Searching for Eclipsing Post Common Envelope Binary Systems with K2

Andrew Vanderburg, Juliette Becker, Dylan Morgan, Philip Muirhead, John Asher Johnson

We propose K2 observations of twelve known White Dwarf/Main Sequence (WDMS) Post Common Envelope Binaries (PCEBs) to search for eclipsing systems. Eclipsing post common envelope binary systems can yield empirical measurements of white dwarf masses and radii, quantities for which a robust population does not yet exist. There are thousands of known WDMS systems, but only about 50 known eclipsing PCEBs (ePCEBs) [1]. Due to the small number of known ePCEB systems, any number of additional systems identified by K2 could have a significant impact on models of white dwarf structure and evolution, which require empirical radii and masses of eclipsing systems [2].

We composed our sample using a combination of the SDSS WDMS binary catalog [3] and [4]'s sample of WDMS binaries. [3] and [4] identified systems using SDSS spectroscopy to find M-dwarf spectra with an additional hot, broad-lined component in the blue. We restricted our targets to those lacking photometric follow-up and those that had been identified as close binaries or PCEBs by the detection of significant RV variations ($\gtrsim$10 km/s) over the course of hours. 12 systems bright enough to observe fall on silicon in K2 Field 1, and 15 others fall nearby. Using the distribution of PCEB orbital periods from [1] and the spectral types of the dM hosts from [3] and [4], **we estimate the probability of an eclipsing system in our "on silicon" sample to be ~90%, with an expected number of 1.86 +/- 0.9 eclipsing systems.**

Even if we do not detect eclipses, K2 will be able to detect any photometric variation present in phase with the orbit, either caused by Doppler beaming, ellipsoidal variations, or starspot modulations from the tidally locked dM component. Doppler beaming and ellipsoidal variations in particular can be used to constrain the orbital period and mass of the components [5].

Our sample consists of M3-6 dwarfs, so the transit of the WD in front of the dM will have a depth of ~1%, which should be detectable when multiple orbits are stacked. Kepler obtained a precision of ~5 mmag in 30 minutes on a Kp~19 target (the faint end of our sample), so we anticipate 2% errors on a similar star with K2 (10% in short cadence). This precision is sufficient to detect the ~20%-90% eclipse depths typical of ePCEBs (Figure 1), and when ~200-400 orbital periods are stacked from a 90 day observing campaign, we anticipate a secure detection of the white dwarf transit as well, which helps constrain WD mass and radius by detecting gravitational lensing (e.g. [2]). **K2's continuous sampling will be critical to detecting any eclipses, and detecting the white dwarf transit from the ground is not feasible.**

For the shortest period ePCEBs (P ~ 2-6 hours), the eclipse durations are of order 10 -30 minutes, and **short cadence observations of these targets are necessary to make K2 data useful for eclipse light curve characterization and detection of the transit.** We request short cadence observations of our five shortest period "on silicon" candidates (as determined using RV variability as a proxy). These systems are also the most likely to eclipse. If short cadence pixels are not allocated to this project, **long cadence data will still be useful to detect eclipses and out-of-eclipse phase variations.**

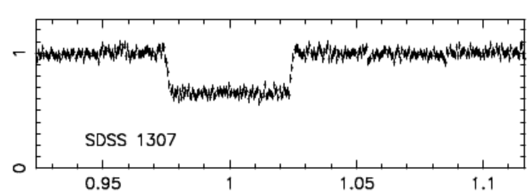

Figure 1: Typical light curve for an ePCEB. The eclipse depth is 40% with a duration of 15 minutes. Source: [1], Figure 5.

References

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