Magnetic Field Study of the Polar V379 Vir

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Abstract. The polar V379 Vir (SDSS J121209.31 +013627.7) has been studied in this work. A spectra of the object contains a clear Zeeman splitting of the H_β line. A behaviour of the observed white dwarf magnetic field was analyzed during the rotation period. The parameters of the white dwarf magnetic dipole were found by a magnetic curve modelling.

Keywords: novae, cataclysmic variables; stars: magnetic field
DOI:10.26119/978-5-6045062-0-2_2020_297

The spectral observations of the V379 Vir were performed on May 7, 2007 at the 6-m telescope BTA of SAO RAS. In a course of observations the focal reducer SCORPIO-1 was used in a mode of long-slit spectroscopy. The 15 spectra of the object were obtained with an exposure of 300 sec in the range 3900-5700 $\mathring{A}$. The spectra were processed using the IRAF software package.

The spectra showed a blue slope of the continuum as well as a strong broad absorption H_β, H_γ, and H_δ lines. A noteworthy is the presence of the splitting of the H_β line onto a 3 components due to the Zeeman effect and their shift to a shorter wavelength. It is known that the splitting between the σ-components and the central unshifted π-component in the linear regime depends on the magnetic field:

$$\delta\lambda_L = \pm 7.9 \left(\frac{\lambda}{4101\mathring{A}}\right)^2 \left(\frac{B}{10^6 G}\right) \mathring{A}, \quad (1)$$

where λ is the wavelength, B is the magnetic field in gauss, and $\delta\lambda_L$ is the splitting between the components. The continuum was approximated by the Chebyshev polynomial of the 3-rd order. The H_β line components were approximated by the sum of three Lorentz functions. To estimate the errors of approximation the Monte-Carlo method was applied. For constructing the phased magnetic curve we used the ephemeris determined by Debes et al. (2006) and refined it with the Lafler-Kinman method:

$$T = (HJD)\ 2453783.8375 + 0.06078141E. \quad (2)$$

The magnetic curve (fig. 1) of V379 Vir has a quasi-sinusoidal shape and the magnetic field varies in range 4.5 - 7.5 MG.

On the other hand in the strong magnetic field of the V379 Vir the quadratic Zeeman effect is observed. If the π- and σ-components are assigned their usual weights, the centroid of their combined pattern will be shifted by

$$\langle \delta\lambda_L \rangle = -7.5 \times 10^{-23} \lambda^2 n^4 B^2, \quad (3)$$

where B is the magnetic field in gauss and n is a principal quantum number ($n = 4$ for H_β). In our case, we measured the shifting of only the π-component. This method gives that the B varies in range 3.5 - 6.5 MG (fig. 2). The amplitude is ~ 3 MG, that correspond with the fig. 1. The calculation of the average

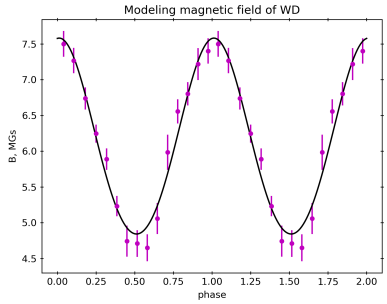

Fig. 1. Comparison of the observed and simulated magnetic curves

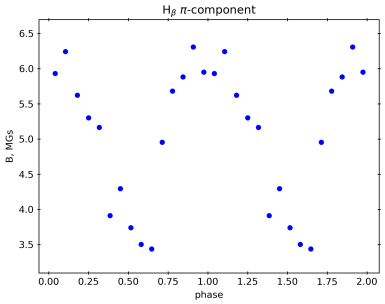

Fig. 2. The magnetic field corresponding to the observed shift of π-component due to quadratic Zeeman effect

magnetic field was carried out under the assumption of dipole magnetic field distribution over a white dwarf surface and using a linear model of limb darkening. We searched for the parameters of the average magnetic field B_0, inclination β and longitude ψ (counted from the direction to the secondary anticlockwise) of magnetic dipole axis. The least-squares method was used for estimating the parameters and the Nelder-Mead optimization method was applied. The found parameters of the V379 Vir is $B_0 \approx 6.4$ MG, $\beta \approx 20.0°$, and $\psi \approx 3.4°$.

Acknowledgements. The reported study was funded by RFBR, project number 19-32-60048. VS thanks the subsidy 671-2020-0052 allocated to KFU for the assignment in the sphere of scientific activities.

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