



CALIFORNIA STATE SCIENCE FAIR 2017 PROJECT SUMMARY

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Project Title Searching for Exoplanets: A Novel K2-based Study of the Effects of Open Cluster Characteristics on Exoplanet Abundance	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Almost all stars form within clusters. Open clusters contain stars that formed at the same time from the same materials, so they are invaluable laboratories for controlled studies of exoplanets. The characteristics of all planetary systems depend upon the composition of the progenitor cluster. As such, it is essential to understand exoplanets in clusters in order to understand whether Earth-like planets are unique or abundant. We therefore address the question "How do the characteristics of an open cluster affect the abundance of exoplanets around stars in the cluster?" We attempt to use the "crippled" Kepler mission to perform a large scale search for these planets.</p> <p>Methods/Materials The Kepler Space Telescope, designed to look for planets, failed in 2012. Scientists devised a salvage mission, the K2 mission, which allowed limited observations to continue. Since there existed no available algorithm to process the images taken by the K2 mission for open clusters, we developed a novel pipeline to search for the minute dips in brightness that occur as planets momentarily cross the faces of their host stars. The algorithm takes millions of images, searches for stars, and graphs each star's brightness. It then applies several processes to mitigate the effect of the flaws of the salvaged K2 mission and to reduce biases for the cluster survey. The algorithm then automatically searches for the characteristic dips. A slew of artificial transits was also used to test the efficacy of the algorithm.</p> <p>Results We find seven exoplanet candidates, one of which is a new discovery. Five are in Praesepe, one in M67, and one in Ruprecht 147. Praesepe has nearly ten times the prevalence of exoplanets that the other clusters have. Over 1600 stars were searched in total.</p> <p>Conclusions/Discussion The abundance of exoplanets in Praesepe is much higher than in the other clusters. The most notable characteristic of stars in Praesepe are their high proportion of elements heavier than helium on the periodic table. This indicates that the composition of the stars in the cluster has a measurable effect on the abundance of planets. This supports our hypothesis, and can be explained by the higher abundance of silicates which agglomerate to form planets. The major implication of this finding is that Earth-like planets have the highest chance of being found around stars with high proportions of elements heavier than helium.</p>	
Summary Statement We developed an algorithm to search for planets in open clusters using the K2 mission, discovered an exoplanet candidate, and found that open clusters with higher metallicities might host more planets.	
Help Received We received advice on concepts regarding open cluster metallicity from our teacher, Mr. Iverson.	