Modeling the Transit of Gliese 436 b

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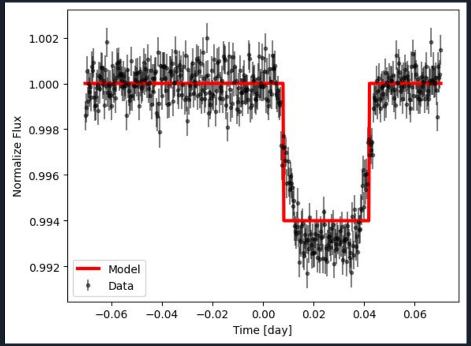
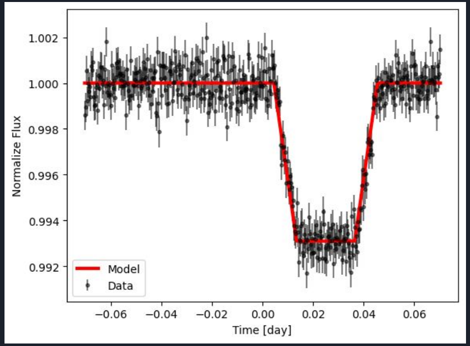
Motivation

- The main goal was to understand the method that goes into detecting and analyzing exoplanets better
- The transit method, which is being analyzed here, involves the planet transiting the disc of the star and blocking some of the light
- We can measure this dip in light and gather valuable information on the planet
- Other information, like the atmospheric composition, can be determined as well, though that will not be analyzed in this project

Methods

- After plotting the data from Deming et al., I tried to fit the light curve using a model
- Initially, I used the box model with the parameters of center time, duration, depth, and change in flux, which were 0.025, 0.034, 0.006, 0.0
- However, this proved to be flawed
- I instead tried the trapezoidal model, plotting it with the parameters center time, duration, depth, change in flux, and ingress which were 0.025, 0.023, 0.0069, 0.0, 0.009
- By calculating the Reduced Chi-Squared of these models, we could calculate if the model overpredicts or underpredicts the curve





Results

- I got a Reduced Chi-Squared value of about 2.37 for the box model, suggesting the model somewhat underpredicts the curve.
- Calculating the Reduced Chi-Squared value for the trapezoidal model, I got about 1.11, significantly better than the box model.
- Using the change in flux from the trapezoidal model as 0.0069 and using the value of the radius of Gliese 436 as 0.432 solar radii from Pineda et al., I found the radius of GJ 436 b to be approximately 24965 km.

Conclusion

- We can detect an exoplanet by measuring the light curve of the star and looking for dips
- Using models, we can gather valuable information from the transit of the planet across the disc of the star
- In the case of GJ 436b, I used both the box model and trapezoidal model, with the trapezoidal model proving far more accurate
- Using the values from the trapezoidal model along with data from Pineda et al., I was able to calculate the radius of the planet, which was approximately 2600 kilometers off from the true value
- This value could likely be more accurate with more work on a more accurate model, with a Reduced Chi-Squared closer to one