
II SUMMER SCHOOL IN ASTRONOMY
The Constellation Andromeda - From the naked eye to the Hubble Space Telescope
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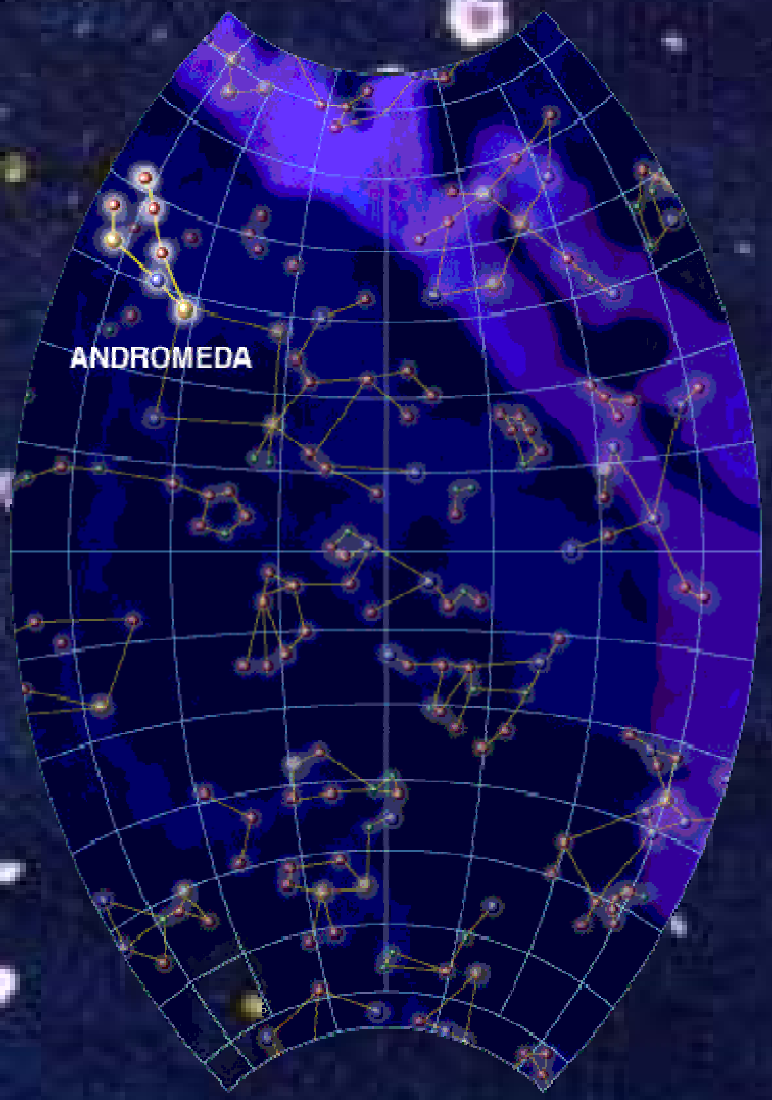
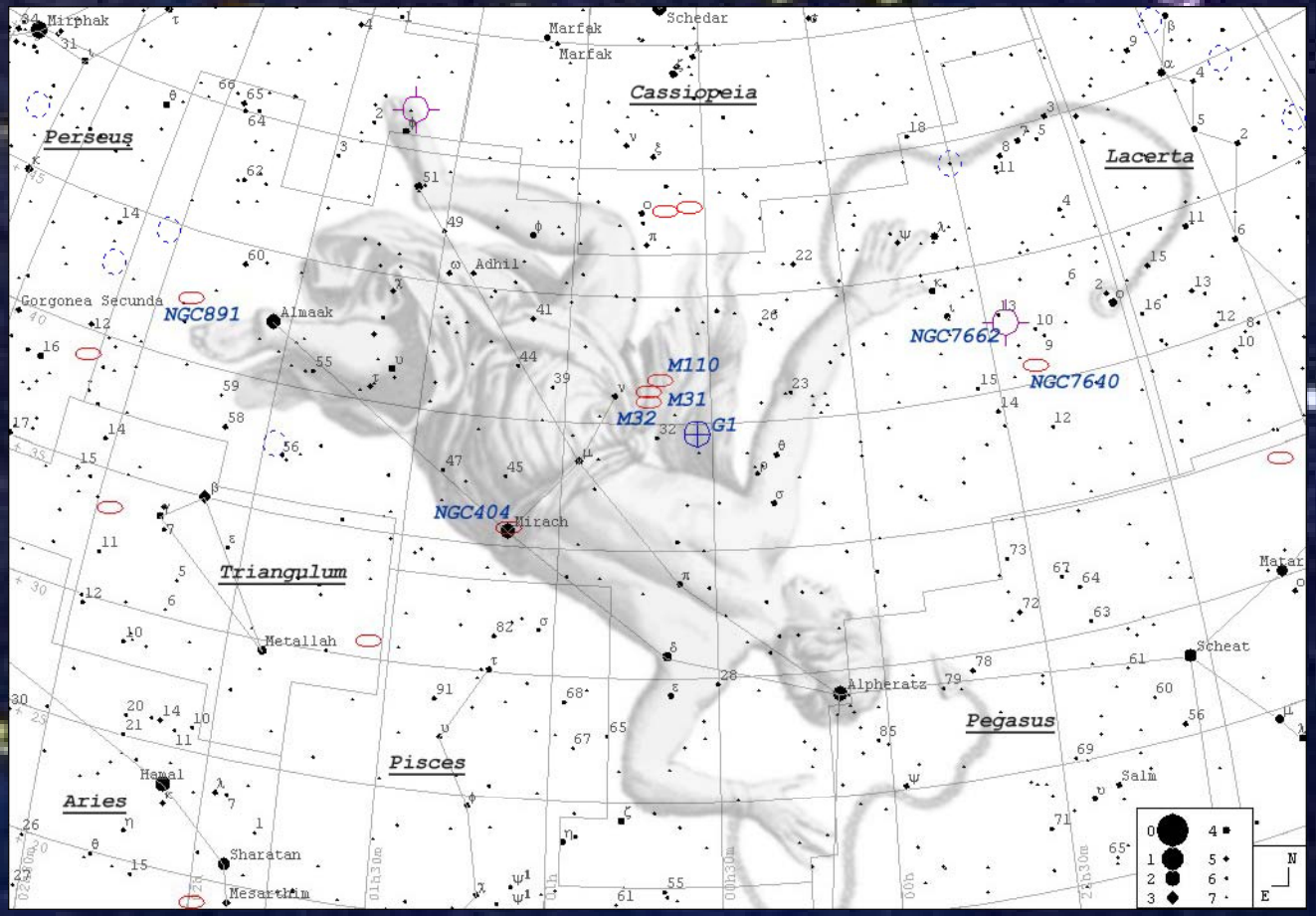
Introduction

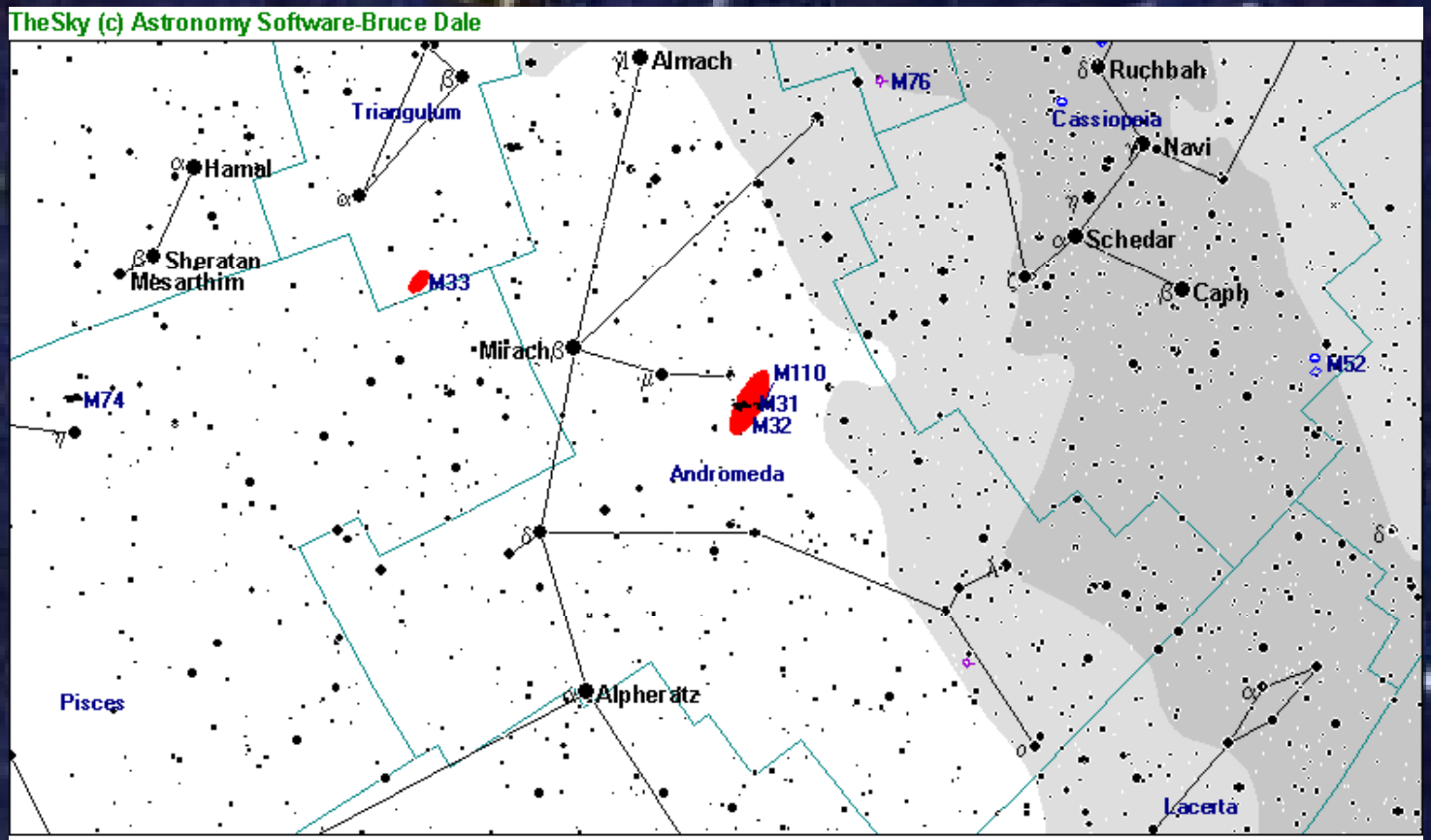
- Andromeda (The Chained Maiden) is a large and bright constellation of the northern hemisphere.
- Andromeda is nearly circumpolar, so it can be observed in the northern hemisphere almost during the whole year, but it can best be seen from September to February.



- Andromeda is easy to find because of the surrounding constellations. The W shape of Cassiopeia lies just above Andromeda, and the Great Square of Pegasus adjoins Andromeda.



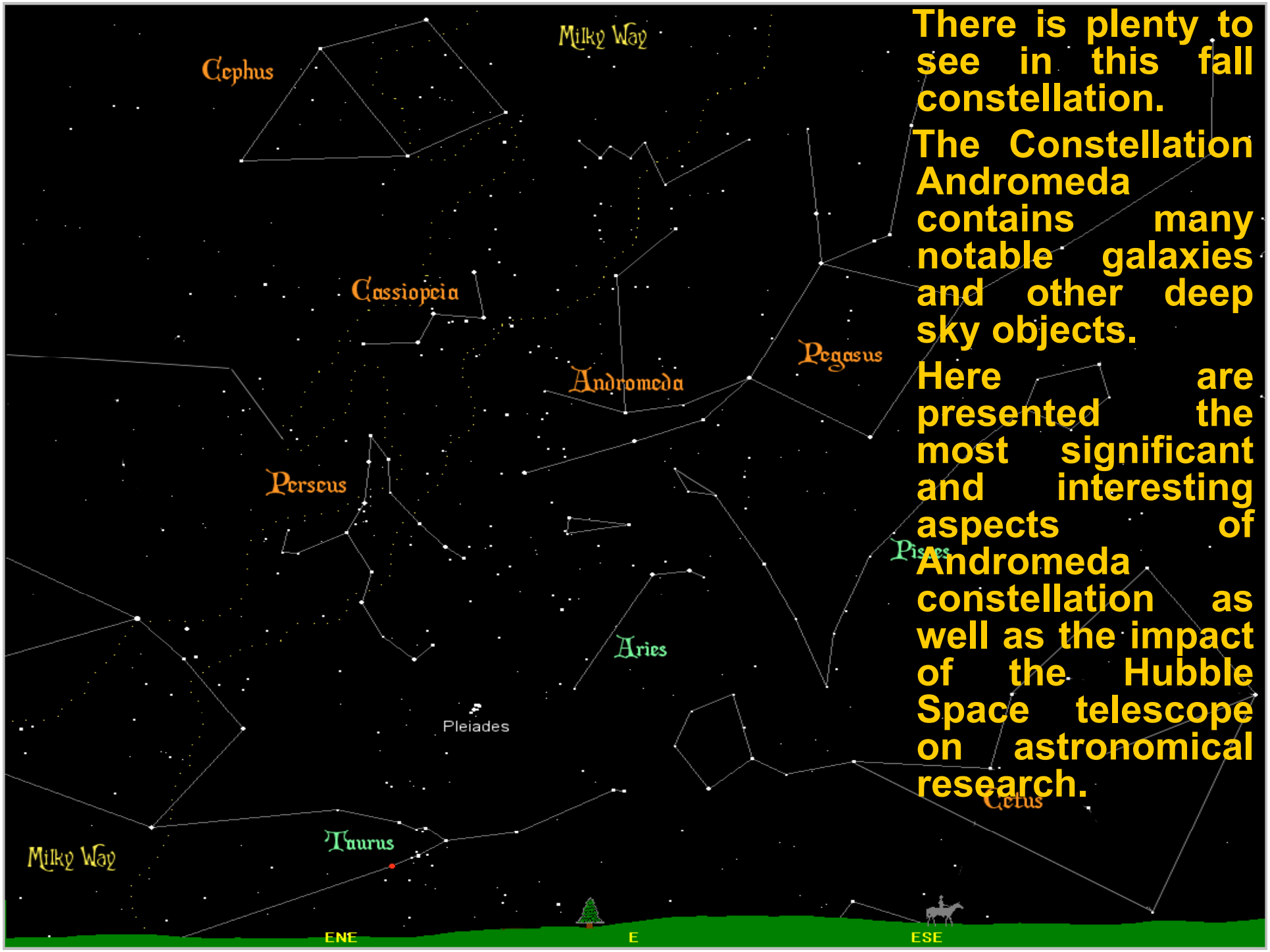
Map of the constellation



Andromeda

Abbreviation: And
Genitive Form: Andromedae
Description: Andromeda, the Princess of Ethiopia
Pronunciation: an DRAHM' ee duh
Genitive Pronunciation: an DRAHM' ee dee

Sky Database: Constellation Labels
RA: 00h 32m 32.2s Dec: +38°33'29"
RA: 00h 32m 24.0s Dec: +38°32'24" (Epoch 2000)



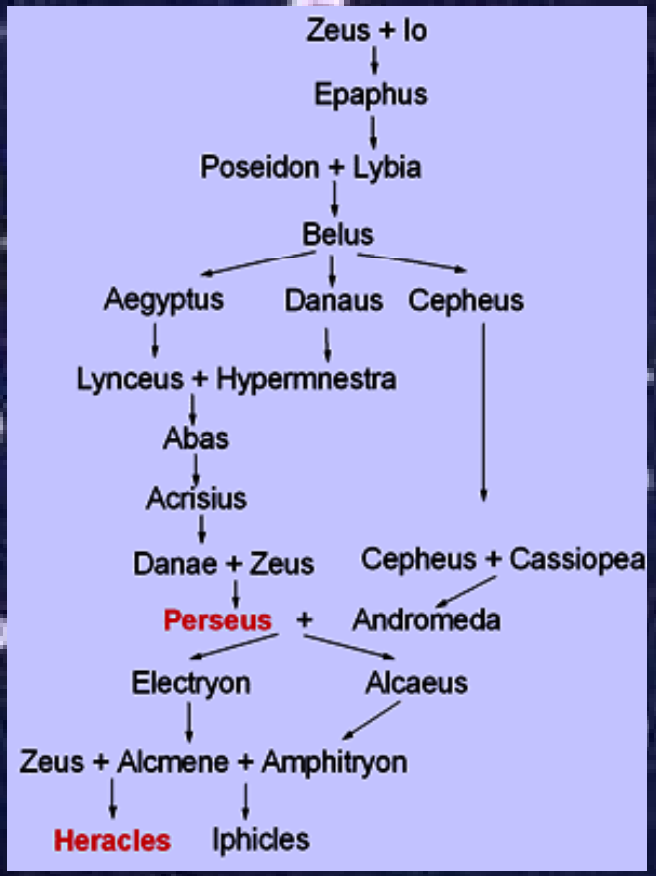
There is plenty to see in this fall constellation.

The Constellation Andromeda contains many notable galaxies and other deep sky objects.

Here are presented the most significant and interesting aspects of Andromeda constellation as well as the impact of the Hubble Space telescope on astronomical research.

Mythology

- Andromeda is a constellation named for the princess Andromeda.
- She was a daughter of King Cepheus and Queen Cassiopeia



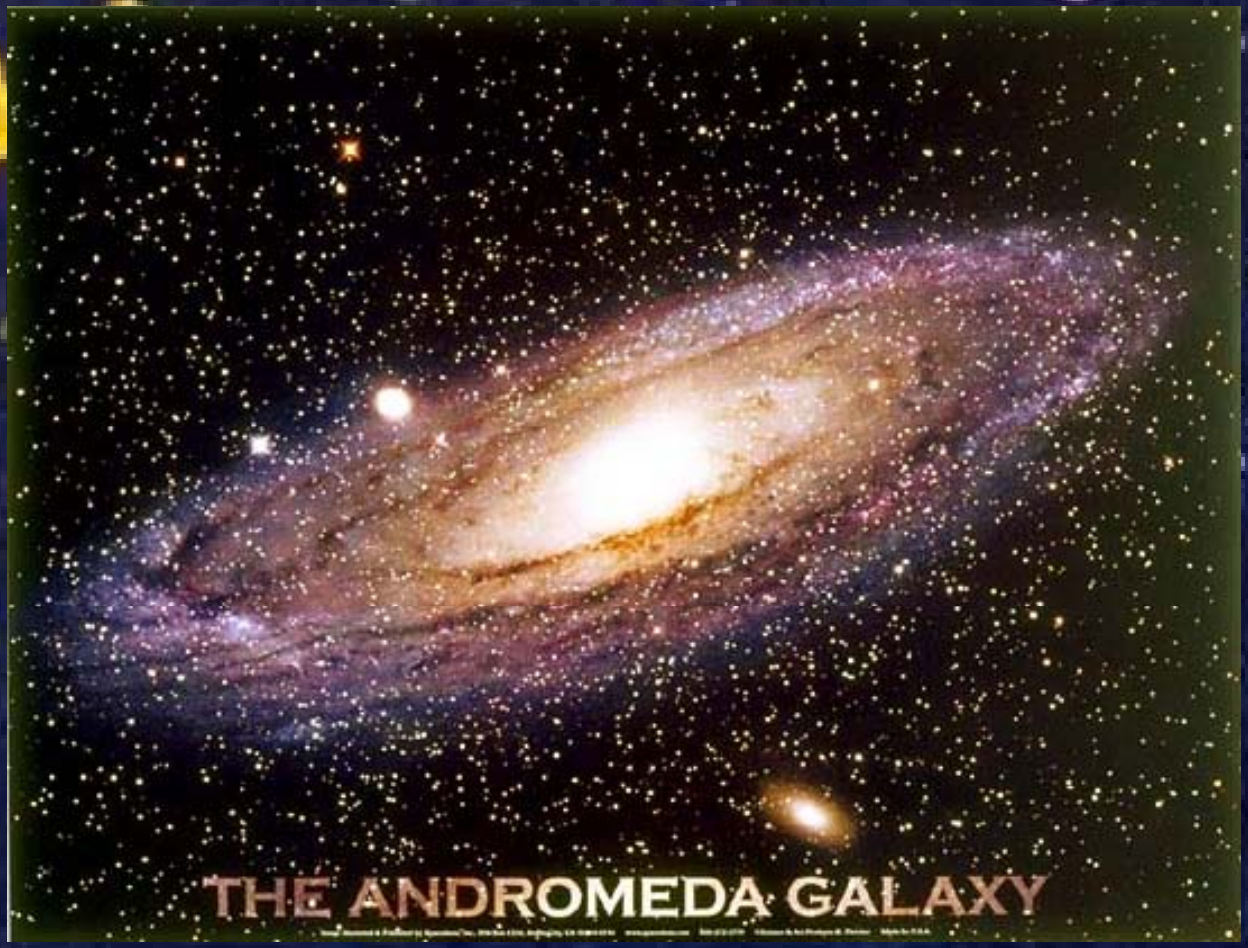
- Casiopeia bragged that she was more beautiful than the Nereid's, the nymph-daughters of Poseidon.
- As a punishment to her mother, Andromeda was chained to a cliff for the monster Cetus, but Perseus rescued her.
- With his miraculous weapons, Perseus killed the monster and married Andromeda.

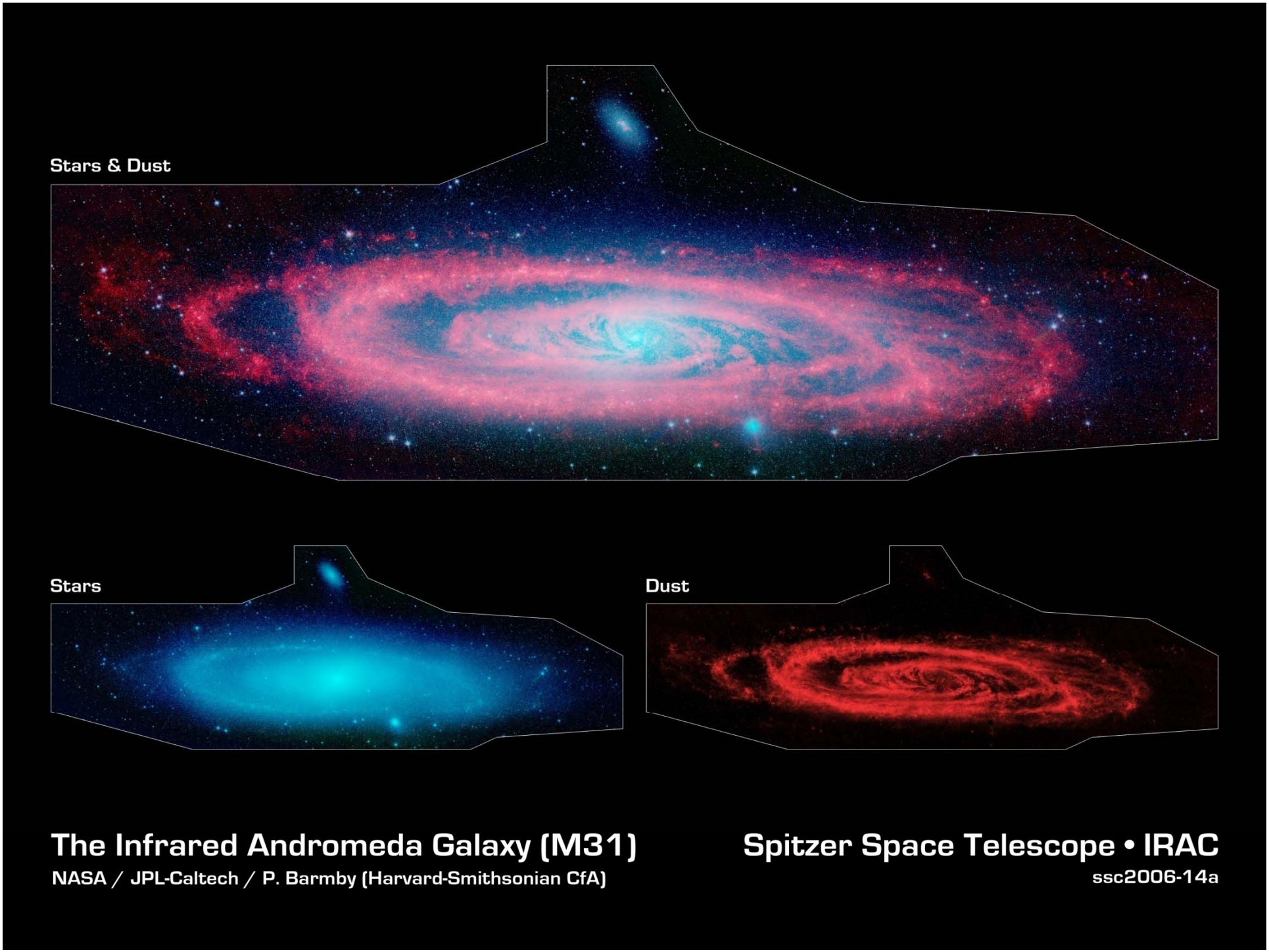
Andromeda is Greek for "ruler of men"

The Andromeda Galaxy

(M31 or NGC224; in older texts - the Andromeda Nebula)

The Great Andromeda Galaxy (M31) is one of the most distant objects visible by the naked eye





The Infrared Andromeda Galaxy (M31)

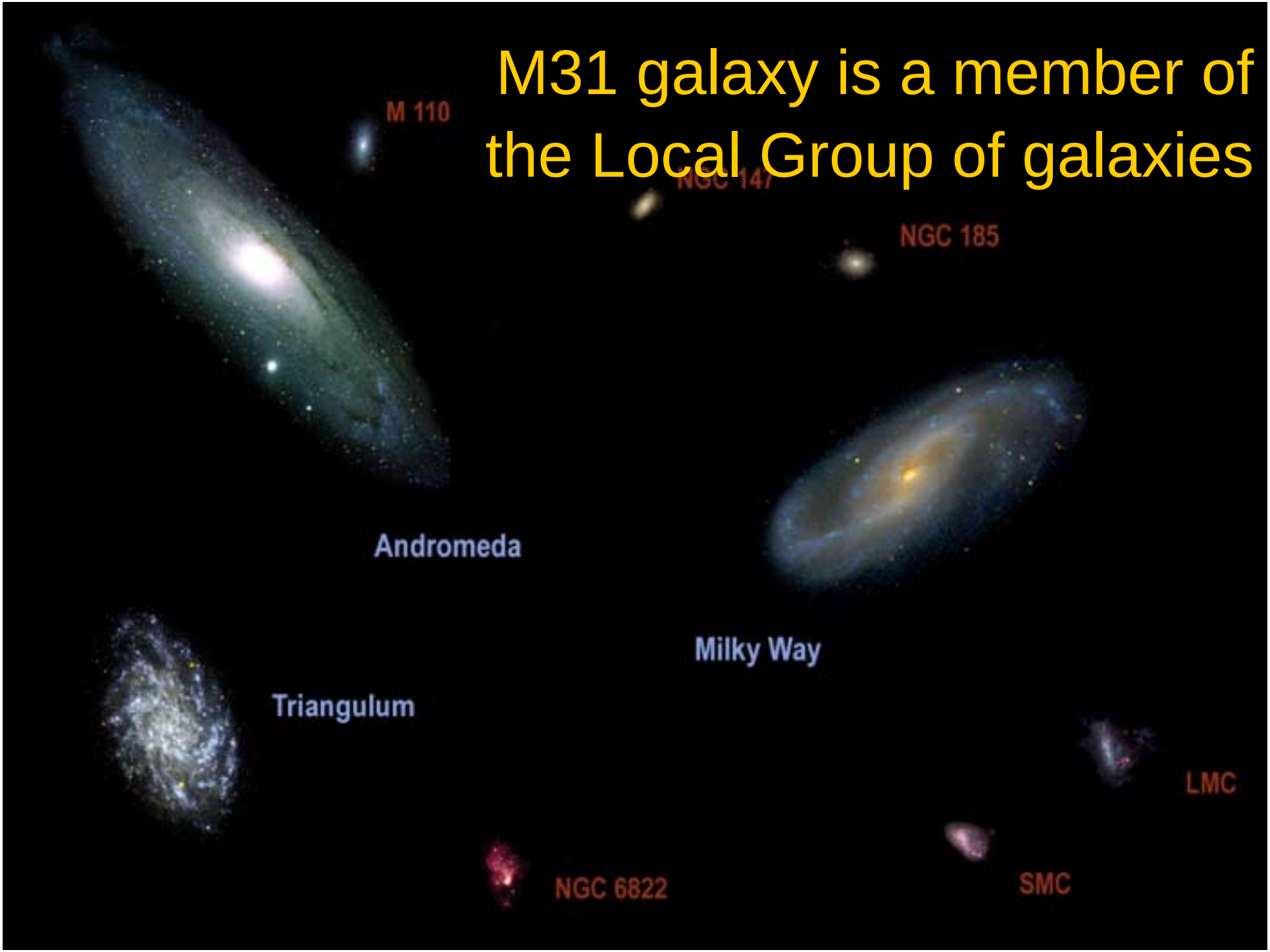
NASA / JPL-Caltech / P. Barmby (Harvard-Smithsonian CfA)

Spitzer Space Telescope • IRAC

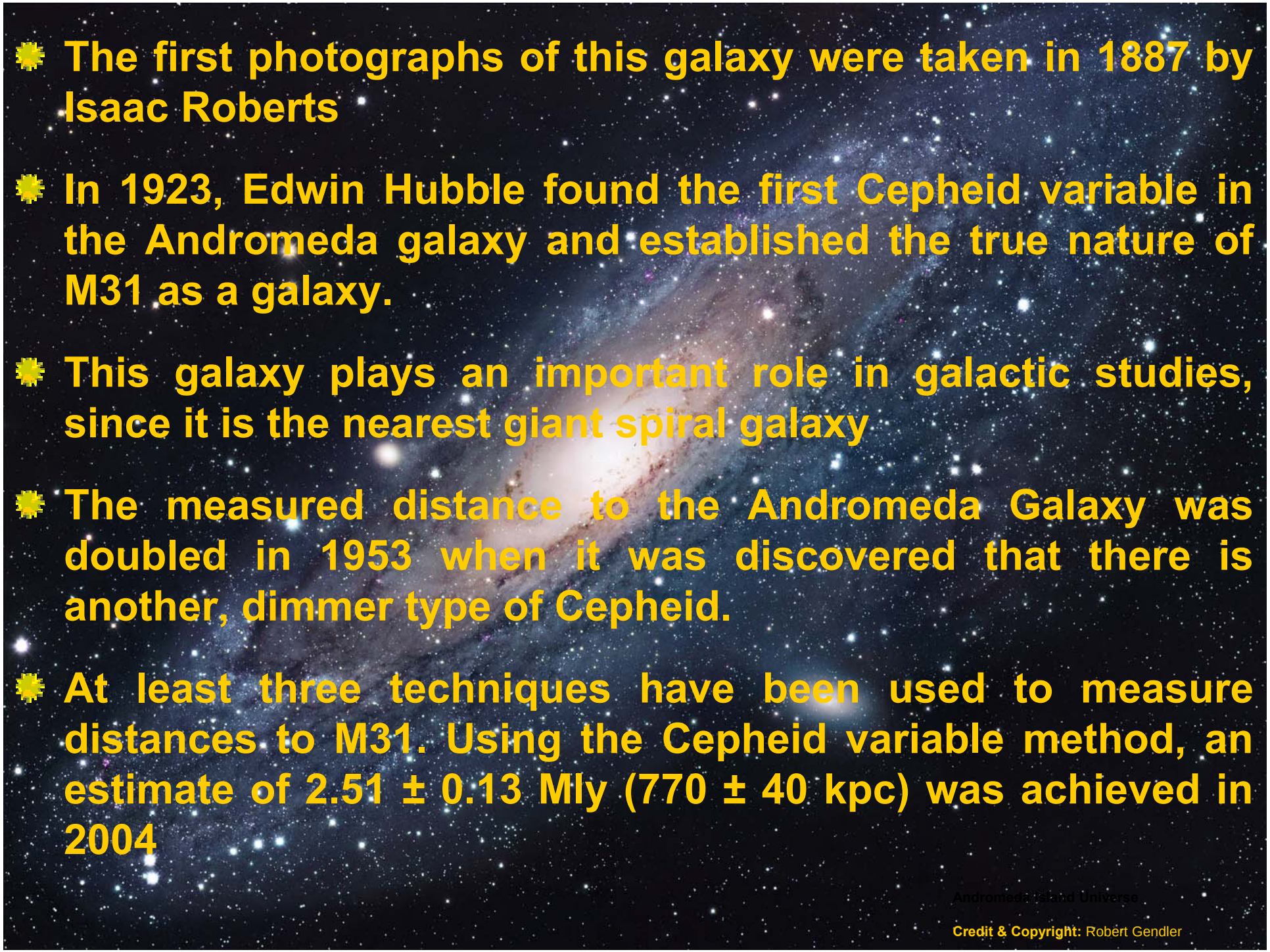
ssc2006-14a

It is a beautiful spiral galaxy much like the Milky Way

- Object Name: M31, NGC224
- Object Description: Spiral Galaxy
- Position (J2000): R.A. 00h 42m44s.31 Dec. +41° 16' 09".4
- Constellation: Andromeda
- Distance: About 2.5 Mly (0.78 mpc)
- Apparent magnitude: 3.4

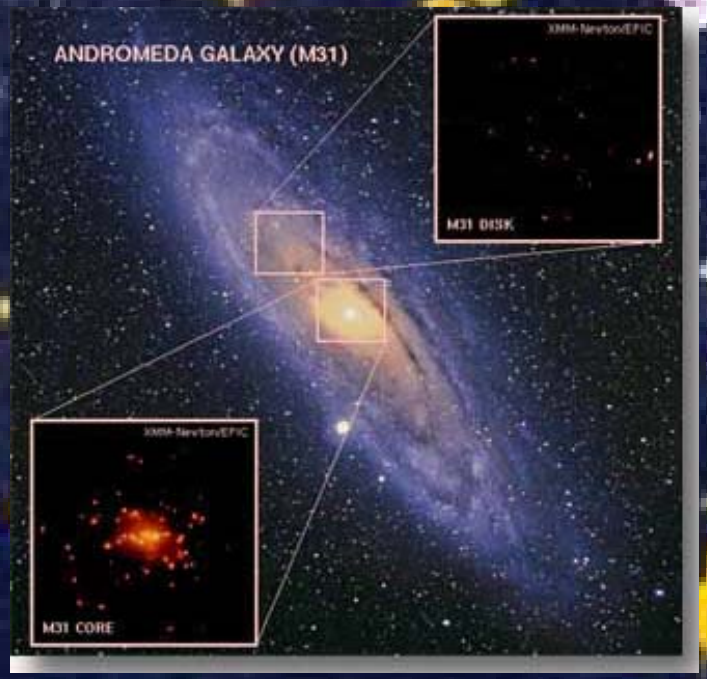

M31 galaxy is a member of the Local Group of galaxies
M 110
NGC 147
NGC 185
Andromeda
Milky Way
Triangulum
LMC
NGC 6822
SMC

- The first photographs of this galaxy were taken in 1887 by Isaac Roberts
- In 1923, Edwin Hubble found the first Cepheid variable in the Andromeda galaxy and established the true nature of M31 as a galaxy.
- This galaxy plays an important role in galactic studies, since it is the nearest giant spiral galaxy
- The measured distance to the Andromeda Galaxy was doubled in 1953 when it was discovered that there is another, dimmer type of Cepheid.
- At least three techniques have been used to measure distances to M31. Using the Cepheid variable method, an estimate of 2.51 ± 0.13 Mly (770 ± 40 kpc) was achieved in 2004



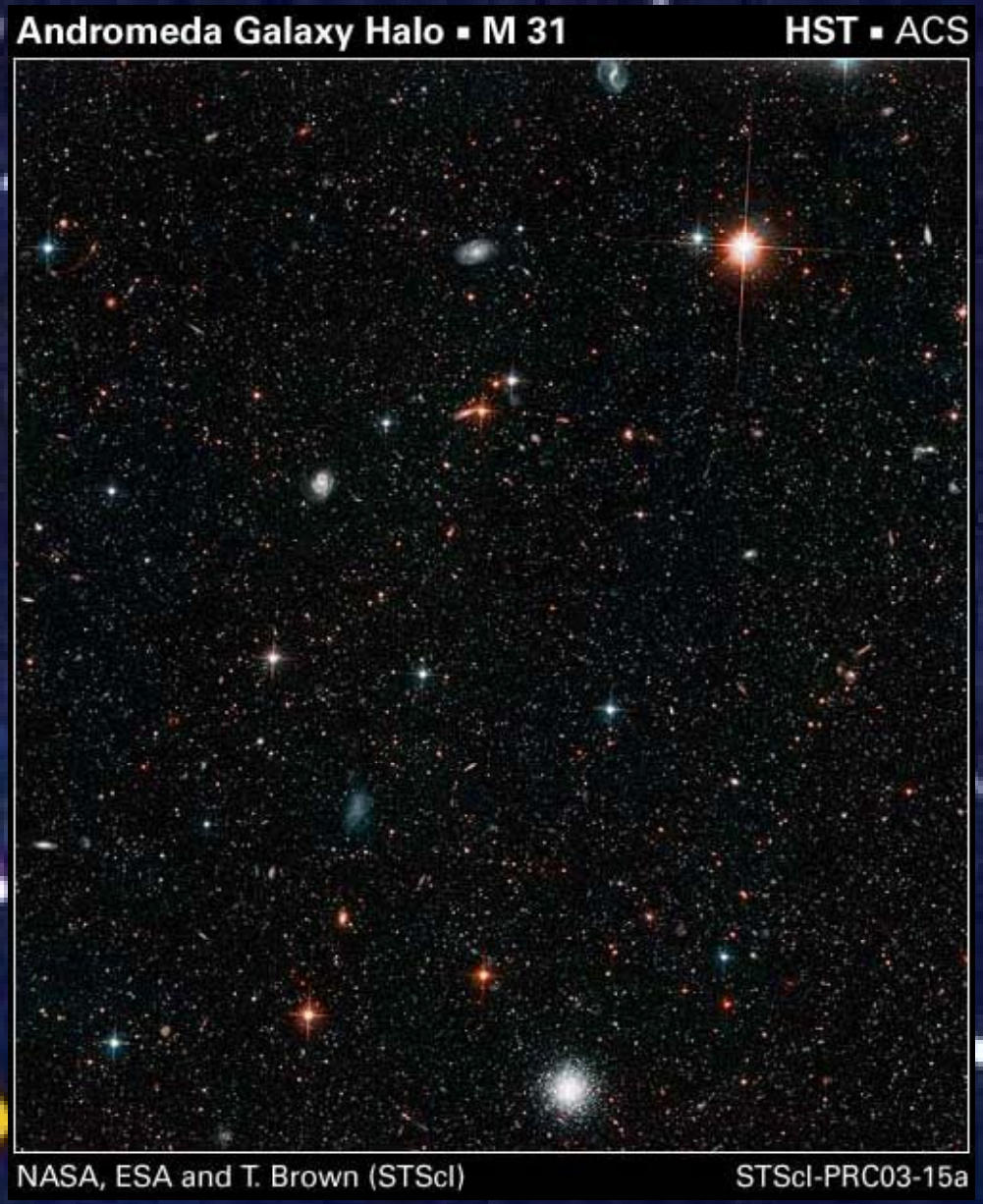
Here are some other interesting discoveries:

- **In the 1990s, astronomers, using the Hubble Space Telescope, found that Andromeda has a nucleus with a double structure.**



The core of Andromeda

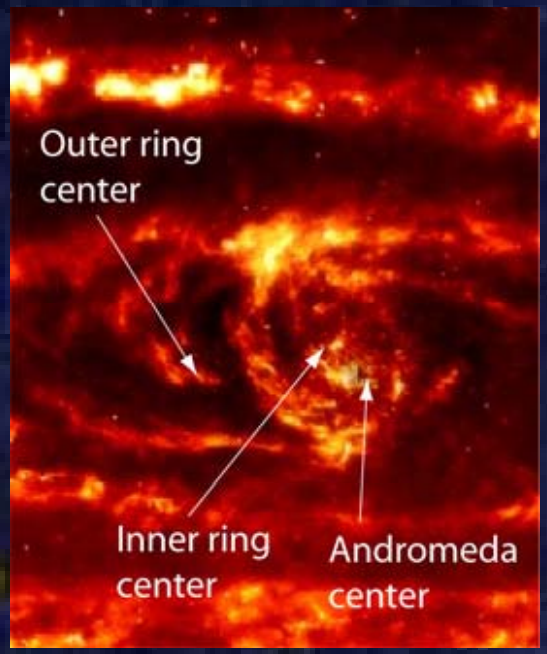
- In 2003, also using the Hubble Space Telescope, astronomers resolved approximately 300,000 stars in Andromeda's luminous halo.
- Astronomers estimated the age of many members of Andromeda's halo population

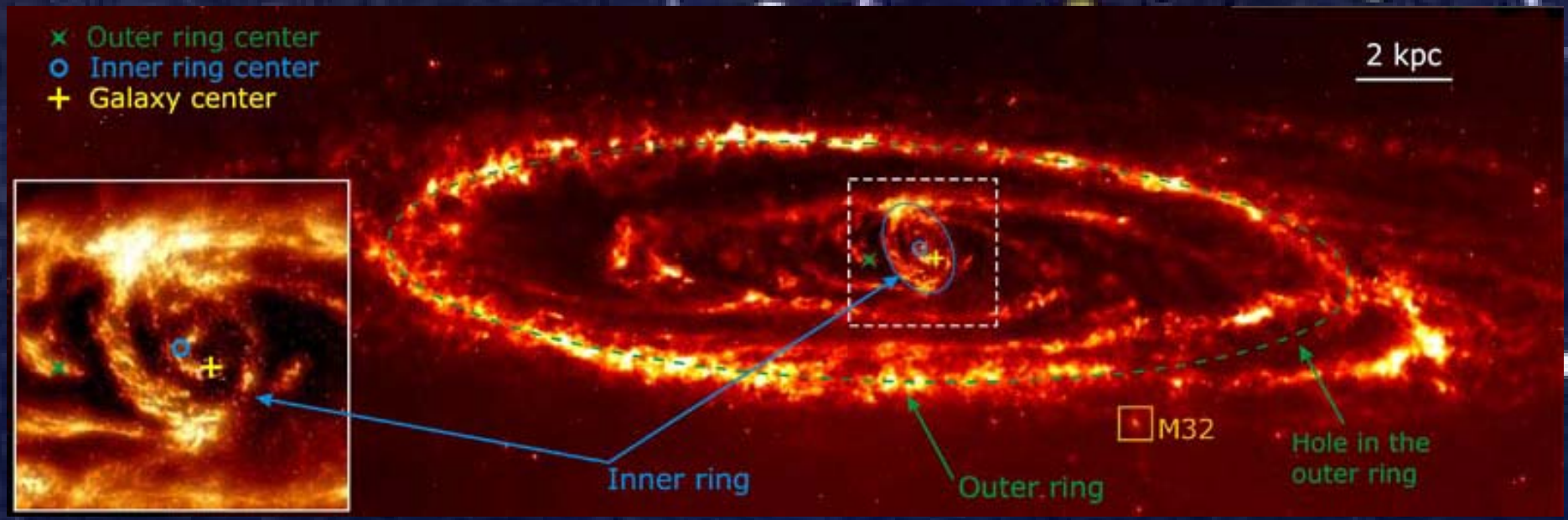


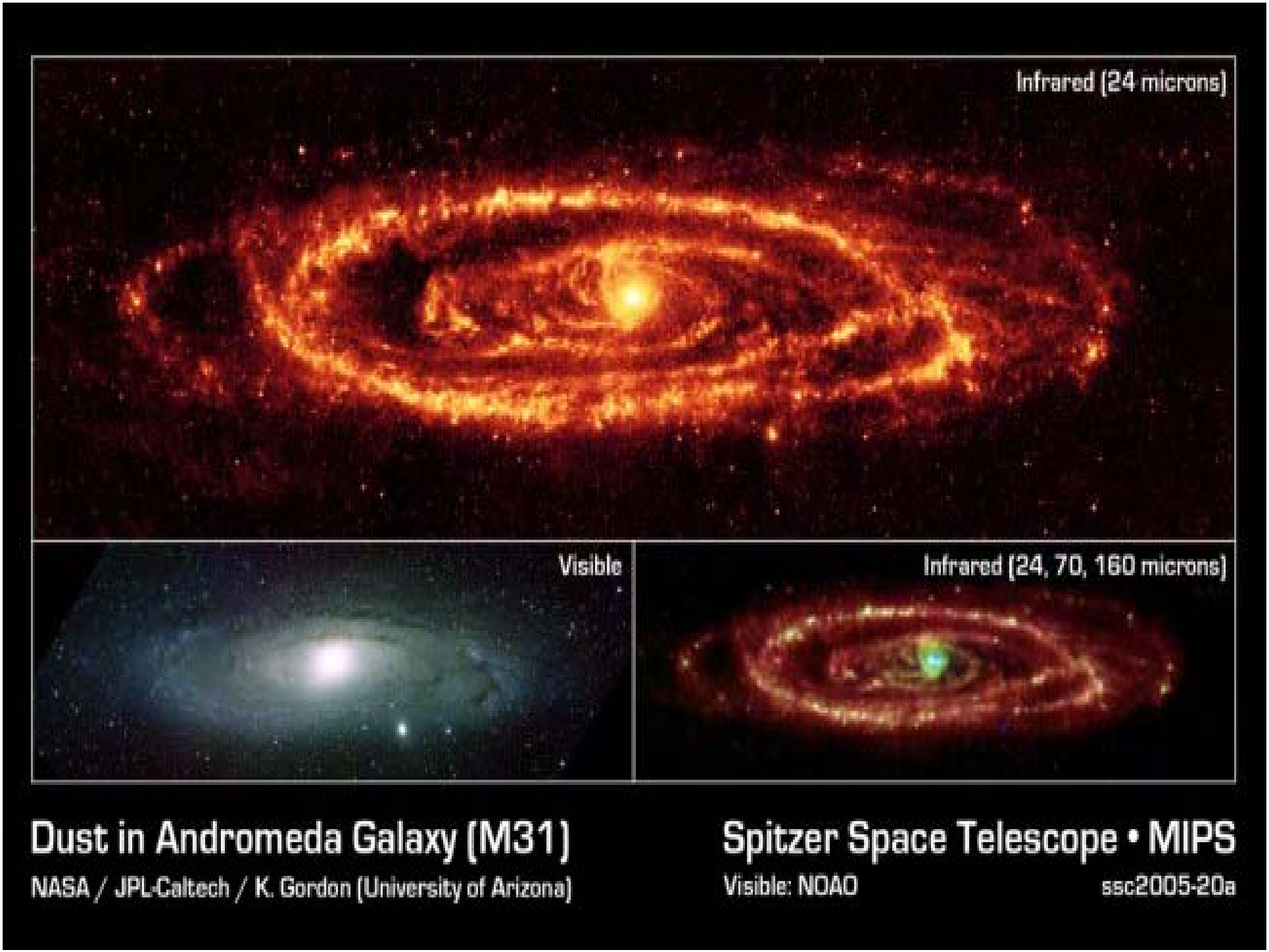
- In 2005, Hubble finds mysterious disk of blue stars around black hole in M 31

- The images and illustration reveal that the Andromeda Galaxy's core is composed of a ring of old, red stars and a newly discovered disk of young, blue stars. Astronomers now believe that Andromeda has one core. The two bright blobs are actually the ring of red stars and the disk of blue stars.

- In 2006, using NASA's Spitzer Space Telescope, astronomers discovered two dust rings in Andromeda's dust disk. They are evidence of an ancient head-on collision with neighboring dwarf galaxy along its polar axis M32 some 210 million years ago.







Dust in Andromeda Galaxy (M31)

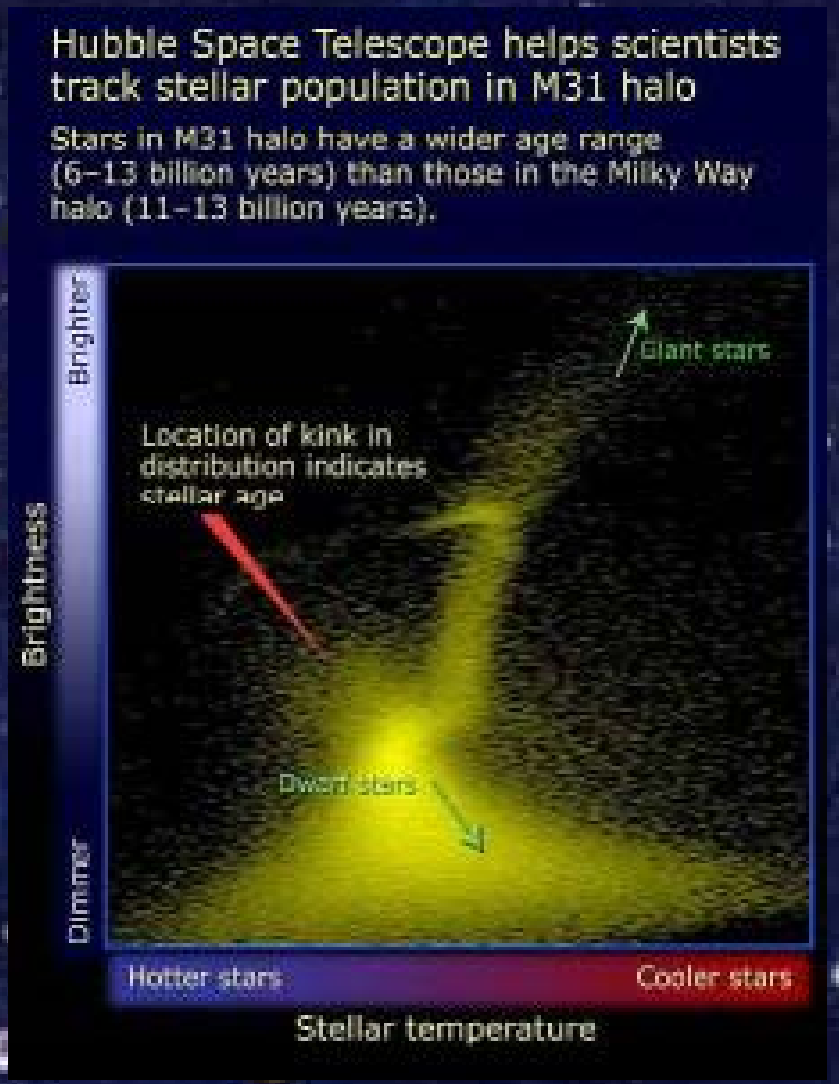
NASA / JPL-Caltech / K. Gordon (University of Arizona)

Spitzer Space Telescope • MIPS

Visible: NOAO

ssc2005-20a

- In 2007, astronomers found old low - metallicity, red giant stars up to some 500,000 light-years from Andromeda's center which suggests that the galaxy is up to five times larger than originally thought



- One finds that the Andromeda Galaxy and the Milky Way are approaching one another at a speed of 100 - 140 km/sec.
- Some astronomers believe that Andromeda and the Milky Way will eventually merge together. The impact is predicted to occur in about 3 billion years. In that case the two galaxies will likely merge to form a giant elliptical galaxy.

M32 and M110

- M 32 and M 110 are two companion galaxies of M 31. M110 is located one degree northwest of M31 and M32 can be found half a degree south of M31.
- M32 is a dwarf elliptical galaxy. It requires a substantial amount of magnification to reveal any detail.
- M110 is a bright E5 elliptical galaxy.

M 32

M 110

NGC 7662

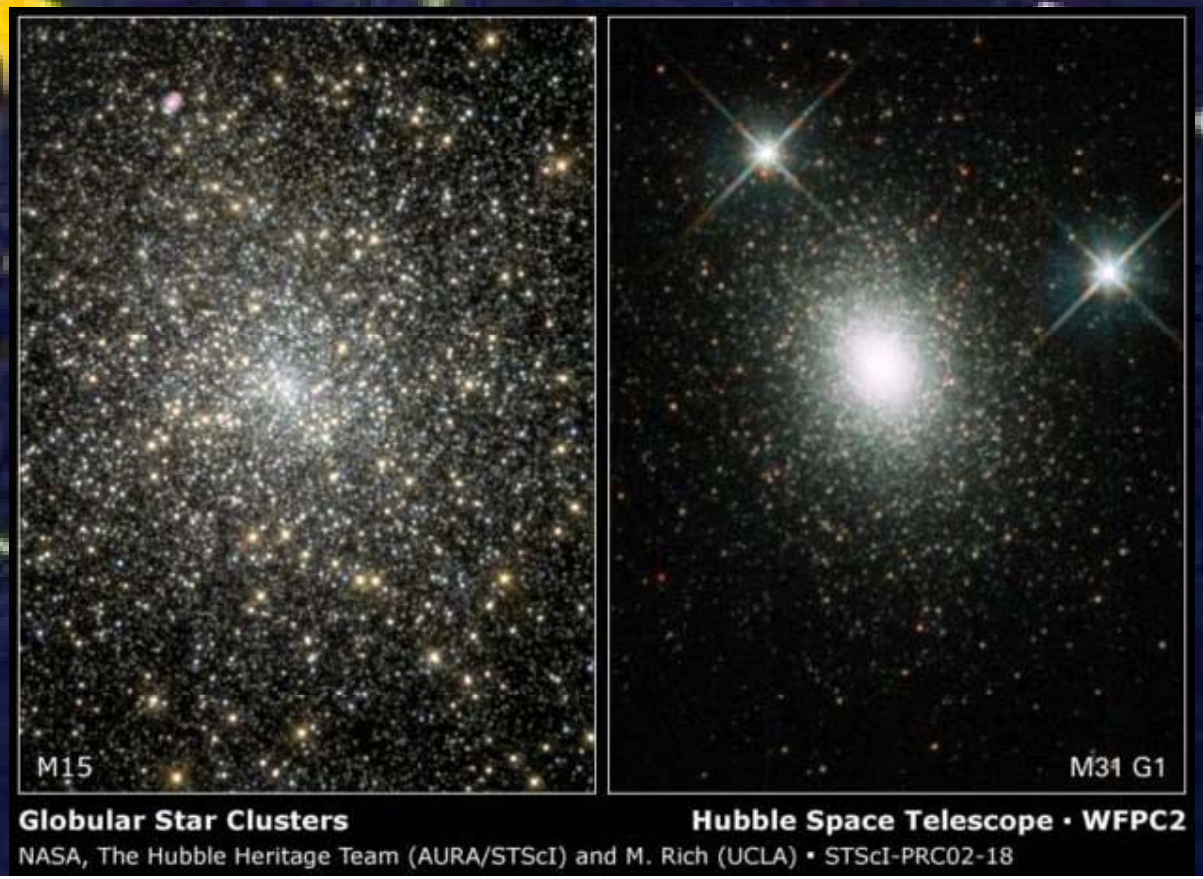
The Blue Snowball Nebula, NGC 7662 is interesting little planetary nebula visible in a good pair of binoculars. Using a high magnification it reveals a fuzzy blue-green elliptical disk.

NGC 891 – In photographs, one of the finest objects to be seen. Visually, however, it is large and faint, with few details.

This galaxy is seen edge on from our earth (This means we look exactly at it's galactic plane).

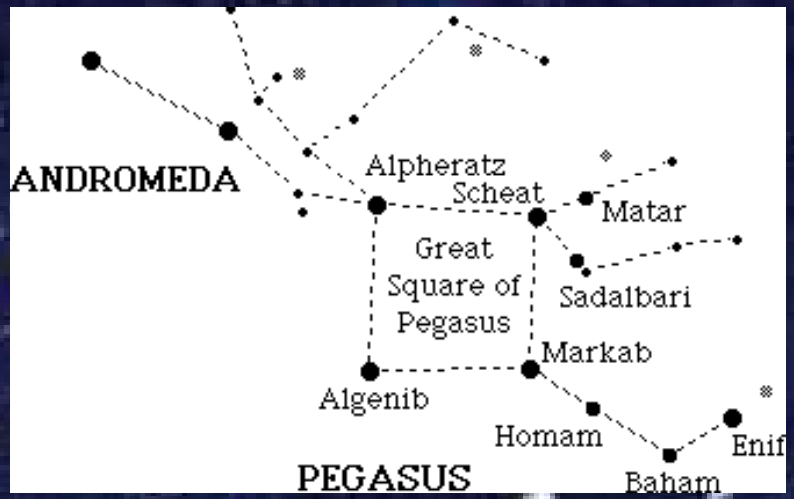
NGC 752 - beautiful open cluster, best viewed with binoculars. Located only 1200 light years away, this very old cluster is almost 2 billion years old.

- There are approximately 460 globular clusters associated with the Andromeda galaxy.
- The most massive of these clusters is Mayall II or G1 - Globular One
- It has a greater luminosity than any other known globular cluster in the local group of galaxies

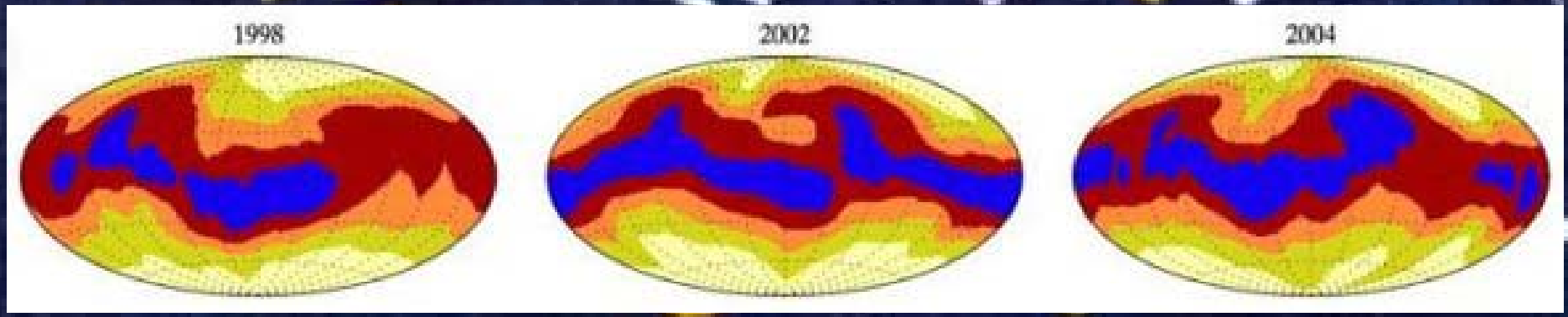


The Stars of Andromeda

- The brightest star in Andromeda, α Andromedae, called Alpheratz or Sirrah, makes up with α, β, and λ Pegasi an asterism called the Great Square of Pegasus.



- In 2007, researchers led by Oleg Kochukhov announced that Alpheratz was the first star observed to have weather. This took the form of shifting clouds of mercury.



Darker regions show greater concentrations of mercury on the surface of Alpheratz. The mercury clouds tend to concentrate along the equator, probably due to the star's rotation. Credit: Kochukhov

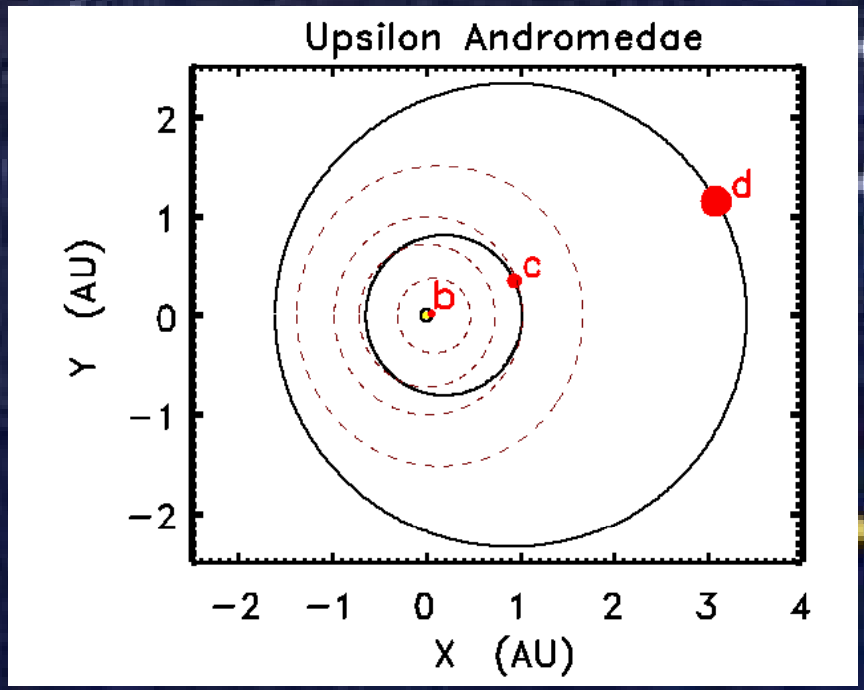
- β And (Mirach) is a magnitude 2.1 red giant star 199 light years away.

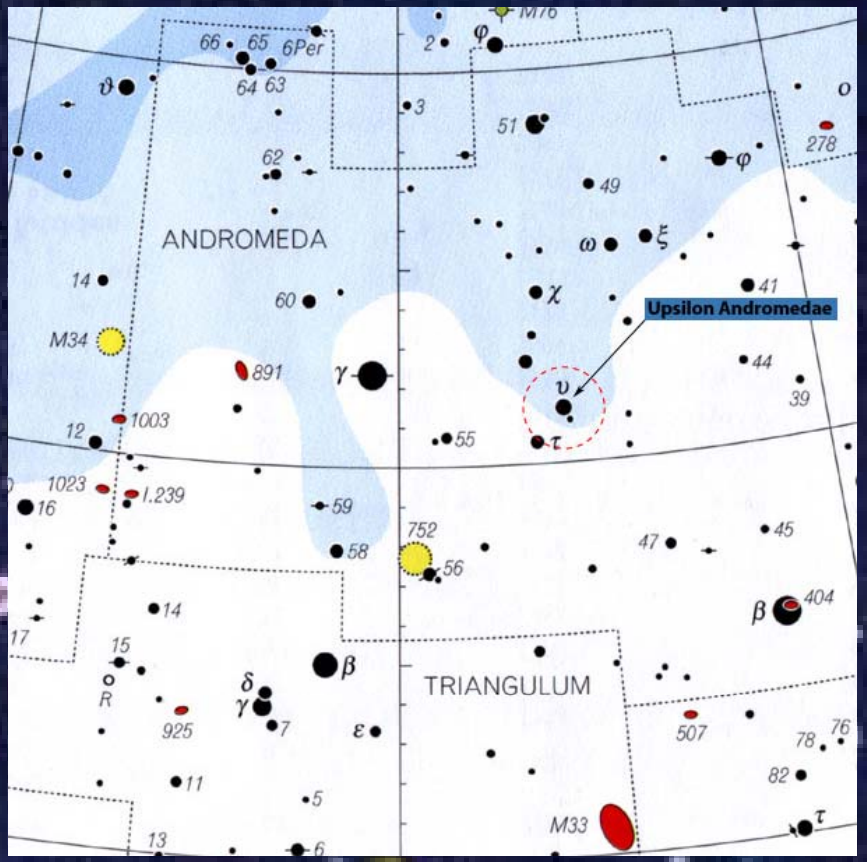
Mirach and NGC 404 galaxy; Credit: Palomar Observatory/STScI / WikiSky

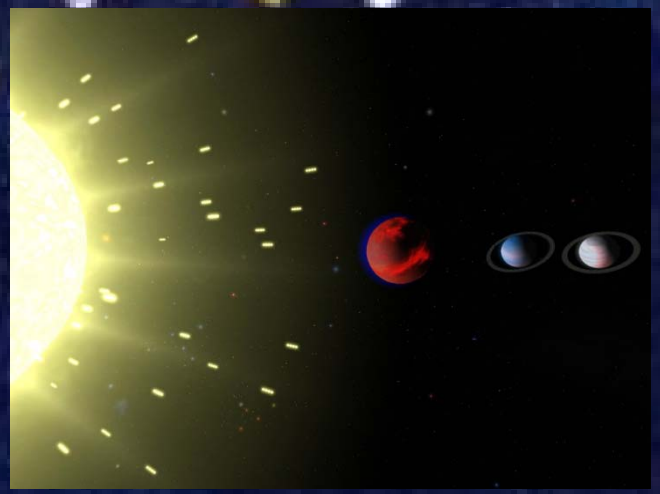
- Almach (γ Andromedae) is one of the most beautiful double stars in the autumn night sky.

- The recent findings show that Upsilon Andromedae has a system of three planets, and it is the first discovered solar system outside our own:

  In 1996, astronomers Geoff Marcy and Paul Butler detected evidence that a planet, about the same mass as Jupiter, was circling the star. In 1999 they discovered two other planets.



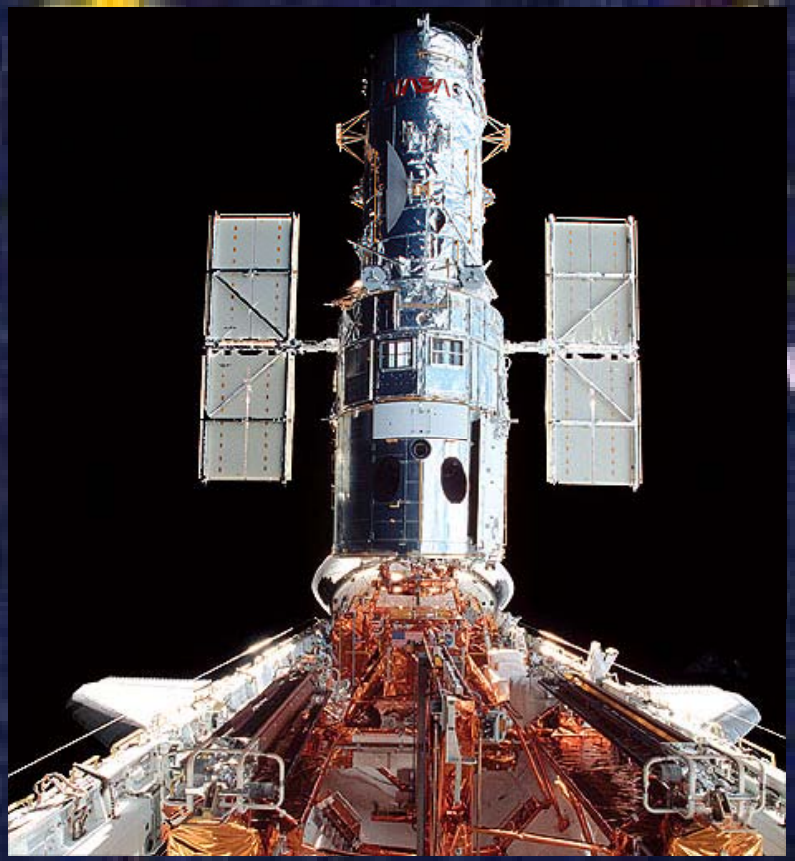




Interesting facts

- 1885 Supernova was recorded in the Andromeda Galaxy and it was the first to be detected outside the Milky Way.
- Andromeda is associated with the Andromedids (Bielids) shower, which produced meteor storms in 1872 and 1885 when Biela comet broke up into two pieces.

The Hubble Space Telescope



- Hubble is not that far away — only about 600 km above Earth. Its nearly circular orbit takes it once around the planet every 97 minutes.
- It never travels farther north than 28.5 degrees N. latitude, or farther south than 28.5 degrees S. latitude

Some of Hubble's top discoveries

- **Supernovae observations:** Data taken by the Hubble of supernovae explosions helped scientists confirm the existence of mysterious dark matter, one of the hottest research areas of astronomy today.
- **Cepheid variables:** Hubble's observations of Cepheids (stars that vary consistently over time,) helped establish a more accurate age of the universe.

- **Extrasolar planets:** Hubble made first direct measurements of the chemical makeup of an extrasolar planet's atmosphere.
- **More evidence of black holes:** At the heart of the elliptical galaxy M87, Hubble observations confirmed that there is a black hole with a mass millions to billions times that of our sun.
- **Gamma-ray bursts:** Hubble captured a gamma ray explosion on January 23, 1999, which at the time was the most powerful explosion ever recorded.
- **Quasars:** Scientists have only just begun to understand the behavior of these powerful bright objects. Astronomers using Hubble tracked down the 'homes' of quasars, proving that these dynamos reside in the centers of galaxies.

Conclusion

Andromeda galaxy plays an important role in galactic studies, being the nearest giant spiral galaxy. Our knowledge about its objects is constantly growing and changing largely thanks to HST. This is very important, considering the similarity between the Andromeda galaxy and the Milky Way.


Thank
You