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AUTHOR(S): PAUL A. BRADLEY and JOYCE A. GUZIK

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Los Alamos Los Alamos National Laboratory
Los Alamos, New Mexico 87545

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SEISMOLOGICAL MODELING OF THE δ SCUTI STAR

CD-24°7599

PAUL A. BRADLEY AND JOYCE A. GUZIK

Los Alamos National Laboratory

Los Alamos, NM 87545

A major goal of asteroseismology is a better understanding of stellar evolution via “snapshots” of many stars of different masses in different evolutionary states. For stars of about $2M_{\odot}$ near the main sequence, δ Scuti stars are the usual suspects. There is an ongoing renaissance in theoretical modeling of δ Scuti stars brought on by improvements in constitutive physics and by a dramatic increase in the number of modes observed (see Audard’s review in these proceedings). FG Viriginis and CD-24° 7599 are two of the best studied objects, and they have 19 and 13 known frequencies, respectively (Breger et al. 1995, 1996; Handler et al. 1996).

We create models using an updated and modified version of the Iben (1963, 1965) code described by Guzik & Cox (1995) that includes either of the two versions of the OPAL opacities (Rogers & Iglesias 1992; Iglesias & Rogers 1996). We use the star’s observed location on the H-R diagram as a starting point for our seismological modeling. Because there is no evidence for observed $\ell = 3$ modes, we only consider $\ell = 0, 1,$ and 2 modes in our analysis. We take into account rotational splitting (about $5 - 10\mu\text{Hz}$) in our frequency matching. Figure 1 shows a comparison of the observed frequencies for CD-24° 7599 to a set of $2.0M_{\odot}$ models. Several observed modes must be rotationally split members of a given mode.

CD-24° 7599 is less than halfway through core hydrogen burning, and the modes appear to be a set of consecutive 3rd through 5th overtones of $\ell = 0$ through 2 modes (see Fig. 1). With *only* 13 modes, we find satisfactory fits with models between 1.9 and $2.0M_{\odot}$ that fall within the observed luminosity and effective temperature range. By contrast, Guzik & Bradley (1995) suggest that FG Viriginis is over halfway through core hydrogen burning and the best fitting models lie near 1.80 or $2.00M_{\odot}$. We see persistent discrepancies in some low frequency modes, which suggests we may

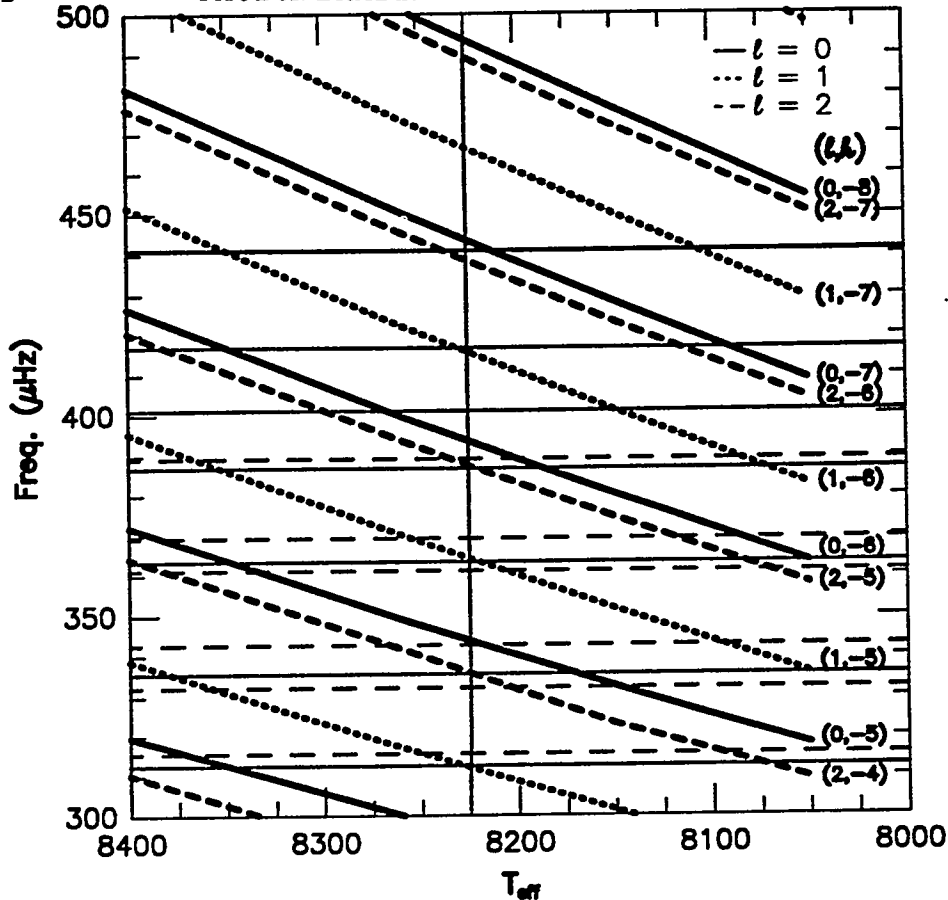


Figure 1. Comparison of CD-24° 7599 observed frequencies (horizontal dashed lines) with calculated $\ell = 0, 1,$ and 2 mode frequencies ($m = 0$ shown here) from $2.00M_{\odot}$ models. Note that several observed modes must have $m \neq 0$. The “-” indicates p -modes and a model near 8225 K best fits the observations.

need a small amount of core overshoot or a slight change in metallicity to duplicate FG Virginis.

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