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30 years of observations of eclipsing variable stars

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The results of observational photometric and spectral investigations of eclipsing variable stars are presented. The observations were executed by the author with telescopes of Kourovka Astronomical Observatory of the Ural Federal University (UrFU) and Special Astrophysical Observatory of Russian Academy of Sciences (SAO RAS).

Keywords: Stars: eclipsing binary stars, variable stars, photometrical observations

1 Introduction

The investigations of eclipsing variable stars in Kourovka Astronomical Observatory were initiated by Mariy Anatolyevich Svechnikov in the mid-sixties of the last century. As a rule, the investigations were based on the observational data obtained with telescopes of the observatory. Generally they were electrophotometrical observations.

One of the observational targets was to gain light curves of the variable stars – components of visual double stars. In this case observational data were obtained with the application of area scanning technique for the first time proposed by Franz (1966) and Racosh (1965) and further developed by the author. For this purpose the single-channel electrophotometer of the telescope reflector AZT-3 ($D = 0.45$ m, $F = 11$ m) equipped with the image scanning block was used.

2 ADS 9537 (BV Dra, BW Dra)

Visual double star ADS 9537 ($\rho = 16.3''$) became the first object that was scanned. In the course of observations it proved that both components of ADS 9537 (BV Dra and BW Dra) are eclipsing variable stars of W UMa type. Obtained light curves for BV Dra and BW Dra were mutually rectified of the light of the neighbor. The analysis of these observations allowed us to make a conclusion about orbital coplanarity of these two eclipsing binaries in ADS 9537 (Gorda (1986, 1990)).

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3 ADS 11061

The next object of photometric scanning was ADS 11061 which is visual double system with $\rho = 19''$. The observations started in 1993 have revealed that one of components of this system is spectrally double star included in the catalog of stars suspected on brightness variability under number of NSV 10205. This research allowed us to estimate values of brightness for both components of ADS 11061 but the brightness variability of the spectral binary component was not found (Gorda and Popov (1994)).

4 ADS 8347 (DN UMa)

In April, 1993 scanning photometric observations were initiated for the multiple system ADS 8347ABC ($A - B = 0.3''$, $AB - C = 3.8''$). For the first time the direct photometric method of observations permitted to identify eclipsing variable DN UMa with the ADS 8347A component (Gorda (1994a)). Later this result was confirmed by M. Drozdz (1997).

5 ADS 2984 (SZ Cam)

Then the scanning photometric observations were addressed to SZ Cam – eclipsing variable star with massive components of early spectral classes. SZ Cam being a northern component of a visual double star of ADS 2984 have been observed in Kourovka Astronomical Observatory covering the period from 1996 to 2007. The observations of light curves for SZ Cam were performed in $UBVR$ filters (Gorda (2000)) and then were supplemented with spectral and speckle interferometric data obtained in the period of 2000–2003 on telescopes Zeiss-1000 ($D = 1$ m) and BTA ($D = 6$ m) at SAO RAS in 2000–2003.

As the result of new speckle interferometric and photometric observations of the eclipsing binary SZ Cam, performed on the six-meter telescope at the SAO RAS, and the AZT-3 telescope of the Kourovka Astronomical Observatory (UrFU) and analysis of the data taken from the literature, a complete set of parameters for the apparent relative orbit of the third body was determined for the first time. The mass of the third body, $M_3 = 23.4\,M_\odot$, and the distance to SZ Cam, $d = 1125$ pc, were estimated. The duality of the third body was also confirmed. The results led to the assumption that SZ Cam is hardly a member of open star cluster NGC 1502, on the center of which it is projected (Gorda (2002), Gorda et al. (2007, 2007a)).

6 New variable 3UC 281-203711

During the monitoring the young irregular variable V645 Cyg the new variable star 3UC 281-203711 ($21^h39^m52^s.40{+}50^\circ18'26''.0$, (2000.0), $V = 12.4^m$) was discovered at the Kourovka Astronomical Observatory (UrFU). Observations were carried out with the telescope reflector ($D = 0.45$ m, $F_{\rm newton} = 2.0$ m) equipped with Alta-U6 CCD

camera (Kodak KAF-1001E, 1048×1048, 24-micron chip). The first decrease of the brightness of 3UC 281-203711, by 0.08 mag, was recorded on $JD_{\odot}2454966.3$. It means that 3UC 281-203711 is an eclipsing system. Its light curve corresponds to Algol type and has obvious ellipsoidality effects. A solution of the light curve was obtained with the PHOEBE package. Realizations of the Wilson–Devinney's light curve analysis method and of the Nelder–Mead simplex method for the search of optimum solution were also used. The whole set of system parameters was found (Gorda and Sobolev (2011, 2012)).

7 CC Cas

The first-ever CCD spectroscopic observations of CC Cas were carried out during the period from March 30, 2011 through March 29, 2012 using the high-resolution fiber-optical echelle spectrometer (Panchuk et al. (2011)) ($R = 30000$) of the new alt-azimuth telescope ($D = 1.21$ m, $F = 12.0$ m) of the Kourovka Astronomical Observatory on the base of UrFU (Gorda et al. (2011)). The measured semi-amplitudes of the radial velocity curves of the components proved to be equal to $K_1 = 123.9$ km/s and $K_2 = 292.4$ km/s, and were in a good accordance with the other published data. The center-of-mass velocity of the system was found to be $V_0 = -20.4$ km/s, which is about -10 km/s greater than the earlier published results. This fact may support the early published hypothesis about the presence of a third body in the system (Gorda (2013)).

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