Asteroseismology of Stars in Eclipsing-Binary Systems

- Selection of Targets for Kepler2, Field 0 -

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Binary systems hosting at least one star with detectable solar-like pulsations are becoming important astrophysical targets because they provide a way to calibrate asteroseismology. As illustrated by the CoRoT and Kepler missions, asteroseismology is an efficient method to measure masses, radii, and ages of large numbers of stars, which is of prime importance to test stellar evolution. However, a crucial test of both asteroseismic masses and radii of a large sample of stars with independent measurements of those quantities has not yet been carried out. Eclipsing binary systems (EBs) potentially permit such an exercise by allowing for accurate determination of masses and radii of both stars by combining photometric and radial-velocity measurements, provided that spectral lines are detectable for both components. Eclipsing binaries are also interesting for the physical processes resulting from tidal interactions, which may influence their evolution when the stars are close enough (e.g. Gaulme et al. 2014, submitted to KASC and ApJ). So far, all the published stars known to both display solar-like oscillations and belong to EBs are red-giants (RGs), and all have been detected by the Kepler mission. The first detection was the 408-day period system KIC 8410637 (Hekker et al. 2010, Frandsen et al. 2013). Since then, Gaulme et al. (2013 & 2014) reported a list of 18 *bona fide* new RG eclipsing-binary candidates of which 14 displayed oscillations. More recently, Beck et al. (2013) reported the discovery of 18 new heartbeat stars, where each system has a RG component with oscillations, and three are also EBs.

From the General Catalog of Variable Stars (GCVS), the Kepler 2 field 0 presents several targets of interest. *Short-cadence data are required to detect oscillations, except for OW Gem*. By decreasing priority:

1. **OW Gem:** only system to be composed of a **pair of red giants** on a 1258-day orbit (Terrell et al. 2003). Masses and radii are (5.8 M_{sun}, 30.1 R_{sun}) and (3.9M_{sun}, 31.7 R_{sun}), which implies n_{max} of 19.7 and 11.8 µHz respectively. Its bright magnitude (8.2) makes it an excellent candidate. Unfortunately, it is at the edge of the currently proposed field (06h31m41.8s +17°04'56'').
2. **HR Aur:** likely a **RS CVn active binary system** composed of K0 star in a 1.63-day orbit (Loomis & Schmidt 1989). This system is interesting for studying the connection between oscillation amplitude, surface activity, and close binarity. Likely out of field (hereafter underlined) (06h31m11.0 +30°56'16''), even if within the 12° cone around the field center.
3. **9 systems: detached main-sequence** stars of F, G, K spectral types, for which magnitudes are less than 12, and orbital periods are known. From brightest to faintest:
    - V0422 Gem: F2V type, 7.54-day orbit, mv = 8.1, coordinates (07h12m41.7s +16°05'05'')
    - AL Gem: F5V type, 1.39-day orbit, mv = 9.8, coordinates (06h57m38.6s +20°53'33'')
    - V0382 Gem: F8 type, 1.45-day orbit, mv = 10.2, coordinates (06h44m14.5s +16°24'04'')
    - V1027 Ori: G5 type, 10.39-day orbit, mv = 10.5, coordinates (06h12m03.8s +14°56'02'')
    - FI Ori: F5 type, 4.44-day orbit, mv =10.8, coordinates (06h23m27.4s +14°32'47'')
    - CP Ori: G0 type, 5.32-day orbit, mv = 11.1, coordinate (06h07m01.9s +17°41'58'')
    - GI Aur: F0 type, 1.21-day orbit, mv = 11.4, coordinates (06h11m36.4s +29°26'42'')
    - KU Aur: F5 type, 1.32-day orbit, mv = 11.7, coordinates (06h28m04.4s +30°23'34'')
    - HI Gem: G-K type, 4.69-day orbit, mv = 12.0, coordinates (07h18m14.4s +30°38'09'')
4. **2 systems: close-in detached systems** where ellipsoidal distortions are important (β-Lyr type). No solar like oscillations have been detected in such systems so far.
    - V0373 Gem: F8 type, 1.60-day orbit, mv=9.3, coordinates (07h11m55.3s +23°24'56'')
    - V0428 Gem: K type, 0.49-day orbit, mv=10.9, coordinates (07h12m41.7s + 26°07'31.6'')
5. **2 systems**: composed of almost **contact main-sequence** binaries of G and F spectral types, for which magnitudes are less than 12, and orbital periods known. No solar like oscillations have been detected in contact systems so far.
    - V0417 Gem: G5 type, 0.33-day orbit, mv=9.8, coordinates (06h59m48.4s +27°41'59'')
    - AH Aur: F7V type, 0.49-day orbit, mv=10.2, coordinates (06h26m04.9s +27°59'56'')