Asteroseismic probing of low mass solar-like stars throughout their evolution with new techniques

Farnir, Martin ; Dupret, Marc-Antoine ; Buldgen, Gael ; Pinçon, Charly ; Salmon, SébastienJ. A. J. ; Noels, Arlette ; Scuflaire, Richard

Abstract

In this oral contribution we present two new techniques that aim at precisely probing the stellar structure of low-mass solar-like stars. These two methods, that focus on different evolution stages (i.e. the main-sequence stars, subgiants and red giants), provide reliable, accurate, fast and efficient means to tightly constrain the stellar structure through the definition of robust seismic indicators, which we proved to be excellent structural proxies. Indeed, they allow to precisely infer stellar masses, radii, ages and surface helium contents. This is particularly relevant to the field of exoplanetary science, as a precise determination of exoplanetary masses and radii relies on precise stellar properties. We will first present the potential of the WhoSGlAd method (Farnir et al. 2019) to accurately, and automatically, constrain the stellar structure of large samples of main-sequence stars, which is necessary in the context of the PLATO mission (Rauer et al. 2014). By building almost uncorrelated indicators defined to hold precise structural information, this method proposes a brand new approach to the adjustment of the oscillation spectra that these stars display. We will then present a new method to coherently account for the spectra of both sub-giant and red-giant stars, the EGGMiMoSA method (Farnir et al. 2021, submitted). Relying on the asymptotic description of mixed-modes (Shibahashi 1979, Mosser et al. 2012, Takata 2016), this is the first method that is able to follow the evolution of relevant seismic indicators during these phases, namely the period spacing, frequency separation, coupling factor and the pressure and gravity offsets, and therefore constrain the masses, radii and ages of these evolved stars. In addition, this method reliably provides measurements for these indicators in an automated fashion, which is a great opportunity for the broad characterisation of the large amount of data the PLATO mission is expected to generate. Finally, the combination of these two techniques, which are extremely fast, and their seismic indicators with large scales model search algorithms, such as AIMS (Rendle et al. 2019), could efficiently and robustly provide stellar masses, radii, ages and surface helium abundances for most of the stars observed by the PLATO spacecraft.

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