

# Galaxies: Types and Classification



Culpeper Astronomy Club Meeting  
September 24 , 2018



# Overview

- Introductions
- Galaxies Classes
- Constellations: Aquila, Delpinus, and Scutum
- Observing Session

# “The Year in Review...”

- Began the year with a study of the Sun, stars, their evolution...and the different types of stars (sizes, composition)...with plans to return to types (Carbon Stars, Variable Stars)...
- Looked at the clusters and groupings in which stars are organized...Binaries and Multiple stars, Open and Globular Clusters...
- Last month took a more in-depth look at nebulae...the gaseous clouds from which stars are born...and to which they give rise when they die...
- This month we will look at much larger and far more distant objects...the galaxies...

# Galaxy Population

- Astronomers used HST to peer into a seemingly empty part of the sky and identified all the galaxies in it (Hubble Ultra Deep Field)
  - Revised the estimate for the number of galaxies, by a factor of 10, from 200 billion to 2 trillion
- James Webb Space Telescope is going to carry a telescope mirror with 25 square meters of collecting surface, compared to Hubble's 4.5 square meters
- Furthermore, JWST is IR telescope able to look at cooler objects, and galaxies which are billions of light-years away



# Galaxy Classes

- The most widely used classification scheme for galaxies is based on one devised by Edwin P. Hubble
  - Work produced a dramatic change in people's beliefs about the universe, proving it is home to galaxies besides the Milky Way
- It uses the three main types, and then further breaks them down by specific characteristics (openness of spirals, size and extent of bars, size of galactic bulges)
  - Spiral
  - Elliptical
  - Irregular
- The sub-classifications also include markers for such characteristics as a galaxy's star-formation rate and age spectrum of its stars

# Spiral Galaxies

- Spiral galaxies are the most common type in the universe
- Our Milky Way is a spiral, as is the close-by Andromeda Galaxy
- Spirals are large rotating disks of stars and nebulae, surrounded by a shell of dark matter
- The central bright region at the core of a galaxy is called the “galactic bulge”
- Many spirals have a halo of stars and star clusters arrayed above and below the disk

# Spiral Galaxies

- Whirlpool Galaxy (M51): a spiral galaxy located in the constellation Canes Venatici
  - Has apparent mag of 8.4; lies at approximate distance of 23M LY
- Andromeda Galaxy (M31):
  - Closest large galaxy to the Milky Way; 1 trillion stars; 220K LY wide
  - In about 4.5B years, it and the Milky Way are expected to collide and become an elliptical galaxy
  - Is accompanied by 14 dwarf galaxies, including M32, M110



# Barred Spirals

- Spirals that have large, bright bars of stars and material cutting across their central sections are called “barred spirals”
- A large majority of galaxies have these bars, and astronomers study them to understand what function they play within the galaxy
  - The current hypothesis is that the bar structure acts as a type of stellar nursery, fueling star birth at their centers
  - Bars are thought to be temporary phenomena in the lives of spiral galaxies; the bar structures decay over time, transforming galaxies from barred spirals to more "regular" spiral patterns
- Since so many spiral galaxies have bar structures, it is likely that they are recurring phenomena in spiral galaxy development
  - The oscillating evolutionary cycle from spiral galaxy to barred spiral galaxy is thought to take on the average about two billion years



# Barred Spiral

- NGC 6217: was photographed on June 13 and July 8, 2009, in the newly repaired Hubble camera
  - It lies at a distance of 60M LY in Ursa Minor
- Messier 109: is a barred spiral galaxy located in the constellation Ursa Major; at a distance of 83.5M LY
- NGC 7479 barred spiral in Pegasus; at 10.8 mag is thought to be the result of the merger of a smaller galaxy <100M years ago

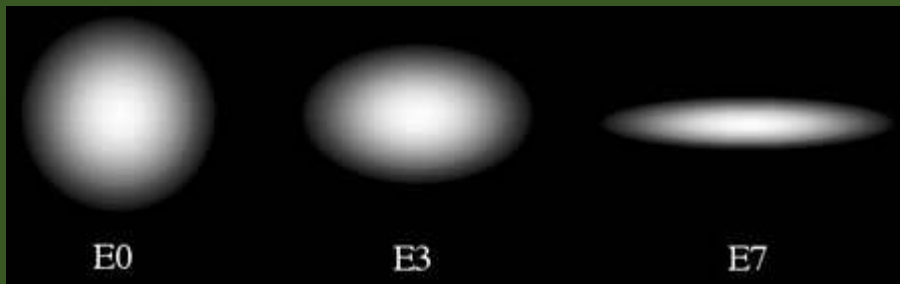


# Elliptical Galaxies

- Elliptical galaxies are roughly egg-shaped and found largely in galaxy clusters or smaller compact groups
- Most ellipticals contain older, low-mass stars, and because they lack a great deal of star-making gas and dust clouds, there is little new star formation occurring in them
- Ellipticals can have as few as a hundred million to perhaps a hundred trillion stars, and they can range in size from a few thousand light-years across to more than a few hundred thousand
- Astronomers now suspect that every elliptical has a central supermassive black hole

# Elliptical Galaxies

- Messier 87: a supergiant elliptical galaxy in Virgo; one of the most massive galaxies in the local Universe; notable for its large population of globular clusters—about 12,000 compared to the 150–200 orbiting the Milky Way
- Messier 60, also known as NGC 4649, is an elliptical galaxy approximately 55M LY distant in Virgo; part of a pair of galaxies with NGC 4647 (Spiral)



# Irregular Galaxies

- Irregular galaxies are as their name suggests: irregular in shape
- Irregulars usually do not have enough structure to characterize them as spirals or ellipticals
- As many as a quarter of known galaxies are irregular with no spiral arms or central bulge
- Having a lot of gas and dust means a lot of star formation going on within them; this can make them very bright
- Typically formed through gravitational interactions and mergers of other galaxies
  - Most, if not all of them, began life as some other galaxy type

# Irregular Galaxies

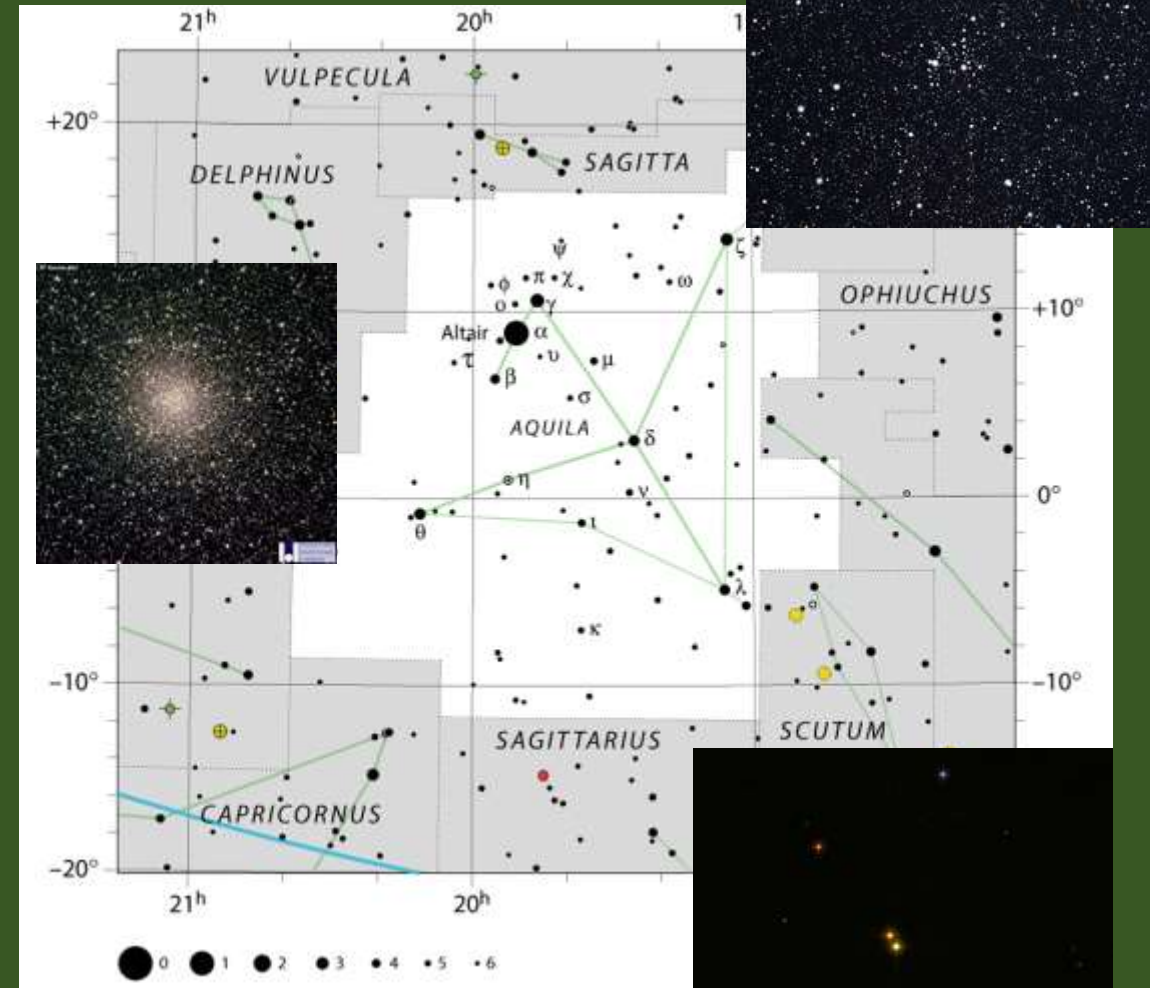
- Large and Small Magellanic Clouds are examples of irregular galaxies; two small galaxies which orbit Milky Way Galaxy
- NGC 2337: is located 25M LY distant in the constellation Lynx; blue patches that indicate the presence of newly formed, young, hot stars



Stellarium

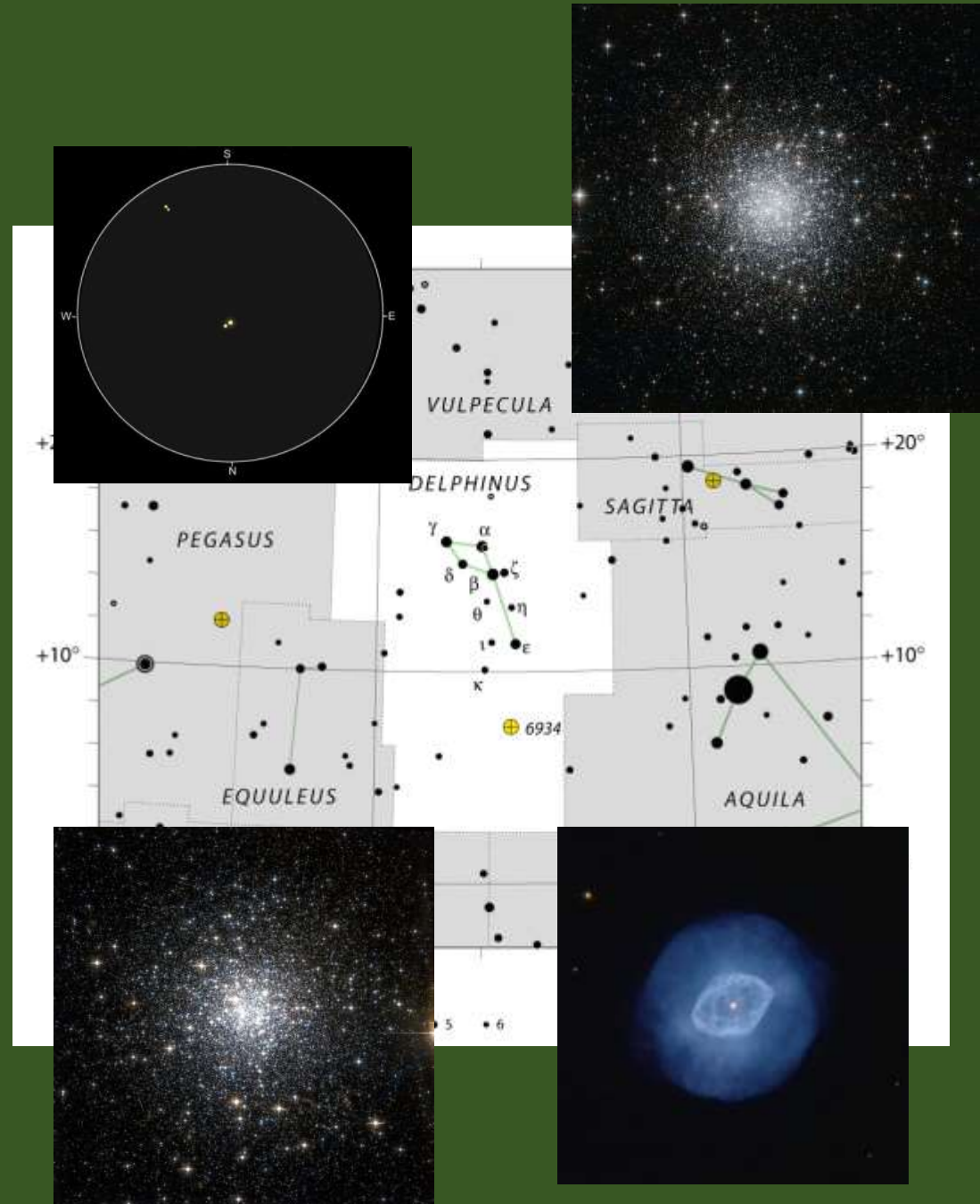
# Aquila - “The Eagle”

- Aquila is identified as the eagle that carried Zeus’ thunderbolts
  - Altair: “flying eagle” or “vulture”; one of the three stars that form the Summer Triangle
  -
- Double Stars:
  - 15 Aquilae: binary star; 5 mag yellow star and 7 mag companion
- Deep Sky Objects:
  - NGC 6709: Open Star Cluster; stars are loosely arranged into a diamond-like shape
  - NGC 6760: Globular Cluster



# Delphinus - "The Dolphin"

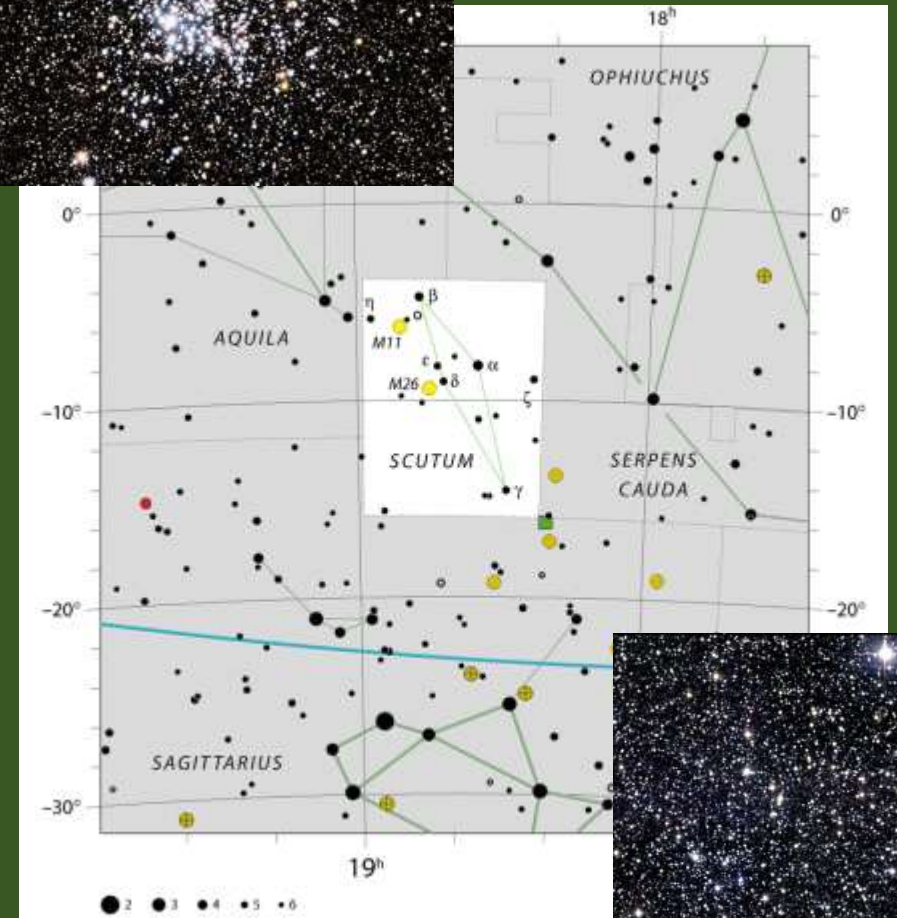
- One of the smallest constellations; represents the dolphin sent by Poseidon to find Amphitrite, his future wife
- Gamma Delphini - binary star; 101 light years distant; yellow-white dwarf and an orange subgiant; mag of 5.14 and 4.27; 9" Sep
- Deep Sky Objects:
  - NGC 6934 - large globular cluster near Epsilon Delphini; 50K LY distant; 8.83 mag
  - NGC 6891 - small planetary nebula located near the star Rho Aquilae; 7.2K LY distant
  - NGC 7006 - globular star cluster located 137K LY distant; The cluster has a visual magnitude of 10.6; located close to Gamma Delphini





# Scutum - “The Shield”

- Hevelius named it “Shield of Sobieski”
  - No associated myths
  - In honor of the Polish King Jan III Sobieski
  - Had been victorious in the Battle of Vienna in 1683
- Deep Sky Objects:
  - Messier 11: Wild Duck Open Star Cluster; one of the richest, most compact open clusters known; contains about 2,900 stars; brightest stars in the cluster form a triangle which represent a flock of wild ducks; mag of 6.3
  - Messier 26: Open Star Cluster; mag of 8.0; 5K LY distant; is about 22 LY across; believed to be about 89 million years old



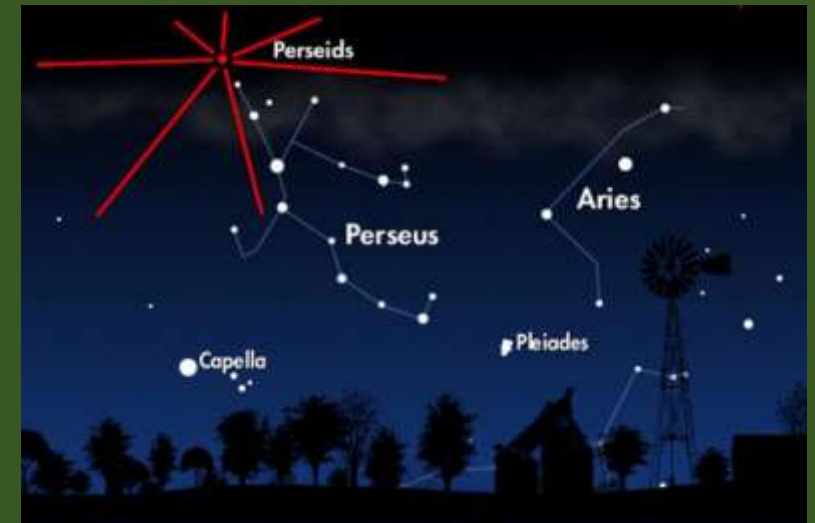
# Meteor Showers

Principal nighttime meteor showers

shower	average date of maximum	normal duration (days)	visual strength (Northern Hemisphere)	entry velocity (km/sec)	associated comet
Quadrantid	January 3	1	medium	41	not known
Lyrid	April 22	1	irregular	48	Thatcher
Eta Aquarid	May 3	5	weak	66	Halley
Southern Delta Aquarid	July 29	8	medium	41	not known
Capricornid	July 30	3	medium	23	not known
Perseid	August 12	5	strong	59	Swift-Tuttle
Andromedid	October 3	11	weak	21	Biela
Draconid	October 9	1	irregular	20	Giacobini-Zinner
Orionid	October 21	2	medium	66	Halley
Taurid	November 8	30	weak	28	Encke
Leonid	November 17	less than 1	irregular	71	Tempel-Tuttle
Geminid	December 14	4	strong	34	(3200) Phaethon*

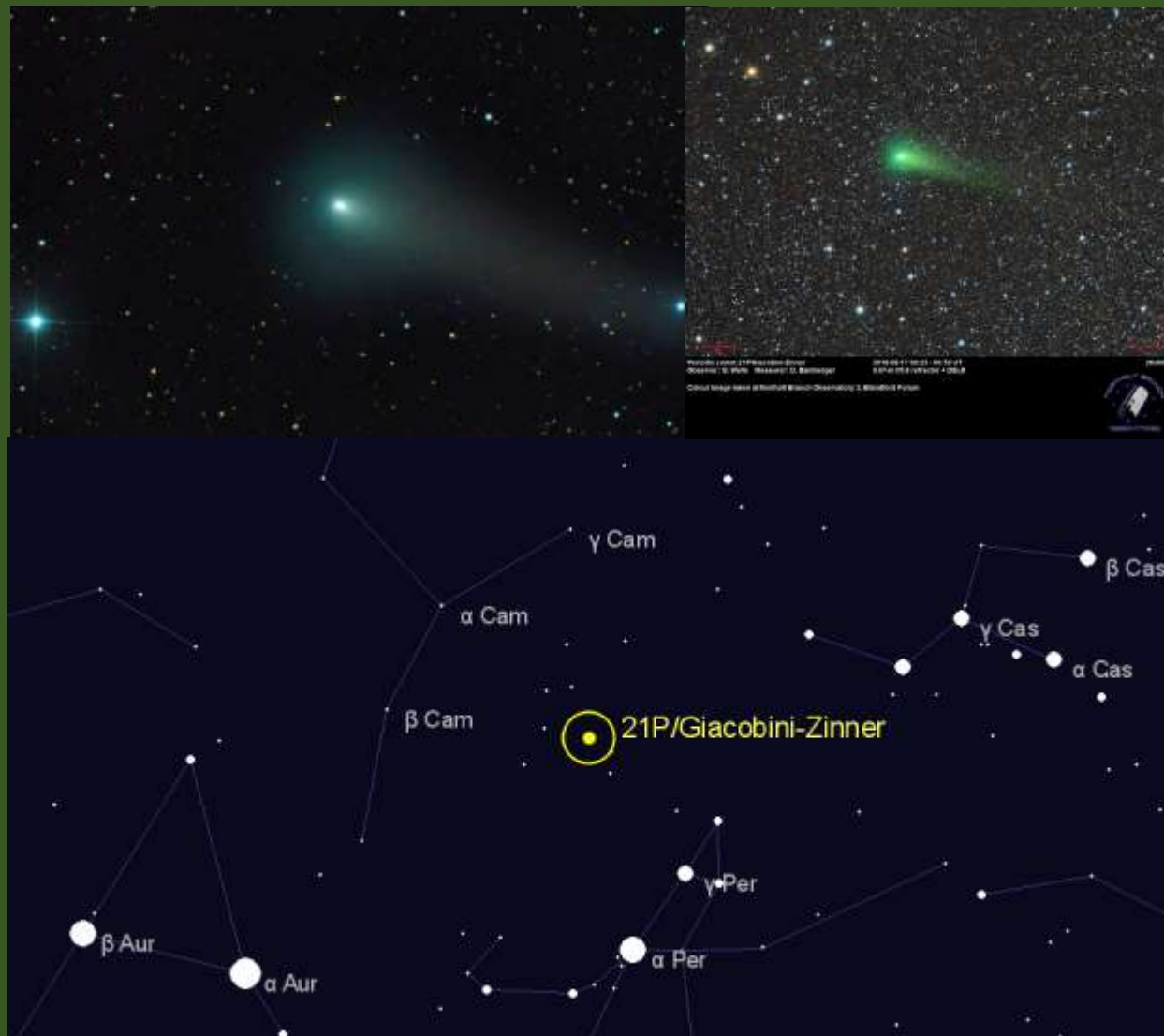
\*This body was classified as an asteroid on discovery, but it is now suspected to be a burnt-out comet.

Source: Data derived primarily from A.F. Cook in NASA SP - 319 (1973).



# Comet 21P/Giacobini-Zinner

- Comet 21/P Giacobini-Zinner is currently a fine binocular comet, shining at +7.7 mag
- We'll be able to track it right through perihelion on September 10
  - Could be 3rd mag by then
- This is its closest passage to Earth since September 14th, 1946
  - Won't be topped until the perihelion passage of September 18th, 2058
- Comet 21/P Giacobini-Zinner is also the source of the Draconid meteors, radiating from the constellation Draco on and around October 7th and 8th



# Upcoming Events

- Next Meeting: October 22
  - Primary Topic:
    - Variable or Carbon Stars
    - Dark Matter, Black Holes
- Orionid Meteor Shower:
  - Set to peak the night of Oct. 21-22
  - Bright Moon will lead to subpar views
  - Particles come from Comet 1P/Halley