

CCD photometry of some areas around the open cluster M45

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We present the results of photometric studies in some areas around the open star cluster M 45. Observations were carried out on January–March 2012. About 600 images were obtained in the V band (Johnsons system). Centres of the observed areas correspond to the maximum concentration of stars with the solar-type activity. Using the V-band magnitude values from the GTSh10 catalogue we analysed the flare activity of the stars. The catalogue of observations with the shared access through the Aladin interface was compiled.

Key words: techniques: photometric, stars: variables: general, catalogues

INTRODUCTION

The open cluster M45, Pleiades, with RA= $03^h47^m00^s$, Dec= $+24^\circ07'00''$ (2000), is located in Taurus and includes more than 3000 stars. The first flare star in this cluster was found in 1958 by Johnson and Mitchell [5]. It was a solar-type star. During compilation of catalogue of stars with the solar-type activity, GTSh10 [4], it was found that the V-magnitude of some stars is unknown. We tried to fill this gap and observed some selected areas around the M45 cluster with the MTO-1000¹ objective mounted on the RC-800 telescope [2].

OBSERVATIONS AND DATA PROCESSING

All observations were carried out on January–March 2012 with the MTO-1000 objective and the QHY6² CCD camera at the Crimean Astrophysical Observatory. The objective MTO-1000 has the focal length of 1000 mm and the relative aperture 1:10. The CCD camera QHY6 has highly sensitive monochromatic matrix with the pixel size $6.5\mu\text{m} \times 6.25\mu\text{m}$ and the quantum yield of 65% at 5800Å . The field of view is $18' \times 14'$ or 752×582 pixels with the resolution of $1.5''/\text{pix}$. Centres of CCD frames for MTO-1000 were selected by means of the Aladin sky atlas — the on-line application based on the Vizier database [1]. An auxiliary Javascript module (AJS) has been created for this purpose. Fig. 1 shows the map of coverage in the Aladin interface window. About 600 images were obtained in the V-band (Johnsons system). Positions of centres of the observed areas correspond to the maximum concentration of stars with the solar-type activity.

List of the observed areas along with the their centres' coordinates, start and end moments of observations, and the number of obtained images are

presented in Table 1.

The database of CCD images has been created in VOTable format in order to be incorporated into Vizier with the access through the Aladin [1]. The access to individual observations and summarised images is provided via XML script (Fig. 1, a hyperlink at the bottom of the picture).

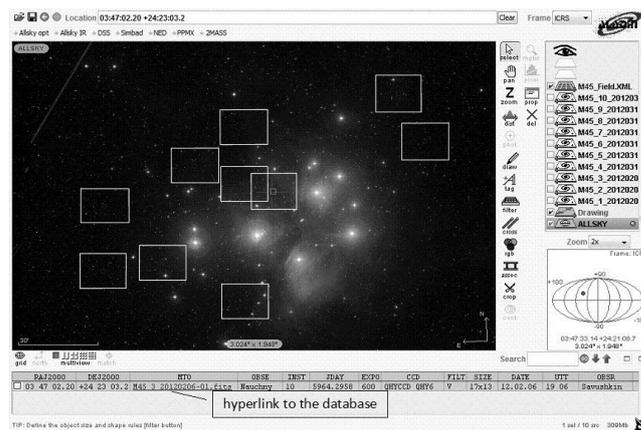


Fig. 1: Map of investigated areas.

In Fig. 2 the dependence of the instrumental magnitudes on those values from NOMAD catalogue is presented, N indicates the number of objects in selected area, R is the correlation coefficient, and $\bar{\sigma}$ is the residual mean square error. The range of brightness variation for stars with the solar-type activity was estimated from GTSh10 and NOMAD catalogues.

In Fig. 3 we present an example of the original image obtained on MTO-1000. The sample of stars was selected from the GTSh10 catalogue.

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¹<http://www.zenitcamera.com/archive/lenses/mto-1000.html>

²<http://qhyccd.com/QHY6.html>

Table 1: Log of observations.

Area number	Coordinates of the centre	Start (JD)	End (JD)	N_{obs}
M45_1	03 ^h 42 ^m 51 ^s .67 +24° 41' 37".7	2455966.19896	2455966.21725	22
M45_2	03 43 35.28 +24 59 38.9	2455966.23070	2455966.25111	20
M45_3	03 47 02.20 +24 23 03.2	2455964.29582	2455966.31449	53
M45_4	03 47 51.50 +24 47 30.6	2456005.28236	2456005.30501	29
M45_5	03 47 50.05 +24 25 44.7	2456005.23534	2456006.23925	60
M45_6	03 49 12.37 +24 32 35.5	2456006.24281	2456006.26320	28
M45_7	03 51 39.29 +24 17 09.3	2456004.33358	2456007.33650	60
M45_8	03 51 41.39 +23 52 43.2	2456004.29780	2456007.30538	55
M45_9	03 50 03.19 +23 55 48.5	2455964.23651	2456007.27916	92
M45_10	03 47 47.43 +23 41 27.9	2455964.20832	2456007.24833	150

Table 2: Partial data of the final catalogue (M45_1 area).

α (2000.0) (h m s)	δ (2000.0) (° ' ")	m1obs (m)	m2cat (m)	m2-m1 (m)	Name of star	GTSh10 number	Type	V SXmax (m)	V SXmin (m)	P
03 42 21.57	+24 39 51.1	13.84	13.99	0.15	V500 Tau	816	F1	14.300	15.900	B
03 42 38.05	+24 41 19.4	15.35	15.07	-0.28	LP Tau	827	F1	16.200	17.000	U
03 42 52.17	+24 42 06.9	13.49	-	-	V1033 Tau	835	F1	13.000	< 18.000	U
03 43 02.95	+24 40 10.9	11.40	11.26	-0.14	V810 Tau	844	BY	12.040	12.115	V
03 43 02.95	+24 41 32.4	15.70	15.62	-0.08	LU Tau	853	F1	14.500	17.970	B
03 43 11.90	+24 44 40.9	16.17	-	-	V509 Tau	854	F1	16.400	18.800	B
03 43 13.06	+24 39 20.1	14.89	15.09	0.20	LV Tau	855	F1	13.800	17.900	B

Calibration of the original image was made using the NOMAD catalogue [8]. Although NOMAD is not a photometric catalogue, its V magnitudes are of high accuracy [6].

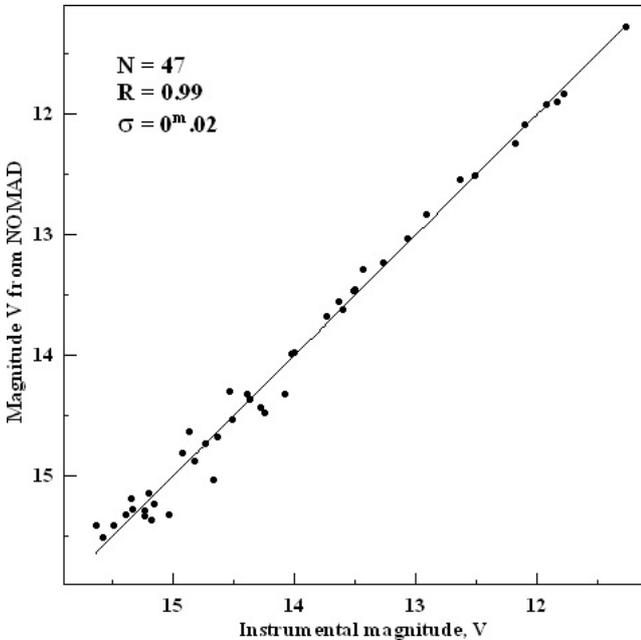


Fig. 2: Dependence of the instrumental magnitudes on those given in the NOMAD catalogue.

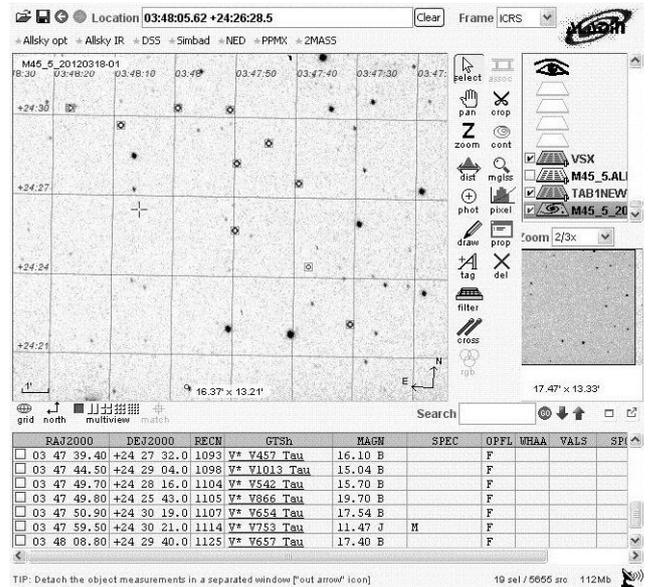


Fig. 3: Example of the original image with stars from GTSh10 catalogue.

Dependence of the mean square error on the instrumental magnitude is shown in Fig. 4. It was built using six measurements of the same area as in Fig. 2.

An example of the data in the final catalogue is given in Table 2 (M45_1 area). It contains coordinates of the stars, instrumental magnitudes (m1obs),

V-magnitudes (*m2cat*) from catalogue NOMAD, differences of magnitudes (*m2-m1*), names of stars, the object number in the GTSh10 catalogue (*GTSh10*), type of the star from SIMBAD [3], magnitudes at maximum and minimum from VSX [7] catalogue (*VSXmax* and *VSXmin*), passband of observations from VSX catalogue (P).

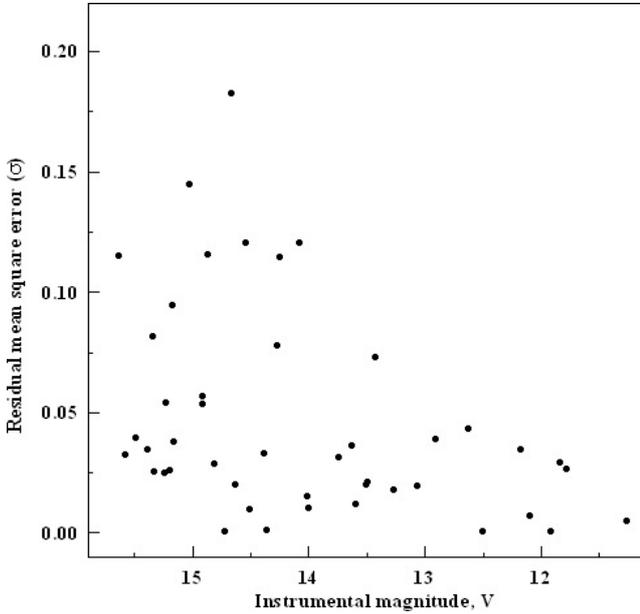


Fig. 4: Dependence of the mean square error on instrumental magnitude.

RESULTS AND CONCLUSIONS

The result of the present work is a final catalogue of about 1000 stars in 10 areas around M45, 77 of

which are from the GTSh10 catalogue. No flares or any other activity were registered in studied objects because of the short period of observations. All observational data are presented on the CrAO webpage³. To view the distribution of areas and CCD images via Aladin interface, click 'MTO-1000 Patrol Observations M45'.

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³<http://crao.crimea.ua/~aas/PROJECTs/PROJECTs.html>