

Echelle-Diagrams for roAp Stars

David E. Mkrtychian

*Astronomical Observatory, Odessa State University, T. G. Shevchenko
Park, 65014 Odessa, Ukraine*

Artie P. Hatzes

*McDonald Observatory, University of Texas at Austin, Austin, TX
78712, USA*

Abstract. We present the echelle-diagrams for p-mode spectra of roAp stars HD 60435, HR 1217 and γ Equ and discuss some their peculiarities.

The high-order nonradial pulsation p-mode spacing in main sequence stars as a function of oscillation frequency is a sensitive indicator for the study of stellar structure and the location depth of convective zone (Guenther & Demarque 1993, 1996). The frequency spectra of high-order p modes in roAp stars can well extend to higher ($\ell > 3$) degrees, and these can be detectable spectroscopically if they are indeed excited (Mkrtychian 1994). So, the diagnostic potential of the echelle-diagrams (ED) for the p-mode rich roAp stars is expected to be high.

In the roAp star HD 60435, the frequency range (709-1457 μ Hz) of excited modes and their number ($n=19$) is the widest and most numerous yet detected in roAp stars (Matthews, Kurtz, & Wehlau 1987). As such, the star is well suited for the application of frequency spacing analysis. In the ED for HD 60435 shown in Fig. 1 (left), the modes of even and odd degrees form approximately 'equidistant' frequency spaced columns. There are probable signatures of the mode-bumping effect (for instance, the modes 1.2848 mHz and 1.1133 mHz shown by circles) predicted by theory (Guenther & Demarque 1993, 1996).

The ED for the multiperiodic roAp star HR 1217 is shown in Fig. 1 (right, top). The interesting signature in the mode spectrum of this multiperiodic roAp star is the non-equidistant spacing of the ν_6 mode (Kurtz et al. 1989; Hatzes, Kanaan, & Mkrtychian 1999). A possible explanation of this peculiarity could be the relation of ν_6 to higher $\ell > 3$ degree modes which are shifted in spacing relative the $\ell=0,2$ and $\ell=1,3$ spacing columns.

The roAp star γ Equ so far has 4 known excited modes (Martinez et al. 1996). The ED is shown in Fig. 1 (right, bottom). Mode discrimination was carried out using the method of "specific phases" (Mkrtychian et al., in preparation). γ Equ, HD 60435, and HR 1217 are promising candidates for multisite high-resolution spectral campaigns using precise stellar radial velocity measurements to search for new pulsation modes (Kanaan & Hatzes 1998; Hatzes et al. 1999).

Acknowledgments. This work was supported by CRDF grant UP2-317.

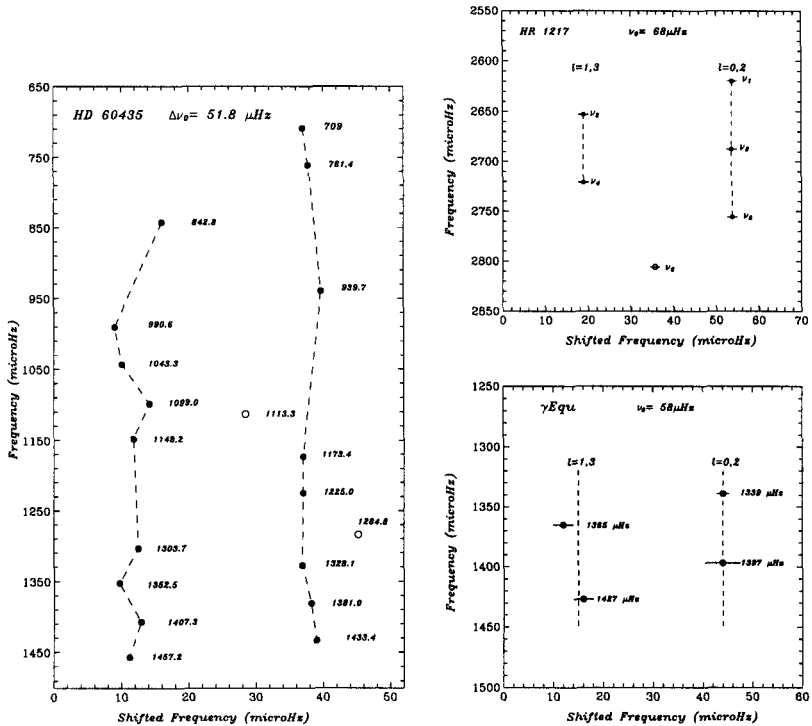


Figure 1. The echelle-diagrams for roAp stars: HD 60435 (left), γ Equ (right, bottom) and HR 1217 (right, top).

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