

UBVRI STANDARD STARS AT NORTHERN DECLINATIONS

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Received September 15, 1995.

Abstract. Accurate values of V , $B-V$ and $U-B$ are given 123 stars of magnitudes from 6 to 11 at high northern declinations. For 36 stars also $V-R$ and $R-I$ color indices are given.

Key words: stars: multicolor photometry, standards – methods: observational – techniques: photometric

1. INTRODUCTION

The UBV system was originally defined by a number of stars (primary and secondary standards) scattered over the sky (Johnson & Morgan 1953, Johnson 1955). The individual accuracy of the standard values is quite good for $B-V$, while the values of V and $U-B$ carry considerable accidental errors. As a result of this, a large number of stars has to be measured when standardizing any instrumental system. The Johnson standards mostly are quite bright, and therefore many of them are inaccessible to large telescopes.

A set of fainter standards, located around the celestial equator, was measured by Landolt (1983) and later on by Wall et al. (1989) and Menzies et al. (1991); for these stars measurements in the R and I passbands were also given. It was assumed that stars near the equator are accessible from everywhere on the Earth, so a considerable number of standards will be always available to any observer. The different lists of equatorial standards are of high internal accuracy (the mean error typically is a few thousandths of magnitude), but show systematic differences with respect to each other, as well as with respect to the original Johnson system (Menzies et al. 1989, Oja 1994). A problem to observers at high northern latitudes (e.g. in

the Scandinavian and Baltic countries) is that the celestial equator is too low in the sky to be useful for the standardization of accurate photometry. Observers in the southern hemisphere have numerous standards in the E regions at about -45 deg declination.

Therefore there is a need for additional accurate standards of bright, intermediate and faint stars at northern declinations. This paper presents a list of accurate *UBV* (and in some cases *RI*) photometry for bright and intermediate brightness stars, most of them being rather high above the celestial equator.

2. OBSERVATIONS

The bright star list presented here consists of stars observed with the 40 cm Cassegrain telescope at the Kvistaberg Observatory (in 1981–1995) and with the 60 cm telescope of the Royal Swedish Academy of Sciences at the Roque de los Muchachos Observatory, La Palma (in 1991–1995). The program stars are either the existing *UBV* standards for the calibration of our photometry or new standard stars for the future use. All measurements have been reduced accurately to the Johnson system (Johnson 1952, 1955); in case of *B–V* and *U–B* it was necessary to include non-linear terms and color excess terms to the transformation equations. The result is given in Table 1, separately for the two instruments. The data in Table 1 include also the measurements published earlier (Oja, 1983, 1984, 1985a, 1985b, 1986, 1987a,b, 1991, 1993).

The program of stars of the intermediate brightness contains the following star groups.

(1) The first part of the program consists of groups of 4–6 stars between visual magnitude 7 and 11 in each of 11 Kapteyn areas at Decl. $+15$ deg and $+45$ deg (SA 68, 72, 76, 80, 84, 88, 20, 24, 28, 36 and 40) and an additional group at R.A. 12 h 35 m, Decl. $+34$ deg in the central part of the region investigated by Malmquist (1936, 1960) and Ljunggren (1965). The intention was to measure these stars also in the *R* and *I* passbands, but this could be realized only partly, because the photometer at the Nordic Optical Telescope (NOT) at the Roque de los Muchachos Observatory, used for these measurements, was taken out of operation before this work was completed.

(2) The second part of the program includes stars of intermediate brightness scattered over the northern sky, mostly comparison stars of variables, and three members of the Praesepe cluster. *R* and *I*

measurements are available for the stars which are observed with the NOT.

All measurements were accurately reduced to the Johnson system. The NOT *UBVRI* measurements were first reduced to the Landolt system; after that, the systematic differences between the Johnson and Landolt systems were added to *V* and *U-B* (see Oja 1994). The resulting photometry is presented in Table 2 separately for all three instruments used.

3. THE RESULTS

All results of the observations were averaged, and the final magnitudes and color indices are presented in Tables 3 and 4. In the case of those bright stars, which have been observed by Johnson (1954), his results were included in averaging the magnitudes and color indices. The same is done with Johnson's results for the Praesepe stars (Johnson 1952). The mean square error of one measurement of any photometric quantity is around ± 0.01 mag; this value is adopted in the weighting procedure. Additionally it is assumed (rather arbitrarily) that all series of observations contain a systematic error of 0.002 mag, in order to prevent a complete domination of the results by one series of photometry. Possibly, this error is underestimated (at least for *U-B*), but the details of the weighting procedure are only of marginal importance for the final result. Unit weight p of the average values in Table 3 is related with the rms error in the following way:

$$\sigma(\text{for weight } p) = \sigma(\text{for } p = 1) / \sqrt{p}.$$

Consequently, the mean errors of the average values are generally about $\pm(0.002 - 0.003)$ mag (perhaps slightly higher for *U-B*).

The coordinates and the proper motions given in Table 3 were taken from the PPM Catalogue (Roser & Bastian 1991) whenever possible; for the stars, which were absent in PPM, other sources were used (see notes).

The results of the *RI* photometry are given in Table 4. The mean error of one measurement of *V-R* is ± 0.007 mag, and of *R-I* it is ± 0.018 mag.

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Table 1. *UBV* measurements of bright stars: n is a number of measurements; instruments: 4 for the 40 cm telescope at Kvistaberg, 6 for the 60 cm telescope on La Palma.

HR	V	$B-V$	$U-B$	n	Instr	HR	V	$B-V$	$U-B$	n	Instr
45	4.789	1.573	1.898	41	4	3579	3.966	0.437	0.038	222	4
45	4.802	1.580	1.927	9	6	3579	3.963	0.442	0.024	27	6
343	4.333	0.172	0.127	108	4	4456	5.942	-0.156	-0.635	116	4
343	4.330	0.169	0.114	9	6	4456	5.939	-0.162	-0.630	17	6
403	2.679	0.132	0.123	171	4	4554	2.442	0.004	-0.002	38	4
437	3.612	0.975	0.729	89	4	4660	3.311	0.075	0.071	115	4
437	3.615	0.975	0.736	7	6	4660	3.312	0.082	0.053	5	6
824	4.505	1.114	1.077	85	4	5019	4.750	0.710	0.265	11	6
824	4.506	1.109	1.082	16	6	5062	4.008	0.171	0.087	156	4
875	5.162	0.081	0.029	26	4	5062	4.000	0.171	0.068	6	6
875	5.164	0.082	0.037	13	6	5072	4.961	0.714	0.265	20	4
882	4.931	1.239	1.282	76	4	5072	4.968	0.713	0.264	11	6
882	4.929	1.230	1.287	19	6	5235	2.682	0.580	0.200	124	4
1030	3.600	0.893	0.602	11	4	5235	2.689	0.584	0.197	1	6
1030	3.602	0.892	0.606	10	6	5291	3.695	-0.049	-0.094	45	4
1046	5.101	0.037	0.040	68	4	5291	3.663	-0.043	-0.068	2	6
1046	5.093	0.040	0.019	4	6	5854	2.634	1.159	1.263	45	4
1411	3.831	0.950	0.725	19	4	5854	2.633	1.167	1.265	13	6
1411	3.839	0.949	0.737	11	6	5947	4.126	1.231	1.276	75	4
1412	3.405	0.179	0.122	91	4	5947	4.130	1.228	1.275	24	6
1412	3.407	0.178	0.121	9	6	5986	4.005	0.533	0.096	126	4
1543	3.189	0.448	-0.022	40	4	5986	4.002	0.530	0.094	11	6
1543	3.195	0.455	-0.028	5	6	6092	3.898	-0.155	-0.551	138	4
1781	5.692	-0.216	-0.863	32	4	6092	3.896	-0.151	-0.565	18	6
1781	5.703	-0.212	-0.873	17	6	6573	5.231	0.610	0.100	31	4
1195	4.506	0.956	0.693	123	4	6573	5.236	0.604	0.910	8	6
1195	4.509	0.951	0.702	21	6	6603	2.752	1.167	1.251	22	4
2012	3.956	1.133	1.075	94	4	6603	2.752	1.171	1.254	17	6
2012	3.958	1.129	1.076	24	6	6705	2.241	1.517	1.880	92	4
2077	3.720	1.014	0.836	229	4	6705	2.231	1.562	1.871	9	6
2077	3.721	1.011	0.840	20	6	6927	3.574	0.498	-0.055	99	4
3249	3.524	1.478	1.767	64	4	6927	3.567	0.501	-0.064	11	6
3249	3.526	1.486	1.765	22	6	7178	3.250	-0.047	-0.127	72	4
3454	4.291	-0.194	-0.728	67	4	7178	3.248	-0.049	-0.065	6	6
3454	4.296	-0.196	-0.731	33	6	7266	5.227	0.346	0.015	83	4

Table 1 (continued)

HR	<i>V</i>	<i>B-V</i>	<i>U-B</i>	<i>n</i>	Instr	HR	<i>V</i>	<i>B-V</i>	<i>U-B</i>	<i>n</i>	Instr
7266	5.232	0.342	0.015	28	6	8430	3.771	0.435	-0.010	98	4
7462	4.672	0.793	0.395	59	4	8430	3.773	0.443	-0.026	13	6
7462	4.678	0.790	0.384	8	6	8513	5.368	-0.019	-0.487	45	4
7602	3.706	0.854	0.494	99	4	8513	5.371	-0.017	-0.484	16	6
7602	3.710	0.860	0.482	11	6	8597	4.036	-0.088	-0.291	19	4
7615	3.883	1.029	0.883	156	4	8597	4.035	-0.080	-0.269	19	6
7615	3.886	1.026	0.887	32	6	8622	4.886	-0.205	-1.023	111	4
7906	3.776	-0.061	-0.206	48	4	8622	4.885	-0.204	-1.033	14	6
7906	3.794	-0.056	-0.200	5	6	8795	4.528	1.566	1.922	16	4
7949	2.479	1.025	0.853	72	4	8795	4.520	1.566	1.912	14	6
7949	2.476	1.032	0.856	6	6	8832	5.572	0.986	0.908	74	4
7957	3.408	0.919	0.623	52	4	8832	5.567	0.991	0.897	10	6
7957	3.414	0.920	0.627	4	6	8969	4.122	0.509	0.005	42	4
8130	3.723	0.395	0.022	195	4	8969	4.120	0.510	-0.006	12	6
8130	3.733	0.399	0.017	16	6	8974	3.213	1.028	0.947	145	4
8162	2.463	0.220	0.093	98	4	8974	3.216	1.030	0.950	7	6

Table 2. *UBV* photometry of intermediate brightness stars: *n* is a number of measurements; instruments: 4 for the 40 cm telescope, 6 for the 60 cm telescope and N for the Nordic Optical Telescope (2.6 m).

BD	<i>V</i>	<i>B-V</i>	<i>U-B</i>	<i>n</i>	Instr	BD	<i>V</i>	<i>B-V</i>	<i>U-B</i>	<i>n</i>	Instr
15°0030	8.317	0.367	-0.030	12	4	44°0195	7.495	1.538	1.880	1	N
15°0030	8.322	0.360	-0.036	6	6	44°0196	7.752	0.991	0.755	17	4
14°0043	8.661	0.466	0.001	12	4	44°0196	7.758	0.988	0.766	6	6
14°0043	8.665	0.465	-0.012	6	6	44°0196	7.736	0.983	0.761	1	N
14°0032	9.787	0.389	0.066	12	4	44°0198	9.647	0.088	-0.046	15	4
14°0032	9.788	0.389	0.063	6	6	44°0198	9.643	0.087	-0.057	6	6
16°0030	9.412	0.598	0.039	12	4	44°0198	9.617	0.097	-0.021	1	N
16°0030	9.415	0.593	0.035	6	6	44°0202	8.385	0.176	0.154	15	4
44°0194	8.932	0.997	0.646	12	4	44°0202	8.382	0.171	0.150	6	6
44°0195	7.530	1.536	1.860	17	4	44°0202	8.379	0.196	0.160	1	N
44°0195	7.535	1.534	1.874	6	6	54°0539	7.633	0.044	-0.213	174	4

Table 2 (continued)

BD	V	B-V	U-B	n	Instr	BD	V	B-V	U-B	n	Instr
54°0539	7.632	0.041	-0.224	17	6	15°1731	9.352	0.437	-0.035	7	N
54°0539	7.632	0.055	-0.213	7	N	16°1614	9.147	1.328	1.452	15	4
14°0677	9.407	0.865	0.598	12	4	16°1614	9.141	1.328	1.456	10	6
14°0677	9.410	0.871	0.564	3	6	16°1614	9.154	1.330	1.463	7	N
14°0677	9.385	0.859	0.567	3	N	15°1811	9.680	0.622	0.102	10	4
14°0679	8.781	0.559	0.452	13	4	15°1811	9.678	0.618	0.104	10	6
14°0679	8.787	0.557	0.599	3	6	15°1811	9.675	0.616	0.102	3	N
14°0679	8.768	0.573	0.490	3	N	15°1819	8.785	0.033	0.045	10	4
15°0614	9.452	0.641	0.167	14	4	15°1819	8.785	0.032	0.073	10	6
15°0614	9.454	0.639	0.212	3	6	15°1819	8.790	0.028	0.089	3	N
15°0614	9.448	0.649	0.178	3	N	16°1721	9.443	0.360	0.118	10	4
14°0689	8.181	1.520	1.333	9	4	16°1721	9.440	0.356	0.134	10	6
14°0689	8.191	1.498	1.325	3	6	16°1721	9.438	0.359	0.125	3	N
14°0689	8.151	1.542	1.327	3	N	15°1822	8.555	1.170	1.218	10	4
14°0690	6.966	0.565	0.092	14	4	15°1822	8.559	1.169	1.216	10	6
14°0690	6.994	0.580	0.112	1	6	15°1822	8.540	1.173	1.213	3	N
44°1044	8.668	0.403	0.179	13	4	20°2171	6.293	0.167	0.152	5	4
44°1044	8.672	0.408	0.204	6	6	20°2171	6.290	0.162	0.158	13	6
44°1044	8.668	0.410	0.185	5	N	20°2172	6.836	0.198	0.136	4	4
45°1000	8.028	0.454	0.173	18	4	20°2172	6.834	0.191	0.149	8	6
45°1000	8.039	0.461	0.208	7	6	20°2175	6.774	0.168	0.130	4	4
45°1000	8.021	0.460	0.186	4	N	20°2175	6.774	0.156	0.142	8	6
45°1001	8.610	0.734	0.398	15	4	44°1795	9.540	0.415	0.033	11	4
45°1001	8.616	0.732	0.410	7	6	44°1795	9.536	0.414	0.042	2	6
45°1001	8.594	0.727	0.404	4	N	46°1456	8.696	1.341	1.441	9	4
44°1052	7.896	0.048	-0.313	13	4	46°1456	8.702	1.336	1.465	10	6
44°1052	7.896	0.048	-0.359	7	6	46°1456	8.700	1.349	1.484	3	N
44°1052	7.882	0.069	-0.319	4	N	45°1658	7.895	0.516	0.024	12	4
45°1004	9.702	0.508	0.034	12	4	45°1658	7.898	0.517	0.016	9	6
45°1004	9.671	0.522	0.049	1	6	45°1658	7.906	0.524	0.019	3	N
20°1686	7.575	0.614	0.093	215	4	46°1458	6.850	0.306	0.029	9	4
20°1686	7.580	0.613	0.078	44	6	46°1458	6.849	0.300	0.028	9	6
20°1686	7.586	0.617	0.083	27	N	46°1458	6.858	0.322	0.028	3	N
20°1822	7.071	0.596	0.095	5	6	44°1807	6.929	0.917	0.570	11	4
20°1822	7.067	0.601	0.093	10	N	44°1807	6.938	0.911	0.574	9	6
15°1731	9.345	0.429	-0.024	15	4	44°1807	6.923	0.920	0.574	3	N
15°1731	9.343	0.429	-0.019	10	6	15°2433	10.846	0.589	0.045	2	4

Table 2 (continued)

BD	V	B-V	U-B	n	Instr	BD	V	B-V	U-B	n	Instr
15°2433	10.845	0.561	0.016	8	6	32°2259	7.357	1.340	1.558	5	6
15°2433	10.850	0.560	0.017	19	N	34°2338	10.794	0.511	0.010	8	4
15°2436	5.096	0.062	0.059	21	4	34°2338	10.792	0.503	0.027	8	6
15°2436	5.096	0.061	0.052	71	6	34°2338	10.787	0.506	0.020	35	N
14°2483	9.928	1.183	1.033	2	4	35°2356	9.391	0.573	0.081	8	4
14°2483	9.912	1.173	1.079	9	6	35°2356	9.385	0.573	0.073	8	6
14°2483	9.909	1.193	1.073	29	N	35°2356	9.387	0.567	0.076	38	N
15°2441	8.155	0.561	0.082	6	4	36°2293	10.188	0.656	0.201	7	4
15°2441	8.159	0.555	0.057	44	6	36°2293	10.181	0.656	0.204	8	6
15°2441	8.165	0.543	0.066	12	N	36°2293	10.173	0.662	0.195	29	N
15°2443	8.354	0.534	0.061	4	4	15°2975	8.575	0.511	0.013	3	4
15°2443	8.350	0.541	0.047	33	6	15°2975	8.571	0.510	0.029	15	6
15°2443	8.357	0.533	0.049	26	N	13°3110	8.403	0.205	0.101	2	4
15°2445	6.518	1.124	0.996	11	4	13°3110	8.402	0.187	0.115	15	6
15°2445	6.524	1.121	1.005	31	6	15°2978	9.153	0.580	0.074	2	4
15°2446	8.947	0.469	0.050	7	4	15°2978	9.155	0.573	0.081	14	6
15°2446	8.947	0.466	0.058	17	6	15°2979	9.343	0.928	0.585	3	4
15°2446	8.960	0.456	0.064	28	N	15°2979	9.332	0.918	0.554	15	6
46°1786	9.747	0.515		5	4	44°2619	8.076	0.485	-0.008	14	4
46°1786	9.741	0.506	0.030	17	6	44°2619	8.071	0.482	-0.016	10	6
46°1786	9.739	0.519	0.015	11	N	44°2620	9.178	0.874	0.445	12	4
47°1960	10.939	0.503		2	4	44°2622	9.227	0.744	0.383	13	4
47°1960	10.965	0.494	0.008	15	6	44°2622	9.225	0.741	0.378	9	6
47°1960	10.957	0.505	0.016	5	N	44°2625	7.510	1.183	1.260	11	4
35°2349	9.535	1.317	1.587	8	4	44°2625	7.514	1.178	1.248	10	6
35°2349	9.540	1.317	1.588	8	6	44°2627	9.362	0.230	0.117	12	4
35°2349	9.525	1.323	1.565	37	N	44°2627	9.359	0.222	0.108	10	6
35°2352	10.199	0.989	0.843	8	4	27°3307	6.913	-0.066	-0.500	253	4
35°2352	10.197	0.993	0.850	8	6	27°3307	6.913	-0.076	-0.507	35	6
35°2352	10.189	0.987	0.839	38	N	16°4218	8.812	1.151	0.996	16	4
34°2332	5.410	1.014	0.837	7	4	16°4218	8.825	1.141	0.993	7	6
34°2332	5.414	1.009	0.843	8	6	15°4125	9.669	-0.004	-0.057	17	4
34°2333	6.233	1.051	0.916	7	4	15°4125	9.666	-0.002	-0.057	7	6
34°2333	6.234	1.051	0.924	6	6	15°4128	7.563	0.521	0.191	16	4
32°2258	7.949	0.580	0.076	6	4	15°4128	7.575	0.522	0.235	7	6
32°2258	7.947	0.577	0.060	5	6	15°4129	9.549	0.947	0.585	9	4
32°2259	7.354	1.349	1.570	6	4	13°4370	9.541	0.555	-0.064	15	4

Table 2 (continued)

BD	V	B-V	U-B	n	Instr	BD	V	B-V	U-B	n	Instr
13°4370	9.552	0.553	-0.062	7	6	45°3310	8.650	0.807	0.452	7	6
44°3604	9.421	-0.008	-0.061	24	4	45°3311	9.546	0.312	0.057	16	4
44°3604	9.418	-0.003	-0.077	7	6	45°3320	8.291	0.551	0.051	33	4
45°3310	8.642	0.812	0.469	24	4	45°3320	8.298	0.544	0.038	7	6

Table 3. Average values of V , $B-V$ and $U-B$; p is the approximate weight of the photometric data: unit weight corresponds to a mean error of ± 0.01 mag.

HR	HD	BD	α (2000)			δ (2000)			p.m.		V	B-V	U-B	p
			h	m	s	°	'	"	s	"				
45	1013	19°0027	0	14	36.2	20	12	24	0.0066	0.000	4.794	1.576	1.908	26
	1213	15°0030	0	16	34.8	15	50	14	0.0036	0.009	8.319	0.364	-0.032	13
	1450	15°0043	0	18	42.8	15	59	25	0.0017	-0.034	8.662	0.466	-0.004	13
		14°0032	0	20	34.1	15	19	26	0.0001	0.004	9.787	0.389	0.065	13
		16°0030	0	24	14.9	17	39	01	-0.0006	-0.036	9.413	0.596	0.038	13
		44°0194	0	55	12.4	44	59	33	0.0025	0.013	8.932	0.997	0.646	8
	5306	44°0195	0	55	26.2	45	05	30	-0.0008	-0.031	7.529	1.535	1.865	16
	5353	44°0196	0	55	56.1	45	40	58	0.0003	-0.007	7.753	0.990	0.759	16
		44°0198	0	56	25.6	45	12	57	0.0002	-0.010	9.644	0.088	-0.048	15
	5469	44°0202	0	57	02.2	45	36	37	0.0011	-0.012	8.384	0.176	0.153	15
343	6961	54°0236	1	11	06.2	55	08	59	0.0264	-0.028	4.332	0.171	0.122	31
403	8538	59°0248	1	25	49.0	60	14	07	0.0399	-0.051	2.679	0.132	0.123	26 *
437	9270	14°0231	1	31	29.0	15	20	45	0.0019	-0.005	3.614	0.974	0.735	29
	14825	54°0539	2	25	13.2	55	15	17	0.0010	-0.002	7.633	0.045	-0.216	37 *
824	17361	28°0462	2	47	54.6	29	14	49	0.0115	-0.131	4.505	1.112	1.079	29
875	18331	-4°0502	2	56	37.4	-3	42	44	-0.0023	-0.044	5.166	0.083	0.040	38
882	18449	34°0550	2	59	03.7	35	10	59	-0.0038	0.006	4.930	1.236	1.284	30
1030	21120	8°0511	3	24	48.8	9	01	44	-0.0044	-0.078	3.599	0.892	0.607	19
1046	21447	54°0684	3	30	00.1	55	27	07	-0.0063	-0.012	5.097	0.039	0.036	26
		14°0677	4	18	17.6	15	00	34	0.0058	-0.103	9.403	0.865	0.585	13
		14°0679	4	19	34.0	14	41	32	-0.0001	0.004	8.780	0.561	0.488	14 *
		15°0614	4	20	54.9	15	56	02	0.0006	-0.024	9.452	0.642	0.177	14
	27686	14°0689	4	22	37.9	14	54	35	0.0000	-0.009	8.177	1.520	1.330	12

Table 3 (continued)

HR	HD	BD	α (2000)			δ (2000)			p.m.		V	B-V	U-B	p
			h	m	s	o	'	"	s	"				
		27691	14 ^o	06	90	4 22 44.2	15 03 23	0.0088	-0.019	6.969	0.566	0.094	10	
1411	28307	15 ^o	06	31		4 28 34.5	15 57 43	0.0069	-0.032	3.842	0.952	0.735	35	
1412	28319	15 ^o	06	32		4 28 39.7	15 52 15	0.0067	-0.028	3.407	0.179	0.126	43	
1543	30652	6 ^o	07	62		4 49 50.4	6 57 41	0.0313	0.011	3.190	0.450	-0.020	27	
		30987	44 ^o	10	44	4 54 20.2	44 43 53	0.0031	-0.048	8.669	0.406	0.187	18	
		31038	45 ^o	10	00	4 54 45.1	45 42 23	-0.0002	-0.023	8.030	0.457	0.185	19	
			45 ^o	10	01	4 55 29.9	45 16 37	0.0110	-0.104	8.609	0.732	0.403	18	
		31195	44 ^o	10	04	4 56 12.4	46 00 18	0.0010	-0.033	9.699	0.509	0.036	9	
1781	35299	-0 ^o	09	36		5 23 42.3	-0 09 36	0.0000	-0.004	5.698	-0.216	-0.868	34	
1995	38656	39 ^o	14	18		5 49 10.4	39 10 52	-0.0029	-0.031	4.507	0.954	0.696	32	
2012	39003	39 ^o	14	29		5 51 29.4	39 08 55	-0.0004	0.007	3.957	1.131	1.075	32	
2077	40035	54 ^o	09	70		5 59 31.6	54 17 05	0.0093	-0.125	3.719	1.012	0.839	36	
		268518	20 ^o	16	86	7 04 05.0	20 35 51	-0.0059	0.042	7.579	0.614	0.086	51 *	
		59360	20 ^o	18	22	7 30 23.4	19 48 50	0.0038	-0.123	7.068	0.599	0.094	11	
			15 ^o	17	31	8 01 54.7	15 33 47	-0.0016	0.015	9.346	0.431	-0.025	22 *	
			16 ^o	16	14	8 01 59.2	15 40 04	-0.0010	-0.003	9.147	1.328	1.456	22 *	
3249	69267	9 ^o	19	17		8 16 30.9	9 11 08	-0.0030	-0.049	3.523	1.481	1.771	46	
			15 ^o	18	11	8 23 57.1	15 03 02	-0.0059	0.003	9.678	0.619	0.103	17	
		71188	15 ^o	18	19	8 26 31.0	14 43 12	-0.0001	0.003	8.786	0.032	0.064	17	
			16 ^o	17	21	8 26 31.4	15 36 08	0.0001	0.004	9.441	0.358	0.126	17	
		71261	15 ^o	18	22	8 26 54.9	14 49 25	-0.0007	0.010	8.554	1.170	1.216	17	
3429	73731	20 ^o	21	71		8 40 27.0	19 32 41	-0.0029	-0.019	6.291	0.166	0.156	24	
		73785	20 ^o	21	72	8 40 43.2	19 43 09	-0.0028	-0.012	6.836	0.199	0.147	18	
		73819	20 ^o	21	75	8 40 56.3	19 34 49	-0.0030	-0.014	6.776	0.163	0.141	20 *	
3454	74280	3 ^o	20	39		8 43 13.6	3 23 54	0.0003	-0.028	4.296	-0.195	-0.733	49 *	
			44 ^o	17	95	8 52 24.7	44 22 00	0.0009	-0.027	9.539	0.415	0.035	9	
			46 ^o	14	56	8 55 36.3	45 39 43	0.0019	-0.020	8.699	1.340	1.458	16	
		76116	45 ^o	16	58	8 55 49.2	44 39 44	0.0043	-0.050	7.898	0.518	0.020	17	
		76238	46 ^o	14	58	8 56 33.8	45 45 51	-0.0025	-0.002	6.851	0.306	0.028	16	
		76348	44 ^o	18	07	8 57 07.5	44 24 34	0.0045	0.015	6.932	0.915	0.572	17	
3579	76943	42 ^o	19	56		9 00 38.4	41 46 58	-0.0393	-0.246	3.954	0.438	0.034	37	
4456	100600	17 ^o	23	74		11 34 42.5	16 47 49	-0.0015	-0.004	5.944	-0.157	-0.636	43 *	
4554	103287	54 ^o	14	75		11 53 49.8	53 41 41	0.0107	0.012	2.442	0.003	-0.001	20	
		106543	15 ^o	24	33	12 15 17.9	14 32 55	-0.0029	-0.027	10.848	0.563	0.019	19 *	
4660	106591	57 ^o	13	63		12 15 25.6	57 01 57	0.0127	0.009	3.311	0.077	0.069	31	
4663	106661	15 ^o	24	36		12 16 00.2	14 53 56	-0.0055	-0.034	5.096	0.061	0.055	30	

Table 3 (continued)

HR	HD	BD	α (2000)			δ (2000)			p.m.		V	B-V	U-B	p
			h	m	s	°	'	"	s	"				
		14°2483	12	16	33.3	14	09	31	-0.0021	0.008	9.912	1.186	1.071	22 *
	106888	15°2441	12	17	36.2	14	26	34	-0.0066	-0.042	8.160	0.553	0.064	29
	106949	15°2443	12	17	50.8	15	01	09	-0.0090	0.005	8.353	0.537	0.049	30
	107170	15°2445	12	19	20.3	14	32	30	-0.0015	-0.049	6.522	1.122	1.002	21
	107254	15°2446	12	19	50.9	14	23	00	-0.0029	0.002	8.953	0.462	0.059	29
		46°1786	12	25	55.2	45	36	27	-0.0026	-0.014	9.741	0.512	0.024	22 *
		47°1960	12	26	19.6	46	28	14	-0.0041	-0.011	10.960	0.498	0.010	15 *
		35°2349	12	32	45.6	34	35	02	0.0012	0.003	9.531	1.320	1.575	27
		35°2352	12	34	23	34	20				10.193	0.989	0.842	27 *
4783	109317	34°2332	12	33	38.9	33	14	51	0.0016	-0.033	5.412	1.011	0.840	12
4784	109345	34°2333	12	33	47.4	33	23	05	0.0006	-0.013	6.233	1.051	0.920	10
	109625	32°2258	12	35	57.9	31	43	57	-0.0020	-0.004	7.948	0.579	0.069	9
	109649	32°2259	12	36	01.2	32	00	14	-0.0023	-0.003	7.356	1.344	1.564	9
		34°2338	12	36	46.5	33	36	49	0.0008	0.008	10.790	0.506	0.019	27
	109803	35°2356	12	37	24.8	34	13	08	0.0012	0.003	9.387	0.570	0.076	27
		36°2293	12	38	37	35	19				10.178	0.659	0.199	25 *
5019	115617	-17°3813	13	18	24.3	-18	18	41	-0.0751	-1.065	4.742	0.710	0.260	12
5062	116842	55°1603	13	25	13.5	54	59	17	0.0135	-0.009	4.007	0.168	0.083	36
5072	117176	14°2621	13	28	25.8	13	46	44	-0.0162	-0.577	4.968	0.713	0.263	25
5235	121370	19°2725	13	54	41.1	19	23	52	-0.0044	-0.358	2.684	0.580	0.198	28
5291	123299	65°0978	14	04	23.3	64	22	33	-0.0084	0.018	3.657	-0.049	-0.091	21
5854	140573	6°3088	15	44	16.1	6	25	32	0.0092	0.047	2.640	1.164	1.254	41
5947	143107	27°2558	15	57	35.3	26	52	40	-0.0057	-0.061	4.135	1.230	1.277	48
5986	144284	58°1608	16	01	53.3	58	33	55	-0.0409	0.335	4.005	0.533	0.097	31
	146873	15°2975	16	18	02.1	15	31	33	0.0006	0.033	8.572	0.510	0.025	12
	146874	13°3110	16	18	04.9	13	03	08	-0.0003	0.001	8.402	0.190	0.113	11
		15°2978	16	19	19.0	15	11	24	-0.0074	0.010	9.155	0.574	0.080	11
6092	147394	46°2169	16	19	44.4	46	18	48	-0.0011	0.040	3.895	-0.153	-0.557	48
		15°2979	16	19	46.7	15	29	38	-0.0014	0.035	9.334	0.920	0.561	12
	152425	44°2619	16	51	14.0	44	09	39	0.0020	0.009	8.074	0.484	-0.012	16
		44°2620	16	51	55.8	43	56	43	-0.0011	-0.062	9.178	0.874	0.445	8
		44°2622	16	52	48.9	44	25	42	-0.0098	0.147	9.226	0.743	0.381	15
	152813	44°2625	16	53	37.7	43	47	01	0.0011	-0.073	7.512	1.181	1.254	15
	152861	44°2627	16	53	56.1	44	24	22	0.0008	0.015	9.361	0.226	0.113	15
6573	160269	61°1678	17	34	59.5	61	52	28	0.0359	-0.515	5.232	0.608	0.098	23
6603	161096	4°3489	17	43	28.4	4	34	02	-0.0027	0.159	2.756	1.167	1.249	29

Table 3 (continued)

HR	HD	BD	α (2000)			δ (2000)			p.m.		V	B-V	U-B	p
			h	m	s	o	'	"	s	"				
6705	164058	51°2282	17	56	36.4	51	29	20	-0.0008	-0.019	2.237	1.519	1.876	29
6927	170153	72°0839	18	21	03.4	72	43	58	0.1194	-0.349	3.573	0.499	-0.059	30
7178	176437	32°3286	18	58	56.6	32	41	22	-0.0002	0.002	3.250	-0.048	-0.109	31
7266	178596	5°4040	19	08	59.9	6	04	24	-0.0004	-0.076	5.229	0.344	0.015	32
	180316	27°3307	19	14	58.9	27	57	40	0.0012	0.002	6.913	-0.067	-0.504	39 *
7462	185144	69°1053	19	32	21.6	69	39	41	0.1144	-1.729	4.674	0.792	0.392	26
7602	188512	6°4357	19	55	18.8	6	24	24	0.0032	-0.482	3.709	0.856	0.488	37
7615	188947	34°3798	19	56	18.4	35	05	00	-0.0026	-0.027	3.884	1.028	0.885	36
		16°4218	20	18	27.5	16	42	16	0.0010	-0.001	8.817	1.147	0.995	15
		15°4125	20	18	28.0	15	41	42	0.0003	-0.005	9.668	-0.003	-0.057	16
	193389	15°4128	20	19	31.5	15	32	42	0.0002	-0.010	7.567	0.521	0.207	15
		15°4129	20	19	35.3	15	56	09	-0.0002	0.001	9.549	0.947	0.585	7
		13°4370	20	21	46.2	13	49	31	0.0095	-0.139	9.545	0.554	-0.063	15
7906	196867	15°4222	20	39	38.3	15	54	43	0.0045	-0.002	3.778	-0.060	-0.208	25
7957	198149	61°2050	20	45	17.4	61	50	20	0.0123	0.818	3.411	0.919	0.623	23
7949	197989	33°4018	20	46	12.7	33	58	13	0.0286	0.328	2.474	1.027	0.856	28
		44°3604	20	51	27.0	45	20	26	0.0000	-0.005	9.420	-0.006	-0.066	18
		45°3310	20	52	44.9	46	06	48	-0.0032	-0.024	8.644	0.810	0.464	18
		45°3311	20	52	50.0	45	50	55	-0.0002	-0.011	9.546	0.312	0.057	10
	199168	45°3320	20	53	50.5	46	00	17	0.0072	0.022	8.293	0.549	0.047	20
8130	202444	37°4240	21	14	47.5	38	02	44	0.0134	0.441	3.732	0.396	0.020	32 *
8162	203280	61°2111	21	18	34.8	62	35	08	0.0218	0.049	2.458	0.221	0.094	22
8430	210027	24°4533	22	07	00.7	25	20	42	0.0220	0.025	3.770	0.438	-0.020	34
8513	211924	5°4998	22	20	27.5	5	47	22	0.0005	0.008	5.369	-0.018	-0.486	26
8597	213998	-0°4384	22	35	21.4	-0	07	03	0.0061	-0.056	4.035	-0.084	-0.280	22
8622	214680	38°4826	22	39	15.7	39	03	01	0.0001	-0.005	4.884	-0.203	-1.031	46
8795	218329	8°4997	23	07	00.3	9	24	34	0.0008	-0.014	4.522	1.565	1.917	21 *
8832	219134	56°2966	23	13	17.0	57	10	06	0.2552	0.296	5.570	0.996	0.899	42
8974	222404	76°0928	23	39	20.8	77	37	57	-0.0210	0.151	3.214	1.028	0.946	29
8969	222368	4°5035	23	39	57.0	5	37	35	0.0253	-0.438	4.123	0.509	0.001	30

Notes to Table 3:

HR 403	01 25	δ Cas, assumed to be an eclipsing variable with amplitude 0.08 mag.; no variations confirming this were observed.
HD 14825	02 25	Comp. star of the variable HR 690.
BD +14 0679	04 19	The values of $U-B$ differ widely between the three instruments (see Table 3), while V and $B-V$ are consistent. The reason for this is not obvious. The $U-B$ value cannot be used as a standart value.
HD 268518	07 04	Comp. star of the cepheid ζ Gem.
BD+15 1731	08 01	Comp. star of the variable UU Cnc.
BD+16 1614	08 01	Comp. star of the variable UU Cnc.
HR 3454	08 43	UBV primary standard star and also standard for <i>uvby</i> photometry, but variable with an amplitude of 0.03 mag.
HD 73819	08 40	Non-radially pulsating variable EP Cnc; the amplitude is very low, ≈ 0.004 mag. (Breger et al. 1994), so the star can be used as a standart in spite of its variability.
HR 4456	11 34	Coord. and p.m. from The Hipparcos Input Catalogue (1992).
HD 106543	12 15	Coord. and p.m. from the Carlsberg Meridian Catalogue (1992).
BD+14 2483	12 16	Coord. and p.m. from AGK3.
BD+46 1786	12 25	Comp. star of the susp. variable BD+47 1961.
BD+47 1960	12 26	Comp. star of the susp. variable BD+47 1961.
BD+35 2352	12 34	Approximate coord. from BD.
BD+36 2293	12 38	Approximate coord. from BD.
HD 180316	19 14	Comp. star of the cepheid HR 7308.
HR 8130	21 14	Coord. and p.m. from The Hipparcos Input Catalogue (1992); suspected of being a δ Sct variable with an amplitude of about 0.02 mag.
HR 8795	23 07	Johnson's $U-B = 1.81$ was omitted from the mean.

Table 4. *VRI* photometry.
n = number of measurements

BD	<i>V-R</i>	<i>R-I</i>	<i>n</i>	BD	<i>V-R</i>	<i>R-I</i>	<i>n</i>
44°0195	0.815	0.733	1	16°1721	0.204	0.229	3
44°0196	0.499	0.481	1	15°1822	0.593	0.544	3
44°0198	0.042	0.067	1	20°1822	0.358	0.346	10
44°0202	0.078	0.154	1	46°1456	0.711	0.694	3
54°0539	0.028	0.066	7	45°1658	0.305	0.338	3
14°0677	0.495	0.484	3	44°1807	0.506	0.490	3
14°0679	0.354	0.448	3	14°2483	0.620	0.581	29
15°0614	0.380	0.442	3	15°2433	0.326	0.322	19
14°0689	0.829	0.796	3	15°2441	0.319	0.295	12
44°1044	0.242	0.306	5	15°2443	0.318	0.319	26
45°1000	0.265	0.316	4	15°2446	0.275	0.275	28
45°1001	0.381	0.396	4	47°1960	0.283	0.308	5
44°1052	0.047	0.092	4	46°1786	0.292	0.335	11
20°1686	0.352	0.353	27	34°2338	0.293	0.299	35
15°1731	0.269	0.294	7	35°2349	0.698	0.613	37
16°1614	0.721	0.680	7	35°2352	0.533	0.475	38
15°1811	0.354	0.372	3	35°2356	0.343	0.348	38
15°1819	0.035	0.072	3	36°3392	0.365	0.346	29