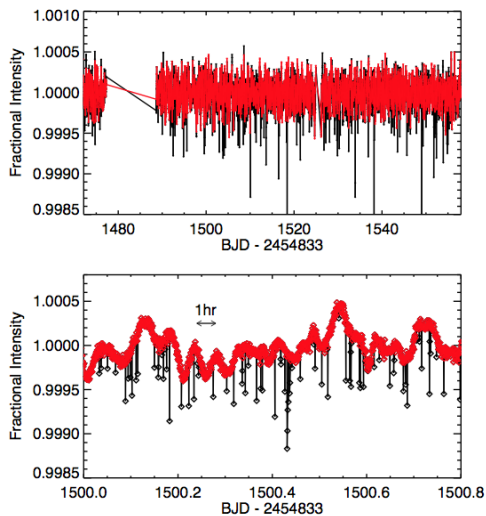


Measuring the Masses of Two Bright, Evolved Stars with K2

John Johnson, Ashley Villar, Ben Montet (Harvard CfA)

Statistical studies of planets discovered by radial velocity (RV) surveys have revealed an apparent correlation between the occurrence rate of giant planets and the mass of the central host star (Johnson et al. 2010a). This result relies heavily on the planets discovered around massive, evolved stars (coined the “retired A stars”). Massive main-sequence stars such as A dwarfs are rapid rotators which makes the detection of planets via RV measurements nearly impossible, but as stars evolve off of the main sequence they cool and spin down, making them better RV targets.

Recently, the masses of retired A stars has been called into question based on theoretical arguments (Lloyd 2011, 2013). Lloyd 2013 implicated systematic errors in the LTE spectroscopic analysis of subgiant spectra, as well as errors in stellar evolution model grids as the cause for the overestimate of stellar properties. These studies suggest that the retired A stars are, in a statistical sense, far more likely to be the evolved counterparts of Solar-mass stars. If true, this would require a new explanation for the apparent increased numbers of giant planets around these stars.



Kepler photometry offers a means of investigating the masses of evolved stars on the giant branch via asteroseismology. Just before the second reaction wheel malfunctioned, PI Johnson and collaborators used Director’s Discretionary Time to obtain short-cadence photometry of the giant star HD 185351, which was the third brightest star on silicon in the original *Kepler* Mission (Johnson et al. 2014, ApJ accepted). The photometric measurements are shown in the figure to left (black outlier points were due to the reaction wheel failure). The star’s angular diameter was also measured using long-baseline optical interferometry with the CHARA array. By using a large assortment of independent measurement techniques, this study

demonstrated that there does not appear to be large systematic errors in the analysis of stellar spectra or the measurement of stellar mass using evolution models. However, there was a 2.6-sigma discrepancy between the radius measured from interferometry and from the stellar evolution models, which warrants further asteroseismic and interferometric studies of nearby, evolved stars.

One of the K2 Mission Motivations is to, “characterize internal stellar structure and fundamental properties of stars using the tools of asteroseismology.” **We propose the observation of two bright, nearby subgiants with short-cadence K2 photometry in order to measure the fundamental properties of these evolved stars.** Short-cadence is necessary to resolve the oscillations which occur on timescales of ~ 1 hour (see Figure). When combined with CHARA angular diameters, we will be able to critically evaluate the accuracy of stellar evolution models at the base of the red giant branch and resolve the question of the existence of large numbers of retired A stars and their planets.

References

- Johnson, Aller et al.(2010a) [2010PASP..122..905J](#)
- Johnson, Howard et al. (2010b) [2010PASP..122..701J](#)
- Schlaufman & Winn (2013) [2013ApJ...772..143S](#)
- Lloyd (2011) [2011ApJ...739L..49L](#)
- Lloyd (2013) [2013ApJ...774L...2L](#)