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. 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. On the flip side, since cluster parameters, like age and metallicity, can be determined well, asteroseismic data on cluster members can be used to constrain stellar structure to learn about underlying processes. Among stars in this category are blue stragglers; their formation scenarios are still debated, although increasingly mergers are being invoked to explain them.

The target list:

We only present a list of short-cadence targets here, these include low-mass solar-like pulsators, some classical pulsators, as well as a few blue stragglers. Full Frame Images (FFI) will be needed to extend the target list to red giants; these targets are not listed.

The solar-like pulsators were selected to be bright enough to detect pulsations as per Campante et al. (2016), and are predominantly subgiants or in the early red-giant phase; we have included a few cool main sequence stars for completeness. 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.

In addition to low-mass, solar-like oscillators we propose 19 high-mass classical pulsators, 11 Am δ Scuti candidate pulsators and 8 Ap stars. The Ap stars need 20-sec cadence, but since there is no 20s mode yet, they are included in the main table with comments. All the Am and Ap stars belong to the same cluster (Melotte 111).

Given that cluster members are most suited to study blue stragglers, we propose 18 (17 in the north and 1 in the south) blue stragglers. They have been selected to be brighter than 10 mag in I-band; have J2000 coordinates and are already in the TIC with a contamination < 0.1. We have only listed pre-identified blue stragglers from the catalogue of Ajumada & Lapasset (2007).

We have prioritized the targets per cluster with ecliptic latitude and within a cluster on TESS magnitude. In order to get the most "cluster science" we request that all proposed stars within a cluster be observed. These data, supplemented with data on red giants from the FFIs will allow a more robust inference of cluster properties. Separate lists are given for the northern and southern ecliptic hemispheres.

References: Ajumada and Lapasset, 2007, A&A, 463, 789; Campante et al. 2016, ApJ, 830, 138