

MESSIER 45, THE PLEIADES STAR CLUSTER

Messier 45 (M45), also known as the Pleiades or Seven Sisters, is a bright open star cluster located in the constellation Taurus, the Bull. It has an apparent magnitude of 1.6 and lies at an average distance of 444 light years from Earth. The cluster is also known as Melotte 22. It does not have an NGC designation.

Messier 45 contains a number of hot, blue, extremely luminous B-type stars and is one of the nearest star clusters to Earth. It is the easiest object of its kind to see without binoculars. M45 has a core radius of 8 light years and its tidal radius extends to about 43 light years. The cluster is home to more than 1,000 confirmed members, but only a handful of these stars are visible to the naked eye. The total mass of M45 is estimated at about 800 solar masses. It occupies an area of 110 arc minutes, about four times the apparent diameter of the full Moon. Up to 14 stars are visible without binoculars in good conditions, with clear skies and no light pollution. The best time of year to observe M45 from northern latitudes is during the winter months, when Taurus constellation rises high in the sky. Because of the cluster's apparent size, the best way to see it is through binoculars and small or wide field telescopes. The stars in the Pleiades cluster have formed in the last 100 million years and they will stay gravitationally bound to each other for another 250 million years before the cluster is expected to disperse as a result of tidal interactions with other objects in the neighbourhood. By that point, the cluster will have moved from Taurus to Orion.

MYTHOLOGY

The names of the nine brightest stars in M45 are taken from Greek mythology and they represent the Pleiades, the Seven Sisters – Sterope, Electra, Merope, Maia, Celaeno, Taygeta, and Alcyone – and their parents, Pleione and Atlas.

The name Pleiades is believed to be derived from the Greek plein, which means “to sail.” The names of the mythical sisters comes from that of their mother Pleione, an Oceanid nymph who was married to the Titan Atlas and also gave birth to the Hyades, nymphs said to bring rain.

The Pleiades have been known to cultures around the world since pre-historic times. The cluster was mentioned in the works of Homer (Iliad and Odyssey, 750 B.C. and 720 B.C.), the prophet Amos (750 B.C.) and Hesiod (700 B.C.) among others.

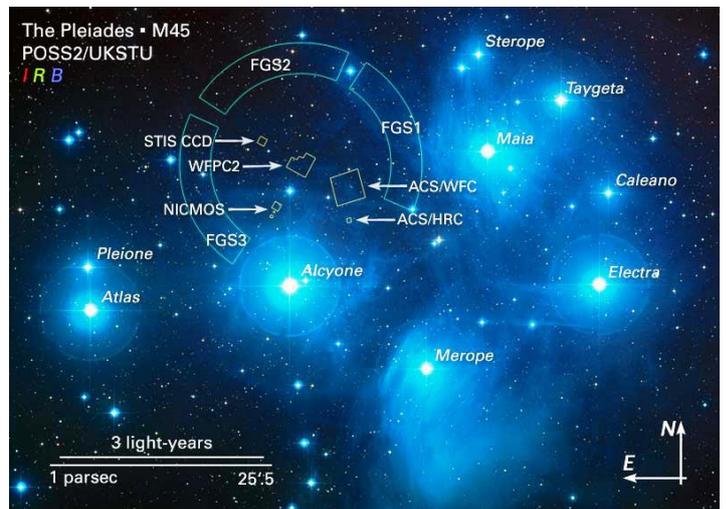
Messier 45 has a faint reflection nebula surrounding it, named Maia Nebula, after one of the cluster's brightest stars. The nebula is not related to the cluster's formation, but is merely a dust cloud through which the Pleiades stars are currently passing. Like other nebulae in the Pleiades cluster, the Maia Nebula has a different radial velocity than the cluster itself, indicating that the two are unrelated and only crossing paths by chance.

Messier 45 has an estimated age of 150 million years. It does not contain extremely high-mass O-type stars or the brightest kind of B-type stars, which means that star formation in the cluster ended at least 80 million years ago. Up to 25 percent of the stars in the Pleiades cluster are brown dwarfs, objects with less than 8 percent of the Sun's mass, and their combined mass is less than 2 percent of the total mass of the cluster.

One of the stars in the cluster, designated HD 23514, was discovered to be surrounded by a large number of hot dust particles, also known as planetesimals, which orbit within the star's circumstellar disk. The discovery, made with the Spitzer Space Telescope, could indicate planet formation around



The Pleiades, an open cluster consisting of approximately 3,000 stars at a distance of 400 light-years (120 parsecs) from Earth in the constellation of Taurus.



the star. HD 23514 is a class F6 main sequence star less than a million years old.

The cluster is home to a large number of X-ray sources, which are usually associated with stars that exploded as supernovae. X-ray sources are powered by dust and gas accelerated by objects like neutron stars or black holes.

Galileo Galilei was the first astronomer to observe M45 through a telescope. He published his notes with a sketch of the cluster in a short astronomical treatise titled *Sidereus Nuncius* (Sidereal Messenger) in March 1610. His sketch showed 36 of the cluster's stars.

Italian astronomer **Giovanni Battista Hodierna** counted 37 stars in the cluster in 1654, noting that “the first, and the most luminous of all assemblies of stars, shines in the belly of Taurus; six, or seven stars are most evident, before many others...”

Charles Messier catalogued the Pleiades as Messier 45 on March 4, 1769, describing the object simply as a “cluster of stars, known by the name of the Pleiades. The position reported is that of the star Alcyone.”

In 1767, **John Michell**, English clergyman and philosopher, proposed that the stars in the cluster had to be physically related because the likelihood of a chance alignment of so many bright stars was 1 in 500,000. His theory was confirmed later, when scientists began to study the stars' proper motions and discovered that they were all travelling in the same direction and at the same rate.

In 1782, French astronomer **Edme-Sébastien Jeaurat** drew a map of 64 stars of M45 based on his observations of the cluster. The map was published in 1786.

Admiral **William Henry Smyth** wrote extensively about the individual stars in the Pleiades cluster and the observation history, he noted:

The Pleiades constitute a celebrated group of stars, or miniature constellation, on the shoulders of Taurus; their popular influences have been said and sung for many years and various are the appellations under which they have been known. Theon liked them to a bunch of grapes; *Aratos* says they were called *Eptaporoi*; *Manilius* clusters them as *glomerabile sidus*; the Arabs said they were *Ath-thurayya*, or the little ones; the French designate them as *poussinière*; the Germans call them *gluckhenne*; the Italians knew them as *le gallinelle*; the Spaniards term them *the cabrillas*, or little manny-goats.

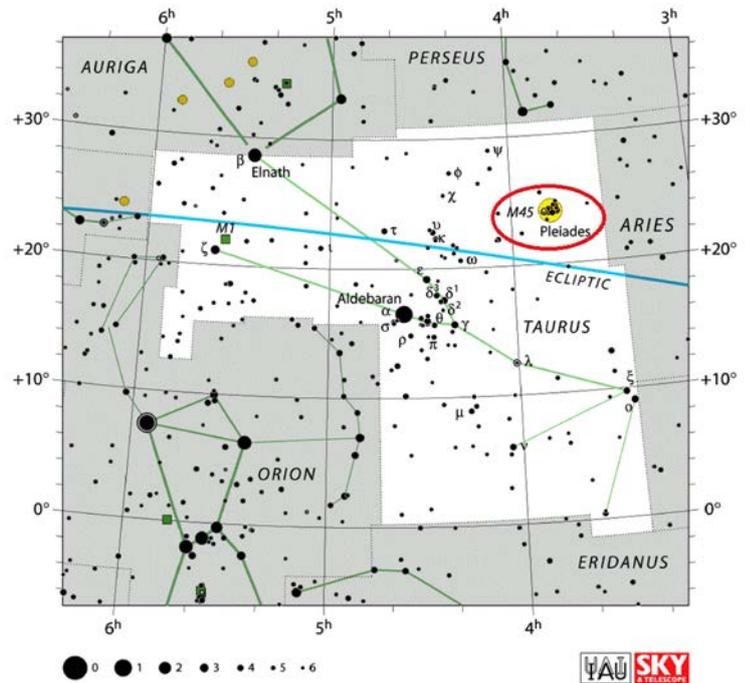
The clusters' Japanese name is Subaru, which means “coming together” or cluster.

The brightest stars in the Pleiades cluster are Alcyone (apparent magnitude 2.86), Atlas (3.62), Electra (3.70), Maia (3.86), Merope (4.17), Taygeta (4.29), the variable star Pleione (5.09), Celaeno (5.44), and Sterope (5.64, 6.41). The nine brightest stars are all luminous, hot, blue B-type stars. Alcyone is an eclipsing binary system. The primary component is a blue-white giant 8.2 times larger than the Sun, six times more massive, and 2,400 times more luminous.

LOCATION

The Pleiades cluster is very easy to find. It is located about 14 degrees northwest of Aldebaran, the brightest star in Taurus and 14th brightest star in the night sky.

AK, with EarthSky and Wikipedia Notes



The Taurus Constellation with the Pleiades (red)



Taurus as depicted in Urania's Mirror, a set of constellation cards published in London c.1825