K2 Campaign 1 proposal: Searching For Hot Jupiters In Binary Stars
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Searching For Hot Jupiters In Binary Stars

Hot Jupiters (HJs) in binary stars serve as an important test for theories of planet formation and evolution, e.g., the influence of disk disruption and truncation due to a companion star in forming planets (Kraus et al. 2012), the role of Kozai perturbation in planet migration (Dong et al. 2013, Knutson et al. 2013), etc. There were Doppler surveys targeting HJs in binary stars (Eggenberger et al. 2007, Konacki et al. 2009), but the statistics of these systems was not very well understood, mainly because of the complications in removing flux contamination and the limited sample size due to "expensive" Doppler measurements.

K2 mission provides an excellent opportunity to the study of HJs in binary stars. In its Campaign 1 field of view, 64 pairs of binary stars (128 stars) can be simultaneously observed to search for the transiting signals of HJs. These stars are selected based on the Washington Double Star Catalog, and their angular separations are less than 1.5 arcsec. The scientific justifications are:

1, ***Test the role of Kozai perturbation***. A few studies suggested the importance of the Kozai perturbation in the evolution of HJ systems (e.g., Dong et al. 2013 and the references therein). If the process dominates, we expect to see more HJs in binary stars than around single stars given the same formation rate. The occurrence rate for HJs is around 1% (Mayor et al. 2011, Wright et al. 2012), we expect to detect ~0.4 HJ in this sample of 384 stars (160 from Kepler main mission, 96 and 128 from Campaign 0 and 1, respectively) assuming ~10% geometric detectability. More than 2 HJs would suggest that HJs are more common in binary stars and hence the importance of the Kozai mechanism.

2, ***Investigate the role of disk disruption due to a companion star in forming planets***. Previous studies shown that a very wide (larger than several hundred AU) stellar companion may not affect the planet formation (Desidera & Barbieri 2007), whereas a nearby (< 20 AU) companion star significantly suppresses the process (Wang et al. 2013). In comparison, this sample mainly consists of binary stars with separation between 20 and 100 AU, an intermediate range that has not been fully probed by previous studies.

3, ***Motivate future Doppler search for planets in binary systems using spectrographs aided by the adaptive optics (AO) technique***. HJs detected in this proposed survey require high spatial resolution to separate components in obtaining follow-up spectroscopic data and Doppler measurements, thus motivate the development of next generation spectrographs aided by the AO technique. The discoveries will likely become the main follow-up targets for the Infrared Camera and Spectrograph at Subaru, and future funded AO high-resolution spectrograph such as iLocator.

As K2 continues to its future campaigns, we will propose to observe the binary stars in its field of view. The increasing sample size helps to strengthen the statistics, and gradually build up the number of discoveries. In summary, this proposal will answer several fundamental questions in planet formation and evolution in binary stars, and link the K2 mission to other frontiers in the field of exoplanet.