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Merging Contact Binary Stars

A binary star is a system that contains two stars orbiting each other. A contact binary is a binary star whose component stars are so close that they share the same atmosphere. Our system of interest, KIC 9832227, is one of these contact binaries. What sets it apart is that its orbital period is decreasing faster than any other contact binary system known, and the rate of decrease is accelerating. This is of particular interest, because some speculate that all contact binaries end in a stellar merger and subsequent nova. The extreme period decay in our system may be a harbinger of such an event in the near future.

Like many binary stars, our system is an eclipsing binary, which means that as the two stars go around their orbits, they pass in front of each other from our point of view. The resulting decrease in light coming from the system is one of the main methods of discovering and studying such eclipsing binary systems. Studying the amount of light coming from an object is called photometry. Another way to study such systems is through spectroscopy, that is, analyzing the light spectrum of the system. All stars have characteristic lines in their light spectra due to the presence of various elements in their atmospheres. When a star moves away from Earth, these spectral lines appear to move towards the red end of the spectrum (redshifted). When a star moves towards Earth, the opposite happens, and its spectral lines are blueshifted. Studying how the stars in our system move is a second way of studying their orbital characteristics.

The data that we have taken so far on the system include both photometric and spectroscopic data. The spectroscopic data was taken at WIRO (Wyoming InfraRed Observatory). The photometric data continues to be taken using Calvin's Rehoboth and Grand Rapids telescopes. By comparing the brightness of our system compared to the brightness of non-variable stars, we can find how our system's brightness changes with time, which we call its light curve. So far its light curve shows that it is on track to merge and explode in roughly 4 years. By studying deviations from the average light curve, we have also modeled the starspot activity on the more massive star. Studying the light spectra taken at WIRO allows us to rule out the possibility of a large third body star which could confound our period measurements. All systematic searches to date for binary systems other than KIC 9832227 likely to merge in the near future have come up empty.

In conclusion, we continue to process the photometric data we take on KIC 9832227. So far, our data are consistent with our previous prediction of a stellar merger approximately 4 years from now. Also, we remain hopeful in our search for other, similar stellar systems.

Overall, this has been an unbelievable opportunity for me, especially considering that I only just completed my freshman year as an undergraduate. I have learned a great deal about operating large telescopes. I have also learned just how demanding full-time research can be. And I have learned more about that particular brand of humor specific to the physics community. I have read and, to some degree, understood a number of astrophysics articles, and have discussed them with my professor. All these things have enabled me to more fully engage research. In the end, the most important thing I have gained is a sense of place within the science community.