Introducing PHOEBE: An Eclipsing Companion Modeling Software Package

Dylan Levsey

Faculty Supervisor: Dr. Nathan De Lee

Northern Kentucky University Department of Physics, Geology, and Engineering Technology

Abstract .

One of the primary ways that we can detect stellar companions is by looking for transits. A transit is when the companion passes in front of or behind its host star. In this poster, we will introduce the Python package PHEOBE as well as present the different visualizations of the model that PHEOBE is capable of creating for a given transiting system. Our model can be visualized in four different ways: mesh model, photometric lightcurve, radial velocity curve, and astrometric orbit. We will ultimately use this package to analyze data from the APOGEE and TESS surveys.

Objective

- To develop the ability to generate PHOEBE, PHysics Of Eclipsing BinariEs, version 2.2 models (Jones et al. 2020) of our eclipsing binary systems.
- To experiment with PHOEBE's visualization capabilities
- To demonstrate how a specific time (shown as dots in the Lightcurve, Radial Veolocity, and Astrometric Orbit graphs) correspond to a physical location in the orbit (shown in the mesh).

Model Visualizations

The following five parameters were given to each visualization for the model: a mass ratio of 0.8, an eccentricity value of 0.15, an inclination of 85 degrees, an effective temperature of 6500 K, and a period of 1.0.

Each row in this poster represents a single time in the Eclipsing Binaries orbit.

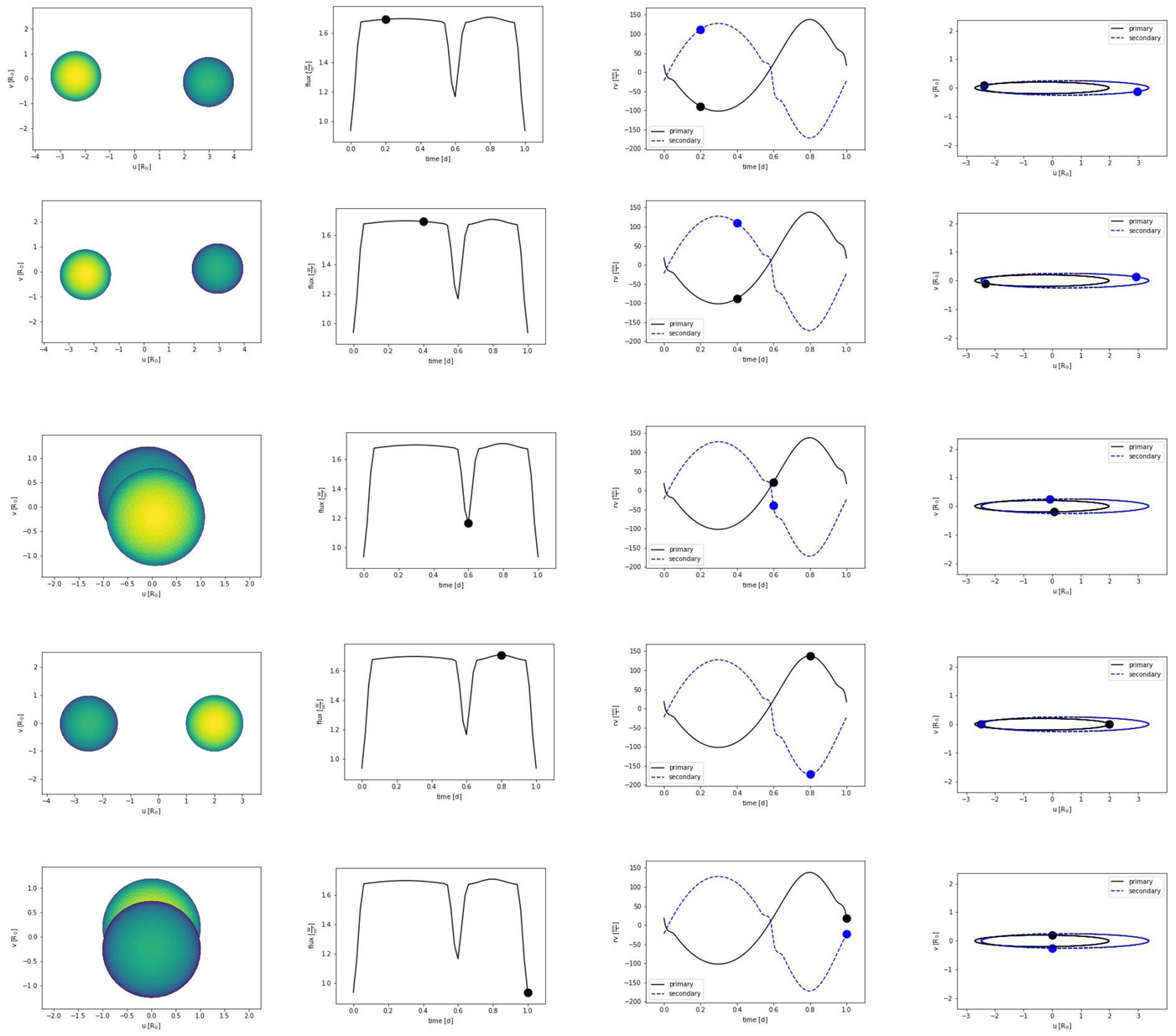
3-D Mesh Model: A 3-d model of both stars in the binary that shows their physical location and size. The mesh surface of each star can be painted with information. In this case, we are displaying the absolute intensities of the system.

3-D Mesh Model

Lightcurve

Radial Velocity Curve

Astrometric Orbit



Lightcurve: A flux vs. time plot to show the changing intensity during transit. The dot indicates where in the lightcurve we are at in this image.

Radial Velocity Curve: A radial velocity vs. time plot, used to show the changing radial velocities that occur during transit. Both the primary and secondary star's radial velocity curve is shown.

Astrometric Orbit: A 2-d plot of the 3-d orbital position of the two stars in the eclipsing binary. U is the position directly towards or away from us. And V is the direction left and right. The third component W, is not show in this graph.

Future Work

- We will continue our ability to use the PHOEBE framework to model real eclipsing systems.
- To use PHOEBE to analyze data from eclipsing systems in the APOGEE and TESS surveys.

References

Jones, D., Conroy, K. E., Horvat, M., et al. 2020, ApJs, 247, 63

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