Planets Around Binary Stars

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Abstract

The purpose of this project was to find the differences between planets in binary stars systems and planets in single star systems. We started off by collecting data of binary and single star systems through online databases. We confirmed the existence of planets around binary stars, and compared those planets to those of the single star systems. After that, we took images of HW Virginis. a binary system with confirmed planets. We measured HW Virginis' light curve and analyzed the data, which showed that we might have caught it right before an eclipse. These observations show that binary systems should receive just as much attention as single star systems when searching for life or other phenomena.

Background on Binary Stars

A binary star system is a star system where two stars orbit around each other. About 40% of all the star systems in the Milky Way are binary systems. Stars in binary systems can range from white dwarfs to red giants and even neutron stars. Examples include are Alpha Centauri, Sirius, and Gamma Cephei.

Methods Used

Our team used two main methods to study planets around binary systems. First, we complied information about planets around both binary and single star systems from online databases. Our parameters were Number of planets in the system, Planet Mass, Orbital period, Eccentricity and Semi Major Axis. We then compared the averages for binary stars and single stars to see if there were any differences.

In addition, we used the 0.35-m (14-in) optical telescope to take pictures of HW Virginis and HD 189733. Then, we graphed the brightness over time of HW Virginis to look for any dips in the brightness curve. These dips could indicate that a planet or other object was transiting in front of the star and blocking some of the light.

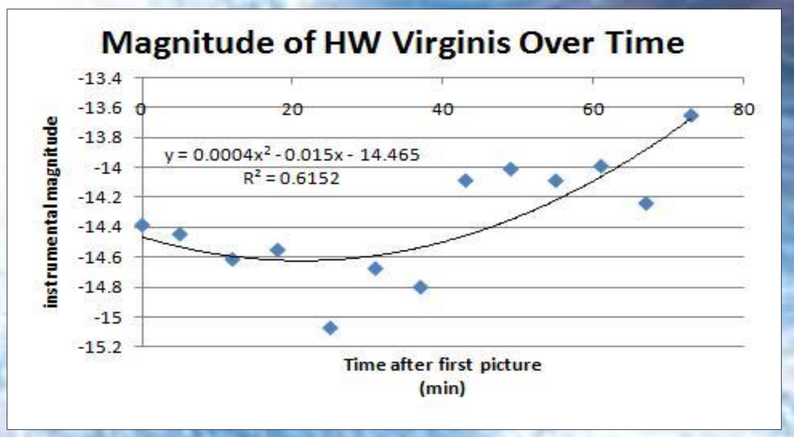

Fig 1 (above): The brightness of HW Virginis plotted over time. The lower the magnitude is, the brighter the star system is. The curve upwards indicates that the overall star system was getting dimmer.

	Single Star Systems	Binary Star Systems	Difference	Percent Difference
Average Number of Planets	2.167	1.182	0.985	Binary Stars have 45% fewer planets than Single Star Systems
Average Mass In Mass of Jupiter (MJ)	1.0126	2.783	1.7704	Binary Stars' planets have 174% larger mass than Single Stars' planets
Average Orbital Period In Days	801.777	1276.745	474.968	Binary Stars' planets have 59% longer orbital periods than Single Stars' planets
Average Eccentricity	0.1743	0.1396	0.0347	Binary Stars' planets have 19% less eccentricity than Single Stars' planets
Average Semi-Major Axis In AU	1.04597	1.7463	0.70033	Binary Stars' planets have 66% larger Semi-Major Axes than Single Stars' planets

Fig 2: The averages of all the planet data we gathered.

Results

Fig 1 shows that the star system got dimmer over time. This is most likely because one star was beginning to eclipse its companion star. It could also be from the transit of a planet in the system, but this is unlikely, as planets cause an extremely small dip in brightness compared to stars.

Fig 2 shows that there are some differences between planets in binary systems and single star systems. Notably, binary stars tend to have fewer planets than single stars. One possible explanation is that there are fewer planets because there are fewer stable orbits in binary systems. This also might explain the fact that planets in binary stars have less eccentric orbits than those in single stars.

Conclusion and Further Research

The statistical data shows that there are a number of differences between planets in binary systems and planets in single star systems. Most of the differences can be explained, however, by the extra gravitational force exerted by the secondary star. In addition, our selection was somewhat limited by our sample size. With more time, we could sample more stars and get more accurate results. We were able to observe what we believe to be an eclipsing binary, but we could not observe the transit of a planet. If the program was longer, we likely would have been able to observe the transit of a planet.

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