Galactic Archaeology on a grand scale – Field 0

K2 Target Proposal by KASC Working Group 8, the asteroSTEP and APOKASC collaborations, and the GALAH team (Point of contact: Dennis Stello, stello@physics.usyd.edu.au)

MOTIVATION: Unraveling the evolutionary history of the Milky Way has been a long-standing problem in contemporary astrophysics, and achieving this will have significant ramifications for our understanding of how other galaxies form and evolve. Success will depend on understanding the stars within our Galaxy: their role as its building blocks and the source of its chemical evolution. This demands precise measurements of the fundamental properties of stars, something we currently have achieved mainly for the solar neighborhood. Initial investigations in this new field of near-field cosmology – better known as Galactic Archaeology – has used *Kepler* and CoRoT data and shown that asteroseismic-determined radii, masses and ages of red giants have tremendous potential for expanding our view into how the Galaxy formed and evolved. However, it is now clear that a lack of well-described and easily reproducible selection criteria for the stellar sample hampers our ability to distinguish differences between observations and Galaxy models from effects of 'unknown' selection effects.

SYNERGY WITH OTHER K2 GOALS: Our targeted fields (Fig.1, left, red dots) include all K–M dwarfs cooler than $J-K=0.5$ in the $11.25<V<13.25$ range (7% of our targets). This will benefit the search for planets in the habitable zones around cool dwarfs – a key goal of K2. If approved, the proposal will also provide the bulk of targets for a wealth of other science goals driven e.g. by KASC Working Group 8.

AIM: The proposal aims to observe a sizable number of colour-magnitude selected red giants to probe the Galaxy far beyond the solar neighborhood. It is our intention to make similar proposals for all future K2 fields in order to probe Galactic directions not probed before taking advantage of K2's '360-degree view' along the ecliptic. Field 0 in particular, provides an invaluable look to larger Galactocentric radii.

URGENCY: The full potential of the data will be reached when combined with independent data such as high-resolution spectroscopy, adding radial velocity, temperature, metallicity and abundance of elements. Through the team behind this proposal, these additional data are already available for a significant fraction of our targets, and will be obtained for the remaining stars within this year by the APOGEE and GALAH surveys. The asteroseismic data from the K2 fields, which complement current observations from the *Kepler* Cygnus field and CoRoT, will form a legacy data set for Galactic Archaeology. Combined with the forthcoming data from Gaia, the results from these efforts will be a true goldmine, allowing exploration of core areas of galactic evolution theory including the age-metallicity and age-velocity relations, as well as chemical and dynamical evolution of the Milky Way.

APPROACH: We make a pure colour-magnitude based selection using 2MASS, which is also the input catalog for our complementary spectroscopic surveys. Our top priority targets comprise all stars with $J-K_s>0.5$ already observed with APOGEE (Fig.1 left, black dots), providing 2426 stars within 11 degrees of the proposed Field 0 centre (Fig.1, left, large circle). Within a single K2 pointing 1500–1600 of these can be observed (Fig.1, left, green/blue stamps). Our 2nd priority targets consist of 14 two-degree-diameter fields (Fig.1, left, red dots) for which we have initiated spectroscopic follow-up to be finalised within this year (4902 stars in total). Here we use the same colour cut and the following magnitude range in V based on J and K: $11.25<V(J,K)<13.25$. These selections ensure we obtain a colour magnitude complete sample (Fig.1 right). All targets can be observed in long-cadence mode. The target list (field0_selected.txt) lists RA, Dec and J mag. The file field0_selected_long.txt lists additional columns (RA, Dec, Jmag, 2MASS_ID, location_ID, flag, Hmag, Kmag)

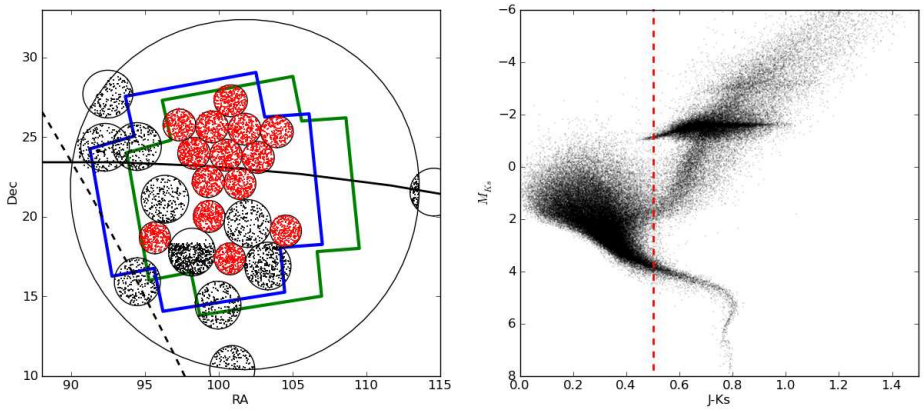

Figure 1: Left: Target fields with existing APOGEE (black) and forthcoming APOGEE/GALAH (red) High-Resolution spectroscopy relative to the K2 Field 0 (current:green/potential:blue). Right: Population synthesis of K2 Field 0 using Galaxia.