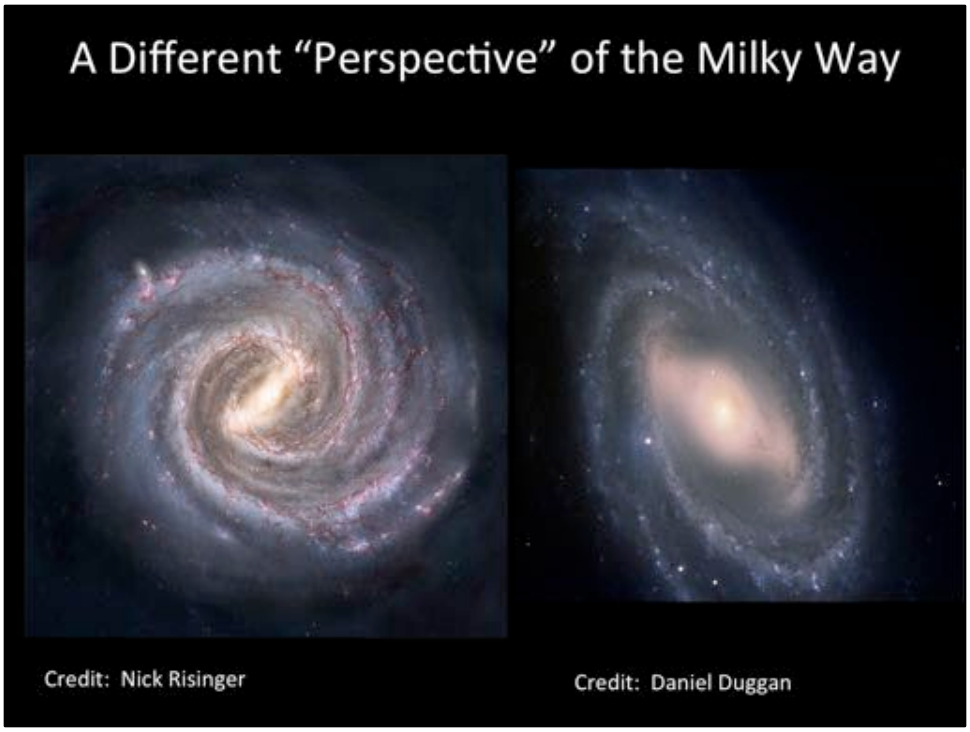
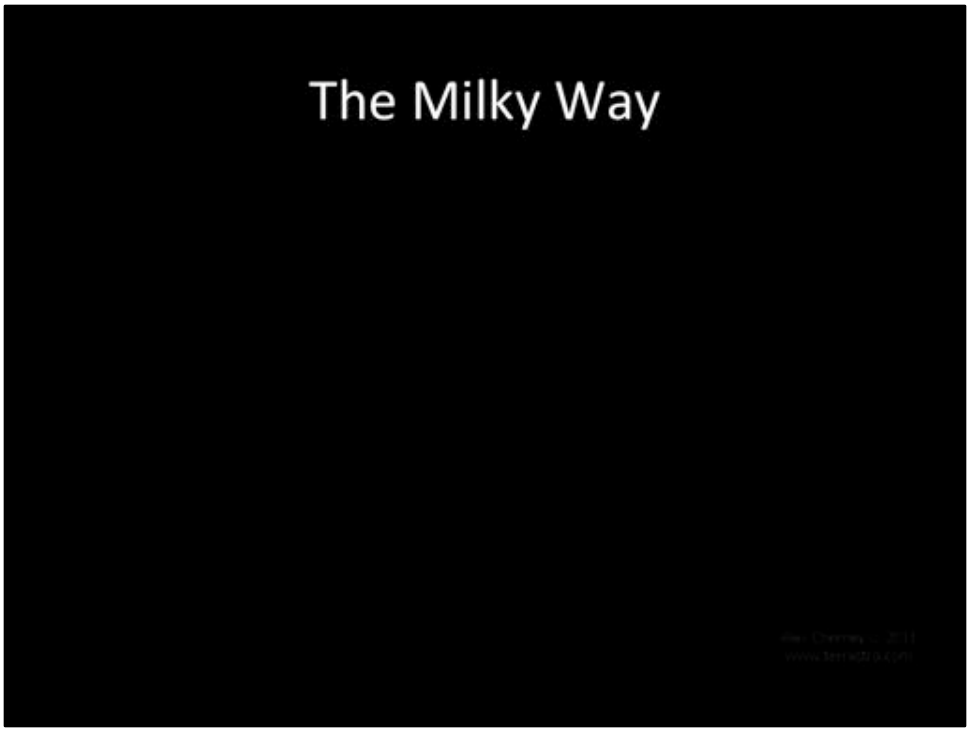
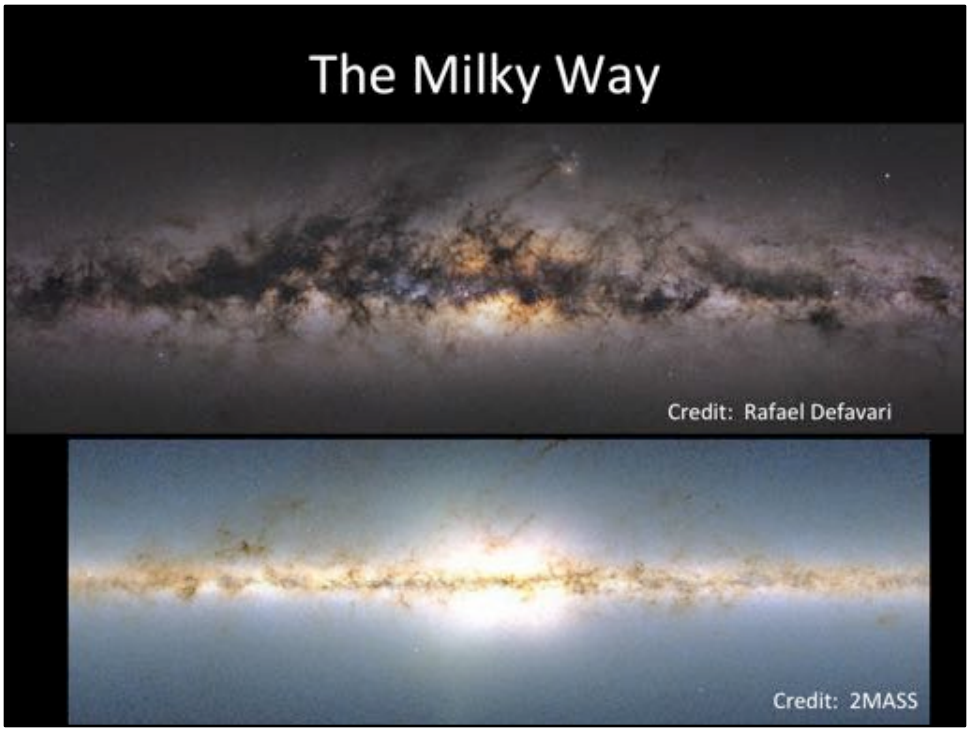

A Tour of the Spring Sky



The left image is an artist’s concept of what the Milky Way would look like from above. The right image is galaxy M109, a spiral galaxy that is thought to resemble the Milky Way.

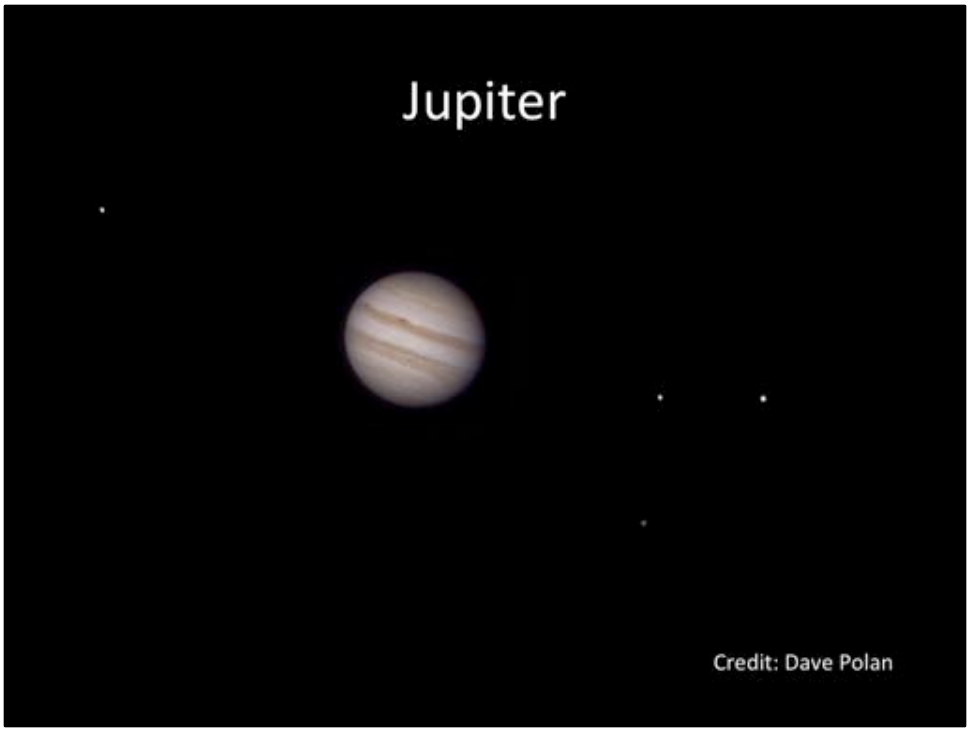


Time-lapse video of the Milky Way



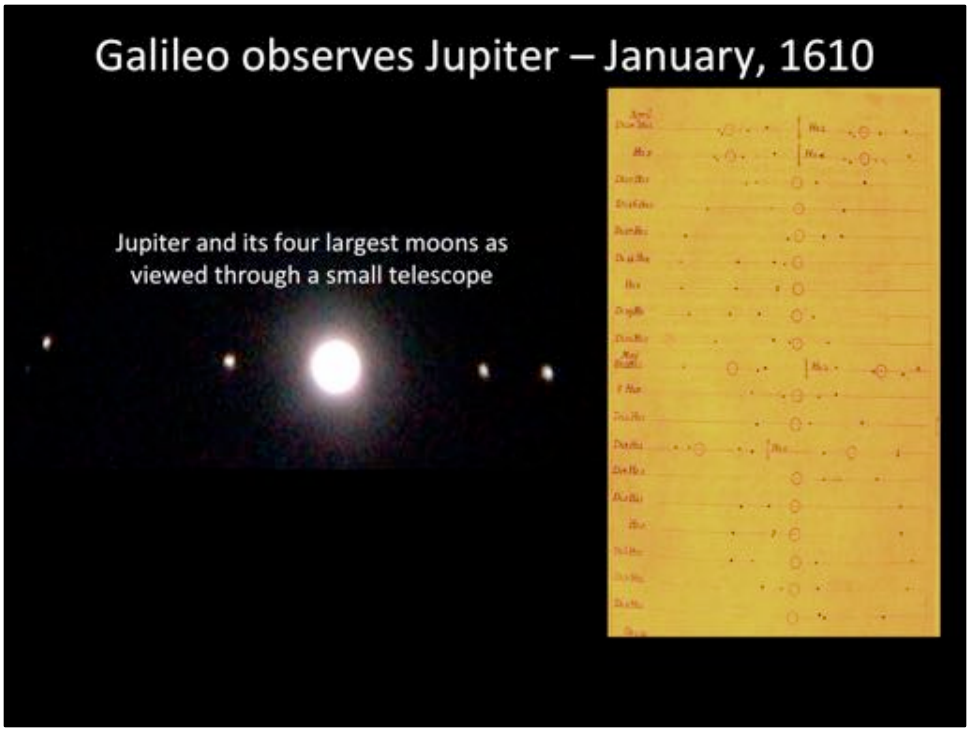
Top view: The Milky Way as seen in visible light. The dark areas are lanes of dust that block out visible light.

Bottom view: An infrared view of the Milky Way. The longer wavelength infrared light is able to penetrate dust very well, allowing us to see much more of the stars in our galaxy.



Jupiter and its four largest moons as seen through a decent-sized telescope on a clear night.

Image of Jupiter from the Cassini probe as it passed the planet for a gravity assist on its way to Saturn. The large spot on Jupiter is the Great Red Spot - a storm that is 2-3 times as big as Earth and that has been observed for at least 350 years.



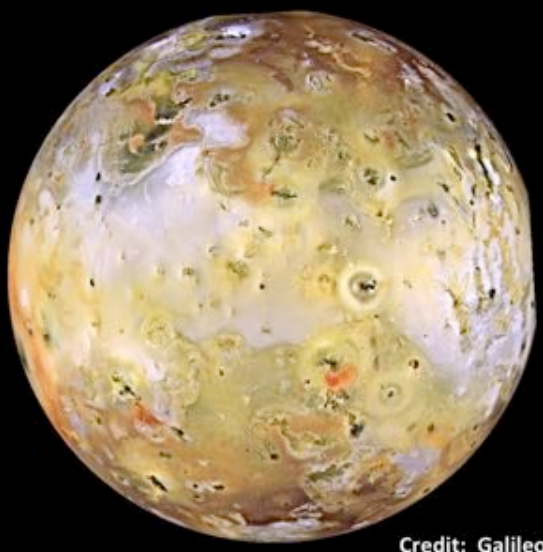
A quick snapshot of Jupiter through a small telescope that highlights the ease of seeing the four largest moons. The inset is a record kept by Galileo of the moons positions over the course of a couple of weeks.

How big are the “Galilean Moons” that Galileo discovered?

The Galilean Moons Io, Europa, Ganymede, and Callisto (top, from left to right) as compared to Mercury (bottom-left) and our moon (bottom-right).

Io

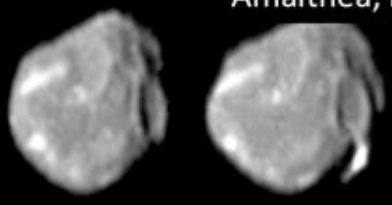
The Most Volcanically Active Body in the Solar System



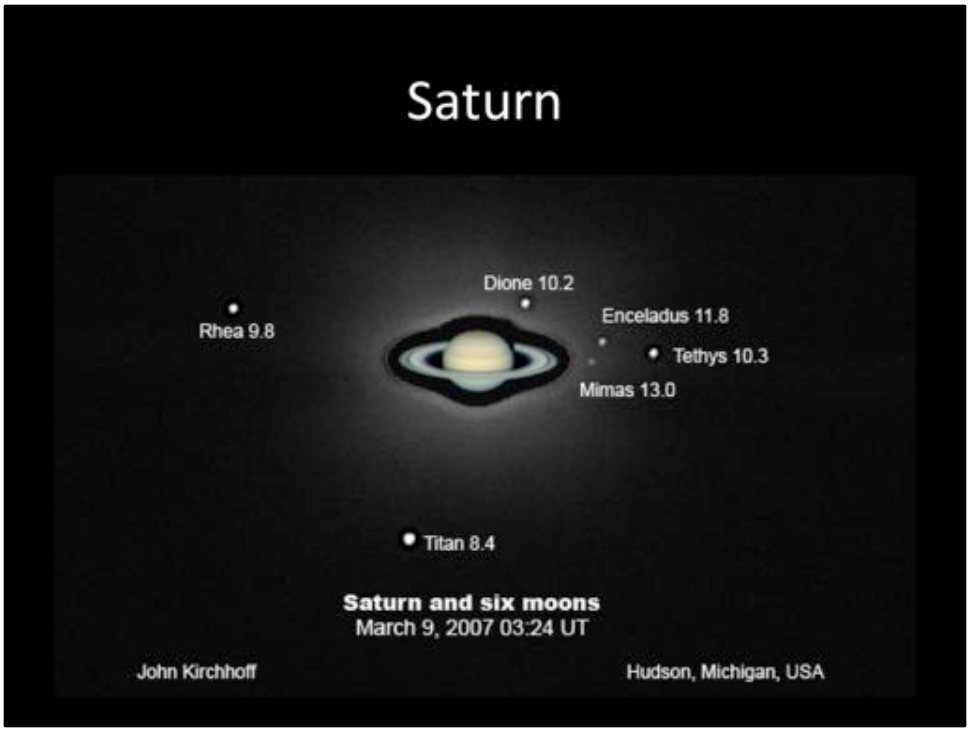
Credit: Galileo Project, JPL, NASA

Images taken by the New Horizons probe as it got a gravity assist from Jupiter on its way to Pluto. The plume of Tvashtar is several hundred kilometers high. Note that you can see some of the night side of Io very well due to light being reflected from Jupiter.

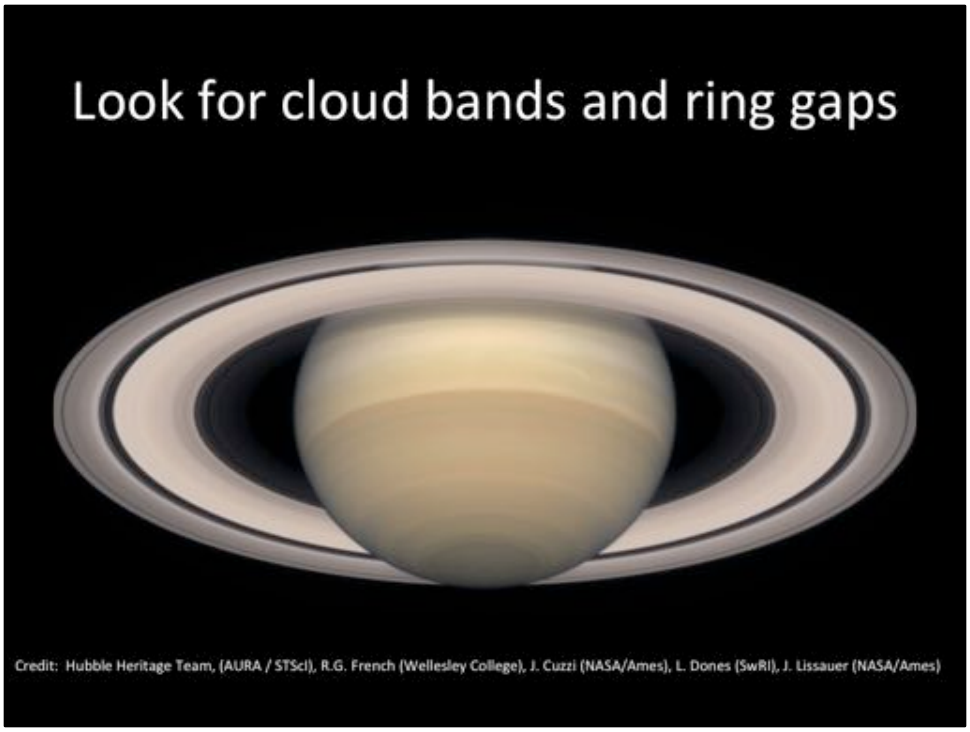
Edward Emerson Barnard discovered the fifth moon of Jupiter, Amalthea, in September 1892



Barnard was a Nashville native and astronomer at Vanderbilt University who would eventually become world-famous. Amalthea was the last moon in the solar system to be discovered by eye.



At least a few of these moons are visible through a decent-sized telescope. Very clear conditions are needed to be able to observe Mimas.

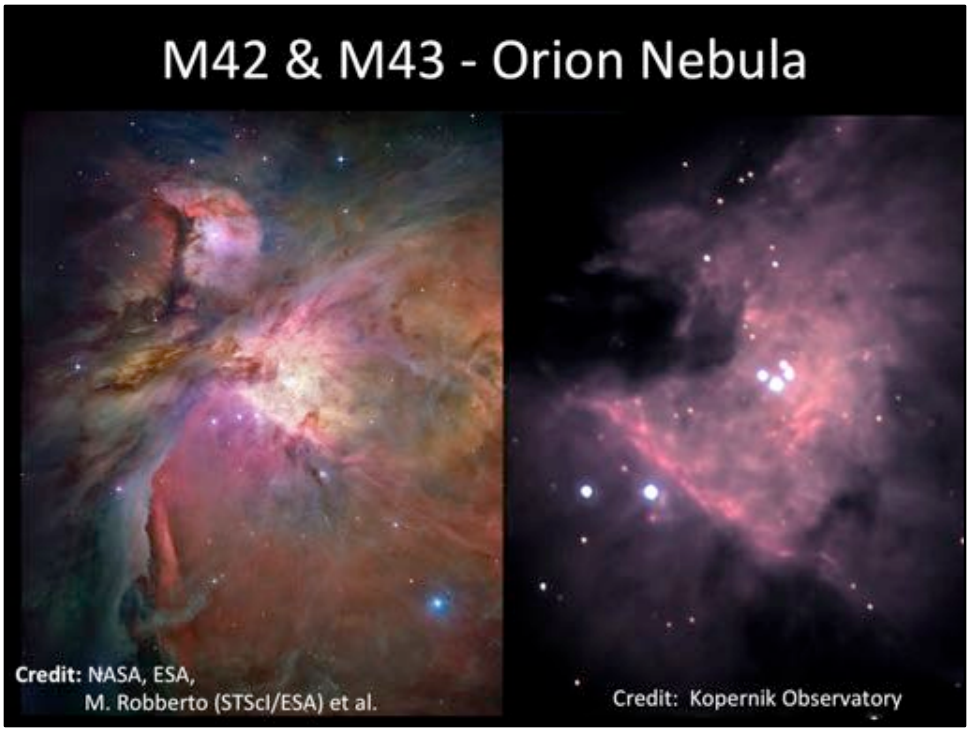


Saturn as viewed by the Hubble Space Telescope. The rings are less than a mile thick but are about 180,000 miles wide. The gaps in the rings are due to gravitational resonances with some of the moons.

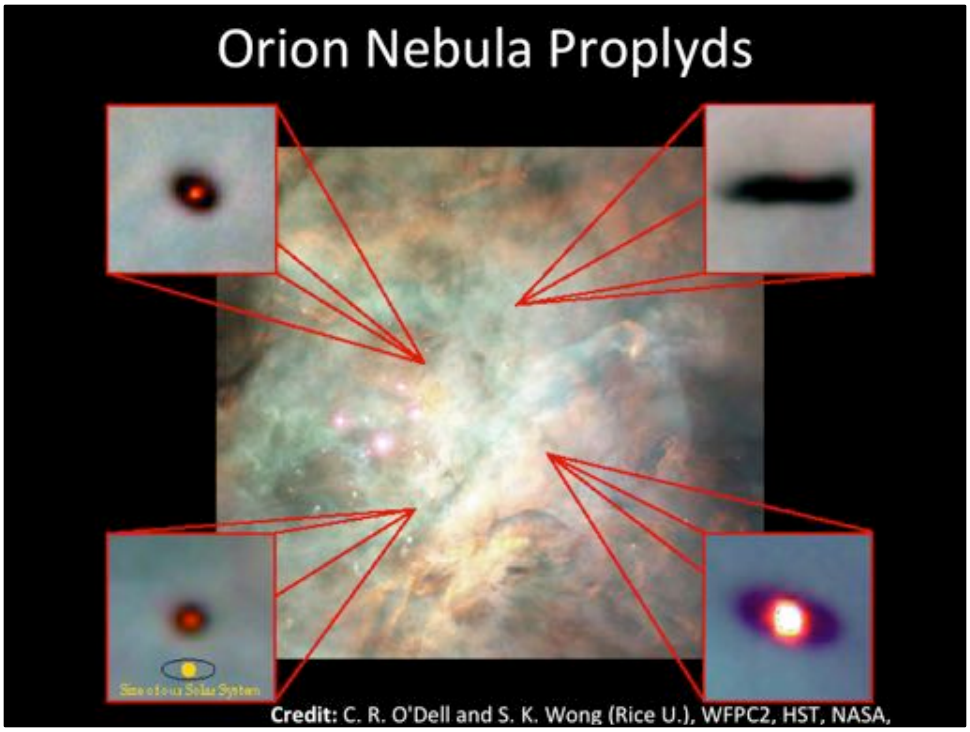
Charles Messier

- 1730-1817
- French Astronomer
- Comet Hunter
- Noted for his list of Messier Objects

In the springtime, Orion sets soon after sunset. The large red loop of gas around the belt stars is known as Barnard's loop after Edward Emerson Barnard. The blue streak near the bottom right is the Witch Head nebula (look up images of it).

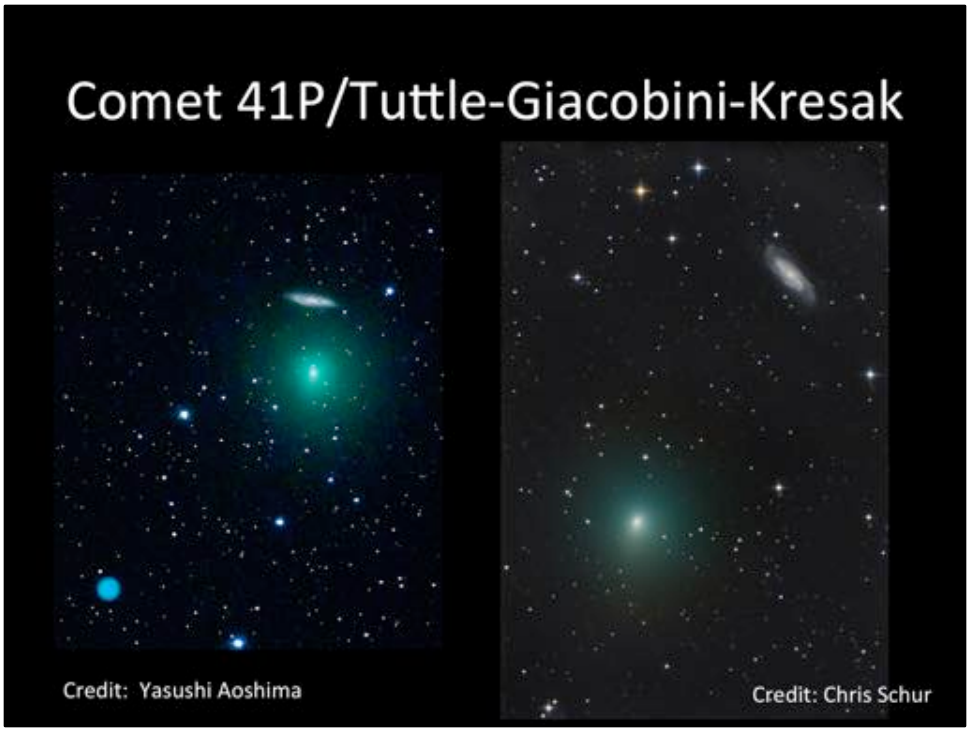


The main Orion nebula is known as M42, and the more circular blob near the top left of the left image is M43. The nebula is illuminated by the four central stars, which are known as the Trapezium, and are easily visible in the right image. The left image is from the Hubble Space Telescope.



The main image shows the four Trapezium stars just to the left of center. The insets are protoplanetary disks ("Proplyds"), which are solar systems in the process of forming. The central protostars are visible as red blobs in each.

The famous Horsehead Nebula is the dark smudge near the center of the image. It is a great example of a dark nebula, a nebula that has a high concentration of dust that blocks out background light. The red arc of gas that puts the Horsehead Nebula in silhouette is an emission nebula – the gas is being irradiated by nearby stars and excited so that it glows the characteristic red of hydrogen. The little blue blob near the bottom center is a reflection nebula, which appears blue because dust preferentially scatters the blue starlight. The two brightest stars in the upper half of the image are the two left belt stars of Orion.

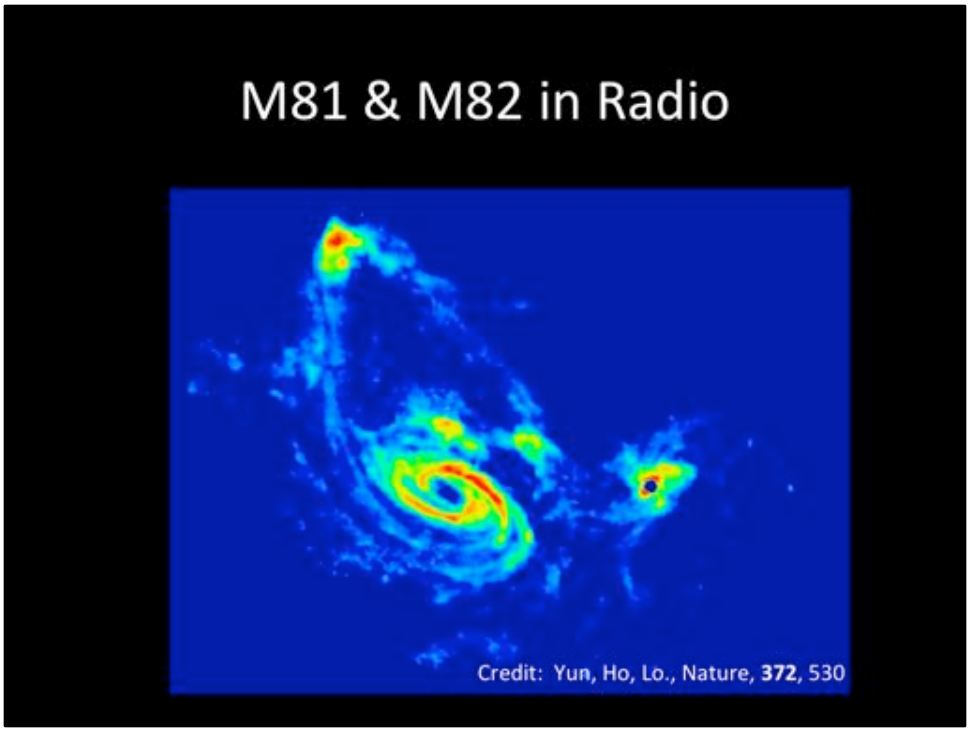


Discovered in 1858, this comet takes about 5.5 years to orbit. Its orbit takes it out to the orbit of Jupiter. The galaxy near the upper right of the two images is galaxy M108, and the blue blob in the bottom part of the left image is M97 – the Owl Nebula.

Galaxies

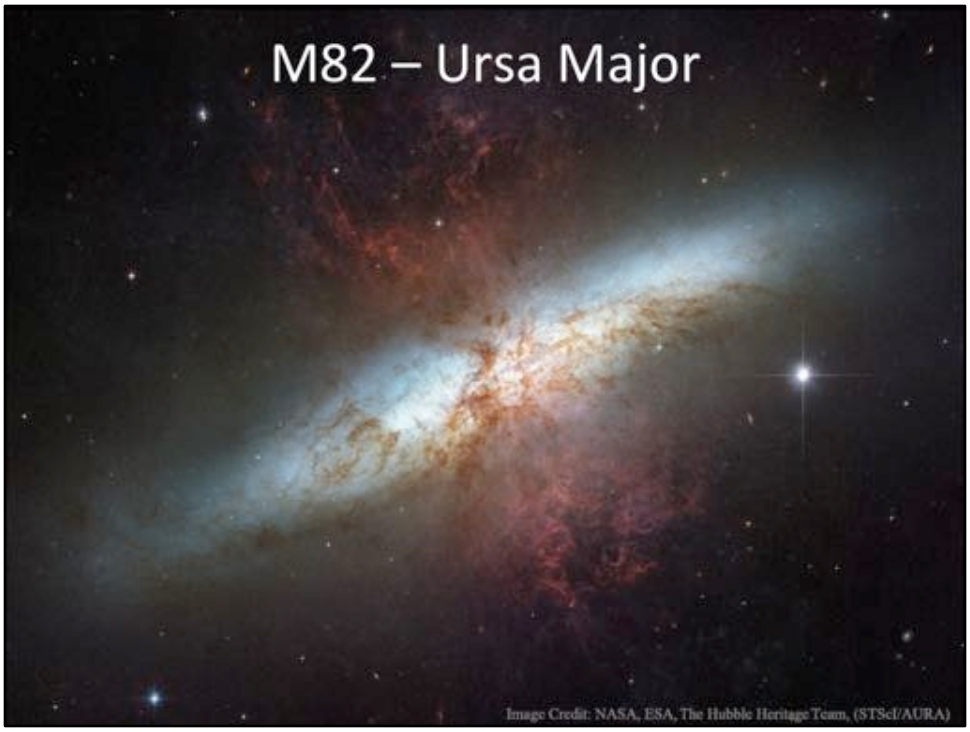
- Three main categories: Spiral, Elliptical, & Irregular
- Spiral
  - Lots of cold gas and dust
  - High amount of star formation
  - Disk shaped with spiral structure
  - Light dominated by hot, young stars
- Elliptical
  - Lots of hot gas, no dust – no star formation
  - Contains older, cooler, smaller stars
  - Spherical or ellipsoidal
- Irregular
  - Neither of the above but typically has lots of star formation

M81 (left) is a spiral galaxy and M82 is an irregular galaxy (though recent studies have shown it does have some spiral structure). Both are in Ursa Major, just off of the bowl of the Big Dipper.

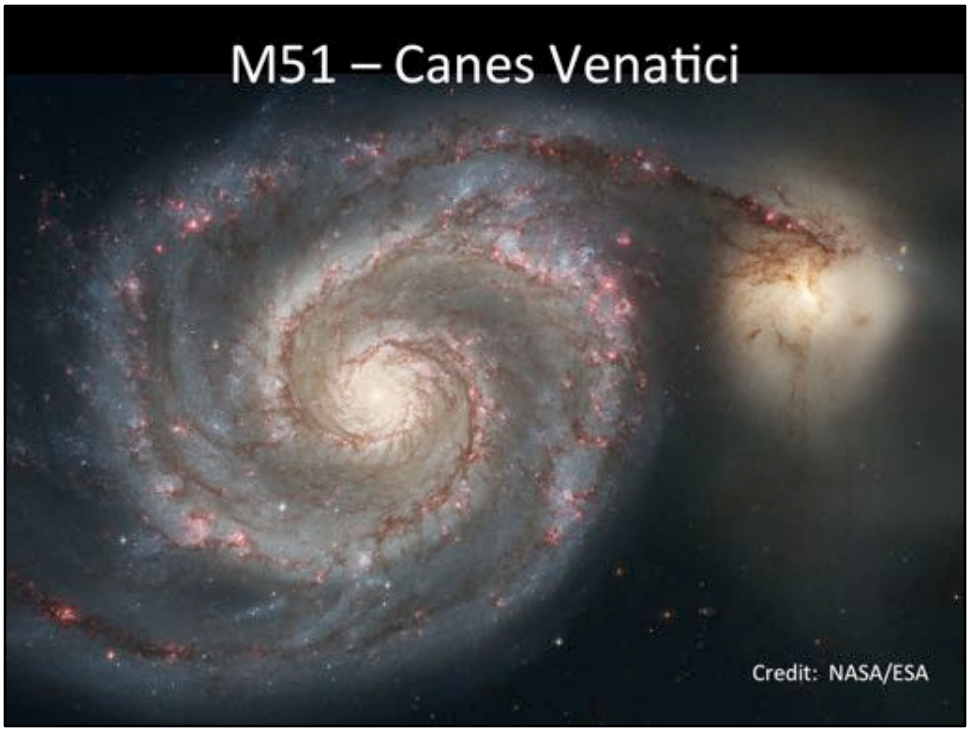


This image shows where very cold hydrogen gas is located. This type of image shows that even though the two galaxies look very separate in the previous image they are interacting.

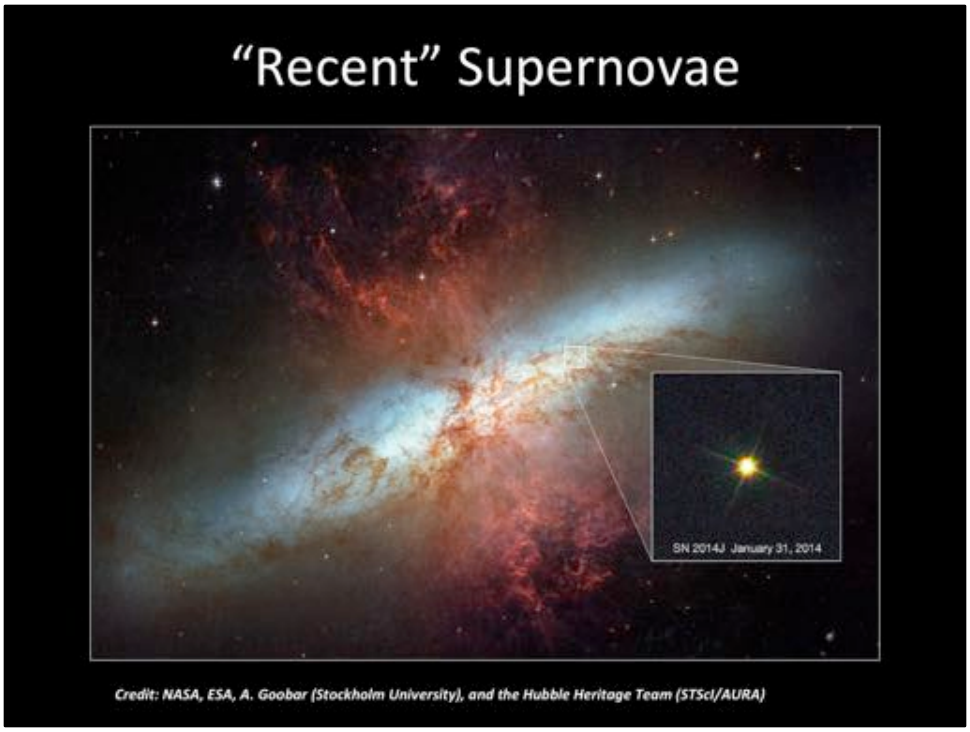
A close-up of M81. Spiral galaxies have arms dotted with bright blue areas (newly formed, massive, hot stars) and pink areas (large clouds of hydrogen gas that formed the blue stars and are glowing due to starlight exciting the gas).



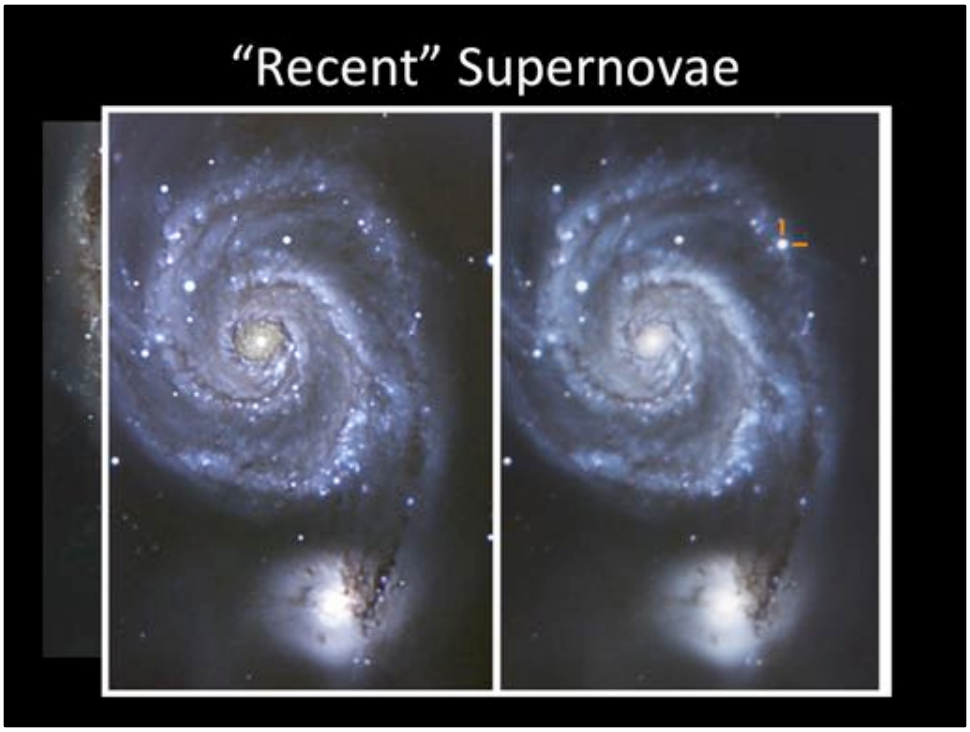
A close-up of M82. The large red filaments are huge clouds of hydrogen gas that have been blown out as a result of high rates of star formation (high star formation rates = lots of radiation pressure and solar wind).



Spiral galaxy M51 (left) and a companion elliptical galaxy NGC 5196 as viewed by the Hubble Space Telescope. The two galaxies are interacting.



A Hubble Space Telescope view of M82 while a supernova was observed to occur (inset). A supernova occurs somewhere in a galaxy like the Milky Way about once every 50 years.



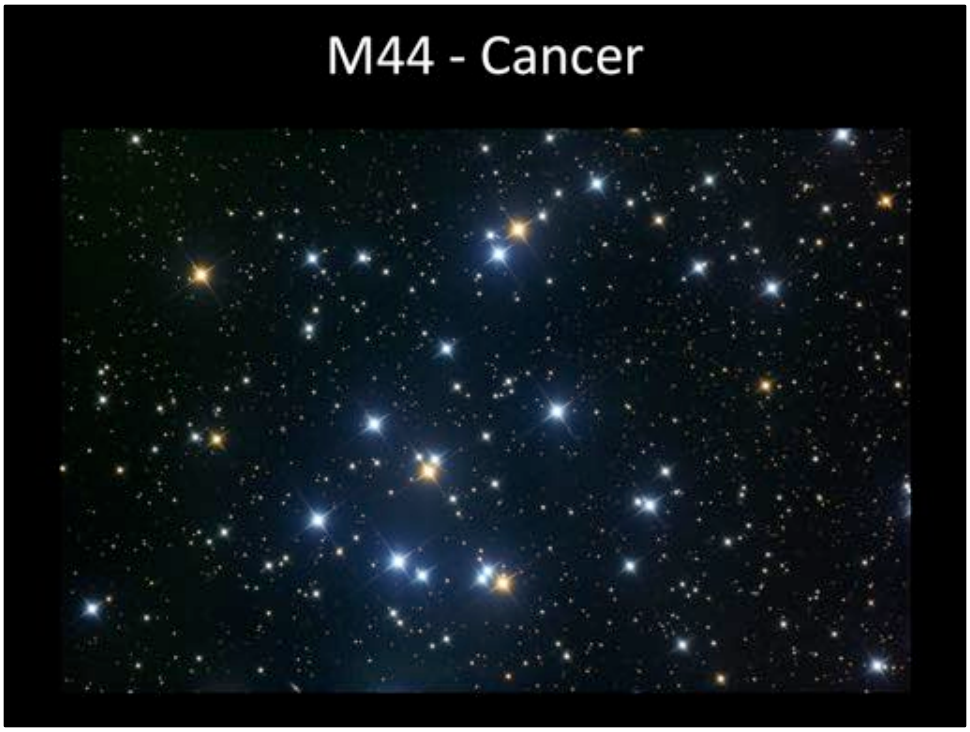
Supernovae occurring in M51 in 1994, 2005 (image shown – note the yellow tick marks highlighting the supernova), and 2011. A supernova occurs somewhere in a galaxy like the Milky Way about once every 50 years. This galaxy has had at least three supernovae in two decades.

Left – a wide-angle view of the the giant elliptical galaxy M87. Note that the other smudges in the image are galaxies in the cluster with M87. This galaxy is about 53 million light-years distant in the constellation Virgo.

Right – a Hubble Space Telescope view of the relativistic (traveling at a significant fraction of the speed of light) jet emanating from the supermassive black hole at the center of M87. This jet is about 5,000 light-years long.

Open Clusters

- Relatively young groupings of stars.
- Cluster members formed at the same, in the same area, in the same material.
- Typically dominated by bluer stars.
- Cluster gradually disperses over time.



The Beehive cluster, also known as M44 or Praesepe. Clusters like this are dominated by hot blue stars, which signify that it is relatively young since hot (massive) stars don't live long lives. These stars formed together at the same time, but as they orbit the galaxy and interact with other stars and nebulae, the stars will drift away from one another.

Planetary Nebulae

- End product of a smaller star's life.
- Outer layers of gas create the nebula.
- Compact core at center (white dwarf).
- Visible for only 10,000 years or so.
- Eventual fate of the Sun.
- Have nothing to do with planets.

A great example of a planetary nebula. The nebula consists of the outer layers of the dead star that were sloughed during its final stages of life. The central star, known as a white dwarf, is the collapsed core of the original star. The white dwarf is still very hot, maybe 50,000 Celsius, and is emitting a large amount of ultraviolet light. This light goes out into the nebula and excites the expanding gas, causing it to glow. As the nebula continues to expand it will grow fainter.

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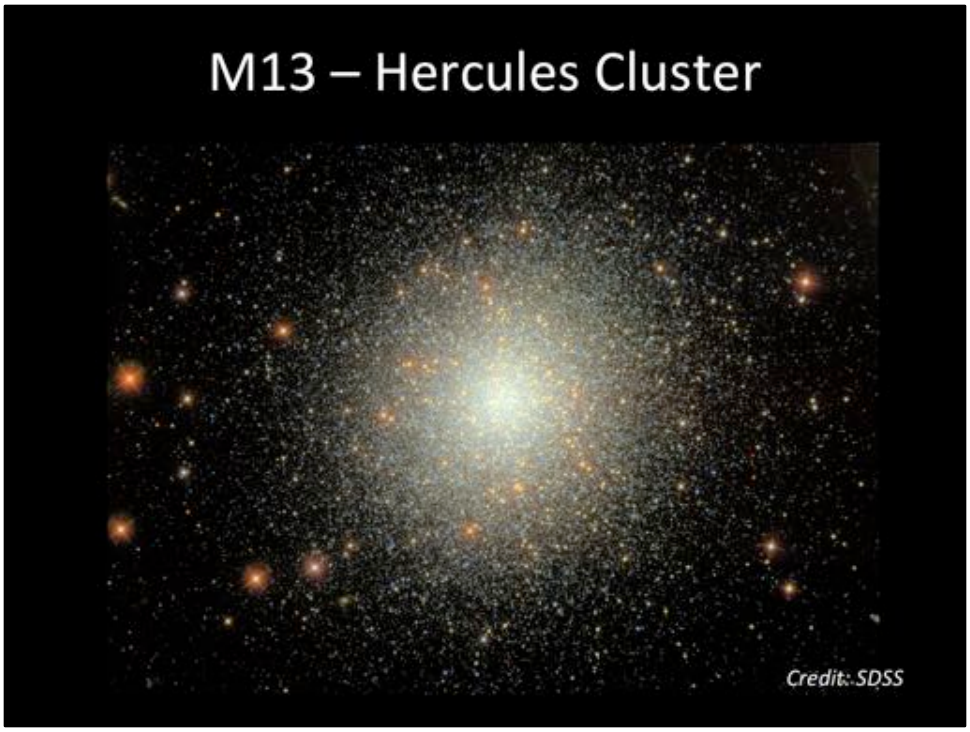
Globular Clusters

- Compact spherical clusters of a few tens of thousands of stars to over one million stars.
- Very old .
- Dominated by smaller, cooler stars.
- Orbit in halo of galaxy.



Most distant object associated with our galaxy that can seen naked eye (27,000 light-years away). This type of cluster appears much redder because it is very old – all of the higher mass (hotter and bluer) stars have died, leaving behind the lower-mass, cooler, redder stars. There are about 150-200 of these types of clusters in the halo of the Milky Way.