Structural glitches near the cores of red giants revealed by oscillations in g-mode period spacings

Margarida Cunha*[1], Dennis Stello[2], Pedro Avelino[1], and Jørgen Christensen-Dalsgaard[3]

[1]Centro de Astrofísica da Universidade do Porto (CAUP) – Rua das Estrelas 4150-762 Porto, Portugal
[2]The University of Sydney (USYD) – Physics Office, Room 210, Building A28 SIfA, H90 School of Physics University of Sydney NSW 2006 Australia, Australia
[3]Aarhus University [Aarhus] – Nordre Ringgade 1 DK-8000 Aarhus C, Denmark

Abstract

In this work we consider the sensitivity of gravity-mode period spacings to sharp changes in the inner structure of red giant stars, more specifically in the Brunt-V´ais´al´a frequency inside the g-mode propagation cavity. Based on asymptotic solutions of the wave equation in the Cowling approximation, valid on each side of the sharp structural variation, we determine how their phases are modified by that sharp variation, taking full account of the coupling between pressure and gravity modes. With this, we derive an analytical expression for the perturbation induced by such a sharp structural variation on the periods of the oscillations.

Comparison of this analysis with numerical results obtained with a full oscillation code allows us to identify and correctly interpret the signature of the above-mentioned sharp structural variations in the numerical results. Based on the analysis of the period spacings for a large grid of models we identify subgroups of red-giant stars in which oscillations in the g-mode period spacing may be detected in the observations. Detection of this signature in CoRoT, Kepler or future PLATO red-giant stars would pin down their evolutionary state in an unprecedented way.

*Speaker