Amateur and Professional Researches at the Ankara University Observatory

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Abstract This study focuses on the observations carried out at the Ankara University Observatory by professional astronomers, student research groups, and amateur astronomers. The idea is to encourage students and amateur astronomers who are interested in observations of variable stars, and bring the amateurs and professionals together. The Astronomy Research Student Group of Ankara University (ASART) has an important role as an interface between amateur and professional astronomers in Ankara, Turkey. In this study we have briefly summarized the types of ongoing observational projects at the observatory and have provided some examples.

1. Introduction

Amateur Astronomy is getting closer and closer every day to professional Astronomy through efforts of persons who have dedicated their life to astronomy like Dr. Janet Akyüz Mattei. Dr. Janet put enormous time, energy, and her love to build a well-organized community to improve abilities and understanding of future generations in Astronomy. The Astronomy Research Student Group of Ankara University (ASART) aims to catch Dr. Janet's dream of joining the experiences of amateur and professional astronomers and create a common ground to work together. ASART consists of mostly astronomy students under the supervision of professionals from our department and periodically organizes star parties, public events, meetings, observation projects, and summer schools.

As ASART, we initially focused on obtaining photometric observations of eclipsing binary stars and participated in several observational projects at the Ankara University Observatory.

For more than three years, we observed some selected eclipsing binaries that show orbital period changes and light curve anomalies due to solar-like dark spots on their surfaces. In this context we put two published examples here; the light variations of SW Lac (Albayrak *et al.* 2004) and orbital period changes of TX Her (Ak *et al.* 2004) in Figures 1 and 2, respectively.

Very recently, we have started a new project with support of professionals at the observatory on observations and analysis of the intrinsic variable (pulsating) stars. This project brings a lot of experience to the student amateurs in exploring the nature of variable stars. As an example of our recent study we include the UBV light curves of RR Lyr which is a well-known pulsating variable prototype (Figure 3). In the following sections we shall briefly summarize our findings.

2. The light curve of SW Lac

SW Lac (BD +37° 4717, $V_{max} = 8.91$) is a short period ($P = 0.32$) W UMa-type eclipsing binary which has a variable and asymmetric light curve. The system was observed in *BV* passband for the observing seasons of 2001, 2002, and 2003. To explain the light-curve asymmetries and the different maximum light levels in the seasonal light curves, we used a Roche model that involved regions containing spots on the components. The analysis shows that SW Lac is in an overcontact configuration with a relatively high degree of overcontact, $f = 31\%$. The Roche model with spotted areas on the more massive and cooler component yields a good fit of the observations for the whole set of the seasonal light curves (see Figure 1), without any changes of the basic system parameters. This indicates that the complex nature of the light-curve variations during the examined period can be explained by the changes of spotted areas on the cooler component, which cover a significant part of the stellar surface.

3. The O–C variation of TX Her

TX Her (BD +42° 2823) is an Algol-type eclipsing binary with an orbital period of 2.0598 days. The study, based on the extensive series of minima times covering almost a century (95 years), indicates the periodic O–C variation for the system (Figure 2). This continuous oscillatory variation covers two maxima, about 16,800 orbital periods, by the present observational data. It can be attributed to the light-time effect due to a third body with a period of 51.47 years in the system. The analysis yields a light-time semi-amplitude of 0.014 day and an orbital eccentricity of 0.81. Adopting the total mass of TX Her, the mass of the third body assumed in a co-planar orbit with the binary is $M_3 = 0.48$ M and the semimajor axis of its orbit is $a_3 = 18.32$ AU.

4. The new photoelectric observations of RR Lyr

RR Lyr (BD +42° 3338) is a well-known prototype of the intrinsic variable (pulsating) stars. The *UBV* observations of RR Lyr were carried out on six nights (indicated on the left-upper corner of Figure 3) in 2004 at the Ankara University Observatory using a SSP5 photometer head which contains a Hamamatsu R1414 photomultiplier tube attached to 30-cm Maksutov telescope. BD+42° 3331 and BD+42° 3334 were used as the comparison and check star, respectively. A total of 130 observing points in each passband was obtained and reduced to a nightly base. The *UBV* light curves are presented in Figure 3. The analysis of the light curves is still in progress.

5. Acknowledgements

This study is dedicated to Dr. Janet Akyüz Mattei.

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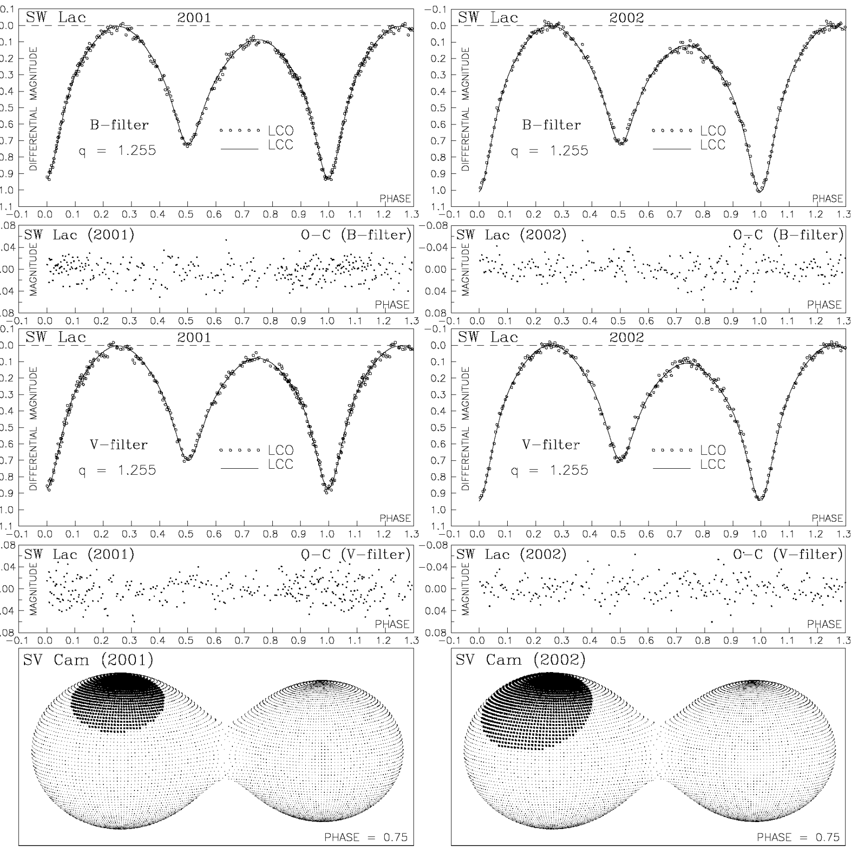

Figure 1. Modeling the changing spot features of SW Lac (Albayrak *et al.* 2004).

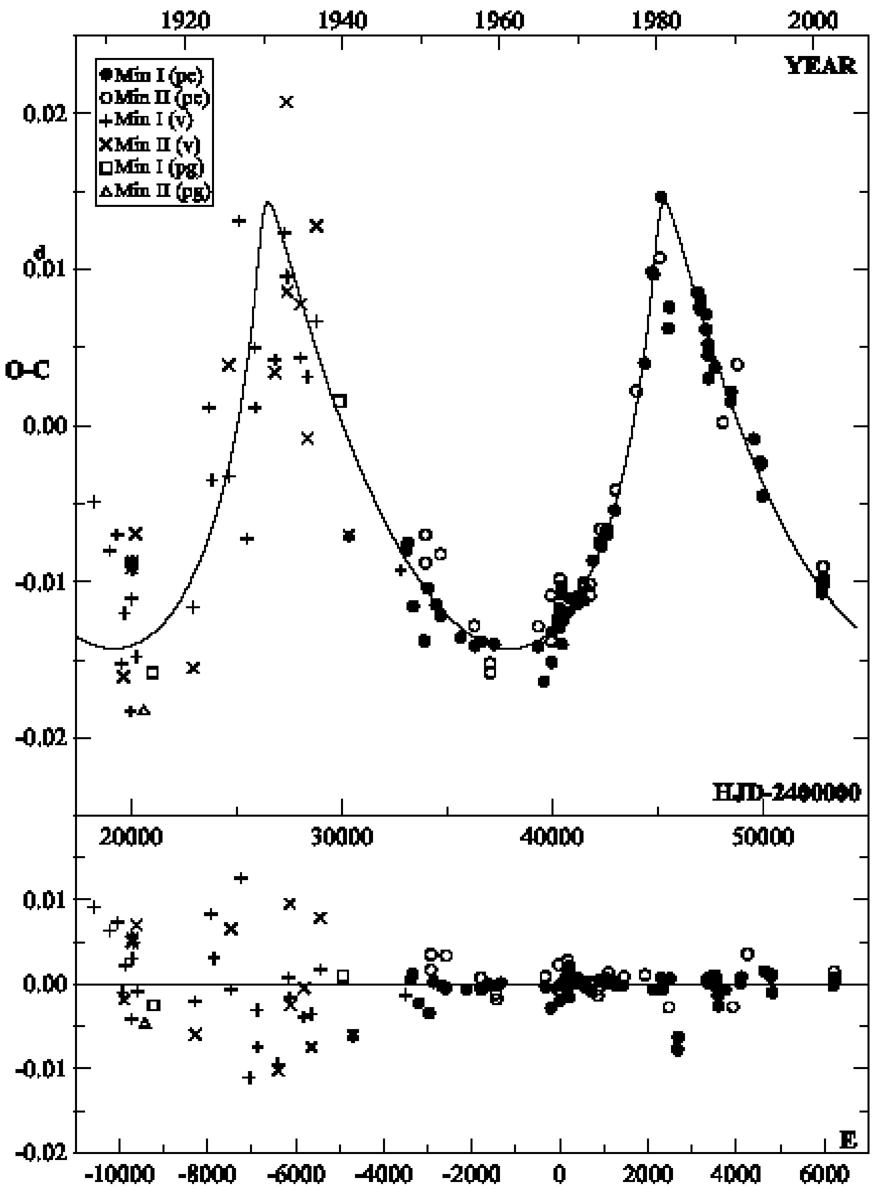

Figure 2. The O–C diagram of TX Her obtained with visual and photographic minima times prior to 1949 and photoelectric ones since. The continuous curve presents the theoretical light-time effect of the hypothetical third body. In the bottom panel, the O–C residuals are plotted after the subtraction of all terms in the light-time equation (Ak *et al.* 2004).

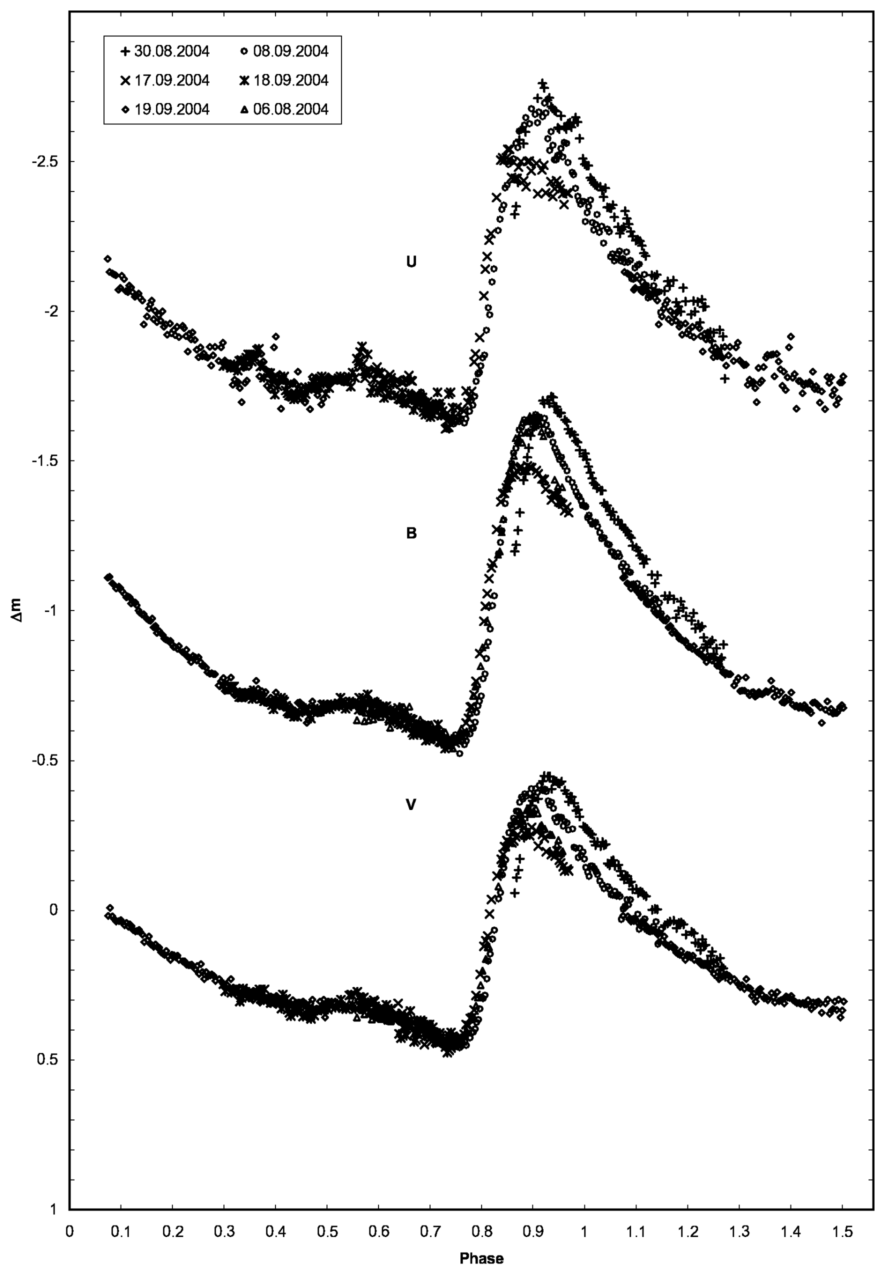

Figure 3. *UBV* light curves of RR Lyr (ASART 2004).