Interacting Stars

Physical Sciences

Broward College

Prepared for AST 1002

Horizons in Astronomy

What are binary star systems?

- Star interact by creating binary or multiple star systems.
- Types of Binary Stars:
  - Visual: One can observe the two stars using a telescope.
  - Spectroscopic: One can use spectroscopy to observe the stars.
  - Eclipsing: One can use light curves to observe the stars.
- Binary stars are called a system if the center of mass is between the interacting stars.
- We can only determine the masses of stars if they are in a binary star system.

Visual Binary

Figure 1. Visual Binary (Van Werven, 2015)

- A binary star that we can visually resolved into two stars.
- These binary systems have the long periods, periods over years.
- We can observe the different types and states of the stars.

Spectroscopic Binary Stars

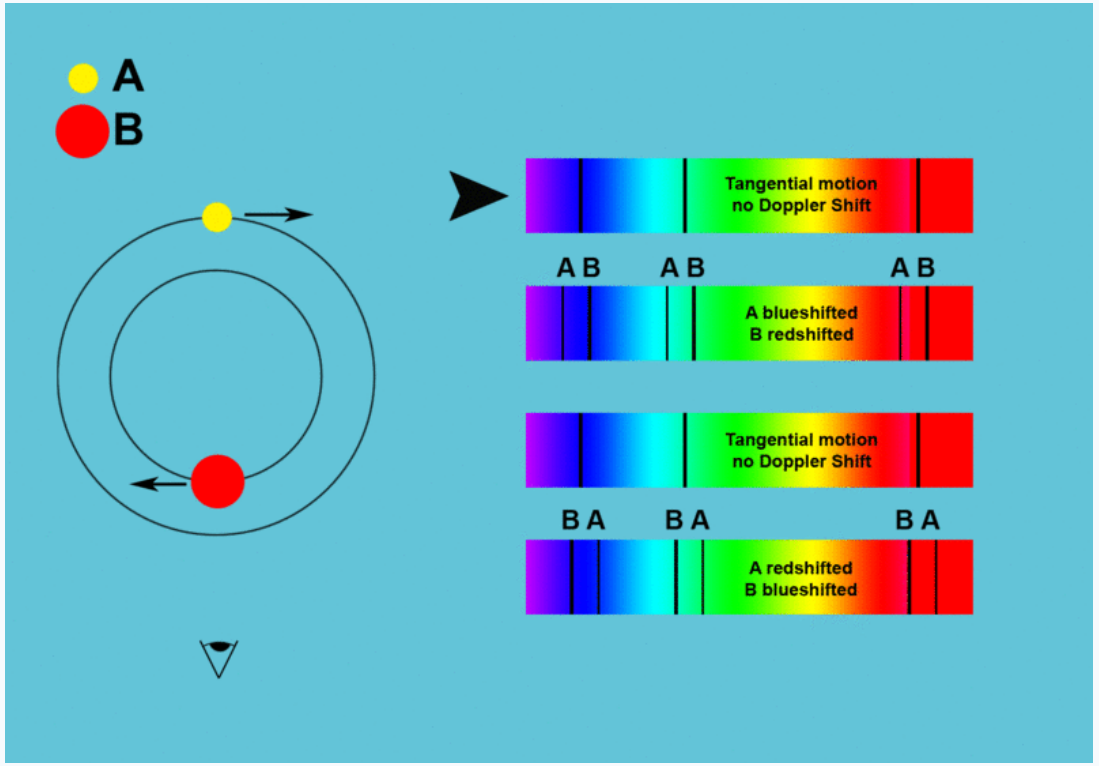


Figure 2. Spectral Binary (Wiki)

- These binary star systems are resolved using their spectral signatures.
- The spectra shift and widen with respect to the movement of the stars.
- These binaries tend to have shorter periods, months or days.
- Their inclinations are 90° with respect to the observer.

Eclipsing Binary

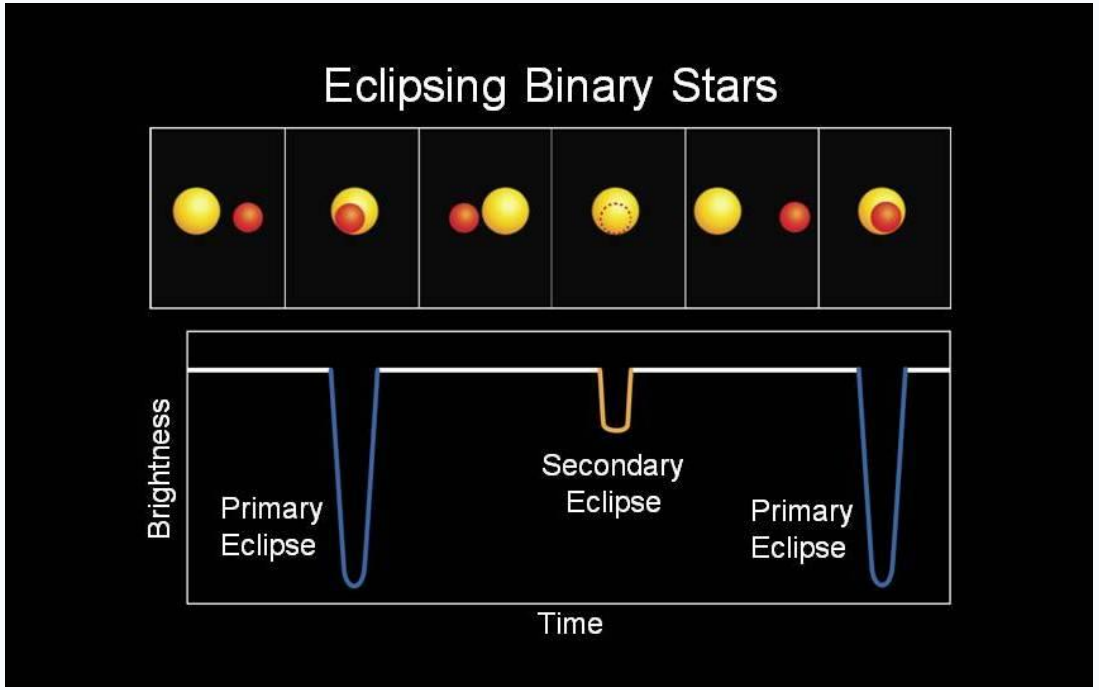
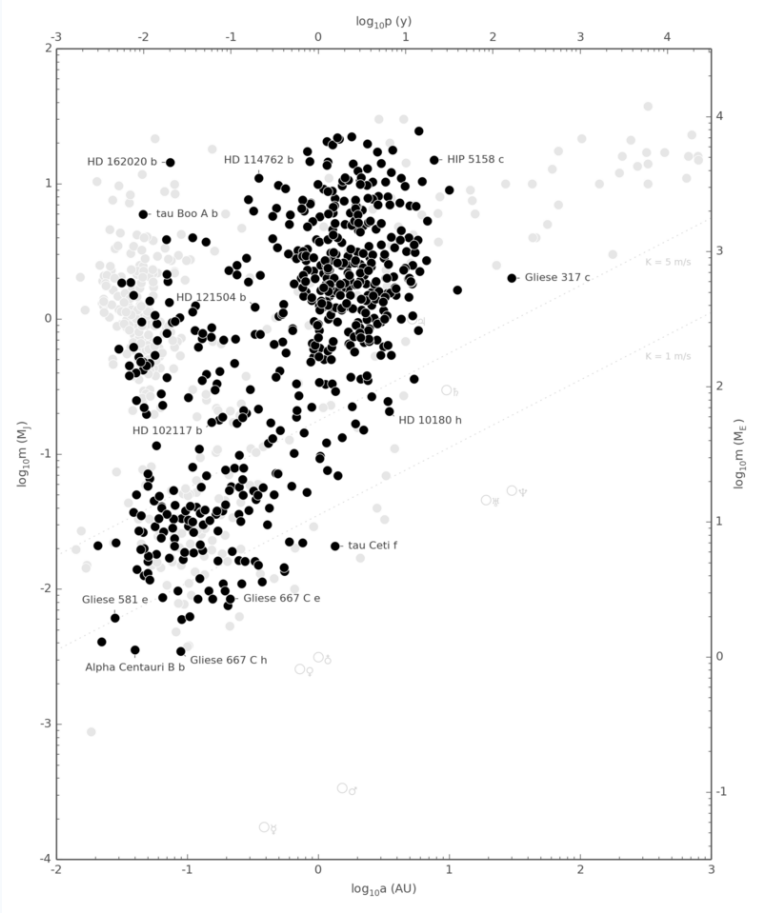


Figure 3. Eclipsing Binary (Wiki)

- Eclipsing binary stars are observed due to decreases with particular pattern in their lightcurves.
- When the hotter star is eclipsed, that produces the primary minimum. The secondary minimum is produced when the cooler star is eclipsed. Sometimes the stars are connected making this determination hard.
- Theses star orbit close, so they have periods of days or hours.
- The stars are zero degree inclination.

Extra Solar Planets – An Interacting System

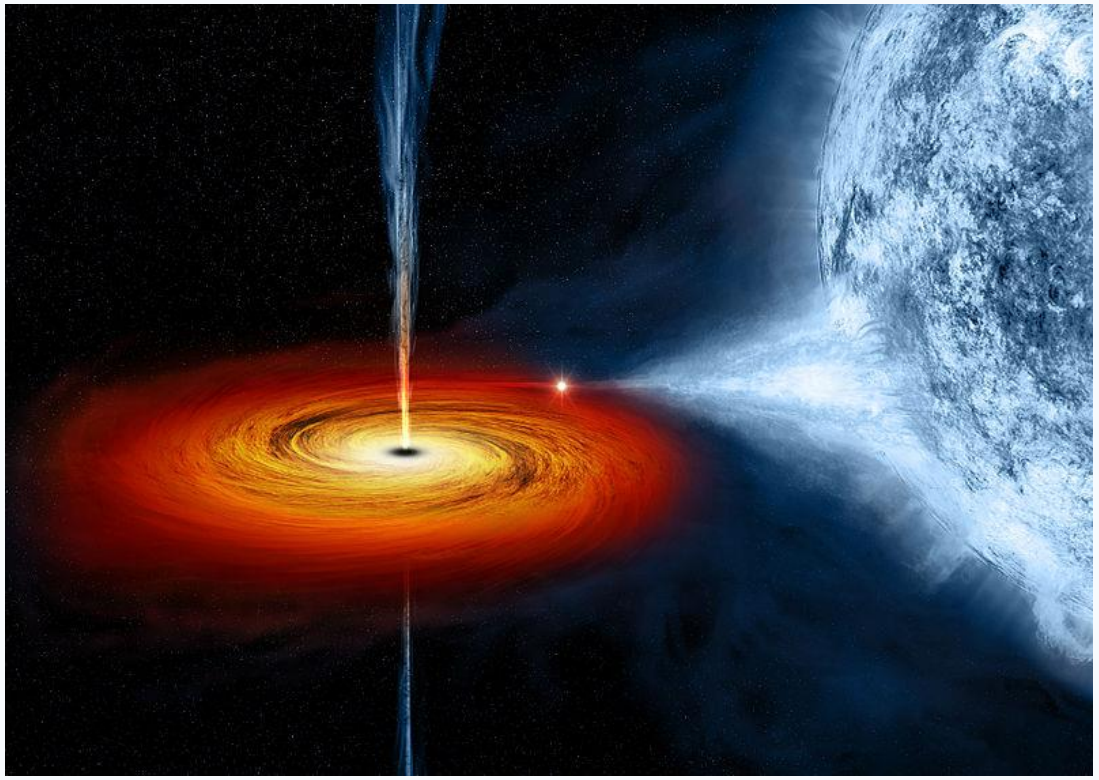


- We can use the two methods, spectroscopic and eclipses, to detect binary stars to find extra solar planets. This is because the planet moves its parent star and we see this a spectra shift or the planet eclipses is parent star as it transits the planet.

- We have found more than 1,000 planets with many more to be confirmed with the Kepler space telescope.

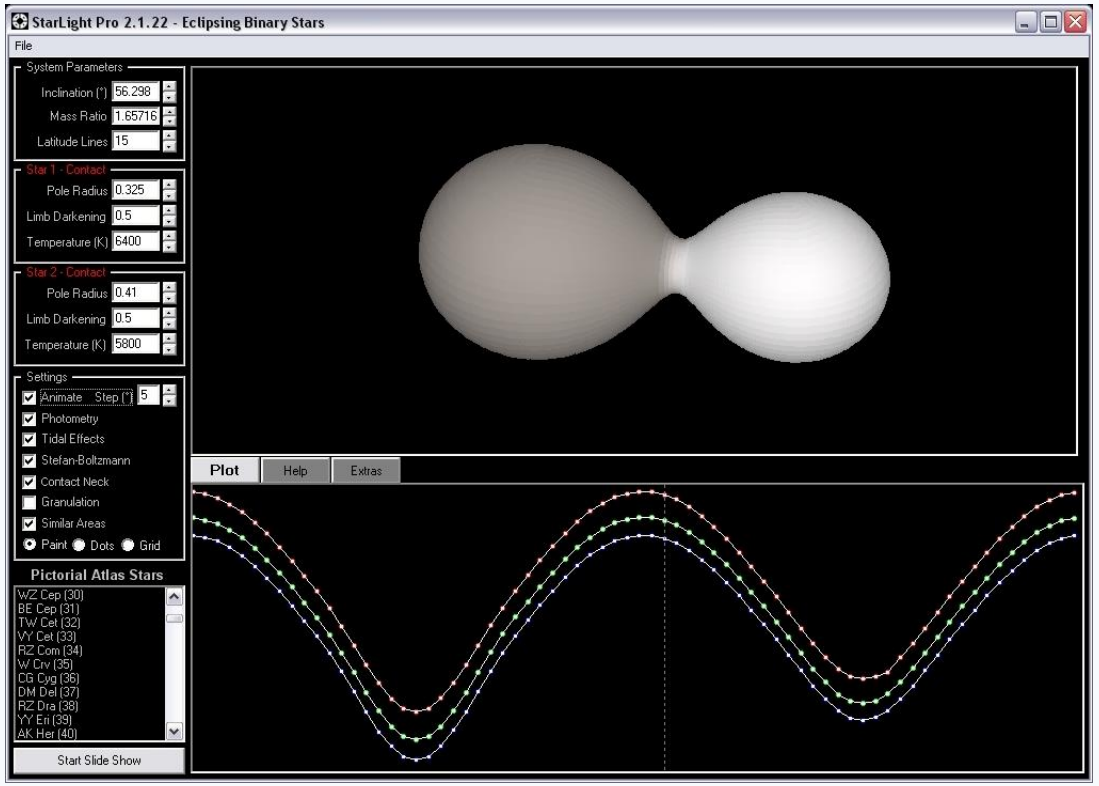
Figure 2. The Masses versus Distances for Extra Solar Planets (Wiki)

X-Ray Binary Stars



- Some interacting binaries are the interaction between a main sequence star and a white dwarf.
- The material from the main sequence star is accreted onto the white dwarf emitting both x-rays and gravity waves.
- Sometimes there is enough hydrogen that accretes and a Type I supernova occurs.

StarLight Pro – Eclipsing Binary Program



- We can calculate the masses and the orbital elements of the stars using their lightcurves and spectra.
- We can determine the different orbital elements.
- Click on the picture to see how this modeling occurs.

Masses of Binary Stars

- Two stars are located close and orbiting each other. They both have 3 Solar Masses and orbital radius of 7 A.U. What is the orbital period?

$$M_1 + M_2 = \frac{a^3}{P^2}$$

$$3M_{SM} + 3M_{SM} = \frac{(7AU)^3}{P^2}$$

$$\sqrt{(7AU)^3/6M_{sM}} = P$$

$$P = 7.3\ years$$

Book/Course Image References

- Van Werven, A. (2004) Retrieved from: http://www.ilovestars.com

Wiki Commons/Wikipedia Image References

- Eclipsing Binaries: "Light curve of binary star Kepler-16" by NASA - http://kepler.nasa.gov/news/nasakeplernews/index.cfm?FuseAction=ShowNews&NewsID=152. Licensed under Public Domain via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Light_curve_of_binary_star_Kepler-16.jpg#/media/File:Light_curve_of_binary_star_Kepler-16.jpg
- The Masses versus Distances for Extra Solar Planets: "Exoplanet Period-Mass Scatter Discovery Method RV" by Aldaron, a.k.a. Aldaron - Own work, based on a figure by E.A.L. and used with permission. Licensed under Public Domain via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Exoplanet_Period-Mass_Scatter_Discovery_Method_RV.png#/media/File:Exoplanet_Period-Mass_Scatter_Discovery_Method_RV.png
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