

## Our Milky Way Galaxy–March 30

- What is our Milky Way Galaxy made of?
- Stars and gas orbit the galaxy.

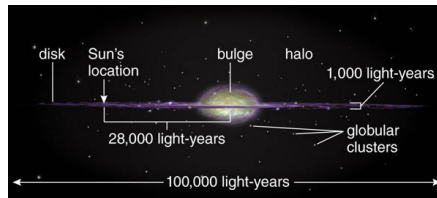
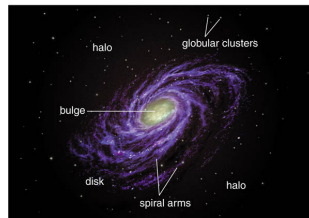


## Announcements

- Test3 will be graded by Fri.
- Broken clickers: What H-ITT says.
  - New (2 columns of buttons) clickers are under warranty. Bookstore will replace these.
  - Old (1 column of buttons). Trade them in to me after I receive replacements from H-ITT.
- Who are you?
  - Found book & notes on 28 Mar.

- Disk
  - Stars, gas, and dust
  - Young & old stars
  - Motion is circular
- Bulge
  - Stars are dense
  - Motion is elliptical in all directions
- Halo
  - Stars are sparse; dark matter
  - No young stars
  - Spherical in shape
  - Motion is elliptical in all directions
- Globular clusters

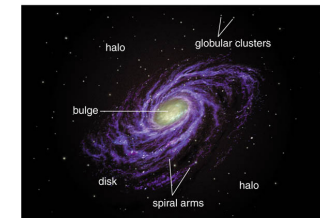
### Parts of the Milky Way



### Parts of the Milky Way

You are the sun.

1. The students in the room are O stars. Where is the disk?
  - a. All around, including up & down
  - b. Above the ceiling
  - c. Toward the front of the room
  - d. Within a few feet of the floor
2. Where is the halo?
3. Where is the dust & gas?
4. Where do you see the most stars?

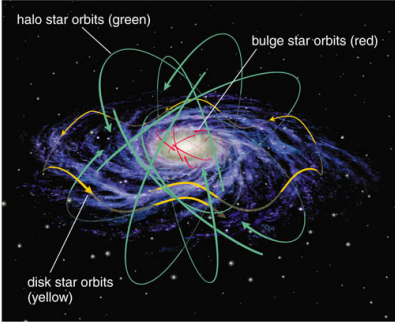


### Orbits of stars

- Disk stars move in a circle around the center of the Milky Way. Orbits dip above and below the plane of the disk.
- Halo and bulge stars move in long, skinny orbits in all directions.
- Why do some stars move in a circle and others move in an skinny orbit?

5. Why does the earth move in a circle today?

- a. Planets are heavenly objects.
- b. It moved in a circle yesterday.



### Orbits of stars

- Why do some stars move in a circle and others move in an skinny orbit?

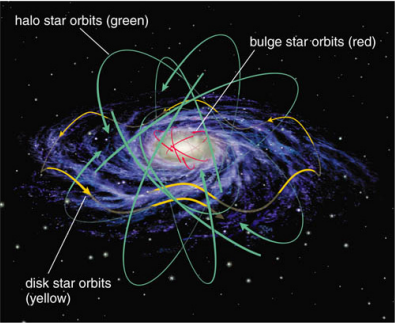
6. Why does the earth move in a circle today?

- a. Planets are heavenly objects.
- b. It moved in a circle yesterday.

7. Why does the earth move in a circle?

- a. The material from which the earth formed moved in a circle.

- Orbit determined at star's birth.
- Gas that formed disk stars was orbiting MW in a circle
- 1. Gas that formed halo stars was streaming toward MW. 2. Halo stars were in a little galaxy that got caught by MW.



### What is the Milky Way made of?

- Method 1: What do astronomers see?
  - Stars, gas, dust
- Method 2: How much mass is in the MW (actually measured in other galaxies)?
  - Use Kepler's 3<sup>rd</sup> Law  
 $Mass = (Radius\ of\ orbit)^3 / Period^2$
  - This form is better, since  $P=200Myr$   
 $Mass = (Radius\ of\ orbit) Speed^2$
- Mass from method 1 is much less than Method 2
- Galaxies are made primarily of matter that does not emit light.
  - This matter is not protons & neutrons, or electrons. This is called dark matter.

### Galaxies fill space around us

- Earth  
 6Mm in radius. 1/50 light-sec
- Solar system
  - Earth is 1 AU from sun. 1/63,000 light year, 500 ls (20,000x)
- Nearest star
  - Distance to Proxima Centauri is 4 ly (200,000x)
- Milky Way galaxy
  - Distance to center is 30 kly (10,000x)
- Nearest big galaxy
  - Distance to Andromeda is 2 Mly (100x)
- Farthest galaxy seen
  - Distance is 10 Bly (5,000x)

