TIDAL LOCKING OF WASP-55

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In the recent years there have been several discoveries of exoplanetary systems. Among the discoveries was that of the WASP-55 system. It is a system that comprises one star called WASP-55 and a planet referred to as WASP-55 b. Since the time the planet was discovered in 2011, various studies and observations have been done to gather information about its physical properties and those of its host planet. One of the most important questions to ask as we continue to learn about it is the nature of tidal locking with WASP-55. To what extent is it tidally locked and how does that locking relate to its physical makeup? These are some of the vital questions our project on the WASP-55 system seeks to answer.

The study of the project will be carried using the Python Code where an algorithm will be developed to analyze at least 100 transits of the WASP-55 b around WASP-55. These transits will provide us with information that will be used to develop light curves that will be eventually examined. We aim at analyzing the tidal locking by making keen observations of how the shape of the planet changes during each of the transit. Implementation of the algorithm will be performed using vital equations that are indicated below.

$$F = \frac{GMm}{R^2} \text{ r^} \quad (1)$$

where G is the Gravitational constant, M is the mass of WASP-55, m is the mass of WASP-55 b, and R is the distance between both bodies. Note that ^ is used to signify a unit vector.
And, tidal lock timescale given by:

$$t = \frac{\omega a^6 IQ}{3GM^3 kr^5} \quad (2)$$

where ω = planet's initial spin rate, a = planet's semi-major axis, I = planet's moment of inertia with respect to the star, Q is the dissipation function, k is the planet's tidal Love number, and r is the planet's radius.

Approach

Vital implementation parameters for the project will be obtained from http://exoplanet.eu/catalog/wasp-55_b/. Equipped with that information, an algorithm (main code) will be written to simulate the orbital movement of WASP-55 b around WASP-55 with the use of equation (1) among other equations. For simplicity, WASP-55 will be considered stationary and its brightness will be kept constant for all transits. The developed will then be used in v-python to generate light curves for 100 transits that the planet will make. For each one of the transits, the tidal lock timescale will be calculated using equation (2), while observing the any shape changes in WASP-55 b. Among the algorithms that will be integrated in the main code will be the verlet algorithm.

Objectives

The objectives of the research project are to;

- Check if WASP-55 b exhibits tidal locking in its transits across WASP-55. Plot the extent of the locking if identified.
- Develop light curves for all transits.
- Observe and record any changes in planetary orbit's inclination.

- Calculate the average density of the planet for all transits and make inferences about the nature of the planet's composition, whether it is composed of rock, gas, ice, or a mixture of at least two of these three.