BRIEF COMMUNICATIONS

DETERMINATION OF THE STELLAR MAGNITUDE OF THE SUN IN TRICOLOR SYSTEMS BASED ON ABSOLUTE SPECTROPHOTOMETRIC MEASUREMENTS

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Stellar magnitude values of the sun have been obtained on the basis of energy distribution data for solar spectra and spectra of 16 stars in absolute energy units (erg/cm^3·sec) in the following color systems: international photovisual ($m_\odot = -26^m.79 \pm 0^m.03$) and Johnson-Morgan V and B (with $m_\odot = -26^m.91 \pm 0^m.03$ and $m_\odot = -26^m.27 \pm 0^m.03$, respectively).

An extensive program of research on the energy distribution in the spectra of 16 stars, in absolute units (erg/cm^3·sec), has been underway in recent years at the Astrophysical Institute of the Academy of Sciences of the Kazakh SSR, under the supervision of A. V. Kharitonov [1]. The center of the solar disk has been used as standard in this work. In making use of the results reported in [1] and the energy distribution in solar spectra in the same units, we determined the stellar magnitude of the sun in three distinct color systems: the international photovisual system and the Johnson-Morgan V and B systems.

Clearly, the following formula:

$$2.512^{-(m_\odot - m_*)} = \frac{\pi r_\odot^2 \int \eta(\lambda) \cdot \beta(\lambda) \cdot B_\odot(\lambda) \cdot S(\lambda) \cdot d\lambda}{\int E_*(\lambda) \cdot S(\lambda) \cdot d\lambda}$$

where $m_\odot$ and m_* are the stellar magnitudes of the sun and of the stars in question in the system whose spectral sensitivity is expressed as a function $S(\lambda)$; $E(\lambda)$ is the spectral illumination from the star at the boundary of the earth's atmosphere; $r_\odot$ is the average solar radius; $B_\odot(\lambda)$ is the energy distribution in the undistorted continuous spectrum of the center of the solar disk; $\beta(\lambda) < 1$ is a factor taking into account the effect contributed by the Fraunhofer lines in the solar spectrum; $\eta(\lambda) < 1$ is a coefficient taking into account limb darkening of the solar disk.

We calculated the value of $\eta(\lambda) \cdot \beta(\lambda) \cdot B_\odot(\lambda)$ and reported it in [2]. The spectral sensitivity values of the IPv, V, and B systems were taken from Allen's handbook [2]. In computing $m_\odot$ in the B system, we took into account absorption lines in the spectra of comparison stars, relying on the data supplied by A. V. Kharitonov [1] and I. M. Kopylov [4].

The results of these calculations are listed in the table. Stellar magnitudes of the comparison stars were taken from [5] for the IPv system and from [6] for the V and B systems.

The values of the stellar magnitude of the sun and of the color index were found to be equal:

$$m_{IPv} = -26^m79 \pm 0^m02,$$
$$m_V = -26.91 \pm 0.01,$$
$$m_B = -26.27 \pm 0.01,$$
$$B - V = +0^m64.$$

The error values listed typify the intrinsic convergence of the results, i.e., the accuracy of the photometric comparison of $\odot$ and $*$ and the effect of errors in the assigned values for the stellar magnitudes of the comparison stars. To make it possible to estimate the accuracy achieved in determining $m_\odot$, we must also take into account the error in the attenuation of the flux from the sun as compared to the stars. This was accomplished in a paper by A. V. Kharitonov [7] and, as may be seen from Table 2 in [7], it does not exceed $0^m.03$.

It would be interesting to compare the values of $m_\odot$ which we obtained with the results cited by D. Ya. Martynov [8] for $m_\odot$ in the IPv and V systems, which we reproduce below:

$$m_{\odot IPV} = -26^m76 \pm 0^m04,$$
$$m_{\odot V} = -26^m80 \pm 0.03.$$

The $m_\odot$ values reported in [8] were determined by means of the differences $m_\odot - m_*$ obtained by 10 different authors. The m_* values were taken from the five most reliable recent investigations. Clearly, the $m_\odot - m_*$ differences would have to be found using the

Determination of Stellar Magnitudes of the Sun in the IPv, V, and B Systems

No.	Comparison star	IPv system			Johnson-Morgan V system			Johnson-Morgan B system		
		m_*	$m_\odot - m_*$	$m_\odot$	m_*	$m_\odot - m_*$	$m_\odot$	m_*	$m_\odot - m_*$	$m_\odot$
1	β Ari	$2^{\mathrm{m}}72$	$-29^{\mathrm{m}}53$	$-26^{\mathrm{m}}81$	$2^{\mathrm{m}}62$	$-29^{\mathrm{m}}55$	$-26^{\mathrm{m}}93$	$2^{\mathrm{m}}76$	$-29^{\mathrm{m}}04$	$-26^{\mathrm{m}}28$
2	ζ Per	2.91	−29.75	−26.84	2.83	−29.76	−26.93	2.96	−29.26	−26.30
3	β Ori	0.34	−27.07	−26.73	0.15	−27.09	−26.94	0.11	−26.39	−26.28
4	γ Ori	1.70	−28.48	−26.78	1.64	−28.50	−26.86	1.41	−27.67	−26.26
5	β Tau	1.78	−28.54	−36.76	1.65	−28.56	−26.91	1.52	−27.80	−26.28
6	ε Ori	1.75	−28.63	−26.88	1.70	−28.63	−26.93	1.52	−27.64	−26.12
7	ζ Ori	2.05	−28.62	−26.57	1.78	−28.65	−26.87	1.57	−27.85	−26.28
8	α Leo	1.34	−28.29	−26.95	1.36	−28.31	−26.95	1.25	−27.54	−26.29
9	γ UMa	2.54	−29.33	−26.79	2.44	−29.35	−26.91	2.44	−28.77	−26.33
10	η UMa	1.91	−28.79	−26.88	1.87	−28.81	−26.94	1.67	−28.03	−26.36
11	α Oph	2.14	−29.02	−26.88	2.08	−29.04	−26.96	2.23	−28.56	−26.33
12	α Lyr	0.14	−26.89	−26.75	0.04	−26.92	−26.88	0.04	−26.29	−26.25
13	δ Cyg	2.97	−29.72	−26.75	2.87	−29.74	−26.87	2.84	−29.09	−26.25
14	α Aql	0.89	−27.65	−26.76	0.80	−27.66	−26.86	1.02	−27.24	−26.22
15	α Cyg	1.33	−28.15	−26.82	1.26	−28.16	−26.90	1.35	−27.62	−26.27
16	α Peg	$2^{\mathrm{m}}57$	$-29^{\mathrm{m}}32$	$-26^{\mathrm{m}}75$	$2^{\mathrm{m}}49$	$-29^{\mathrm{m}}34$	$-26^{\mathrm{m}}85$	$2^{\mathrm{m}}44$	$-28^{\mathrm{m}}69$	$-26^{\mathrm{m}}25$
		Average $m_\odot = -26^{\mathrm{m}}79 \pm 0^{\mathrm{m}}02$			Average $m_\odot = -26^{\mathrm{m}}91 \pm 0^{\mathrm{m}}01$			Average $m_\odot = -26^{\mathrm{m}}27 \pm 0^{\mathrm{m}}01$		

same photometric system in order to obtain $m_\odot$ values strictly within the photometric system of reference stars. The reduction carried out by D. Ya. Martynov, converting $m_\odot$ to the IPv system and particularly to the V system, therefore contains an uncertainty due to the possible difference in the color systems of $m_\odot - m_*$ and m_*. A similar uncertainty was completely eliminated only in a paper by Stebbins and Kron [9] who took as their comparison stars objects belonging to the spectral classes G and F, and performed their observations in narrow spectral regions. The $m_\odot$ values which we obtained do not require any reductions for the color system either and, as we may readily see, are in excellent agreement, in the IPv system, with the average reported by D. Ya. Martynov, and with the most reliable recent determinations:

E. K. Nikonova [10]	$-26^{\mathrm{m}}69 \pm 0^{\mathrm{m}}04$,
Z. V. Karyagina [11]	−26.76 ± 0.04,
Stebbins and Kron [9]	−26.73 ± 0.03,
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The agreement between our results and those reported by other authors, in the IPv system, shows that a possible systematic error which might have gone unaccounted for in the absolute spectrophotometric measurements reported by A. V. Kharitonov [1] does not exceed 3-4%.

The $m_\odot$ value in the V_1 system which we obtained does not differ significantly from the average value arrived at by D. Ya. Martynov [8]; the reason for this might be the uncertainty in properly taking into account the difference in the photometric systems of $m_\odot - m_*$ and of the reference stars in [8].

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