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CCD PHOTOMETRY OF THE OLD OPEN CLUSTER M67

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ABSTRACT

We present a CCD photometric survey of the central one-half degree of the old open cluster, M67, in U, B, V, and I colors to magnitude $V=20$. Extensive comparison of our photometry with other published datasets shows excellent agreement, indicating that CCD photometry is capable of producing a uniform set of measurements consistent with the photometric system defined primarily by the Landolt standard sequence. The color–magnitude diagram of the cluster shows a well-defined main sequence extending at least to the limit of the photometry at $M_V=10.55$ and a substantial binary sequence. At least 38% of cluster stars are binaries. The current generation of theoretical isochrones cannot be fit to the observed sequences within the observational errors. We find a tendency for more massive members of the cluster to be more centrally concentrated, along with a turnover in the cluster luminosity function at low masses, which may be due to dynamical relaxation of the cluster. To the limit of our photometry, we find a mass of the cluster of 724 solar masses. In addition, we present a sample of stars of well-determined standard magnitudes that are suitable as photometric standards for further studies of this cluster and for general calibration of *UBVI* photometry using CCDs.

1. INTRODUCTION

With the exception of the Hyades and the Pleiades, few open clusters are as well studied as M67. It is easy to understand why. Not only is it a rich cluster, but its location, within 1 kpc of the Sun in a direction of low reddening and at high enough galactic latitude to minimize confusion with background stars, makes it possible to study its members from the giant branch to the lower main sequence with relative ease. In addition, its metallicity and its age, according to numerous determinations (most recently, Nissen *et al.* 1987; Gilliland & Brown 1992), are close to the accepted values for the Sun. The population of M67 thus serves as a paradigm sample for studies of the structure and evolution of Population I solar-age stars, just as the Hyades and Pleiades do for younger objects, and both the ensemble of stars in the cluster and its individual members have received considerable attention. Recent investigations of M67 have focused on its giants (Janes & Smith 1984), blue stragglers (Mathys 1992; Gilliland & Brown 1992; Mathieu & Latham 1986), spectroscopic binaries (Mathieu *et al.* 1990), and on stars which display low-amplitude solar-type oscillations (Gilliland & Brown 1988). Since the advent of CCDs, M67 has taken on additional utility as a convenient calibration field for *BVRI* photometry (Schild 1983), since a good range of colors can be imaged on a single frame near the central "dipper asterism" of the cluster.

Over the years, a number of broadband photometric surveys of the M67 region have been undertaken, most notable among them the pioneering photoelectric work of Johnson & Sandage (1955), Eggen & Sandage (1964), and the deep photographic work of Racine (1971). Racine noted that his photometry yielded "the most precise C–M diagram ever obtained for an old star cluster." His diagram show a clearly delineated main sequence and a giant branch, a photometric binary sequence 0.75 mag above the main sequence, and an absence of a notable white-dwarf sequence down to the limits of his photometry.

Two decades have passed since the last large-scale photometric survey of M67 was published, however, and certain developments suggested to us the usefulness of covering the region once again. One prime factor, of course, was the advent of CCDs, whose sensitivity and linearity have already been put to good use in deep studies of globular clusters. The depth, completeness, and consistency of existing photometry, it seemed evident, could be improved through systematic CCD imaging of the cluster, reduced by modern digital processing techniques. In the years since Racine's publication, Landolt's photoelectric *UBVRI* standards (Landolt 1983; Landolt 1973) have become de facto standards for broadband photometry, and though the accuracy of the published photometry is quite good in retrospect when compared with Landolt reference stars (Taylor & Joner 1985), no single study covers the cluster center exhaustively. Therefore a new deep survey with a single instrument seemed likely to produce a sample which could serve as a consistent standard reference for future research. Further, recent proper motion studies of the cluster (Girard *et al.* 1989; Sanders 1977) brought forth the need for photometry of those stars to which kinematic membership could be assigned yet which had not been included in earlier photometric studies.

Our objective, therefore, was to produce a deep *UBVI* survey of a region a half a degree on a side centered on the dipper asterism of M67, calibrated by the Landolt *UBVRI* standards, with associated equatorial coordinates and cross references to previous surveys, which would be useful for the future study of individual objects in the cluster. This new photometry would also be immediately applicable for comparison with theoretical isochrones, and for the investigation of the binary content, spatial distribution, and luminosity function of the cluster. The scope of our survey was limited primarily by the size of our detectors (512 $\times$512 chips were the largest available at the time) and the amount of observing time available. The resulting photometry should, in short, give us a fresh look at an old cluster.

2. PHOTOMETRY

2.1 Observations

Observations were conducted using the Tektronix 512 $\times$512 CCD camera (the "Tek 2") on the 1 0.9 m telescope at Kitt Peak National Observatory on three nights spanning 1990 February 15–18 (UT). Except for the last hour of the final night, when high cirrus clouds moved in, the weather was exceptionally clear with seeing of 1–2 arcsec. The telescope was used with the $f/7.5$ secondary, producing an image scale of 0.77 arcsec/pixel (for 27 μ pixel) and a full field of 6.6 arcmin. In order to cover the entire central half-degree of the cluster, the field surrounding the central dipper asterism was partitioned into 25 overlapping fields, with centers offset north–south or east–west from each other by 5 arcmin to form a 5$\times$5 mosaic whose center frame included the asterism. During the 1990 spring run, all but 5 of the 25 fields were imaged.

A standard KPNO *UBVRI* filter set was used, the *U* filter consisting of a UG 2 with a copper-sulfate red block, the *B*, *V*, and *R* filters being the Harris set, and the *I* filter, the "nearly Mould." The procedure for each field was to take four 60 s exposures in *V* and *I*, four 120 s exposures in *B*, and one 900 s exposure in *U*. A series of images of the central field were taken several times each evening, both as a test of the internal repeatability of the measurements, and to provide a sequence of standard stars from which transformation and extinction corrections could be provided. In addition, a half-dozen or more standard stars from Landolt's (1983) list were observed several times a night over a wide range of airmasses (1.0 to at least 1.5) as a fundamental calibration source. Altogether, counting individual frames of Landolt objects and standard stars in the central field, about 100 standards were observed each night. A series of dome and skyflats were obtained every evening as well.

Additional observations were carried out on 1990 November 26/27 (UT) using a Tektronix 1024 CCD mounted on the KPNO 0.9 m telescope, the same telescope as used for the February run, now repositioned in a different dome a hundred feet to the east. The weather was clear and seeing was about 2 arcsec. Again the telescope was used at $f/7.5$, making the image scale 0.68 arcsec/pixel (24 μ pixel) and the full field of view 11.68 arcsec.

Two fields were imaged using the same *U*, *B*, and *V* filters as during the February run. A series of 60 and 120 s exposures were taken through the *B* and *V* filters, and a single 900 s exposure through the *U* filter. These two frames covered most of the area missed in the February run, and overlapped considerably the area already covered. Due to lack of time, no *I* frames were taken, nor were any standard stars outside the cluster observed.

One year later, on 1991 November 29 and 30, we obtained a few 15 s *I* images and 20 s *V* images using the same filters and configuration on the 0.9 m telescope as above, and a Tektronix 2048 CCD detector (T2K2) with 24 μ pixel giving a field of view of 23.36 arcmin. We used the short exposure images to get photometry on stars which were saturated on the longer exposure frames.

Preliminary processing of all CCD frames, to apply bias and flatfield corrections, was done with standard routines in the IRAF software package. For each evening, at least 20 flatfield exposures were available in each filter, *U*, *B*, *V*, *R*, and *I*, from dome illumination, and at least three frames each in *U*, *B*, and *V* using sky illumination. All well-exposed flatfield exposures in each filter were combined using the "avsigclip" procedure in IRAF. The dome flats were applied to all images, but for the *U*, *B*, and *V* images, the dome flats left slight residual patterns due presumably to the illumination or color balance problems. The IRAF sky illumination procedure was used with the sky frames to correct this problem. No residual patterns can be seen on the images.

The photometric reductions were made with a software package, SPS, developed at Boston University and the University of Hawaii (Janes & Heasley 1993). The SPS program is similar to several other photometry programs in using a point-spread-function (PSF) fitting procedure to calculate the magnitudes of all stars on a CCD image. Once a model PSF is computed, based on the observed image profiles of the brighter, relatively isolated stars on the frame, a map of the cross-correlation function between the PSF and the original image is used to identify all measurable stars on the frame. The magnitudes of stars in the list are computed by fitting the position and scale of the PSF to each star image in turn, in order of decreasing brightness. Once they have been measured, stars are subtracted to form an image of the residuals, which can be examined manually or searched automatically for additional stars. The zero point of the frame is set during the PSF calculation, through aperture photometry of the stars used to calculate the PSF. Extensive tests and comparisons of the SPS program are discussed by Janes & Heasley

(1993). These tests show that the program gives results consistent with those from other existing software packages.

2.2 Transformations

Instrumental magnitudes for all measured stars were transformed to a standard system using fitting coefficients derived from observations of standard stars whose magnitudes have been well established in earlier studies. Our primary source of standard stars was the venerable list of equatorial standards compiled by Landolt (1983). For additional local standards on our cluster images, we chose stars in the dipper asterism near the center of M67, calibrating our instrumental magnitudes against published values from Joner & Taylor (1990) for $V-I$ and values of $B-V$ from Schild (1983). Both Joner and Taylor and Chevalier & Ilovaisky (1991) have noted a systematic error in Schild's V magnitudes of 0.04 mag, a value we confirmed from our data. We found no systematic error in Schild's values for $B-V$, however, and therefore included them as $B-V$ standards in the cluster. Neither Schild nor Joner and Taylor listed values for U.

Transformation coefficients between instrumental and standard magnitudes were determined using the following equations, which are based on the discussion by Harris *et al.* (1983). In the following equations u, b, v, and i are the instrumental magnitudes, U, B, V, and I are the standard magnitudes, and X is the airmass.

$$v=V+a_1+a_2X+a_3(B-V)+a_5(B-V)^2, \quad (1)$$

$$b=V+b_1+b_2X+b_3(B-V)-0.03X(B-V)+b_5(B-V)^2, \quad (2)$$

$$u=B+c_1+c_2X+c_3(U-B)+c_5(U-B)^2, \quad (3)$$

$$i=V+d_1+d_2X+d_3(V-I)+d_5(V-I)^2. \quad (4)$$

The derived coefficients are given in Table 1. The observing run in February is listed as nights 1–3 and the run in November is listed as nights 4 and 5. The zero points were derived independently for each night. Mean extinction coefficients were calculated for the observing run in February and were assumed for the run in November. The color terms and the color-squared terms are the means of all the nights within each observing run. It was found that the color-squared terms for the November observing run did not significantly improve the solutions. Note that for the November observing run a different CCD was used from the February run, which accounts for the differing zero points.

The standard deviations of the magnitudes of the stars used in transforming to the *UBVI* system for the February observing run were 0.015 in V, 0.013 in B, 0.018 in U, and 0.012 in I. Since independent standard star fields were not observed in the November run, 54 stars in common with both November and February datasets were used as internal standards for that run. Standard magnitudes for these stars were taken from the transformed February data. The standard deviations of fit for these 54 stars in the November data were 0.021 in V, 0.022 in B, and 0.030 in U. The slightly higher standard deviations are a result of using much fainter stars than are normally used as standard stars. I frames were not taken in November.

TABLE 1. Transformation coefficients.

	a	b	c	d
Feb. 1				
1	4.5904±0.0045	4.5988±0.0044	6.2722±0.0087	5.4348±0.0037
2	0.1748±0.0086	0.2799±0.0083	0.5025±0.0534	0.0693±0.0086
3	-0.0028±0.0115	0.9922±0.0116	1.0786±0.0421	-0.9657±0.0093
5	0.0264±0.0082	-0.0150±0.0081	-0.0755±0.0451	-0.0404±0.0078
Feb. 2				
1	4.6145±0.0045	4.6159±0.0045	6.3711±0.0079	5.4516±0.0037
2	0.1748±0.0086	0.2799±0.0083	0.5025±0.0534	0.0693±0.0086
3	-0.0028±0.0115	0.9922±0.0116	1.0786±0.0421	-0.9657±0.0093
5	0.0264±0.0082	-0.0150±0.0081	-0.0755±0.0451	-0.0404±0.0078
Feb. 3				
1	4.5985±0.0042	4.6203±0.0043	6.4070±0.0077	5.4545±0.0036
2	0.1748±0.0086	0.2799±0.0083	0.5025±0.0534	0.0693±0.0086
3	-0.0028±0.0115	0.9922±0.0116	1.0786±0.0421	-0.9657±0.0093
5	0.0264±0.0082	-0.0150±0.0081	-0.0755±0.0451	-0.0404±0.0078
Nov. 1				
1	4.0222±0.0095	4.1966±0.0106	6.0482±0.0076	—
2	0.1500±0.0000	0.2700±0.0000	0.5700±0.0000	—
3	0.0599±0.0099	0.9879±0.0110	0.9754±0.0123	—
5	—	—	—	—
Nov. 2				
1	4.0237±0.0137	4.1565±0.0134	6.0602±0.0168	—
2	0.1500±0.0000	0.2700±0.0000	0.5700±0.0000	—
3	0.0599±0.0099	0.9879±0.0110	0.9754±0.0123	—
5	—	—	—	—

To check for systematic errors in the fit to standard magnitudes, the magnitudes and colors of the dipper asterism stars were compared to studies done by Eggen & Sandage (1964), Racine (1971), Schild (1983), Joner & Taylor (1990), Chevalier & Ilovaisky (1991), and Gilliland *et al.* (1991). The residuals as compared to the different datasets are shown in Tables 2(a)–2(d). They are of the form of our values minus their values. Also given are the means and standard deviations about the means for each set of residuals. To make a meaningful comparison between our dataset and Schild's data, the latter was first compared with the Joner and Taylor data. The residuals in V magnitude of the Joner and Taylor values minus the Schild values when plotted against V magnitude showed a linear correlation. Joner and Taylor noted this discrepancy in their paper, but did not attempt any correction of the Schild data. We choose to correct the Schild data by deriving a least-squares solution to the residuals yielding the following relation:

$$V_{\rm corr}=0.9843V_{\rm Schild}+0.1514. \quad (5)$$

Schild's magnitudes were then adjusted to fit this line. The brightest stars had very little correction, but the fainter stars had corrections of up to 0.056 mag. All the corrections were in the direction of increasing the brightness of Schild's magnitudes.

The residuals in Tables 2(a)–2(d) demonstrate that our magnitudes agree quite well with those found by Eggen and Sandage, Chevalier and Ilovaisky, and Joner and Taylor. We therefore consider those studies, and our own, to represent a single uniform photometric system which is in good agreement with the system defined by Landolt's work. The standard deviations are within the range expected when comparing two independent datasets each

TABLE 2. Dipper–asterism residuals.

Star	V Mag.	Schild	J & T	E & S	Racine	C & I	Gill.	Mean
F81	10.032	0.031	0.005	0.002	0.002	0.010	—	0.010
F117	12.595	-0.034	-0.035	-0.015	-0.035	-0.041	-0.035	-0.033
F124	12.130	0.022	0.012	-0.010	0.040	0.006	-0.010	0.010
F127	12.739	-0.027	-0.030	-0.031	-0.041	-0.026	-0.041	-0.033
F128	13.139	0.013	-0.013	-0.021	-0.021	-0.008	-0.021	-0.012
F129	13.159	-0.003	0.007	-0.031	-0.021	-0.015	-0.041	-0.017
F130	12.880	0.000	0.011	0.000	0.000	-0.004	-0.030	-0.004
F134	12.250	0.004	-0.006	-0.020	0.020	0.003	-0.020	-0.003
F135	11.433	-0.003	-0.003	-0.017	0.003	0.001	-0.017	-0.006
	mean	0.000	-0.006	-0.016	-0.006	-0.008	-0.027	-0.010
	σ	0.020	0.016	0.011	0.025	0.016	0.011	0.015

Star	B-V	Schild	E & S	Racine	C & I	Gill.	Mean
F81	-0.067	0.031	0.006	—	0.019	—	0.019
F117	0.788	-0.012	0.018	0.018	-0.006	-0.012	0.001
F124	0.458	-0.008	0.008	-0.002	0.000	-0.002	-0.001
F127	0.575	0.022	0.015	0.045	0.018	0.005	0.021
F128	0.578	0.001	-0.002	0.028	-0.002	-0.002	0.005
F129	0.591	-0.010	0.011	0.041	0.002	0.011	0.011
F130	0.466	0.017	-0.004	0.046	0.013	0.006	0.016
F134	0.579	-0.010	-0.001	-0.001	0.000	-0.011	-0.005
F135	1.067	0.016	0.007	-0.003	0.010	-0.023	0.001
	mean	0.005	0.006	0.022	0.006	-0.004	0.008
	σ	0.015	0.007	0.020	0.009	0.011	0.009

Star	V-I	Schild	J & T	C & I	Mean
F81	-0.049	0.019	0.019	0.019	0.019
F117	0.908	-0.004	0.007	0.016	0.006
F124	0.566	0.001	0.006	0.010	0.006
F127	0.665	-0.007	0.014	0.016	0.008
F128	0.694	0.000	0.066	0.040	0.035
F129	0.670	-0.066	0.009	-0.005	-0.021
F130	0.576	0.000	-0.004	0.022	0.006
F134	0.697	0.013	0.028	0.024	0.022
F135	1.082	0.013	0.029	0.023	0.022
	mean	-0.003	0.019	0.018	0.011
	σ	0.024	0.019	0.011	0.015

Star	U-B	E & S	Racine	Gill.	Mean
F81	-0.233	0.152	—	—	0.152
F117	0.249	-0.031	-0.031	-0.021	-0.028
F124	-0.012	-0.042	-0.102	-0.062	-0.069
F127	0.022	-0.038	-0.048	-0.028	-0.038
F128	0.066	0.016	0.006	0.046	0.023
F129	0.075	0.015	-0.025	0.002	0.002
F130	0.000	-0.005	-0.070	0.000	-0.025
F134	0.074	0.014	-0.016	0.034	0.011
F135	0.896	-0.024	-0.004	-0.024	-0.017
	mean	0.006	-0.036	-0.005	0.001
	σ	0.056	0.034	0.033	0.059

with their own internal errors. Our data also agree very well with Schild's data after correcting for the linear shift within the published data. The magnitude shift seen in the residuals of our data as compared to Eggen and Sandage's will also account for the shift in our data as compared to Racine's and Gilliland's since they used the Eggen and Sandage data as standards. The somewhat larger residuals of our data when compared to Racine are also expected because of the larger internal errors inherent in his photographic photometry. We note that star F106, I11, was not used in the comparison because it has a close neighbor which can be separated by PSF fitting, but not with traditional photoelectric photometry. Chevalier and Ilovaisky, who also used a CCD, left star F106 out of their calibration for the same reason. Other stars used in the comparison also had companions, but the magnitude difference or the separation between the two stars was large enough not to affect the comparison.

Instrumental magnitudes for all stars on our images were transformed to the *UBVI* system by using Eqs. (1)–(4) and the derived transformation and extinction coefficients. The photometry for all stars is listed in Table 3. Stars with a V magnitude greater than 12 are from our study, and stars with a V magnitude less than 12 are taken from published sources. The stars with photometry taken from other sources have star numbers enclosed in parentheses, and the source of the photometry can be found in Table 4. In Table 3 we have introduced a new numbering system to account for the faint stars which did not have previously published photometry. Our numbering system begins in the northwest corner of the survey, and is in approximate order of right ascension. In order to avoid confusion with previous numbering systems we have begun numbering from 5001. Star numbers followed with an asterisk correspond to stars which fall on the photometric binary sequence in the color–magnitude diagram (see Sec. *4.3*). CCD pixel coordinates were converted to equatorial coordinates using standard reference stars from Girard *et al.* (1989). The conversion process included corrections for curvature of the coordinate system, and possible variations in the orientation of the CCD frames. The rms error in the fit of the reference stars was 0.3 arcsec. Columns 2 and 3 give the right ascension and declination of each star for the 1950.0 epoch. Columns 4–7 give the magnitudes of each star as determined by this study. The last column, titled comments, gives cross references to other studies. The first number in the comments column corresponds to Sanders (1977), a number preceded by a roman numeral comes from Eggen & Sandage (1964), a number preceded by a F comes from Fagerholm (1906), and numbers preceded with a G refer to Gilliland *et al.* (1991).

For the sake of completeness and to account for stars which were saturated on the CCD frames, the photometry for stars with a V magnitude less than 12 was compiled from previously published sources and from several short exposure frames obtained in 1991 November. A list of these stars is given in Table 4, and they are also identified in Table 3 by parentheses around the star number. The stars for which the photometry is listed to a thousandth of a magnitude are based on V and $V-I$ magnitudes determined using short exposures on images taken in 1991 November, and transformed to the standard system by using the previously determined photometry. The sources for the published data in column 7 are the following: ES for Eggen & Sandage (1964), JS for Janes & Smith (1984), G for Gilliland *et al.* (1991), M for Murray *et al.* (1965), and S for Sanders (1989). In order to facilitate easy cross referencing between our photometry and previous published photometry, Table 5 lists Sanders' number and the corresponding MMJ No. for each star in common. (A complete version of Tables 3–7 can be received by sending e-mail to kent@hyades.bu.edu.)

TABLE 3. Photometry.

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
(6469)	8 46 51.02	12 02 45.0	9.53	1.38	—	1.33	258, table 4	5031	8 47 47.02	12 10 06.1	15.368	0.501	-0.053	—	
(6470)	8 47 12.90	11 52 86.0	9.84	1.36	—	1.30	364, table 4	5032	8 47 47.07	12 09 44.2	19.334	1.501	—	—	
(6471)	8 47 27.70	12 02 45.0	8.86	1.59	—	1.67	488, table 4	5033	8 47 47.84	12 02 42.4	15.532	0.667	0.126	0.810	
(6472)	8 47 34.04	12 06 34.9	9.98	1.10	—	1.09	494, table 4	5034	8 47 49.00	11 54 57.0	17.118	1.011	0.805	1.233	
(6474)	8 47 36.12	12 32 30.0	10.52	1.23	—	1.15	676, table 4	5035	8 47 49.66	11 47 20.1	19.424	1.110	0.655	1.192	
5001	8 47 44.81	11 59 37.9	19.400	1.475	—	—		5036	8 47 48.57	12 01 36.5	18.132	1.252	1.076	1.455	
5002	8 47 45.00	11 57 28.4	19.868	1.458	—	2.184		5037	8 47 49.90	11 47 18.9	19.537	0.981	0.589	1.265	
5003	8 47 44.38	12 04 43.5	16.814	1.078	1.086	—		5038	8 47 48.50	12 05 10.9	19.445	0.889	—	—	
5004	8 47 44.65	12 01 44.6	18.133	1.416	—	1.692		5039	8 47 49.12	12 00 16.9	14.422	0.656	0.122	0.763	
5005	8 47 45.47	11 53 28.3	17.502	0.619	0.026	—		5040	8 47 49.41	11 59 46.8	19.561	1.072	—	1.293	
5006	8 47 45.44	11 55 34.6	20.222	1.407	—	2.038		5041	8 47 50.31	11 51 11.4	12.629	0.594	0.065	0.703	
5007	8 47 44.56	12 06 25.4	18.576	1.407	—	—		5042	8 47 49.76	11 57 40.6	12.856	0.531	0.025	0.665	
5008	8 47 45.14	12 01 02.1	20.369	0.513	-0.218	0.848		5043	8 47 48.60	12 12 30.1	19.198	1.603	—	—	
5009	8 47 44.77	12 06 13.9	19.670	0.706	—	—		5044	8 47 48.85	12 10 06.9	16.571	0.619	0.054	—	
5010	8 47 46.45	11 48 32.8	18.064	0.532	-0.114	0.670		5045	8 47 50.58	11 51 49.2	20.636	0.852	—	0.957	
5011	8 47 45.19	12 04 03.2	20.702	0.052	-1.101	—		5046	8 47 50.17	11 57 48.8	18.491	1.396	0.871	1.827	
5012	8 47 46.55	11 48 53.1	16.856	0.839	0.281	0.984		5047	8 47 50.54	11 56 38.5	15.650	0.860	0.497	0.944	
5013	8 47 46.23	11 53 27.6	16.540	0.927	0.691	—		5048	8 47 49.98	12 05 25.6	18.305	1.406	—	—	
5014	8 47 45.48	12 02 32.8	19.444	1.179	—	1.399		5049	8 47 50.83	11 56 10.1	20.215	1.498	—	2.497	
5015	8 47 46.12	11 55 13.7	19.496	0.928	—	1.192		5050	8 47 51.49	11 49 07.0	19.918	1.217	—	1.765	
5016	8 47 46.43	11 53 41.3	17.033	1.034	0.892	—		5051	8 47 51.70	11 48 51.7	15.234	0.782	0.342	0.895	
5017	8 47 45.61	12 03 28.9	21.239	0.200	—	—		5052	8 47 52.01	11 48 21.4	16.200	0.982	0.776	1.065	
5018	8 47 46.19	12 00 35.4	20.721	0.507	—	—		5053	8 47 52.10	11 48 13.3	18.715	1.525	—	1.908	
5019	8 47 45.86	12 04 41.9	18.858	0.670	0.176	—		5054	8 47 50.17	12 10 28.8	18.144	0.669	0.184	—	
5020	8 47 46.59	11 56 33.9	19.731	0.647	—	—		5055	8 47 51.00	12 01 49.6	20.176	0.257	-0.379	0.591	
5021	8 47 46.10	12 05 24.1	18.162	0.769	0.114	—		5056	8 47 50.73	12 05 08.3	17.047	1.191	1.234	—	
5022	8 47 47.14	11 54 32.5	19.132	1.371	—	2.008		5057	8 47 50.99	12 03 39.5	18.428	1.219	—	—	
5023	8 47 46.84	12 02 32.3	16.895	1.134	1.089	1.298		5058	8 47 50.93	12 06 26.0	17.174	0.571	-0.215	—	
5024	8 47 48.16	11 50 25.1	19.207	1.196	—	1.383		5059	8 47 52.01	11 54 30.2	12.712	0.913	0.555	0.966	
5025	8 47 46.95	12 04 41.4	17.165	1.167	1.114	—		5060	8 47 52.58	11 58 21.5	15.442	0.835	0.426	0.898	
5026	8 47 47.28	12 04 05.6	17.126	1.102	0.968	—		5061	8 47 52.49	12 00 10.2	13.025	0.574	0.049	0.700	
5027	8 47 48.30	11 53 57.9	19.534	0.642	-0.064	0.812		5062	8 47 52.83	11 56 31.5	20.163	1.379	—	2.077	
5028	8 47 47.10	12 08 11.6	18.277	0.842	0.538	—		5063	8 47 52.63	11 59 19.6	19.198	1.614	—	2.008	
5029	8 47 48.48	11 52 46.7	20.722	0.642	—	—		5064	8 47 52.66	11 59 15.2	14.632	0.813	0.369	0.877	
5030	8 47 47.66	12 02 32.7	18.319	1.136	0.937	1.361		5065	8 47 51.45	12 13 39.9	16.683	1.229	—	—	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
5066	8 47 53.55	11 50 31.9	18.873	0.478	-0.111	0.621		5101	8 47 54.53	12 08 06.2	18.350	1.497	—	—	
5067	8 47 51.53	12 13 38.8	14.040	0.879	0.676	—		5102	8 47 56.05	11 50 44.8	20.696	0.630	-0.065	1.098	
5068	8 47 52.09	12 09 04.4	15.475	0.679	0.063	—		5103	8 47 55.62	11 57 04.4	19.095	1.613	—	1.950	
5069	8 47 53.54	11 52 36.2	18.431	1.516	1.025	—		5104	8 47 56.02	11 52 45.2	19.394	0.980	0.503	1.167	
5070	8 47 51.72	12 13 33.5	19.232	1.158	—	—		5105	8 47 56.41	11 48 39.5	18.599	1.533	—	1.819	
5071	8 47 53.60	11 52 39.5	18.482	1.593	1.128	2.463		5106	8 47 56.07	11 52 47.8	19.324	1.087	0.554	1.021	
5072	8 47 52.68	12 03 06.9	19.475	0.955	—	—		5107	8 47 56.22	11 52 04.9	17.779	1.390	1.154	—	
5073	8 47 54.24	11 46 47.9	16.906	0.811	0.381	0.918		5108	8 47 56.25	11 52 08.2	17.824	1.339	1.212	1.615	
5074	8 47 52.69	12 05 18.7	14.465	0.760	0.297	—		5109	8 47 55.58	12 00 32.5	19.018	1.033	0.799	1.370	
5075	8 47 52.99	12 02 09.8	15.234	0.617	0.039	0.733		5110	8 47 56.23	11 53 38.4	20.004	1.616	—	2.189	
5076	8 47 52.95	12 02 48.3	17.243	1.252	1.181	1.479		5111	8 47 56.39	11 53 23.7	14.042	0.590	0.046	—	
5077	8 47 52.94	12 02 46.3	17.241	1.217	1.217	—		5112*	8 47 56.99	11 49 05.4	18.093	1.542	1.088	1.908	
5078	8 47 52.52	12 07 57.8	18.982	1.404	—	—		5113	8 47 57.07	11 50 02.0	19.300	0.712	-0.026	0.900	
5079	8 47 53.70	11 56 48.8	16.669	1.092	0.977	1.217		5114*	8 47 57.17	11 49 14.5	18.749	1.474	0.966	2.080	
5080	8 47 53.33	12 01 06.3	20.683	1.105	—	0.913		5115	8 47 57.07	11 50 53.1	20.599	0.629	—	0.718	
5081	8 47 53.87	11 55 01.8	19.010	1.435	—	1.630		5116	8 47 55.48	12 09 46.5	15.734	0.851	0.565	—	
5082	8 47 53.92	11 55 38.3	16.330	0.992	0.828	1.114		5117	8 47 55.84	12 07 11.7	19.984	1.552	—	—	
5083	8 47 52.55	12 12 37.6	19.819	0.773	—	—		5118	8 47 56.63	11 59 00.8	12.818	0.521	-0.005	0.653	
5084	8 47 52.63	12 12 36.4	16.149	0.918	0.783	—		5119	8 47 55.65	12 10 18.5	16.756	0.641	0.018	—	
5085	8 47 54.05	11 56 35.4	17.260	1.257	1.169	1.430		5120	8 47 56.18	12 04 41.6	19.608	1.456	—	—	
5086	8 47 54.41	11 53 59.1	17.866	0.763	0.307	0.975		5121*	8 47 56.97	11 56 46.9	19.147	1.480	—	2.186	
5087	8 47 53.05	12 11 39.1	15.918	0.767	0.373	—		5122	8 47 56.39	12 05 13.6	17.311	1.183	1.300	—	
5088	8 47 53.55	12 06 49.2	19.693	1.709	—	—		5123	8 47 57.91	11 48 08.3	12.647	0.685	0.175	0.796	
5089	8 47 53.71	12 05 54.8	14.760	0.705	0.223	—		5124	8 47 57.44	11 55 43.3	12.374	0.746	0.209	0.872	
5090	8 47 54.42	11 57 50.3	15.415	0.832	0.424	0.910		5125	8 47 56.94	12 04 08.3	19.689	1.110	—	—	
5091	8 47 55.27	11 48 42.0	18.339	0.676	0.141	0.843		5126	8 47 58.34	11 48 08.6	16.116	0.967	0.715	1.113	
5092	8 47 54.57	11 58 07.5	19.407	1.523	—	1.416		5127	8 47 56.51	12 10 25.0	18.938	0.510	-0.274	—	
5093*	8 47 54.74	11 58 09.7	15.427	0.902	0.500	1.026		5128	8 47 56.39	12 12 41.3	15.305	0.560	-0.027	—	
5094	8 47 53.93	12 11 21.5	19.781	1.497	—	—		5129	8 47 56.88	12 07 30.0	15.731	0.886	0.617	—	
5095	8 47 54.52	12 04 46.6	15.276	0.618	0.049	—		5130	8 47 57.22	12 03 45.1	17.815	1.292	—	—	
5096	8 47 55.64	11 52 29.3	18.151	1.513	1.212	—		5131	8 47 57.21	12 05 03.1	17.840	1.006	1.003	—	
5097	8 47 55.83	11 50 40.5	20.124	1.695	—	2.256		5132	8 47 58.45	11 51 04.6	13.411	0.562	0.032	0.693	
5098	8 47 55.68	11 52 32.3	18.185	1.516	1.182	2.324		5133	8 47 57.29	12 05 19.3	18.716	1.509	—	—	
5099	8 47 54.25	12 09 16.4	15.352	0.622	0.097	—		5134	8 47 57.38	12 05 46.9	17.269	1.173	1.317	—	
5100	8 47 54.70	12 04 33.2	18.006	0.540	-0.066	—		5135	8 47 56.83	12 12 34.5	17.603	0.609	0.086	—	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
5136	8 47 59.00	11 48 59.4	19.569	1.530	—	2.307		5170	8 48 02.38	11 50 04.2	19.879	0.900	0.290	0.694	
5137	8 47 58.00	12 03 10.7	20.497	0.249	—	—		5171	8 48 01.18	12 06 34.4	17.863	1.258	—	—	
5138	8 47 58.10	12 04 57.9	17.868	0.820	0.488	—		5172	8 48 01.29	12 06 50.3	15.851	0.907	0.676	—	
5139	8 47 59.54	11 49 19.5	18.170	1.378	1.245	1.620		5173	8 48 01.28	12 07 18.0	17.573	1.219	—	—	
5140	8 47 58.31	12 03 41.7	16.843	1.090	1.010	—		5174	8 48 01.67	12 03 17.1	14.426	1.029	0.929	—	
(6473)	8 47 59.49	11 47 04.8	11.57	0.68	—	—	590, table 4	5175	8 48 01.03	12 11 04.0	18.397	1.414	—	—	
5141	8 47 59.87	11 47 04.7	19.030	0.341	—	—		5176	8 48 00.89	12 13 18.8	18.059	1.321	—	—	
5142	8 47 59.95	11 47 45.3	19.114	1.385	—	2.008		5177	8 48 01.56	12 05 56.5	16.780	1.179	1.127	—	
5143	8 47 58.25	12 07 35.2	16.289	0.670	0.142	—		5178	8 48 03.26	11 48 59.8	20.313	1.302	—	1.496	
5144	8 47 59.57	11 53 01.7	16.984	0.817	0.386	-2.523		5179	8 48 02.17	12 03 31.5	15.009	0.799	0.340	—	
5145	8 47 58.25	12 08 31.5	19.587	1.555	—	—		5180	8 48 02.96	11 54 43.6	16.361	0.632	-0.008	0.749	
5146	8 47 58.39	12 07 33.7	16.021	0.575	-0.060	—		5181	8 48 03.04	11 54 08.3	14.154	0.594	0.064	0.727	
5147	8 47 59.94	11 50 11.9	19.224	0.848	0.546	1.036		5182	8 48 02.07	12 05 45.8	13.668	0.622	0.089	—	
5148	8 47 58.46	12 08 55.1	20.237	1.470	—	—		5183	8 48 01.78	12 13 12.8	13.448	0.536	0.002	—	
5149	8 47 59.58	11 56 40.6	16.479	1.059	0.872	1.170		5184	8 48 02.62	12 04 12.6	14.823	0.736	0.240	—	
5150	8 47 58.30	12 12 31.8	17.905	0.859	0.543	—		5185	8 48 02.85	12 02 19.0	18.424	0.612	—	0.869	
5151	8 47 59.92	11 54 02.5	15.695	0.872	0.548	0.953		5186	8 48 02.61	12 05 07.4	15.353	0.802	0.420	—	
5152*	8 47 59.78	11 55 44.8	14.105	0.734	0.224	0.858		5187	8 48 04.03	11 49 29.6	18.469	0.840	0.346	1.002	
5153	8 48 00.15	11 54 37.2	16.752	0.928	0.488	1.101		5188	8 48 02.64	12 05 51.5	19.625	1.348	—	—	
5154	8 47 59.58	12 01 45.0	19.229	1.373	—	1.344		5189	8 48 03.49	11 56 37.2	13.915	0.569	0.014	0.680	
5155	8 47 59.97	11 58 28.5	20.063	0.632	-0.201	1.178		5190	8 48 03.75	11 53 47.6	18.681	1.408	—	1.983	
5156	8 47 58.95	12 11 08.5	19.802	1.249	—	—		5191	8 48 03.55	11 56 05.6	12.700	0.482	-0.023	0.627	
5157*	8 48 01.05	11 47 18.4	15.688	1.007	0.689	1.162		5192*	8 48 03.54	11 56 24.6	16.598	1.137	0.966	1.356	
5158	8 48 00.92	11 48 46.0	12.080	0.778	0.321	0.876		5193	8 48 02.91	12 03 47.8	16.148	0.858	0.612	—	
5159	8 48 00.78	11 51 20.6	16.375	1.055	0.860	1.145		5194	8 48 04.04	11 51 36.6	16.183	0.953	0.718	1.143	
5160	8 48 00.81	11 51 23.5	16.371	1.035	0.877	1.142		5195	8 48 04.07	11 51 38.9	16.171	0.963	0.679	1.106	
5161	8 47 59.76	12 06 43.7	17.996	0.757	0.262	—		5196	8 48 03.52	11 59 07.7	13.598	0.551	-0.005	0.678	
5162	8 48 01.68	11 49 10.8	19.968	1.159	-0.157	1.265		5197	8 48 03.40	12 00 36.7	19.662	1.469	—	1.409	
5163	8 47 59.62	12 13 31.8	19.950	1.671	—	—		5198	8 48 04.55	11 50 02.5	19.426	1.513	—	1.518	
5164	8 48 00.13	12 10 39.7	14.493	0.582	-0.032	—		5199	8 48 03.08	12 08 52.9	18.424	1.003	—	—	
5165	8 48 01.98	11 50 02.8	17.653	0.671	0.066	0.794		5200	8 48 03.85	12 00 57.1	14.535	0.673	0.132	0.788	
5166	8 48 01.86	11 52 11.2	18.536	1.639	—	1.898		5201	8 48 03.64	12 05 33.3	20.194	0.491	—	—	
5167	8 48 01.90	11 52 13.6	18.508	1.560	1.002	1.867		5202	8 48 04.55	11 56 19.1	18.700	1.497	—	1.947	
5168	8 48 00.54	12 11 03.2	19.653	1.486	—	—		5203	8 48 03.84	12 06 02.5	14.140	0.602	0.066	—	
5169	8 48 02.00	11 54 21.7	13.117	0.542	0.027	0.682		5204	8 48 03.59	12 10 21.7	14.975	0.701	0.046	—	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
5205	8 48 05.45	11 51 50.9	19.646	1.451	—	1.578		5240*	8 48 07.62	12 00 42.1	18.315	1.512	1.021	2.047	
5206	8 48 05.34	11 53 38.8	18.825	1.330	—	1.391		5241	8 48 06.82	12 10 30.9	19.942	0.494	—	—	
5208	8 48 05.58	11 50 58.6	18.725	0.387	-0.122	0.627		5242	8 48 06.92	12 11 06.5	21.091	1.389	—	—	
5209	8 48 04.56	12 02 51.7	19.908	1.499	—	1.437		5243	8 48 08.19	11 56 17.9	14.693	0.632	0.230	0.778	753,I42
5210	8 48 05.40	11 53 40.1	17.690	1.223	—	1.218		5244	8 48 07.40	12 06 19.7	17.503	1.301	1.258	1.452	
5211	8 48 05.46	11 53 41.6	19.183	0.957	—	1.249		5245	8 48 08.01	12 00 00.0	19.378	1.031	0.324	1.129	
5212	8 48 05.14	11 57 29.4	18.187	0.702	0.116	0.897		5246	8 48 08.09	11 59 55.0	15.599	0.804	0.453	0.829	
5213	8 48 04.10	12 09 42.9	14.264	0.699	0.309	—		5247	8 48 08.04	12 01 39.6	18.564	1.570	—	2.759	
5214	8 48 04.07	12 11 01.8	15.467	0.833	0.423	—		5248	8 48 07.54	12 08 11.0	12.803	0.547	0.017	—	
5215*	8 48 05.99	11 50 06.0	17.966	1.474	0.951	1.901		5249	8 48 09.05	11 51 17.9	13.703	0.561	0.039	0.670	733
5216	8 48 05.58	11 55 14.3	16.488	1.067	0.927	1.245		5250	8 48 08.79	11 55 01.4	17.558	1.111	0.916	1.296	
5217	8 48 04.16	12 12 09.1	15.094	0.766	0.315	—		5251	8 48 08.86	11 54 28.2	16.929	0.891	0.552	0.954	
5218	8 48 04.35	12 10 12.2	17.334	0.715	0.132	—		5252	8 48 09.00	11 52 51.3	19.340	1.466	-0.059	1.299	
5219	8 48 04.34	12 11 24.0	12.797	0.553	-0.002	—		5253	8 48 08.15	12 03 06.9	19.685	0.707	0.144	0.976	
5220	8 48 05.67	11 57 26.5	19.262	0.511	-0.093	0.815		5254	8 48 07.44	12 11 40.0	13.469	0.557	0.012	—	
5221	8 48 05.04	12 04 54.7	19.827	1.409	—	—		5255	8 48 08.92	11 55 16.9	18.095	1.399	1.048	1.671	
5222	8 48 06.67	11 46 19.6	12.988	0.540	—	0.740		5256	8 48 07.63	12 10 26.9	19.557	1.449	—	—	
5223*	8 48 05.41	12 02 32.3	16.436	1.211	1.139	1.381		5257	8 48 09.31	11 51 57.3	13.726	0.609	0.051	0.737	
5224	8 48 06.88	11 47 33.5	18.799	1.319	1.376	1.572		5258	8 48 08.80	11 58 28.5	19.638	0.790	0.131	0.917	
5225	8 48 04.88	12 10 43.6	20.225	1.012	—	—		5259	8 48 09.83	11 46 59.4	17.434	1.111	—	1.310	
5226	8 48 04.82	12 11 40.6	18.638	1.382	—	—		5260	8 48 07.84	12 10 38.5	19.693	1.301	—	—	
5227	8 48 06.47	11 52 30.3	17.244	0.722	0.148	0.873		5261	8 48 09.25	11 54 54.3	14.380	0.709	0.229	0.800	746,I46
(6475)	8 48 05.72	11 46 24.5	11.24	1.10	—	1.07	721, table 4	5262	8 48 07.83	12 12 25.6	17.385	0.815	0.255	—	
5228	8 48 05.79	12 00 28.3	12.931	0.851	0.404	0.933		5263	8 48 09.04	11 58 49.6	13.285	0.575	0.062	0.692	760,I36
5229	8 48 05.50	12 05 39.4	14.055	0.578	0.035	0.687		5264	8 48 09.35	11 55 49.2	13.640	0.659	0.140	0.717	750,I44
5230	8 48 05.63	12 04 54.6	18.143	1.134	0.814	1.210		5265	8 48 08.98	12 01 02.3	15.415	0.811	0.387	0.888	
5231	8 48 07.00	11 58 47.3	18.562	1.467	—	1.881		5266	8 48 09.09	12 00 54.9	18.696	1.122	0.789	1.318	
5232	8 48 06.16	12 08 44.4	20.892	1.690	—	—		5267	8 48 08.33	12 10 04.2	16.057	0.917	0.802	—	
5233	8 48 06.43	12 06 46.6	16.196	0.998	0.858	1.072		5268	8 48 08.75	12 05 26.1	16.137	0.714	0.148	0.806	
5234*	8 48 07.09	12 01 25.2	18.409	1.443	—	1.933		5269	8 48 09.21	12 00 13.0	15.186	0.762	0.320	0.840	
5235	8 48 07.00	12 03 12.4	18.330	1.430	—	1.718		5270	8 48 08.85	12 05 27.2	17.203	0.783	0.537	0.880	
5236	8 48 08.08	11 50 56.0	18.165	0.529	-0.156	0.749		5271	8 48 10.05	11 52 44.1	15.361	0.630	-0.033	0.820	
5237	8 48 07.92	11 53 27.8	19.132	0.579	-0.135	0.817		5272	8 48 08.67	12 09 26.1	17.656	0.708	0.231	—	
5238	8 48 06.44	12 11 57.5	18.819	0.622	-0.190	—		5273	8 48 10.62	11 47 57.2	19.073	1.490	—	2.020	
5239	8 48 07.58	11 59 25.6	12.846	0.501	0.013	0.602		5274	8 48 09.88	12 03 13.0	19.676	1.543	—	2.263	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
5275	8 48 10.68	11 55 28.8	17.372	1.277	1.285	1.466		5309	8 48 12.76	12 04 46.6	19.245	1.526	—	2.567	
5276	8 48 09.63	12 08 02.0	14.551	1.071	1.045	—		5310	8 48 12.79	12 08 06.2	14.996	0.734	0.273	—	
5277	8 48 11.63	11 46 52.3	13.382	0.548	—	0.718		5311	8 48 13.41	12 02 01.7	18.454	1.023	-0.481	-0.837	
5278	8 48 09.57	12 11 39.5	17.160	0.781	0.486	—		5312	8 48 12.72	12 10 31.4	13.153	0.548	0.025	—	
5279	8 48 10.05	12 06 30.7	15.114	0.810	0.399	0.960		5313	8 48 14.33	11 53 26.3	13.361	0.733	—	0.766	741,I67
5280	8 48 11.64	11 47 56.9	19.581	0.458	—	0.682		5314	8 48 13.38	12 06 30.4	13.402	0.557	0.093	0.675	
5281	8 48 11.27	11 52 54.3	17.807	1.339	—	1.598		5315	8 48 13.07	12 10 20.9	18.709	0.783	0.143	—	
5282	8 48 09.69	12 11 52.5	15.301	0.815	0.419	—		5316	8 48 13.69	12 05 12.3	18.465	0.863	0.574	—	
5283	8 48 10.57	12 02 25.4	13.551	0.569	0.043	0.666		5317	8 48 14.32	11 59 22.5	15.696	0.902	0.636	0.956	764,I33
5284	8 48 10.12	12 07 44.4	12.844	0.522	0.019	—		5318	8 48 13.96	12 03 38.2	12.862	0.941	0.686	0.981	794,IV77
5285	8 48 10.07	12 11 48.5	16.277	1.019	0.876	—		5319	8 48 14.37	11 59 59.8	15.586	0.869	0.550	0.924	769,IV65
5286	8 48 12.13	11 47 52.5	19.372	1.477	—	1.801		5320	8 48 13.37	12 11 56.2	15.807	0.884	0.601	—	
5287	8 48 10.89	12 02 38.2	15.322	0.518	0.021	0.661		5321	8 48 13.62	12 09 43.2	20.700	0.713	—	—	
5288	8 48 11.01	12 01 32.7	19.026	1.003	—	1.188		5322	8 48 13.79	12 09 20.7	19.057	1.409	—	—	
5289	8 48 12.10	11 49 11.2	19.869	0.736	-0.090	0.941		5323	8 48 13.65	12 11 06.5	19.391	1.512	—	—	
5290	8 48 10.70	12 08 05.6	15.905	1.024	0.738	—		5324	8 48 14.18	12 05 11.2	19.577	1.423	—	2.292	
5291	8 48 11.72	11 57 08.7	18.708	1.527	—	1.941		5325	8 48 13.66	12 11 48.3	20.036	1.020	—	—	
5292	8 48 11.36	12 01 17.3	15.989	0.823	0.351	0.981		5326	8 48 14.37	12 04 07.6	19.682	1.577	—	2.293	
5293	8 48 12.60	11 47 39.0	20.146	0.083	-0.414	—		5327	8 48 13.85	12 10 16.4	16.108	0.613	0.094	—	
5294	8 48 12.50	11 49 24.4	14.098	0.602	—	0.708		5328	8 48 14.78	11 59 35.1	13.762	0.583	0.115	0.689	766,I34
5295*	8 48 12.12	11 56 30.6	16.280	1.128	1.089	1.313	I43	5329	8 48 14.82	12 00 12.6	17.929	1.420	-0.477	-0.120	
5296	8 48 12.44	11 52 34.9	18.319	1.345	—	1.525		5330	8 48 14.89	11 59 45.0	16.157	0.989	0.830	1.104	
5297	8 48 11.51	12 04 11.3	15.011	0.756	0.339	0.843		5331	8 48 14.06	12 09 30.4	14.548	0.625	0.113	—	
5298	8 48 12.58	11 52 30.0	17.795	1.088	0.956	1.206		5332	8 48 14.90	12 00 13.5	13.557	0.554	0.123	0.684	771,IV64
5299	8 48 11.16	12 09 42.4	18.779	1.548	—	—		5333	8 48 14.66	12 02 54.4	20.301	0.239	0.027	—	
5300	8 48 11.41	12 07 09.6	17.913	1.469	1.215	1.626		5334	8 48 15.13	11 57 28.3	13.488	0.627	0.126	0.735	758,I29
(6477)	8 48 11.49	12 03 30.3	12.04	0.60	—	0.671	792, table 4	5335	8 48 15.71	11 51 08.6	13.065	0.534	-0.001	0.676	731
5301	8 48 11.79	12 05 07.6	13.637	0.561	0.091	0.674		5336	8 48 15.74	11 50 38.5	12.964	1.107	0.912	1.218	729
5302	8 48 11.97	12 03 11.4	14.634	0.747	0.380	0.777		5337	8 48 14.92	12 00 15.9	16.382	1.045	0.858	1.105	
5303	8 48 11.28	12 11 59.8	15.501	0.828	0.464	—		5338	8 48 14.19	12 10 55.1	14.261	0.630	0.067	—	
5304	8 48 12.76	11 55 08.8	19.531	0.516	-0.048	0.598		5339	8 48 14.13	12 11 35.7	16.341	0.665	0.094	—	
5305	8 48 12.14	12 02 45.0	14.088	0.619	0.128	0.705		5340	8 48 15.57	11 55 23.0	14.632	0.829	0.449	0.874	748,I47
5306	8 48 12.51	12 01 10.6	14.652	0.688	0.263	0.777		5341	8 48 14.36	12 10 32.4	20.788	0.831	—	—	
5307	8 48 13.83	11 46 31.6	14.072	0.602	0.088	0.736		5342	8 48 14.97	12 07 52.5	13.265	0.575	0.005	—	
5308	8 48 11.82	12 10 30.5	20.290	0.482	—	—		5343	8 48 14.86	12 09 30.1	17.136	1.232	1.115	—	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
5344	8 48 15.53	12 02 27.8	19.829	0.278	0.360	0.561		5378	8 48 18.19	11 59 07.8	15.515	0.570	0.055	0.722	762,I30
5345	8 48 15.20	12 06 08.2	15.830	0.801	0.300	1.019		5379	8 48 17.56	12 07 22.0	17.165	0.649	0.054	0.777	
5346	8 48 15.64	12 02 28.6	14.823	0.698	0.308	0.818	785,IV58	5380	8 48 18.21	12 00 09.6	16.341	1.056	0.923	1.144	
5347	8 48 16.67	11 51 57.3	15.350	0.830	0.369	0.896	737	5381*	8 48 17.93	12 03 48.8	18.593	1.447	—	1.995	
5348	8 48 16.81	11 50 53.7	12.620	0.721	0.304	0.777	730	5382	8 48 19.32	11 47 30.4	19.133	1.641	—	1.918	
(6478)	8 48 16.81	12 12 40.6	11.52	0.70	—	—	838, table 4	5383	8 48 17.61	12 07 56.2	19.476	0.922	—	—	
5349	8 48 15.66	12 07 55.3	15.681	0.901	0.560	—		5384	8 48 18.15	12 02 16.6	17.315	1.139	1.089	1.358	
5350	8 48 15.96	12 05 48.0	12.782	0.813	0.396	0.893	806,IV81	5385	8 48 17.89	12 08 11.3	19.636	1.526	—	—	
5351	8 48 16.57	11 59 39.4	19.490	0.997	—	1.196		5386	8 48 18.23	12 06 38.2	15.774	0.934	0.680	1.009	
5352	8 48 16.14	12 04 56.2	19.943	1.681	—	1.434		5387*	8 48 18.62	12 02 41.7	14.562	0.862	0.472	0.971	787,IV57
5353*	8 48 17.71	11 47 02.6	17.288	1.321	1.063	1.617		5388	8 48 19.17	11 57 03.1	12.673	0.620	0.158	0.726	756,I25
5354	8 48 17.23	11 53 13.6	13.482	0.551	—	—	740,I66	5389	8 48 19.63	11 51 47.2	13.374	0.554	0.010	0.691	736
5355	8 48 16.20	12 05 20.7	17.176	1.254	1.206	1.375		5390	8 48 18.63	12 04 11.0	16.724	1.093	1.094	1.241	
5356	8 48 17.61	11 48 55.3	20.578	1.267	—	—		5391	8 48 18.81	12 03 41.8	14.997	0.741	0.342	0.852	795,IV55
5357	8 48 16.67	12 00 08.8	14.636	0.678	0.232	0.787	770,IV63	(6476)	8 48 19.43	11 56 18.3	11.32	0.295	—	0.379	752, table 4
5358	8 48 16.68	12 02 21.7	17.776	0.803	0.381	0.981		5392	8 48 19.52	11 57 33.1	16.169	0.747	0.277	0.828	759,I23
5359	8 48 17.23	11 55 51.1	19.284	1.102	—	0.994		5393	8 48 19.91	11 53 39.1	14.537	0.587	—	—	742,I65
5360	8 48 16.56	12 04 27.4	14.792	0.719	0.255	—	802,IV78	5394	8 48 18.58	12 10 13.8	16.272	0.934	0.771	—	
5361	8 48 17.77	11 51 15.0	19.912	0.563	—	1.644		5395	8 48 20.61	11 46 41.1	19.345	1.300	—	1.657	
5362	8 48 16.91	12 01 27.1	12.725	0.739	0.317	0.830	781,IV59	5396	8 48 18.62	12 11 37.1	14.280	0.893	0.730	—	
5363	8 48 17.09	11 59 37.4	16.754	1.123	1.095	1.258	I32	5397	8 48 19.36	12 02 56.6	17.176	1.239	1.299	1.405	
5364	8 48 17.46	11 55 44.3	19.105	1.381	—	1.524		5398	8 48 18.65	12 13 13.3	20.976	0.011	—	—	
5365	8 48 17.84	11 51 15.2	15.097	1.190	0.956	1.364	2201	5399	8 48 19.50	12 04 21.9	17.581	1.321	1.284	1.523	
5366	8 48 18.48	11 46 49.8	18.559	0.834	0.373	1.006		5400	8 48 19.67	12 02 55.5	18.726	1.536	—	1.832	
5367	8 48 17.44	11 59 06.2	13.522	0.573	0.142	0.720	761,I31	5401	8 48 20.98	11 47 34.6	20.514	1.453	—	1.902	
5368	8 48 16.56	12 09 34.4	19.561	1.480	—	—		5402	8 48 20.74	11 51 29.0	15.920	0.930	0.591	1.035	735
5369	8 48 17.36	12 00 49.8	16.783	0.537	—	1.320		5403	8 48 19.72	12 03 40.9	15.997	0.780	0.348	0.922	IV54
5370	8 48 17.42	12 00 43.3	14.742	0.740	0.372	0.886	2214,IV61	5404	8 48 20.21	12 02 04.2	17.801	1.234	1.274	1.364	
5371	8 48 17.41	12 00 50.4	12.687	0.631	0.167	0.711	775,IV60	5405	8 48 20.74	11 57 12.8	13.594	0.622	0.115	0.745	757,I24
5372	8 48 17.96	11 56 34.6	14.972	0.765	0.323	0.829	754,I26	5406	8 48 21.16	11 52 08.4	19.128	1.667	—	2.563	
5373	8 48 17.77	12 01 09.5	17.570	1.306	1.348	1.459		5407	8 48 20.81	11 57 12.1	19.568	0.222	—	—	
5374	8 48 17.28	12 07 31.6	18.807	0.730	—	—		5408	8 48 20.32	12 03 02.2	14.054	0.656	0.181	0.792	789,IV56
5375	8 48 17.15	12 09 19.7	19.745	1.385	—	—		5409	8 48 20.20	12 05 30.9	19.685	0.906	—	—	
5376	8 48 17.36	12 07 32.2	14.971	0.750	0.366	0.884		5410	8 48 20.59	12 00 52.2	15.687	0.948	0.625	1.041	IV38
5377	8 48 17.99	12 00 17.4	13.312	0.589	0.112	0.733	773,IV62	5411	8 48 20.04	12 09 52.0	19.729	1.431	—	—	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
5412	8 48 20.75	12 03 42.4	13.894	0.535	0.101	0.748	796,IV53	5446	8 48 22.08	12 12 56.4	19.892	1.310	—	—	
5413	8 48 21.11	12 00 50.5	13.763	0.566	0.115	0.718	776,IV37	5447	8 48 24.01	11 51 22.2	20.454	0.477	-0.272	—	
5414	8 48 21.69	11 55 02.5	14.052	0.703	0.215	0.787	747,I48	5448	8 48 24.38	11 46 34.0	19.595	1.564	—	1.805	
5415	8 48 20.33	12 10 55.5	19.601	1.395	—	—		5449	8 48 22.37	12 10 20.8	17.974	0.954	0.682	—	
5416	8 48 22.21	11 49 10.9	20.635	0.326	-0.480	0.788		5450	8 48 22.94	12 04 12.5	18.690	0.541	—	—	
5417	8 48 21.28	12 00 43.4	19.370	0.369	-0.049	0.717		5451	8 48 23.04	12 04 18.3	12.595	0.637	0.150	0.843	1077,IV51
5418	8 48 20.96	12 06 34.6	20.184	1.431	—	1.563		5452	8 48 22.80	12 09 52.9	17.286	1.175	1.110	—	
5419*	8 48 21.33	12 03 48.4	15.750	0.981	0.814	1.153	797,IV52	5453	8 48 22.70	12 11 01.4	16.983	1.098	1.137	—	
5420	8 48 20.95	12 09 14.7	19.153	1.382	—	—		5454	8 48 23.33	12 04 12.5	13.900	0.597	0.093	0.727	2224,IV50
5421*	8 48 22.40	11 52 49.1	18.492	1.521	1.142	1.965		5455	8 48 23.40	12 03 12.9	14.925	0.713	0.289	0.845	1067,IV39
5422	8 48 21.79	12 02 26.2	13.340	0.549	0.086	0.725	783,IV36	5456	8 48 24.00	11 57 02.8	18.124	1.480	1.133	1.691	
5423*	8 48 23.07	11 47 18.7	19.110	1.414	—	2.175		5457*	8 48 23.87	12 01 12.4	15.793	0.880	0.444	1.101	1042,IV33
5424	8 48 21.63	12 04 26.9	15.094	0.721	0.326	—	801,IV49	5458	8 48 24.04	11 59 59.0	17.149	1.394	1.279	1.850	
5425	8 48 21.02	12 11 50.1	19.308	0.542	-0.039	—		5459	8 48 24.03	12 01 01.1	15.565	0.822	0.479	0.927	1039,IV32
5426	8 48 23.14	11 47 05.9	14.137	0.592	0.025	0.742		5460	8 48 24.55	11 55 15.2	18.725	0.871	0.874	1.016	
5427	8 48 22.46	11 55 39.6	19.998	0.452	-0.143	—		5461	8 48 23.50	12 07 47.0	15.611	0.547	-0.088	—	
5428	8 48 21.00	12 13 04.8	17.708	1.348	—	—		5462	8 48 23.26	12 11 38.3	17.909	0.826	0.500	—	
5429	8 48 21.70	12 05 03.7	18.403	1.445	—	1.880		5463	8 48 25.12	11 50 03.7	19.289	0.532	-0.189	0.825	
5430	8 48 22.33	11 58 47.0	16.412	1.082	0.927	1.162		5464	8 48 24.56	11 57 28.2	13.430	0.560	0.084	0.689	990,I20
5431	8 48 22.91	11 52 27.0	16.504	1.243	—	—	I64	5466	8 48 24.37	12 00 49.4	17.316	1.242	0.998	1.458	
5432	8 48 22.90	11 53 04.4	15.609	0.950	—	—		5467	8 48 23.56	12 10 51.2	15.793	0.881	0.601	—	
5433	8 48 23.19	11 49 42.9	20.552	0.610	-0.154	0.899		5468	8 48 24.06	12 05 36.3	16.730	0.634	0.076	0.805	
5434	8 48 23.42	11 48 10.6	13.422	0.541	-0.012	0.695		5469	8 48 23.69	12 10 09.3	14.760	0.689	0.189	—	
5435	8 48 22.16	12 05 35.1	18.361	1.513	—	2.144		5470	8 48 23.99	12 06 52.3	15.771	0.896	0.677	1.003	1091,IV48
(6484)	8 48 23.70	11 59 25.7	11.55	0.41	—	0.514	1013, table 4	5471	8 48 24.42	12 02 09.6	13.795	0.586	0.090	0.699	1055,IV35
5436	8 48 23.70	11 48 59.6	19.656	0.796	-0.191	0.955		5472	8 48 24.54	12 00 48.0	14.848	0.716	0.111	0.821	
5437	8 48 23.07	11 56 59.7	15.864	0.770	0.284	0.917	983,I21	5473	8 48 25.43	11 51 00.5	20.197	0.856	-0.171	1.046	
5438	8 48 23.81	11 48 41.9	19.396	1.738	—	2.326		5474	8 48 24.79	11 59 54.2	13.994	0.717	0.277	0.796	
5439	8 48 22.23	12 07 47.4	20.112	0.510	—	—		5475	8 48 24.68	12 01 43.8	18.176	1.237	—	1.774	
5440	8 48 21.92	12 13 13.7	17.041	0.175	-0.592	—		5476	8 48 23.83	12 12 22.1	13.639	0.562	0.000	—	
5441	8 48 23.27	11 57 44.2	15.376	0.835	0.472	0.896	993,I22	5477*	8 48 25.91	11 48 44.1	16.935	1.341	1.210	1.548	
5442	8 48 23.96	11 49 42.4	19.817	1.049	—	1.484		5478	8 48 25.14	11 59 37.2	13.372	0.563	0.070	0.680	1017,I14
5443	8 48 24.11	11 48 40.4	20.214	1.271	—	1.453		5479	8 48 24.60	12 09 09.8	14.281	0.587	0.049	—	
5444	8 48 24.02	11 49 42.9	14.475	0.628	0.081	0.758	942	5480	8 48 25.03	12 04 30.8	17.644	1.306	1.295	1.547	
5445	8 48 22.32	12 10 00.0	20.652	0.826	—	—		5481	8 48 26.25	11 50 07.2	16.556	0.605	-0.060	0.798	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
5482	8 48 25.06	12 04 56.0	17.042	1.198	1.227	1.329		5518	8 48 28.13	11 58 31.6	15.107	0.777	0.340	0.883	1002,I13
5483	8 48 26.65	11 47 12.2	19.690	0.783	0.095	0.892		5519	8 48 26.93	12 12 48.3	17.457	0.886	0.544	—	
5484	8 48 24.90	12 08 16.6	14.581	0.648	0.134	—		5520	8 48 28.22	11 57 38.0	13.214	0.577	0.126	0.713	492
5485	8 48 25.84	11 57 33.5	14.564	0.684	0.215	0.796	991,I19	5521	8 48 27.52	12 06 51.1	17.839	0.800	0.301	0.940	
5486	8 48 26.39	11 51 20.2	19.009	1.222	—	1.365		5522	8 48 28.12	11 59 51.5	13.898	0.575	0.070	0.688	1021,I7
5487	8 48 24.72	12 11 30.4	19.554	0.412	-0.400	—		5523	8 48 28.34	11 58 23.0	17.764	1.368	1.255	1.687	
5488	8 48 26.27	11 56 24.9	18.389	0.935	0.557	1.121		5524	8 48 28.06	12 01 49.8	14.919	0.732	0.286	0.893	2222,IV23
5489	8 48 26.78	11 51 07.7	14.704	0.718	0.126	0.784	951,I158	5525	8 48 28.97	11 52 10.4	20.449	0.853	—	1.203	
5490	8 48 26.88	11 50 50.8	20.831	0.774	—	—		5526	8 48 27.93	12 05 57.1	15.315	0.810	0.385	0.874	1090,IV45
5491	8 48 27.06	11 48 57.9	20.410	1.409	—	2.401		(6492)	8 48 28.53	12 03 59.1	10.59	1.12	—	1.09	1074, table 4
5492	8 48 26.78	11 52 40.8	19.643	1.746	—	2.098		5527	8 48 28.56	11 59 23.1	16.683	0.745	0.217	0.829	
5493	8 48 25.43	12 10 25.6	13.785	0.551	-0.011	—		5528	8 48 28.10	12 04 53.2	16.595	0.792	0.324	0.882	
5494	8 48 25.44	12 10 29.6	13.594	0.560	0.009	—		5529*	8 48 28.16	12 04 12.4	16.424	1.212	1.148	1.390	
5495	8 48 25.95	12 04 42.3	19.124	1.103	—	1.265		5530	8 48 29.59	11 48 22.7	15.788	0.805	0.301	0.940	940
5496	8 48 27.06	11 53 10.7	20.712	1.103	—	2.943		5531	8 48 29.71	11 46 29.4	17.445	1.506	0.812	2.400	
5497	8 48 27.32	11 51 17.0	16.351	0.630	0.072	0.790	952,I157	5532	8 48 28.10	12 05 39.7	14.199	0.666	0.147	0.717	1089,IV44
5498	8 48 25.85	12 10 43.5	20.233	1.492	—	—		5533*	8 48 29.39	11 50 54.5	15.979	0.986	0.697	1.149	949,I59
5499*	8 48 26.79	12 00 15.6	16.025	1.077	0.998	1.223	1026	5534	8 48 28.54	12 01 51.4	13.664	0.568	0.084	0.694	1052,IV22
5500	8 48 26.53	12 04 43.2	16.585	1.095	1.049	1.180		5535	8 48 28.88	11 58 32.9	19.341	0.432	-0.022	0.790	
5501	8 48 26.47	12 05 50.8	16.369	1.030	0.913	1.134	IV46	5536	8 48 27.99	12 10 07.4	19.247	1.486	—	—	
5502	8 48 25.99	12 12 47.1	16.118	0.916	0.704	—		5537	8 48 28.71	12 03 09.7	19.186	1.438	—	1.912	
5504	8 48 27.32	11 58 27.6	18.450	1.503	—	2.139		5538	8 48 29.32	11 57 32.7	19.436	0.886	0.697	1.033	
5505	8 48 27.50	11 57 10.2	15.141	0.878	0.606	0.852	985,I18	5539	8 48 28.74	12 05 09.0	15.562	0.849	0.520	0.920	1085,IV43
5506	8 48 26.59	12 08 26.5	18.819	1.308	—	—		5540	8 48 28.93	12 05 24.1	20.501	0.613	—	—	
5507	8 48 27.42	11 59 59.5	18.081	1.052	1.081	1.196		5541	8 48 28.73	12 08 17.6	14.477	0.658	0.100	—	
5508	8 48 27.53	12 00 07.3	13.779	0.588	0.106	0.701	1025,IV9	5542	8 48 29.20	12 02 56.9	13.790	1.051	0.716	1.199	1063,IV25
5509	8 48 28.70	11 47 14.7	19.345	1.461	—	2.499		5543	8 48 30.08	11 53 18.6	19.934	2.184	—	1.165	
5511*	8 48 27.64	12 01 18.6	15.447	0.958	0.733	1.062	1044	5544	8 48 29.47	12 01 54.9	12.286	0.676	0.190	0.741	1053
5512	8 48 26.67	12 13 13.6	20.107	1.389	—	—		5545	8 48 30.16	11 53 57.2	19.511	0.902	—	1.043	
5513	8 48 27.07	12 08 37.6	15.798	0.841	—	—		5546	8 48 29.47	12 02 35.1	13.626	0.568	0.050	0.687	1061,IV24
5514	8 48 27.70	12 01 17.7	18.746	0.743	0.866	—		5547	8 48 29.59	12 01 15.6	14.333	0.537	0.021	0.683	1043,IV16
(6481)	8 48 27.72	11 56 38.8	10.03	-0.073	—	—	977, table 4	5548	8 48 28.96	12 09 09.7	16.921	1.143	1.038	—	
5515	8 48 28.20	11 55 32.0	19.847	0.959	—	0.799		5549	8 48 29.02	12 09 09.1	16.931	1.112	1.013	—	
5516	8 48 28.61	11 50 53.0	20.102	0.406	0.012	0.749		5550	8 48 30.11	11 58 30.5	18.518	1.476	—	1.807	G147
5517	8 48 27.92	11 59 43.4	14.867	0.726	—	0.805	2213	5551	8 48 30.42	11 55 53.3	15.341	0.824	0.348	0.873	2202

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
5552	8 48 30.42	11 55 57.7	15.742	0.903	0.576	0.960	974
5553*	8 48 29.83	12 02 46.1	18.314	1.677	—	1.964	
(6480)	8 48 30.30	11 56 17.3	11.078	0.43	—	0.534	975, table 4
5554	8 48 30.39	11 56 20.2	12.839	0.532	0.069	0.667	G501
5555*	8 48 30.88	11 50 49.6	17.413	1.421	1.166	1.653	
5556	8 48 30.47	11 55 52.3	19.632	1.186	—	0.625	
5557	8 48 30.59	11 56 41.0	18.745	0.788	0.299	0.983	G146
5558	8 48 29.70	12 08 51.2	15.217	0.813	0.232	—	
5559	8 48 30.30	12 01 57.2	13.409	0.584	0.077	0.683	2221,IV21,G59
5560	8 48 29.75	12 08 50.7	15.258	0.752	0.283	—	
5561	8 48 30.53	12 00 07.5	17.430	1.284	1.426	1.467	G128
5562	8 48 30.68	11 58 40.9	12.805	0.572	0.077	0.660	1003,I12,F93,G34
5563	8 48 30.71	12 00 16.8	15.377	0.848	0.472	0.897	1028,IV7,G98
5564	8 48 29.48	12 15 07.4	17.270	0.732	—	—	
5565	8 48 30.51	12 04 23.3	17.962	1.268	1.303	1.360	
5566	8 48 30.91	12 00 09.7	17.716	1.398	—	1.633	
5567	8 48 30.94	12 00 38.0	14.164	0.608	0.109	0.732	1033,IV8,G73
5568	8 48 30.24	12 10 26.7	17.401	1.305	—	—	
5569	8 48 31.72	11 53 55.0	20.187	1.449	—	1.196	
5570	8 48 32.25	11 48 15.0	19.638	1.650	—	2.293	
5571	8 48 31.36	11 58 48.4	12.651	0.517	0.043	0.607	1005,F95,G19
5573	8 48 31.22	12 01 31.3	12.823	0.565	0.081	0.680	1049,F94,G24
(6482)	8 48 31.96	11 56 40.8	9.72	1.37	—	1.36	978, table 4
5574	8 48 30.07	12 15 24.8	15.061	0.766	—	—	
5575	8 48 31.23	12 02 19.7	19.281	0.628	-0.106	0.832	G155
5576	8 48 30.28	12 14 39.9	18.150	1.124	—	—	
5577	8 48 31.59	11 59 32.6	14.321	0.520	-0.027	0.659	1015,I6,G84
5578	8 48 31.29	12 03 14.9	15.028	0.747	0.323	0.814	1068
5579	8 48 32.19	11 53 12.8	20.796	1.063	—	1.121	
5580	8 48 31.50	12 02 13.1	13.015	0.854	0.441	0.917	1056,IV221,G53
5581	8 48 30.91	12 09 54.8	13.909	0.531	-0.183	—	
5582	8 48 30.52	12 15 15.9	17.598	1.409	—	—	
5583	8 48 32.24	11 55 49.8	13.491	0.630	0.045	0.707	973,I49
5584	8 48 31.43	12 05 30.9	19.118	1.650	—	2.090	
5585	8 48 30.99	12 10 41.1	18.856	1.225	—	—	
5586	8 48 31.59	12 04 15.7	12.831	0.567	0.109	0.685	1076,IV30
5587	8 48 32.83	11 51 28.1	20.396	1.636	—	1.195	
5588	8 48 31.66	12 05 20.7	15.474	0.856	0.539	0.944	1086,IV42
5589	8 48 33.29	11 46 30.7	16.902	1.170	1.030	1.291	
5590	8 48 32.41	11 57 24.4	19.817	1.581	—	2.192	G167
5591	8 48 32.65	11 56 46.4	12.418	0.734	0.280	0.848	2206,I228,G17
5593	8 48 31.41	12 12 52.7	20.362	0.416	—	—	
5594	8 48 32.77	11 56 58.6	14.160	0.708	0.254	0.814	981,I227,G79
5595	8 48 33.18	11 53 53.5	14.513	0.706	0.167	0.791	963
(6486)	8 48 33.00	11 59 33.1	10.30	1.26	—	1.23	1016, table 4
5596	8 48 33.01	11 56 39.2	16.612	1.658	—	—	
5597	8 48 32.66	12 01 56.0	13.173	0.578	0.068	0.685	2220,IV19,G44
5598	8 48 33.68	11 49 27.4	18.548	1.513	—	1.784	
5599*	8 48 32.75	12 00 55.7	16.182	1.179	1.037	1.284	IV10,G117
5600	8 48 33.61	11 50 53.2	13.562	0.567	0.056	—	948,I162
5601	8 48 32.38	12 05 32.1	13.549	0.621	0.194	0.701	1088,IV41
(6489)	8 48 32.90	12 02 03.4	11.20	1.08	—	1.08	1054, table 4
5602*	8 48 32.96	11 59 43.7	17.410	1.394	—	1.617	
5603	8 48 32.86	12 01 26.4	13.173	0.557	0.079	0.652	G45
5605	8 48 31.66	12 15 35.6	18.335	1.390	—	—	
5606	8 48 33.91	11 48 55.5	17.564	1.320	—	1.460	
5608	8 48 33.30	11 57 20.2	13.928	0.574	0.098	0.724	987,G65
5610	8 48 33.27	11 58 17.6	13.060	0.567	0.044	0.667	998,I11,F106,G44
5611	8 48 33.41	11 56 45.7	16.643	1.453	—	—	
5612	8 48 32.47	12 07 55.5	17.838	1.623	—	—	
5614	8 48 32.95	12 03 22.0	17.470	1.352	1.307	1.508	
5615*	8 48 33.69	11 55 46.5	15.371	0.887	0.371	1.090	972,I50
5616	8 48 34.13	11 50 43.5	20.658	0.899	—	—	
5617	8 48 32.46	12 11 45.5	18.708	0.183	-0.608	—	
5618	8 48 34.25	11 50 59.8	18.593	1.339	1.165	1.654	
5619	8 48 32.41	12 13 14.5	20.042	0.726	—	—	
5620*	8 48 33.66	11 58 11.7	15.779	1.068	—	1.171	I10,G108
(6495)	8 48 33.92	12 29 27.6	9.37	1.48	—	1.50	1135, table 4
5621	8 48 34.39	11 49 51.4	19.876	1.953	—	2.408	
5622	8 48 34.08	11 54 11.7	13.257	0.603	0.069	0.661	964,I60

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
5623	8 48 34.28	11 52 46.6	15.920	0.935	0.629	0.999	960,I63	5658*	8 48 35.48	11 56 29.6	16.567	1.156	1.024	1.376	G124
5624	8 48 33.94	11 57 11.2	12.730	0.554	0.079	0.690	986,F111,G41	5659	8 48 34.96	12 02 55.0	19.194	0.698	0.205	0.862	
5625	8 48 33.63	12 01 22.6	13.511	0.571	0.038	0.691	1046,IV12,G56	5660	8 48 34.10	12 13 18.2	16.936	1.117	—	—	
5626*	8 48 34.41	11 52 21.2	16.782	1.266	1.103	1.487		5661*	8 48 36.39	11 47 27.1	16.735	1.314	1.144	1.458	
5627	8 48 34.91	11 46 35.6	16.212	1.032	0.689	1.075		5662	8 48 34.42	12 11 49.7	19.421	1.593	—	—	
5628	8 48 33.19	12 07 37.7	18.898	1.560	—	—		5663	8 48 34.69	12 09 28.3	12.313	0.989	0.687	—	
5629	8 48 34.32	11 54 42.2	13.393	0.578	0.042	0.673	967,I56	5665	8 48 35.80	11 58 20.4	16.280	1.003	0.561	1.059	
5630	8 48 34.67	11 50 27.1	21.326	1.507	—	2.577		5666	8 48 35.58	12 00 56.3	15.677	0.859	0.554	0.960	1038,G103
5631	8 48 32.85	12 12 17.7	20.353	0.990	—	—		5667	8 48 35.84	11 58 17.5	12.126	0.458	-0.008	0.562	997,F124,G13
5632	8 48 34.10	11 58 02.2	19.513	0.783	—	1.010	G160	5668	8 48 36.13	11 55 44.7	20.899	0.516	—	1.043	
5633	8 48 34.69	11 51 53.8	14.054	0.561	0.010	0.691	956,I167	5669	8 48 35.79	11 59 54.8	16.876	1.055	—	1.097	
5634	8 48 34.67	11 52 23.5	19.983	1.359	—	2.025		5670	8 48 35.82	11 59 57.9	18.612	-0.113	-0.896	—	G152
5635	8 48 32.70	12 16 08.3	16.769	1.083	—	—		5671	8 48 35.54	12 03 27.9	13.898	0.625	0.120	0.742	1070,IV27
5636	8 48 34.76	11 52 28.9	16.079	0.617	0.000	0.750	959,I164	5675	8 48 36.06	11 57 58.9	12.755	0.559	0.022	0.681	995,F127,G27
5637	8 48 33.81	12 03 42.7	18.305	0.897	0.480	0.975		5677	8 48 35.49	12 05 33.5	17.758	0.595	0.067	0.736	
5638	8 48 34.44	11 56 39.9	18.535	1.489	—	1.289		5678*	8 48 36.21	11 57 37.0	17.718	1.473	—	1.758	G138
5639	8 48 34.14	12 01 36.7	14.292	0.658	0.100	0.779	1050,IV15,G78	5679	8 48 36.28	11 57 09.6	13.145	0.566	0.071	0.700	2205,I198,F128,G48
5640	8 48 35.06	11 51 32.8	13.735	0.569	0.029	0.671	954,I168	(6483)	8 48 37.50	11 57 23.4	11.44	1.06	—	1.05	989, table 4
5641	8 48 35.13	11 51 34.0	19.006	1.737	0.322	0.507		5680	8 48 36.81	11 50 57.5	13.687	0.552	0.038	—	950,I169
5642	8 48 35.15	11 51 31.8	17.596	0.405	0.017	—		5683	8 48 35.91	12 02 18.8	14.303	0.675	0.115	0.758	1057,IV17,G85
5643	8 48 34.61	11 58 19.8	12.596	0.783	0.253	0.908	999,F117,G37	5684	8 48 37.10	11 48 15.2	17.784	0.473	-0.147	0.669	
5644	8 48 34.43	12 00 38.6	12.647	0.608	0.054	0.723	1034,F115,G25	5685	8 48 36.01	12 01 40.4	13.933	0.605	0.048	0.692	1051,IV11,G72
5645	8 48 35.44	11 48 57.7	20.814	1.159	—	1.585		5687	8 48 36.49	11 57 22.0	13.183	0.574	0.069	0.693	I199,F129,G49
5646*	8 48 34.45	12 01 31.4	15.606	1.030	0.848	1.136	2217,IV14,G102	5688	8 48 36.52	11 57 33.6	12.891	0.448	0.007	0.586	2204,F130,G28
5647	8 48 33.98	12 07 23.7	18.952	1.361	—	—		(6493)	8 48 36.62	12 04 43.3	11.251	0.415	—	0.529	1082, table 4
5648	8 48 35.41	11 51 29.9	19.733	0.321	—	—		5691*	8 48 36.62	11 56 42.5	15.828	1.016	0.750	1.168	979,F132a,G107
5649	8 48 35.64	11 49 23.5	19.953	1.371	—	1.646		5692	8 48 36.00	12 04 05.2	13.837	0.598	0.098	0.658	1075
5650	8 48 34.92	11 58 38.3	18.722	1.508	—	1.863	G150	5694	8 48 36.85	11 54 52.2	20.655	1.457	—	2.151	
5651	8 48 34.64	12 02 35.8	13.051	0.877	0.423	0.937	1060,IV18,G51	5695	8 48 36.76	11 56 19.7	13.095	0.608	0.109	0.718	976,F132,G46
5652	8 48 35.81	11 49 14.1	19.955	1.500	—	2.690		5696	8 48 35.24	12 14 51.4	15.546	0.743	—	—	
5653	8 48 35.10	11 59 11.8	13.666	0.560	0.022	0.698	1009,I5,G64	5697	8 48 36.61	11 59 48.7	18.607	1.550	—	1.961	G151
5654	8 48 34.90	12 01 22.8	12.540	0.591	0.066	0.703	1045,F119,G20	5698	8 48 37.59	11 50 25.9	13.626	0.473	-0.094	—	946
5655	8 48 34.63	12 05 35.3	16.814	1.231	1.256	1.414		5699	8 48 37.17	11 57 09.9	12.260	0.569	0.074	0.707	984,F134,G16
5656	8 48 34.51	12 07 06.9	14.134	0.640	0.132	0.718	1093,IV47	5700	8 48 37.37	11 55 18.0	17.026	1.219	1.167	1.315	
5657	8 48 35.12	12 00 41.5	13.854	0.572	0.053	0.692	1035,G71	5701	8 48 37.47	11 54 23.1	20.723	1.283	—	1.410	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
5702	8 48 37.23	11 59 25.5	19.173	0.936	—	1.069	G154	(6485)	8 48 38.71	11 59 19.0	10.48	1.11	—	1.08	1010, table 4
5704	8 48 37.82	11 54 34.9	14.481	0.670	0.146	0.740	966,I57	5740	8 48 38.75	12 01 13.1	18.943	1.370	—	1.485	G157
5705	8 48 37.74	11 55 22.3	14.177	0.665	0.134	0.777	969,I54	5741	8 48 38.86	12 00 30.4	13.260	0.464	-0.024	0.593	1031,IV6,G47
5706	8 48 38.26	11 49 16.8	19.319	1.472	—	2.109		5743	8 48 38.06	12 11 36.1	17.160	1.516	—	—	
5707	8 48 38.16	11 51 55.9	19.046	1.494	—	1.938		5744	8 48 39.90	11 50 09.8	14.528	0.665	0.109	—	945
5708*	8 48 37.28	12 02 44.8	18.651	1.621	—	2.060		5745*	8 48 39.43	11 56 03.5	18.431	1.532	0.897	2.003	
5709	8 48 37.52	12 00 19.8	15.214	0.793	0.265	0.881	1029,G99	5746	8 48 39.22	11 59 04.4	16.417	1.022	—	1.158	G118
5710	8 48 37.97	11 55 02.3	16.678	1.119	1.020	1.219	I55	5747	8 48 40.30	11 46 26.9	16.571	0.820	0.289	0.968	
5711	8 48 37.11	12 05 31.7	16.253	1.015	—	1.142	IV40	5748	8 48 39.19	11 59 43.8	14.335	0.807	0.265	0.997	1019,F6,G80
5712	8 48 36.47	12 14 01.7	19.897	1.444	—	—		5749	8 48 38.01	12 14 20.7	17.628	0.293	—	—	
5713	8 48 36.34	12 16 48.9	15.814	0.680	—	—		5750	8 48 38.64	12 07 39.7	19.059	1.285	—	—	
5715	8 48 38.14	11 55 56.2	17.440	0.769	0.492	0.894		5751	8 48 39.88	11 52 58.4	20.374	0.315	0.211	0.886	
5716	8 48 37.99	11 57 58.2	13.183	0.581	0.047	0.687	994,I9,G52	5752	8 48 40.28	11 48 17.5	20.619	0.747	—	0.731	
(6491)	8 48 37.60	12 03 55.1	11.315	0.61	—	0.720	1072, table 4	5753	8 48 38.97	12 05 22.4	14.160	0.638	—	0.713	1087
5718	8 48 37.62	12 02 59.3	14.040	0.660	—	0.759	1064	5754	8 48 39.41	12 00 23.2	16.224	1.004	0.728	1.089	G116
5719	8 48 38.26	11 55 26.2	16.362	1.059	—	1.122	970,I53	5755	8 48 38.86	12 08 54.0	19.160	1.459	—	—	
5720	8 48 38.60	11 52 15.3	17.455	1.309	1.105	1.460		(6488)	8 48 39.66	12 01 06.6	11.52	0.87	—	0.91	1040, table 4
5721	8 48 38.05	11 59 45.2	15.708	0.907	0.507	1.013	I4,G111	5756	8 48 39.74	11 58 33.4	12.835	0.783	0.296	0.854	1000,G40
5722	8 48 37.21	12 10 22.1	14.148	0.639	0.034	—		5760	8 48 39.98	11 58 29.1	13.767	0.574	-0.047	0.714	2209a,G68
5723	8 48 38.53	11 54 53.1	18.736	0.663	-0.056	0.747		5761	8 48 38.76	12 13 11.4	17.977	0.963	—	—	
5724	8 48 38.83	11 51 47.4	19.486	1.801	—	2.025		5762	8 48 40.58	11 52 08.4	18.132	0.931	0.529	1.051	
5725	8 48 37.78	12 04 26.2	15.267	0.818	—	0.868	1079,IV29	5763	8 48 40.05	11 58 26.7	13.477	0.614	0.093	0.731	2209b,G62
5726	8 48 39.15	11 48 15.3	16.891	1.375	1.266	1.635		5764	8 48 40.00	11 59 39.3	12.834	0.568	0.010	0.681	1018,F145,G35
5727	8 48 38.97	11 52 23.7	16.155	0.828	0.255	0.932	959,I165	5765	8 48 38.82	12 14 10.0	19.024	1.300	—	—	
5728	8 48 37.55	12 10 05.3	18.673	1.607	—	—		5766	8 48 40.06	11 59 44.1	17.026	1.221	—	1.308	G125
5729	8 48 39.05	11 52 22.7	20.363	1.724	—	0.139		5767	8 48 39.35	12 08 42.5	18.999	1.508	—	—	
5730	8 48 39.22	11 50 32.4	14.916	0.735	0.242	0.837	947,I170	5768	8 48 40.23	11 58 45.8	14.928	0.759	0.231	0.810	1004,F149a,G94
5731	8 48 37.84	12 07 35.4	19.388	1.537	—	1.839		5769	8 48 40.67	11 54 23.6	14.695	0.761	0.240	0.855	965,I58
5732	8 48 37.80	12 08 17.2	18.972	0.771	—	—		5770	8 48 40.27	12 01 07.9	15.055	0.797	0.202	0.866	2216,IV239,G93
5733	8 48 38.27	12 02 46.5	13.289	0.594	-0.011	0.693	1062,IV26	5771	8 48 41.26	11 49 34.0	15.209	0.786	0.310	0.873	941
5734	8 48 38.43	12 02 07.0	16.501	1.081	0.894	1.167	G119	5772	8 48 41.04	11 52 35.1	19.693	0.949	—	1.130	
5735	8 48 38.41	12 02 35.6	16.179	0.631	0.036	0.754	G113	5773	8 48 38.97	12 17 22.7	19.680	1.440	—	—	
5737	8 48 37.87	12 10 26.0	13.836	0.642	-0.016	—		5776	8 48 40.94	11 57 00.4	14.122	0.606	0.065	0.714	982,I51,G76
5738	8 48 39.00	11 57 25.5	20.417	1.231	—	1.136	G209	5777	8 48 40.76	11 59 21.4	14.516	0.737	0.179	0.874	1012,I3,G86
5739	8 48 38.82	12 00 06.7	12.718	0.553	-0.026	0.685	1024,IV4,G36	5780	8 48 39.76	12 12 48.3	14.981	0.781	—	—	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
5781	8 48 40.86	12 00 18.2	13.242	0.596	0.059	0.697	1027,IV5,G57	5814	8 48 41.85	12 09 08.8	16.723	0.585	-0.101	—	
5782	8 48 40.18	12 08 17.0	19.080	0.536	—	—		5815	8 48 43.71	11 47 08.0	18.331	0.451	-0.296	0.685	
5783	8 48 39.76	12 13 29.7	20.555	0.306	—	—		5816	8 48 43.71	11 47 33.5	17.491	0.944	0.566	1.017	
5784	8 48 40.66	12 03 06.7	19.187	1.525	—	2.017		5817	8 48 43.26	11 53 16.3	16.623	0.594	-0.008	0.736	962
5786	8 48 41.71	11 52 14.3	20.147	1.772	—	2.238		5818	8 48 43.53	11 51 16.9	20.211	0.697	0.519	1.135	
5787	8 48 40.07	12 12 14.3	19.778	1.541	—	—		5819	8 48 42.32	12 08 26.8	14.460	0.812	0.233	—	
5788	8 48 41.19	11 59 31.0	14.183	0.711	0.210	0.831	1014,I2,G77	5820	8 48 43.22	11 58 50.5	14.746	0.467	-0.081	0.645	1006,F149b,G89
5789	8 48 41.98	11 50 16.4	17.908	0.640	0.014	—		5821	8 48 42.50	12 07 29.7	15.850	1.128	0.733	—	III79
5790	8 48 41.30	11 58 51.7	12.533	0.589	0.082	0.694	1007,F149,G21	5822	8 48 41.98	12 15 00.5	19.916	0.714	—	—	
5791	8 48 39.77	12 17 15.3	15.794	0.903	—	—		5823	8 48 43.97	11 51 20.6	17.957	1.438	1.098	1.673	
5792*	8 48 41.40	12 00 12.4	17.653	1.527	—	1.727	G133	5824	8 48 44.03	11 53 52.4	18.589	1.674	—	1.907	
(6494)	8 48 42.01	12 05 09.4	10.48	1.10	—	—	1084, table 4	5825	8 48 43.26	12 04 44.1	12.756	0.592	—	0.687	1083
(6479)	8 48 42.41	11 55 08.2	11.28	0.13	—	0.179	968, table 4	5826	8 48 43.34	12 04 20.0	14.174	0.656	—	0.733	1078,III36
5793	8 48 42.42	11 48 18.6	19.284	0.942	-0.267	1.272		5827	8 48 44.39	11 53 13.2	16.981	1.280	1.153	1.416	
5794	8 48 42.52	11 49 54.7	13.695	0.552	0.002	—	944	5828	8 48 44.66	11 49 49.5	14.960	0.759	0.249	0.898	943
5795	8 48 41.37	12 03 56.3	13.259	0.619	—	0.695	1073,IV28	5829	8 48 43.84	12 01 29.5	14.411	0.685	0.084	0.777	1048,III9,G83
5796	8 48 42.16	11 54 42.1	18.083	0.864	0.303	0.954		5831	8 48 43.74	12 03 03.7	14.645	0.800	—	0.873	1065,III16
5797	8 48 42.48	11 51 30.1	13.949	0.849	0.455	0.897	953,I166	5832	8 48 45.03	11 47 35.9	19.623	1.537	—	2.137	
5798	8 48 41.75	12 00 03.1	16.185	1.000	0.604	1.153	G114	5833	8 48 44.05	12 00 45.0	12.784	0.487	-0.009	0.600	1036,III2,G33
5799	8 48 42.46	11 52 04.8	16.628	0.662	-0.070	0.886		5835*	8 48 44.29	11 58 07.0	14.972	0.891	0.460	0.995	996,II8,G91
5800	8 48 41.44	12 04 33.3	15.556	0.895	—	0.912	1081	5836	8 48 43.43	12 08 47.8	15.797	0.870	0.362	—	
(6487)	8 48 42.75	11 59 58.0	10.544	0.57	—	0.627	1023, table 4	5837*	8 48 44.48	11 56 51.5	15.809	1.006	0.672	1.127	1232,II23,G112
5801	8 48 42.78	11 48 40.6	20.757	0.784	—	—		5838	8 48 43.68	12 06 58.5	13.308	0.631	0.659	0.733	1092,III43
5802	8 48 41.27	12 06 56.2	17.941	1.440	—	1.619		5839	8 48 43.89	12 04 37.2	16.666	1.134	—	1.209	
5803	8 48 41.86	12 00 26.4	13.233	0.566	0.026	0.688	1030,IV3,G50	5840	8 48 43.68	12 08 53.5	19.669	0.661	—	—	
5804	8 48 42.45	11 53 56.6	16.600	1.141	1.106	1.188	I59	5841	8 48 44.90	11 54 26.4	15.474	0.864	0.459	0.943	1215,II31
5805	8 48 42.96	11 48 27.0	18.406	0.856	0.044	0.963		5842	8 48 44.16	12 03 35.1	12.808	0.589	—	0.681	1071
5806	8 48 42.41	11 55 14.3	18.036	0.589	-0.098	—		5843	8 48 45.37	11 49 08.9	18.124	1.450	1.029	2.321	
5807	8 48 41.94	12 01 13.0	14.718	0.729	0.185	0.832	1041,IV1,G88	5844	8 48 44.62	11 59 19.8	13.821	0.627	0.053	0.803	1011,II1,G66
5808	8 48 40.90	12 14 14.7	13.766	1.013	0.520	—		(6503)	8 48 44.87	12 01 50.7	10.55	1.12	—	1.09	1279, table 4
5810	8 48 42.55	11 55 39.3	15.296	0.603	-0.029	0.732	971,I52	5845	8 48 45.18	11 53 29.5	15.727	0.560	-0.049	0.689	1210,II32
5811	8 48 42.84	11 53 40.9	18.231	1.469	1.215	1.752		5846	8 48 45.25	11 54 05.0	17.773	0.659	0.023	0.785	
(6490)	8 48 42.88	12 03 10.1	10.99	0.11	—	0.128	1066, table 4	5847*	8 48 44.90	11 59 00.6	15.736	0.992	0.620	1.109	1253,II2,G105
5812	8 48 42.60	11 57 00.8	17.145	1.200	0.997	1.328	G127	5848	8 48 43.55	12 15 39.4	12.253	0.623	—	—	
5813	8 48 42.43	12 00 37.8	13.480	0.573	0.036	0.700	1032,IV2,G54	5849	8 48 45.58	11 51 51.9	19.497	0.507	0.002	0.650	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
(6499)	8 48 45.83	11 58 34.5	9.69	1.36	—	1.33	1250, table 4	5890	8 48 47.66	11 48 11.9	19.473	1.675	—	1.358	
5850	8 48 46.03	11 46 29.6	12.777	0.548	-0.003	—		5891	8 48 47.09	11 55 15.7	17.558	1.331	1.222	1.469	
5852	8 48 44.04	12 10 32.4	18.946	1.492	—	—		5892	8 48 46.27	12 05 20.2	19.720	0.997	—	1.021	
5853	8 48 44.67	12 03 17.6	12.677	0.684	—	0.761	1069,III17	5893	8 48 45.93	12 10 39.2	15.439	0.946	0.645	—	
5855	8 48 45.32	11 56 45.3	12.934	0.917	0.562	0.972	1231,II22,G42	5894	8 48 45.77	12 12 49.3	17.892	0.899	—	—	
5856	8 48 44.86	12 02 31.5	17.598	1.355	—	1.548	G136	5895	8 48 46.40	12 06 41.0	19.665	1.634	—	2.090	
5857	8 48 44.82	12 03 30.1	14.991	0.798	—	0.911	1297,III18	5896	8 48 47.20	11 57 08.4	12.650	0.574	0.018	0.700	1234,II20,G22
5858	8 48 46.20	11 47 52.2	20.594	0.683	-0.229	—		5897	8 48 47.20	11 57 14.3	19.407	0.855	—	0.051	
5859	8 48 43.99	12 14 35.2	13.015	0.750	0.141	—		5898	8 48 47.97	11 49 33.9	16.904	1.197	1.061	1.363	
5861	8 48 45.73	11 56 24.2	17.798	1.443	1.210	1.575	G134	5899	8 48 46.96	12 01 56.8	19.925	1.533	—	2.272	G170
5862	8 48 46.63	11 47 28.3	16.183	1.001	0.762	1.102		5900	8 48 48.25	11 47 30.9	13.290	0.573	0.024	0.682	1189
5863	8 48 46.11	11 55 07.6	13.148	0.597	0.042	0.685	1219,II30	5901*	8 48 47.17	12 01 08.8	16.627	1.290	1.181	1.414	G122
5864	8 48 45.23	12 05 31.6	12.868	0.603	—	0.691	1308,III40	5902	8 48 47.62	11 57 31.1	20.399	1.440	—	1.730	G176
5866	8 48 46.77	11 47 16.4	21.170	0.777	—	2.737		5903	8 48 47.03	12 04 35.9	13.709	0.601	0.020	0.695	1303
5868*	8 48 46.41	11 53 01.2	18.600	1.556	—	2.043		5904	8 48 47.72	11 56 26.6	15.514	0.865	0.495	0.941	1229,II21,G101
5869	8 48 45.77	12 01 40.5	14.401	0.775	0.285	0.861	1278,III10,G87	5905	8 48 46.49	12 12 34.4	16.421	0.755	—	—	
5870	8 48 46.88	11 49 01.8	19.763	0.900	0.561	0.815		5906	8 48 48.01	11 54 38.4	18.986	1.172	—	1.304	
5871	8 48 45.73	12 02 47.9	13.329	0.495	-0.085	0.640	2223,III15	5907	8 48 47.89	11 56 42.4	19.674	1.340	—	1.493	G165
5872	8 48 46.28	11 56 23.6	19.053	1.376	—	1.781	G153	5908	8 48 46.30	12 15 36.1	14.737	0.744	—	—	
5873	8 48 45.84	12 02 26.7	14.115	0.640	0.066	0.744	1283,III13,G69	(6501)	8 48 48.51	12 00 09.9	11.063	0.19	—	0.262	1263, table 4
5874	8 48 44.79	12 15 33.8	17.319	0.763	—	—		5909	8 48 48.57	11 48 41.9	18.050	1.415	1.078	1.670	
5875	8 48 46.31	11 58 19.3	17.720	1.338	1.246	1.599	G135	5910	8 48 47.41	12 03 15.2	14.889	0.756	0.205	0.879	1294,III19
5876	8 48 44.82	12 16 52.0	17.838	1.310	—	—		5911*	8 48 48.49	11 50 35.0	18.323	1.513	0.986	2.066	
5877	8 48 46.37	12 00 16.0	12.110	1.006	0.718	1.029	1264a ,G15	5912	8 48 46.47	12 16 39.1	19.371	1.519	—	—	
5878*	8 48 46.30	12 01 23.5	15.796	1.090	0.866	1.157	III8,G109	5913*	8 48 48.11	11 57 44.8	16.409	1.116	0.967	1.296	II9,G121
5879	8 48 46.20	12 02 39.9	14.901	0.762	0.256	0.840	1289,III14,G92	5914	8 48 47.30	12 08 01.7	17.067	0.648	-0.075	—	
5880	8 48 46.82	11 55 20.4	19.045	0.953	0.738	1.239		5915	8 48 48.14	11 58 13.0	16.255	1.030	0.789	1.142	II11,G115
5881*	8 48 46.56	11 59 05.1	15.921	1.076	0.934	1.223	II3,G110	5916	8 48 48.34	11 55 39.8	17.875	1.386	1.260	1.585	
5882	8 48 46.48	12 00 12.5	13.349	0.590	0.045	0.739	1264b,G55	5917	8 48 47.80	12 02 34.4	14.030	0.608	0.056	0.747	1287,III20,G67
5883	8 48 45.67	12 10 20.1	18.628	1.465	—	—		5918	8 48 47.18	12 10 12.8	16.978	0.679	-0.010	—	
5884	8 48 46.49	12 00 30.9	12.725	0.587	0.062	0.704	2212,III1,G26	5919	8 48 47.53	12 06 15.0	17.352	1.285	1.090	1.422	
5885	8 48 46.78	11 57 08.0	19.529	0.674	—	—		5920	8 48 47.40	12 08 14.9	19.055	1.391	—	—	
5886	8 48 46.60	12 00 10.2	15.781	0.981	0.819	0.965	G502	5921	8 48 47.73	12 04 44.5	16.646	0.701	0.171	0.855	
5887	8 48 47.60	11 48 19.5	19.637	1.479	—	1.325		5922	8 48 48.33	11 58 03.5	14.623	0.685	0.151	0.833	1246,II10,G90
5888	8 48 45.85	12 09 42.4	14.038	0.533	-0.050	—		5923	8 48 47.37	12 09 18.5	16.828	0.713	0.059	—	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
5924	8 48 47.74	12 04 50.8	15.444	0.852	—	—	1304	5964	8 48 50.21	11 57 11.4	14.980	0.877	0.484	0.951	1235,II18,G95
5925	8 48 48.05	12 01 21.4	12.664	0.598	0.066	0.685	1274,III7,G31	5965	8 48 49.90	12 02 01.5	20.841	0.966	—	—	G224
5926	8 48 47.79	12 04 29.7	13.076	0.564	0.014	0.668	1302,III37	5966	8 48 50.48	11 55 07.3	14.590	0.684	0.170	0.754	1218
5927	8 48 48.33	11 59 19.0	12.777	0.822	0.332	0.882	2208,II6,G39	5967	8 48 50.84	11 51 38.6	18.871	0.918	0.434	1.035	
5928	8 48 48.32	11 59 39.9	18.210	0.493	—	0.805		5968	8 48 49.10	12 12 40.2	15.786	0.677	—	—	
5929	8 48 48.38	11 59 10.2	12.648	0.617	0.070	0.728	2207,II5,G30	5969	8 48 50.19	12 01 01.7	12.909	0.534	-0.028	0.665	1271,III6,G32
5930*	8 48 48.59	11 57 17.6	19.265	1.647	—	2.241	G156	5972	8 48 50.15	12 02 12.4	13.717	0.547	0.013	0.689	1281,III24,G63
5931	8 48 47.14	12 15 08.3	17.239	0.686	-0.022	—		5973	8 48 50.88	11 53 35.7	19.656	-0.098	-0.763	-0.189	
5932	8 48 47.87	12 06 26.7	13.698	0.635	0.091	0.739	1314,III42	5975	8 48 50.10	12 03 49.0	17.595	1.023	0.661	1.158	
5933	8 48 47.96	12 05 24.2	19.947	1.658	—	2.289		5978*	8 48 50.47	12 00 24.8	15.550	0.978	0.738	1.083	1266,III4,G106
5937	8 48 48.50	11 59 41.9	14.191	0.625	0.045	0.736	1260,II4,G75	5979	8 48 50.81	11 56 55.4	18.024	1.425	1.401	1.747	G142
5939	8 48 48.00	12 07 11.6	18.599	0.841	0.407	1.038		5980	8 48 51.08	11 54 04.6	17.099	1.244	1.173	1.400	
5940	8 48 48.47	12 01 58.4	12.257	0.260	0.020	0.335	1280,III12,G11	5981*	8 48 51.58	11 51 04.8	14.413	0.715	0.124	0.909	1203,II68
5941	8 48 47.24	12 17 11.1	16.295	1.449	—	—		5982	8 48 51.64	11 50 50.1	17.135	1.233	1.084	1.355	
5942	8 48 49.70	11 47 45.3	20.160	1.206	—	1.537		5983	8 48 51.17	11 57 29.7	16.707	0.694	0.141	0.808	G120
5943	8 48 48.57	12 01 48.7	15.761	0.904	0.546	0.973	G104	5984	8 48 51.66	11 52 28.3	17.886	0.496	-0.215	0.708	
5944	8 48 49.26	11 53 39.5	19.921	1.678	—	2.145		5985	8 48 51.04	12 01 49.4	19.851	1.583	—	1.486	G184
5945	8 48 49.72	11 49 51.8	16.215	1.020	0.726	1.217		5986	8 48 51.11	12 01 43.6	19.521	1.348	—	2.190	G159
5946	8 48 49.52	11 53 17.2	20.236	0.430	-0.310	0.651		5987	8 48 49.90	12 16 34.5	16.391	0.739	—	—	
5948	8 48 49.32	11 57 17.6	15.244	0.792	0.323	0.913	1236,II19,G97	5988	8 48 50.82	12 06 33.3	18.858	1.475	—	1.893	
5949	8 48 48.68	12 05 02.7	15.167	0.807	0.276	0.870	1307,III39	5989	8 48 52.21	11 50 13.7	13.939	0.583	0.012	0.742	1201
5950	8 48 48.29	12 10 18.8	18.355	1.470	—	—		5990	8 48 51.36	12 01 37.2	19.830	0.741	—	0.861	G168
5951	8 48 49.14	12 00 09.2	12.767	0.577	0.014	0.719	III3,G23	5991	8 48 52.29	11 50 58.6	19.093	1.567	—	1.720	
5952	8 48 48.95	12 02 33.9	15.263	0.820	0.343	0.924	1286,III21,G96	5992	8 48 51.76	12 00 09.5	13.663	0.585	0.043	0.691	1262,III5,G60
5954	8 48 49.69	11 54 45.1	21.214	0.252	—	—		5993	8 48 51.97	11 57 51.6	12.722	0.683	0.134	0.807	1242,II17,G29
5955	8 48 47.96	12 15 45.1	17.290	0.946	1.958	—		5994	8 48 51.41	12 06 10.7	20.186	0.666	-0.204	0.626	
5956	8 48 48.76	12 06 05.5	15.801	0.914	0.576	0.989	1311,III41	5995	8 48 52.01	11 59 05.0	14.486	0.666	0.116	0.774	1255,II7,G81
5957	8 48 49.64	11 57 34.0	18.126	1.432	1.309	1.678	G141	5996	8 48 51.19	12 09 14.6	12.826	0.775	0.278	—	
5958	8 48 50.45	11 48 29.6	19.972	1.514	—	2.427		5997	8 48 51.62	12 04 52.9	12.230	0.993	0.681	1.002	1305
5959	8 48 50.52	11 49 14.4	13.186	0.559	-0.002	0.698		5998	8 48 51.36	12 08 31.3	18.999	1.530	—	—	
5960	8 48 49.13	12 06 02.0	18.762	1.513	—	1.864		5999*	8 48 53.11	11 48 10.2	14.865	0.829	0.401	0.949	
5961	8 48 49.53	12 03 02.9	13.198	0.620	0.047	0.737	1292,III22	6000	8 48 51.58	12 08 28.1	20.072	1.123	—	—	
5962	8 48 49.00	12 10 59.2	13.864	0.660	0.045	—		6001	8 48 52.05	12 05 53.3	20.137	1.555	—	2.138	
5963	8 48 50.07	11 58 13.7	14.220	0.621	0.088	0.734	1248,II12,G82	6002	8 48 53.29	11 51 49.9	19.651	1.222	—	1.354	
(6504)	8 48 50.20	12 02 28.4	10.940	0.22	—	0.318	1284, table 4	6003	8 48 53.69	11 47 27.4	16.410	0.584	-0.048	0.746	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
6004	8 48 52.01	12 08 00.1	19.572	0.548	—	—		6038	8 48 55.28	11 54 53.6	16.452	1.070	0.919	1.159	
6005	8 48 52.64	12 01 17.1	15.571	0.863	0.456	0.950	2215,III25,G100	6039	8 48 54.99	11 59 13.5	13.673	0.660	0.128	0.728	1256,II13,G70
6006	8 48 53.79	11 48 20.7	12.278	0.385	-0.034	0.501		6040	8 48 53.65	12 16 36.4	17.299	1.032	—	—	
6007*	8 48 53.01	11 57 51.0	19.453	1.619	—	2.268	G163	6041	8 48 55.58	11 53 29.0	15.658	0.484	-0.082	0.634	1209,II37
6008	8 48 52.37	12 05 45.6	15.158	0.832	0.352	0.866	1309,III44	6042	8 48 53.70	12 16 29.9	13.799	0.629	—	—	
6009	8 48 52.18	12 08 08.9	14.001	0.617	-0.008	—		6043	8 48 55.66	11 53 46.4	16.593	1.117	0.900	1.178	
6010	8 48 53.20	11 58 13.8	14.044	0.619	0.064	0.778	1247,II6,G74	6044	8 48 55.23	11 59 01.5	17.181	1.271	1.203	1.376	G126
6011	8 48 52.01	12 14 12.1	19.220	1.429	—	—		6045	8 48 54.04	12 13 23.4	18.458	1.338	—	—	
6012	8 48 53.06	12 02 50.1	20.477	0.940	—	—		6046	8 48 55.52	11 56 19.5	15.319	0.820	0.421	0.863	1227,II27
6013	8 48 53.51	11 57 39.9	17.950	0.982	0.645	1.089	G144	6047	8 48 55.14	12 01 22.0	12.219	0.567	0.080	0.653	1273,III27,G14
6014	8 48 54.20	11 49 50.1	17.718	0.505	-0.080	0.692		6048*	8 48 54.91	12 04 23.5	15.465	0.966	0.612	1.056	1301,III48
6015	8 48 52.85	12 06 08.3	15.511	0.867	0.442	0.935	1312,III45	6049	8 48 55.80	11 54 13.1	14.346	0.643	0.085	0.752	1214,II35
6016	8 48 52.57	12 09 54.8	19.424	1.329	—	—		6050	8 48 55.27	12 03 03.9	12.094	1.007	0.731	1.016	1293,III35
6017	8 48 52.40	12 12 07.4	18.573	1.098	—	—		6051	8 48 55.31	12 05 45.0	20.935	0.319	—	0.708	
6018	8 48 53.31	12 01 23.3	12.562	0.593	0.113	0.688	1275,III26,G18	6052	8 48 56.40	11 53 40.6	20.466	0.943	-0.165	—	
6019	8 48 52.93	12 06 18.3	13.213	0.600	0.021	0.679	1313,III46	6053	8 48 54.91	12 11 51.0	18.262	1.199	—	—	
6020	8 48 52.27	12 14 34.1	18.408	1.419	—	—		6054	8 48 55.89	12 01 47.7	21.080	0.569	—	—	G196
6021	8 48 54.41	11 52 48.2	16.520	1.099	0.898	1.268		6055	8 48 55.14	12 12 15.8	14.645	0.747	—	—	
6022	8 48 52.77	12 12 43.4	18.775	1.522	—	—		6056	8 48 56.63	11 54 29.9	19.449	1.323	—	1.519	
6023	8 48 54.88	11 47 27.1	18.907	1.555	—	1.949		6057	8 48 56.03	12 02 31.7	19.658	1.682	—	2.383	
6024*	8 48 54.58	11 51 15.8	17.792	1.541	1.036	1.828		6058	8 48 56.41	11 57 56.1	13.794	0.590	0.071	0.703	1244,II24,G61
6025	8 48 53.41	12 05 34.7	18.852	1.576	—	1.932		6059	8 48 56.57	11 56 09.9	19.685	0.450	-0.207	—	
6026	8 48 53.49	12 05 15.9	18.854	1.539	0.799	1.856		6060	8 48 55.94	12 04 01.6	13.754	0.597	0.045	0.670	1300,III49
6027	8 48 53.74	12 02 15.2	13.333	0.564	0.067	0.699	1282,III33,G58	6061	8 48 56.53	11 57 19.0	20.534	-0.140	—	—	
6028	8 48 53.37	12 08 02.7	14.438	0.706	0.123	—		6062	8 48 55.10	12 14 38.3	18.062	0.794	—	—	
6029	8 48 54.85	11 50 19.4	16.632	0.942	0.638	1.050		6063	8 48 57.41	11 49 25.5	16.475	0.931	0.343	1.002	
6030	8 48 52.94	12 14 40.1	13.748	0.605	—	—		6064	8 48 55.18	12 17 14.9	15.770	0.937	—	—	
(6507)	8 48 52.95	12 10 20.7	11.103	0.85	—	0.855	1327, table 4	6065	8 48 56.74	12 00 23.8	13.763	0.592	0.052	0.660	1265,III28
6031	8 48 54.73	11 53 55.4	14.114	0.600	0.053	0.716	1213,II34	6066	8 48 55.40	12 16 49.4	19.688	1.589	—	—	
6032	8 48 53.25	12 12 06.8	15.211	0.623	-0.142	—		6067*	8 48 56.54	12 03 25.1	16.788	1.292	1.249	1.472	
6033	8 48 53.63	12 10 06.4	17.103	1.093	—	—		6068	8 48 57.26	11 56 11.3	14.901	0.733	0.230	0.817	1223,II28
6034	8 48 53.76	12 10 07.5	12.911	1.000	0.743	—		6069	8 48 55.79	12 15 46.7	15.459	0.875	—	—	
6035	8 48 55.50	11 49 05.2	18.037	1.149	0.807	1.266		6070	8 48 56.09	12 13 09.8	12.695	0.584	—	—	
6036	8 48 53.84	12 09 20.9	18.249	0.682	0.146	—		6071	8 48 56.94	12 04 00.3	16.373	0.864	0.314	0.944	1299,III50
6037	8 48 53.78	12 12 43.3	13.037	0.667	—	—		6072	8 48 58.32	11 47 25.3	18.087	1.473	1.207	1.653	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
6073	8 48 57.44	11 58 54.4	14.067	0.643	0.094	0.729	1252,II14	6104	8 48 58.60	12 10 49.6	14.079	0.658	0.011	—	
6074	8 48 57.45	11 59 17.7	19.518	0.661	0.020	0.999		6105	8 48 59.73	11 58 14.4	19.922	1.010	—	1.106	
6075	8 48 56.70	12 09 02.8	15.930	1.072	0.849	—		6106	8 48 59.87	11 56 55.7	16.201	0.838	0.378	0.909	1233
6076	8 48 57.94	11 54 55.6	12.690	0.564	0.042	0.675	1216,II36	6107	8 48 59.97	11 57 42.9	12.750	0.758	0.241	0.822	1239
6077	8 48 57.07	12 05 47.5	12.760	0.580	0.010	0.650	1310,III47	6108	8 49 00.67	11 53 09.9	13.214	0.556	0.032	0.690	
6078	8 48 58.70	11 48 06.5	16.673	1.101	0.989	1.208		6109	8 49 00.99	11 50 16.8	13.534	0.540	0.030	0.670	
6079	8 48 56.50	12 16 05.6	16.164	0.554	—	—		6110	8 48 59.35	12 12 14.2	13.629	0.659	—	—	
6080	8 48 57.81	12 00 56.0	14.934	0.758	0.283	0.791	1269,III30	6111	8 48 58.98	12 17 00.2	18.359	0.964	0.394	—	
(6502)	8 48 58.23	12 01 26.0	11.63	1.05	—	—	1277, table 4	6112	8 49 00.73	11 56 19.8	13.338	0.575	-0.007	0.667	1226,II53
6081	8 48 58.36	11 55 47.3	17.427	0.884	0.451	1.028		6113	8 49 00.36	12 01 03.6	20.205	0.481	0.046	1.080	
6082	8 48 59.17	11 47 46.0	14.141	0.709	0.183	0.802		6114	8 49 00.70	11 58 04.5	12.934	0.919	0.549	0.940	1245
6083	8 48 56.78	12 17 08.2	18.685	1.189	—	—		6115	8 49 00.81	11 57 49.4	18.302	1.479	1.196	1.760	
6084*	8 48 58.51	11 57 17.1	15.505	1.098	0.905	1.097	2203,II26,G39	(6500)	8 49 01.00	11 59 04.4	11.52	1.05	—	—	1254, table 4
6085	8 48 58.01	12 03 48.4	16.008	0.678	0.046	0.764	1298,III51	6116	8 48 59.26	12 16 41.8	18.610	1.006	—	—	
6086	8 48 57.08	12 15 05.8	18.592	1.506	—	—		6117	8 48 59.98	12 09 09.6	19.708	0.647	—	—	
6087	8 48 58.03	12 04 15.0	19.787	0.874	0.278	0.884		6118	8 49 01.54	11 53 29.1	17.118	0.625	-0.019	0.751	
6088	8 48 59.01	11 52 18.0	15.124	0.848	0.478	0.918	1206,II66	6119	8 49 01.83	11 50 03.1	14.387	0.598	-0.049	0.720	
6089	8 48 58.36	12 01 10.3	12.514	0.598	0.046	0.697	1272,III31	6120	8 49 00.89	12 03 12.4	19.964	0.971	-0.044	1.213	
6090	8 48 58.63	11 57 55.0	12.368	0.581	-0.041	0.722	1243,II25	6121	8 49 02.37	11 46 42.4	19.270	1.511	—	2.011	
6091	8 48 58.96	11 55 56.0	18.802	1.011	0.582	1.056		6122	8 49 00.44	12 10 11.6	18.086	1.469	—	—	
6092	8 48 57.41	12 17 01.6	16.933	0.913	0.957	—		6123	8 49 00.99	12 03 52.0	15.915	0.841	0.341	0.869	
(6497)	8 48 59.52	11 55 44.9	10.76	1.13	—	1.10	1221, table 4	6124	8 49 02.19	11 51 47.3	20.695	0.489	-0.145	—	
6093	8 48 59.54	11 52 05.3	21.306	0.839	—	1.075		(6496)	8 49 02.19	11 47 36.2	11.26	0.62	—	—	1190, table 4
6094	8 48 59.21	11 56 35.7	17.176	0.933	0.560	1.063		6125	8 49 01.96	11 55 28.1	13.371	0.572	0.026	0.648	1220,II56
6095	8 48 58.01	12 11 47.2	17.998	1.005	—	—		6126	8 49 01.66	11 59 53.2	20.924	-0.185	—	—	
(6505)	8 48 58.23	12 02 41.3	11.33	1.07	—	—	1288, table 4	6127	8 49 01.03	12 08 14.0	13.584	0.594	0.003	—	
6096	8 48 58.41	12 07 23.5	15.914	0.980	0.602	1.022		6128*	8 49 01.31	12 05 53.9	18.720	1.600	—	2.150	
6097	8 48 59.48	11 54 29.9	20.907	0.715	—	—		6129*	8 49 01.54	12 05 13.0	16.929	1.346	1.271	1.513	
(6506)	8 48 59.68	12 08 00.8	10.58	1.10	—	1.08	1316, table 4	6130	8 49 02.03	11 59 52.0	15.943	0.623	0.095	0.645	1261,II15
6098	8 48 59.85	11 50 04.4	18.580	1.549	—	1.931		6131	8 49 01.30	12 09 11.6	16.990	1.332	—	—	
6099	8 48 58.09	12 11 47.3	18.007	0.988	—	—		6132	8 49 01.34	12 08 41.7	18.806	1.316	—	—	
6100	8 48 58.60	12 05 58.2	17.371	1.308	1.166	1.441		6133	8 49 02.65	11 54 03.8	16.784	1.245	1.152	1.373	II64
6101	8 48 59.02	12 02 20.5	17.690	1.469	—	—		6134	8 49 02.38	11 57 45.2	13.381	0.572	0.036	0.687	1240,II43,F164,G7
6102	8 48 59.39	12 00 10.6	15.720	0.921	0.596	0.971	III29	6135	8 49 02.62	11 56 16.9	12.831	0.504	-0.071	0.625	1225,II54
6103	8 48 59.73	11 56 33.3	13.079	0.559	0.025	0.667	1230	6136	8 49 01.92	12 04 58.8	17.872	1.354	1.221	1.501	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
6137	8 49 03.48	11 48 01.3	16.059	0.874	0.524	0.957		6171	8 49 04.60	12 09 38.6	15.383	0.990	0.585	—	
6138*	8 49 02.88	11 56 31.0	18.557	1.535	—	2.007		6172	8 49 06.72	11 47 51.5	13.419	0.445	-0.076	0.618	
6139	8 49 03.11	11 53 49.0	15.320	0.782	0.359	0.899	1212	6173	8 49 06.51	11 51 07.7	18.791	0.743	-0.018	0.821	
6140	8 49 01.92	12 09 22.6	19.101	1.248	—	—		6174	8 49 05.29	12 06 11.9	17.500	0.590	-0.031	0.739	
6141	8 49 01.98	12 12 14.9	14.918	0.701	—	—		6175	8 49 06.11	11 56 19.2	13.776	0.608	0.060	0.736	1224b
6142	8 49 03.38	11 56 01.0	14.671	0.694	0.124	0.770	1222,II55	6176	8 49 06.20	11 56 16.0	13.505	0.630	0.080	0.693	1224a
6143	8 49 03.85	11 51 54.4	20.218	1.334	—	1.880		6177	8 49 05.87	12 00 50.0	12.647	0.581	0.103	0.734	1268
6144*	8 49 03.38	11 58 28.3	14.314	0.783	0.269	0.877	1249,II42	6178	8 49 05.49	12 06 51.2	18.813	1.460	—	1.867	
6145	8 49 03.32	12 01 55.6	18.556	1.319	—	—		6180	8 49 07.14	11 48 20.3	13.303	0.459	-0.111	0.633	
6146	8 49 03.67	12 00 00.1	19.620	1.380	—	1.954		6182	8 49 05.85	12 05 32.2	20.076	0.960	—	—	
6147	8 49 04.08	11 56 04.5	19.245	1.342	—	1.558		6183	8 49 05.79	12 06 37.1	18.355	0.688	—	—	
6148	8 49 04.21	11 54 37.6	18.119	1.282	1.443	1.525		6184	8 49 05.74	12 08 04.1	15.894	0.932	0.557	0.945	
6149	8 49 04.48	11 53 42.2	14.047	0.602	0.051	0.719		6185	8 49 07.35	11 48 36.2	19.449	1.006	0.465	1.050	
6150	8 49 03.83	12 03 21.1	18.715	1.548	—	1.914		6186	8 49 07.32	11 50 54.0	19.588	1.754	—	2.065	
6151	8 49 03.87	12 03 02.1	20.034	0.585	0.116	1.106		6187	8 49 07.04	11 55 47.5	17.219	1.331	—	—	
6152	8 49 04.56	11 54 50.3	17.181	1.274	1.141	1.390		6188	8 49 06.47	12 02 50.1	15.714	0.649	0.036	0.781	
6153	8 49 03.50	12 07 55.2	20.157	0.724	—	—		6189	8 49 05.65	12 14 16.6	17.372	1.055	—	—	
6154	8 49 03.62	12 06 37.0	19.234	0.720	-0.278	0.909		6190	8 49 06.93	11 59 05.3	15.896	1.185	1.081	1.323	1451,II40
6155	8 49 03.45	12 10 52.6	18.974	1.165	—	—		6192	8 49 07.66	11 50 14.9	18.546	0.625	-0.098	0.718	
6156	8 49 03.22	12 13 41.5	17.139	0.729	—	—		6193	8 49 06.62	12 04 41.4	16.672	1.136	1.014	1.291	
6157	8 49 05.20	11 50 40.0	20.209	0.784	-0.215	0.647		6194	8 49 08.01	11 48 05.1	14.136	0.514	-0.111	—	
6158	8 49 04.22	12 02 30.6	12.505	0.663	0.103	0.764	1285,III53	6195	8 49 06.77	12 03 27.4	15.843	0.958	0.625	0.997	1296,III55
6159	8 49 03.70	12 09 40.9	20.052	0.707	—	—		6197	8 49 07.13	11 59 48.2	20.379	1.692	—	1.819	
6160	8 49 04.62	11 58 54.3	14.790	0.750	0.211	0.851	1251,II41	6198*	8 49 08.18	11 48 38.3	15.774	1.013	0.625	1.189	
6161	8 49 04.98	11 54 59.0	15.289	0.828	0.392	0.873	1217,II60	6199*	8 49 07.60	11 56 09.3	14.901	0.910	0.564	1.020	1436,II58
6162	8 49 03.52	12 12 56.8	17.991	1.382	—	—		6200	8 49 08.26	11 48 37.1	19.607	1.474	—	1.011	
6163	8 49 03.98	12 10 50.2	15.389	0.879	0.341	—		6201	8 49 07.18	12 02 34.7	17.815	0.544	-0.053	0.725	
6164	8 49 05.14	11 58 28.4	17.255	0.880	0.507	0.964		6202	8 49 07.41	12 01 45.7	20.269	0.874	-0.042	—	
6165	8 49 05.07	12 00 02.9	20.862	0.314	—	—		6203	8 49 06.79	12 13 45.1	16.742	0.689	—	—	
6166	8 49 05.02	12 01 02.4	12.729	0.577	0.079	0.704	1270	6204	8 49 06.75	12 15 10.0	18.281	1.422	—	—	
6167*	8 49 05.83	11 51 16.7	14.622	0.808	0.374	0.916		6205	8 49 07.29	12 09 08.8	12.809	0.603	-0.003	—	
(6498)	8 49 06.15	11 57 25.7	10.78	0.94	—	0.96	1237, table 4	6206	8 49 08.88	11 50 42.4	20.222	0.936	-0.399	0.927	
6168	8 49 06.27	11 48 25.5	18.880	0.407	-0.112	0.649		6207	8 49 08.37	11 57 10.4	18.666	1.535	1.146	1.842	
6169	8 49 04.65	12 08 10.1	12.906	0.970	0.577	—		6208	8 49 07.86	12 05 04.2	20.258	1.752	—	2.216	
6170	8 49 05.82	11 54 28.0	18.535	1.499	0.840	1.837		6209	8 49 07.99	12 03 39.2	20.262	0.607	-0.222	—	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
6210	8 49 07.02	12 15 18.8	18.252	0.628	-0.014	—		6246	8 49 11.30	11 54 05.3	19.511	1.648	—	2.063	
6211*	8 49 07.65	12 07 27.7	16.018	1.148	0.988	1.230		6247*	8 49 11.43	11 52 44.6	18.979	1.486	0.327	2.189	
6212	8 49 07.15	12 16 10.0	13.448	0.613	—	—		6248	8 49 10.83	12 04 25.0	15.752	0.927	0.574	0.951	1472,III64
6213	8 49 09.13	11 52 12.2	13.388	0.577	0.032	0.708		(6509)	8 49 10.95	11 51 45.4	11.721	0.51	—	0.782	1425, table 4
6214	8 49 08.89	11 55 26.8	15.677	0.867	0.472	0.920		6249	8 49 10.62	12 07 38.4	20.246	1.431	—	1.448	
6215	8 49 08.49	12 00 38.2	17.230	1.505	—	—		6250	8 49 11.67	11 54 59.0	16.095	1.014	0.748	1.120	II62
6216*	8 49 08.86	11 57 54.8	15.975	1.105	0.923	1.208	II49	6251	8 49 12.10	11 50 32.2	14.628	0.694	0.134	0.779	
6218	8 49 09.53	11 49 50.8	12.690	0.569	0.000	0.686		6252	8 49 12.20	11 50 22.6	14.115	0.632	0.093	—	
6219	8 49 09.01	11 57 53.8	20.482	0.566	—	—		6253	8 49 11.63	11 58 02.1	18.817	1.557	—	1.870	
6220	8 49 09.75	11 49 17.4	20.489	0.902	-0.353	0.918		6254	8 49 11.52	11 59 57.2	13.898	0.700	0.151	0.746	1457,II44
6221	8 49 08.64	12 03 30.2	18.024	1.431	—	—		6255	8 49 11.42	12 05 29.7	16.919	0.881	0.420	0.949	
6222	8 49 08.65	12 05 14.1	15.323	0.568	-0.039	0.715	1476,III66	6256	8 49 12.08	11 57 20.3	21.038	1.180	—	—	
6223	8 49 09.08	12 01 06.3	16.074	0.961	0.463	0.993	1460,III56	6257	8 49 11.05	12 13 11.1	19.621	1.412	—	—	
6224	8 49 09.29	11 59 39.8	12.705	0.575	0.041	0.663	1456	6258	8 49 12.60	11 54 20.2	20.010	1.598	—	2.307	
6225	8 49 08.17	12 14 29.8	18.724	1.422	—	—		6259	8 49 12.03	12 01 33.9	12.920	0.983	0.692	1.014	
6226	8 49 09.17	12 02 17.2	18.089	1.470	—	—		6260	8 49 12.82	11 52 03.2	18.415	1.026	1.119	1.328	
6227	8 49 08.85	12 07 59.0	20.746	0.715	-0.258	1.310		6261	8 49 12.83	11 52 05.8	18.333	1.195	1.161	1.091	
6228	8 49 08.23	12 15 41.8	12.688	0.622	—	—		6262	8 49 11.73	12 06 07.6	16.295	1.424	1.213	—	
6229	8 49 09.99	11 54 47.0	16.251	0.993	0.765	1.109	1433,II61	(6511)	8 49 11.90	12 02 45.6	10.600	0.34	—	0.283	1466, table 4
6230	8 49 09.16	12 05 38.5	14.593	0.718	0.144	0.747	1477,III69	6263*	8 49 11.97	12 05 07.7	15.584	0.946	0.570	1.071	1475,III68
6231	8 49 09.13	12 07 36.3	14.504	0.846	0.369	—		6264	8 49 11.93	12 05 07.0	19.727	0.840	—	1.351	
6232	8 49 08.64	12 14 54.2	13.904	0.637	-0.025	—		6265	8 49 12.54	11 58 44.0	14.381	0.656	0.112	0.738	1449,II48
6233*	8 49 09.99	11 58 31.2	18.740	1.575	1.031	2.077		6266	8 49 13.11	11 51 45.6	18.627	0.598	-0.016	0.817	
6234	8 49 10.93	11 47 36.6	16.760	0.957	0.624	1.180		6267	8 49 12.48	11 59 31.6	13.960	0.612	0.071	0.684	1453,II45
6235	8 49 09.80	12 01 32.7	20.618	0.683	-0.249	0.829		6268	8 49 13.12	11 51 48.3	18.612	0.659	-0.050	0.788	
6236	8 49 10.90	11 49 53.2	16.575	0.951	0.627	1.068		6269	8 49 12.08	12 04 54.8	15.055	0.775	0.304	0.827	1473,III67
6237	8 49 11.37	11 46 51.5	14.100	0.549	0.037	0.728		6270	8 49 12.71	11 58 13.6	16.648	1.176	1.088	1.341	
6238	8 49 10.44	11 59 05.1	18.912	0.525	-0.176	0.639		6271	8 49 13.57	11 50 27.4	19.648	1.769	—	2.378	
6239	8 49 11.08	11 52 09.0	14.093	0.689	1.104	0.806		6272	8 49 13.41	11 52 48.4	19.312	1.542	—	1.996	
6240	8 49 10.25	12 02 27.3	20.731	1.111	—	2.229		6273	8 49 12.53	12 08 33.6	18.772	1.156	0.107	0.978	
6241	8 49 11.21	11 50 58.6	14.386	0.650	0.076	0.726		6274	8 49 12.17	12 14 10.1	14.228	0.658	-0.041	—	
6242	8 49 09.71	12 09 36.7	19.023	1.574	—	1.976		6275	8 49 13.03	12 05 39.4	18.063	1.419	1.576	1.692	
6243	8 49 11.29	11 52 52.5	17.898	1.477	0.915	1.977		6276	8 49 13.51	12 00 09.1	18.780	1.440	0.315	1.398	
6244	8 49 11.30	11 52 54.0	18.027	1.441	—	2.071		6277	8 49 13.97	11 54 57.3	17.840	1.449	1.111	—	
6245	8 49 11.82	11 47 37.7	18.075	0.530	-0.194	0.752		6278*	8 49 13.84	11 57 04.9	15.472	0.909	0.524	1.077	1439,II52

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
6279	8 49 12.69	12 11 30.6	17.800	1.024	—	—		6313	8 49 15.49	12 04 16.9	12.790	0.584	0.080	0.675	
6280	8 49 14.47	11 50 04.2	16.297	0.950	0.609	1.058		6314	8 49 16.79	11 49 39.0	18.779	1.479	0.865	1.903	
6281	8 49 12.97	12 09 20.9	18.315	1.338	0.586	0.746		6315*	8 49 15.84	12 01 53.7	18.067	1.496	—	1.850	
6282	8 49 12.47	12 15 46.5	17.435	0.846	—	—		6316	8 49 16.30	11 59 32.7	17.461	0.872	0.442	0.946	
6283	8 49 14.67	11 49 59.2	17.576	0.535	-0.055	0.710		6317	8 49 16.96	11 52 27.1	18.426	1.559	0.604	1.854	
6284	8 49 13.02	12 11 29.9	17.799	1.015	0.851	—		6318	8 49 15.99	12 04 24.3	19.255	1.516	—	2.154	
6285	8 49 13.45	12 06 34.9	19.722	0.732	-0.318	0.837		6319	8 49 16.40	12 02 54.3	17.414	1.535	1.171	2.044	
6286*	8 49 14.03	11 59 35.1	16.054	1.057	0.836	1.187	II46	6320	8 49 17.10	11 54 19.1	20.031	0.646	—	—	
6287	8 49 14.07	11 59 42.4	18.955	0.487	-0.239	0.755		6321	8 49 16.39	12 03 48.4	15.224	0.807	0.349	0.857	
6288	8 49 13.91	12 01 56.7	19.823	1.650	—	2.153		6322	8 49 16.16	12 07 26.2	14.340	0.682	0.134	0.756	1483
6289	8 49 13.20	12 10 44.3	18.841	1.235	—	1.089		6323	8 49 17.57	11 51 03.2	19.725	0.858	0.074	0.851	
6290*	8 49 14.81	11 51 38.5	19.180	1.464	—	2.207		6324	8 49 17.93	11 48 28.0	18.345	0.403	-0.206	0.589	
6291	8 49 13.36	12 10 56.9	19.265	1.415	—	1.234		6325	8 49 17.92	11 50 53.8	19.112	0.514	-0.178	0.817	
6292	8 49 14.72	11 54 26.4	19.493	1.570	—	—		6326	8 49 17.44	11 58 53.5	19.817	1.820	—	2.117	
6293	8 49 14.48	11 58 11.9	12.429	0.618	0.063	0.722	1447,II51	6327	8 49 18.46	11 47 28.7	18.583	1.298	—	1.788	
6295	8 49 14.42	11 59 18.8	19.789	0.992	—	1.466		6328	8 49 18.17	11 52 13.2	19.109	1.206	0.576	1.359	
6296	8 49 14.83	11 55 08.1	18.706	1.391	—	—		6329	8 49 18.67	11 47 20.7	14.741	0.649	0.051	0.810	
6297	8 49 14.82	11 55 31.4	18.627	1.167	1.099	—		6330	8 49 17.40	12 05 07.4	18.985	1.435	—	—	
6298	8 49 15.04	11 53 08.0	14.712	0.699	0.203	—		6331	8 49 17.47	12 07 29.2	20.340	1.089	—	1.496	
6299	8 49 14.94	11 55 08.7	16.735	0.919	0.448	—		6332	8 49 18.08	12 00 27.5	13.355	0.577	0.036	0.686	1458,III59
6300	8 49 14.69	11 59 53.0	17.685	1.089	1.139	1.165		6333	8 49 17.89	12 05 19.5	17.770	0.610	-0.289	1.632	
6301	8 49 15.05	11 55 26.9	16.690	0.740	0.196	—		6334	8 49 18.96	11 54 20.0	18.395	1.283	—	—	
6302	8 49 15.35	11 52 05.1	19.498	1.284	—	1.566		6335	8 49 18.92	11 54 56.5	18.579	1.527	—	—	
6303	8 49 14.73	11 59 33.9	15.530	0.891	0.542	0.920	1455,II47	6336	8 49 18.73	11 57 23.0	13.151	0.572	0.016	0.683	1441,II122
6304	8 49 14.86	11 58 11.2	19.493	0.266	0.254	—		6337	8 49 19.52	11 48 48.0	20.170	0.715	-0.090	0.710	
6305	8 49 14.47	12 03 34.4	15.240	0.843	0.394	0.871		6338	8 49 18.95	11 56 23.1	15.994	0.709	0.162	0.855	
6306	8 49 14.68	12 01 21.6	14.318	0.674	0.143	0.797		6339	8 49 19.32	11 51 48.4	18.871	1.330	—	1.619	
6307	8 49 15.27	11 54 48.1	17.730	1.448	1.166	—		6340	8 49 19.31	11 53 59.6	15.262	0.802	0.274	—	
6308	8 49 14.72	12 02 09.0	19.524	1.267	—	1.387		6341	8 49 18.27	12 06 53.6	14.786	0.711	—	—	
6309	8 49 13.68	12 16 00.8	19.523	1.138	—	—		6342	8 49 19.45	11 53 57.1	16.381	1.063	0.906	—	
6310	8 49 15.02	12 00 29.0	19.811	0.644	-0.327	0.902		6343	8 49 19.59	11 52 42.9	12.699	0.561	0.002	0.695	
6311	8 49 14.88	12 02 33.3	15.154	0.819	0.363	0.870	1465,III60	6344	8 49 19.50	11 55 41.7	19.727	1.737	—	—	
6312	8 49 16.53	11 48 23.3	18.985	1.502	—	1.627		6345*	8 49 20.34	11 47 19.0	16.204	1.156	0.871	1.264	
(6513)	8 49 15.32	12 37 12.0	10.02	1.23	—	1.25	1533, table 4	6346	8 49 19.95	11 52 42.6	19.555	0.499	—	—	
(6512)	8 49 15.35	12 06 24.0	10.55	1.10	—	1.06	1479, table 4	6347	8 49 19.44	11 59 07.3	14.578	0.672	0.115	0.746	1452,II125

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
6348	8 49 19.28	12 02 55.5	19.239	1.346	—	—		6383	8 49 25.24	11 48 17.7	17.262	1.294	0.922	1.549	
6349	8 49 20.02	11 54 28.4	17.481	1.056	0.907	—		6384	8 49 24.38	11 59 29.8	14.710	0.736	0.211	0.779	
6350	8 49 19.97	11 56 21.1	17.562	1.376	1.186	—		6385	8 49 24.28	12 01 17.8	16.548	1.081	0.925	1.188	
6351	8 49 20.28	11 53 26.0	20.200	1.479	—	—		6386	8 49 24.67	11 56 57.8	20.826	0.170	—	—	
6352	8 49 20.49	11 54 14.9	17.598	1.328	1.126	—		6387	8 49 24.54	11 59 35.2	13.762	0.581	-0.015	0.673	2211
6353	8 49 20.63	11 55 09.0	20.473	0.856	—	—		6388	8 49 25.50	11 50 07.0	15.051	0.775	0.278	0.856	
6354	8 49 19.90	12 04 48.9	17.190	0.622	-0.022	0.725		6389	8 49 24.25	12 06 59.8	13.094	0.749	0.208	0.826	1482
6355	8 49 20.12	12 06 02.4	16.525	0.616	0.023	0.724		6390	8 49 24.33	12 06 54.1	19.862	0.913	—	—	
6356	8 49 21.64	11 48 02.0	19.240	0.552	-0.201	0.607		6391	8 49 24.47	12 06 06.2	20.564	1.129	—	—	
6357	8 49 20.89	11 58 57.3	15.016	0.780	0.278	0.836	1450,II126	6392	8 49 25.06	11 59 20.5	18.784	0.700	0.111	0.871	
6358	8 49 20.97	11 58 50.8	19.836	0.520	-0.243	0.545		6393	8 49 25.97	11 49 27.1	20.104	1.423	—	1.441	
6359	8 49 21.81	11 50 10.0	15.561	0.698	0.164	0.765		6394	8 49 25.97	11 49 31.6	17.787	0.881	0.370	0.958	
6360	8 49 20.94	12 04 28.7	18.632	1.496	—	1.848		6395	8 49 25.57	11 58 05.5	14.036	0.615	0.050	0.718	1446
6361	8 49 21.47	11 58 03.1	15.589	0.779	0.314	0.835	1445,II124	6396	8 49 26.71	11 47 06.5	17.505	1.534	—	2.312	
6362	8 49 21.82	11 53 43.8	13.701	0.596	-0.049	—		(6510)	8 49 26.73	11 55 25.2	10.70	0.11	—	—	1434, table 4
6363	8 49 22.46	11 48 50.2	14.689	0.720	0.130	0.808		6397	8 49 25.99	11 56 30.6	17.156	0.950	0.562	1.030	
6364	8 49 22.37	11 50 00.1	13.414	0.567	0.000	0.686		6398	8 49 26.64	11 49 49.6	16.692	0.642	0.013	0.782	
6365	8 49 21.46	12 02 18.8	19.029	0.737	—	—		6399	8 49 25.94	11 58 44.1	17.498	1.304	1.241	1.502	
6366	8 49 21.49	12 07 04.1	19.740	1.557	—	—		6400	8 49 26.59	11 56 05.6	18.847	1.304	—	—	
6367	8 49 22.46	11 59 27.2	18.680	0.741	-0.082	0.776		6401	8 49 25.81	12 06 48.5	17.358	1.625	0.847	—	
6368	8 49 22.43	12 04 15.2	20.871	0.458	—	1.219		6402	8 49 26.19	12 04 17.9	19.107	1.517	—	2.419	
6369	8 49 23.03	11 57 53.6	19.709	1.766	—	1.859		6403	8 49 26.32	12 04 18.0	16.243	1.357	1.192	1.562	
6370	8 49 23.24	11 58 28.3	14.765	0.614	0.054	0.735	1448	6404	8 49 26.26	12 06 19.6	18.359	1.474	—	1.888	
6371	8 49 23.06	12 00 44.7	13.410	0.582	0.034	0.680		(6508)	8 49 27.14	11 43 09.3	10.93	1.15	—	1.14	1402, table 4
6372	8 49 23.00	12 04 28.7	20.174	1.414	—	1.854		6405	8 49 27.44	11 51 51.4	14.234	0.618	0.064	0.732	
6373	8 49 23.18	12 02 50.7	19.369	1.416	—	2.068		6406	8 49 27.57	11 51 49.8	18.982	0.933	—	—	
6374	8 49 23.31	12 01 41.4	13.220	0.604	0.075	0.699		6407	8 49 28.02	11 46 36.9	19.679	0.858	0.704	1.061	
6375	8 49 23.80	11 56 54.5	16.367	0.640	0.044	0.841		6408	8 49 27.32	11 56 57.3	12.889	0.817	0.310	0.870	1438
6376	8 49 23.28	12 03 24.7	17.562	1.592	1.112	2.017		6409	8 49 27.44	12 00 03.9	18.536	1.508	—	1.849	
6377	8 49 24.56	11 48 40.9	15.256	0.617	-0.016	0.792		6410	8 49 27.02	12 07 35.3	19.681	0.908	—	—	
6378	8 49 23.49	12 02 33.6	19.291	0.534	-0.095	0.708		6411	8 49 28.60	11 48 58.0	17.816	1.404	0.969	1.587	
6379	8 49 24.56	11 50 50.3	16.512	1.079	0.871	1.236		6412	8 49 28.76	11 48 14.2	19.588	1.438	—	2.127	
6380	8 49 23.76	12 01 09.3	13.833	0.615	0.035	0.687		6413	8 49 27.09	12 08 54.8	17.952	0.448	-0.207	0.713	
6381	8 49 24.35	11 55 07.9	20.053	0.567	-0.368	—		6414	8 49 27.16	12 08 47.7	17.197	1.142	0.963	1.296	
6382*	8 49 24.08	12 02 24.3	19.533	1.562	—	2.263		6415*	8 49 29.04	11 48 24.2	17.803	1.426	1.167	1.745	

TABLE 3. (continued)

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments	MMJ#	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I	comments
6416	8 49 28.50	11 55 49.8	19.490	0.584	-0.252	—		6444	8 49 29.82	12 07 01.3	20.859	1.127	—	—	
6417	8 49 28.20	12 00 48.4	17.373	1.306	1.170	1.404		6445	8 49 29.52	12 11 32.8	21.053	1.039	—	1.610	
6418	8 49 27.40	12 11 10.9	19.511	0.440	-0.058	1.701		6446	8 49 30.16	12 04 49.8	19.620	1.661	—	2.066	
6419	8 49 27.93	12 04 57.8	15.803	0.858	0.409	0.894		6447	8 49 29.65	12 12 23.1	19.188	0.540	—	0.561	
6420	8 49 27.59	12 11 12.2	20.830	0.544	—	—		6448	8 49 29.71	12 11 59.5	16.101	0.519	—	0.643	
6421	8 49 28.03	12 06 34.9	20.940	0.630	—	1.558		(6515)	8 49 30.02	11 30 57.0	10.12	1.30	—	1.27	1557, table 4
6422*	8 49 28.92	11 56 48.3	18.556	1.474	1.161	2.048		6449	8 49 31.74	11 47 22.5	20.069	0.600	-0.232	0.860	
6423	8 49 28.37	12 03 52.9	14.120	0.724	0.198	0.812	1470	6450	8 49 31.87	11 47 07.9	16.477	0.579	-0.051	0.773	
6424*	8 49 29.46	11 50 33.3	18.352	1.606	1.151	2.023		6451	8 49 31.94	11 47 07.1	19.901	1.601	—	—	
6425	8 49 29.66	11 49 03.6	18.991	0.829	0.310	1.100		6452*	8 49 31.61	11 51 16.3	16.061	1.010	0.698	1.165	
6426	8 49 28.38	12 06 17.0	15.392	0.591	—	0.693		6453	8 49 30.51	12 08 59.4	17.383	1.064	0.894	1.154	
6427	8 49 28.84	12 01 05.8	17.150	1.139	0.786	1.370		6454	8 49 30.75	12 06 57.3	20.309	0.540	-0.025	1.038	
6428	8 49 28.45	12 06 55.8	18.380	1.105	0.977	1.330		6455	8 49 31.76	11 54 23.7	18.128	0.739	0.119	—	
6429	8 49 29.92	11 49 36.4	18.939	0.959	0.387	1.072		6456	8 49 30.55	12 09 57.8	19.866	1.883	—	2.079	
6430	8 49 29.39	11 57 20.7	13.457	0.514	-0.064	0.614		6457	8 49 30.43	12 11 42.0	20.711	1.388	—	2.208	
6431	8 49 29.73	11 53 22.1	20.020	1.186	—	—		6458	8 49 31.17	12 03 02.4	17.439	1.430	0.857	2.242	
6432	8 49 29.12	12 01 53.3	20.199	0.595	-0.275	0.915		6459	8 49 31.77	11 57 51.4	15.010	0.748	0.204	0.834	
6433	8 49 28.46	12 11 38.3	20.867	0.744	—	0.802		6460	8 49 31.28	12 04 21.1	14.537	0.684	0.136	0.768	1616
6434	8 49 29.83	11 54 28.4	16.650	0.573	-0.149	—		6461	8 49 31.20	12 07 11.7	15.925	0.654	-0.044	0.735	
6435	8 49 28.78	12 08 17.8	19.792	1.333	—	1.402		6462	8 49 31.97	11 57 53.7	18.942	1.554	0.526	—	
6436	8 49 28.91	12 08 20.3	17.914	1.088	0.957	1.255		6463	8 49 32.84	11 47 18.7	17.963	1.526	1.077	2.079	
6437	8 49 29.20	12 08 33.0	17.636	1.366	1.095	1.636		6464	8 49 31.22	12 07 48.4	17.996	0.882	0.312	0.912	
6438	8 49 30.43	11 53 24.6	18.265	1.415	1.123	—		6465	8 49 32.33	11 55 32.7	16.672	1.124	0.960	—	
6439	8 49 30.70	11 50 17.1	18.868	0.530	-0.168	0.665		6466	8 49 31.42	12 08 45.5	20.218	0.878	—	0.993	
6440	8 49 30.64	11 52 43.2	20.369	1.282	—	1.526		6467	8 49 32.67	11 53 49.5	13.517	0.536	-0.045	—	
6441*	8 49 30.36	11 57 52.4	15.807	0.969	0.487	1.119		6468	8 49 33.09	11 52 29.0	16.919	1.676	1.066	2.664	
6442	8 49 31.00	11 51 22.8	19.224	0.685	-0.085	0.826		(6516)	8 49 34.57	11 55 46.7	10.47	1.12	—	1.04	1592, table 4
6443	8 49 30.17	12 02 11.5	14.248	0.775	0.260	0.833	1608	(6514)	8 49 46.90	11 26 53.1	8.74	1.67	—	2.06	1553, table 4

TABLE 4. Bright stars.

MMJ#	α (1950.0)	δ (1950.0)	V	B-V	V-I	Source	Comments
6469	8 46 51.02	12 02 45.0	9.53	1.38	1.33	JS	258
6470	8 47 12.90	11 52 86.0	9.84	1.36	1.30	JS	364
6471	8 47 27.70	12 02 45.0	8.86	1.59	1.67	JS	488
6472	8 47 34.04	12 06 34.9	9.98	1.10	1.09	JS	494
6473	8 47 59.49	11 47 04.8	11.57	0.68	—	M	590
6474	8 47 36.12	12 32 30.0	10.52	1.23	1.15	JS	676
6475	8 48 05.72	11 46 24.5	11.24	1.10	1.07	JS	721
6476	8 48 19.43	11 56 18.3	11.32	0.295	0.379	ES	752
6477	8 48 11.49	12 03 30.3	12.04	0.60	0.671	ES	792
6478	8 48 16.81	12 12 40.6	11.52	0.70	—	M	838
6479	8 48 42.41	11 55 08.2	11.28	0.13	0.179	ES	968
6480	8 48 30.30	11 56 17.3	11.078	0.43	0.534	S	975
6481	8 48 27.72	11 56 38.8	10.03	-0.073	—	ES	977
6482	8 48 31.96	11 56 40.8	9.72	1.37	1.36	JS	978
6483	8 48 37.50	11 57 23.4	11.44	1.06	1.05	JS	989
6484	8 48 23.70	11 59 25.7	11.55	0.41	0.514	ES	1013
6485	8 48 38.71	11 59 19.0	10.48	1.11	1.08	JS	1010
6486	8 48 33.00	11 59 33.1	10.30	1.26	1.23	JS	1016
6487	8 48 42.75	11 59 58.0	10.544	0.57	0.627	G	1023
6488	8 48 39.66	12 01 06.6	11.52	0.87	0.91	JS	1040
6489	8 48 32.90	12 02 03.4	11.20	1.08	1.08	JS	1054
6490	8 48 42.88	12 03 10.1	10.99	0.11	0.128	ES	1066
6491	8 48 37.60	12 03 55.1	11.315	0.61	0.720	S	1072
6492	8 48 28.53	12 03 59.1	10.59	1.12	1.09	JS	1074
6493	8 48 36.62	12 04 43.3	11.251	0.415	0.529	ES	1082
6494	8 48 42.01	12 05 09.4	10.48	1.10	—	S	1084
6495	8 48 33.92	12 29 27.6	9.37	1.48	1.50	JS	1135
6496	8 49 02.19	11 47 36.2	11.26	0.62	—	M	1190
6497	8 48 59.52	11 55 44.9	10.76	1.13	1.10	JS	1221
6498	8 49 06.15	11 57 25.7	10.78	0.94	0.96	JS	1237
6499	8 48 45.83	11 58 34.5	9.69	1.36	1.33	JS	1250
6500	8 49 01.00	11 59 04.0	11.52	1.05	—	JS	1254
6501	8 48 48.51	12 00 09.9	11.063	0.19	0.262	G	1263
6502	8 48 58.23	12 01 26.0	11.63	1.05	—	JS	1277
6503	8 48 44.87	12 01 50.7	10.55	1.12	1.09	JS	1279
6504	8 48 50.20	12 02 28.4	10.940	0.22	0.318	G	1284
6505	8 48 58.23	12 02 41.3	11.33	1.07	—	JS	1288
6506	8 48 59.68	12 08 00.8	10.58	1.10	1.08	JS	1316
6507	8 48 52.95	12 10 20.7	11.103	0.85	0.855	M	1327
6508	8 49 27.14	11 43 09.3	10.93	1.15	1.14	JS	1402
6509	8 49 10.95	11 51 45.4	11.721	0.51	0.782	M	1425
6510	8 49 26.73	11 55 25.2	10.70	0.11	—	ES	1434
6511	8 49 11.90	12 02 45.6	10.600	0.34	0.283	M	1466
6512	8 49 15.35	12 06 24.0	10.55	1.10	1.06	JS	1479
6513	8 49 15.32	12 37 12.0	10.02	1.23	1.25	JS	1533
6514	8 49 46.90	11 26 53.1	8.74	1.67	2.06	JS	1553
6515	8 49 30.02	11 30 57.0	10.12	1.30	1.27	JS	1557
6516	8 49 34.57	11 55 46.7	10.47	1.12	1.04	JS	1592

The photometry of stars located on overlapping frames was compared, in order to check the zero point shifts of the frames relative to one another and to evaluate the random errors of the photometry. For each filter the mean zero point and mean rms deviation were found and are given in Table 6, along with the number of frames used in the comparison. Table 6 shows that the zero points match very well.

Another test of the internal errors of the photometry was to examine the errors associated with the solution of the least-squares fit for stars which occur on more than three separate frames, most of the stars with multiple observations are located on the central frame or in the regions of overlap between frames. Figure 1 shows a plot of the standard deviations of the magnitude measurements vs V magnitude and $B-V$ colors. As expected, the errors increase with fainter magnitudes and the $U-B$ colors show the greatest errors.

2.3 Comparison with Previous Studies

We have compared our transformed magnitudes to previously published photometry from five independent studies. The five studies span a period of almost 30 yr, several types of detectors, and various sets of standard stars. Eggan & Sandage (1964) used photoelectric photometry calibrated by standards within M67 which in turn had been calibrated by *UBV* standards of Johnson & Morgan (1953). Racine's (1971) photographic photometry and Gilliland's CCD photometry were both calibrated against Eggen and Sandage stars. The Chevalier & Ilovaisky (1991) CCD photometry was referenced to the Joner and Taylor stars. And Sanders (1989) used photoelectric photometry calibrated with Landolt standard stars. Our magnitudes are tabulated to the nearest thousandth of a magnitude, but in all the studies except for Chevalier & Ilovaisky (1991) the magnitudes were tabulated only to the nearest hundredth of a magnitude.

The results of these comparisons are shown in Figs. 2–6 where the residuals are in the sense: our photometry minus the previously published values. We also list the mean and the standard deviation of the residuals about the mean.

The only systematic variations between datasets in Figs. 2–6 appear in the residuals of $B-V$ with respect to the $B-V$ color in the comparison with Gilliland and with Sanders. Sanders used Landolt stars as standards, but his published photometry was a combination of photometry from up to five previous sources, so the origin of the systematic trend in his $B-V$ data cannot be traced. A comparison of the $B-V$ residuals vs $B-V$ color between Gilliland, and Chevalier and Ilovaisky, shows the same linear shift with $B-V$ color as in Fig. 4, indicating that the problem lies in the Gilliland data. The best agreement is between our data and the Chevalier and Ilovaisky data, both of which are based on CCD photometry using the Joner and Taylor stars for standards. The zero point differences between datasets are within the range expected when accounting for internal and roundoff errors, and the standard deviations are those expected for adding independent datasets each with standard deviations on the order of 0.01 mag.

3. A NEW STANDARD SEQUENCE

In recent years, M67 has increasingly been used as a source of photometric standard stars. Schild (1983), and Taylor & Joner (1985) set up stellar photometric sequences in the dipper asterism to be used in CCD photometry, since at that time the existing Landolt (1983) standards were too sparse and mostly too bright to be convenient for CCD work, and since M67 provides the opportunity to image stars with a wide range of colors on a single frame. The usefulness of M67 as a standard star field, however, has been limited somewhat by the fact that Taylor and Joner observed only in V, R, and I, and by the reported discrepancies in some of Schild's data. Landolt's latest compilation of faint *UBVRI* standard (1992) has eased the situation a great deal, but a standard sequence in M67 is still desirable, not only as a quick reference field for general photometry but also for future studies of the cluster itself.

TABLE 5. Sanders to MMJ cross references.

Sanders	MMJ#	Sanders	MMJ#	Sanders	MMJ#	Sanders	MMJ#	Sanders	MMJ#	Sanders	MMJ#
492	5520	948	5600	1015	5577	1081	5800	1252	6073	1441	6336
729	5336	949	5533	1017	5478	1083	5825	1253	5847	1445	6361
730	5348	950	5680	1018	5764	1085	5539	1255	5995	1446	6395
731	5335	951	5489	1019	5748	1086	5588	1256	6039	1447	6293
733	5249	952	5497	1021	5522	1087	5753	1260	5937	1448	6370
735	5402	953	5797	1024	5739	1088	5601	1261	6130	1449	6265
736	5389	954	5640	1025	5508	1089	5532	1262	5992	1450	6357
737	5347	956	5633	1026	5499	1090	5526	1264a	5877	1451	6190
740	5354	959	5636	1027	5781	1091	5470	1264b	5882	1452	6347
741	5313	959	5727	1028	5563	1092	5838	1265	6065	1453	6267
742	5393	960	5623	1029	5709	1093	5656	1266	5978	1455	6303
746	5261	962	5817	1030	5803	1189	5900	1268	6177	1456	6224
747	5414	963	5595	1031	5741	1201	5989	1269	6080	1457	6254
748	5340	964	5622	1032	5813	1203	5981	1270	6166	1458	6332
750	5264	965	5769	1033	5567	1206	6088	1271	5969	1460	6223
753	5243	966	5704	1034	5644	1209	6041	1272	6089	1465	6311
754	5372	967	5629	1035	5657	1210	5845	1273	6047	1470	6423
756	5388	969	5705	1036	5833	1212	6139	1274	5925	1472	6248
757	5405	970	5719	1038	5666	1213	6031	1275	6018	1473	6269
758	5334	971	5810	1039	5459	1214	6049	1278	5869	1475	6263
759	5392	972	5615	1041	5807	1215	5841	1280	5940	1476	6222
760	5263	973	5583	1042	5457	1216	6076	1281	5972	1477	6230
761	5367	974	5552	1043	5547	1217	6161	1282	6027	1482	6389
762	5378	976	5695	1044	5511	1218	5966	1283	5873	1483	6322
764	5317	979	5691	1045	5654	1219	5863	1285	6158	1608	6443
766	5328	981	5594	1046	5625	1220	6125	1286	5952	1616	6460
769	5319	982	5776	1048	5829	1222	6142	1287	5917	2201	5365
770	5357	983	5437	1049	5573	1223	6068	1289	5879	2202	5551
771	5332	984	5699	1050	5639	1224a	6176	1292	5961	2203	6084
773	5377	985	5505	1051	5685	1224b	6175	1293	6050	2204	5688
775	5371	986	5624	1052	5534	1225	6135	1294	5910	2205	5679
776	5413	987	5608	1053	5544	1226	6112	1296	6195	2206	5591
781	5362	990	5464	1055	5471	1227	6046	1297	5857	2207	5929
783	5422	991	5485	1056	5580	1229	5904	1298	6085	2208	5927
785	5346	993	5441	1057	5683	1230	6103	1299	6071	2209a	5760
787	5387	994	5716	1060	5651	1231	5855	1300	6060	2209b	5763
789	5408	995	5675	1061	5546	1232	5837	1301	6048	2211	6387
794	5318	996	5835	1062	5733	1233	6106	1302	5926	2212	5884
795	5391	997	5667	1063	5542	1234	5896	1304	5924	2213	5517
796	5412	998	5610	1064	5718	1235	5964	1305	5997	2214	5370
797	5419	999	5643	1065	5831	1236	5948	1307	5949	2215	6005
801	5424	1000	5756	1067	5455	1239	6107	1308	5864	2216	5770
802	5360	1002	5518	1068	5578	1240	6134	1309	6008	2217	5646
806	5350	1003	5562	1069	5853	1242	5993	1310	6077	2220	5597
940	5530	1004	5768	1070	5671	1243	6090	1311	5956	2221	5559
941	5771	1005	5571	1071	5842	1244	6058	1312	6015	2222	5524
942	5444	1006	5820	1073	5795	1245	6114	1313	6019	2223	5871
943	5828	1007	5790	1075	5692	1246	5922	1314	5932	2224	5454
944	5794	1009	5653	1076	5586	1247	6010	1433	6229		
945	5744	1011	5844	1077	5451	1248	5963	1436	6199		
946	5698	1012	5777	1078	5826	1249	6144	1438	6408		
947	5730	1014	5788	1079	5725	1251	6160	1439	6278		

We have selected a sample of stars in the cluster which appear to be suitable standards based on the following criteria.

(1) The star is brighter than $m_V = 14.0$.

(2) The star is located within 5 arcmin of the center of the cluster, (defined to be at $\alpha = 8\ 48\ 42.75$ and $\delta = 11\ 59\ 58.0$, 1950.0).

TABLE 6. Frame-to-frame residuals.

	V	B	U	I
Zero Pt.	0.002	0.002	-0.001	0.000
rms dev.	0.012	0.011	0.038	0.016
# frames	35	35	35	27

(3) Magnitudes for the star were measured on at least 4 separate frames in this study.

(4) Published photometry from at least 2 other sources exists for the star.

(5) Mean V and $B-V$ magnitudes derived from the available data have standard deviations of less than 15 mmag.

(6) The star is not listed as a known variable. Criteria 3, 4, and 5 provide some check against this, but sensitive time series studies (Gilliland & Brown 1988; Gilliland *et al.* 1991; Gilliland & Brown 1992) have identified a number of short period variable stars in M67. We have used those studies as a check against low-level variability. For instance, our star 5855, Gilliland's No. 42, is listed as having

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TABLE 7. Standard stars.

MMJ#	Fig ID	α (1950.0)	δ (1950.0)	V	B-V	U-B	V-I
6505	1	8 48 58.23	12 02 41.3	11.328	1.072	0.910	—
6504	2	8 48 50.20	12 02 28.4	10.968	0.238	0.214	0.318
5871	3	8 48 45.73	12 02 47.9	13.316	0.494	-0.016	0.640
6503	4	8 48 44.87	12 01 50.7	10.553	1.121	1.014	1.090
6489	5	8 48 32.90	12 02 03.4	11.184	1.077	0.939	1.080
5559	6	8 48 30.30	12 01 57.2	13.403	0.575	0.068	0.683
5534	7	8 48 28.54	12 01 51.4	13.669	0.562	0.079	0.694
5573	8	8 48 31.22	12 01 31.3	12.812	0.563	0.091	0.680
5813	9	8 48 42.43	12 00 37.8	13.499	0.569	0.060	0.700
5781	10	8 48 40.86	12 00 18.2	13.259	0.596	0.056	0.697
5739	11	8 48 38.82	12 00 06.7	12.711	0.565	0.004	0.678
6487	12	8 48 42.75	11 59 58.0	10.512	0.584	0.044	0.627
5844	13	8 48 44.62	11 59 19.8	13.830	0.636	0.084	0.803
6485	14	8 48 38.71	11 59 19.0	10.479	1.104	1.003	1.070
6486	15	8 48 33.00	11 59 33.1	10.305	1.264	1.320	1.221
5522	16	8 48 28.12	11 59 51.5	13.903	0.578	0.064	0.688
6499	17	8 48 45.83	11 58 34.5	9.685	1.357	1.464	1.330
5571	18	8 48 31.36	11 58 48.4	12.668	0.507	0.057	0.599
5562	19	8 48 30.68	11 58 40.9	12.821	0.566	0.081	0.655
5667	20	8 48 35.84	11 58 17.5	12.125	0.459	0.021	0.556
5675	21	8 48 36.06	11 57 58.9	12.770	0.559	0.036	0.661
5688	22	8 48 36.52	11 57 33.6	12.895	0.454	0.007	0.568
6483	23	8 48 37.50	11 57 23.4	13.186	0.577	0.068	0.682
5679	24	8 48 36.28	11 57 09.6	13.154	0.574	0.049	0.675
5624	25	8 48 33.94	11 57 11.2	12.728	0.564	0.065	0.685
5896	26	8 48 47.20	11 57 08.4	12.649	0.577	0.029	0.700
5695	27	8 48 36.76	11 56 19.7	13.097	0.609	0.080	0.709
6482	28	8 48 31.96	11 56 40.8	9.711	1.373	1.539	1.352
6481	29	8 48 27.72	11 56 38.8	10.027	-0.086	-0.385	-0.068
5464	30	8 48 24.56	11 57 28.2	13.424	0.576	0.038	0.689

a variability of 0.0028 mag. It meets our criteria 1–5, but has been excluded from our list.

The stars fitting the above criterion are listed in Table 7. The star numbers in column 1 refer to Table 3, while column 2 numbers are only to identify stars in the finding chart, Fig. 7. The finding chart, Fig. 7, is a 30 s exposure through a V filter with north up and east to the left. The star number given on the chart refers to the star nearest the number.

As we noted earlier, our measurements seem to be on the same photometric system as other studies, and since we have deliberately chosen stars for which the internal errors are small, the tabulated values are simple means of our data combined with published data from Eggen & Sandage (1964), Janes & Smith (1984), Gilliland *et al.* (1991), Racine (1971), Chevalier & Ilovaisky (1991), and Joner & Taylor (1990). All data except Racine's were weighted equally. Due to the higher scatter in Racine's photographic magnitudes, his photometry was weighted half as much as the rest. For $U-B$ and $V-I$ colors all available data were used. The stars in the sample span a range of colors from $B-V$ of -0.09 to 1.37 as well as V magnitudes from 9.69 to 13.90. Subsets of this set of standards should thus be useful regardless of telescope configuration or CCD size. Further work to investigate possible low-level light variations, of the kind found by Gilliland *et al.* (1991) would still be of value to confirm the constancy of these standards, however.

4. DATA ANALYSIS

4.1 Color–Magnitude and Color–Color Diagrams

A V, $B-V$ color–magnitude diagram, for all 1468 stars listed in Table 3, is shown in Fig. 8. A distinct main sequence extends to the limit of the photometry at $V=20$th magnitude. Because of the large area covered by the survey, the color–magnitude diagram also includes a large number of field stars, especially at fainter magnitudes. A visual comparison between our color–magnitude diagram and the color–magnitude diagram of Gilliland *et al.* (1991), gives the appearance that Gilliland's diagram has a slightly tighter main-sequence ridge line. This is to be expected since Gilliland's random errors are smaller than ours, and in the outer regions of our survey most stars were only observed once. Further, our much larger field also means the cluster sequences are contaminated with many field stars.

The main sequence is more readily apparent when looking at the V vs $V-I$ plot in Fig. 9. There are fewer stars in Fig. 9 than Fig. 8 because the I band was not observed during the November observing run, and some fields were missed near the outer edge of the cluster.

Figure 10 is the color–magnitude diagram of the stars which Girard *et al.* (1989) found to be proper motion members of the cluster at the 90% probability level. To the limit of the proper motions near $m_V=16$, almost all stars in the region are cluster members, since only a few of the brighter stars in Fig. 8 are missing from Fig. 10. However, there are no stars below the main sequence in Fig. 10, so the large number of faint stars below the main sequence in Figs. 8 and 9 are presumably nonmembers.

The $U-B$, $B-V$ two-color diagram for M67 main-sequence stars is shown in Fig. 11. The diagram includes only stars with V magnitudes between 14 and 18 that are within 0.2 mag of the main sequence. While some cluster members may have been excluded, the large majority of stars in Fig. 11 should be cluster members. Also shown in Fig. 11 is the Schmidt-Kaler (1982) empirical two-color curve shifted to fit the observed sequence. The same stars on the main sequence between V magnitudes of 14 and 18, are also shown in a $B-V$ vs $V-I$ diagram in Fig. 12.

Using the reddening line coefficients given by Crawford & Mandwewala (1976) it was not possible to match the Schmidt-Kaler line and the observed cluster sequence without adding an ultraviolet excess $\delta(U-B)=0.025$ to the reddening of $E(B-V)=0.05$. The estimated errors in reddening and ultraviolet excess are 0.01 mag each.

The value of $E(B-V)=0.05$ found here is consistent with other reddening estimates found for the cluster. Eggen & Sandage (1964) derived a value of 0.06, Racine (1971) found a value of 0.09, Nissen *et al.* (1987) using *uvbyHβ* photometry found a value of 0.032, and Taylor (1978), in an exhaustive analysis, found $E(B-V)=0.053 \pm 0.005$. For the $U-B$ color excess Janes & Smith (1984), using DDO photometry, found a $\delta(U-B)=0.056\pm0.006$ for giant branch stars.

The metallicity for the cluster can be estimated using $\delta(U-B)$ at $B-V=0.6$. Cameron (1985) fit a second-order polynomial through data from clusters with known metallicity and $\delta(U-B)_{0.6}$ to find a relation between [Fe/H] and $\delta(U-B)_{0.6}$. Using Cameron's relation and $\delta(U-B)=0.025$ the metallicity of M67 is [Fe/H] $=-0.05$, a value consistent with Janes & Smith (1984), who found [Fe/H]$=-0.05\pm0.03$, and Hobbs & Thorburn

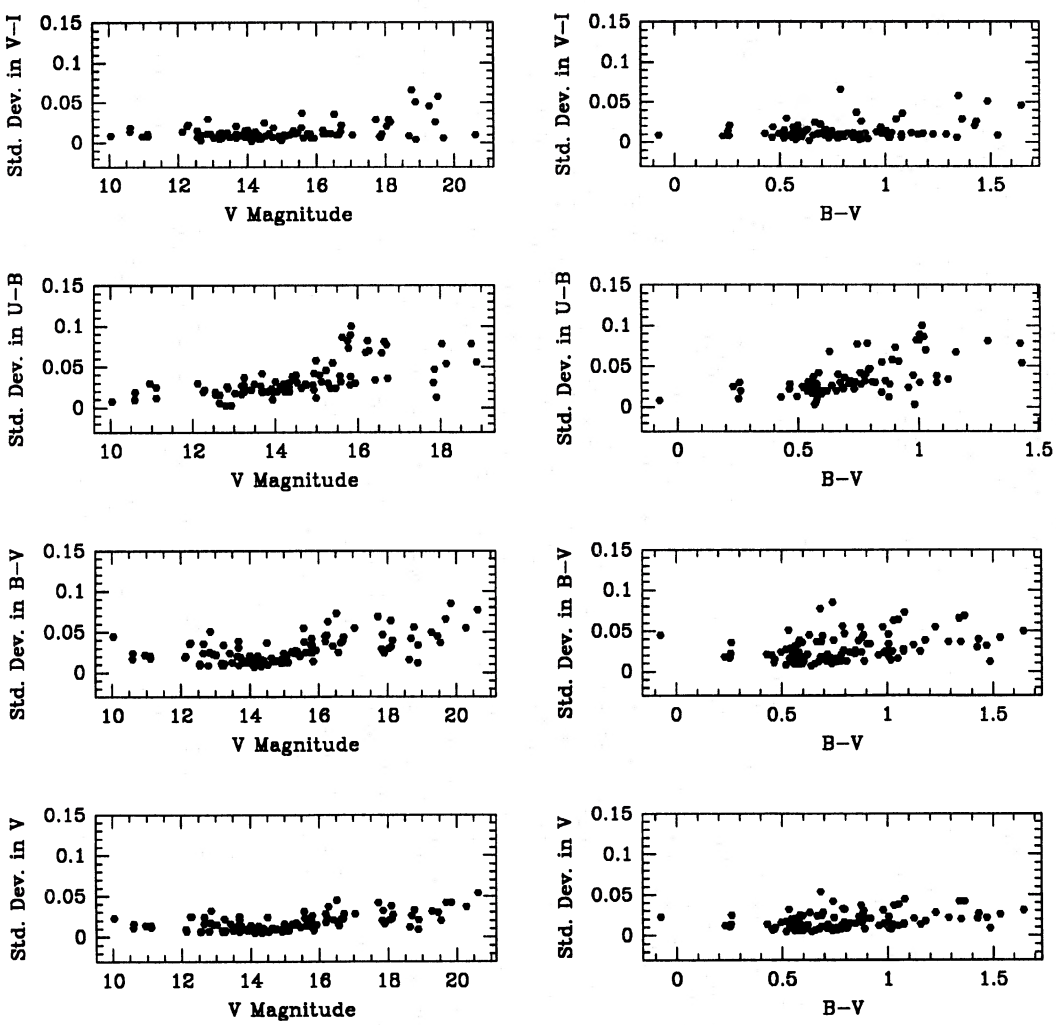

FIG. 1. Plot of the standard deviations in V magnitude and $B-V$, $U-B$, and $V-I$ colors vs both V magnitude and $B-V$ color for stars in which more than one measurement was obtained.

(1991) who used spectra of five stars near the cluster turnoff point to derive a value of $[Fe/H]=-0.04\pm0.12$.

4.2 Isochrones

Having specified the reddening and metallicity of M67, we can determine the age and distance modulus of the cluster by fitting isochrones to the data. We first compared our photometry with the theoretical isochrones of Castellani *et al.* (1992, hereafter referred to as C92). The C92 isochrones are based on computed stellar models with $Z=0.02$, $Y=0.27$, and $\alpha=1.6$ determined by a comparison with standard solar data. Transformations to the V, $B-V$ plane were based on the CCD-compatible color–temperature relations defined for stars of solar temperature or cooler by Arribas & Martinez (1989) and for stars of higher temperature by Buser & Kurucz (1978). Bolometric corrections for these transformations were taken from VandenBerg (1983).

Figure 13 shows our data near the turnoff point as well as the 3, 4, and 6 billion yr isochrones from C92, matched to our data using $E(B-V)=0.05$. From the fitting, a distance modulus of $(m-M)_V=9.60$ is appropriate, along with a cluster age (from the main sequence turnoff) between 3 and 4 billion yr. However, none of the isochrones matches the red giant branch, the theoretical isochrones being bluer than the observed colors. The observed colors of the clump stars, like those of the giants, are redder than theoretical predictions.

Castellani *et al.* (1992) defined two methods for determining a cluster's age from its color–magnitude diagram. The first method is to use the difference in magnitudes between the $B-V$ color of the turnoff and the color of the red giant branch at the level of the clump stars; the second method is the V magnitude difference between the brightest point of the turnoff and the clump stars. We derive an age of 3.6 billion yr from the $B-V$ color difference using the color of the turnoff as $B-V=0.53$ and the color of the red giant branch at the clump of $B-V=1.09$. An age of

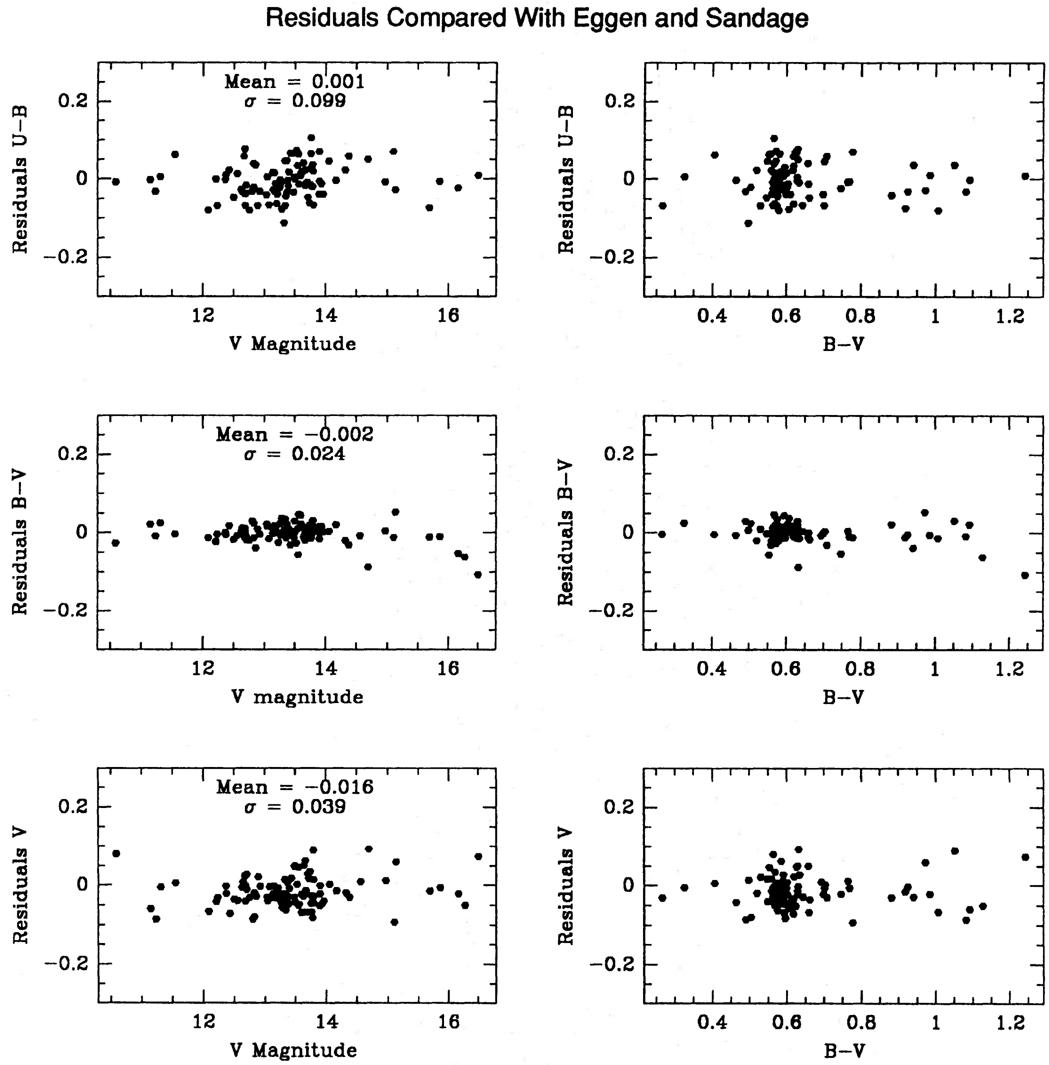

FIG. 2. Comparison of the residuals obtained when comparing our photometry and that of Eggen & Sandage (1964). The residuals are in the form of ours minus theirs. Also given is the mean and the standard deviation about the mean.

3.4 billion yr was derived using the V magnitude difference between the clump stars at $V=10.55$ and the turnoff at $V=12.63$. Though the locations of the turnoff color and brightest V magnitude at the turnoff are poorly defined because of confusion with the binary star sequence, these ages do agree well with the age determined by straightforward isochrone fitting.

A second comparison was made with isochrones from VandenBerg (1985, hereafter referred to a V85). The V85 solar-type models were computed with $Y=0.25$, $Z=0.0169$, and $\alpha=1.6$, the color–temperature relations were taken from unpublished Kurucz calculations, see V85, and the bolometric corrections from VandenBerg & Bell (1985) as well as Buser & Kurucz (1978). As suggested by VandenBerg, a correction was added to the model stars redder than $B-V=0.4$. Both the corrected isochrones and the original isochrones were fit to our data, using the same color excess as used in the comparison with the C92 models.

The best fit to VandenBerg's models is achieved by interpolating between his 5 and 6 billion yr isochrones, from which we determine a distance modulus of $(m-M)_V=9.6$ and an age of 5.5 billion yr. The poor match to the data shows that a color correction to the isochrones is indeed necessary, as the isochrone is too blue for most of the main sequence. In Fig. 14 the corrected 5 billion year old isochrone was matched to the data, but it still deviates from the lower main sequence. None of the V85 isochrones fit the hook region near the turnoff.

As a check on the color temperature relations the V85 5 billion year old isochrone was matched to the V, $V-I$ color–magnitude diagram, (Fig. 15). The same distance modulus was used and the $E(B-V)=0.05$ was converted to $E(V-I)=0.065$ by using the ratio of $E(V-I)/$

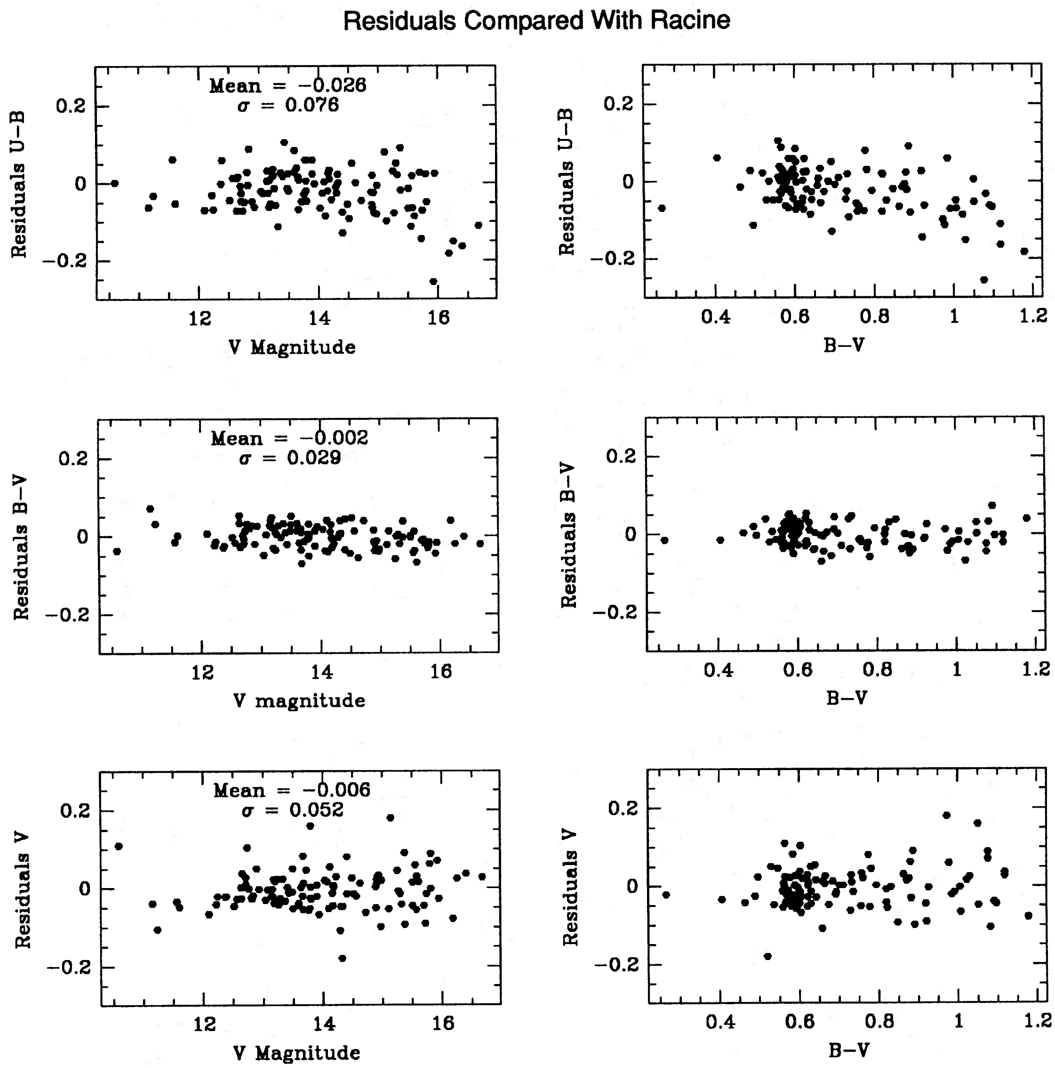

FIG. 3. Comparison of the residuals obtained when comparing our photometry and that of Racine (1971) (see Fig. 2).

$E(B-V)=1.3$ as determined by Dean (1978). The fit is noticeably worse than that for the V, $B-V$ color–magnitude diagram. The red end of the subgiant branch does not fit well and the theoretical main sequence is too red. The best fit in the V, $V-I$ color-magnitude diagram was found by using a 6 billion year old isochrone and a corrected distance modulus $(V-M_V)=9.85$.

In their earlier study of M67, Hobbs & Thorburn (1991) found an age of 5.2 billion yr by taking the effective temperatures derived from spectra of stars in the turnoff region and matching them to new unpublished isochrones of VandenBerg. Nissen & Twarog (1987), using *uvbyHβ* photometry and an $E(b-y)$ of 0.023, found an age of 5 billion yr and a distance modulus of 9.61 ± 0.04. VandenBerg, using the isochrones from V85 and $E(B-V)$ of 0.06, determined an age of 5 billion yr and a distance modulus, $(m-M)_V=9.50$. Demarque *et al.* (1992) using the revised Yale isochrones with new opacities and color–temperature relations found an age of $4.0^{+1.0}_{-0.5}$ billion yr by using a $E(B-V)=0.06$ and $(m-M)_V=9.60$. Gilliland & Brown (1992), using their own evolutionary models, found an age of 4 billion yr by adopting the reddening values and distance modulus of Nissen & Twarog (1987).

4.3 Main Sequence and Binary Sequence

The distribution of stars across the main sequence in the V vs $V-I$ color–magnitude diagram was determined by modeling the main sequence as four straight line segments between V magnitudes of 14 and 20 and taking the perpendicular distance of each star from the line segments. Figure 16 shows the number of stars vs distance from the main sequence in 0.1 mag bins, where a positive distance indicates a star is above the main sequence and a negative distance represents one below the main sequence.

The peak in the distribution at 0.7 mag above the main sequence is the expected position for main-sequence binary

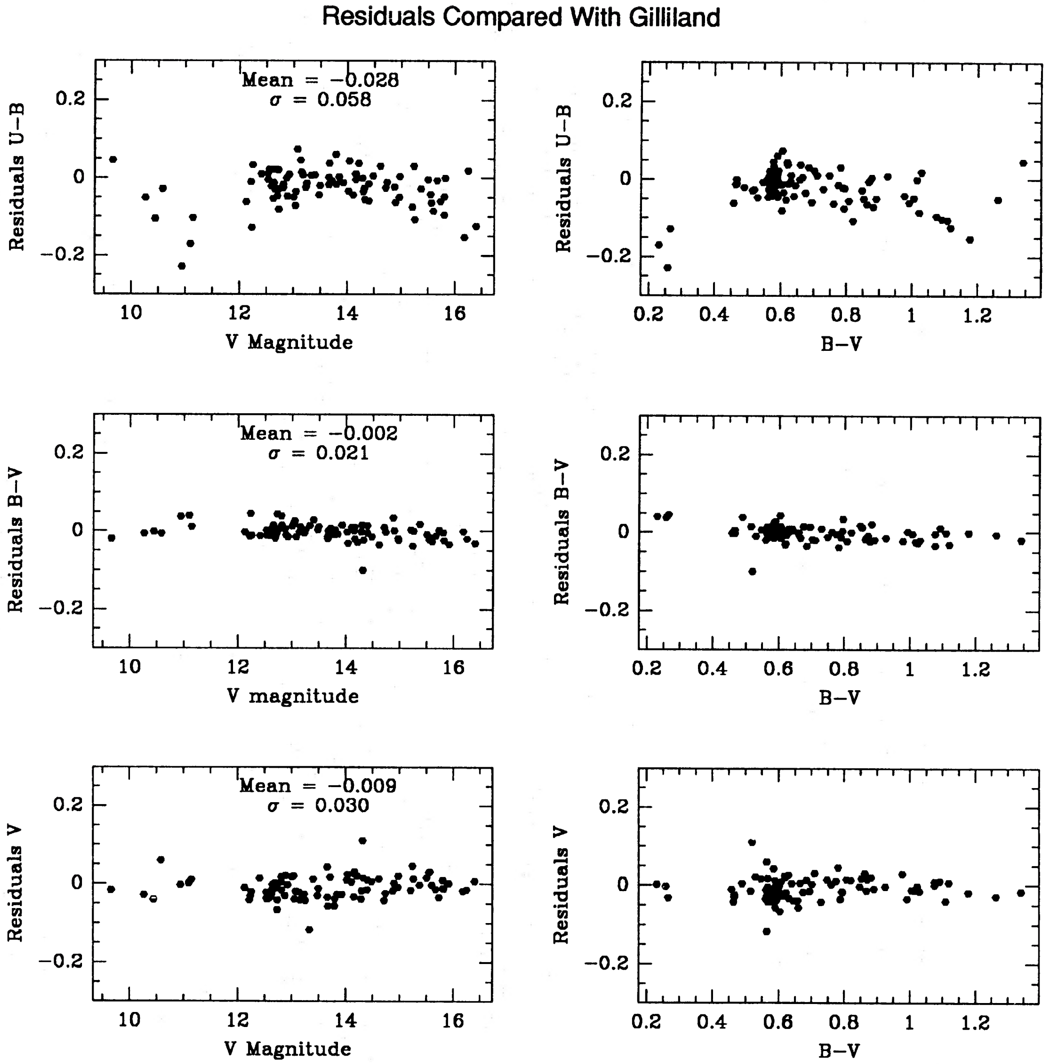

FIG. 4. Comparison of the residuals obtained when comparing our photometry and that of Gilliland *et al.* (1991) (see Fig. 2).

stars with components of equal mass (Maeder 1968). Binaries with components of unequal mass lie in the region between the main sequence and binary sequence. Below the main sequence are fainter, more distant field stars which are also present in the main sequence and binary sequence peaks. To estimate the extent of field-star contamination to these peaks, a polynomial was fit through the background distribution. It is shown as the dotted line in Fig. 16. A simple estimate of the percentage of equal mass component binaries can then be made by comparing the number within the binary sequence to the total number of stars. This gives an estimate of 22% of the cluster members being binary stars, but since binaries of low mass ratios are not detected in this way, this percentage is a lower limit.

To better account for the low-mass-ratio binaries, a Gaussian function was fit to the main sequence to account for the single star population. This is shown as the dashed line in Fig. 16. The standard deviation of the fit to the Gaussian was 0.076 mag, a value which includes both errors in the photometry and the errors incurred by approximating the main sequence as a series of line segments. The difference between the raw curve and the two "contaminant" distributions, i.e., the field stars and the single main-sequence stars, gives an estimate to the number of binary stars. Dividing the number of binary stars by the total number of stars yields a binary or unresolved visual double frequency of 38%. However, this method still does not account for binary stars in which the mass ratio is so low that the system appears to lie on the main sequence. As a comparison, Stauffer (1984) found by photometric means that the Pleiades had a binary frequency of 26% and spectroscopic studies by Abt & Levy (1976) on G field stars found a binary frequency of 57%.

Some of the uncertainty here can be resolved by further spectroscopic observations of the stars in the photometric binary sequence, although even these studies are sensitive primarily to systems of nearly equal mass.

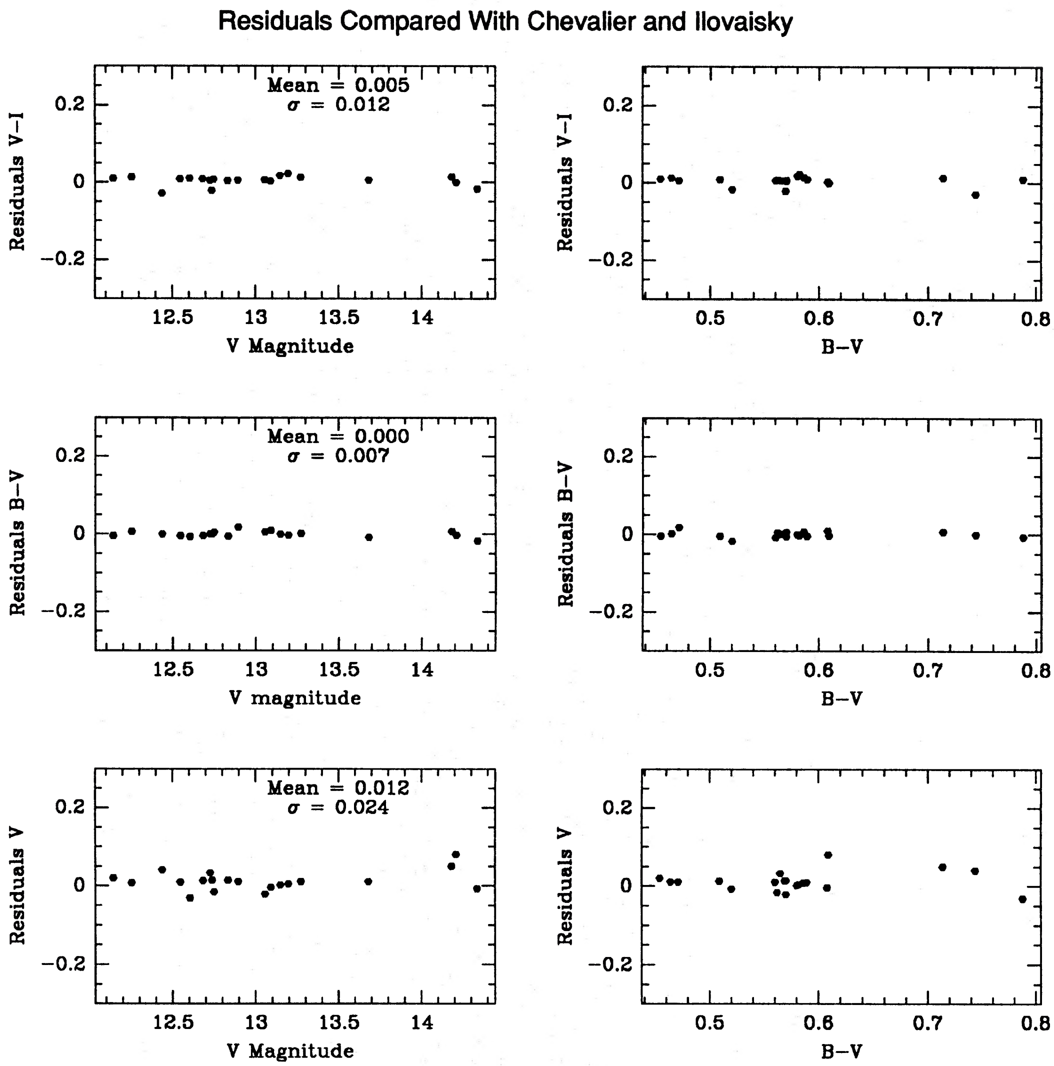

FIG. 5. Comparison of the residuals obtained when comparing our photometry and that of the Chevalier & Ilovaisky (1991) (see Fig. 2).

4.4 The Stellar Density Profiles of M67

Because our study did not reach the edge of the cluster, a full analysis of the structure of the cluster was not possible. However, a simple investigation of the spatial distribution of stars in M67 was undertaken. This was done by taking annuli with a width of 100 pixel centered on the cluster center (defined as the centroid of all star positions within a radius of 1000 pixel of the origin of our central frame) and counting the numbers of stars falling within each annulus. In the outer regions, where a full annulus could not be fit, the counts were corrected by the fraction of the annulus falling outside the region we observed. The resulting radial density distribution is shown in Fig. 17, where the error bars were calculated assuming that the number of stars in a bin was governed by Poisson statistics. The average volume density of stars within the cluster can be calculated using the true distance modulus of 9.45 the two-dimensional distribution of Fig. 17, and the assumption of a spherical distribution of stars. The density at the edge of the cluster was used as the background field-star density and was subtracted from the other regions. For the inner region of the cluster, bounded by the sharp inflection of the distribution at 350 pixel on Fig. 17, we derive an average density of 59.67 stars/pc^3 and a mean separation of 0.159 pc. If, alternately, we calculate the density at the edge of the cluster, taken to be at a distance of 11.55 arcmin, we find an average density of 11.04 stars/pc^3 with a mean separation of 0.289 pc.

To further investigate whether there is any tendency for mass segregation in a cluster of this age, the color–magnitude diagram was split up into 7 bins, starting with the giant branch and working down the main sequence. Blue stragglers and members of the photometric binary sequence were plotted separately as well. Figure 18 shows a plot of the log of the surface density vs the log of the distance from the cluster center for the stars in each of

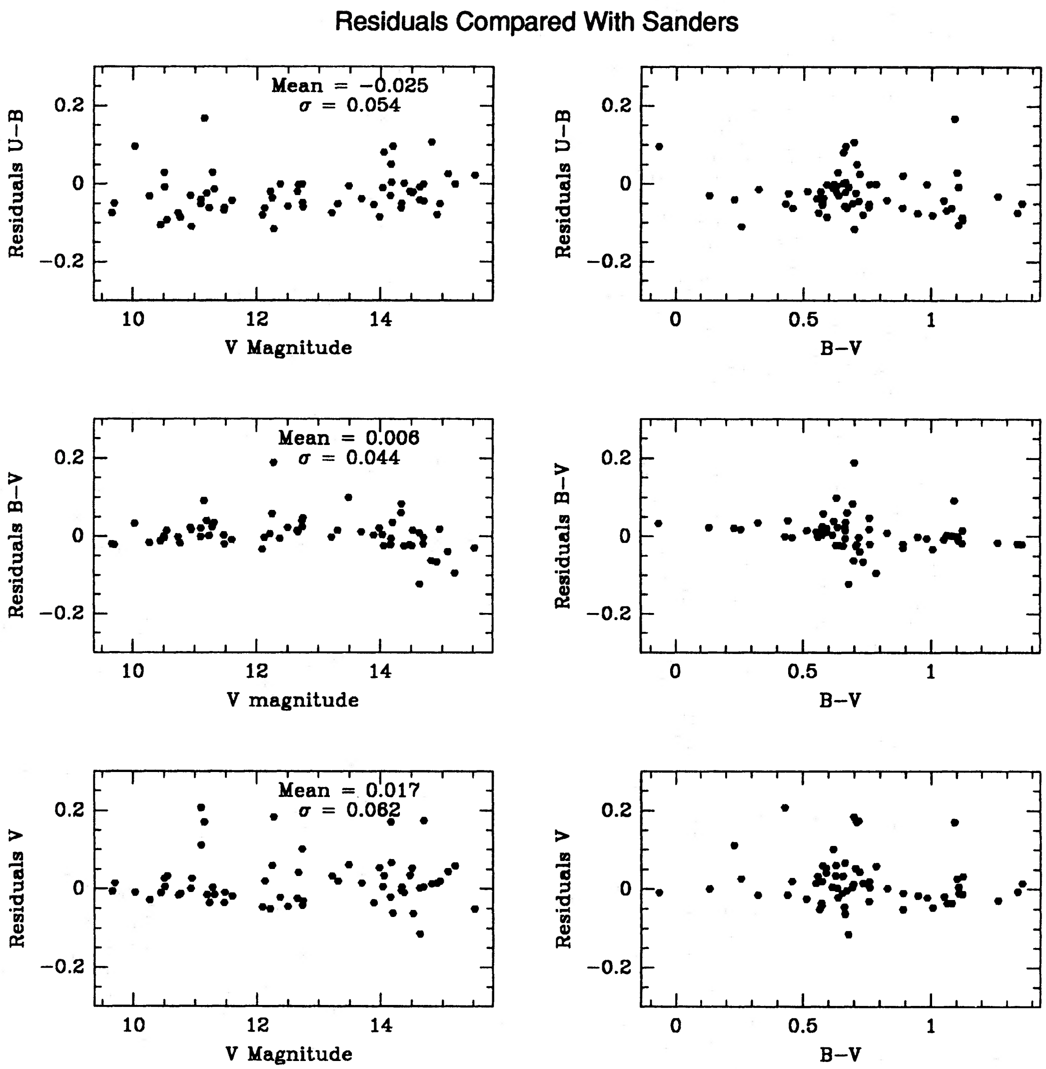

FIG. 6. Comparison of the residuals obtained when comparing our photometry and that of Sanders (1989) (see Fig. 2).

these groups. The stars with the greatest change in density over the range of our study are the blue stragglers, binaries, and giant stars. On the lower main sequence the density of stars is more nearly constant.

Mathieu (1983, 1985) has studied the dynamics of M67 using the proper motion of Sanders (1977) to determine cluster membership. Mathieu's work extends to a radius of 23 arcmin, nearly twice the limit of our study, He concludes that even with this increased radius, up to 15% of the cluster members may have been outside his study, making it difficult to distinguish a true distribution of field stars in the dataset, and therefore making it difficult to correct for field contamination. Nevertheless Mathieu found that the less massive components did tend to have a somewhat lower central concentration then the giants and blue stragglers. In a more recent study, Mathieu & Latham (1986) have shown that the cumulative distribution of blue stragglers and binaries is well fit by a theoretical isotropic equipartition 2 $\mathscr{M}_\odot$ King model, and that blue stragglers in M67 show a significantly higher central concentration than single stars. Our data seem to bear this out, though we cannot attach much statistical significance to any further apparent differences in concentration of stars of different mass, especially between the faint and the bright end of the main sequence.

4.5 The Luminosity Function and Total Cluster Mass

Determining the number of stars as a function of luminosity in a cluster is a difficult procedure because of the presence of background stars in the same line of sight. In his photographic survey, Racine (1971) used a comparison field outside the cluster to determine the amount of field-star contamination. Francic (1989) used proper motion studies to determine membership. Neither method was suitable for this study, since our fields did not go out even to the cluster edge, and since the available proper motion data does not go faint enough. Instead, we applied a sta-

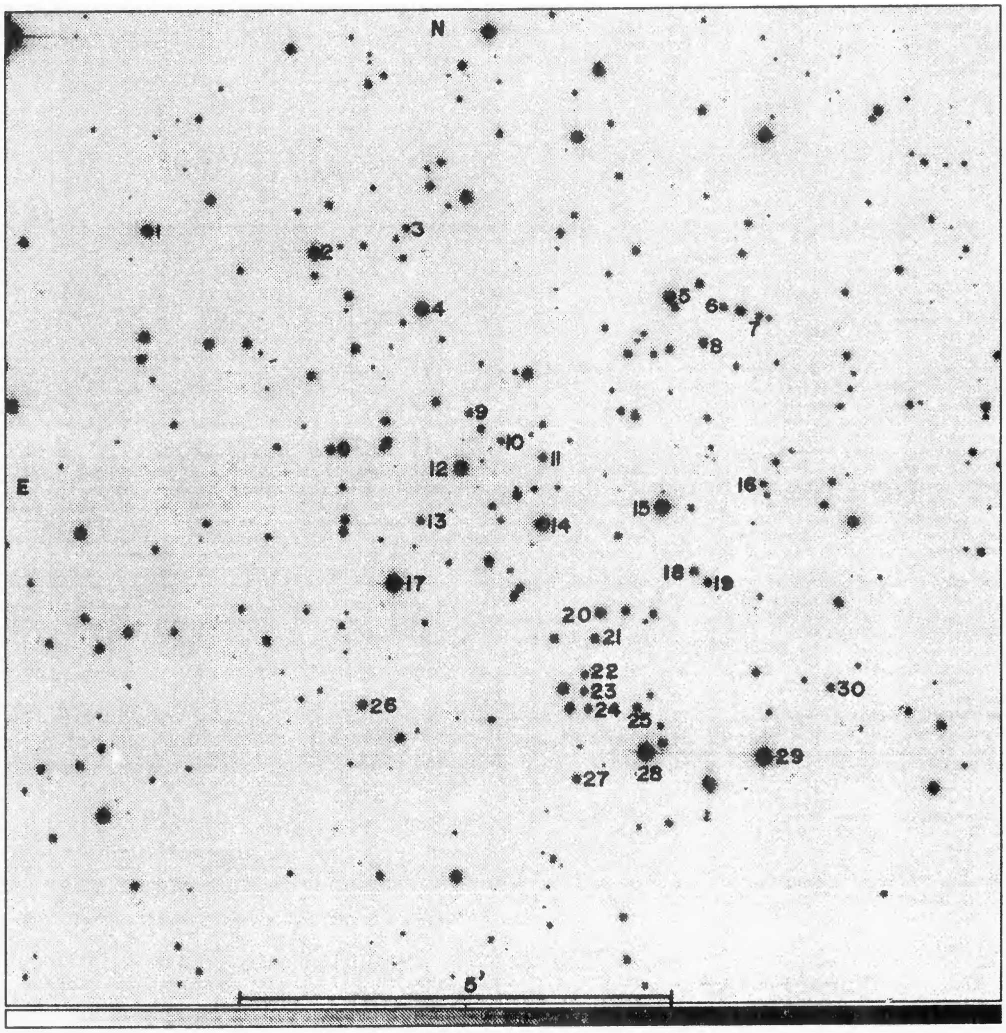

FIG. 7. Finding chart to locate standard stars in Table 7. North is up, east is to the left, and the scale of the image is given by the arrow at the bottom. The numbers in the figure correspond to the star closest to the number and refer to column 2 in Table 7.

tistical correction to our data based on the distribution of stars in the color–magnitude diagram. The method involved counting the number of field stars of a given magnitude within a region just blue of the main sequence and equal in area to that covered by the main sequence. The resulting brightness distribution of field stars was then used to correct the raw data to determine the number of main-sequence stars within each magnitude bin.

The agreement with published luminosity functions is quite good, and a comparison of our luminosity function with Francic's is shown in Fig. 19.

Despite this observational consistency, the luminosity function of M67 does not resemble those found for young clusters or for field stars, which all continue to increase toward fainter magnitudes. This turnover in the luminosity function was first noted by van den Bergh & Sher (1960). The age of M67 may indeed be the critical factor in producing the anomalous turnover. Francic (1989) determined a relaxation time for M67 of 17.4 million yr, during which an equipartition of energy among the stars will be established. Accordingly, the lower-mass stars will attain higher velocities and will more easily escape from the cluster, evaporating, on the average, on a time scale of 100 crossing times (Spitzer & Harm 1958). During the 5 billion yr life of the cluster, some 290 crossing times have elapsed, more than enough time to modify profoundly the distribution of low-mass stars in the cluster.

But it is also likely that a systematic selection bias affects all the results, including ours, to some degree. Mathieu (1983) points out that if the sample of stars does not extend to the edge of the cluster, it will undersample the low-mass stars which are not as centrally concentrated. Further, stars of low luminosity may sometimes escape detection if they happen to be close to a star of higher luminosity, while the converse is not the case.

We determined the total mass of the cluster by separating the main sequence into bins of absolute magnitude, and assigning a mass to each bin according to the calibration in Schmidt-Kaler (1982). For all stars above the main sequence we assumed a mass of 1.2 solar masses, based on the corrected turnoff color and the assumption that the stars above the main sequence are all of relatively the same

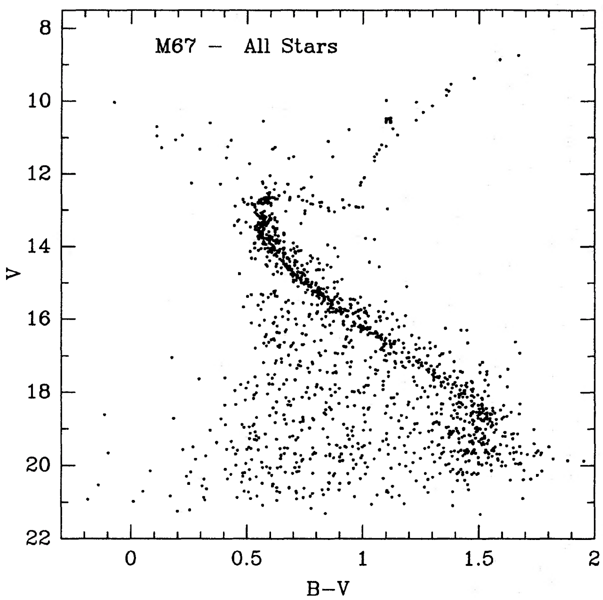

FIG. 8. Color–magnitude diagram of V vs $B-V$ for all stars listed in Table 3. The stars with V magnitude brighter than 12 are taken from outside sources which are listed in Table 4. Note the binary sequence at 0.7 mag above the main sequence, and the stars below the main sequence which are presumably field stars.

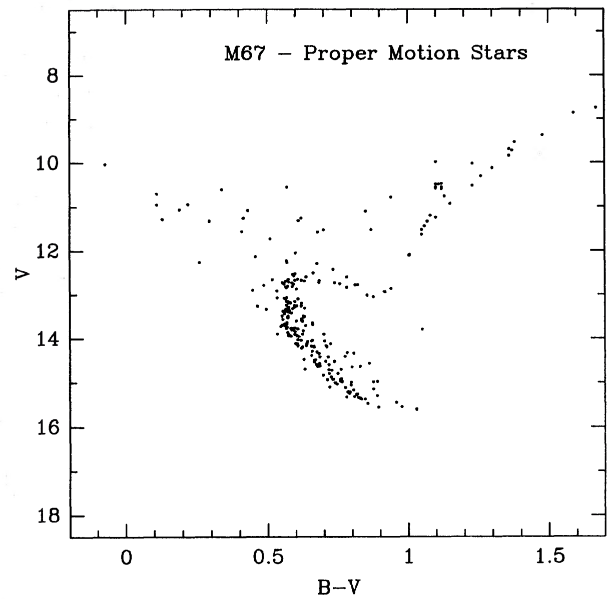

FIG. 10. Color–magnitude diagram of proper motion members determined by Girard *et al.* (1989). The lack of stars below the main sequence shows that stars at these locations on Figs. 8 and 9 are most likely field stars.

mass. To account for the binary sequence a line was drawn between the main sequence and the binary sequence 0.7 mag above the main sequence. Stars which fell above the line were considered to have twice the mass of the stars on the main sequence. Using these procedures, we derived a total mass of 802 solar masses. To correct for field-star contamination, the mass attributed to the field-star distribution was subtracted from the calculated mass of the cluster. This gives a mass for M67 of 724 solar masses. Mathieu (1983), studying an area much larger than ours, but to a brighter limiting magnitude, found a mass for the

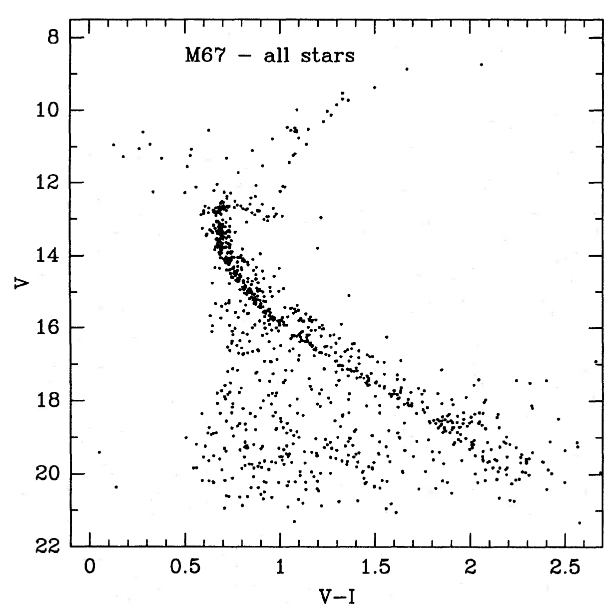

FIG. 9. Color–magnitude diagram of V vs $V-I$ for all stars listed in Table 3. The stars with V magnitude less than 12 are taken from outside sources which are listed in Table 4. Note that the main sequence is still visible to the limit of the photometry and the well-defined binary sequence.

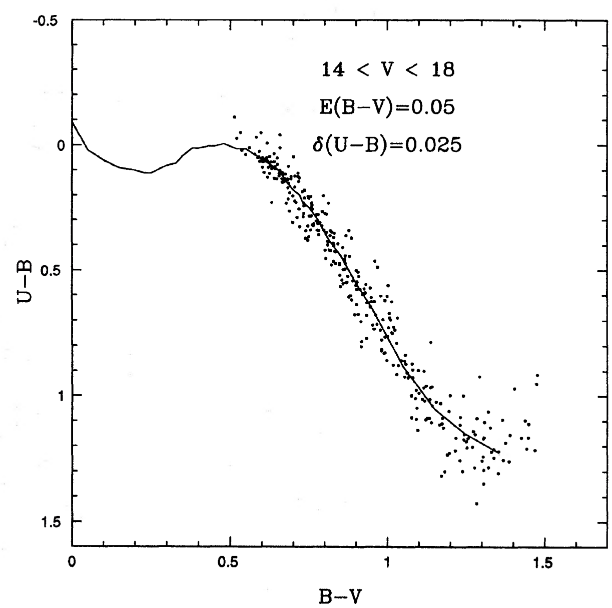

FIG. 11. Color–color diagram of main sequence stars with V magnitudes between 14 and 18. The solid line is an empirical curve of Schmidt-Kaler shifted to best match the data. The values of color excess and $\delta(U-B)$ were derived from the shift of the empirical curve which best matched the data.

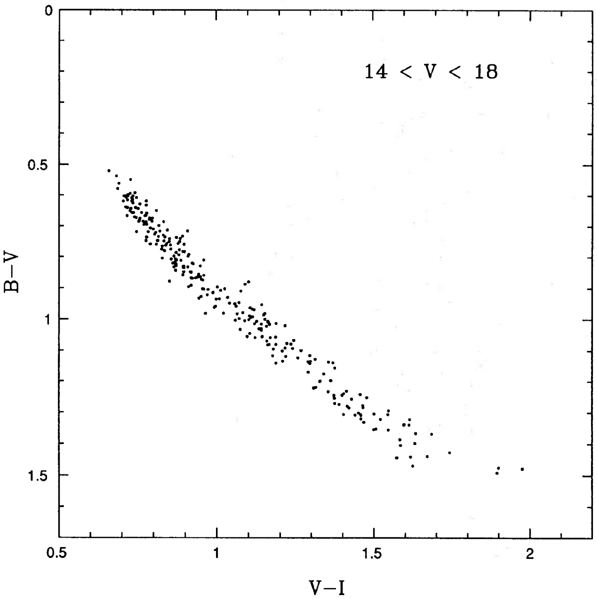

FIG. 12. Color–color diagram with $B-V$ vs $V-I$ colors. Note the spread in stars is less than in Fig. 11 due to the errors in the photometry being less for $V-I$ as compared to $U-B$.

cluster of 903 solar masses, and Francic (1989) found a mass for the cluster of 553 solar masses.

5. CONCLUSIONS

From a mosaic of CCD images of the M67 cluster we have derived the following information.

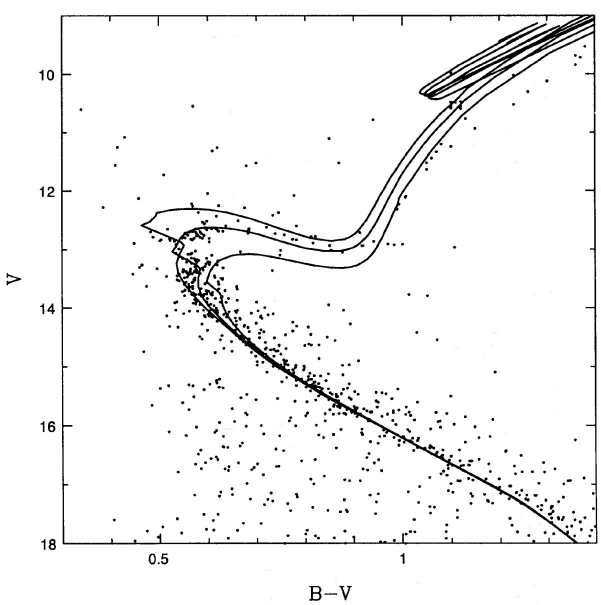

FIG. 13. Isochrones of Castellani *et al.* (1992) of 3, 4, and 6 billion yr, and our data near the turnoff point. The isochrones were shifted using $E(B-V)=0.05$ and a distance modulus of $(V-M_V)=9.6$ was determined. The main sequence turnoff falls halfway between 3 and 4 billion year old isochrones.

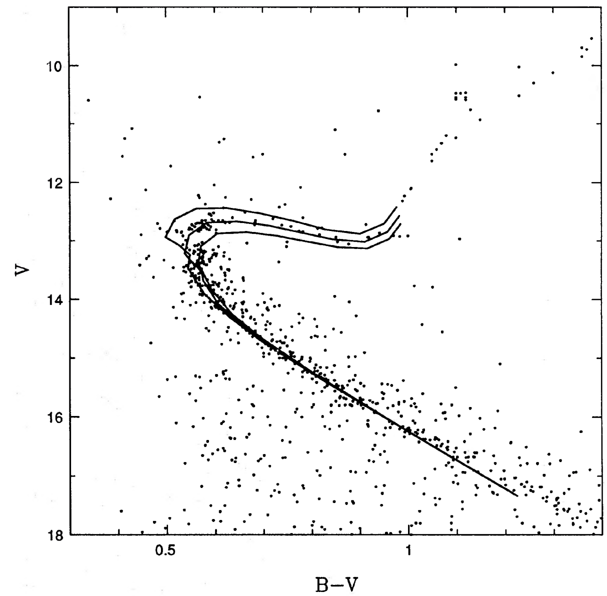

FIG. 14. Isochrones of VandenBerg (1985) of 4, 5, and 6 billion yr, and our data near the turnoff point. The isochrones were shifted using $E(B-V)=0.05$ and a distance modulus of $(V-M_V)=9.6$ was determined. The best fit of the subgiant branch is obtained with the 5 billion year old isochrone. None of the isochrones match the turnoff region.

(1) We have tabulated *U*, *B*, *V*, and *I* colors for 1468 stars within 15 arcmin of the center of M67. The photometry is presented with equatorial coordinates for each star and cross references to other studies to make it handy and

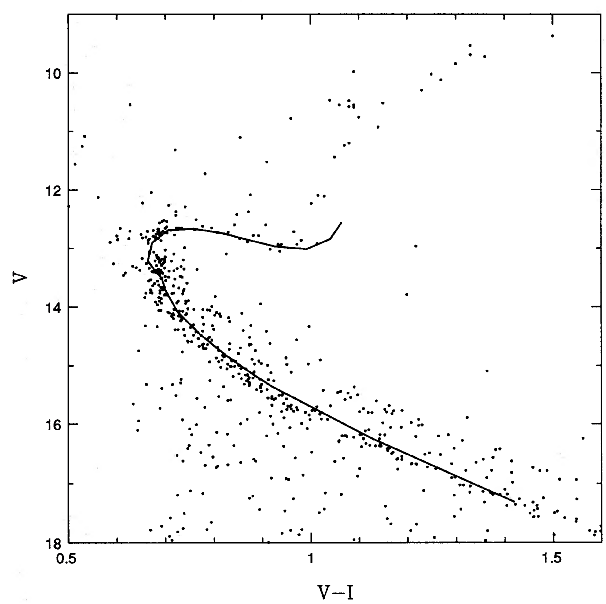

FIG. 15. 5 billion year old Isochrone of VandenBerg (1985) compared to the V, $V-I$ color–magnitude diagram using parameters determined from the V, $B-V$ color–magnitude diagram. The $B-V$ color excess of 0.05 was converted to a $V-I$ color excess of 0.065. The distance modulus was left as 9.6. Note that the distance modulus should be increased which would also change the age determination of the cluster. The good fit of the isochrone to the subgiant and giant branch in Fig. 14 does not exist in this diagram.

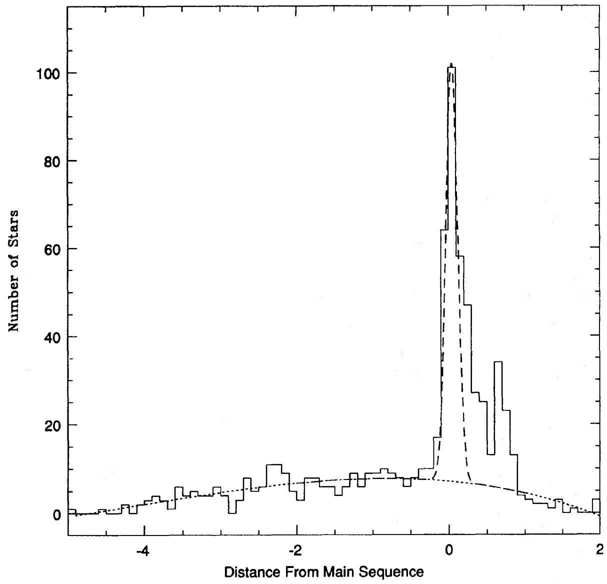

FIG. 16. A plot of the distance a star is from the main sequence on the V, $V-I$ color–magnitude diagram. The secondary peak at 0.7 mag in the distribution is caused by the near equal mass binaries. The dashed line is a Gaussian fit to the distribution of stars along the main sequence. The dotted line is a fit through the background distribution of field stars. From this diagram the cluster was found to have a high proportion of binary stars.

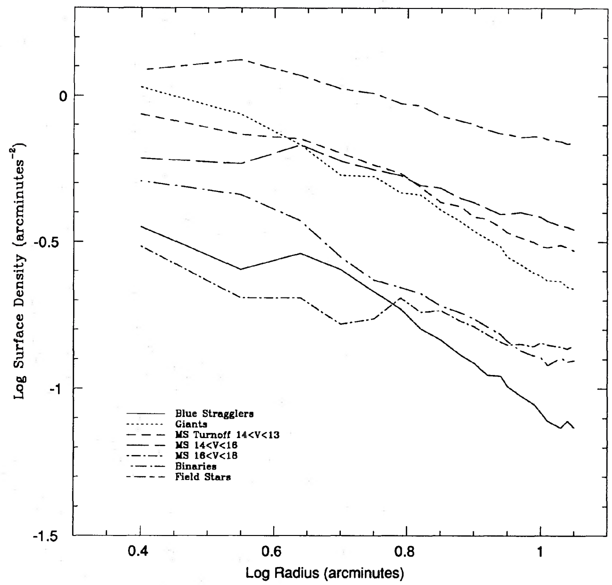

FIG. 18. A comparison of the change in surface density for different groups of stars. Notice that the greatest change in surface density occurs for the blue stragglers, giants, and binaries. The field stars and lower main-sequence stars all show fairly flat distributions.

useful for further research on the cluster. A comparison with previous studies shows that the photometry fits well into the standard system defined by the Landolt (1973, 1992), with a rms error of, typical 10 to 20 mmag, depending on color.

(2) We present a sample of stars suitable for use as internal standards in the cluster and as a standard calibration for general CCD photometry.

(3) Based on color–color plots of the cluster, we derive

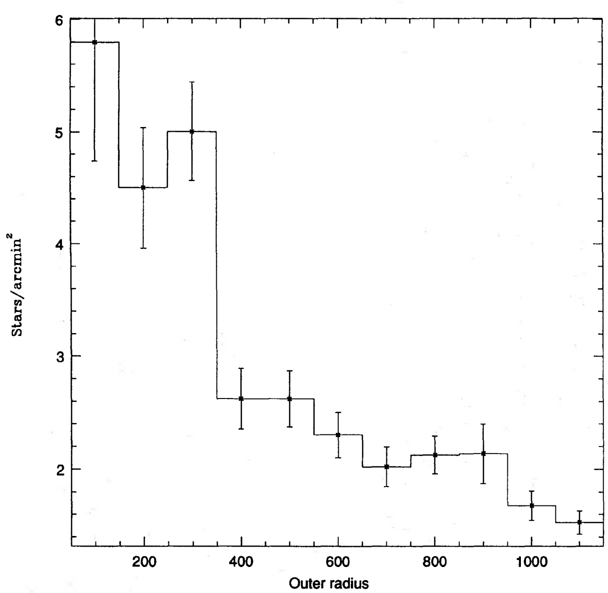

FIG. 17. A plot showing the variation in the stellar surface density with distance. The density was determined using annuli of 100 pixel width centered on the cluster center, and counting the number of stars within each annulus and dividing by the area of the annulus.

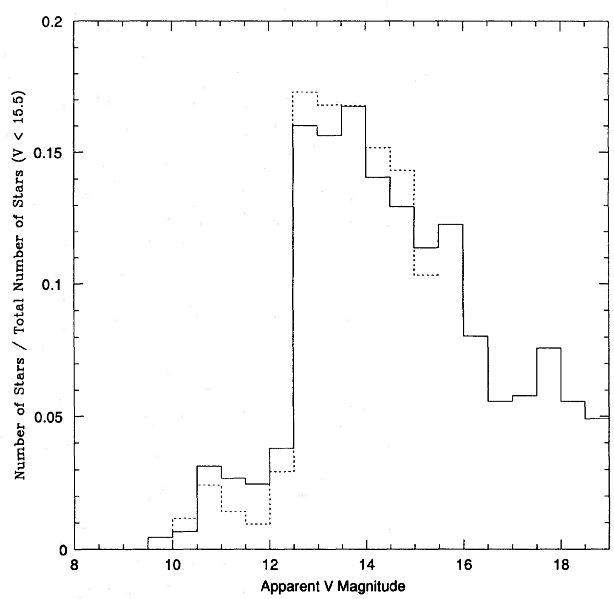

FIG. 19. The luminosity function of M67 is shown as the solid line. The luminosity function of Francic (1989) is given as the dotted line. The distribution was normalized to the number of stars with $V<15.5$. The stars in Table 3 were used to create this diagram, but a statistical correction determined from the color–magnitude diagram was applied to the totals in order to account for field-star contamination.

a reddening, $E(B-V)$, of 0.05 ± 0.01, and a metallicity, $[Fe/H] = -0.05 \pm 0.03$.

(4) The color–magnitude diagram of M67 shows a well-defined binary sequence, from which we find at least 38% of the stars in the cluster are binary systems. The stars on this photometric binary sequence merit further spectroscopic study to investigate the characteristics (mass ratio, eccentricity distribution) in a sample of solar age.

(5) From cluster fitting to theoretical isochrones, we derive ages between 3 and 5 billion yr. None of the current isochrones fit our data consistently, pointing out the need for further work on the models to remove or explain the discrepancy.

(6) The stellar density profile of M67 indicates a tendency for more massive cluster members to concentrate toward the center. This, along with an observed turnover in the luminosity function of the cluster at low mass, may indicate the effect of dynamical relaxation on the cluster. Such conclusions, however, are subject to several sources of systematic bias, and further studies of the low-mass end of the main sequence, covering a larger region in space and incorporating proper-motion and/or radial velocity measurements of cluster membership, will be of value for reducing these problems.

Because of its low reddening and moderate distance modulus, M67 will continue to be an object of great interest for a wide variety of studies. The current study shows that much can be learned as our sample becomes more internally consistent and extends to lower luminosity. At the same time, the new photometry raises problems which may be addressed even better with large-format CCDs and mosaics of CCDs, with astrometry spanning a wider range in time and brightness, and with spectroscopy of the faint single stars and binaries on the cluster main sequence.

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