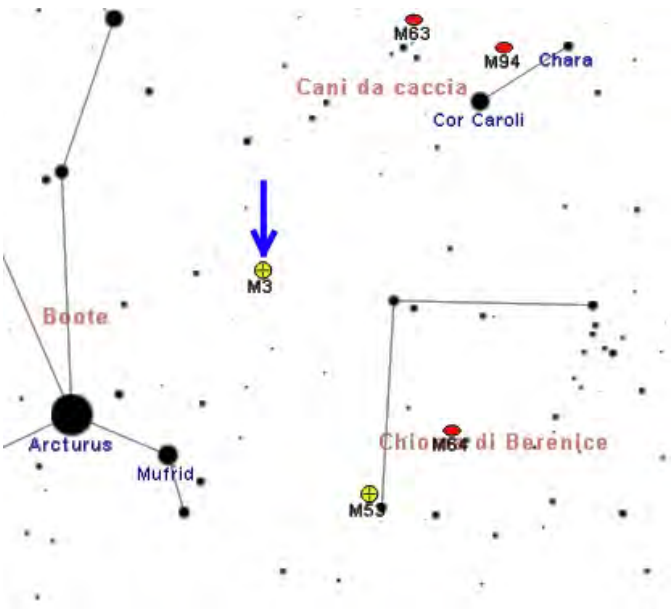
M 3 GLOBULAR CLUSTER

Messier 3 (also known as M3 or NGC 5272) is a globular cluster of stars in the northern constellation of Canes Venatici. It was discovered by **Charles Messier** on May 3, 1764,[8] and resolved into stars by **William Herschel** around 1784. Since then, it has become one of the best-studied globular clusters. Identification of the cluster's unusually large variable star population was begun in 1913 by American astronomer **Solon Irving Bailey** and new variable members continue to be identified up through 2004. To date it contains 274 known variable stars; by far the highest number found in any globular cluster. These include 133 RR Lyrae variables, of which about a third display the Blazhko effect of long-period modulation.
The Blazhko effect is a variation in period and amplitude in the RR Lyrae type variable stars, first observed by **Sergey Blazhko** in 1907 in the star RW Draconis. The physics behind it is currently still a matter of debate, with there being three primary hypotheses:

- In the first, referred to as the resonance model, the cause of the modulation is a non-linear resonance among either the fundamental or the first overtone pulsation mode of the star and a higher mode.
- The second, known as the magnetic model, assumes the variation to be caused by the magnetic field being inclined to the rotational axis, deforming the main radial mode.
- The third model assumes that cycles in the convection cause the alternations and the modulations

The overall abundance of elements in the cluster other than hydrogen and helium, what astronomers term the metallicity, is in the range of –1.34 to –1.50 dex. This value gives the logarithm of the abundance relative to the Sun; the actual proportion is 3.2–4.6% of the solar abundance. Messier 3 is the prototype for the Oosterhoff type I cluster, which is considered "metal-rich". That is, for a globular cluster, Messier 3 has a relatively high abundance of heavier elements.
It was the Dutch astronomer **Pieter Oosterhoff** who first noticed that there appear to be two populations of globular clusters, which became known as Oosterhoff groups. Both groups have weak lines of metallic elements. But the lines in the stars of Oosterhoff type I cluster are not quite as weak as those in type II. **Hence type I are referred to as "metal-rich" while type II are "metal-poor"**
These two populations have been observed in many galaxies, especially massive elliptical galaxies. Both groups are nearly as old as the universe itself and are of similar ages, but differ in their metal abundances. Many scenarios have been suggested to explain these subpopulations, including violent gas-rich galaxy mergers, the accretion of dwarf galaxies, and multiple phases of star formation in a single galaxy. **In the Milky Way, the metal-poor clusters are associated with the halo and the metal-rich clusters with the bulge**
Many amateur astronomers consider M 3 one of the finest northern globular clusters, following only Messier 13. M3 has an apparent magnitude of 6.2, making it a difficult naked eye target even with dark conditions. With a moderate-sized telescope, the cluster is fully defined. **It can be a challenge to locate through the technique of star hopping, but can be found by looking almost exactly halfway along an imaginary line connecting the bright star Arcturus to Cor Caroli**. Using a telescope with a 25 cm (9.8 in) aperture, the cluster has a bright core with a diameter of about 6 arcminutes and spans a total of 12 arcminutes.
This cluster is one of the largest and brightest, and is made up of around 500,000 stars. It is estimated to be 8 billion years old. It is located at a distance of about 33,900 light-years away from Earth.



In the Middle Ages the constellation Canes Venatici was identified with the two dogs held on a leash by Boötes, the Herdsman, because there was a mistake in the translation of Ptolemy's Almagest from Greek to Arabic. In Ptolemy's text, some of the stars in Boötes represent the Herdsman's club. The translator loosely translated the Greek word for "club" as "the spearshaft with a hook. When the Arabic phrase he used was later translated to Latin, the translator mistook one of the words for kilab, which means "dogs."

Boötes was depicted with two dogs in 1533 on a map by the German astronomer **Peter Apian**, and **Hevelius** decided to define the dogs' position in the night sky in the 17th century. Hevelius named the northern dog Asterion ("little star" in Greek) and the southern one Chara ("joy"). The name Chara later started to be used specifically to refer to the star Beta Cvn. Alpha CVn (Cor Caroli) is the constellation's brightest star, named by **Sir Charles Scarborough** in memory of King Charles I, the deposed king of Britain. Legend has it that a CVn was brighter than usual during the Restoration, as Charles II returned to England to take the throne.

HISTORY

Messier 3 was the first 'original' discovery by Charles Messier when he logged it on May 3rd, 1764. At that time it was the 75th deep sky object ever observed by human eyes (and apparatus), although at that time, it was only the 54th known nebulous object, while 21 objects had been forgotten again, according to the sources and current knowledge. Perhaps the discovery of this object eventually caused Charles Messier to start a systematical search for these comet resembling objects, and not just catalogue chance findings as in the previous cases, M1 and M2. Alternatively, Messier may have started this endeavour due to other reasons, and it was just his first discovery - anyway, the search which started with M3 lead him to catalogue the objects up to M40 during this year 1764.

When the final object of the catalogue, M107, a globular cluster in Ophiuchus, was discovered by Messier's friend **Pierre Méchain** 18 years later, in 1782, a total of at least 154 objects had been observed.

At a distance of about 33,900 light years, M3 is further away than the centre of our Galaxy, the Milky Way, but still shines at magnitude 6.2. Its absolute magnitude is about -8.93, corresponding to a luminosity of about 300,000 times that of our sun. M3 is thus visible to the naked eye under very good conditions - and a superb object with the slightest optical aid. Its apparent diameter of 18.0 arc minutes corresponds to a linear extension of about 180 light years; **Kenneth Glyn Jones** mentions an estimate of even 20 arc minutes from deep photographic plates, corresponding to about 200 light years linear diameter. The somewhat smaller radius in amateur instruments of about 10 minutes of arc, is deceiving. Its tidal radius, beyond which member stars would be torn away by the tidal gravitational force of the Milky Way Galaxy, is about 38 minutes of arc. Thus, this cluster gravitationally dominates a spherical volume 760 light years in diameter.

On the other hand, M3 has a compressed, dense core measuring 1' in diameter, or linearly, 11 light years, comparatively large for a globular. So that half of this cluster's mass is contained in a volume of only 22 light years in diameter.

Situated in the Galactic halo, out about 40,000 light-years from the Galactic Center, M3 is moving on a box-type orbit of approximate excentricity 0.55, which takes it out up to 66,000 light-years apogalactic distance and up to 49,000 light-years above and below the Galactic plane (currently it is about 33,000 light-years above - i.e., north of - that plane). On the other hand, its perigalactic distance is only 22,000 light-years - at that distance, the tidal radius of M3 will go down to below 200 light-years, so that the outermost stars may easily escape from this globular cluster.

M3 contains a relatively large number of so-called Blue Stragglers, blue main-sequence stars which appear to be rather young, much younger than the rest of the globular's stellar population would suggest. These were first discovered by **Alan Sandage** (1953) on photographic plates taken with the 200-inch telescope on Mt. Palomar. A mystery for a long time, these stars are now thought to have undergone dramatic changes in stellar interactions, getting their cooler outer layers stripped away in close encounters in the dense central regions of globular clusters. AK, with Wikipedia Notes