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Search for Variables in the Globular Cluster M 56

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The latest Catalogue of Variable Stars in Galactic Globular Clusters (Clement et al. 2001) lists 12 variables in the field of the cluster M 56 (NGC 6779). Although five of them are surely non-members, some of them (V1, V4 and V12) proved to be members and pulsating variable (RR Lyrae and BL Her type) stars (see Wehlau & Sawyer Hogg 1985). The core of the cluster, has not investigated yet in the points of view of variability. We carried out the first CCD variable search in the core of the cluster as a part of the globular cluster's variable star survey at Konkoly Observatory.

The observations were made by a CCD camera attached to the 1m f/13.6 RCC telescope of the Konkoly Observatory located in the mountain station at Piszkéstető on 2-5 of June 2000. The camera was built by Photometrics Inc. and contains a Thomson TH7896M 16 bits chip with 1024×1024 pixels. It yields a $5' \times 5'$ field of view and $0\farcs288$/pixel resolution. The total amount of frames were 83 and 27 in the Johnson V and Cousins $I_{\rm C}$ bands, respectively. The exposition time was 5 minutes for both colors during all nights. The basic reductions steps, overscan correction and flat fielding were made using standard tasks of IRAF[1]. Due to the quality of the camera (see for details Bakos 2000) other corrections were unnecessary.

The reduced images were processed using the facilities of the Image Subtraction Method (ISM, Alard & Lupton 1998, Alard 2000) as implemented in the software package ISIS-2.1[2]. The two short period variables of the field, V1 and V4 are only seen in the subtracted images. These images show also inhomogeneity at some positions where saturated (or nearly saturated) stars are. Due to this phenomenon the variability image obtained from ISIS software shows both real variables and very bright stars. Fortunately, these two groups can be separated very well by their radial profiles: variables show standard Gaussian profile while bright stars have strange irregular ones.

The standard deviation of the ISM photometry was $\sigma_{\Delta I} = 200$ ADU, which means $\sigma_{\rm m} = 0\fm01$ at $16\fm5$ and $\sigma_{\rm m} = 0\fm1$ at $19^{\rm m}$. That is, we could detect any variable with period between ~ 0.01–5 days and amplitude higher than $\sim 3\sigma_{\rm m}$. *But no new variable has been found.*

[1] IRAF is distributed by the NOAO, operated by the Association of Universities for Research in Astronomy Inc., under contract with the NSF.

[2] Available via anonymous ftp from `http://www.aip.fr/users/alard/package.html`

We prepare the V vs. $V-I$ colour–magnitude diagram (CMD) using V and I images combined from 15 and 5 good seeing CCD frames, respectively. PSF photometry have been implemented for both frames using processes of IRAF/DAOPHOT package. The CMD consists of 4550 stars down to 22^{m}. To transform our observational magnitudes into the international colour system we used the only CCD study (Rosenberg et al. 2000) as a source of standard magnitude values.

Table 1. Positions (x, y according to Küstner's catalogue) and relative proper motions (μ_{x}, μ_{y}) of suspected instability strip stars. 'No' denotes Küstner's number, comment 'F' indicates a probable field star.

No.	x [″]	y [″]	μ_{x} [″/100 y]	μ_{y} [″/100 y]	comment
146	−104.81	58.69	−0.201	0.479	F
177	−78.52	86.16	0.086	−0.488	F
262	−13.78	31.48	−0.277	0.076	
278	−3.37	27.96	−0.079	−0.038	
297	2.69	−92.52	0.112	−0.112	
321	14.47	134.92	0.316	0.324	F
329	21.19	75.81	0.138	0.239	
342	29.10	0.45	−0.116	0.084	
361	44.12	−30.64	−0.169	0.068	
392	70.04	−96.41	−0.019	0.661	F
430	105.58	−10.24	0.092	0.170	
434	116.37	103.78	0.219	0.593	F
	−20.49	−12.43			
	−10.75	−15.57			
	−3.90	−2.62			
	90.73	49.98			
	117.40	134.96			

In our special point of view the most important part of the CMD is the the area of instability strip. Accepting reddening value $E(B-V)$ as 0.20 (Rosenberg et al. 2000) the RR Lyrae instability strip is between $0.61 < V-I < 0.86$. We found 19 stars locating there. Are these stars members of the cluster or not? Two of them are known variables and members: V1 and V4.

The two radial velocity study Webbink (1981) and Harris et al. (1983) assign 11 stars which are surely members. Using these stars as a reference we transformed the Küstner catalogue positions (Küstner 1920) into our frame. We can identify 12 stars among 17 stars lying in the instability strip with Küstner's stars. Determined relative proper motions (where $\mu_{\mathrm{cluster}} = 0$) are shown in Table 1. We found five probable field stars on the basis of membership criteria $|\mu| < 0\farcs3$ /100 years given by Rishel et al. (1981). Since the proper motion information alone is not sufficient to decide the membership we cannot take a definite statement for other 7 stars. In the case of remaining 5 stars we have no any informations about their membership.

Although, the statistics of the field stars in the galactic direction of M 56 allows that all stars in Table 1. are in the field, radial velocity measurements would be necessary to decide the question.

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