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UBV OBSERVATIONS OF AG Dra DURING THE 1996–1997 ACTIVE PHASE

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The symbiotic system AG Dra has undergone a great number of outbursts (Luthardt 1983, Skopal & Chochol 1994, Skopal 1994) and in many cases has displayed orbital photometric variability during the periods between them (Meinunger 1979, Hric et al. 1993). The last extended quiescent period was from 1987 to 1993 when the V magnitude of the system was about $9\overset{m}{.}8$. This period was followed by a new active phase which was characterized by two outbursts in 1994 and 1995 (Montagni et al. 1996). In the beginning of 1996 the brightness practically reached its typical values of the quiescent state, but soon after the star entered a phase of increased activity again. The maximum values of the brightness, observed by us during this phase, were in July 1996 ($V = 9\overset{m}{.}25$) and June 1997 ($V = 9\overset{m}{.}20$), followed by a rapid decrease almost to the quiescent magnitude.

Table 1. Photometric observations of AG Dra

JD−2450000	n	V	B	U	JD−2450000	n	V	B	U
267.3	3	9.24	10.12	9.15	477.7	2	9.76	11.04	11.00
268.3	3	9.26	10.14	9.21	478.7	2	9.75	11.06	10.99
293.6	2	9.48	10.46	9.73	504.6	3	9.72	11.01	10.96
294.6	3	9.43	10.37	9.60	520.5	3	9.78	11.07	10.95
295.4	3	9.41	10.35	9.47	628.5	3	9.17	9.99	8.96
296.4	3	9.38	10.32	9.45	629.4	3	9.21	10.05	9.05
297.3	3	9.41	10.31	9.42	643.5	2	9.14	10.00	8.92
303.4	2	9.34	10.27	9.36	651.3	2	9.26	10.10	9.11
317.3	3	9.48	10.50	9.47	652.3	2	9.25	10.08	9.07
321.3	3	9.58	10.68	9.83	698.3	3	9.28	10.18	9.19
322.3	3	9.60	10.68	9.84	699.3	4	9.32	10.18	9.25
324.3	2	9.60	10.69	9.85	701.3	3	9.30	10.17	9.20
390.2	2	9.77	11.05	11.08	702.3	3	9.28	10.17	9.19
391.2	3	9.74	11.02	11.10	704.3	2	9.32	10.21	9.22
398.2	3	9.69	10.98	11.06	729.2	3	9.64	10.70	10.17
431.2	2	9.72	11.04	11.14	739.2	5	9.65	10.78	10.46
466.3	2	9.72	11.01	—	741.2	2	9.71	10.83	10.60
476.7	2	9.75	11.05	11.00	742.2	3	9.69	10.83	10.58

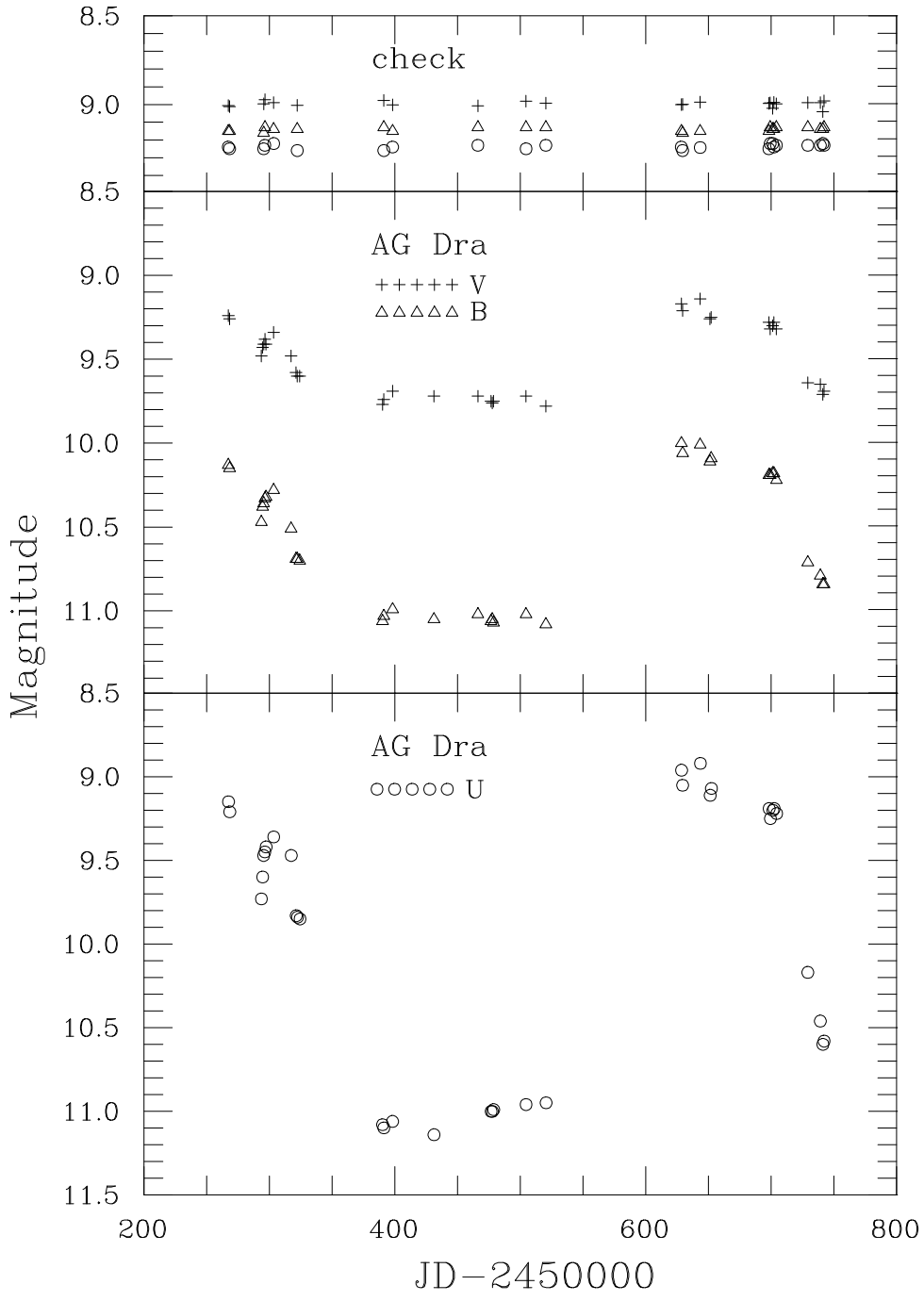

Figure 1. The UBV light curves of AG Dra

Our observations were performed in the UBV system during July 1996 – October 1997 (Table 1) with a single channel photoelectric photometer, mounted at the Cassegrain focus of the 0.6 m telescope of the National Astronomical Observatory "Rozhen". The brightness data in the period JD 2450317÷2450324 were obtained with the similar telescope and equipment of the Astronomical Observatory Belogradtchik. The star BD+67°925 having $V = 9\overset{m}{.}88$, $B - V = 0\overset{m}{.}56$ and $U - B = -0\overset{m}{.}04$ (Skopal & Chochol 1994) was used as a comparison star checked by the star BD+67°926. We estimated the accuracy using the observational data of the check star. The m.s. errors are not larger than $0\overset{m}{.}01$ in all bands.

The three colour light curve of AG Dra during the time of the observations is shown in Figure 1. Our data cover mainly the declining phases and the quiescent period between the two outbursts. It can be noted that the light monotonically increases in JD $\sim$ 2450290 ÷ 2450310, although this interval is a part of the first declining phase. The brightness of AG Dra varied in all the colours, but the amplitude of these variations was largest in U and decreased with the wavelength. In the time between the outbursts it reached the typical values of the quiescent state. The variation in the U magnitude indicates a mean increase for the two light maxima by a factor of about 5.3 of the continuum flux compared with the quiescent period before the 1994 outburst. The B and V increase factors are equal to 2.3 and 1.6. In our view the reason for the visual brightening of AG Dra is the increased radiation of its nebula. This is directly seen from the energy distribution in the spectrum of AG Dra from IR to X-ray wavelengths, obtained during quiescence and outburst (see Fig. 5 of Greiner et al. 1997). The spectrum in the optical/near-UV region is dominated by a nebular continuum which strongly increases during the outburst phase. Therefore we conclude that the increase of the UBV fluxes results from an increase of the emission measure of the nebular component in the system. This is probably caused by a larger production of both the ionizing photons and the hot star wind, which developed during the outburst (cf. Viotti et al. 1994). Then we can determine the lower limit of the contribution of the nebula for the maximal values of the B and V light on the basis of the approach used in the work of Montagni et al. (1996), using the amplitudes of the variation. It turns out that this lower limit is about 55% in B and 35% in V.

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