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Photometry of two candidates for M67 contact binaries

AG Cnc has been classified as a variable star by Kurochkin (1960; AG Cnc=SVS 1283). Based on 36 photometric measurements derived from photographic plates he concluded that its period of variations is equal to 0.313335 day and that the total amplitude of the light curve is about 0.6 mag. AG Cnc is located in the field of the open cluster M67. According to the results of the proper motion study, it is a highly probable member of the cluster (Sanders 1977; star No. 1113 ;its membership probability is 96 per cent). Kurochkin (1960) suggested that AG Cnc belongs to dwarf cepheids. However, its period and an absolute magnitude (derived under the assumption that it is a M67 member) suggest that it may be a short period eclipsing binary. M67 is known to possess at least three W UMA-type systems: AH Cnc (Kurochkin 1960; Efremov et al. 1964) and two systems discovered recently by Gilliland et al. (1991).

The star IV-25 (designation according to Eggen and Sandage 1964) is located in the central region of M67 and its proper motion indicates that it is a cluster member (Sanders 1977; star No. 1063; its membership probability is 93 per cent). Racine (1971) concluded from the comparison of his photographic photometry and photoelectric photometry published by Eggen and Sandage (1964) that the brightness of IV-25 varies by at least 0.18 magnitude. On the other hand, Frolov (1983) failed to detect any evidence for a variability of IV-25 on six photographic plates. Results of the recent proper motion study of M67 by Girard et al. (1989) also support membership of AG Cnc and IV-25 to M67. They derived membership probabilities 97% and 98% for IV-25 and AG Cnc respectively.

To clarify the questions concerning the nature of AG Cnc and IV-25 we collected a CCD photometry of these stars. Observations were performed using a #1 0.9-m telescope of the Kitt Peak National

Table 1
 BV photometry of AG Cnc. Phases are calculated
 for a period 0.31333 d and for an arbitrary
 ephemeris.

JDhel 244 6700+	B	V	Phase
74.044	14.849	13.782	0.142
75.987	-	13.766	0.340
75.989	14.831	13.788	0.346
76.052	14.853	-	0.549
76.055	14.848	13.803	0.558
78.055	14.871	13.758	0.941
78.055	14.855	-	0.940
78.890	14.863	-	0.607
79.019	14.899	13.837	0.016
79.046	14.895	13.847	0.103
79.816	14.834	13.785	0.561
80.061	14.850	13.777	0.343

Observatory. During the period between Dec. 9 and Dec. 15 1986 we collected 11 B and 9 V frames of the 7.3x4.6 arcmin field centered on AG Cnc. The obtained photometric data are given in Table 1. The transformation to the standard BV system was based on the observations of several stars from the central part of M67. The standard error of an individual measurement is about 0.015. We phased our observations with a period of 0.313335 day and concluded that AG Cnc hardly exhibits any large amplitude variability with the quoted period. However, there is a strong evidence that on the frames collected on Dec. 14 the star was by about 0.05 mag fainter than during the remaining measurements (it is worthy to point out that this weakening was observed in both filters). The area covered by our frames contains 17 stars with $B > 17$. None of these stars, with an exception of AG Cnc, exhibited a variability with a full amplitude exceeding 0.040 mag.

Our photometry of IV-25 is given in Table 2. On the frames collected on Dec 9, the star was by about 0.10 magnitude fainter than during the remaining observations.

In Figure 1 we show a color-magnitude diagram for a part of a central region of M67 with the marked positions of AG Cnc and IV-25. Both stars are located 2 magnitudes above the cluster main sequence in the same area of the diagram. Their colors are too red and their magnitudes are too faint as for a star from the M67 subgiant

Table 2
BV photometry of M67 star IV-25

JDhel 244 6700+	B	V
74.042	14.599	13.582
74.048	14.589	13.579
75.981	14.529	-
76.056	14.531	13.518
78.054	14.503	13.498
78.891	14.504	13.523
79.022	14.520	13.499
79.047	14.491	13.493
79.8170	14.483	13.485
80.060	14.480	13.488

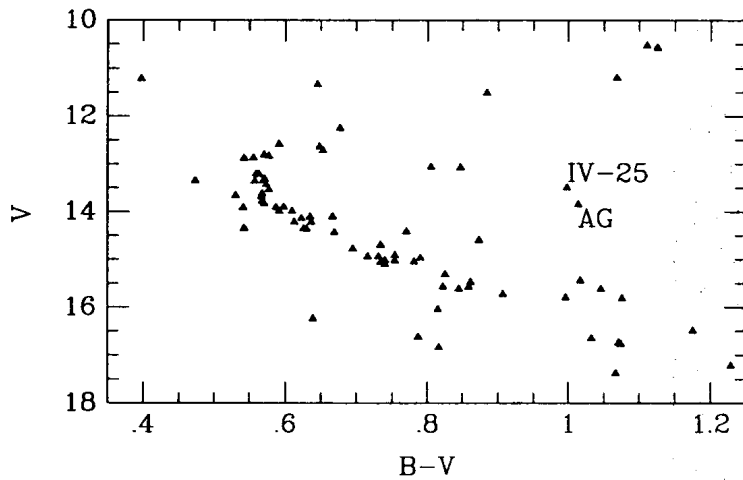


Figure 1 - Color-magnitude diagram for a subset of M67 stars with the positions of AG Cnc and IV-25 indicated.

branch (for more complete color-magnitude diagram see Racine, 1971). Concluding, our photometry supports claims about variability of AG Cnc and IV-25. At the same time it rules out large amplitude variations of AG Cnc with the period of about 8 hours. The nature of variability of both stars remains unknown. The strange positions of both stars on the color magnitude diagram of M67 support the hypothesis about a binary nature of AG Cnc and

IV-25. We note that, two M67 contact binaries identified recently by Gilliland et al. (1991) possess light curves whose full amplitudes do not exceed 0.15 mag. We suggest that AG Cnc and IV-25 are highly evolved W UMA-type binaries with extremely small mass ratios and consequently small amplitudes of light variations.

J. Kałużny¹ and J. Radczyńska
 Warsaw University Observatory
 Al. Ujazdowskie 4
 00-478 Warszawa, Poland

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