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LINE IDENTIFICATION IN SOME ALGOL–TYPE STARS

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Abstract. Several binary stars of Algol type were observed at National Astronomical Observatory–Rozhen with 2m telescope using Coude spectrograph. Observations were made from 2002 to 2004. We present the preliminary results of reduction of these spectra and identification of some spectral lines.

1. INTRODUCTION

In the framework of International Basic Sciences Programme of collaboration between some Balkan astronomical institutions (Project: Eclipsing Binary Stars - EBS), non-stationary processes are being investigated on several eclipsing binary stars of Algol type, combining spectroscopic and photometric data. The ultimate goal of spectra reduction of these stars is to determine the radial velocities due to revolution and pulsating phenomena. The spectrum of these stars is usually a mixture of lines from different sources (components of the binary system, accretion disks, jets, dark and bright spots, circumstellar envelopes, interstellar gas, Earth atmosphere etc.). For successful separation and examination of these sources it is necessary to identify the spectral lines. In this paper we present preliminary results of spectral line identification of five observed stars.

2. OBSERVATION AND REDUCTION

The basic data on selected stars is given in Table 1. The observations were made by Bulgarian colleagues using the 2-m Ritchey-Chretien-Coude (RCC) telescope and the Coude horizontal spectrograph at the National Astronomical Observatory (NAO) -Rozhen. These observations were made in two, approximately 200 Å wide, spectral regions of interest: in the range around prominent ionized magnesium (MgII) line at 4481 Å and in the neighborhood of D1 and D2 sodium lines (5900 Å) from July 2002 to June 2004.

Table 1: Basic data of observed stars

Star	HD	α_{2000} h m s	δ_{2000} ^{o} ' "	V	Spectral type
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+
V889 Aql	181166	19 18 49.84	16 15 00.4	8.59	A
V994 Her	170314	18 27 45.89	24 41 50.7	7	B9

The reduction of spectra (flat field, bias, dark signal, cosmic rays) was done at the Astronomical Observatory in Belgrade, according to the standard procedure. The ArTh spectrum was used, for the wavelength calibration.

3. IDENTIFICATION OF LINES

In the course of the spectra reduction, by visual inspection and comparison of our spectra with spectra of field stars, we identified D1 and D2 sodium lines (which we believe originate in interstellar gas), as well as eleven telluric lines (Lalović and Vince, 2005). Using these as reference points, we managed to identify the lines belonging to the stars themselves, by a method of coincidence - trough comparison with synthetic spectra.

To reduce statistical fluctuations, the observed spectra of each star were averaged throughout the observations made on the same night. Then we compared the averaged spectra with synthesized spectra using our program "Isaac". Isaac uses Spectrum program package and Kurutz stellar models to produce synthetic spectra. The line list was taken from the NIST database. To confirm our identification further, we compared our stellar spectra with spectra of field stars of appropriate type.

4. RESULTS

In the spectral region around D1 and D2 sodium lines, we identified with certainty only one neutral helium line at 5876 Å; further observations of greater quality might reveal more lines.

In the magnesium region we identified more than 20 lines, mostly of ionized iron and titanium, as well as some lines of ionized manganese (MnII), magnesium (MgII), and chrome (CrII). A feature of some interest for further study appeared in the spectrum of V889 Aql, where the lines of both components are visible (Fig. 1).

The lines identified in the spectra of the stars V477 Cyg, V889 Aql, Rx Her, HS Her and V994 Her are listed in Table 2, showing the observed (λ_{obs}) and referent (λ_{ref}) wavelengths, and their differences ($\lambda_{obs} - \lambda_{ref}$). Since many lines apper in spectra of more than one star, the names of reffered stars are given in the last column.

Table 2: Identified spectral lines

Emitter	λ_{obs}[Å]	λ_{ref}[Å]	$\lambda_{obs} - \lambda_{ref}$[Å]	Star
TiII	4395.59	4395.040	-0.545	V889 Aql, V477 Cyg
TiII	4397.63	4399.778	2.151	V477 Cyg
FeI	4405.30	4404.761	-0.540	V889 Aql, V477 Cyg
FeI	4412.96	4415.130	2.167	V477 Cyg
TiII	4444.36	4443.812	-0.552	V889 Aql, V477 Cyg
FeII	4445.50	4447.807	2.311	V477 Cyg
TiII	4469.02	4468.500	-0.521	V889 Aql, V477 Cyg
HeI	4469.81	4471.479	1.667	V994 Her
HeI	4388.23	4387.929	-0.305	HS Her
MgII	4479.74	4481.226	1.489	V994 Her
MgII	4481.24	4481.226	-0.012	HS Her
MgII	4481.78	4481.226	-0.556	V889 Aql, V477 Cyg
FeII	4491.87	4491.400	-0.471	V889 Aql
TiII	4501.84	4501.273	-0.567	V889 Aql, V477 Cyg
FeII	4508.76	4508.288	-0.471	V889 Aql, V477 Cyg
FeII	4515.82	4515.339	-0.476	V889 Aql, V477 Cyg
FeII	4520.75	4520.224	-0.526	V889 Aql, V477 Cyg
FeII	4523.12	4522.634	-0.483	V889 Aql, V477 Cyg
TiII+FeII	4534.45	4534.069	-0.379	V889 Aql, V477 Cyg
FeII	4542.06	4541.524	-0.531	V889 Aql
FeII+FeII+TiII	4547.80	4549.428	1.628	V994 Her
FeII+FeII+TiII	4550.00	4549.428	-0.573	V889 Aql, V477 Cyg
FeII	4556.60	4555.893	-0.703	V889 Aql, V477 Cyg
CrII	4559.12	4558.650	-0.466	V889 Aql, V477 Cyg
TiII	4564.17	4563.761	-0.412	V889 Aql, V477 Cyg
TiII	4572.36	4571.968	-0.392	V889 Aql, V477 Cyg
FeII	4576.71	4576.340	-0.368	V889 Aql, V477 Cyg
HeI	5874.35	5875.620	1.274	HS Her
NaI(D2)	5889.98	5890.000	0.016	V994 Her, RX Her
FeII	5891.91	5891.329	-0.579	RX Her
CII	5891.93	5891.598	-0.335	HS Her
FeII	5893.36	5891.329	-2.031	RX Her
NaI(D1)	5895.79	5895.900	0.108	V994 Her, RX Her
SiII	5958.56	5957.559	-1.005	RX Her

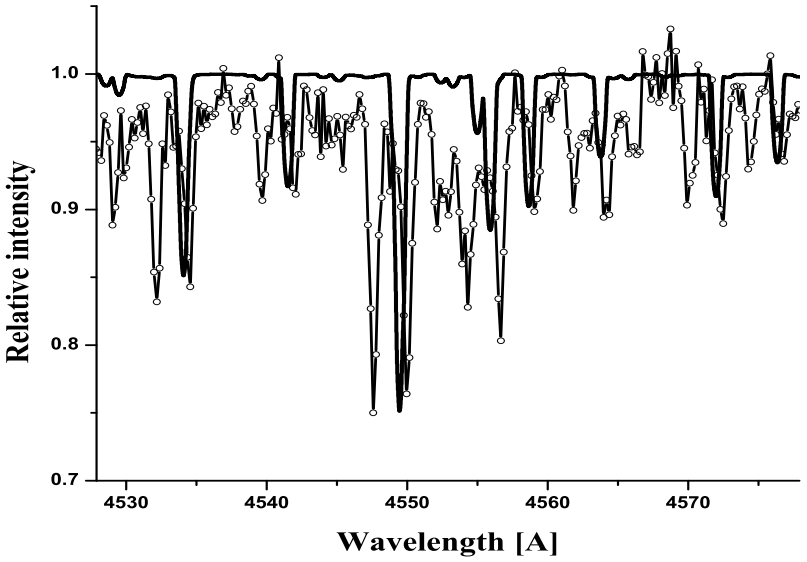

Figure 1: Observed (line with open circles) and synthetic (solid line) spectrum of V889 Aql.

The spectrum of RX Her is observed only in spectral region of D1 and D2 sodium lines. No positive evidence of the He I 5876 Å line is found in this spectrum.

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