

New Orbital Spectral and Eclipsing Binary System BD -20 4369

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Introduction.

BD -204369 was found to be an Algol-type eclipsing binary from the 2007 MOST photometry [1]. Because of its southern location it's rather difficult to obtain precise photometric data in our conditions. Secondary minimum occurs at phase 0.5 indicating a circular orbit for this system which seems to be a detached binary. BD -20 4369 was observed during ASAS program, but was not identified as a variable – see Fig. 4.

Observations and their first analysis.

Photometric observations were made in 2015-2019 with Zeiss-600 and Zeiss-1000 telescopes in Simeiz Observatory of INASAN on mt.Koshka(Crimea). We used CCD camera FLI PL09000 with BVRc filter set mounted on 1-m reflector and VersArray512UV with UBVRIc filters and 60-cm telescope. We've obtained measurement during 31 nights in 2014–2019 years. Observations were processed using the software package Maxim-5DL, situated on the same frame with the variable served as the reference. We analyzed photometric data using the methods described in our earlier works (see [2]). Magnitudes of variable star were derived by observing HD142640 [8] as standard star. All observations were corrected for differential atmospheric extinction. Example of observed light curve in V is presented in Fig. 1.

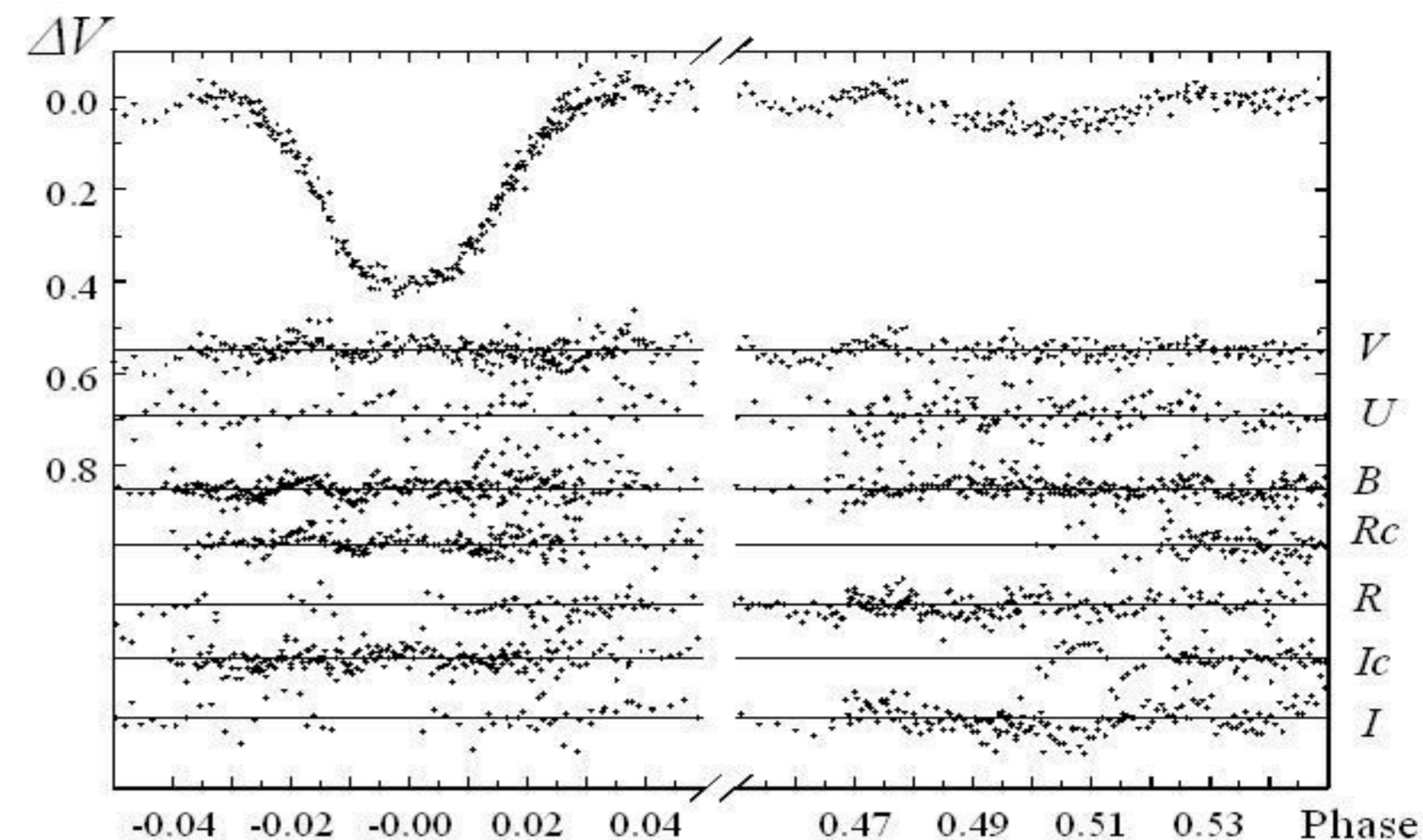


Fig. 1. Light curve in V of BD -20 4369, and O-C in VUBRcRIc photometric bands.

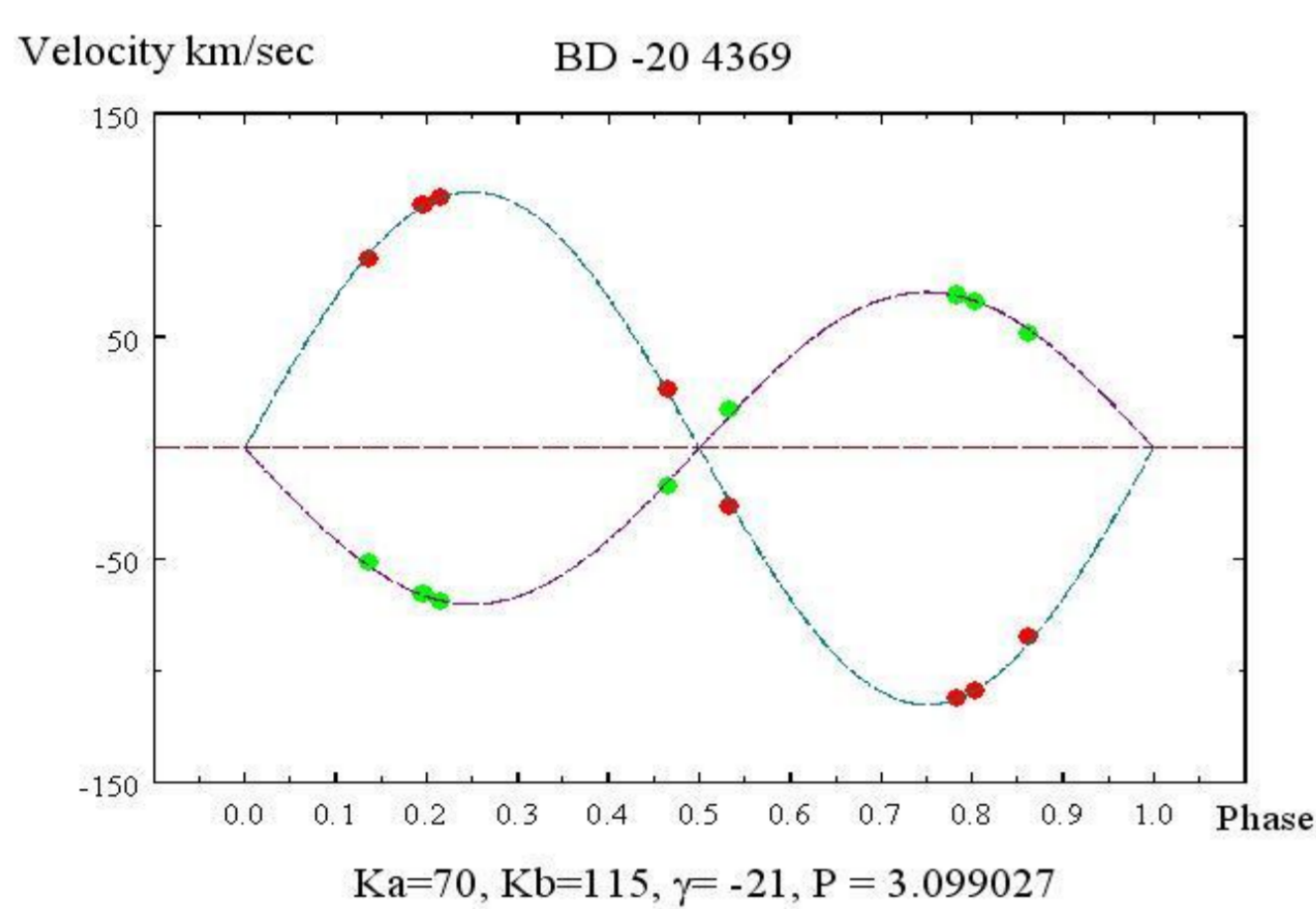


Fig. 2. Radial velocity curve for both components

Orbital motion of the components.

We have 4 spectra of BD -20 4369 observed on LCO observatory in Chile with eshelle spectrograph in 2008. Spectra of IN Vir were analyzed using the broadening-function (hereafter BF) technique developed by Rucinski [3]. The BFs have been extracted in the 4900-5510 Å spectral range (free of hydrogen Balmer lines and telluric lines). The extracted BFs clearly show two components. The curve of radial velocities is presented in Fig. 2. Mass center velocity is equal to -21.1 ± 0.2 km/s

	Primary	Secondary
K, km/s	70	115
R	0.0575	0.167
Lv	0.387	0.613
u	0.557	0.76
i, deg	82.25	
a, R _*	11.467	

Table 1. The result of light curve solution.

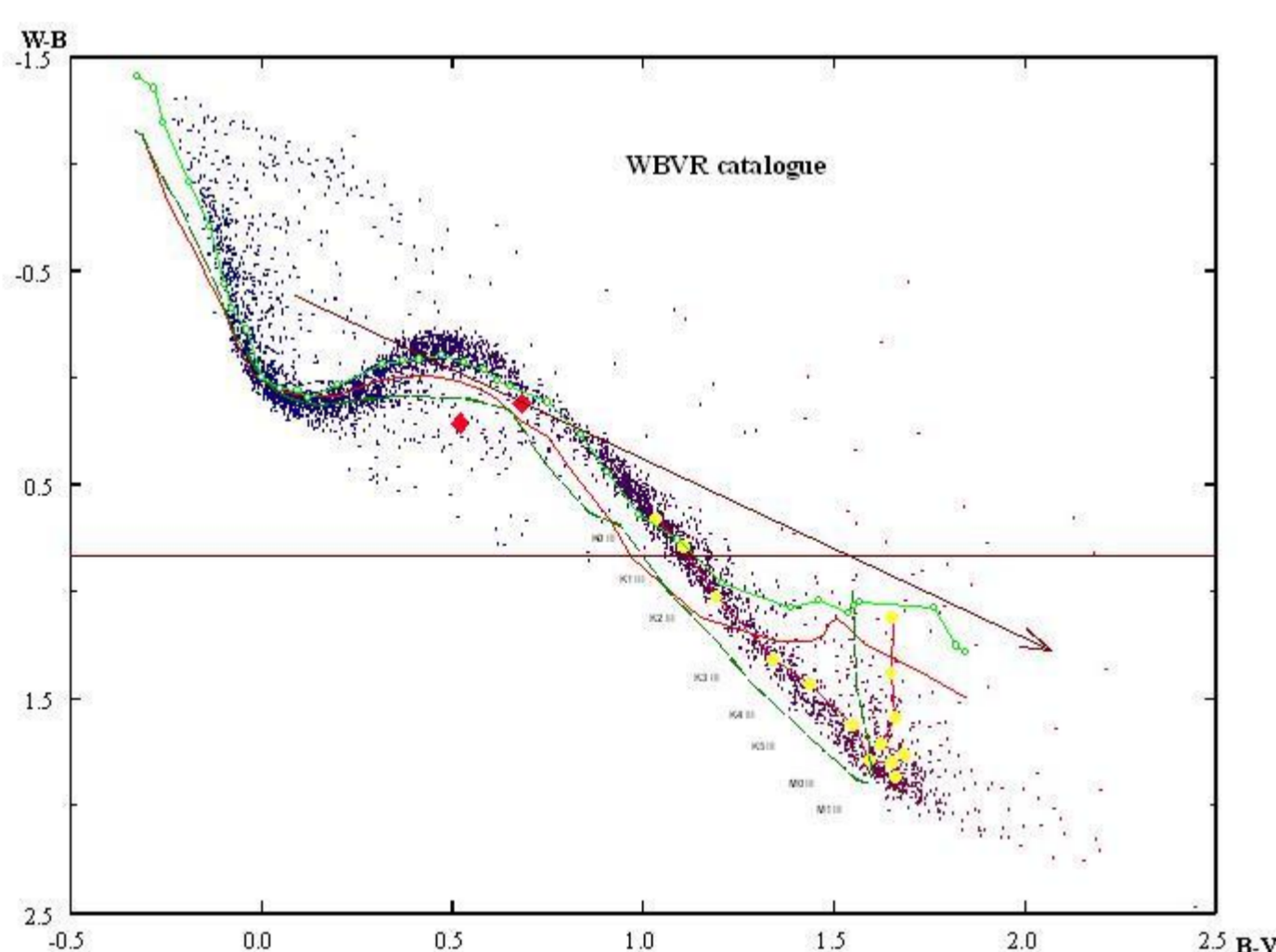


Fig. 3. A two-colour (W-B, B-V) diagram constructed with the data from catalogue [5]. Yellow and green lines designate the third and the fifth luminosity classes according to [7]. Observed positions of the variable and of the comparison stars are denoted by red squares. Straight arrow stays for interstellar reddening.

Light curve solution

We derive period as $P=3.099035$ days, the same for primary and secondary minima.

The position of the variable star in a two-colour (U-B, B-V) diagram, shown in Fig. 3, indicates a strong interstellar absorption: $E(B-V)=0.22$. Relative parameters for our light curve solution are presented in Table 1.

To derive the absolute parameters of the binary from the third Kepler's law in combination with mass-luminosity relation one should find the temperatures of the components. From (U-B, B-V) diagram, Fig. 3, we get temperatures for components from [4, 5] calibration – see Table 2

We are able to derive absolute masses and radii of components from light curve solution – see Table 2

Such masses and radii indicate that BD -20 4369 is strongly evolved stellar system after the first mass exchange.

	Primary	Secondary
M/M	1.314	0.80
R/R	0.659	1.91
Log g	4.511	4.002
L/L	0.705	1.79
T, deg	6525	4770
Mbol	5.069	4.057
Mv	5.050	4.482
π''	0.0082	
a, R	11.467	

Table 2. Absolute parameters of components

Conclusion

High-precision spectral and photometric observations of BD -20 4369 have been carried out, which have made it possible to determine the reliable parameters of the system: masses, velocities, sizes, temperatures of the components. The period of the orbital motion of the binary star is specified.

Acknowledgements.

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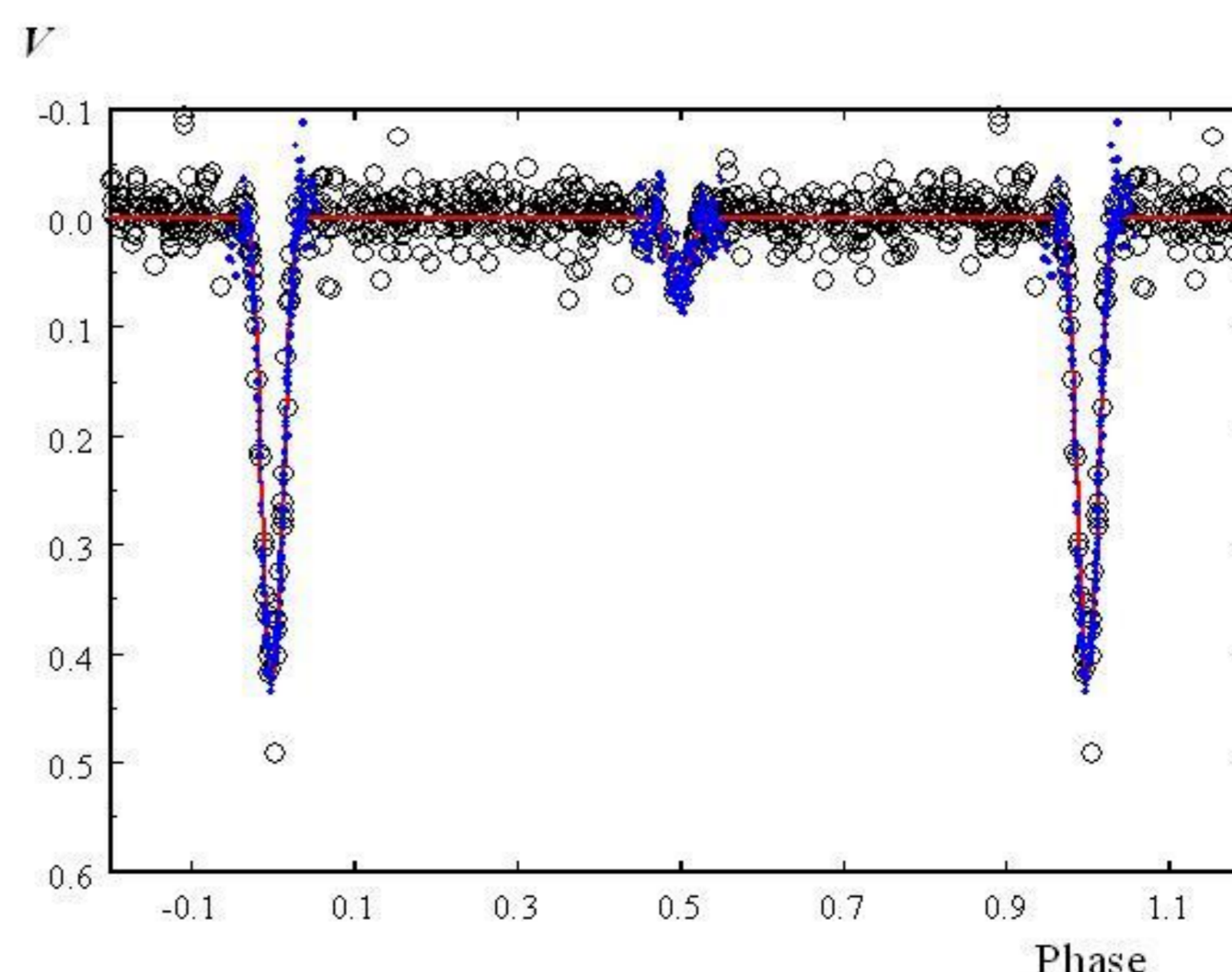


Fig. 4. General view of light curve. Black empty circles – ASAS data. Blue points – our photometry in V. Red line is our solution.