K2 Proposal on behalf of KASC WG3 (field 2 & 3)

Asteroseismology of (SP)B stars

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Slowly pulsating B (SPB) stars are mid-to-late B-type stars in the main sequence oscillating in high-order gravity (g-)modes with periods from 0.3 to 3 days. These oscillations are driven by the κ mechanism acting in the iron opacity bump at around 200,000 K (e.g. Dziembowski, Moskalik & Pamyatnykh, 1993, MNRAS 265, 588). Since most SPB stars are multi-periodic, the observed variations have long beat periods and are generally complex. The large observational efforts required for in-depth asteroseismic studies are hard to achieve with ground-based observations. Only complementary long-term space-based observations can lead to asteroseismic discoveries:

- The first in-depth asteroseismic study for an SPB star has been performed for HD50230 based on observation of the CoRoT mission (Degroote et al. 2010, Nature 464, 259). Applying the theory of deviations from regular period spacings predicted for g-modes in the asymptotic regime (A. Miglio et al., 2008, MNRAS 386, 1487) allowed to estimate the extent of the convective core (from the mean period spacing) and to constrain the location of the chemical transition zone (from the deviation of the mean).

- The detection of frequency multiplets induced by stellar rotation and/or magnetic fields has the potential to reveal information about the deep interior of these massive stars.

- There have been speculations about the possible occurance of stochastically excited g-modes in massive stars by the turbulent convection (Cantiello et al. 2009, A&A, 499, 279; Samadi et al. 2010, Ap&SS, 328, 253; Shiode et al. 2013, MNRAS 430, 1736). According to Cantiello et al. (2009), the only subsurface convective layer present in SPB stars is in the He II ionisation zone, but it is shallow and inefficient. No solar-like oscillations driven by the convection in the envelope are expected in SPB stars. If there would be any, these would be excited by the convection in the core but none were observed so far.

Unfortunately, the SPB stars were poorly represented in the nominal *Kepler* mission because of the rather high Galactic latitude of the observed field, so seismic results are still lacking. Balona et al. (2011, MNRAS 413, 2403) studied the *Kepler* lightcurves of a sample of 48 candidate B-type stars, revealing different types of frequency spectra: (1) SPB stars only showing long period variations, (2) Hybrid pulsators exhibiting both SPB- and β Cephei-type oscillations (both the central and outer internal layers can be probed simultaneously), (3) Stars showing (more or less) equally spaced frequency groupings (typical for Be stars) for which it is not clear yet if these frequency groups are caused by rotational modulation and/or stellar pulsations in combination of fast rotation, (4) Stars for which there is evidence for (additional) variations originating from migrating spots, and (5) Constant stars (which are a challenge for theory).
K2 has better prospects for a study of the morphology of the variability and for asteroseismic studies of *candidate* SPB stars. Eventhough there are no known SPB in Fields 2 & 3 which fall on silicon, we can identify 69 known mid-to-late B-type stars which likely lie in the SPB instability strip (59 in field 2; 10 in field 3). As the K2 photometric data should most likely be complemented with time-series of high-resolution spectroscopy to allow an indepth asteroseismic investigation, these targets are sorted from bright to faint. Long cadence observations are sufficient for this type of variable stars. Our targets list ends with 106 early-type stars in Field 2 and and 34 targets in Field 3.