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The reduction of eclipsing binary stars spectra observed at Rozhen Observatory

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Abstract. Several binary stars of Algol type were observed at Rozhen Observatory with 2m telescope using Coude spectrograph. Observations were made from 2001 to 2004. We present the preliminary results of reduction of these spectra.

Key words. Stars: eclipsing – Stars: binary – Spectra: reduction

1. Introduction

In framework of collaboration between some Balkan observatories, non-stationary processes are to being investigated on several eclipsing binary stars of Algol type, which are related to pulsating variability. The ultimate goal of spectra reduction of these stars is to determine the radial velocities, due to revolution and pulsating phenomena. In this paper we present the results of spectra reduction, using suitable software packages-MaximDL and Spe.

2. Observation

For observation six eclipsing binary Algol type stars were selected. Basic data on these stars are given in Table 1. The observations were made by Bulgarian colleagues using 2-m Ritchey-Chretien-Coude (RCC) telescope and the Coude horizontal spectrograph of the National Astronomical Observatory (NAO) - Rozhen (the Rhodopes). The spectra of astronomical objects were taken with dispersion of 10.08 nm px^{-1}. We dispose with CCD-images, in fits format taken in spectral region NaD5895 and MgII4481 during the period from July 2002, to June 2004. A set of observed images consists of biases, flat frames, calibration and stellar spectra.

3. The Reduction

We will briefly present the method of spectra reduction using MaxImDL. First of all, CCD-images contain over scan region that is needed to be averaged over columns and rows. It was subtracted from the image as a constant. Cosmic rays from biases and flat frames were eliminated by taking median of these spectra. But for the stellar spectra, they were removed manually as bad pixels. Flat field and bias reduction was done according to standard procedure. The wavelength calibration and normalization to local continuum were performed using SPE program package. For wavelength calibration the ArTh spectrum was used. The intensity of spectra was normalized to highest peaks in the spectrum, because it was difficult to find the points that belong to local contin-

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Table 1. Some basic data on observed stars

star	**HD**	$\alpha_{2000.0}$	$\delta_{2000.0}$	**V**	**Spectral type**
As Cam	35311	05 29 46.91	69 29 45.4	8.6	A0
Hs Her	174714	18 50 49.77	24 43 11.9	8.61	B6III
Rx Her	170757	18 30 39.26	12 36 40.3	7.27	A0Vvar
V477 Cyg	190786	20 05 27.69	31 58 18.1	8.55	A3Vvar+
V889Aql	181166	19 18 49.84	16 15 00.4	8.59	A
V994 Her	170314	18 27 45.89	24 41 50.7	7.00	B9

Table 2. Identified spectral lines (first column) and their parameters. In the second column we give wavelengths from Moore et al. (1966), in the third wavelengths in our spectra and in the eighth the laboratories wavelengths.

lines	λ_{cat}	λ_{obs}	D	EW	FWHM	$\lambda_{cat} - \lambda_{obs}$	λ_{lab}	$\lambda_{cat} - \lambda_{lab}$
NaI (D2)	5889.973	5889.896	0.45	0.21	0.56	0.077	5889.896	0.077
NaI (D1)	5895.94	5895.834	0.37	0.16	0.51	0.106	5895.828	0.112
Atm.H2O	5918.422		0.13	0			5918.765	-0.343
Atm. H2O	5919.054	5919.124	0.14	0.18	1.65	-0.07	5919.359	-0.305
Atm. H2O	5919.644		0.15	0			5919.958	-0.314
Atm. H2O	5920.56	5920.852	0.05	0.02	0.51	-0.292	5920.887	-0.327
Atm. H2O	5922.519	5922.765	0.1	0.06	0.58	-0.246	5922.843	-0.324
Atm. H2O	5924.272	5923.974	0.14	0.14	1.1	0.298	5924.231	0.041
Atm. H2O	5941.627	5941.3	0.16	0.14	1.02	0.327	5941.531	0.096
Atm. H2O	5968.278	5968.695	0.12	0.09	1.09	-0.417	5968.387	-0.109
Atm. H2O	5969.035	5969.483	0.05	0.03	0.57	-0.448	5969.405	-0.37
Atm. H2O	5970.058	5970.945	0.07	0.03	0.49	-0.887	5970.387	-0.329
Atm. H2O	5971.335	5971.677	0.09	0.05	0.43	-0.342	5971.688	-0.353

uum. Though, it is not important for radial velocity determination.

4. Results

As results of reduction we obtained calibrated and normalized spectra of the target objects. On these spectra we identified two resonant sodium lines - D1 and D2. Furthermore, by visual inspection and comparison of our spectra with spectra of field stars of different spectral types we also identified eleven telluric lines in target stellar spectra. The corresponding wavelengths of identified telluric lines were taken from the Table of solar spectrum wavelengths (Moore et al. 1966). The parameters (equivalent width, EW, full width at half maximum, FWHM, and central depth, D) of line profile were measured using the SPE program package. These data are given in Table 2. We recalibrated the target spectra using telluric lines as wavelength standards (λ_{obs}) and compared the results with those that were obtained from ThAr spectrum (λ_{lab}). The corresponding wavelengths and their differences between wavelengths from Table of solar spectrum wavelengths (Moore et al. 1966) are presented in Table 2 (column 7 and 9). The statistics of these differences show that laboratory spectrum provide smaller errors of wavelength measurements than telluric lines (standard errors are 0.21 Å and 0.36 Å respectively). It could be refer to lower signal to noise ratio in stellar spectra than in laboratory spectra.

References

Moore, Ch. E., Minnaert, M. G. J., Houtgast, J. 1966, The Solar Spectrum 2935 A to 8770 A, National Bureau of Standards Monographs 61, Washington, D.C.