EPJ Web of Conferences **152**, 05005 (2017) DOI: 10.1051/epjconf/201715205005
Wide-Field Variability Surveys: A 21st Century Perspective

Determining the core stratification in white dwarfs with asteroseismology

S. Charpinet[1,2,⋆], *N.* Giammichele[1,2,⋆⋆], *P.* Brassard[3,⋆⋆⋆], and *G.* Fontaine[3,⋆⋆⋆⋆]

[1] *Université de Toulouse, UPS-OMP, IRAP, Toulouse, F-31400,France*
[2] *CNRS, IRAP, 14 avenue Edouard Belin, F-31400 Toulouse, France*
[3] *Département de Physique, Université de Montréal, CP 6128, Succursale Centre-Ville, Montréal, QC H3C 3J7, Canada*

Abstract. Using the forward modeling approach and a new parameterization for the core chemical stratification in ZZ Ceti stars, we test several situations typical of the usually limited constraints available, such as small numbers of observed independent modes, to carry out asteroseismology of these stars. We find that, even with a limited number of modes, the core chemical stratification (in particular, the location of the steep chemical transitions expected in the oxygen profile) can be determined quite precisely due to the significant sensitivity of some confined modes to partial reflexion (trapping) effects. These effects are similar to the well known trapping induced by the shallower chemical transitions at the edge of the core and at the bottom of the H-rich envelope. We also find that success to unravel the core structure depends on the information content of the available seismic data. In some cases, it may not be possible to isolate a unique, well-defined seismic solution and the problem remains degenerate. Our results establish that constraining the core chemical stratification in white dwarf stars based solely on asteroseismology is possible, an opportunity that we have started to exploit.

1 Introduction

In Giammichele et al. (2017a, [1]), we introduced a new generation of hydrostatic equilibrium white dwarf models designed specifically for in-depth asteroseismic probing of the stellar structure. These new models most notably provide a new parameterization for the C/O stratification allowing us to explore a vast range of chemical configurations in the core. We hereafter use these tools to investigate the core seismic signatures. To estimate the potential of asteroseismology for probing the core, we also propose a series of three "hare and hounds" (blind) tests.

⋆ stephane.charpinet@irap.omp.eu
⋆⋆ ngiammichele@irap.omp.eu
⋆⋆⋆ brassard@astro.umontreal.ca
⋆⋆⋆⋆ fontaine@astro.umontreal.ca

2 Core seismic signature and blind tests

The impact of the core structure on the oscillation periods of white dwarf pulsators and the series of tests presented at this conference are now discussed extensively in Giammichele et al. (2017b, [2]). We refer the reader to this article.

3 Conclusion

We conclude that determining the core stratification in white dwarf stars with asteroseismology is possible even with a limited number of observed periods. Success or failure to do so depends on the star analyzed and its ability to show modes that are partially confined in its core (see also Giammichele et al. 2016, [3], for a discussion on such modes).

Acknowledgments: S. Charpinet acknowledges financial support from "Programme National de Physique Stellaire" (PNPS) of CNRS/INSU, France, and from the Centre National d'Études Spatiales (CNES, France). This work was granted access to the HPC resources of CALMIP under allocation number 2016-p0205. This work was supported by the FQRNT (Québec) through a postdoctoral fellowship awarded to N. Giammichele. G. Fontaine also acknowledges the contribution of the Canada Research Chair Program.

References

[1] Giammichele, N., Charpinet, S., Fontaine, G., & Brassard, P., ApJ, **834**, 136 (2017a)
[2] Giammichele, N., Charpinet, S., Brassard, P., & Fontaine, G., A&A, **598**, A109 (2017b)
[3] Giammichele, N., Fontaine, G., Brassard, P., & Charpinet, S., ApJS, **223**, 10 (2016)