

K2 Proposal on behalf of KASC WG 3  
**Asteroseismology of Delta Scuti Stars**  
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Delta Scuti stars are important astrophysical laboratories, as they allow us to investigate stellar structures under the influence of different physical phenomena. This is possible because the transition from very deep and vigorous to shallow convective envelopes takes place in the region of the Hertzsprung -Russel Diagram where these stars are located. The existence of convection in the outer layers is of great importance to many aspects of astrophysics; for example, it is believed that the observed alignment of planets around their host stars is strongly related to the depth of the convective zone (so far only approximated; e.g. Lai 2012, MNRAS, 423, 486), but determining the stellar structure is not straight-forward and requires the help of asteroseismology.

While the puzzle of delta Sct stars is not entirely solved yet, observations from the *Kepler* space telescope, revolutionised the field of A and F type stars significantly. Thanks to the unprecedented high quality and long data sets we can now conclude that the mechanism triggering pulsations in  $\delta$  Sct stars is not (well) understood. Not only do we find *constant* stars inside the  $\delta$  Sct instability strip (e.g. Uytterhoeven et al. 2011, A&A, 534, 125), which cannot be explained yet, but current models predict, in many cases, a far smaller frequency region of oscillation modes to be excited than observed (e.g. Balona & Dziembowski 2011, MNRAS, 417, 591; Smalley et al. 2011, A&A 535, A3; Antoci et al. 2012, Nature, 477, 570). This suggests either missing physics in the current models and/or additional excitation mechanisms.

The K2 mission offers the unique opportunity to measure known  $\delta$  Sct stars at ultra-high precision, combining with available ground-based and space data (e.g. SuperWasp, CoRoT, MOST, SPITZER) as well as parallaxes and well determined effective temperature and gravities, covering different evolutionary stages. For example, Field 0 contains several known pre-main-sequence pulsators (e.g. Zwintz et al. 2011, ApJ, 729, 20), which not only give us an insight on how the stellar structure changes as the stars evolve toward the Zero Age Main Sequence, where they start burning H to He in their cores. But it is also to be expected that some of these young objects already host planetary systems, making these perfect targets to meet the primary and secondary mission of K2. Their oscillatory behaviour as well as available parallaxes can help to characterise these systems in case of a positive detection.

Observing A and early F type stars with K2 will also allow to shed light on an additional puzzle for these type of stars: from the ‘first’ *Kepler* mission, there were some A type stars discovered to show flare-like structures (Balona 2012, MNRAS, 423, 3420; Balona 2013, MNRAS, 43, 2240). The flaring phenomenon is directly linked to magnetic fields induced by the dynamo effect, which can only operate if a substantial convective envelope is present. This is not expected for such hot stars. The alternative explanation is that very active low-mass companions are responsible for the flares. New data, in combination with known physical parameters will allow to distinguish between the two scenarios.

Nine of the known  $\delta$  Scuti stars which are situated in Field 0, have dominant modes well below the Nyquist frequency imposed by the LC observing mode, which means that LC data are sufficient. There are 17 targets (**NOTE, subject to change and can still be debated**), however, with modes having higher frequencies than the Nyquist frequency and therefore require SC observations. The attached ascii file indicates which targets need LC and which SC data.

**To summarise, with the targets proposed here we plan to investigate: (1)  $\delta$  Scuti stars at different ages and therefore different stellar structures; (2) pulsation mechanism(s); (3) the possible presence of flares; (4) planetary systems, if found around these stars.**