Comments on the UBV Photometric System's Defining Standard Stars

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Abstract The purpose of this paper is to call the observing community's attention to the re-affirmation that a majority, 80 percent, of the basic UBV standard stars either are suspected or known variable stars. The elucidation of these stars' variability characteristics in exquisite detail is a task for which AAVSO observers are eminently qualified.

1. Introduction

The photometry portion of astronomy's observational community in particular is well aware of the fundamental nature of the UBV photometric system which was invented by Johnson and Morgan (1953) and Morgan (1988). A recent review of the UBV photometric system has appeared in Landolt (2011).

The basic steps in analyzing photometric data have been published in a number of places, including the well known books by Henden and Kaitchuck (1982, 1990) and Sterken and Manfroid (1992). Those books and other works in the astronomical literature, such as Landolt (2007), describe the use of stars of known magnitude and color to standardize data in a given observational program, thereby transforming the data onto a standard photometric system and enabling the inter-comparison of the photometric results with those of other observers as well as with theoretical models.

When one reduces all sky photometry, and accomplishes relative photometry, which is the kind of photometry that a vast majority of photometrists do, the results include the recovered magnitudes and color indices of the standard stars used in the processing. This author has wondered for years why the recovered standard star magnitudes and color errors for the stars defining the UBV photometric system (Johnson 1963) were larger than for the recovered errors when using, for example, standard star magnitudes from Cousins (1976), or from the author's papers (Landolt 1983, 1992, 2009).

Careful data acquisition and reduction techniques, over the past sixty years using photoelectric photometry techniques, and now CCDs, should provide photometric errors of data transformed to a standard photometric system, say, on the order of 0.005 magnitude. Such errors also were achievable through use of photoelectric photometers. However, the author's recovered photometry when

using the basic UBV standard stars normally featured errors more like 0.015 to 0.018 mangitude, or so. The exact numbers are not so important here. What is notable is that those errors are three to four times the size of achievable errors using Cousins and Landolt photoelectric photometer-based standard stars. The question, then, is why the difference in the size of the recoverable errors?

2. Stars omitted from original set

Johnson and Harris (1954) published the original set of 108 standard stars on the UBV photometric system. A final list of UBV standard stars was published by Johnson (1963), wherein he eliminated four stars: HR 753A, γ Tau, δ Tau, and α Lyr, without comment. The reasoning for their elimination from the original 108 UBV standard stars appears to be as indicated in the following paragraphs. Johnson (1963), in section 3, and Johnson and Iriarte (1959) do indicate that "some of the stars observed are more variable than others."

HR 753A: BD+06 398A, HD 16160, CCDM J02361+0653A, GJ 105 A, G73-70, 2MASS J02360498+0653140, UCAC4 485-003628, NLTT 8447; μ_α = 1807.8 ± 1.0 mas/yr, μ_δ = 1444.0 ± 1.0 mas/yr.

HR 753B: BD+06 398B, CCDM J02361+0653B, G73-71, GJ 105 B, NLTT 8455, BX Cet, variable of BY Dra type = 2MASS J02361535+0652191, UCAC4 485-003632; μ_α = 1813.0 ± 8.0 mas/yr, μ_δ = 1447.0 ± 8.0 mas/yr. Flare activity on HR 753B was predicted by Pettersen (1975) and remarked on by Petit (1980). Johnson's (1963) V magnitude differed from a V magnitude by Weistrop (1977) by 0.1 magnitude. Their (B–V) color index agreed well within their errors. The variability of HR 753B was announced by Weis (1994). The AAVSO database indicates a magnitude range 11.64 < V < 11.68.

It is interesting that Johnson retained HR 753B in his final publication of the UBV system (Johnson 1963), and not HR 753A. The latter appears to be constant in light, whereas HR 753B is not. Evidently Johnson's photometry did not convincingly show what is now known from the literature as a variation of a few percent for HR 753B through the V filter. The two stars appear in Giclas *et al.* (1961) as G 73-70 and G 73-71, with a separation of 2.8 arc minutes, and identified as a common proper motion pair. The stars' UCAC4 proper motions confirm that they are a common proper motion pair.

γ *Tauri*: 54 Tau, BD+15 612, HD 27371, CCDM J04198+1538AB, CSV 102439, NSV 1553, plus many names in SIMBAD. γ Tau is a double star whose components were separated by 0.4 arcsecond in position angle 179 degrees in 1979 (Dommanget and Nys (2002). Johnson and Harris (1954) were the first to identify the variability of the brighter component, γ Tau, of about 0.1 magnitude. The AAVSO archive indicates a range in V of 3.60–3.67 magnitudes.

δ *Tauri*: 61 Tau, BD+17 712A, HD 27697, CCDM J04229+1733A, CSV 102443, NSV 1582, plus many names in SIMBAD. δ Tau is a double star, the brighter component at V = 3.76, and the fainter at V = 12.6 magnitude.

The two stars were separated by 106.6 arcseconds, with a position angle of 341 degrees in 1909. Johnson and Harris (1954) were the first to identify the variability of the brighter component, δ Tau, of about 0.1 magnitude. The AAVSO archive indicates a range in V of 3.72–3.77 magnitudes.

α *Lyrae*: Vega, HR 7001, HD 172167, CSV 101745, NSV 11128, plus many more names via SIMBAD. α Lyr initially was reported as a variable star by Guthnick and Prager (1915), of the "δ Cephei-type." No individual data points were provided, other than to say that the amplitude of light variation was "on average" 0.04 magnitude, and that the period was short. Further note of the discovery appeared in the annual report of the Berlin-Babelsberg Observatory for 1915 (Struve 1916) and in Guthnick and Prager (1918). Photoelectric data were published by Johnson (Johnson *et al.* 1966) which indicated a total variation through the V filter of 0.129 magnitude. A periodic variation of 0.19 day in the radial velocity of α Lyr was reported by Belopolsky (1931), and was confirmed by Beardsley and Zizka (1980). The variation also was noted in Breger (1979). Note, though, that Neubauer and Farnsworth (1935) disputed the reported radial velocity variation.

3. The tables

Tables 1 and 2 contain the 104 UBV standard stars as published in a final form (Johnson 1963). Table 1 contains the ten primary UBV standard stars, and Table 2 lists the remaining original UBV standard stars, for a total of 104 stars. Information describing the many acronyms identifying a given star and the star catalogues in which useful information appears is provided in Appendix 1.

The first column in each table gives the star's HD number, while the second column provides the star's name by constellation, or HR, or BD, or Flamsteed number. Column three lists the star name from the UCAC4 catalogue (Zacharias *et al.* 2013). The fourth column provides a NSV identification (Kholopov *et al.* 1982) for stars suspected of variability. Columns five and six contain the Johnson V magnitude and B–V color index taken from Tables 1 and 2 (Johnson 1963). Columns seven and eight contain the J2000.0 right ascension and declinations from the UCAC4 catalogue (Zacharias *et al.* 2013), followed by columns nine through twelve which provide the proper motions and their errors in milli-arcseconds per year, also taken from the UCAC4 catlaogue. The last column indicates the presence of a footnote to the table containing a literature reference and/or additional comments pertaining to the star. The UCAC4 coordinates are the most recent highly accurate coordinates. A considerable number of these bright stars have large proper motions, and hence the proper motions given in columns nine through twelve will aid in centering these stars' positions for observing purposes.

The author went star by star through the tables, looking at each star's record in SIMBAD, in the AAVSO's VSX database, and elsewhere in the

literature, to determine whether there was information about that star's possible variability. The last columnn in both tables provides, via the footnotes for the tables, literature and variability information, the latter primarily via the NSV identification. One star, HD 47105, γ Gem, is listed as a spectroscopic binary, but nothing was found regarding its possible variability.

Eight of the ten primary UBV standard stars in Table 1 are variable. Seventy-five of the ninety-four UBV standard stars in Table 2 are variable. Hence, there are eighty-three variable stars among the 104 stars which define the UBV photometric standard star system. To put it another way, 80% of the stars which define the UBV photometric system now are known to be, or are suspected of being, variable in light.

4. A call for observations

The defining stars of the UBV photometric system are bright. Therefore, essentially only amateur astronomers have the equipment available to monitor these stars without saturating the images. Since modern light curves are not available, and in many instances light curves may not exist at all, here is an opportunity for careful observers to observe, preferably with a V filter, these variable and suspected stars over a time interval sufficiently long to obtain definitive light curves. Any observational effort for a given star should last long enough to thoroughly define the light curve, complete with a period (unless it becomes obvious that the star possesses non-periodic behavior). The observer's *goal* should be to reach both a precision and an accuracy of 0.001 magnitude in order to best understand these low amplitude variable stars. It must be emphasized that an undertaking of a study of these stars presupposes the greatest possible care and skill by the observer, for the suspected light variations are small, nearing the level of detectability, from ground-based observatories. Such attention to detail means that the observer must account for extinction effects, properly transform the data, and so on. Finally, the observer needs to be cognizant that variations are "suspected," remaining to be convincingly proven.

As the observer prepares to observe these stars, it is good to recall that the AAVSO's International Variable Star Index (VSX) database (www.aavso.org/vsx) is an excellent starting place for a wealth of information for these and other variable stars. The VSX database indicates the range in magnitude for many of the known or suspected variable stars, although the source of the information is not always clear. Tables 1 and 2 herein list the V magnitude and the (B–V) color index as aids in planning an observational program. Spectral types and the range in the known or suspected light variation is given in the footnotes. This information came from the VSX database, or from SIMBAD, if missing in the VSX database. The SIMBAD Astronomical Database (www.simbad.u-strasbg.fr/simbad) leads one to the majority of the modern literature for a given star.

Interpretation of one's data can be aided through reference to books, ordered by date of publication, such as those by Sterken and Jaschek (1996), Warner (2006), and Percy (2007). An explanation of the spectral type nomenclature may be found in Drilling and Landolt (1999).

It is to be noted that the MOST Microsatellite (Microvariability and Oscillations of STars) already has provided exquisite data for several of these stars (http://www.utias-sfl.net/microsatellites/MOST/)!

An obvious place to publish these definitive light curves, including the individual data points together with the heliocentric Julian Day for the observation(s)—such complete publication a highly desired *must*—is in the *Journal of the American Association of Variable Star Observers* (*JAAVSO*)!

5. Summary

This paper has shown that the majority of the original 104 UBV standard stars, 80 percent, either are known or suspected variable stars. The vast majority of these stars are very bright, many visible to the naked eye. Few modern observers have the capability of observing such bright stars, but most AAVSO observers do have such capabilities. Very, very careful and accurate light curves, appropriately defined by a Johnson V filter, at the minimum, are achievable by AAVSO observers. Such accurate and long-term studies of the light variations of these important stars would be of great value to the astronomical community.

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Table 1. The ten primary standard stars of the UBV system.

HD (1)	*Name* (2)	*UCAC4* (3)	*NSV* (4)	*V* (5)	*B–V* (6)	*R.A. (J2000.0)* (7) *h m s*	*Dec. (J2000.0)* (8) ° ′ ″	*pm/a* (9)	*e/a* (10)	*pm/d* (11)	*e/d* (12)	*Note* (13)
12929	α Ari	568–004324	725	2.00	+1.15	02 07 10.407	+23 27 44.71	191.0	1.0	–147.1	1.0	note, ref.
18331	HR 875	432–003634	—	5.17	+0.08	02 56 37.424	–03 42 44.36	–36.6	1.0	–44.2	1.0	
69267	β Cnc	496–050763	3973	3.52	+1.48	08 16 30.921	+09 11 07.96	–46.8	1.0	–49.3	1.0	ref.
74280	η Hya	467–040291	4212	4.30	–0.20	08 43 13.476	+03 23 55.18	–18.5	1.0	–1.5	1.0	note, ref.
135742	β Lib	404–059971	7009	2.61	–0.11	15 17 00.414	–09 22 58.50	–97.6	1.0	–20.0	1.0	note, ref.
140573	α Ser	483–060001	20391	2.65	+1.17	15 44 16.074	+06 25 32.26	133.8	1.0	44.8	1.0	note, ref.
143107	ε CrB	585–052496	—	4.15	+1.23	15 57 35.251	+26 52 40.36	–77.1	1.0	–60.6	1.0	
147394	τ Her	682–056339	7641	3.89	–0.15	16 19 44.437	+46 18 48.11	–13.3	1.0	38.5	1.0	note, ref.
214680	10 Lac	646–115008	25932	4.88	–0.20	22 39 15.679	+39 03 00.98	–0.3	1.0	–5.0	1.0	note, ref.
219134	HR 8832	736–099538	14458	5.57	+1.01	23 13 16.976	+57 10 06.08	2075.0	1.0	294.7	1.0	note, ref.

Notes:

HD 12929: H. Moreno, Astron. Astrophys.*, 12, 442, 1971 (only says possible variable, no numbers); B. A.Gould,* Resultados del Observatorio Nacional Argentino en Cordoba*, 1, 1, 1879 (see pages 128–342); K2 IIIab; 1.98 < V < 2.04.*

HD 69267: A. Gutierrez–Moreno et al., Cerro Tololo Inter–Amer. Obs. Contrib.*, No. 9, 1966; also see M. P. FitzGerald,* Astron. Astrophys., Suppl. Ser.*, 9, 297, 1973; K4 III; 3.53 (0.005)V.*

HD 74280: variable star of β *Cep type; E. W. Elst,* Inf. Bull. Var. Stars*, No. 1562, 1, 1979; B3 V; 4.27 < V < 4.33.*

HD 135742: M. Golay, IAU Symp. No. 54, 275, 1973; B8 V; 2.60 < V < 2.63.

HD 140573: in double system; variable type, SR; magnitude range 0.2 magnitude; microvariable in V? via F. Rufener, Astron. Astrophys., Suppl. Ser.*. 45, 207, 1981; also, M. Petit,* Inf. Bull. Var. Stars*, No. 1788, 1980; K2 IIIe; 2.64 (0.2)V.*

HD 147394: variable type SPB; Perryman, M. A. C. et al., The Hipparcos and Tycho Ctalogues*, ESA SP–1200, European Space Agency, 1997; B5 IV; 3.83 < V < 3.86.*

HD 214680: HR 8622; variability discovered by A. J. Delgado and R. Garrido, Inf. Bull. Var. Stars*, No. 1992, 1981; variability verified by B. J. Taylor and M. D. Joner,* Publ. Astron. Soc. Pacific*; 104, 911, 1992;* O9 V; 4.86 (0.03)B.

HR 8832: flare star; H. Moreno, Astron. Astrophys.*, 12, 442, 1971; also, W. A. Hiltner,* Astrophys. J.*, 120, 41, 1954 (suggests that HR 8832 might be variable by 0.02 magnitude); K3; 5.52 < V < 5.61.*

Table 2. The photometric standards of the UBV system.

HD (1)	Name (2)	UCAC4 (3)	NSV (4)	V (5)	B–V (6)	R.A. (J2000.0) (7) h m s	Dec. (J2000.0) (8) ° ′ ″	pm/a (9)	e/a (10)	pm/d (11)	e/d (12)	Note (13)
886	γ Peg	526–000414	—	2.83	–0.23	00 13 14.151	+15 11 00.94	1.9	1.0	–9.4	1.0	note, ref.
1280	θ And	644–001051	116	4.61	+0.06	00 17 05.499	+38 40 53.89	–49.4	1.0	–17.7	1.0	note, ref.
4727	ν And	656–003126	15178	4.53	–0.15	00 49 48.847	+41 04 44.08	22.8	1.0	–18.4	1.0	note, ref.
6961	θ Cas	726–010067	423	4.33	+0.17	01 11 06.162	+55 08 59.65	226.8	1.0	–18.8	1.0	note, ref.
8538	δ Cas	752–016413	—	2.68	+0.13	01 25 48.952	+60 14 07.02	296.6	1.0	–49.6	1.0	note, ref.
9270	η Psc	527–002693	532	3.62	+0.97	01 31 29.042	+15 20 45.41	25.7	1.0	–3.3	1.0	note, ref.
10476	107 Psc	552–003413	600	5.23	+0.83	01 42 29.762	+20 16 06.60	–302.4	1.0	–678.9	1.0	note, ref.
10700	τ Cet	371–001883	15373	3.50	+0.72	01 44 04.084	–15 56 14.92	–1720.5	1.0	855.3	1.0	note, ref.
11636	β Ari	555–003766	658	2.65	+0.13	01 54 38.411	+20 48 28.91	98.7	1.0	–110.4	1.0	note, ref.
—	–18 359	362–002344	15436	10.18	+1.53	02 05 04.814	–17 36 52.61	1317.5	8.0	–173.9	8.0	note, ref.
—	+2 348	468–002996	—	10.03	+1.44	02 12 20.917	+03 34 31.11	–1761.1	8.0	1852.8	8.0	
15318	ξ^2 Cet	493–003597	—	4.28	–0.06	02 28 09.543	+08 27 36.20	41.8	1.0	–13.6	1.0	
—	HR 753B	485–003632	—	11.65	+1.61	02 36 15.344	+06 52 18.99	1813.0	8.0	1447.0	8.0	note, ref.
20630	κ Cet	467–004501	1100	4.82	+0.68	03 19 21.697	+03 22 12.71	270.5	1.0	93.7	1.0	note, ref.
21120	ο Tau	496–005017	1134	3.59	+0.89	03 24 48.798	+09 01 43.95	–67.0	1.0	–78.0	1.0	note, ref.
21447	HR 1046	728–028717	1159	5.08	+0.05	03 30 00.183	+55 27 06.52	–46.1	1.0	–11.1	1.0	note, ref.
22049	ε Eri	403–004235	—	3.73	+0.89	03 32 55.845	–09 27 29.73	–975.2	1.0	19.5	1.0	note, ref.
28305	ε Tau	546–009607	—	3.54	+1.02	04 28 37.000	+19 10 49.56	108.0	1.0	–36.2	1.0	
30652	π^3 Ori	485–008472	1731	3.19	+0.45	04 49 50.411	+06 57 40.60	464.7	1.0	12.0	1.0	note, ref.
30836	π^4 Ori	479–008295	1742	3.69	–0.17	04 51 12.365	+05 36 18.37	–2.2	1.0	0.8	1.0	note, ref.

Table continued on following pages

Table 2. The photometric standards of the UBV system, cont.

HD (1)	Name (2)	UCAC4 (3)	NSV (4)	V (5)	B–V (6)	R.A. (J2000.0) (7) h m s	Dec. (J2000.0) (8) ° ′ ″	pm/a (9)	e/a (10)	pm/d (11)	e/d (12)	Note (13)
32630	η Aur	657–029789	1822	3.17	–0.18	05 06 30.892	+41 14 04.11	30.2	1.0	–68.3	1.0	note, ref.
33111	β Eri	425–008420	1841	2.80	+0.13	05 07 50.980	–05 05 11.25	–92.9	1.0	–80.4	1.0	note, ref.
35299	–0 936	450–010142	16300	5.70	–0.22	05 23 42.310	–00 09 35.35	2.1	1.0	–2.6	1.0	note, ref.
35468	γ Ori	482–011583	1972	1.64	–0.23	05 25 07.863	+06 20 58.94	–8.2	1.0	–12.2	1.0	note, ref.
35497	β Tau	594–018583	—	1.65	–0.13	05 26 17.513	+28 36 26.83	22.7	1.0	–173.6	1.0	note
36395	–3 1123	432–009930	2075	7.97	+1.47	05 31 27.396	–03 40 38.03	761.9	1.0	–2093.6	1.0	note, ref.
36512	υ Ori	414–009336	16333	4.63	–0.26	05 31 55.860	–07 18 05.54	–0.1	1.0	–4.9	1.0	note, ref.
36591	–1 935	443–010496	2107	5.35	–0.20	05 32 41.353	–01 35 30.59	–2.0	1.0	0.8	1.0	note, ref.
37043	ι Ori	421–010083	—	2.77	–0.25	05 35 25.982	–05 54 35.64	1.4	1.0	–0.5	1.0	note
37128	ε Ori	444–010753	—	1.70	–0.19	05 36 12.813	–01 12 06.92	1.4	1.0	–1.5	1.0	note, ref.
38678	ζ Lep	376–009566	—	3.55	+0.10	05 46 57.341	–14 49 19.02	–15.0	1.0	–0.6	1.0	
38899	134 Tau	514–015191	—	4.90	–0.07	05 49 32.930	+12 39 04.76	–23.0	1.0	–18.2	1.0	note
—	+17 1320	538–030603	—	9.63	+1.50	06 37 10.739	+17 33 53.61	–775.5	8.0	331.8	8.0	
47105	γ Gem	532–029305	—	1.93	0.00	06 37 42.711	+16 23 57.41	13.8	1.0	–54.9	1.0	note
—	+5 1668	477–036219	—	9.82	+1.56	07 27 24.506	+05 13 32.14	571.3	8.0	–3694.3	8.0	
56537	λ Gem	533–040057	3512	3.58	+0.11	07 18 05.580	+16 32 25.39	–44.5	1.0	–36.6	1.0	note, ref.
58946	ρ Gem	609–039674	17482	4.16	+0.32	07 29 06.719	+31 47 04.38	159.1	1.0	193.3	1.0	note, ref.
62345	κ Gem	572–041547	—	3.57	+0.93	07 44 26.854	+24 23 52.79	–23.4	1.0	–54.6	1.0	
71155	HR 3314	431–046612	17882	3.90	–0.02	08 25 39.632	–03 54 23.12	–66.6	1.0	–23.5	1.0	note, ref.
76644	ι UMa	691–048807	4329	3.14	+0.18	08 59 12.454	+48 02 30.58	–441.3	1.0	–215.3	1.0	note, ref.

Table continued on following pages

Table 2. The photometric standards of the UBV system, cont.

HD (1)	Name (2)	UCAC4 (3)	NSV (4)	V (5)	B–V (6)	R.A. (J2000.0) (7) h m s	Dec. (J2000.0) (8) ° ′ ″	pm/a (9)	e/a (10)	pm/d (11)	e/d (12)	Note (13)
79469	θ Hya	462–044140	4425	3.88	–0.06	09 14 21.860	+02 18 51.34	114.6	1.0	–313.9	1.0	note, ref.
—	–12 2918	383–056111	4515	10.06	+1.53	09 31 19.433	–13 29 19.33	722.9	8.0	53.5	1.0	note, ref.
82885	11 LMi	630–044785	—	5.41	+0.77	09 35 39.503	+35 48 36.49	–728.7	1.0	–259.8	1.0	note
87696	21 LMi	627–045317	4736	4.48	+0.18	10 07 25.762	+35 14 40.89	51.4	1.0	0.3	1.0	note, ref.
87901	α Leo	510–051462	4750	1.36	–0.11	10 08 22.311	+11 58 01.95	–248.7	1.0	5.6	1.0	note, ref.
89021	λ UMa	665–055971	—	3.45	+0.03	10 17 05.783	+42 54 51.68	–180.7	1.0	–46.1	1.0	
—	+1 2447	455–050081	18415	9.63	+1.52	10 28 55.545	+00 50 27.49	–602.3	8.0	–731.9	8.0	note, ref.
91316	ρ Leo	497–055273	—	3.85	–0.14	10 32 48.672	+09 18 23.71	–5.9	1.0	–3.4	1.0	note. ref.
100600	90 Leo AB	534–051686	—	5.95	–0.16	11 34 42.492	+16 47 48.89	–8.8	1.0	–0.6	1.0	note
102647	β Leo	523–054144	5349	2.14	+0.09	11 49 03.578	+14 34 19.41	–497.7	1.0	–114.7	1.0	note, ref.
102870	β Vir	459–049231	—	3.61	+0.55	11 50 41.719	+01 45 52.99	741.9	1.0	–270.6	1.0	
103095	HR 4550	639–046031	5374	6.45	+0.75	11 52 58.769	+37 43 07.24	4003.3	1.0	–5815.1	1.0	note, ref.
103287	γ UMa	719–051426	5379	2.44	0.00	11 53 49.839	+53 41 41.12	98.9	1.0	9.1	1.0	note, ref.
106591	δ UMa	736–053984	5513	3.31	+0.08	12 15 25.561	+57 01 57.42	103.8	1.0	8.1	1.0	note, ref.
106625	γ Crv	363–062247	5515	2.60	–0.11	12 15 48.370	–17 32 30.95	–159.4	1.0	21.9	1.0	note, ref.
111631	+0 2989	447–054239	19498	8.49	+1.41	12 50 43.566	–00 46 05.24	–32.0	1.0	–393.8	2.8	note, ref.
113139	78 UMa	732–051636	6058	4.93	+0.36	13 00 43.700	+56 21 58.82	108.4	1.0	2.7	1.0	note, ref.
114710	β Com	590–051410	19648	4.28	+0.57	13 11 52.394	+27 52 41.45	–801.2	1.0	881.8	1.0	note, ref.
115617	61 Vir	359–064461	—	4.75	+0.71	13 18 24.315	–18 18 40.31	–1068.7	1.0	–1064.1	1.0	
116658	α Vir	395–055656	—	0.96	–0.23	13 25 11.579	–11 09 40.75	–42.4	1.0	–30.7	1.0	note, ref.

Table continued on following pages

Table 2. The photometric standards of the UBV system, cont.

HD (1)	Name (2)	UCAC4 (3)	NSV (4)	V (5)	B–V (6)	R.A. (J2000.0) (7) h m s	Dec. (J2000.0) (8) ° ′ ″	pm/a (9)	e/a (10)	pm/d (11)	e/d (12)	Note (13)
116842	80 UMa	725–051101	6238	4.01	+0.16	13 25 13.538	+54 59 16.66	120.2	1.0	–16.0	1.0	note, ref.
117176	70 Vir	519–054549	—	4.98	+0.71	13 28 25.809	+13 46 43.64	–235.7	1.0	–576.0	1.0	
121370	η Boo	542–053388	19993	2.69	+0.58	13 54 41.079	+18 23 51.80	–61.0	1.0	–356.3	1.0	note, ref.
130109	109 Vir	460–053938	6794	3.74	0.00	14 46 14.924	+01 53 34.37	–116.4	1.0	–24.2	1.0	note, ref.
130819	α^1 Lib	371–068727	—	5.16	+0.41	14 50 41.181	–15 59 50.05	–136.4	1.0	–59.0	1.0	
130841	α^2 Lib	370–069040	6827	2.75	+0.15	14 50 52.713	–16 02 30.40	–105.7	1.0	–68.4	1.0	note, ref.
—	–7 4003	412–059591	7023	10.56	+1.61	15 19 26.806	–07 43 20.23	–1224.6	8.0	–99.5	8.0	note, ref.
141003	β Ser A	528–059498	20396	3.67	+0.06	15 46 11.254	+15 25 18.60	65.4	1.0	–38.6	1.0	note, ref.
141004	λ Ser	487–059560	7246	4.43	+0.60	15 46 26.614	+07 21 11.04	–224.0	1.0	–70.7	1.0	note, ref.
142860	γ Ser	529–057946	7350	3.85	+0.48	15 56 27.183	+15 39 41.82	310.8	1.0	–1282.8	1.0	note, ref.
—	–12 4523	387–070731	7768	10.13	+1.60	16 30 18.061	–12 39 44.88	–93.6	8.0	–1184.9	8.0	note, ref.
149757	ζ Oph	398–065625	—	2.56	+0.02	16 37 09.537	–10 34 01.52	12.1	1.0	25.6	1.0	note, ref.
154363	–4 4225	425–069303	—	7.73	+1.16	17 05 03.394	–05 03 59.44	–917.1	1.0	–1139.3	1.0	note
154363B	–4 4226	425–069319	8176	10.07	+1.43	17 05 13.752	–05 05 39.70	–921.2	8.0	–1128.2	8.0	note, ref.
157881	+2 3312	461–067140	21919	7.54	+1.36	17 25 45.233	+02 06 41.12	–579.7	1.0	–1184.8	1.0	note, ref.
159561	α Oph	513–067491	9189	2.08	+0.15	17 34 56.069	+12 33 36.13	108.1	1.0	–221.6	1.0	note, ref.
161096	β Oph	473–066890	23613	2.77	+1.16	17 43 28.352	+04 34 02.29	–42.0	1.0	159.3	1.0	note, ref.
161868	γ Oph	464–066593	—	3.75	+0.04	17 47 53.560	+02 42 26.20	–23.5	1.0	–74.4	1.0	
—	+4 3561	472–067401	9910	9.54	+1.74	17 57 56.930	+04 14 52.07	3.6	1.0	4.6	0.9	note, ref.
—	–3 4233	435–075468	10167	9.38	+1.52	18 05 07.601	–03 01 52.94	570.1	8.0	–332.6	8.0	note, ref.

Table continued on following pages

Table 2. The photometric standards of the UBV system, cont.

HD (1)	Name (2)	UCAC4 (3)	NSV (4)	V (5)	B–V (6)	R.A. (J2000.0) (7) h m s	Dec. (J2000.0) (8) ° ′ ″	pm/a (9)	e/a (10)	pm/d (11)	e/d (12)	Note (13)
176437	γ Lyr	614–066016	11624	3.25	–0.05	18 58 56.622	+32 41 22.40	–3.1	1.0	1.1	1.0	note, ref.
177724	ζ Aql	520–091451	11724	2.99	0.00	19 05 24.608	+13 51 48.52	–7.3	1.0	–95.6	1.0	note, ref.
180617	+4 4048	476–093846	—	9.13	+1.49	19 16 55.230	+05 10 07.12	–578.9	8.0	–1331.7	8.0	note, ref.
184279	+3 4065	469–106653	—	6.82	+0.02	19 33 36.919	+03 45 40.78	0.0	1.0	–3.0	1.0	note, ref.
184915	κ Aql	415–127824	12204	4.96	–0.01	19 36 53.449	–07 01 38.92	0.3	1.0	–3.2	1.0	note, ref.
187642	α Aql	495–118192	24910	0.77	+0.22	19 50 46.999	+08 52 05.96	536.2	1.0	385.3	1.0	note, ref.
188512	β Aql	483–118413	12557	3.71	+0.86	19 55 18.793	+06 24 24.34	45.3	1.0	–481.9	1.0	note, ref.
196867	α Del	530–136721	13207	3.77	–0.06	20 39 38.287	+15 54 43.49	52.8	1.0	9.7	1.0	note
198001	ε Aqr	403–132292	—	3.77	+0.01	20 47 40.552	–09 29 44.79	32.6	1.0	–35.5	1.0	note
—	–15 6290	379–165686	—	10.17	+1.60	22 53 16.717	–14 15 49.14	960.3	8.0	–675.6	8.0	note, ref.
216494	74 Aqr	392–129365	—	5.81	–0.08	22 53 28.703	–11 36 59.45	20.8	1.0	1.7	1.0	note, ref.
218045	α Peg	527–148659	14417	2.49	–0.05	23 04 45.654	+15 12 18.96	61.6	1.0	–41.5	1.0	note, ref.
222368	ι Psc	479–133082	14657	4.13	+0.51	23 39 57.041	+05 37 34.65	376.8	1.0	–436.6	1.0	note, ref.
—	+1 4774	463–135261	14719	8.98	+1.48	23 49 12.570	+02 24 03.77	995.1	8.0	–968.3	8.0	note, ref.

Notes:

HD 886: HR 39, CSV 100009; variable star of β Cep type, G. Handler et al., Astrophys. J., Lett., 698, L56, 2009; B2 IV; 2.82–2.86V.
HD 1280: HR 63; double or multiple star; NSV 116; M. Golay, IAU Symp. 54, 275, 1973; A2 V; 4.58–4.62V.
HD 4727: HR 226; magnitude range in V unknown; V. G. Kornilov et al., Tr. Sternberg Astron. Inst., 63, 1, 1991 (see page 3); B5 V + F8 V; 4.53–?V.
HD 6961: HR 343, NLTT 3919; M. S. Zverev, Tr. Gos. Astron. Inst. Sternberg, 8, No. 1, 1936 (pages 90, 150); A7 V; 4.32–4.36V.
HD 8538: HR 403, NLTT 4718; eclipsing binary of Algol type, P. Guthnick, and R. Prager, Veroff. K. Sternw. Berlin-Babelsberg, 2, 112 (H.3), 1918; AAVSO's VSX database notes the period still is to be confirmed; A5 V; 2.68–2.76V.

Table continued on following pages

Table 2. The photometric standards of the UBV system, cont.

Notes (continued):

HD 9270: HR 437, CSV 100120, NSV 532; J. F. J. Schmidt, Astron. Nachr.*, 47, 314, 1858; P. Baize,* J. Obs.*, 45, No. 6–7, 117, 1962; G7 IIIa; 3.59–3.65V.*

HD 10476: NSV 600, GJ 68, CCDM J01425+2016A; A. Gutierrez-Moreno et al., Publ. Obs. Astron. Natl. Cerro Calan*, No. 1, 1966; K1 V; 5.14–5.26V.*

HD 10700: τ Cet, HR 509; suspected variable, F. Rufener and P. Bartholdi, Astron. Astrophys, Suppl. Ser.*, 48, 503, 1982; G8 Vp; 3.5–?V.*

HD 11636: CSV 100146, HR 553; P. Guthnick and R. Prager, Veroff. K. Sternw. Berlin-Babelsberg*, 2, 114 (H.3), 1918; A4 V; 2.56–2.70V.*

BD–18 359: GJ 84, G 272-148; suspected variable, E. W. Weis, Astron. J.*, 107, 1135, 1994; amplitude of 0.026 magnitude, M. Kiraga and K. Stepien,* Acta Astron.*, 57, 149, 2007; M2.5; 10.19(0.026)V.*

HR 753B: BD+06 398B; see text above; the variable star BX Cet.

HD 20630: HR 996, CSV 6022; variable of BY Dra type; M. A. C. Perryman et al., The Hipparcos and Tycho Ctalogues*, ESA SP-1200, European Space Agency, 1997; G5 Vvar; 4.95–4.99Hp.*

HD 21120: HR 1030, CSV 100272; E. Zinner, Astron. Abh., Erganzungshefte zu den Astron. Nachr.*, 8, No. 1, 1929; G6 III; 23.57–3.62V.*

HD 21447: CSV 100281; G. Hill et al., Astron. J.*, 76, 246, 1971; also, H. E. Lau,* Astron. Nachr.*, 196, 425, 1914; A1 V; 5.06–5.13V.*

HD 22049: HR 1084, CCDM J03329-0927A; variable of BY Dra type, G. J. Frey et al., Astron. J.*, 102, 1813, 1991; stellar rotation period between 10 and 12 days; magnitude range about 0.05 magnitude; K2 Vk, R. O. Gray et al.* Astron. J.*, 132, 161, 2006 (Table 2); 3.73(0.05)V.*

HD 30652: HR 1543, CSV 100411; H. Moreno, Astron. Astrophys.*, 12, 442, 1971; F6 V; 3.15–3.21V.*

HD 30836: HR 1552, CSV 100415; spectroscopic binary; E. Zinner, Astron. Abh., Erganzungshefte zu den Astron. Nachr.*, 8, No. 1, 1929; C. Koen and L. Eyer,* Mon. Not. Roy. Astron. Soc.*, 331, 45, 2002, give an amplitude of 0.0032 magnitude for HIP 22549 = HD 30836; B2 III; 3.68(0.003)V.*

HD 32630: HR 1641, CSV 100441; P. Guthnick and F. Pavel, Astron. Nachr.*, 215, 395, 1922; Var?, G. Larsson-Leander,* Ark. Astron.*, 2, 283, 1959; G. M. Fracastoro and S. Catalano,* Mem. Soc. Astron. Ital.*, 36, 99, 1965, T. Widorn,* Mitt. Univ. Sternw. Wien*, 10, 3 (No. 2), 1959; C. Koen and L. Eyer,* Mon. Not. Roy. Astron. Soc.*, 331, 45, 2002, find for V = 3.18, an amplitude of 0.0053 magnitude for HIP 23767 = HD 32630; B3 V; 3.18(0.005)V.*

HD 33111: HR 1666, CSV 100450, IDS 05030-0513 A; B. A. Gould, Resultados del Observatorio Nacional Argentino en Cordoba*, 1, 1, 1879 (see pages 128-342); A3 III; 2.72–2.80V.*

HD 35299: HR 1781; suspected variable, W. H. Warren, Jr. and J. E. Hesser, Astrophys. J., Suppl. Ser.*, 34, 115, 1977; B2 V; 5.69–5.72V.*

HD 35468: HR 1790, CSV 100483; J. F. W. Herschel, Results of Astronomical Observations made during the years 1834, 5, 6, 7, 8 at the Cape of Good Hope*, pp.341, 343, 349, 350, 1847; A. W. J.Cousins and H. R. Stoy,* Roy. Obs. Bull.*, No. 64, 103, 1962., A.Gutierrez-Moreno et al.,* Cerro Tololo Inter-Amer. Obs. Contrib.*, No. 9, 1966; B2 III; 1.59–1.64V.*

HD 35497: HR 1791, double star, IDS 05200+2831 A, CCDM J05263+2836A.

HD 36395: CSV 6182, GJ 205; BY Dra type variable; V = 7.96 magnitude with an amplitude of 0.008 magnitude, period 33.61 days; M. Kiraga and K. Stepien, Acta Astron.*, 57, 149, 2007; R. Weber,* J. Obs.*, 41, 74, 1958; M1.5; 7.96(0.008)V.*

Table continued on following pages

Table 2. The photometric standards of the UBV system, cont.

Notes (continued):

HD 36512: HR 1855; line profile variable of 0.009 magn. amplitude; perhaps a β *Cep star, L. A.Balona and C. A. Engelbrecht,* Mon. Not. Roy. Astron. Soc.*, 214, 559, 1985; B0 V; 4.62–?V.*

HD 36591: HR 1861, CSV 100504, ADS 4141; F. B.Wood, Princeton Obs. Contrib.*, 21, 1946; B1 IV; 5.31–5.38V.*

HD 37043: HR 1899, ADS 4193 A, CCDM J05355-0555A, IDS 05305-0559 A.

HD 37128: HR 1903, CCDM J05363-0112A; pulsating variable, A. W. J. Cousins, Roy. Obs. Bull.*, No. 122, E59, 1966; W. H. Warren., Jr. and J. E. Hesser,* Astrophys. J., Suppl. Ser.*, 34, 115, 1977; B0.5 Iabea; 1.64–1.74V.*

HD 38899: HR 2010, CCDM J05495+1239A, IDS 05439+1237 A.

HD 47105: HR 2421, IDS 06319+1629 A, CCDM J06377+1624A, spectroscopic binary.

HD 56537: HR 2763, CSV 100844, ADS 5961 A, IDS 07124+1643 A; H. L. Johnson et al., 1966; A3 V; 3.52–3.62V.

HD 58946: ρ *Gem, HR 2852, GJ 274.0; suspected variable, A. V. Kusakin, 1992, manuscript only, see VSX database; F0 V; 4.18–?V.*

HD 71155: suspected variations in H Beta, A. Heck, Astron. Astrophys., Suppl. Ser.*, 27, 47, 1977; A0 V; 3.9–?V.*

HD 76644: HR 3569; spectroscopic binary, short period A-star, G. Jackisch, Veroff. Sternw. Sonneberg, 5, 271 (H. 5), 1963; A7 IV; 3.12–3.18V.

HD 79469: θ *Hya, HR 3665, ADS 7253 A; H. E. Lau,* Astron. Nachr.*, 196, 425, 1914; suspected variable, C. J. Durant,* Mon. Not. Roy. Astron. Soc.*, 147, 75, 1970; B9.5 V; 3.88–3.91V.*

BD–12 2918: double or multiple, IDS 09265-1303 AB, CCDM J09313-1329AB, GJ 352, NLTT 21974, Ross 440; sp type M2; V 10.05–?; P. M.Corben et al., Mon. Not. Astron. Soc. S. Africa*, 31, No.1–2, 7, 1972, change in (U–B) = 0.18; J. Alfonso-Garzon et al., 2012, arXiv:1210.0821 [astro-ph.IM] (online info); M.Petit,* Inf. Bull. Var. Stars*, No. 320, 1, 1968.*

HD 82885: NLTT 22117; SV LMi, a variable of RS CVn type, amplitude in Stromgren y *of 0.033 magnitude, with period of 18.0 days, B. Skiff and W. Lockwood,* Publ. Astron. Soc. Pacific*, 98, 338, 1986; G8 IIIv; 5.39(0.004)V.*

HD 87696: discovered by G. Jackisch, Sky & Telescope*, 18, 73, 1958; also G. Jackisch, Veroff. Sternw. Sonneberg, 5, 1963, variable of* δ *Scuti type, P = ~0.1 day; suspected variable, G. Hill et al.,* Astron. J.*, 76, 246, 1971; A7 V; 4.47–4.52V.*

HD 87901: Regulus; double, ADS 7654 A, HR 3982; A. Gutierrez-Moreno et al., Cerro Tololo Inter-Amer. Obs. Contrib.*, No. 9, 1966; P. Guthnick and R. Prager,* Veroff. K. Sternw. Berlin-Babelsberg*, 2, 116 (H.3), 1918; B7 V; 1.33–1.40V.*

BD+01 2447: GJ 393.0, G 55-24, Ross 446; H. L. Giclas et al., Lowell Obs. Bull.*, 5, 61, 1961; suspected variable, E. W. Weis,* Astron. J.*, 107, 1135, 1994; M2.5 V; 9.63–9.68V.*

HD 91316: pulsating variable of amplitude 0.07 magnitude, E. H. Olsen, Inf. Bull. Var. Stars*, No. 925, 1, 1974; illustrated light curve with period 3.4271 days in* The Hipparcos and Tycho Catalogues, Variability Annex*: periodic variables, HIP 51624, SP-1200, vol. 12, page A236; B1 Ib; 3.83–3.9V.*

Table continued on following pages

Table 2. The photometric standards of the UBV system, cont.

Notes (continued):

HD 100600: double star, ADS 8220 AB, CCDM J11347+1648AB, IDS 11295+1721, component B also spectroscopic binary via D. Hoffleit and C. Jaschek, The Bright Star Catalogue, *1982.*

HD 102647: Denebola, β Leo, ADS 8314 A; predicted variable of δ Scuti type, M. S. Frolov, Inf. Bull. Var. Stars, *No. 427, 1, 1970; found to have approximate amplitude of 0.025 magnitude and period about 0.05 day by C. Bartolini et al.,* Inf. Bull. Var. Stars., *No. 2010, 1, 1981; A3 Va, G. T. van Belle and K. von Braun,* Astrophys. J., *694, 1085, 2009; 2.14(0.025)V.*

HD 103095: Groombridge 1830A, high proper motion star and metal-poor subdwarf; NLTT 28839; flare caused change in photographic magnitude from 6.6 to 7.2 on secondary component, named CF UMa, W. R. Beardsley et al., Astrophys. J., *194, 637, 1974; W. D. Heintz,* Publ. Astron. Soc. Pacific, *96, 557, 1984, casts strong doubt on the reality of the flare star, CF UMa; G8 Vp; 6.6–7.20B.*

HD 103287: emission line star; CSV 101229, HR 4554; short period variation with up to 0.03 magnitude variation, P. Guthnick, Astron. Nachr., *205, 97, 1917 (see page 112); A0 Ve; 2.41–2.45V.*

HD 106591: HR 4660, CSV 101249, CCDM J12155+5702A; possible micro-variable, F. Rufener, Astron. Astrophys., Suppl. Ser., *26, 275, 1976; A3 V; 3.27–3.34V.*

HD 106625: HR 4662, CSV 101250; discoverer Ferrero; E. Zinner, Astron. Abh., Erganzungshefte Astron. Nachr., *8, No. 1, 1929; B8 III; 2.56–2.60V.*

HD 111631: GJ 488.0, G 14-6, NLTT 32069; suspected variable, F. Rufener and P. Bartholdi, Astron. Astrophys., Suppl. Ser., *48, 503, 1982; M0.5 Ve; 8.46–?V.*

HD 113139: ADS 8739 AB, CCDM J13007+5622AB, IDS 12564+5654, HR 4931; P. Baize, J. Obs., *45, 117, 1962; G6 V; 7.4–10.5V (note: this range in magnitude is huge; correct?).*

HD 114710: β Com, HR 4983, GJ 502.0; variable, D. F. Gray et al., Astrophys. J., *456, 365, 1996; F9.5 V; 4.26(0.02)V.*

HD 116658: Spica, α Vir, IDS 13200-1038 A,; an eclipsing binary with the primary component a β Cep type variable star, M. Desmet et al., Amer. Inst. Physics Conf. Proc. 1170, page 376, 2009; B1 III-IV; 0.95(0.1)V.

HD 116842: HR 5062, CSV 101383; variability suspected by H. Shapley, Astron. Nachr., *196, 398, 1914; A5 Vn; 3.93–4.03V.*

HD 121370: η Boo, HR 5235; 0.1 magnitude variation in V, M. Petit, Astron. Astrophys., Suppl. Ser., *85, 971, 1990; G0 IV; 2.68(0.1)V.*

HD 130109: 109 Vir, HR 5511; A. Gutierrez-Moreno et al., Publ. Obs. Astron. Natl. Cerro Calan, *No. 1, 1966; A0 V; 3.70–3.75V.*

HD 130841: α Lib 2, HR 5531, A. Gutierrez-Moreno et al., Publ. Obs. Astron. Natl. Cerro Calan, *No.1, 1966; A3 V; 2.72–2.75V.*

BD–07 4003: HO Lib; variable of BY Dra type; E. W. Weis, Astron. J., *107, 1135, 1994; J. Alfonso-Garzon et al., 2012, arXiv:1210.0821 [astro-ph.IM] (online info); M5.0 V; 10.56–10.58V.*

HD 141003: β Ser, 28 Ser, HR 5867, double star, ADS 9778 A; micro-variable, F. Rufener, Astron. Astrophys., Suppl. Ser., *45, 207, 1981; A1 V; 3.65–?V.*

HD 141004: 27 Ser, HR 5868; J. E. Gore, A Catalogue of Suspected Variable Stars, Proc. Roy. Irish Acad. (II), *4, 267, 1884; suspected variablility in Kukarkin et al., 1951; A.Gutierrez-Moreno et al.,* Cerro Tololo Inter-Amer. Obs. Contrib., *No. 9, 1966.; and G. Hill et al.,* Astron. J., *76, 246, 1971; G0 V; 4.39–4.44V.*

Table continued on following pages

Table 2. The photometric standards of the UBV system, cont.

Notes (continued):

HD 142860: γ Ser, 41 Ser, HR 5933; suspected variable, M. Golay, IAU Symp. 54, 275, 1973; F6 V; 3.79–3.88V.

BD–12 4523: GJ 628, V2306 Oph, a variable of BY Dra type; suspected variable, E. W. Weis, Astron. J.*, 107, 1135, 1994; J. Alfonso-Garzon et al., 2012, arXiv:1210.0821 [astro-ph.IM] (online info); M3.5 V; 10.05–10.1V.*

HD 149757: ζ Oph, 13 Oph, HR 6175; Be star; S. S. Vogt and G. D. Penrod, Astrophys. J.*, 275, 661, 1983; O9.5 V(e); 2.56–2.58V.*

HD 154363: double star, Wolf 635, CCDM J17051-0504A, GJ 653, IDS 16597-0456 A, NLTT 44127.

HD 154363B: variable in (U–B), P. M.Corben, B. S.Carter, R. M.Banfield, G. M. Harvey, Mon. Not. Astron. Soc. S. Africa*, 31, 7, 1972; M4 V; 10.06–?V.*

HD 157881: G 19-24, GJ 673.0; V magnitude only marked as a weak determination in A. W. J. Cousins, S. Afr. Astron. Obs. Circ.*, 1, 234, 1980 (Table 1); K7 V; 7.51–7.56:V.*

HD 159561: α Oph, HR 6556, CSV 101982, CCDM J173449+1234A, NLTT 45084; found in minimum once, H. E. Lau, Astron. Nachr.*, 196, 425, 1914; DSCT+GDOR; "Rotationally-modulated g-modes in the rapidly-rotating δ Scuti star Rasalhague (α Ophiuchi)," J. D. Monnier et al.,* Astrophys. J.*, 725, 1192, 2010; has a low mass companion; A5 IV; 2.08V(0.006).*

HD 161096: HR 6603; suspected variable in near-infrared, D. Engels et al., Astron. Astrophys., Suppl. Ser.*, 45, 5, 1981; K2 III; 2.75–2.77V.*

BD+04 3561: V2500 Oph, Barnard's Star, G 140-24, GJ 699.0; G. F. Benedict et al., Astron. J.*, 116, 429, 1998; M. Kiraga and K. Stepien,* Acta Astron.*, 57, 149, 2007; M4; 9.55(0.02)V.*

BD–03 4233: HD 165222, G 20-22; variable, M. P. FitzGerald, Astron. Astrophys., Suppl. Ser.*, 9, 297, 1973; M. Petit,* Inf. Bull. Var. Stars*, No. 1056, 1, 1975; M2; 9.28–9.43V.*

HD 176437: γ Lyr, ADS 11980 A, HR 7178; variable in P. Guthnick and R. Prager, Astron. Nachr.*, 201, 443, 1915; B9; 3.23–3.26V.*

HD 177724: ζ Aql, HR 7235, double star, ADS 12026 A; suspected variable, A.Gutierrez-Moreno et al., Publ. Obs. Astron. Natl. Cerro Calan*, No.1, 1966; A0; 2.98–2.99V.*

HD 180617: Ross 652, CCDM J19169+0510A, NLTT 47619, suspected variable, E. W. Weis, Astron. J.*, 107, 1135, 1994; V1428 Aql, a BY Dra type variable star, J. Alfonso-Garzon et al., 2012, arXiv:1210.0821 [astro-ph.IM] (online info); M3.5 V; 9.09–9.13V.*

HD 184279: V1294 Aql; Be star; variable in P. Tempesti and R. Patriarca, Inf. Bull. Var. Stars*, No. 1164, 1, 1976; G. Pojmański,* Acta Astron.*, 52, 397, 2002; J. Alfonso-Garzon et al., 2012, arXiv:1210.0821 [astro-ph.IM] (online info); B0.5 IVe; 6.78–7.59V.*

HD 184915: κ Aql, HR 7446; possibly variable, 0.02 magnitude or less, C. R. Lynds, Astrophys. J.*, 130, 577, 1959; B1; 4.94–4.98V.*

HD 187642: Altair, HR 7557, ADS 13009 A; δ Scuti type variable, demonstrated by D. L. Buzasi et al., Astrophys. J.*, 619, 1072, 2005; A7 IV/V; 0.77(0.004)V.*

HD 188512: β Aql, HR 7602, ADS 13110 A, CSV 101909; variable, H. E. Lau, Astron. Nachr. *196, 425, 1914; C. Wylie,* Astrophys. J.*, 56, 217, 1922; A. Gutierrez-Moreno et al.,* Publ. Obs. Astron. Natl. Cerro Calan*, No.1, 1966; G8; 3.68–3.74V.*

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Table 2. The photometric standards of the UBV system, cont.

Notes (continued):

HD 196867: α Del, HR 7906, ADS 14121 A, CCDM J20396+1555A, described as suspected variable in A. Auwers, Astron. Nachr.*, 50, 99, 1859 (see page 105), but seems unrealistic based on modern possible variation in I, G. E. Kron et al.,* Publ. U.S. Naval Obs., Second Ser.*, 20, part 5, 1972, pages 54 and 70; B9; 3.77–3.80V.*

HD 196867: α Del, HR 7906, ADS 14121 A, CCDM J20396+1555A, described as suspected variable in A. Auwers, Astron. Nachr.*, 50, 99, 1859 (see page 105), but seems unrealistic based on modern possible variation in I, G. E. Kron et al.,* Publ. U.S. Naval Obs., Second Ser.*, 20, part 5, 1972, pages 54 and 70; B9; 3.77–3.80V.HD 198001: ε Aqr, HR 7950 suspected of variability, but by whom?*

BD–15 6290: NLTT 55130, GJ 876.0, suspected variable, E. W. Weis, Astron. J.*, 107, 1135, 1994; IL Aqr, a variable of BY Dra type, J. Alfonso-Garzon et al., 2012, arXiv:1210.0821 [astro-ph.IM] (online info); M4 V; 10.15–10.21V.*

HD 216494: 74 Aqr, HR 8704, HI Aqr, a variable star of α2 CVn type, G. Mathys and J. Manfroid, Astron. Astrophys., Suppl. Ser.*, 60, 17, 1985, with period 0.724 day; B9 pHgMn; 5.80(0.01)V.*

HD 218045: α Peg, HR 8781, variable star, Anon., Observatory*, 2, 420, 1879; J. Lub and J. W. Pel,* Astron. Astrophys.*, 54, 137, 1977 (Table 13); B9; 2.47–2.52V.*

HD 222368: ι Psc, HR 8969; M.Golay, IAU Symp. 54, 275, 1973 (Table 4.2); F7; 4.11–4.14V.

BD+01 4774, GJ 908, NLTT 58069: BR Psc, a BY Dra type var.; E. W. Weis, Astron. J.*, 107, 1135, 1994; M2 V; 8.93–9.03V.*

Appendix A: Notes on stellar nomenclature

Most of the stars in Tables 1 and 2 have additional identifications. Therefore a description follows next of the stellar nomenclature which the reader will encounter. These different star naming systems and catalogues are given in alphabetical order.

2MASS: The 2 Micron All-Sky Survey (Skrutskie *et al.* 2006) is a survey of the sky in the near-infrared. There is an online catalogue, VizieR, II/246, Cutri, *et al.* (2003).

ADS: An Aitken double star (Aitken 1932).

BD: The *Bonner Durchmusterung* is a multiple-volume star catalogue published between 1852 and 1859 by F. W. A. Argelander, A. Krüger, and E. Schönfeld (1859, 1861, 1862). It is a visual survey of stars in declination zones from +90 to –01 Degrees. The *Sudliche Bonner Durchmusterung* covers the declination range from –02 to –22 degrees (Schönfeld 1886).

CCDM: A catalogue of the components of double and multiple stars by J. Dommanget and Nys (1994; online version, CDS Catalogue I/211), first edition.

CSV: An acronym used for stars in the *Catalogue of Suspected Variable Stars* (Kukarkin *et al.* (1951) and in the *Second Catalogue of Suspected Variable Stars* (Kukarkin *et al.* 1965).

G and GD: Proper motion stars published by Giclas and colleagues in the *Lowell Observatory Bulletins* (Giclas *et al.* 1971)—Northern Hemisphere, the G numbered stars; Giclas *et al.* (1978)—Southern Hemisphere Catalogue; Giclas *et al.* (1980)—Summary catalogue of the GD and GR stars. This latter group contained very blue (GD) or very red (GR) stars of little or no proper motion.

GD: A list of white dwarf suspects compiled by Giclas and colleagues in *Lowell Observatory Bulletins* (Giclas, Burnham, and Thomas, 1980).

GJ: The nomenclature GJ pertains to stars in the Gliese and Jahreiss (1979) catalogue of nearby stars.

HD: *The Henry Draper Catalogue* was published in the *Annals of the Harvard College Observatory*, vols. 91–99 in the time interval 1918–1924.

IDS: *The Index Catalogue of Double Stars* was published in 1963 (Jeffers, van den Bos, and Greeby 1963).

Luyten devised several numbering systems for the white dwarf and high proper motion stars that he discovered (Luyten 1963, 1976).

NLTT: *The New Luyten Two Tenths Catalogue* (Luyten, 1979a,b,c; 1980a,b; Luyten and Hughes 1980); includes stars in the LTT from Luyten publications in the 1954–1969 era.

NSV: The NSV terminology began with the *New Catalogue of Suspected Variable Stars* (Kholopov *et al.* 1982). One can now most easily access variable and suspected variable star information by entering the Sternberg Astronomical

Institute's web page, clicking on the "GCVS Research Group" (*General Catalogue of Variable Stars*), and then going to the appropriate catalogue; see http://www.sai.msu.su.

Ross: The Ross stars numbers arise from a series of papers in the *Astronomical Journal* by F. E. Ross on high proper motion stars. The papers appeared in the time interval 1925–1939.

UCAC4: A catalogue of accurate coordinates and proper motions for stars around the sky (Zacharias *et al.* 2103). The photometry is by the AAVSO, on its APASS photometric system.

VSX: The American Association of Variable Star Observers' International Variable Star Index (Watson, Henden, and Price 2013).

Wolf: Wolf star numbers are stars catalogued by M. Wolf in his studies of high proper motion stars. These papers appeared in the *Astronomische Nachrichten* in the time interval 1919–1931.