Study of the pulsational behaviour of an unbiased sample of A and F type stars

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Science case:

The lower part of the instability strip is populated with stars in very different evolutionary stages. The evolution history of these stars have marked their central regions and the differences in structure are reflected in their oscillation frequency spectrum. For a number of these stars in which the κ-mechanism or the partial blocking of the energy flux in the convective zone are efficient enough to excite a few oscillations (δ Scuti, γ Doradus) we may hope to probe their structure with the techniques of asteroseismology.

In the data collected from the exoplanet field a number of presently undetected variables of spectral types A and F will emerge. Using statistical tools (multivariate analysis) in conjunction with a seismological study (mode identification, seismic modelling, nonadiabatic computations) would help understand the problems of structure and evolutionary stages of these objects. Colours will be useful for the mode identification and for the nonadiabatic analysis. Our comprehension of a number of problems may benefit from such observations: the roles of rotation and diffusion in the structure of these stars, the interaction between convection and pulsation (red edge of the instability strip), the overshooting mechanism,...

Only about one third of the A-F stars in the lower instability strip are pulsating and the cause of this is still unclear. Many suspect that the so-called constant stars are variables that pulsate with amplitudes below the present detection limit (a few mmag). The study of an unbiased sample of A-F stars will therefore allow to assess the incidence of photometric variability in this region of the HR diagram with a resolution never reached before.

Type of observations:

All observations of A and F stars from the long runs in the exoplanet field, and from the short runs. As long as that does not perturb the exoplanet program, as many as possible windows for short integration times of 32 seconds, with colours are welcome.

Targets

All A and F stars.

5 Relevant works:

1. Dupret, M.-A., De Ridder, J., De Cat, P., Aerts, C., Scuflaire R., Noels, A., Thoul, A., 2003, A photometric mode identification method, including an improved non-adiabatic treatment of the atmosphere, *Astronomy & Astrophysics* **398**, 677–685

   Description of an improved mode identification method based on a nonadiabatic treatment of the atmosphere layers.

2. Thoul, A., Aerts, C., Dupret, M.-A., Scuflaire, R., Korotin, S.A., Egorova, I.A., Andrievsky, S.M., Lehmann, H., Briquet, M., De Ridder, J., Noels, A., 2003, Seismic modelling of the β Cep star EN(16) Lacertae, *Astronomy & Astrophysics* **406**, 287–292

   A typical seismic modelling. Of course, the identification of the observed frequencies and the modelling of δ Scuti and γ Doradus variables will be harder.

3. Dupret, M.-A., Grigahcène, A., Garrido, R., Montalban, J., Gabriel, M., Scuflaire, R., Non-adiabatic seismic study of the thin convective envelope of δ Scuti stars, in *Variable stars in the Local Group*, IAU Colloquium 193, 6–11 July 2003, Christchurch, New Zealand

4. Lampens, P., Boffin, H.M.J., 2000, δ Scuti Stars in Stellar Systems: a Review, in *Delta Scuti and Related Stars*, Reference Handbook and Proceedings of the 6th Vienna Workshop in Astrophysics, Vienna, Austria, 4-7 August, 1999. ASP Conference Series 210, eds. M. Breger & M. Montgomery, 309–331

   This paper gathers information on binarity and pulsational properties of δ Scuti stars in stellar systems.

5. Cuypers, J., Aerts, C., Buzasi, D., Catanzarite, J., Conrow, T., Laher, R., 2002, Asteroseismology "on a WIRE", in *Proceedings of the First Eddington Workshop on Stellar Structure and Habitable Planet Finding*, 11-15 June 2001, Córdoba, Spain, editors F. Favata, I.W. Roxburgh and D. Galadi, ESA SP-485, 41–47

   Asteroseismological data have been obtained from the Wide-field Infra Red Explorer, in particular for the δ Sct variable β Cas.

Needed ground-based observations plan:

We will apply for UVES time at the VLT for the AF stars that will turn out to be the most promising targets for asteroseismology (large number of frequencies), in order to determine their surface abundance and derive an upper limit of $V \sin i$.