Solar-Type Stars for Asteroseismology in K2 Short Cadence

KASC Working Group 1, Target Proposal: K2 Fields 2 and 3

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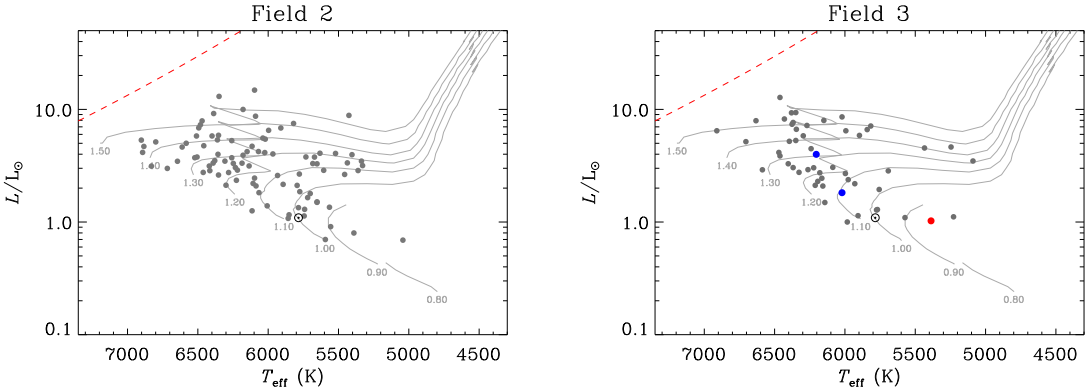
Science Case: This document proposes a selection of very bright solar-type stars, including cool main-sequence dwarfs and sub-giants, for asteroseismic observations in K2 Fields 2 and 3. These stars show detectable solar-like oscillations with periods of the order of minutes. SC data are therefore a pre-requisite for detecting the oscillations. Our list comprises stars that will be prime targets for one of the main goals of K2, the detection of exoplanets around bright solar-type stars, for which precise RV follow-up will be possible. We seek to take advantage of the opportunity to have *Kepler* observe targets for asteroseismology that are typically brighter than those observed in the nominal Mission. Because the targets are brighter, much more accurate and detailed prior constraints (e.g., from parallaxes, detailed spectroscopy, interferometry, etc.) will be available on these stars than was usually the case for asteroseismic targets in the original field. It will therefore be possible to bring the full potential of asteroseismology to bear to test stellar interiors physics (e.g., to place constraints on convective overshooting). This is particularly true for the binaries in our list. It will also be possible to go beyond studying stellar structure, to put constraints on the evolution of the solar neighbourhood. These solar-type targets in Field 2 and 3, along with the targets from previous and future fields, will allow us to constrain the age-metallicity relation of nearby field stars in a manner that has not been possible before. Note that asteroseismic data can constrain stellar ages much better than any other method. By providing asteroseismic ages of stars with detectable surface rotation periods we will also provide additional calibrators for gyrochonology. And of course, asteroseismology will allow us to better characterize targets that have detected exoplanets, including any new detections made by K2 and also already-known hosts that are on our list.



Target List: Our list is comprised of targets from the Hipparcos catalogue, and only includes targets that are predicted to fall on active silicon. Selecting targets with good prior constraints is at a premium to avoid wasting SC slots. We applied procedures used to select targets for SC asteroseismic follow-up on exoplanet hosts in the nominal Mission (e.g., see Chaplin et al., 2011, ApJ, 732, 54) to estimate seismic parameters and relevant performance metrics. For this proposal we have for the first time tested against the higher K2 noise levels, with expected photometric performance guided by analysis of short-cadence data from the January K2 engineering test. Our results suggest that we should get high-quality asteroseismic data with K2. The figure shows the selected targets. One known exoplanet host star, HIP 109378, is shown in red. Two known bright SB2 binaries are plotted in blue.

Our list includes some very bright targets, to maximize the asteroseismic SNR and hence the science return. Targets nearer the centre of the field were given overriding priority, since they cost less in pixels (effects of spacecraft rotation minimized). We grouped targets into three cohorts, based on their location on the CCD, and then ranked by brightness within each cohort. The cohorts (from highest to lowest priority) comprise targets on: the centre module; the eight adjacent modules around the centre module; and, finally, the outer modules. Targets on non-functioning modules were removed from the lists. Despite being predicted to fall on an outer module, we have put the very bright exoplanet host near the top of the Field 3 list. Its priority placement might need revisiting, depending on pixel allocations and availability (we accept that it may be too expensive, pixel-wise, to observe). [Additional information is provided in the comment field of the target tables: HIP number, fractional parallax uncertainty, $T_{\rm eff}$, M, R, seismic $\nu_{\rm max}$ parameter, seismic SNR, estimated approximate probability of detection for K2, probability of detection for original *Kepler* performance, and location of target on CCD (0: centre module; 1: eight adjacent surrounding modules; and 2: outermost modules).]