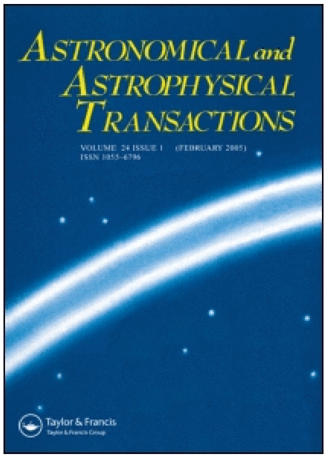

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THE EFFECTIVE TEMPERATURES AND ANGULAR DIAMETERS OF A–G MAIN SEQUENCE STARS

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Effective temperature, bolometric correction, radius, angular diameter and luminosity have been obtained for 9 stars of the spectral type A5–G2, belonging to IV and V liminosity classes, by means of the infrared flux method as modified by Blackwell *et al.* (1980).

The comparison of the effective temperature values with those obtained using the calibration of monochromatic flux by Koornneef for *J*, *K* and *L* bands (Koornneef, 1983) and by Johnson for *I*, *J*, *K* and *L* bands (Johnson, 1966) shows that $T_{\rm eff}$ in Koornneef's calibration are systematically lower with the difference of the mean values for the stars investigated being about 1.6%.

KEY WORDS Effective temperature, spectrophotometry, infrared flux method

The infrared flux method (Blackwell and Shallis, 1977) is often used for determination of the stellar effective temperature and angular diameter when reliable spectrophotometric measurements in the ultraviolet and visible ranges and infrared photometry are available.

Nine stars have been chosen belonging to the A5–G2 spectral type interval and IV and V liminosity classes, which are the members of the catalogue of 238 secondary spectrophotometric standards (Glushneva *et al.*, 1992). In this catalogue, the energy distribution is characterized by the mean monochromatic flux in the range 3200–7600 Å obtained independently at the Sternberg State Astronomical Institute and Fessenkov Astrophysical Institute, Alma-Ata. Furthermore, this catalogue contains also near-infrared (6300–10,800 Å) energy distribution data for 99 stars, obtained at the Crimean Station of the Sternberg Institute. This provides a homogeneous spectrophotometric data set for a rather wide range from 3200 to 10,800 Å which is especially important for A5–G2 stars where the fraction of the total flux in this range is about 70–75%.

The list of the stars investigated is presented in Table 1, where the BS and HD numbers of stars are given with their V magnitude, spectral type and parallax taken from The Bright Star Catalogue (Hoffleit, 1982). BS 21 F2 III–IV was included in the list of IV and V luminosity class stars because this belongs to 113 stars investigated by Blackwell *et al.* (1990, 1991) by the infrared flux method; thereby we increase the number of common stars for the comparison of the resulting effective temperatures.

The total fluxes were obtained by integrating the monochromatic fluxes in the UV, visual and IR ranges. In the ultraviolet, for $\lambda < 3200$ Å the spectro-

Table 1 The list of stars

BS	*HD*	*V*	*Spectral type*	π''
21	432	$2^m.27$	F2e III–IV	+0.072
269	5448	3.87	A5 V	+0.039
483	10,307	4.95	G1.5 V	+0.081
1543	30,652	3.19	F6 V	+0.137
2943	61,421	0.38	F5 IV–V	+0.292
4540	102,870	3.61	F9 V	+0.104
5986	144,284	4.01	F8 IV	+0.051
6561	159,876	3.54	F0 IV	+0.030
8162	203,280	2.44	A7 V	+0.068

photometric data of IUE were used (Heck *et al.*, 1984; Wu *et al.*, 1991). For BS 21, BS 2943, BS 5986 and for BS 8162 (in the range 1720–3200 Å), where IUE low-dispertion data are absent, OAO-2 measurements were taken (Code and Meade, 1979).

In the range 3200–10,800 Å, spectrophotometric data obtained at the Crimean Station of the Sternberg Institute and Alma-Ata Astrophysical Institute from the catalogue of 238 secondary spectrophotometric standards (Glushneva *et al.*, 1992) were used. For BS 483, BS 4540, BS 5986 and BS 6561 in the near-infrared range 7650–11,084 Å, 13-color photometry by Johnson and Mitchell (1975) was taken using the calibration given in this paper. For longer wavelengths up to 4 μm, the flux was calculated using the trapezium formula and the absolute flux obtained from J_n, K_n, L_n photometry by Selby *et al.* (1988) and the calibration for *J*, *K* and *L* bands by Saxner and Hammarback (1985) for the stars BS 483, BS 1543 and BS 2943. This calibration is based on the model of α Lyr by Dreiling and Bell (1980). In the visible and infrared up to 1 μm, the calibration of α Lyr by Hayes (1985) was used. For BS 6561, where infrared photometry data are absent, the flux for $\lambda > 11{,}084$ Å was obtained using the model atmosphere data by Kurucz (1979) for $T_{\rm eff} = 7500$ K and $\lg g = 4.00$. In this case, the monochromatic flux for λ 11,084 Å was taken from Johnson and Mitchell (1975).

The values of the total flux are presented in the Table 3. The comparison of the total flux obtained in this paper with the data of Petford *et al.* (1989) for 5 common stars in the range 3800–9000 Å shows that they are in a very good agreement and do not differ by more than 1%.

Total fluxes in 10^{-10} w/m^2.

BS	Our data	Petford *et al.* (1989).
21	19.34	19.08
269	4.326	4.379
1543	8.252	8.184
2943	111.79	111.70
8162	16.360	16.100

The effective temperature was obtained using the infrared flux method modified by Blackwell *et al.* (1980).

$R = F_{tot}/F_\lambda$ were obtained, where F_{tot} is the total flux and F_λ are the monochromatic fluxes in the I, J, K and L Johnson photometric bands, using infrared photometry by Johnson *et al.* (1966). In order to obtain the effective temperature, we plotted R versus T_{eff} for $\log g = 3.5$, 4.0 and 4.5 using the atmosphere model by Kurucz (1979). For the effective temperature, two estimates were obtained: for the calibration in I, J, K and L photometric bands by Johnson (1966) and for the calibration in J, K and L bands by Koornneef (1983).

In both cases, systematic differences between the temperatures obtained using photometric measurements in different infrared bands were found. As shown by Glushneva (1985), the best estimate of T_{eff} based on the direct interferometric measurements of stellar angular diameters is that resulting from the photometry in the K band. So, special graphs were plotted for the dependence of $T_{eff}(I)$, $T_{eff}(J)$ and $T_{eff}(L)$ versus $T_{eff}(K)$ and T_{eff} for each band: I, J, L were transformed to the "system K". These corrected T_{eff} values are presented in Table 2 where mean values of T_{eff} are also given. For BS 483, T_L was excluded from the averaging because of too large differences with all the other T_{eff} determinations for I, J and K bands.

The comparison of mean T_{eff} values obtained on the basis of the calibrations of Johnson a Koornneef shows that T_{eff} in Koornneef calibration are systematically lower, and the difference of the mean values for the stars investigated is about 1.6%.

The T_{eff} values obtained using Koornneef's calibration for the two stars, BS 21 and BS 269, are in a better agreement with the results of Blackwell *et al.* (1991) than T_{eff} obtained using Johnson's calibration. For BS 21, the mean effective temperature from the left part of Table 2 (Koornneef's calibration) differs from Blackwell's *et al.* T_{eff} by less than 1%, for BS 269 the difference is only 0.2%. At the same time, for BS 5986 the difference in T_{eff} is large, about 6%.

Table 3 contains main physical parameters of the stars: the total flux and bolometric correction, angular diameter, radius, luminosity and $\lg g$. ϑ'', $R/R_\odot$ and $\lg g$ are calculated for the two values of the mean T_{eff} from the Table 2, using two calibrations in each case. $\log \mathfrak{M}/\mathfrak{M}_\odot$ were taken from Straizys and Kuriliene (1981).

Table 2 Effective temperatures

Calibration by Koornneef						*Calibration by Johnson*				
BS	T_I	T_J	T_K	T_L	T_{mean}	T_I	T_J	T_K	T_L	T_{mean}
21	6990	6900	6960	—	6950	7010	6955	7090	—	7018
269	8010	—	—	—	8010	8160	—	—	—	8160
483	6130	6020	5925	5730	6025	6240	6155	6020	5885	6138
1543	6430	6520	6450	—	6467	6540	6595	6565	—	6567
2943	6550	6600	6585	6600	6584	6670	6675	6715	—	6687
4540	6110	6035	6095	—	6080	6215	6175	6190	6325	6193
5986	6520	—	—	—	6520	6635	—	—	—	6635
6561	7520	—	—	—	7580	7720	—	—	—	7720
8162	7820	7770	7725	7730	7774	8020	7855	7855	7850	7895

Table 3 The physical parameters of the stars: total flux F (w/m^2), bolometric correction B.C., angular diameter ϑ'' (milliarcsec), Radius $R/R_\odot$, Luminosity $\log L/L_\odot$, $\log \mathfrak{M}/\mathfrak{M}_\odot$, $\log g$

BS	F_{tot}	Calibration by Koornneef *B.C.*	ϑ''	$R/R_\odot$	$\log L/L_\odot$	$\log \mathfrak{M}/\mathfrak{M}_\odot$	$\log g$
21	$3.114\ 10^{-9}$	−0.01	2.00	2.92	1.270	0.18	3.68
269	$6.963\ 10^{-10}$	+0.01	0.712	1.93	1.152	0.26	4.12
483	$3.014\ 10^{-10}$	−0.16	0.83	1.08	0.156	0.00	4.36
1543	$1.392\ 10^{-9}$	−0.06	1.55	1.19	0.364	0.08	4.36
2943	$1.868\ 10^{-8}$	−0.07	5.46	1.97	0.832	0.10	3.94
4540	$9.571\ 10^{-10}$	−0.07	1.45	1.47	0.436	0.04	4.14
5986	$6.684\ 10^{-10}$	−0.08	1.05	2.18	0.900	0.11	3.86
6561	$9.536\ 10^{-10}$	0.00	0.932	3.27	1.516	0.20	3.60
8162	$2.702\ 10^{-9}$	−0.03	1.49	2.32	1.260	0.22	3.92
BS	F_{tot}	Calibration by Johnson *B.C.*	ϑ''	$R/R_\odot$	$\log L/L_\odot$	$\log \mathfrak{M}/\mathfrak{M}_\odot$	$\log g$
21	$3.114\ 10^{-9}$	−0.01	1.96	2.87	1.270	0.18	3.70
269	$6.963\ 10^{-10}$	+0.01	0.684	1.86	1.152	0.26	4.15
483	$3.014\ 10^{-10}$	−0.16	0.799	1.04	0.156	0.00	4.39
1543	$1.392\ 10^{-9}$	−0.06	1.50	1.16	0.364	0.08	4.38
2943	$1.868\ 10^{-8}$	−0.07	5.29	1.91	0.832	0.10	3.97
4540	$9.571\ 10^{-10}$	−0.07	1.40	1.41	0.436	0.04	4.17
5986	$6.684\ 10^{-10}$	−0.08	1.02	2.10	0.900	0.11	3.90
6561	$9.536\ 10^{-10}$	0.00	0.897	3.16	1.516	0.20	3.63
8162	$2.702\ 10^{-9}$	−0.03	1.45	2.24	1.260	0.22	3.95

For the majority of the stars considered here, one can compare the values of the physical parameters from Tables 2 and 3 with the results obtained earlier by means of the method of infrared flux using iterations (Glushneva, 1984, 1985) and based on the calibration by Johnson. Such a comparison demonstrates that the results are in a good agreement. For example, there is no systematic difference between the effective temperatures and the mean difference for T_{eff} is only 0.5%. For the majority of the stars, Table 3 gives a slightly larger radius, the mean difference being about 2%. The mean difference in $\log g$ is 0.01, and for individual stars this difference does not exceed 0.05, which includes also some difference in $\log \mathfrak{M}/\mathfrak{M}_\odot$ because of distinctions in spectral classification for some stars.

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