RR Lyrae and red giant stars in the dwarf spheroidal galaxy Leo IV

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Kepler is predominantly a Galactic mission focusing on the stars in the Milky Way. Its capabilities, however, allow for observing the brighter individual stars in the nearest dwarf galaxies. Field 1 contains one close-by, metal-poor spheroidal dwarf called Leo IV. It is a very faint and sparse object dominated by dark matter and was discovered as a slight overdensity in the outer halo in the SDSS data less than 10 years ago [1]. A few member stars were confirmed spectroscopically and three RR Lyrae stars were also discovered there [2].

Aims The observations of the brightest stars in Leo IV provide the opportunity to investigate the following questions.

- The observations will allow for a direct comparison between the *Kepler* measurements of the stars in the Milky Way, and their extremely metal-poor counterparts in an old dwarf galaxy. The metallicity of Leo IV is [Fe/H] $= -2.4 \pm 0.2$ [3].
- Does any of the three RR Lyrae stars show similar dynamical effects as their galactic siblings do? Can we identify modulation, period doubling or additional modes in them? The stars represent a homogeneous sample of metallicities at the extreme end: in the original field only a single star had a [Fe/H] index lower than -2.0 [4]. The astrophysical importance therefore counterbalances the faintness of the stars.
- We expect the brightest supergiants – above ~ 21 magnitudes – to pulsate with periods ranging from a few days to a few weeks. The period and amplitude distribution of the stars can be compared to the *Kepler* supergiants in the Milky Way [5].
- The fainter red giants are expected to show solar-like oscillations. The observations of *Kepler* may provide a unique opportunity to investigate the nature of convection-induced oscillations in very metal-poor stars and test the universality of the scaling relations derived from field stars. Based on the $B-V$ colors, the temperatures of the proposed stars fall in the range of $\log T_{\rm eff} = 3.7 \pm 0.2$ [3]. According to the Milky Way scaling relations, their $\nu_{\rm max}$ range extends from a few tens to a few hundred μHz. The peak amplitudes per mode are expected to be a few hundred ppm [6]. Although the targets are extremely faint, the long, uninterrupted time series of K2 might just allow us to detect the excess power accumulated by the oscillations in the power spectra the same way as they were detected in the ground-based observations of M67 [7].

Targets All targets are very faint, between $Kp = 18.9 - 22.2$ magnitudes. Although Leo IV is a galaxy, it is very sparse and we expect that crowding will be a minor issue at worst. These observations will push the detection limit of K2 and will provide not only valuable science but useful engineering data on the faintest end of the sensitivity curve of the telescope as well.

References:

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