Astronomy 100
Tuesday, Thursday 2:30 - 3:45 pm

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www.xanga.com/astronomy100
OWL assignment (Due Today)

- There is an OWL assignment due on Thursday April 14 at 11:59 pm.
- There are 15 questions and a perfect score will give you 2 homework points.
Homework Assignment
(Due May 3)

• Make up a test question for next test
• Multiple Choice
• A-E possible answers
• 1 point for handing it in
• 1 point for me using it on test
• The question needs to be on material that will be on the 3rd exam
• 15 people got extra HW credit for me using their question (or inspiring a question)
Astronomy Help Desk

• There is an Astronomy Help Desk in Hasbrouck 205.
• It is open Monday through Thursday from 7-9 pm.
Last Class

- We live in Milky Way Galaxy
- Milky Way Galaxy is Spiral Galaxy
- Flat rotation curve due to Dark Matter
If you are interested in astronomy articles

• Go to www.space.com
• Show simulations
Globular Cluster

- Cluster of a million or more stars in an area of 60-150 light years
- Tend to be found in Halos of Galaxies
- Tend to have very old stars
Galaxies

- Usually labeled by an NGC and then a number
- NGC is New General Catalog
Spiral galaxies

- Spheroidal Component – Bulge and Halo
- Disk that slices through the Halo and Bulge
- Spiral arms
NGC 6744
Barred Spiral

NGC 1300

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Barred Spiral

- Have a straight bar of stars with spiral arms curling away from the bars
- Some astronomers think that the Milky Way Galaxy is a barred spiral since our bulge appears to be elongated
Lenticular Galaxy

- Galaxy with disk but no spiral arms
- They look lens-shaped when viewed edge-on
Elliptical Galaxies

- Do not have significant disk component
- Looks like bulge and halo of spiral
- Very little star formation
Irregular Galaxies

- Do not look like Spiral or Elliptical Galaxies
Irregular Galaxies

• Distant galaxies are more likely to be irregular than closer ones
• Irregular galaxies more common when the universe was younger
Distances

• Distances are hard to measure in space
• Apparent brightness = \textbf{Luminosity}

\[ 4\pi \times (\text{distance})^2 \]
What you can measure

- You can measure apparent brightness
- If you know the object’s luminosity
- You can calculate the distance
A standard candle is a light source of known luminosity. If you can measure its apparent brightness and know its luminosity, you can determine its distance.
For example

- If we see a star like the Sun
- We measure its apparent brightness
- We assume its luminosity is the same as the Sun
- We then can calculate its distance
However

• Sun-like stars are relatively dim
• So we can’t use this method for distances greater than 1,000 light years
Main Sequence Fitting

• We identify a star cluster that is close enough to determine its distance by parallax
• We plots its H-R diagram
• Since we know the distances to the cluster stars
• We can determine their luminosities
Then

- We can look at stars in other clusters that are very far away
- Measure apparent brightnesses
- We assume that stars of the same color have the same luminosity
- Use that to calculate distances
Nearby star cluster
Main Sequence Fitting

- Main sequence fitting only works for stars in our galaxy
For other Galaxies

- We use Cepheid Variables
Variable Star

• Variable Stars change in brightness
Cepheid Variables

- Cepheid Variables change in brightness regularly.
Interestingly

- For Cepheid Variables
- The period of the brightness changes is a function of luminosity
So

• So if you know the period of the brightness changes
• You know the luminosity
Edwin Hubble (1889-1953)

- Hubble used Cepheid Variables to determine the distance to the Andromeda Galaxy.
- Demonstrated it was a separate galaxy.
Remember

• At the dawn of the 20th century, most astronomers thought that the Milky Way Galaxy was the universe, and it measured only a few thousand light-years across.
Hubble

• Kept on measuring distances to galaxies
• Since you can’t see Cepheid Variables in far-away galaxies, he assumed the “brightest stars” in galaxies had the same luminosity
• Made a mistake since the “brightest stars” were actually star clusters
Remember

• As something moves away from us
• The wavelength of light from the source increases
Found out

- The more distant a galaxy,
- The greater its redshift
- The faster it is moving away from us
Came up with Hubble’s Law

- Velocity = Hubble’s Constant x distance
- \( v = H_o \times d \)
- Hubble’s Constant is the slope of the line
So

- $d = \frac{v}{H_0}$
- So if you can measure the velocity that a galaxy is moving away from you
- You can calculate its distance
And

- You can calculate the velocity that something is moving away from you from its redshift
Difficulties

• Galaxies do not obey Hubble’s Law perfectly because they can velocities due to gravitational interactions

• Distances are only as accurate as well as we know Hubble’s Constant
Constant

- $H_0 = 71$ km/s/Mpc
- 1 megaparsec = one million parsecs

**Constant**
Importance of Hubble’s Constant

- Remember: $v = \frac{d}{t}$
- $d = vt$
- $d = \frac{v}{H_0}$
- so $t = \frac{1}{H_0}$
- so if you know Hubble’s constant, you can determine the age of the universe
Questions