

ASTEROSEISMOLOGICAL MODELING OF PG 1159–035, THE PROTOTYPE OF THE GW VIR VARIABLE STARS

A. H. Córscico¹, L. G. Althaus¹, S. O. Kepler², J. E. S. Costa², M. M. Miller Bertolami¹

¹ *Facultad de Ciencias Astronómicas y Geofísicas, Universidad Nacional de La Plata, Paseo del Bosque S/N, (1900) La Plata, Argentina.*

² *Instituto de Física, Universidade Federal do Rio Grande do Sul, 91501-970 Porto Alegre, RS, Brazil.*

We present an asteroseismological study on PG 1159-035—the prototype of the GW Vir variable stars—on the basis of detailed and full PG1159 evolutionary models recently presented by Miller Bertolami & Althaus (2006). We carried out extensive g -mode adiabatic period computations on PG1159 evolutionary models with stellar masses spanning the range 0.530 to $0.741M_{\odot}$. These models are derived from the complete evolution of progenitor stars, including the thermally pulsing AGB phase and born-again episode.

We first constrain the stellar mass of PG 1159–035 by comparing the observed period spacing with the asymptotic period spacing and with the average of the computed period spacings. In this way we derive a stellar mass in the range $0.56 - 0.59M_{\odot}$. We also employ the individual observed periods reported recently by Costa et al. (2007) and found a representative seismological model for PG 1159–035 which nicely reproduces the observed period pattern. The model has an effective temperature $T_{\text{eff}} = 127\,680$ K, a stellar mass $M_{*} = 0.565M_{\odot}$, a surface gravity $\log g = 7.42$, a stellar luminosity and radius $\log(L_{*}/L_{\odot}) = 2.15$ and $\log(R_{*}/R_{\odot}) = -1.62$, respectively, and a He-rich envelope thickness $M_{\text{env}} = 0.017M_{\odot}$. Nonadiabatic calculations predict that this asteroseismological model is pulsationally stable against dipole ($\ell = 1$) modes, contradicting the observational evidence. In addition, all of the theoretical pulsation modes are characterized by positive rates of period changes, at odds with the recent measurements by Costa & Kepler (2007).