Mode Determination by Fourier Analysis of Line-Profile Variations: Application to τ Peg

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Abstract

The identification of modes of oscillation is an important first step towards the seismology of stars. Low- and high-degree ($0 \leq \ell \leq 16^{+}$) nonradial modes of oscillation may appear as variations in the line profiles of rapidly rotating δ Scuti stars. We present a technique whereby complex patterns in the line profiles are decomposed into Fourier components in both time and "Doppler space". The technique is applied to the 7.3-hour time series of high-resolution data obtained from CFHT for the δ Scuti star τ Peg. In addition to the low-degree mode which has been identified in photometric studies (Breger 1991), we find evidence for at least three high-degree modes near $\ell = |m| = 7$, 11 and 15. Correcting for the rotation of the star, most of these modes appear to oscillate with frequencies near 17 cycles day^{-1}. Our results are found to be in good agreement with the theoretical limits imposed on the frequencies of oscillation by the models of Dziembowski (1990).

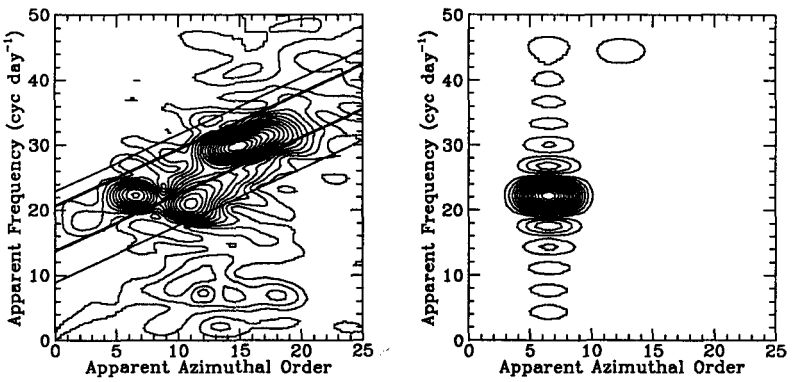

Figure Caption. The two-dimensional Fourier spectrum of the line-profile variations of τ Peg (left) and a window function generated from a time series of synthetic line profiles resulting from an $\ell = |m| = 6$ mode (right). Theoretical limits to the pulsation frequency are plotted for Dziembowski's standard (thick lines) and He-rich models (thin lines).

References:

Breger, M., 1991, Astron. Astrophys. **250**, 107.

Dziembowski, W., 1990, in: *Progress of Seismology of the Sun and Stars*, eds. Y. Osaki and H. Shibahashi, Lecture Notes in Physics **367**, p 359.

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