

Oscillating Red Giants in Clusters: *KASC Working Group 2: K2 Target Proposal*

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Science Case: Star clusters are extremely useful in studying stellar structure and evolution. Since all stars in a cluster are coeval and have roughly the same metallicity, they allow us to put stringent constraints on the stellar models. Asteroseismology enables us to study the stars with data that do not depend on reddening and extinction and thus complements results obtained by isochrone fitting. The original *Kepler* field of view had four clusters, and asteroseismic data of stars in these clusters have not only led to studies of cluster properties, but also of the properties of the oscillations themselves.

The K2 mission will enable us to perform a much more extensive study of clusters and hence, of stellar evolution. The proposed target fields have clusters of different ages and metallicities. Some of these clusters are bright enough to study stars at different states of evolution, and are thus well suited for detailed studies of well constrained stellar systems. The questions that can be answered include whether or not convective properties (in the form of the mixing length parameter) do indeed depend on metallicity, whether or not the extent of core-convective overshoot is mass dependent, and how mass loss changes with mass and metallicity. The K2 Field 0 contains at least five open clusters — M35 (NGC 2168), NGC 2304, NGC 2266, NGC 2158 and Berkeley 29 — suitable for asteroseismic studies. **This is a proposal to conduct an asteroseismic study of red giants in these clusters.** The main-sequence solar-type oscillators of the clusters are too faint for their oscillations to be detected.

M35 is young (~ 100 Myr) with solar or slightly subsolar metallicity. Isochrone fits indicate a distance modulus of just over 10 mag. It contains massive red giants and perhaps even helium-burning stars with expected masses of $5M_{\odot}$. These would be the highest-mass red-giants studied so far with asteroseismology. Note that the results arising from this proposal will directly support the proposal aimed at studying δ Scuti stars (Murphy et al.) and possibly others targeting this cluster.

NGC 2304 is older, roughly 800Myr, with a subsolar metallicity and a distance modulus of 13.3 mag. The red giants in this cluster should have masses slightly larger than $2M_{\odot}$. This cluster will allow us to do a comparative study of red-giants in this cluster and those already observed by *Kepler* in NGC 6811, a cluster with a similar age, but higher metallicity.

NGC 2266 is about 1 Gyr old and has solar metallicity and a distance modulus of about 12.9 mag. NGC 2158 is somewhat older than NGC 2266, but has higher metallicity. It is farther way (distance modulus ~ 14.6 mag), but is a rich cluster with many red-clump stars, making it a potential distance calibrator. Berkeley 29 is metal poor, older (1-2 Gyr) and even farther away (distance modulus ~ 16 mag) but has several red-clump stars that make this cluster interesting too.

All these clusters will serve as test beds for assessing the K2 photometric performance in crowded fields providing extremely valuable information for the selection of targets in some of the prime clusters within K2's future fields of view.

Targets: The proposed targets are listed in ASCII file k2f0_wg2_targets.txt. All targets can be observed in the Long Cadence mode. The file has three columns, RA, Dec and V magnitude. We propose total of 73 targets. In Figure 1 we show in red the selected targets in the clusters.

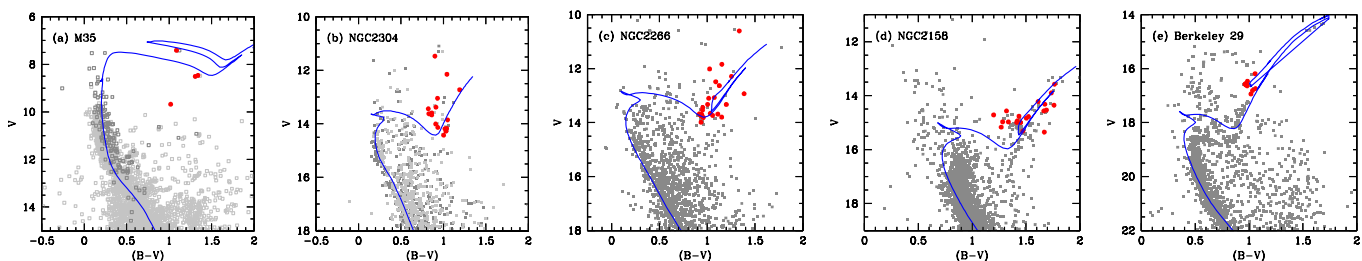


Fig.1: Proposed targets (in red) and a representative isochrone (in blue) for the five clusters.