Asteroseismology of Cluster Stars

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Why cluster asteroseismology?

Stars in open clusters are assumed to be co-eval and have the same metallicity at birth. These stars therefore allow us to constrain cluster properties such as age and distance, but are also extremely important in improving our understanding of stellar evolution. Asteroseismic data on cluster stars will allow us to make more robust determinations of cluster parameters; more importantly, because the stars have the same age and metallicity, we can use the data to conduct detailed tests of stellar structure and evolution.

The target list:

In this document we present a target list to do short-cadence observations on stars that are members of clusters and that are either classical pulsators or solar-like oscillators. The solar-like oscillators selected are predominantly subgiants or stars in the early red-giant phase, we have included a few cool main sequence stars for completeness. The solar-like pulsators were selected to be bright enough to detect pulsations as per Campante et al. (2016). We have included some high-mass main sequence classical pulsators to the target list too. Short-cadence observations of these targets are important to supplement the full frame images (FFI) of the clusters to extend the information available for each cluster to different evolutionary phases.

The selection criteria for the solar-like oscillators are as follows:

- The cluster is reasonably close (less than 1kpc) to avoid issues of faintness or crowding.
- The targets have a proper motion membership probability of $> 85\%$.
- The total flux of the target is at least 1000 times the g-band flux of all other stars within a radius of 12 arc sec.

There are few clusters that meet the criteria, and we propose a total of 102 solar-like clusters members for which we except to detect oscillations in 2-min cadence. Additionally, we propose 19 high-mass classical pulsators, 11 Am δ Scuti candidate pulsators and 8 Ap stars. The Ap stars need 20-sec cadence and are listed separately. All the Am and Ap stars belong to the same cluster. As we will also have FFI in which we expect to detect oscillations in red-giant stars, even a single star in another evolutionary phase will be of use. We would nevertheless ask to observe all proposed stars for a cluster as this will allow for more robust inferences on the cluster properties.

We have prioritized the targets per cluster with ecliptic latitude and within a cluster on TESS magnitude. This is because we expect to obtain more information of oscillators with longer periods from the FFI close the ecliptic poles and therefore, these systems will be our best test cases for stellar evolution. Separate lists are given for the northern and southern ecliptic hemispheres.

References:

Campante et al. 2016, ApJ, 830, 138