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**VARIABLE STARS IN THE GLOBULAR CLUSTER NGC 6681**

NGC 6681 (M 70, C1840 - 323,  $l = 2^{\circ}9$ ,  $b = -12^{\circ}5$ ) is a variable poor Oo II cluster (II VP). With  $[Fe/H] = -1.51$  it is one of several clusters which lie in the metallicity interval where alongside with II VP there coexist I VR (Oo I variable rich) clusters. The cluster has an absolute magnitude  $M_{v_0} = -7^m05$ , concentration class  $CC = V$ , apparent radius  $r = 3'9$  (Kukarkin 1974) and limiting radius  $r = 11'0$  (Kukarkin & Kireeva, 1979).

The cluster was first searched for variable stars by Rosino (1962). In the investigated area he discovered five variable stars, three of which are field variables with a distance  $r > 11'7$  from the cluster center. The other two variables, designated V1 and V3, at  $r = 2'0$  and  $9'8$  respectively, were noted by Rosino as RR?, and at the time of publication of the Third Catalogue of Variable Stars in Globular Clusters (Sawyer Hogg 1973) were the only known variables assumed to be cluster members.

A further search for variables was made by Liller (1983). In the investigated field she discovered 18 variables including the five previously detected by Rosino. Three of the variables found by Liller with  $r = 0'9$ ,  $5'9$  and  $8'3$  are within the limiting radius of the cluster. The estimated periods for four of them (excluding V4) enabled their classification as RR Lyrae variables. However according to the "mean" magnitude two of the latter V5 and V2 (renamed Rosino V3) at  $r = 8'3$  and  $9'8$  were found to have low probability membership, thus limiting the distance of the three cluster variables at  $r = 5'9$ . In Liller's table 1 there is a misprint in the signs of the X coordinates of V3 and V4, which should be - and + respectively.

Details of the CCD observations, obtained with the 0.9 m Dutch telescope at ESO-La Silla, methods of reduction are given in the paper by Brocato et al. (1996). The method of a search for as yet undiscovered variables was the same as in the companion paper (Kadla et al., 1996). The V and B magnitudes of the measured stars are based on 16 photoelectric standards (Landolt, 1992) within the magnitude intervals  $12^m52 < V < 15^m91$  and  $13^m02 < B < 16^m13$  ( $-0^m24 < B - V < 1^m91$ ). CMD was obtained using for the mean V and B magnitudes from 3 V and 3 B consecutive exposures, the time difference between the mean V and B magnitudes being 25 minutes.

The stars in the instability strip of the resulting CMD diagram are shown in Figure 1. The available photometric data (23 exposures - 15 V and 8 B) permitted to confirm the variability of nine stars (including the aforementioned two known RR Lyr variables discovered by Rosino and Liller). Data for these variables (numbered 1 - 12, open circles) and other stars in the instability strip are given in Table 1 and Figure 2. Six stars (Nos. 13 - 18, triangles) are probably variables but need further confirmation and three (Nos. 19 - 21,  $V > 16^m36$ ) are probably field variables. There are three stars (Nos. 22 - 24, asterisks) in the instability strip which did not show any sign of variability in our data. If the variable V4 without a determined period at  $r = 5'9$ , found by Liller, is included there are at present ten known RR Lyrae stars belonging to the cluster.

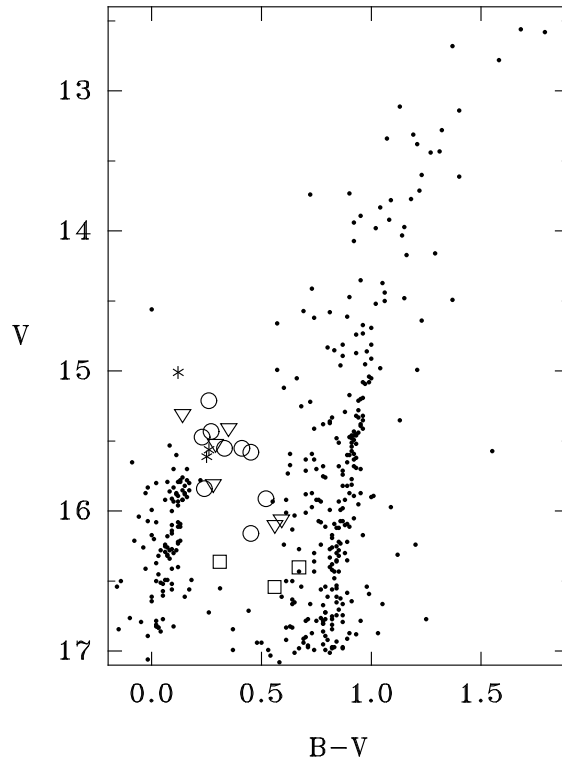


Figure 1. The CMD for stars in an area  $3/8 \times 3/8$  centered on the cluster. Concerning notation of stars in the instability strip see the text

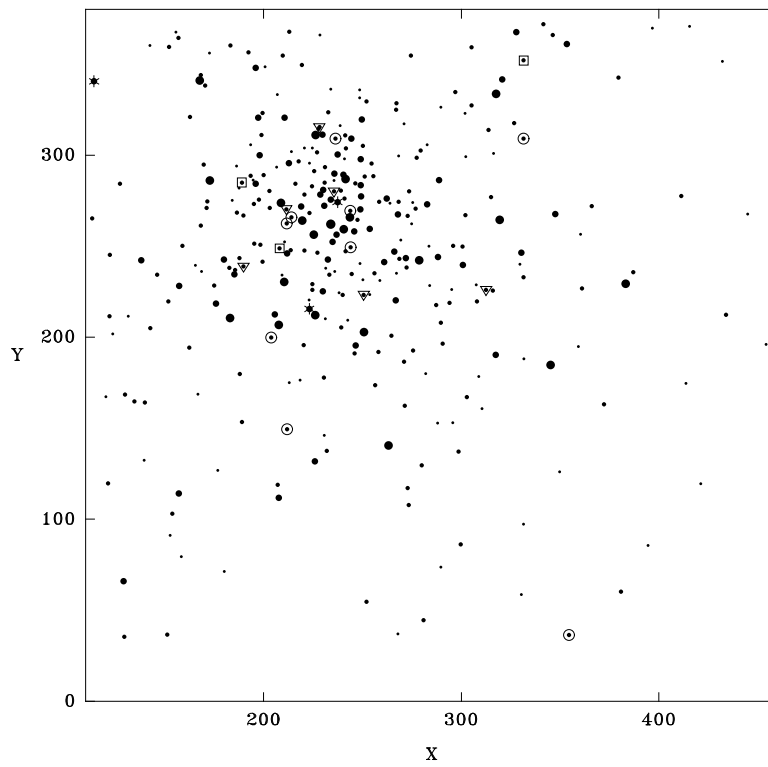


Figure 2. Chart of the cluster showing the position stars in Table 1

Table 1. Photometric data for variables

$N$	$X$ (arcsec)	$Y$ (arcsec)	$V$	$B - V$	$N$	$X$ (arcsec)	$Y$ (arcsec)	$V$	$B - V$
1	56.4	-105.1	15.58	0.45	13	-19.3	-12.0	16.06	0.59
3	-9.2	-53.2	15.91	0.52	14	-9.4	2.5	15.31	0.14
6	-12.9	-30.0	15.55	0.33	15	-1.6	23.2	15.41	0.35
7	-9.3	-1.2	15.55	0.41	16	1.7	6.9	16.10	0.56
8	-8.2	0.4	15.84	0.24	17	8.7	-19.1	15.52	0.29
9	2.1	20.3	15.47	0.23	18	37.1	-17.9	15.81	0.28
10	5.5	2.1	15.21	0.26	19	-19.7	9.2	16.36	0.31
11	5.6	-7.1	16.16	0.45	20	-10.9	-7.4	16.54	0.56
12	45.9	20.3	15.43	0.27	21	45.9	40.0	16.40	0.67
					22	2.6	4.3	15.01	0.12
					23	-4.0	-22.7	15.56	0.26
					24	-54.1	34.8	15.61	0.25

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#### References:

- Brocato, E., Buonanno, R., Malakhova, Yu. & Piersimoni A.M.: 1996, *A&A*, **312**, 80  
 Kadla, Z.I., Gerashchenko, A.N. & Malakhova, Yu.N., 1997, *IBVS*, No. 4413  
 Kukarkin, B.V.: 1974, *The General Catalogue of Globular Clusters of our Galaxies*. Publishing House Nauka, Moscow  
 Kukarkin, B.V. & Kireeva, N.N.: 1979, *Astr. Zh.*, **56**, 465 [English transl.: *Soviet Astr.*, **23**, 261]  
 Landolt, A.U.: 1992, *AJ*, **104**, 340  
 Liller, M.: 1983, *AJ*, **88**, 1463  
 Rosino, L.: 1962, *Mem. Soc. Astron. Ital.*, No. 5, **33**, 351  
 Sawyer-Hogg, H.: 1973, *Publ. David Dunlap Obs.*, **3**, No. 6