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Line profile variations in the bright subdwarf B star Balloon 090100001

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Abstract

We have acquired time series of high resolution Echelle spectra for the bright pulsating subdwarf B star Balloon 090100001. The data consist of six nights spanning from August to December, 2006. At least five independent frequencies are retrieved from the frequency analysis, both in the p- and the g-mode domain. Preliminary results on mode identification for the dominant peak are presented.

Introduction

The relative faintness of pulsating B-type hot subdwarfs (sdBs, $B > 12$) difficults their asteroseismic study, since the required precision for an observational mode identification is extremely demanding. Here we attempt the application of line profile variations analysis for the dominant mode of the pulsating sdB Balloon 090100001. With this purpose, we acquired with FIES@NOT $\sim$1600 high resolution spectra over 6 nights from August until December, 2006.

Frequency analysis

Cross-correlation profiles (ccp’s) were produced for each individual frame, merging the information from metal lines into a single profile with higher signal-to-noise. The software package FAMIAS (Zima 2008) was used to compute the amplitude spectrum of the time series ccp’s, shown in Fig.1. While a further analysis will be presented elsewhere, we note the dominant peak at 2.80744 mHz ($f$), and the first confirmed spectroscopic detection of g-modes in an sdB star.

Phase folding to the dominant mode

Since $f$ has been accurately determined, frames within the same phase-bin were combined to further increase the signal-to-noise. The equivalent width (EW) and first three moments computed for 25 phase-bins are plotted in Fig.1. The EW and 1st moment vary with a phase shift of $\sim \pi/2$, as expected for adiabatic oscillations. The 2nd moment shows a clear dependence with 2$f$, a signature of an $m = 0$ mode (Aerts et al. 1992), in agreement with Baran et al. (2008) and Telting et al. (2008). In a forthcoming paper, we will constrain the
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Figure 1: Top panel: amplitude spectrum obtained from the time-series ccp’s. Bottom four panels: EW and first three moments computed for 25 phase-folded ccp’s, using $f = 2.80744$ mHz. In red, a $sin(f)$ fit, $sin(2f)$ for the 2nd moment.

dominant peak mode identification (MI) using moments information. MI for other modes will be also explored, as well as the influence of temperature effects on MI.

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References

Zima, W. 2008, Comm. in Asteroseismology, 155, 17

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