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δ Scuti-type pulsation in the eclipsing and spectroscopic binary HD 172189 in the cluster IC 4756

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Abstract. The binary system nature of the HD 172189 as well as the presence of the pulsating δ Scuti-type component in the system have been discovered. The great interest of this object lies in that three important characteristics coexist: membership of the cluster IC 47456, binary and pulsation. An orbital period of 5.702 d has been found. A frequency analysis of all the *uvby* out-of-primary-eclipse measurements reveals a dominant frequency of 19.5974 c/d as well as high values in the range of 18-20 c/d. In addition, it is located in the FOV of COROT mission, being a good candidate for its observation from space.

Key words. Stars: binaries: eclipsing – Stars: oscillations – δ Sct – Open clusters and association: IC 4756

1. Introduction

HD 172189 (V=8.85, A2) is a member star of the open cluster IC 4756. Different studies using proper motions (Herzog et al. 1975; Sanders 1971; Missana & Missana 1995) demonstrate that the star 93 (numbering system of Kopff (1943)) belongs to this cluster. Its binarity was discovered in the summer of 1997 during observing campaigns carried out for detecting γ Doradus variables in several open clusters (Martín 2003). In order to verify the binary status of the star as well as to confirm the short and small variability of a component, new measurements were collected during 2003 and 2004. A detailed study on the obtained results is reported in Martín-Ruiz et al. (2005). Furthermore, HD 172189 lies close to the star HD 171384, main target in the summer field of view of the COROT mission, and there-

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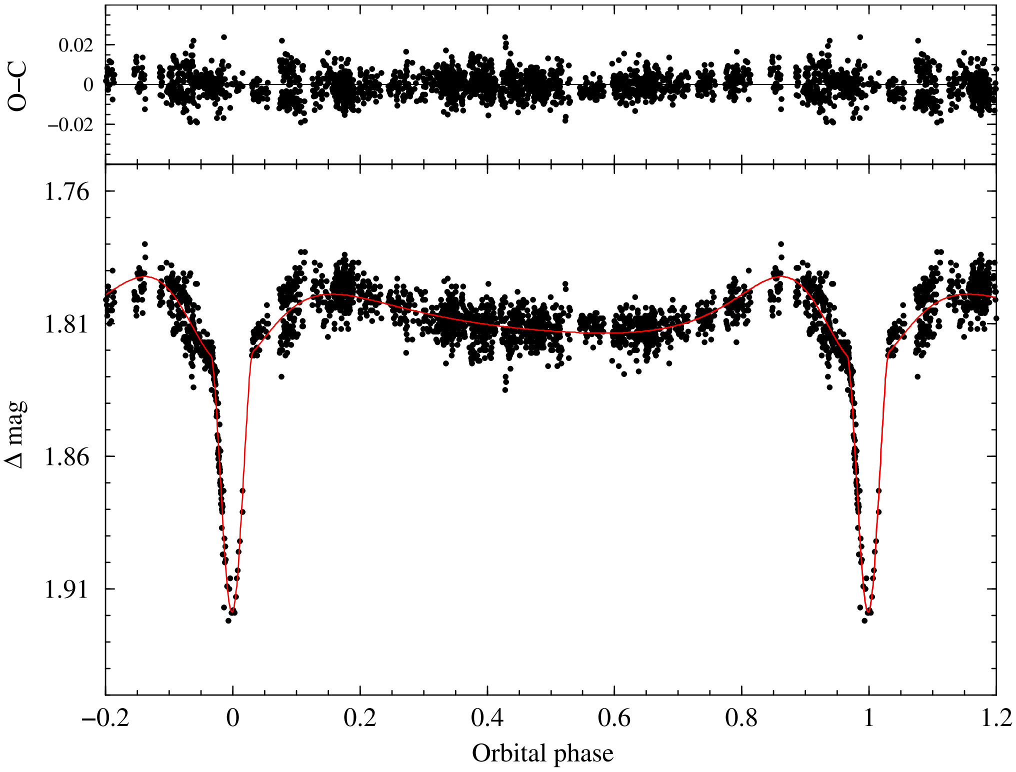

Fig. 1. Differential v light curve of HD 172189 and the (O-C) residuals.

fore, it could be considered as an excellent asteroseismologic secondary target.

2. Observations

The photometric measurements were collected in different campaigns during 1997, 2003 and 2004. The twin Strömgren photometers attached to the 90-cm telescope at Sierra Nevada Observatory (SNO, Spain) and to the 1.5-m telescope at San Pedro Mártir Observatory (SPMO, Mexico) were used to perform this study. Only in summer of 2004, the coordinated observations together with San Pedro Mártir were able to carried out. The comparison and check stars HD 172365, SAO 123720, HD 173369, HD 181414 were employed during the different observing epochs. More than 2500 points in each of the four filters have been taken. Moreover, two closely time spaced, high-resolution spectra were obtained in June 2004 using the FEROS spectrograph attached to the ESO 2.2-m telescope, La Silla(Chile).

3. Results and new observations

A value of the ephemeris $T(\text{min I})$ = HJD2452914.644(3) + 5.70198(4) d was obtained using the method of the Schwarzenberg-Czerny (1996). The primary eclipse depth is of 0.12 mag. The Strömgren v-filter differential magnitude for all data phased with the orbital period of 5.70198 d together with the (O-C) residuals are depicted in the Fig. 1. A first modelling of the photometric light curve was performed employing the Wilson-Devinney program (2003 version) (Wilson & Devinney 1971). The orbital parameters: $e \approx 0.24$, $\omega \approx 68°$ and $i \approx 73°$ were obtained as the best fit to our data. This binary system has two component with different radii $r_2/r_1 \approx 0.6$ but similar temperatures $T_{\rm eff2}/T_{\rm eff1} \approx$

1.05. Concerning to the spectroscopic results, double lines (SB2) have been detected measuring the radial velocities of both component: 63 $kms^{-1}$and -127 $kms^{-1}$for the primary and secondary ones, respectively. Taking into account the radial velocity of the cluster (~ -26 kms^{-1}; Mermilliod & Mayor 1990), we estimated that both components are quite similar in mass ($M_2/M_1 \approx 0.9$) but rather different in luminosity ($L_2/L_1 \approx 0.5$). The small-amplitude oscillations are related to the primary component since it contributes $\sim$70% of the total light. A frequency analysis has been made in the *vby*-filters using all out-of-primary-eclipse data. The frequencies $f_1 = 0.17541$ cd^{-1}corresponding to the orbital period, $f_2 = 19.59740$ $cd^{-1}$and $f_5 = 18.87939$ cd^{-1}have been detected with the highest values in the amplitudes. New photometric and high-resolution spectroscopic observations are planned to verify the physical parameters of the binary system. Such measurements are necessary to identify the oscillation modes of the δ Scuti component.

References

Herzog, A. D., Sanders, W. L., & Seggewiss, W. 1975, A&AS, 19, 211

Kopff, E. 1943, Astronomische Nachrichten, 274, 69

Martín, S. 2003, in ASP Conf. Ser. 292, 59

Martín-Ruiz, S., Amado, P. J., Suárez, J. C., et al. 2005, å, 440, 711

Mermilliod, J.-C. & Mayor, M. 1990, A&A, 237, 61

Missana, M. & Missana, N. 1995, AJ, 109, 1903

Sanders, W. L. 1971, A&A, 14, 226

Schwarzenberg-Czerny, A. 1996, ApJ, 460, L107

Wilson, R. E. & Devinney, E. J. 1971, ApJ, 166, 605