

**SPECTROSCOPIC OBSERVATIONS OF UU Cas –
PRELIMINARY RESULTS**

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Abstract. High dispersion ($R = 30000$) spectra of the eclipsing binary system UU Cas are presented for the first time. Spectra covering 15 different phases were taken in two spectral regions - the vicinity of H_{α} and another centered on 5800\AA . Seven spectral lines were identified in common. Four of them belonging to the brighter component were used to construct radial velocity curve. Some constrains on the spectral classification of the components are presented.

1. INTRODUCTION

The photometric variability of UU Cas ($V = 10.4$ to 10.8 mag) has been discovered by Luizet(1913) who classified the star as a Cepheid with a period of about 4 days. While Martin and Plummer (1921) assigned the same period to the light variations observed by them in the interval 1917-21, Seliwanow (1931) announced a period that is 4 time longer. On the other hand, Sanford (1934) established periodic variations in the radial velocity and argued this variability can be reconciled with the light variations if a period of 8.520676 days is to be assumed. Consequently, he classified UU Cas as a single-lined eclipsing binary, a result that was additionally supported by the spectral type: BI (Sanford, 1934) or B0.5 III (Martin, 1972).

While the work of Sanford was the first and the last spectral investigation in the history of UU Cas, its photometric behaviour was studied many times by different authors (see e.g., Polushina, 2002; Kumsiashvili et al. 2009 and references therein). The newest and the most thorough analysis of this kind is that of Polushina, who was monitoring the system in the UBVR for about 5 years (1984 – 1989). Based on these data she determined the orbital parameters of the system and put constrains on the masses and radii of the two components. In addition, suggestive evidence for the presence of a common for the binary system envelope which contributes significantly to the observed light curve was also derived.

Motivated by the above outlined, a long-term spectral monitoring campaign of UU Cas has been started by our group with the primary goal to refine and if possible to

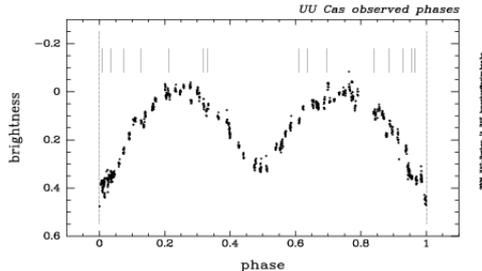


Figure 1: The light curve of UU Cas as derived by Kumsiashvili (2009) with vertical lines corresponding to the phases of our spectral observations.

disentangle the contribution of the stellar components into the radial velocity curve. In case of success this will enable us to derive more accurate estimates of the orbital and physical parameters, and to check the presence of an accretion disk about the secondary star suggested by one of us (G.Dj.) and to investigate its characteristics.

2. OBSERVATIONS AND RESULTS

In this contribution preliminary results based on coude spectra ($R = 30000$, S/N from 50 to 150) obtained with the 2m telescope of the Bulgarian National Astronomical Observatory since the beginning of 2008 are presented. The phases covered by our observations are shown in Fig. 1. Spectra taken within about two hours were averaged to improve the S/N ratio¹. Consequently, 15 spectra centred on 5800 \AA with a typical S/N ratio of about 120, and 5 - in the vicinity of H_α with a typical S/N ratio of about 160 were obtained. All spectra were reduced and analyzed using standard IRAF routines.

The spectra ordered by phase are illustrated in Figs. 2 and 3. On the top of each figure the identified stellar lines are given. In order to guide the eye, the positions of the lines, determined by the corresponding laboratory wavelength, are marked with vertical dashed lines. Three things become immediately apparent from these figures: (i) at some phases the profiles of HeI lines are clearly splitted due to the contribution of the secondary component; (ii) the H_α profiles show strong and variable emission component; and (iii) the four metal lines do not show clear line splitting which might indicate these lines originate from one of the components only.

To test the last possibility, the radial velocities and line widths at continuum level of $SiIII$ 5739.8\AA , NII 5710.8\AA , NII 6482.1\AA and $FeIII$ 5722.5\AA were measured and analyzed. It was found that for a given spectrum/phase the V_r values of individual lines are practically identical (within the error) and that for a given line the phase behaviour of its line width is quite stable (within 30 percent). Thus, and at least at present, we believe these four lines more likely represent the contribution of one of the two stellar components in the UU Cas system. Guided by this result, we averaged

¹Given the relatively long orbital period of the system, the influence of this manipulation on the results presented in this contribution is expected to be insignificant.

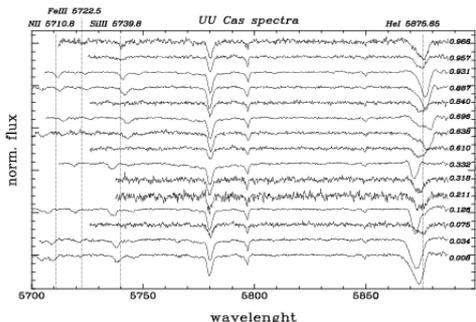


Figure 2: The set of spectra centered on 5800 Å with a wavelength scale corrected for the Earth motion.

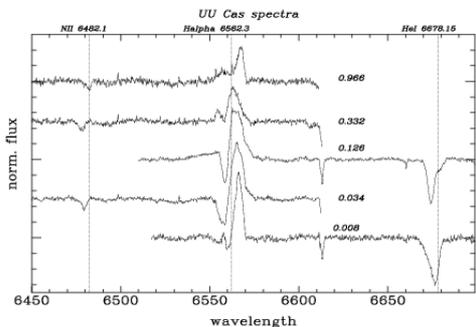


Figure 3: The set of spectra in the region of H_{α} with a wavelength scale corrected for the Earth motion.

the radial velocities of the individual metal lines and constructed the radial velocity curve of UU Cas shown in Fig. 4. Approximating the distribution of the points with a curve we estimated the semi-amplitude to be of about 200 km s^{-1} . This value exceeds by about 25 % the one derived by Sanford (1934). In addition, we evaluated the system barycentre velocity to be between -20 to -30 km s^{-1} that is a factor of 2 to 3 lower than the estimate of -56 km/s derived by Sanford. Since Sanford does not provide any information which spectral lines have been used to derived the radial velocity curve, these results is difficult to interpret.

Finally, let us point out that though quite limited by number the identified stellar lines allow us to put some constraints on the spectral type, luminosity class of the components and/or the presence an accretion disk in the UU Cas system. In particular:

- the presence of *SiIII* and *NII* suggests an early-B spectral type for the primary; the relatively strong *NII* lines may indicate an evolved luminosity class I object.

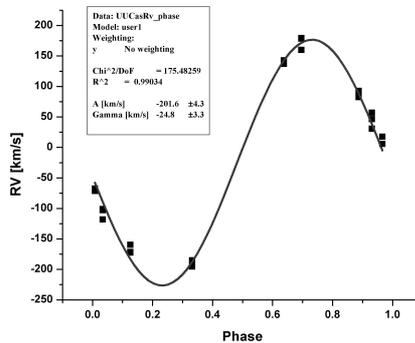


Figure 4: Radial velocity curve of UU Cas as derived in the present study. Each point is a mean value for at least 3 stellar lines with an error of less 12 km s^{-1} .

- the observed splitting of *HeI* lines suggests a spectral type between mid-O to late B for the companion. The lack of clear line splitting in *SiIII* (if real) would support the O-type classification. However, no evidence for the presence of either *HeII* 6527 or *HeII* 6683 was found on the available spectra. This fact could be explained supposing the presence of an optically thick, relatively cool accretion disk around the companion. Since this disk hides a great part of the companion these spectral lines are not detectable.

High quality observations in a wider spectral range (e.g., from 4000 to about 7000Å), covering as many phases as possible are needed to solve the points raised by the results outlined above. Such observations have been planned by our group

Acknowledgments

This investigation is supported partly by the Bulgarian National Science Foundation contracts - DO 02-85 and DO 02-362 (SMARTNET) and by the Ministry of Science and Technological Development of the Republic of Serbia through the project "Stellar and Solar Physics" (No. 146003).

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