Cepheid Variables

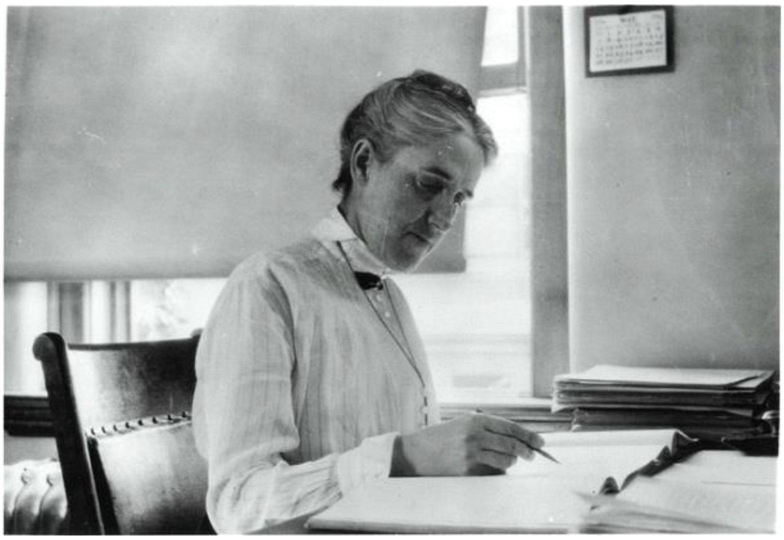
Formulas & Theorems Covered Today:

- Beyond Stellar Parallax
- Cepheid Variables

Homework:

Notes:

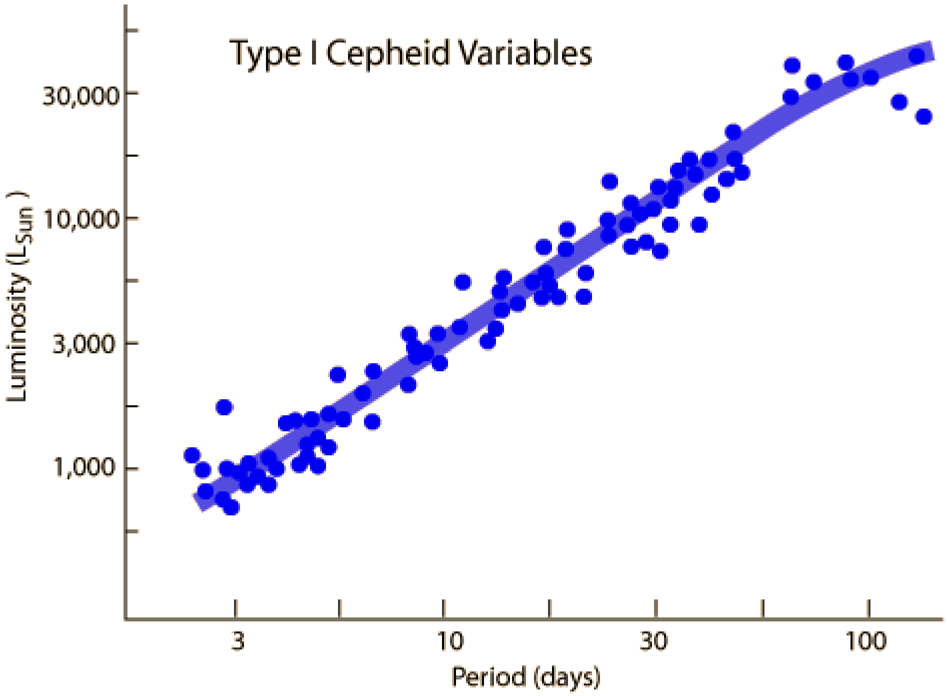
- In the 1920's an assistant of Edwin Charles Pickering (Harvard Astronomer), Henrietta Swan Leavitt, made arguably one of the most important discoveries in modern astronomy history.

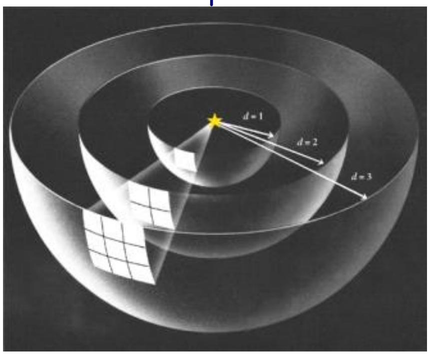


- Her discovery allowed us to begin to make measurements to distant objects possible.
- Even to this day we don't have any instruments to make measurements to any stars beyond our galaxy.
- She was asked by Pickering to classify stars in the Large Magellanic Cloud

- She was particularly looking at a class of stars called Cepheid Variables (standard candles)
- These stars are extremely bright, sometimes up to 30000x as bright and they are

anywhere between 5-20x the suns mass
- This allows these stars to be seen quite clearly from very far away (in other galaxies)
- Their light intensity also varies with a well-defined period

- She then decided to plot, which was not very obvious, the relative luminosity vs the period in days and she got the following
- She did have to make an assumption which is a pretty easy one to make which was that all stars in the distant galaxies were roughly the same distance from the Earth
- 

- You can clearly measure its relative brightness in some distant galaxy and along with that you can also measure its period
- If you now know the absolute luminosity of any Cepheid variable then you know the absolute luminosity of any star with that period
- 
- This system allows us to look at the apparent and absolute luminosities of stars which basically allows us to compare how much more dim a star is relative to us from its actual brightness
- To do this, we can measure Cepheid variables within our scope of parallax, to get their absolute luminosities

$$b = \frac{L}{4\pi d^2}$$

- b = apparent brightness of the star (in watts/meter2)
- L = luminosity of the star (in watts) (1 solar luminosity = 3.828×10^{26} W)
- d = distance to the star (in meters)
- pi = approximately 3.14159265

OR

$$m - M = 5\log(\frac{d}{10})$$

- m = apparent magnitude of the star
- M = absolute magnitude of the star
- d = distance to the star (in parsec)

- These have a measurement threshold of 29Mpc
- To go into further distances you can use type IA supernovas