Mem. S.A.It. Vol. 77, 97

Memorie della

The rapidly pulsating pre-main sequence star HD 34282: New observations

P.J. Amado[1,2], E. Rodríguez[1], Kyung-J. Choo[3], S.-L. Kim[3], R. Garrido[1], J.C. Suárez[1], A. Moya[4], and S. Martín-Ruíz[1]

[1] European Southern Observatory. Alonso de Cordova 3107. Casilla 19001, Santiago. e-mail: pamado@eso.org
[2] Instituto de Astrofísica de Andalucía (CSIC). P.O. Box 3004. 18080 Granada, Spain
[3] Korea Astronomy and Space science Institute, Daejeon 305-348, Korea
[4] Observatoire de Paris, LESIA, UMR 8109, 92195. Meudon, France

Abstract. Observations taken during a multi-site campaign in November 2005 of the pre-main sequence (PMS) star HD 34282 are presented. The star was observed in *uvby* Strömgren and *V* and *I* Johnson photometry. The analysis of the photometry yielded ten frequencies with values between 64.7 and 79.4 cycle d^{-1}. The main period, with a value of 18.1 min, represents the shortest period observed up to now for a δ Scuti-type pulsator. A preliminary seismic modelling has been attempted. Both, main sequence and pre-main sequence models predict modes in the range of 56 to 82 cycle d^{-1} (between 648 and 949 μHz), corresponding to oscillations of radial order n from 6 to 8 and grouped in sets of frequencies for modes with $\ell = 0$, 1 and 2 consistent with the observed values.

Key words. Stars: Individual: HD 34282 – Stars: pre-main sequence – δ Scuti

1. Introduction

HD 34282 was found to pulsate during a systematic search for short-term photometric variability in Herbig Ae/Be stars with the goal of determining the position and size of the pre-main sequence instability strip (Amado et al., 2004). Only two full nights and another two half nights of simultaneous Strömgren photometry were used in the frequency analysis, yielding two frequencies of 79.5 and 71.3 cycle d^{-1}. The main period of 18.1 min represents the shortest period ever observed for a δ Scuti.

Send offprint requests to: P.J. Amado

2. HD 34282 and the observing program

HD 34282 (V1366 Ori) has a spectral type of class A3 (Merín et al., 2004) with a strong infrared excess (Sylvester et al., 1996). It shows signatures of a large rotating disk (Piétu et al., 2003), with disk outer radii from $R_{\rm out} = 700$ to 835 AU and a mass of the disk from $M_{\rm disk} = 0.11$ to 0.70 $M_\odot$ (Merín et al., 2004; Piétu et al., 2003). The Johnson V magnitude and the Strömgren colours are $V = 9.873$, $(b-y) = 0.126$, $m_1 = 0.174$, $c_1 = 1.001$, $\beta = 2.918$ (this work), from which the parameters $T_{\rm eff} = 8760$ K and $\log g = 4.4$ were determined. From high-res spectroscopy

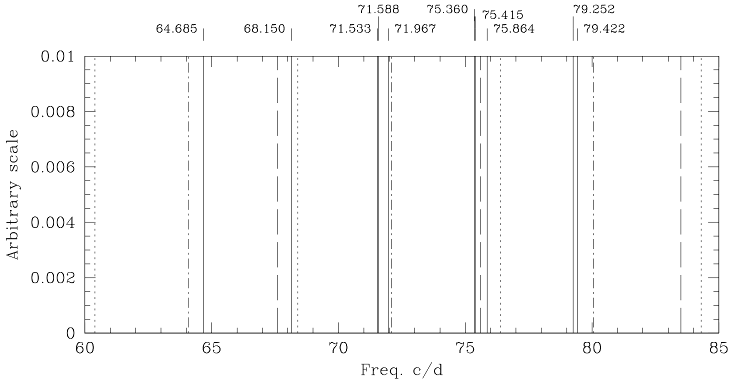

Fig. 1. Frequencies of observed modes (solid) and of modes from the best-fit model with $\ell = 0$ (dotted), $\ell = 1$ (dash-dotted) and $\ell = 2$ (dashed lines). The values of the observed frequencies are given at the top of the box.

(Merín et al., 2004) these parameters were $T_{\rm eff} = 8625 \pm 200$ K, $\log g = 4.2 \pm 0.2$ and [Fe/H] $= -0.8 \pm 0.1$. Distance determinations range from 326 pc (from our photometry) to 547 pc (Sylvester et al., 1996). The Hipparcos distance was determined to be 160 pc (van den Ancker et al., 1998).

The observations for HD 34282 were taken in a multi-site campaign. involving the 0.9-m telescope at the Observatorio de Sierra Nevada (OSN, Granada, Spain) and the 0.75-m Austrian T6 (Wolfgang) APT at Fairborn Observatory (Tucson, Arizona, US) from November 1 to 24, 2004, and the 1.0-m Korean telescope at Mt. Lemmon Obs. (Arizona, US) and the 0.61-m telescope at Sobaeksan Obs. (Korea) from November 18 to 24. Data were acquired only at the OSN (Strömgren *uvby*), Fairborn (Strömgren *vy*) and Sobaeksan (Johnson *VI*). All together, a total of 3642 measurements in 176.59 hours were gathered for a time-span of 24 days. We present here only the data from OSN and from Sobaeksan.

3. Results and Conclusions

A set of frequencies between 64.7 and 79.4 cycle d^{-1} (749 and 920 μHz) was found, grouped in sets of peaks with a mean separation of 40.5 μHz, corresponding to modes of $\ell = 0$, 1, 2 from the model (see figure 1). The main frequency corresponds to a period of 18.1 min, the shortest period found up to now for a δ Scuti-type pulsator. Such periods only become unstable for models of low metallicity, i.e., compatible with the spectroscopic observations of [Fe/H] $= -0.8$ (Merín et al., 2004). The star behaves as do all stars pulsating in a high radial order near the blue edge of the instability strip (larger pulsational amplitudes for the bluer photometric bands). The star does not seem to be a λ Bootis star since Oxygen and Carbon lines can only be fitted with the aforementioned low metallicity (B. Montesinos, private communication) nor a rapidly oscillating Ap (roAp) object as no magnetic field was detected by FORS at the VLT (S. Bagnulo, private communication).

References

Amado, P. J., Moya, A., Suárez, J. C., et al. 2004, MNRAS, 352, L11

Merín, B., Montesinos, B., Eiroa, C., et al. 2004, A&A, 419, 301

Piétu, V., Dutrey, A., & Kahane, C. 2003, A&A, 398, 565

Sylvester, R. J., Skinner, C. J., Barlow, M. J., & Mannings, V. 1996, MNRAS, 279, 915

van den Ancker, M. E., de Winter, D., & Tjin A Djie, H. R. E. 1998, A&A, 330, 145