

## THE SOLAR NEIGHBORHOOD. XVIII. DISCOVERY OF NEW PROPER-MOTION STARS WITH $0.40'' \text{ yr}^{-1} > \mu \geq 0.18'' \text{ yr}^{-1}$ BETWEEN DECLINATIONS $-90^\circ$ AND $-47^\circ$

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### ABSTRACT

We report 1606 new proper-motion systems in the southern sky (declinations  $-90^\circ$  to  $-47^\circ$ ) with  $0.40'' \text{ yr}^{-1} > \mu \geq 0.18'' \text{ yr}^{-1}$ . This effort is a continuation of the SuperCOSMOS-RECONS (SCR) proper-motion search to lower proper motions than reported in Papers VIII, X, XII, and XV in this series. Distance estimates are presented for the new systems, assuming that all stars are on the main sequence. We find that 31 systems are within 25 pc, including two systems (SCR 0838–5855 and SCR 1826–6542) that we anticipate to be within 10 pc. These new discoveries constitute a more than 10-fold increase in new systems found in the same region of sky searched for systems with  $\mu \geq 0.40'' \text{ yr}^{-1}$ , suggesting a happy hunting ground for new nearby slower proper-motion systems in the region just north (declinations  $-47^\circ$  to  $0^\circ$ ), much of which has not been rigorously searched during previous efforts.

*Key words:* astrometry — solar neighborhood — stars: distances — stars: statistics — surveys

*Online material:* machine-readable table

### 1. INTRODUCTION

In this new edition of the investigation of the solar neighborhood, we continue the search for nearby stars by focusing our efforts on systems with proper motions between  $0.40'' \text{ yr}^{-1}$  and  $0.18'' \text{ yr}^{-1}$ . The likelihood that a slow proper motion system is nearby is far lower than the likelihood that a fast proper motion system is. Nonetheless, the much larger number of slow proper motion systems discovered provides an extensive data set for Galactic structure analyses, yields many candidates for follow-up work, and reveals a few nearby gems that move little relative to the Sun.

The pioneering surveys of Giclas et al. (1971, 1978) and Luyten (1979, 1980)<sup>1</sup> have provided most of the proper-motion systems cataloged, even as massive computer searches of digitized photographic plates have become possible. The comprehensive New Luyten Two-Tenths catalog (NLTT) contains 58,693 proper-motion objects with  $\mu \geq 0.18'' \text{ yr}^{-1}$ . Since then, many new high proper motion surveys have been carried out using new techniques, each of which complements the work of Giclas and Luyten. In chronological order, surveys that sampled the sky south of declination  $-47^\circ$  (the region relevant to the survey reported here) include (1) seven papers covering various portions of the southern sky by Wroblewski and collaborators who used photographic plates (Wroblewski & Torres 1994), (2) UK Schmidt Telescope survey plates of 40 survey fields by Scholz and collaborators (Scholz et al. 2000, 2002), (3) a survey of the south Galactic cap down to  $R_{59F} = 19.8$  (Oppenheimer et al. 2001), (4) the machine-selected catalog of 11,289 objects from SuperCOSMOS  $R$ -band material generated by Pokorny et al. (2004), (5) our own SuperCOSMOS-RECONS (SCR) proper-motion search of the entire southern sky (Hambly et al. 2004 [Paper VIII]; Henry et al.

2004 [Paper X]; Subasavage et al. 2005a [Paper XII], 2005b [Paper XV]), which used plates with all four emulsions, (6) the Southern Infrared Proper-Motion Survey (SIPS; Deacon et al. 2005), which used a combination of Two Micron All Sky Survey (2MASS) data and SuperCOSMOS  $I$ -band images, and (7) Lépine's SUPERBLINK survey of a portion of the southern sky (Lépine 2005). The Calan-ESO survey (Ruiz et al. 2001), which identified proper motions in 14 ESO areas of the southern sky, did not reach as far south as declination  $-47^\circ$  (but one of the three ESO regions in Ruiz et al. [1993] did reach south of  $-47^\circ$ , yielding 39 objects). In addition, Lépine's continuing SUPERBLINK survey will provide a vast database of proper-motion systems down to  $0.15'' \text{ yr}^{-1}$ . He has already published the northern portion of the survey, which yielded 61,977 objects (Lépine & Shara 2005).

Our goal since the beginning of the SCR search has been to complete a comprehensive proper-motion survey of the neglected southern sky. Adding results from this paper, we have searched the sky from the south celestial pole to declination  $-47^\circ$  for objects with  $10.00'' \text{ yr}^{-1} \geq \mu \geq 0.18'' \text{ yr}^{-1}$ , where the lower cutoff has been chosen to match the NLTT.

### 2. SEARCH CRITERIA

This phase of the SCR search uses techniques identical to our earlier efforts, simply with a lower proper-motion cutoff. Identical methodology allows us to assess completeness comprehensively and compare statistics from the various search phases. The search techniques are described in detail in Paper VIII in this series. Additional phases of the search can be found in Papers X, XII, and XV. Briefly, the SCR search uses four of the Schmidt survey photographic plates available in each ESO/SRC survey field, which provide astrometric and photometric information in the  $B_J$ , ESO- $R$ ,  $R_{59F}$ , and  $I_{VN}$  photographic passbands. Two distinct epochs in the  $R$  band come from the ESO (first epoch; also

<sup>1</sup> VizieR Online Data Catalog, 1098, 0 (W. J. Luyten, 1995).

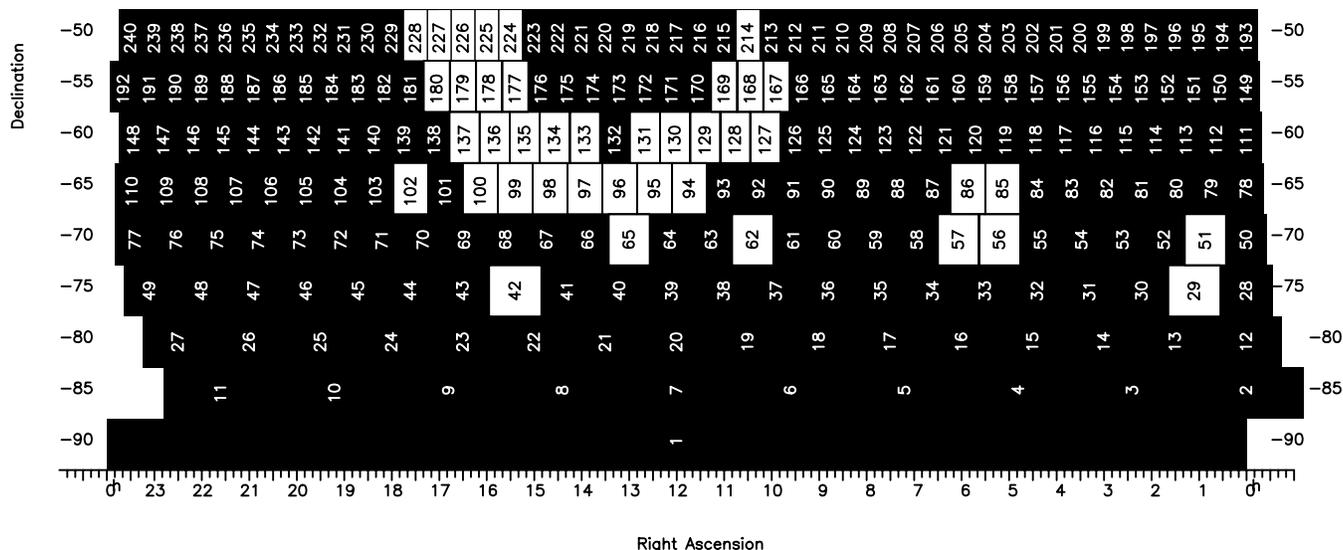


FIG. 1.—Plate coverage of the sky included in the MINIMO search. White boxes indicate plates that were excluded, primarily due to crowding in the Galactic plane, LMC, and SMC, or because of an insufficient spread in plate epochs.

known as ESO-*R*) and UK (second epoch; also known as AAO-*R*) Schmidt telescope surveys. Sources must be detected on at least three plates, and are required to have  $R_{59F}$  brighter than 16.5 mag.

We introduce clear nomenclature here in an effort to sort three categories of systems revealed during the SCR proper-motion search. MOTION systems have  $\mu \geq 1.00'' \text{ yr}^{-1}$  (Paper VIII). The  $1.00'' \text{ yr}^{-1}$  cutoff is convenient and has been studied in detail by Jao (2004). SLOWMO systems have  $1.00'' \text{ yr}^{-1} > \mu \geq 0.50'' \text{ yr}^{-1}$  (Papers XII and XV). The  $0.50'' \text{ yr}^{-1}$  cutoff has been selected to match the famous Luyten Half Second (LHS) sample. MINIMO systems have  $0.50'' \text{ yr}^{-1} > \mu \geq 0.18'' \text{ yr}^{-1}$ , where the lower cutoff is designed to match that of the NLTT catalog. Papers XII and XV include some MINIMO stars because we pushed to  $\mu = 0.40'' \text{ yr}^{-1}$  to ensure that we picked up any “LHS-equivalent” systems with  $\mu \sim 0.50'' \text{ yr}^{-1}$ . Those papers also split the southern sky into two portions: Paper XII covered the sky from declinations  $-90^\circ$  to  $-47^\circ$ , while Paper XV stretched north to the celestial equator. In this paper, we match the boundaries of the search in Paper XII and report the remainder of the MINIMO systems in the range  $0.40'' \text{ yr}^{-1} > \mu \geq 0.18'' \text{ yr}^{-1}$ .

Photographic plates scanned and folded into the SuperCOSMOS database are  $6^\circ \times 6^\circ$  with a  $0.5^\circ$  overlap of adjacent fields on each side, providing  $\sim 25 \text{ deg}^2$  of unique sky coverage for each field. Two hundred fields have been included in the present search, yielding a total coverage of  $\sim 5000 \text{ deg}^2$ , corresponding to 12% of the entire sky. In this region a total of 7410 candidate objects were detected, more than 4 times the number of candidates found in Paper XII. Fields shown as white spaces in Figure 1 were omitted because of crowding near the Magellanic Clouds or Galactic plane, or because those plate regions had epoch spreads inadequate for reliable proper-motion measurements. It is worth noting that three more plates have been omitted in this paper than in Paper XII because longer plate epoch separations are required to reliably determine slower proper motions. The total region omitted amounts to 2.4% of the entire sky.

After object detection and parameterization (see Hambly et al. 2001b), coordinates are given to each detection, making use of a grid of reference stars with known coordinates distributed over the plates as described in Hambly et al. (2001a). The default SuperCOSMOS Sky Survey (SSS) pairing is then used to extract

proper-motion objects (a full description can be found in Hambly et al. 2001a). The pairing is set to exclude all images that appear on all four plates having an astrometric solution that indicates a proper motion less than the cutoff for this search at  $0.18'' \text{ yr}^{-1}$  and a goodness-of-fit parameter of  $\chi^2 < 1.0$  (Paper VIII). Each image either not paired or having inconsistent astrometric solutions due to incorrect pairing is then processed one at a time using every possible combination to find a pair out to the upper limit of the SCR search,  $0.40'' \text{ yr}^{-1}$  for this portion of the search. Proper motions so determined are relative to the mean reference frame defined for all stars on the plates, because all stars are used to map out small-scale systematic errors in positions due to the photographic and measurement processes (see, e.g., Hambly et al. 2001a).

We continue to use a three-stage sifting method discussed in detail in Paper XII to remove false detections. Generally, if a candidate object survives two color checks and a check of the ellipticity quality flag, it advances to a check of databases for previous identifications. Coordinates of these objects are cross-checked using both VizieR and SIMBAD to identify previously known objects. In VizieR, a  $10'$  radius is used to match SCR detections with both the NLTT and the Liverpool-Edinburgh High Proper Motion (LEHPM) catalogs. If the coordinates of an SCR object are within a few arcminutes of a catalog object, and the proper motion and magnitude match, then the target object is labeled as previously known. As a final discovery verification, all potentially new objects are checked against SIMBAD to determine if they have been previously reported as proper-motion objects. One class of known objects, GSC objects from the *Hubble Space Telescope* (*HST*) Guide Star Catalog, is *not* considered previously “found,” as those stars have merely been selected as pointing reference points for *HST*, not as scientifically noteworthy sources. Some near-matches were found to be common proper motion (CPM) companions to previously known proper-motion objects. All of these new companions were visually inspected for accuracy and are discussed in § 5.3.

If the object is not found to be previously known, a visual inspection is done to confirm its veracity. Visual inspections are carried out by blinking the  $B_J$  and  $R_{59F}$  SuperCOSMOS digitally scanned plate images, which have a sufficient spread in epochs to

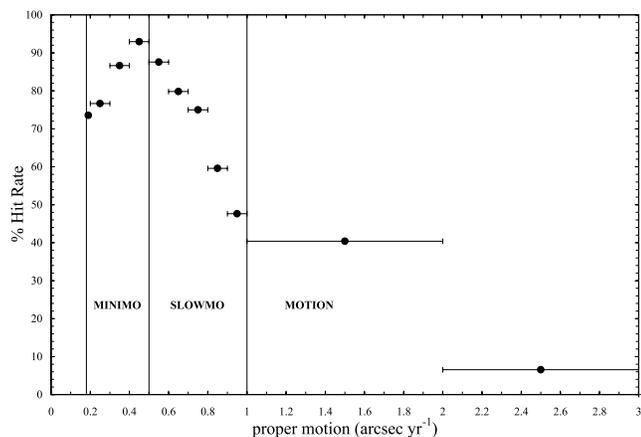


Fig. 2.—Hit rate percentage of true proper-motion objects (real proper-motion objects divided by total candidates extracted) for the entire SCR sample having  $\mu \geq 0.18'' \text{ yr}^{-1}$  south of  $-47^\circ$ . Horizontal bars show the proper-motion bins adopted, while vertical lines delineate the three individual SCR samples: MOTION, SLOWMO, and MINIMO.

confirm or refute derived proper motions. Thus, all objects reported here have been confirmed by eye, but some small number of real objects may have been discarded because visual inspections were not carried out for sources that did not pass the three checks.

In keeping with previous discovery statistics, we compare the successful hit rates (real proper-motion objects divided by total candidates extracted) for the MOTION, SLOWMO, and MINIMO samples in the portion of the sky covered by all three, from declinations  $-90^\circ$  to  $-47^\circ$  (not including individual plate regions that were discarded in any search). The hit rates are 6.6% for MOTION systems, 78.6% for SLOWMO systems, and 78.1% for MINIMO systems. These hit rates take into account new, known, duplicate, and “garbage” (not real) objects. In Figure 2 we show a plot of proper motion versus percent successful hit rate for the entire SCR sample having  $\mu \geq 0.18'' \text{ yr}^{-1}$  south of declination  $-47^\circ$ . The SCR search has a sweet spot near  $\mu \sim 0.45'' \text{ yr}^{-1}$ , where the success rate in picking up proper-motion objects is 93%. This high success rate deteriorates toward faster and slower proper-motion regimes, where the SCR search is more susceptible to false detections. Causes include mistaken object movement from one plate to another when there are slight shifts between the plates, focus abnormalities, spurious objects created via plate defects, and bright-star halos. In Table 1, SCR objects in the various papers have been categorized into the MOTION, SLOWMO, and MINIMO samples and discovery statistics are shown for the entire SCR sample.

### 3. COMPARISON TO PREVIOUS PROPER-MOTION SURVEYS

The NLTT catalog lists 58,693 objects with  $\mu \geq 0.18'' \text{ yr}^{-1}$ . Of these, 2278 objects meet the search criteria of this paper and have estimated red magnitudes of 16.5 or brighter. We recover 1852 of 2278 objects found in the fields we searched, resulting in an 81% recovery rate. Several factors contribute to the 19% of unrecovered stars. Our proper motions are accurate to  $\sim 0.02'' \text{ yr}^{-1}$  and our magnitudes to  $\sim 0.3$  mag. Proper motions and magnitudes in the NLTT in some cases differ from ours, which causes us to drop some objects that were included in the NLTT. On rare occasions we also miss stars that are lost on recent plates due to mergers but were uncorrupted during previous efforts. Our SCR search has trouble picking up brighter sources because of halo

TABLE 1  
DISCOVERY STATISTICS FOR ENTIRE SCR SAMPLE

Category	MOTION <sup>a</sup>	SLOWMO <sup>b</sup>	MINIMO <sup>c</sup>
New discoveries.....	9	142	1879
Known.....	171	1159	5581
Duplicates.....	15	91	864
Garbage.....	1989	344	3613
Total hits.....	2184	1736	11937

NOTE.—The “entire SCR sample” includes all previous SCR proper-motion papers.

<sup>a</sup> MOTION sample includes  $\mu \geq 1.00'' \text{ yr}^{-1}$ .

<sup>b</sup> SLOWMO sample includes  $1.00'' \text{ yr}^{-1} > \mu \geq 0.50'' \text{ yr}^{-1}$ .

<sup>c</sup> MINIMO sample includes  $0.50'' \text{ yr}^{-1} > \mu \geq 0.18'' \text{ yr}^{-1}$ .

effects present on the photographic plates. The brightest NLTT source we identified in the search is at  $R_{59F} \sim 5.4$  mag while the brightest NLTT source in this portion of the sky is  $R \sim 1.6$  mag. Here we compare the results from our SCR survey to date for declinations  $-90^\circ$  to  $-47^\circ$  to the proper-motion surveys listed in Table 2.<sup>2</sup> The numbers listed reflect only the total number of entries in each work; we have not confirmed that all sources by other groups are both real and original.

### 4. DATA

Rather than list all of the 1606 new MINIMO systems reported in this paper explicitly, we give the first five lines in Table 3; the full table can be found in the electronic version of the *Astronomical Journal*. In Table 4 we highlight the 31 systems for which we estimate distances of less than 25 pc and 13 additional white dwarf candidates. As in previous SCR search papers, in Tables 3 and 4 we list SCR names, coordinates, relative proper motions, plate magnitudes from SuperCOSMOS, infrared photometry from 2MASS, the  $R_{59F} - J$  color, a distance estimate, and notes.

All coordinates are for epoch and equinox J2000.0 and are computed using the 2MASS coordinates and adjusted to epoch J2000.0 using the SCR proper motions and position angles. From our search algorithm, the average proper-motion errors are  $\sim 0.010'' \text{ yr}^{-1}$ . We show in Figure 3 that our proper motion and position angle measurements are consistent with those in NLTT and *Hipparcos* by examining 298 MINIMO stars that had data in both catalogs.<sup>3</sup> The results indicate that the SCR proper motions and position angles have an average deviation of  $\sim 0.025'' \text{ yr}^{-1}$  and  $\sim 6.8^\circ$  compared to NLTT motions and  $\sim 0.020'' \text{ yr}^{-1}$  and  $\sim 3.9^\circ$  compared to *Hipparcos*. We also show that the NLTT and *Hipparcos* proper motions and position angles show average deviations in proper motions of  $\sim 0.019'' \text{ yr}^{-1}$  and  $\sim 5.1^\circ$  when compared to each other. Comparison of the three outlying data points in position angle in the SCR versus NLTT and *Hipparcos* versus NLTT plots indicates that these NLTT measurements are incorrect. The consistency between SCR and *Hipparcos* is particularly encouraging because *Hipparcos* only observed stars brighter than  $V \sim 12$ , and these are the stars with the poorest measured proper motions in the SCR survey.

<sup>2</sup> For samples that were reported in B1950.0 coordinates, we have not computed J2000.0 coordinates or slid stars because of proper motion over 50 yr. The number of objects that may have slipped out of the sample by moving north of  $-47^\circ$  is expected to be small, and a comparable number of replacement objects have likely slipped south.

<sup>3</sup> NLTT proper-motion data are quantized south of declination  $-45^\circ$  because those proper motions are reported to hundredths, whereas north of declination  $-45^\circ$  proper motions are reported to thousandths.

TABLE 2  
NUMBER OF NLTT OBJECTS DISCOVERED SOUTH OF DECLINATION  $-47^\circ$

Survey	$\mu \geq 1.00'' \text{ yr}^{-1}$	$1.00'' \text{ yr}^{-1} > \mu \geq 0.50'' \text{ yr}^{-1}$	$0.50'' \text{ yr}^{-1} > \mu \geq 0.18'' \text{ yr}^{-1}$	Total	Number of Publications	References
NLTT.....	56	261	3529	3846	1	1
SuperCOSMOS-RECONS.....	5	70	1742	1817	5	2, 3, 4, 5, 6
Wroblewski and collaborators.....	3	28	488	519	4	7, 8, 9
SUPERBLINK.....	1	43	29	73	1	10
Scholz and collaborators.....	2	11	55	68	2	11, 12
Ruiz and collaborators.....	0	2	37	39	1	13
SIPS.....	7	20	0	27	1	14
Oppenheimer et al.....	1	4	2	7	1	15
Pokorny et al.....	Mixed	Mixed	Mixed	Mixed	2	16, 17

NOTES.—Numbers listed indicate objects reported as “new” in the survey publications. Pokorny did not differentiate between new and previously known objects, so the entry is labeled as mixed.

REFERENCES.—(1) Luyten 1979, 1980; (2) Paper VIII; (3) Paper X; (4) Paper XII; (5) Paper XV; (6) this paper; (7) Wroblewski & Torres 1989; (8) Wroblewski & Torres 1991; (9) Wroblewski & Torres 1994; (10) Lépine 2005; (11) Scholz et al. 2000; (12) Scholz et al. 2002; (13) Ruiz et al. 1993; (14) Deacon et al. 2005; (15) Oppenheimer et al. 2001; (16) Pokorny et al. 2003; (17) Pokorny et al. 2004.

Photographic magnitudes are given in Tables 3 and 4 for three plate emulsions:  $B_J$ ,  $R_{59F}$ , and  $I_{IVN}$ . Plate magnitude errors are typically less than 0.3 mag for sources fainter than 15 mag, with errors increasing for brighter objects because of systematic errors (Hambly et al. 2001b). Plate color errors are typically only 0.07 mag. The 2MASS  $JHK_s$  photometry and a representative color,  $R_{59F} - J$ , generated using two of the most reliable photometric measurements, are given. All  $JHK_s$  infrared photometry is extracted from 2MASS via VizieR, and these magnitudes were spot-checked by eye for accuracy. The 2MASS magnitude errors are 0.03 mag or less in most cases. This holds true unless  $J > 15$ ,  $H > 14.5$ , or  $K_s > 14$ , for which the errors are typically 0.05 mag or greater.

The six-band photometry is used to generate 12 colors that are used to compute distance estimates, as described in Paper VIII. All estimates assume that the objects are single, main-sequence stars. The scatter is 26%, defined as the mean of the absolute values of the differences between distances for stars with trigonometric parallaxes and distances estimated via the relations. In cases where objects are too blue for the relations, no distance is listed. In a few cases the  $B_J$  and/or  $I_{IVN}$  plate magnitudes are not determined (likely causes include confusing sources and plate defects), making the distance estimate less reliable. Thirteen white dwarf and 173 subdwarf candidates have erroneous distances (listed in brackets) from the suite of relations because they are not main-sequence stars; more accurate estimates are given in the notes for the white dwarfs. Overall, we find two systems within 10 pc, 29 between 10 and 25 pc, and 377 between 25 and 50 pc.

Some of the CPM candidates were not revealed during the SCR search because of confusion with another source or because the companion was fainter than our magnitude cutoff; however, these were noticed during the blinking process. In these cases the objects are investigated using SIMBAD and VizieR to check for previous identifications. If the object was not previously known, we use SuperCOSMOS and 2MASS magnitudes to obtain the six colors used to compute distance estimates and proper-motion data from SuperCOSMOS to compute proper motions and position angles.

## 5. ANALYSIS

### 5.1. Color-Magnitude Diagram

Plotted in Figure 4 is a color-magnitude diagram comparing the new SCR objects (*circles*) to the known objects (*dots*) from this phase of the search. Data points below  $R_{59F} = 16.5$  are CPM companions noticed during the blinking process. As in Papers XII and XV, the bulk of the new discoveries are fainter and redder than the known stars, including three objects, SCR 0838–5855, SCR 1826–6542, and SCR 2241–6119B with  $R_{59F} - J > 5.5$ . Unlike the sources extracted in our previous efforts, there are more new discoveries featured in this paper that are brighter and bluer than in previous discoveries. In fact, there are nine new discoveries with  $R_{59F}$  brighter than 10 mag that had not been identified previously. The point at  $R_{59F} = 8.14$  is SCR 1914–7109, which is too blue for us to estimate a distance using the plate-2MASS relations.

TABLE 3  
CHARACTERISTICS OF NEW SCR SYSTEMS WITH  $0.40'' \text{ yr}^{-1} > \mu \geq 0.18'' \text{ yr}^{-1}$  FROM  $-90^\circ < \delta \leq -47^\circ$

Name	R. A. (J2000.0)	Decl. (J2000.0)	$\mu$ (arcsec)	$\theta$ (deg)	$B_J$	$R_{59F}$	$I_{IVN}$	$J$	$H$	$K_s$	$R_{59F} - J$	Est. Dist. (pc)	Notes
SCR 0001–7015.....	00 01 56.59	−70 15 08.4	0.202	141.1	18.22	16.20	14.64	13.36	12.79	12.66	2.84	142.5	
SCR 0003–6021.....	00 03 59.01	−60 21 58.1	0.249	145.1	17.84	15.68	12.92	11.68	11.08	10.75	4.00	35.3	
SCR 0004–5740.....	00 04 26.79	−57 40 02.7	0.181	091.2	16.00	13.87	12.36	11.47	10.87	10.65	2.41	66.0	
SCR 0004–6120A.....	00 04 56.20	−61 20 58.0	0.180	129.0	13.63	11.28	9.94	9.66	9.08	8.81	1.62	35.8	<sup>a</sup>
SCR 0004–6120B.....	00 04 45.41	−61 23 40.0	0.171	127.6	16.87	16.76	16.54	16.44	15.94	16.48	0.33	[1216.2]	<sup>a,b,c</sup>

NOTE.—Units of right ascension are hours, minutes, and seconds, and units of declination are degrees, arcminutes, and arcseconds. Table 3 is published in its entirety in the electronic edition of the *Astronomical Journal*. A portion is shown here for guidance regarding its form and content.

<sup>a</sup> CPM companion; see Table 5.

<sup>b</sup> White dwarf candidate selected from RPM diagram, plate distance (in brackets) is incorrect; see Table 4.

<sup>c</sup> Not detected during automated search but noticed by eye during the blinking process.

TABLE 4  
CHARACTERISTICS OF NEW SCR SYSTEMS ESTIMATED TO BE NEARER THAN 25 pc AND NEW WHITE DWARF CANDIDATES  
WITH  $0.40'' \text{ yr}^{-1} > \mu \geq 0.18'' \text{ yr}^{-1}$  FROM  $-90^\circ < \delta \leq -47^\circ$

Name	R.A. (J2000.0)	Decl. (J2000.0)	$\mu$ (arcsec)	$\theta$ (deg)	$B_J$	$R_{59F}$	$I_{IVN}$	$J$	$H$	$K_s$	$R_{59F} - J$	Est. Dist. (pc)	Notes
SCR Red Dwarf Candidates <25 pc													
SCR 0100–7904.....	01 00 56.08	–79 04 25.2	0.379	215.3	13.69	11.69	9.98	8.79	8.16	7.88	2.89	14.9	
SCR 0135–6127.....	01 35 53.66	–61 27 11.1	0.255	256.8	15.61	13.67	11.80	10.05	9.53	9.24	3.61	20.8	
SCR 0138–5353.....	01 38 20.51	–53 53 26.1	0.297	071.0	15.70	13.69	11.73	10.27	9.69	9.42	3.42	24.2	
SCR 0211–6108.....	02 11 35.42	–61 08 53.8	0.234	060.8	11.68	9.73	9.23	8.67	8.15	8.07	1.06	22.9	
SCR 0232–8458.....	02 32 50.12	–84 58 09.5	0.220	141.9	12.31	10.17	9.87	8.99	8.34	8.18	1.17	24.9	
SCR 0246–7024.....	02 46 02.25	–70 24 06.3	0.259	113.2	15.71	13.32	10.71	9.83	9.32	9.01	3.49	20.0	
SCR 0527–7231.....	05 27 06.99	–72 31 20.0	0.368	018.3	16.01	13.96	11.76	10.33	9.76	9.47	3.63	22.6	
SCR 0635–6722.....	06 35 48.81	–67 22 58.5	0.383	340.0	12.21	9.83	8.66	8.54	7.95	7.69	1.29	22.7	
SCR 0838–5855.....	08 38 02.24	–58 55 58.7	0.320	188.9	18.44	16.11	12.43	10.30	9.70	9.26	5.80	8.4	
SCR 1147–5504.....	11 47 52.49	–55 04 11.9	0.192	011.3	14.95	12.23	10.25	9.67	9.08	8.81	2.56	24.1	
SCR 1217–7810.....	12 17 26.93	–78 10 45.9	0.212	056.6	17.54	15.69	13.14	11.19	10.64	10.35	4.49	24.5	
SCR 1220–8302.....	12 20 03.71	–83 02 29.2	0.243	244.2	17.03	14.93	12.79	10.97	10.39	10.07	3.96	25.0	
SCR 1224–5339.....	12 24 24.44	–53 39 08.8	0.189	251.9	16.93	14.77	12.30	10.50	9.93	9.64	4.26	18.1	
SCR 1347–7610.....	13 47 56.80	–76 10 20.0	0.194	089.7	12.39	10.26	8.88	8.62	8.01	7.77	1.64	22.5	
SCR 1420–7516.....	14 20 36.84	–75 16 5.90	0.195	243.7	14.22	12.68	10.44	9.44	8.90	8.63	3.23	21.3	
SCR 1441–7338.....	14 41 14.42	–73 38 41.4	0.207	029.0	18.27	16.14	13.04	11.19	10.60	10.26	4.95	19.0	
SCR 1448–5735.....	14 48 39.82	–57 35 17.7	0.202	188.8	12.47	10.59	12.46	9.14	8.55	8.43	1.45	18.2	
SCR 1456–7239.....	14 56 02.29	–72 39 41.4	0.207	225.0	16.50	14.22	11.99	10.62	10.05	9.74	3.60	24.9	
SCR 1738–5942.....	17 38 41.02	–59 42 24.4	0.280	148.2	16.57	14.20	11.92	10.38	9.83	9.58	3.82	20.8	
SCR 1820–6225.....	18 20 49.35	–62 25 52.7	0.190	164.8	13.35	11.17	8.43	9.13	8.48	8.29	2.04	22.4	
SCR 1826–6542.....	18 26 46.83	–65 42 39.9	0.311	178.9	18.68	16.43	12.91	10.56	9.96	9.54	5.86	9.2	
SCR 1853–7537.....	18 53 26.61	–75 37 39.8	0.304	168.7	12.20	9.85	9.09	8.34	7.73	7.49	1.51	20.0	
SCR 1856–4704.....	18 56 38.40	–47 04 58.3	0.252	131.3	16.29	13.92	11.64	10.29	9.74	9.44	3.63	21.4	
SCR 1926–8216.....	19 26 48.64	–82 16 47.6	0.195	172.5	12.22	10.00	10.20	9.04	8.42	8.30	0.96	17.3	
SCR 1932–5005.....	19 32 48.64	–50 05 38.9	0.257	157.5	16.86	14.50	11.99	10.75	10.11	9.84	3.75	24.4	
SCR 1959–6236.....	19 59 33.55	–62 36 13.4	0.189	288.7	17.47	15.35	12.67	11.06	10.49	10.22	4.29	24.3	
SCR 2016–7531.....	20 16 11.25	–75 31 04.5	0.253	081.3	17.06	14.74	12.24	10.46	9.86	9.50	4.28	16.2	
SCR 2042–5737.....	20 42 46.44	–57 37 15.3	0.264	142.6	15.06	13.22	11.55	9.97	9.52	9.03	3.25	22.7	
SCR 2230–5244.....	22 30 27.95	–52 44 29.1	0.369	125.7	19.01	16.34	...	11.84	11.23	10.91	4.49	24.6	
SCR 2241–6119A.....	22 41 44.36	–61 19 31.2	0.184	124.0	15.64	13.65	11.70	10.20	9.61	9.35	3.44	23.2	<sup>a</sup>
SCR 2335–6433A.....	23 35 18.43	–64 33 42.4	0.196	103.1	11.79	9.97	9.01	8.63	8.02	7.86	1.33	24.5	<sup>a</sup>
SCR WD Candidates													
SCR 0004–6120B.....	00 04 45.41	–61 23 40.0	0.171	127.6	16.86	16.76	16.53	16.43	15.93	16.47	0.32	[1216.2]	$59.3 \pm 11.9 \text{ pc}^{\text{a,b,c}}$
SCR 0018–6851.....	00 18 08.56	–68 51 19.4	0.220	091.6	16.55	16.46	16.48	16.62	16.13	17.18	–0.16	...	$52.2 \pm 10.4 \text{ pc}^{\text{c,d}}$
SCR 0104–5742B.....	01 04 12.14	–57 42 48.6	0.239	091.1	16.19	15.89	15.78	15.67	15.56	15.75	0.22	[872.1]	$34.5 \pm 6.9 \text{ pc}^{\text{c,e}}$
SCR 0150–7207.....	01 50 38.49	–72 07 16.8	0.334	223.9	16.18	15.71	15.24	15.65	15.64	15.42	0.06	...	$28.0 \pm 5.6 \text{ pc}^{\text{c,d,e}}$
SCR 0245–6038.....	02 45 27.77	–60 38 58.2	0.196	049.6	17.15	16.36	16.07	15.83	15.47	15.66	0.52	[821.9]	$29.9 \pm 6.0 \text{ pc}^{\text{c}}$
SCR 0355–5611.....	03 55 31.89	–56 11 28.2	0.279	029.1	17.36	16.46	16.11	16.05	15.53	15.44	0.41	[755.9]	$28.9 \pm 5.8 \text{ pc}^{\text{c}}$
SCR 0429–5423B.....	04 29 05.93	–54 23 03.6	0.170	39.70	17.91	17.08	16.97	...	...	...	...	...	$40.5 \pm 8.1 \text{ pc}^{\text{a,b,c,f}}$
SCR 0840–7826.....	08 40 29.00	–78 26 46.0	0.399	010.3	16.06	15.82	15.77	15.62	15.57	15.47	0.20	[763.9]	$34.8 \pm 7.0 \text{ pc}^{\text{c}}$
SCR 0857–6032.....	08 57 08.21	–60 32 45.4	0.217	333.3	15.20	15.37	15.45	15.94	16.20	15.78	–0.56	...	$38.2 \pm 7.6 \text{ pc}^{\text{c,d}}$
SCR 1821–5951.....	18 21 59.54	–59 51 48.5	0.365	194.9	17.49	16.31	15.72	15.20	15.00	14.90	1.11	[588.9]	$22.2 \pm 4.4 \text{ pc}^{\text{c,e}}$
SCR 2020–7806.....	20 20 52.98	–78 06 18.7	0.276	209.2	16.03	16.09	16.11	15.92	15.59	15.68	0.16	[834.9]	$49.1 \pm 9.8 \text{ pc}^{\text{c}}$
SCR 2032–4948B.....	20 32 41.74	–49 48 57.2	0.270	182.4	17.15	16.77	16.73	16.62	15.87	15.88	0.14	[900.1]	$48.7 \pm 9.7 \text{ pc}^{\text{a,b,c}}$
SCR 2354–6023.....	23 54 50.63	–60 23 16.0	0.230	098.6	16.31	16.06	15.93	15.87	15.77	16.31	0.18	[1127.8]	$38.6 \pm 7.7 \text{ pc}^{\text{c}}$

NOTE.—Units of right ascension are hours, minutes, and seconds, and units of declination are degrees, arcminutes, and arcseconds.

<sup>a</sup> Common proper motion; see Table 5.

<sup>b</sup> Not detected during automated search but noticed by eye during the blinking process.

<sup>c</sup> WD candidate with unreliable distance estimate (in brackets); more reliable WD distance estimate in notes.

<sup>d</sup> All colors are too blue or too red for distance relations.

<sup>e</sup> WD confirmed via spectroscopy; results to be published in a future paper by coauthor J. P. S.

<sup>f</sup> Not in 2MASS.

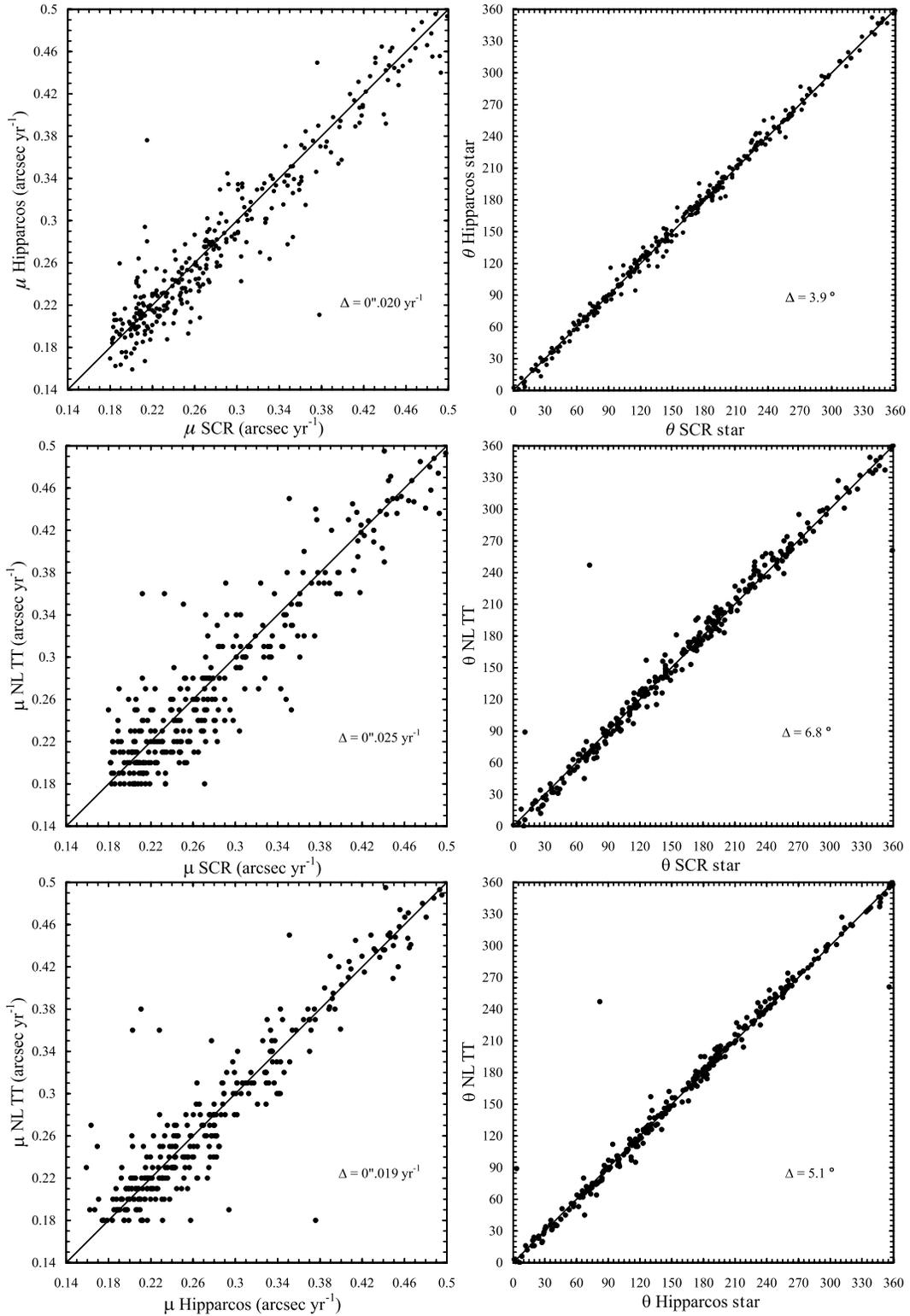


FIG. 3.—Comparison of NLTT, *Hipparcos*, and SCR proper motions and position angles. The solid line indicates perfect agreement. Note that proper-motion data for NLTT are quantized south of  $-45^\circ$ .

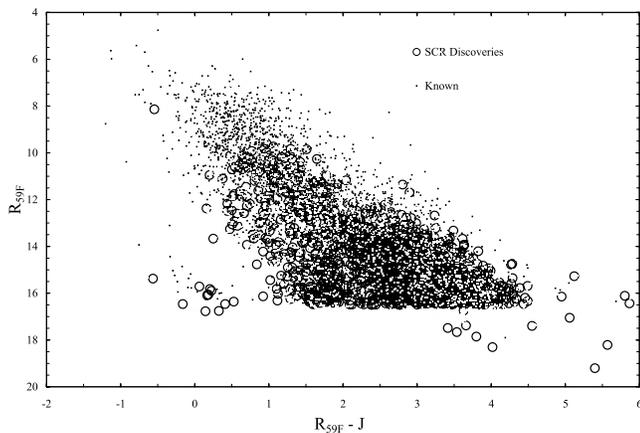


FIG. 4.—Color–apparent magnitude diagram for SCR systems (*circles*) and known systems (*dots*) with  $0.40'' \text{ yr}^{-1} > \mu \geq 0.18'' \text{ yr}^{-1}$  from  $-90^\circ < \delta \leq -47^\circ$ . Data points below  $R_{59F} - J = 16.5$  are CPM companions noticed during the blinking process.

As in comparable plots in previous papers, several white dwarf candidates are clearly separated from the bulk of the sample. The subdwarf population is less well defined, but a population of subdwarfs can be detected below the concentration of main-sequence stars.

### 5.2. Reduced Proper Motion Diagram

Shown in Figure 5 is the reduced proper motion (RPM) diagram for objects found in this search, similar to the RPM diagrams shown in Papers XII and XV. The RPM diagram relies on the statistical (inverse) relationship between proper motion and distance; objects that have larger distances generally have smaller proper motions. As such, it can be used to separate white dwarfs and (less clearly) subdwarfs from main-sequence stars. While this assumption is not always valid, it is a fairly reliable indicator of luminosity class for most stars. As in previous papers, the relation used to determine  $H_R$  is

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

A comparison of Figures 4 and 5 shows that the RPM diagram is slightly better at separating the three samples.

There is a clear break separating the white dwarfs from the rest of the sample. The arbitrary dashed line between the subdwarfs and white dwarfs is the same as used in Paper XV, although the proper motions are smaller. In this region of the diagram, we find 12 new white dwarf candidates: SCR 0004–6120B, SCR 0018–6851, SCR 0104–5742B, SCR 0150–7207, SCR 0245–6038, SCR 0355–5611, SCR 0840–7826, SCR 0857–6032, SCR 1821–5951, SCR 2020–7806, SCR 2032–4948B, and SCR 2354–6023. One additional candidate, SCR 0429–5423B, was noticed while blinking to have colors consistent with a white dwarf, but lacks the 2MASS data to plot in the RPM diagram, bringing the total number of white dwarf candidates for this paper to 13. One object, SCR 1800–5112B, is a close double with blended photometry in SuperCOSMOS, which puts it inside the white dwarf regime of the RPM diagram. The infrared colors, however, are not consistent with a white dwarf; therefore, it is not considered a white dwarf candidate. Of the 13 candidates, three (SCR 0104–5742B, SCR 0150–7207, and SCR 1821–5951) have been spectroscopically confirmed (results to be presented in a future publication). Each is listed in Table 4 with a bracketed erroneous distance estimate assuming the object is a

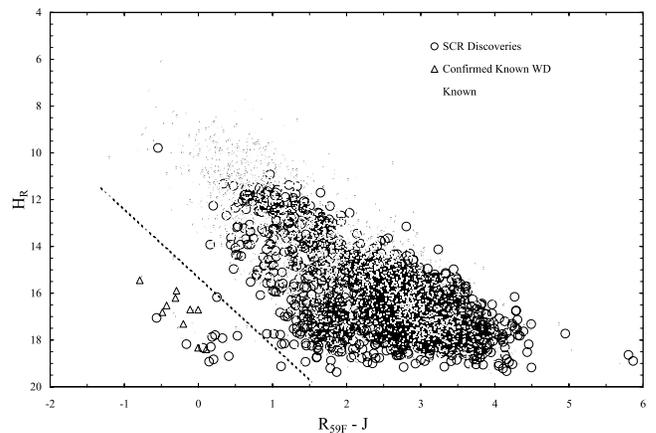


FIG. 5.—RPM diagram for SCR systems (*circles*) and known systems (*dots*) with  $0.40'' \text{ yr}^{-1} > \mu \geq 0.18'' \text{ yr}^{-1}$  from  $-90^\circ < \delta \leq -47^\circ$ . The arbitrary dotted line separates the white dwarfs from the subdwarfs. Triangles denote previously known white dwarfs.

main-sequence star. We include a distance estimate based on the assumption of the source being a main-sequence member because large distances can be used to flag possible white dwarfs. All white dwarfs are estimated to be beyond 700 pc except SCR 0018–6851, SCR 0150–7207, SCR 0429–5423B, SCR 0857–6032, and SCR 1821–5951, which have blended SuperCOSMOS photometry, no 2MASS data, or are too blue for the relations. In the notes to the table we give more accurate distance estimates assuming the objects are single white dwarfs and using the relation of Oppenheimer et al. (2001), with adopted errors of 20% as given by the authors. This brings the total number of white dwarf candidates to 23 for the SCR survey.

To be consistent with Paper XV, subdwarf candidates are selected to have  $R_{59F} - J > 1.0$  and  $H_R > 4.0$  mag above the dashed line separating the white dwarfs from the subdwarfs. As with the white dwarf cutoff line, the subdwarf cutoff used is arbitrary yet provides a fairly accurate distinction between the subdwarfs and main-sequence classes. Although some contamination of the sample is expected, we count a total of 173 new subdwarf candidates from this paper. This brings the total number of SCR subdwarf candidates to date to 237.

### 5.3. New Common Proper Motion Systems

In this search we find a total of 54 new likely CPM systems, including 52 doubles and two triples (i.e., 56 companions). All primaries and companions and their proper motions are recorded in Table 5; the separations and position angles are of companions relative to the primary star. Distance estimates for multiple components that agree to within a factor of 2 are considered to be consistent given the errors of the distance estimating relations. Twenty-two pairs of objects were discovered via the automated search and were subsequently noticed to have CPM. Twenty-five additional new SCR companions not revealed during the automated search were noticed during the blinking process. Nine previously known objects were noticed by eye to have CPMs to SCR stars discovered during the automated search.

In Figures 6 and 7, we compare the proper motions and position angles for the 52 pairs having complete sets of  $\mu$  and  $\theta$  (because of blending in four systems, SuperCOSMOS data could not be obtained for the potential companion, and they were too close to obtain accurate manual measurements). Values obtained through the systematic SCR trawl are shown with filled circles, while open circles are used if a companion was noticed during

TABLE 5  
COMMON PROPER MOTION SYSTEMS

Primary	$\mu$ (arcsec)	$\theta$ (deg)	Distance (pc)	Secondary/Tertiary	$\mu$ (arcsec)	$\theta$ (deg)	Distance (pc)	Separation (arcsec)	$\theta$ (deg)	Notes
HD 120056 .....	0.164	230.1	...	SCR 1348–5536B	0.204	112.1	236.9	46.9	310.9	<i>Hipparcos</i> distance at 100.70 pc <sup>a,b</sup>
HD 158866 .....	0.235	188.4	(13.1)	SCR 1746–8211B	0.228	184.9	14.5	76.5	290.8	<i>Hipparcos</i> distance at 30.61 pc <sup>c</sup>
NLTT 01733 .....	0.250	115.3	36.1	SCR 0032–5528B	0.221	115.2	70.3	349.6	71.4	<sup>b</sup>
NLTT 03566 .....	0.257	87.5	27.9	SCR 0104–5742B	0.239	91.1	[872.1]	110.6	206.6	WD candidate at 34.5 ± 6.9 pc <sup>d</sup>
NLTT 13852 .....	0.233	46.3	...	SCR 0436–8233B	0.233	51.1	48.6	108.9	338.7	<i>Hipparcos</i> distance at 46.46 pc <sup>a</sup>
NLTT 15903 .....	0.223	17.9	36.4	SCR 0551–8116B	0.233	19.5	56.5	99.6	266.1	
NLTT 20147 .....	0.222	342.8	(40.4)	SCR 0843–5007B	0.225	338.8	74.1	24.0	64.3	<i>Hipparcos</i> distance at 93.63 pc <sup>b,c</sup>
NLTT 21827 .....	0.231	312.1	53.9	SCR 0927–6239B	0.204	312.2	41.6	200.9	92.0	
				SCR 0927–6239C	0.197	309.0	...	316.2	59.6	<sup>b,e</sup>
NLTT 26256 .....	0.194	283.9	(12.5)	SCR 1104–7856B	0.203	283.1	101.1	260.4	167.7	<i>Hipparcos</i> distance at 47.46 pc <sup>b,c</sup>
NLTT 36394 .....	0.238	238.9	(36.9)	SCR 1411–7525B	0.250	242.1	111.5	21.8	275.5	<sup>c</sup>
NLTT 45592 .....	0.174	178.9	(23.3)	SCR 1755–7241B	0.199	175.2	60.3	102.2	273.7	<i>Hipparcos</i> distance of 77.94 pc <sup>b,c</sup>
NLTT 49033 .....	0.270	159.1	28.8	SCR 2019–4701B	0.265	158.1	52.5	67.9	86.9	<sup>b</sup>
NLTT 49299 .....	0.295	100.1	(22.9)	SCR 2029–5757B	0.314	107.8	79.0	111.7	102.8	<i>Hipparcos</i> distance at 56.31 pc <sup>c</sup>
PPM 365916 .....	0.259	135.1	(33.0)	SCR 2237–6238B	0.191	127.4	69.6	118.8	107.6	<sup>c</sup>
SCR 0004–6120A.....	0.180	129.0	35.8	SCR 0004–6120B	0.171	127.6	[1216.2]	179.6	205.5	WD candidate at 59.3 ± 11.9 pc <sup>b,d</sup>
SCR 0017–5036A.....	0.204	112.1	(83.6)	NLTT 00918	...	...	...	...	...	<sup>a,b,c</sup>
SCR 0025–5254A.....	0.196	101.2	44.4	SCR 0025–5254B	0.110	107.1	80.0	286.8	330.7	<sup>b</sup>
SCR 0055–5529A.....	0.234	53.6	88.9	SCR 0055–5529B	0.212	52.6	...	5.8	359.3	<sup>a,b</sup>
SCR 0156–6402A.....	0.197	85.6	140.4	SCR 0156–6402B	0.217	86.2	82.1	280.5	261.8	<sup>b</sup>
SCR 0156–6702A.....	0.183	57.4	29.7	SCR 0156–6702B	0.177	47.4	45.2	19.3	79.8	<sup>b</sup>
SCR 0205–6122A.....	0.184	192.8	[74.6]	SCR 0205–6122B	...	...	...	...	...	<sup>a,b</sup>
SCR 0206–6609A.....	0.181	80.6	101.4	SCR 0206–6609B	0.220	75.9	124.5	107.4	92.6	<sup>b</sup>
SCR 0246–4935A.....	0.247	72.3	40.0	SCR 0246–4935B	0.243	58.0	(31.4)	8.2	145.3	<sup>a,b,c</sup>
SCR 0353–6844A.....	0.232	38.0	53.2	SCR 0353–6844B	0.238	38.1	59.3	13.5	226.4	
SCR 0429–5423A.....	0.188	49.4	54.4	SCR 0429–5423B	0.170	39.7	...	138.0	115.4	WD candidate at 40.5 ± 8.1 pc <sup>b,d</sup>
SCR 0454–8045A.....	0.195	14.2	43.0	SCR 0454–8045B	0.191	13.5	56.5	14.4	189.1	
SCR 0611–7302A.....	0.188	208.1	65.7	SCR 0611–7302B	0.190	211.4	69.4	101.9	46.1	
SCR 0745–4814A.....	0.200	174.9	31.4	SCR 0745–4814B	0.201	176.0	25.7	43.7	220.5	<sup>b</sup>
SCR 0757–7444A.....	0.197	50.9	(99.4)	SCR 0757–7444B	0.180	48.0	158.5	10.4	311.4	<sup>b,c</sup>
SCR 0853–7705A.....	0.211	306.7	52.6	SCR 0853–7705B	0.225	293.2	76.2	224.1	99.5	
SCR 0921–7523A.....	0.291	321.1	62.2	SCR 0921–7523B	0.286	316.3	80.4	14.0	309.5	
SCR 1117–7226A.....	0.188	275.8	72.2	NLTT 26927	0.204	273.7	52.0	28.8	30.5	
SCR 1229–5738A.....	0.197	256.6	92.7	SCR 1229–5738B	0.189	262.7	109.8	10.8	215.0	<sup>b</sup>
SCR 1246–5328A.....	0.188	29.0	45.3	SCR 1246–5328B	0.183	25.3	82.1	19.5	298.8	
SCR 1800–5112A.....	0.289	226.5	...	SCR 1800–5112B	0.317	220.3	178.3	4.6	123.7	<sup>a,b</sup>
SCR 1804–5541A.....	0.222	194.4	(47.2)	SCR 1804–5541B	0.198	201.7	163.4	18.9	302.6	<sup>b,c</sup>
SCR 1809–6154A.....	0.218	253.2	159.3	SCR 1809–6154B	0.201	259.8	163.9	19.3	269.7	
SCR 1816–6615A.....	0.209	207.1	[448.4]	SCR 1816–6615B	...	...	...	...	...	<sup>a,b</sup>
SCR 1902–7550A.....	0.303	168.8	75.9	P1248-2	0.286	168.5	111.7	20.3	129.4	<sup>b</sup>
SCR 1912–4910A.....	0.229	187.7	35.8	SCR 1912–4910B	0.254	185.5	42.3	20.9	262.8	
SCR 1917–4915A.....	0.216	200.3	48.2	P3221-2	0.212	200.8	81.8	44.0	131.6	<sup>b</sup>
SCR 1953–5037A.....	0.181	144.3	31.6	SCR 1953–5037B	0.171	142.9	45.0	82.5	188.8	<sup>b</sup>
SCR 1958–8000A.....	0.183	149.1	(61.3)	SCR 1958–8000B	0.192	145.8	(133.4)	6.7	258.7	Without <i>I</i> A at 81 pc and B at 128 pc <sup>b,f</sup>
SCR 2032–4948A.....	0.265	179.0	75.3	SCR 2032–4948B	0.270	182.4	[900.1]	8.8	213.1	WD candidate at 48.7 ± 9.7 pc <sup>b,d</sup>
SCR 2036–6454A.....	0.197	146.0	72.7	SCR 2036–6454B	0.190	153.3	88.2	35.3	72.5	
SCR 2057–6358A.....	0.187	139.9	[102.0]	SCR 2057–6358B	...	...	...	...	...	<sup>a,b</sup>
				SCR 2057–6358C	0.130	138.7	46.7	261.5	121.6	<sup>b</sup>
SCR 2100–5804A.....	0.186	117.6	80.5	SCR 2100–5804B	0.181	116.1	147.0	16.4	300.7	<sup>b</sup>
SCR 2112–5428A.....	0.209	95.3	35.6	SCR 2112–5428B	0.152	117.0	13.5	15.3	60.6	<sup>b</sup>
SCR 2218–5310A.....	0.190	95.3	(61.1)	SCR 2218–5310B	0.191	95.9	96.6	35.2	142.1	<sup>c</sup>
SCR 2241–6119A.....	0.184	124.0	23.2	SCR 2241–6119B	0.162	117.6	27.8	9.6	211.2	<sup>b</sup>
SCR 2255–5120A.....	0.335	227.1	69.7	SCR 2255–5120B	0.263	228.9	112.6	17.4	359.3	<sup>b</sup>
SCR 2333–7923A.....	0.394	101.4	[183.1]	SCR 2333–7923B	0.388	100.0	[216.2]	11.2	123.0	<sup>g</sup>
SCR 2335–6433A.....	0.196	103.1	(24.5)	SCR 2335–6433B	0.196	99.1	57.5	22.4	25.9	<sup>h</sup>
SCR 2353–8204A.....	0.216	66.9	(26.8)	SCR 2353–8204B	0.209	68.4	54.2	34.5	181.9	<sup>h</sup>

<sup>a</sup> Distance estimate unreliable when listed (in brackets); if distance not given, *BRI* photometry not available.

<sup>b</sup> Companion not detected during automated search but noticed to be a CPM companion during visual inspection.

<sup>c</sup> Fewer than six relations; therefore, distance estimate unreliable (in parentheses); *Hipparcos* distance given in notes when available.

<sup>d</sup> WD candidate with unreliable distance when listed (in brackets).

<sup>e</sup> No 2MASS photometry available for companion.

<sup>f</sup> *I* photometry suspect, therefore distance unreliable (in parentheses).

<sup>g</sup> Subdwarf candidate with unreliable distance listed (in brackets).

<sup>h</sup> Distance estimate unreliable (in parentheses) because primary is likely a double.

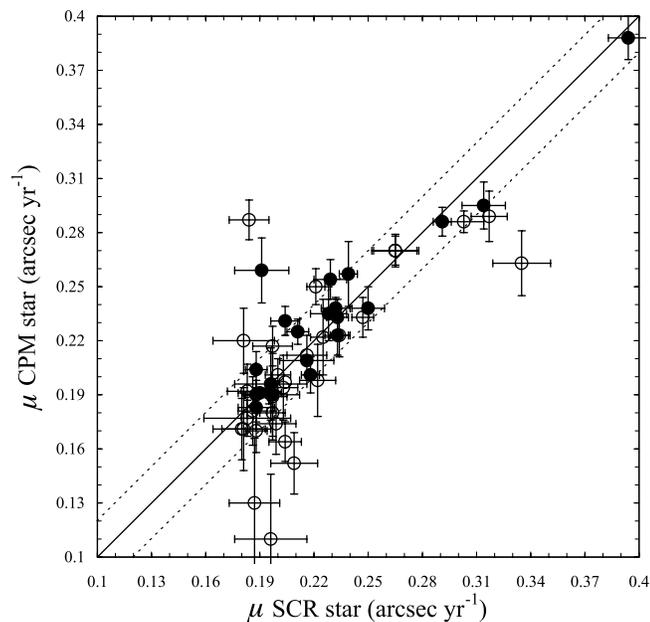


FIG. 6.—Comparison of proper motions for components in CPM systems. Proper motions from the automated SCR search are denoted by filled circles, and proper motions manually obtained through SuperCOSMOS are denoted by open circles. The solid line indicates perfect agreement between the two, and the dashed lines represent conservative limits of  $0.020'' \text{ yr}^{-1}$  based on our uncertainties.

the blinking process of the SuperCOSMOS scans. Data were then retrieved manually from SuperCOSMOS for the noticed companions. Usually, such companions are fainter than our search cutoff of  $R_{59F} = 16.5$ .

As is typical with proper-motion surveys, the position angles of the proper motions are better determined than the proper motions themselves, which are especially volatile at these relatively low values. Hence, the position angles are given greater weight when deciding whether or not two sources really are part of the same system. The average scatter for the proper motions and position angles are  $\sim 0.020'' \text{ yr}^{-1}$  and  $\sim 5.0^\circ$ , respectively, which is consistent with comparisons of SCR data to NLTT and *Hipparcos*, as discussed previously.

#### 5.4. Comments on Individual Systems

*SCR 0838–5855*.—This star has  $R_{59F} = 16.11$  and  $R_{59F} - J = 5.80$ . This is likely to be a late-M dwarf at an estimated distance of only 8.4 pc. This is a high-priority target on our CTIOPI parallax program at the CTIO 0.9 m (Jao et al. 2005; Henry et al. 2006).

*SCR 0927–6239BC*.—These stars are CPM companions to NLTT 21827. The B component has a separation of  $200.9''$  at position angle  $92.0^\circ$  from the primary. The C component is not in 2MASS and has a separation of  $316.2''$  at a position angle of  $59.6^\circ$  from the primary. See Table 5.

*SCR 1441–7338*.—This star has  $R_{59F} = 16.14$  and  $R_{59F} - J = 4.95$  with a distance estimate of 19.0 pc.

*SCR 1826–6542*.—This star has  $R_{59F} = 16.43$  and  $R_{59F} - J = 5.86$ . This is likely to be a late-M dwarf at an estimated distance of only 9.2 pc.

*SCR 1914–7109*.—This star is very bright, with  $R_{59F} = 8.14$  and  $R_{59F} - J = -0.54$ . It is too blue for us to estimate a distance using the plate-2MASS relations.

*SCR 2057–6358ABC*.—These stars comprise a possible triple system with the A and B component separated by less than  $2.00''$ ,

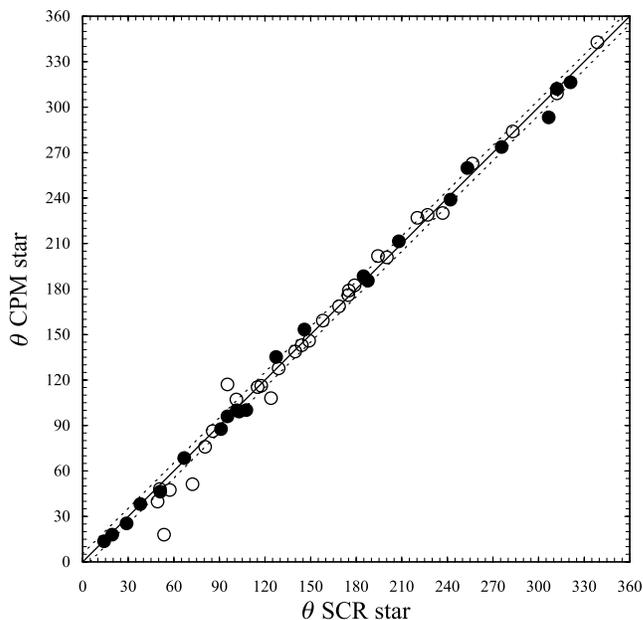


FIG. 7.—Comparison of position angles for components in multiple CPM systems. Position angles from the automated SCR search are denoted by filled circles, and position angles manually obtained through SuperCOSMOS are denoted by open circles. The solid line indicates perfect agreement between the two, and the dashed lines represent conservative limits of  $5.0^\circ$  based on our uncertainties.

which have blended SuperCOSMOS photometry but are separated in 2MASS. Both the B and C components were noticed by eye during the blinking process. The C component has a separation of  $261.5''$  at position angle  $121.6^\circ$  from the primary. See Table 5.

## 6. DISCUSSION

Including all papers pertaining to the SCR proper-motion survey, we have discovered 1967 new systems (2030 objects) with  $\mu \geq 0.18'' \text{ yr}^{-1}$  between declinations  $-90^\circ$  and  $0^\circ$ . Systems reported in previous papers are represented by dots in the sky map of SCR systems in Figure 8; systems in this paper are represented by open circles.

The 1606 systems in this paper comprise 82% of the entire SCR sample and bring the total number south of  $-47^\circ$  to 1761 systems (1817 objects). From this paper, there are 13 likely white

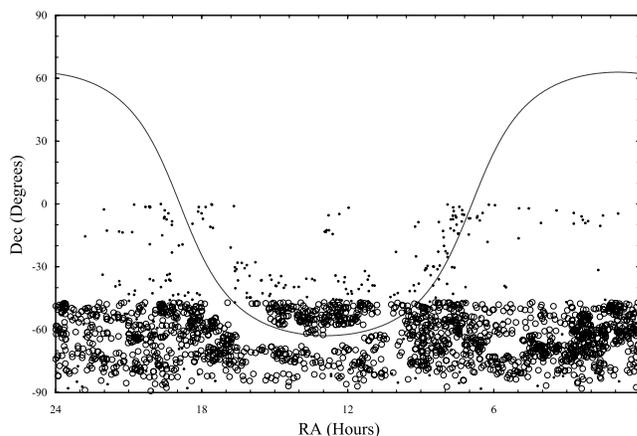


FIG. 8.—Sky distribution of SCR systems with  $\mu \geq 0.18'' \text{ yr}^{-1}$ . Open circles denote SCR discoveries from this paper, and dots indicate SCR discoveries from past papers. The curve represents the Galactic plane.

TABLE 6  
DISTANCE ESTIMATE STATISTICS FOR NEW SCR SYSTEMS

Proper Motion	$d \leq 10$ pc	$10 \text{ pc} < d \leq 25$ pc	$d > 25$ pc
$\mu \geq 1.00'' \text{ yr}^{-1}$ .....	2 + 0 + 0	0 + 0 + 0	2 + 4 + 0
$1.00'' \text{ yr}^{-1} > \mu \geq 0.80'' \text{ yr}^{-1}$ .....	0 + 0 + 0	3 + 0 + 0	2 + 1 + 0
$0.80'' \text{ yr}^{-1} > \mu \geq 0.60'' \text{ yr}^{-1}$ .....	0 + 1 + 0	4 + 7 + 0	25 + 23 + 0
$0.60'' \text{ yr}^{-1} > \mu \geq 0.40'' \text{ yr}^{-1}$ .....	1 + 1 + 0	8 + 16 + 0	95 + 93 + 0
$0.40'' \text{ yr}^{-1} > \mu \geq 0.18'' \text{ yr}^{-1}$ .....	0 + 0 + 2	0 + 0 + 29	0 + 0 + 1542
Total .....	3 + 2 + 2	15 + 23 + 29	124 + 121 + 1542

NOTE.—Entire SCR sample, excluding white dwarf candidates and new CPM companions to known objects noticed by eye. The first number is from Paper XII, the second is from Paper XV, and the third is from this paper.

dwarfs and 173 subdwarf candidates. Three of the white dwarfs (but none of the subdwarfs) have been spectroscopically confirmed, while the rest remain to be targeted in future spectroscopic efforts to confirm their luminosity classes.

Discovery statistics for the entire SCR sample, separated by distance horizons, are given in Table 6. In order to be consistent with previous SCR papers, new CPM candidates that are companions to known objects and probable white dwarfs (because their distance estimates require a different set of relations) are not included. For all proper-motion bins except the last, we have searched the entire southern sky; for the last bin only  $-47^\circ$  to  $-90^\circ$  has been searched. In the complete sample of new SCR systems to date, seven are estimated to be within 10 pc, and 67 additional systems lie between 10 and 25 pc. Of the 1606 systems reported in this paper, two were estimated to be within 10 pc, with an additional 29 between 10 and 25 pc. This illustrates that even in this relatively slow proper-motion regime there are nearby stars hidden in the solar neighborhood. Should they prove to be within 10 pc, the two nearest stars reported in this paper would rank as the 10th ( $0.311'' \text{ yr}^{-1}$  for SCR 1826–6542) and 11th ( $0.320'' \text{ yr}^{-1}$  for SCR 0838–5855) slowest systems in the RECONS sample of 248 systems within 10 pc (Henry et al. 2006).

Although the counts of new 10 pc candidates are small in each proper-motion bin, the largest number of candidates between 10 and 25 pc is found in the slowest proper-motion bin, even though only a portion of the southern sky has been searched. We anticipate that continuing searches for MINIMO systems in the southern sky will be a promising endeavor for finding additional nearby stars.

*Note added in manuscript.*—The SIPS southern sky proper-motion survey, carried out on a similar timescale as the SCR survey, also uses SuperCOSMOS, and there are many objects identified in both searches, e.g., nearby-star candidate SCR 1826–6542 = SIPS 1826–6542. The SIPS survey (whose most recent paper is Deacon & Hambly 2007) uses the SuperCOSMOS I photographic plates combined with 2MASS for object discovery, while the SCR survey uses all four SuperCOSMOS plates. Thus, the two surveys are complementary, with SIPS concentrating on M and L dwarfs and the SCR survey revealing bluer stars, white dwarfs, and M dwarfs.

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