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THE SOLAR NEIGHBORHOOD. XII. DISCOVERY OF NEW HIGH PROPER MOTION STARS WITH $\mu \geq 0''.4$ yr^{-1} BETWEEN DECLINATIONS $-90°$ AND $-47°$

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ABSTRACT

We report the discovery of 141 new high proper motion systems ($\mu \geq 0''.4$ yr^{-1}) in the southern sky ($\delta = -90°$ to $-47°$) brighter than UKST plate $R_{59F} = 16.5$ via our SuperCOSMOS-RECONS search. When combined with the nine systems having $\mu \geq 1''.0$ yr^{-1} and/or late spectral type from the initial phases of this effort, we find that 73 of the 150 total systems are moving faster than $0''.5$ yr^{-1} and are therefore new members of the classic Luyten Half-Second sample. These constitute a 21% increase in the sample of stars with $\mu \geq 0''.5$ yr^{-1} in the declination region searched, thereby comprising an important addition to this long-neglected region of the sky. Distance estimates are provided for the entire sample, based on a combination of photographic plate magnitudes and Two Micron All Sky Survey photometry, using the relations recently presented by Hambly et al. for the presumed main-sequence stars. Three systems are anticipated to be within 10 pc, and an additional 15 are within 25 pc. Nine of these 18 nearby systems have proper motions falling between $0''.4$ and $0''.6$ yr^{-1}, hinting at a large population of nearby stars with fast, but not extremely high, proper motions that have not been thoroughly investigated.

Key words: solar neighborhood — stars: distances — stars: statistics

1. INTRODUCTION

In an effort to identify the Sun's nearest neighbors, the Research Consortium on Nearby Stars (RECONS) is using the SuperCOSMOS Sky Survey to reveal previously unknown high proper motion (HPM) stars in the southern hemisphere. Here we report the discovery of 141 new HPM systems with $\mu \geq 0''.4$ yr^{-1} found between declinations $-90°$ and $-47°$ that are brighter than $R_{59F} = 16.5$. The stars are mainly white dwarfs, subdwarfs, and red dwarfs, which are underrepresented in the solar neighborhood population because of their intrinsic faintness (Henry et al. 1997).

Recent HPM surveys, listed in Table 1, have uncovered numerous new stars that complement the traditional surveys of Giclas et al. (1971, 1978) and Luyten (1979a). Luyten summarized his effort in the famous Luyten Half-Second Catalogue (Luyten 1979a, hereafter LHS), which has become the gold standard for more recent proper-motion surveys. While most of these surveys have targeted limited pieces of the sky, all have revealed important new HPM objects. (The work of Pokorny et al. 2003 is currently difficult to assess, because our initial checking of many of the objects in the list of 6206 detections indicates that many are previously known and several are not real HPM sources.) Noteworthy is the large SUPERBLINK survey by Lépine et al. (2002, 2003) in the northern hemisphere, which included 49% of the entire sky and ranks as the largest contributor of new LHS stars since the pioneering days of Luyten and Giclas.

One goal of our RECONS group is to complete a comprehensive proper-motion survey of the southern sky that reaches to a magnitude limit similar to that of the Lépine work (~20 mag at R). To reveal new HPM objects, we mine the SuperCOSMOS database developed and maintained at the Royal Observatory in Edinburgh, Scotland. Two previous papers in this series, Hambly et al. (2004) and Henry et al. (2004), report initial results of this effort, which we refer to as the SCR (SuperCOSMOS-RECONS) survey. In this paper we present comprehensive results of the SCR survey for the portion of sky centered on the south celestial pole and reaching northward to $\delta = -47°$.

2. SEARCH METHODOLOGY

The search techniques used here are identical to those in Hambly et al. (2004), in which a full discussion can be found. The SCR search uses all astrometric and photometric information from the four photographic plates available (B_J, ESO-R, R_{59F}, and I_{IVN}) in the portion of the sky searched. Parameter limits for the current search are $10''.0$ yr$^{-1} \geq \mu \geq 0''.4$ yr^{-1} and brighter than $R_{59F} = 16.5$.

The current search includes 13.4% of the entire sky reaching from the south celestial pole northward to $\delta = -47°$. As shown in Figure 1, a few fields have not been searched because of a limited spread in epochs for available plates or crowding near the Magellanic Clouds or the Galactic plane. These missed regions include only 2.3% of the entire sky, so the current SCR search covers 83% of the sky south of $\delta = -47°$.

In the search region, a total of 1424 candidate objects were detected with the adopted parameters. A three-step sifting process was then used to vet the candidates for true and false detections, including checks of magnitudes, colors, and image ellipticities: (1) The two R magnitudes were checked for consistency, and (2) the colors were examined to determine whether they matched that of a real object, i.e., both $B - R$ and $B - I$ positive, or both negative. If the candidate passed these initial two checks, it was

TABLE 1

Proper-Motion Surveys and Number of New Objects Discovered

Survey	$\mu \geq 1''.0$ yr^{-1}	$1''.0$ yr$^{-1} > \mu \geq 0''.5$ yr^{-1}	Number of Publications[a]
LHS	528	3074	1
SUPERBLINK	18	180	2
SuperCOSMOS-RECONS	5	68	3
WT (Wroblewski and collaborators)	2	46	7
Scholz and collaborators	5	21	3
Calan-ESO (Ruiz and collaborators)	3	14	2
Oppenheimer et al.	3	8	1
Pokorny et al.	Unknown	Unknown	1

[a] References include Luyten (1979a), Lépine et al. (2002, 2003), Hambly et al. (2004), Henry et al. (2004), this paper, Wroblewski & Torres (1989, 1991, 1994, 1996, 1997), Wroblewski & Costa (1999, 2001), Scholz et al. (2000, 2002, 2004), Ruiz & Maza (1987), Ruiz et al. (2001), Oppenheimer et al. (2001), and Pokorny et al. (2003).

selected for visual inspection. In cases in which a candidate failed the first two tests, (3) the ellipticity quality flag was also checked. Experience revealed that if two or more image ellipticities were larger than 0.2, the object was spurious. Detections that failed all three tests were classified as false without visual inspection. As a final check, all of the 99 candidates found between $\delta = -90°$ and $-80°$ were inspected visually (regardless of the checks), and all fell into the appropriate true or false detection bins.

For the true detections, coordinates were cross-checked with the SIMBAD database and the NLTT (Luyten 1979b; Luyten & Hughes 1980) catalog. If the coordinates agreed to within a few arcminutes and the magnitudes and proper motion were consistent, the detection was considered previously known. In three cases, the coordinates and proper motions agreed well, but the magnitudes did not. These near matches turned out to be new common proper motion companions to previously known proper-motion objects.

The final count of real, distinct, new systems with $\mu \geq 0''.4$ yr^{-1} and brighter than $R_{59F} = 16.5$ is 150, including five systems from Hambly et al. (2004) and four additional systems from Henry et al. (2004). For completeness, all 150 objects are listed in Table 2 and finder charts are given at the end of this paper in Figure 6. We continue using our naming convention, "SCR" for objects discovered during the survey.

It is worth noting that the extension of the cutoff from $1''.0$ yr in Hambly et al. (2004) down to $0''.4$ yr^{-1} in this paper has resulted in an increased hit rate for objects: only 0.7% of objects detected with $10''.0$ yr$^{-1} \geq \mu \geq 1''.0$ yr^{-1} are real, while 87% of objects detected with $1''.0$ yr$^{-1} > \mu \geq 0''.4$ yr^{-1} are real. These fractions include both new and known objects. The higher hit rate is due to the fact that higher proper motion searches are susceptible to spurious contamination because reliable source association between different epochs is more difficult for fast-moving sources. The greater the search area for the counterpart, the higher the likelihood that an incorrect match will be made (especially if one plate has a defect, a fairly common occurrence).

3. COMPARISON TO PREVIOUS PROPER-MOTION SURVEYS

The classic work of Luyten still remains the most fruitful proper- motion survey to date. This is demonstrated in Figure 2, in which the objects listed in the LHS Catalogue with $\mu \geq 0''.5$ yr^{-1} are plotted. Many HPM objects were also provided by Giclas et al. (1971, 1978), although none were south of $\delta = -47°$. What is immediately obvious is that objects south of $\delta = -30°$ are undersampled relative to similar northern declinations. A direct comparison of counts in the four quartiles of the sky illustrate this bias clearly: 1004 objects are found between

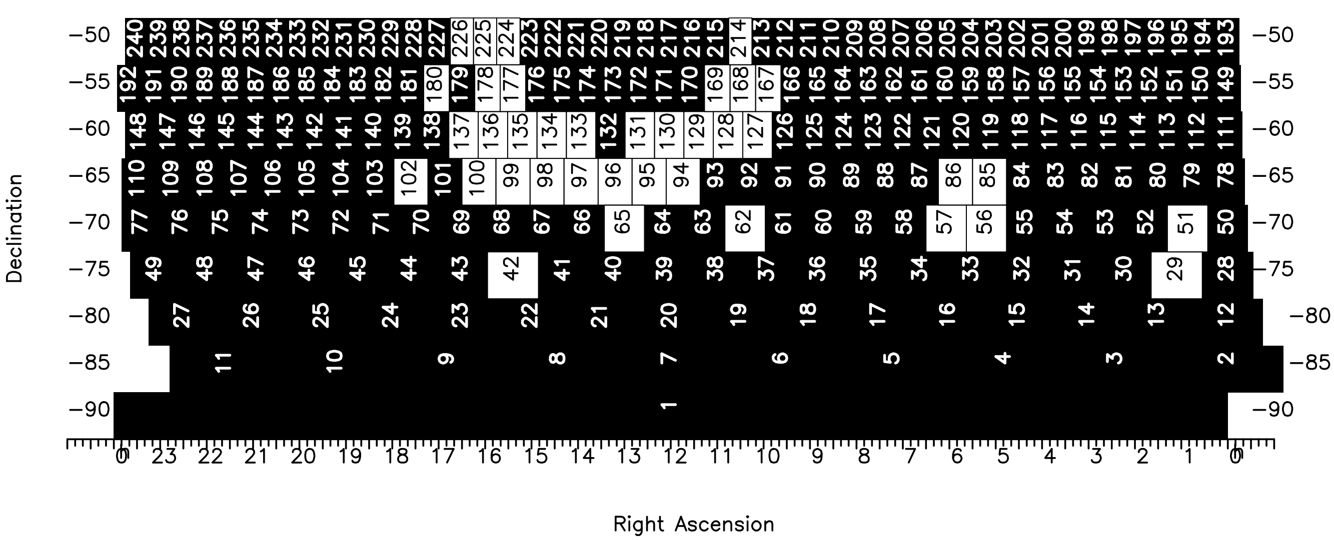

Fig. 1.—Plate coverage of the SCR survey reported here. Plates colored in white were excluded from the search for reasons mentioned in the text.

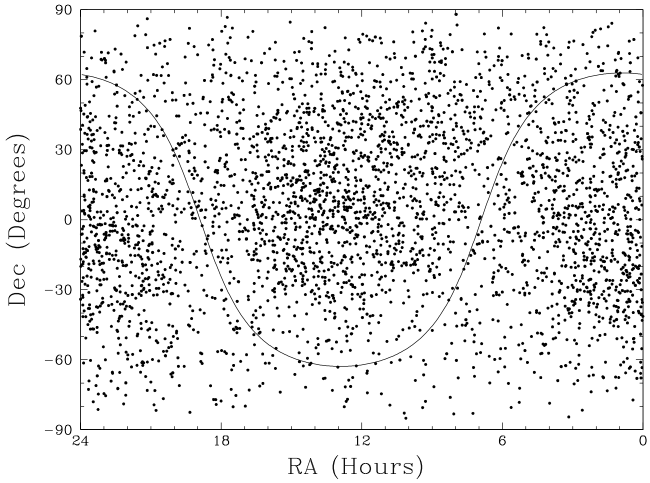

Fig. 2.—Sky distribution of LHS objects. Only stars with $\mu \geq 0''.5$ yr^{-1} are plotted. The curve represents the Galactic plane.

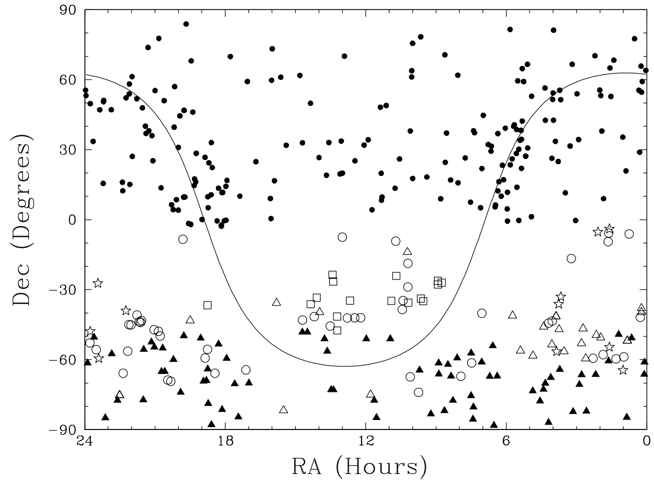

Fig. 3.—Sky distribution of new LHS objects from recent proper motion surveys: *filled circles*, SUPERBLINK survey; *filled triangles*, SCR survey; *open circles*, WT survey; *open triangles*, Scholz survey; *squares*, Calan-ESO survey; *stars*, Oppenheimer survey. Only stars with $\mu \geq 0''.5$ yr^{-1} are plotted. The curve represents the Galactic plane.

$\delta = +90°$ and +30°, 988 between +30° and 0°, and 944 between 0° and −30°, but only 666 between −30° and −90°. It is therefore not surprising that six of the seven recent proper-motion surveys have concentrated on the southern hemisphere. The one notable exception is the work of Lépine et al. (2002, 2003) using SUPERBLINK, which has been very successful at filling in gaps in the northern hemisphere (primarily along the Galactic plane). Table 1 lists the number of new discoveries by each of these surveys. Of the southern hemisphere surveys, many only cover small portions of the sky. Although we avoid the Galactic plane and Magellanic Clouds, the SCR survey has the most uniform sky coverage in the southern hemisphere. Figure 3 shows the distribution of HPM objects discovered by five recent proper-motion surveys and the SCR survey (distinguished by various symbols; Pokorny et al. 2003 not shown because of the difficulties mentioned previously).

A primary goal of the SCR effort is to further complete the LHS Catalogue for stars listed by Luyten that have $\mu \geq 0''.5$ yr^{-1}. Our extension of the cutoff to $\mu \geq 0''.4$ yr^{-1} in this survey is to ensure that no known LHS stars were missed because of proper-motion measurement errors for objects very near the $0''.5$ yr^{-1} limit. Only two objects for which our measured proper motion was below $0''.5$ yr^{-1} are LHS stars: LHS 3694, with $\mu = 0''.493$ yr^{-1}, and LHS 3803, with $\mu = 0''.444$ yr^{-1}.

An assessment of the completeness of the SCR search indicates that for $R_{59F} < 16.5$, we recover 216 of 287 (75%) of the LHS stars in the portion of sky searched. For stars brighter than $R_{59F} = 10.0$, we recover only 29 of 71 (41%) of the LHS stars because the search is insensitive to bright objects that are saturated in the photographic emulsions. In what we consider the "sweet spot" of the SCR search, $10.0 < R_{59F} < 16.5$, we recover 87% of the LHS stars. This relatively high recovery rate is virtually identical for stars moving faster than $1''.0$ yr^{-1} (30 of 35) or $0''.4$–$1''.0$ yr^{-1} (155 of 178), indicating that there is no particular bias in whether fast- or slow-moving objects are recovered more easily.

In addition to LHS recoveries, the SCR search recovered numerous objects from other recent proper-motion surveys. During the compilation of values listed in Table 1, we noticed sources with similar sets of coordinates appearing in more than one survey. In total, seven stars have been found to be duplicates, although two surveys claimed the discovery. Table 1 reflects counts for each object only once, assigned to the original discovery survey. The seven overlap stars are ER 2 (Ruiz & Maza 1987), listed as WT 392 (Wroblewski & Torres 1991); LHS 1140, 1147, 1152, and 1160 (Luyten 1979a), listed as WT 1138, 1147, 1161, and 1170 (Wroblewski & Torres 1996), respectively; LHS 3983 (Luyten 1979a), listed as WT 1007 (Wroblewski & Torres 1994); and WT 1141 (Wroblewski & Torres 1996), listed as WD 0045−061 (Oppenheimer et al. 2001).

4. DATA MINING

4.1. *SuperCOSMOS: Astrometry and Plate Photometry*

Coordinates, proper motions, and plate magnitudes have been extracted from SuperCOSMOS and are listed in Table 2. Coordinates are for epoch and equinox J2000. Errors in the coordinates are typically $\pm 0''.3$, and errors in the proper motions are given. Errors in position angle are usually $\pm 0.1°$. Photometric magnitudes are given for three sets of plates: B_J, R_{59F}, and I_{IVN}. Extractions of a region around each SCR object have been made to check for problems in the data retrieved via the automated source extractions. In a few cases, one or more plates were not available, or sources were merged, thereby preventing the determination of reliable magnitudes.

4.2. *2MASS: Infrared Photometry*

Infrared photometry is used to extend the color baseline, which allows more accurate photometric distance estimates for red dwarfs and permits a fairly reliable separation of the white and red dwarfs. The infrared JHK_s photometry has been extracted from the Two Micron All Sky Survey (2MASS) via Aladin. Each SCR object has been identified by eye to ensure that no extracted magnitudes are in error. In nearly every case, the errors are smaller than 0.03 mag. Exceptions include objects with $J > 15$, $H > 14.5$, and $K_s > 14$, where the errors are 0.05 mag or greater. In several cases in which $H > 16$ or $K_s > 15$, the error is null, and the value is therefore unreliable.

TABLE 2

Proper Motions, Photographic and Infrared Photometry, and Distance Estimates for the SuperCOSMOS-RECONS Sample with $\mu \geq 0''.4$ yr^{-1} and South of $\delta = -47°$

Name	R.A. (J2000)	Decl. (J2000)	μ (arcsec)	σ_μ (arcsec)	θ (deg)	B_J	R_{59F}	I_{IVN}	J	H	K_s	$R_{59F}-J$	Estimated Distance (pc)	Notes
SuperCOSMOS-RECONS Sample with $\mu \geq 0''.5$ yr^{-1}														
SCR 0005−6103........	00 05 56.49	−61 03 55.2	0.504	0.009	84.3	18.19	16.02	13.37	12.04	11.43	11.18	3.98	43.2	Common proper motion with LHS 1018
SCR 0006−6617........	00 06 33.73	−66 17 30.8	0.559	0.011	161.7	16.94	15.11	13.18	12.01	11.36	11.11	3.10	63.2	
SCR 0038−5038........	00 38 48.00	−50 38 22.3	0.726	0.010	115.1	16.77	14.92	12.76	11.43	10.94	10.66	3.49	44.9	
SCR 0051−8441........	00 51 16.42	−84 41 59.0	0.502	0.007	77.2	18.22	16.20	14.57	13.26	12.71	12.50	2.94	126.3	
SCR 0111−4908........	01 11 47.51	−49 08 09.0	0.542	0.008	213.1	18.93	16.50	13.01	11.54	11.00	10.61	4.96	23.6	
SCR 0138−6029........	01 38 01.13	−60 29 56.0	0.580	0.009	83.3	17.46	15.17	12.44	11.19	10.66	10.29	3.98	28.7	
SCR 0210−6622........	02 10 45.17	−66 22 26.6	0.769	0.020	56.3	16.86	14.60	12.15	10.97	10.43	10.09	3.63	30.0	
SCR 0234−8204........	02 34 44.28	−82 04 25.3	0.618	0.017	333.3	20.29	14.13	12.81	11.11	10.51	10.25	3.03	28.5	
SCR 0247−6627........	02 47 05.35	−66 27 14.3	0.711	0.016	53.4	15.94	13.79	12.15	10.63	10.10	9.78	3.16	31.3	
SCR 0252−7038........	02 52 32.02	−70 38 22.3	0.767	0.013	201.0	13.56	11.66	10.86	10.73	10.23	10.04	0.92	69.1	
SCR 0308−8212........	03 08 54.56	−82 12 30.6	0.507	0.009	27.3	17.80	15.62	13.09	11.70	11.15	10.89	3.92	38.9	
SCR 0342−6407........	03 42 57.44	−64 07 56.4	1.071	0.023	141.2	17.17	15.13	12.34	11.32	10.89	10.58	3.81	39.3	[a]
SCR 0406−6735........	04 06 06.79	−67 35 28.9	0.608	0.007	150.2	17.29	14.98	13.99	13.53	13.06	12.80	1.45	239.4	
SCR 0411−8654........	04 11 38.07	−86 54 09.8	0.557	0.006	46.5	17.83	15.79	13.39	12.06	11.53	11.26	3.73	51.3	
SCR 0420−7005........	04 20 12.54	−70 05 58.8	0.670	0.007	21.2	18.18	15.68	12.58	11.19	10.59	10.25	4.49	22.5	[b]
SCR 0424−7243........	04 24 33.63	−72 43 04.8	0.563	0.006	33.5	16.43	15.03	12.67	11.21	10.67	10.40	3.82	38.0	
SCR 0433−7740........	04 33 26.62	−77 40 09.7	0.514	0.006	49.6	17.92	15.86	14.76	14.05	13.49	13.36	1.81	291.4	
SCR 0452−7321........	04 52 06.87	−73 21 56.7	0.554	0.008	53.6	17.98	16.29	13.83	11.98	11.44	11.12	4.31	39.1	
SCR 0623−6701........	06 23 09.04	−67 01 18.9	0.514	0.007	27.9	...	16.15	13.64	12.58	12.09	11.81	3.57	76.3	
SCR 0631−8811........	06 31 31.28	−88 11 36.8	0.516	0.006	349.9	16.96	14.67	11.46	10.04	9.46	9.07	4.63	12.8	
SCR 0634−5403........	06 34 36.88	−54 03 12.7	0.524	0.006	176.6	17.18	14.89	12.29	11.07	10.44	10.13	3.82	27.6	
SCR 0642−6707........	06 42 27.15	−67 07 19.9	0.811	0.008	120.4	17.00	14.69	11.60	10.61	10.15	9.81	4.08	24.1	
SCR 0702−6102........	07 02 50.33	−61 02 47.6	0.786	0.006	41.4	17.50	15.10	11.73	10.36	9.85	9.52	4.75	15.9	[c]
SCR 0723−8015........	07 23 59.65	−80 15 17.8	0.828	0.006	330.4	18.68	16.44	13.27	11.30	10.82	10.44	5.14	19.3	[d]
SCR 0725−8530........	07 25 22.19	−85 30 58.3	0.612	0.011	192.5	15.40	13.39	11.47	10.53	10.02	9.70	2.86	36.8	
SCR 0730−5707........	07 30 11.11	−57 07 42.4	0.505	0.007	82.7	15.08	13.03	11.23	10.23	9.73	9.47	2.80	33.8	
SCR 0730−7527........	07 30 15.98	−75 27 29.4	0.569	0.009	0.5	14.47	12.46	11.44	11.52	11.03	10.85	0.94	99.5	
SCR 0805−5912........	08 05 46.18	−59 12 50.6	0.637	0.007	155.0	15.76	13.76	11.33	10.07	9.52	9.22	3.69	20.4	
SCR 0816−7727........	08 16 35.70	−77 27 12.0	0.676	0.006	325.4	16.41	14.43	13.58	12.62	12.07	11.87	1.81	145.7	
SCR 0821−6703........	08 21 26.67	−67 03 20.4	0.758	0.005	327.6	16.44	15.08	14.61	13.79	13.57	13.34	1.28	267.6	White dwarf
SCR 0829−6203........	08 29 24.67	−62 03 23.2	0.585	0.005	299.2	17.78	15.72	13.42	11.69	11.21	10.92	4.02	37.9	
SCR 0838−8148........	08 38 20.47	−81 48 46.1	0.625	0.005	9.4	17.50	15.37	13.55	12.32	11.82	11.57	3.06	77.9	
SCR 0852−6608........	08 52 49.99	−66 08 46.9	0.508	0.006	333.7	17.81	15.49	12.88	11.34	10.73	10.39	4.16	26.3	
SCR 0853−6123........	08 53 03.11	−61 23 48.4	0.587	0.006	145.7	17.93	15.73	12.96	11.82	11.27	10.91	3.91	40.3	
SCR 0912−8311........	09 12 59.55	−83 11 51.6	0.812	0.006	331.8	17.99	15.74	13.19	11.56	10.98	10.69	4.17	30.4	
SCR 0942−6428........	09 42 17.90	−64 28 43.5	0.531	0.011	307.3	14.76	12.59	12.04	11.96	11.33	11.18	0.63	111.3	
SCR 1057−5103........	10 57 02.98	−51 03 35.0	0.622	0.009	277.2	15.96	13.85	12.20	11.15	10.64	10.43	2.70	54.1	
SCR 1132−8446........	11 32 21.98	−84 46 28.4	0.650	0.006	279.9	17.64	15.87	13.94	12.22	11.76	11.51	3.65	62.7	
SCR 1138−7721........	11 38 16.82	−77 21 48.0	2.141	0.007	286.7	16.45	14.12	11.45	9.40	8.89	8.52	5.60	8.8	[e]
SCR 1158−5103........	11 58 38.90	−51 03 31.8	0.521	0.005	294.2	18.27	16.16	14.11	13.17	12.68	12.44	2.98	123.6	
SCR 1322−7254........	13 22 27.37	−72 54 36.6	0.572	0.009	270.7	16.24	14.12	12.25	11.14	10.55	10.31	2.97	44.1	
SCR 1328−7253........	13 28 42.10	−72 53 47.4	0.789	0.005	247.2	17.91	15.97	13.77	12.47	12.00	11.69	3.50	71.2	
SCR 1338−5622........	13 38 48.13	−56 22 20.6	0.547	0.010	260.6	15.46	14.90	13.06	13.14	12.57	12.34	1.75	170.7	
SCR 1345−5101........	13 45 41.48	−51 01 01.5	0.527	0.006	168.4	16.61	14.51	12.17	10.91	10.39	10.12	3.60	31.9	
SCR 1429−4808........	14 29 41.38	−48 08 31.2	0.791	0.006	351.4	17.11	15.48	12.52	11.25	10.78	10.45	4.24	32.8	

TABLE 2—*Continued*

Name	R.A. (J2000)	Decl. (J2000)	μ (arcsec)	σ_μ (arcsec)	θ (deg)	B_J	R_{59F}	I_{IVN}	J	H	K_s	$R_{59F}-J$	Estimated Distance (pc)	Notes
SuperCOSMOS-RECONS Sample with $\mu \geq 0''.5$ yr^{-1}														
SCR 1442−4810	14 42 16.59	−48 10 50.8	0.507	0.008	248.0	16.92	14.33	14.13	12.98	12.47	12.29	1.35	173.8	
SCR 1659−6958	16 59 27.99	−69 58 18.7	0.749	0.007	216.3	15.77	14.19	12.02	10.53	9.99	9.70	3.65	27.9	
SCR 1726−8433	17 26 23.04	−84 33 08.4	0.518	0.008	134.8	15.42	13.31	11.16	9.87	9.33	9.02	3.44	20.1	
SCR 1735−7020	17 35 40.71	−70 20 21.6	0.963	0.005	190.1	18.19	16.14	14.04	12.82	12.31	12.10	3.32	90.9	
SCR 1756−5927	17 56 27.94	−59 27 18.0	0.537	0.006	210.0	18.02	15.73	14.68	13.44	12.89	12.69	2.29	170.6	
SCR 1808−8120	18 08 00.06	−81 20 48.8	0.680	0.009	200.0	17.32	15.45	13.19	11.36	10.79	10.52	4.09	31.0	
SCR 1817−5318	18 17 06.43	−53 18 04.8	0.617	0.009	209.9	14.69	13.27	12.46	11.93	11.43	11.23	1.34	114.6	
SCR 1835−8754	18 35 14.60	−87 54 08.9	0.639	0.006	199.5	18.18	16.02	15.10	14.11	13.56	13.29	1.92	264.2	
SCR 1843−7849	18 43 35.71	−78 49 02.6	0.745	0.008	194.9	17.57	15.70	14.65	13.27	12.74	12.59	2.43	168.4	
SCR 1845−6357	18 45 05.09	−63 57 47.7	2.558	0.012	74.8	...	16.33	12.53	9.54	8.97	8.51	6.78	3.5	[f]
SCR 1848−6855	18 48 21.14	−68 55 34.5	1.287	0.013	194.3	...	16.07	13.97	11.89	11.40	11.10	4.97	34.8	[g]
SCR 1855−6914	18 55 47.87	−69 14 14.8	0.832	0.011	145.3	18.01	15.63	12.20	10.47	9.88	9.51	5.16	12.5	
SCR 1902−5044	19 02 47.53	−50 44 00.6	0.510	0.009	150.2	16.54	14.52	12.98	11.99	11.48	11.26	2.53	86.7	
SCR 1946−4945	19 46 02.47	−49 45 49.0	0.585	0.006	210.2	17.34	15.39	14.53	13.51	12.95	12.78	1.88	218.5	
SCR 1954−7356	19 54 06.43	−73 56 50.8	0.535	0.008	148.6	16.85	14.89	12.96	11.81	11.31	11.08	3.08	64.3	
SCR 2012−5956	20 12 31.79	−59 56 51.6	1.440	0.011	165.6	16.66	15.63	15.13	14.93	15.23	15.41	0.70	734.1	White dwarf[h]
SCR 2035−6505	20 35 05.60	−65 05 26.1	0.785	0.011	166.0	17.22	15.07	13.18	12.23	11.73	11.51	2.85	84.3	
SCR 2040−5501	20 40 12.40	−55 01 25.7	0.514	0.013	125.4	16.56	14.26	12.16	10.56	10.02	9.69	3.70	22.9	
SCR 2043−6501	20 43 10.43	−65 01 17.6	0.533	0.013	170.0	16.18	14.04	12.04	11.25	10.76	10.52	2.79	55.3	
SCR 2101−5437	21 01 45.76	−54 37 31.7	0.667	0.011	241.5	16.90	14.59	13.46	12.79	12.26	12.08	1.80	157.0	
SCR 2109−5226	21 09 02.56	−52 26 18.1	0.791	0.012	176.5	18.00	15.97	14.93	13.76	13.29	13.05	2.21	221.8	
SCR 2128−5532	21 28 41.23	−55 32 32.1	0.699	0.010	123.3	16.37	14.23	12.04	10.70	10.06	9.78	3.53	26.4	
SCR 2130−7710	21 30 07.07	−77 10 37.5	0.589	0.007	118.0	18.28	15.93	13.44	11.29	10.67	10.36	4.64	20.6	
SCR 2235−7722	22 35 57.78	−77 22 16.2	0.612	0.009	197.6	18.42	16.36	...	14.17	13.67	13.46	2.19	285.9	
SCR 2250−5726 AB	22 50 45.05	−57 26 01.8	0.714	0.007	117.3	18.07	16.10	13.80	12.63	12.00	11.81	3.48	73.7	[i]
SCR 2307−8452	23 07 19.88	−84 52 03.8	0.613	0.011	97.2	16.33	14.16	11.83	10.36	9.81	9.47	3.80	20.6	
SCR 2335−5020	23 35 52.96	−50 20 18.9	0.661	0.010	127.0	16.54	15.17	13.97	13.14	12.69	12.47	2.03	179.4	
SCR 2352−6124	23 52 29.56	−61 24 23.1	0.848	0.009	167.1	17.10	14.73	12.63	11.52	11.02	10.82	3.21	50.3	Common proper motion with LHS 4031
SuperCOSMOS-RECONS Sample with μ between $0''.4$ yr^{-1} and $0''.5$ yr^{-1}														
SCR 0000−5029	00 00 44.12	−50 29 25.0	0.402	0.017	91.8	15.55	13.44	11.66	11.22	10.73	10.49	2.22	68.3	
SCR 0122−6400	01 22 21.37	−64 00 33.1	0.423	0.012	113.9	15.13	13.23	12.48	12.53	11.93	11.80	0.70	176.0	
SCR 0128−7104	01 28 50.80	−71 04 52.7	0.452	0.010	88.8	17.59	15.45	13.23	12.64	12.13	11.88	2.81	103.5	
SCR 0133−7200	01 33 13.09	−72 00 04.6	0.433	0.008	172.2	16.92	14.64	12.16	11.37	10.79	10.50	3.27	43.0	
SCR 0135−5943	01 35 46.71	−59 43 14.3	0.412	0.008	81.5	17.36	15.25	13.01	12.01	11.52	11.24	3.24	63.7	
SCR 0149−8038	01 49 43.55	−80 38 27.8	0.464	0.008	80.5	18.42	16.35	13.84	11.68	11.11	10.72	4.68	25.3	
SCR 0210−6252	02 10 43.99	−62 52 30.1	0.456	0.018	50.0	17.23	14.95	12.92	11.85	11.29	11.02	3.10	56.8	
SCR 0224−6433	02 24 10.98	−64 33 02.4	0.448	0.023	107.3	16.26	13.97	11.80	10.94	10.43	10.12	3.03	39.9	
SCR 0242−5935	02 42 26.34	−59 35 02.4	0.466	0.007	185.2	16.04	15.02	14.04	13.55	13.00	12.78	1.46	228.9	
SCR 0252−7522	02 52 45.57	−75 22 44.5	0.496	0.013	63.5	17.10	16.32	16.17	15.77	15.76	15.34	0.55	675.9	White dwarf
SCR 0255−7242	02 55 05.52	−72 42 42.1	0.439	0.013	51.7	17.52	15.44	14.26	13.74	13.23	13.01	1.70	254.4	
SCR 0303−7209	03 03 44.13	−72 09 59.9	0.430	0.009	85.9	18.77	16.38	14.11	12.72	12.23	11.95	3.66	67.8	
SCR 0311−6215	03 11 21.28	−62 15 15.9	0.416	0.015	83.3	15.68	16.05	16.13	16.13	16.31	16.50	-0.08	...	White dwarf[j]
SCR 0331−8251	03 31 41.78	−82 51 10.5	0.447	0.007	50.8	18.24	16.43	14.66	13.21	12.69	12.46	3.22	115.2	
SCR 0525−7425	05 25 45.56	−74 25 25.9	0.417	0.009	40.2	14.81	12.89	11.35	10.03	9.42	9.21	2.86	28.7	

TABLE 2—*Continued*

Name	R.A. (J2000)	Decl. (J2000)	μ (arcsec)	σ_μ (arcsec)	θ (deg)	B_J	R_{59F}	I_{IVN}	J	H	K_s	$R_{59F}-J$	Estimated Distance (pc)	Notes
SuperCOSMOS-RECONS Sample with μ between 0″.4 yr^{-1} and 0″.5 yr^{-1}														
SCR 0537−5612	05 37 53.75	−56 12 17.4	0.402	0.009	122.7	. . .	14.89	13.12	12.34	11.85	11.57	2.56	96.9	
SCR 0615−5807	06 15 05.02	−58 07 43.4	0.410	0.006	314.6	16.63	14.45	12.44	11.48	10.98	10.70	2.97	54.4	
SCR 0618−6704	06 18 26.01	−67 04 00.3	0.436	0.009	31.4	14.59	12.67	10.74	10.40	9.88	9.60	2.27	45.7	
SCR 0629−6938	06 29 56.40	−69 38 13.3	0.473	0.007	153.6	18.14	16.23	14.75	13.66	13.14	12.90	2.57	183.8	
SCR 0630−7643 AB	06 30 46.63	−76 43 09.2	0.483	0.008	356.8	15.78	13.56	10.74	8.89	8.27	7.92	4.67	6.9	k
SCR 0654−7358	06 54 06.34	−73 58 04.0	0.467	0.008	20.2	18.19	16.24	15.11	13.99	13.47	13.28	2.25	246.7	
SCR 0740−7212	07 40 00.80	−72 12 27.8	0.481	0.006	3.7	17.25	15.28	13.31	11.77	11.27	11.00	3.51	49.8	
SCR 0744−6941	07 44 35.21	−69 41 58.1	0.441	0.007	1.2	17.14	15.05	13.38	12.18	11.69	11.41	2.87	78.8	
SCR 0756−5434	07 56 48.71	−54 34 57.1	0.446	0.005	324.2	17.86	15.91	13.56	11.86	11.28	10.98	4.05	38.2	
SCR 0812−6402	08 12 23.36	−64 02 24.0	0.409	0.005	340.0	17.08	15.23	13.26	11.80	11.32	11.03	3.43	54.4	
SCR 0824−6721	08 24 03.20	−67 21 50.5	0.403	0.005	288.9	17.54	15.29	13.13	11.55	10.95	10.70	3.74	36.0	
SCR 0843−5154	08 43 11.02	−51 54 03.4	0.402	0.008	310.7	16.10	13.94	12.36	11.77	11.22	10.97	2.18	84.6	
SCR 0843−5209	08 43 38.80	−52 09 27.5	0.482	0.007	307.3	16.41	14.29	12.57	11.87	11.38	11.11	2.42	84.2	
SCR 0850−4934	08 50 24.90	−49 34 23.7	0.469	0.006	295.5	17.42	15.60	13.46	12.22	11.77	11.52	3.38	72.3	
SCR 0956−8518	09 56 14.12	−85 18 01.5	0.478	0.007	319.2	17.11	15.14	13.98	12.49	11.94	11.74	2.64	100.7	
SCR 1011−8106	10 11 12.37	−81 06 42.0	0.450	0.008	112.4	16.54	14.50	12.53	10.81	10.24	9.93	3.68	26.7	
SCR 1054−5159	10 54 16.31	−51 59 03.0	0.408	0.006	306.1	17.32	15.38	13.37	11.71	11.10	10.87	3.66	42.7	
SCR 1104−8352	11 04 51.06	−83 52 25.2	0.440	0.015	256.7	. . .	13.47	12.23	10.53	9.96	9.67	2.94	29.1	
SCR 1143−7047	11 43 11.44	−70 47 21.4	0.460	0.007	266.5	17.58	15.63	13.81	12.35	11.82	11.59	3.28	72.5	
SCR 1155−7904	11 55 00.07	−79 04 13.1	0.401	0.006	297.3	18.17	16.23	14.99	13.30	12.66	12.44	2.94	119.6	
SCR 1211−6849	12 11 39.70	−68 49 29.9	0.489	0.008	293.4	16.91	14.73	12.43	11.39	10.91	10.62	3.35	45.4	
SCR 1213−4820	12 13 07.11	−48 20 07.9	0.480	0.006	268.0	16.51	14.24	11.96	11.25	10.72	10.45	2.99	47.9	
SCR 1239−4759	12 39 51.37	−47 59 07.8	0.401	0.006	268.5	17.26	15.26	12.92	11.57	11.08	10.80	3.69	42.8	
SCR 1240−8116	12 40 56.05	−81 16 31.1	0.492	0.006	279.8	15.15	13.12	11.25	9.73	9.16	8.89	3.39	19.2	
SCR 1240−8209	12 40 51.09	−82 09 03.4	0.486	0.008	272.4	16.18	14.56	12.30	10.85	10.20	9.93	3.70	29.3	
SCR 1245−5506	12 45 52.60	−55 06 49.9	0.412	0.011	107.0	14.84	12.82	10.34	8.99	8.43	8.12	3.83	11.5	
SCR 1257−5554 A	12 57 32.84	−55 54 48.6	0.410	0.012	290.1	14.84	13.47	11.45	10.48	9.90	9.66	2.98	39.1	l
SCR 1257−5554 B	12 57 33.08	−55 54 38.0	0.403	0.006	293.2	17.30	. . .	16.82	. . .	. . .	. . .	. . .	. . .	m
SCR 1320−7542	13 20 47.55	−75 42 51.1	0.434	0.006	249.3	17.88	15.82	14.71	13.93	13.32	13.26	1.89	270.9	
SCR 1331−5138	13 31 06.82	−51 38 02.8	0.484	0.007	294.9	16.07	14.10	11.95	10.99	10.50	10.27	3.11	44.5	
SCR 1409−5337	14 09 49.48	−53 37 26.4	0.450	0.007	212.4	16.45	14.33	13.06	11.72	11.24	10.96	2.61	70.2	
SCR 1412−4954	14 12 43.89	−49 54 32.4	0.420	0.012	212.9	15.86	13.82	12.25	11.66	11.12	10.89	2.16	83.9	
SCR 1420−5106	14 20 21.71	−51 06 50.7	0.489	0.010	130.4	14.64	13.02	11.57	10.47	9.92	9.70	2.55	44.5	
SCR 1443−5502	14 43 25.99	−55 02 53.0	0.477	0.017	277.5	15.08	13.22	11.57	10.28	9.71	9.49	2.94	32.4	
SCR 1445−5046	14 45 23.96	−50 46 06.4	0.435	0.007	244.1	17.10	15.52	13.64	12.02	11.50	11.30	3.49	63.1	
SCR 1552−7052	15 52 46.95	−70 52 02.4	0.468	0.006	216.0	16.33	14.18	11.92	10.81	10.28	10.07	3.37	34.5	
SCR 1627−7337	16 27 37.13	−73 37 06.2	0.439	0.007	235.8	15.71	13.89	13.26	12.65	12.02	11.95	1.23	151.7	
SCR 1717−6916	17 17 52.66	−69 16 43.2	0.466	0.005	320.9	17.45	15.04	12.86	11.48	10.94	10.67	3.56	38.4	
SCR 1724−5637	17 24 36.47	−56 37 02.9	0.421	0.008	154.5	15.18	13.11	11.42	10.39	9.86	9.63	2.72	37.2	
SCR 1739−8222	17 39 45.45	−82 22 02.3	0.465	0.008	211.8	17.06	15.04	14.21	12.90	12.38	12.19	2.14	151.7	
SCR 1740−5646	17 40 46.93	−56 46 57.9	0.448	0.005	229.5	18.48	15.90	14.44	13.83	13.33	13.19	2.07	232.9	
SCR 1748−7211	17 48 51.85	−72 11 53.1	0.428	0.008	191.0	16.99	14.85	12.88	11.57	10.99	10.75	3.28	46.9	
SCR 1811−5510	18 11 34.94	−55 10 37.9	0.482	0.006	197.9	17.39	15.16	12.87	11.62	11.06	10.78	3.54	42.6	
SCR 1821−5549	18 21 45.87	−55 49 17.5	0.424	0.007	181.0	16.97	14.63	12.61	11.57	11.00	10.74	3.06	50.2	
SCR 1912−5034	19 12 45.01	−50 34 34.4	0.447	0.005	233.7	18.24	16.03	13.70	12.19	11.67	11.35	3.84	48.3	
SCR 1926−5218	19 26 48.73	−52 18 17.4	0.494	0.007	191.2	16.97	15.22	14.39	13.54	12.97	12.87	1.68	229.7	

TABLE 2—*Continued*

Name	R.A. (J2000)	Decl. (J2000)	μ (arcsec)	σ_μ (arcsec)	θ (deg)	B_J	R_{59F}	I_{IVN}	J	H	K_s	$R_{59F}-J$	Estimated Distance (pc)	Notes
SuperCOSMOS-RECONS Sample with μ between 0″.4 yr^{-1} and 0″.5 yr^{-1}														
SCR 1931−5840........	19 31 21.58	−58 40 37.2	0.402	0.007	135.7	16.83	14.69	13.32	12.18	11.67	11.44	2.51	91.7	
SCR 1948−5914........	19 48 58.82	−59 14 23.3	0.415	0.008	151.7	16.60	14.63	12.39	11.11	10.58	10.28	3.52	35.9	
SCR 1958−5609........	19 58 31.28	−56 09 10.6	0.494	0.007	161.9	17.60	15.55	14.41	13.30	12.77	12.52	2.25	169.1	
SCR 1959−5549........	19 59 58.76	−55 49 29.6	0.413	0.011	169.9	16.19	13.95	11.82	10.47	9.88	9.63	3.48	25.0	
SCR 2009−6005........	20 09 23.44	−60 05 43.3	0.414	0.010	154.3	18.17	15.87	13.71	12.11	11.58	11.27	3.76	46.5	
SCR 2016−7945........	20 16 49.73	−79 45 53.0	0.434	0.007	128.4	16.75	16.09	15.75	15.11	15.03	14.64	0.99	482.5	White dwarf
SCR 2018−4836........	20 18 13.66	−48 36 51.9	0.410	0.007	147.2	17.38	15.20	13.33	12.08	11.62	11.37	3.12	69.0	
SCR 2018−6606........	20 18 28.69	−66 06 44.5	0.462	0.008	191.3	17.72	15.76	14.71	13.68	13.14	12.99	2.08	228.0	
SCR 2104−5229........	21 04 00.61	−52 29 43.4	0.400	0.009	233.7	17.60	15.42	14.42	13.44	12.94	12.76	1.98	207.2	
SCR 2151−8604........	21 51 37.56	−86 04 33.4	0.454	0.012	192.7	16.57	14.48	13.57	12.74	12.23	12.03	1.74	160.6	
SCR 2155−7330........	21 55 47.55	−73 30 24.5	0.459	0.011	202.0	15.78	13.97	11.85	10.60	10.05	9.78	3.38	31.6	Common proper motion with HIP 108158
SCR 2212−7337........	22 12 05.47	−73 37 17.2	0.419	0.008	122.9	17.43	15.32	12.90	11.39	10.85	10.48	3.92	31.6	
SCR 2249−6324........	22 49 47.16	−63 24 37.7	0.454	0.009	174.0	18.26	16.28	15.50	14.69	14.04	13.95	1.58	393.6	
SCR 2254−8712........	22 54 21.45	−87 12 51.7	0.401	0.011	115.6	16.11	14.13	12.30	11.10	10.54	10.29	3.03	44.2	
SCR 2305−7729........	23 05 01.97	−77 29 12.8	0.429	0.007	193.7	17.31	15.73	14.89	13.82	13.30	13.18	1.91	238.7	
SCR 2317−5140........	23 17 08.89	−51 40 19.4	0.446	0.007	192.1	17.04	15.02	13.71	12.82	12.25	12.04	2.19	139.4	
SCR 2329−8758........	23 29 02.47	−87 58 06.2	0.429	0.006	111.6	15.79	14.48	13.44	12.70	12.12	11.97	1.77	144.5	

[a] First reported in Hambly et al. (2004); 38.1 ± 7.8 pc in Henry et al. (2004).
[b] 15.4 ± 2.6 pc in Henry et al. (2004).
[c] 10.8 ± 2.1 pc in Henry et al. (2004).
[d] 17.2 ± 3.1 pc in Henry et al. (2004).
[e] First reported in Hambly et al. (2004); 9.4 ± 1.7 pc in Henry et al. (2004).
[f] First reported in Hambly et al. (2004); 4.6 ± 0.8 pc in Henry et al. (2004).
[g] First reported in Hambly et al. (2004); 37.0 ± 9.4 pc in Henry et al. (2004).
[h] First reported in Hambly et al. (2004); 17.4 ± 3.5 pc in Henry et al. (2004); K_s suspect.
[i] Separation 2″.3 at P.A. 28°.
[j] All colors too blue for distance relations.
[k] 7.0 ± 1.2 pc in Henry et al. (2004); binary with separation ∼1″.0.
[l] Separation 11″.0 at P.A. 16°.
[m] Not detected during automated search because of faint limit but noticed to be a common proper-motion companion during the visual inspection; R is ESO-R = 16.94, R_{59F} blended.

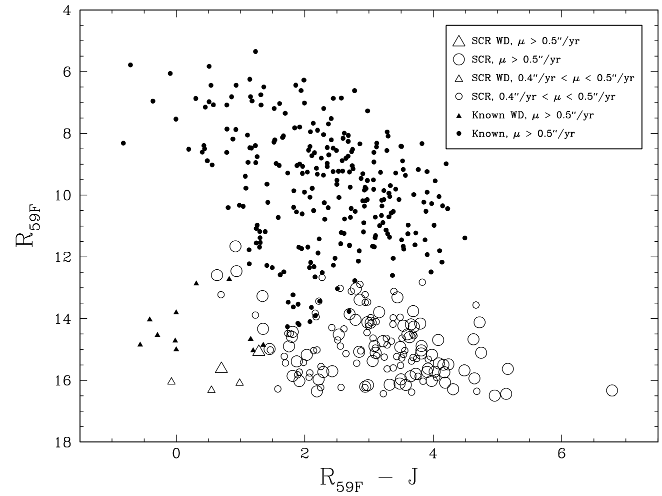

FIG. 4.—Color-magnitude diagram for the SCR systems with $\mu \geq 0''\!.4$ yr^{-1} (size of the symbols splits SCR sample into stars with μ more or less than $0''\!.5$ yr^{-1}) and known systems with $\mu \geq 0''\!.5$ yr^{-1} south of $\delta = -47°$.

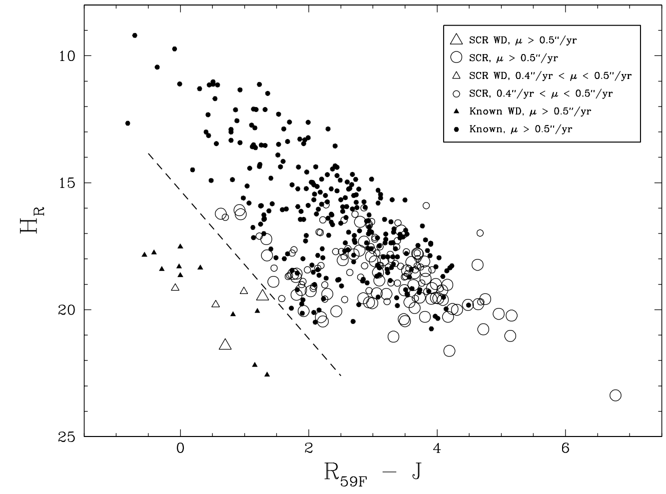

FIG. 5.—RPM diagram for the SCR systems with $\mu \geq 0''\!.4$ yr^{-1} (size of the symbols splits SCR sample into stars with μ more or less than $0''\!.5$ yr^{-1}) and known systems with $\mu \geq 0''\!.5$ yr^{-1} south of $\delta = -47°$. The dashed line serves merely as a reference to distinguish white dwarfs from subdwarfs.

5. ANALYSIS

5.1. *Color-Magnitude Diagram*

The color-magnitude diagram illustrated in Figure 4 clearly shows that the new SCR objects are generally fainter and redder than those found by previous studies. Sources south of $\delta = -47°$ with $\mu \geq 0''\!.5$ yr^{-1} from the previous studies are collectively labeled as "known" in Figure 4 (and in Fig. 5 as well). Large open symbols for the SCR stars indicate new LHS members, whereas smaller open symbols are for additional SCR stars with $0''\!.5$ yr$^{-1} > \mu \geq 0''\!.4$ yr^{-1}.

Other than the white dwarfs, there are very few known sources fainter than $R_{59F} \sim 14$, whereas most of the new SCR sources are fainter. This is caused primarily by the lack of red plates available to Luyten. Nonetheless, there are a half dozen new SCR objects brighter than $R_{59F} = 13$, the brightest of which has $R_{59F} = 11.7$. That such bright HPM objects remain unknown indicates that this portion of the sky, which has comprehensive coverage only from the Bruce Proper Motion Survey carried out by Luyten (with a blue photographic limit of ~15.5), had not yet been thoroughly searched until this SCR effort.

Several of the objects are quite red, including the remarkable object SCR 1845−6357 ($V - K_s = 8.89$, M8.5 V; Henry et al. 2004), for which a trigonometric parallax of $\pi = 282 \pm 23$ mas has been determined from photographic plates (Deacon et al. 2005). This object is represented in Figure 4 as the single circle to the far right. We note that there is no obvious decrease in the number of objects at the faint limit of $R_{59F} = 16.5$ adopted for the current search, hinting that there is likely to be a large population of fainter objects yet to be discovered in the SuperCOSMOS data.

5.2. *Reduced Proper-Motion Diagram*

The reduced proper motion (RPM) diagram shown in Figure 5 is a powerful diagnostic for assigning rough luminosity classes for stars using proper motion and apparent magnitude. It is similar to an H-R diagram except that absolute magnitude is replaced by RPM, in which the proper motion is used in lieu of a trigonometric parallax measurement to determine H_R, as follows:

$$H_R = R_{59F} + 5 + 5 \log \mu.$$

The assumption here is that proper motion is directly related to distance—an assumption certainly not always valid, because high-velocity populations, such as subdwarfs with large tangential velocities, can masquerade as very nearby main-sequence stars. Nonetheless, use of the RPM diagram allows the identification (albeit roughly) of subdwarfs, which are found at fainter H_R values for a given color or, alternately, at bluer colors for a given H_R. In addition, white dwarfs are clearly differentiated from the main-sequence stars and subdwarfs, providing a reliable means for identifying new white dwarfs.

From Figure 5 it is apparent that most of the new SCR stars are main-sequence red dwarfs, as expected, while there are a few dozen new subdwarf candidates. The dashed line represents a somewhat arbitrary boundary between the subdwarfs and white dwarfs, of which five new candidates have been found in the SCR search. As in Figure 4, the single circle to the far right is SCR 1845−6357.

5.3. *Red Dwarfs: Photometric Distances*

Once all available data have been collected, we can search for targets that are potentially nearby, specifically within the volumes defined by the RECONS sample (horizon at 10 pc) and the CNS (Catalog of Nearby Stars; Gliese & Jahreiss 1991) or NStars (Nearby Stars) samples (horizons at 25 pc).

Distances for the SCR objects in Table 2 have been estimated using a combination of plate magnitudes from SuperCOSMOS and infrared photometry from 2MASS, following the methodology of Hambly et al. (2004). Briefly, the six magnitudes provide 15 color-M_K combinations, 11 of which can be used to estimate individual distances (JHK_s-only colors are not used because of limited color discrimination, and $B_J - R_{59F}$ is not reliable). These relations have been developed using a large set of stars within 10 pc that have high-quality parallaxes, plate magnitudes (specifically extracted from the SuperCOSMOS database for this purpose), and 2MASS infrared photometry. The relations assume that the objects are single, main-sequence dwarfs of types ~K0 V–M9 V. To estimate the reliability of this technique, the same 10 pc sample that generated the relations was run through, giving a mean difference between the photometric and trigonometric distances of 26%.

Results indicate that three of the 150 systems are estimated to be within 10 pc (each has been discussed previously in Hambly et al. 2004 and/or Henry et al. 2004): SCR 1845−6357 (3.5 pc), SCR 0630−7643 AB (6.9 pc), and SCR 1138−7721 (8.8 pc). An additional 15 systems are predicted to be within 25 pc.

We have also run distance estimates for the 266 known objects recovered and found that 120 have distance estimates placing them within the 25 pc horizon. Of these, 34 objects have trigonometric parallaxes in the Yale Parallax Catalogue (van Altena et al. 1995, hereafter YPC) and/or from the *Hipparcos* mission (ESA 1997) that confirm they are within 25 pc, whereas 24 objects have trigonometric parallaxes placing them beyond 25 pc. As with any volume-limited survey, most of the objects are found near the distance limit, so it is not surprising that a substantial sample of objects slip beyond the adopted horizon. These statistics strongly suggest the necessity of determining a trigonometric parallax prior to inclusion of the NStars 25 pc sample based solely on photometric distance estimates. The remaining 62 stars have no trigonometric parallaxes. Of these, 21 are currently being observed as part of our Cerro Tololo Inter-American Observatory Parallax Investigation (CTIOPI), including three with distance estimates nearer than 10 pc: LHS 271 (GJ 1128; 8.0 pc), LHS 263 (GJ 1123: 8.2 pc), and LHS 532 (GJ 1277; 9.1 pc).

A small subsample of 16 SCR stars have distance estimates in excess of 200 pc. (The five white dwarf candidates have been removed from this count.) K- and M-type subdwarfs tend to have larger distance estimates than their true distances because the relations assume luminosities of main-sequence stars, whereas subdwarfs are intrinsically fainter (hence closer for a given brightness). These 16 stars are therefore the best subdwarf candidates. Worthy of note is the most extreme star in this subsample, SCR 2249−6324, which has a distance estimate of nearly 400 pc. The colors of this object indicate that it is only slightly red, but red enough to nearly eliminate the possibility that it is a cool white dwarf. Its position in Figure 5 ($H_R = 19.56$, $R_{59F} - J = 1.58$) lies in the subdwarf region just above the broken line. Follow-up spectroscopy will confirm its luminosity class.

5.4. *White Dwarfs*

Five SCR discoveries lie in the white dwarf region of Figure 5: SCR 0252−7522, 0311−6215, 0821−6703, 2012−5956, and 2016−7945. We have obtained spectroscopy on each and confirmed that all are white dwarfs. The spectra will be presented in a future publication.

Of the 150 systems in the complete list, only two have no distance estimate because of colors too blue to be addressed by the relations: SCR 1257−5554 B and the white dwarf SCR 0311−6215. Cooler white dwarfs having colors that are within the ranges covered by the relations tend to have very large distance estimates because the relations assume they are intrinsically bright F or G dwarfs. The distance estimates in Table 2 for the four new white dwarfs with colors covered by the relations range from 267 to 734 pc. This provides a second diagnostic for identifying white dwarfs that is useful but not as reliable as the RPM diagram.

SCR 1257−5554 B is a source too faint to be picked up in this SCR search but was noticed on frames that were blinked to confirm its primary. Infrared data are not available because this object exceeds the faint limit of 2MASS. We suspect that it is a hot white dwarf because of its plate colors and because its companion is a modestly bright M star estimated to be at 39 pc. The B component is not plotted in Figure 5 because of the lack of the $R_{59F} - J$ color.

Oppenheimer et al. (2001) have derived a single-color linear fit to obtain distance estimates for white dwarfs using plate magnitudes. We use this relation and adopt the error quoted therein of 20% to give the following distances: SCR 0252−7522 = 29.8 ± 6.0 pc; SCR 0311−6215 = 60.7 ± 12.2 pc; SCR 0821−6703 = 10.9 ± 2.2 pc; SCR 2012−5956 = 18.0 ± 3.6 pc (consistent with Henry et al. [2004], using CCD photometry and the relation of Salim et al. [2004] to obtain a distance of 17.4 ± 3.5 pc); SCR 2016−7945 = 29.3 ± 5.9 pc. Note that should the distance for SCR 0821−7522 hold true, it would become an addition to the 13 pc sample (thought to be largely complete) from which Holberg et al. (2002) determine the white dwarf local density. CTIOPI parallax observations are currently under way for verification.

5.5. *Comments on Individual Systems*

The five systems with $\mu \geq 1\farcs0$ yr^{-1} have been discussed in detail in Hambly et al. (2004) and Henry et al. (2004). Four more systems (one double) having spectral types of M6.0 V or M6.5 V were also discussed in Henry et al. (2004). Here we provide details of additional noteworthy systems, each of which is a multiple.

SCR 0005−6103 ($\mu = 0\farcs504$ yr^{-1} at position angle 84.3°) is a common proper motion companion to LHS 1018 ($\mu = 0\farcs519$ yr^{-1} at position angle 85.7°), for which there is no trigonometric parallax available. The distance estimates for SCR 0005−6103 and LHS 1018 are 43.2 and 34.0 pc, respectively. This is a reasonably good match, considering the errors in the distance estimation technique (26%).

SCR 0006−6617 ($\mu = 0\farcs559$ yr^{-1} at position angle 161.7°) at first appears to be a very widely separated (~27′) common proper motion companion to LHS 1019 ($\mu = 0\farcs576$ yr^{-1} at position angle 158.9°). However, the estimated distance for SCR 0006−6617 is 63.2 pc, whereas the trigonometric parallax from YPC for LHS 1019 indicates a distance of 17.6 pc. In addition, SCR 0006−6617 ($H_R = 18.85$, $R_{59F} - J = 3.10$) does not fall within the subdwarf region of Figure 5, rendering it unlikely that this object is a subdwarf with an overestimated distance. We conclude that this is a rare case of two physically unassociated objects of similar proper motion being found in the same region of the sky.

SCR 0630−7643 AB was discussed in Henry et al. (2004). It is a new nearby (~7 pc) binary with separation 1″.0 and brightness difference of ~0.25 mag at I_C.

SCR 1257−5554 AB was discussed in § 5.4 as a probable red dwarf/white dwarf pair.

SCR 2155−7330 is a common proper motion companion to HIP 108158. The *Hipparcos* parallax for this object is 0″.02510 ± 0″.00074 (distance = 39.8 pc), which is reasonably consistent with the photometric distance estimate for SCR 2155−7330 of 31.6 pc.

SCR 2250−5726 AB is noticeably peanut-shaped in the SuperCOSMOS frames. CCD frames taken at the CTIO 0.9 m confirm it to be a close binary source with separation 2″.3 at position angle 28°.

SCR 2352−6124 is a common proper motion companion to LHS 4031, which has a *Hipparcos* parallax of 0″.02070 ± 0″.00120 (distance = 48.3 pc), which is consistent with our photometric distance estimate for SCR 2352−6124 of 50.3 pc.

6. DISCUSSION

Listed in Table 3 is a summary of the number of SCR systems with distance estimates within each of the two horizons (10 and 25 pc) and beyond. The five confirmed white dwarfs

TABLE 3

Distance Estimate Statistics for SCR Stars (Excluding White Dwarfs)

Proper Motion	$d \leq 10$ pc	10 pc $< d \leq 25$ pc	$d > 25$ pc
$\mu \geq 1''\!.0$ yr^{-1}	2	0	2
$1''\!.0$ yr$^{-1} > \mu \geq 0''\!.8$ yr^{-1}	0	3	3
$0''\!.8$ yr$^{-1} > \mu \geq 0''\!.6$ yr^{-1}	0	4	25
$0''\!.6$ yr$^{-1} > \mu \geq 0''\!.4$ yr^{-1}	1	8	97
Total	3	15	127

have been removed; however, there remain several likely subdwarfs with overestimated distances that are not accounted for in the statistics, and a few may be within 25 pc. Perhaps the most surprising result of this survey is the discovery that the slowest proper-motion bin of width $0''\!.2$ yr^{-1}—stars moving between $0''\!.4$ and $0''\!.6$ yr^{-1}—contains the largest number (nine) of new candidates for systems within 25 pc. One of these systems, SCR 0630−7643 AB, is a binary with separation of $\sim 1''$ that is probably only ∼7 pc distant (Henry et al. 2004) yet has a relatively low proper motion of only $0''\!.483$ yr^{-1}. Of course, the largest number of new proper-motion stars is found in the slowest bin, yet the presence of so many nearby candidates hints that large numbers of nearby stars may lie undetected at even smaller proper-motion values. It is quite possible that stars within a few parsecs of the Sun have escaped detection simply because they exhibit little proper motion. Pushing to lower proper-motion limits and combining efforts with full-sky photometric surveys may yet reveal these hidden neighbors.

The SCR search detailed here for 13.4% of the sky currently has revealed about one-third as many new LHS systems as the SUPERBLINK effort of Lépine et al. (2002, 2003), which covered 49% of the sky. We anticipate that as we move further northward, the discovery rate of new objects will decrease, because Luyten, Giclas, Lépine, and several of the others listed in Table 1 have searched portions of these regions. Nonetheless, viable new nearby star candidates undoubtedly remain to be found.

Once the SCR search employing the current constraints (magnitude and proper motion) is completed for the southern hemisphere, we intend to carry out new searches with fainter magnitude limits (to $R \sim 20$, consistent with Lépine's survey) and to smaller proper motions (perhaps to $\mu \geq 0''\!.18$ yr^{-1} to match the NLTT catalog limit). These searches will again begin at the south Galactic pole and progress northward. We predict that both surveys will produce considerable numbers of potential nearby systems and help us to provide a more accurate census of the solar neighborhood.

Finder charts for the systems in our sample are found in Figure 6.

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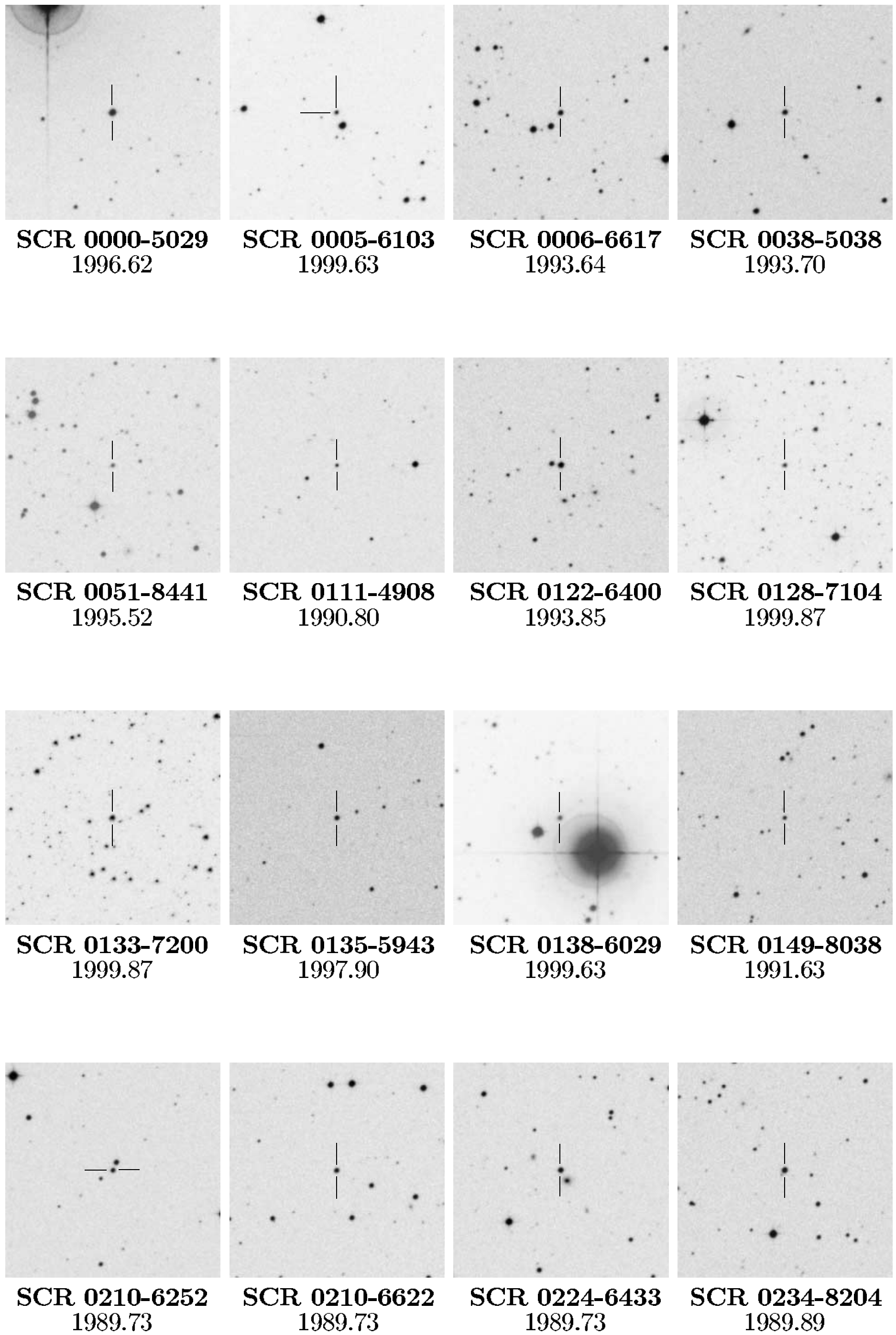


FIG. 6.—Finder charts for the 150 SCR systems in the R_{59F} filter, 5′ on a side. North is up; east is to the left. The observation epoch for each frame is given.

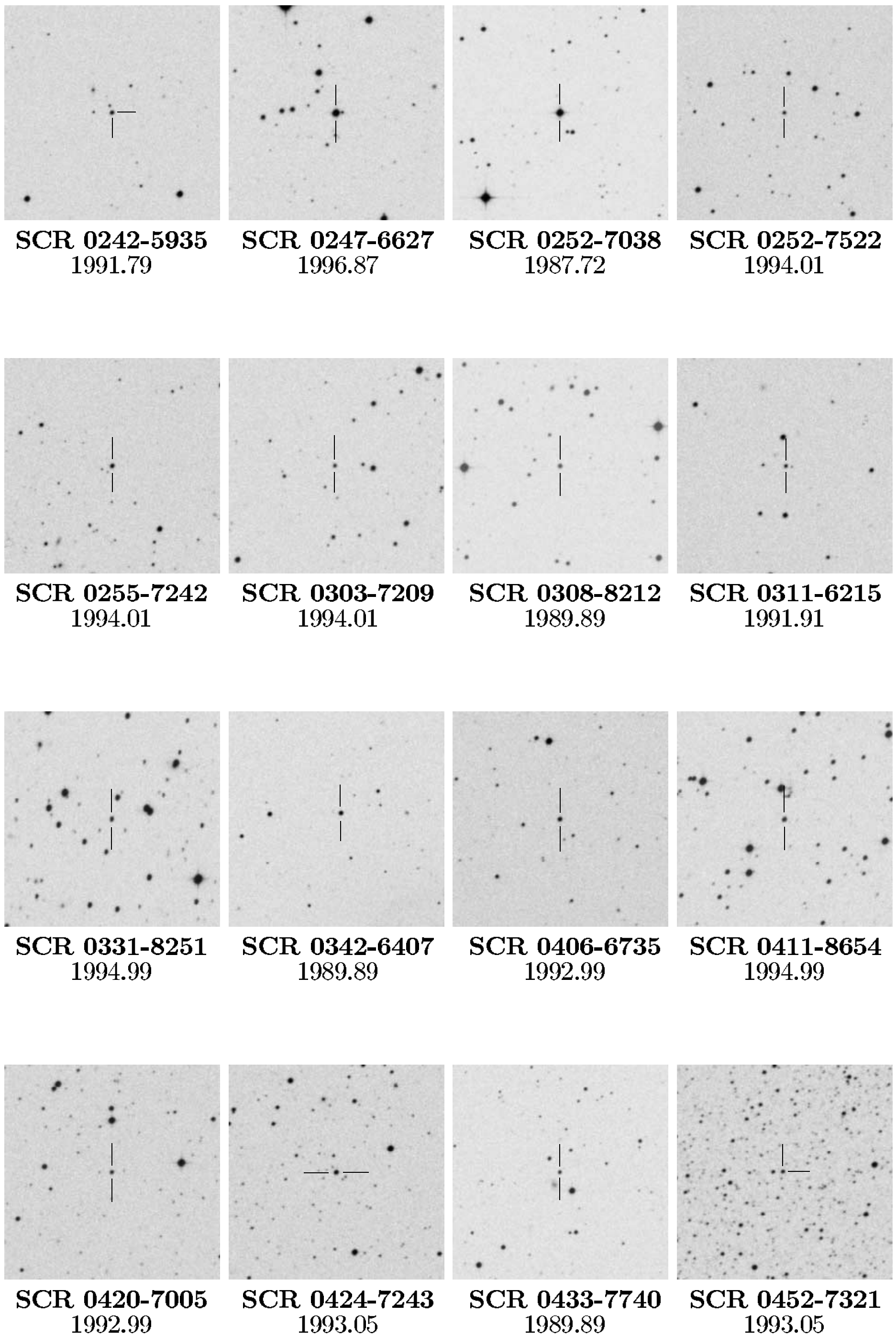


FIG. 6.—*Continued*

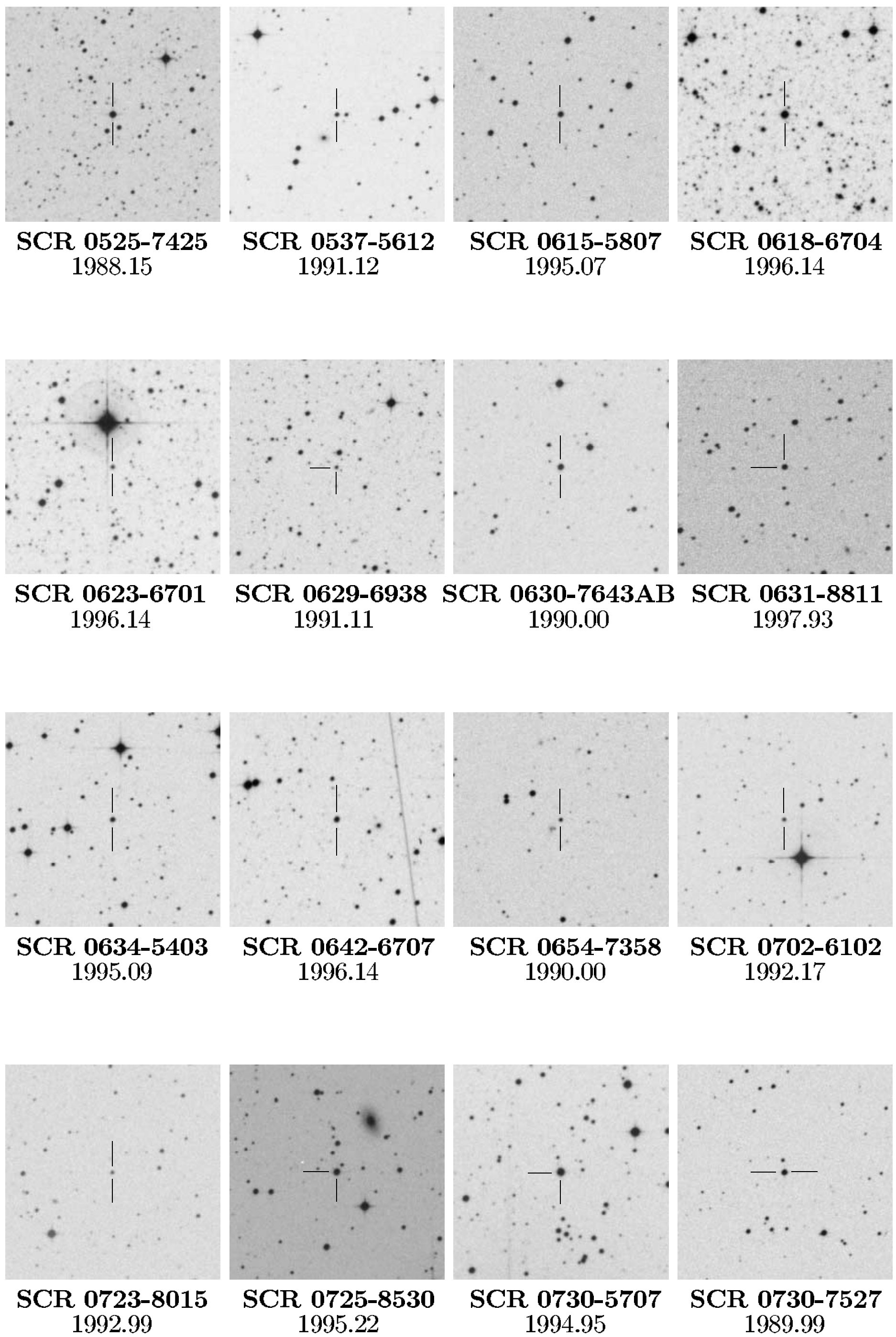


Fig. 6.—*Continued*

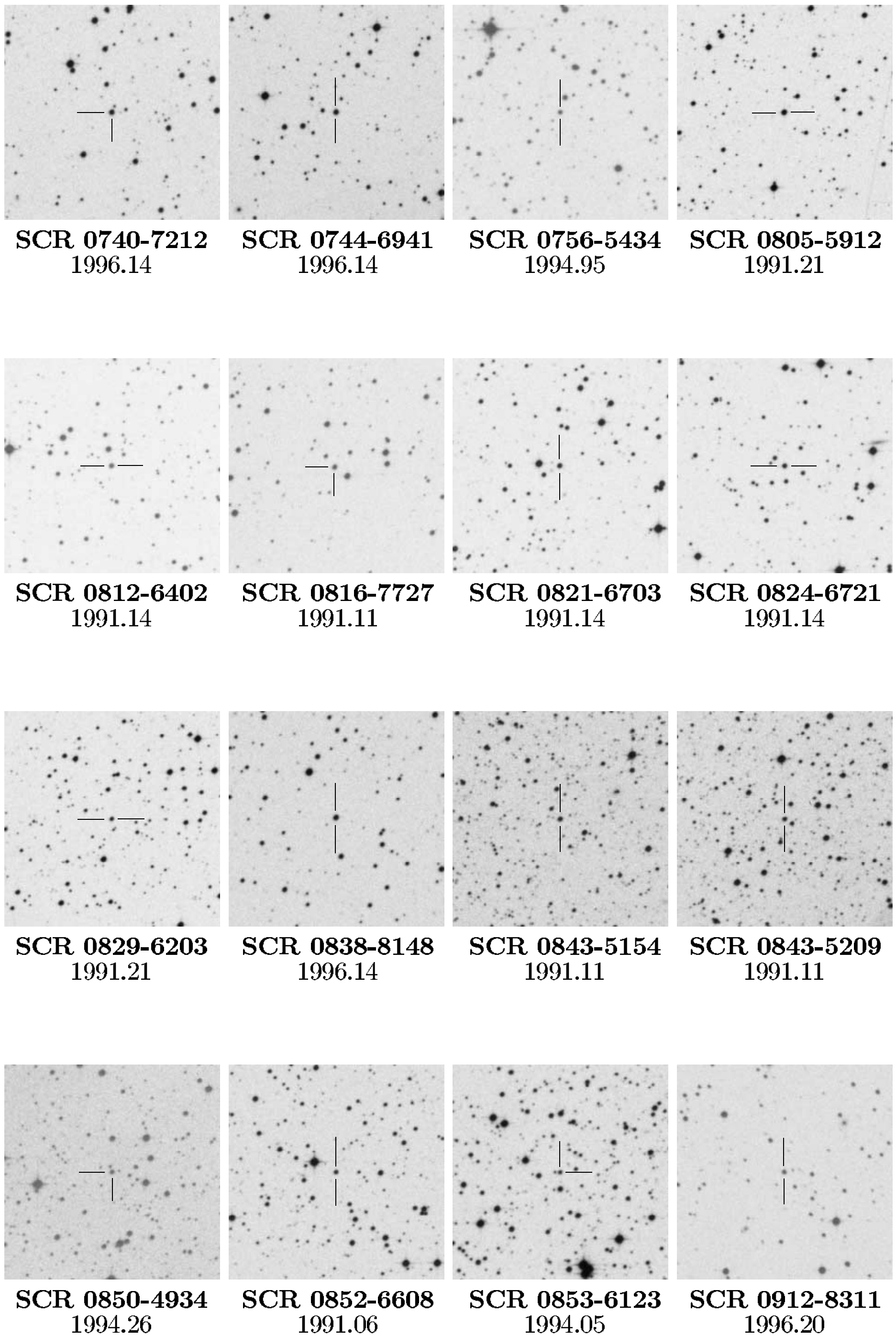
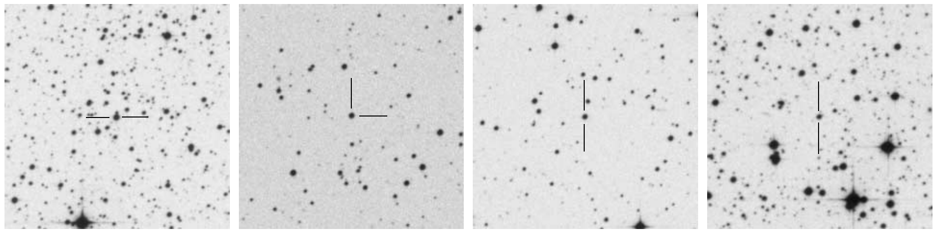
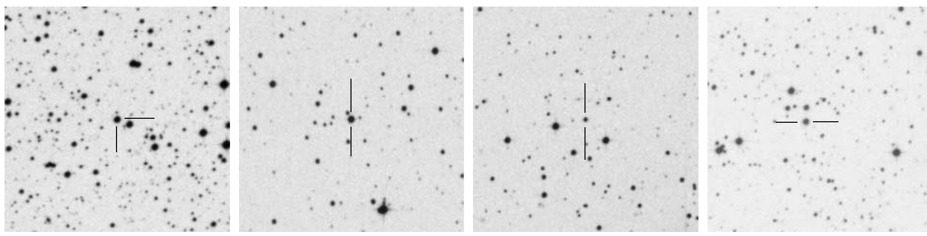


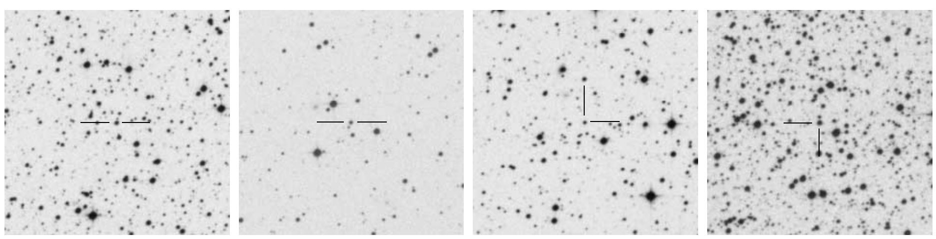
FIG. 6.—*Continued*



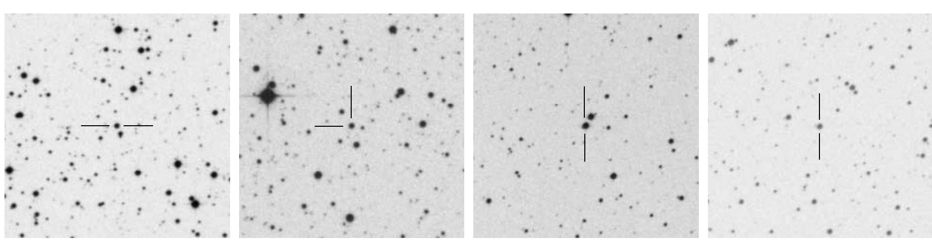
SCR 0942-6428 1991.12 | **SCR 0956-8518** 1996.20 | **SCR 1011-8106** 1991.28 | **SCR 1054-5159** 1995.31



SCR 1057-5103 1995.31 | **SCR 1104-8352** 1993.25 | **SCR 1132-8446** 1993.25 | **SCR 1138-7721** 1991.21



SCR 1143-7047 1991.27 | **SCR 1155-7904** 1991.29 | **SCR 1158-5103** 1991.12 | **SCR 1211-6849** 1994.10



SCR 1213-4820 1991.12 | **SCR 1239-4759** 1994.42 | **SCR 1240-8116** 1991.29 | **SCR 1240-8209** 1991.29

FIG. 6.—*Continued*

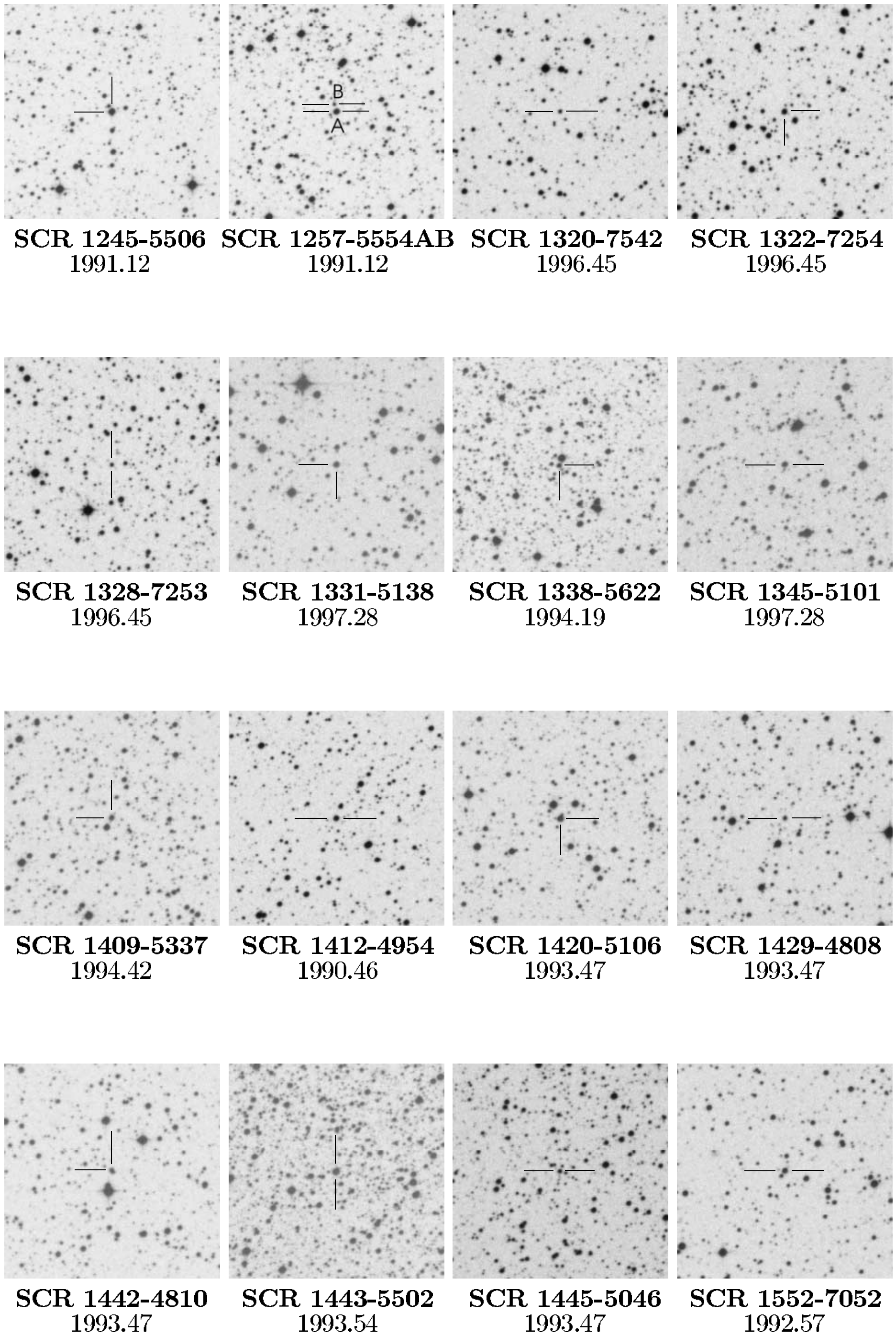
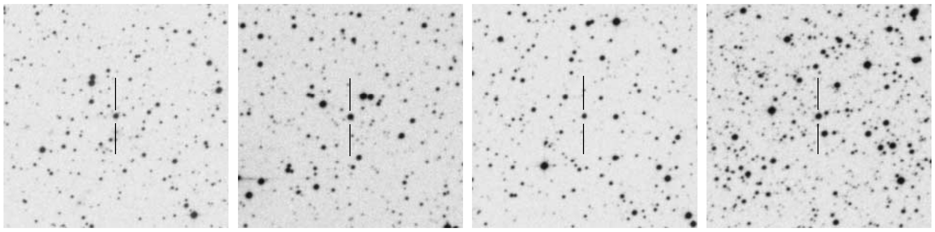
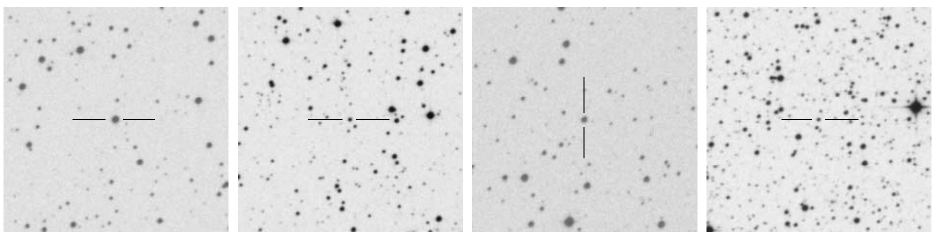


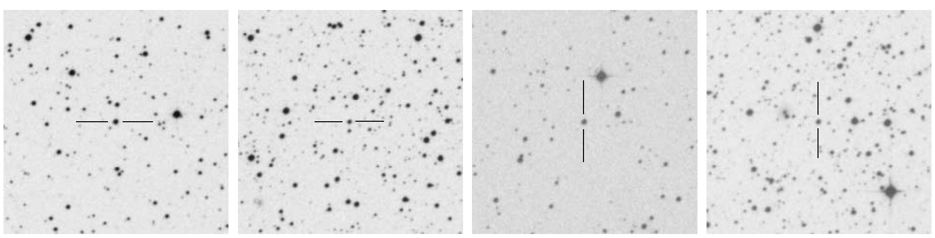
Fig. 6.—*Continued*



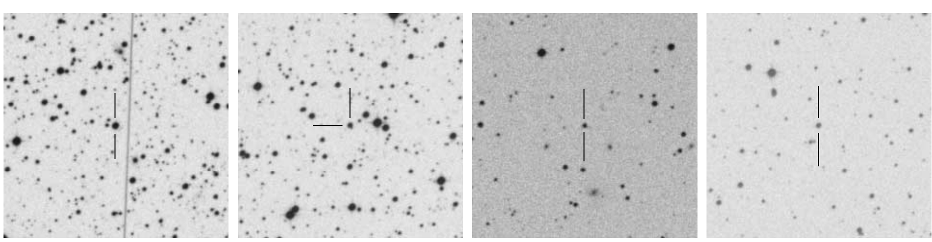
SCR 1627-7337 1991.29 | **SCR 1659-6958** 1993.31 | **SCR 1717-6916** 1991.29 | **SCR 1724-5637** 1991.67



SCR 1726-8433 1996.30 | **SCR 1735-7020** 1991.29 | **SCR 1739-8222** 1994.30 | **SCR 1740-5646** 1991.67



SCR 1748-7211 1991.29 | **SCR 1756-5927** 1990.48 | **SCR 1808-8120** 1994.30 | **SCR 1811-5510** 1995.66



SCR 1817-5318 1995.66 | **SCR 1821-5549** 1995.66 | **SCR 1835-8754** 1997.93 | **SCR 1843-7849** 1994.30

FIG. 6.—*Continued*

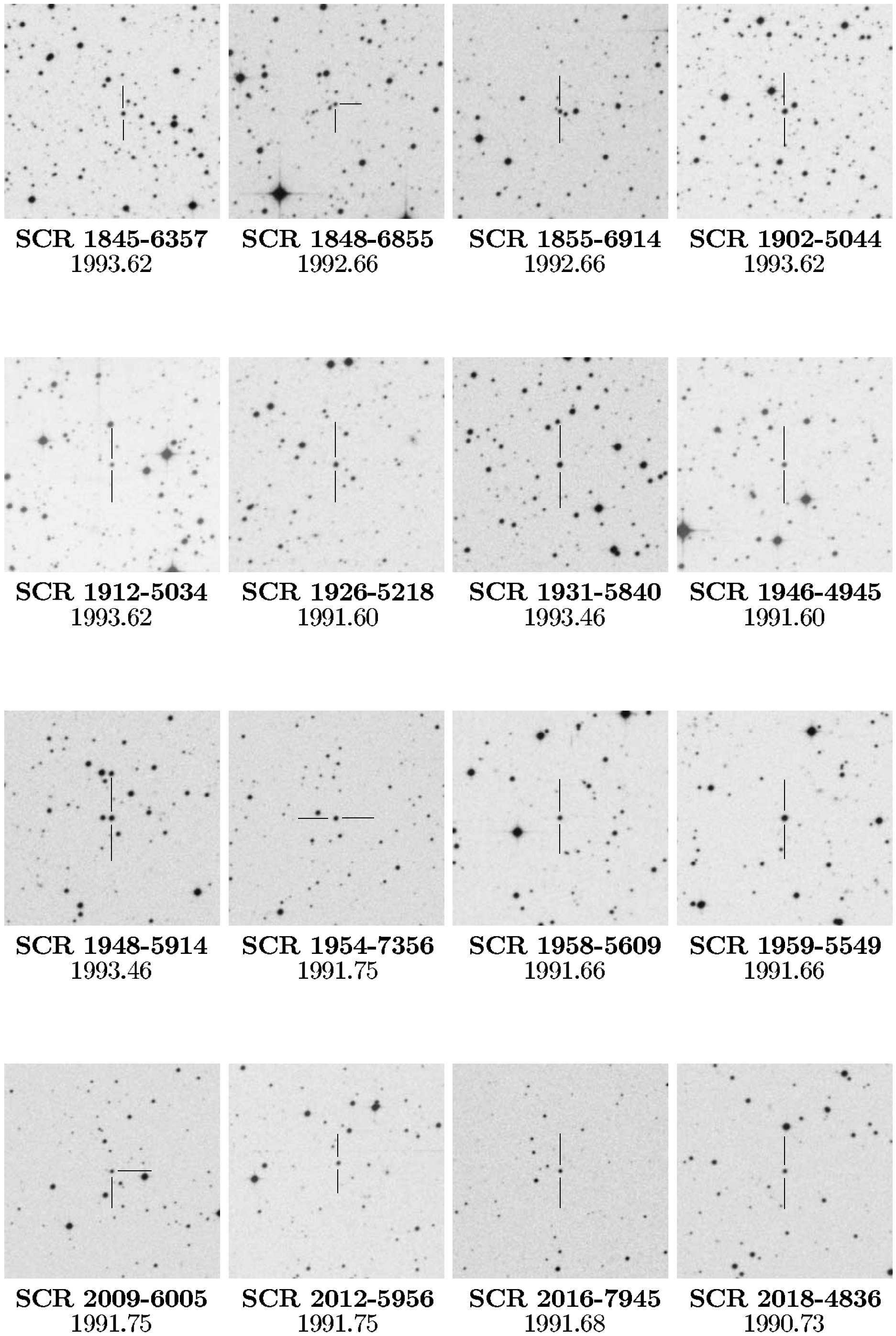


FIG. 6.—*Continued*

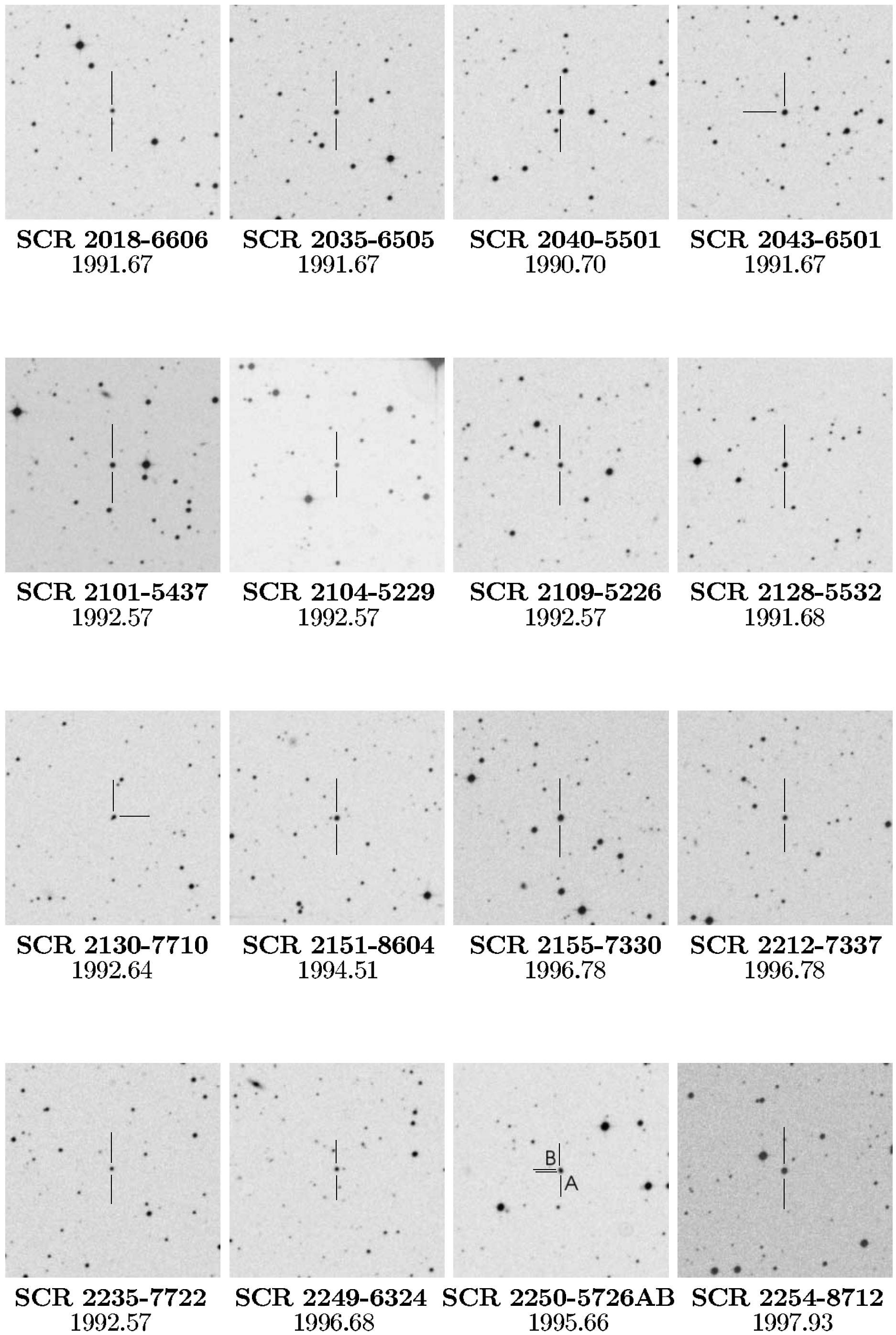


Fig. 6.—*Continued*

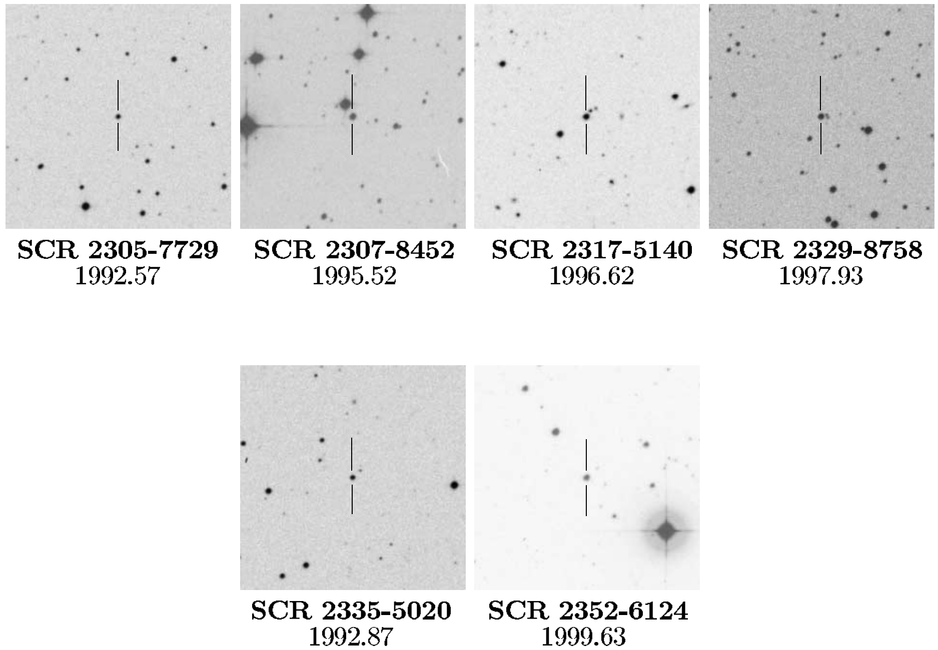


Fig. 6.—*Continued*

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