

Compact variable candidates for K2 Field 2-3

Date: 2014/05/08
Number of targets proposed: 9 + 21 = 30
Proposed cadence: Short
PI: Roy Østensen, K.U. Leuven (roy@ster.kuleuven.be)
Co-I: John Telting, Nordic Optical Telescope

During the *Kepler 1* mission, an extremely successful search for compact variables was executed in the initial survey phase. Compact stars are the end-products of the vast majority of stellar evolutionary paths. In many cases the normal evolution gets interrupted when binary stars get into contact during the red-giant expansion stage. Such scenarios produce some of the most interesting binary interaction stages which can lead to mass-transfer systems, common-envelope stages, envelope stripping, mergers and eventually supernova Ia explosions. K1 explored more than 100 targets for one month each in short cadence mode [1,2]. From this sample a large number of new and interesting variables were discovered, including 15 subdwarf-B pulsators [1,2], two cataclysmic variables [1], one AM CVn binary [3], one white-dwarf pulsator [4], the first example of a new class of blue-horizontal-branch pulsators [6], and close planetary systems around hot subdwarf stars [6]. Many of these objects were followed in short cadence for the full duration of the K1 mission, and are the subject of intense ongoing research and are fundamentally changing our understanding of such short period variables [see 7 for a very recent result].

The K2 mission can be a great extension of the original mission for compact star research. Already from the engineering test run in February 2014, a pulsating sdB star was found to reside in a close binary with a period of 19.2 h, a record for sdB+dM binaries [8].

The low-galactic-latitude Field 2 has been avoided by blue-star surveys, and the list of known compact variables within it is pitifully short. We compiled a list of UV-excess objects based on a cross-match of the GALEX satellite survey and the SuperCosmos optical photometry, but for Field 2, only 3 of the targets were found to fall on silicon. We obtained spectroscopy of all three targets with the Nordic Optical Telescope, and found that all are hot subdwarf stars, and likely pulsator candidates. To supplement this list we scoured the archives for more obscure surveys, and found that Luyten made a survey of a region that falls well inside Field 2 [9]. The report of these stars is only published in a bulletin that is neither indexed in ADS nor incorporated into SIMBAD (LB 3541-3564). We recovered 18 of these and found 9 on active silicon. We ignored the faintest 3, and recovered EPIC numbers for 4. Two more are retained, but are fainter than $K_p = 18$, and are therefore low priority targets. Luyten's targets are all very blue objects that lie close to the dark cloud in Ophiuchi. They are quite certain to be white dwarfs or hot subdwarfs, as blue main-sequence stars would suffer too much extinction to show blue colours in these high-extinction fields.

For Field 3 we also do not have any known compact variable stars on active silicon. We used a similar approach as for Field 2, and recovered 21 GALEX targets, some of which have rough classifications in SIMBAD. We have spectra of two stars from our own archive, and recovered one more from the SDSS. Classifications are given in the comments column of the tables. We are confident based on our experience with surveys based on UV-excess objects, that all these objects are compact stars and excellent candidates for variability, either pulsational or as close binaries. To detect pulsations in compact objects, short cadence is required as pulsation periods can be as short as two minutes. If short-cadence slots are not available for any of these, long-cadence observations are useful to detect binary effects.

References:

- [1] "First Kepler results on compact pulsators - I. Survey target selection and the first pulsators", R. H. Østensen, R. Silvotti, S. Charpinet et al., 2010 MNRAS 409, 1470. [2] "First Kepler results on compact pulsators - VI. Targets in the final half of the survey phase" R. Østensen, R. Silvotti, S. Charpinet et al., 2011, MNRAS 414, 2860. [3] "Discovery of an AM CVn system with the Kepler satellite" G. Fontaine, P. Brassard, E. M. Green et al., 2010, ApJ 414, 2860. [4] "At Last - A V777 Her Pulsator in the Kepler Field" R. Østensen, S. Bloemen, M. Vučković et al., 2011, ApJL 736, L39. [5] "KIC 1718290: A Helium-rich V1093-Her-like Pulsator on the Blue Horizontal Branch" R. Østensen, P. Degroote, J. H. Telting et al., 2012, ApJL 753, L17. [6] "A compact system of small planets around a former red-giant star" S. Charpinet, G. Fontaine, P. Brassard et al., 2011, Nature 480, 496. [7] "Stochastic pulsations in the subdwarf-B star KIC 2991276" R. H. Østensen, M. D. Reed, A. S. Baran and J. H. Telting, 2014, A&A (Letters; Highlight) 564, L14. [8] "K2 observations of the pulsating subdwarf B star EQ Piscium: an sdB+dM binary" C. S. Jeffery and G. Ramsay, 2014, MNRAS, accepted. [9] "A Search For Faint Blue Stars. XX. The Rho Ophiuchi Region" Willem J. Luyten, 1959, *The Observatory, University of Minnesota, Minneapolis*, 31 Dec. 1959.