

MODELLING PHOTOMETRIC AND SPECTROSCOPIC DATA OF HS 2231+2441: AN HW VIR TYPE SYSTEM WITH A BROWN DWARF COMPANION

L. A. Almeida¹, A. Daminieli¹, F. Jablonski², C. V. Rodrigues², and D. Cieslinski²

We present a photometric and spectroscopic study of the HW Vir system HS 2231+2441. We derived the physical and geometrical parameters of the system and showed that HS 2231+2441 is composed by a low-mass sdB star and a brown dwarf.

HW Vir type systems are an interesting class of eclipsing binaries with only a few known members. These systems consist of a B subdwarf (sdB) plus a low-mass star in a compact orbit ($P_{\text{orb}} \sim 0.1$ days). As eclipsing binary systems provide a straightforward method for measuring masses and radii, they play an important role in present observational efforts and theoretical developments.

In this study we present an analysis of BVR_CI_C photometry and phase-resolved optical spectroscopy of the HW Vir type system HS 2231+2441. Photometric and spectroscopic data were collected using the 1.6-m telescope at Observatório do Pico dos Dias in Brazil and the 4.2-m William Herschel telescope in Spain, respectively. We use the differential aperture photometry for extracting the differential flux of the target and comparison stars. The spectroscopic data were reduced in the standard way using IRAF tasks (Tody 1993) – see Almeida et al. (2012) for more details.

From the spectroscopic data analysis, we derived the radial velocity semi-amplitude $K_1 = 37.8 \pm 0.8$ km/s of the sdB star. Following the same methodology presented in Almeida et al. (2012), we fit simultaneously the photometric and spectroscopic data using the Wilson-Devinney code (Wilson & Devinney 1971), see Figure 1. We obtained the geometrical and physical parameters of HS 2231+2441. With orbital period $P_{\text{orb}} = 2.65$ h, inclination $i = 80.0 \pm 0.3$, and mass ratio $q = 0.17 \pm 0.01$, the components of the system have: $M_1 = 0.190 \pm 0.15 M_{\odot}$, $M_2 = 0.033 \pm 0.3 M_{\odot}$, $R_1 = 0.143 \pm 0.003 R_{\odot}$, and $R_2 = 0.073 \pm 0.09 R_{\odot}$. Therefore, HS 2231+2441 is composed by a low-mass sdB star and a brown dwarf

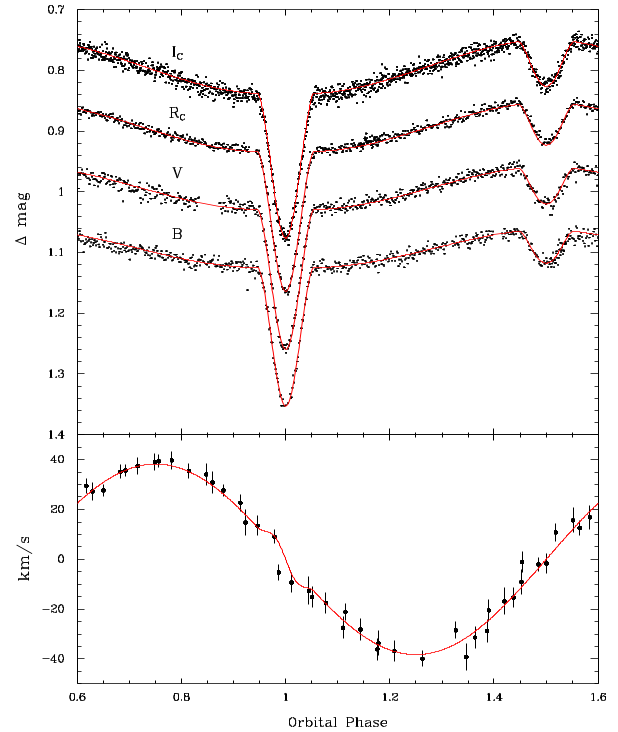


Fig. 1. HS 2231+2441 light curves and radial velocity curve of the sdB star. The best fit obtained using the Wilson-Devinney code is shown with red lines.

as a secondary companion.

Acknowledgements

This study was supported by FAPESP (LAA: 2012/09716-6)

REFERENCES

- Almeida, L. A., Jablonski, F., Tello, J., & Rodrigues, C. V. 2012, MNRAS, 423, 478
 Tody, D. 1993, Astronomical Data Analysis Software and Systems II, 52, 173
 Wilson, R. E. and Devinney, E. J. 1971, ApJ, 166, 605

¹Instituto de Astronomia, Geofísica e Ciências Atmosféricas, Universidade de São Paulo, Rua do Matão, 1226 Cidade Universitária, São Paulo (leonardo-dealmeida.andrade@gmail.com).

²Instituto Nacional de Pesquisas Espaciais/MCTI.