The Close-Binary Fraction of Planetary Nebulae in K2 Field 2.

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The common text book states that any single star, similar to our Sun, will eventually result in a Planetary Nebula (PN). Recently, however, theory suggests that PNe can only occur from close binary systems, indicating that a single star might not create a PN. Thus leaving the mass loss mechanism and fate of single stars, much like our Sun, unknown. To test the theory and differentiate between these two ideas one must measure the binary fraction of central stars in PNe. To date, there is an estimated binary fraction of $\sim$20% (Miszalski et al. 2009), however this might be due to the inefficiency of ground based periodicity searches. Kepler has proven to be much more efficient in detecting eclipses and ellipsoidal effects at millimag accuracy, thus allowing detection of binary systems with periods <10 days. As such, I propose to use Kepler to search four PNE in Field 2 for binarity.

There were six PNe located in the original Kepler field (Douchin et al. 2011). Kepler studies of these PNe found periodic variations in their light curves that indicate binarity, that is eclipses, ellipsoidal modulation, or reflection effects. The periods of the central stars where determined to range between 0.17-1.47 days with orbital modulations at the 0.2-10 millimag level. Of these six PNe, the faintest star was at V=18.2 mag in the center of Kn 61. The current status of the Kepler mission now allows for multiple known PNe, along the ecliptic, to be observed throughout the course of the K2 operations. For example, in Field 0 there were 3 PNe accepted as targets to be observed in similar fashion with the K2 mission. Also, the several upcoming fields, each potentially containing several PNe, can be used to study multiple PNe with similar methods as Douchin et al. (2011). In the upcoming field alone there are four more PNe to be sampled.

There are 4 PNe located in Field 2 that have central stars with reported brightness from Acker et al. (1992). Only one of these PNe, ESO 515-17, is listed in the EPIC catalog, therefore, the other 3 PNe have their J2000 right accession and declination given. Three of the targets have a central star ranging from 12.75 to 16.16 V mag, thus K2 will be able to offer accuracy at the millimag level (with the fourth PNe being fainter at 19.7 V mag, forcing us to be sensitive only to larger variations). This will be the first time a detailed photometric study of these four stars will be conducted and will allow possible periodic variations to be detected. The increased sample size of PNe from K2 observations will double the number of PNe observed by the Kepler spacecraft, thus allowing for tighter constraints to be placed on the actual binary fraction of central stars in PNe. Thus, I propose that the central stars of the four listed PNe in the attached target list be observed with long cadence, 30-minute exposures, by the K2 mission.

References:

Acker, A., et al. 1992, Strasbourg-ESO Catalogue of Galactic Planetary Nebulae
Douchin, D., et al. 2011, arXiv 1110.4436v2
Miszalski, B., et al. 2009, A&A, 496, 813