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PHOTOELECTRIC OBSERVATIONS OF BRIGHT SOLAR TYPE STARS

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PHOTOELECTRIC OBSERVATIONS OF BRIGHT SOLAR TYPE STARS

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The results of precision photoelectric UBV photometry of 7 G1–G3 main-sequence stars with color indexes $0.60 < (B-V) < 0.67$ are presented. Five of these stars are stationary at level of 0.005–0.01 in V and B bands.

Keywords: Solar analogs; Photoelectric photometry

1 INTRODUCTION

Glushneva *et al.* (2000) determined the physical parameters of several solar type stars by using infrared and spectral observations. However, the stability of brightness was not investigated precisely. In the present paper we report results of the photoelectric photometry of 6 solar analogs carried out, mainly, in 1996–2002: HD 10307 = BS 483 (spectral type G1.5V), HD 89010 = BS 4030 (G1.5IV–V), HD 146233 = BS 6060 (G2Va), HD 186427 = BS 7504 (G2.5V), HD 193664 = BS 7783 (G3V), HD 213575 (G2V). Seventh solar analog, HD 186408 = BS 7503 (G1.5V) was used as comparison star for HD 186427.

2 OBSERVATIONS AND DATA REDUCTION

The observations were started in general in 1996 with the use of the 60-cm Zeiss reflector of the Sternberg Astronomical Institute located in Crimea, and were continued, with interruptions, until April 2002. For this programme we use the photon counting UBV photometer developed by Lyuty (1971).

Our study was based upon high-precision system of the photoelectric standards (Khaliullin *et al.*, 1985; Kornilov *et al.*, 1991). Each night of observations had excellent sky conditions; each measurement of stellar brightness was obtained on the basis of its own atmospheric extinction coefficient, determined by using the method of measurements of four or more standard stars at different zenith distances.

TABLE I Mean Values V , $B-V$, $U-B$, Together with Their Standard Errors and Numbers of Our Measurements. Corresponding Magnitudes V and $B-V$ from Catalogues Kornilov *et al.*, 1991 ('K') and Mermilliod, 1991 ('M') are Given for Comparison.

HD	V	$Error$	$B-V$	$Error$	$U-B$	$Error$	n	V 'K'	$(B-V)$ 'K'	V 'M'	$(B-V)$ 'M'
10307	4.956	0.003	0.604	0.004	0.047	0.007	13	4.965	0.623	4.953	0.618
89010	5.978	0.001	0.660	0.001	0.115	0.005	26	5.968	0.668	5.968	0.655
146233	5.509	0.006	0.635	0.003	0.144	0.008	9	5.499	0.650	5.503	0.652
186427	6.252	0.002	0.667	0.002	0.167	0.015	19	6.244	0.671	6.215	0.661
193664	5.921	0.002	0.601	0.002	0.050	0.017	10	5.932	0.601	5.919	0.585
213575	6.948	0.005	0.675	0.008	0.058	0.013	8	6.951	0.677	—	—

3 RESULTS

Table I presents the mean results of measurements reduced to the standard UBV system. For each star it gives HD number of the star, mean values V , $B-V$, $U-B$, together with their uncertainties determined on the basis of dispersion of the data, and also a number of individual

TABLE II Individual Results of V and $B-V$ Measurements.

<i>JD hel 2400000+</i>	<i>V</i>	<i>B-V</i>	<i>JD hel 2400000+</i>	<i>V</i>	<i>B-V</i>
HD 10307 = BS 483					
50484.2598	4.947	0.589	51866.5204	4.935	0.610
50868.2819	4.964	0.611	51879.4388	4.957	0.608
50868.2889	4.955	0.613	51901.3458	4.956	0.595
50874.3148	4.960	0.623	51902.4055	4.927	0.606
51047.5526	4.958	0.595	51917.3050	4.965	0.596
51863.3614	4.960	0.621	52310.2556	4.971	0.575
51864.3739	4.968	0.616			
HD 89010 = BS 4030					
50588.3599	5.992	0.657	51901.4033	5.988	0.658
50591.3513	5.975	0.655	51902.4280	5.992	0.658
50868.3462	5.975	0.661	51917.3318	5.978	0.662
50868.3539	5.980	0.658	51934.4769	5.977	0.666
50874.3711	5.975	0.659	51951.3824	5.978	0.659
50874.3787	5.975	0.658	52003.3759	5.965	0.662
50874.4114	5.971	0.663	52012.3587	5.972	0.665
51261.3934	5.969	0.659	52308.4878	5.973	0.670
51282.2980	5.980	0.658	52309.4260	5.976	0.668
51287.3580	5.984	0.637	52309.4441	5.977	0.664
51305.4017	5.980	0.649	52339.4626	5.982	0.667
51866.5404	5.984	0.665	52381.3327	5.972	0.667
51879.5090	5.980	0.660	52387.3404	5.985	0.656
HD 146233 = BS 6060					
50326.2609	5.485	0.625	51305.4514	5.510	0.640
50549.5191	5.541	0.633	51647.4364	5.524	0.621
50588.3852	5.522	0.638	51683.3873	5.495	0.641
50591.3678	5.504	0.645	51741.3944	5.483	0.625
51294.3941	5.521	0.635			
HD 186427 = BS 7504					
50325.3998	6.234	0.666	51711.4317	6.241	0.679
50326.2852	6.258	0.673	51741.3514	6.255	0.665
50326.3908	6.261	0.671	51742.4053	6.256	0.671
50588.4503	6.243	0.659	51771.4416	6.251	0.663
50591.3729	6.251	0.661	51864.3461	6.265	0.670
51047.5819	6.264	0.668	51865.3360	6.243	0.671
51420.2860	6.246	0.670	52196.3699	6.238	0.683
51420.3360	6.258	0.673	52208.4131	6.263	0.664
51683.3703	6.247	0.648	52210.4263	6.269	0.642
51684.4030	6.239	0.669			
HD 193664 = BS 7783					
50325.4089	5.910	0.601	51420.4136	5.927	0.596
50326.2924	5.929	0.609	51683.3937	5.918	0.602
50326.3840	5.932	0.608	51684.4056	5.914	0.607
50588.4570	5.918	0.602	51863.3528	5.913	0.607
50591.3806	5.928	0.598	51864.3667	5.919	0.583
HD 213575					
48462.4702	6.934	0.676	48844.4131	6.935	0.716
48524.3570	6.952	0.686	50295.4332	6.979	0.641
48526.3780	6.954	0.687	50326.4085	6.940	0.658
48816.5052	6.962	0.681	51420.3576	6.929	0.651

measurements (the first to eighth columns). The next columns give, for comparison, values V and $B-V$ from catalog Kornilov *et al.* (1991) (ninth and tenth columns) and from homogeneous catalog Mermilliod (1991) (eleventh and twelfth columns).

The accuracy of our U measurements is three times lower. There are still more systematic errors due to uncertainties in the procedures of reduction for atmospheric extinction and reduction to standard U system. Consequently U magnitudes are unfit for investigations of stability (or low-amplitude variations) of these stars. Therefore we only give mean values of $U-B$, contrary to individual measurements of V and $B-V$.

Table II presents the individual results of measurements. For each star it gives: the heliocentric times of observations, V magnitudes and $B-V$ colors.

4 CONCLUSIONS

Our measurements, together with data from catalogs Mermilliod (1991) and Kornilov *et al.* (1991) allows to conclude that HD 10307, HD 89010, HD 186427 and HD 193664 are stationary at level 0.005–0.01 in the V and B bands. The dispersion of measured magnitudes of these stars is low (standard deviations are 0.005–0.01, standard errors are 0.001–0.003), and long-time variations are less than 0.005–0.01. One should note that the solar-type star HD186408 is stationary at the same level, since it was used as comparison star for HD 186427. HD 89010 and HD 186427 were investigated for possible regular and semi-regular brightness variations, but significant changes were not detected.

The standard deviations of HD 146233 and HD 213575 measurements are two times more; however, the conditions of HD 146233 observations were worse (declination is -9°).

HD 10307, 89010, 186408, 186427, 193664 may be used as standard stars with high stability level.

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