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Faint photometric BVR_c CCD sequences *

The North galactic pole ($b \simeq 85°$) and the anticenter ($l = 133.°2$, $b = -1.°6$)

A. Spagna[1], M.G. Lattanzi[12], B.J. Mclean[2], G. Massone[1], and B.M. Lasker[2]

[1] Osservatorio Astronomico, Strada Osservatorio 20,
I-10025 Pino Torinese, Italy
[2] Space Telescope Science Institute,
3700 San Martin Dr., Baltimore MD 21218, USA

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Abstract. Lists of CCD photometric standard stars in the BVR_c system of Johnson and Cousin are presented for two regions of importance in studies of galactic structure and kinematics: one at the North galactic pole (NGP) ($b_{II} = 85°$), and a second on the galactic equator toward the anti–center ($l_{II} = 133.°2$, $b_{II} = -1.°6$). Precision of both magnitudes and colors is better than 0.05 mag down to V=18.5 for the NGP sample, and to V=18.0 for the set on the galactic plane. Accuracy is at the 0.01 mag level, as shown by comparison to standard (intrinsic) color-color data.

These sequences should fulfill the needs for faint reference stars in the photometric calibration of old and new large-area surveys realized with wide-angle photographic plates. This is the case, for example, of the new multicolor surveys of the Palomar Observatory, which uses the Oschin Schmidt telescope, and the Second Generation Southern Sky Survey, which utilizes UK Schmidt of the Anglo Australian Observatory in Siding Spring.

Key words: catalogs, surveys, Galaxy:structure, techniques:photometric

1. Introduction

Considerable attention has been devoted in recent years to the complex structure of the phase space of the Galaxy, as depicted by both narrow angle deep CCD multicolor star counts or large-angle surveys of colors and proper motions (Robin et al. 1992, Majewski 1992; Spagna et al. 1996a). Large-area surveys covering several square degrees utilize large format photographic plates taken at, usually, Schmidt-type telescopes. Noticeable examples of photographic surveys on Schmidt plates are the first Palomar sky survey (POSS I) (Minkowski and Abell 1963), its present day continuation (POSS II) (Reid 1991), the Quick-V survey, taken specifically for the construction of the first guide star catalog for the Hubble Space Telescope (Lasker et al. 1990), and, for the Southern hemisphere, the ESO/SERC survey (ref.???), and the on-going Second Epoch Southern (SES) survey ($\delta \leq 0$) with the UK Schmidt (Lasker and Cannon 1990). As discussed by many authors, the photometric calibration of such large format plates is challenging (see e.g. Bienaymé et al. 1992, Andruk et al. 1994, Ohja et al. 1994b, Spagna et al. 1996a). Precisions to 0.1 mag or better are possible, especially for Kodak IIIa emulsions, but photometric quality appears to be particularly vulnerable to position-dependent systematics. Faint photometric standards, best if evenly distributed over the area studied, are essential for the most accurate results. Although the imminent release of the TYCHO catalog will certainly help (especially for the zero-point "flat fielding" across plates) today, the situation if far from ideal! Faint photometric standards of suitable bandpasses are not always availailable, and, when so, they tend to be concentrated in small regions compared to the extension of the plates. These are the motivations for the extension of the first Guide Star Photometric Catalog (GSPC I) (Lasker et al. 1988) into the GSPC II (Postman et al. 1992). The GSPC II is a joint effort of the STScI and the Osservatorio Astronomico di Torino aimed at the creation of photometric standard sequences throughout the celestial sphere down to $V \approx 19$ in the B, V, R_C bandpasses, with an accuracy of 5% (Ferrari et al. 1993). More

Send offprint requests to: spagna@otovs4.to.astro.it

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details on the project can be found in the quoted references. The data presented in this article are part of the GSPC II photometric database.

2. CCD observations and data reductions

The standard photometry presented here satisfies the needs for photographic photometry calibrations in two fields along the meridian section of the Milky Way toward the galactic anticenter; the North galactic pole (NGP) region is centered at ($l \simeq 162°$, $b \simeq 87°$), and the galactic plane region (GPR) at ($l \simeq 134°$, $b \simeq -2°$) around the open cluster Stock 2. These fields are part of a systematic study (which includes a total of twelve regions) aiming at the detailed investigation of the structural and kinematical properties of the Galaxy (Spagna et al. 1996a, and references therein; Spagna et al. 1996b). New CCD observations have been produced to establish sequences of standard stars in the BVR_c Johnson-Cousins photometric system, down to V$\simeq$ 19.

BVR_c CCD data for the GPR were taken at the Kitt Peak Observatory on October 15 1993, using the 1.2m telescope equipped with a 1024 × 1024 pixel CCD (scale $\simeq 0''.67$/pixel) The CCD frames, covering $11' \times 11'$, were all centered on star No.49 from the list of Krzeminski and Serkowski (1963): $\alpha = 2^h\,13^m\,45^s.9$, $\delta = 59°\,37'\,08''$ (J2000), corresponding to $l_{II} = 133°.2$, $b_{II} = -1°.6$.

The NGP field was imaged the night of June 5 1994 with the 1032 × 1032 pixel CCD at the 1.2m telescope of Mt. Hopkins (scale $\simeq 0''.67$/pixel). Three $11' \times 11'$ fields have been selected, located respectively to the center (I), the North-East (II) and North-West (III) edges of the $4° \times 5°$ NGP region tackled on the photographic plates. The coordinates of the three fiels are reported in Tab. 1.

Table 1. NGP. Celestial (J2000.0) and galactic coordinates of the CCD fields

	α_c	δ_c	l_{II}	b_{II}
I.	$12^h\,46^m\,10^s$,	$28°\,47'\,14''$	157°.68	87°.97
II.	$12^h\,49^m\,37^s$,	$31°\,32'\,03''$	127°.97	85°.58
III.	$12^h\,35^m\,01^s$,	$32°\,04'\,04''$	157°.79	83°.91

The CCD frames were reduced utilizing standard packages; bias subtractions and flat-field corrections were handled with MIDAS (Grøsbol & Ponz 1985), and image centering and instrumental magnitudes with DAOPHOT 2.0 in MIDAS (Stetson 1987). The final transformation to the Johnson-Cousins standard system used a version of the code SNOPY developed at ESO, properly modified to run on CCD data (Mitton 1992).

The average precision of the standard sequences derived here is, for both regions, better than 0.05 mag for V, $B-V$, and $V-R_c$.

2.1. The galactic plane field

The BVR$_c$ CCD frames specifically taken for the photometric calibration of the GPR were calibrated using, as in-situ standards, those stars in Krzeminski & Serkowski (1967) within the $11' \times 11'$ field covered by the CCD (Table 2).

These standards are all too bright ($V \leq 12.22$) for a direct calibration of the frames down to $V \simeq 18$. To bridge the magnitude gap we took frames of different exposures (1, 2, 10, 60 sec in R; 2, 4, 20, 120 sec in V; 4, 8, 40, 240 sec in B) using field stars as standards for the deeper frames. Krzeminski and Serkowski only provide UBV photometry. Therefore, we had to calculate R$_c$ magnitudes from spectral types, E(B–V), and V magnitudes as given in Krzeminski & Serkowski (1967), the (V–R$_c$)$_0$ intrinsic colors from Table 7 (p.311) of Straizys (1992), and the ratios of red to blue reddening E(V-R$_c$)/E(B-V) as published by Taylor (1986) (see Table 2).

Table 2. GPR. Primary photometric calibrators

K-S No.	V	$B-V$	$V-R_c^*$
32	12.04	+0.94	+0.69
35	10.66	0.47	0.40
38	12.22	0.76	0.60
49	9.42	0.59	0.54
54	10.95	0.95	0.55
57	10.33	0.58	0.86
58	10.00	0.49	0.44

* Synthetic color (see text).

As a check on the accuracy of the synthetic red magnitudes, we looked at the (V–R$_c$) vs. (B–V) plot of the CCD-based colors. Fig. 1 shows the CCD colors (dots) and, superimposed (solid line), the sequence obtained using the intrinsic BVR$_C$ color data in Straizys (1992). A part from the expected shift along the curve defined by the intrisinc colors (due to the strong interstellar absorption in this field), the observed colors have practically the same slope as that defined by the intrinsic colors. Again, this was expected as the selective reddening ratio E(V–R$_c$)/E(B–V) is about the same as the natural slope of the intrisic color sequence, and it shows that the R$_c$ calibration is consistent with the observed B and V magnitudes. Any systematic effect on the red magnitudes would manifest itself as a translation along the (V–R$_c$) axis.

2.2. The North galactic pole field

For each of the three CCD fields imaged in the direction of the NGP region, we proceeded in a way in all similar to that adopted for the GPR region. To bridge the magnitude range needed for a proper calibration of the photographic photometry, we took four series of exposures for

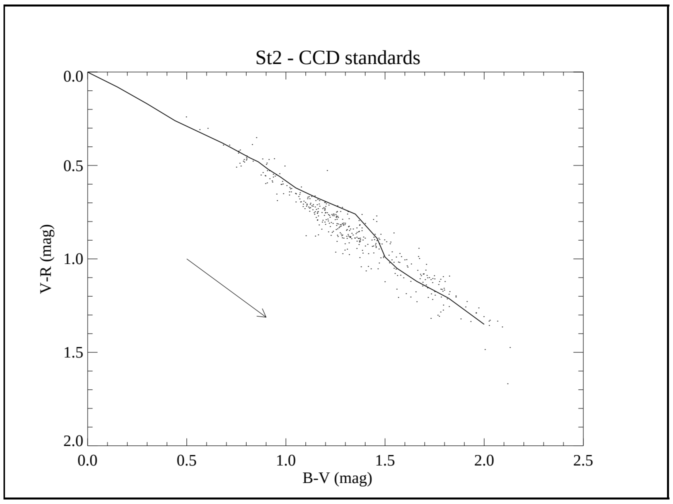

Fig. 1. GPR. Two-color diagram. The points show the colors as derived from the CCD data. The solid line represents the intrinsic colors of Straizys (1992), and the arrows the corresponding *intrinsic* slope

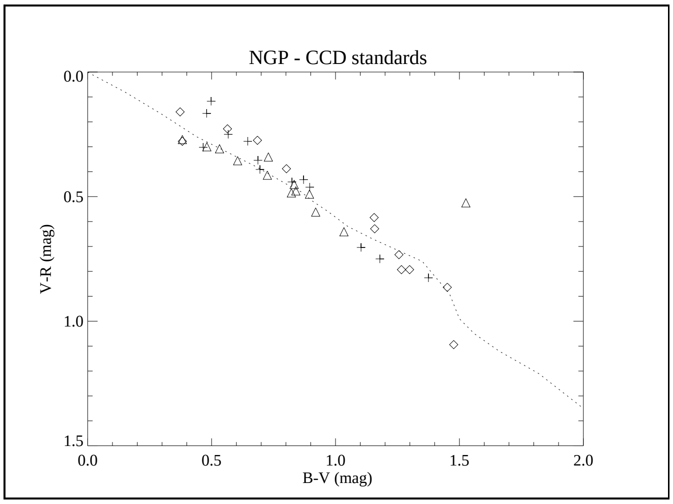

Fig. 2. NGP. Two-color diagram. Diamonds, crosses and triangles, show the colors as derived from the CCD data for central (I), North-East (II), North-West (III) field. The solid line represents the intrinsic colors of Straizys (1992).

each bandpass used: 1, 2, 10, 60 sec in R_c, 2, 4, 20, 120 sec in V, and 4, 8, 40, 240 in B.

The low star density and a noticeable variation of the telescope point-spread-function (PSF) across the chip suggested the use of aperture photometry, instead of PSF fitting (which was the method of choice for the low latitude field) for the derivation of the instrumental magnitudes. In particular, we used the growth curve technique (Stetson 1990; Da Costa 1992) for the determination of the optimal software aperture.

The transformation to the standard Johnson-Cousin system was done via the usual method of observing a set of primary photometric standard stars at different air masses throughout the same night. Stars[1] from Landolt (1992) in the magnitude range $12.116 \le V \le 15.530$, and in the color ranges $0.516 \le (B-V) \le 1.344$, $0.351 \le (V-R_c) \le 0.897$, were used.

The final list of CCD photometric standard stars was derived from the second and fourth exposure. In the magnitude range covered by both exposures, proper averaging was applied.

As for the GPR, Fig. 2 shows the color-color plot for NGP with superimposed Straizys' unreddened main sequence. Besides the reliability of the photometric calibration, this plot testifies, as expected, of the quite low reddening along this line of sight.

These CCD colors have been corrected for an offset of -4 and $+5$ hundredths of magnitude in $(B-V)$ and $(V-R_c)$ respectively. Such values are consistent with the external errors of the photographic photometry, calibrated using these CCD data, as derived from direct comparison with independent photometric catalogs (see Spagna et al. 1996a for details). These offsets can be interpreted as the expected effect of the propagation of the errors in the transformation from intrumental to standard magnitude and colors.

[1] Number 107-599, 107-602, 107-611, 107-612, 107-614, 113-233, 113-239, 113-241, 113-337, 113-339, 113-L1.

3. The faint photometric sequences

Photometric results, V, $(B-V)$, $(V-R_c)$, are presented in Tabs. 3-4. Table 3 contains 56 stars for the NGP region, and Tab. 4 lists 207 stars for the GPR. Each object is identified by two indexes: (1) $N_{\rm CCD}$, the identification number from the CCD frames (v. Tab. 1), and (2) $N_{\rm POSS}$, the identification number from the photographic survey which provided (α, δ) for the equinox J2000.

These data are available electronically via anonymous FTP at OTOAX2.TO.ASTRO.IT (193.205.67.42).

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Table 3. NGP: photometry and positions of the CCD standards in fields I, II, III

N_{POSS}	N_{CCD}	V (mag)	$B-V$ (mag)	$V-R_c$ (mag)	R.A. (J2000) h m s	Dec. (J2000) ° ′ ″
15372	7-I	14.387	0.646	0.278	12 45 51.9	+28 52 25
15323	9-I	16.685	1.375	0.826	12 45 56.0	+28 51 53
14666	10-I	16.060	0.896	0.462	12 46 00.3	+28 44 40
14480	11-I	17.259	1.179	0.750	12 46 00.4	+28 42 19
15219	12-I	18.063	0.879	0.608	12 46 01.0	+28 50 34
15099	15-I	16.614	0.466	0.302	12 46 11.0	+28 49 12
15039	16-I	15.901	0.687	0.354	12 46 11.9	+28 48 32
15005	17-I	18.048	0.747	0.633	12 46 13.3	+28 48 11
15084	18-I	15.134	0.480	0.166	12 46 13.8	+28 48 58
14974	19-I	16.319	0.824	0.441	12 46 16.8	+28 47 53
14846	20-I	16.787	0.498	0.117	12 46 20.1	+28 46 34
14820	21-I	16.473	1.103	0.704	12 46 20.6	+28 46 13
15236	22-I	17.821	0.763	0.049	12 46 23.7	+28 50 49
14903	23-I	14.914	0.871	0.432	12 46 24.2	+28 47 12
15221	25-I	16.608	0.567	0.250	12 46 29.1	+28 50 29
15368	26-I	18.283	0.592	0.194	12 46 31.6	+28 52 19
29250	2-II	14.601	0.725	0.414	12 49 11.5	+31 29 48
29618	4-II	15.807	0.920	0.562	12 49 22.4	+31 34 16
29792	5-II	18.075	1.010	0.598	12 49 23.9	+31 35 54
29106	6-II	17.997	0.786	0.638	12 49 23.6	+31 28 13
29796	7-II	17.229	0.481	0.300	12 49 29.5	+31 35 53
29861	8-II	17.959	0.398	0.210	12 49 29.9	+31 36 33
29915	9-II	16.790	0.729	0.341	12 49 30.0	+31 37 13
29377	10-II	15.489	1.034	0.641	12 49 34.5	+31 31 11
29462	11-II	14.826	0.895	0.490	12 49 34.7	+31 32 08
29590	13-II	18.399	0.109	0.435	12 49 35.2	+31 33 55
29528	14-II	18.059	1.047	0.929	12 49 36.2	+31 32 59
29274	15-II	18.589	0.650	0.359	12 49 38.0	+31 30 05
29360	16-II	16.199	0.840	0.477	12 49 39.4	+31 31 01
29729	17-II	16.194	0.822	0.485	12 49 42.2	+31 35 18
29288	18-II	18.346	0.930	0.640	12 49 42.0	+31 30 13
29771	19-II	14.014	0.532	0.308	12 49 42.9	+31 35 37
29337	20-II	12.821	0.833	0.451	12 49 42.6	+31 30 41
29102	21-II	18.107	0.595	0.381	12 49 42.7	+31 28 09
29286	22-II	16.777	0.605	0.356	12 49 45.5	+31 30 08
29567	23-II	18.295	1.446	1.072	12 49 51.7	+31 33 36
29827	24-II	18.171	0.812	0.556	12 49 52.6	+31 36 10
29779	26-II	16.259	0.382	0.271	12 49 59.0	+31 35 38
32338	2-III	13.845	0.802	0.388	12 34 43.3	+32 04 49
31858	3-III	15.138	1.158	0.629	12 34 45.0	+31 59 30
32255	5-III	15.160	1.256	0.733	12 34 52.5	+32 04 01
32153	7-III	18.095	0.247	0.527	12 34 54.4	+32 02 50
32128	8-III	17.257	1.477	1.094	12 34 57.0	+32 02 35
32094	10-III	16.931	0.373	0.160	12 34 58.0	+32 02 18
32183	11-III	14.023	0.564	0.228	12 35 03.3	+32 03 08
32313	12-III	16.499	0.685	0.274	12 35 05.7	+32 04 40
32233	13-III	15.675	1.156	0.584	12 35 07.0	+32 03 48
32320	15-III	16.791	0.382	0.278	12 35 09.6	+32 04 45
32471	18-III	17.957	0.559	0.053	12 35 14.0	+32 06 22
32571	19-III	18.238	1.138	0.468	12 35 14.5	+32 07 29
32562	20-III	18.289	0.577	0.120	12 35 17.4	+32 07 22
32350	21-III	15.627	1.299	0.793	12 35 18.0	+32 05 05
32318	23-III	18.208	1.523	0.963	12 35 18.4	+32 04 48
32552	24-III	16.773	1.266	0.793	12 35 19.2	+32 07 17
32567	25-III	14.975	1.451	0.864	12 35 19.9	+32 07 20
32560	26-III	18.177	0.411	0.906	12 35 21.1	+32 07 21

Table 4. St2: photometry and positions of the CCD standards

$N_{\rm POSS}$	$N_{\rm CCD}$	V (mag)	$B-V$ (mag)	$V-R_c$ (mag)	R.A. (J2000) h m s	Dec. (J2000) ° ′ ″
196031	42	14.972	0.978	0.601	2 13 03.3	+59 37 34
195795	51	12.048	0.904	0.487	2 13 07.1	+59 37 19
191885	72	16.318	1.723	1.100	2 13 04.1	+59 34 34
200559	82	17.938	1.906	1.257	2 13 03.2	+59 41 10
195745	92	15.268	1.170	0.718	2 13 04.0	+59 37 20
192099	112	17.593	1.714	1.101	2 13 04.4	+59 34 43
200189	122	16.331	0.901	0.494	2 13 03.9	+59 40 51
200788	150	14.861	1.263	0.813	2 13 13.0	+59 41 21
201656	180	15.513	1.162	0.731	2 13 14.6	+59 42 01
191283	190	15.116	2.029	1.328	2 13 17.0	+59 34 09
189113	210	14.882	1.573	1.019	2 13 20.5	+59 32 28
190185	222	14.874	1.136	0.718	2 13 07.8	+59 33 13
193357	241	13.260	1.774	1.121	2 13 23.2	+59 35 31
201579	301	13.078	0.914	0.468	2 13 26.6	+59 41 59
192569	302	16.776	0.906	0.528	2 13 08.6	+59 35 05
198401	311	12.237	0.762	0.423	2 13 27.5	+59 39 29
198273	330	15.751	1.203	0.705	2 13 32.0	+59 39 23
193355	341	13.089	1.959	1.288	2 13 34.1	+59 35 42
199083	350	15.656	0.968	0.544	2 13 35.4	+59 40 03
199029	362	16.536	1.160	0.748	2 13 09.0	+59 39 58
197012	370	14.918	1.167	0.706	2 13 38.3	+59 38 28
190972	372	17.250	1.144	0.761	2 13 10.1	+59 33 53
201135	380	15.934	1.797	1.157	2 13 39.4	+59 41 44
194478	382	17.446	1.090	0.691	2 13 10.1	+59 36 28
191957	411	15.143	1.208	0.527	2 13 46.0	+59 34 46
193945	412	15.783	1.051	0.652	2 13 10.6	+59 36 05
194479	431	12.212	0.801	0.458	2 13 48.6	+59 36 33
197202	440	15.659	1.794	1.247	2 13 48.7	+59 38 39
196749	451	11.293	0.802	0.449	2 13 50.0	+59 38 11
196955	452	17.126	1.109	0.678	2 13 11.3	+59 38 19
190076	462	17.215	1.253	0.777	2 13 12.2	+59 33 13
190414	472	17.972	1.285	0.872	2 13 12.5	+59 33 28
201459	490	15.715	0.800	0.471	2 13 53.0	+59 42 02
190696	511	10.946	0.565	0.308	2 13 57.9	+59 33 45
190919	512	17.786	1.695	1.080	2 13 12.8	+59 33 52
197678	520	15.748	1.271	0.828	2 13 59.6	+59 39 04
189886	542	16.652	0.882	0.465	2 13 13.6	+59 33 04
190544	551	12.209	1.122	0.708	2 14 02.0	+59 33 42
194564	572	17.760	1.263	0.778	2 13 13.6	+59 36 32
193821	611	13.873	1.196	0.729	2 14 08.0	+59 36 12
195927	622	17.015	1.472	0.896	2 13 14.0	+59 37 34
197505	632	17.720	1.242	0.761	2 13 13.9	+59 38 47
192257	652	16.786	1.857	1.198	2 13 14.6	+59 34 54
202457	660	15.415	1.118	0.728	2 14 17.3	+59 42 54
193212	662	17.688	1.197	0.697	2 13 14.5	+59 35 37
188592	671	15.121	0.851	0.351	2 14 23.3	+59 32 21
194728	712	17.820	0.985	0.599	2 13 15.3	+59 36 41
202552	721	13.297	0.917	0.528	2 14 25.5	+59 42 56
199262	730	14.897	0.760	0.434	2 14 26.0	+59 40 22
201375	770	15.324	1.028	0.623	2 14 28.5	+59 42 08

(Continued)

$N_{\rm POSS}$	$N_{\rm CCD}$	V (mag)	$B-V$ (mag)	$V-R_c$ (mag)	R.A. (J2000) h m s	Dec. (J2000) ° ′ ″
189506	772	17.646	1.357	0.834	2 13 16.4	+59 32 50
195147	791	13.761	1.673	0.998	2 13 04.4	+59 36 52
197443	800	14.087	1.235	0.768	2 13 04.6	+59 38 38
192886	820	15.826	0.830	0.388	2 13 07.8	+59 35 18
191997	832	17.941	1.239	0.760	2 13 17.5	+59 34 43
193946	860	15.167	1.544	1.018	2 13 13.5	+59 36 05
190476	862	16.440	0.834	0.477	2 13 17.7	+59 33 32
199670	892	17.434	1.339	0.840	2 13 17.2	+59 40 31
195606	900	14.973	1.022	0.625	2 13 26.2	+59 37 21
192108	920	15.807	1.574	0.971	2 13 29.0	+59 34 43
201889	970	14.596	0.750	0.509	2 13 40.2	+59 42 18
202609	972	17.217	0.930	0.582	2 13 18.6	+59 42 48
189806	981	12.146	0.874	0.551	2 13 44.6	+59 33 04
196068	982	17.683	1.157	0.710	2 13 19.5	+59 37 41
196848	1001	13.456	1.069	0.679	2 13 47.4	+59 38 18
190998	1002	17.783	1.593	1.101	2 13 20.6	+59 33 58
201364	1011	12.219	0.715	0.391	2 13 56.1	+59 41 54
193411	1041	12.532	0.802	0.465	2 14 02.1	+59 35 51
196563	1051	10.306	0.606	0.301	2 14 03.0	+59 38 03
197637	1052	17.066	1.391	0.883	2 13 21.9	+59 38 56
193358	1062	17.308	1.017	0.658	2 13 22.7	+59 35 43
193637	1070	15.345	1.748	1.090	2 14 04.0	+59 36 04
198836	1091	9.999	0.497	0.240	2 14 05.9	+59 39 47
193169	1101	13.782	0.953	0.653	2 14 06.4	+59 35 44
200932	1121	14.094	2.118	1.668	2 14 10.3	+59 41 42
192134	1171	15.082	1.770	1.137	2 14 23.2	+59 35 04
191624	1192	17.907	1.752	1.194	2 13 25.9	+59 34 29
191915	1201	13.516	1.913	1.228	2 13 11.2	+59 34 34
199935	1211	15.492	0.941	0.464	2 13 41.5	+59 40 48
202536	1212	16.581	1.599	1.005	2 13 26.0	+59 42 45
192644	1221	11.784	0.684	0.391	2 13 49.2	+59 35 03
200395	1240	15.083	1.135	0.737	2 13 25.7	+59 41 08
195422	1332	15.347	1.705	1.060	2 13 29.5	+59 37 12
188690	1432	17.689	1.098	0.698	2 13 33.3	+59 32 15
189079	1512	17.214	1.248	0.790	2 13 34.9	+59 32 33
192192	1522	17.320	1.284	0.810	2 13 34.7	+59 34 55
193451	1592	17.887	1.739	1.217	2 13 36.3	+59 35 52
201228	1652	16.801	1.823	1.255	2 13 37.3	+59 41 50
198139	1702	17.520	1.451	0.925	2 13 39.8	+59 39 24
195798	1732	17.611	1.332	0.863	2 13 40.8	+59 37 34
198988	1742	17.788	1.308	0.843	2 13 40.7	+59 40 06
198987	1762	16.914	1.186	0.793	2 13 40.8	+59 39 59
192702	1822	16.720	1.353	0.865	2 13 42.5	+59 35 21
196451	1882	15.542	1.253	0.843	2 13 46.7	+59 38 04
190594	1892	17.610	1.374	0.905	2 13 47.3	+59 33 46
200185	1902	17.844	1.306	0.879	2 13 46.8	+59 41 03
200588	1912	17.540	1.492	0.986	2 13 47.3	+59 41 22
192995	1962	17.584	1.435	0.933	2 13 48.3	+59 35 35
190323	1992	17.705	1.258	0.746	2 13 49.4	+59 33 35
191223	2062	17.406	1.129	0.666	2 13 51.2	+59 34 15

(Continued)

N_{POSS}	N_{CCD}	V (mag)	$B-V$ (mag)	$V-R_c$ (mag)	R.A. (J2000) h m s	Dec. (J2000) ° ′ ″
191256	2112	17.606	1.123	0.726	2 13 52.4	+59 34 18
198578	2172	16.829	1.017	0.641	2 13 53.1	+59 39 48
200862	2192	16.046	0.936	0.562	2 13 53.7	+59 41 37
198991	2202	17.919	1.185	0.731	2 13 54.1	+59 40 08
190375	2222	14.991	1.208	0.753	2 13 55.5	+59 33 36
201365	2292	16.548	1.750	1.107	2 13 57.3	+59 42 00
196834	2302	17.594	1.348	0.889	2 13 59.2	+59 38 27
199506	2332	17.394	1.260	0.839	2 13 59.8	+59 40 33
200974	2482	17.607	1.695	1.080	2 14 01.6	+59 41 44
197641	2502	16.919	1.019	0.617	2 14 02.7	+59 39 05
198430	2512	15.696	0.884	0.538	2 14 03.2	+59 39 41
199112	2522	14.353	2.024	1.333	2 14 03.2	+59 40 13
190888	2532	16.368	0.936	0.547	2 14 04.0	+59 34 03
202227	2542	17.953	1.443	0.884	2 14 03.5	+59 42 40
189755	2672	17.158	1.822	1.189	2 14 08.3	+59 33 13
198032	2692	15.163	1.429	1.053	2 14 08.2	+59 39 24
196952	2772	17.153	1.366	0.855	2 14 11.3	+59 38 34
194430	2782	13.952	1.740	1.105	2 14 11.6	+59 36 39
193911	2802	15.936	1.106	0.711	2 14 12.7	+59 36 18
199062	2812	14.931	0.790	0.482	2 14 12.4	+59 40 14
202049	2822	17.152	1.074	0.695	2 14 12.6	+59 42 34
201814	2912	17.498	1.404	1.064	2 14 13.7	+59 42 22
196673	2932	17.481	1.223	0.827	2 14 14.2	+59 38 22
197454	2972	17.192	1.257	0.788	2 14 15.5	+59 38 59
202657	3022	17.002	1.369	0.852	2 14 16.4	+59 43 02
192196	3062	17.682	1.211	0.787	2 14 18.1	+59 35 06
198881	3292	15.140	1.147	0.747	2 14 25.0	+59 40 08
201538	3312	17.315	0.918	0.571	2 14 25.1	+59 42 13
200736	3322	17.629	1.299	0.809	2 14 25.3	+59 41 39
198108	3342	17.800	1.026	0.641	2 14 26.5	+59 39 33
194351	3382	17.364	1.183	0.803	2 14 27.1	+59 36 42
199556	3492	17.405	1.120	0.678	2 13 05.0	+59 40 24
196757	3532	16.880	1.110	0.670	2 13 06.6	+59 38 08
190929	3562	17.896	1.218	0.809	2 13 08.4	+59 33 51
196538	3652	15.938	1.076	0.694	2 13 11.3	+59 37 59
200665	3662	16.779	1.213	0.797	2 13 11.2	+59 41 17
198024	3692	17.665	1.689	1.145	2 13 12.1	+59 39 12
195343	3722	17.890	1.824	1.092	2 13 13.4	+59 37 06
196667	3752	17.089	1.260	0.772	2 13 14.1	+59 38 07
190077	3822	17.191	1.441	0.931	2 13 19.2	+59 33 15
201962	3852	16.738	1.690	1.125	2 13 19.7	+59 42 18
192231	3862	16.549	1.632	1.027	2 13 21.6	+59 34 54
199933	3892	15.451	1.255	0.821	2 13 21.2	+59 40 43
202980	3922	17.807	1.297	0.816	2 13 22.3	+59 43 06
200211	3962	17.731	1.678	1.082	2 13 23.3	+59 40 58
195719	3982	16.491	0.952	0.550	2 13 23.9	+59 37 26
195485	3992	16.358	1.251	0.762	2 13 24.2	+59 37 15
191404	4012	16.293	1.676	1.106	2 13 25.2	+59 34 17
197469	4022	17.631	1.195	0.698	2 13 25.2	+59 38 48
193087	4032	16.548	1.124	0.702	2 13 26.0	+59 35 34

(Continued)

$N_{\rm POSS}$	$N_{\rm CCD}$	V (mag)	$B-V$ (mag)	$V-R_c$ (mag)	R.A. (J2000) h m s	Dec. (J2000) ° ′ ″
192607	4162	14.886	2.067	1.333	2 13 29.8	+59 35 12
191402	4212	17.273	1.826	1.175	2 13 32.3	+59 34 18
193354	4222	17.588	0.975	0.601	2 13 32.7	+59 35 36
201193	4282	17.443	1.318	0.914	2 13 33.5	+59 41 46
189623	4302	16.162	1.146	0.663	2 13 36.3	+59 32 58
200586	4342	17.468	1.442	0.968	2 13 38.4	+59 41 20
197214	4382	17.039	1.478	0.994	2 13 39.5	+59 38 37
201134	4412	16.789	1.562	1.089	2 13 40.0	+59 41 34
193217	4442	17.897	1.308	0.890	2 13 43.2	+59 35 45
192645	4522	16.849	1.277	0.825	2 13 48.4	+59 35 19
196912	4552	16.192	1.288	0.815	2 13 51.2	+59 38 26
190841	4562	17.233	1.791	1.173	2 13 52.1	+59 33 58
192215	4632	17.764	1.273	0.817	2 13 56.6	+59 35 03
195196	4682	17.924	2.130	1.474	2 13 58.6	+59 37 11
192221	4692	17.448	1.375	0.897	2 13 59.1	+59 35 04
189403	4732	17.395	1.324	0.885	2 14 01.6	+59 32 54
198018	4752	16.486	0.932	0.589	2 14 01.1	+59 39 24
197675	4762	17.940	1.857	1.204	2 14 01.2	+59 39 08
199701	4782	17.959	1.959	1.290	2 14 02.7	+59 40 44
193329	4822	17.595	1.357	0.884	2 14 04.5	+59 35 54
189691	4832	17.983	1.932	1.335	2 14 04.9	+59 33 09
190006	4862	17.317	1.048	0.649	2 14 06.2	+59 33 22
202183	4872	16.246	1.196	0.735	2 14 05.5	+59 42 38
198838	4892	16.133	1.499	1.122	2 14 06.2	+59 40 03
194436	4932	17.080	1.114	0.722	2 14 09.0	+59 36 41
196744	4952	17.072	1.567	1.017	2 14 09.6	+59 38 24
202788	4972	17.400	1.219	0.767	2 14 09.6	+59 43 08
199943	4992	17.667	1.285	0.788	2 14 11.2	+59 40 58
199593	5012	17.518	1.388	0.899	2 14 11.5	+59 40 41
194642	5042	14.673	1.731	1.111	2 14 13.9	+59 36 46
202424	5052	17.410	1.119	0.745	2 14 13.9	+59 42 54
193755	5082	16.866	1.313	0.869	2 14 16.4	+59 36 12
192996	5142	16.860	1.237	0.810	2 14 18.2	+59 35 40
195562	5172	17.618	1.291	0.889	2 14 19.0	+59 37 32
197058	5242	16.454	1.103	0.718	2 14 23.7	+59 38 40
196601	5252	15.906	1.318	0.825	2 14 23.7	+59 38 19
197315	5272	17.805	1.167	0.818	2 14 24.4	+59 38 53
198256	5282	16.971	0.905	0.593	2 14 24.4	+59 39 40
197710	5352	15.965	1.064	0.666	2 14 26.7	+59 39 14
195931	5402	16.528	0.897	0.597	2 14 28.0	+59 37 51
188876	5432	15.758	1.116	0.667	2 13 02.9	+59 32 13
200949	5442	16.927	1.611	1.037	2 13 03.8	+59 41 28
201655	5482	16.602	1.780	1.109	2 13 07.3	+59 42 00
190726	5502	17.443	1.802	1.121	2 13 08.7	+59 33 43
201457	5592	16.914	1.181	0.752	2 13 30.0	+59 41 57
194588	5612	15.710	1.692	1.081	2 13 31.7	+59 36 37
200499	5702	16.050	1.614	1.044	2 13 52.5	+59 41 18
188775	5712	17.803	1.275	0.746	2 13 57.4	+59 32 24
192313	5752	17.579	1.400	0.931	2 14 03.9	+59 35 08
202378	5782	17.344	1.198	0.754	2 14 22.3	+59 42 53

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$N_{\rm POSS}$	$N_{\rm CCD}$	V (mag)	$B-V$ (mag)	$V-R_c$ (mag)	R.A. (J2000) h m s	Dec. (J2000) ° ′ ″
202551	5792	16.342	1.095	0.731	2 14 26.3	+59 42 47
196293	5812	17.501	1.087	0.707	2 14 28.1	+59 38 08
201256	5842	14.357	1.453	0.917	2 13 10.7	+59 41 42
192771	5892	17.191	1.069	0.655	2 13 25.3	+59 35 18
199967	5902	16.802	1.358	0.905	2 13 29.6	+59 40 48
198837	5952	17.993	1.379	1.042	2 14 04.7	+59 39 59
192670	5962	17.968	1.629	1.204	2 14 20.9	+59 35 28

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