The Algol Triple System

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Algol, a bright, triple star system in the constellation Perseus, has been studied for centuries and currently remains an object of great observational interest. Consisting of a brighter primary star (Algol A) accompanied by its dimmer secondary companion (Algol B), Algol was the first star system to be categorized as an eclipsing binary system. The binary has two eclipses over the course of its 2.85 day orbital period: a deep primary eclipse (when Algol B moves in front of Algol A) and a shallow secondary eclipse (when Algol A moves in front of Algol B).

The pair is accompanied by a distant third star (Algol C) which orbits with a period of 680 day in a plane that is nearly perpendicular to the plane of the mutual orbit of A and B. The presence of this third star at such an inclination poses several observational questions that we hope to answer by measuring the effects of the third star on the orbit of the close pair.

Firstly, we should expect Algol C to pull on the orbit of Algol A and B, causing it to be slightly eccentric, meaning elliptical rather than circular. I intend to obtain a precise value for the eccentricity by measuring the time lapse between the primary eclipse minimum and the secondary eclipse minimum.

Secondly, if the inclination Algol C is not exactly ninety degrees we expect the orientation of inner orbit of Algol A and B to 'wobble'. This wobbling, called precession, is measurable by observing the changing depth of the eclipse minimum.

Analyzing these data presents several observational challenges that I have been working to overcome throughout the summer. Firstly, Algol is extremely bright -- so bright, in fact, that it easily saturates the images, degrading the resolution. Avoiding saturation requires several observational techniques of photometry. I use a small telescope equipped with infrared filter in order to refine the light and reduce saturation. The technique of defocusing will also be used to reduce saturation further. This requires a shorter exposure for each measurement but helps to eliminate saturation and greatly increases resolution and accuracy.

To further ensure precise results, I am using another technique called differential photometry. This means that I include other stars in the same frame as Algol and measure relative brightness instead of absolute brightness. This makes each frame easier to process but requires a significant amount of data to ensure accuracy, so ample data has been taken over the course of several years.

This summer we have applied photometry to over 45,000 images and once calibration of all our images have been finalized, we hope to use our results to make a prediction about the orbit of the third star and provide insight into the long term evolution of the system that resulted in observations that we see today.

After graduation from Calvin, I hope to apply to graduate school to continue my studies in astrophysics and astronomy. A record of undergraduate experience in research not only sets me apart from other graduate school applicants, but also gives me valuable first-hand experience in the methods and techniques of astronomy research that can't be learned any other. This research project has helped to further develop my specific interests and skills within the domain of physics research. Furthermore, this summer has been amazing time to study, in depth, a topic that I love learning about and find fascinating. Most of the time I was so engrossed in the project that it didn't even feel like work.