● 5 ● 7

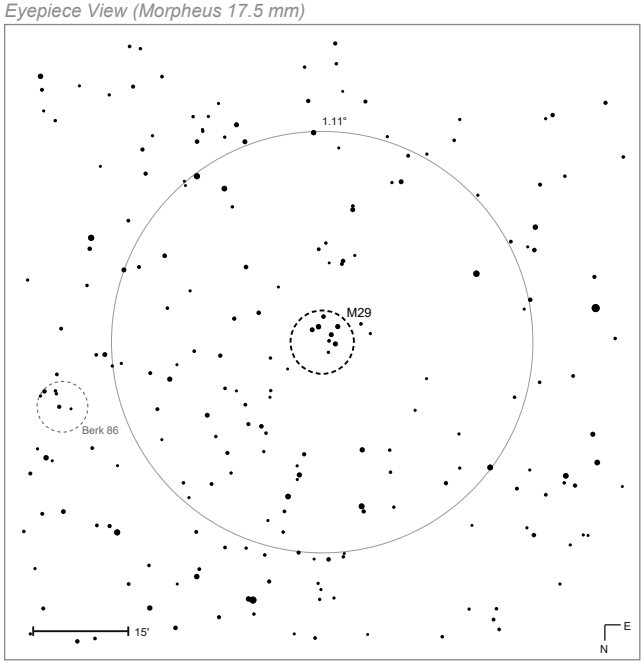
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 ● 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

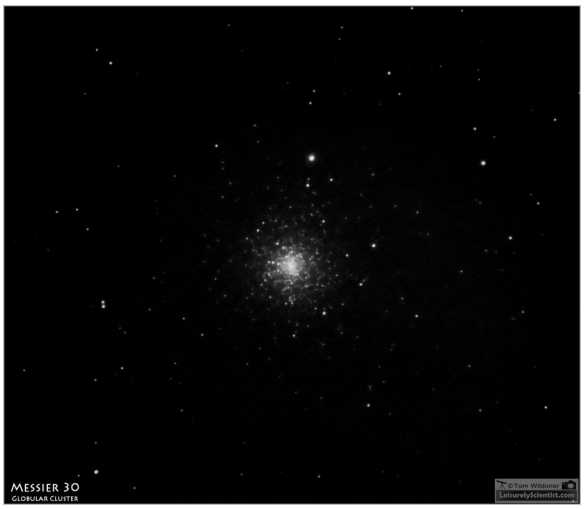



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 10.9*

mag ● 6 ● 8 ● 10 ● 12

# M30

GLOBULAR CLUSTER




| | |
|---|---|
| MESSIER | 30 |
| NGC | 7099 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Capricornus |
| DISTANCE | 27.1 kly |
| APPARENT MAG. | +6.9 |
| RA (J2000) | 21h 40m 24s |
| DEC (J2000) | −23° 11′ |
| APPARENT SIZE | 12.0′ |
| RADIUS (LY) | 47 |
| AGE (YEARS) | 12.9 billion |

## DISCOVERY & HISTORY

Charles Messier discovered M30 on 3 August 1764 near the star 41 Capricorni and described it as circular, star-free and difficult in his 3½-foot telescope. William Herschel resolved it in 1783 and classified it as a globular; Admiral Smyth saw a pale elliptical object with a chain of stars along its northern side. The New General Catalogue called it "a remarkable globular, bright, large, slightly oval". It lies 26,000–27,000 light-years away, spans about 93 light-years, and at roughly 12.9 billion years is one of the oldest objects in this book.

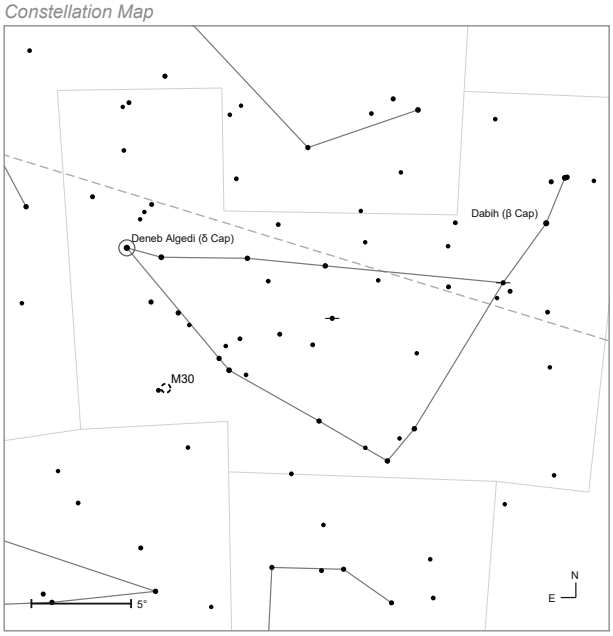
## AT THE EYEPIECE

M30 lies about 3° east of ζ Capricorni in the south-east corner of the constellation; from 50°N it culminates at 17°, and August is the month for it. In 10×50 binoculars it is an easy but unresolved hazy patch some 4′ wide, slightly elongated east–west. A 114 mm telescope picks off a few stars at higher power. A 10″ Dobsonian under Bortle 4 skies shows the full 12′ extent with several dozen stars resolved, tightening into a compressed core about 1′ across with more density inside — and Smyth's northern star chain is genuinely there.

## WHY IT MATTERS

M30 follows a retrograde orbit through the inner galactic halo — it moves against the general flow, which strongly suggests it was captured from a satellite galaxy rather than born in the Milky Way. It has also undergone core collapse, concentrating roughly a million solar masses per cubic parsec at its centre. Together those two facts make it a compact case study in both galactic accretion history and the late dynamical evolution of dense clusters. A dwarf nova has been observed in it.

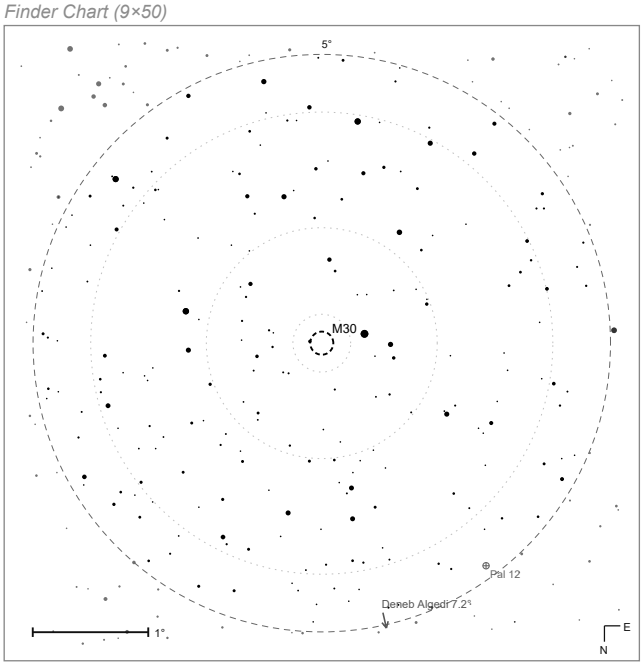
*Constellation Map*




*Naked-eye view · mag 6 · field 3°*

mag ● 1 ● 3 • 5 • 7 — ecliptic

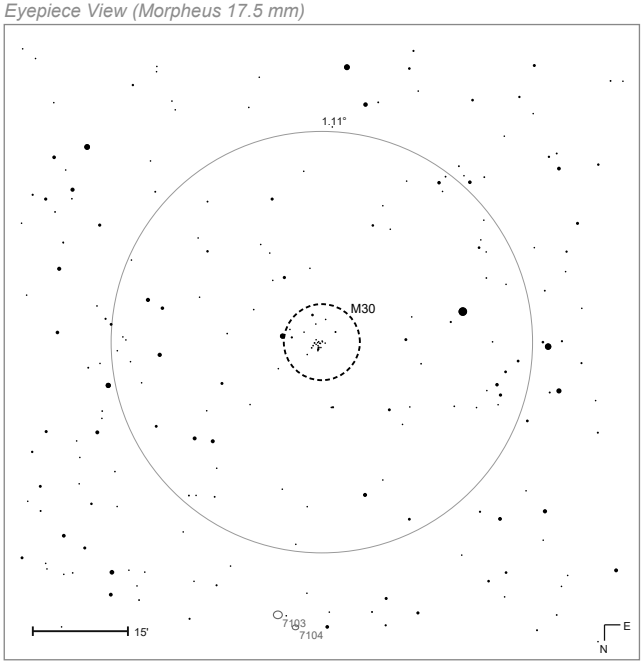
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 • 6 • 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.1*

mag • 8 • 10 · 12 · 14

# M31 Andromeda Galaxy

| | |
|---|---|
| MESSIER | 31 |
| NGC | 224 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Andromeda |
| DISTANCE | 2.5 Mly |
| APPARENT MAG. | +3.4 |
| RA (J2000) | 00h 42m 42s |
| DEC (J2000) | +41° 16′ |
| APPARENT SIZE | 189.0′ × 61.0′ |
| RADIUS (LY) | 68,700 |

## DISCOVERY & HISTORY

The Persian astronomer Abd al-Rahman al-Sufi described M31 in 964 CE as a "small cloud" — the first recorded observation of any galaxy beyond our own. Simon Marius made the first telescopic observation in 1612 and noted it looked like "a candle shining through horn." For three centuries it was assumed to be a nebula inside the Milky Way. In 1925 Edwin Hubble measured Cepheid variables in its outskirts and proved M31 was a separate galaxy, instantly enlarging the known universe by a factor of thousands.

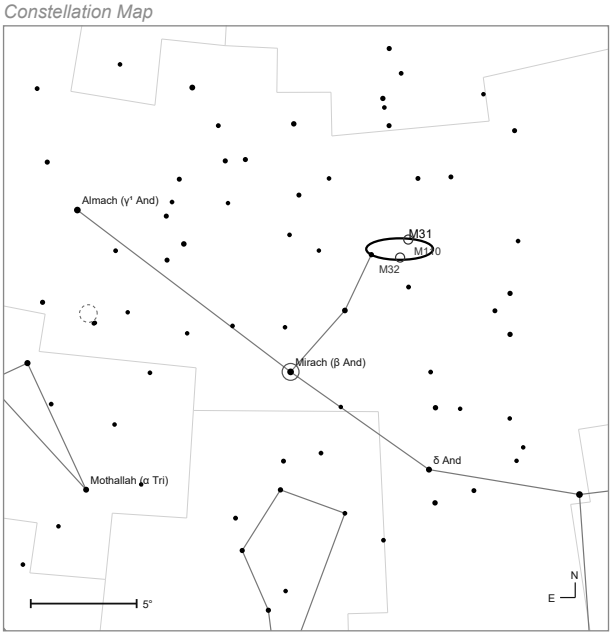
## AT THE EYEPIECE

M31 is visible to the naked eye as a hazy oval 2.5 million light-years away. In a 10″ Dobson at low power it overflows the eyepiece — the bright core dominates, with dust lanes ghosting through the surrounding disk at 60–80×. Hop from Mirach (β Andromedae): M31 sits 8° NW. The two satellite galaxies, M32 and M110, frame the view in a low-power field. Don't expect spiral arms; what you'll see is the central bulge plus mottling in the disk if you look long enough.

## WHY IT MATTERS

M31 is the largest galaxy of the Local Group and our Milky Way's nearest large neighbour. The two are approaching each other at 110 km/s and will merge in roughly 4.5 billion years — a slow-motion collision that astronomers are watching unfold in fine detail. M31 has been the testbed for nearly every technique used to study other galaxies, from rotation curves (which first revealed dark matter) to stellar population synthesis.

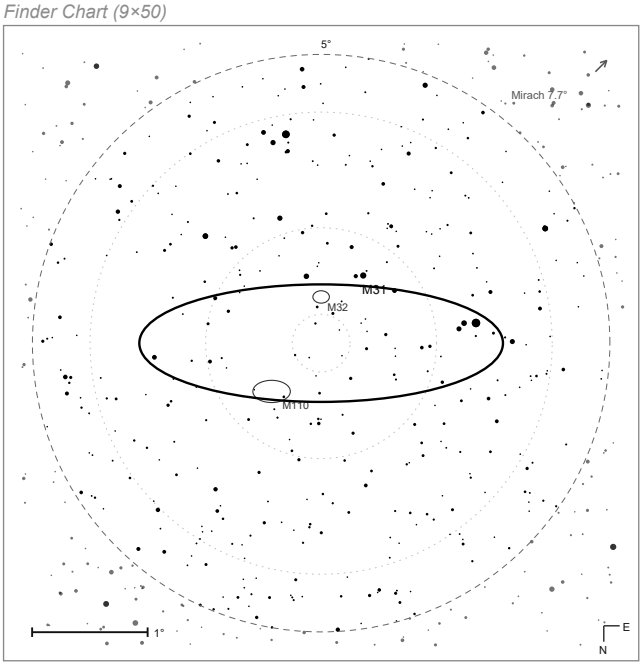
*Constellation Map*




*Naked-eye view · mag 6 · field 29°*

mag ● 1 ● 3 ● 5 ● 7

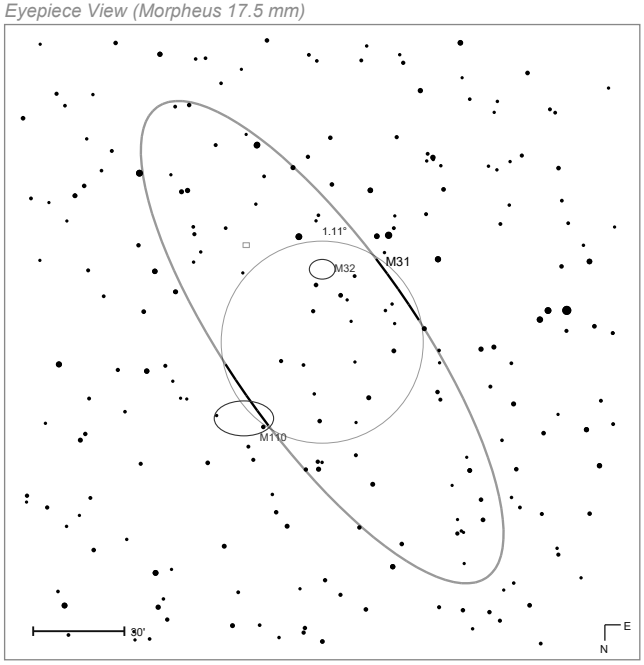
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 ● 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

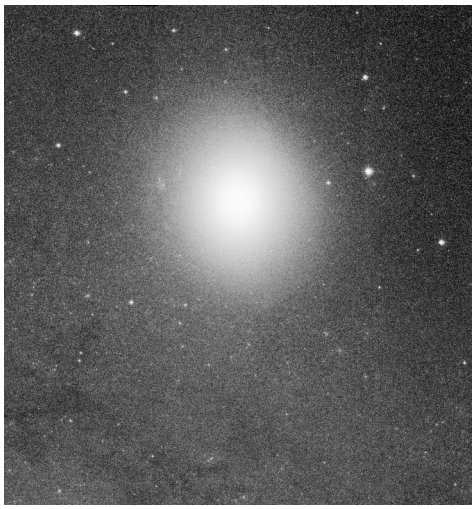



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 10.6 · outside the ring at 40 % opacity*

mag ● 6 ● 8 ● 10 ● 12

# M32





*M32 is the bright oval at centre; the mottled glow filling the frame is the disc of M31 behind it.*

| | |
|---|---|
| *MESSIER* | 32 |
| *NGC* | 221 |
| *OBJECT TYPE* | Galaxy |
| *CONSTELLATION* | Andromeda |
| *DISTANCE* | 2.5 Mly |
| *APPARENT MAG.* | +8.1 |
| *RA (J2000)* | 00h 42m 42s |
| *DEC (J2000)* | +40° 52′ |
| *APPARENT SIZE* | 8.5′ × 6.5′ |
| *RADIUS (LY)* | 3,090 |

## DISCOVERY & HISTORY

Guillaume Le Gentil found M32 on 29 October 1749 — the first companion of the Andromeda Galaxy ever noticed, and one of the first satellite galaxies known to anyone, though nobody could have described it that way at the time. It lies about 2.5 million light-years away, sharing M31's distance, and is the prototype of the rare compact elliptical (cE) class. Like ordinary ellipticals it holds mostly old red and yellow stars with essentially no dust or gas, though it shows traces of star formation in the relatively recent past.

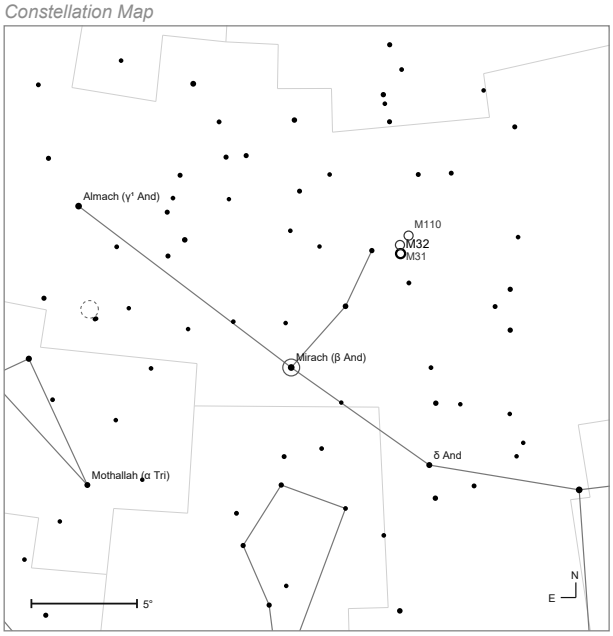
## AT THE EYEPIECE

M32 sits 24′ south of M31's nucleus, so you find it by finding M31 — it appears in the same field in almost any instrument. Large binoculars or a small telescope already show it. From 50°N it culminates at 81°. In a 10″ Dobsonian under Bortle 4 skies it is a small, bright, slightly oval glow about 8′ × 6′ with a sharply concentrated centre — much more condensed than the diffuse M110 on the other side of M31, and easily mistaken for an out-of-focus star at low power. The contrast between the three objects in one field is the point.

## WHY IT MATTERS

M32's structure resists standard galaxy-formation models. Half its stars sit inside an effective radius of only 330 light-years, and its central density exceeds 30 million solar masses per cubic parsec — figures more typical of a star cluster than a galaxy. The favoured explanation is violent transformation: a small disc galaxy fell into M31, had its outer layers tidally stripped, and kept only its bulge, while gas driven inward triggered a starburst that built the dense core we see now.

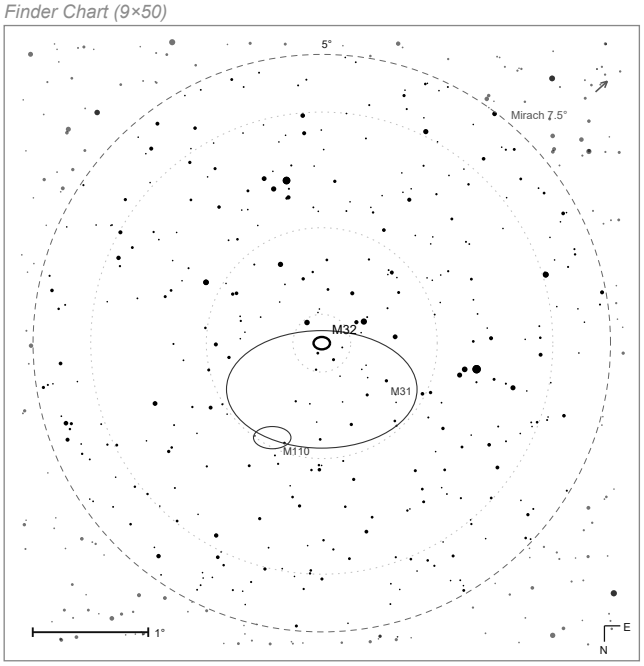
*Constellation Map*




*Naked-eye view · mag 6 · field 29°*

mag ● 1 ● 3 ● 5 ● 7

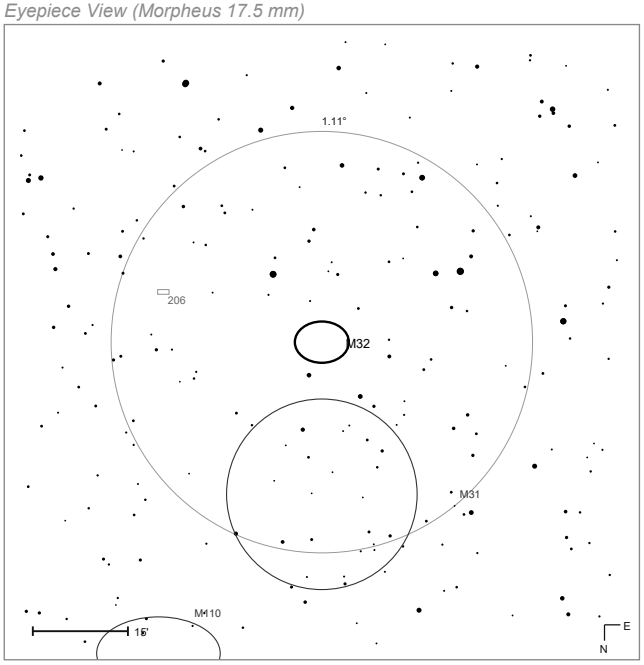
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.2*

mag ● 8 ● 10 · 12 · 14

# M33 Triangulum Galaxy

| | |
|---|---|
| MESSIER | 33 |
| NGC | 598 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Triangulum |
| DISTANCE | 2.9 Mly |
| APPARENT MAG. | +5.7 |
| RA (J2000) | 01h 33m 54s |
| DEC (J2000) | +30° 39′ |
| APPARENT SIZE | 70.8′ × 41.7′ |
| RADIUS (LY) | 29,900 |
| NUMBER OF STARS | 40 billion |

## DISCOVERY & HISTORY

Giovanni Battista Hodierna probably found M33 before 1654; Charles Messier catalogued it independently in 1764. William Herschel gave it the number H V.17 but, unusually, avoided renumbering Messier's object. Some references call it the Pinwheel Galaxy, but SIMBAD reserves that name for M101 — a long-running confusion worth knowing about. M33 lies about 2.9 million light-years away, and with an isophotal diameter near 61,000 light-years it is the third-largest member of the Local Group, after M31 and the Milky Way.

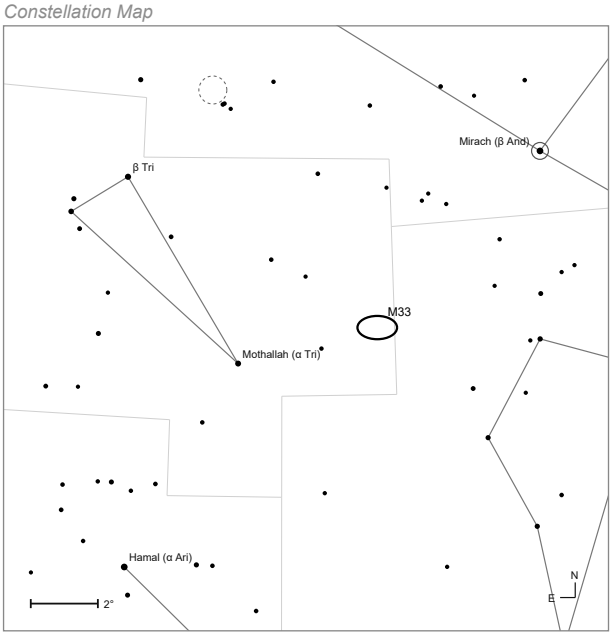
## AT THE EYEPIECE

M33 lies 7° south-east of Mirach (β And) and culminates at 71° from 50°N, so altitude is never the problem — surface brightness is. Its light is spread across 71′ × 42′, giving it the lowest surface brightness of any Messier galaxy, and it is one of the reference objects on the Bortle scale: under a genuinely dark sky some observers see it with the naked eye, making it the most distant thing visible without optics. Binoculars often show it better than a telescope. In a 10″ Dobsonian use your widest field and expect a large, pale oval with a slightly brighter core; the spiral arms come only with patience, averted vision and no Moon.

## WHY IT MATTERS

M33 is the second-smallest spiral in the Local Group after the Large Magellanic Cloud, and probably a satellite of M31 — or on the rebound from a past encounter, judging by their velocities and proximity. Its H II nucleus and abundance of resolvable star-forming regions make it a favourite laboratory for studying stellar populations in a spiral other than our own, at a distance close enough that individual stars, clusters and nebulae can all be picked out.

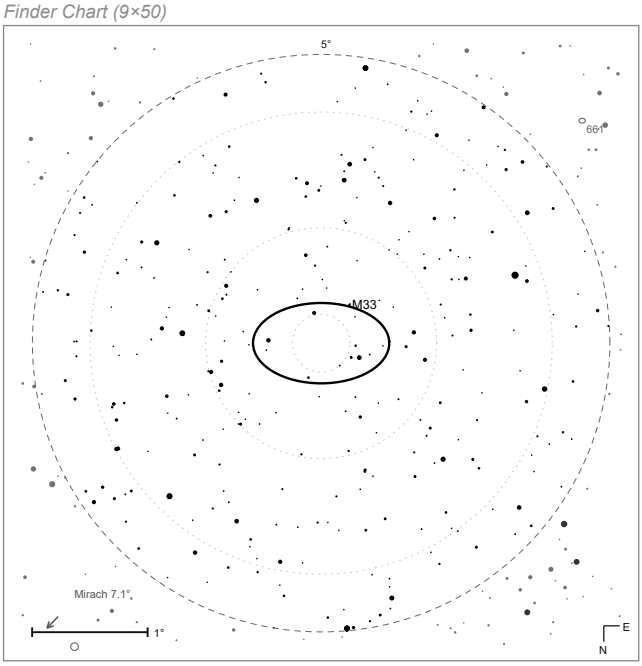
*Constellation Map*




*Naked-eye view · mag 6.5 · field 18°*

mag ● 1 ● 3 ● 5 ● 7

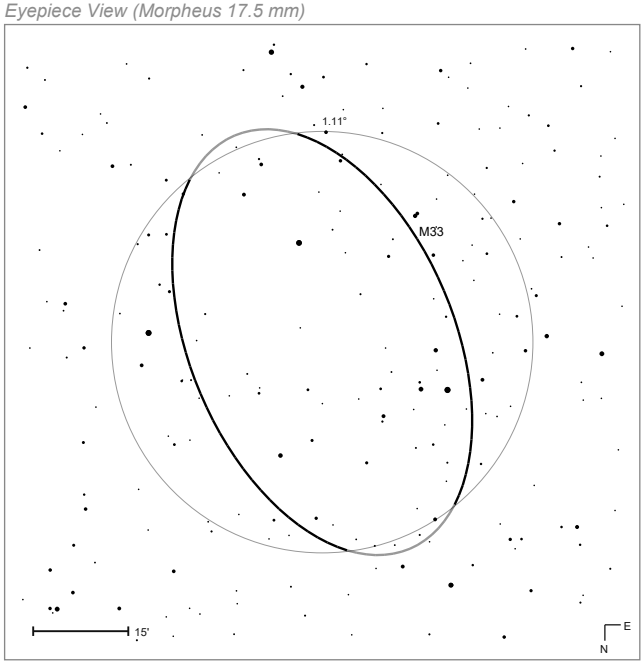
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.8 · outside the ring at 40 % opacity*

mag ● 8 ● 10 · 12 · 14

# M34

OPEN CLUSTER

| | |
|---|---|
| MESSIER | 34 |
| NGC | 1039 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Perseus |
| DISTANCE | 1,500 ly |
| APPARENT MAG. | +5.2 |
| RA (J2000) | 02h 42m 06s |
| DEC (J2000) | +42° 47′ |
| APPARENT SIZE | 25.0′ |
| RADIUS (LY) | 5 |
| AGE (YEARS) | 200 million |

## DISCOVERY & HISTORY

Giovanni Battista Hodierna probably found M34 before 1654. Charles Messier added it in 1764: "A cluster of small stars a little below the parallel of γ Andromedae. In an ordinary telescope of 3 feet one can distinguish the stars." It lies about 1,500 light-years away and spans some 15 light-years, with roughly 400 members between 0.12 and 1 solar mass. Its age falls between the Pleiades and the Hyades — comparison of stellar spectra with evolutionary models gives 200–250 million years.

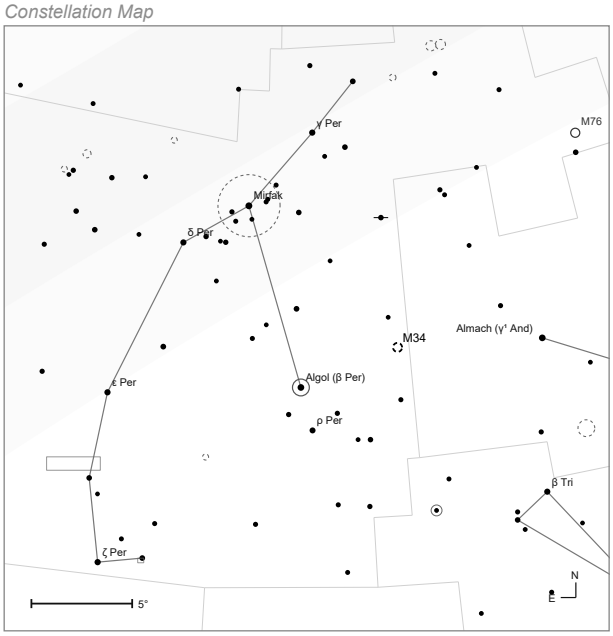
## AT THE EYEPIECE

M34 sits almost exactly halfway between Almach (γ And) and Algol (β Per), both 2nd-magnitude stars, and culminates at 83° from 50°N — effectively overhead. Under a transparent dark sky it is a naked-eye patch. In 10×50 binoculars several 7th- and 8th-magnitude members separate out. A 114 mm telescope resolves it fully into dozens of stars strung into distinct chains, which is where the alternative name Spiral Cluster comes from. In a 10″ Dobsonian keep the magnification lowest — at 25′ it overflows a high-power field. Several double stars sit among the members. NGC 891, an edge-on galaxy, lies 4° west.

## WHY IT MATTERS

At 200–250 million years M34 sits at an instructive point in cluster evolution: it is roughly the age at which half-solar-mass stars finally settle onto the main sequence, while Sun-like stars need only 30 million years. Its metallicity is slightly above solar, about 17% richer in iron. Clusters like this — nearby, well-populated and of intermediate age — are the calibrators that pin the middle of the stellar age scale between young groups like the Pleiades and old ones like the Hyades.

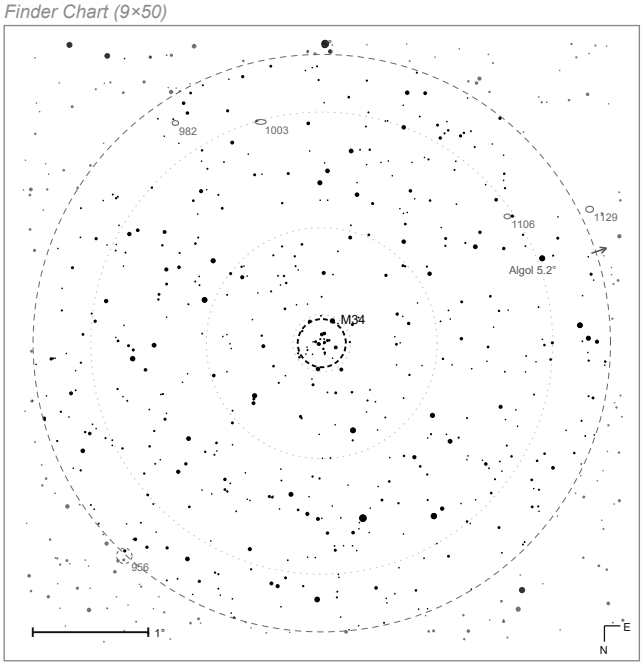
*Constellation Map*




*Naked-eye view · mag 5.5 · field 3°*

mag ● 1 ● 3 ● 5 ● 7

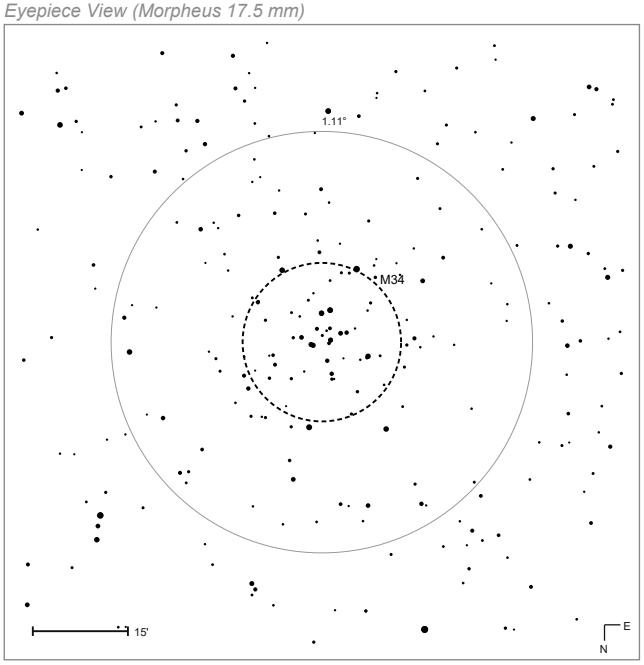
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.7*

mag ● 6 ● 8 ● 10 · 12

# M35

*M35 fills the frame; the compact knot of fainter stars is the older, more distant NGC 2158.*

| | |
|---|---|
| MESSIER | 35 |
| NGC | 2168 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Gemini |
| DISTANCE | 2,970 ly |
| APPARENT MAG. | +5.1 |
| RA (J2000) | 06h 08m 54s |
| DEC (J2000) | +24° 21′ |
| APPARENT SIZE | 25.0′ |
| RADIUS (LY) | 11 |
| AGE (YEARS) | 100 million |

## DISCOVERY & HISTORY

Philippe Loys de Chéseaux found M35 around 1745 and John Bevis independently before 1750; Charles Messier catalogued it in 1764. It is sometimes called the Shoe-Buckle Cluster. Lying about 2,800–2,970 light-years away and spanning roughly 24 light-years, it is one of the nearest rich open clusters. Its age is around 100 million years and its metallicity slightly below solar. Membership studies find 305 near-certain members, and up to 4,349 if every star with a 50% membership probability is counted.

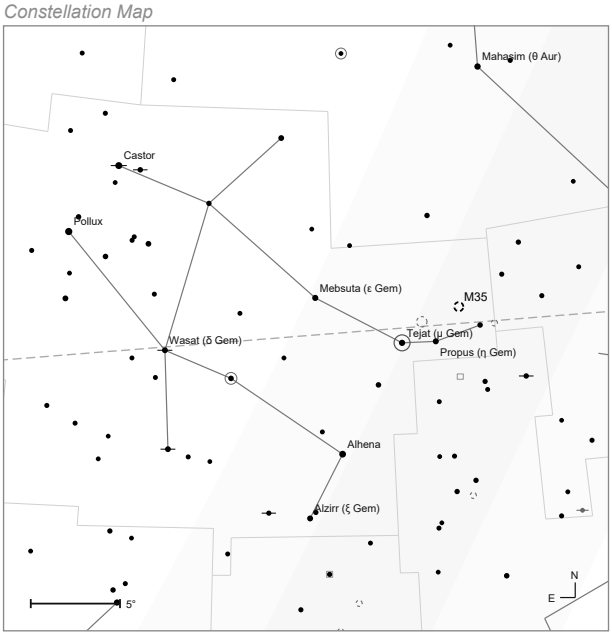
## AT THE EYEPIECE

M35 lies 3.7° north-west of Tejat (μ Gem), by the three stars marking the feet of Gemini; from 50°N it culminates at 64°. Under very good conditions it is a naked-eye patch. A 7×30 binocular splits off a few stars, 10×50 gives about 50. A rich-field telescope at low power shows it best — in a 10″ Dobsonian at 60× the cluster fills 25′ with hundreds of stars in an almost circular, remarkably even distribution, an orange giant among them. Then look 30′ south-west for NGC 2158: far smaller, tighter and much older, an instructive contrast in the same field.

## WHY IT MATTERS

M35's mass has been measured repeatedly by different methods — proper-motion statistics give 1,600–3,200 solar masses within the central 12 light-years, later work about 1,600 within the central half-degree — which makes it a benchmark for cluster mass determination. Of 418 probable members, 64 turned out to have variable radial velocities and are therefore binaries, a binary fraction that matters for models of how clusters dissolve. Four members are chemically peculiar stars.

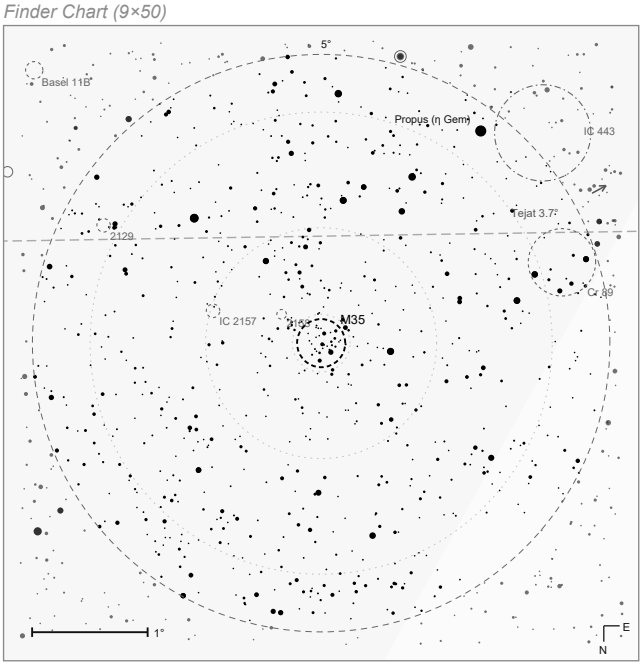
*Constellation Map*




*Naked-eye view · mag 5.5 · field 34°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

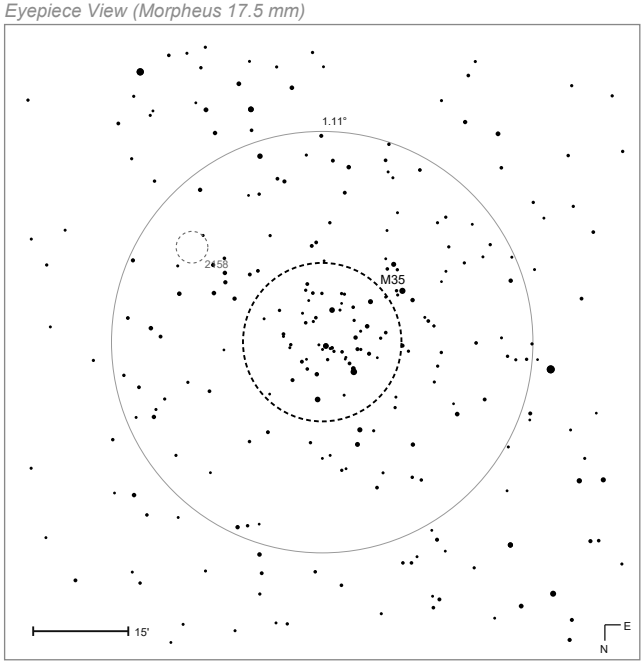
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 — ecliptic · · Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.1*

mag ● 6 ● 8 ● 10 · 12

# M36

OPEN CLUSTER

| | |
|---|---|
| MESSIER | 36 |
| NGC | 1960 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Auriga |
| DISTANCE | 4,340 ly |
| APPARENT MAG. | +6.0 |
| RA (J2000) | 05h 36m 18s |
| DEC (J2000) | +34° 08′ |
| APPARENT SIZE | 10.0′ |
| RADIUS (LY) | 6 |
| AGE (YEARS) | 25 million |

## DISCOVERY & HISTORY

Giovanni Battista Hodierna found M36 before 1654 and described it as a nebulous patch; Guillaume Le Gentil rediscovered it independently in 1749, and Charles Messier observed it on 2 September 1764, fixing its position from φ Aurigae and noting that it was purely stellar. It is sometimes called the Pinwheel Cluster. Distance estimates run from about 3,800 to 4,340 light-years. The cluster is essentially a more distant twin of the Pleiades — at M45's distance it would look much the same.

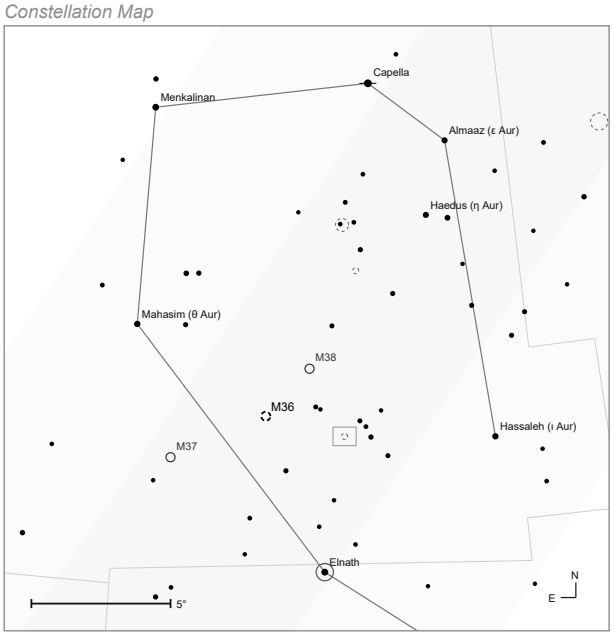
## AT THE EYEPIECE

M36 lies about 6° south-west of θ Aurigae, in the middle of a region crowded with open clusters; from 50°N it culminates at 74°. It shows in the smallest binoculars, and under exceptional skies is at the edge of naked-eye visibility. A 7×30 binocular partly resolves it but leaves a hazy centre; 20×80 gives dozens of blue-tinted stars. In a 10″ Dobsonian expect around 80 stars across 10′, many of them in pairs, with the double Struve 737 near the middle at 10.7″ separation. M38 lies 2° north-west, M37 4° south-east — all three in one evening.

## WHY IT MATTERS

M36 is young: photometry gives 25–26 million years, and the luminosity of members that have not yet burned their lithium gives 22 ± 4 million — a rare case where two independent age clocks agree closely. Ten members are brighter than magnitude 10 and 178 down to magnitude 14; 38 show an infrared excess, the signature of surviving dust discs. The cluster field also contains "Holoea", a young stellar object with an outflow associated with the infrared source IRAS 05327+3404.

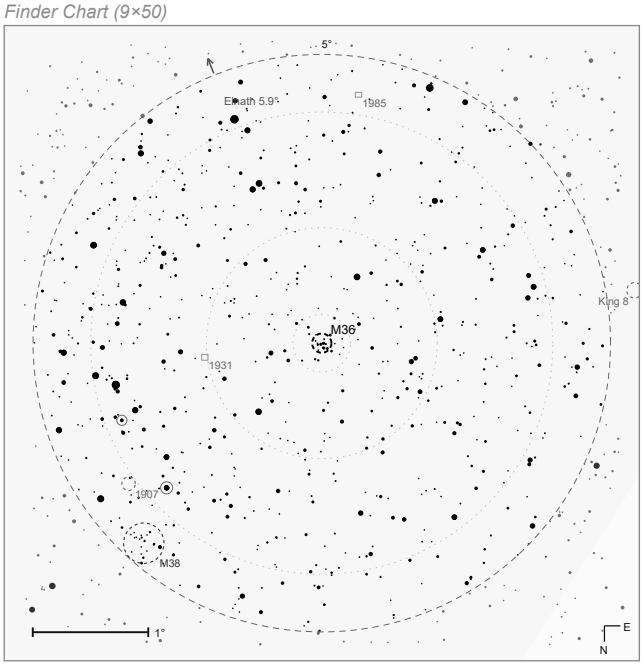
Constellation Map




Naked-eye view · mag 6 · field 22°

mag ● 1 ● 3 ● 5 ● 7

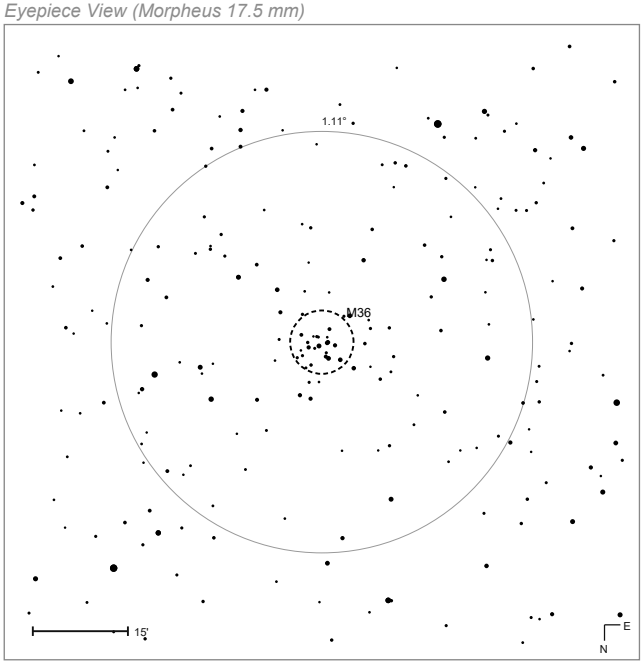
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

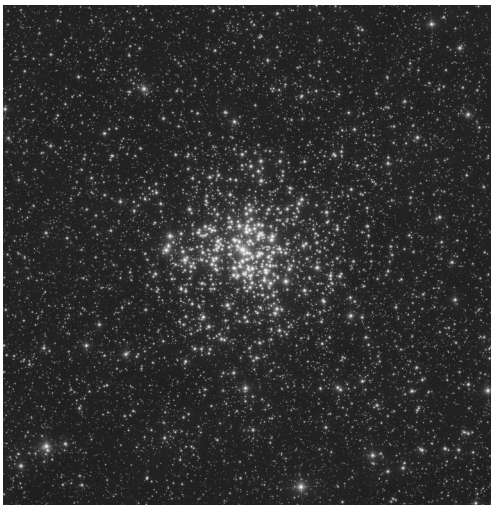



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.4

mag ● 6 ● 8 ● 10 · 12

# M37

OPEN CLUSTER



| | |
|---|---|
| MESSIER | 37 |
| NGC | 2099 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Auriga |
| DISTANCE | 4,500 ly |
| APPARENT MAG. | +5.6 |
| RA (J2000) | 05h 52m 18s |
| DEC (J2000) | +32° 33′ |
| APPARENT SIZE | 15.0′ |
| RADIUS (LY) | 10 |

## DISCOVERY & HISTORY

Giovanni Battista Hodierna found M37 before 1654, but his catalogue was lost to view — and when Guillaume Le Gentil rediscovered M36 and M38 in 1749 he missed this one, the best of the three. Charles Messier found it independently in September 1764. Its nickname, the Salt and Pepper Cluster, describes the mix of bright and faint members. It lies about 4,500 light-years away in the direction opposite the galactic centre, spans 20–25 light-years, and estimates of its age run from 347 to 550 million years.

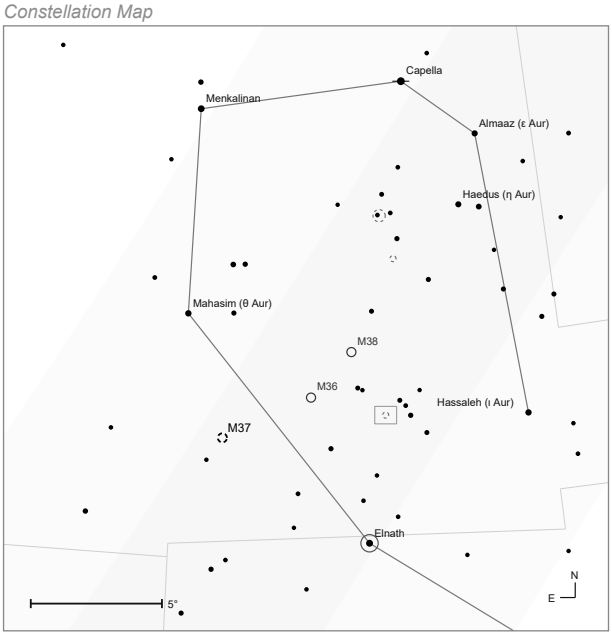
## AT THE EYEPIECE

M37 lies about 5° south-south-west of θ Aurigae, in a patch of sky separated from the richest Auriga star fields; from 50°N it culminates at 73°. Under exceptional conditions it is a naked-eye object; binoculars show only an indefinite grainy haze. From 114 mm upward it becomes what it really is — the brightest and richest cluster in Auriga and one of the finest anywhere: in a 10″ Dobsonian, 150 or more stars fill 15′, with obvious colour differences from blue to red, a prominent red giant near the centre and dark lanes threading between knots of brighter members.

## WHY IT MATTERS

M37 holds over 500 identified stars and 1,500 solar masses, with at least a dozen red giants and a hottest surviving main-sequence star of class B9 V — a well-populated, middle-aged cluster whose turn-off point makes it a standard test of stellar evolution models. Its metallicity matches the Sun's or slightly exceeds it. As of 2022 it also contains only the third planetary nebula known to be associated with an open cluster, a rare configuration because most clusters disperse before their stars reach that stage.

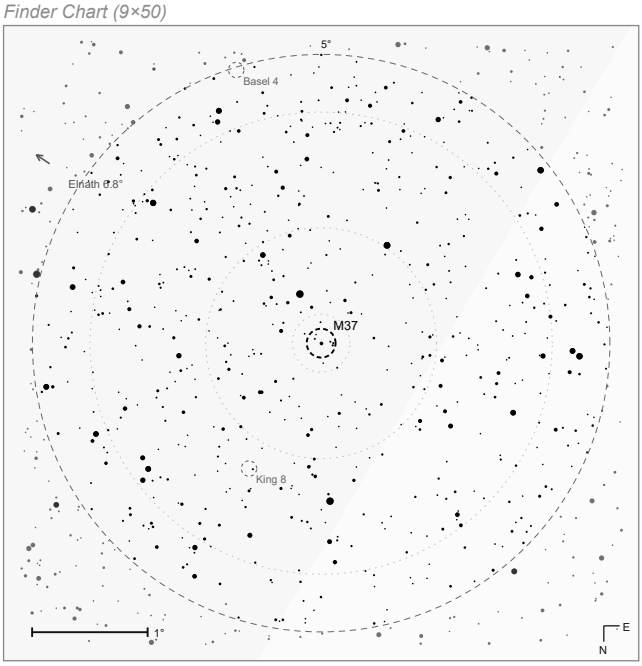
Constellation Map




Naked-eye view · mag 6 · field 23°

mag ● 1 ● 3 ● 5 ● 7

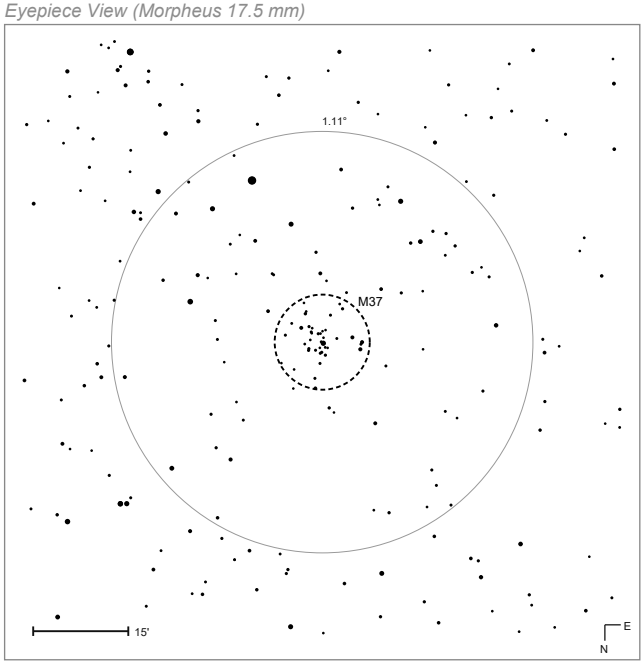
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

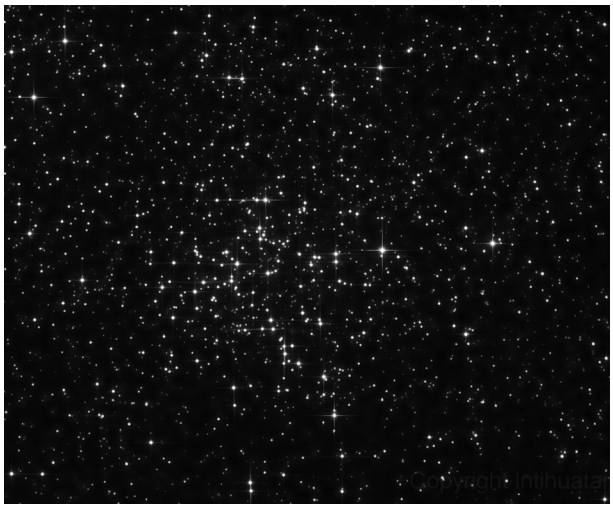



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.3

mag ● 6 ● 8 ● 10 · 12

# M38






| | |
|---|---|
| MESSIER | 38 |
| NGC | 1912 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Auriga |
| DISTANCE | 4,200 ly |
| APPARENT MAG. | +6.4 |
| RA (J2000) | 05h 28m 42s |
| DEC (J2000) | +35° 51′ |
| APPARENT SIZE | 15.0′ |
| RADIUS (LY) | 9 |
| AGE (YEARS) | 250 million |

## DISCOVERY & HISTORY

Giovanni Battista Hodierna found M38 before 1654 and Guillaume Le Gentil independently in 1749; Charles Messier observed it on 25 September 1764 and confirmed that a good telescope left no trace of nebulosity in it. Its brightest members form a pattern read variously as the Greek letter Pi, an "oblique cross" (Webb) or a starfish — hence the modern nickname. Walter Scott Houston noted that the cross is most convincing in small instruments and dissolves in large ones. The cluster lies about 3,500–4,200 light-years away and is of intermediate age, roughly 290 million years.

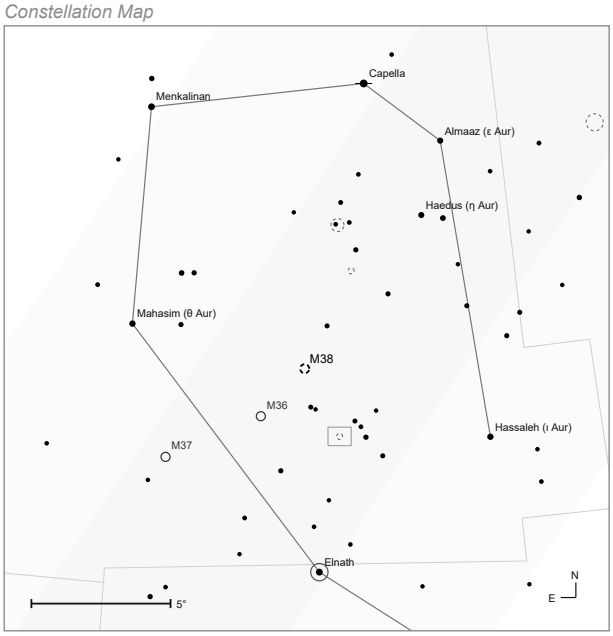
## AT THE EYEPIECE

M38 sits about halfway between θ and ι Aurigae, the northernmost of the three bright Auriga clusters; from 50°N it culminates at 76°. Small binoculars show a bright patch that barely resolves. An 80 mm telescope breaks it into a few dozen stars; at 120–150 mm another hundred appear, arranged in multiple chains, one running east–west. A 10″ Dobsonian can show over 200 stars across 15′. Half a degree south lies NGC 1907, much smaller and denser — the two are a fly-by, not a pair, having formed in different parts of the galaxy.

## WHY IT MATTERS

M38's brightest member is a yellow giant of magnitude 7.9 and spectral class G0, absolute magnitude −1.5, some 900 times more luminous than the Sun — a star of roughly solar composition caught in the brief phase our own Sun will reach in billions of years. With about a hundred members in 13 light-years, the cluster is a well-defined intermediate-age population, and its chance superposition with NGC 1907 is a standard caution against inferring physical pairs from proximity on the sky.

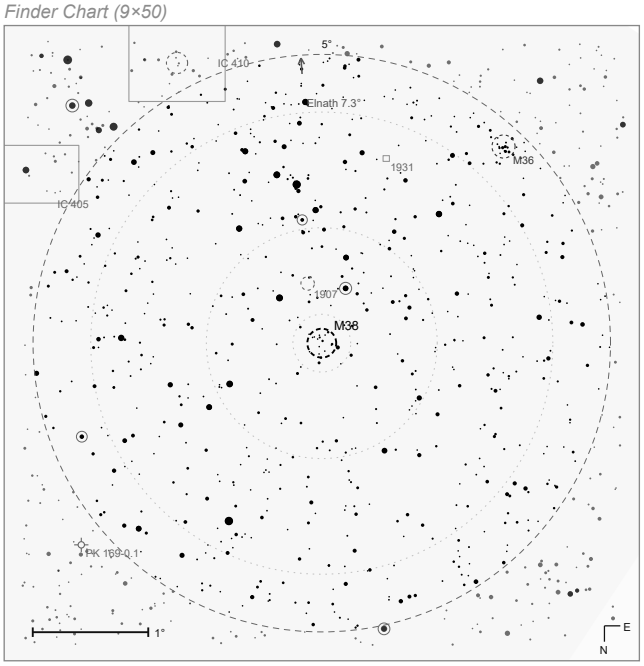
*Constellation Map*




*Naked-eye view · mag 6 · field 22°*

mag ● 1 ● 3 ● 5 ● 7

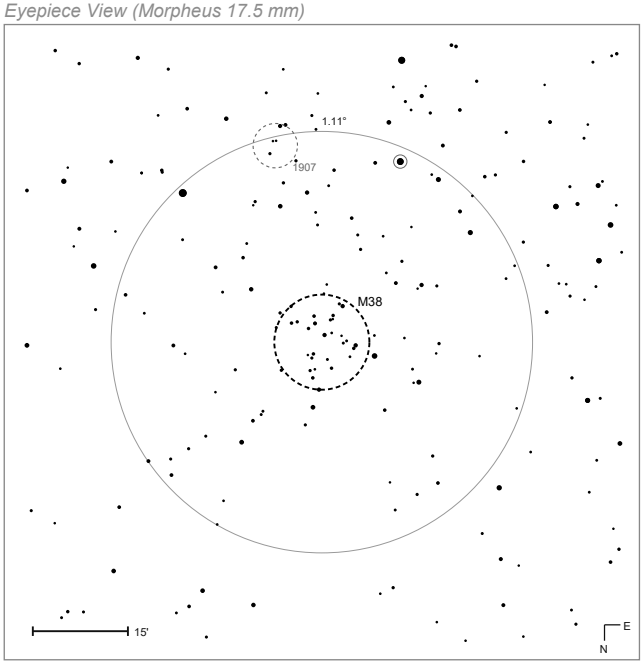
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

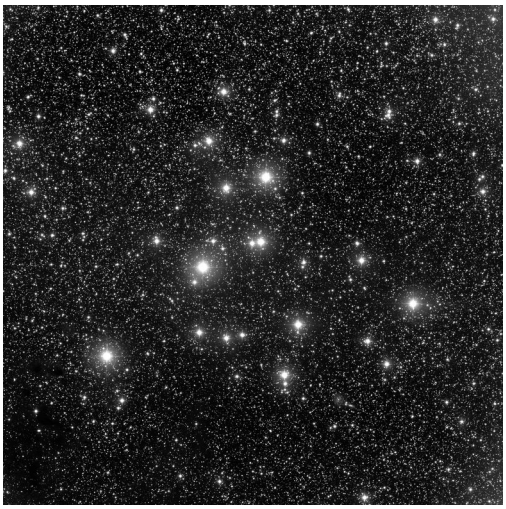



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.4*

mag ● 6 ● 8 ● 10 · 12

# M39





| | |
|---|---|
| MESSIER | 39 |
| NGC | 7092 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Cygnus |
| DISTANCE | 1,010 ly |
| APPARENT MAG. | +4.6 |
| RA (J2000) | 21h 32m 12s |
| DEC (J2000) | +48° 26′ |
| APPARENT SIZE | 31.0′ |
| RADIUS (LY) | 5 |
| AGE (YEARS) | 280 million |

## DISCOVERY & HISTORY

Guillaume Le Gentil found M39 in 1749 and Charles Messier catalogued it on 24 October 1764, describing "a cluster of stars near the tail of Cygnus" a degree across, visible in an ordinary 3.5-foot telescope. Some researchers argue Aristotle may have recorded it as a comet-like object in antiquity. It is occasionally called the Pyramid Cluster for the triangle its brightest members form. At about 825–1,010 light-years it is one of the nearest open clusters in this catalogue, with a modest mass of only 232 solar masses.

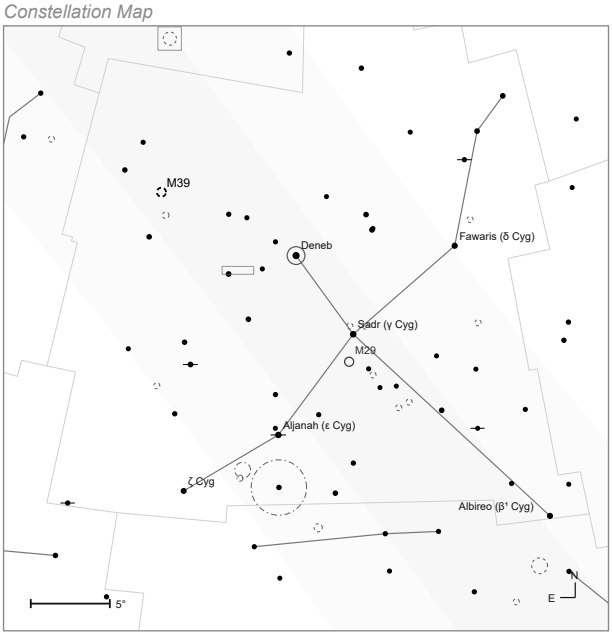
## AT THE EYEPIECE

M39 lies 2.5° west of π² Cygni and roughly 9° east-north-east of Deneb; from 50°N it culminates at 88°, essentially in the zenith. Under a dark transparent sky it is a naked-eye glow. This is a binocular object above all: 7×30 resolves about twenty stars and shows the triangular shape clearly, and 10×50 splits them cleanly and picks up several doubles. In a 10″ Dobsonian keep the power very low — the cluster is loose and 31′ wide, and too much magnification simply scatters it into the rich Cygnus background. The Cocoon Nebula lies 4° east, with dark nebula B168 trailing toward M39.

## WHY IT MATTERS

M39 is sparse and nearby, which makes its membership unusually tractable: of the fifteen brightest components, six are binary systems and a seventh is suspected. HD 205117 is a probable eclipsing binary of two subgiants with a 113.2-day period and a 0.05-magnitude variation. The cluster also contains at least five chemically peculiar stars and ten suspected short-period variables. Loose clusters like this are the last stage before dissolution into the general field population.

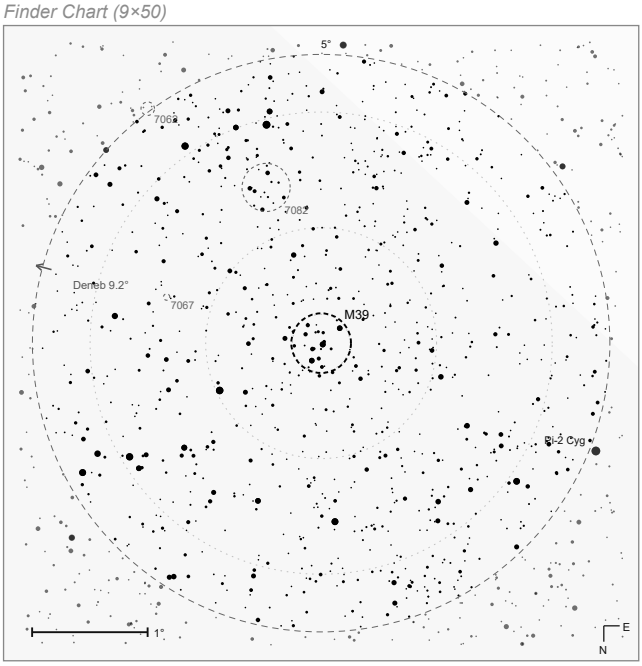
*Constellation Map*




*Naked-eye view · mag 5 · field 38°*

mag ● 1 ● 3 ● 5 ● 7

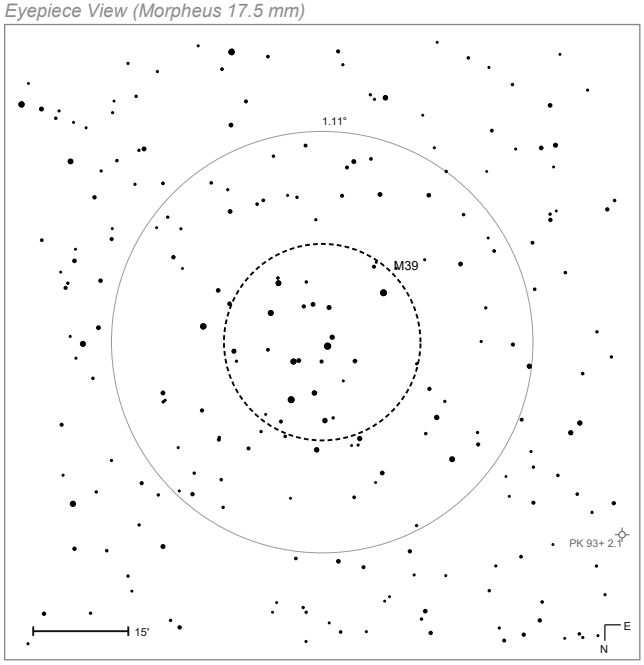
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

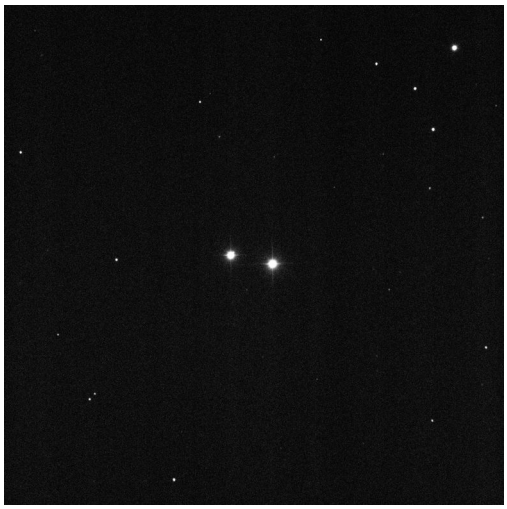



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 10.9 · outside the ring at 40 % opacity*

mag ● 6 ● 8 ● 10 · 12

# M40 Winnecke 4

DOUBLE STAR



*M40 is only the close pair of stars at centre — Messier's mistaken „nebula“.*

| | |
|---|---|
| MESSIER | 40 |
| OBJECT TYPE | Double Star |
| CONSTELLATION | Ursa Major |
| APPARENT MAG. | +9.0 |
| RA (J2000) | 12h 21m 54s |
| DEC (J2000) | +58° 06′ |
| APPARENT SIZE | 0.9′ |

## DISCOVERY & HISTORY

Charles Messier logged M40 on 24 October 1764 while hunting for a nebula Johannes Hevelius had reported above the Great Bear's tail. Finding none, he catalogued the double star he saw instead and wrote plainly that Hevelius had probably mistaken two stars for a nebula. In fact Hevelius had seen 74 and 75 Ursae Majoris, a naked-eye pair a degree further east. Friedrich Winnecke rediscovered the pair in 1863, giving it the designation Winnecke 4. Burnham called M40 "one of the few real mistakes in the Messier catalog".

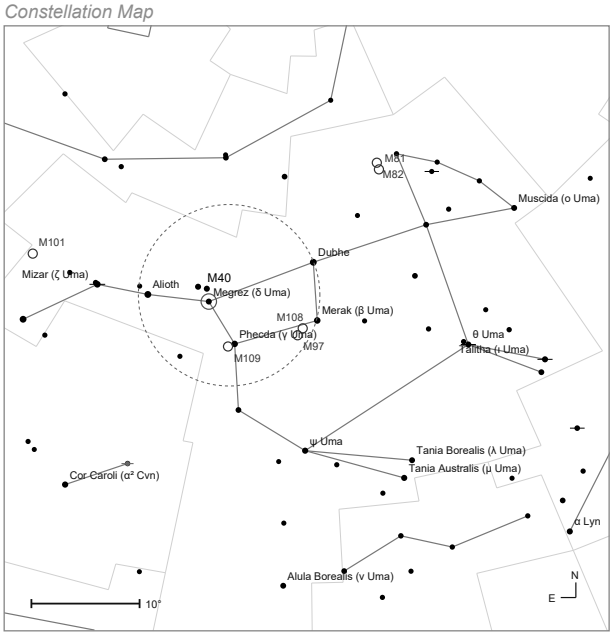
## AT THE EYEPIECE

Start at δ Ursae Majoris, move 1° north-east to the 5.7-magnitude star 70 UMa, then 16′ further north-east. From 50°N this passes directly overhead. What you will see in a 10″ Dobsonian is exactly what Messier saw: two stars of magnitude 9 and 9.3 about 52″ apart, and nothing else — no nebulosity of any kind. It is worth the visit as a piece of history rather than as a sight. Observers with 100 mm and up can hunt for the 12th-magnitude spiral galaxy NGC 4290, 9′ west, which is arguably the better object in the field.

## WHY IT MATTERS

M40 is an optical double, not a binary: the components merely line up. Gaia parallaxes put the brighter star, HD 238107, at 1,013 ± 4 light-years and the fainter, HD 238108, at 470 ± 1 — utterly unrelated systems. Their measured separation has widened from about 49″ in 1764 to 52″ today, the expected signature of independent proper motions. As a catalogue entry M40 is a mistake; as a lesson in how projection deceives, it earns its page.

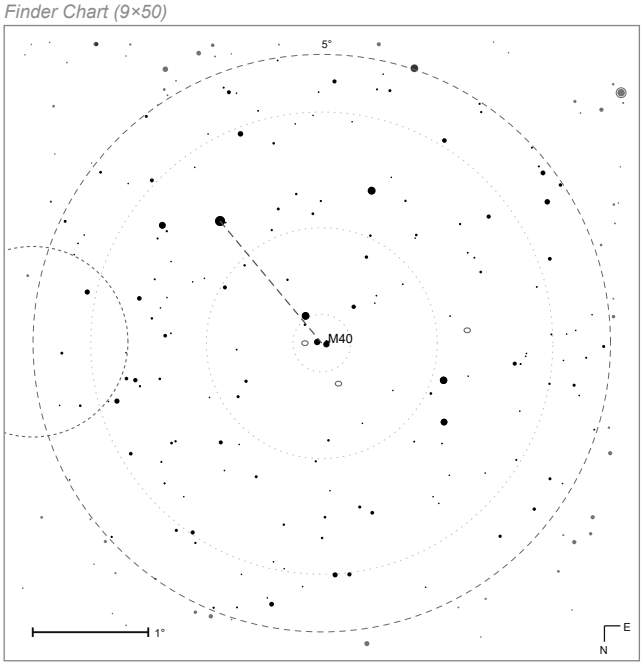
*Constellation Map*




*Naked-eye view · mag 5 · field 56°*

mag ● 1 ● 3 ● 5 ● 7

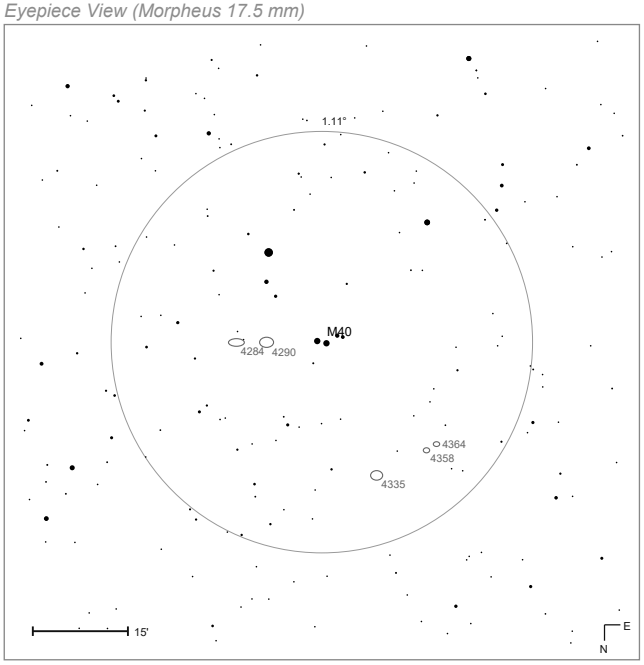
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

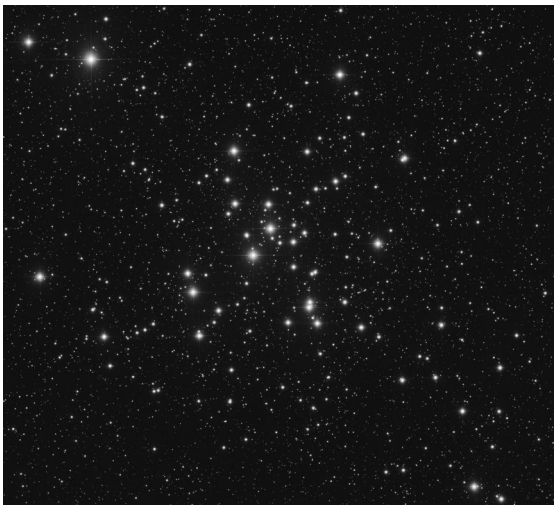



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M41





| | |
|---|---|
| MESSIER | 41 |
| NGC | 2287 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Canis Major |
| DISTANCE | 2,360 ly |
| APPARENT MAG. | +4.5 |
| RA (J2000) | 06h 46m 00s |
| DEC (J2000) | −20° 45′ |
| APPARENT SIZE | 39.0′ |
| RADIUS (LY) | 13 |
| AGE (YEARS) | 200 million |

## DISCOVERY & HISTORY

Giovanni Battista Hodierna found M41 before 1654, and Aristotle may have noted it as a nebulous patch as early as 325 BC — which would make it one of the oldest recorded deep-sky objects. Charles Messier catalogued it in 1765. It is sometimes called the Little Beehive for its resemblance to M44. The cluster lies about 2,300 light-years away, spans 25–26 light-years, contains around 100 stars including several red giants and white dwarfs, and is roughly 190–240 million years old.

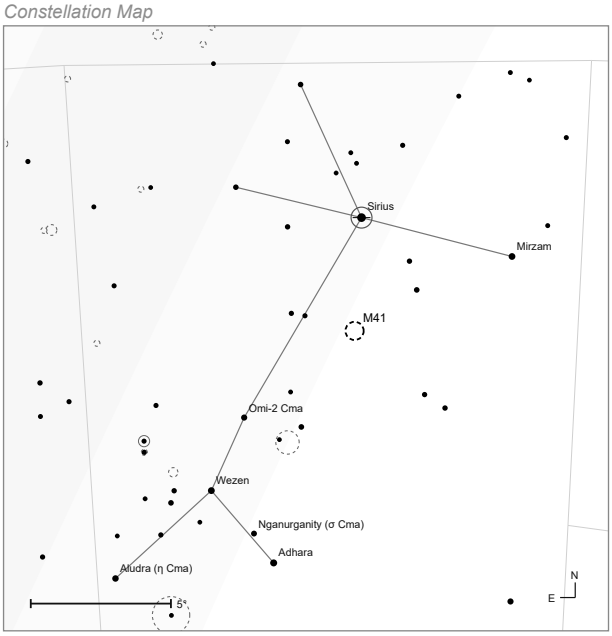
## AT THE EYEPIECE

M41 lies 4° south of Sirius, forming a near-equilateral triangle with Sirius and v² Canis Majoris — the easiest star hop in the winter sky. From 50°N it culminates at only 19°, so it wants a clear southern horizon. It is a naked-eye patch under good conditions; low-power binoculars almost fully resolve it into dozens of blue-white stars across 39′. In a 10″ Dobsonian at low power the curved chains of stars that many observers report stand out strongly — they are far less obvious on photographs — along with the prominent red-orange giant near the centre, HIP 32406, a K-type star of magnitude 6.9.

## WHY IT MATTERS

M41 is a textbook intermediate-age open cluster: old enough that its most massive stars have already become red giants and its lowest-mass members have settled onto the main sequence, young enough to remain a coherent group. Models give it about 500 million years of life before galactic tides disperse it. Its brightest member is a K3 red giant of magnitude 6.3, and the cluster recedes from us at 23.3 km/s.

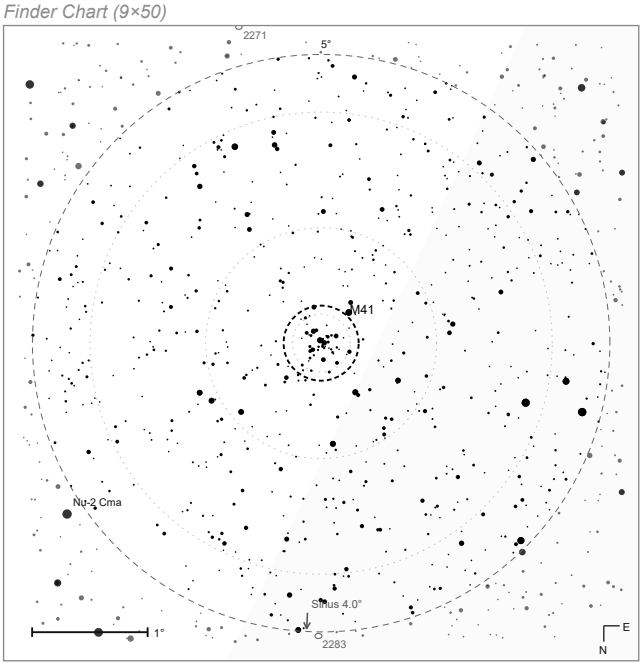
*Constellation Map*




*Naked-eye view · mag 5.5 · field 22°*

mag ● 1 ● 3 ● 5 ● 7

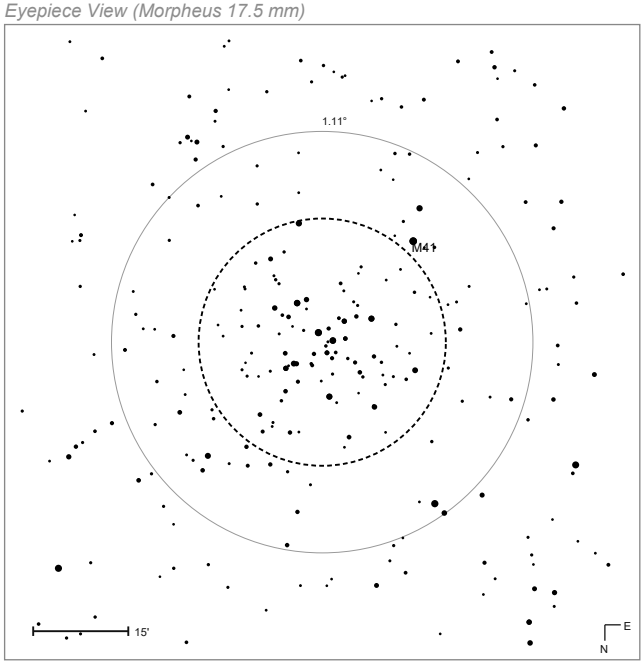
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 ● 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.3 · outside the ring at 40 % opacity*

mag ● 6 ● 8 ● 10 ● 12

# M42 Orion Nebula

| | |
|---|---|
| MESSIER | 42 |
| NGC | 1976 |
| OBJECT TYPE | Diffuse Nebula |
| CONSTELLATION | Orion |
| DISTANCE | 1,270 ly |
| APPARENT MAG. | +4.0 |
| RA (J2000) | 05h 35m 18s |
| DEC (J2000) | −05° 23′ |
| APPARENT SIZE | 40.0′ × 35.0′ |
| RADIUS (LY) | 7 |

## DISCOVERY & HISTORY

The Orion Nebula is the only deep-sky object obvious to the naked eye in temperate skies, yet ancient astronomers — Aristotle, Ptolemy, even al-Sufi — recorded the stars of Orion's sword without mentioning the nebulosity around them. Nicolas-Claude Fabri de Peiresc made the first telescopic observation in 1610. Christiaan Huygens published the first detailed drawing of its centre in 1659, and Messier added M42 to his catalogue in 1769. In 1880 Henry Draper took the first astrophotograph of any nebula here, and M42 has been the most photographed object in the sky ever since.

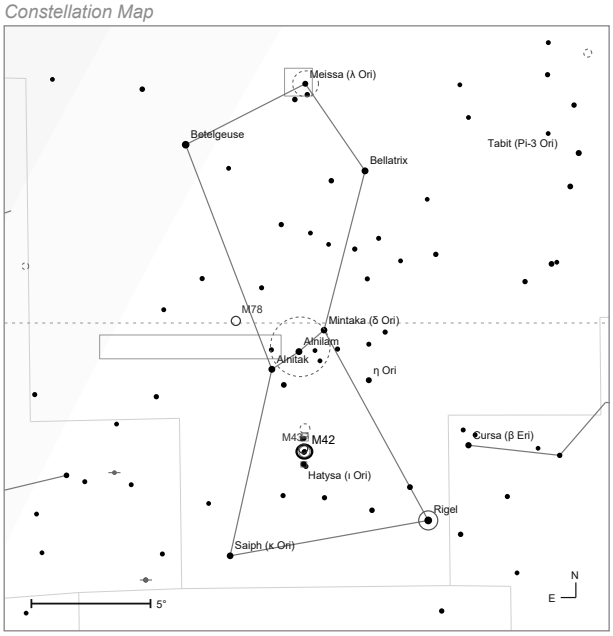
## AT THE EYEPIECE

From 50°N, M42 culminates at just 34°, so seeing matters — wait for a still night and let the scope cool. In a 10″ Dobson it stretches across nearly a degree, with the dark "fish's mouth" cutting in toward the Trapezium. The four bright Trapezium stars resolve cleanly at 100×; a 6th and 7th member emerge at 150×–200× on good nights. M43 hangs to the north as a smaller, rounder smudge.

## WHY IT MATTERS

M42 is the nearest region of massive star formation, 1,267 light-years away and roughly 25 light-years across. Hundreds of newly-formed stars are visible inside it, many with protoplanetary disks resolved by Hubble and JWST. The Orion Nebula is the rosetta stone for star formation studies — close enough to dissect, young enough that the process is still happening, bright enough that even modest amateur instruments can follow the structural detail.

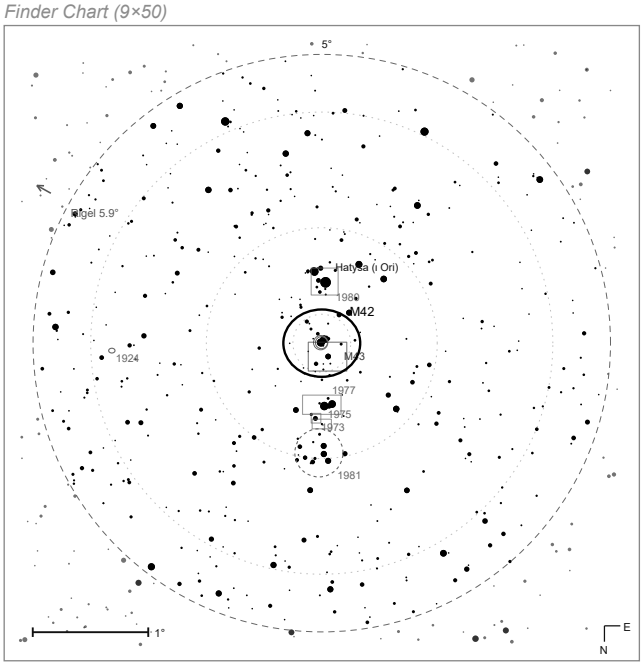
*Constellation Map*




*Naked-eye view · mag 5.5 · field 25°*

mag ● 1 ● 3 ● 5 ● 7 – – celestial equator

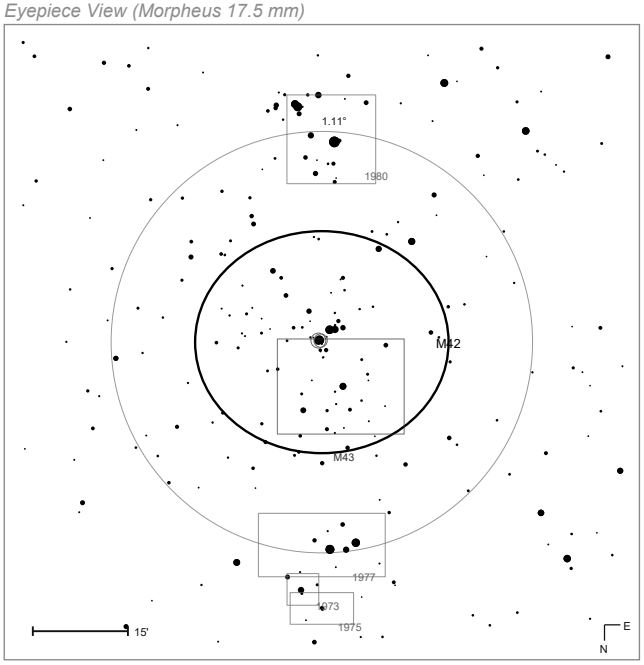
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

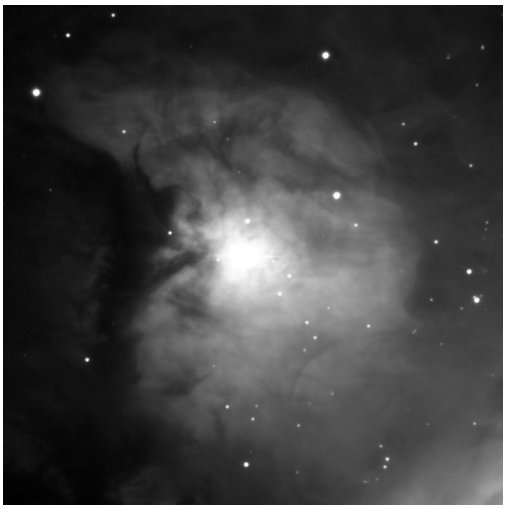



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.3 · outside the ring at 40 % opacity*

mag ● 8 ● 10 · 12 · 14

# M43 De Mairan's Nebula





| | |
|---|---|
| MESSIER | 43 |
| NGC | 1982 |
| OBJECT TYPE | Diffuse Nebula |
| CONSTELLATION | Orion |
| DISTANCE | 1,360 ly |
| APPARENT MAG. | +7.0 |
| RA (J2000) | 05h 35m 30s |
| DEC (J2000) | −05° 16′ |
| APPARENT SIZE | 20.0′ × 15.0′ |
| RADIUS (LY) | 4 |

## DISCOVERY & HISTORY

Jean-Jacques d'Ortous de Mairan found this nebula some time before 1731 — hence De Mairan's Nebula — and Charles Messier catalogued it in 1769, giving it a separate number from M42 even though the two are physically one object. What divides them is the northeast dark lane, a dense ribbon of dust; both belong to the far larger Orion molecular cloud complex. Its ionising star, the quadruple system NU Orionis, sits 1,360 ± 30 light-years away.

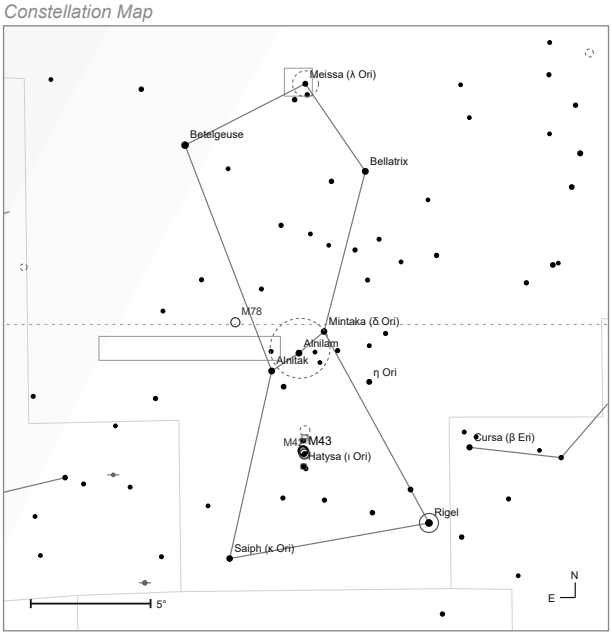
## AT THE EYEPIECE

M43 lies immediately north-east of M42's Trapezium region, just north of θ¹ Orionis in the Sword; from 50°N it culminates at 35°. In a 10″ Dobsonian under Bortle 4 skies it appears as a comma or apostrophe of glow wrapped around the 7th-magnitude star NU Orionis, roughly 20′ × 15′ overall but with a much brighter round core about 4.5′ across. The dark lane separating it from M42 is obvious once you look for it, and a second dark lane crosses M43 itself from north to south. Most observers sweep past it while admiring M42 — worth stopping for.

## WHY IT MATTERS

M43 is a small H II region powered by a single, cooler ionising source rather than the Trapezium's hot O stars, so it produces very little [O III] emission compared with M42. That contrast, in one telescope field, is a direct demonstration of how nebular spectra depend on the temperature of the ionising star. Its hydrogen-alpha luminosity of about 78 Suns comes from an ionised volume just 2.1 light-years across, making it a well-bounded test case for models of small H II regions.

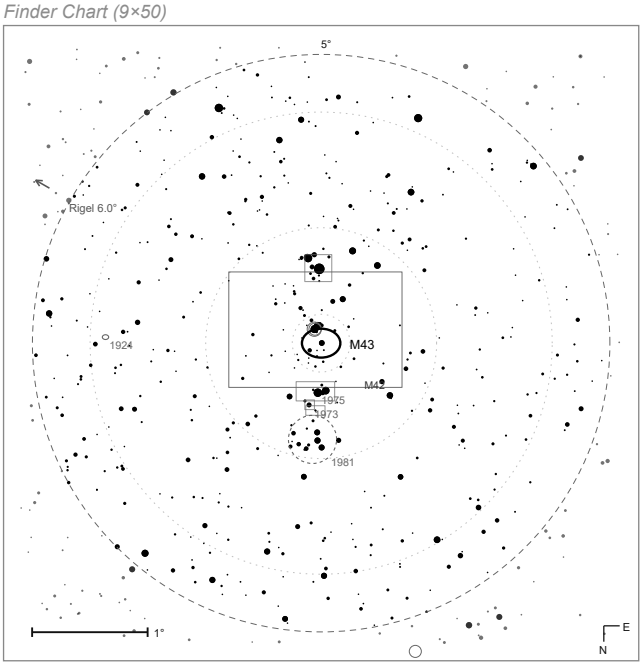
Constellation Map




Naked-eye view · mag 5.5 · field 25°

mag ● 1 ● 3 ● 5 ● 7 – – celestial equator

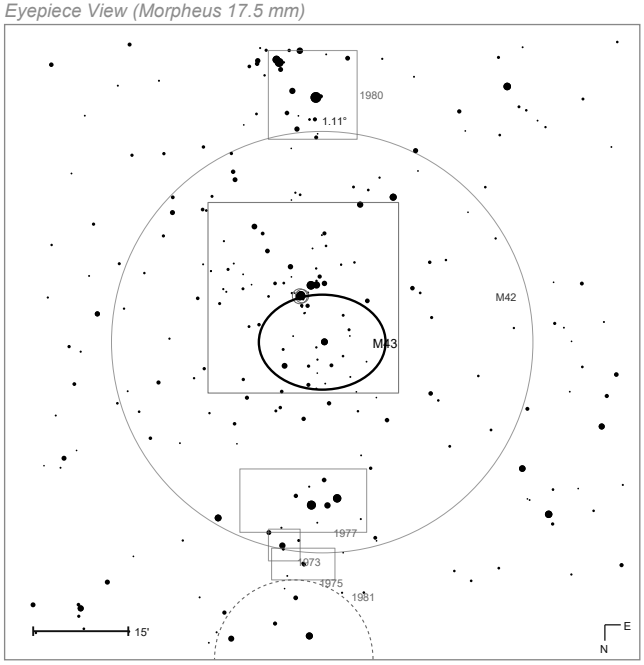
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

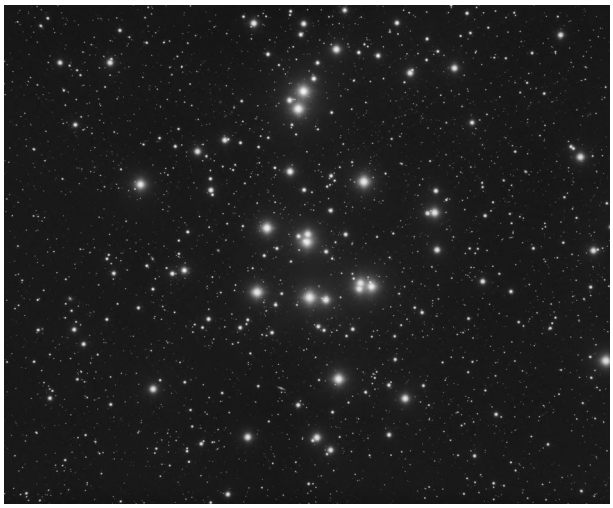



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.3

mag ● 8 ● 10 · 12 · 14

# M44 Beehive Cluster

OPEN CLUSTER



| | |
|---|---|
| MESSIER | 44 |
| NGC | 2632 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Cancer |
| DISTANCE | 610 ly |
| APPARENT MAG. | +3.1 |
| RA (J2000) | 08h 40m 00s |
| DEC (J2000) | +19° 40′ |
| APPARENT SIZE | 70.0′ |
| RADIUS (LY) | 6 |

## DISCOVERY & HISTORY

The Beehive has been known since antiquity: Ptolemy described it as "a nebulous mass in the breast of Cancer", and its Latin name Praesepe means manger or crib. In late 1609 it became one of the first objects Galileo turned a telescope on, and he resolved it into about 40 stars — early evidence that nebulous patches could be crowds of stars. Charles Messier added it to his catalogue in 1769. It lies roughly 590–610 light-years away, holds around 1,000 stars, and is about 600 million years old.

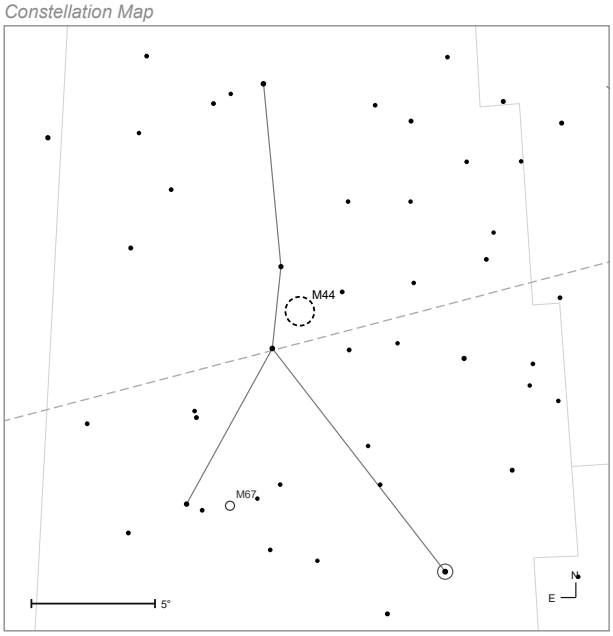
## AT THE EYEPIECE

M44 lies between Regulus and Pollux, which are the guide stars; from 50°N it culminates at 60°. Under a dark sky it is an obvious naked-eye patch, and its brightest members at 6th to 7th magnitude are comfortable in binoculars even from a city. At 70′ — more than two full Moons — it is fundamentally a binocular or rich-field object; in a 10″ Dobsonian only a fraction fits the field at once, so sweep it at the lowest power you own. Look for the several wide double stars among the brighter members and the scattering of orange giants.

## WHY IT MATTERS

The Beehive's age and proper motion match those of the Hyades, which suggests the two clusters formed from the same molecular cloud complex and have drifted apart since — one of the strongest cases for a common origin between separate clusters. Both contain red giants and white dwarfs alongside their main-sequence populations, making them paired benchmarks for stellar evolution at known age. M44 is also one of the nearest clusters rich enough for statistically meaningful studies, and exoplanets have been found orbiting its member stars.

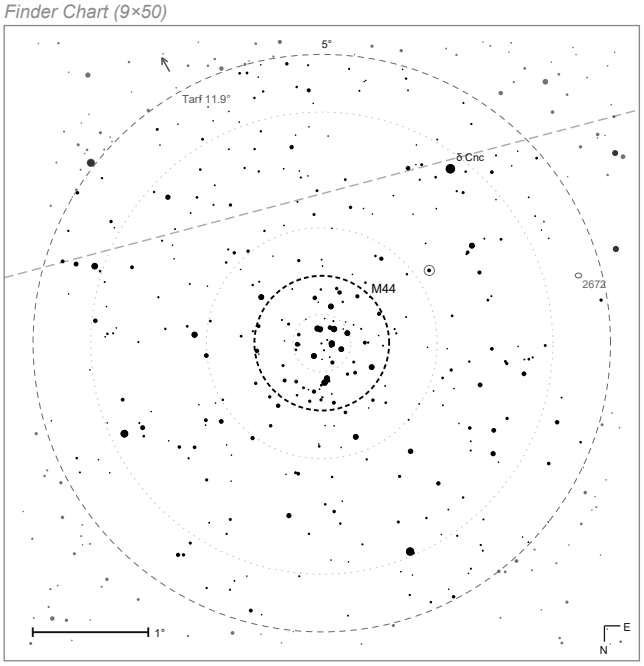
Constellation Map




Naked-eye view · mag 6 · field 24°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

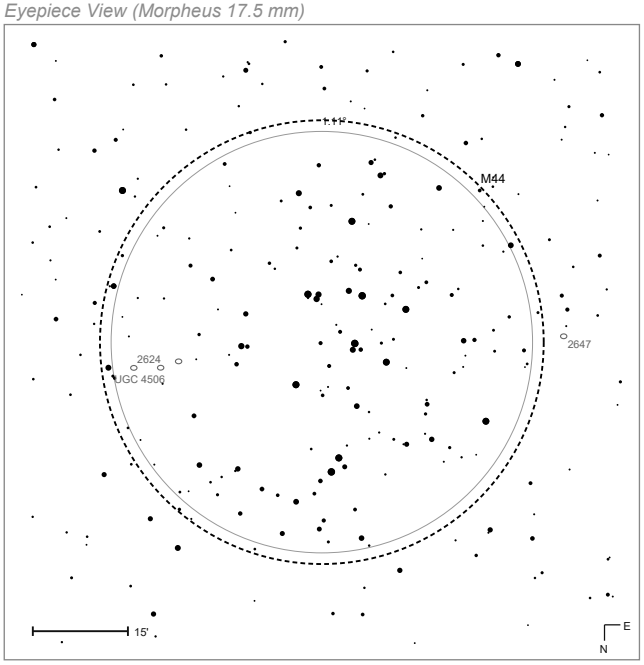
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 — ecliptic · · Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.2 · outside the ring at 40 % opacity

mag ● 8 ● 10 · 12 · 14

# M45 Pleiades

| | |
|---|---|
| MESSIER | 45 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Taurus |
| DISTANCE | 444 ly |
| APPARENT MAG. | +1.2 |
| RA (J2000) | 03h 47m 00s |
| DEC (J2000) | +24° 07′ |
| APPARENT SIZE | 110.0′ |
| RADIUS (LY) | 7 |
| AGE (YEARS) | 120 million |

## DISCOVERY & HISTORY

The Pleiades are mentioned in every major astronomical tradition — Hesiod, the Babylonian MUL.APIN tablet, the Māori Matariki, the Japanese Subaru. They appear on the Nebra sky disk from around 1600 BCE. Galileo turned a telescope on them in 1610 and counted 36 stars where Greek myth had named only seven. Messier catalogued the cluster in 1771 to round out his list at 45 entries, even though the Pleiades had been part of human sky-knowledge for millennia.

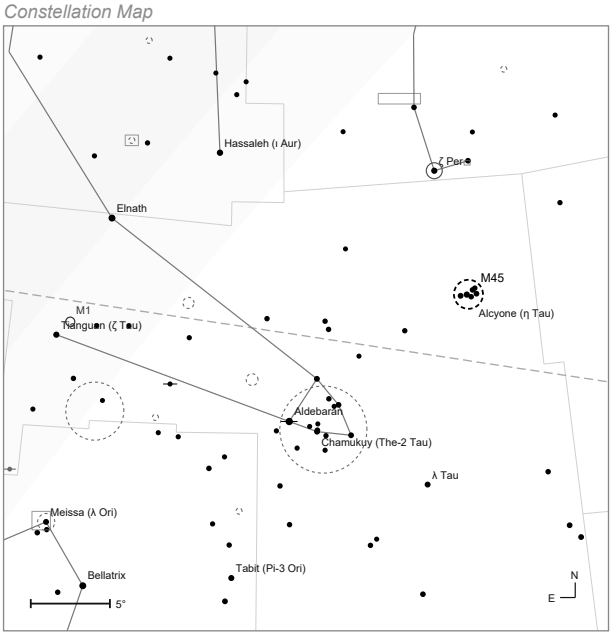
## AT THE EYEPIECE

The Pleiades are best seen with naked eyes or binoculars — at 1.8° across, they overflow most eyepiece fields. A 10″ Dobson at minimum magnification (a 32 mm Plössl gives a 1.5° field) frames the bright members nicely. Six or seven stars are easy by naked eye from Bortle 4; the cluster contains around a thousand. Long exposures reveal the famous blue reflection nebulosity, but visually you'll see only a hint around Merope on the steadiest nights with averted vision.

## WHY IT MATTERS

The Pleiades formed together about 100 million years ago and remain bound by their mutual gravity — making M45 one of the closest and most-studied open clusters. Its main-sequence stars provide a clean snapshot of stellar youth: hot blue B-type giants, no red giants yet, no white dwarfs. Distance measurements to M45 have historically anchored the cosmic distance ladder; the precise figure (~444 light-years) was a famous controversy resolved only by Gaia in the 2010s.

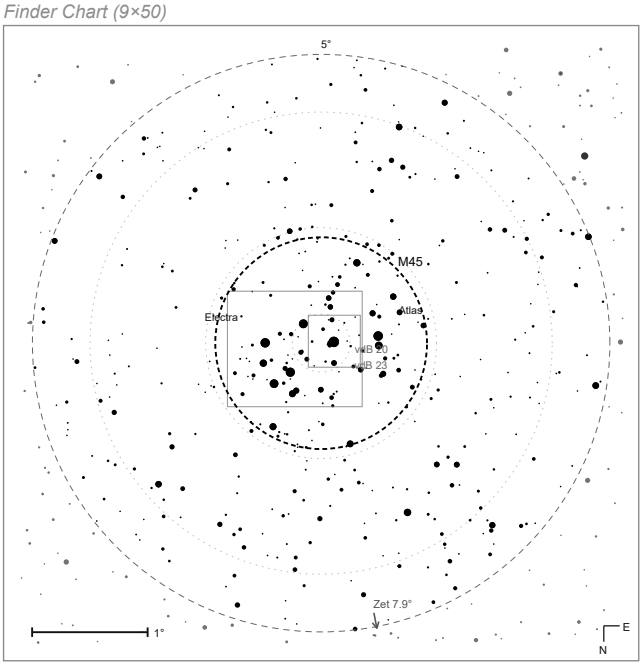
*Constellation Map*




*Naked-eye view · mag 5 · field 38°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

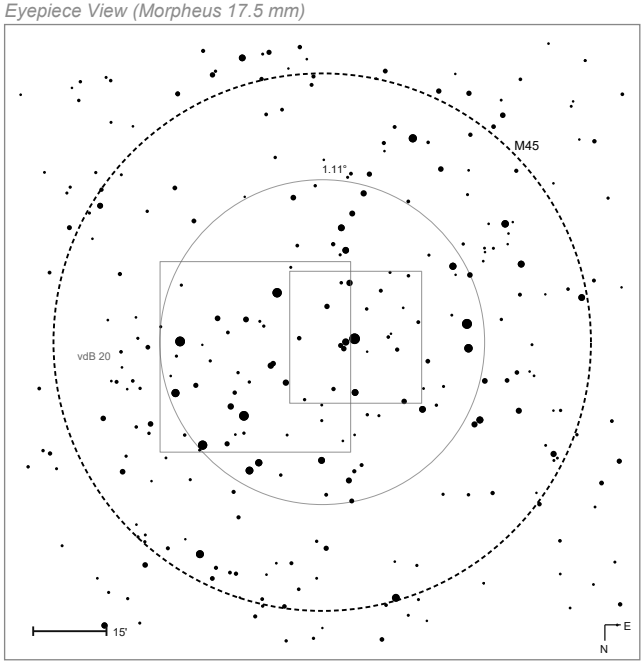
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

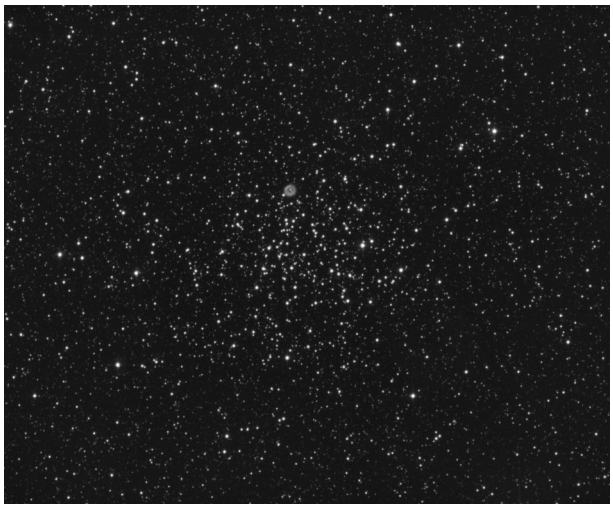



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.4 · outside the ring at 40 % opacity*

mag ● 6 ● 8 ● 10 · 12

# M46





*M46 is the cluster; the small ring near its northern edge is the planetary nebula NGC 2438.*

| | |
|---|---|
| *MESSIER* | 46 |
| *NGC* | 2437 |
| *OBJECT TYPE* | Open Cluster |
| *CONSTELLATION* | Puppis |
| *DISTANCE* | 5,000 ly |
| *APPARENT MAG.* | +6.1 |
| *RA (J2000)* | 07h 41m 48s |
| *DEC (J2000)* | −14° 49′ |
| *APPARENT SIZE* | 20.0′ |
| *RADIUS (LY)* | 15 |
| *AGE (YEARS)* | 250 million |

## DISCOVERY & HISTORY

Charles Messier discovered M46 on 19 February 1771 and described "a cluster of very small stars between the head of Canis Major and the hind legs of Monoceros… the cluster contains a little nebulosity." He fixed its position from 2 Puppis and, as with several of his entries, recorded the coordinates wrongly — the cluster counted as a lost Messier object until T. F. Morris sorted it out in 1959. Dreyer called it "very bright, very rich, very large". It lies about 5,000 light-years away, holds some 500 stars and is roughly 250 million years old.

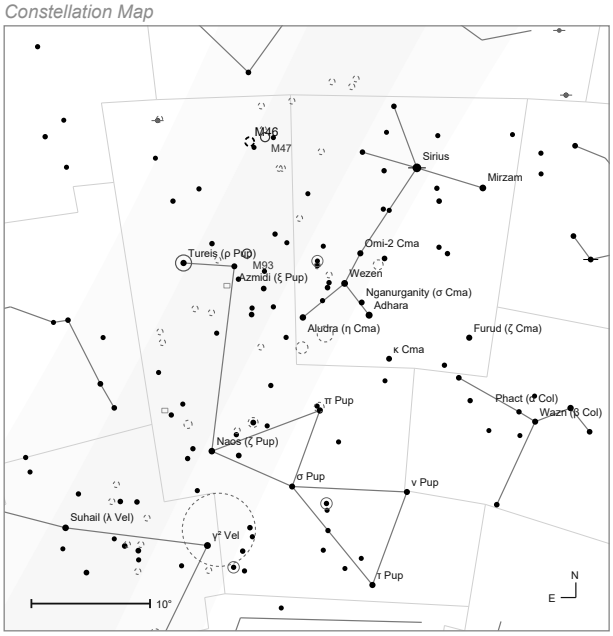
## AT THE EYEPIECE

M46 sits in a blank part of northern Puppis, 1.3° east of M47 — find M47 first, or use the 6th-magnitude double 2 Puppis. From 50°N it culminates at 25°. Binoculars show a soft glow with a few stars; from 150–200 mm it resolves into 150 or more stars of 10th to 13th magnitude across 20′, noticeably fainter and denser than M47. Its great attraction sits on the northern edge: the planetary nebula NGC 2438, a small grey ring that needs an OIII filter and about 200× to show its hole. Both clusters fit one binocular field.

## WHY IT MATTERS

NGC 2438 looks embedded in M46 but does not share the cluster's radial velocity, so it is almost certainly a foreground object — a well-known superposition, comparable to NGC 2818. The illuminating star of the bipolar Calabash Nebula, by contrast, matches M46 in distance, radial velocity and proper motion and is a genuine member. The cluster is also more extended in infrared than in visible light, evidence of mass segregation, with fainter red stars migrating outward into a tail that may be tidal.

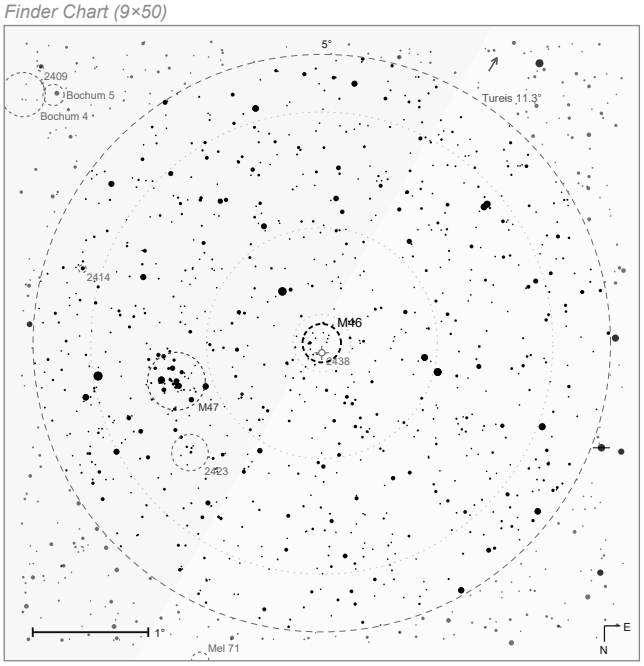
*Constellation Map*




*Naked-eye view · mag 5 · field 51°*

mag ● 1 ● 3 ● 5 ● 7

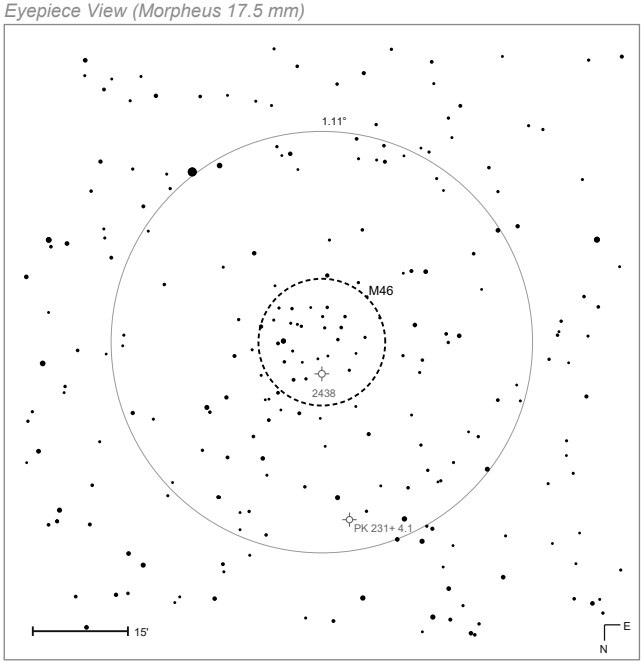
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

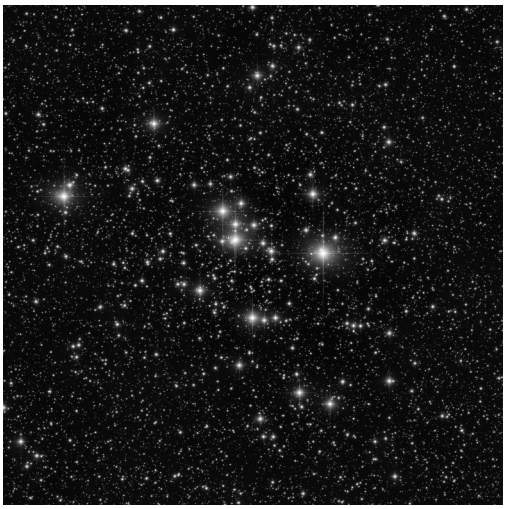



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11*

mag ● 6 ● 8 ● 10 · 12

# M47





| | |
|---|---|
| MESSIER | 47 |
| NGC | 2422 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Puppis |
| DISTANCE | 1,600 ly |
| APPARENT MAG. | +4.4 |
| RA (J2000) | 07h 36m 36s |
| DEC (J2000) | −14° 29′ |
| APPARENT SIZE | 25.0′ |
| RADIUS (LY) | 6 |
| AGE (YEARS) | 78 million |

## DISCOVERY & HISTORY

Giovanni Battista Hodierna found M47 before 1654, though his record only surfaced in 1984; Charles Messier rediscovered it on 19 February 1771, and Caroline Herschel independently after that. Messier wrote the position relative to 2 Puppis with the wrong signs, so there is no cluster where he said — M47 counted as a lost Messier object until T. F. Morris swapped the signs in 1959 and matched it to NGC 2422. It had meanwhile been catalogued twice, also as NGC 2478. It lies about 1,600 light-years away and is roughly 78 million years old.

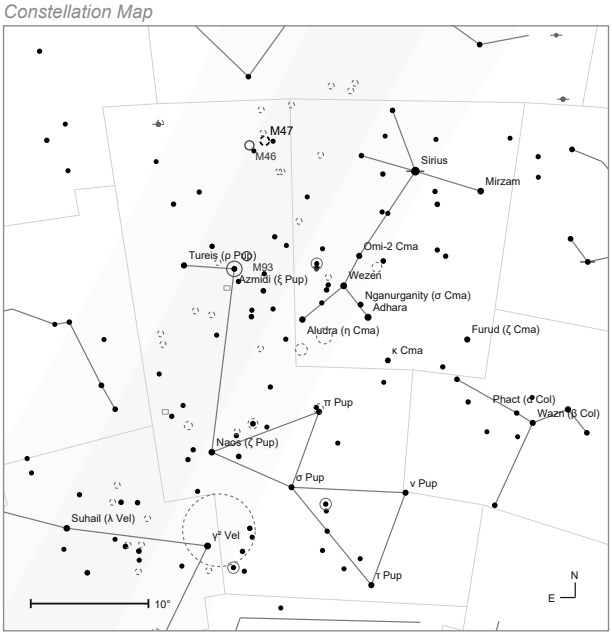
## AT THE EYEPIECE

M47 lies about 1.3° west of M46 and is the brighter, coarser of the two; at magnitude 4.4 and 25′ across it is a naked-eye object under good conditions, though from 50°N it only reaches 26°. Binoculars resolve both clusters at once — one of the finest wide-field pairings in the sky, the loose bright M47 beside the dense faint M46. In a 10″ Dobsonian at low power M47 shows a few dozen hot blue-white stars including the double Struve 1121, with noticeable colour contrast from its red giants. NGC 2423 lies half a degree north.

## WHY IT MATTERS

M47 is dominated by hot class B main-sequence and giant stars, its brightest being HD 60855, a 5.7-magnitude Be star; members have been measured all the way down to red dwarfs at 19th magnitude, giving a mass function that spans nearly the full stellar range in one cluster. Its real value in this book, though, is comparative: M46 and M47 sit a degree apart yet differ by a factor of three in both distance and age, so the eye can weigh the effects of both in a single glance.

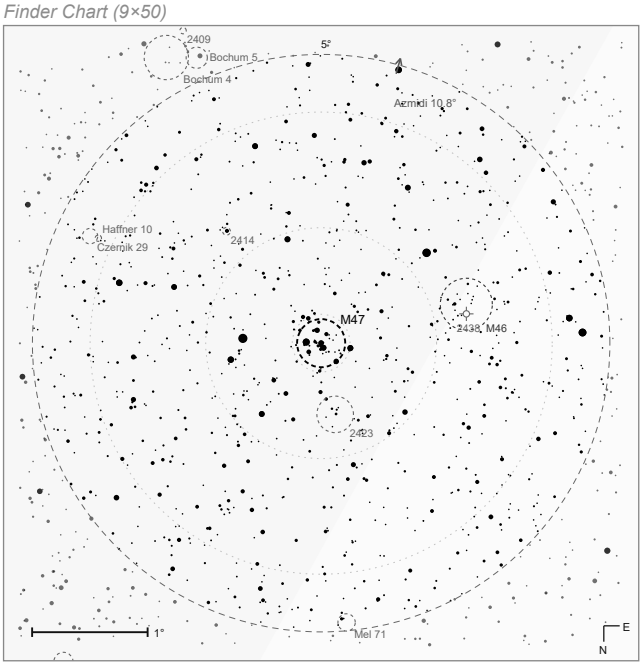
*Constellation Map*




*Naked-eye view · mag 5 · field 51°*

mag ● 1 ● 3 ● 5 ● 7

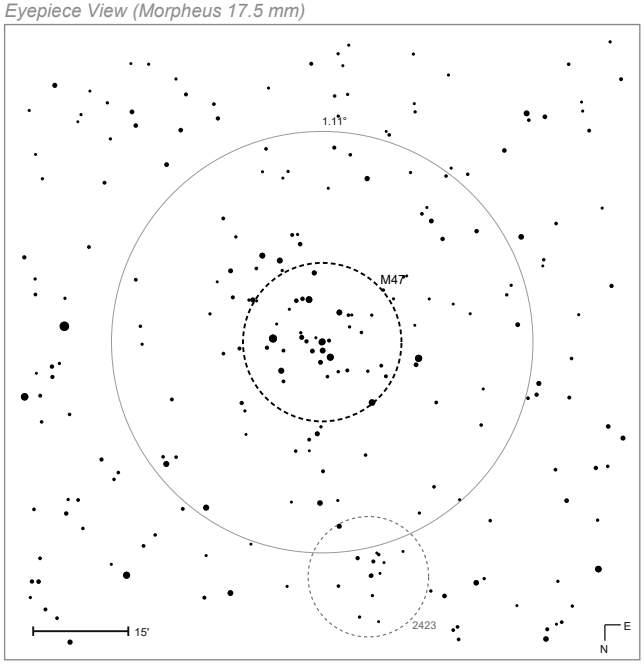
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

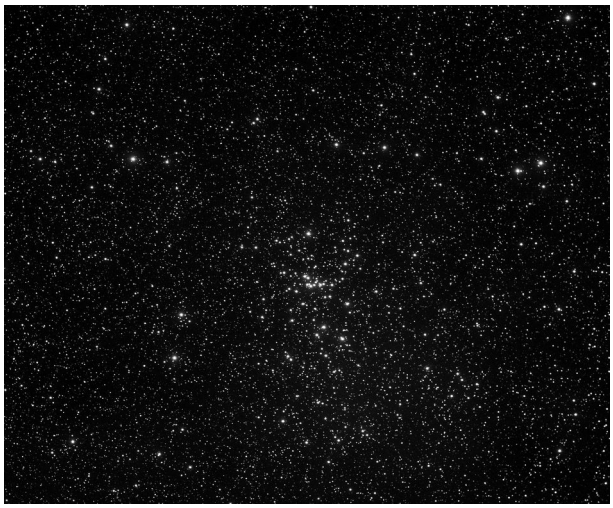



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 10.9*

mag ● 6 ● 8 ● 10 · 12

# M48

OPEN CLUSTER



| | |
|---|---|
| MESSIER | 48 |
| NGC | 2548 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Hydra |
| DISTANCE | 2,500 ly |
| APPARENT MAG. | +5.8 |
| RA (J2000) | 08h 13m 42s |
| DEC (J2000) | −05° 45′ |
| APPARENT SIZE | 30.0′ |
| RADIUS (LY) | 11 |
| AGE (YEARS) | 450 million |

## DISCOVERY & HISTORY

Charles Messier found M48 on 19 February 1771 — the same night as M46 and M47 — and made the same kind of error: his right ascension is right but his declination is five degrees off, so nothing lies where he indicated. The cluster stayed a lost Messier object until T. F. Morris identified it with NGC 2548 in 1959. Credit is sometimes given instead to Caroline Herschel in 1783. Her nephew John described "a superb cluster which fills the whole field; stars of 9th and 10th to the 13th magnitude — and none below". It lies some 1,500–2,500 light-years away.

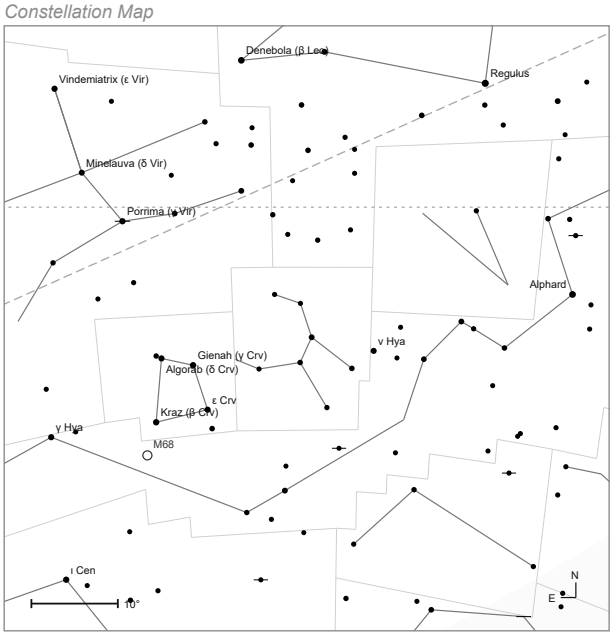
## AT THE EYEPIECE

M48 sits in a bare stretch of Hydra near the Monoceros border, about 14° south-east of Procyon and 3.5° south-west of the conspicuous trio anchored by C Hydrae; from 50°N it culminates at 34°. Under good conditions it is a faint naked-eye disc. A small telescope shows about fifty stars; a 10″ Dobsonian at low power resolves well over a hundred across 30′ — so large it barely fits a medium-power field, which is exactly the impression John Herschel recorded. The background is dusted with much fainter points.

## WHY IT MATTERS

M48's age is unusually well constrained because two independent methods agree: isochrone fitting gives 400 ± 100 million years and gyrochronology — dating from stellar rotation rates — gives 450 ± 50 million. That places it between the Pleiades and the Hyades, and its metallicity is slightly lower than any of the three nearby benchmark clusters. With at least 438 members and a tidal radius of 63 light-years, it is a well-populated calibrator for the middle of the cluster age sequence.

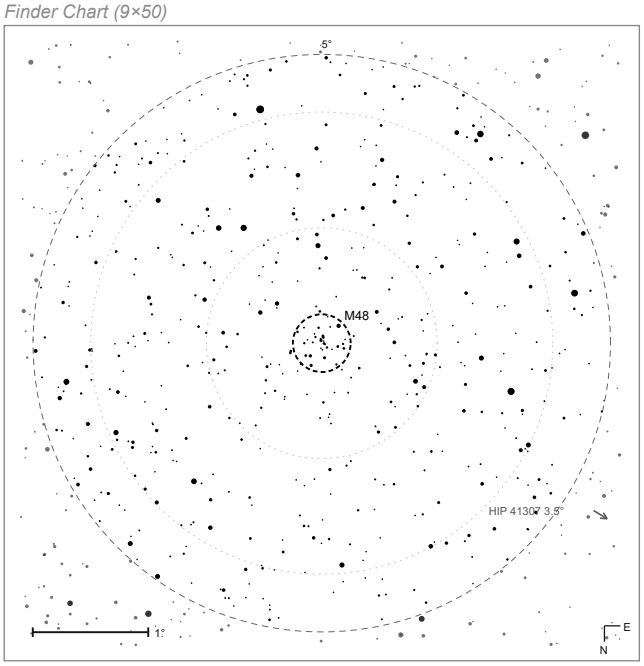
Constellation Map




Naked-eye view · mag 5 · field 7°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

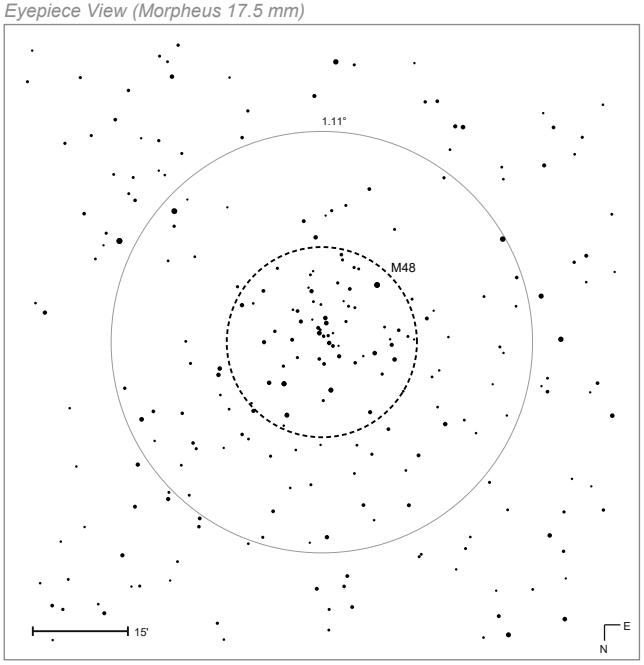
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

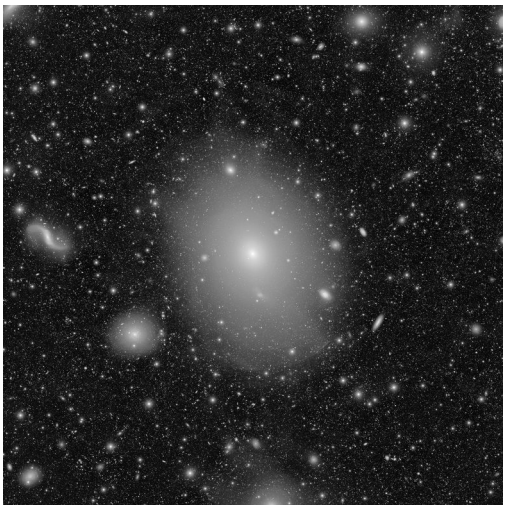



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.6

mag ● 6 ● 8 ● 10 · 12

# M49





*M49 is the big elliptical at centre; the smaller smudges around it are other Virgo Cluster galaxies.*

| | |
|---|---|
| MESSIER | 49 |
| NGC | 4472 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Virgo |
| DISTANCE | 56 Mly |
| APPARENT MAG. | +8.4 |
| RA (J2000) | 12h 29m 48s |
| DEC (J2000) | +08° 00′ |
| APPARENT SIZE | 10.2′ × 8.3′ |
| RADIUS (LY) | 83,100 |

## DISCOVERY & HISTORY

Charles Messier first saw this galaxy on 19 February 1771, describing it as a cloud hard to observe, and catalogued it in 1777. It was the first member of the Virgo Cluster to be discovered — a full century before anyone understood what a cluster of galaxies was. M49 lies about 52–56 million light-years away and is the most luminous galaxy in Virgo, brighter even than M87, and more luminous than any galaxy closer to Earth. It anchors the Virgo B subcluster, 4.5° from the cluster's dynamical centre.

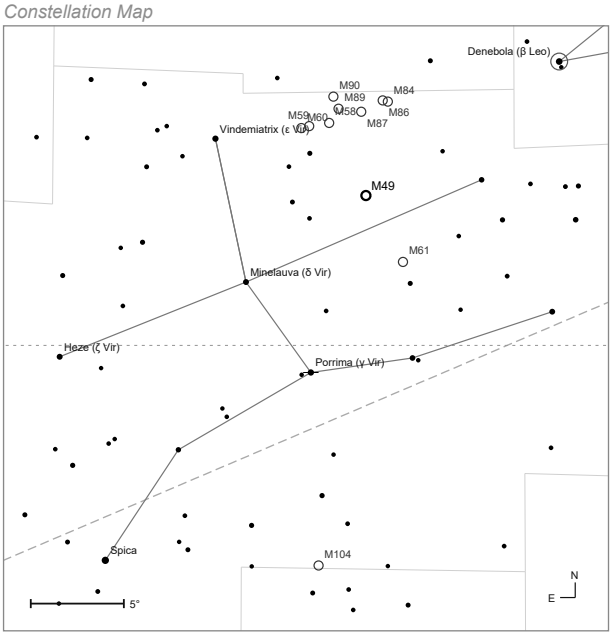
## AT THE EYEPIECE

M49 is one of the more prominent galaxies in Virgo and, under good conditions, reachable with 10×50 binoculars; from 50°N it culminates at 48°, best from March to July. A 60 mm telescope shows a bright round patch that stubbornly refuses to change with magnification. In a 10″ Dobsonian under Bortle 4 skies you get a 4′ halo fading gradually into the background with a distinctly brighter bulge and a star-like nucleus at its centre. Several faint NGC galaxies share the field — NGC 4467 at 4.2′, NGC 4465 at 5.8′, NGC 4470 at 10.5′.

## WHY IT MATTERS

M49 has the physical form of a radio galaxy but only the radio output of a normal one, and its nucleus emits X-rays consistent with a supermassive black hole of some 565 million solar masses. X-ray imaging shows a bow-shock-like structure to the north, the signature of the galaxy ploughing through the cluster's hot intergalactic gas. It hosts roughly 5,900 globular clusters — against about 150 for the Milky Way, though far short of M87's 13,450 — and strong evidence for stellar-mass black holes has been found inside two of them.

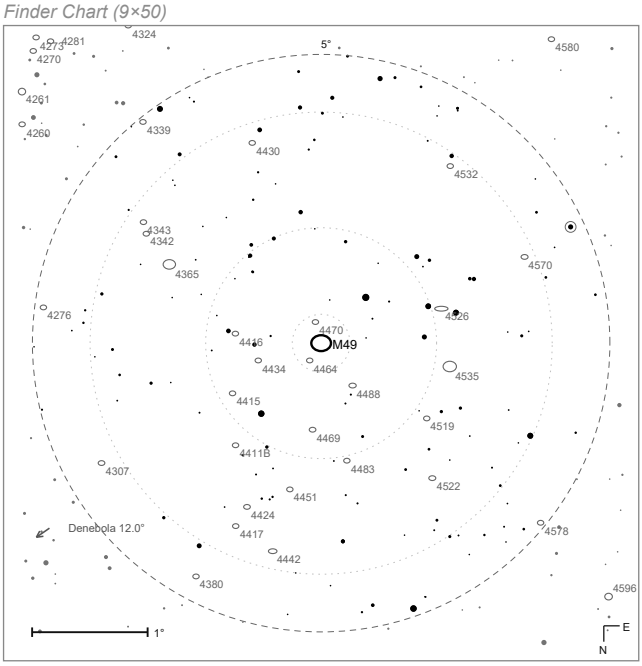
*Constellation Map*




*Naked-eye view · mag 6 · field 32°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

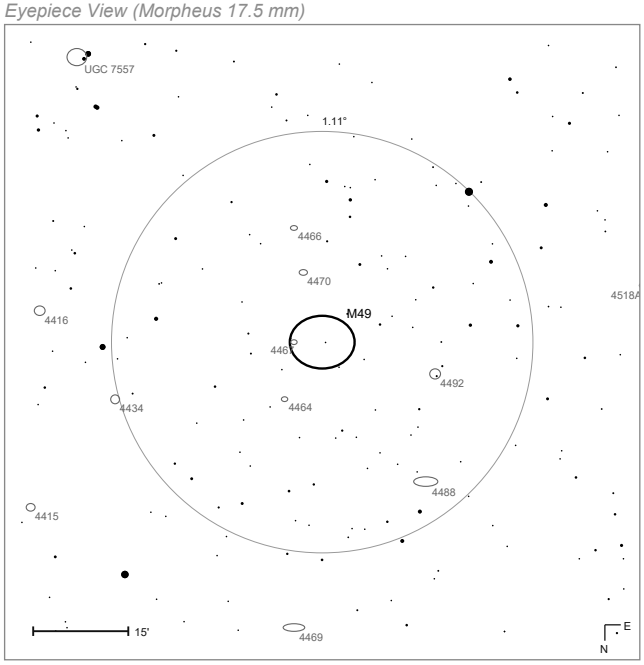
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M50

OPEN CLUSTER

| | |
|---|---|
| MESSIER | 50 |
| NGC | 2323 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Monoceros |
| DISTANCE | 2,870 ly |
| APPARENT MAG. | +5.9 |
| RA (J2000) | 07h 02m 30s |
| DEC (J2000) | −08° 23′ |
| APPARENT SIZE | 15.0′ |
| RADIUS (LY) | 6 |
| AGE (YEARS) | 160 million |

## DISCOVERY & HISTORY

G. D. Giovanni Domenico Cassini recorded M50 before 1711, and Hodierna may have seen it around 1654; Charles Messier found it independently on 5 April 1772 while following Biela's Comet and logged it as a cluster of small stars. Observers have described its outline as heart-shaped or as a blunt arrowhead. It lies about 2,900–3,100 light-years away, spans nearly 18 light-years, and is roughly 140 million years old. Membership studies count 508 confirmed and 109 probable members.

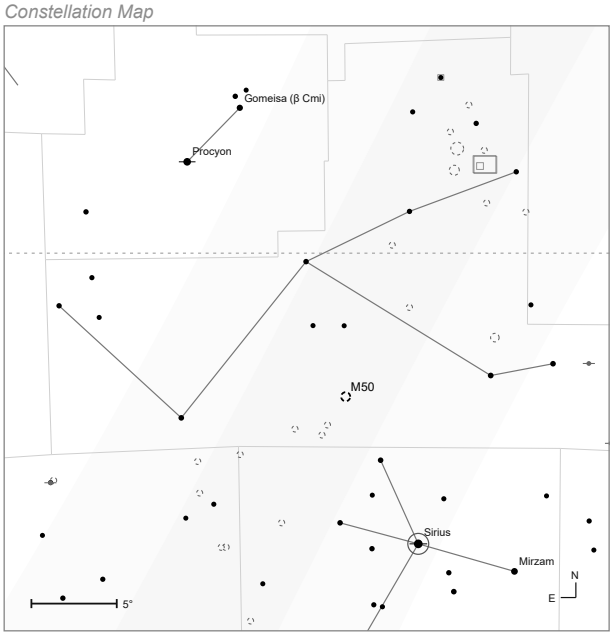
## AT THE EYEPIECE

M50 sits in a field without bright stars, about 7° north of Muliphein (γ CMa) or a third of the way from Sirius toward Procyon; from 50°N it culminates at 32°, best from December to April. A 50 mm binocular picks out up to 15 stars on a still-hazy background. A 90–150 mm telescope resolves it fully — about 50 stars concentrated in 10′, with the brighter ones lying toward the edge, which is what produces the heart-shaped impression. A 10″ Dobsonian pushes the count past 80 and shows several pairs among them.

## WHY IT MATTERS

M50 was treated as a single cluster for three centuries, but in 2025 it was found to consist of two distinct sub-clusters, NGC 2323-a and NGC 2323-b — making it a binary cluster, and a reminder that even bright, well-observed objects can hide their structure until precise astrometry arrives. It lies close to the Canis Major OB1 association without being gravitationally bound to it. Its population includes two high-mass white dwarfs and two chemically peculiar stars, at a mean density of 1.3 stars per cubic parsec.

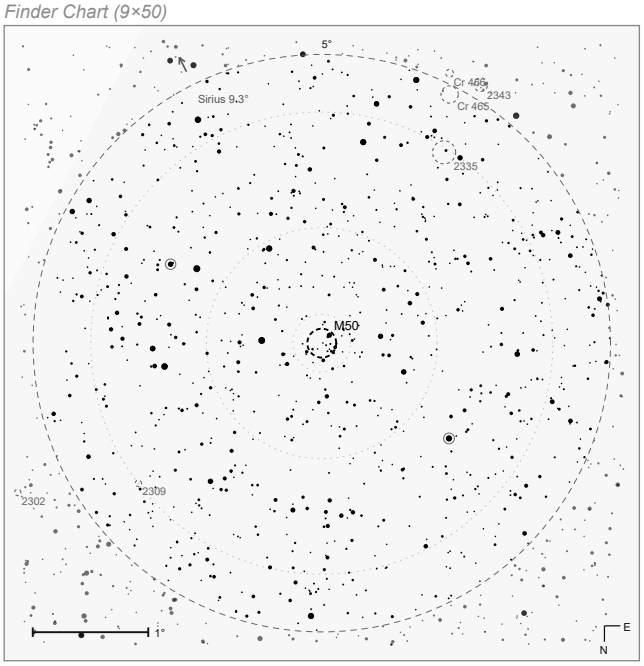
*Constellation Map*




*Naked-eye view · mag 5 · field 35°*

mag ● 1 ● 3 ● 5 ● 7 – – celestial equator

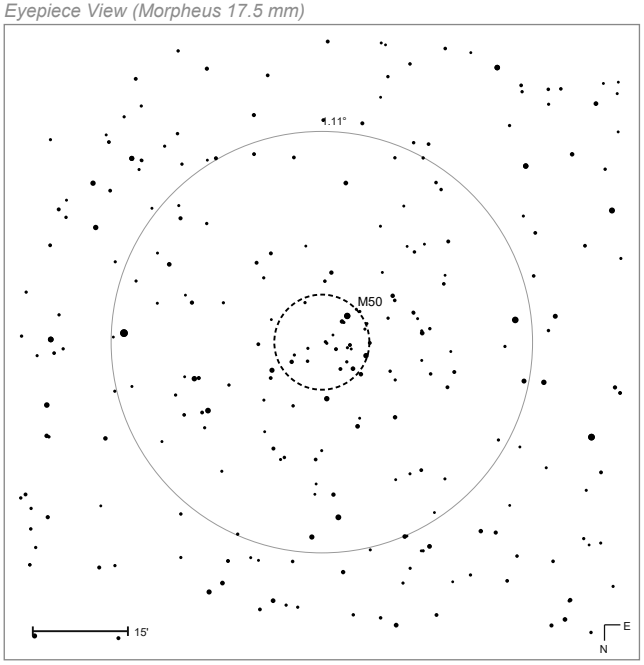
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11*

mag ● 6 ● 8 ● 10 · 12

# M51 Whirlpool Galaxy

*M51 is the large spiral; the smaller companion at the end of its arm is NGC 5195.*

| | |
|---|---|
| MESSIER | 51 |
| NGC | 5194 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Canes Venatici |
| DISTANCE | 23.5 Mly |
| APPARENT MAG. | +8.4 |
| RA (J2000) | 13h 29m 54s |
| DEC (J2000) | +47° 12′ |
| APPARENT SIZE | 11.2′ × 6.9′ |
| RADIUS (LY) | 38,300 |

## DISCOVERY & HISTORY

Charles Messier discovered the Whirlpool on 13 October 1773 while cataloguing objects that might confuse comet hunters; its companion NGC 5195 was found by Pierre Méchain in 1781. In spring 1845 William Parsons, third Earl of Rosse, turned his 72-inch reflector at Birr Castle on it and saw spiral arms — the first "nebula" ever known to have them, a discovery that set the agenda for eighty years of debate about what the nebulae were. Only when Edwin Hubble measured Cepheids in such objects did they become galaxies.

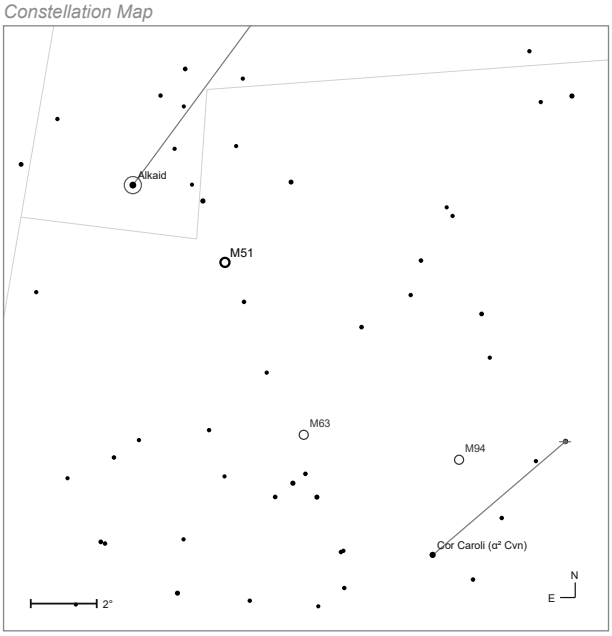
## AT THE EYEPIECE

M51 lies 3.5° south-west of Alkaid (η UMa), the tip of the Dipper's handle, and from 50°N passes almost overhead at 87°. It is bright enough to show in binoculars as an oval smudge. A small telescope gives both the halo and the companion; from 150 mm the spiral arms begin to appear, the western arm most readily. In a 10″ Dobsonian under Bortle 4 skies the two nuclei and the bridge of material between them are clear, but the full pinwheel needs a dark, moonless night and low power — high magnification hurts rather than helps.

## WHY IT MATTERS

M51 is the textbook grand-design spiral, seen almost exactly face-on at about 28 million light-years, with a Seyfert 2 active nucleus. Its pairing with the dwarf NGC 5195 is one of the closest and most famous interacting systems known, and the standard laboratory for testing how tidal encounters drive spiral structure: the companion's passage is thought to have amplified the arms into their present symmetry. Several supernovae have been recorded in it, and Halton Arp catalogued it as a peculiar galaxy with a companion.

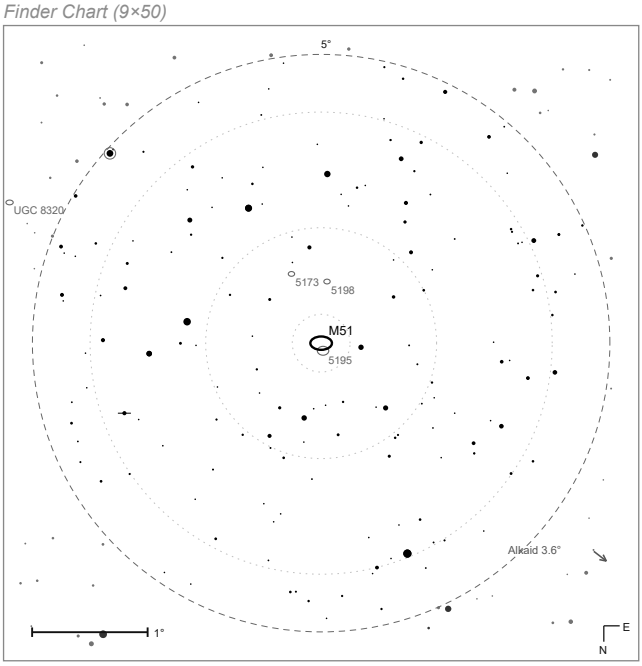
*Constellation Map*




*Naked-eye view · mag 6.5 · field 18°*

mag ● 1 ● 3 ● 5 ● 7

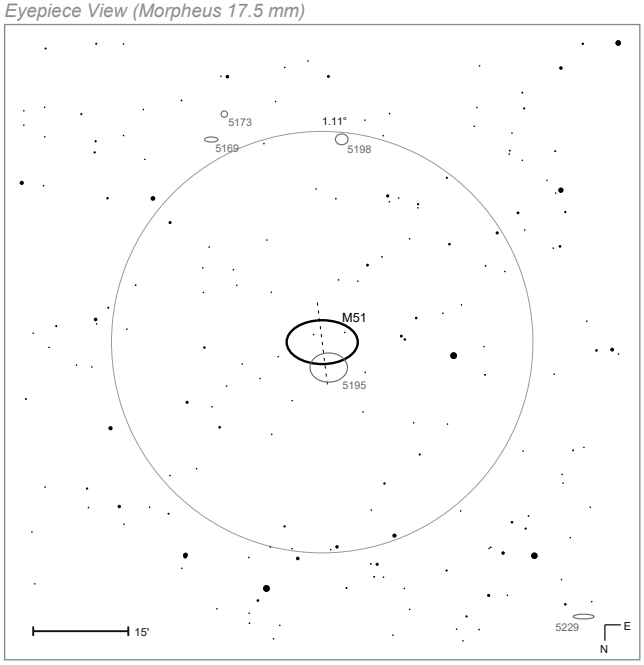
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M52

| | |
|---|---|
| MESSIER | 52 |
| NGC | 7654 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Cassiopeia |
| DISTANCE | 4,600 ly |
| APPARENT MAG. | +6.9 |
| RA (J2000) | 23h 24m 12s |
| DEC (J2000) | +61° 35′ |
| APPARENT SIZE | 16.0′ |
| RADIUS (LY) | 11 |
| AGE (YEARS) | 160 million |

## DISCOVERY & HISTORY

Charles Messier discovered M52 in 1774 and reported nebulosity in it; there is none — the impression comes from unresolved faint members. Trumpler first classified it as II2r, a rich cluster with little central concentration, later revised to I2r once its dense core was recognised. It is sometimes called the Scorpion Cluster. Distance estimates are poor, ranging from 3,000 to 7,000 light-years, because dust reddens it unevenly — extinction is stronger across the southern half. Its age is put at 35 to 158 million years and its mass near 1,200 Suns.

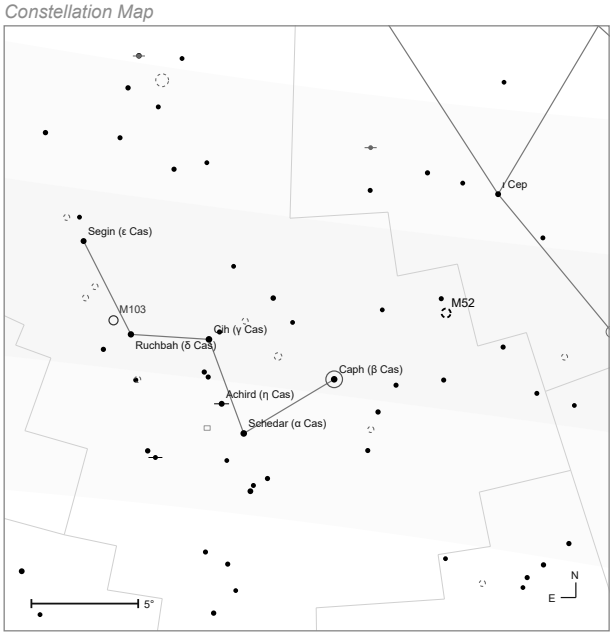
## AT THE EYEPIECE

M52 lies on the western edge of Cassiopeia near the Cepheus border: extend the line from Schedar (α Cas) through Caph (β Cas) by the same distance again. From 50°N it is circumpolar and passes through the zenith. Under a Bortle 1–2 sky it is a naked-eye object. Binoculars show only its brightest members, dominated by a yellowish 8.3-magnitude star on the western edge. A 150 mm telescope gives about 50 faint close-set stars; a 10″ Dobsonian adds well over a hundred more across 16′. The Bubble Nebula NGC 7635 lies 35′ south-west.

## WHY IT MATTERS

M52's core is notably empty of interstellar matter, which may have been swept out by supernovae early in the cluster's history — a directly observable consequence of massive stars ending their lives inside a young cluster. Its variable population is rich: eighteen candidate slowly pulsating B stars, one Delta Scuti variable, three candidate Gamma Doradus variables and possibly three Be stars, plus the probable member BD +60°2532, a supergiant of magnitude 8.3. Its metallicity sits marginally below solar.

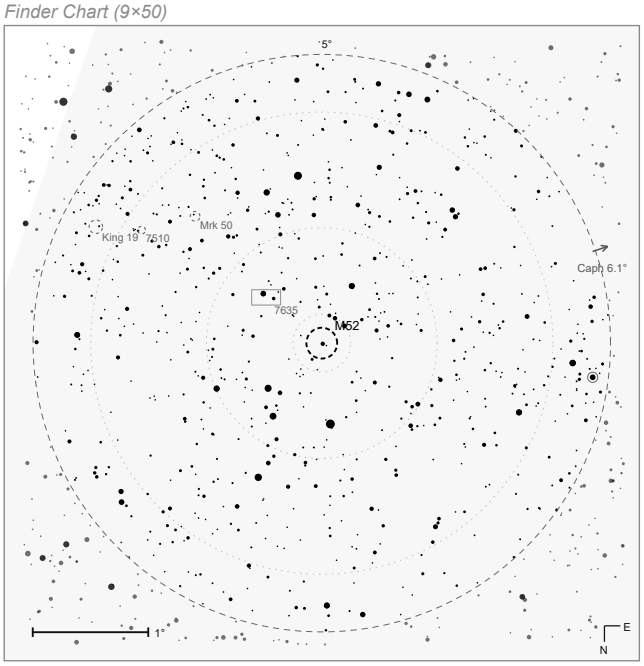
*Constellation Map*




*Naked-eye view · mag 5.5 · field 28°*

mag ● 1 ● 3 ● 5 ● 7

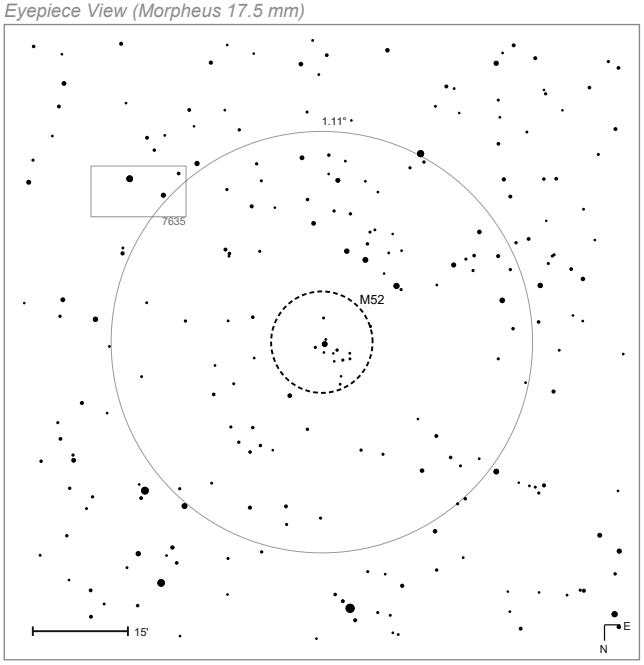
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.3*

mag ● 6 ● 8 ● 10 · 12

# M53

| | |
|---|---|
| MESSIER | 53 |
| NGC | 5024 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Coma Berenices |
| DISTANCE | 58 kly |
| APPARENT MAG. | +7.7 |
| RA (J2000) | 13h 12m 54s |
| DEC (J2000) | +18° 10′ |
| APPARENT SIZE | 13.0′ |
| RADIUS (LY) | 110 |
| AGE (YEARS) | 12.7 billion |

## DISCOVERY & HISTORY

Johann Elert Bode found M53 on 3 February 1775, describing "a new nebula 1° east of 41 Comae, round and very bright in the telescope"; Charles Messier observed it independently in 1777. It lies about 58,000 light-years from the Sun and some 60,000 from the galactic centre, spanning roughly 220 light-years. Long considered one of the most metal-poor clusters in the Milky Way, its stellar composition closely matches that of the galactic halo generally.

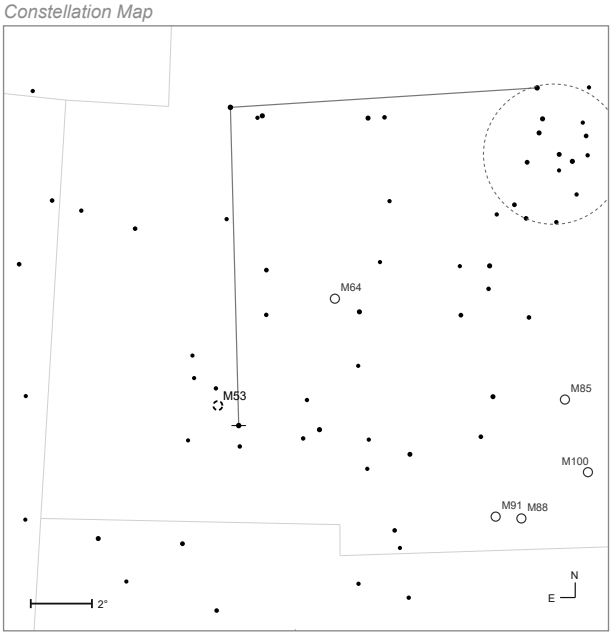
## AT THE EYEPIECE

M53 could hardly be easier to find: it sits 1° north-east of the double star Diadem (α Comae Berenices). From 50°N it culminates at 58°, best from February to August. It is beyond naked-eye reach, but a binocular finds it on a clear night. A 114 mm telescope resolves a few stars, and 150 mm shows the whole halo. In a 10″ Dobsonian at 200× you can count a couple of hundred members, though the core stays soft and unresolved. Look 1° south-east for NGC 5053, a very low surface brightness globular — a hard but rewarding contrast.

## WHY IT MATTERS

Most of M53's red giant branch consists of first-generation stars, formed directly from primordial gas rather than material recycled from earlier cluster stars — the reverse of most globulars, which are dominated by second-generation members. The cluster also shows tidal clumps, ripples and tails, and what looks like a tidal bridge and common envelope connecting it to NGC 5053: possibly a unique case of two globular clusters interacting inside the Milky Way. M53 is additionally a candidate member of the Sagittarius dwarf tidal stream, and contains 55 RR Lyrae variables.

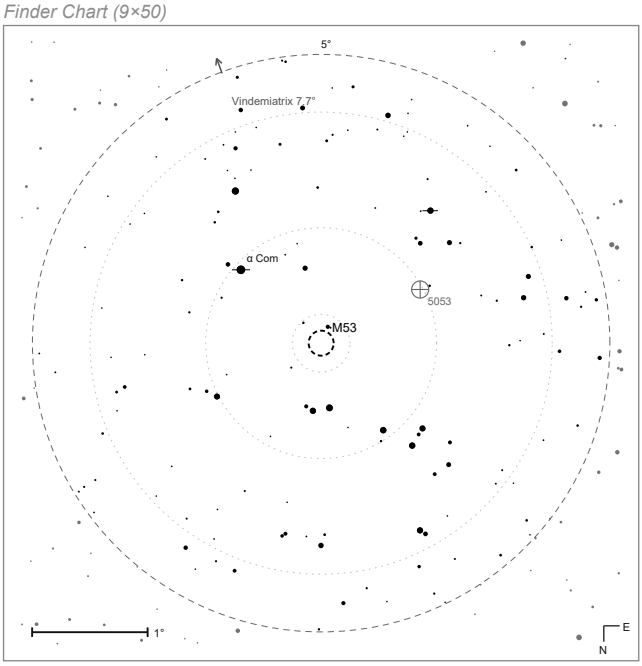
*Constellation Map*




*Naked-eye view · mag 6.5 · field 2°*

mag ● 1 ● 3 ● 5 ● 7

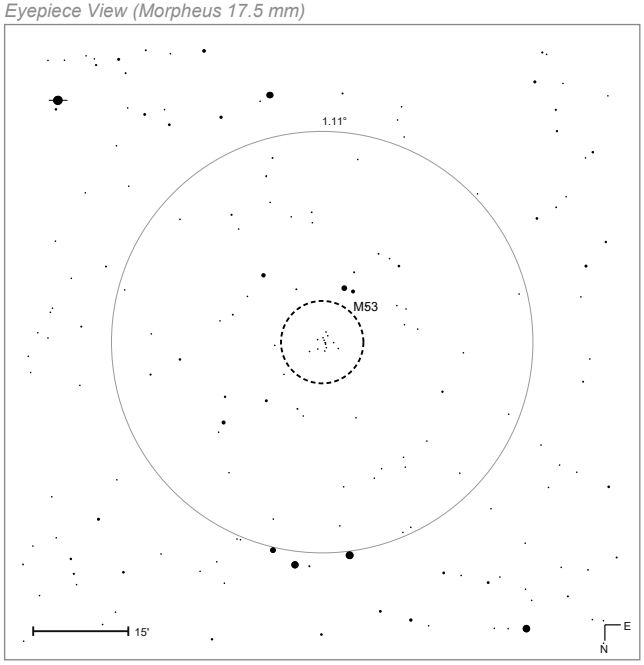
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M54

GLOBULAR CLUSTER

| | |
|---|---|
| MESSIER | 54 |
| NGC | 6715 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Sagittarius |
| DISTANCE | 86 kly |
| APPARENT MAG. | +7.7 |
| RA (J2000) | 18h 55m 06s |
| DEC (J2000) | −30° 29′ |
| APPARENT SIZE | 12.0′ |
| RADIUS (LY) | 150 |
| AGE (YEARS) | 13 billion |

## DISCOVERY & HISTORY

Charles Messier discovered M54 on 24 July 1778 and described a very bright nebula with a bright core containing no stars. For two centuries it was taken to be an ordinary Milky Way globular about 50,000 light-years away. Then in 1994 it turned out to lie inside the Sagittarius Dwarf Elliptical Galaxy — the first globular cluster ever reassigned from our galaxy to another one. Modern estimates put it around 80,000–86,000 light-years away, shining with the luminosity of about 850,000 Suns.

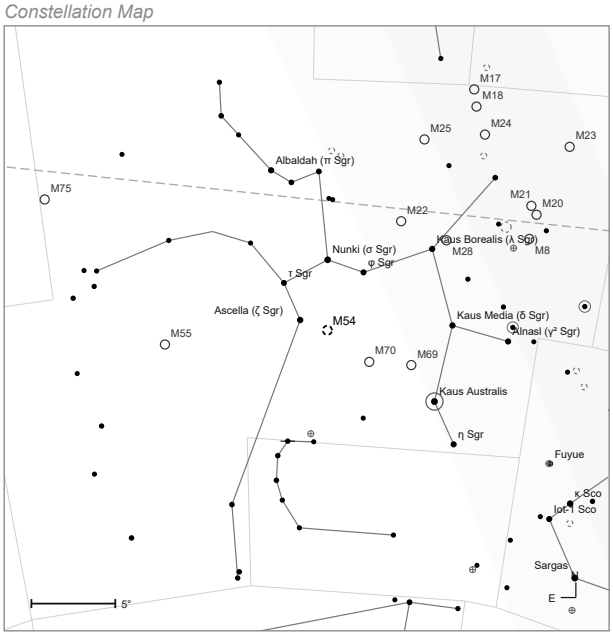
## AT THE EYEPIECE

M54 lies just under 2° south-west of Ascella (ζ Sgr), which makes it easy to locate and almost impossible to see well from central Europe: at 50°N it culminates at barely 10°. It is difficult even in 10×50 binoculars and only under the best conditions. Because it is so distant, a 10″ Dobsonian shows a bright, sharply concentrated round glow that refuses to resolve — its brightest stars are 15th magnitude, and 250–300 mm with steady air is the realistic threshold for grain. M70 lies 3° south-west, M22 8° north-west.

## WHY IT MATTERS

M54 sits at the centre of the Sagittarius dwarf galaxy, and opinion divides on what that means: it may be the dwarf's own nucleus, or a true globular cluster that spiralled into the centre as dynamical friction decayed its orbit. Either way it is our closest laboratory for watching a satellite galaxy being digested by the Milky Way. In July 2009 a team reported evidence of an intermediate-mass black hole in its core — one of the better cases for that elusive class of object.

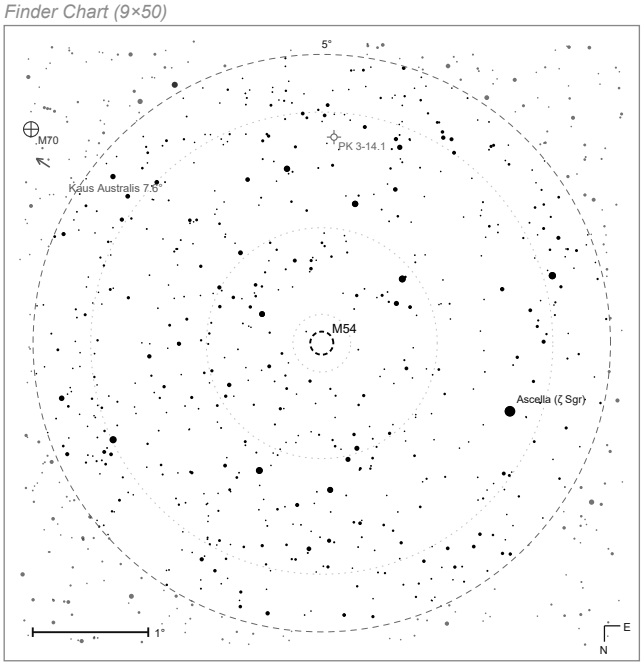
Constellation Map




Naked-eye view · mag 5 · field 36°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

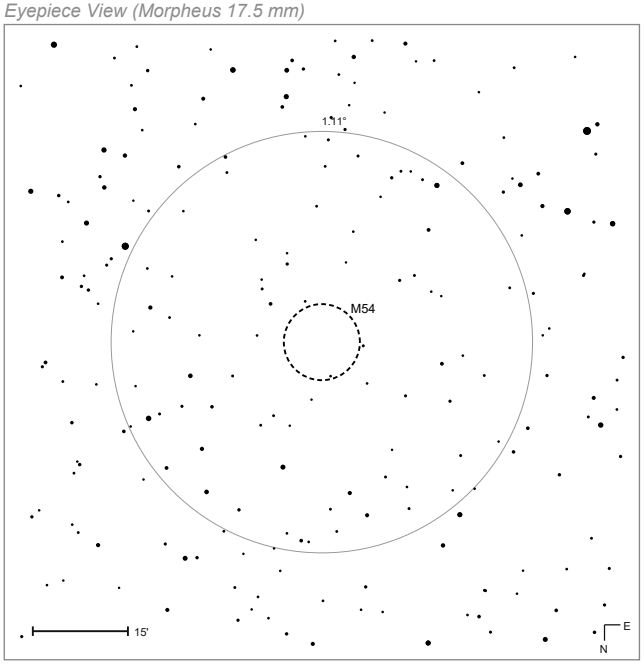
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

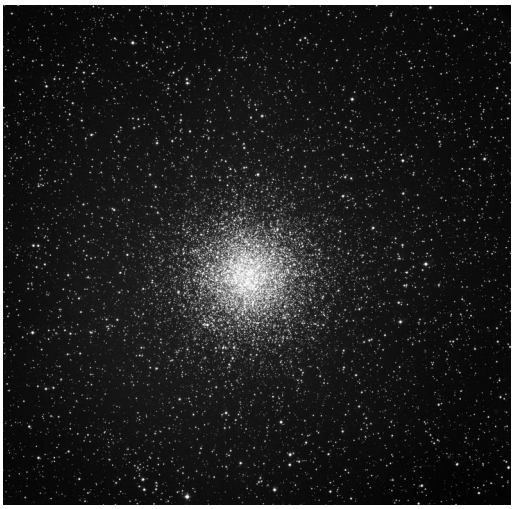



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.4

mag ● 6 ● 8 ● 10 · 12

# M55

GLOBULAR CLUSTER



| | |
|---|---|
| MESSIER | 55 |
| NGC | 6809 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Sagittarius |
| DISTANCE | 17.6 kly |
| APPARENT MAG. | +6.3 |
| RA (J2000) | 19h 40m 00s |
| DEC (J2000) | −30° 58′ |
| APPARENT SIZE | 19.0′ |
| RADIUS (LY) | 49 |
| AGE (YEARS) | 12.3 billion |

## DISCOVERY & HISTORY

Nicolas Louis de Lacaille found M55 on 16 June 1752 from the Cape of Good Hope. Charles Messier tried repeatedly from 1754 to locate it from Paris, but at that declination it barely clears the horizon there, and he only succeeded in 1778 — recording "a nebula appearing as a whitish patch… it seems to contain no stars." It lies about 17,600 light-years away and contains some 269,000 solar masses. It is sometimes called the Specter Cluster.

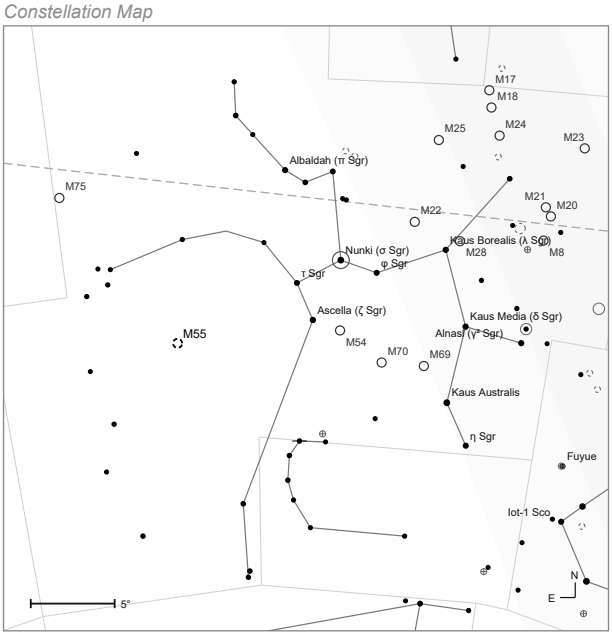
## AT THE EYEPIECE

M55 stands alone in a field without bright stars, about 8° east of Ascella (ζ Sgr); from 50°N it culminates at 9°, so Messier's difficulty is ours too. It shows in 50 mm binoculars under the very best conditions. Its stars are 15th magnitude and it is a loosely concentrated cluster, so resolving it properly asks for 300–350 mm — but that same looseness means what you do see is a broad, even 19′ glow rather than a hard core. Observers in southern Europe or further south get a genuinely fine object; from Bohemia it is a trophy.

## WHY IT MATTERS

M55 is strikingly metal-poor: its iron abundance is about 1.1% of the Sun's, placing it among the chemically most primitive objects in this catalogue and therefore among the oldest structures in the galaxy. Clusters this unenriched are direct samples of the gas from which the halo formed, before generations of supernovae had built up heavy elements. Only about 55 variable stars have been found in its central region, and its colour–magnitude diagram is a standard reference for old, metal-poor populations.

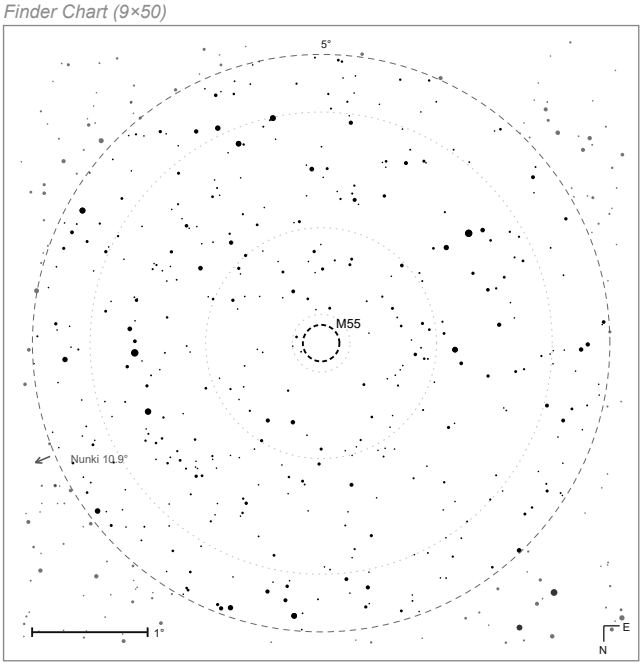
*Constellation Map*




*Naked-eye view · mag 5 · field 36°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

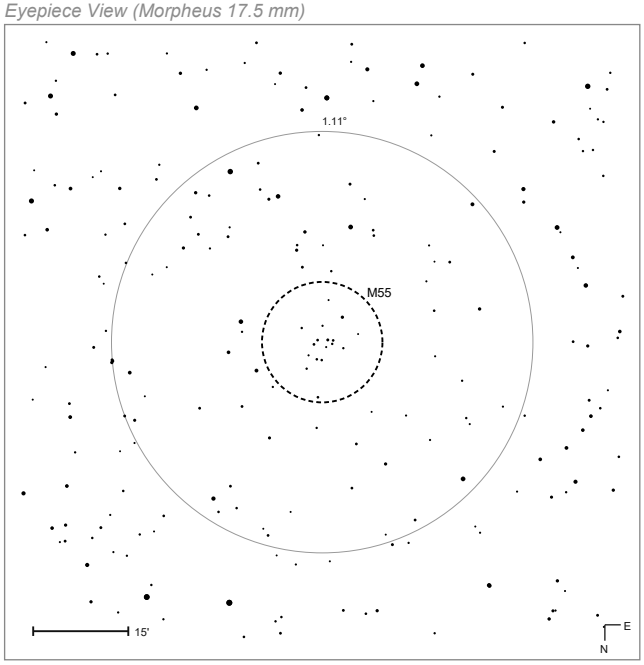
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 ● 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12*

mag ● 6 ● 8 ● 10 ● 12

# M56

| | |
|---|---|
| MESSIER | 56 |
| NGC | 6779 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Lyra |
| DISTANCE | 33 kly |
| APPARENT MAG. | +8.3 |
| RA (J2000) | 19h 16m 36s |
| DEC (J2000) | +30° 11′ |
| APPARENT SIZE | 8.8′ |
| RADIUS (LY) | 42 |
| AGE (YEARS) | 13.7 billion |

## DISCOVERY & HISTORY

Charles Messier discovered M56 on 23 January 1779 and called it "a nebula without stars, not very bright". William Herschel was the first to resolve it, observing it repeatedly with different instruments through the 1780s. The cluster lies about 31,000–33,000 light-years away, measures roughly 84 light-years across and contains 230,000 solar masses. It sits 4,800 light-years above the galactic plane, follows a retrograde orbit, and at an estimated 13.7 billion years is one of the oldest objects known.

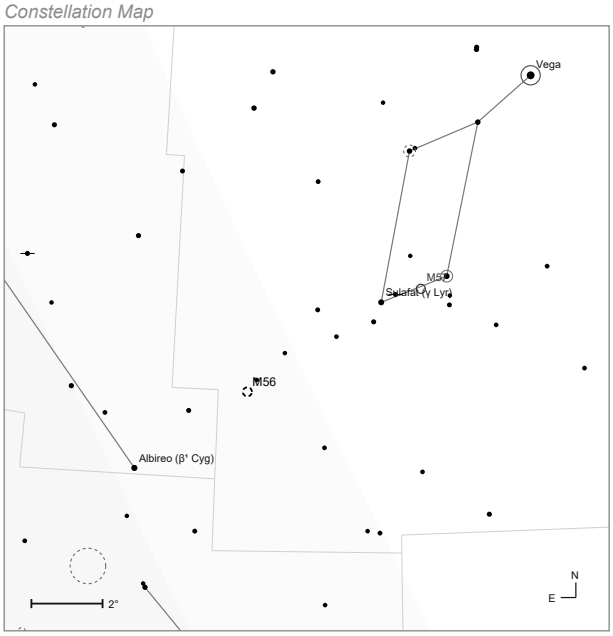
## AT THE EYEPIECE

M56 is easy to place — almost exactly midway between Albireo (β Cygni) and Sulafat (γ Lyrae) — and from 50°N it culminates at 70°, so summer nights are ideal. In 50–80 mm binoculars it is a slightly fuzzy star and genuinely tricky to pick out. A 114 mm telescope gives a round, hazy patch; 150 mm under good conditions hints at grain. A 10″ Dobsonian at high power resolves dozens of 13th-magnitude stars across 9′. The Ring Nebula (M57) lies 6° north-west, which makes for a natural pairing on one evening.

## WHY IT MATTERS

M56's retrograde orbit, extreme metal poverty — about 1% of the Sun's iron — and position well off the plane all point the same way: it was probably not born in the Milky Way but acquired in the merger of a dwarf galaxy whose surviving nucleus is Omega Centauri. It contains only about a dozen known variables, among them the RV Tauri star V6 with a 90-day period and the Cepheid V1 at 1.51 days. In 2000 a diffuse X-ray emission was tentatively detected near the cluster, most likely shocked interstellar medium.

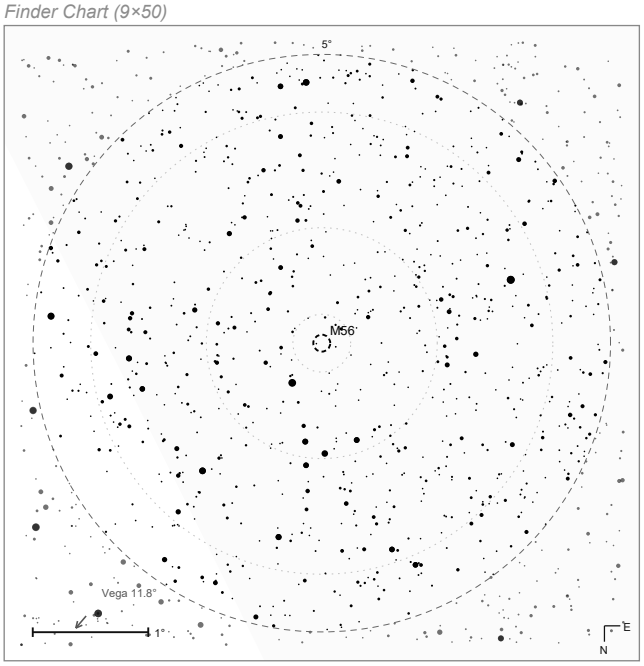
*Constellation Map*




*Naked-eye view · mag 6 · field 17°*

mag ● 1 ● 3 ● 5 ● 7

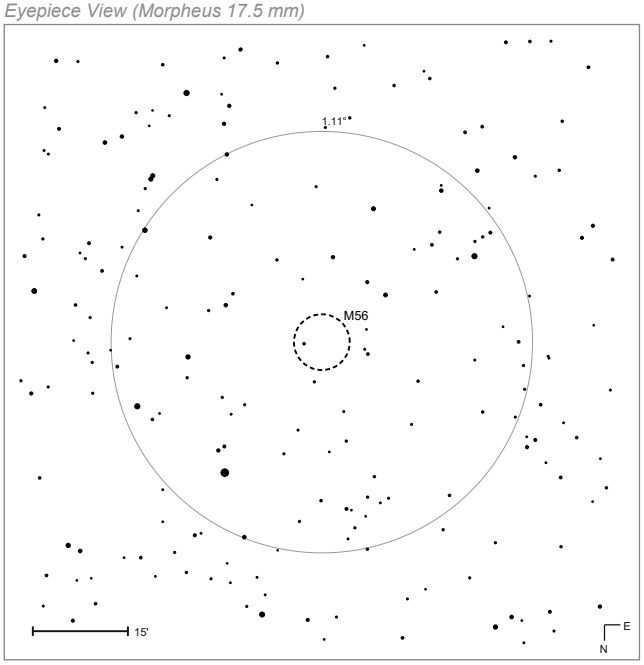
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.2*

mag ● 6 ● 8 ● 10 · 12

# M57 Ring Nebula

PLANETARY NEBULA

| | |
|---|---|
| MESSIER | 57 |
| NGC | 6720 |
| OBJECT TYPE | Planetary Nebula |
| CONSTELLATION | Lyra |
| DISTANCE | 2,570 ly |
| APPARENT MAG. | +9.4 |
| RA (J2000) | 18h 53m 36s |
| DEC (J2000) | +33° 02′ |
| APPARENT SIZE | 3.0′ × 2.4′ |
| RADIUS (LY) | 1 |

## DISCOVERY & HISTORY

Charles Messier found the Ring in late January 1779 while chasing Comet Bode. Two weeks later Antoine Darquier de Pellepoix, following the same comet on Messier's report, rediscovered it independently and wrote that it was "as large as Jupiter and resembles a planet which is fading" — a phrase that may have helped fix the misleading term "planetary nebula" in the language. The nebula is the ejected envelope of a dying star, now a carbon-oxygen white dwarf of magnitude 15.75 at about 2,570 light-years. After 1,610 years of expansion it is 4.6 light-years across.

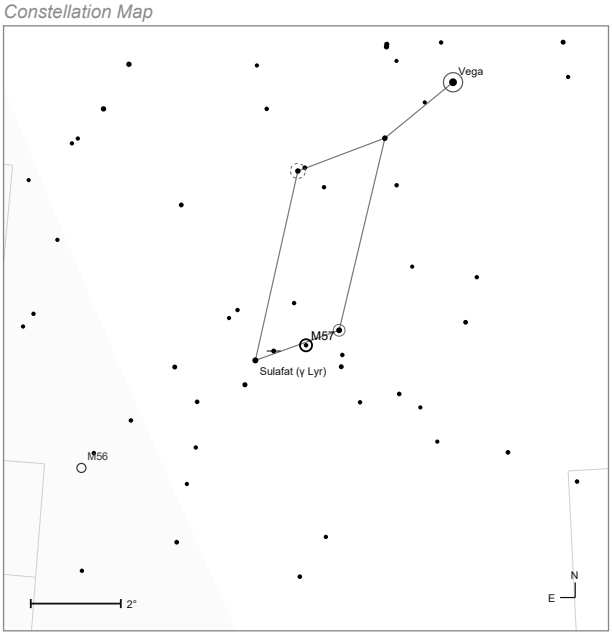
## AT THE EYEPIECE

M57 lies about 40% of the way from Sheliak (β Lyrae) toward Sulafat (γ Lyrae), south of Vega; from 50°N it culminates at 73°. In 10×50 binoculars it is only a slightly fuzzy star; 20×80 may just suggest a disc. A small telescope shows a definite small oval. From about 100 mm the ring itself appears, and in a 10″ Dobsonian under Bortle 4 skies the hole is unmistakable at 150–200×, with darker notches on the east and west rims and a faint haze filling the interior. The 15th-magnitude central star is a serious test. M56 lies 6° south-east.

## WHY IT MATTERS

The Ring looks like a ring because we happen to view it nearly pole-on down the axis of a barrel-shaped shell; seen from its equatorial plane it would look much like M27. Hubble imaging separates the temperature structure by colour, from hot blue gas near the white dwarf to cool red gas at the rim — a direct map of how a stellar envelope cools as it expands. As one of the nearest and brightest planetaries it anchors the calibration of nebular distance and age estimates.

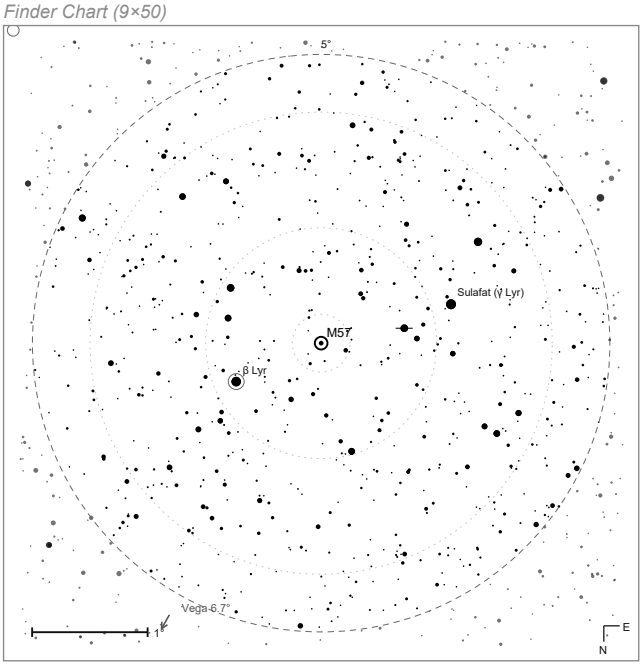
Constellation Map




Naked-eye view · mag 6.5 · field 13°

mag ● 1 ● 3 ● 5 ● 7

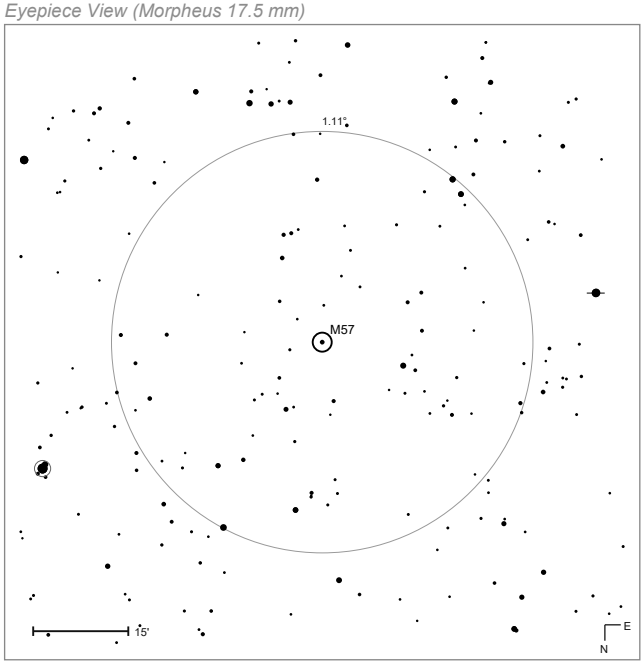
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

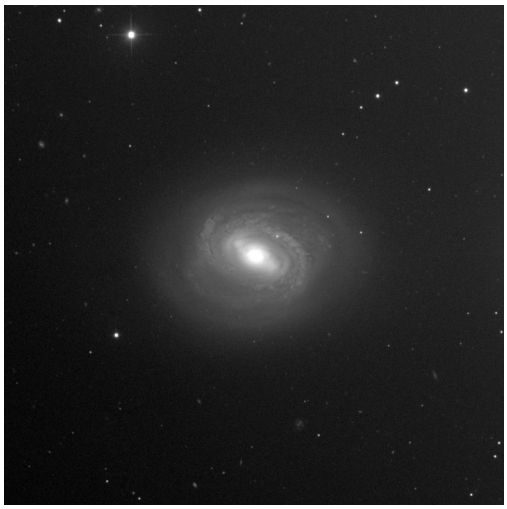



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.4

mag ● 6 ● 8 ● 10 · 12

# M58

GALAXY



| | |
|---|---|
| MESSIER | 58 |
| NGC | 4579 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Virgo |
| DISTANCE | 68 Mly |
| APPARENT MAG. | +9.7 |
| RA (J2000) | 12h 37m 42s |
| DEC (J2000) | +11° 49′ |
| APPARENT SIZE | 6.0′ × 4.8′ |
| RADIUS (LY) | 59,300 |

## DISCOVERY & HISTORY

Charles Messier discovered M58 on 15 April 1779 along with M59 and M60, while charting the comet of that year, and described it as a very faint nebula that vanished as soon as he lit the micrometer wires. John Herschel disagreed sharply in 1833, calling it very bright and much brighter toward the middle — as did Dreyer and Smyth. It lies about 62–68 million light-years away, and from 1779 until the New General Catalogue appeared it was arguably the most distant object known to astronomy, though nobody could have said so.

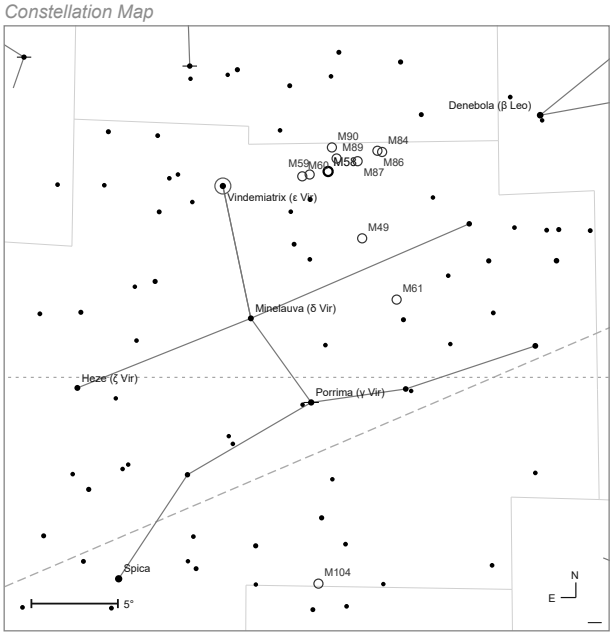
## AT THE EYEPIECE

M58 lies in a starless stretch between Virgo and Coma Berenices, about a third of the way from Vindemiatrix (ε Virginis) toward Denebola; from 50°N it culminates at 52°, best March to July. It is at the limit of 10×50 binoculars — a very small bright smudge with no detail — and an 80 mm telescope adds little. From 200 mm a bright nucleus emerges inside a halo up to 4′ across, and a 10″ Dobsonian on a good night hints at the bar. M59 lies 1° east, M60 1.5° east; the three make an easy sweep.

## WHY IT MATTERS

M58 is one of only four barred spirals in Messier's catalogue, alongside M91, M95 and M109, and one of the brightest galaxies in the Virgo Cluster. Like M90 and other Virgo spirals it is anaemic: its star formation rate is unusually low for its type, most likely because the cluster environment has stripped or heated the gas it would otherwise use. Its nucleus is a well-studied low-luminosity active galactic nucleus, an important bridge case between quiescent galaxies and true Seyferts.

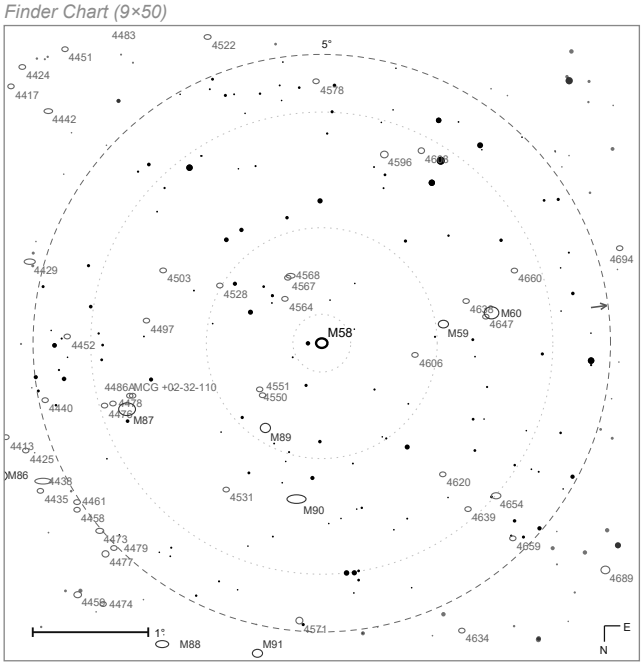
Constellation Map




Naked-eye view · mag 6 · field 35°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

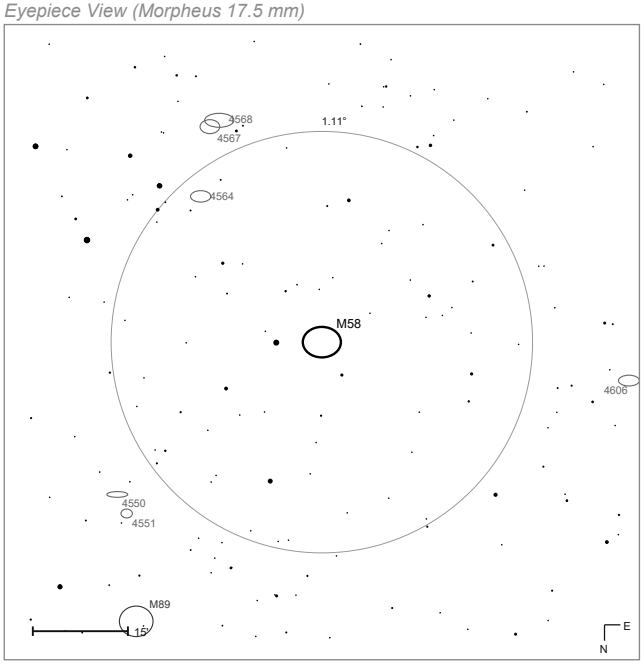
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

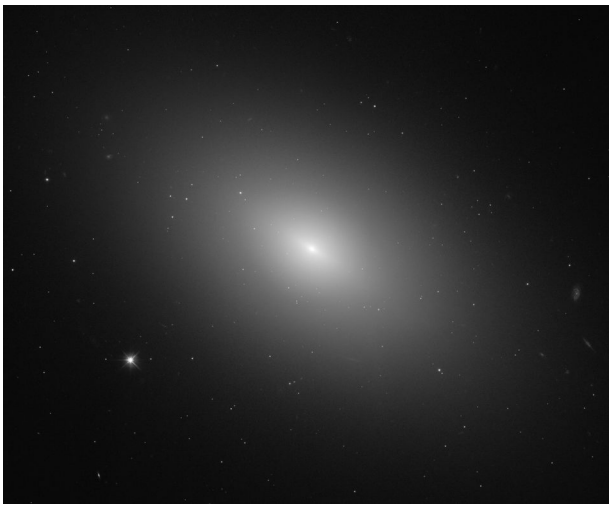



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5

mag ● 8 ● 10 · 12 · 14

# M59





| | |
|---|---|
| MESSIER | 59 |
| NGC | 4621 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Virgo |
| DISTANCE | 60 Mly |
| APPARENT MAG. | +9.6 |
| RA (J2000) | 12h 42m 00s |
| DEC (J2000) | +11° 39′ |
| APPARENT SIZE | 5.4′ × 3.7′ |
| RADIUS (LY) | 47,100 |

## DISCOVERY & HISTORY

Johann Gottfried Koehler found M59 and its neighbour M60 on 11 April 1779 while following a comet through this part of the sky; Charles Messier came upon both about three days later, together with M58, and listed all three. John Herschel described it as a bright, gradually brightening object. M59 lies roughly 60 million light-years away in the Virgo Cluster; its nearest cluster neighbour is 8′ off and five magnitudes fainter, the nearest of comparable brightness being the lenticular NGC 4638 about 17′ away.

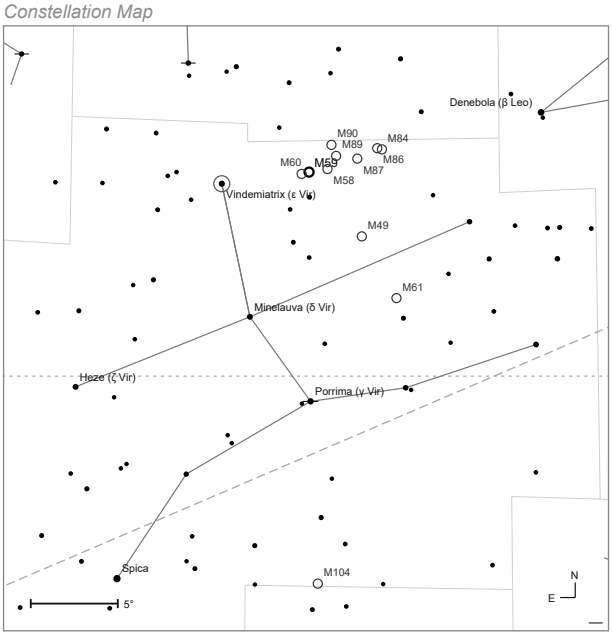
## AT THE EYEPIECE

M59 is straightforward to locate — about 5° west of Vindemiatrix (ε Virginis); from 50°N it culminates at 52°. It sits at the limit of 10×50 binoculars but shows clearly from 60 mm as a bright oval smudge. In a 10″ Dobsonian under Bortle 4 skies expect a smooth, slightly elongated glow about 3′ long with a sharply brighter centre and no internal structure — ellipticals give the eye nothing to resolve. The reward here is the company: M60 25′ east, M58 1° west, NGC 4638 17′ south-east and NGC 4606 25′ north-west.

## WHY IT MATTERS

M59 is an E5 elliptical flattened by about 50%, but its isophotes are pointed rather than truly elliptical, and decompose into three components: a main elliptical body contributing 62% of the light, a circular halo at 22%, and a flattened disc making up the rest. That disc-to-bulge light ratio of 0.25 is half the typical lenticular value, placing M59 midway between the two classes. Its central supermassive black hole, some 270 million solar masses, counter-rotates against the rest of the galaxy — a fossil of a past merger.

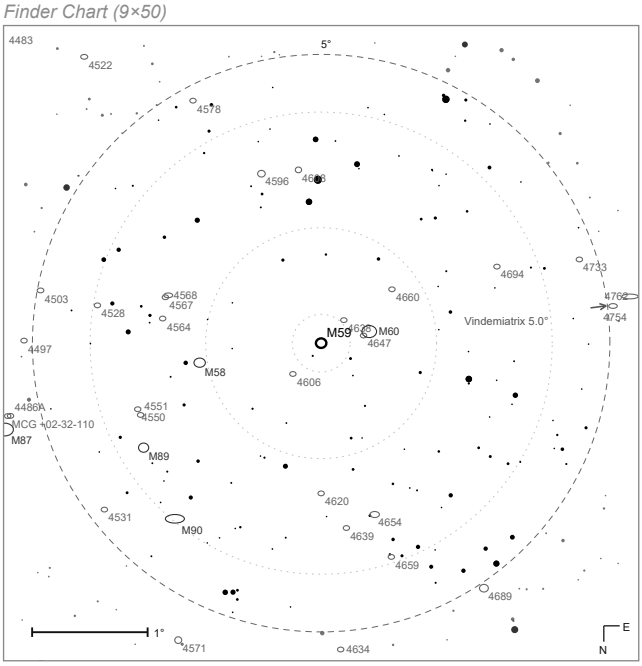
*Constellation Map*




*Naked-eye view · mag 6 · field 35°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

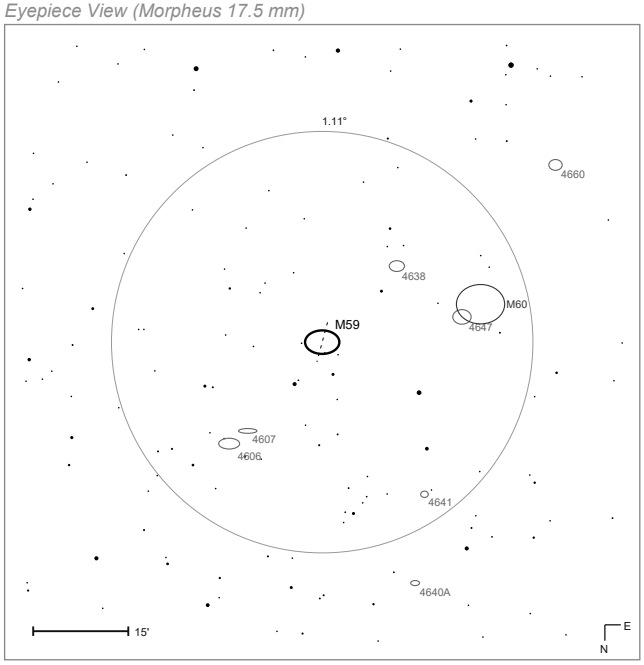
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

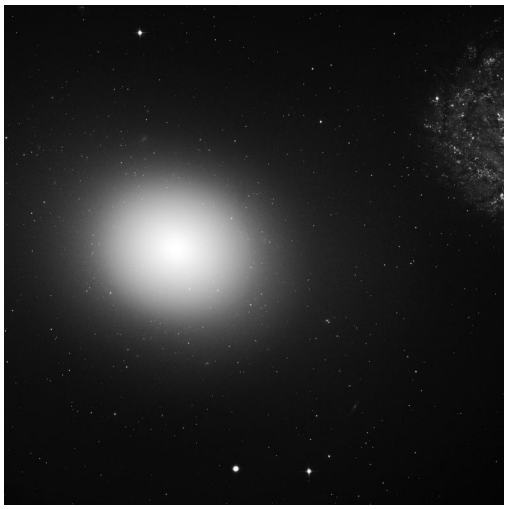



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M60





| | |
|---|---|
| MESSIER | 60 |
| NGC | 4649 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Virgo |
| DISTANCE | 57 Mly |
| APPARENT MAG. | +8.8 |
| RA (J2000) | 12h 43m 42s |
| DEC (J2000) | +11° 33′ |
| APPARENT SIZE | 7.6′ × 6.2′ |
| RADIUS (LY) | 63,000 |

## DISCOVERY & HISTORY

Johann Gottfried Koehler discovered M60 together with M59 on 11 April 1779 while watching a comet pass through Virgo, and Charles Messier catalogued both about three days later. M60 lies roughly 57 million light-years away and is the third-brightest member of the Virgo Cluster. With the spiral NGC 4647 apparently touching its north-western edge, Halton Arp listed the pair as Arp 116. Its mass within five effective radii is about $10^{12}$ solar masses, nearly half of it dark matter.

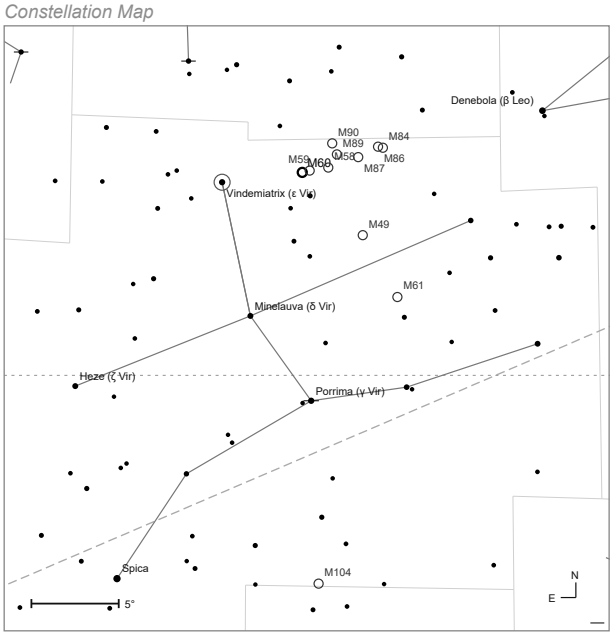
## AT THE EYEPIECE

M60 lies 4.5° west of Vindemiatrix (ε Virginis) and, at magnitude 8.8, is the easiest galaxy in this group — visible in 10×50 binoculars as a small soft spot. From 50°N it culminates at 52°. In a 10″ Dobsonian under Bortle 4 skies it shows a 3′ halo around a very dense, bright core, and a faint patch to the north-west resolves into the separate spiral NGC 4647; whether the two are actually interacting is still debated. M59 lies 25′ west, so both fit a single medium-power field.

## WHY IT MATTERS

At the centre of M60 sits a supermassive black hole of 4.5 ± 1.0 billion solar masses — one of the largest ever measured, and currently dormant. X-ray images show a cavity carved by jets during past active episodes, matched by weak radio lobes; the power required to excavate them was of order $10^{41}$ erg per second. M60 is therefore a case study in black-hole duty cycles: the galaxy is quiet now, but the scars of its active phases remain readable in the surrounding hot gas.

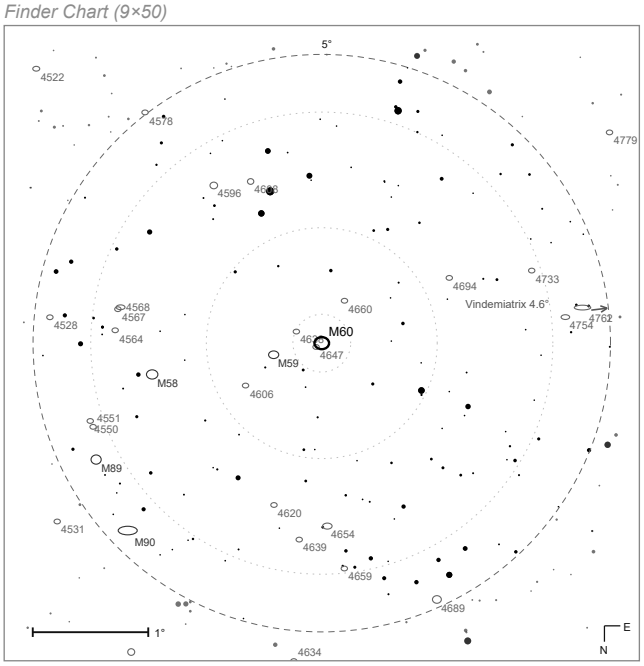
*Constellation Map*




*Naked-eye view · mag 6 · field 35°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

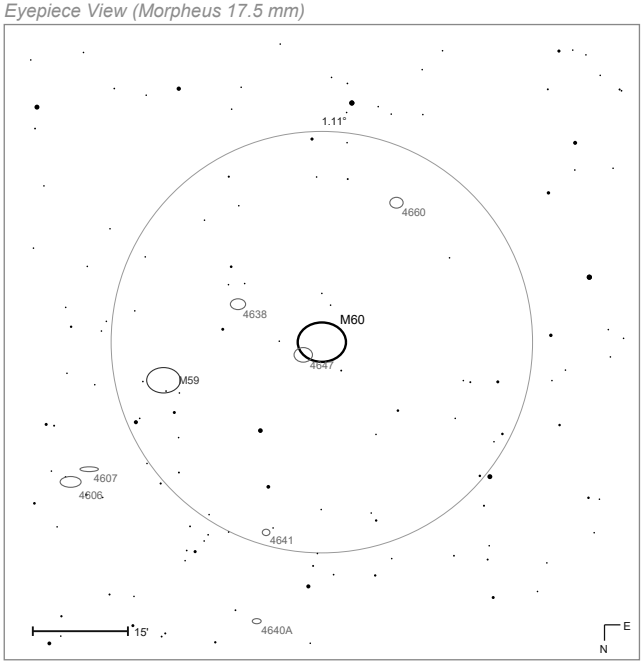
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M61

| | |
|---|---|
| MESSIER | 61 |
| NGC | 4303 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Virgo |
| DISTANCE | 45 Mly |
| APPARENT MAG. | +9.6 |
| RA (J2000) | 12h 21m 54s |
| DEC (J2000) | +04° 28′ |
| APPARENT SIZE | 6.5′ × 5.9′ |
| RADIUS (LY) | 42,500 |

## DISCOVERY & HISTORY

Barnaba Oriani of Milan found M61 on 5 May 1779 while following a comet. Charles Messier observed it the same night but took it for the comet itself, and only recognised his mistake six days later — a rare case of the comet-hunter's confusion running in the opposite direction. It lies about 45 million light-years away and is one of the largest members of the Virgo Cluster, belonging to the smaller subgroup known as the S Cloud. Seven supernovae have been recorded in it — more than in any other Messier galaxy, though NGC 6946 holds the overall record with ten.

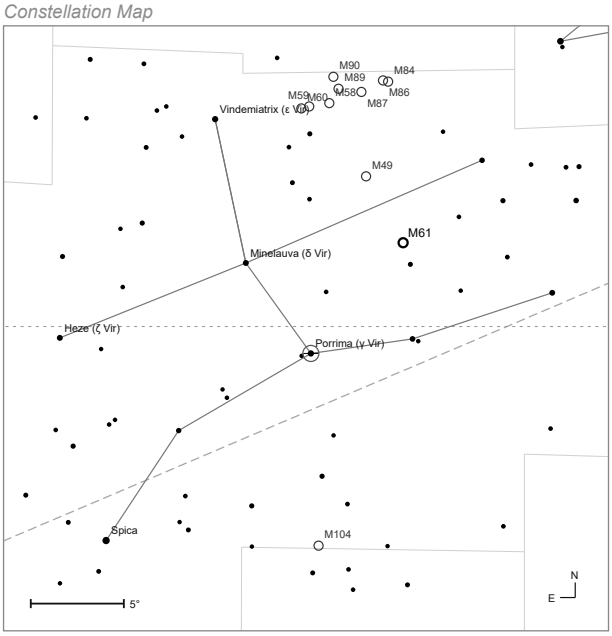
## AT THE EYEPIECE

M61 lies in an empty field about 1.2° north of the 5th-magnitude star 16 Virginis; from 50°N it culminates at 45°, best March to July. In 10×50 binoculars it is a very faint fleeting patch. Real detail needs 140 mm or more: a 5′ halo with a small bright nucleus dead centre. In a 10″ Dobsonian under Bortle 4 skies the shape is visibly not circular but slightly elongated north-east to south-west, and the halo carries several brightenings that make it look lopsided — those are the inner spiral arms of a nearly face-on galaxy.

## WHY IT MATTERS

M61 is classified SAB(rs)bc — weakly barred, with a hint of a ring — and is a starburst galaxy with an active nucleus. Its core holds a massive nuclear star cluster of about a million solar masses aged only 4 million years, alongside an older massive cluster and probably an older starburst, with a candidate supermassive black hole of some 5 million solar masses at the centre. Unlike most late-type Virgo spirals it retains an unusual abundance of neutral hydrogen — the fuel that lets its star formation continue.

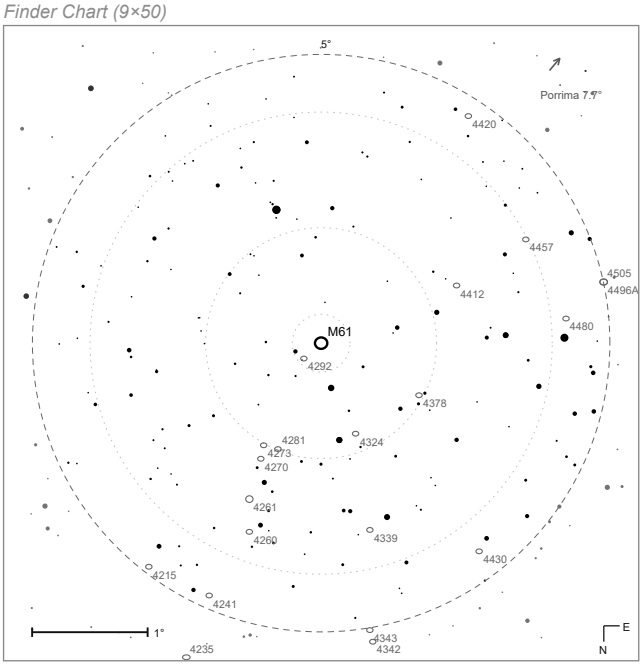
*Constellation Map*




*Naked-eye view · mag 6 · field 32°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

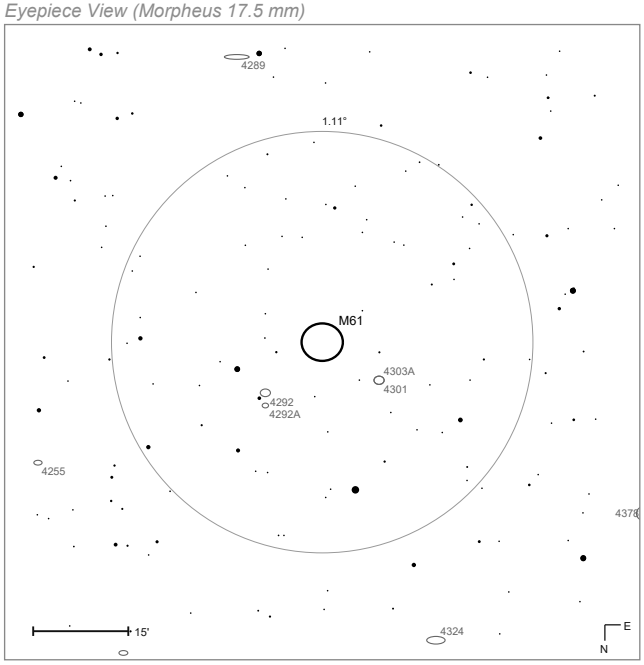
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

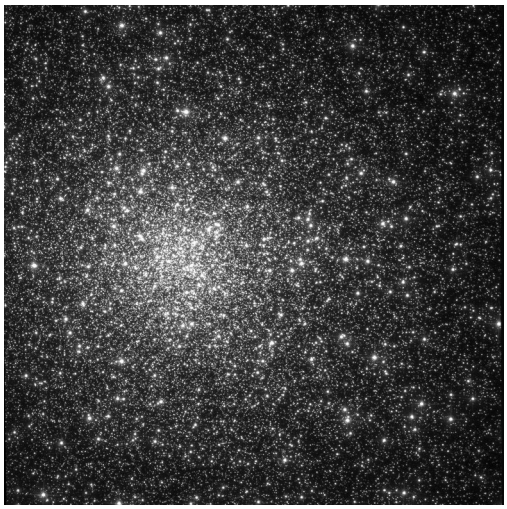



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M62

GLOBULAR CLUSTER



| | |
|---|---|
| MESSIER | 62 |
| NGC | 6266 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Ophiuchus |
| DISTANCE | 21.5 kly |
| APPARENT MAG. | +6.4 |
| RA (J2000) | 17h 01m 12s |
| DEC (J2000) | −30° 07′ |
| APPARENT SIZE | 15.0′ |
| RADIUS (LY) | 47 |
| AGE (YEARS) | 11.8 billion |

## DISCOVERY & HISTORY

Charles Messier found M62 on 7 June 1771 but measured its position poorly, so the cluster only entered his published catalogue after he re-observed it in 1779 — and the wrong coordinates persisted in print for years. It is sometimes called the Flickering Globular. It lies about 21,500 light-years from Earth and only 5,500 from the galactic centre, and with 1.22 million solar masses it ranks among the most massive and luminous globulars in the Milky Way.

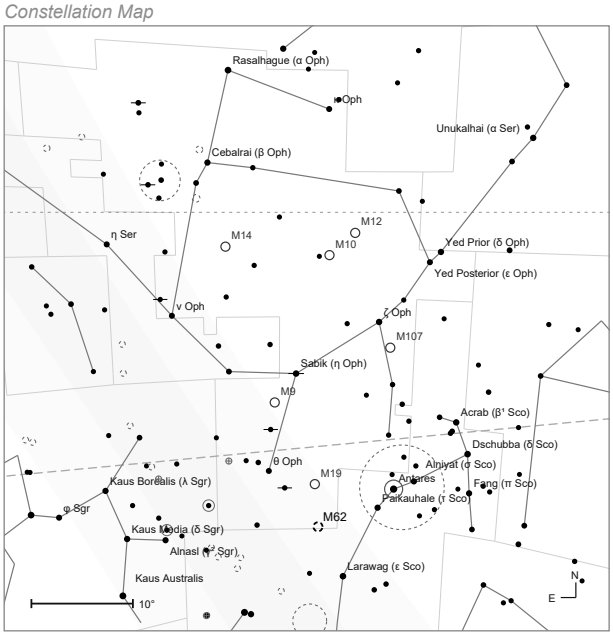
## AT THE EYEPIECE

Finding M62 is simple — locate Antares and move about 8° south-east — but from 50°N it culminates at just 10°, which makes it one of the hardest objects in this book for Czech observers. A 10×50 binocular shows a small bright hazy disc. Telescopes of 80–120 mm leave it unresolved. A 10″ Dobsonian on a steady night picks out stars of 14th and 15th magnitude, some apparently linked into chains, across 15′. M19 lies 4° north, M4 9° north-west.

## WHY IT MATTERS

Its density profile shows M62 has not yet undergone core collapse, making it a useful "before" case beside clusters like M15 and M30 that have. It also shows two clearly distinct stellar populations: 79% of its main-sequence stars belong to a first generation and 21% to a second enriched by the first, with measurable differences in helium, carbon, magnesium, aluminium and sodium. This multiple-population pattern, now known to be common, overturned the old picture of globulars as single-age, single-composition systems. A 2010 study identified 245 variable stars in it.

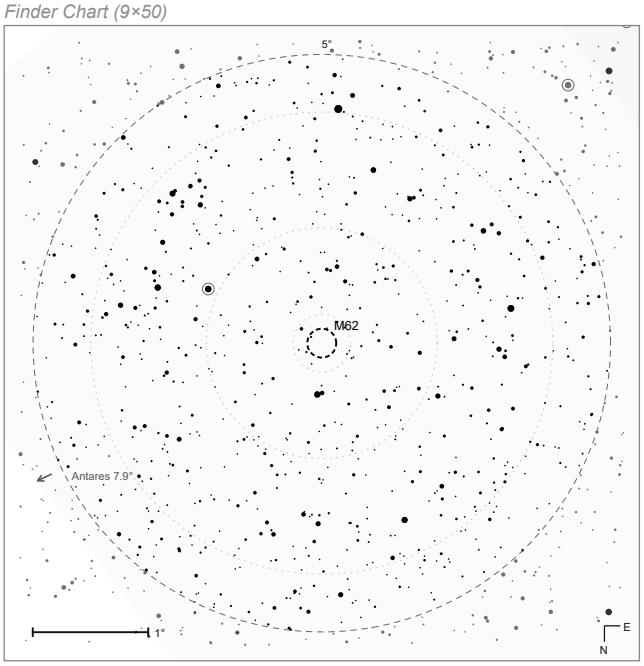
*Constellation Map*




*Naked-eye view · mag 5 · field 6°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

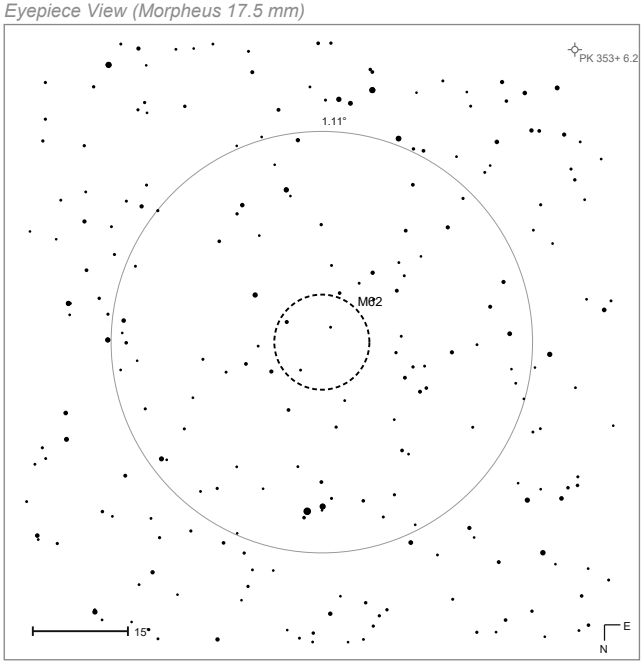
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.3*

mag ● 6 ● 8 ● 10 · 12

# M63 Sunflower Galaxy

| | |
|---|---|
| MESSIER | 63 |
| NGC | 5055 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Canes Venatici |
| DISTANCE | 29 Mly |
| APPARENT MAG. | +8.6 |
| RA (J2000) | 13h 15m 48s |
| DEC (J2000) | +42° 02′ |
| APPARENT SIZE | 12.6′ × 7.2′ |
| RADIUS (LY) | 53,100 |
| NUMBER OF STARS | ~400 billion |

## DISCOVERY & HISTORY

M63 was the first deep-sky object Pierre Méchain ever discovered, on 14 June 1779; he told Charles Messier the same day and Messier verified it and entered it as number 63. In the mid-19th century Lord Rosse identified spiral structure in it, making it one of the first galaxies known to be a spiral. Its occasional nickname is the Sunflower Galaxy. It holds roughly 400 billion stars, lies about 29 million light-years away, and forms the M51 group together with the Whirlpool and several smaller galaxies.

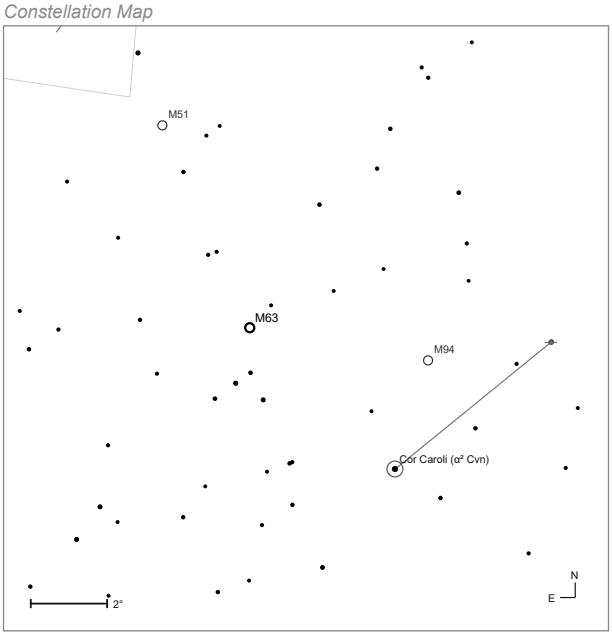
## AT THE EYEPIECE

M63 is easy enough to find: 1.5° north of the little chain of stars 19, 20 and 23 CVn, which lie about 4° north-east of Cor Caroli. From 50°N it culminates at 82° and is effectively circumpolar. On very transparent nights binoculars show a diffuse patch with no central condensation. A 60–80 mm telescope gives a handsome few-arcminute glow; 150 mm reaches the outer regions. At 300 mm the core takes on a grainy texture and two arm stubs emerge east and west of the nucleus.

## WHY IT MATTERS

M63 is the classic flocculent spiral: in visible light it has no continuous large-scale arms, only a fleece of short fragmentary ones. Yet in the near infrared a clean symmetric two-arm pattern appears, each arm wrapping 150° around the galaxy and reaching 13,000 light-years out — proof that the underlying spiral structure can be masked by the patchiness of star formation and dust. Its nucleus is a weakly active LINER, with soft X-ray and hydrogen-alpha emission extended along the same axis.

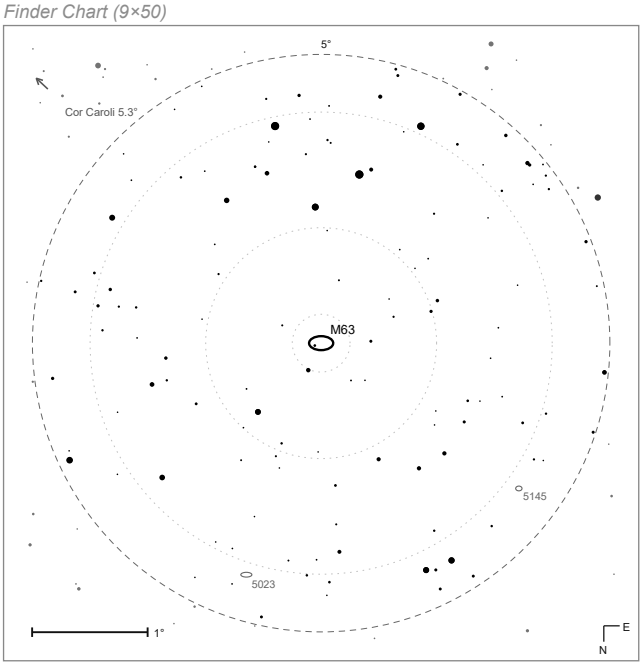
*Constellation Map*




*Naked-eye view · mag 7 · field 16°*

mag ● 1 ● 3 ● 5 ● 7

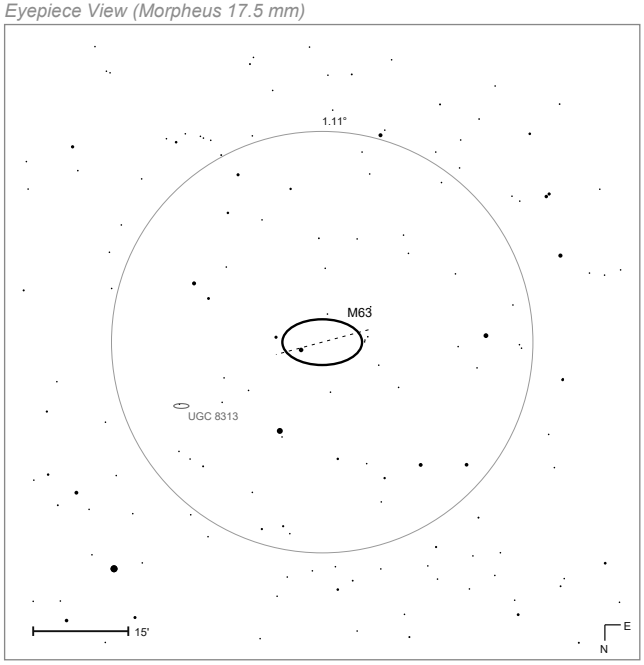
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

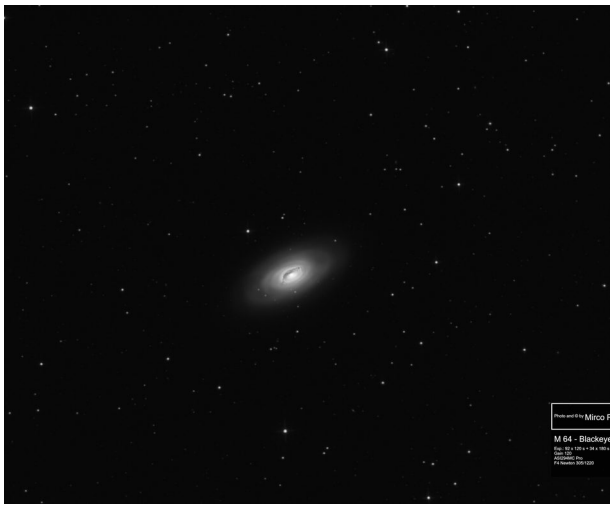



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M64 Black Eye Galaxy





| | |
|---|---|
| MESSIER | 64 |
| NGC | 4826 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Coma Berenices |
| DISTANCE | 17 Mly |
| APPARENT MAG. | +8.5 |
| RA (J2000) | 12h 56m 42s |
| DEC (J2000) | +21° 41′ |
| APPARENT SIZE | 10.0′ × 5.4′ |
| RADIUS (LY) | 24,700 |
| NUMBER OF STARS | ~100 billion |

## DISCOVERY & HISTORY

Edward Pigott found M64 in March 1779, Johann Elert Bode independently the following month, and Charles Messier the year after — three discoveries in thirteen months for a galaxy nobody had noticed before. The dark band of dust lying partly across its bright nucleus earned it the names Black Eye, Evil Eye and Sleeping Beauty. It is a relatively isolated spiral about 17 million light-years away in Coma Berenices, inclined 60° to our line of sight.

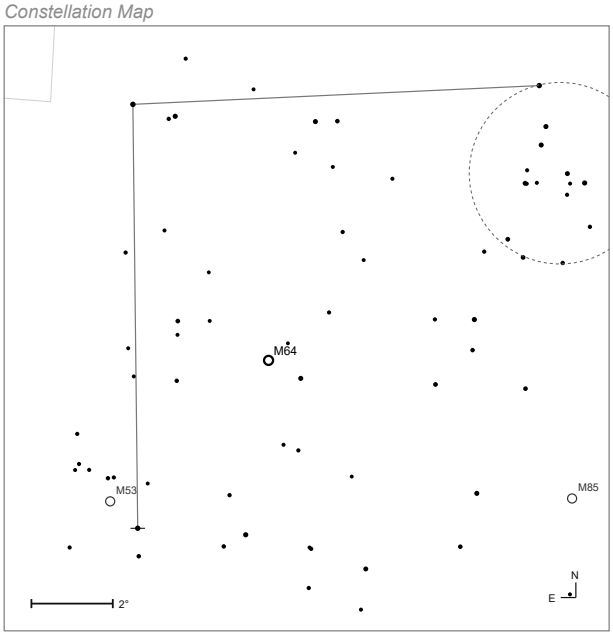
## AT THE EYEPIECE

M64 lies just under 1° north-east of the 5th-magnitude star 35 Comae Berenices, or 11° north of Vindemiatrix; from 50°N it culminates at 62°, best February to August. On transparent nights it is at the limit of 10×50 binoculars. An 80 mm telescope shows the bright nucleus. From 150 mm the object becomes what its nickname promises: a 9′ × 5′ oval with a mottled dark band curving across the near edge of the core, wrapped in a hazy halo. It is one of the few galaxies whose dust lane is genuinely easy visually — a good target for suburban skies. M53 lies 5° south-east.

## WHY IT MATTERS

M64 is a type 2 Seyfert with an HII/LINER nucleus and a weak radio and soft X-ray source at its centre, the X-rays probably coming from the circumnuclear region rather than the black hole itself. Its real peculiarity is dynamical: the interstellar gas in its outer disc rotates in the opposite direction to the gas and stars inside about 3,000 light-years, and the friction along that boundary drives vigorous star formation. The counter-rotation is best explained by the absorption of a satellite galaxy.

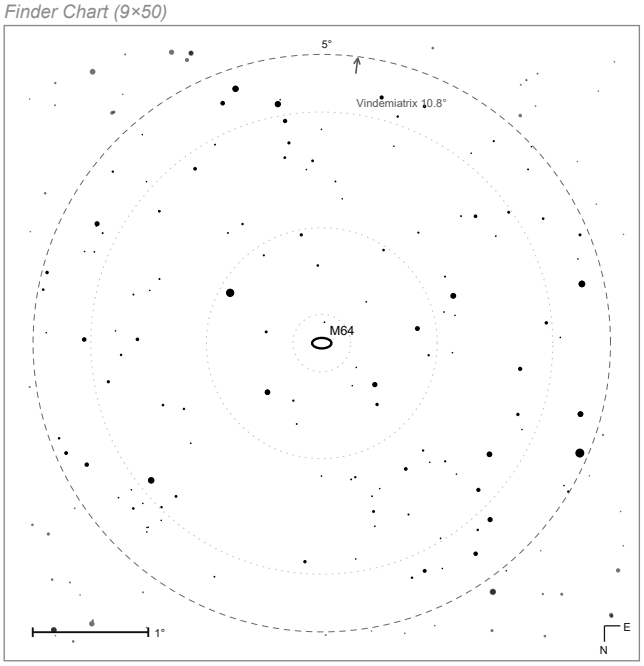
*Constellation Map*




*Naked-eye view · mag 7 · field 15°*

mag ● 1 ● 3 ● 5 ● 7

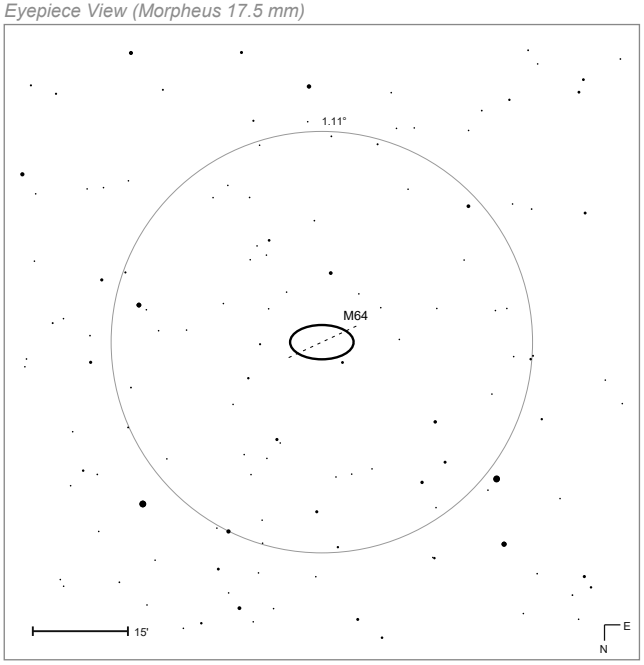
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M65

GALAXY

| | |
|---|---|
| MESSIER | 65 |
| NGC | 3623 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Leo |
| DISTANCE | 41 Mly |
| APPARENT MAG. | +9.3 |
| RA (J2000) | 11h 18m 54s |
| DEC (J2000) | +13° 05′ |
| APPARENT SIZE | 9.8′ × 2.9′ |
| RADIUS (LY) | 58,400 |

## DISCOVERY & HISTORY

Charles Messier discovered M65 together with M66 on 1 March 1780 and described a very faint nebula without stars. William Henry Smyth later stated in A Cycle of Celestial Objects that Méchain had pointed both galaxies out to Messier — an error repeated by Kenneth Glyn Jones and from there into many later books, although Messier's own notes credit no one else. M65 lies about 35–41 million light-years away and, with M66 and NGC 3628, forms the Leo Triplet.

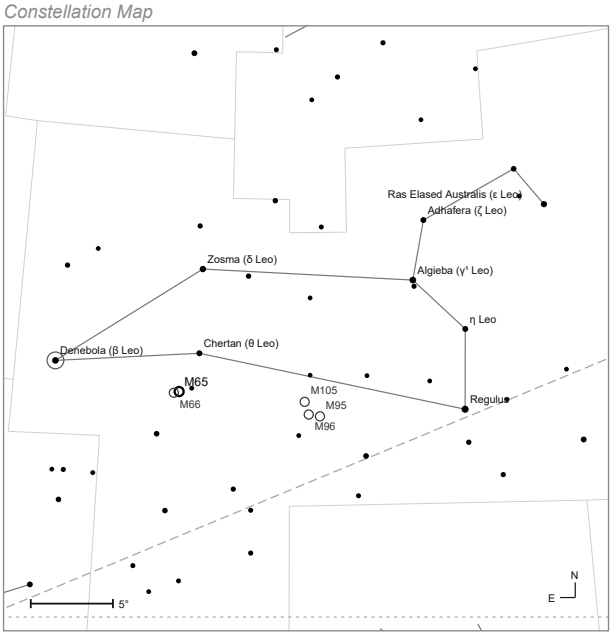
## AT THE EYEPIECE

M65 is easy to place, exactly halfway between Chertan (θ Leonis) and Asellus Australis (ι Leonis); from 50°N it culminates at 53°, best February to August. It sits at the limit of 10×50 binoculars and wants 150 mm or more. In a 10″ Dobsonian under Bortle 4 skies it is a silvery spindle roughly 9′ × 3′ elongated nearly north–south, with a dust lane traceable along its eastern flank. M66 lies 20′ east and NGC 3628 further north — all three in one low-power field, which is the classic view.

## WHY IT MATTERS

M65 is poor in dust and gas and forms few stars, so its ratio of old to young stars is high — at most wavelengths it is a quiet, unremarkable galaxy. What makes it interesting is context: its disc appears slightly warped and it has had a comparatively recent burst of star formation, both of which point to disturbance by its neighbours. The Leo Triplet is therefore a natural experiment in how a close group affects each member differently, with M65 the least disrupted of the three.

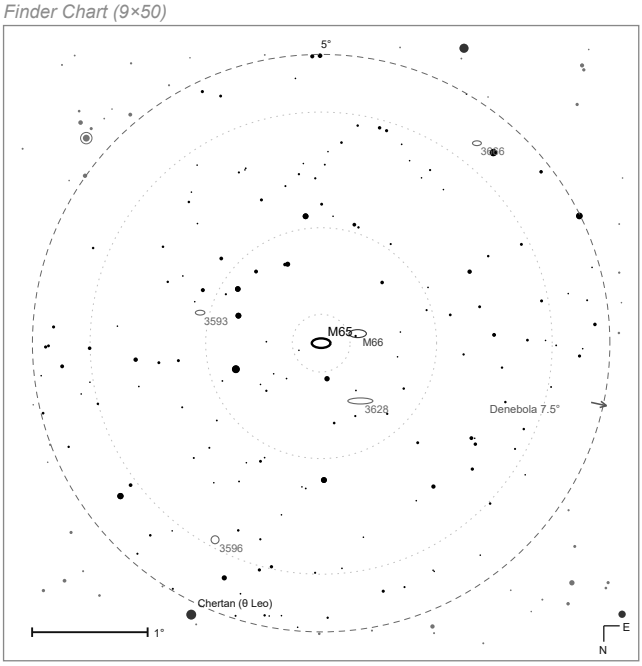
Constellation Map




Naked-eye view · mag 5.5 · field 37°

mag ● 1 ● 3 • 5 • 7 — ecliptic - - celestial equator

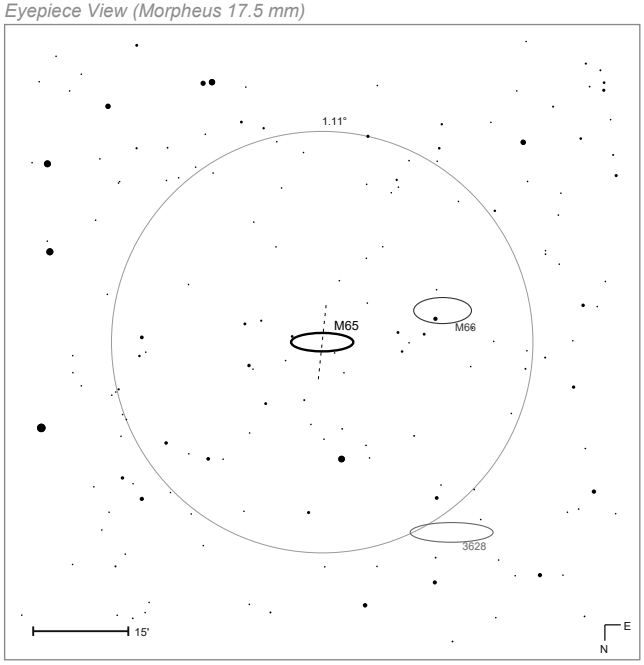
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 • 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

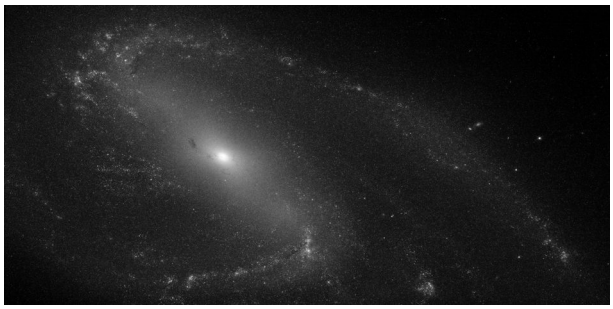



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5

mag • 8 • 10 · 12 · 14

# M66





| | |
|---|---|
| MESSIER | 66 |
| NGC | 3627 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Leo |
| DISTANCE | 31.3 Mly |
| APPARENT MAG. | +8.9 |
| RA (J2000) | 11h 20m 12s |
| DEC (J2000) | +13° 00′ |
| APPARENT SIZE | 9.1′ × 4.1′ |
| RADIUS (LY) | 41,400 |

## DISCOVERY & HISTORY

Charles Messier found M66 with M65 on 1 March 1780 and called it "very long and very faint". A comet had passed close by in 1773 and he had missed the galaxy then, most likely because the comet's glare drowned it. M66 lies about 31–35 million light-years away, spans some 95,000 light-years, and is the brightest member of the Leo Triplet. Its classification SABb marks it as a spiral with a weak bar and loosely wound arms.

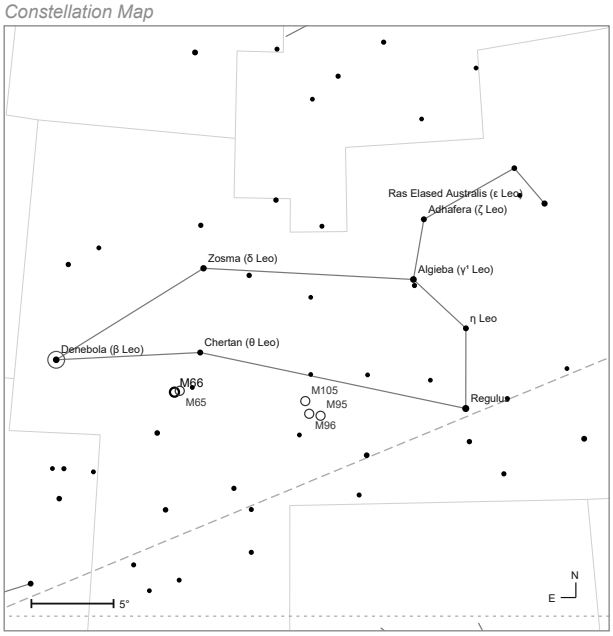
## AT THE EYEPIECE

M66 lies halfway between Chertan (θ Leonis) and ι Leonis, 20′ east of M65; from 50°N it culminates at 53°. It is at the limit of 10×50 binoculars and repays 150 mm or more. In a 10″ Dobsonian under Bortle 4 skies it looks brighter and rounder than M65, about 9′ × 4′, with a strong central bulge; at 300 mm the arms can be traced curving anticlockwise and the core takes on a bar-like shape. A 10th-magnitude foreground star of our own galaxy sits on the north-western edge.

## WHY IT MATTERS

M66's past encounter with NGC 3628 left visible fingerprints: an extremely high central mass concentration, an unusually high ratio of molecular to atomic gas, and a resolved non-rotating clump of neutral hydrogen displaced from the disc. Its spiral arms are markedly asymmetric and knotted with bright star clusters and dust lanes, forming stars at roughly 0.05 solar masses per year. The Triplet is thus one of the most accessible demonstrations that galaxy interactions rearrange gas long before they merge galaxies.

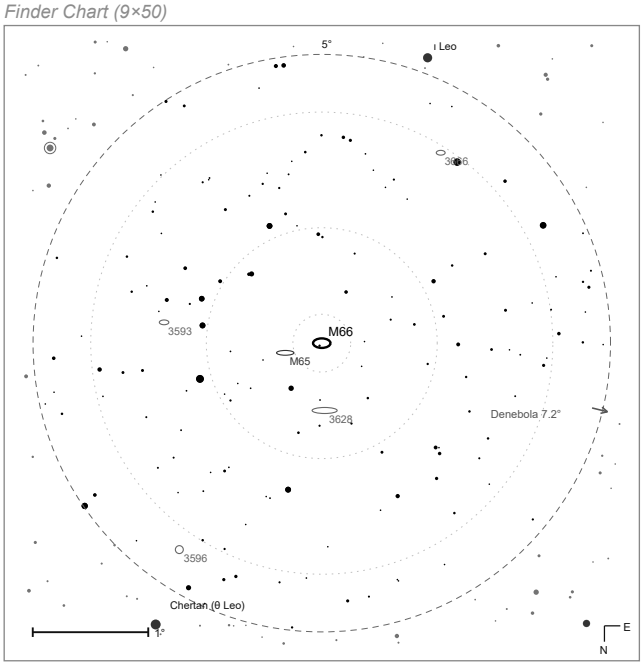
*Constellation Map*




*Naked-eye view · mag 5.5 · field 37°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

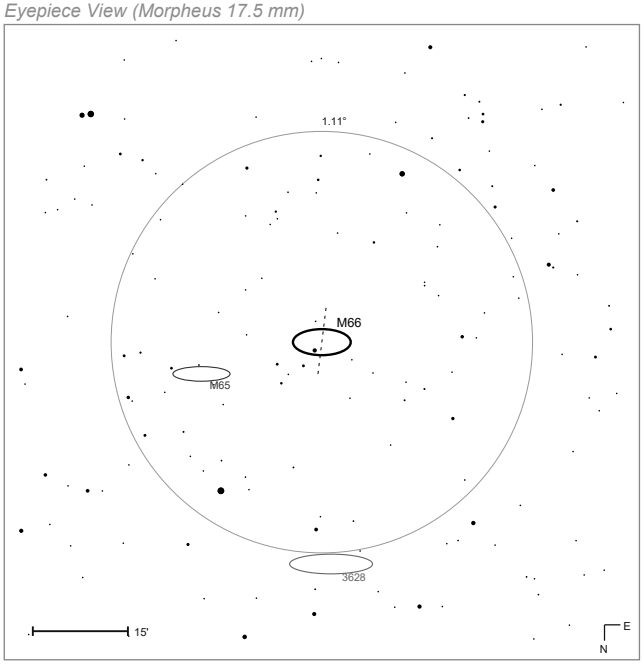
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M67

OPEN CLUSTER

| | |
|---|---|
| MESSIER | 67 |
| NGC | 2682 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Cancer |
| DISTANCE | 2,700 ly |
| APPARENT MAG. | +6.9 |
| RA (J2000) | 08h 51m 24s |
| DEC (J2000) | +11° 49′ |
| APPARENT SIZE | 25.0′ |
| RADIUS (LY) | 10 |
| AGE (YEARS) | 3.2 billion |

## DISCOVERY & HISTORY

Johann Gottfried Koehler observed M67 before 1779 and Charles Messier catalogued it in 1780. It is occasionally called the King Cobra or Golden Eye Cluster. Age estimates run from 3.2 to 5 billion years — most work settles near 4 — making it by far the oldest open cluster in this catalogue, though a few more distant Milky Way clusters are older still. Distance estimates cluster around 815–855 parsecs, roughly 2,700 light-years, derived from binary-star modelling and infrared colour–magnitude fitting.

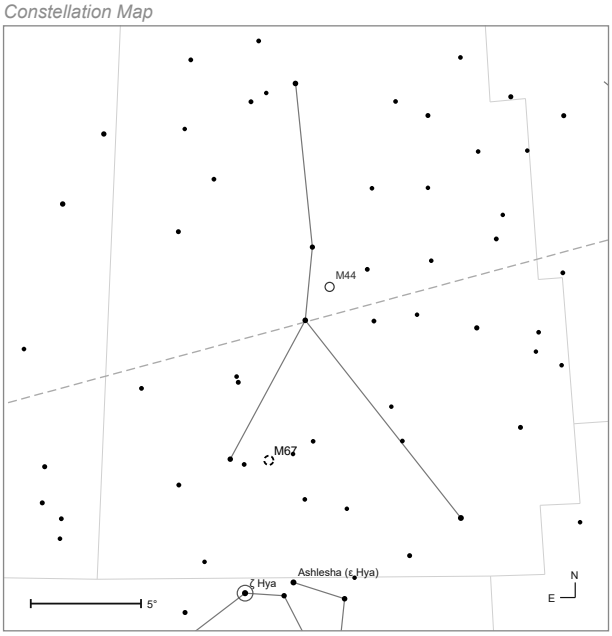
## AT THE EYEPIECE

M67 lies 2° west of Acubens (α Cancri) and about 9° south of the Beehive; from 50°N it culminates at 52°, best January to June. At magnitude 6.9 it is on the edge of naked-eye visibility and easy in a 7×30 binocular, though small instruments show only a hazy patch with a few stars. From 120–140 mm dozens of distinctly yellow stars appear — the colour is the giveaway that this cluster is old. A 10″ Dobsonian resolves it completely across 25′, with over 500 members and a curious darker spot near the centre noted by Mallas.

## WHY IT MATTERS

M67 is the paradigm object of stellar evolution studies: well populated, essentially unobscured by dust, and with every star at the same distance and age — except for about 30 anomalous blue stragglers. It contains more than 100 stars closely similar to the Sun and around 150 white dwarfs, on a present mass near 1,100–1,400 solar masses and an initial mass perhaps ten times greater. Because Sun-like stars of known age are rare, M67 has even been proposed, though not confirmed, as the Sun's birth cluster.

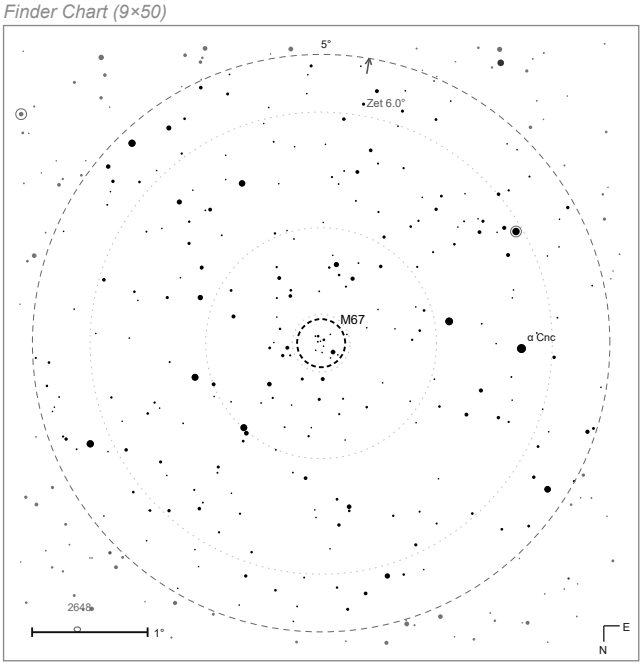
*Constellation Map*




*Naked-eye view · mag 6 · field 27°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

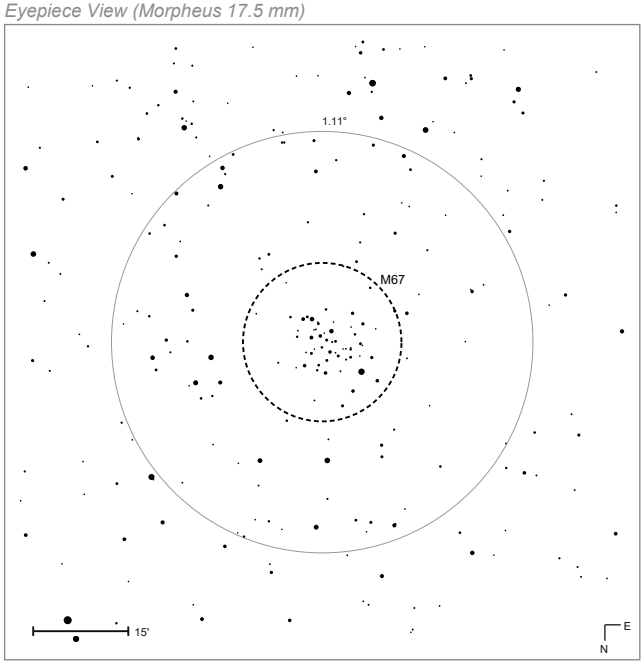
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.5*

mag ● 8 ● 10 · 12 · 14

# M68

GLOBULAR CLUSTER

| | |
|---|---|
| MESSIER | 68 |
| NGC | 4590 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Hydra |
| DISTANCE | 33 kly |
| APPARENT MAG. | +7.3 |
| RA (J2000) | 12h 39m 30s |
| DEC (J2000) | −26° 45′ |
| APPARENT SIZE | 11.0′ |
| RADIUS (LY) | 53 |
| AGE (YEARS) | 11.2 billion |

## DISCOVERY & HISTORY

Charles Messier discovered M68 on 9 April 1780: "a nebula without stars between Corvus and Hydra; it is very faint and difficult to see with the telescope; near it is a star of 6th magnitude." William Herschel resolved it in 1786 and described "a beautiful cluster of stars, extremely rich, and so compressed that most of the stars are blended together"; his son John found it "all clearly resolved into stars of 12th magnitude, very loose and ragged at the borders". It lies about 33,000 light-years away.

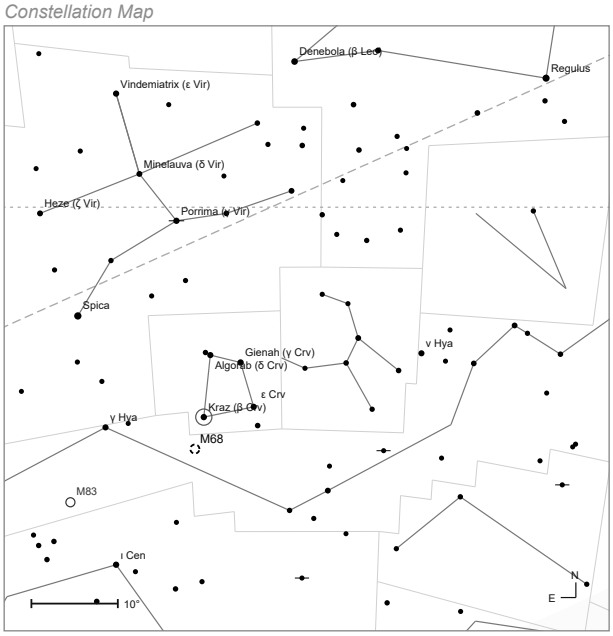
## AT THE EYEPIECE

M68 is not hard to locate — about 3.5° south-east of Kraz (β Corvi) — but from 50°N it culminates at just 13°, so it needs a clear southern horizon and a still atmosphere. On transparent nights 10×50 binoculars find it; 60 mm will not resolve it. From 150 mm a few 13th-magnitude stars emerge, and at 200–300 mm it finally looks like a proper globular, with several dozen stars across 11′ and the ragged edges John Herschel noted. Best from March to July.

## WHY IT MATTERS

M68 is one of the most metal-poor globulars known, and it orbits the galactic bulge on a markedly eccentric path — eccentricity 0.5, carrying it out to 100,000 light-years from the centre. Both facts, along with signs of rotation, suggest it was captured from a satellite galaxy rather than formed with the Milky Way. The cluster may also be undergoing core collapse. Fifty variable stars are known, the first 28 found by Harlow Shapley in 1919–20; most are RR Lyrae, and six are short-period SX Phoenicis pulsators.

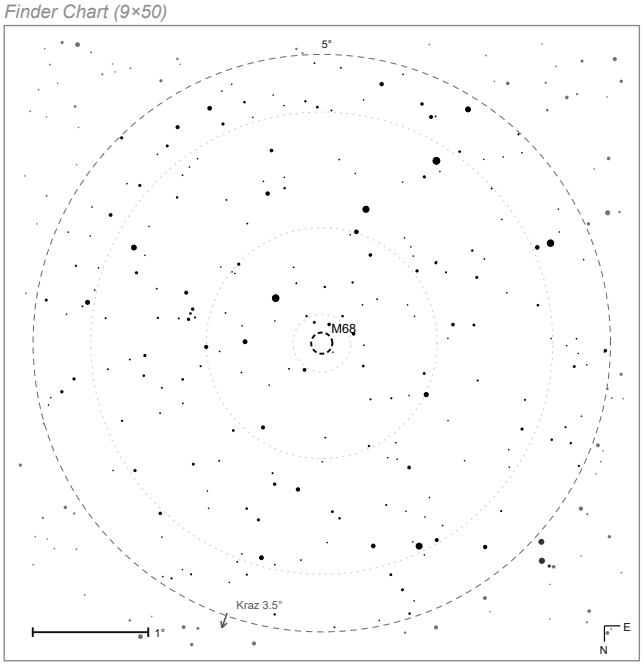
*Constellation Map*




*Naked-eye view · mag 5 · field 7°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

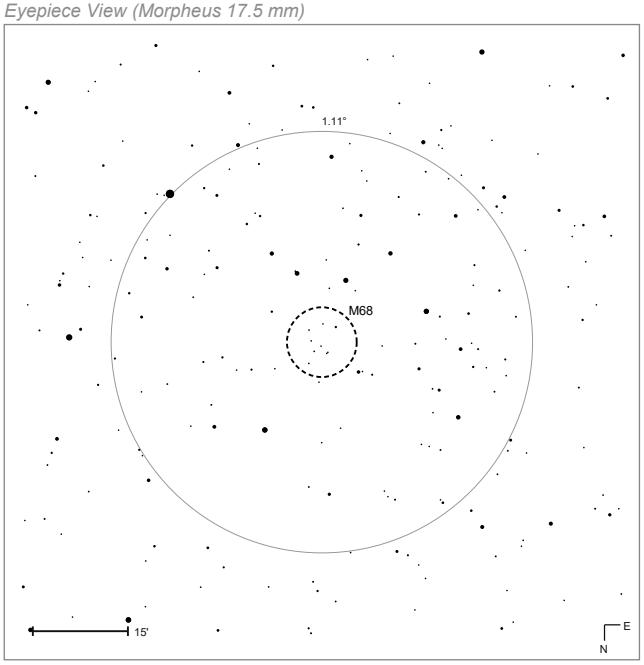
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.9*

mag ● 8 ● 10 · 12 · 14

# M69

GLOBULAR CLUSTER

| | |
|---|---|
| MESSIER | 69 |
| NGC | 6637 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Sagittarius |
| DISTANCE | 28.7 kly |
| APPARENT MAG. | +7.7 |
| RA (J2000) | 18h 31m 24s |
| DEC (J2000) | −32° 21′ |
| APPARENT SIZE | 7.1′ |
| RADIUS (LY) | 30 |
| AGE (YEARS) | 13.1 billion |

## DISCOVERY & HISTORY

Charles Messier found M69 on 31 August 1780, the same night he found M70. He was searching for an object Lacaille had described in 1751–52 and believed he had recovered it; whether Lacaille's object was really M69 has never been settled. The cluster lies about 28,700 light-years from Earth and only 5,200 from the galactic centre, with a radius near 45 light-years and a mass of some 200,000 Suns. Unusually for a globular it is relatively metal-rich, marking it as a member of the galactic bulge population.

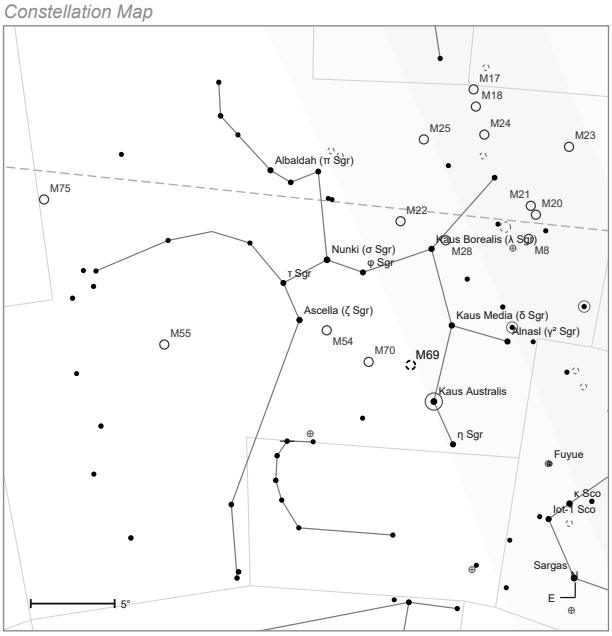
## AT THE EYEPIECE

M69 lies 2.5° north-east of Kaus Australis (ε Sagittarii) in a moderately rich field. From 50°N it culminates at barely 8° — among the lowest objects in this catalogue, and a genuine challenge from central Europe. It is difficult even in 10×50 binoculars, and resolving individual stars needs 250 mm or more with steady air; at 7′ across it otherwise reads as a small bright fuzzy ball. M70 lies 2.5° east — the two are worth comparing — with M54 5.5° north-east and M22 9° north.

## WHY IT MATTERS

M69 and M70 are close analogues in size and luminosity, and may be separated by as little as 1,800 light-years in space — an unusually tight pairing of globulars deep in the bulge. Their metal-richness sets them apart from halo clusters like M55 or M68 and identifies them with the old but chemically enriched population that formed alongside the galaxy's central bulge. M69's core luminosity density reaches 6,460 solar luminosities per cubic parsec.

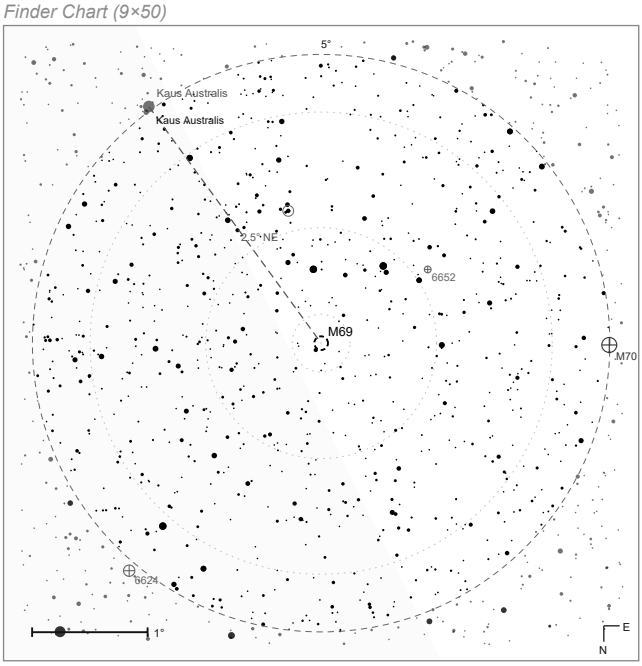
Constellation Map




Naked-eye view · mag 5 · field 36°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

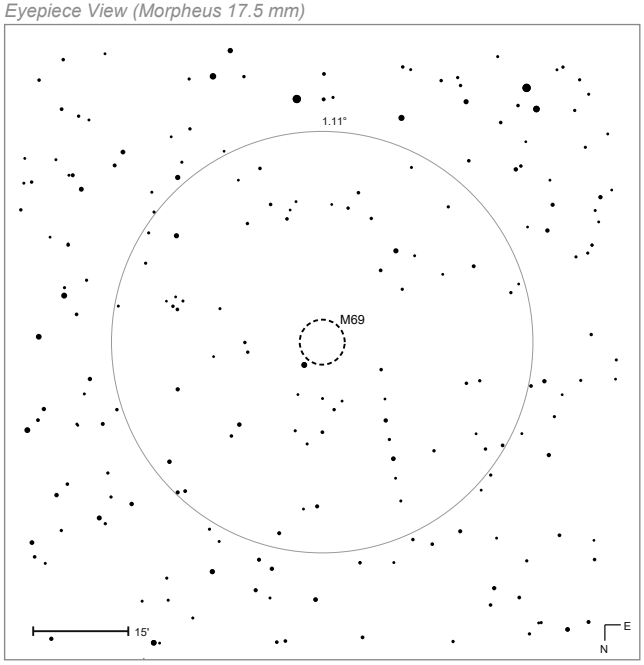
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

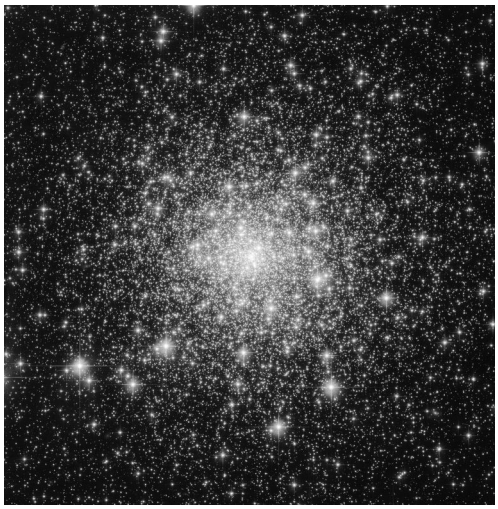



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.1

mag ● 6 ● 8 ● 10 · 12

# M70

GLOBULAR CLUSTER



| | |
|---|---|
| MESSIER | 70 |
| NGC | 6681 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Sagittarius |
| DISTANCE | 29.4 kly |
| APPARENT MAG. | +7.8 |
| RA (J2000) | 18h 43m 12s |
| DEC (J2000) | −32° 18′ |
| APPARENT SIZE | 8.0′ |
| RADIUS (LY) | 34 |
| AGE (YEARS) | 12.8 billion |

## DISCOVERY & HISTORY

Charles Messier discovered M70 on 31 August 1780 and described "a nebula without stars, near the preceding [M69] and on the same parallel", noting a 9th-magnitude star beside it. Its greatest moment of fame came in July 1995, when Alan Hale and Thomas Bopp independently spotted a comet while observing this cluster — Comet Hale–Bopp. M70 lies about 29,400 light-years from Earth and 6,500 from the galactic centre, and closely matches M69 in both size and luminosity.

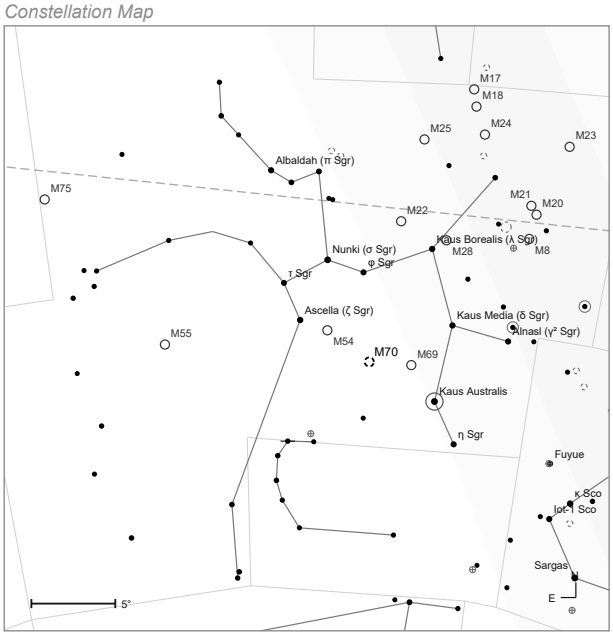
## AT THE EYEPIECE

M70 sits almost exactly halfway between Kaus Australis (ε Sagittarii) and Ascella (ζ Sgr); from 50°N it culminates at 8°, so only the best nights give anything. It is hard in 10×50 binoculars and needs 250–300 mm to resolve stars, whose brightest are 14th magnitude. In a 10″ Dobsonian expect a tight bright ball about 8′ across with a curved arc of stars trailing to the north-east — the one distinguishing feature between it and its twin M69, 2.5° west.

## WHY IT MATTERS

M70 has undergone core collapse, and its core radius is extraordinarily small — about 0.22 light-years, with the surface brightness following a power law right into the centre. That makes it one of the clearest examples of a post-collapse cluster in the catalogue, the end state of dense stellar systems where the innermost stars transfer energy outward until the core implodes. It also shows two distinct stellar populations with different chemical abundances, and its five known variables are all RR Lyrae stars.

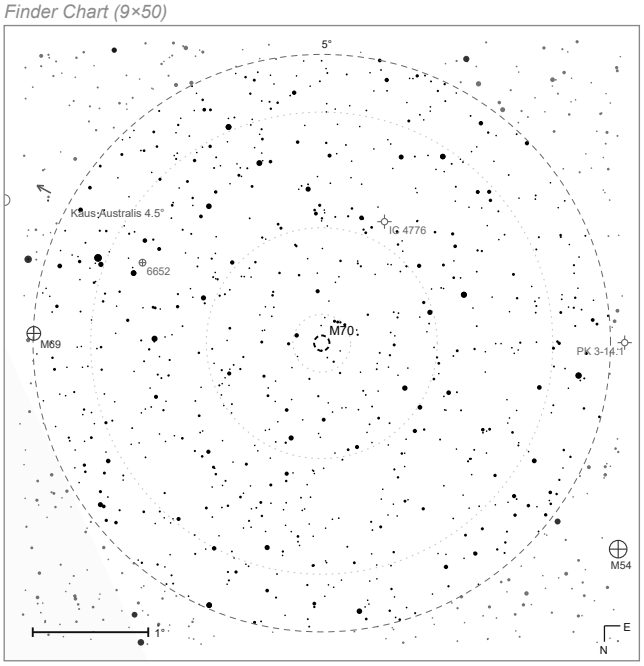
Constellation Map




Naked-eye view · mag 5 · field 36°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

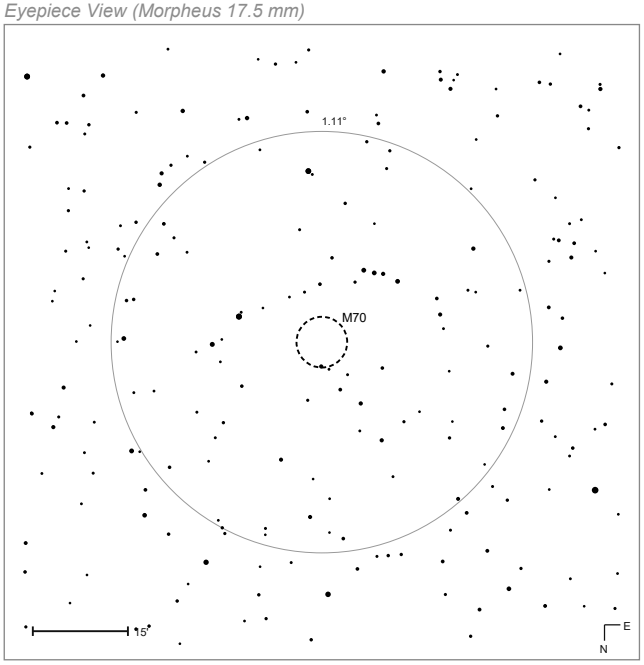
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.3

mag ● 6 ● 8 ● 10 · 12

# M71

GLOBULAR CLUSTER

| | |
|---|---|
| MESSIER | 71 |
| NGC | 6838 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Sagitta |
| DISTANCE | 13 kly |
| APPARENT MAG. | +8.3 |
| RA (J2000) | 19h 53m 48s |
| DEC (J2000) | +18° 47′ |
| APPARENT SIZE | 7.2′ |
| RADIUS (LY) | 14 |
| AGE (YEARS) | 9 billion |

## DISCOVERY & HISTORY

Philippe Loys de Chéseaux found M71 in 1745, Koehler noted it at Dresden around 1775, and Charles Messier catalogued it in 1780. For more than two centuries its very nature was disputed: it lacks a dense central concentration, its stars are richer in metals than an ancient globular's should be, and it has none of the RR Lyrae variables common in globular clusters. Leading researchers classified it as a dense open cluster well into the 1970s. It lies about 13,000 light-years away and spans 27 light-years.

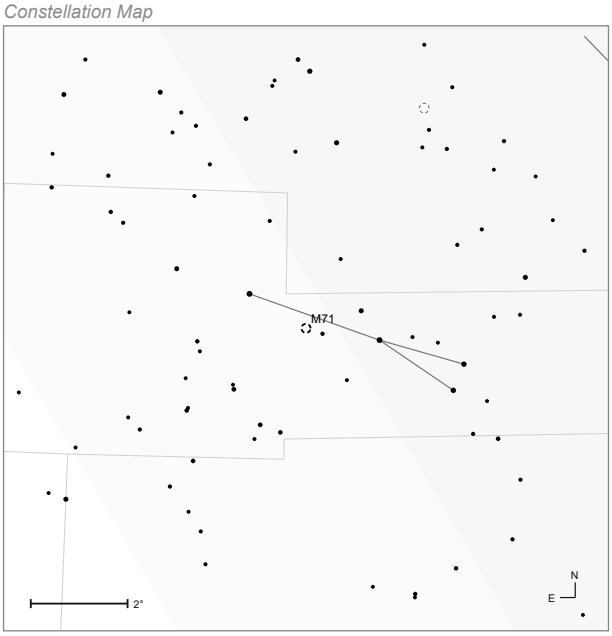
## AT THE EYEPIECE

M71 sits in the middle of the small but distinctive constellation Sagitta, 2° east of δ Sagittae; from 50°N it culminates at 59°. Even under clear skies it is barely visible in 8×30 or 10×50 binoculars. Resolving it takes 150–200 mm and decent magnification; at 300 mm it comes apart easily into stars of 11th to 16th magnitude across 7′, in a wedge some observers read as an arrowhead. The Dumbbell Nebula lies 4° north-north-east and the Coathanger asterism 7° west.

## WHY IT MATTERS

Modern photometry settled the argument: M71's H–R diagram shows a short horizontal branch, the signature of a globular cluster. Its shortness explains the missing RR Lyrae stars and follows from a relatively young age of 9–10 billion years — young for a globular, which also accounts for its higher metal content. M71 is therefore classified today as a very loosely concentrated globular, and stands as the catalogue's best illustration that the line between cluster types is a continuum, not a wall. The irregular variable Z Sagittae is a member.

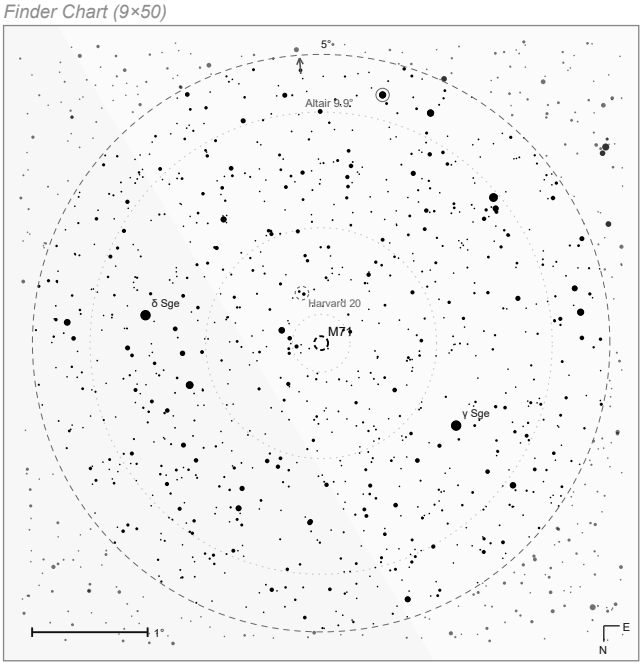
*Constellation Map*




*Naked-eye view · mag 7 · field 12°*

mag ● 1 ● 3 ● 5 ● 7

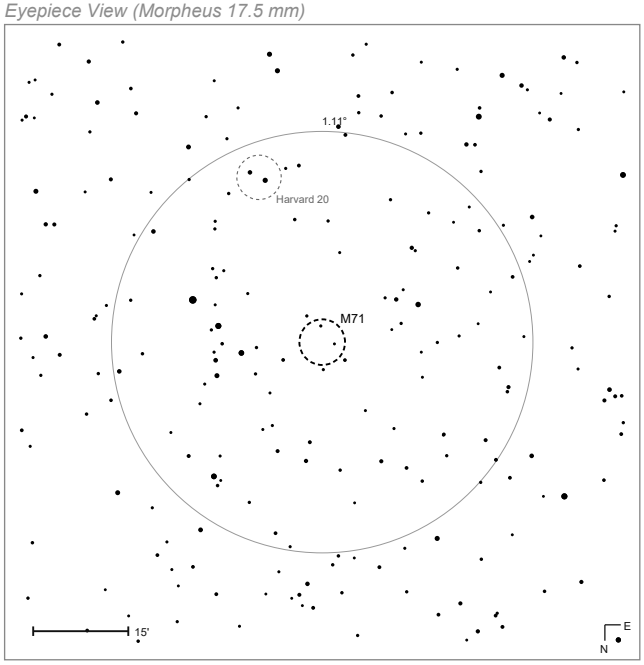
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11*

mag ● 6 ● 8 ● 10 · 12

# M72

GLOBULAR CLUSTER

| | |
|---|---|
| MESSIER | 72 |
| NGC | 6981 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Aquarius |
| DISTANCE | 54.5 kly |
| APPARENT MAG. | +9.2 |
| RA (J2000) | 20h 53m 30s |
| DEC (J2000) | −12° 32′ |
| APPARENT SIZE | 6.6′ |
| RADIUS (LY) | 52 |
| AGE (YEARS) | 9.5 billion |

## DISCOVERY & HISTORY

Pierre Méchain discovered M72 on 29 August 1780. Charles Messier looked for it 36 days later, on 7–8 October, and added it to his catalogue; both men called it a faint nebula rather than a cluster, in line with the terminology of the day. With a larger instrument John Herschel saw a bright "cluster of stars of a round figure". Harlow Shapley later noted its similarity to M4 and M12. Based on a 2011 census of its variables the cluster lies 54,500 light-years away, holds about 168,000 solar masses and is roughly 9.5 billion years old.

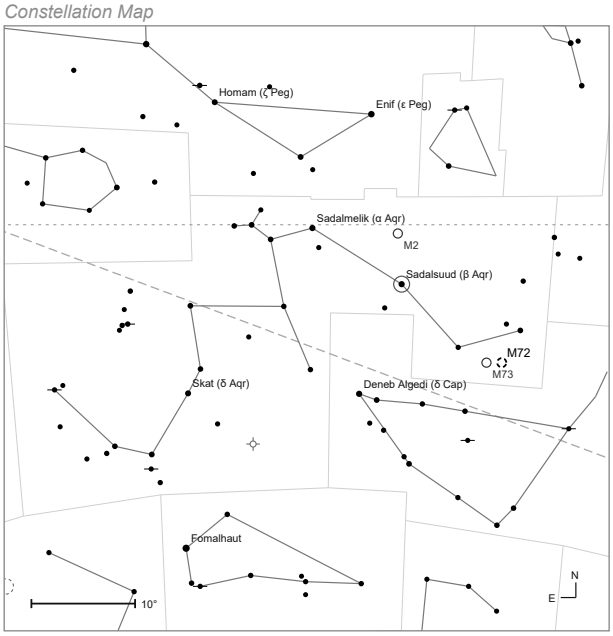
## AT THE EYEPIECE

M72 lies in western Aquarius, about 3° south-east of Albali (ε Aquarii); from 50°N it culminates at 28°, best July to November. Under a transparent sky 10×50 binoculars will find it, but it is one of the harder globulars to break up — it stays a small nebulous smudge even in modest telescopes. A few individual stars appear only from 250 mm at high magnification. The asterism M73 lies 1.5° east and the Saturn Nebula NGC 7009 3° north-east, making a natural three-object tour.

## WHY IT MATTERS

M72's distance of over 54,000 light-years puts it among the most remote globulars in the Messier catalogue — nearly twice as far as M13 — which is precisely why it looks so unimpressive: an intrinsically luminous cluster reduced to a faint patch by distance. Its 43 identified variable stars are what pin that distance down, since RR Lyrae stars serve as standard candles. Studying clusters this far out maps the extent and structure of the galactic halo.

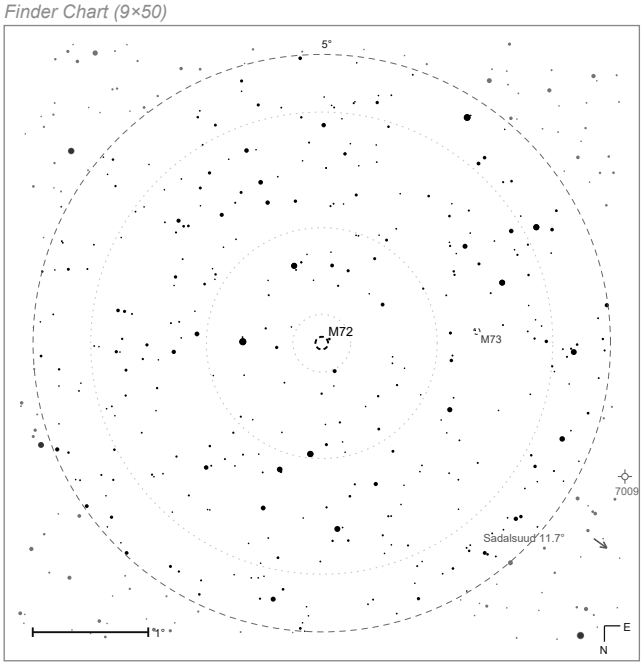
*Constellation Map*




*Naked-eye view · mag 5 · field 58°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

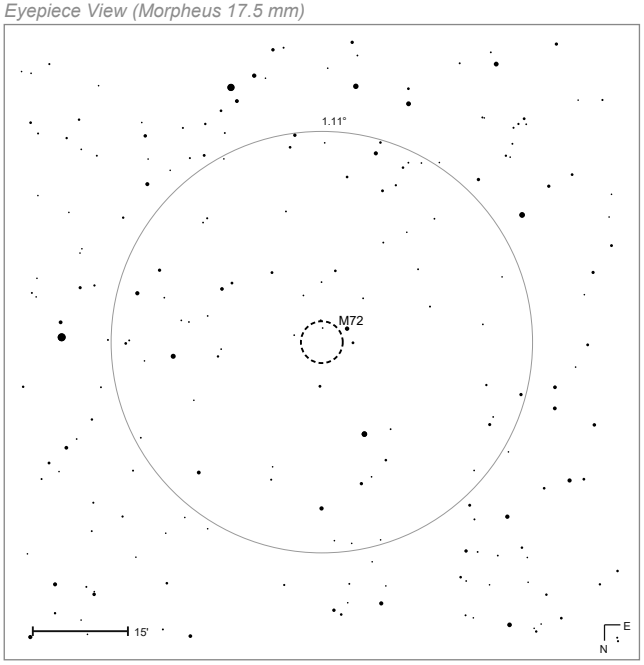
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.6*

mag ● 8 ● 10 · 12 · 14

# M73

*The four stars near the centre are all of M73 — an asterism, not a cluster.*

| | |
|---|---|
| MESSIER | 73 |
| NGC | 6994 |
| OBJECT TYPE | Asterism |
| CONSTELLATION | Aquarius |
| APPARENT MAG. | +9.7 |
| RA (J2000) | 20h 59m 00s |
| DEC (J2000) | −12° 38′ |
| APPARENT SIZE | 1.4′ |

## DISCOVERY & HISTORY

Charles Messier recorded M73 on 4 October 1780 as a cluster of four stars with some nebulosity. John Herschel could find no nebulosity at all and openly doubted that it was a cluster — but he listed it in his General Catalogue anyway, and Dreyer carried it into the NGC as NGC 6994. Whether the four stars formed a sparse open cluster was still argued in the early 2000s, until Gaia settled it: their distances are 1,030, 1,249, 2,170 and 2,290 light-years, with the second a binary. M73 is an asterism — four unrelated stars in a line of sight.

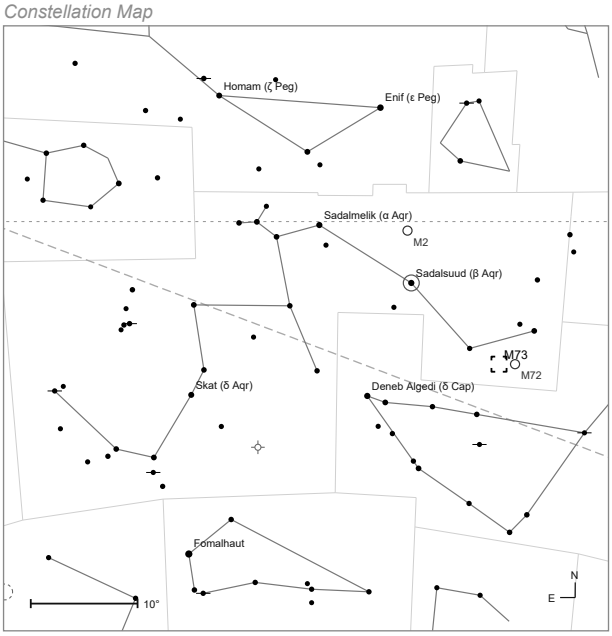
## AT THE EYEPIECE

M73 lies in western Aquarius, 1.5° east of M72 and 2° south-west of the Saturn Nebula NGC 7009; from 50°N it culminates at 27°, best July to November. Under a transparent sky 10×50 binoculars show a tiny knot of four or five stars, and even a small telescope reveals the whole truth of the object: four stars of 10th to 12th magnitude in a Y-shaped group about 1.4′ across, and nothing more. Visit it for completeness — a Messier marathon needs it — and for the pleasure of seeing exactly what Messier saw.

## WHY IT MATTERS

M73 is the catalogue's other honest mistake, alongside M40, and a cleaner one scientifically: it took two and a half centuries and micro-arcsecond parallaxes to prove definitively that four stars which look grouped are not. Two studies published in 2000 reached opposite conclusions from much the same photometry — one found the stars followed a cluster-like colour–magnitude relation, the other found no relation at all — a good reminder that photometric coincidence is not physical association.

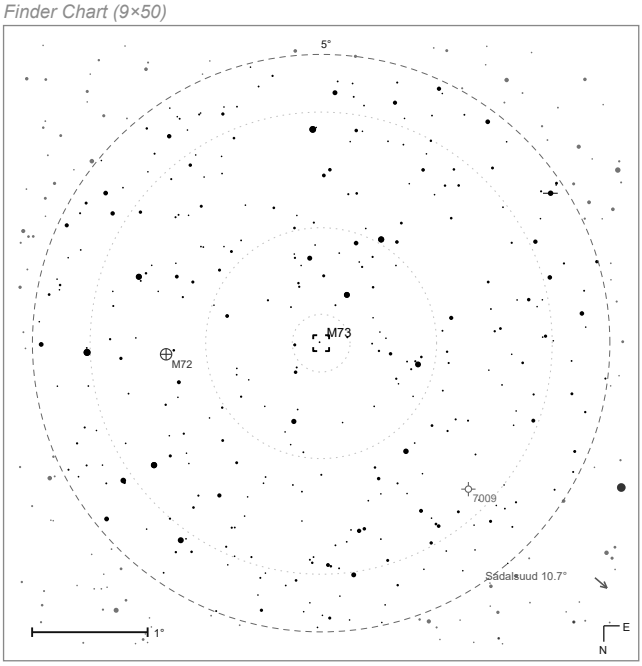
*Constellation Map*




*Naked-eye view · mag 5 · field 57°*

mag ● 1 ● 3 • 5 • 7 — ecliptic - - celestial equator

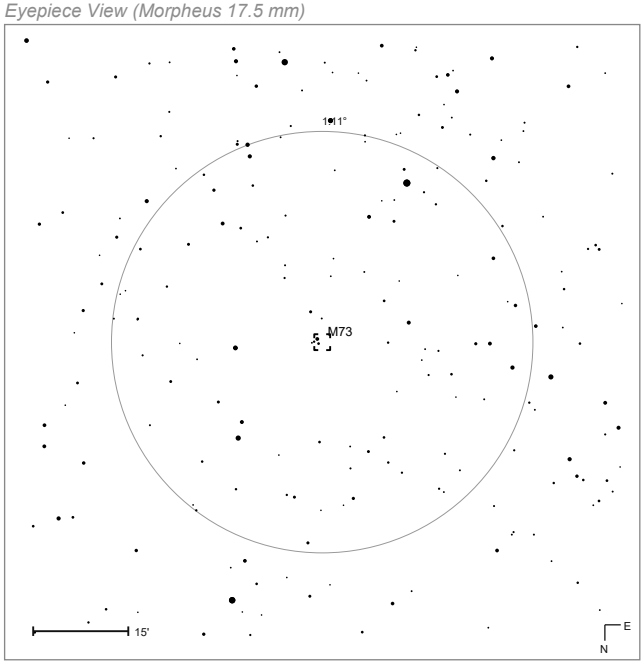
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 • 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.5*

mag • 8 • 10 · 12 · 14

# M74 Phantom Galaxy

| | |
|---|---|
| MESSIER | 74 |
| NGC | 628 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Pisces |
| DISTANCE | 32 Mly |
| APPARENT MAG. | +9.4 |
| RA (J2000) | 01h 36m 42s |
| DEC (J2000) | +15° 47′ |
| APPARENT SIZE | 10.5′ × 9.5′ |
| RADIUS (LY) | 48,900 |
| NUMBER OF STARS | 100 billion |

## DISCOVERY & HISTORY

Pierre Méchain found M74 in late September 1780 and passed it to Charles Messier, who measured its position and catalogued it. Its nickname, the Phantom Galaxy, is well earned: with one of the lowest surface brightnesses in the whole catalogue, it is generally reckoned the hardest of the 110 for amateurs. It lies about 32 million light-years away in Pisces, holds an estimated 100 billion stars, and was imaged by the James Webb Space Telescope in July 2022.

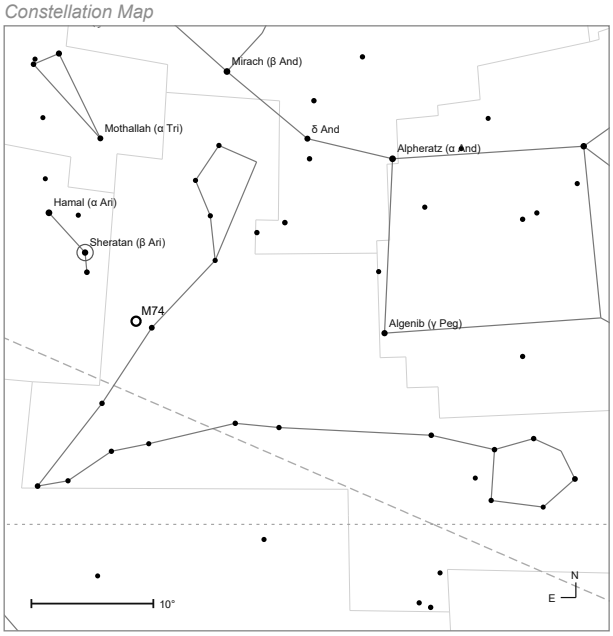
## AT THE EYEPIECE

M74 lies 1.5° east-north-east of Alpherg (η Piscium); from 50°N it culminates at 56°, but altitude is not the issue. Use the lowest power you have — higher magnification spreads its feeble light over more area and it disappears entirely for most eyes. Wait for full dark adaptation, use averted vision, and choose a moonless night far from towns. What you are looking for is a large, very faint round glow with a slightly brighter centre; the two arms are a photographic target, not a visual one. Do not attempt it from a light-polluted site.

## WHY IT MATTERS

M74 is the archetype of the grand design spiral: two clearly defined arms winding anticlockwise from the centre, widening outward, deviating only slightly from a constant pitch angle. Combined with its face-on orientation and large angular size, that makes it the standard test object for theories of spiral arm structure and density waves — everything that makes it useless visually makes it ideal professionally. Three supernovae have been recorded in it, including the Type Ic hypernova SN 2002ap.

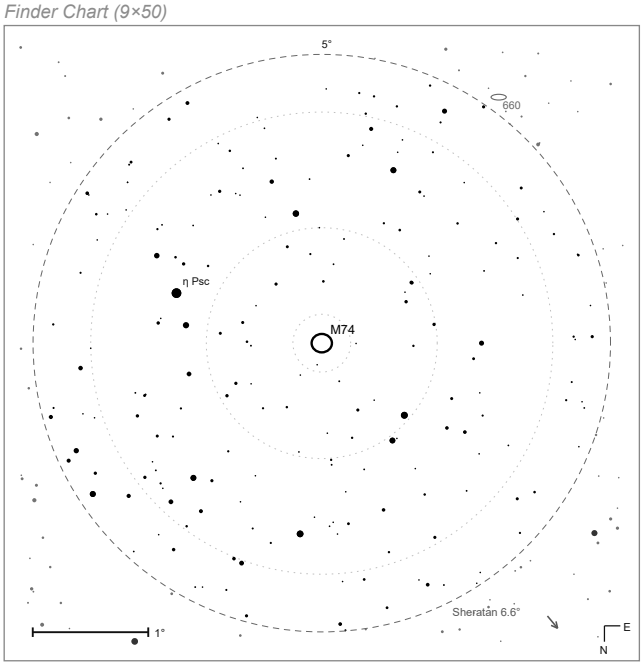
*Constellation Map*




*Naked-eye view · mag 5 · field 5°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

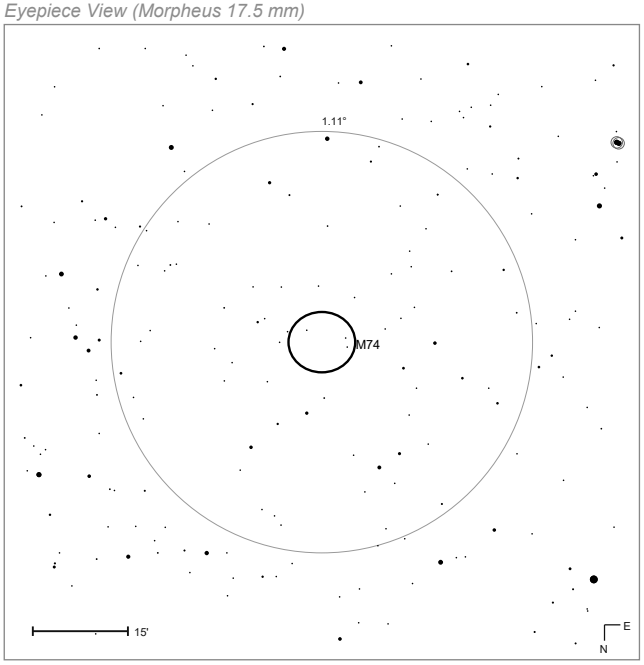
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

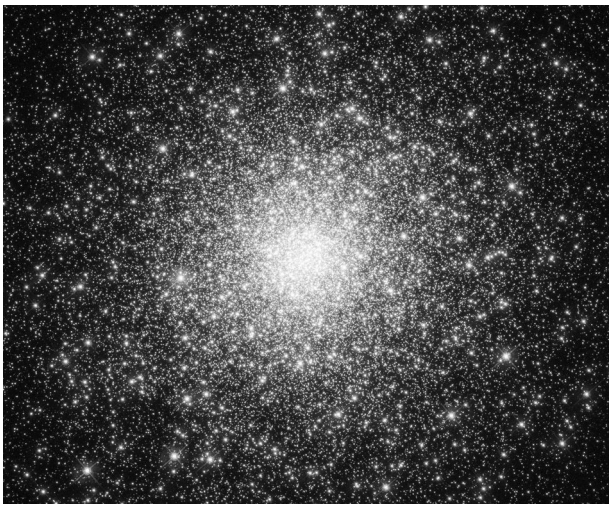



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M75





| | |
|---|---|
| MESSIER | 75 |
| NGC | 6864 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Sagittarius |
| DISTANCE | 68 kly |
| APPARENT MAG. | +8.6 |
| RA (J2000) | 20h 06m 06s |
| DEC (J2000) | −21° 55′ |
| APPARENT SIZE | 6.8′ |
| RADIUS (LY) | 67 |

## DISCOVERY & HISTORY

Pierre Méchain discovered M75 on 27 August 1780 and Charles Messier included it in his catalogue the same year, describing "a nebula without stars between Sagittarius and the head of Capricorn". William Herschel first resolved its stars in 1784. It lies about 67,500–68,000 light-years from Earth and 14,700 light-years beyond the galactic centre — we see it across the far side of the galaxy — with a true radius of some 67 light-years and an absolute magnitude of −8.5, 180,000 times the Sun's luminosity.

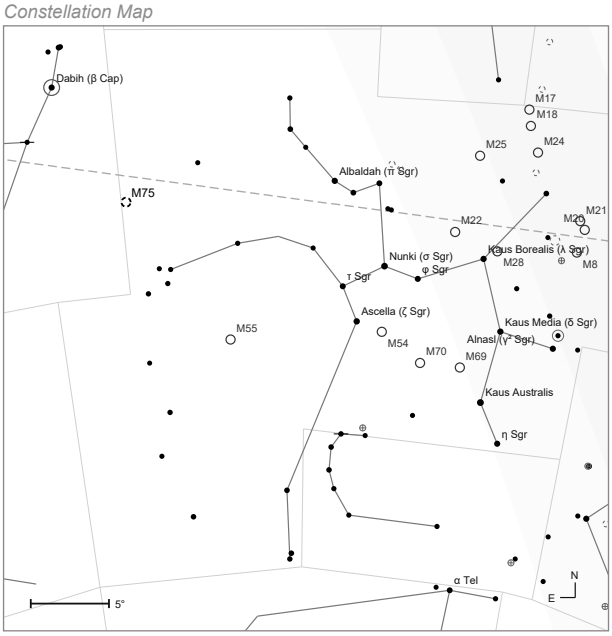
## AT THE EYEPIECE

M75 lies in a field without bright stars, 8° south-west of Dabih (β Capricorni); from 50°N it culminates at 18°. Small instruments will not find it — start with 11×80 binoculars, in which it is a faint point. Because it is both distant and among the most concentrated globulars known, it looks almost stellar at low power: a 10″ Dobsonian shows a small bright ball about 7′ across with a blazing centre and essentially no resolution, its brightest stars being 17th magnitude. Class I concentration in a nutshell.

## WHY IT MATTERS

M75 belongs to the Gaia Sausage — the debris of a dwarf galaxy that merged with the Milky Way early in its history — so it is an immigrant, not a native. It circles the galaxy every 400 million years on a strongly eccentric halo orbit. Despite its extreme concentration it appears not to have undergone core collapse yet, and it rotates slowly about an axis inclined near −15°. It contains 38 RR Lyrae variables and 62 candidate blue stragglers, 60% of them in the core.

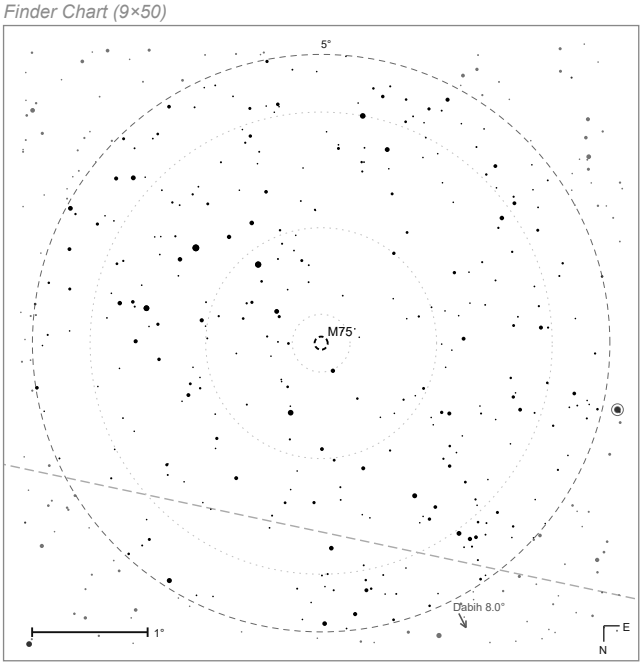
*Constellation Map*




*Naked-eye view · mag 5 · field 39°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

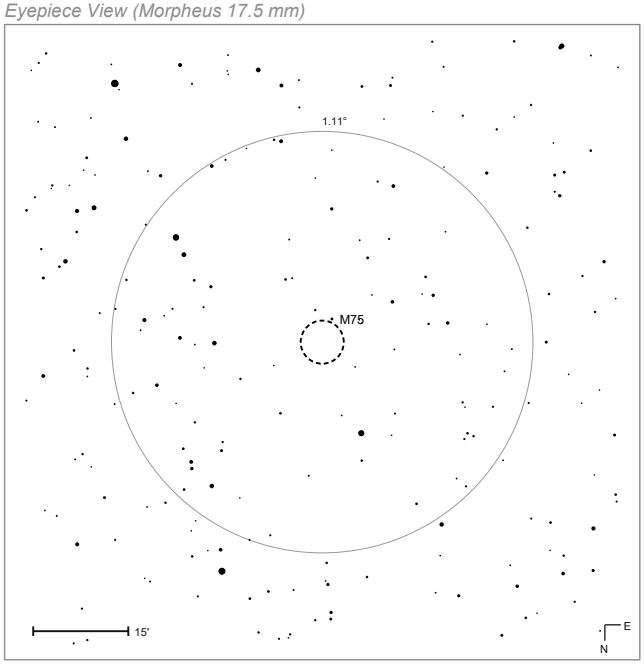
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 — ecliptic · · Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

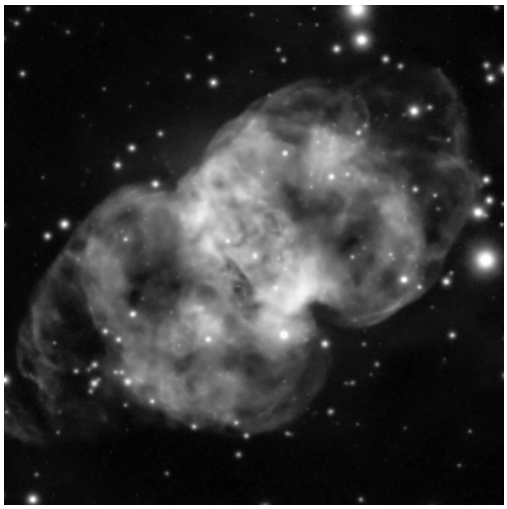



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.4*

mag ● 8 ● 10 · 12 · 14

# M76 Little Dumbbell Nebula





| | |
|---|---|
| MESSIER | 76 |
| NGC | 650 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Planetary Nebula |
| CONSTELLATION | Perseus |
| DISTANCE | 2,500 ly |
| APPARENT MAG. | +10.1 |
| RA (J2000) | 01h 42m 18s |
| DEC (J2000) | +51° 35′ |
| APPARENT SIZE | 3.1′ |
| RADIUS (LY) | 1 |

## DISCOVERY & HISTORY

Pierre Méchain found M76 on 5 September 1780 and told Charles Messier, who observed it on 21 October and noted that even the faint light used to illuminate his micrometer scale made it disappear. William Herschel was convinced it was two separate nebulae, which is why it carries two NGC numbers, 650 and 651. William Huggins showed spectroscopically that it was gaseous; Isaac Roberts suggested in 1891 that it might be a Ring Nebula seen edge-on; and Heber Curtis formally classified it as a planetary nebula in 1918. It lies about 2,500 light-years away.

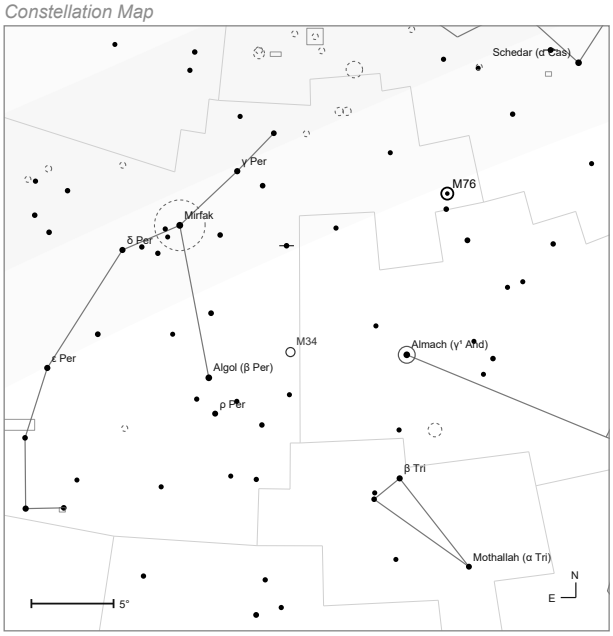
## AT THE EYEPIECE

M76 is among the faintest objects in the catalogue and sits in a field without bright stars: start from the 4th-magnitude φ Persei and move just under 1° north. From 50°N it passes overhead and is circumpolar, best September to February. It is out of reach of medium binoculars; 11×80 may show a blurred point. A 150 mm telescope gives an object elongated north-east to south-west, and a 10″ Dobsonian at 150× with an OIII filter shows the two lobes that earn it the name Little Dumbbell. The 16th-magnitude central star is beyond most instruments.

## WHY IT MATTERS

M76 is a bipolar planetary nebula: a ring seen edge-on, appearing as the central bar, with a lobe flaring out of each opening. The sequence is legible in its shape — the progenitor star shed the ring while still on the asymptotic giant branch, then expelled its remaining outer layers to form the lobes, leaving a white dwarf behind. Few objects show the two-stage geometry of stellar death so plainly, which is why an unpromising smudge repays the effort.

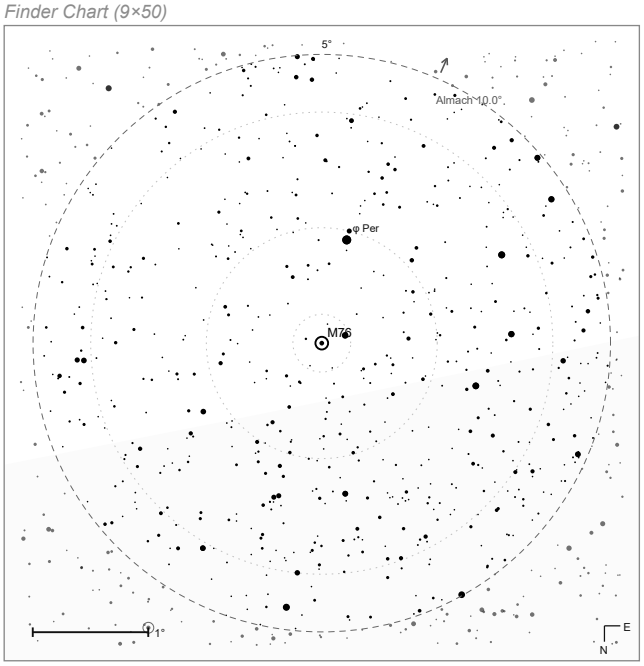
Constellation Map




Naked-eye view · mag 5 · field 37°

mag ● 1 ● 3 ● 5 ● 7

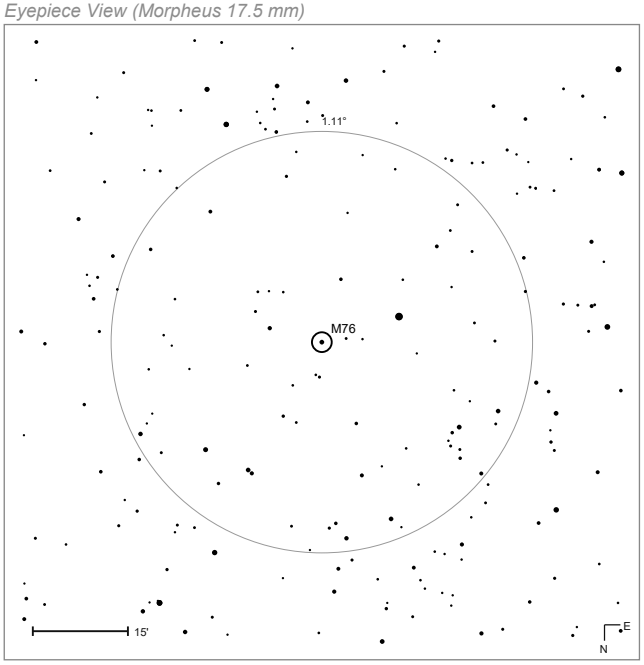
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

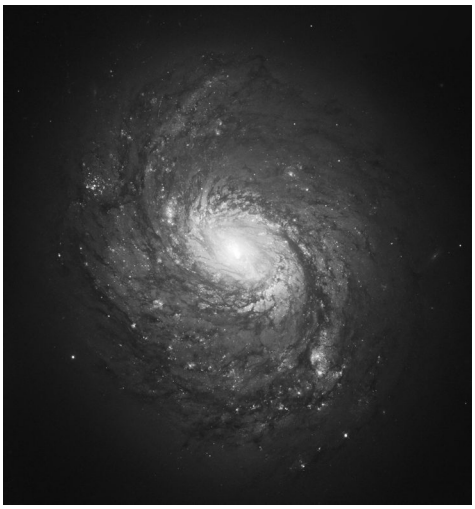



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.6

mag ● 6 ● 8 ● 10 · 12

# M77 Cetus A

GALAXY



| | |
|---|---|
| MESSIER | 77 |
| NGC | 1068 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Cetus |
| DISTANCE | 47 Mly |
| APPARENT MAG. | +8.9 |
| RA (J2000) | 02h 42m 42s |
| DEC (J2000) | −00° 01′ |
| APPARENT SIZE | 7.1′ × 6.0′ |
| RADIUS (LY) | 48,500 |

## DISCOVERY & HISTORY

Pierre Méchain found M77 on 29 October 1780 and called it a nebula; Charles Messier added it on 17 November as a cluster with nebulosity, probably misled by foreground stars or by the bright knots in its arms. William Herschel also read it as a star cluster. Despite that, M77 was among the first 14 objects William Parsons described as "spiral nebulae" in 1850. It lies about 47 million light-years away in Cetus, spans some 90,000 light-years, and is one of the brightest Seyfert galaxies visible from Earth.

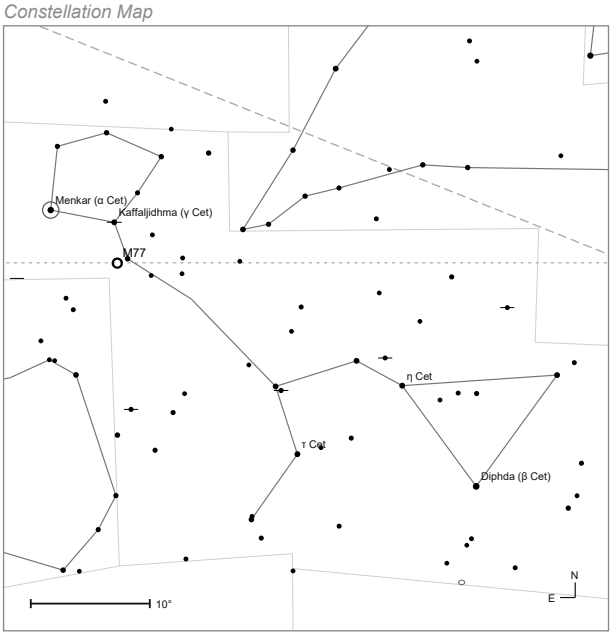
## AT THE EYEPIECE

M77 lies about 1° south-east of δ Ceti; from 50°N it culminates at 40°, and December is its month. Under good conditions small telescopes show a compact round haze with a 9th-magnitude star nearby; traces of spiral structure need a larger amateur instrument, and the very bright core dominates at any aperture. Half a degree north-west lies the edge-on spiral NGC 1055, visible in the same low-power field, and NGC 1073 sits 1.5° north — all three belong to the M77 group.

## WHY IT MATTERS

M77 is the archetypal Seyfert 2 galaxy: its nucleus radiates as fiercely as an entire small galaxy, powered by accretion onto a supermassive black hole hidden behind a thick torus of dust. It was in M77 that the obscuring-torus picture of active galaxies was largely worked out, and radio and infrared observations resolve gas clouds orbiting the black hole directly. Infrared imaging also reveals a prominent bar invisible in optical light, which is why the galaxy is now classified as a barred spiral.

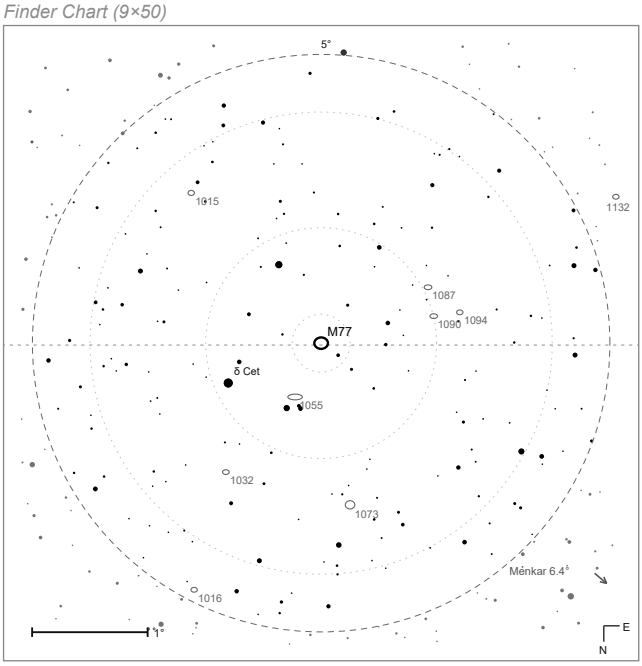
*Constellation Map*




*Naked-eye view · mag 5.5 · field 51°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

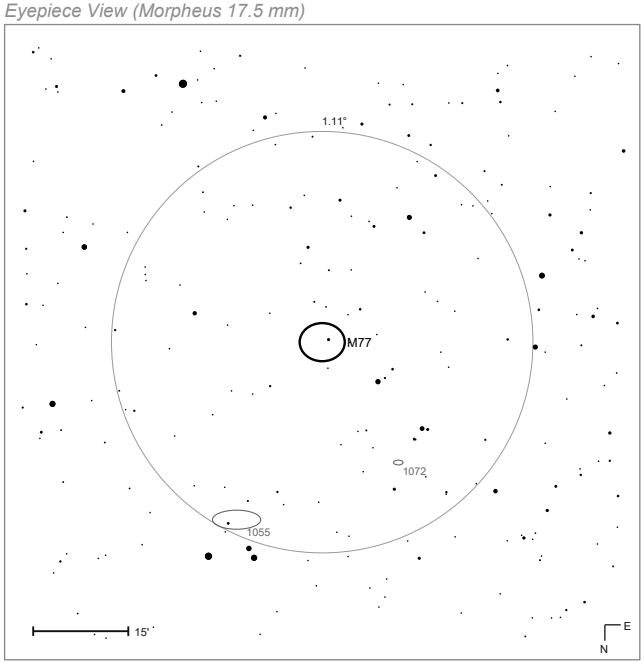
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - celestial equator · · Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

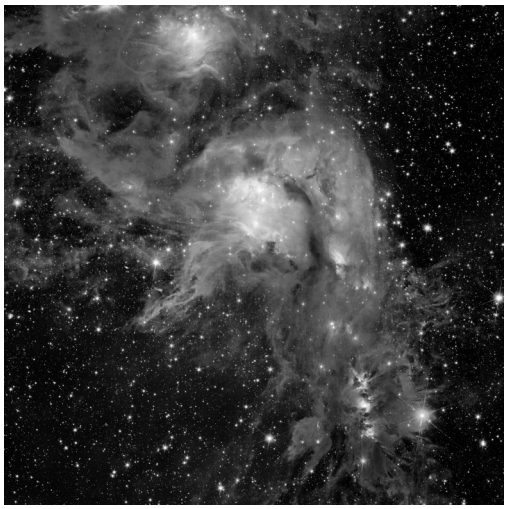



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.4*

mag ● 8 ● 10 · 12 · 14

# M78





| | |
|---|---|
| MESSIER | 78 |
| NGC | 2068 |
| OBJECT TYPE | Diffuse Nebula |
| CONSTELLATION | Orion |
| DISTANCE | 1,600 ly |
| APPARENT MAG. | +8.0 |
| RA (J2000) | 05h 46m 48s |
| DEC (J2000) | +00° 05′ |
| APPARENT SIZE | 8.0′ × 6.0′ |
| RADIUS (LY) | 2 |

## DISCOVERY & HISTORY

Pierre Méchain discovered M78 in 1780 and Charles Messier catalogued it the same year. It is the brightest diffuse reflection nebula in the sky, and the brightest of a group that includes NGC 2064, NGC 2067 and NGC 2071, all part of the Orion B molecular cloud complex about 1,350–1,600 light-years away. Amateur observers have nicknamed it the Casper the Friendly Ghost Nebula. In May 2024 ESA released a Euclid image of it revealing hundreds of thousands of previously unseen objects, including substellar bodies.

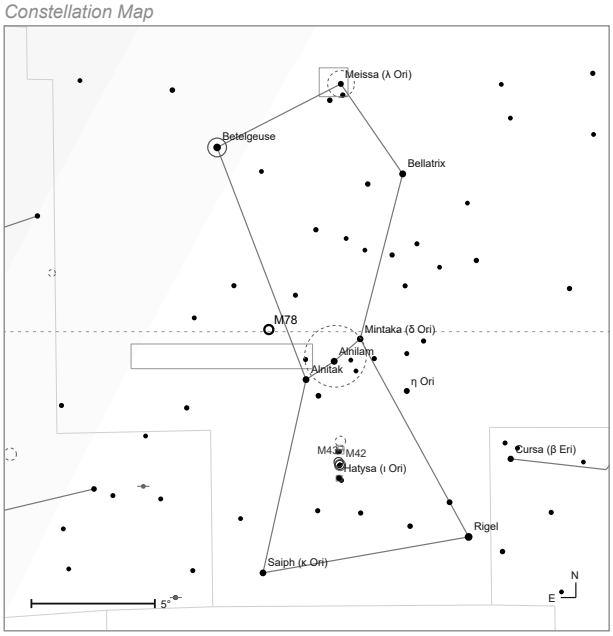
## AT THE EYEPIECE

M78 is easy to place: 3.5° east and half a degree north of Mintaka (δ Orionis) in Orion's Belt. From 50°N it culminates at 40°, best November to April. It is within reach of 10×50 binoculars on a transparent night, as it is for a 60–80 mm telescope. From 140 mm it is unmistakable — a broad grey-blue fan wrapped around a close pair of 10th- and 11th-magnitude stars, HD 38563 A and B, which supply all its light. At 300 mm the northern edge looks strikingly sharp, cut off by a dark dust lane. NGC 2071 lies 12′ north.

## WHY IT MATTERS

M78 shines by reflection, not emission: the dust simply scatters starlight, so its spectrum is that of its illuminating stars — the cleanest demonstration in the catalogue of the difference between reflection and emission nebulae. Behind the visible fan, infrared observations find an embedded star cluster and a hierarchy of gas clumps from 0.3 to 5 solar masses, along with 45 T Tauri stars and 17 Herbig–Haro objects: jets from stars still in the act of forming.

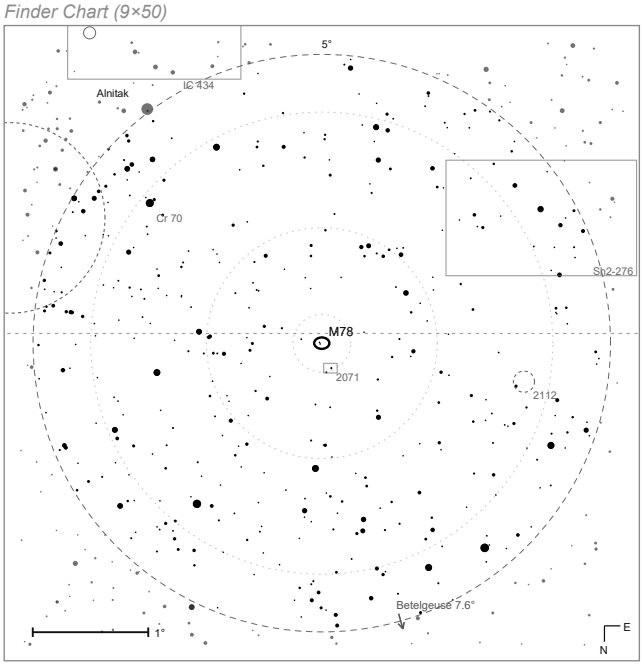
*Constellation Map*




*Naked-eye view · mag 5.5 · field 24°*

mag ● 1 ● 3 • 5 • 7 – – celestial equator

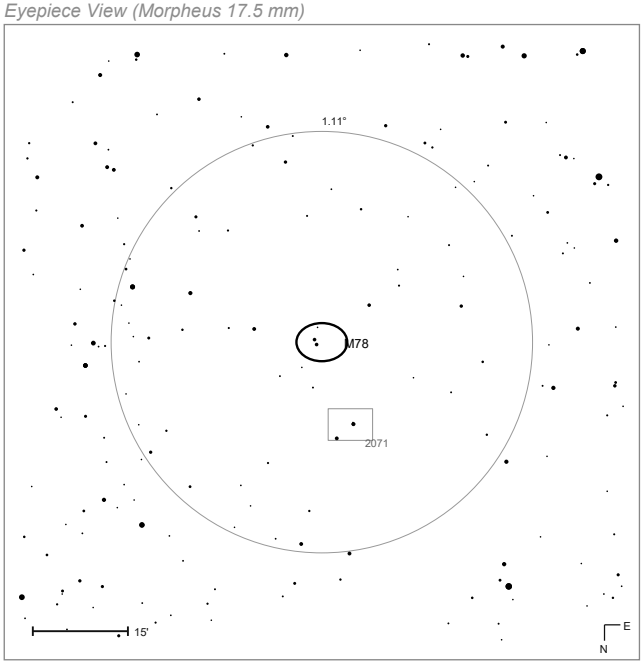
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 • 6 • 8 · 10 – – celestial equator - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

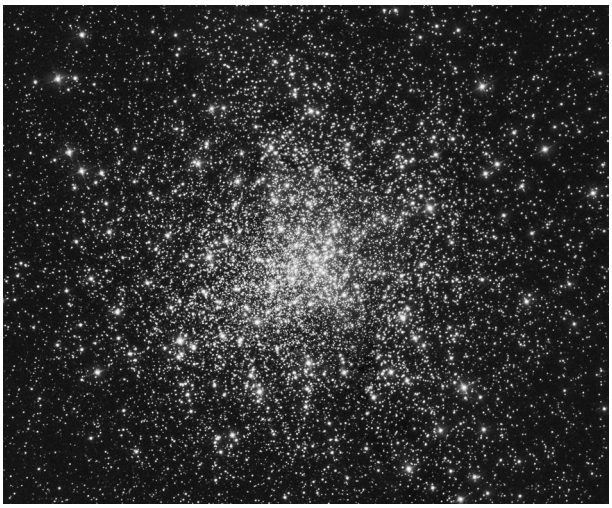



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.7*

mag • 8 • 10 · 12 · 14

# M79





| | |
|---|---|
| MESSIER | 79 |
| NGC | 1904 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Lepus |
| DISTANCE | 42 kly |
| APPARENT MAG. | +7.7 |
| RA (J2000) | 05h 24m 12s |
| DEC (J2000) | −24° 31′ |
| APPARENT SIZE | 9.6′ |
| RADIUS (LY) | 59 |
| AGE (YEARS) | 11.7 billion |

## DISCOVERY & HISTORY

Pierre Méchain discovered M79 on 26 October 1780 and Charles Messier measured its position and catalogued it the same year. It lies about 42,000 light-years from Earth and 60,000 from the galactic centre — a globular cluster in a part of the sky where, on the standard picture of the halo, one should not be. That anomaly turned out to be the point: M79 appears not to be native to the Milky Way at all.

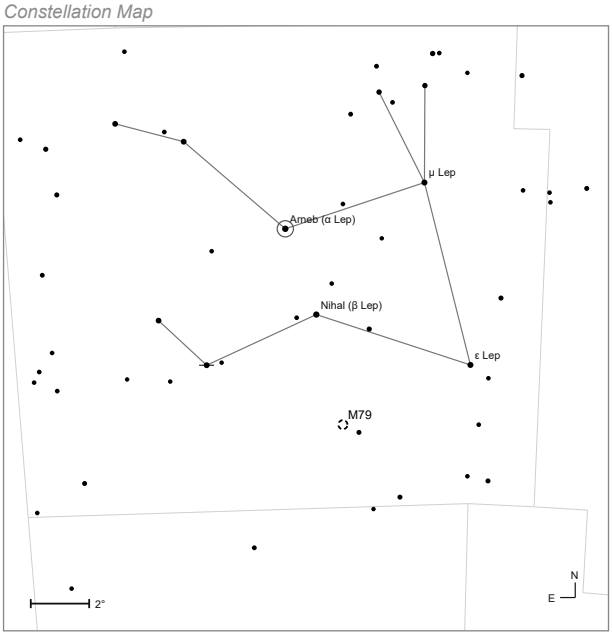
## AT THE EYEPIECE

Find M79 by extending the line from Arneb (α Leporis) to Nihal (β Leporis) southward by the same distance again. From 50°N it culminates at 16°, so a clean southern horizon matters; best November to April. Medium binoculars need a very clear sky, while an 80 mm telescope picks it up easily. At 140 mm and 25× it is a round patch hiding a few very faint stars; 200 mm brings the count to about fifty, and at 300 mm well over a hundred appear, including inside the bright central glow.

## WHY IT MATTERS

Like M54, M79 is probably extragalactic in origin — most likely a cluster of the putative Canis Major Dwarf Galaxy, currently in a very close encounter with our own, though the existence of that dwarf is still debated; it may instead belong to the Gaia Sausage merger debris. Either way the galactic tide is now pulling it apart, and it trails a long tidal tail. Its near-infrared colour–magnitude diagram is a standard teaching example, with the red giant branch standing out as a long elongated sequence.

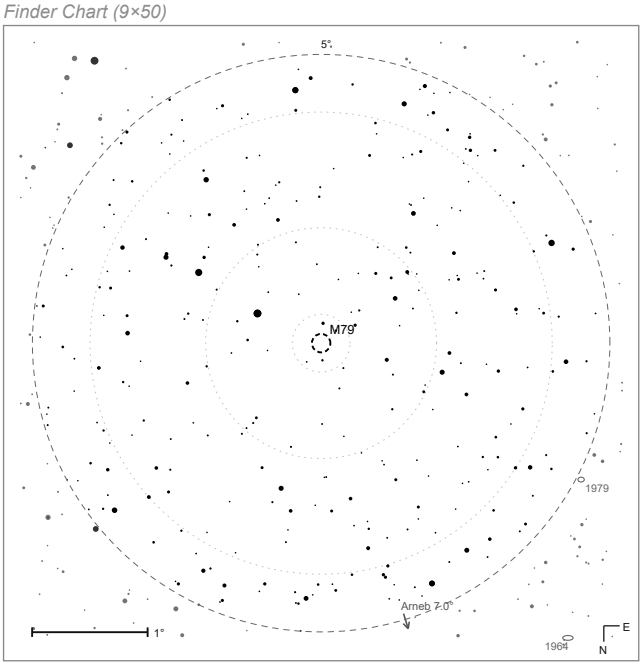
*Constellation Map*




*Naked-eye view · mag 6 · field 21°*

mag ● 1 ● 3 ● 5 ● 7

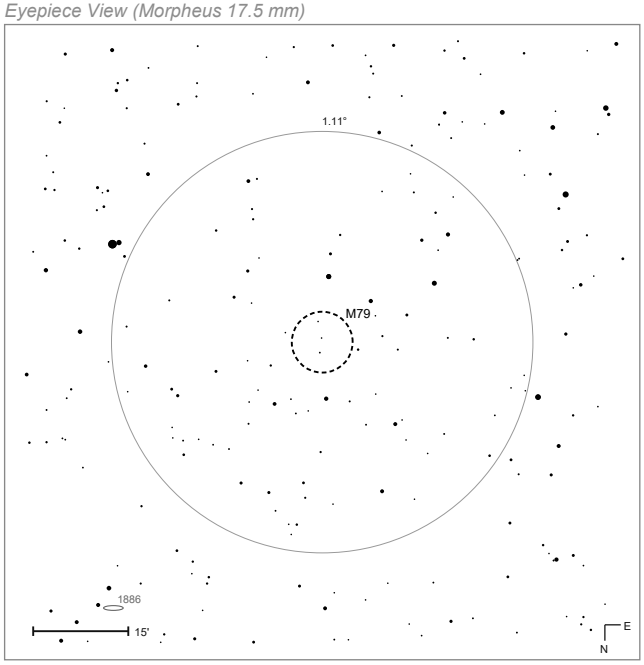
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.6*

mag ● 8 ● 10 · 12 · 14

# M80

GLOBULAR CLUSTER

| | |
|---|---|
| MESSIER | 80 |
| NGC | 6093 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Scorpius |
| DISTANCE | 32.6 kly |
| APPARENT MAG. | +7.3 |
| RA (J2000) | 16h 17m 00s |
| DEC (J2000) | −22° 59′ |
| APPARENT SIZE | 10.0′ |
| RADIUS (LY) | 47 |

## DISCOVERY & HISTORY

Charles Messier discovered M80 on 4 January 1781 and described "a nebula without stars; it resembles the nucleus of a comet." William Herschel partially resolved it in 1786 and pronounced it a very rich cluster; Admiral Smyth thought it looked like a comet without a tail. It lies roughly 28,000–32,600 light-years away in the galactic halo and contains several hundred thousand stars within some 86–95 light-years.

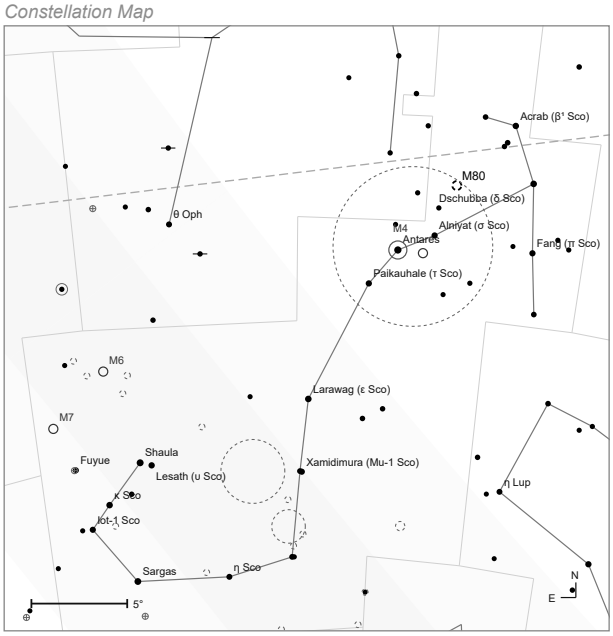
## AT THE EYEPIECE

M80 could hardly be easier to find — it sits halfway between Antares (α Scorpii) and Acrab (β Scorpii), in a region rich in nebulosity. From 50°N it culminates at 17°. A good binocular shows a soft round concentration; a 120 mm telescope gives a patch just under 10′. It is one of the densest globulars in the galaxy, so resolution comes hard: 200 mm begins to grain the outer edge while most of the disc stays milky, its stars being 14th magnitude and fainter. Best May to August.

## WHY IT MATTERS

M80 is notable for an exceptionally rich population of blue stragglers — stars that look younger than the cluster they belong to. Hubble images show them concentrated in distinct regions, which points to frequent stellar collisions and mergers in the crowded core: the stragglers are rejuvenated products of those encounters. The cluster also produced the nova T Scorpii on 21 May 1860, which briefly outshone the entire cluster at magnitude 7.0, absolute magnitude −8.5 — one of very few novae ever seen in a globular.

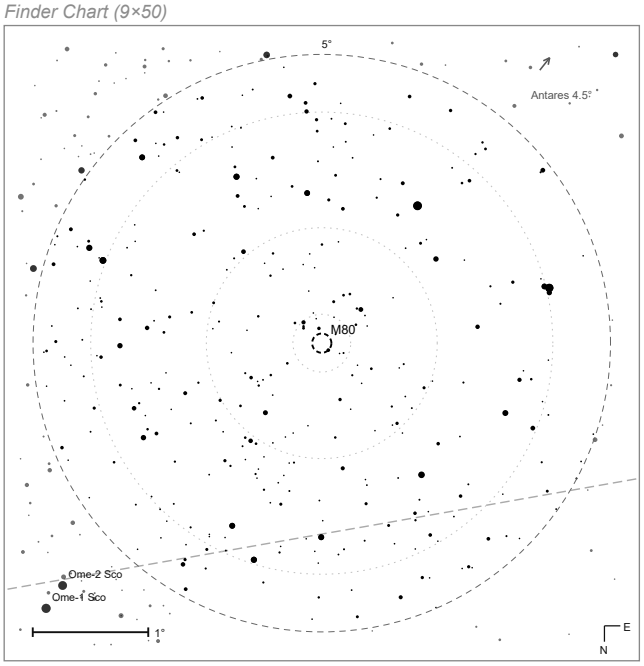
Constellation Map




Naked-eye view · mag 5 · field 32°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic

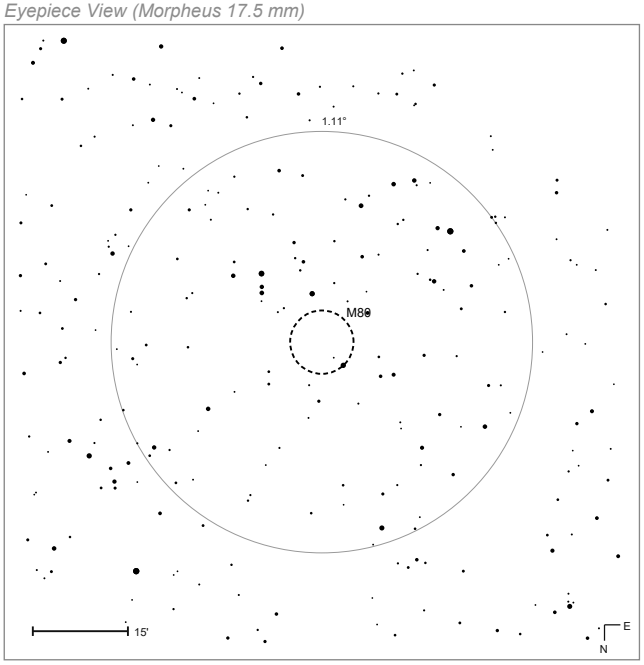
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 ● 10 — ecliptic - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.2

mag ● 8 ● 10 ● 12 ● 14

# M81 Bode's Galaxy

| | |
|---|---|
| MESSIER | 81 |
| NGC | 3031 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Ursa Major |
| DISTANCE | 12 Mly |
| APPARENT MAG. | +6.9 |
| RA (J2000) | 09h 55m 36s |
| DEC (J2000) | +69° 04′ |
| APPARENT SIZE | 26.9′ × 14.1′ |
| RADIUS (LY) | 46,900 |

## DISCOVERY & HISTORY

Johann Elert Bode found M81 and M82 on 31 December 1774, which is why M81 still carries his name. Pierre Méchain re-identified both in 1779 and reported them to Charles Messier, who added them to his catalogue. M81 lies about 12 million light-years away and spans some 96,000 light-years — a grand design spiral close enough, large enough and active enough to have been studied exhaustively ever since. In late February 2022 astronomers reported that it may be the source of the repeating fast radio burst FRB 20200120E.

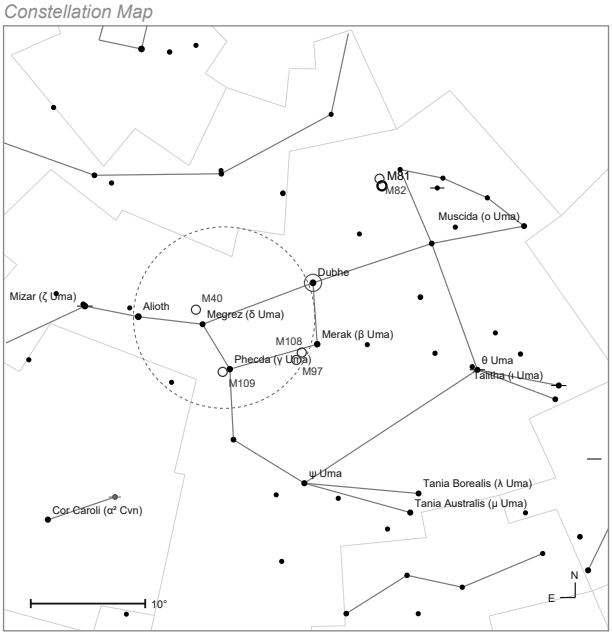
## AT THE EYEPIECE

M81 lies roughly 10° north-west of Dubhe (α UMa) and from 50°N passes almost overhead. Under good skies a plain binocular finds it. A 60–80 mm telescope shows a bright patch several arcminutes long elongated NNW–SSE; 150 mm brings out core detail, far brighter than the outer regions, which simply fade into the sky. At 250–300 mm the arms register as uneven brightness in the halo. M82 lies 35′ north and NGC 3077 45′ south-east — the finest galaxy pair in the northern sky in one field.

## WHY IT MATTERS

M81's active nucleus hosts a supermassive black hole of about 70 million solar masses, and its proximity makes it one of the best-resolved examples of a low-luminosity active nucleus. Long-exposure imaging shows M81 and M82 embedded in a broad web of interwoven filaments — gas and dust drawn out by their mutual encounter, tangled with foreground Milky Way nebulosity. That encounter is what triggered M82's starburst, making this pair a standard case study in interaction-driven galaxy evolution.

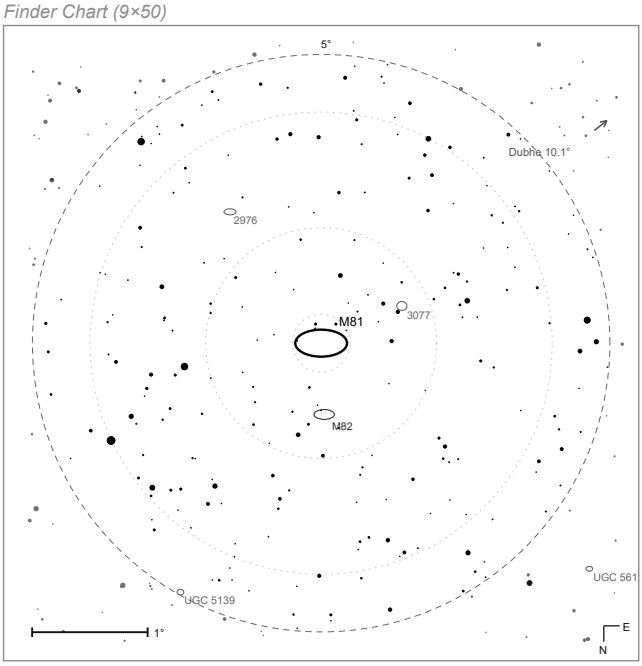
Constellation Map




Naked-eye view · mag 5 · field 53°

mag ● 1 ● 3 ● 5 ● 7

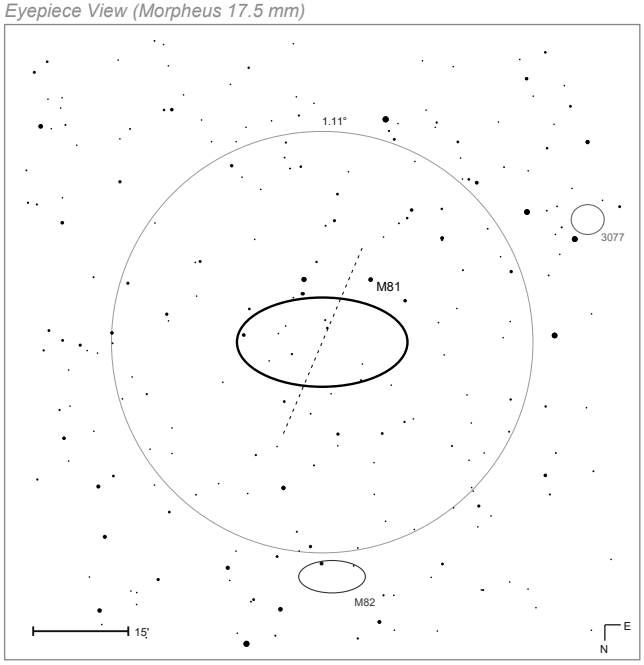
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.3

mag ● 8 ● 10 · 12 · 14

# M82 Cigar Galaxy

GALAXY

*M82 is the narrow cigar at right; the face-on spiral at left is M81.*

| | |
|---|---|
| MESSIER | 82 |
| NGC | 3034 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Ursa Major |
| DISTANCE | 12 Mly |
| APPARENT MAG. | +8.4 |
| RA (J2000) | 09h 55m 54s |
| DEC (J2000) | +69° 41′ |
| APPARENT SIZE | 11.2′ × 4.3′ |
| RADIUS (LY) | 19,500 |

## DISCOVERY & HISTORY

Johann Elert Bode found M82 with M81 in 1774, describing a "nebulous patch… very pale and of elongated shape" three-quarters of a degree from its neighbour. Pierre Méchain rediscovered both in 1779 and reported them to Charles Messier. Long taken for an irregular galaxy, M82 was shown in 2005 to have two symmetric spiral arms, visible only in the near infrared through its dust. It lies about 12 million light-years away, spans some 41,000 light-years and is five times more luminous than the Milky Way — its central region a hundred times more.

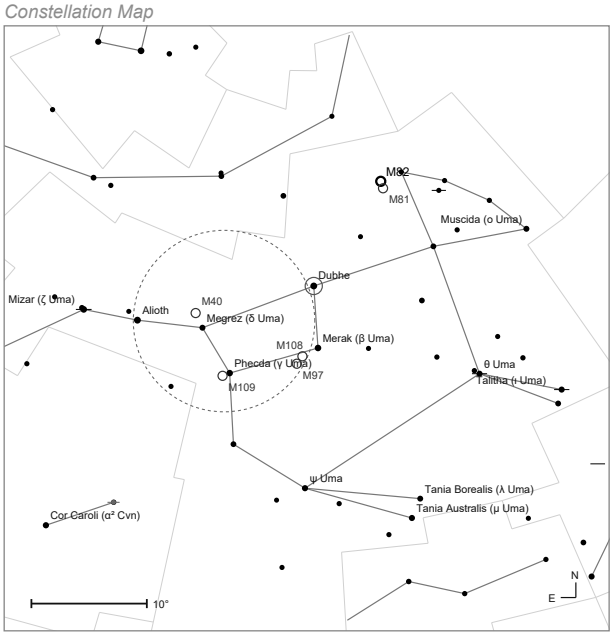
## AT THE EYEPIECE

M82 lies 35′ north of M81 and shares its field; from 50°N it culminates near the zenith. Binoculars show a thin streak beside M81's oval. In a 10″ Dobsonian under Bortle 4 skies it is the more dramatic of the two: a bright cigar about 11′ × 4′ crossed by dark irregular lanes, with a distinctly mottled, blotchy texture that no smooth galaxy shows. Higher power on the central region repays the effort; the dust lanes cutting across the middle are its signature.

## WHY IT MATTERS

M82 is the prototype starburst galaxy — the nearest and best-studied example — its furious star formation triggered by the gravitational encounter with M81. That intensity makes it a factory of extremes: SN 2014J, a Type Ia supernova, appeared here in January 2014; the brightest pulsar known, M82 X-2, was identified the same year; and in November 2023 a gamma-ray burst was traced to a magnetar in M82, the first such detection outside the Milky Way.

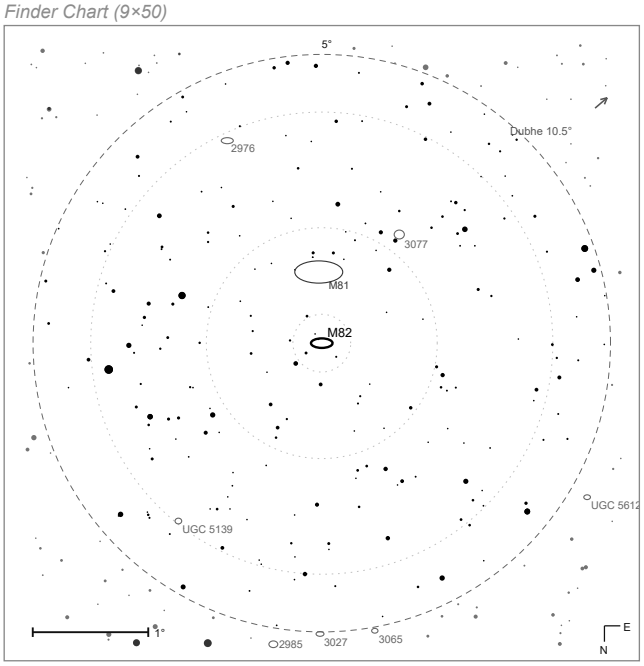
*Constellation Map*




*Naked-eye view · mag 5 · field 52°*

mag ● 1 ● 3 ● 5 ● 7

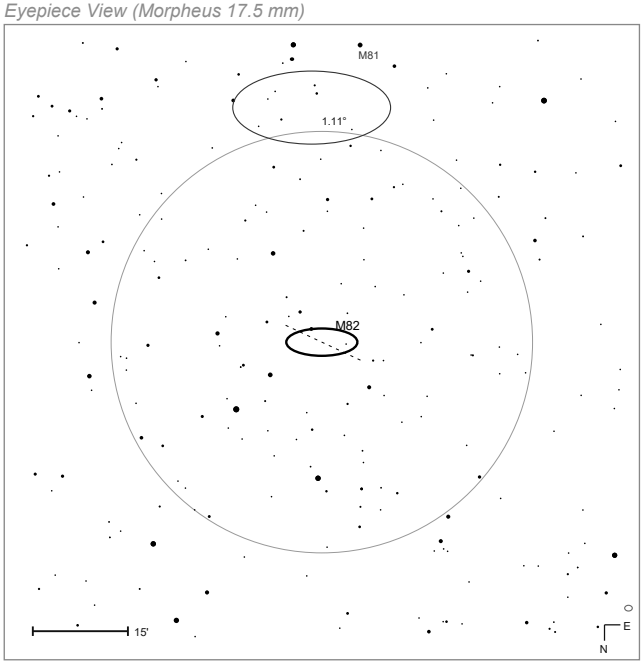
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

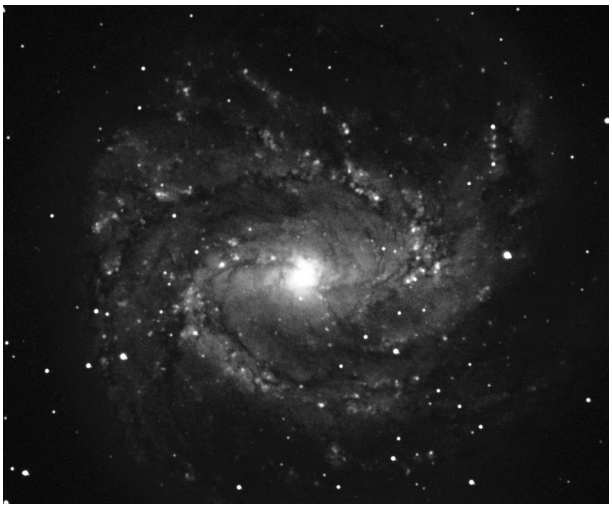



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.3*

mag ● 8 ● 10 · 12 · 14

# M83 Southern Pinwheel Galaxy





| | |
|---|---|
| MESSIER | 83 |
| NGC | 5236 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Hydra |
| DISTANCE | 15 Mly |
| APPARENT MAG. | +7.5 |
| RA (J2000) | 13h 37m 00s |
| DEC (J2000) | −29° 52′ |
| APPARENT SIZE | 12.9′ × 11.5′ |
| RADIUS (LY) | 28,100 |

## DISCOVERY & HISTORY

Nicolas-Louis de Lacaille discovered M83 in February 1752 from the Cape of Good Hope — one of the southern objects European astronomers could not reach — and Charles Messier added it to his catalogue in March 1781. Its nickname, the Southern Pinwheel, comes from its resemblance to M101. It lies about 15 million light-years away on the Hydra–Centaurus border, spans some 118,000 light-years, and is one of the closest and brightest barred spirals in the sky.

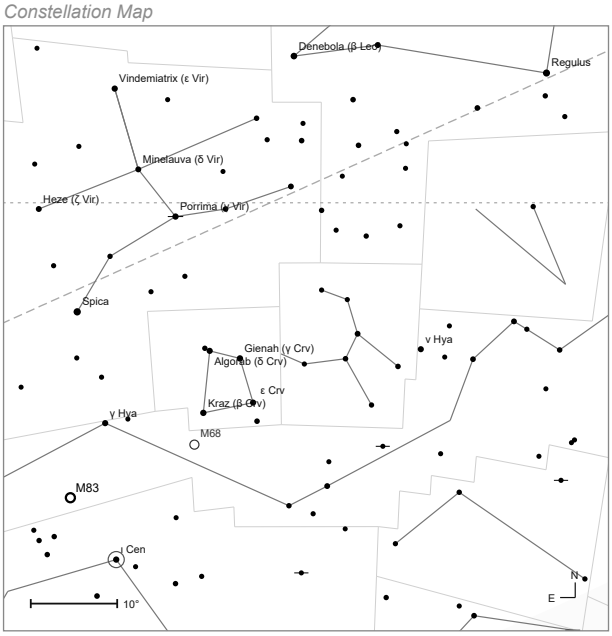
## AT THE EYEPIECE

M83 lies about 18° south of Spica, just north of the stars forming the head of Centaurus. From 50°N it culminates at only 10°, so Czech observers get a brief, low, atmosphere-dimmed view at best; from southern Europe it is transformed. Under a reasonably dark sky binoculars find it. A 150 mm telescope shows an ill-defined hazy patch with a bright nucleus emerging from it, and 250 mm reveals the irregular disc with a dark lane crossing its southern side. Best March to July.

## WHY IT MATTERS

M83 is a massive grand design spiral whose star formation runs faster along the leading edges of its arms — exactly as density wave theory predicts, making it a key observational test of that theory. In April 2008 GALEX reported large numbers of young stars in its far outskirts, 20 kpc from the centre, where the gas was thought too thin for star formation. The peculiar dwarf NGC 5253 lies nearby and probably interacted with M83 within the last billion years, triggering starbursts in both. M83 is also a prolific supernova producer — six recorded since 1923.

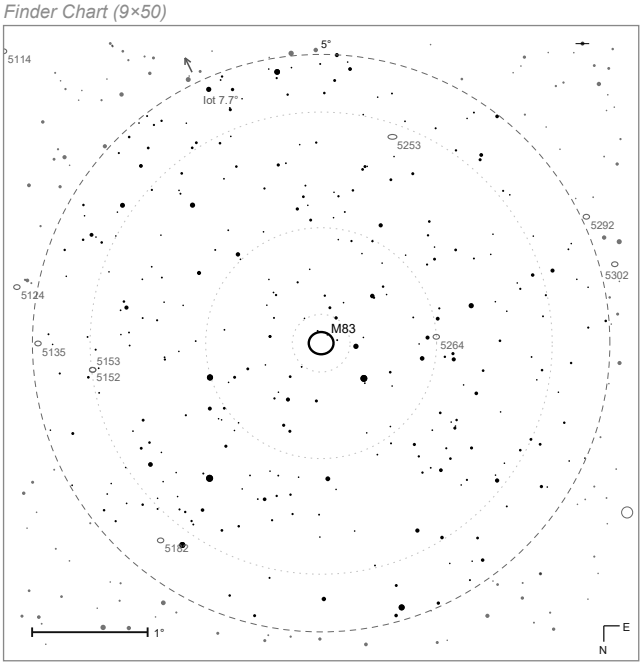
*Constellation Map*




*Naked-eye view · mag 5 · field 7°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

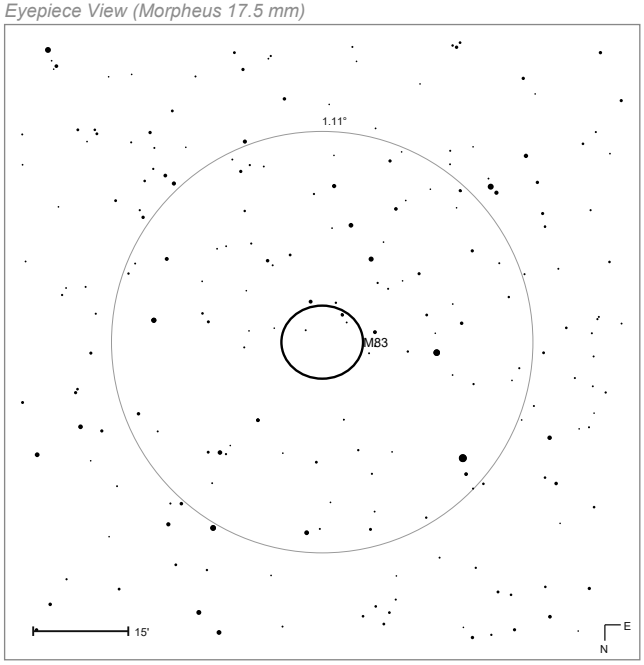
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.4*

mag ● 8 ● 10 · 12 · 14

# M84

GALAXY

*The large elliptical at centre is M84; the edge-on spiral at lower left is NGC 4388.*

| | |
|---|---|
| MESSIER | 84 |
| NGC | 4374 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Virgo |
| DISTANCE | 55 Mly |
| APPARENT MAG. | +9.1 |
| RA (J2000) | 12h 25m 06s |
| DEC (J2000) | +12° 53′ |
| APPARENT SIZE | 6.5′ × 5.6′ |
| RADIUS (LY) | 52,000 |

## DISCOVERY & HISTORY

Charles Messier discovered M84 on 18 March 1781 during a systematic sweep for nebulous objects, and described a round nebula without stars with a bright centre. That single night in 1781 produced a whole run of Virgo Cluster galaxies, M84 among the first. It is a giant elliptical or lenticular galaxy about 55 million light-years away, sitting in the crowded core of the Virgo Cluster, and its visible body is wrapped in a massive dark matter halo.

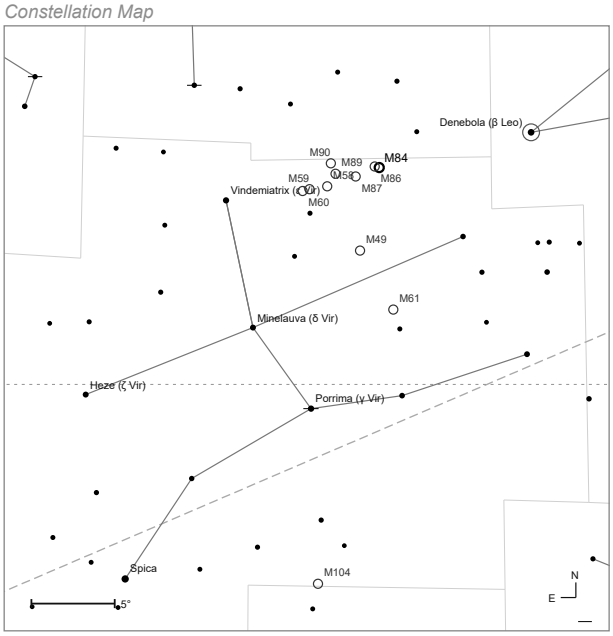
## AT THE EYEPIECE

M84 lies between Virgo and Coma Berenices in a starless field, roughly halfway from Vindemiatrix (ε Virginis) to Denebola. From 50°N it culminates at 53°, best March to August. Binoculars will not show it under any conditions. From 200 mm it is a bright patch fading gradually into the sky with a distinctly brighter core. Its real interest is the company: it forms a pair with M86 that fits almost any eyepiece field, and NGC 4388 and NGC 4402 lie nearby — the western end of Markarian's Chain, which a low-power sweep follows across the cluster core.

## WHY IT MATTERS

Radio observations and Hubble imaging reveal two jets shooting from M84's centre and a disc of rapidly rotating gas and stars, implying a supermassive black hole of about 1.5 billion solar masses. Its globular cluster population, 1,775 ± 150, is far smaller than expected for an elliptical of its size — a clue to a formation history unlike that of the cluster's other giants. Star formation continues at a very low rate. Three supernovae have been observed in it.

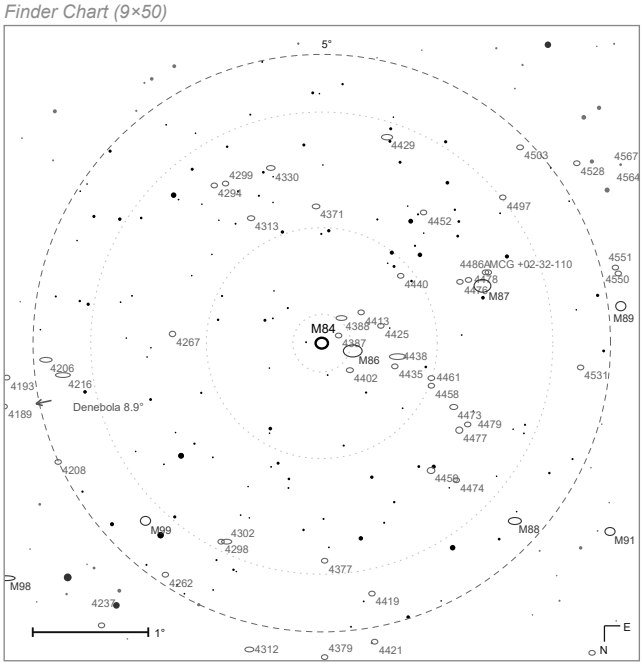
*Constellation Map*




*Naked-eye view · mag 5.5 · field 36°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

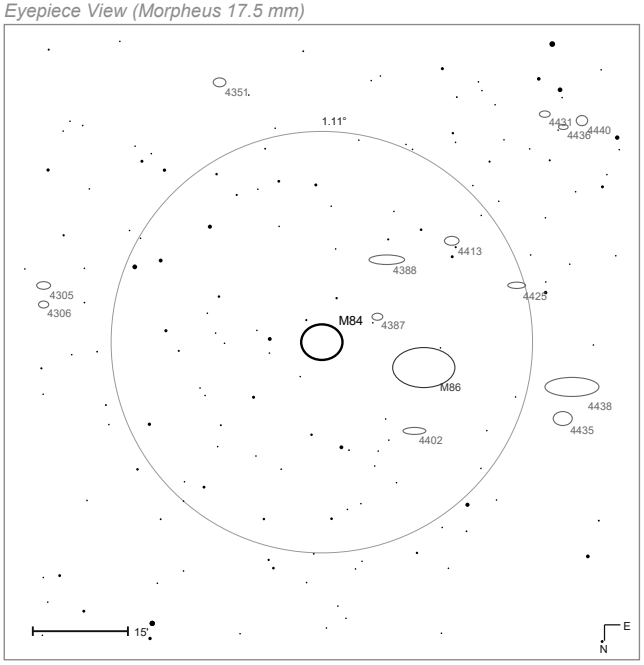
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M85

GALAXY

*M85 is the lenticular galaxy at right; the barred spiral at left is NGC 4394.*

| | |
|---|---|
| MESSIER | 85 |
| NGC | 4382 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Coma Berenices |
| DISTANCE | 60 Mly |
| APPARENT MAG. | +9.1 |
| RA (J2000) | 12h 25m 24s |
| DEC (J2000) | +18° 11′ |
| APPARENT SIZE | 7.1′ × 5.5′ |
| RADIUS (LY) | 62,000 |

## DISCOVERY & HISTORY

Pierre Méchain discovered M85 on 4 March 1781. It is a lenticular galaxy — some authors call it elliptical — about 52–60 million light-years away, roughly 120,000 light-years across, and the northernmost Messier member of the Virgo Cluster, lying in the cluster's outskirts and relatively isolated. Its outer structure is unusually complex, with shells and ripples attributed to a merger 4 to 7 billion years ago.

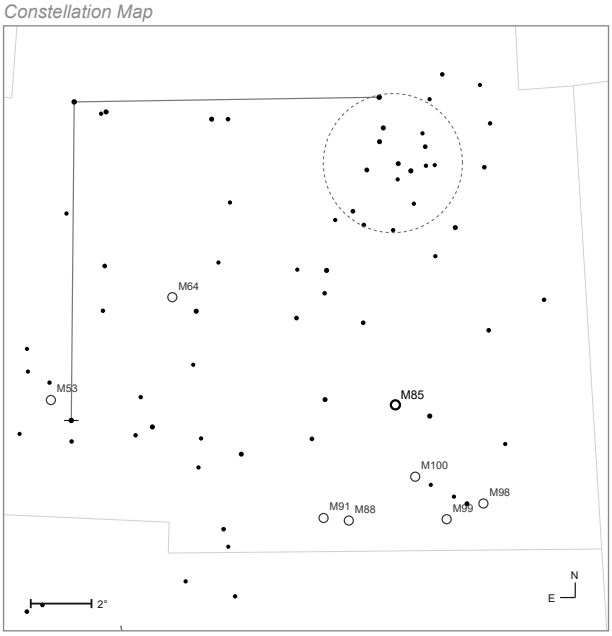
## AT THE EYEPIECE

M85 lies at the southern edge of Coma Berenices near the Virgo border, 10° north-east of Denebola; it also stands 10° west of Diadem (α Com) and 10° south of γ Com, forming a near-perfect square with those stars. From 50°N it culminates at 58°. In 10×50 binoculars it is nearly invisible, though 20×80 shows a point of light. An 80 mm telescope reveals the halo; at 140 mm it is a north–south oval about 4′ × 2′, and even 200 mm leaves that halo featureless — the fate of most lenticulars. NGC 4394 lies 7.8′ away.

## WHY IT MATTERS

M85 is extremely poor in neutral hydrogen yet has a stellar population less than 3 billion years old in its centre, partly arranged in a ring, probably built by a late starburst following the merger that also raised its shells. Its globular clusters come in four colour groups rather than the usual red and blue, another merger signature. It appears to be transitioning from lenticular to elliptical. Curiously, while indirect methods predict a central black hole near 100 million solar masses, velocity dispersion measurements suggest it may have none at all.

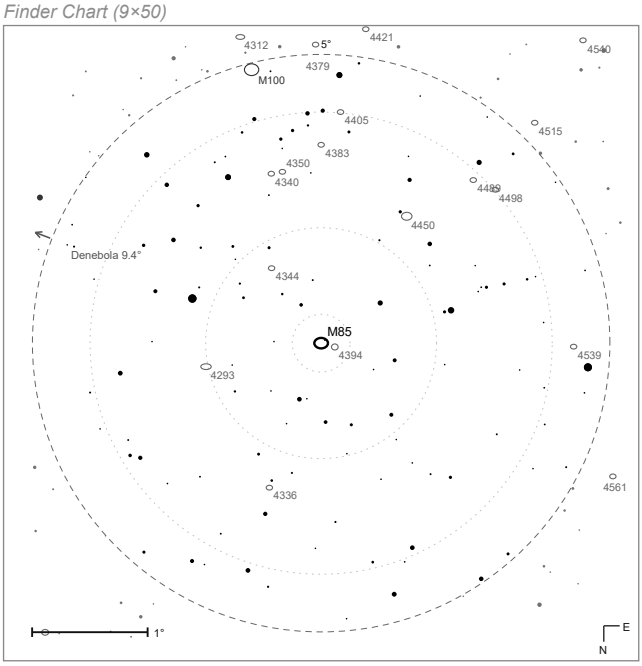
*Constellation Map*




*Naked-eye view · mag 6.5 · field 2°*

mag ● 1 ● 3 ● 5 ● 7

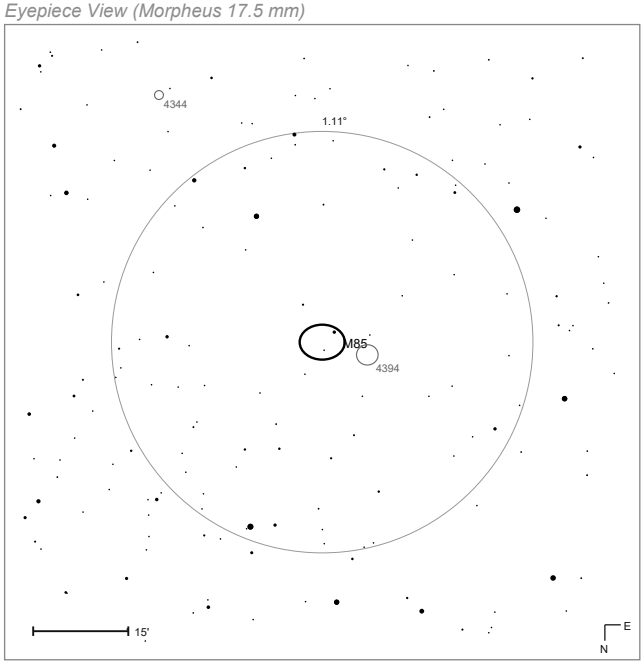
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M86

GALAXY

| | |
|---|---|
| MESSIER | 86 |
| NGC | 4406 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Virgo |
| DISTANCE | 56 Mly |
| APPARENT MAG. | +8.9 |
| RA (J2000) | 12h 26m 12s |
| DEC (J2000) | +12° 57′ |
| APPARENT SIZE | 8.9′ × 5.8′ |
| RADIUS (LY) | 72,500 |

## DISCOVERY & HISTORY

Charles Messier discovered M86 on 18 March 1781, the same night as M84 and half a dozen other Virgo galaxies. It is a bright elliptical or lenticular galaxy about 56 million light-years away, lying in the very heart of the Virgo Cluster and forming a conspicuous pair with M84. It holds the record among Messier objects for blueshift: it is approaching the Milky Way at 244 km/s, because both galaxies are falling toward the Virgo Cluster's centre from opposite sides.

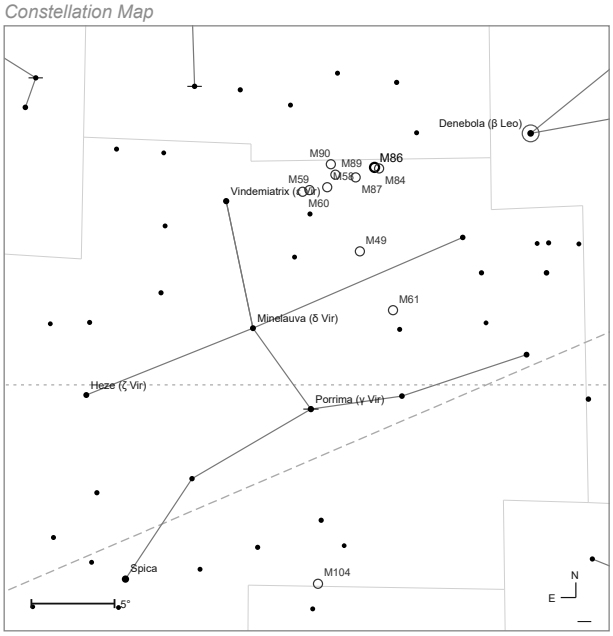
## AT THE EYEPIECE

M86 lies between Virgo and Coma Berenices, roughly halfway from Vindemiatrix (ε Virginis) to Denebola, and shares a field with M84. From 50°N it culminates at 53°, best March to August. Even though it is slightly brighter than M84, binoculars need a perfect sky. From 200 mm it shows a bright core inside a halo that fades gradually into the background. NGC 4388 and NGC 4402 lie close by; a slow low-power sweep east from here traces Markarian's Chain through the cluster core, one of the great sights of spring.

## WHY IT MATTERS

M86 is being visibly processed by its cluster. Filaments of ionised gas link it to the badly disrupted spiral NGC 4438, suggesting M86 has stripped gas and dust from it, and its own interstellar medium is being torn away by ram pressure as it ploughs through the intracluster gas — Chandra has traced a very long trail of X-ray-emitting hot gas behind it. Its 3,800 globular clusters and the stellar streams in its halo, remnants of digested dwarf galaxies, complete the picture of a galaxy built by consumption.

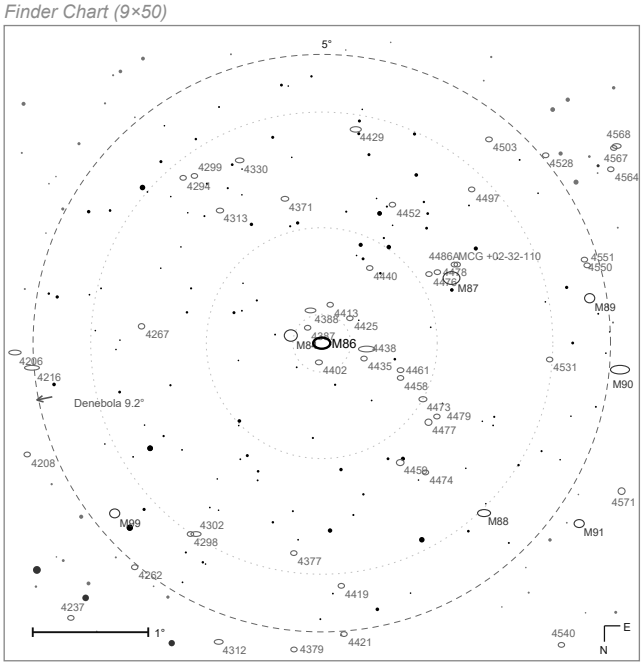
Constellation Map




Naked-eye view · mag 5.5 · field 36°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

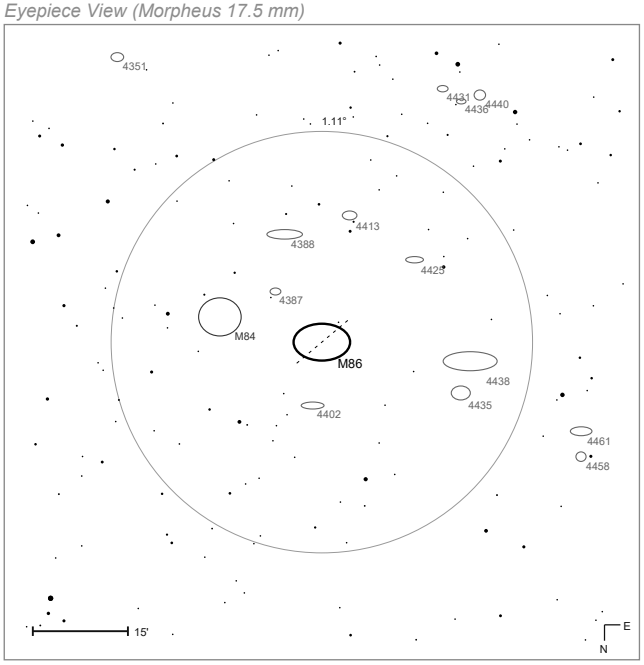
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

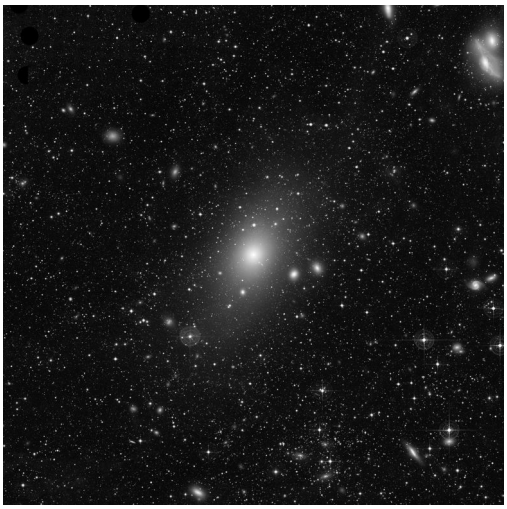



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5

mag ● 8 ● 10 · 12 · 14

# M87 Virgo A





| | |
|---|---|
| MESSIER | 87 |
| NGC | 4486 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Virgo |
| DISTANCE | 53 Mly |
| APPARENT MAG. | +8.6 |
| RA (J2000) | 12h 30m 48s |
| DEC (J2000) | +12° 23′ |
| APPARENT SIZE | 8.3′ × 6.6′ |
| RADIUS (LY) | 64,000 |

## DISCOVERY & HISTORY

Charles Messier discovered M87 on 18 March 1781 and catalogued it as a nebula, one of many he logged that night to keep comet hunters from being fooled. It is a supergiant elliptical galaxy about 53 million light-years away, containing several trillion stars, and the central member of the Virgo Cluster — one of the largest and most massive galaxies in the local universe. Its plasma jet was photographed as early as 1918 by Heber Curtis, decades before anyone could explain it.

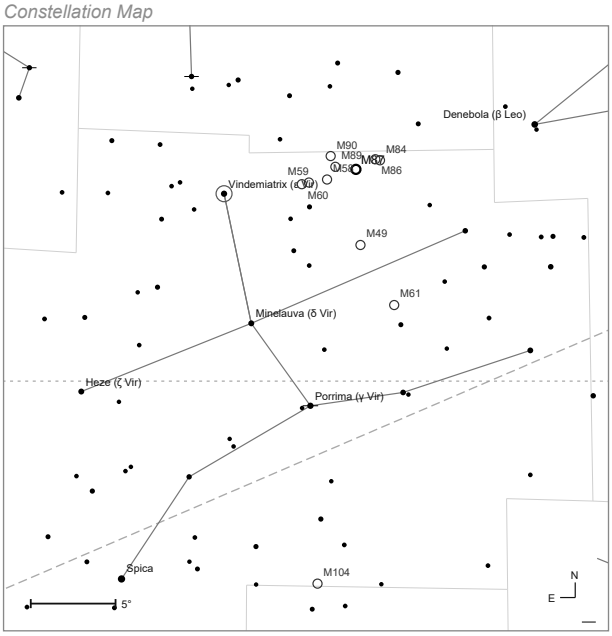
## AT THE EYEPIECE

M87 lies about 8° west of Vindemiatrix (ε Virginis), in the crowded cluster core; from 50°N it culminates at 52°. Visually it is honest about what it is: a round, almost featureless glow about 5′ across, brightening smoothly toward the centre, with no dust lanes and no structure — a giant elliptical looks the same at every aperture. The jet is far beyond visual reach. NGC 4486A and 4486B sit within 8′, and the rest of the Virgo core surrounds it, so sweep widely at low power.

## WHY IT MATTERS

M87 holds around 12,000–15,000 globular clusters, against 150–200 for the Milky Way, and one of the brightest radio sources in the sky. From its core a jet of relativistic plasma extends at least 4,900 light-years. Its central black hole, some 6.5 billion solar masses, became the first ever imaged directly when the Event Horizon Telescope published its shadow in April 2019 — the photograph that turned a theoretical object into an observed one.

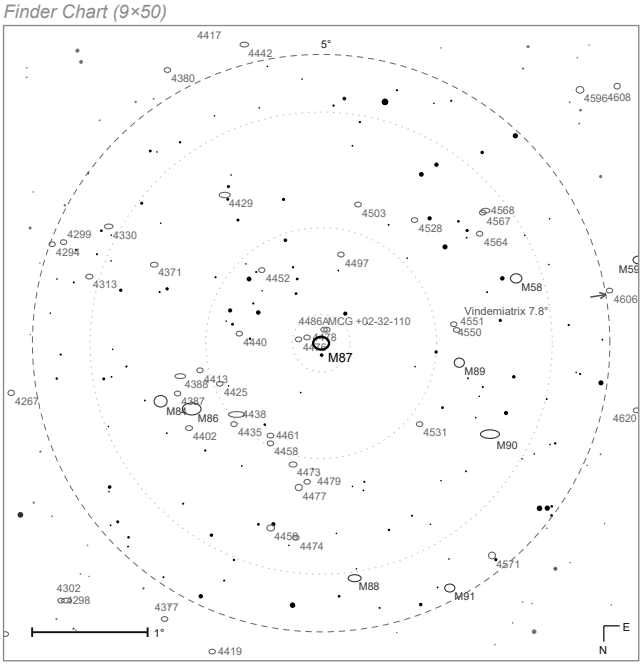
*Constellation Map*




*Naked-eye view · mag 6 · field 36°*

mag ● 1 ● 3 • 5 • 7 — ecliptic - - celestial equator

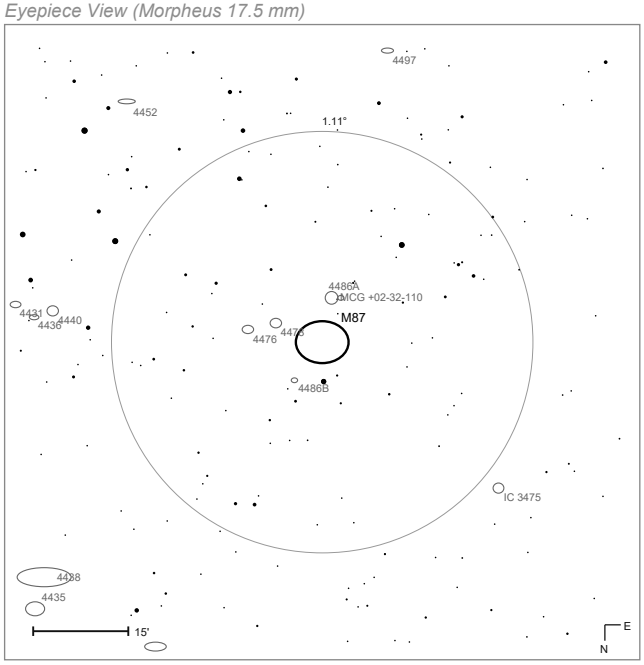
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 • 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag • 8 • 10 · 12 · 14

# M88

| | |
|---|---|
| MESSIER | 88 |
| NGC | 4501 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Coma Berenices |
| DISTANCE | 65 Mly |
| APPARENT MAG. | +9.6 |
| RA (J2000) | 12h 32m 00s |
| DEC (J2000) | +14° 25′ |
| APPARENT SIZE | 6.8′ × 3.7′ |
| RADIUS (LY) | 64,300 |
| NUMBER OF STARS | 400 billion |

## DISCOVERY & HISTORY

Charles Messier discovered M88 on 18 March 1781. It is a spiral galaxy 50 to 65 million light-years away in Coma Berenices, one of the fifteen Messier objects belonging to the Virgo Cluster and number 1401 in the Virgo Cluster Catalogue. It was among the first galaxies in which spiral structure was recognised. Inclined 64° to our line of sight, it is classified Sbc — between medium- and loosely-wound arms — and those arms are unusually regular, traceable inward all the way to the core.

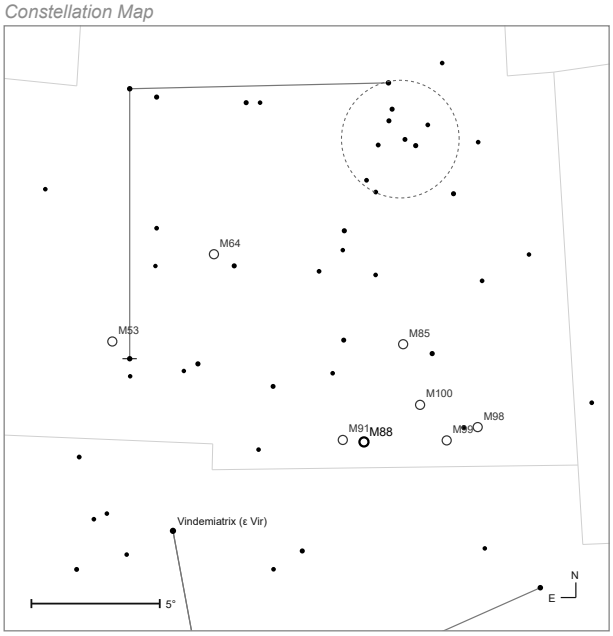
## AT THE EYEPIECE

M88 lies a little north of the midpoint between Vindemiatrix (ε Virginis) and Denebola; from 50°N it culminates at 54°, best February to August. It is at the limit of medium binoculars. An 80 mm telescope shows a slightly elongated patch; at 150 mm it is a clear ellipse running south-east to north-west with a very bright nucleus, and 200–300 mm brings hints of the spiral arms within the disc. A companion galaxy sits 6.9′ away.

## WHY IT MATTERS

M88 is on a highly elliptical orbit heading almost straight toward the Virgo Cluster's centre, currently 1.0–1.6 million light-years out and due to make its closest approach to M87 in 200 to 300 million years. The consequences are already measurable: ram pressure from the intracluster medium is stripping neutral hydrogen from its western, leading edge. It is also a type 2 Seyfert, showing narrow emission lines from highly ionised gas around its nucleus, with gas rotating at up to 242 km/s.

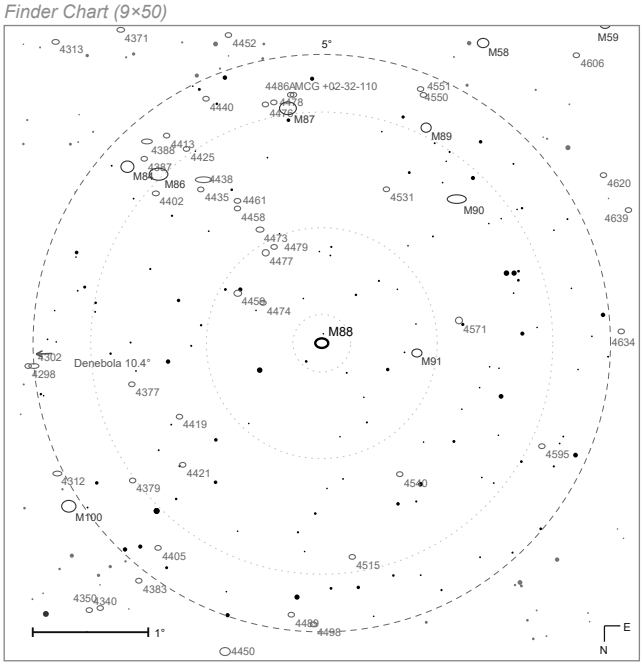
*Constellation Map*




*Naked-eye view · mag 6 · field 24°*

mag ● 1 ● 3 ● 5 ● 7

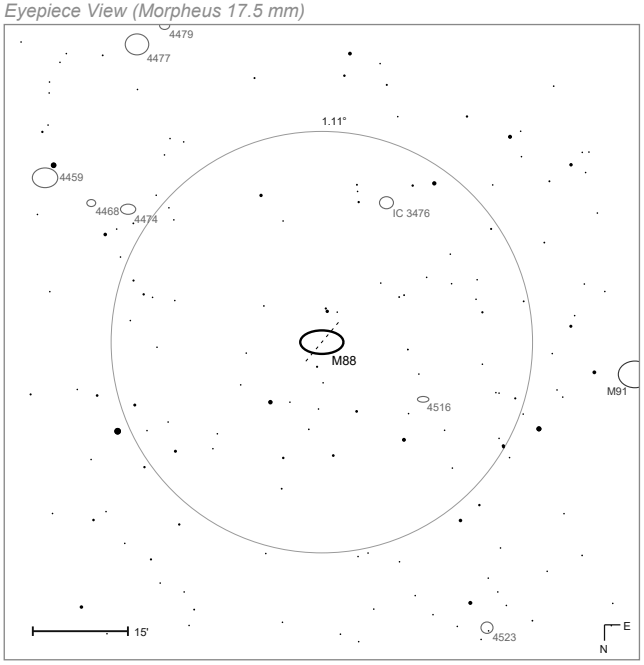
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

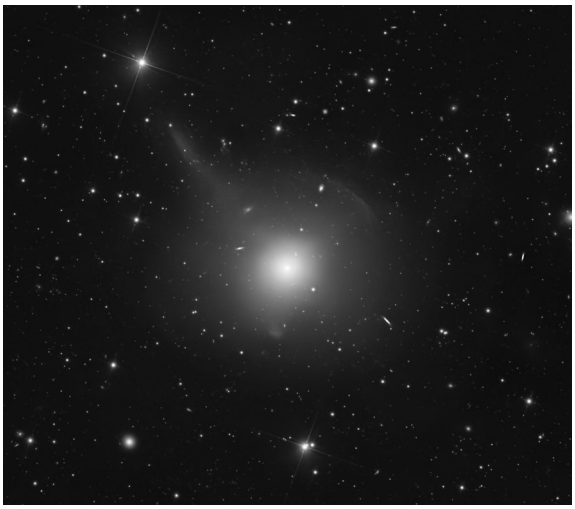



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M89





| | |
|---|---|
| MESSIER | 89 |
| NGC | 4552 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Virgo |
| DISTANCE | 50 Mly |
| APPARENT MAG. | +9.8 |
| RA (J2000) | 12h 35m 42s |
| DEC (J2000) | +12° 33′ |
| APPARENT SIZE | 3.5′ |
| RADIUS (LY) | 25,500 |

## DISCOVERY & HISTORY

Charles Messier discovered M89 on 18 March 1781, his most productive night: seven Virgo galaxies plus the globular cluster M92. M89 is an elliptical galaxy about 50 million light-years away and a member of the Virgo Cluster. Its distinguishing feature is its shape — as far as measurement can tell, M89 may be very nearly perfectly spherical, which no comparable galaxy within several times its distance is. The alternative is that it is an ellipsoid pointed almost exactly at us.

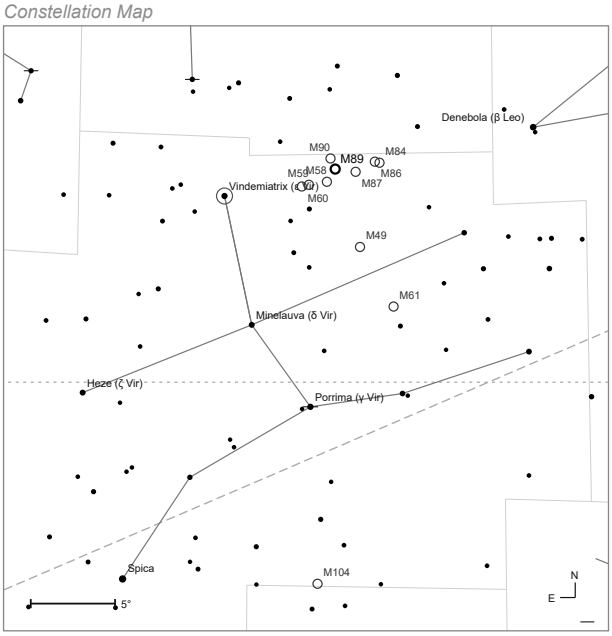
## AT THE EYEPIECE

M89 lies between Virgo and Coma Berenices in a field with no bright stars, and the sheer number of galaxies around it makes identification harder than finding it. It is out of reach of medium binoculars; a 60 mm telescope shows a featureless round patch. From 100–200 mm you see only the brightest part of the halo, about 1.5′ across. From 50°N it culminates at 53°, best February to August. Treat it as one stop on a cluster-core tour rather than a target in itself.

## WHY IT MATTERS

M89 is surrounded by a structure of gas and dust extending 150,000 light-years and jets of heated particles reaching two-thirds as far — evidence that it was once an active quasar or radio galaxy. Its complex shells and plumes record one or more major mergers. Chandra finds two rings of hot gas in the nucleus, implying an outburst 1 to 2 million years ago, plus ram-pressure stripping as it moves through the cluster. Its black hole is about 480 million solar masses, and it hosts some 2,000 globular clusters.

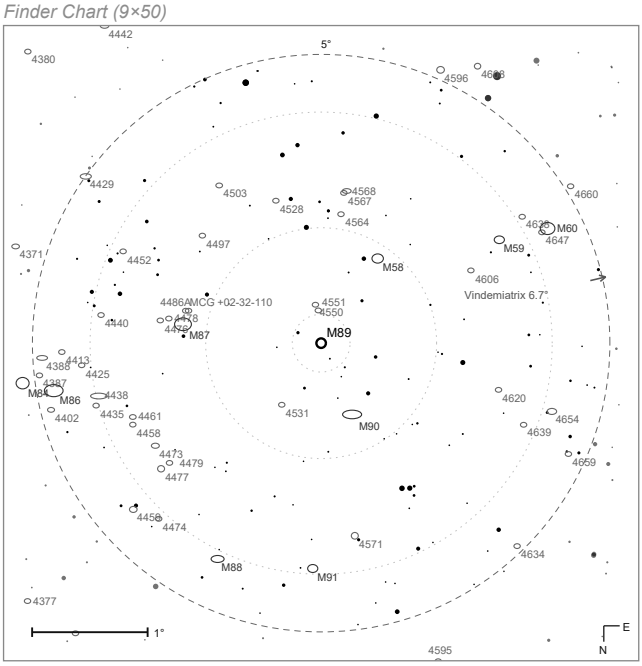
*Constellation Map*




*Naked-eye view · mag 6 · field 36°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

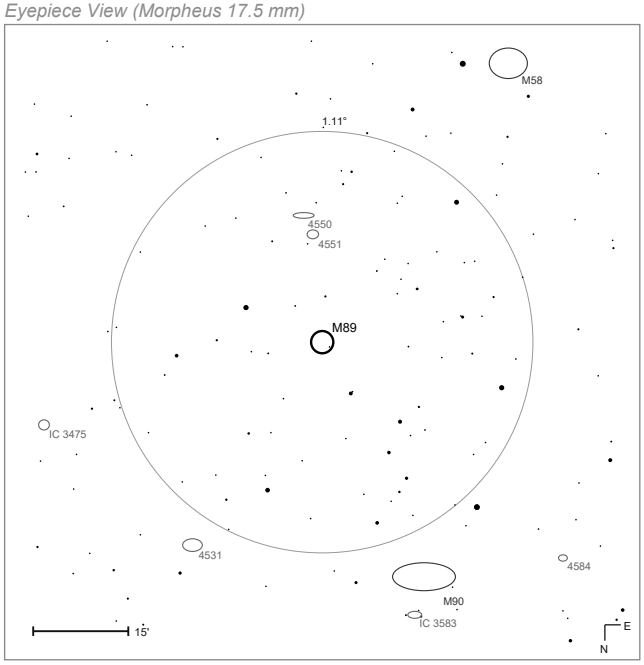
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

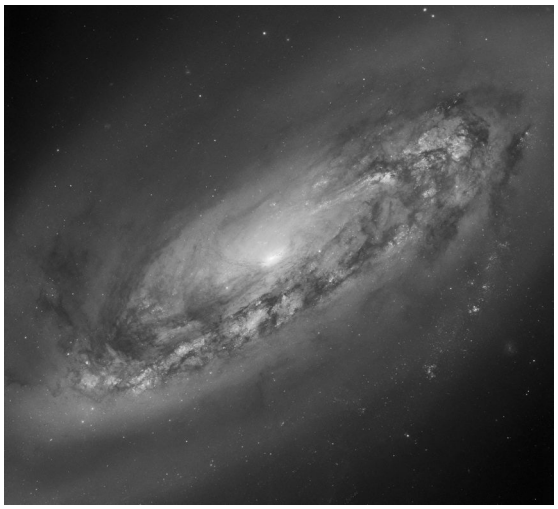



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M90





| | |
|---|---|
| MESSIER | 90 |
| NGC | 4569 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Virgo |
| DISTANCE | 60 Mly |
| APPARENT MAG. | +9.5 |
| RA (J2000) | 12h 36m 48s |
| DEC (J2000) | +13° 10′ |
| APPARENT SIZE | 9.5′ × 4.4′ |
| RADIUS (LY) | 82,900 |

## DISCOVERY & HISTORY

Charles Messier discovered M90 on 18 March 1781 and described a nebula without stars; William Herschel called it a large patch, bright in the middle, with a very distinct nucleus, and Heinrich d'Arrest left the most detailed early description. It is an intermediate spiral with a weak inner ring about 60 million light-years away, one of the largest and brightest spirals in the Virgo Cluster, with an absolute magnitude near −22 — intrinsically brighter than the Andromeda Galaxy. It lies about 1.5° from M87's central subgroup.

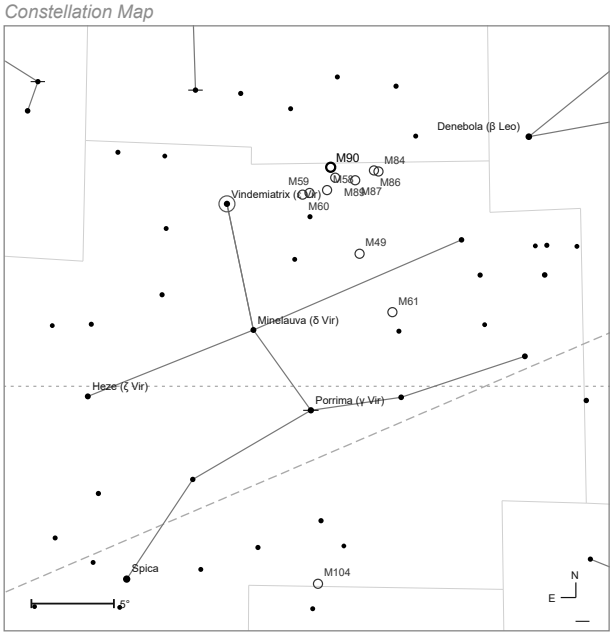
## AT THE EYEPIECE

M90 lies between Virgo and Coma Berenices in a starless field; from 50°N it culminates at 53°, best March to August. Under exceptional conditions a binocular can find it. A 60–80 mm telescope shows an elongated patch with a faint halo; from 140 mm the 12th-magnitude point-like nucleus appears, and the halo looks divided into two regions by the brightest part of the disc. IC 3583 lies 6′ away. The smoothness is the thing to notice — there is nothing knotted or mottled about this galaxy.

## WHY IT MATTERS

That smoothness is diagnostic. M90's encounter with the intracluster medium has stripped away most of its interstellar gas, leaving star formation truncated and its arms featureless rather than knotted — which is why it is, with NGC 4921 in Coma, the prototype of an anaemic galaxy. The stripping is directly visible: H II regions sit outside the galactic plane, and tails of ionised gas trail up to 260,000 light-years behind it. M90 is one of the clearest demonstrations that clusters kill spirals slowly, by starving them.

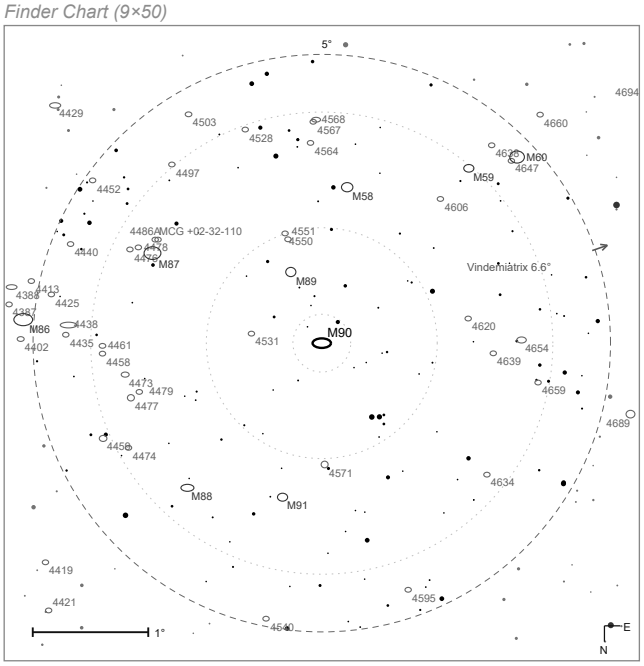
*Constellation Map*




*Naked-eye view · mag 5.5 · field 37°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

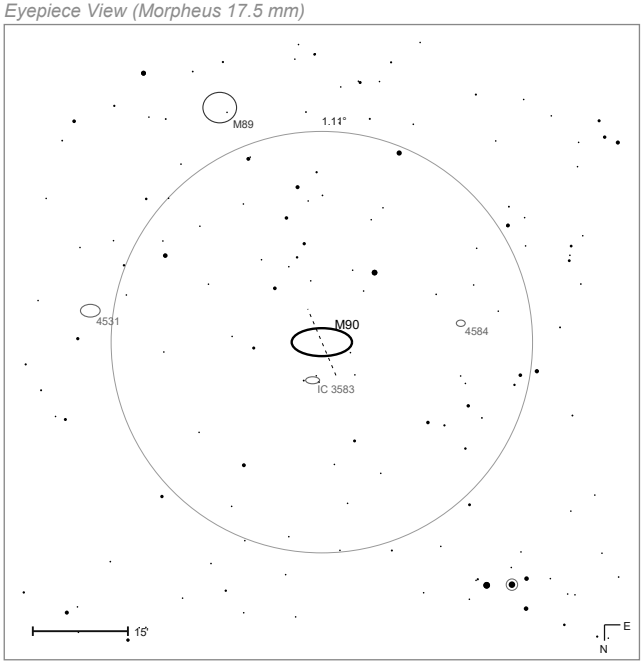
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 ● 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 ● 12 ● 14

# M91

| | |
|---|---|
| MESSIER | 91 |
| NGC | 4548 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Coma Berenices |
| DISTANCE | 63 Mly |
| APPARENT MAG. | +10.1 |
| RA (J2000) | 12h 35m 24s |
| DEC (J2000) | +14° 30′ |
| APPARENT SIZE | 5.2′ × 4.2′ |
| RADIUS (LY) | 47,600 |

## DISCOVERY & HISTORY

M91 was the last of eight "nebulae" Charles Messier found on 18 March 1781, and at magnitude 10.1 it is the faintest object in his catalogue. He logged its position relative to M58 when he should have used M89, and the bookkeeping error left M91 as one of the catalogue's missing entries for nearly two centuries — no known object lay where the coordinates said. Only in 1969 did the amateur astronomer William C. Williams work out that M91 is NGC 4548, catalogued by William Herschel in 1784.

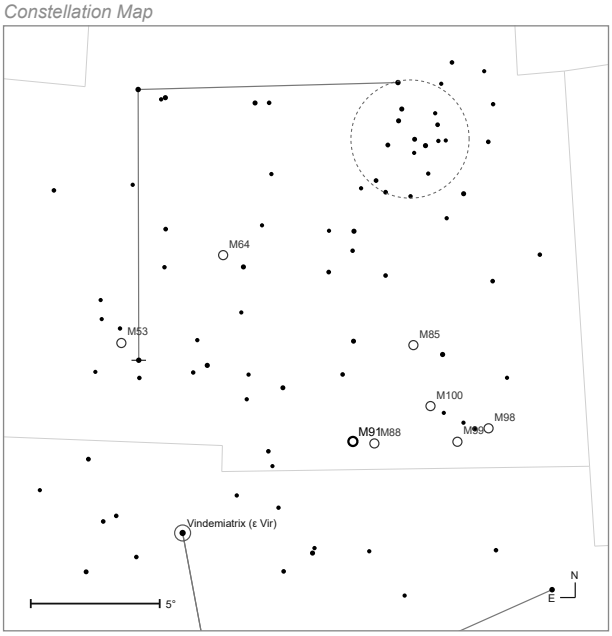
## AT THE EYEPIECE

M91 lies at the southern edge of Coma Berenices, a little north-east of the midpoint between Vindemiatrix and Denebola; from 50°N it culminates at 55°. It is among the hardest Messier objects, very difficult even in an 80 mm telescope. Its most prominent feature is the bar, visible from 150 mm as a patch elongated north-east to south-west; the halo runs north–south and needs 200–300 mm. Its apparent shape changes with conditions: a large aperture under a transparent sky shows the oval halo and the galaxy looks nearly round, while a small one shows only the bar.

## WHY IT MATTERS

M91 is one of only four barred spirals in the Messier catalogue, and a textbook case of an anaemic Virgo spiral — gas-poor and quiet, like M90 and M58 — about 56–63 million light-years away. Its history in the catalogue is instructive in itself: it took 188 years and an amateur's careful re-measurement to recover an object recorded by the most systematic observer of his age, because one reference star was written down wrongly.

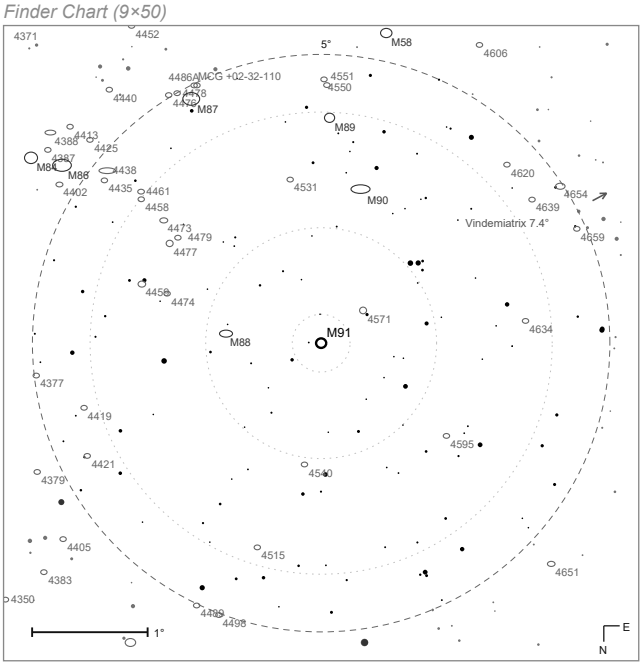
*Constellation Map*




*Naked-eye view · mag 6.5 · field 24°*

mag ● 1 ● 3 ● 5 ● 7

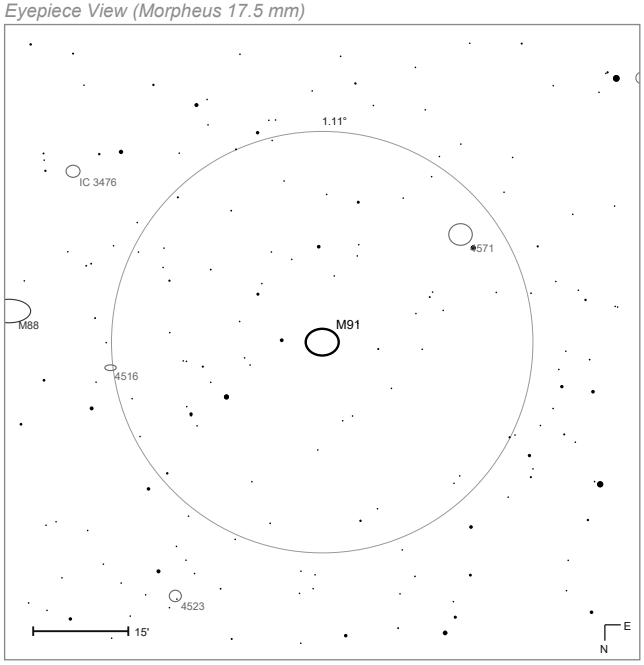
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M92

GLOBULAR CLUSTER

| | |
|---|---|
| MESSIER | 92 |
| NGC | 6341 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Hercules |
| DISTANCE | 26.7 kly |
| APPARENT MAG. | +6.5 |
| RA (J2000) | 17h 17m 06s |
| DEC (J2000) | +43° 08′ |
| APPARENT SIZE | 14.0′ |
| RADIUS (LY) | 54 |

## DISCOVERY & HISTORY

Johann Elert Bode discovered M92 on 27 December 1777 and published it in the Berliner Astronomisches Jahrbuch in 1779. Charles Messier came across it independently on 18 March 1781 — the same night as his run of Virgo galaxies — and made it his 92nd entry. William Herschel first resolved its stars in 1783; Lord Rosse later thought he saw spiral structure in it. The cluster lies about 26,700 light-years away, 33,000 light-years from the galactic centre and 16,000 above the plane, and is one of the galaxy's oldest.

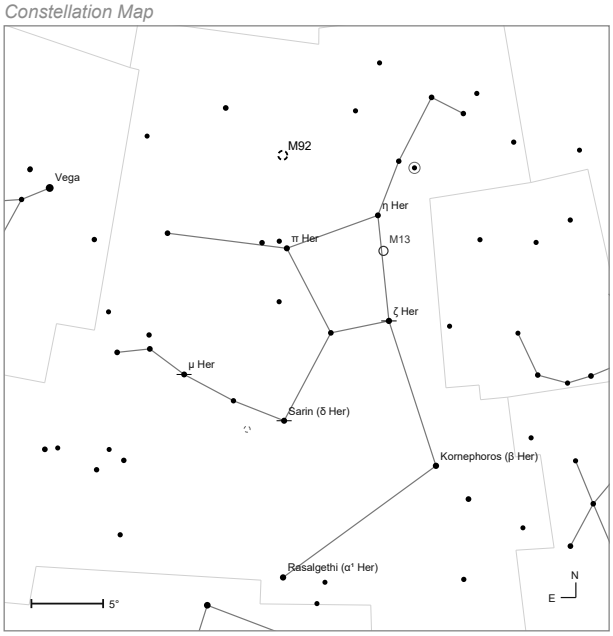
## AT THE EYEPIECE

M92 lies about 5° south-west of ι Herculis, on the line running from ι toward η Herculis, in a patch of sky without bright stars. From 50°N it culminates at 83°, nearly overhead, best April to October. It is visible to the naked eye under very good conditions and shows in a small telescope as a nebulous smudge even from a badly light-polluted site. Its brightest stars are 12th magnitude, so real resolution starts around 200 mm; in a 10″ Dobsonian it is a compact, strongly concentrated ball across 14′.

## WHY IT MATTERS

M92 is intrinsically among the brightest globulars in the northern sky — only slightly fainter than M13 and about two-thirds its diameter — yet routinely overlooked because M13 sits nearby and looks bigger. It is also extremely metal-poor and very old, close to the age of the universe itself, which makes it one of the standard objects used to place a lower bound on cosmic age. Its orbit takes it high above the galactic plane, marking it as a halo cluster.

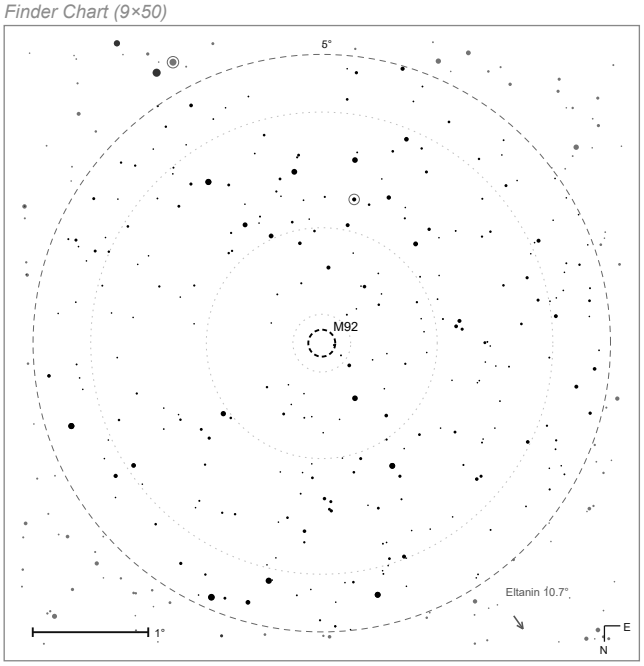
Constellation Map




Naked-eye view · mag 5 · field 42°

mag ● 1 ● 3 ● 5 ● 7

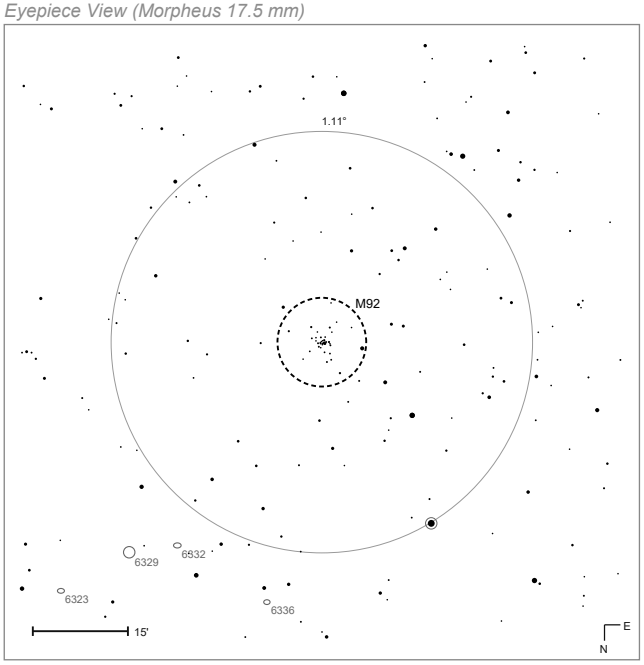
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

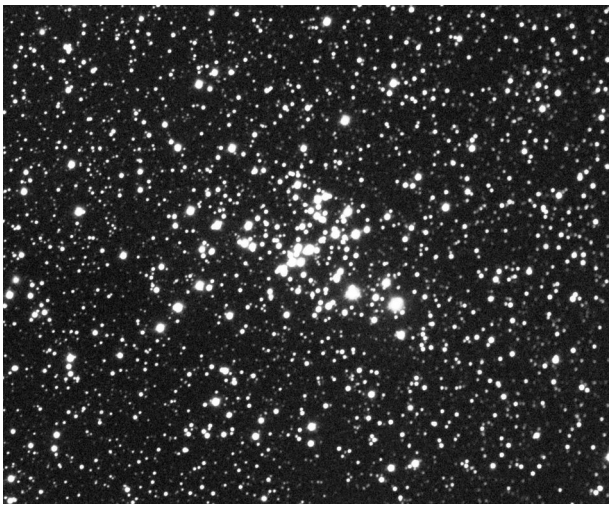



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.7

mag ● 8 ● 10 · 12 · 14

# M93





| | |
|---|---|
| MESSIER | 93 |
| NGC | 2447 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Puppis |
| DISTANCE | 3,380 ly |
| APPARENT MAG. | +6.2 |
| RA (J2000) | 07h 44m 30s |
| DEC (J2000) | −23° 51′ |
| APPARENT SIZE | 10.0′ |
| RADIUS (LY) | 5 |
| AGE (YEARS) | 390 million |

## DISCOVERY & HISTORY

Charles Messier discovered M93 on 20 March 1781 — one of the last objects he found himself — and described a cluster without nebulosity. Caroline Herschel found it independently in 1783, believing it uncatalogued. Walter Scott Houston noted that observers often call it starfish-shaped, which is how it looks in a fair-sized telescope on a poor night, while a four-inch refractor shows a typical star-studded galactic cluster. It lies about 3,380 light-years away and is roughly 387 million years old.

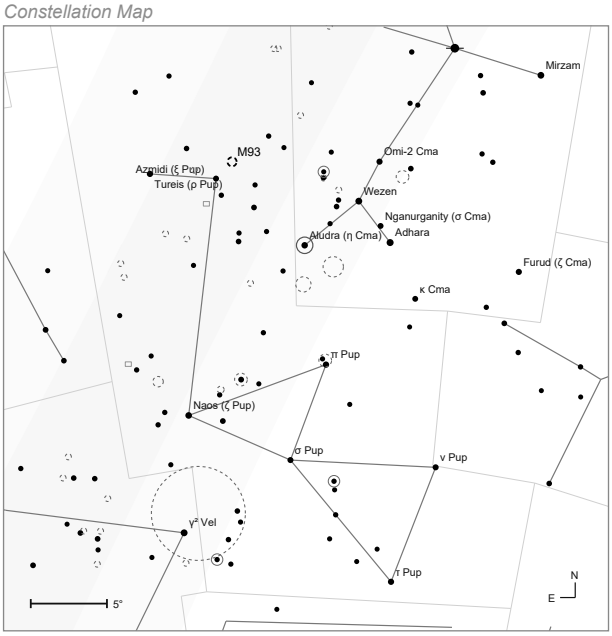
## AT THE EYEPIECE

M93 lies 1.5° north-west of Azmidiske (ξ Puppis) and is the brightest cluster in Puppis; from 50°N it culminates at 16°, so from central Europe it is a low, brief target and naked-eye detection needs a southern site and a very transparent night. In 10×50 binoculars it looks slightly elongated with a few stars resolved; 20×80 gives about thirty. A 140 mm telescope resolves it completely into dozens of faint stars, and a 10″ Dobsonian shows about a hundred down to 13th magnitude, with the wedge-shaped concentration at its centre.

## WHY IT MATTERS

M93 is Trumpler class I 3 r — strongly concentrated, wide brightness range, rich — and sits almost exactly in the galactic plane, on an orbit that carries it between 28,000 and 29,000 light-years from the galactic centre every 243 million years. Fifty-four variable stars have been identified in it, including slowly pulsating B stars, Delta Scuti variables and a rotating ellipsoidal variable, making it a useful sample of variability across a coeval population.

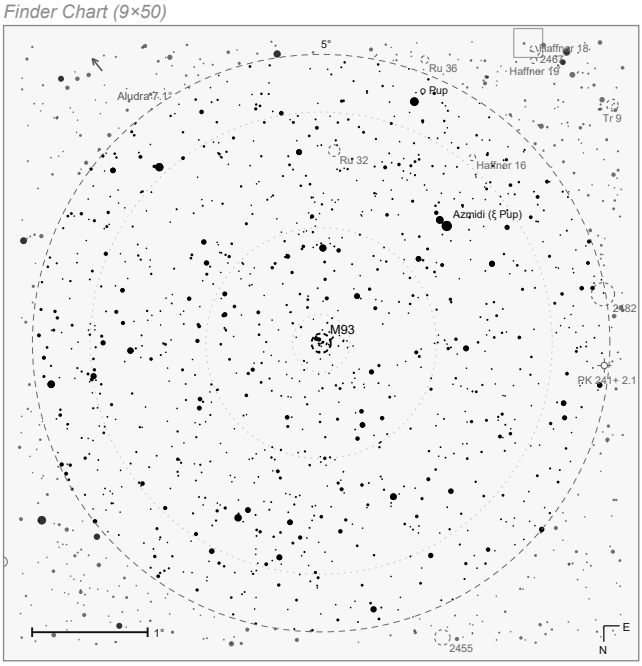
*Constellation Map*




*Naked-eye view · mag 5 · field 4°*

mag ● 1 ● 3 ● 5 ● 7

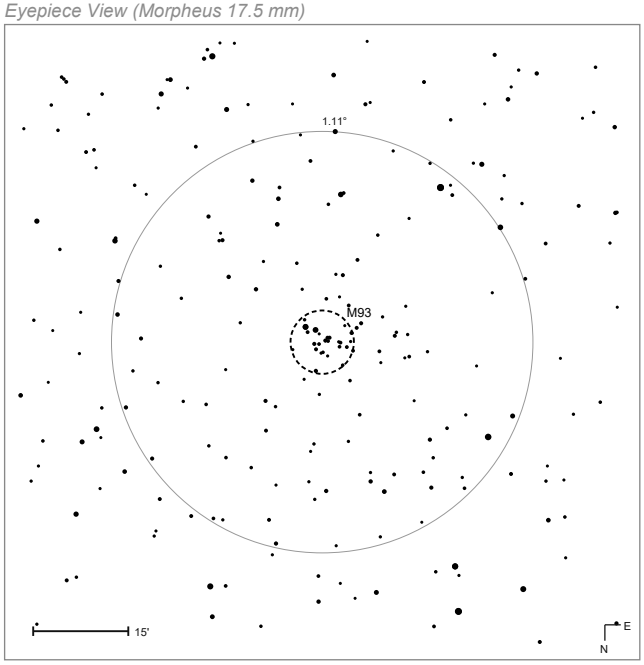
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 10.8*

mag ● 6 ● 8 ● 10 · 12

# M94

| | |
|---|---|
| MESSIER | 94 |
| NGC | 4736 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Canes Venatici |
| DISTANCE | 15 Mly |
| APPARENT MAG. | +8.2 |
| RA (J2000) | 12h 50m 54s |
| DEC (J2000) | +41° 07′ |
| APPARENT SIZE | 14.4′ × 12.1′ |
| RADIUS (LY) | 31,400 |

## DISCOVERY & HISTORY

Pierre Méchain discovered M94 on 22 March 1781 and told Charles Messier, who measured its position and catalogued it two days later. Its nicknames — Cat's Eye, Crocodile Eye — come from the bright ring around its intense core. It lies about 15 million light-years away in Canes Venatici and is the brightest member of the Canes Venatici I group. Some references call it barred, though the "bar" is more oval than bar-like.

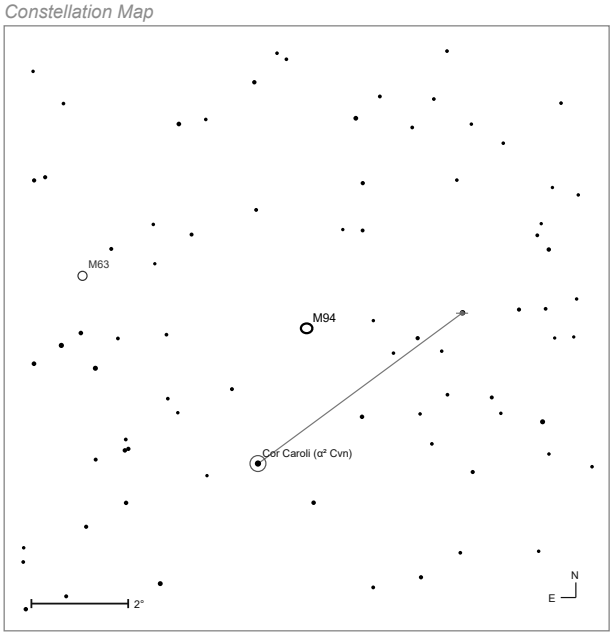
## AT THE EYEPIECE

M94 is easy to find, 3° north-west of Cor Caroli (α CVn), and from 50°N it culminates at 81°, effectively circumpolar from northern Europe. Under a dark transparent sky an ordinary binocular can reach it. At 140–150 mm it is almost circular with edges fading away — genuinely globular-cluster-like at first glance — and greater magnification changes nothing: the brightness rises steadily toward the soft-edged nucleus, with hints of dark patches in the disc and no trace of spiral arms. Best January to August.

## WHY IT MATTERS

M94 has two rings formed at resonance points in its disc: an inner ring 5,400 light-years across and an outer one about 45,000. The inner ring is a starburst ring, fed by gas driven inward by the oval distortion, and it is one of the best nearby laboratories for studying resonantly triggered star formation. Its nucleus is a LINER, and JWST stellar kinematics give its supermassive black hole a mass of 16 million Suns — consistent with the standard black hole–galaxy scaling relations.

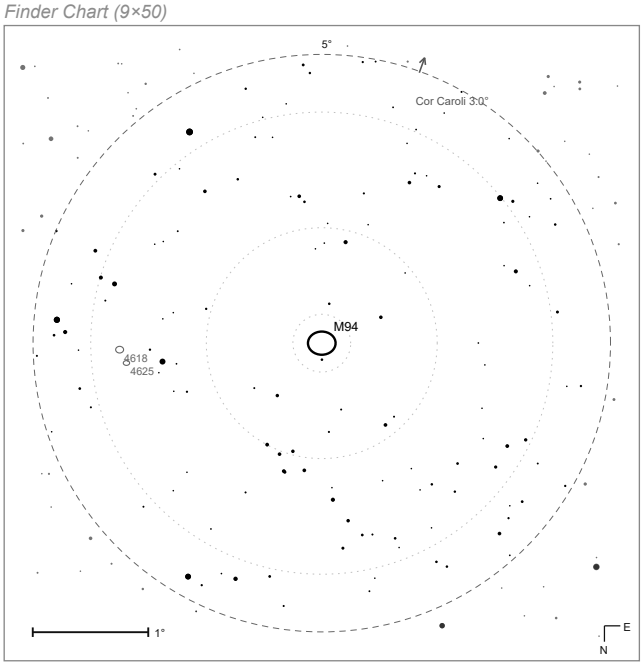
*Constellation Map*




*Naked-eye view · mag 8 · field 12°*

mag ● 1 ● 3 ● 5 ● 7

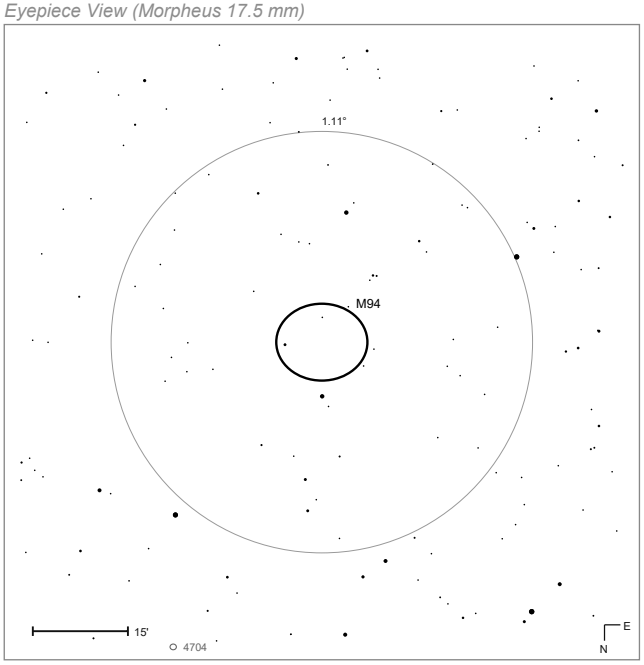
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

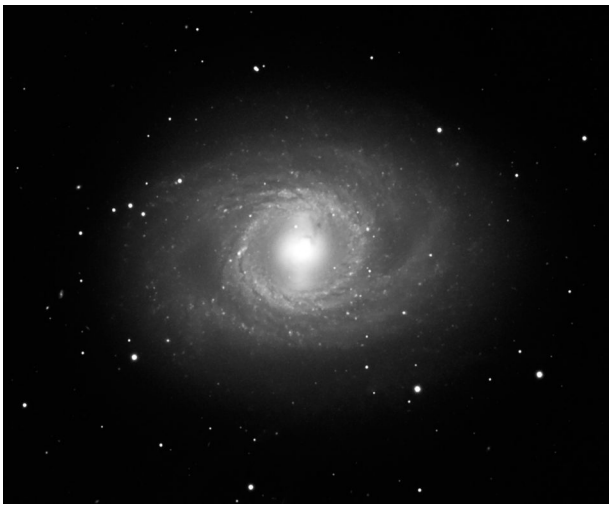



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M95





| | |
|---|---|
| MESSIER | 95 |
| NGC | 3351 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Leo |
| DISTANCE | 33 Mly |
| APPARENT MAG. | +9.7 |
| RA (J2000) | 10h 44m 00s |
| DEC (J2000) | +11° 42′ |
| APPARENT SIZE | 7.4′ × 5.0′ |
| RADIUS (LY) | 35,500 |

## DISCOVERY & HISTORY

Pierre Méchain discovered M95 together with M96 on 20 March 1781, and Charles Messier catalogued it four days later. It is a barred spiral about 33 million light-years away in Leo, classified SB(r)b — a bar with intermediate-wound arms and an inner ring surrounding the bar. Together with M96 and M105 it belongs to the M96 group in the middle of Leo. Its most recent supernova, SN 2012aw, was found in 2012.

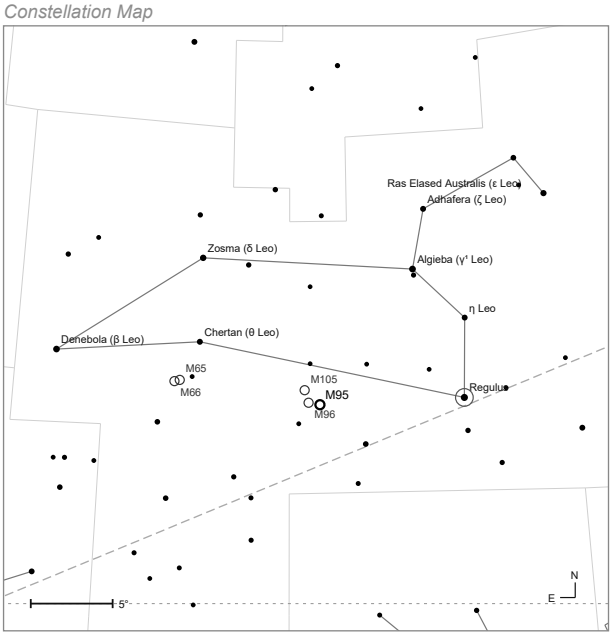
## AT THE EYEPIECE

M95 lies in an empty field: from the midpoint of the line between Regulus and Chertan (θ Leonis), find the 6th-magnitude star 52 Leonis and drop 2° south. From 50°N it culminates at 52°, best February to August. It is beyond 10×50 binoculars; an 80 mm telescope shows a small bright spot. From 150 to 300 mm the detail builds: a 40″ nucleus of 10th magnitude, a very faint 5′ halo, and — with patience — the barely visible bar crossing it. M96 lies less than a degree east.

## WHY IT MATTERS

M95's inner ring is a circumnuclear star-forming ring roughly 2,000 light-years (600 parsecs) across, holding some 350 million solar masses of molecular gas and converting it into stars at 0.38 solar masses a year. The activity concentrates in at least five regions 100–150 parsecs wide, each made of several clusters of 1.8 to 8.7 million solar masses — massive enough that some may be young globular clusters in the making, which is what makes this ring worth studying.

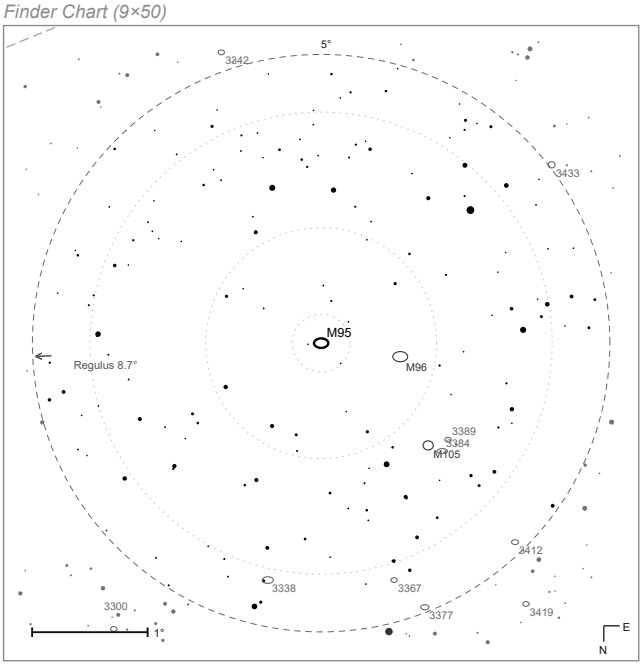
*Constellation Map*




*Naked-eye view · mag 5.5 · field 37°*

mag ● 1 ● 3 • 5 • 7 — ecliptic - - celestial equator

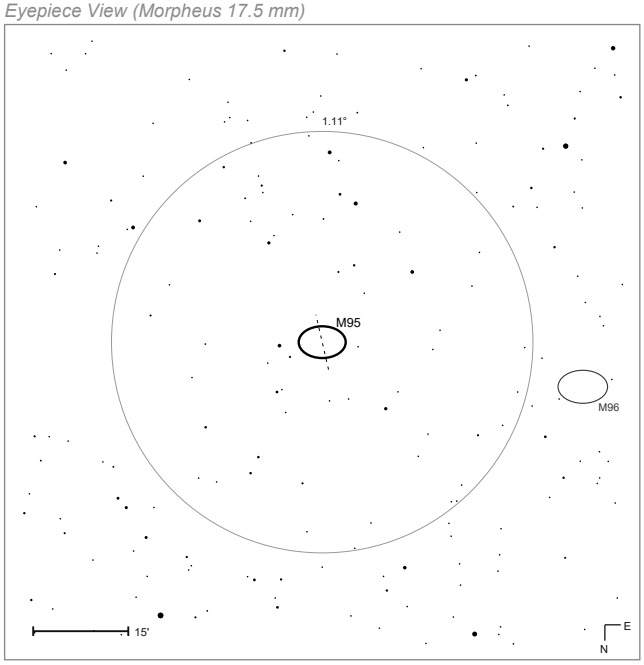
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 • 8 · 10 — ecliptic · · Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

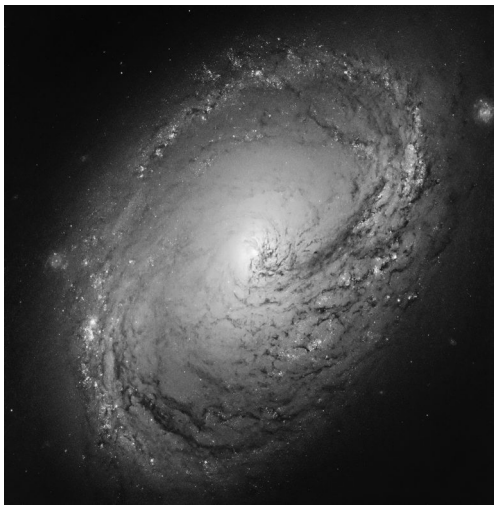



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag • 8 • 10 · 12 · 14

# M96





| | |
|---|---|
| MESSIER | 96 |
| NGC | 3368 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Leo |
| DISTANCE | 35 Mly |
| APPARENT MAG. | +9.3 |
| RA (J2000) | 10h 46m 48s |
| DEC (J2000) | +11° 49′ |
| APPARENT SIZE | 7.8′ × 5.2′ |
| RADIUS (LY) | 39,700 |

## DISCOVERY & HISTORY

Pierre Méchain discovered M96 on 20 March 1781 and Charles Messier confirmed it four days later, adding it to his catalogue. It is an intermediate spiral about 31–35 million light-years away and the brightest member of the M96 group in Leo. Inclined 53° to our line of sight, it is roughly the same mass and size as the Milky Way — a useful yardstick galaxy, if a strangely lopsided one.

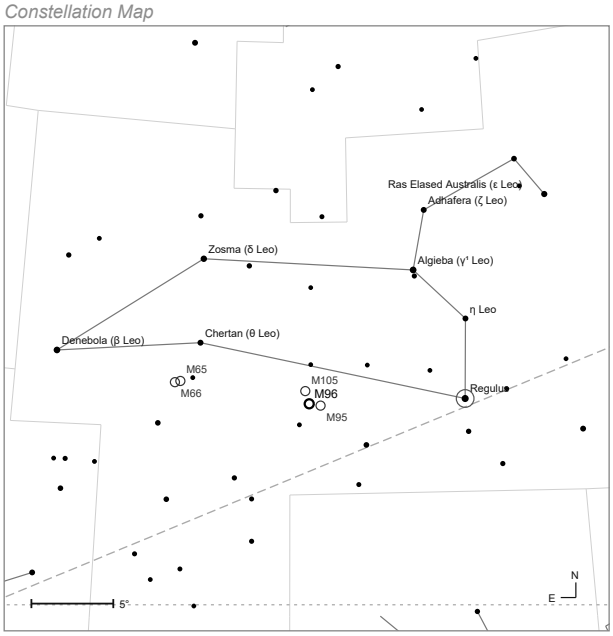
## AT THE EYEPIECE

M96 lies about 2° south of the midpoint between Regulus and Chertan (θ Leonis); from 50°N it culminates at 52°, best February to August. As the brightest of its group it is just reachable with 10×50 binoculars on a good night, as an indistinct glow, and looks much the same at 60–80 mm. From 150 to 250 mm you get a bright oval core elongated south-east to north-west inside a halo running the same way, with a few brightenings from which the spiral pattern can be inferred. A 10″ aperture is the practical minimum for its 3′ × 5′ halo and brighter core.

## WHY IT MATTERS

M96 is a double-barred spiral — a small inner bulge inside an outer one — with a weakly active LINER2 nucleus whose ultraviolet variability implies a supermassive black hole somewhere between 1.5 and 48 million solar masses. Its most striking property is asymmetry: dust and gas are spread unevenly through weak spiral arms and the core sits off the geometric centre of the disc, most likely the result of gravitational interaction within its group.

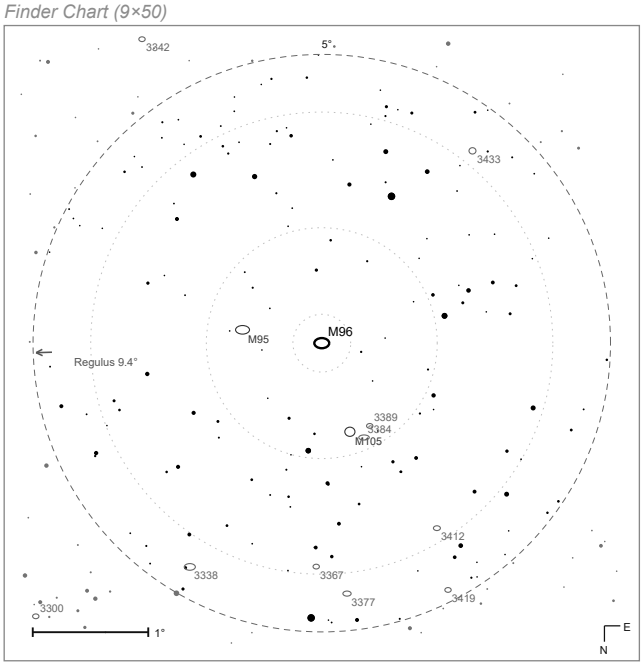
*Constellation Map*




*Naked-eye view · mag 5.5 · field 37°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

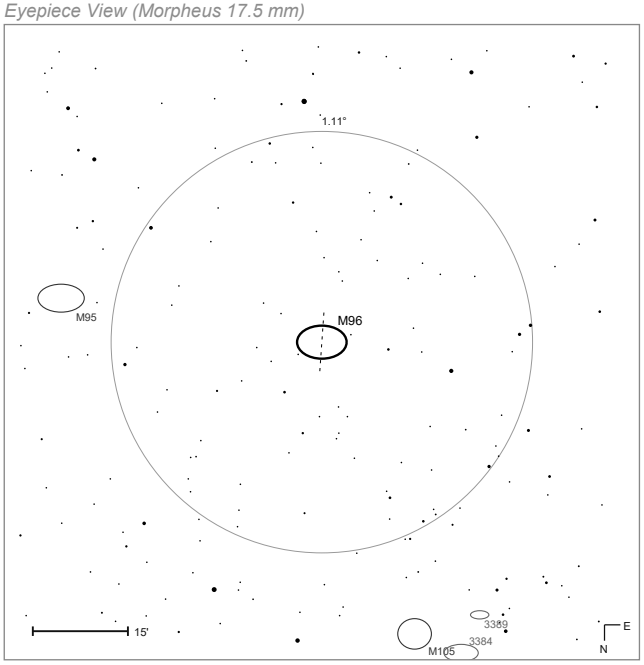
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 — ecliptic - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M97 Owl Nebula

| | |
|---|---|
| MESSIER | 97 |
| NGC | 3587 |
| OBJECT TYPE | Planetary Nebula |
| CONSTELLATION | Ursa Major |
| DISTANCE | 2,030 ly |
| APPARENT MAG. | +11.0 |
| RA (J2000) | 11h 14m 48s |
| DEC (J2000) | +55° 01′ |
| APPARENT SIZE | 2.8′ |
| RADIUS (LY) | 1 |

## DISCOVERY & HISTORY

Pierre Méchain first observed this nebula on 16 February 1781, describing an ordinary patch near β Ursae Majoris and noting how hard it was to see; Charles Messier catalogued it as number 97. Lord Rosse named it the Owl Nebula in 1848, after the two dark hollows his drawing showed. It lies about 2,030 light-years away and is roughly 8,000 years old — very young for a planetary nebula, formed from the stellar wind of its central star as it left the asymptotic giant branch.

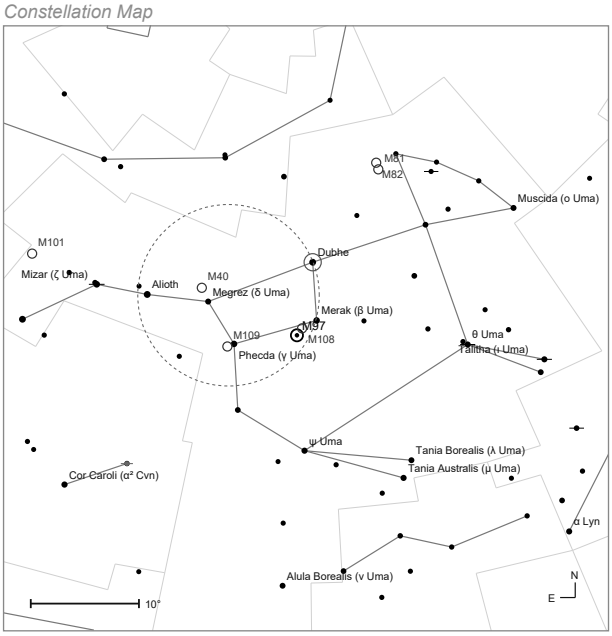
## AT THE EYEPIECE

M97 lies 2.3° south-east of Merak (β UMa), on the way to Phecda (γ UMa); from 50°N it passes through the zenith and is circumpolar. Its small size and low surface brightness put it beyond binoculars in any conditions. A small telescope shows a round misty disc with surprisingly sharp edges; the two darker patches that make the owl's eyes need a larger aperture, an OIII filter and patience. The galaxy M108 lies just 48′ north-west, and at low power both fit one field — a rare planetary-plus-galaxy pairing.

## WHY IT MATTERS

The Owl is built from three concentric shells, the outermost 20–30% larger than the inner one. Its owl-like face comes from the inner shell not being spherical but barrel-shaped, tilted 45° to our line of sight — a clear lesson in how projection creates apparent structure. The nebula holds only about 0.13 solar masses of gas expanding at 27–39 km/s. Its 14th-magnitude central star has passed its evolutionary turning point and is contracting into a white dwarf, at 123,000 K.

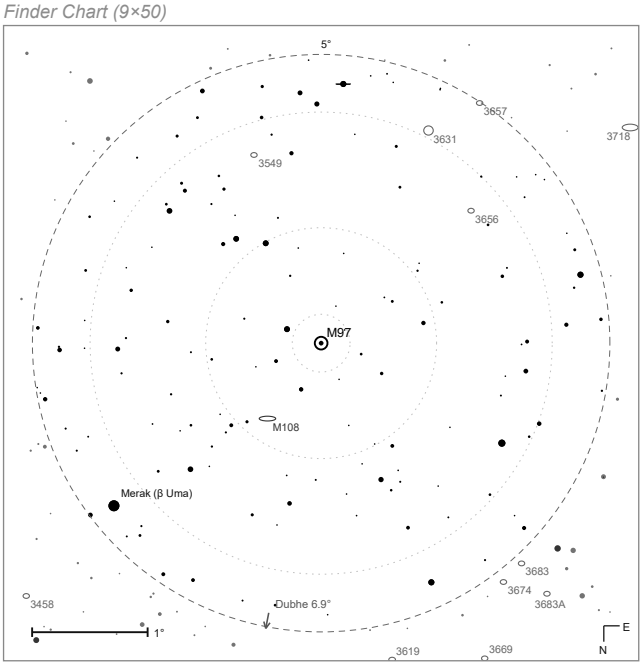
*Constellation Map*




*Naked-eye view · mag 5 · field 56°*

mag ● 1 ● 3 ● 5 ● 7

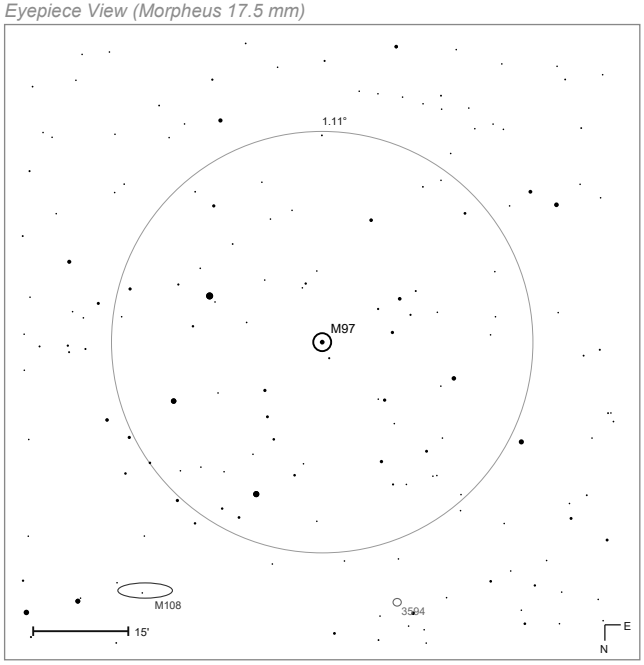
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

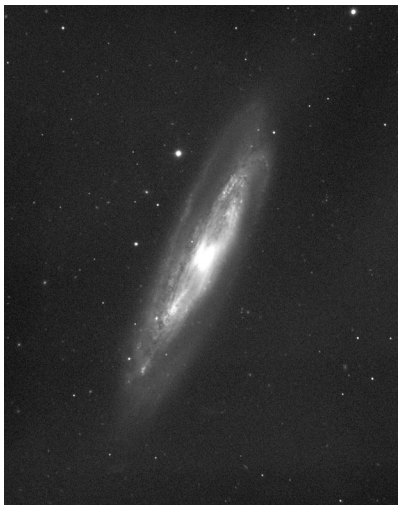



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M98





| | |
|---|---|
| MESSIER | 98 |
| NGC | 4192 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Coma Berenices |
| DISTANCE | 44.4 Mly |
| APPARENT MAG. | +10.1 |
| RA (J2000) | 12h 13m 48s |
| DEC (J2000) | +14° 54′ |
| APPARENT SIZE | 9.8′ × 2.8′ |
| RADIUS (LY) | 63,300 |

## DISCOVERY & HISTORY

Pierre Méchain discovered M98 on 15 March 1781, along with M99 and M100, and Charles Messier catalogued all three 29 days later. It is an intermediate spiral about 44–60 million light-years away in Coma Berenices, a member of the Virgo Cluster, and one of the fainter objects in the catalogue. Unusually, it is blueshifted — approaching us at roughly 120–140 km/s — because it shares the cluster's infall rather than the general expansion.

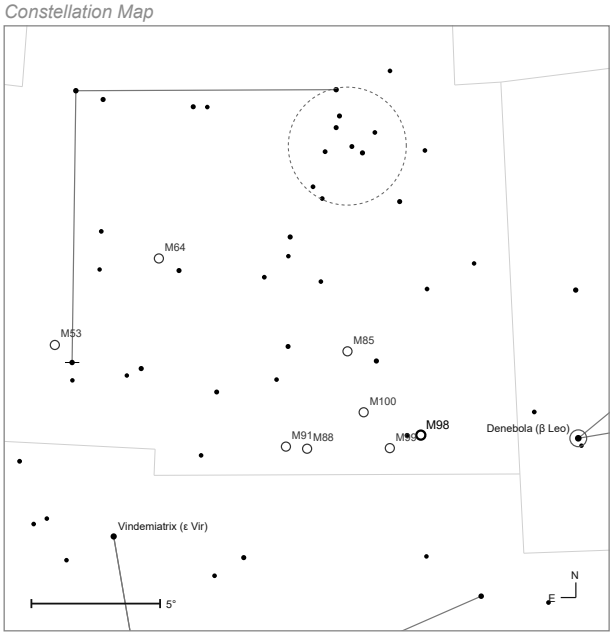
## AT THE EYEPIECE

M98 lies in the south-western corner of Coma Berenices, 6° east of Denebola and 30′ west of the 5th-magnitude star 6 Comae Berenices; from 50°N it culminates at 55°, best February to August. It needs large binoculars at minimum. At 150 mm it is a streak strongly elongated north–south, about 7′ long — one of the most edge-on-looking Messier galaxies at 74° inclination. A 200 mm aperture shows the lens-shaped nucleus, but disc detail requires 300 mm or averted vision.

## WHY IT MATTERS

M98 holds about 76 billion solar masses of stars, 4.3 billion solar masses of neutral hydrogen and 85 million in dust, with gas rotating at up to 236 km/s. Its nucleus is a transition object, mixing LINER behaviour with an H II region — a useful intermediate case for classifying weak nuclear activity. About 750 million years ago it appears to have interacted with M99, now 1.3 million light-years away, which helps explain its disturbed outer structure.

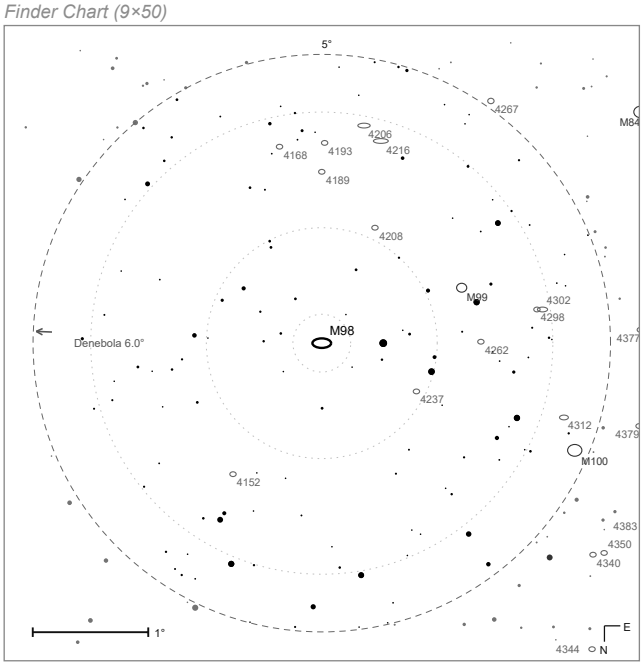
*Constellation Map*




*Naked-eye view · mag 6 · field 24°*

mag ● 1 ● 3 ● 5 ● 7

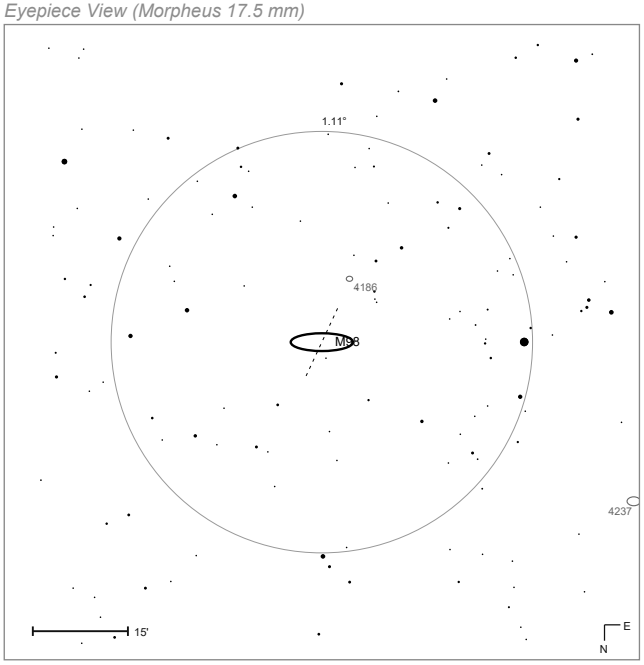
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M99 Coma Pinwheel

| | |
|---|---|
| MESSIER | 99 |
| NGC | 4254 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Coma Berenices |
| DISTANCE | 49 Mly |
| APPARENT MAG. | +9.9 |
| RA (J2000) | 12h 18m 48s |
| DEC (J2000) | +14° 25′ |
| APPARENT SIZE | 5.3′ × 4.6′ |
| RADIUS (LY) | 37,800 |

## DISCOVERY & HISTORY

Pierre Méchain discovered M99 on 17 March 1781 and reported it to Charles Messier, who added it to the catalogue. Also called St. Catherine's Wheel or the Coma Pinwheel, it was one of the first galaxies in which a spiral pattern was recognised — Lord Rosse identified it in spring 1846. It lies about 45–49 million light-years away in Coma Berenices, is a grand design spiral of class SA(s)c, and has the highest radial velocity of any Messier object at 2,324 km/s.

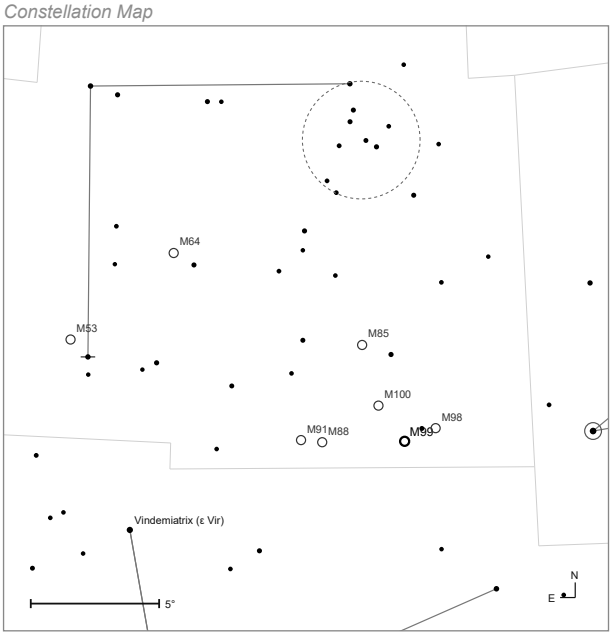
## AT THE EYEPIECE

M99 lies in the south-western corner of Coma Berenices, 7° east of Denebola and just under 1° south-east of 6 Comae Berenices; from 50°N it culminates at 54°. Its brightness is at the outer limit of medium binoculars, but a small telescope already shows an almost perfectly circular patch of light. At 150 mm the bright nucleus separates clearly from the much fainter extended disc, and only at 250–300 mm can traces of the spiral pattern be glimpsed, with difficulty.

## WHY IT MATTERS

M99 is lopsided: one arm looks normal while another is extended and less tightly wound. A bridge of neutral hydrogen links it to VIRGOHI21, an HI cloud once proposed as a dark galaxy whose gravity may have drawn out that arm — or which may itself be tidal debris from an encounter with the lenticular NGC 4262 some 280 million years ago. Either way the stretched arm should relax back into symmetry once the encounter is over, making M99 a snapshot of a distortion in progress.

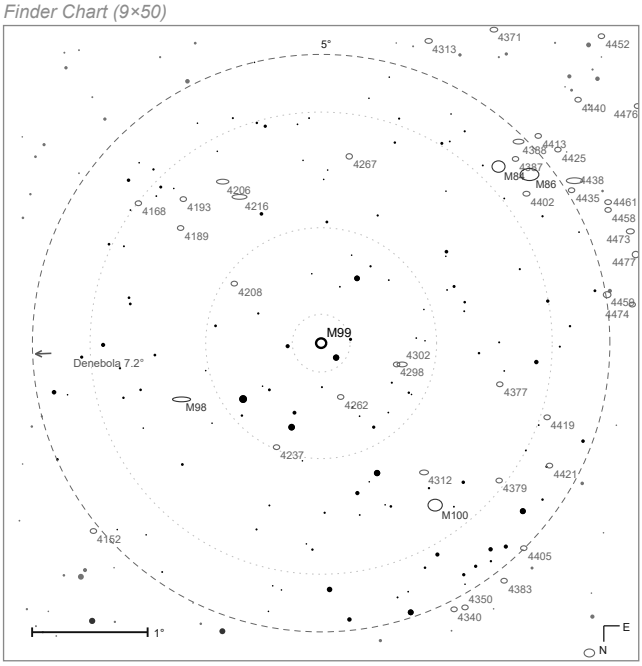
*Constellation Map*




*Naked-eye view · mag 6 · field 24°*

mag ● 1 ● 3 ● 5 ● 7

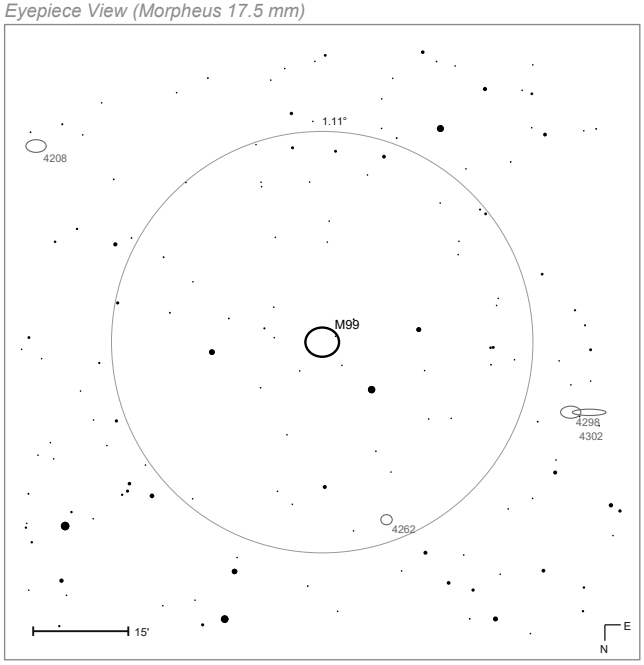
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M100

*M100 is the face-on spiral; the two small companions below are NGC 4323 and NGC 4328.*

| | |
|---|---|
| *MESSIER* | 100 |
| *NGC* | 4321 |
| *OBJECT TYPE* | Galaxy |
| *CONSTELLATION* | Coma Berenices |
| *DISTANCE* | 55 Mly |
| *APPARENT MAG.* | +9.4 |
| *RA (J2000)* | 12h 22m 54s |
| *DEC (J2000)* | +15° 49′ |
| *APPARENT SIZE* | 7.5′ × 6.1′ |
| *RADIUS (LY)* | 60,000 |
| *NUMBER OF STARS* | 400 billion |

## DISCOVERY & HISTORY

Pierre Méchain discovered M100 on 15 March 1781; Charles Messier saw it again 29 days later and entered it in his catalogue, noting how hard its faintness made it to recognise. William Herschel identified a bright knot of stars within the "nebula", and Lord Rosse listed it in 1850 among his fourteen spiral nebulae. It is a grand design intermediate spiral about 55 million light-years away, roughly 166,000 light-years across, and one of the brightest and largest galaxies in the Virgo Cluster.

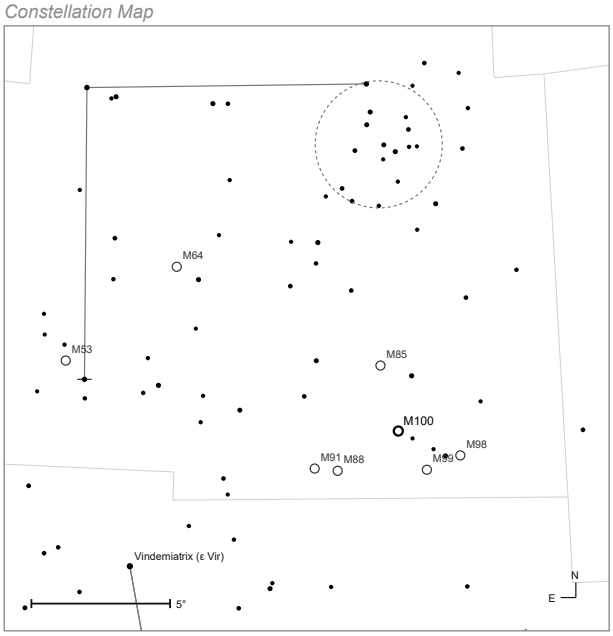
## AT THE EYEPIECE

M100 lies in the south-western corner of Coma Berenices, 8° east of Denebola and 2° north-east of 6 Comae Berenices; from 50°N it culminates at 56°. Its brightness sits at the very limit of medium binoculars; a giant binocular or an 80 mm telescope shows a faint central condensation inside a disc. At 150 mm dark patches appear within the disc, and at 200 mm under good conditions its two spiral arms register as brighter regions east and west of the nucleus. Being face-on, the arms can be traced their full length in photographs. NGC 4323 and NGC 4328 are satellites.

## WHY IT MATTERS

M100 is one of the anchors of the extragalactic distance scale: Cepheid variables measured in it — among the first such measurements made with the Hubble Space Telescope — gave a reliable distance to the Virgo Cluster and hence a step toward the Hubble constant. It is also a frequent supernova producer, with seven recorded since 1901. NGC 4323 is connected to it by a bridge of luminous matter, evidence of ongoing interaction with its satellites.

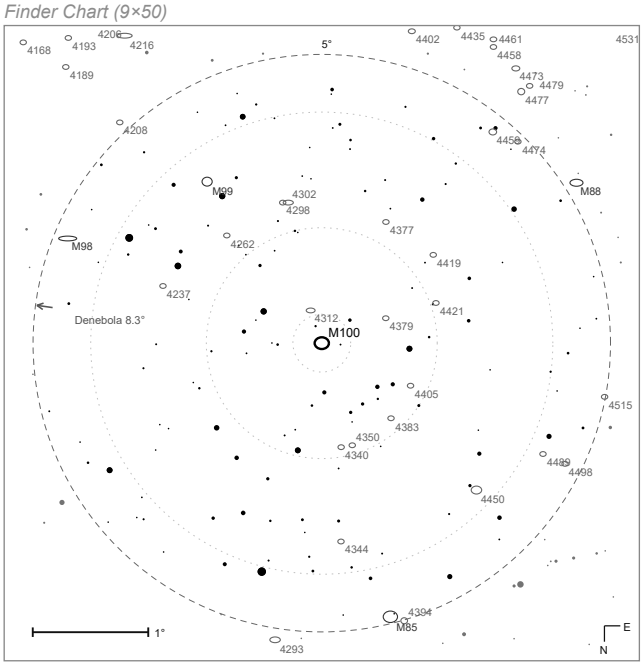
*Constellation Map*




*Naked-eye view · mag 6.5 · field 22°*

mag ● 1 ● 3 ● 5 ● 7

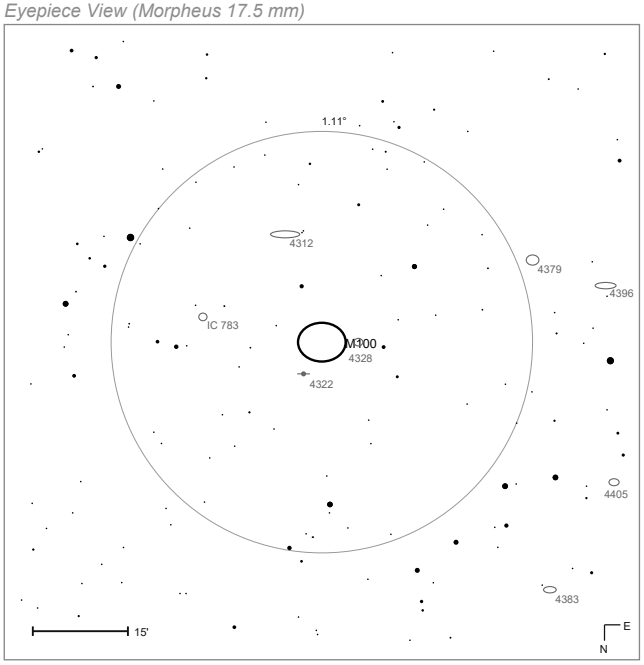
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*




*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M101 Pinwheel Galaxy

| | |
|---|---|
| MESSIER | 101 |
| NGC | 5457 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Ursa Major |
| DISTANCE | 27 Mly |
| APPARENT MAG. | +7.9 |
| RA (J2000) | 14h 03m 12s |
| DEC (J2000) | +54° 21′ |
| APPARENT SIZE | 28.8′ × 26.9′ |
| RADIUS (LY) | 113,000 |
| NUMBER OF STARS | 1 trillion |

## DISCOVERY & HISTORY

Pierre Méchain discovered M101 on 27 March 1781 and described "a nebula without star, very obscure and pretty large, 6′ to 7′ in diameter, between the left hand of Boötes and the tail of the great Bear," adding how hard it was to see once he lit his micrometer wires. William Herschel reported in 1784 that it showed "a mottled kind of nebulosity, which I shall call resolvable" — and he was right. The small patches Herschel catalogued around it turned out to be the brighter parts of its spiral arms. It lies 21–27 million light-years away.

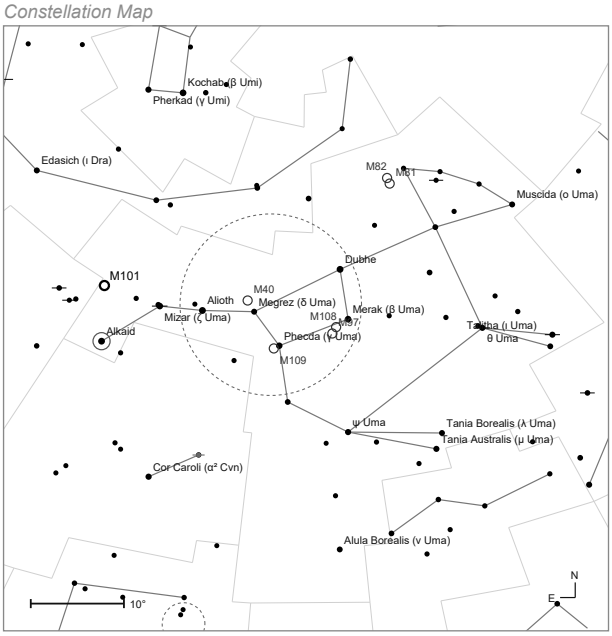
## AT THE EYEPIECE

A pretty chain of 6th- and 7th-magnitude stars leads to M101 from Mizar, which makes finding it easy; from 50°N it is circumpolar, passing overhead. Under exceptional skies an ordinary binocular shows it, since it is both close and large — 29′ across, the size of the full Moon. Use the lowest power you have: its surface brightness is very low. The bright core and the brighter arm segments need 250 mm, and at 400 mm on a good night the arms are a remarkable sight. Its companion NGC 5474 lies to the south.

## WHY IT MATTERS

M101 is a face-on grand design spiral with one notably heavier arm, distorted by past interactions with its group companions. On 28 February 2006 NASA and ESA released a mosaic of 51 Hubble exposures of it — then the largest and most detailed Hubble image of any galaxy — which resolved individual stars, H II regions and star clusters across the disc, making M101 a reference atlas for star formation in spiral arms. Four supernovae have been recorded in it, the brightest SN 2011fe at magnitude 9.9.

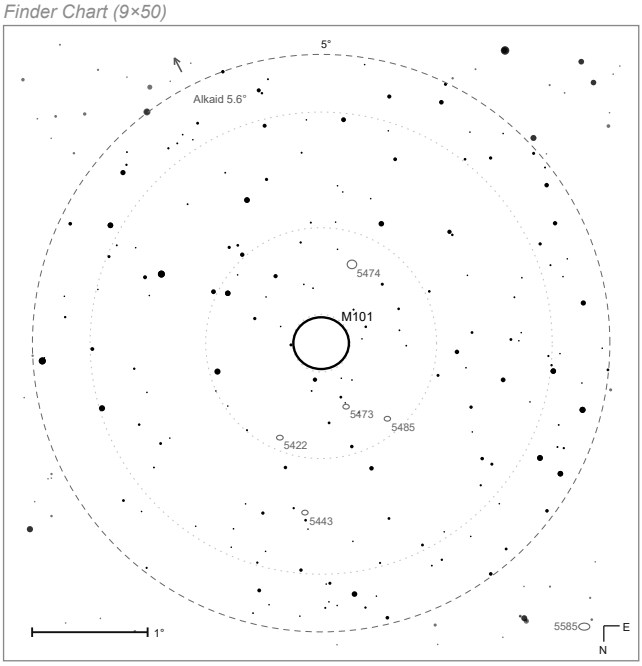
*Constellation Map*




*Naked-eye view · mag 5 · field 65°*

mag ● 1 ● 3 ● 5 ● 7

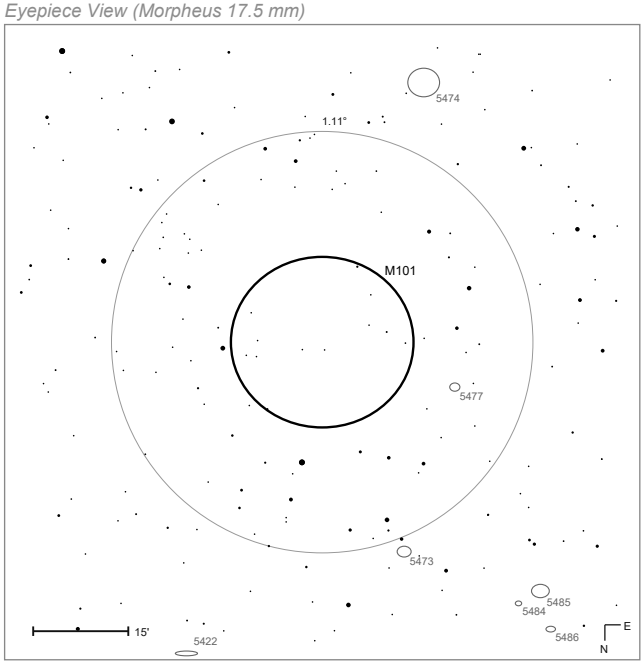
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

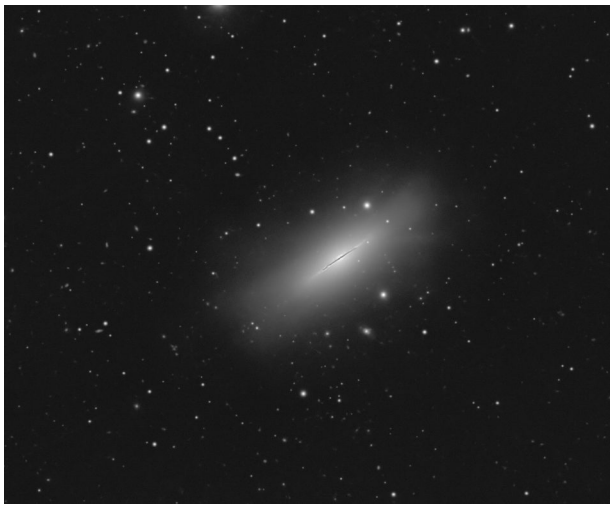



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M102 Spindle Galaxy

GALAXY



| | |
|---|---|
| MESSIER | 102 |
| NGC | 5866 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Draco |
| DISTANCE | 48 Mly |
| APPARENT MAG. | +9.9 |
| RA (J2000) | 15h 06m 30s |
| DEC (J2000) | +55° 46′ |
| APPARENT SIZE | 6.5′ × 3.1′ |
| RADIUS (LY) | 45,400 |

## DISCOVERY & HISTORY

M102 is the catalogue's unresolved entry. Pierre Méchain observed it in late March or early April 1781, Charles Messier added it to the final 1781 list without coordinates, and two years later Méchain retracted the discovery, saying it had been a duplicate observation of M101. Historical detective work since then favours the lenticular galaxy NGC 5866 — the Spindle Galaxy — and NASA treats the two as the same object, though other candidates have been proposed. On that identification it lies about 48 million light-years away in Draco.

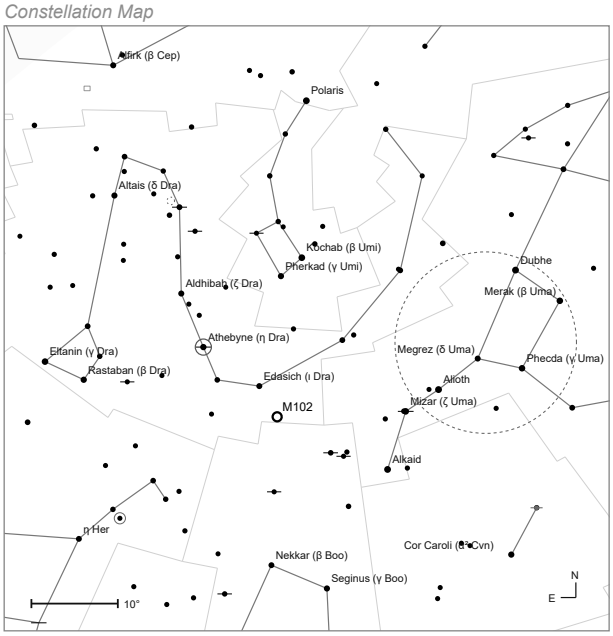
## AT THE EYEPIECE

Taking M102 as NGC 5866: it lies in southern Draco, 4° south-west of Edasich (ι Dra) and 1° north of a 5th-magnitude star; from 50°N it is circumpolar and passes overhead, best March to August. At magnitude 10 it is beyond naked eye and binoculars, but a 100 mm telescope shows its elongated spindle shape clearly. The dark lane along its equatorial plane needs a large amateur aperture and good seeing. NGC 5907, another fine edge-on galaxy in the same group, lies 1.5° north-east.

## WHY IT MATTERS

M102 is a lesson in the limits of eighteenth-century record-keeping: an object entered without coordinates, retracted by its discoverer, and still argued over two centuries later. NGC 5866 itself is worth the visit — a lenticular galaxy seen almost exactly edge-on, whose thin, sharply defined dust lane against a smooth bulge is among the cleanest illustrations anywhere of how a disc and a bulge differ.

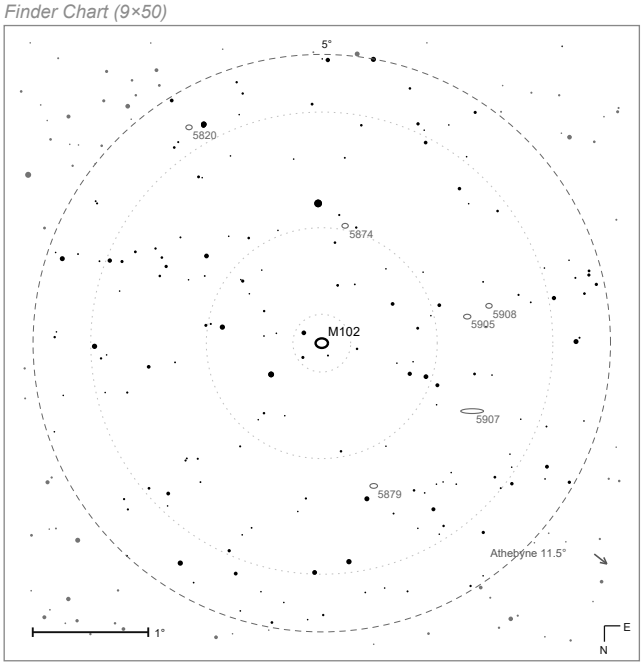
*Constellation Map*




*Naked-eye view · mag 5 · field 7°*

mag ● 1 ● 3 ● 5 ● 7

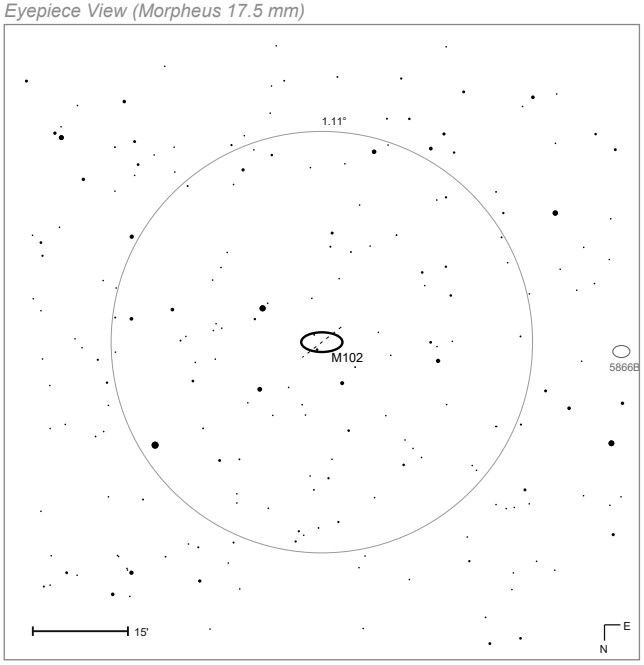
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

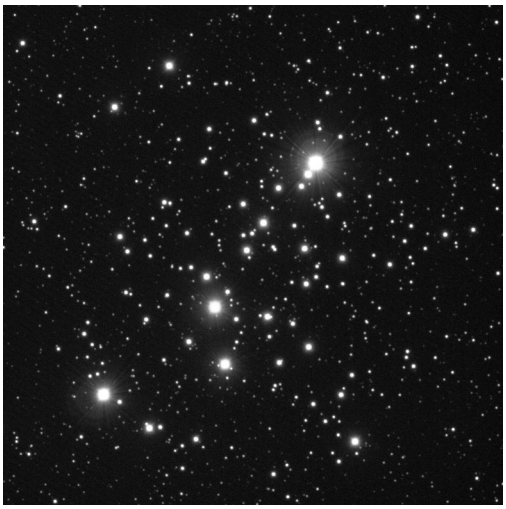



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M103

OPEN CLUSTER



| | |
|---|---|
| MESSIER | 103 |
| NGC | 581 |
| OBJECT TYPE | Open Cluster |
| CONSTELLATION | Cassiopeia |
| DISTANCE | 9,400 ly |
| APPARENT MAG. | +7.4 |
| RA (J2000) | 01h 33m 24s |
| DEC (J2000) | +60° 39′ |
| APPARENT SIZE | 6.0′ |
| RADIUS (LY) | 8 |
| AGE (YEARS) | 13 million |

## DISCOVERY & HISTORY

Pierre Méchain discovered M103 on 27 March 1781 and Charles Messier added it as the last deep-sky object in his own published catalogue — everything from M104 onward was appended later by other hands. William Herschel described the region in 1783 as a dozen or so fairly large stars with a great many extremely faint ones. Star counts have climbed with instruments: Åke Wallenquist found 40 members, Antonín Bečvář 60, and Archinal and Hynes settle on about 172. It lies 8,500–9,400 light-years away and is 15 light-years across.

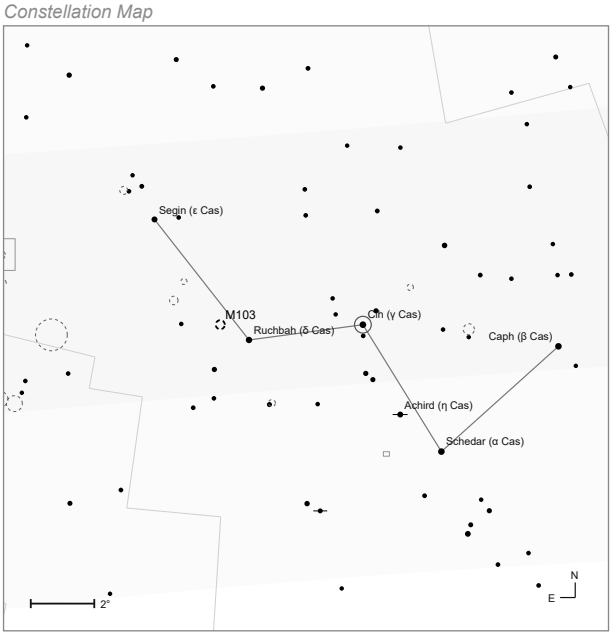
## AT THE EYEPIECE

M103 is easy to find, about 1° north-east of Ruchbah (δ Cassiopeiae) — bright enough to be a nuisance, since in 10×50 binoculars star and cluster share the field. From 50°N it is circumpolar, best August to January. Binoculars partly resolve a few members. At 114 mm the cluster takes on a triangular shape with several 8th-magnitude stars standing out, including the double Struve 131, a foreground object rather than a member. Larger apertures resolve it fully. NGC 663, NGC 654 and NGC 457 lie within a few degrees.

## WHY IT MATTERS

M103 is young — somewhere between 12.6 and 25 million years — and belongs to the Cassiopeia OB8 association, so it traces a region of recent massive star formation in the Perseus arm. Its brightest member is magnitude 10.5, and a 10.8-magnitude red giant sits near the centre: in a cluster this young, a star that has already evolved off the main sequence must be among the most massive present, which is what makes such objects useful age markers.

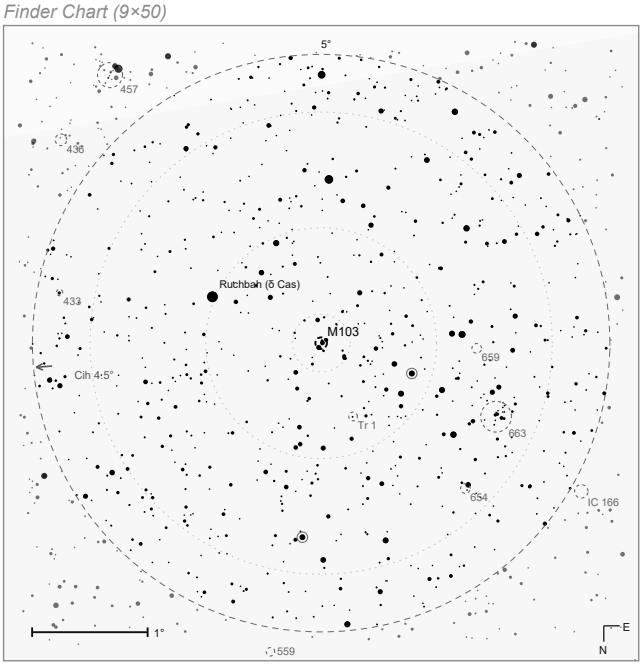
Constellation Map




Naked-eye view · mag 6 · field 19°

mag ● 1 ● 3 ● 5 ● 7

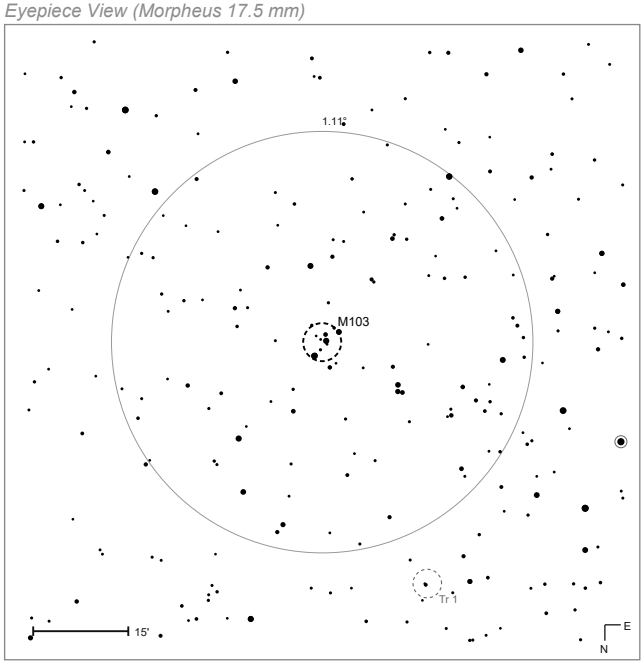
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

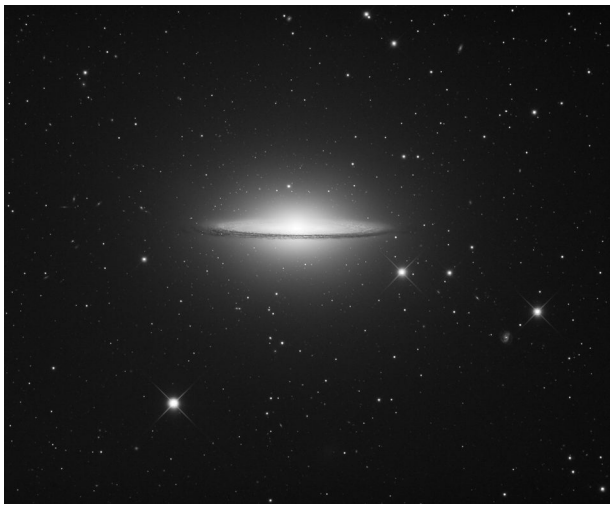



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 11.2

mag ● 6 ● 8 ● 10 · 12

# M104 Sombrero Galaxy





| | |
|---|---|
| MESSIER | 104 |
| NGC | 4594 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Virgo |
| DISTANCE | 31 Mly |
| APPARENT MAG. | +8.0 |
| RA (J2000) | 12h 40m 00s |
| DEC (J2000) | −11° 37′ |
| APPARENT SIZE | 8.6′ × 4.2′ |
| RADIUS (LY) | 38,800 |

## DISCOVERY & HISTORY

Pierre Méchain discovered the Sombrero in May 1781 and described it in an 1783 letter to Bernoulli, published in the Berliner Astronomisches Jahrbuch; William Herschel found it independently in 1784. Messier added it by hand to his personal copy of the catalogue after publication, which is why the printed 1781 list stops at M103. Camille Flammarion found that annotated copy in 1921, and M104 duly became the catalogue's 104th entry. It lies about 31 million light-years away on the Virgo–Corvus border.

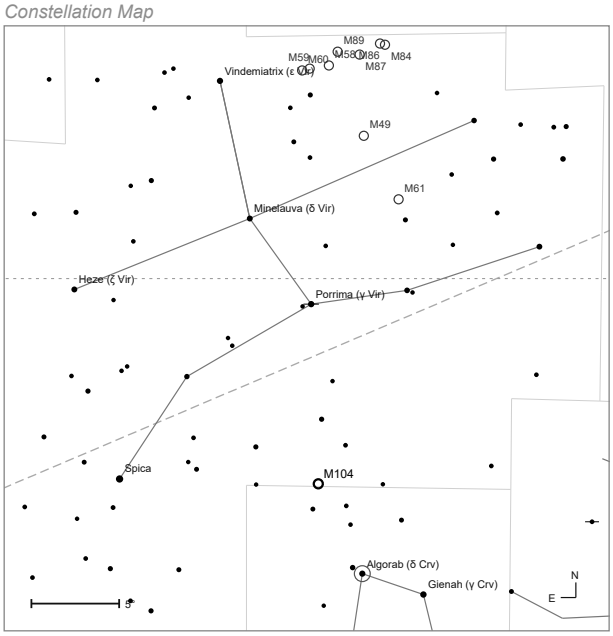
## AT THE EYEPIECE

M104 lies 5.5° north-east of Algorab (δ Corvi); from 50°N it culminates at 28°, so it wants a clear southern horizon and a spring evening. At magnitude 8.0 it is easy in small telescopes as a bright elongated glow with a strikingly large bright core. The dust lane along its equator — the brim of the hat — is the target: it shows from about 200 mm on a steady night and is unmistakable at 300 mm. Because the disc is tilted only 6° from edge-on, the tightly wound arms themselves stay out of reach.

## WHY IT MATTERS

The Sombrero resists classification. Its small bright halo suggested a spiral, but Spitzer found the halo far larger and more massive than expected — the profile of a giant elliptical. Its central bulge is unusually large, it holds 1,200–2,000 globular clusters, and a supermassive black hole of about a billion solar masses sits at its centre. Slightly larger than the Milky Way and possibly the most luminous galaxy within 33 million light-years, it is a standing argument that galaxy morphology is a spectrum, not a set of boxes.

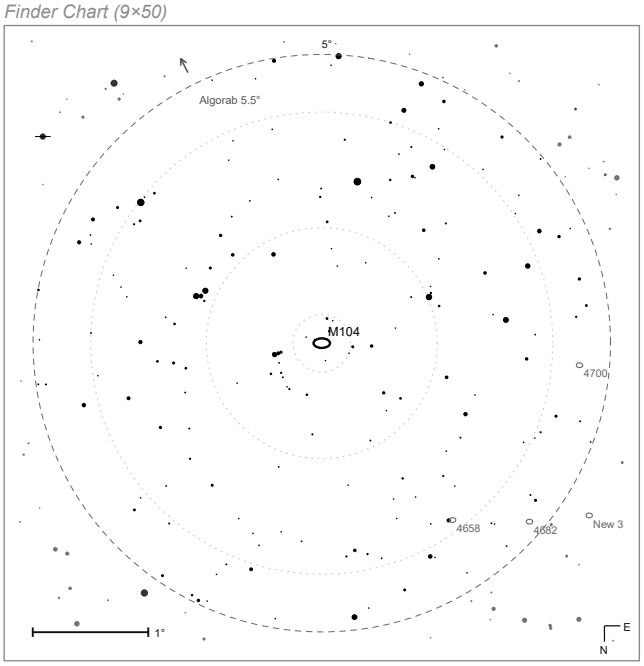
*Constellation Map*




*Naked-eye view · mag 6 · field 34°*

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

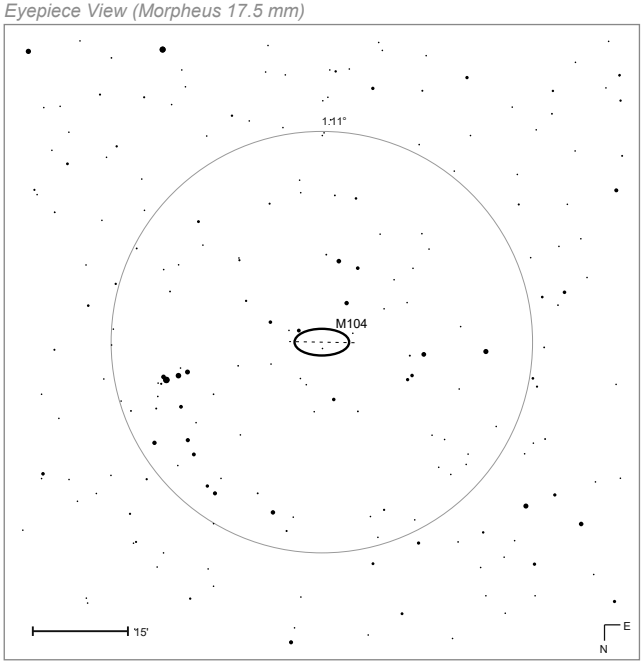
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

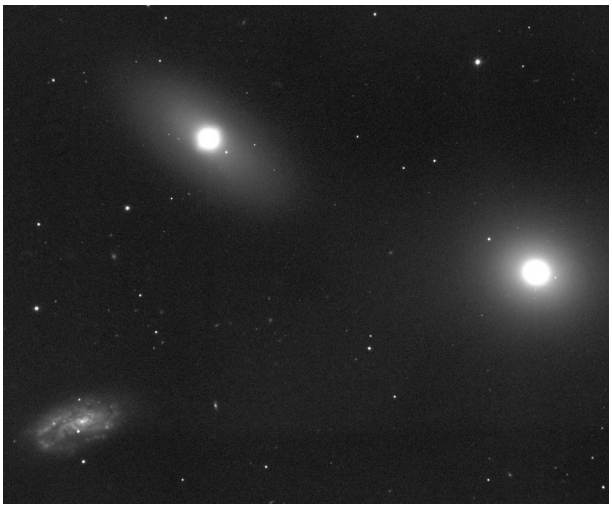



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.4*

mag ● 8 ● 10 · 12 · 14

# M105





*M105 is the round elliptical; the elongated galaxy nearby is NGC 3384, the faint spiral NGC 3389.*

| | |
|---|---|
| MESSIER | 105 |
| NGC | 3379 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Leo |
| DISTANCE | 36.6 Mly |
| APPARENT MAG. | +9.3 |
| RA (J2000) | 10h 47m 48s |
| DEC (J2000) | +12° 35′ |
| APPARENT SIZE | 5.3′ |
| RADIUS (LY) | 28,200 |

## DISCOVERY & HISTORY

Pierre Méchain discovered M105 on 24 March 1781, a few days after M95 and M96. Messier never verified it, so it was left out of the editions published in his lifetime and appeared as NGC 3379; it was only added to the catalogue after Helen S. Hogg found a letter of Méchain's locating and describing it. It lies about 36.6 million light-years away in Leo, belongs to the M96 group, and is the largest elliptical in the catalogue outside the Virgo Cluster.

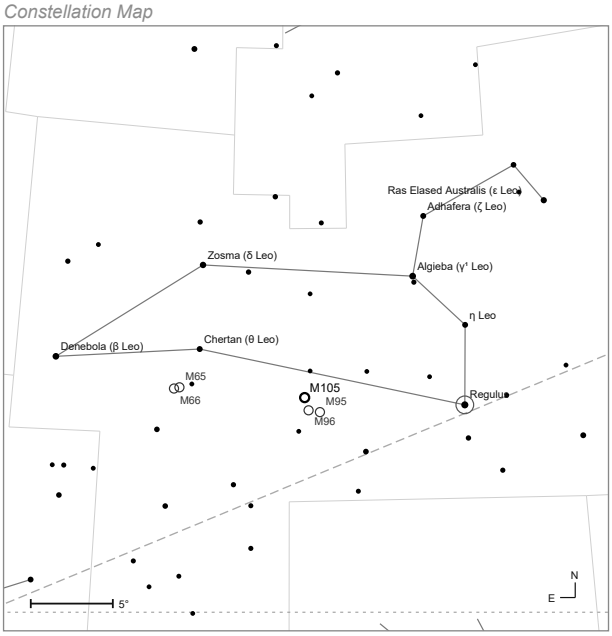
## AT THE EYEPIECE

M105 lies in a field without bright stars: from the midpoint between Regulus and Chertan find 52 Leonis and move 1.5° south. From 50°N it culminates at 53°. It is at the limit of 10×50 binoculars, so an 80 mm telescope is the practical minimum, showing a small bright spot. At 140 mm two neighbours join it — NGC 3384 and NGC 3389 — the three forming a right-angled triangle with NGC 3384 at the corner. M105 itself shows a very bright core inside a halo that fades into the sky. Three galaxies in one field is the attraction.

## WHY IT MATTERS

M105 is an unusually pure elliptical. Its isophotes are near-perfect ellipses, twisting less than 5° and varying in ellipticity by no more than 0.06, with no ripples or fine structure — the shells and plumes that betray past mergers in galaxies like M85 or M89 are simply absent. Halo giants split into a dominant metal-rich population and a weaker metal-poor one. Its central black hole is 140–200 million solar masses, with only weak nuclear activity.

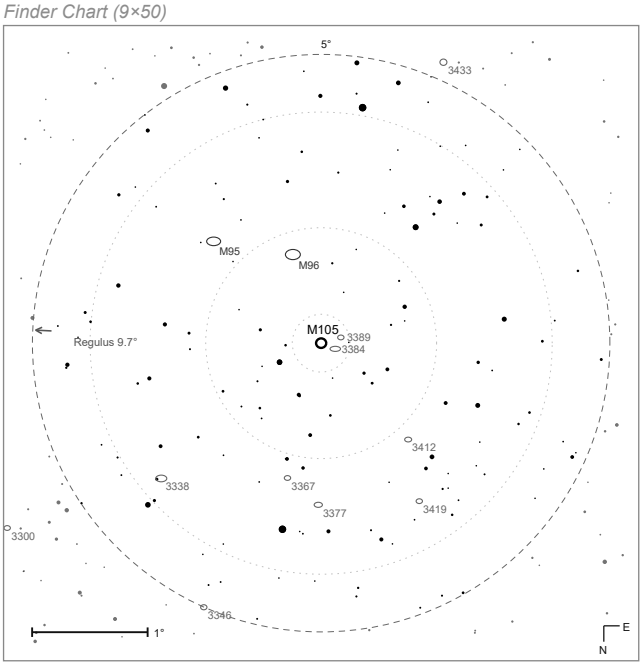
*Constellation Map*




*Naked-eye view · mag 5.5 · field 37°*

mag ● 1 ● 3 • 5 • 7 — ecliptic - - celestial equator

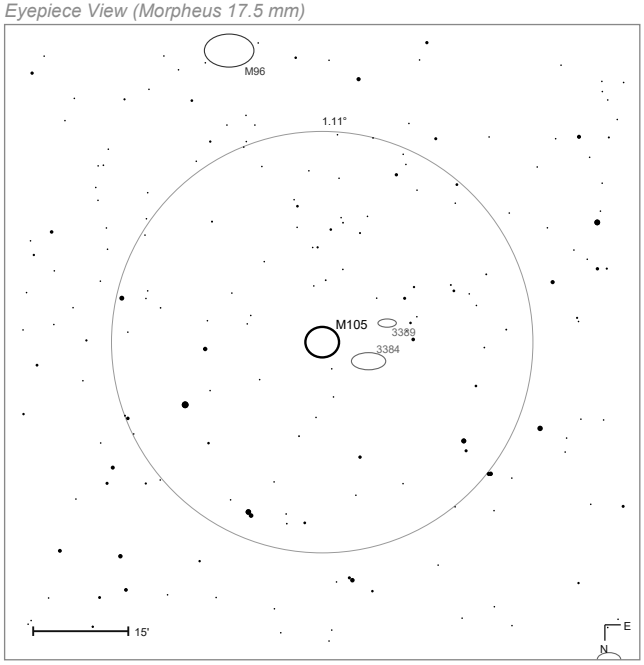
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 • 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

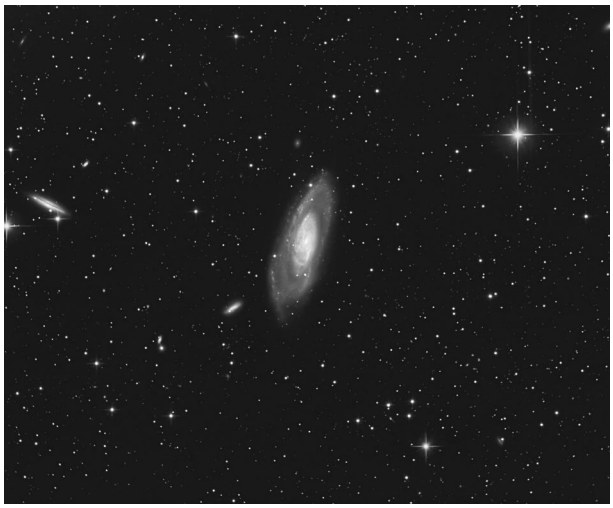



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag • 8 • 10 · 12 · 14

# M106

GALAXY



| | |
|---|---|
| MESSIER | 106 |
| NGC | 4258 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Canes Venatici |
| DISTANCE | 25 Mly |
| APPARENT MAG. | +8.4 |
| RA (J2000) | 12h 19m 00s |
| DEC (J2000) | +47° 18′ |
| APPARENT SIZE | 18.6′ × 7.2′ |
| RADIUS (LY) | 67,600 |

## DISCOVERY & HISTORY

Pierre Méchain discovered M106 in 1781, but like M105 and M107 it was never verified by Messier and only entered the modern catalogue in 1947, when Helen Sawyer Hogg added the objects Méchain had reported. It is an intermediate spiral 22–25 million light-years away in Canes Venatici, one of the largest and brightest nearby galaxies, and the dominant member of the Canes Venatici II group.

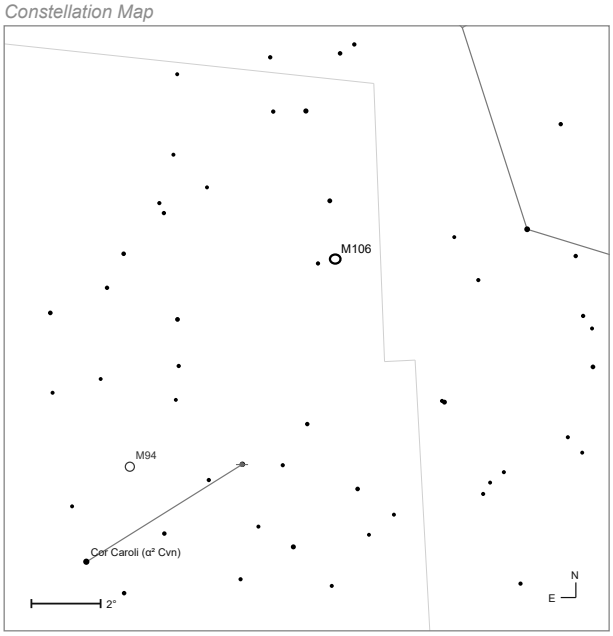
## AT THE EYEPIECE

M106 lies about 2° south of the 5th-magnitude star 3 Canum Venaticorum, itself 6° south-east of Phecda (γ UMa) in the Big Dipper. From 50°N it culminates at 87°, almost overhead, and is circumpolar; best January to August. It is bright enough for 10×50 binoculars under good conditions, showing as an oval patch. A small telescope gives the very bright core; from 150–200 mm the disc shows uneven brightness and the spiral arms begin to appear. The edge-on spiral NGC 4217 lies 40′ south-west, though it is far more distant and probably not a true companion.

## WHY IT MATTERS

M106 hosts a Type 2 Seyfert nucleus and a water-vapour megamaser — a natural microwave laser in dense warm molecular gas. Tracking those masers mapped a thin, slightly warped Keplerian disc orbiting within a light-year of the centre, proving a black hole of about 36–40 million solar masses and yielding the first direct geometric distance ever measured to another galaxy. That measurement remains an independent anchor of the cosmic distance ladder. M106 also has two "anomalous arms" visible only in X-rays.

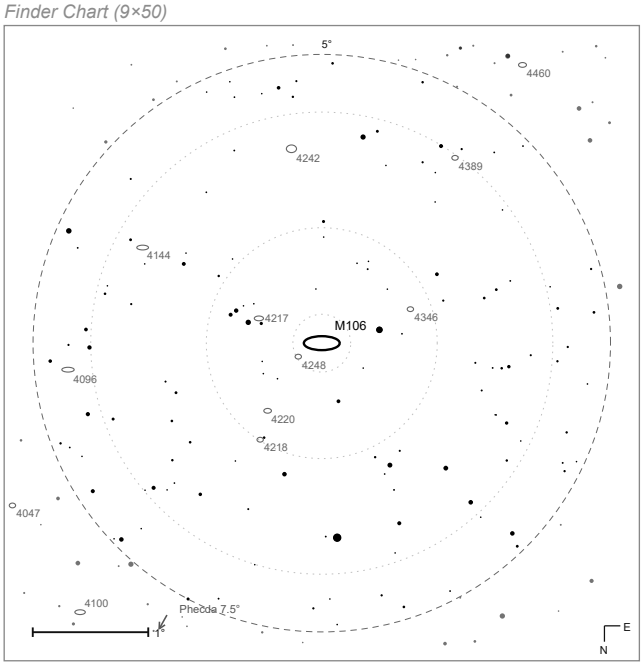
Constellation Map




Naked-eye view · mag 7 · field 18°

mag ● 1 ● 3 ● 5 ● 7

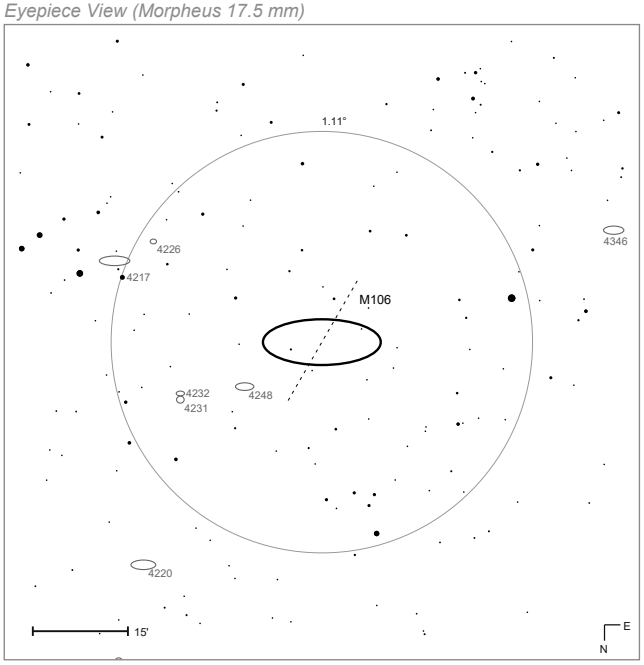
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5

mag ● 8 ● 10 · 12 · 14

# M107

GLOBULAR CLUSTER

| | |
|---|---|
| MESSIER | 107 |
| NGC | 6171 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Globular Cluster |
| CONSTELLATION | Ophiuchus |
| DISTANCE | 20.9 kly |
| APPARENT MAG. | +7.8 |
| RA (J2000) | 16h 32m 30s |
| DEC (J2000) | −13° 03′ |
| APPARENT SIZE | 13.0′ |
| RADIUS (LY) | 40 |
| AGE (YEARS) | 13.9 billion |

## DISCOVERY & HISTORY

Pierre Méchain found M107 in April 1782 — probably the latest-discovered object in the catalogue — and William Herschel came upon it independently in 1793. His son John described it in his 1864 General Catalogue as a large, very rich, much compressed globular cluster, clearly consisting of stars. It waited until 1947, when Helen Sawyer Hogg added it and three other Méchain objects to the modern catalogue, making it the last globular cluster in the list. It lies about 20,600–20,900 light-years away.

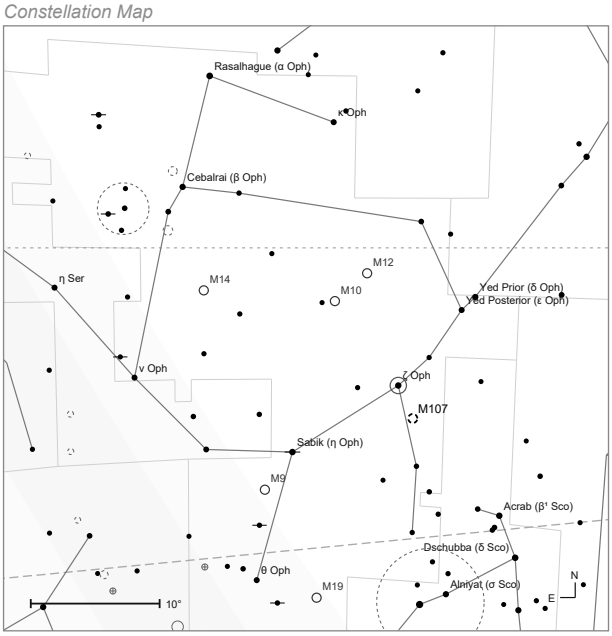
## AT THE EYEPIECE

M107 lies just under 3° south-west of Han (ζ Ophiuchi); a right-angled triangle of 7th-magnitude stars just north of the cluster confirms the field. From 50°N it culminates at 27°, best May to September. A 10×50 binocular will find it as a faint round glow. It is a very loose globular, so it resolves comparatively easily — from about 150 mm in good conditions individual stars appear across its 13′, giving a mottled, half-resolved texture rather than a hard core.

## WHY IT MATTERS

M107 lies close to the galactic plane, 9,800 light-years from the centre, on an orbit that ranges between 9,200 and 12,400 light-years out — the inner end carrying it into and back out of the galactic bar on every pass. Clusters on such orbits are steadily eroded by the bar's tidal field, which helps explain how loose M107 is. Twenty-two RR Lyrae variables are known in it, plus a probable SX Phoenicis pulsator.

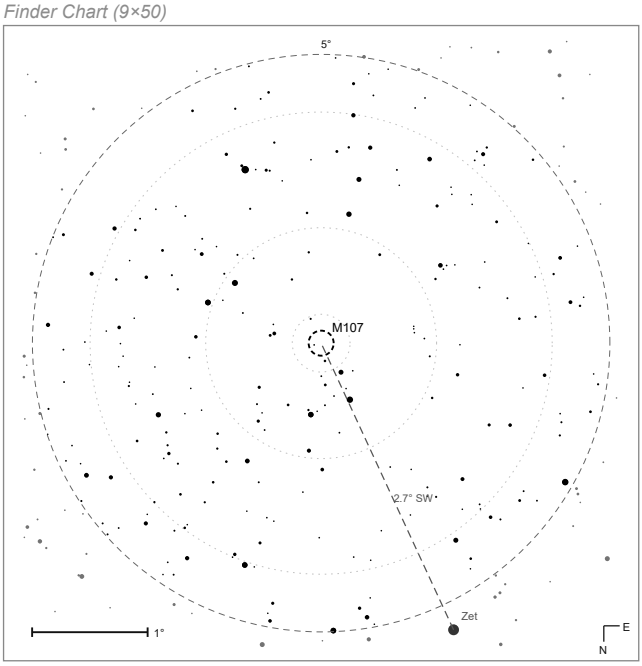
Constellation Map




Naked-eye view · mag 5 · field 47°

mag ● 1 ● 3 ● 5 ● 7 — ecliptic - - celestial equator

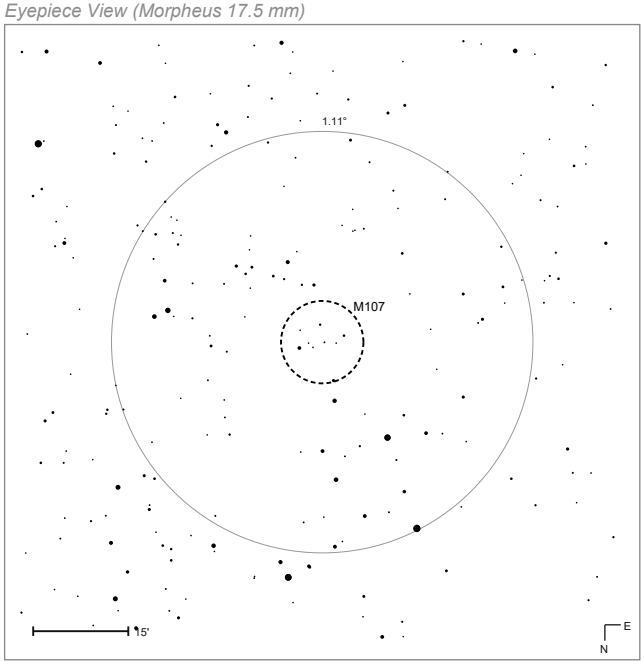
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)

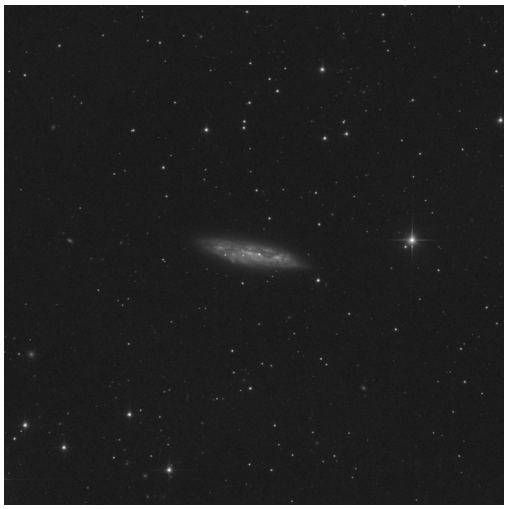



Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.7

mag ● 8 ● 10 · 12 · 14

# M108

GALAXY



| | |
|---|---|
| MESSIER | 108 |
| NGC | 3556 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Ursa Major |
| DISTANCE | 46 Mly |
| APPARENT MAG. | +10.0 |
| RA (J2000) | 11h 11m 30s |
| DEC (J2000) | +55° 40′ |
| APPARENT SIZE | 8.6′ × 2.4′ |
| RADIUS (LY) | 57,500 |

## DISCOVERY & HISTORY

Pierre Méchain discovered M108 on 19 February 1781. Nicknamed the Surfboard Galaxy, it is a barred spiral seen almost edge-on — inclined 75° to our line of sight — and an isolated member of the Ursa Major Cloud in the local supercluster. Distance estimates range from about 31 to 46 million light-years. Its mass is around 125 billion Suns and it carries some 290 globular clusters.

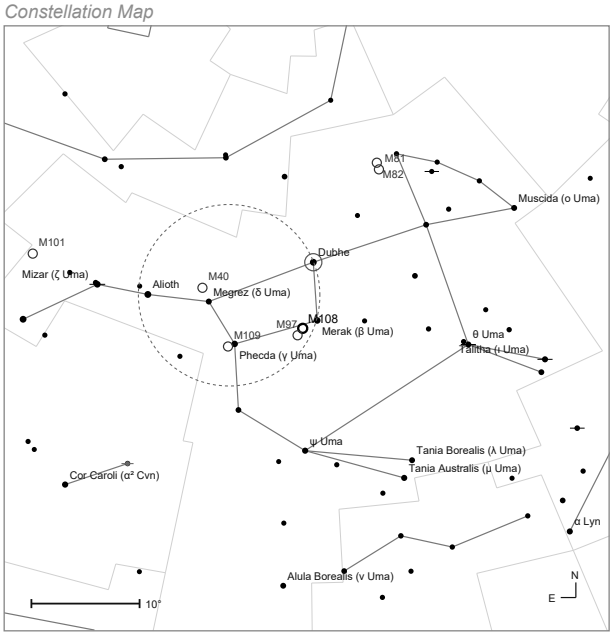
## AT THE EYEPIECE

M108 is easy to place: 1.5° south-east of Merak (β UMa), the Dipper star that with Dubhe points toward Polaris. From 50°N it is circumpolar and passes overhead, best January to August. Under a dark transparent sky a binocular can reach it. A 60 mm telescope shows a spindle strongly elongated east–west; at 150 mm its brightest condensations become traceable, though at any aperture it stands out only weakly against the sky. The most irregular and most prominent part of the spindle is on its eastern side. The Owl Nebula M97 lies 48′ south-east.

## WHY IT MATTERS

The neutral hydrogen in M108 is arranged in discrete expanding shells several thousand light-years across — H I supershells — most likely blown by clustered supernova explosions, though infall from the intergalactic medium or radio jets have also been proposed. Chandra has found 83 X-ray sources in the galaxy including one at the nucleus, and the brightest of them is consistent with an intermediate-mass black hole, a class of object that remains hard to confirm anywhere.

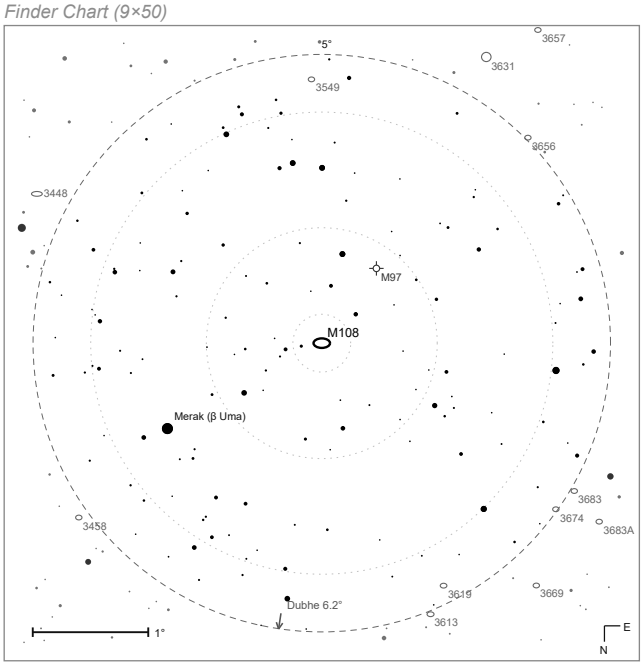
Constellation Map




Naked-eye view · mag 5 · field 56°

mag ● 1 ● 3 ● 5 ● 7

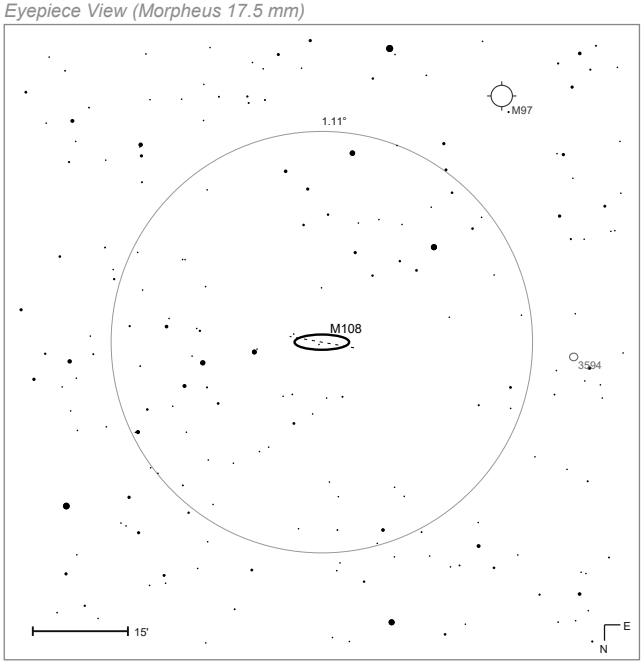
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5

mag ● 8 ● 10 · 12 · 14

# M109

| | |
|---|---|
| MESSIER | 109 |
| NGC | 3992 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Ursa Major |
| DISTANCE | 67 Mly |
| APPARENT MAG. | +9.8 |
| RA (J2000) | 11h 57m 36s |
| DEC (J2000) | +53° 22′ |
| APPARENT SIZE | 7.5′ × 4.4′ |
| RADIUS (LY) | 73,100 |

## DISCOVERY & HISTORY

Pierre Méchain discovered M109 in 1781 and Charles Messier catalogued it two years later as an appended object. Through the 1920s to 1950s objects beyond M103 were widely treated as unofficial — Patrick Moore drew the line at 104, listing M105 to M109 as addenda, while David Levy used the modern 110 — and only by the late 1970s did all 110 become standard. M109 is a barred spiral with a weak inner ring, 67 to 85 million light-years away, and the most distant object in the entire catalogue.

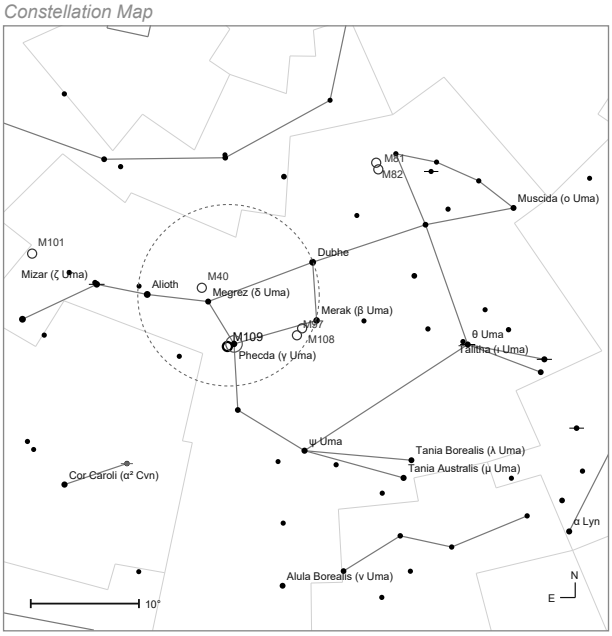
## AT THE EYEPIECE

M109 lies only 40′ south-east of Phecda (γ UMa), which makes it trivial to locate and awkward to observe: use Phecda to find the field, then shift it out of view, because its glare swamps the galaxy's faint light. From 50°N it is circumpolar, best January to August. It is beyond 50–60 mm finders. The nucleus is the easiest part; from it the bar extends to both sides, with a spiral arm unwinding from each end. NGC 3953, a similarly bright barred spiral of the same group, lies 1° south-west.

## WHY IT MATTERS

M109 anchors its own group and has at least three satellite galaxies — UGC 6923, UGC 6940 and UGC 6969. Detailed neutral hydrogen mapping shows a regular H I distribution with a low-level extension beyond the stellar disc and a central hole inside the bar: the bar has swept its own region clear of gas, which is exactly what dynamical models of barred galaxies predict, and is why this otherwise unspectacular galaxy is a useful test case.

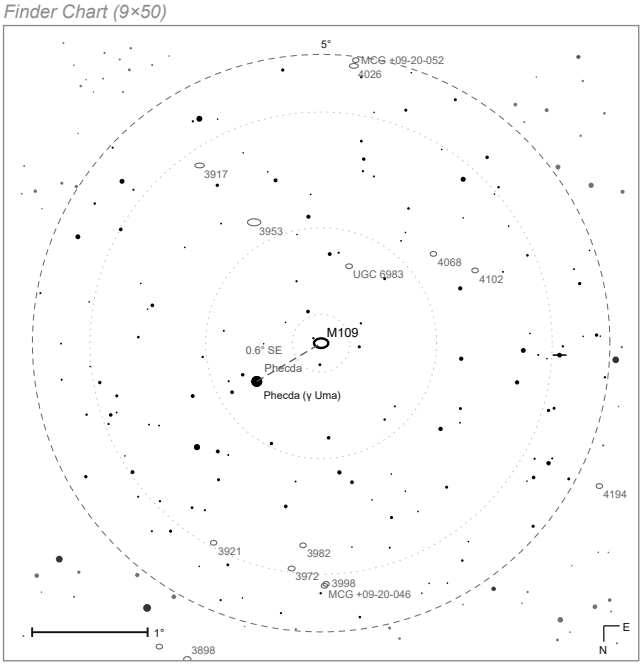
*Constellation Map*




*Naked-eye view · mag 5 · field 56°*

mag ● 1 ● 3 ● 5 ● 7

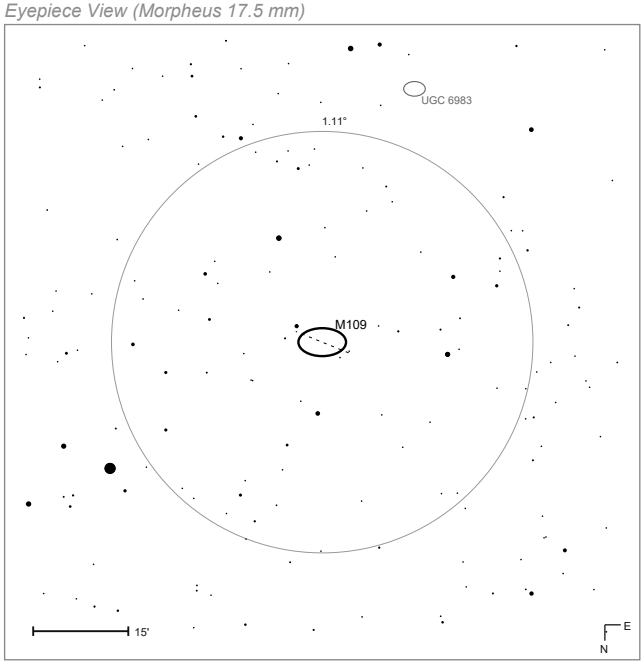
*Finder Chart (9×50)*




*9×50 finder · rotated 180° · mag 10.5*

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

*Eyepiece View (Morpheus 17.5 mm)*

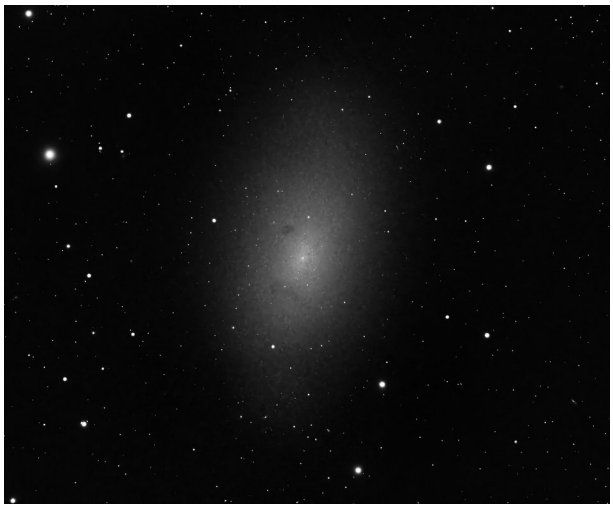



*Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 13.5*

mag ● 8 ● 10 · 12 · 14

# M110

GALAXY



| | |
|---|---|
| MESSIER | 110 |
| NGC | 205 |
| ALSO IN | Herschel 400 |
| OBJECT TYPE | Galaxy |
| CONSTELLATION | Andromeda |
| DISTANCE | 2.69 Mly |
| APPARENT MAG. | +8.1 |
| RA (J2000) | 00h 40m 24s |
| DEC (J2000) | +41° 41′ |
| APPARENT SIZE | 19.5′ × 11.5′ |
| RADIUS (LY) | 7,630 |

## DISCOVERY & HISTORY

Charles Messier never listed this galaxy, though he drew it beside M32 on his sketch of the "Nébuleuse d'Andromède" and noted that he first saw it on 10 August 1773. Caroline Herschel found it independently on 27 August 1783, and her brother William described her discovery in 1785. Kenneth Glyn Jones proposed giving it a Messier number in 1967, which made M110 the last entry in the catalogue — nearly two centuries after the object was first seen.

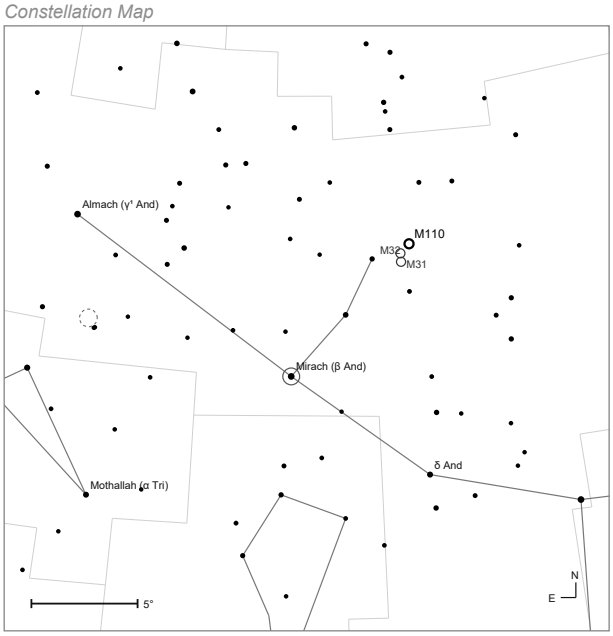
## AT THE EYEPIECE

M110 lies 35′ north-west of M31's nucleus and shows in small telescopes as a strongly elliptical misty patch. From 50°N it culminates at 82°. Its surface brightness is lower than M32's, so it is the less conspicuous of the two companions and rewards a dark sky; at low power all three galaxies fit one field, which is the view worth arranging. Note the contrast: M32 is small and sharply concentrated, M110 large, diffuse and gently elongated — two satellites of the same galaxy could hardly look less alike.

## WHY IT MATTERS

M110 is a dwarf elliptical of class pec dE5, the "pec" earned by patches of dust and young blue stars near its centre — unusual for a dwarf elliptical, and still unexplained. Unlike M32 it shows no evidence of a central supermassive black hole. Its inner region is notably swept clear of interstellar medium, most likely by supernovae, and what remains amounts to only some 10,000–18,000 solar masses of dust at 18–22 K. As a satellite being slowly stripped by M31, it previews the fate of such companions.

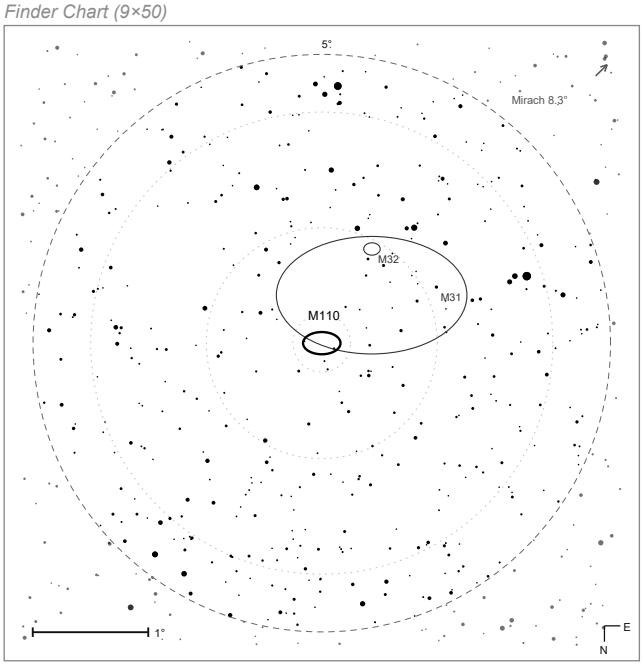
Constellation Map




Naked-eye view · mag 6 · field 28°

mag ● 1 ● 3 ● 5 ● 7

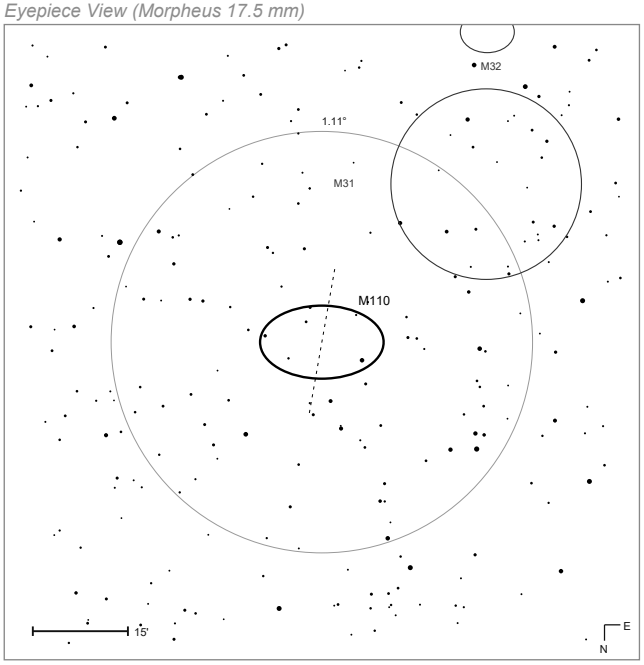
Finder Chart (9×50)




9×50 finder · rotated 180° · mag 10.5

mag ● 2 ● 4 ● 6 ● 8 · 10 - - Telrad rings

Eyepiece View (Morpheus 17.5 mm)




Morpheus 17.5 mm @ 68.6× · rotated 180° · mag 12.2

mag ● 8 ● 10 · 12 · 14

# Chart symbols

*Every symbol used on the three charts of an object spread.*

## Stars

**Star brightness**
Dot size gives the magnitude; each chart states its own limit

**Variable star**
Ring around a star that varies by 0.4 mag or more

**Multiple star**
Bar through a star belonging to a multiple system

**Outside the field**
Dimmed stars lie beyond the finder circle

## The object and its surroundings

**The object**
Its true size and orientation; a galaxy or nebula

**Cluster**
Dashed circle: an open or globular cluster

**Planetary nebula**
Ring with its central star

**Double star**
The two components at their catalogue separation

**Star cloud**
A Milky Way region at its catalogue extent, not a cluster (M24)

**Asterism**
Corner brackets: a line-of-sight pattern, no physical group (M73)

**Larger than the eyepiece field**
The part outside the eyepiece circle is drawn at 40 %

**Position angle**
Dashed line along the major axis of an elongated object

**Another Messier object**
Marked and labelled with its own number

**Star-hop anchor**
The reference star, with an arrow and its distance

## Chart furniture

**Scale bar**
Angular size on the chart, labelled in ° or ′

**Orientation**
N and E as they fall on this chart, rotation included

## Deep-sky symbols

**Galaxy**
Ellipse at the catalogued size and position angle

**Globular cluster**
Circle with a cross

**Open cluster**
Dashed circle

**Planetary nebula**
Circle with four spikes

**Bright nebula**
Box around the glowing region

**Dark nebula**
Dashed box: dust blocking the starlight

**Supernova remnant**
Dash-dotted circle

**Multiple star (catalogued)**
Dot with a bar

## Lines, bands and fields

**Constellation line**
The figure as drawn in Sky & Telescope

**Constellation boundary**
The IAU border between constellations

**Ecliptic**
The Sun's path; the Moon and planets stay near it

**Celestial equator**
Declination zero

**Milky Way**
Schematic band, brighter towards the galactic equator

**Finder field**
Dashed circle: the 5° field of a 9×50 finder

**Eyepiece field**
The 1.11° field of a 17.5 mm Morpheus at 68.6×

**Telrad rings**
Dotted circles at 0.5°, 2° and 4° diameter

# Notes on the charts

Every object in this atlas carries three charts, drawn at three scales and not all oriented the same way. This page explains how they work together, why two of them are turned, which instrument each one assumes, and where their constellation figures come from.

### WORKING FROM ONE CHART TO THE NEXT

The three charts are a sequence, each picking up where the one before it runs out.

The **constellation chart** is the naked-eye view. Its field runs from 12° to 70°, according to how much sky the object needs around it to be recognisable, and the caption states it; the chart goes about as deep as an eye sees under a decent sky, so the figure on the page is the figure overhead. Use it to place the object within its constellation and to get the tube roughly pointed — or to park the outer Telrad ring on the right patch of sky. The star this atlas has chosen as your starting point is ringed here.

The **finder chart** carries the hop itself. A dashed line runs from that starting star to the object, labelled with the star's name; when the star falls outside the 5° field, a marker at the edge of the chart points toward it and gives its distance in degrees. Put the star in the finder, then work along the line. Stars beyond the field circle are drawn dimmed, so the circle reads as the edge of what you will actually see rather than as one more line on a map.

The **eyepiece view** is for confirming what you have found and knowing what else is in there. It usually reaches about two magnitudes deeper than the finder chart and never more than three — the depth is chosen per field to keep the chart legible, and the caption states it. It labels the other catalogue objects sharing the field, and draws the object at its catalogued size and orientation, with a dashed axis along the long direction of anything elongated. An object larger than the field is continued outside the ring at reduced opacity, so you can see which part of it the eyepiece holds.

The last two charts are turned; the rest of this page is about that.

### WHICH WAY IS UP

All three charts use a gnomonic projection onto a plane tangent to the sky at the object, so angles and shapes near the centre are true.

The **constellation chart** is drawn as you see the sky with your eyes: north up, east to the left. East is to the *left*, not the right, because you are looking outward at the sphere rather than down at a terrestrial map.

The **finder chart** and the **eyepiece view** are turned through 180°. Every point sits diametrically opposite where the naked-eye chart would put it, at the same distance from the centre — the object itself, being at the centre, does not move. In the language of geometry the two charts are related by *central symmetry* about the object.

### WHY 180°, AND WHY THAT MATTERS

A Newtonian collects light off two mirrors: the parabolic primary and the flat secondary. Two reflections is an even number, so the image is **rotated, not mirrored**. A straight-through finder, which has no prism to erect the image, does the same.

The distinction is worth more than it sounds. A rotation can be undone by turning this book upside down, and the star pattern will then match what you see. A mirror image could not — no rotation of a printed page ever recovers a mirrored one; you would have to read it through the back of the paper. So if you replace the supplied finder with a right-angle one containing a star diagonal, the finder chart will no longer match at any angle, and you should use the constellation chart instead. A right-angle *correct-image* finder shows the sky upright, and wants the constellation chart too.

Note that only the star positions are turned. Labels are always drawn upright so that the page stays readable, which means that when you do turn the book to match the eyepiece, the lettering stands on its head.

### THE INSTRUMENTS ASSUMED

The finder chart assumes a **9×50 straight-through finder** and draws its field as a dashed 5.0° circle. That figure is nominal: finders of this class run from about 5° to 5.6°, and yours is worth measuring — time a star near the celestial equator drifting across the full field, and multiply the minutes by 15′.

The eyepiece view assumes a **254 mm f/4.7 Newtonian of 1200 mm focal length** with a **17.5 mm Morpheus** eyepiece: 68.6× and a true field of 1.11°, drawn as the solid circle. The 20 mm eyepiece supplied with that telescope gives 60× and 1.17°, within five per cent of the same circle, so these charts serve it as well. The 12.5 mm gives 96× and 0.73°, about two thirds of the drawn circle.

Each chart states its own limiting magnitude in its caption, since the useful depth differs between a 50 mm finder and a 254 mm mirror, and between a sparse field and the heart of the Milky Way.

### FIELD ROTATION

The 180° is a convention, not a promise. On an altazimuth mount the field turns slowly against the celestial coordinates as an object crosses the sky, and the angle at which the eyepiece meets that field depends on where the tube is pointing. Expect to rotate the page a little either way until the pattern locks on. What never changes is the handedness: the chart and the view are the same way round, and that is what lets any rotation succeed.

### THE TELRAD RINGS

The dotted circles on the finder chart — 0.5°, 2° and 4° in diameter — are the reticle of a Telrad or similar reflex sight. Such a sight has no optics in the light path, so it shows the sky the right way up, like your eyes. The ring diameters are unaffected by that, and so is the question of which star falls inside which ring; but to compare the *pattern* against the sight, turn the page.

### THE CONSTELLATION FIGURES

The lines that join stars into figures are a convention rather than a fact about the sky, and atlases disagree about them. This one follows the Czech convention: the *Western (O. Hlad)* sky culture distributed with Stellarium, whose lines Miroslav Brož drew after the printed atlas *Hvězdná obloha 2000.0* (Hlad et al., 1988). It joins the Greek-lettered stars and little else, which makes it the sparsest set available and the one that stays legible at the size these charts are printed; it is also the closest published stand-in for Antonín Rükl's *Souhvězdí*, the book most Czech observers learned the sky from. Should fewer than four fifths of a figure's stars be identifiable in the star database, that one constellation is drawn instead from Stellarium's plain *Western* culture, which joins more stars — so if a figure looks unusually busy, that is why.

The faint lines that cross the constellation chart and no other are a different thing: the IAU constellation boundaries of 1930, which do state a fact — which constellation any given patch of sky officially belongs to.

# The people in this atlas

Messier worked in a crowded field. Most of the objects in his list had been seen by somebody before him, several were handed to him by his assistant, and nearly everything we now know about what they actually are was worked out by other people over the two centuries after his death. These are the names that appear in the object descriptions, alphabetically, with what each of them did here.

**Halton Arp** (1927–2013), American, compiled the *Atlas of Peculiar Galaxies* in 1966, the standard reference for galaxies that refuse to look like anything in the textbooks. Both M51 and the M60 / NGC 4647 pair are in it, the latter as Arp 116. In 1959, with William Melbourne, he followed up Shapley's work on the crowded core of M22.

**Heinrich Louis d'Arrest** (1822–1875), German, born in Berlin, went through the Messier objects carefully at a time when most observers were content to repeat Herschel. He and John Herschel independently noticed that the core of M15 is offset to the east, and he left the most detailed early description of M90 — though, oddly for so diligent an observer, nothing at all on M19.

**Edward Emerson Barnard** (1857–1923), American, was the finest visual observer of his generation and the first to catalogue the dark nebulae — the places where there is dust instead of stars. Two of his entries appear here: Barnard 64, which empties the field just west of M9, and Barnard 85, the dust that splits M20 into three lobes and gives the Trifid its name.

**John Bevis** (1695–1771), English physician and astronomer, found the Crab Nebula in 1731, twenty-seven years before Messier stumbled on it and made it M1. He also picked up M35 independently before 1750. His star atlas *Uranographia Britannica* was of real quality but was lost in his printer's bankruptcy and never properly published.

**Johann Elert Bode** (1747–1826), German, director of the Berlin observatory, determined the orbit of Uranus and proposed the planet's name. He described M10 in 1774 as "very pale", discovered M53 in 1775, and found M64 independently a month after Pigott. Messier was chasing a comet of Bode's when he came across the Ring Nebula, M57.

**Robert Burnham Jr.** (1931–1993), American, wrote *Burnham's Celestial Handbook*, three volumes that a generation of deep-sky observers read at the eyepiece and still quote. His reading of the dark silhouette in M16 as a Star Queen in profile is one of the two names that stuck to it, and his verdict on M40 — "one of the few real mistakes in the Messier catalog" — has never been bettered. He died destitute.

**Giovanni Domenico Cassini** (1625–1712), Italian-French, founder of the observing dynasty and first director of the Paris Observatory, recorded M50 at some point before 1711. Messier found it again in 1772 without knowing.

**Jacques Cassini** (1677–1756), son of the above and known as Cassini II, was observing a comet with Maraldi in 1746 when his companion noticed M2. The two Cassinis are easy to confuse: the elder saw M50, the younger was present at M2.

**Jean-Philippe Loys de Chéseaux** (1718–1751), Swiss, found M4, M6, M16, M17, M35 and M71 in 1745–46, in his twenties, with a good refractor at his family's estate near Lausanne. His report went unnoticed and every one of those objects had to be discovered again, mostly by Messier. He also stated the dark-sky paradox later named after Olbers. He died at thirty-three.

**James Cuffey** (1911–1999), American, specialised in the photometry of star clusters. His work on M26 ruled out the obvious explanation for the gap near its centre — an intervening dust cloud — and argued that the hole is real: a genuine shell of low stellar density inside the cluster.

**Heber Doust Curtis** (1872–1942), American, argued in the Great Debate of 1920, against Shapley, that the spiral nebulae were separate galaxies, and was right. He classified M76 as a planetary nebula in 1918 and in the same year photographed the jet of M87, six decades before anyone could explain what it was.

**Antoine Darquier de Pellepoix** (1718–1802), French, of Toulouse, read Messier's report of Comet Bode, followed the comet, and so rediscovered the Ring Nebula independently a fortnight after Messier. His description of it — "as large as Jupiter and resembles a planet which is fading" — is probably where the misleading term *planetary nebula* comes from.

**William Derham** (1657–1735), English clergyman and natural philosopher, resolved M11 into stars in 1732, one of the earliest demonstrations that a nebulous patch could be a crowd of suns. He also produced the first reasonably accurate measurement of the speed of sound.

**Henry Draper** (1837–1882), American physician and pioneer of astrophotography, took the first photograph of any nebula in 1880 — the Orion Nebula, M42. It has been the most photographed object in the sky ever since.

**John Louis Emil Dreyer** (1852–1926), Danish, working in Ireland, compiled the *New General Catalogue* of 1888 and its two Index Catalogues, which gave almost every object in this atlas the NGC number it still carries. His terse verdicts run throughout: M46 is "very bright, very rich, very large". He also carried the doubtful M73 into the NGC, and left the bright M25 out of it altogether.

**Camille Flammarion** (1842–1925), French, the most successful populariser of astronomy of his century, found in 1921 the annotated copy of Messier's catalogue in which the Sombrero Galaxy is described in Messier's own hand. The object duly became M104, a hundred and forty years late.

**Guillaume Le Gentil** (1725–1792), French, found M8 independently in 1747, M32 in 1749 — the first companion of the Andromeda Galaxy anyone had noticed — and rediscovered M36 and M38 the same year. He is better remembered for eleven years of travel to observe the transits of Venus of 1761 and 1769, and for being clouded out or diverted at every attempt.

**Alan Hale** (1958–2026) and **Thomas Bopp** (1949–2018), Americans, independently spotted the same comet on the night of 22–23 July 1995. Both were looking at M70 at the time; Bopp, an amateur in the Arizona desert with a borrowed telescope, had never found a comet before. Comet Hale–Bopp became the brightest of its generation.

**Edmond Halley** (1656–1742), English, the second Astronomer Royal, noticed M13 in 1714 and wrote that it "shews it self to the naked Eye, when the Sky is serene and the Moon absent". His calculation that the comet of 1682 would return was the prediction Messier spent 1757 and 1758 trying to confirm — the search that produced M1, and with it the catalogue.

**Caroline Herschel** (1750–1848), German-British, sister and observing partner of William, was the first woman paid to do science and the first to publish in the *Philosophical Transactions*. Observing on her own account she found M110 on 27 August 1783, and M93 and M47 independently, believing them uncatalogued. She discovered eight comets and lived to ninety-seven.

**John Herschel** (1792–1871), English, son of William, extended his father's survey to the southern sky from the Cape of Good Hope and produced the catalogue that became the backbone of the NGC. His 1833 drawing of M17 fixed the name Omega on it; his sketch of M20 fixed the trifid appearance in the literature; he counted the stars of M23 from the Cape, doubted out loud that M73 was a cluster, and dismissed M18 as loose and star-poor.

**William Herschel** (1738–1822), German-British, discovered Uranus, built the largest telescopes in the world, and swept the sky for nebulae with far more aperture than Messier ever had. The consequence runs right through this atlas: object after object that Messier had logged as a "nebula without stars" was resolved into stars by Herschel — M2 and M9 in 1783, M3 around 1784, M5 in 1791. He published catalogues of 2,500 nebulae in 1802 and 5,000 in 1820, and worked throughout with his sister Caroline.

**Jeff Hester** and **Paul Scowen**, American astronomers then at Arizona State University, photographed the central pillar of M16 with the Hubble Space Telescope in 1995 and named the result the Pillars of Creation. It is probably the most reproduced astronomical image ever made.

**Johannes Hevelius** (1611–1687), of Gdańsk, brewer, city councillor and founder of lunar mapping, reported a nebula above the tail of the Great Bear. Messier went looking for it in 1764, found nothing, and catalogued the double star he saw instead as M40 — noting drily that Hevelius had probably mistaken two stars for a nebula. He had, though not those two: he had seen 74 and 75 Ursae Majoris, a degree further east.

# The people in this atlas

**Giovanni Battista Hodierna** (1597–1660), Sicilian priest at the court of the Duke of Palma, compiled a catalogue of some forty objects around 1654 that included at least nineteen real nebulae and clusters — the first list of its kind anyone made. It sank without trace, and was not appreciated until the twentieth century; in the case of M47, not until 1984. Hodierna had seen M6, M7, M8, M33, M36, M37, M38, M41 and M47 a century before Messier.

**Helen Sawyer Hogg** (1905–1993), American-Canadian, spent sixty years on globular clusters and their variable stars and wrote a newspaper column about the sky for thirty. In 1947 she added to the modern catalogue the objects Méchain had reported but Messier never verified — among them M106 and M107 — which is why M107 is the last globular in the list.

**Walter Scott Houston** (1912–1993), American, wrote the "Deep-Sky Wonders" column in *Sky & Telescope* for forty-seven years and knew better than anyone what a given object actually looks like in a given telescope. He is quoted here on M38, where the cross is convincing in a small instrument and dissolves in a large one, and on M93.

**Edwin Hubble** (1889–1953), American, proved that the spiral nebulae are galaxies and that the universe is expanding. He appears here for a smaller piece of work: the proposal in 1928 that M1 is the wreck of the star Chinese astronomers recorded in 1054, which turned out to be right.

**William Huggins** (1824–1910), English, working with his wife Margaret, founded astronomical spectroscopy and settled by direct observation which nebulae are gas and which are crowds of stars. He showed that M76 is gaseous.

**Christiaan Huygens** (1629–1695), Dutch, discovered Titan, invented the pendulum clock, and published the first detailed drawing of the centre of the Orion Nebula in 1659. The brightest part of M42 still carries his name as the Huygens Region.

**Johann Abraham Ihle** (1627 – c. 1699), German, an amateur from Leipzig, found M22 in 1665, one of the first globular clusters ever seen, more than a century before anyone knew what a globular cluster was.

**Kenneth Glyn Jones** (British, twentieth century) edited the Webb Society's eight-volume *Deep-Sky Observer's Handbook* and wrote *Messier's Nebulae and Star Clusters*, the standard modern study of the catalogue's history. It was his suggestion, in 1967, that gave M110 its number and closed the list at 110. He also repeated Smyth's mistaken claim about who showed M65 and M66 to Messier, which is how that error reached so many later books.

**Gottfried Kirch** (1639–1710), German, first astronomer of the Berlin observatory, discovered M11 in 1681 and M5 in 1702, the latter during a comet search — the earliest telescopic discoveries in this atlas apart from Ihle's.

**Johann Gottfried Köhler** (1745–1801), German, of Dresden, found M59 and M60 on the same night in April 1779 while following a comet through Virgo, saw M67 before 1779, and noted M71 around 1775. Messier came upon M59 and M60 about three days later, unaware.

**Nicolas-Louis de Lacaille** (1713–1762), French abbé, spent 1750–54 at the Cape of Good Hope observing more than ten thousand southern stars and naming fourteen constellations. He found M55 and M83 in 1752, both awkwardly far south for observation from Paris; Messier took nearly thirty years to confirm the first, and it is still unsettled whether an object Lacaille described in 1751–52 was really M69.

**David H. Levy** (born 1948), Canadian-American, co-discoverer of the comet that struck Jupiter in 1994, is cited here on a matter of bookkeeping: when others still treated everything past M103 as unofficial, Levy used the full modern list of 110, which is now standard.

**Jean-Jacques d'Ortous de Mairan** (1678–1771), French, described the detached patch of nebulosity north-east of the Orion Nebula some time before 1731. Messier gave it a number of its own, M43, although it is physically part of M42, and it is still called De Mairan's Nebula. His experiments with plants kept in the dark also began the study of circadian rhythms.

**Jean-Dominique Maraldi** (1709–1788), Italian-born, working in Paris, discovered M2 in 1746 while observing a comet with Jacques Cassini, and M15 on 7 September of the same year. He described M15 as a nebulous star made of many stars — closer to the truth than most descriptions of that period.

**Simon Marius** (1573–1625), German, one of the first observers of the moons of Jupiter, made the first telescopic observation of the Andromeda Galaxy in 1612 and said it looked like "a candle shining through horn". Nobody improved on that description for a long time, and for three centuries the object was assumed to lie inside the Milky Way.

**Nicholas Mayall** (1906–1993), American, later director of Kitt Peak, settled the question Hubble had raised by showing spectroscopically that M1 is expanding at a rate consistent with an explosion in 1054. The Crab thus became the first object tied to a recorded supernova.

**Pierre Méchain** (1744–1804), French, was Messier's friend, colleague and best source of objects. He found his first, M63, on 14 June 1779 and told Messier the same day; he went on to discover at least twenty entries in the catalogue, among them M72, M76, M77, M94, M100, M101, M103 and M105 to M109. He also surveyed the meridian arc from Dunkirk to Barcelona on which the metre was defined, and died in Spain, of malaria, still trying to finish the work.

**Patrick Moore** (1923–2012), English, presented the BBC's *The Sky at Night* for fifty-five years, compiled the Caldwell catalogue, and wrote more than seventy books. He drew the line of the Messier catalogue at M104, listing M105 to M109 as addenda — a defensible position at the time, and one the subject abandoned in the 1970s.

**Barnaba Oriani** (1752–1832), Italian priest and astronomer at Milan, found M61 on 5 May 1779 while following a comet — Messier saw it the same night but took it for the comet, and needed six days to notice. Oriani was the first to compute the orbit of Uranus, and the first to work out the path of the newly discovered Ceres.

**William Parsons, 3rd Earl of Rosse** (1800–1867), Irish, built the 72-inch "Leviathan of Parsonstown" at Birr Castle, the largest telescope in the world for the next seventy years. In spring 1845 he turned it on M51 and saw spiral arms — the first nebula ever known to have them, and the start of eighty years of argument about what the nebulae were. He listed M77 among the first fourteen spirals in 1850, believed he saw spiral structure in M63 and M92, and named M97 the Owl in 1848 after the two dark hollows in his drawing.

**Francis Gladheim Pease** (1881–1938), American, designed the 100-inch telescope at Mount Wilson, used it with Michelson to measure the diameter of Betelgeuse, and in 1928 found on its plates the first planetary nebula ever seen inside a globular cluster. Pease 1, in M15, is still one of only four known.

**Nicolas-Claude Fabri de Peiresc** (1580–1637), French antiquary, patron and correspondent of half the scientists in Europe — Galileo's lawyer, among other things — made the first telescopic observation of the Orion Nebula in 1610. He never published it.

**Edward Pigott** (1753–1825), English, one of the founders of the study of variable stars, discovered M64 in March 1779: the first of three independent discoveries of that galaxy within thirteen months, the others being Bode's and Messier's.

**Isaac Roberts** (1829–1904), Welsh engineer and businessman, pioneered long-exposure photography of the nebulae and produced the first plates on which the spiral structure of the Andromeda Nebula is unmistakable. He suggested in 1891 that M76 might be a ring nebula seen edge-on, which is close to the modern view.

**Harlow Shapley** (1885–1972), American, director of the Harvard College Observatory, used globular clusters to establish the size of the Milky Way and the Sun's off-centre place in it. He counted some 70,000 stars in M22 in 1930 and found the first 28 variables in M68 in 1919–20. The Shapley–Sawyer scale that ranks globulars from concentrated to diffuse, quoted throughout this atlas, is his and Helen Sawyer Hogg's.

# The people in this atlas

**William Henry Smyth** (1788–1865), English admiral, hydrographer and observer, wrote *A Cycle of Celestial Objects*, whose descriptions shaped how English-speaking amateurs saw these objects for a century. His names for M17 — Omega and Horseshoe — stuck, and so did his eye for a rich field, quoted here for M19, M21 and M23. He also stated, wrongly, that Méchain had pointed out M65 and M66 to Messier, an error that outlived him by generations.

**Friedrich Georg Wilhelm von Struve** (1793–1864), Baltic German, founded the systematic study of double stars and measured tens of thousands of them at Dorpat and Pulkovo. His catalogue numbers are still in use, and three of his pairs appear in this atlas as field stars: Struve 737 in M36, Struve 1121 in M47 and Struve 131 in M103.

**Robert Julius Trumpler** (1886–1956), Swiss-American, proved that interstellar space is dusty by showing that distant open clusters look smaller than they ought to, and devised the classification of open clusters — concentration, brightness range, richness — that appears on many of these pages as "Trumpler class I 3 r" and the like.

**Thomas William Webb** (1807–1885), English clergyman, wrote *Celestial Objects for Common Telescopes* in 1859, the book that taught small-telescope observing to the Victorians and has never entirely gone out of print. Two of his readings survive as names: Webb's Cross for M21, and the oblique cross of M38.

**Friedrich August Theodor Winnecke** (1835–1897), German, discoverer of comets and cataloguer of double stars, rediscovered Messier's problematic M40 in 1863 and gave it the designation Winnecke 4, by which it is still often known.

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**NGC and IC identities** — cross-identifications, and the flagging of duplicate and nonexistent designations, follow Wolfgang Steinicke's *Revised New General Catalogue and Index Catalogue* (2026 edition), used with credit.

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**Faint stars** — the telescope-view charts use data from the European Space Agency (ESA) mission *Gaia* (cosmos.esa.int/gaia), Data Release 3, processed by the Gaia Data Processing and Analysis Consortium (DPAC). Funding for the DPAC has been provided by national institutions, in particular the institutions participating in the Gaia Multilateral Agreement.

**Constellation figures** — the stick figures on the locator and monthly charts follow the *Western (O. Hlad)* sky culture distributed with Stellarium, GNU GPL v2.0: lines by Miroslav Brož after the Czech printed atlas *Hvězdná obloha 2000.0* (Hlad, Hovorka, Polechová, Weiselová, 1988). Where a figure's stars cannot be resolved, the chart falls back to Stellarium's *Western* culture, whose data is CC BY-SA. Constellation boundaries are the IAU 1930 set from the same source.

### THIS ATLAS

Built with open-source software: Python, ReportLab, pandas and pypdfium2. The full pipeline — data extraction, chart rendering and page layout — is reproducible from the sources above.