New models for the CoRoT primary target HD 52265, including core overshooting.

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Both triangles, Fischer & Valenti 2005 (triangles), and Takeda et al. 2005 (crosses).

Stellar Parameters

HD 52265 is a G0-V type star with a Jupiter-mass planet. Its visual magnitude is $V=6.301$ mag, and its parallax is $\pi=34.54\pm0.40$ mas. We deduce for HD 52265 a luminosity of $\log(L/L_\odot)=3.49\pm0.03$.

Five groups of observers have derived the external parameters of this star (for example, surface gravity and metallicity).

We computed evolutionary tracks, using the TGEC Code (see Hui Bon Hoa 2008) for overshooting models, using three values of metallicity: [Fe/H]=0.19, 0.23 and 0.27 (see for example Figs. 1 and 2). We added overshooting at the edge of the core, and we have analysed the influence of this on the frequencies of HD 52265, and more specifically on the small separations.

When overshooting is added, the radius of the convective core is increased, but there is not enough helium in the core to create a discontinuity in the sound speed profile and induce a change in the small separations.

Seismic Analysis

When overshooting is added at the edge of the core, the evolutionary time scales increase. The development of the convective core is increased during a longer main sequence phase. We chose, for our seismic analysis, models in agreement with the external parameters of HD 52265, i.e. models lying inside the corresponding error boxes. They all correspond to main sequence stars. The radius of their central mixed zone is extended in the case of models with overshooting.

On Fig. 3, we show the example of models of 1.22 M$_\odot$, 1.544 Gyr, [Fe/H]=0.27, with and without overshooting. We can see that we obtain the same value of the large separation and the same echelle diagram in the two cases. There is no clear and visible influence of overshooting on the oscillation frequencies. These models are young, lying at the beginning of the main sequence. Their central helium abundance is low ($Y_c=0.50$ for both models). When overshooting is added, the radius of the convective core is increased, but there is not enough helium in the core to create a discontinuity in the sound speed profile and induce a change in the small separations.

Models

We computed evolutionary tracks, using the TGEC Code (see Hui Bon Hoa 2008) for overshooting models, using three values of metallicity: [Fe/H]=0.19, 0.23 and 0.27 (see for example Figs. 1 and 2). We added overshooting at the edge of the core, and we have analysed the influence of this on the frequencies of HD 52265, and more specifically on the small separations.

When overshooting is added, the radius of the convective core is increased, but there is not enough helium in the core to create a discontinuity in the sound speed profile and induce a change in the small separations.

On Fig. 4, we show the case of models with [Fe/H]=0.19, lying in the Takeda et al. (2005) error box. In this case, the models correspond to more evolved stars. The model without overshooting has a central helium abundance $Y_c=0.88$, while the one with overshooting has $Y_c=0.78$.

As already described in Soriano et al. (2007) and Soriano & Vauclair (2008), the small separations between $l=0$ and $l=2$ become negative at the frequency for which the $l=2$ waves reach the helium core. We can see that this happens at a lower frequency when overshooting is added, as the central mixed zone is larger.

Conclusion

We have computed many models which could account for the spectroscopic parameters of HD 52265, with and without overshooting (see Soriano et al. 2007). As soon as the data are ready, we will be able to analyse this star. As shown for the cases of other seismically observed main sequence stars: iota Hor (Vauclair et al. 2008) and nu Arae (Soriano & Vauclair, in preparation), we expect to be able to obtain precise values of age, mass and radius of the star, as well as metallicity and primordial helium value, even if other details of the stellar structure cannot be completely disentangled.