**K2 field 0 target proposal: Eclipsing Binary Stars**

*Kepler Eclipsing Binary Working Group*

A thorough understanding of the fundamental stellar parameters (masses, radii, luminosities, ages, chemical compositions and distances) and processes (energy transport mechanisms, nucleosynthesis, etc.) in stars across the Hertzsprung-Russell diagram is the core of stellar astrophysics. To rigorously study stars, we need to determine their properties as accurately as possible, using the minimum number of underlying assumptions. Eclipsing binary stars (hereafter EBs) are ideal astrophysical laboratories to achieve this goal: the favorable alignment of the line of sight with the orbital plane and the basic principles of classical dynamics that govern the motion of the components in a binary reduce the determination of principal parameters to a tractable geometric problem. In addition, an increasing number of EBs are found in triple and multiple systems, hosting circumbinary planets, and featuring mass transfer and apsidal motion. In connection with asteroseismology, we can probe stellar interiors by studying tidally induced and gravity-mode pulsations. Ubiquitous overcontact binaries are still a mystery in terms of their formation and evolution, but it seems that they are all associated with multiple systems. Intriguing unique EBs, such as ε Aur, VV Cep, V838 Mon, β Cep and others, have been boggling the minds of scientists for decades only to reveal the wealth of new physics: from accretion discs and colliding winds to quasi-periodic outbursts and reflective outer shells. The range and scientific importance of binaries can thus hardly be overstated.

*Kepler* 1 provided us with ~2600 EBs. To study them, we organized a vibrant working group of ~120 scientists around the world that specialize in different aspects of binary star studies. The group distinguished itself with several high-profile publications: the *Kepler* EB catalogs, circumbinary planets and numerous individual EB analyses. In preparation for K2, we cross-matched all available catalogs with known EBs and assembled a list that coincides (with ~20% overlap) with K2 field 0. The list includes 989 targets in the magnitude range V=6-16.

The motivation for observing these stars with K2 includes:

- observations of EBs for which we already have some auxiliary data (such as colors, RVs, cluster membership, dynamics, temporal baseline), which greatly aids data mining for scientific results;
- tentative discovery of circumbinary planet transits, adding to the count exclusive to K1;
- objects in rare evolutionary stages, such as the proposed tentative pre-main-sequence targets in NGC 2264, of which fewer than a dozen are known across the whole sky;
- deriving fundamental properties of stars across the H-R diagram and finding those EBs that enable us to pursue asteroseismic studies (gravity modes, solar-like oscillations in giants, etc);
- near-continuous coverage of EBs, ranging from low-mass main sequence dwarfs to red giants, will allow us to sample an inherently different population from K1 in detail for the first time;
- the K2 photometric precision will unveil many signals that are currently buried in noise, such as low-amplitude pulsations, chromospheric activity, flares, component interaction, etc;
- stellar multiplicity of short-period EBs will be inferred from eclipse timing variations;
- building a unique synergy between K2 and *Gaia*, where we will be able to bridge sub-milliarcsec astrometry and sub-millimag photometry to obtain absolute scales and distances;
- *Kepler* EBWG has an immense experience and expertise with the *Kepler* instrument; we successfully proposed for and have access to spectroscopic instruments, we developed open-source tools that are solely devoted to *Kepler* data, and we are well poised to attain important scientific results right off the bat, providing K2 with pronounced visibility.

The target list includes objects classified as EBs in the SIMBAD database, from 41 unique VIZIER-hosted catalogs, from the Kilodegree Extremely Little Telescope (KELT), from the General Catalogue of Variable Stars (GCVS), and from SuperWASP.

The final list of targets is sorted by priority. The criteria taken into the account are: (1) astrophysical significance; (2) contamination due to crowding; (3) orbital period; (4) magnitude (especially on the bright end); and (5) classification reliability. The list contains 989 targets that we propose for the inclusion in the K2 field 0 target list.