Accretion Phenomena and Related Outflows, IAU Colloquium 163
ASP Conference Series, Vol. 121, 1997
D.T. Wickramasinghe, L. Ferrario, and G.V. Bicknell, eds.

Parameters Of Dwarf Nova SS Cygni

Irina Voloshina and Tatjana Khruzina

Sternberg Astronomical Institute, 13 Universitetskij Prosp., 119899 Moscow, Russia

Abstract. The analysis of dwarf nova SS Cyg light curves at quiescence is performed and some important are determined.

We present the preliminary results of analysis of the mean light curves of dwarf nova SS Cyg. *UBV*-curves were derived from the numerous observations during the period 1982-1995 (more than 2000 *UBV*- measurements). All observations were performed with *UBV*- photometer on the 60-cm telescope of Sternberg Astronomical Crimean Station at quiescence. The accuracy of results is 1% in V and B bands and about 2-3% in U. The mean light curves of SS Cyg were constructed with the help of the elements of Voloshina & Lyuty (1993). The mean observational V light curve of SS Cyg relative to the mean magnitude is shown in Fig. 1 (left panel).

For analyzing the optical variability of SS Cyg a new version of the computer code using a geometrically thick axisymmetric disc around a finite-size sphere approximating the white dwarf surface was applied (see Khruzina 1997). The red dwarf form and size expressed in units of the distance between the components' centers of mass a are set by the mass ratio $q = M_w/M_{rd}$ and the Roche lobe filling degree μ, in our case $\mu = 1$. The star luminosity is the function of its effective temperature T_{eff}, and transformation coefficient of X-ray emission from disc hot spot into the optical light k_X. The white dwarf luminosity is determined by its radius R_w and the effective surface temperature T_w. The accretion disc is geometrically thick in outer regions and geometrically thin in inner regions. To determine the light curve fitting parameters, we used the Nelder-Mid method (Himmelblau 1975) (the method of deformed polyhedrons). To estimate the fit quality, the χ^2 criterion was used. Two different mass ratios $q \sim 1$ (Cowley *et al.* 1980), and $q \simeq 1.7$ (Echevarria *et al.* 1989) are known from the literature, so we tried q in the whole range 0.5–2.3. Our analysis does not permit to choose any mass ratio q, a critical confidence level $\alpha = 10\%$ of the χ^2-test cuts off the range from $q = 0.7$ to $q = 1.85$ including both q-determination for the system. But the orbital inclination intervals are rather narrow: $56° - 57°.8$. The red dwarf effective temperature is $T_{eff} = 3175(5)$ K regardless of q, its value corresponds to a main-sequence star of spectral class M3 V. The accretion disc radius increases steeply with q from $R_d = 0.28 - 0.31a$ $(q = 0.7 - 1.1)$ to $R_d = 0.31 - 0.35a$ for $q = 1.1 - 1.8$. The spot contribution to the total flux depends weakly on q, $r_{sp} \simeq 0.22 - 0.16R_d$ for $q = 0.7 - 1.8$. The hot spot azimuth changes with increasing q from 65° to 71°. The relative contributions of different components of the system in the total luminosity (in arbitrary units) are shown in Fig.1 (right panel).

https://doi.org/10.1017/S025292110004416X Published online by Cambridge University Press

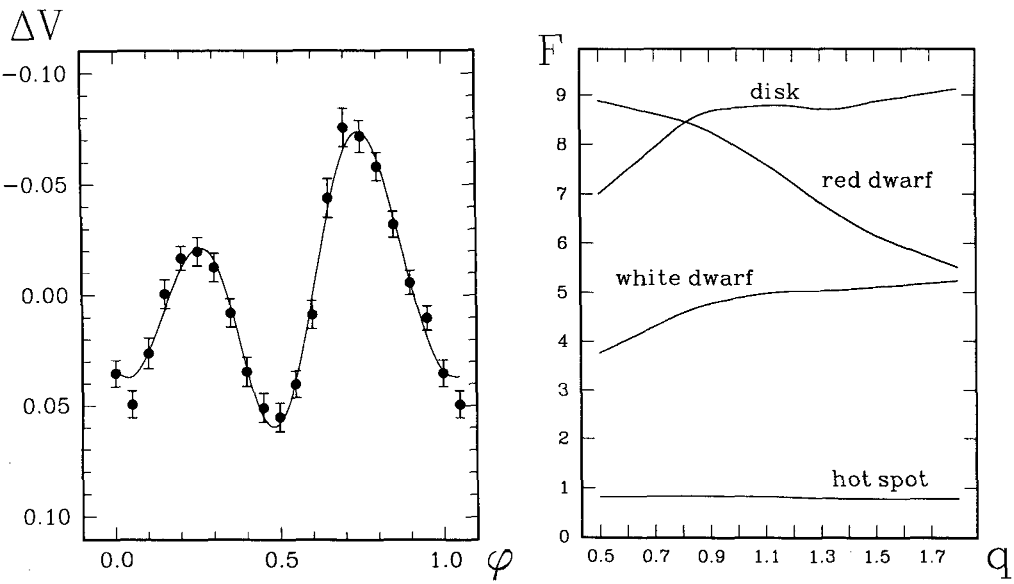

Figure 1. Left panel: the fitting of the mean V-light curve of dwarf nova SS Cyg (points with bars) by the model one (the solid line) for parameters q=1.5, i=57.3 and $T_{eff} = 3175K$, $r_w = 0.009\xi$.
Right panel: the contribution of different components into total light curve as a function of the mass ratio q.

The white dwarf temperature is obtained $T_w = 19000 \pm 400$ K, the mean value for the stars of this class. The white dwarf radius at $\lambda = 5500$Åis $R_w \sim 0.0079 - 0.0085a$ for $q = 0.7 - 1.8$. This allows us, using the 3^d Kepler's law, the mass-radius relation for helium white dwarfs (Hamada & Salpeter 1961) and value of semiamplitude of radial velocity curve, $K_r = 146 - 162$ km·s^{-1} (Davey & Smith 1992), to determine the white dwarf mass $M_w \sim 0.45 - 0.53 M_\odot$. Therefore the use of spectral data permits us to obtain the preferable mass ratio, $q \sim 1.2 - 1.8$, in which case the red star mass would be $M_{rd} \sim 0.26 - 0.4 M_\odot$.

References

Cowley, A.P., Crapmton, D., Hutchings, J.B. 1980, ApJ, 241, 269
Davey, S. & Smith, R.C. 1992, MNRAS, 257, 476
Echevarria, J., Diego, F., Tapia, M. & al., 1989, MNRAS, 240, 975
Hamada, T. & Salpeter, E.E., 1961, ApJ, 134, 683
Himmelblau, D. 1975, in Applied nonlinear programming, Moscow: Mir, 163
Khruzina, T.S. 1997, Astron. Zh. (in press)
Voloshina, I.B. & Lyuty, V.M. 1993, Astron. Zh., 70, 61