STATISTICAL RESTORATION OF SECONDARY MINIMA DEPTHS FOR ECLIPSING VARIABLE STARS AND SPECIFICATION OF THEIR EVOLUTIONARY TYPES

E. M. Svirskaya
Chelyabinsk University, Physics Department.
Russia, 454136, Chelyabinsk-136, ul.Br.Kashirinikh, 129
E-mail: nig@cgu.chel.su

ABSTRACT. 30 unknown magnitudes of secondary minima depths for eclipsing variable stars are restored by ZET – method. Evolutionary types of some eclipsing variable stars are specified on the basis of obtained data.

Key words: Stars: Binaries: Eclipsing; secondary minima depths

In this paper secondary minima depths A(2) of eclipsing variable stars are computed by statistical method, namely, ZET algorithm (Zagoruiko et al. 1985). The statistical approach is necessary for stars with uncertain orbital elements.

ZET algorithm is intended to predict uncertain elements in empirical tables "object–property" and to verify the table or part of it. In tables "object–property" with dimension $M \cdot N$, the lines (objects) have numbers $i = 1...M$ and columns (properties) – $j = 1...N$.

Uncertain element a(i,j) in ZET algorithm is predicted on the basis of local linearity principle, i.e. under assuming the linear dependence between lines and/or columns, most similar with line i and/or column j.

7 characteristics of stars from Svechnikov & Kuznetsova (1990), most informative for predicting secondary minima depths, were used to restore 30 uncertain magnitudes A_2 for DM–type eclipsing variable stars: the mass ratio of main and secondary components M_1/M_2, the luminosity of more massive component L_1 (in units of $L_1 + L_2 = 1$), the ratio of surface brightnesses of more massive and less massive components J_1/J_2, the value of orbital inclination i, the absolute bolometric magnitude M_{2b}, the main component radius r_1 (in units of orbital major semi–axis) and the spectral class of the more massive component Sp_1).

The table with 8 parameters such as A_1/A_2, M_1/M_2, L_1, J_1/J_2, i, M_{2b}, r_1, Sp_1, for 392 DM-type stars were compiled (A_1– main minima depths). All certain elements of first column were verified . The average error of verification was 3.87%. This result shows application expediency of ZET method for restoration of uncertain secondary minima depths on the basis of this table.

Actually, approximately 2/3 magnitudes A_2 were restored with the error about 5%, 1/3 magnitudes – with the error about 10%, and prediction error only of two magnitudes A_2 was greater than 10%, but less then 20%. It turned out that calculated by ZET method magnitudes A_2 for 27 eclipsing variable stars in fact correspond to secondary minima depths of DM-type stars according to classification of Svechnikov et al. (1980). However, the calculated magnitudes A_2 for stars: GU Car, V566 Sco and V585 Sco exceed unity, although magnitudes A_1 are much less than unity according to GCVS (Kholopov 1985-1987). Such differences between depths of main and secondary minima in accordance with classification of Svechnikov et al. (1980) are more characteristic for SD-systems. Therefore these stars, probably, are not DM–type stars, but belong to SD–systems.

The obtained results allow us to conclude that effective prediction of secondary minima depths for eclipsing variable stars by ZET method and specification of their evolutionary types on this basis are possible.

References

Kholopov P.N. (Ed.): 1985-1987: *The General Catalogue of Variable Stars, 4-th Ed.*, Moscow, Nauka Publ., 1985, V.1, 376pp.; V.2, 360pp.; 1987, V.3, 368pp.

Svechnikov M.A., Istomin L.F., Grekhova O.A.: 1980, *Peremennye zvezdy*, **21**, N 3, 399.

Svechnikov M.A., Kuznetsova E.F.: 1990, *A Catalogue of approximate photometric and absolute elements of eclipsing variable stars* (in Russian), Sverdlovsk: Ural University, V.1. 224pp.; V.2. 232pp.

Zagoruiko N.G., Elkina V.N., Lbov G.S.: 1985, *Algorithms of finding the empiric regularities* (in Russian), Novosibirsk, Nauka Publ., 110pp.

POLARIZATION ECLIPSE MODEL OF THE WOLF-RAYET BINARY V444 CYGNI WITH CONSTRAINS ON THE STELLAR RADII AND AN ESTIMATE OF THE WOLF-RAYET MASS-LOSS RATE

N. St-Louis[1], A. F. J. Moffat[1], L. Lapointe[1], Yu. S. Efimov[2], N. M. Shakhovskoy[2], G. K. Fox[3], V. Piirola[4]

[1] Departement de Physique, Universite de Montreal, C.P. 6128, Succ.A Montreal (Qc), H3C 3J7, Canada, and Observatoire du Mont Megantic

[2] Crimean Astrophysical Observatory, P/O Nauchny, 334413, Crimea, Ukraine

[3] Department of Physics and Astronomy, University of Glasgow Glasgow G12 8QQ, Scotland, UK

[4] Observatory and Astrophysics Laboratory, University of Helsinki Tahtitornmaki, SF-00130 Helsinki 13, Finland

ABSTRACT. We present an improved analytical model as well as a new set of multiwavelength observation of the polarization eclipse of the Wolf-Rayet binary V444 Cygni (WN5+O6). Comparing the model with the observations yields an estimate of the O and Wolf-Rayet star radii as well as of the Wolf-Rayet mass-loss rate. For the O star we find R = 8.5 $R_\odot$ and for the Wolf-Rayet star R<4 $R_\odot$. This values are in agreement with those derived by Cherepashchuk et al. from the detailed analysis of multiwavelength light curves.

For the Wolf-Rayet mass-loss rate we obtain $\dot{M} = 7.5 \cdot 10^{-6} M_\odot$/yr, which is compatible with the dynamical values obtained from the rate of orbital period increase and with the value of dM/dt determined from the orbital double-wave modulation in polarization, but is at least 3 times smaller than the values derived from free-free radio fluxes and modeling of infrared spectral lines. However, no allowance has been made in calculating the mass-loss rates for inhomogeneities, for which evidence is increasing in hot star winds. If the wind of the WR star V444 Cygni is found to be clumpy, the radio/IR mass-loss rates are likely to be overestimated because of their dependency on the square of density. In such case, these values would probably have to be significantly decreased, bringing them closer to the polarization estimates, for which clumpy winds are irrelevant, providing the electron scattering remains optically thin.

Full version was published in: *Ap. J.*, **410**, 342-356 (1993).

Key words: Stars: Wolf-Rayet, V 444 Cygni