HD 172189: a further step to furnish one of the best laboratories known for asteroseismic studies

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Received September 15, 1996; accepted March 16, 1997

ABSTRACT

Context. HD172189 is a spectroscopic eclipsing binary system, that has a rapidly-rotating pulsating δ Scuti component. It is also a member of the galacic cluster IC 4756. These combined characteristics make it an excellent laboratory for asteroseismic studies.
Aims. To date it has been analyzed in detail photometrically but not spectroscopically. We have compiled a set of spectroscopic data that were taken during 2005 and 2007 and we aim to determine the absolute parameters of the system.
Methods. We determine the radial velocities (RV) of both components using a variety of techniques, such as calculating the Least Squares Deconvolution profiles and determining the RVs by fitting Gaussian functions or calculating the first moments. We disentangle the binary spectra using KOREL, and perform an abundance analysis on both disentangled spectra. We subsequently present combined photometric and spectroscopic results.
Results. Our results indicate that with an inclination of 72.4°, eccentricity of 0.29 and orbital period of 5.70198 days, the components of the system have masses 1.8 and 1.7 $M_\odot$, and radii of 4.1 and 2.5 $R_\odot$. Both components are rapidly rotating and have measured $v \sin i$ = 78 and 74 km s^{-1} , respectively. From the disentangled spectra, an abundance analysis shows [Fe/H] = -0.28 for the primary star, consistent with earlier observations of IC 4756.
Conclusions.

Key words. (Stars:) binaries: spectroscopic – Stars: fundamental parameters (classification, colors, luminosities, masses, radii, temperatures, etc. – Stars: oscillations (including pulsations) (Stars: variables:) δ Sct – Stars: abundances (Galaxy:) open clusters and associations: individual: IC 4756

1. Introduction

Eclipsing and *spectroscopic* binary, *pulsating star*, and *member of cluster* are the characteristics of HD 172189. Each of these provide unique constraints that allow us to test stellar evolution theories in an independent form: a) an eclipsing spectroscopic binary system is fundamental for determining the absolute global parameters of both stars and the system with precision; b) a pulsating star allows us to use the oscillation frequencies to probe the interior of the star, and thereby also determining the evolutionary state; c) cluster membership has the distinct advantage that the properties such as age, metallicity and distance can be well determined. With these combined characteristics, in the ideal case for the study of stellar interior physics, given the constraints imposed by the cluster membership and the binary system on the mass, age, and metallicity of the pulsating star, the observed seismic frequencies can be used to test and improve the current asteroseismic models. For example, because both components are rapidly rotating, we can investigate the effects of rotation, such as the mixing of elements and transport of angular momentum. Several theories have been made regarding rapid rotation, but as yet, observations have not been able to confirm any of these hypotheses. Some examples of these unproved theories include understanding the interplay between rapid rotation and convective cores enabling the transport of angular momen-