



# CALIFORNIA STATE SCIENCE FAIR 2013 PROJECT SUMMARY

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<b>Project Title</b> <b>The Sky Is No Limit: A Photometric Analysis of Short Period Variable Stars and Extra-Solar Planetary Systems</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> Our project was aimed at finding the internal characteristics of variable stars by analyzing their light curves. Last year's experiment showed us that we could capture a variable star's light curve using just a digital camera. This year, we wanted to extend our experiment to analyzing the internal characteristics of short period variable stars and extra solar planetary systems.</p> <p><b>Methods/Materials</b> We used a method called photometry to analyze the brightness of three types of variable stars - Eclipsing binary systems, Cepheid variables and Exoplanet systems. We attached a DSLR camera to a 4" telescope to take sets of images of a star. We averaged each set of images to enhance the precision of our data. We then located a few stars of known and fixed brightness, called comparison stars and used them to derive the magnitude of the variable star. This process was repeated from 30 to 100 times, and the brightness at each point in time was graphed. We analyzed the light curve to deduce some of the internal characteristics of the variable stars.</p> <p><b>Results</b> We were able to detect the dip in brightness caused when the exoplanet transited its host star. From the light curve we derived some of the exoplanet's internal characteristics, such as the amount of light it blocked from the host star. We also could find out about the internal characteristics of the eclipsing binary and Cepheid stars. One of the eclipsing binaries, Beta Lyrae, exhibited qualities of a system where the stars are very close but are separate, while the other star, W UMA, exhibited qualities of a system where the two stars are conjoined. The light curves of the both the Cepheids were quite similar, but had differences in the amplitude of brightness change and period length. Using properties unique to Cepheid type variable stars we were able to calculate the mass, luminosity and even distance of these two stars.</p> <p><b>Conclusions/Discussion</b> The fact that we were able to observe the minute dip in brightness characteristic of an exoplanet transit shows the precision of our experiment. Although our data supported our hypothesis for the most part, we also were surprised by some very interesting features in the light curve such as a plateau of brightness in one of the minima of W UMA. In the future, we hope to be able to conduct wide field surveys with high precision for the detection of Earth-sized exoplanet systems.</p>	
<b>Summary Statement</b> In this experiment, we were able to derive the internal characteristics of short period variable stars and exoplanet systems by analyzing their brightness over time.	
<b>Help Received</b> Father helped with Excel formulae	