Long cadence RR Lyrae targets - K2 Mission / C0 campaign

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Introduction. RR Lyrae stars are horizontal branch, large-amplitude pulsators, and cosmic distance indicators. Ultra-precise, continuous photometric observations with *Kepler* have revolutionized our understanding of these objects. New dynamical phenomena, like period doubling [8], chaos [7], and new pulsational modes [4] and behaviors have been discovered, while we got a better picture on the mysterious light curve modulation, *the Blazhko effect* [1,2,3]. With this proposal we capitalize on Kepler's findings and plan to extend our investigations by the new capabilities of the K2 Mission. We propose 68 RR Lyrae targets for long-cadence observations. By the end of the *Kepler* Mission, we knew of about 50 RR Lyrae stars in the *Kepler* field. Therefore K2-C0 will more than double the amount of RR Lyrae stars observed with *Kepler*.

Aims. The field selections of the K2 Mission open up new and outstanding opportunity to
- multiply the RR Lyrae sample available to ultra-high precision optical photometry
- provide new insights into the intricate dynamics of these pulsators
- investigate the dependence on metallicity of the occurrence and behavior of period doubling (among Blazhko stars). Further bifurcations and chaotic behavior are also key science drivers.
- give a more precise handle on the occurrence rate of Blazhko effect, which is estimated to be ~50% in fundamental mode (RRab) pulsators and somewhat less, but quite uncertain in RRc stars pulsating in the first radial overtone mode
- find out whether the presence of additional frequencies (with 0.61-0.63 period ratio) seen in the small *Kepler* RRc sample is a generality or peculiarity [4,6]
- provide evidence for other radial overtones seen with *Kepler* (first and second overtone in RRab stars)
- allow us searching for hints of nonradial modes
- derive metallicities for a large sample of RR Lyrae stars [5]
- use RR Lyrae stars as tracers of the dynamics of our Galaxy

High-precision observations - by providing unique insights into the dynamics and long-term behavior of RR Lyrae stars - complement spectroscopic monitoring that focuses on atmospheric phenomena and statistical studies carried out by survey telescopes, like SDSS, OGLE or LSST. Follow-up observations are planned after the C0 run with small and medium-sized telescopes to put the detected long-term variations (period, Blazhko, modulation) into context.

Targets. With this proposal we provide a prioritized list containing 68 targets for **long cadence monitoring**: 28 confirmed RRab (with 15-18 Blazhko candidates), 2 confirmed RRc stars and 38 RRL candidates. The target list was searched within a 12 degree radius circle around the published C0 field center. We emphasize that based on our experiences with *Kepler*, where we performed a similar pre-launch target search, a large percentage of candidate RRL stars turned out to be bona fide RR Lyrae. In addition, an even larger fraction proved to be the most valuable modulated (Blazhko) stars (17, compared to zero that had been known before *Kepler*). Regardless of the position within the 24 degree diameter area, we prioritized the targets based on their pulsation mode (RRc stars ranked higher), then on the confidence level of their classification (less certain RR Lyrae candidates got lower ranks). Our target list starts with the highest priority objects.

References

[1] Benkő et al. 2010, MNRAS, **409**, 1585
[2] Kolenberg et al. 2010, ApJL, **713**, 182
[3] Kolenberg et al. 2011, MNRAS, **411**, 878
[4] Moskalik et. al. 2012, arXiv:1208.4251
[5] Nemec et al. 2011, MNRAS, **417**, 1022
[6] Moskalik 2014, arXiv:1401.7271
[7] Plachy et al. 2013, MNRAS, **433**, 3590
[8] Szabó et al. 2010, MNRAS, **409**, 1244