

Chapter 13: The Milky Way

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AST 1002

“The Milky Way” vs. the Milky Way Galaxy

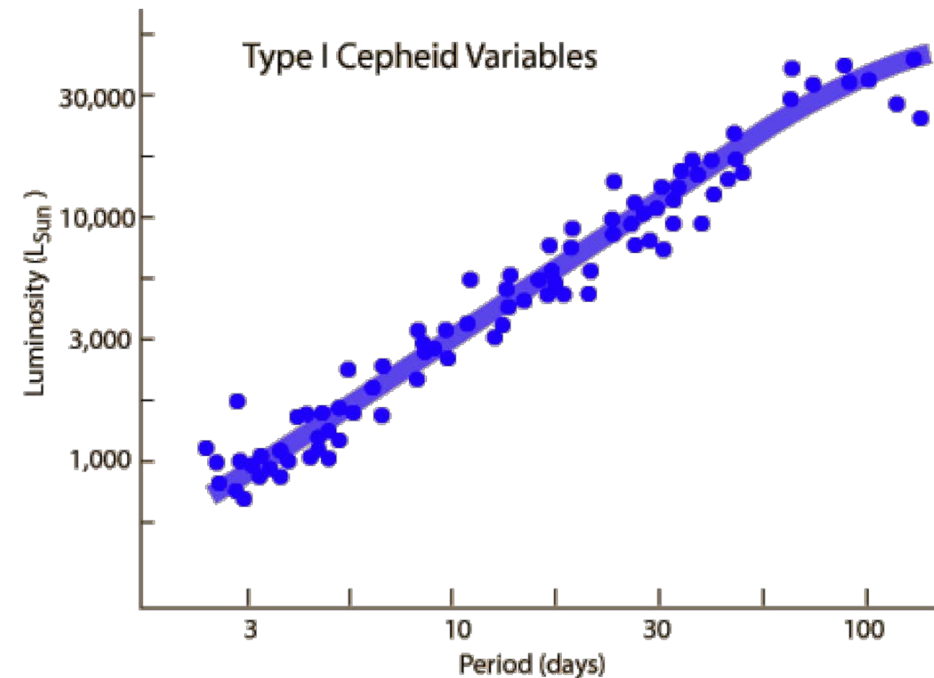
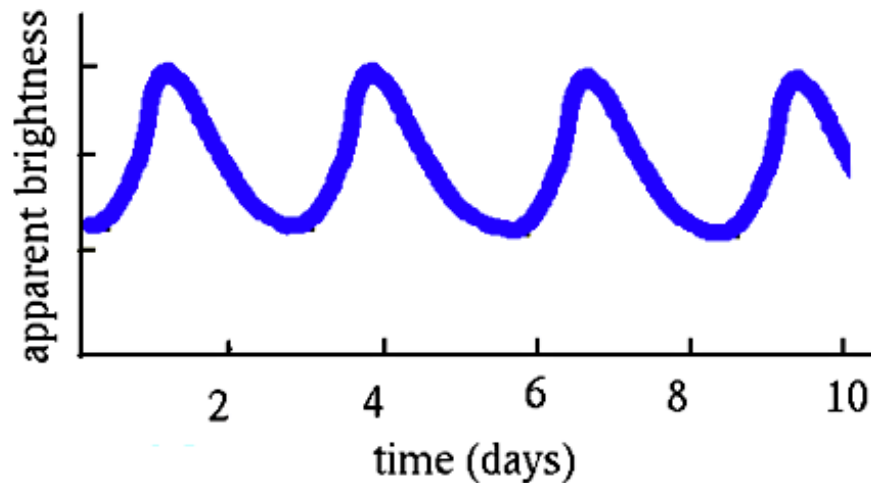


Galaxies as Island Universes

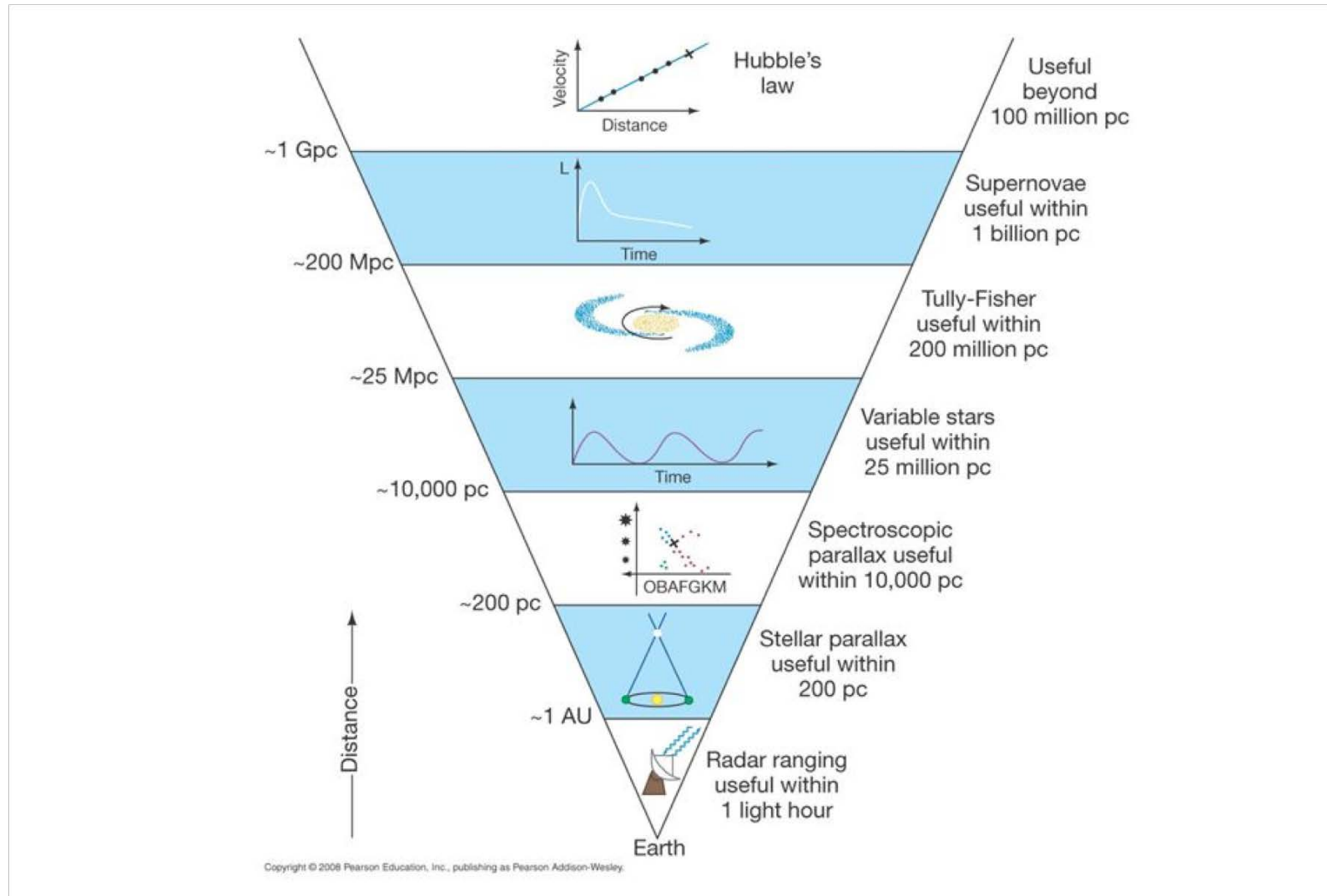
- In the 1920's, a “great debate” was taking place in astronomy regarding diffuse objects in the sky referred to as spiral nebulae.
- One side thought they were small and lay within our own galaxy.
- The other side thought they were very large, and lay very far outside our galaxy. They referred to spiral nebulae as “island universes.”
- Edwin Hubble, in 1924, proved that these spiral nebulae were much too far away to be within our galaxy, and thus the “island universe” concept won out.
- We now call these “island universes” galaxies.

Cepheid Variables

- Knowing the luminosity (absolute brightness) and the apparent brightness allows one to compute the distance to the Cepheid.



Cosmic Distance Ladder



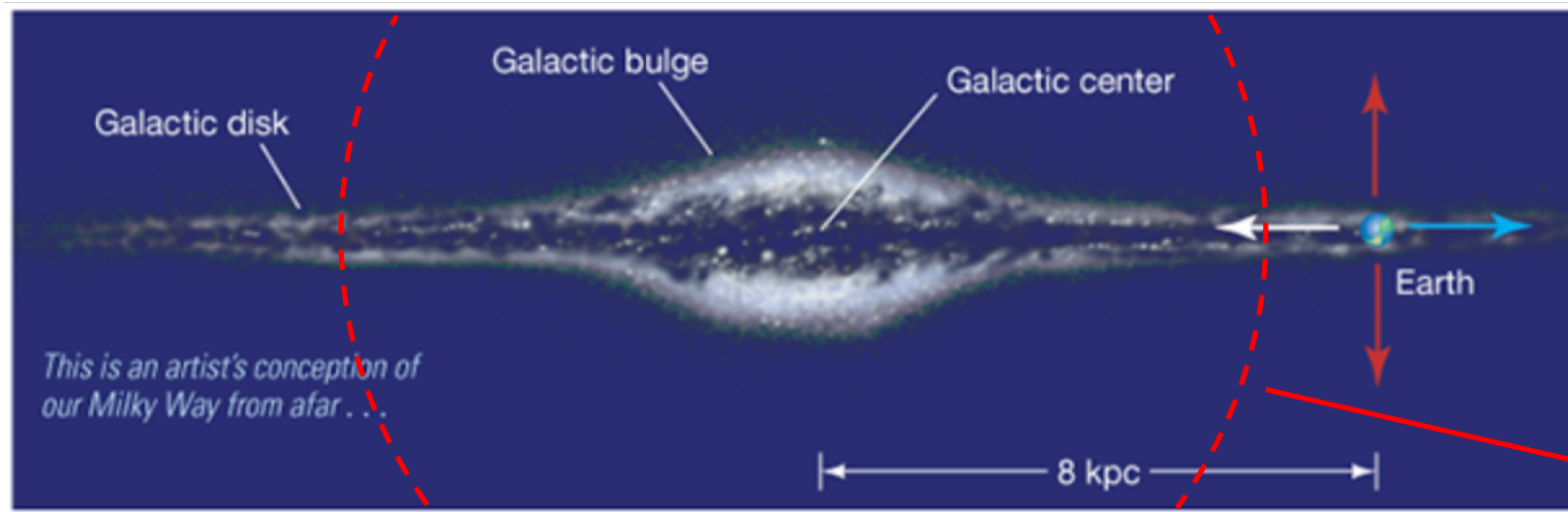
Structure of the Milky Way

- Milky way is a spiral galaxy: a flat, rotating disk.
- The disk splits itself into 2 spiral arms, that wind very tightly towards the center.
- The galactic disk is some 150,000 ly across.

“Edge on” view

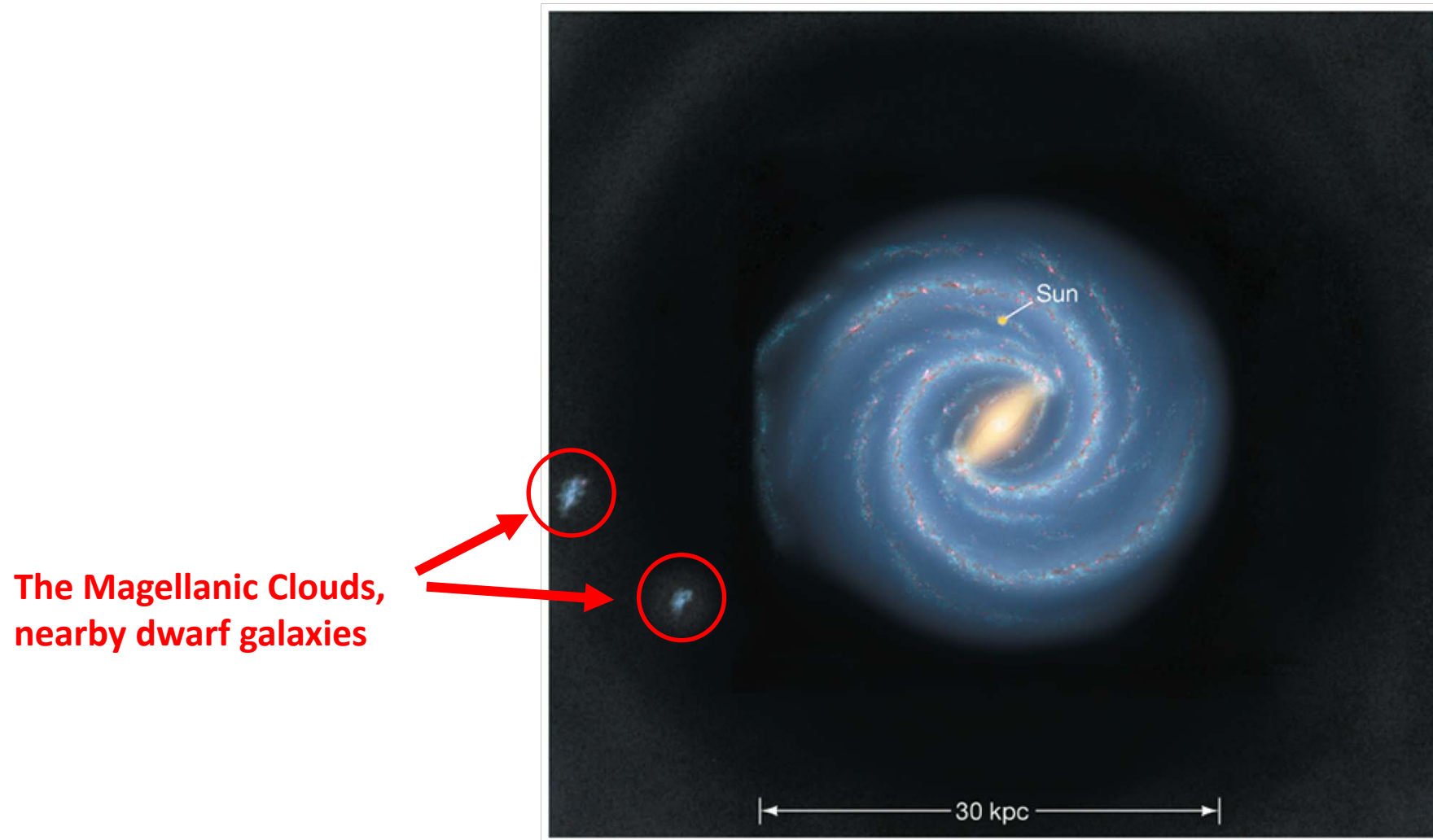


“Face on” view



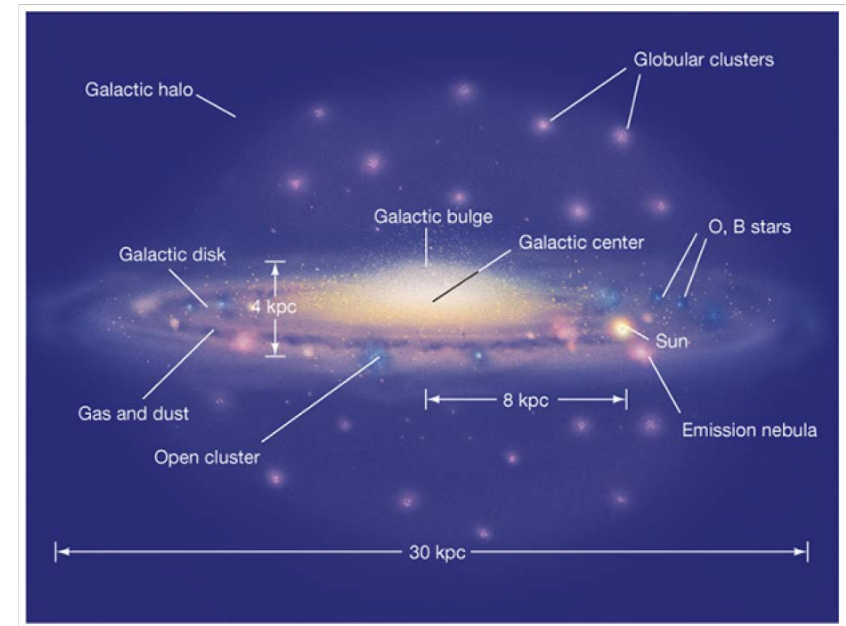
Galactic Halo

Location of the Sun in the Milky Way

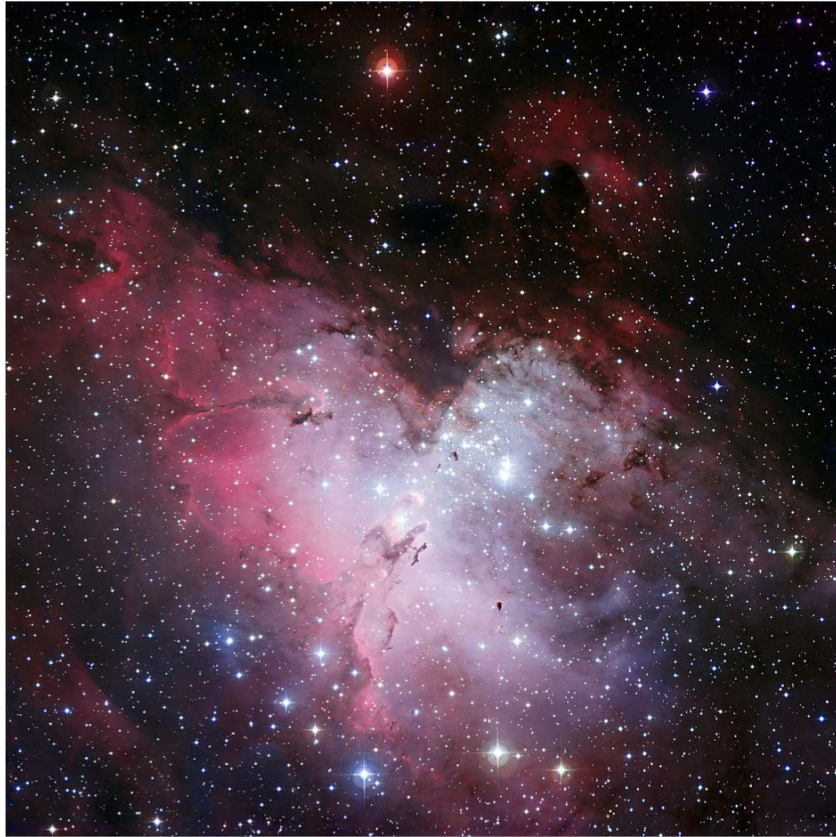


Star Content of the Milky Way

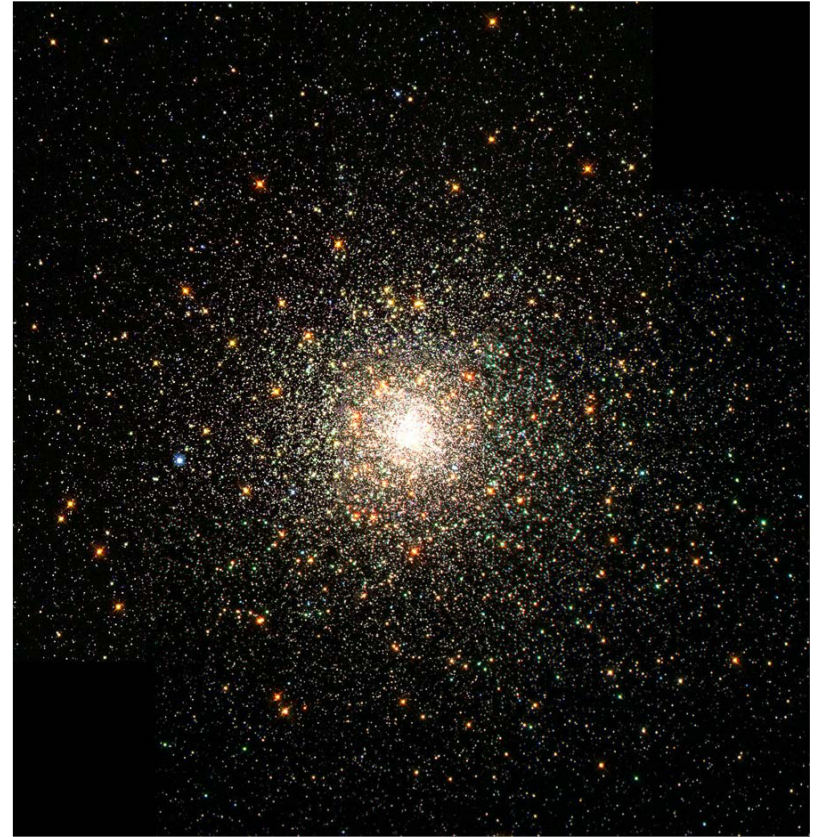
- Stars are distributed in two main ways:
 - Open clusters
 - Globular clusters
- Open clusters are loosely packed groups of stars, sometimes referred to as “clouds.”
- Globular clusters are tightly packed groups of stars, roughly spherical.
- Open clusters are found in the galactic disk, which globular clusters are found in the galactic halo.



Examples of Star Clusters



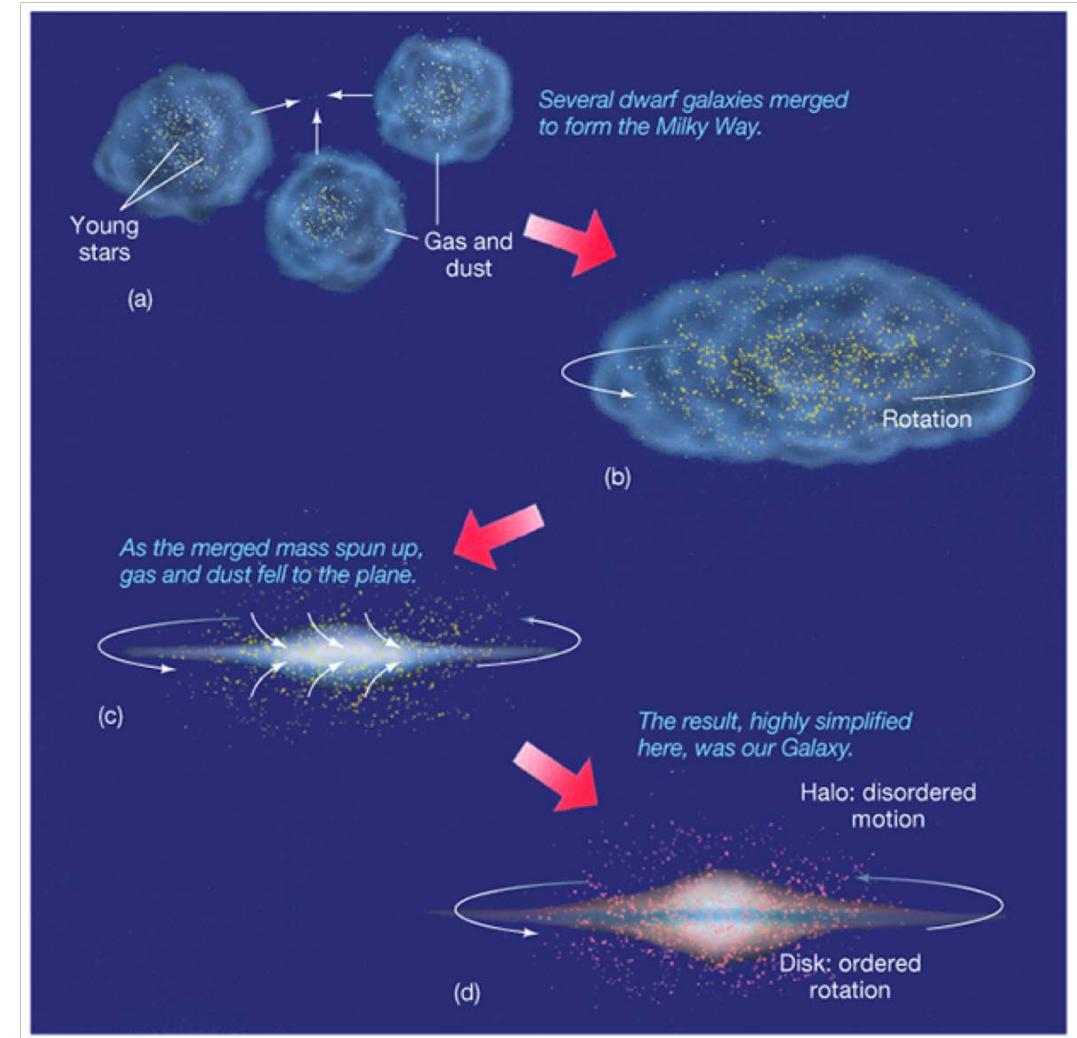
Eagle Nebula (Open Cluster)



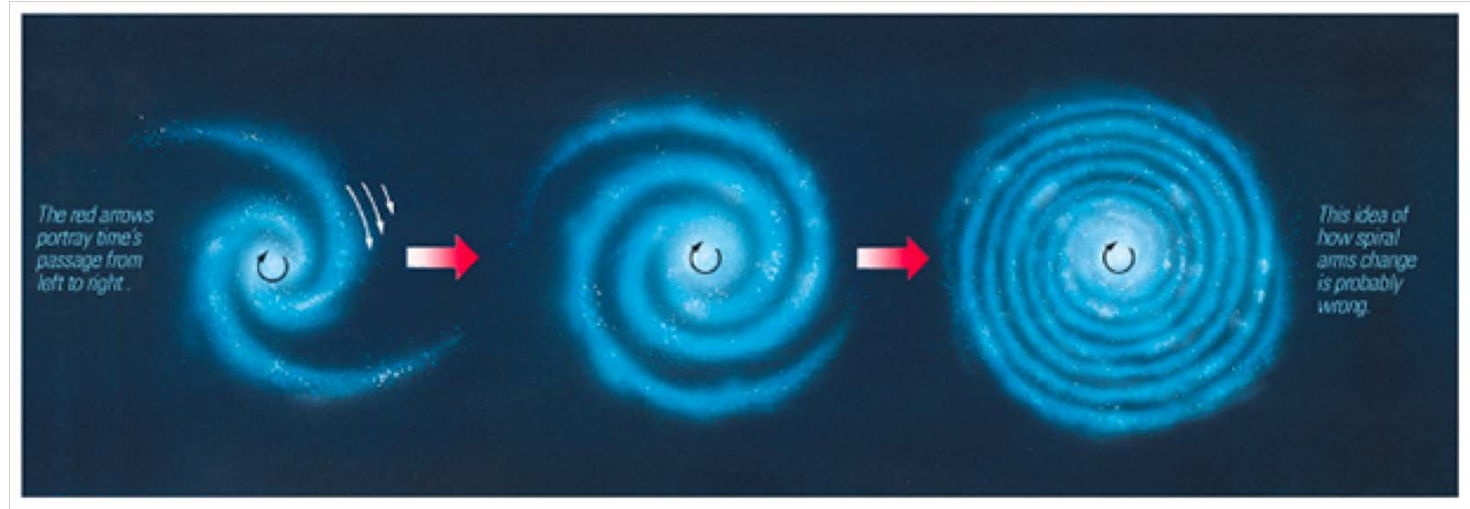
M80 (Globular Cluster)

Formation of the Milky Way

- Milk way is about 10 billion years old.
- It forms through a process essentially identical to that of stars.
- All structure formation in the universe occurs in basically the same way.



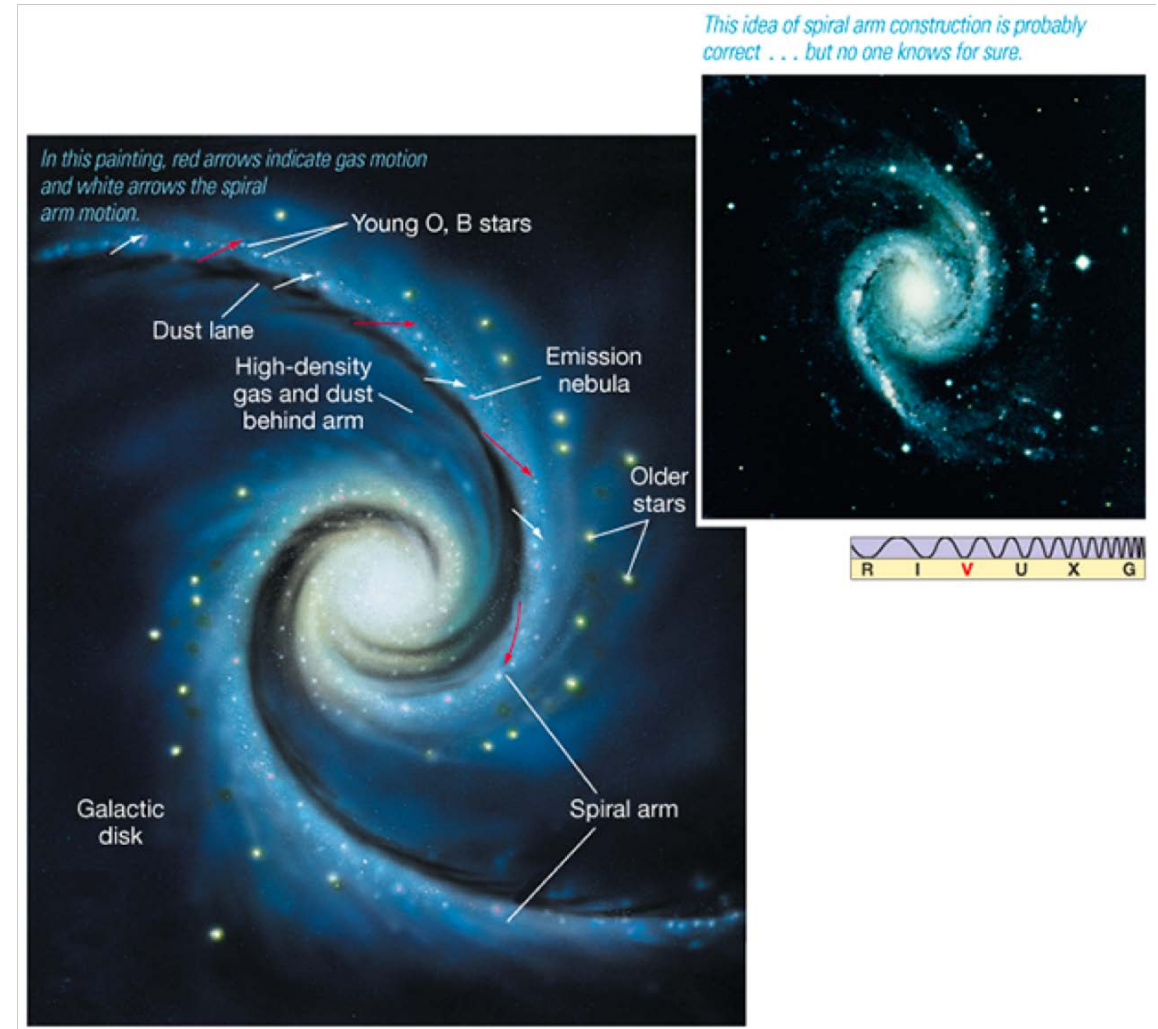
Spiral Arms



- Spiral arms are inherently unstable if thought of as high density gas spinning around the galaxy. In this view, spiral arms would only last about 100 million years, not the 10 billion years corresponding to the age of the Milky Way.
- Spiral Density Wave theory explains spiral arms as pressure waves traveling *through* the gas/stars of the galaxy, which cause temporary compression of the gas, which we see as a spiral arm.

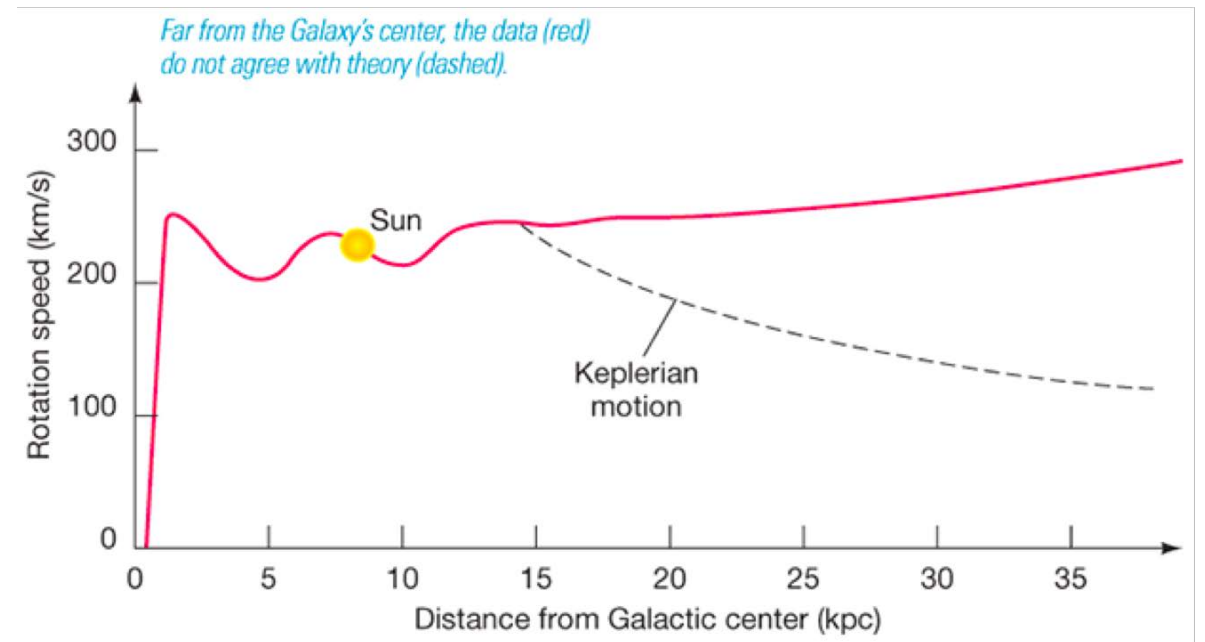
Spiral Arms and Star Formation

- To be stable, spiral arms must rotate more slowly than the gas and stars within the galaxy.
- Star formation occurs within the spiral arms, which act like pressure waves, driving star formation.
- Young stars form on the spiral arms, while older stars are found in front of the arms.



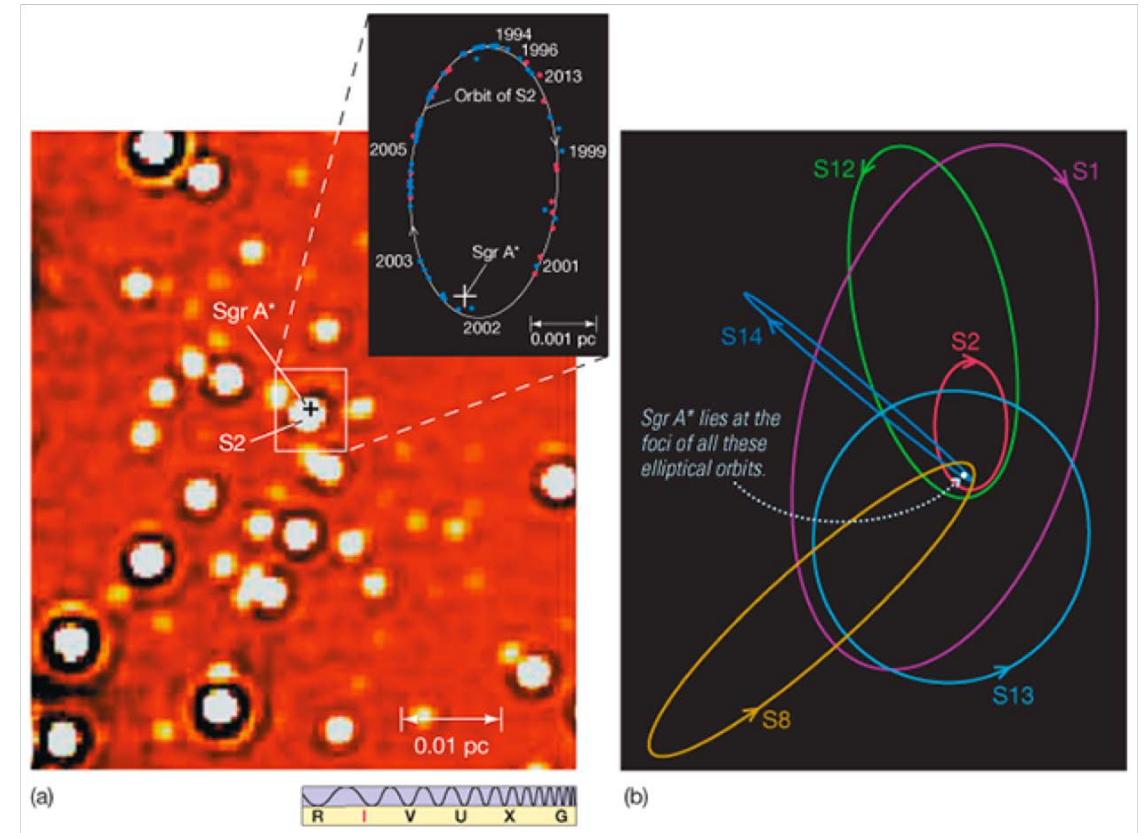
Rotation Curves and Dark Matter

- Rotation vs. distance is determined by Kepler's 3rd law.
- Observed data doesn't agree with Kepler's 3rd law.
- Explanation: unseen matter known as Dark Matter.
- Alternate explanation: Modified Newtonian Dynamics (MOND).



Sagittarius A*

- At the very center of the Milky Way, Sgr A*, is a very compact object with a mass of 4 million M_{\odot}
- This incredibly small and incredibly massive object is a black hole.
- Because its mass is in the millions of solar masses, it's known as a supermassive black hole.
- All galaxies are thought to have SMBHs at their centers.



Different Types of Galaxies

