Modeling Fast and Unusual Binary Stars
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Although most stars in the sky remain at a constant brightness some show changes in light output. These variable stars can be used in such diverse applications as finding the masses of stars, measuring distances to other galaxies and even showing the expansion of the universe. The primary focus of our research is on eclipsing binary stars. There remain many open questions for binary systems as to their past history and future evolution.

Using software I have developed, I accomplished a goal of two years standing to complete a systematic search for short-period variables within a substantial archive of images from the Calvin Observatory. After many follow-up observations to characterize them, we submitted many new discoveries including several eclipsing binaries to the International Variable Star Index. This requires the variable’s type and period to be well defined for each new discovery. Because Calvin has control of two large telescopes we can often follow up on interesting objects almost immediately.

One of the most interesting systems that I discovered last year is an extremely dense, hot subdwarf B (sdB) called V2008-1753. It is a helium star and has a cool normal star in an eclipsing orbit around it. Completing an orbit every 95 minutes, it is the fastest of its class. I also identified several more sdB systems that were misidentified in publications and was able to refine some of the reported periods. Such systems are very rare. How they form and how they evolve is unknown. Because these unusual stars are of particular interest, we attracted several international collaborators. They have provided access to the large SOAR telescope in Chile and new modeling software called MORO.

A major goal for the summer was to acquire additional observations of the sdB system in order to create a physical model. This task was hampered by technical problems at Calvin’s Rehoboth telescope site. Therefore we used almost all the Grand Rapids telescope time to make observations on the sdB. We also worked extensively to complete physical models on the new sdB system. To get acquainted with the software, we applied it to modeling a similar binary system (EC 10246-2707), already published. We were able to improve the model by placing more realistic constraints on a model parameter that had been admittedly troublesome in a number of published models of similar systems. Once the SOAR data is taken we will refine our model of the system and submit a paper to an astronomical journal.

I was first author on a paper and coauthor on two others delivered at a conference on variable stars at Michigan State University in May, with proceedings in publication. This project has given me a chance to work with astronomers from all over the world. I now have credit for the discovery of a very large number of variable stars. I have also had incredible access to astronomical tools here at Calvin and have learned an incredible amount about telescope operations. Because Calvin has two telescopes I have had more access to telescope time then most astronomers dream of. Finally this research project has given me the opportunity to be the first author of a very important and interesting research paper.