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Southern infrared proper motion survey. II. A sample of low mass stars with $\mu \geq 0.1''/\mathrm{yr}$[⋆]

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ABSTRACT

We present details of the second part of the Southern Infrared Proper Motion Survey (SIPS). Here accurate relative astrometry allows us to reduce the minimum proper motion to 0.1 arcsec per year. This yields 6904 objects with proper motions between our minum cut and half an arcsecond a year. A small overspill sample with proper motions greater than this is also included. We examine our sample to identify interesting individual objects such as common proper motion binaries, potential L dwarfs and candidate nearby stars. Finally we show our survey is incomplete due to many factors, factors which we will take into account when simulating these survey results in the next paper in this series.

Key words. astrometry – stars: low mass, brown dwarfs

1. Introduction

Proper motion surveys provide a wealth of information for the study of Low Mass Stars and Brown Dwarfs. Firstly studies of the Luminosity Function (and hence Mass Function, birthrate and space density) require large, clean samples of cool objects. Proper motion surveys provide this by allowing the easy exclusion of distant, intrinsically bright contaminants such giants. Secondly they can also identify common proper motion binaries. The make-up of these systems (and of their individual components) can provide interesting insights, not only into multiplicity, but into the star formation processes that created them (Burgasser et al. 2005).

In Deacon et al. (2005) (hereafter DHC) we combined J, H, and K_S data from the 2MASS survey with I_N data from SuperCOSMOS (Hambly et al. 2001) scans of UKST plates to produce an infrared proper motion survey (SIPS) with a lower proper motion limit of half an arcsecond a year. Using such an infrared proper motion survey allowed us to study low mass stars and Brown Dwarfs in the passbands in which they are brightest. This yielded approximately 70 new high proper motion objects. While many of these objects were interesting in themselves, it was clear that a reduction in the lower proper motion limit (and hence an increase in the number of objects detected) was required to produce a significant sample. Henced we have produced a survey with a lower proper motion limit of $0.1''/\mathrm{yr}$. For the sake of comparison with SIPS I (DHC) we take the maximum proper motion of our sample to be 0.5/yr, although there will be a number of objects which spill over this limit.

The majority of current proper motion surveys have focussed on identifying objects with high proper motions. Many, such as Lepine & Shara (2002), have proper motion limits well above our maximum proper motion limit of $0.5''/\mathrm{yr}$. Others (Scholz et al. 2002; Subasavage et al. 2005; Lepine 2005) have lower limits of $0.45{-}0.4''/\mathrm{yr}$, just encroching on the region covered by our sample. Of those which go to lower limits two, Ruiz et al. (2001) and Wroblewski & Costa (2001), are limited in the areas of sky they cover. This leaves only three surveys which cover the majority of the southern hemisphere to lower proper motion limits comparable to ours: Luyten's New Luyten Two Tenths catalogue (NLTT, Luyten 1979b), Pokorny et al.'s (2003) Liverpool–Edinburgh High Proper Motion survey (LEHPM) and Finch et al. (2007). Both Luyten and Pokorny have lower proper motion limits of $0.2''/\mathrm{yr}$, however Luyten's survey is incomplete below $\delta = -30°$. The survey by Finch et al. (2007) expands the work done by Subasavage et al. (2005) to a lower proper motion limit of $0.18''/\mathrm{yr}$. This survey covers the area south of $\delta = 47°$, i.e. the area where Luyten's surveys are most incomplete. Many of the objects identified here are also present in this study. All of these surveys primarily make use of optical data.

Hence the approximately 7000 objects presented here provide a large proper motion selected sample of low mass stars of comparable area and depth to those currently available but with better completeness for cool, red dwarfs. Here we present details of this sample along with a selection of interesting objects contained within it. In the third paper of this series we will outline the method used to simulate the survey results and the constraints on underlying distributions fundamental to star formation that can be set from these.

⋆ Full Tables 7 and 8 are only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via
http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/468/163
⋆⋆ Scottish Universities' Physics Alliance.

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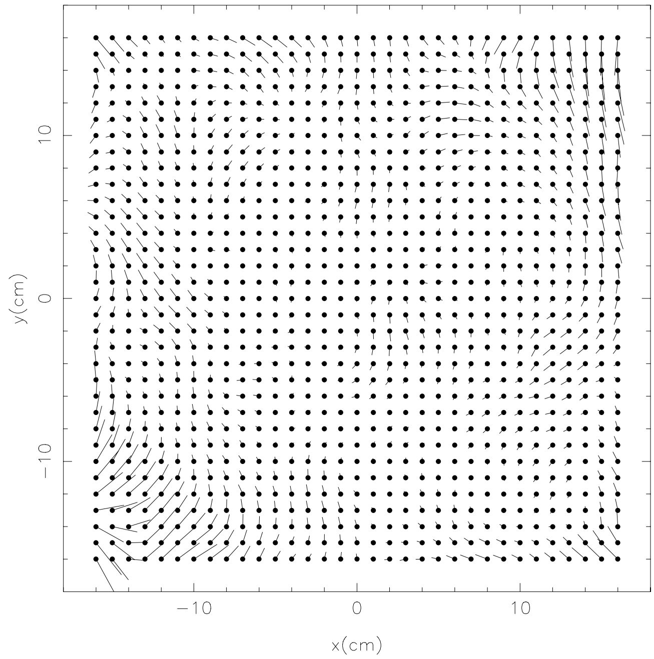

Fig. 1. The errors across one single UKST I plate (field 411). The axes represent the position on the plate in centimetres and the size and direction of the lines on each lollipop show the positional offsets. The scale for the length of the lines is 4 cm = 1″.

2. The SIPS selection method

In Deacon et al. (2005) we outlined the SIPS selection method. Here we give a brief recap.

The first stage of candidate selection is using 2MASS photometry. Here objects are plotted on a $J-H$ vs. $H-K_{\rm s}$ colour-colour diagram. An object's position on this diagram leads it to be classified as a potential M/L dwarf, early T dwarf or mid-late T dwarf. There is also a fourth category in an overlap region between the mid M and mid T dwarf range. Any object that does not fall into one of the four categories is rejected. Next each candidates object had to be paired with an I plate counterpart. In the first run of the SIPS survey we simply used the positions from both the UKST I plates and the 2MASS survey to calculate the movement of an object and hence its proper motion. As the minimum proper motion in this case was half an arcsecond per year this was generally well above a 5σ limit. However by reducing the lower proper motion limit to $0.1''$/yr we run the risk of large errors in the measured proper motions and therefore spurious detections. Hence we employ a relative error mapping technique to reduce the rms error on the proper motions. The details of this are outlined in Sect. 2.1. Other than this the candidate selection method is identical to that outlined in DHC with I plate candidates being selected and then filtered on $I-J$ colour, ellipticity, and being a good single image far from bright stars. Following the initial selection process all candidates were inspected by eye to reduce the number of spurious detections. The proper motions were then calculated using the same method as DHC.

2.1. Relative astrometry

In order to map out the systematic astrometric errors between 2MASS and the SSS, we employed the 2MASS catalogue positions as a standard. Robust median offsets in X and Y in 1cm boxes were computed over the field of view of each I plate, and the residuals were smoothed and filtered within 3×3 boxes to create a map of any systematic offsets between the photographic plate and 2MASS astrometry. A typical example of the resulting systematic positional error map is shown in Fig. 1, with errors at the field edges of up to 0.5 arcsec. These positional error maps were then applied to the photographic positions before using them, in conjunction with the 2MASS epoch positions, to measure proper motions.

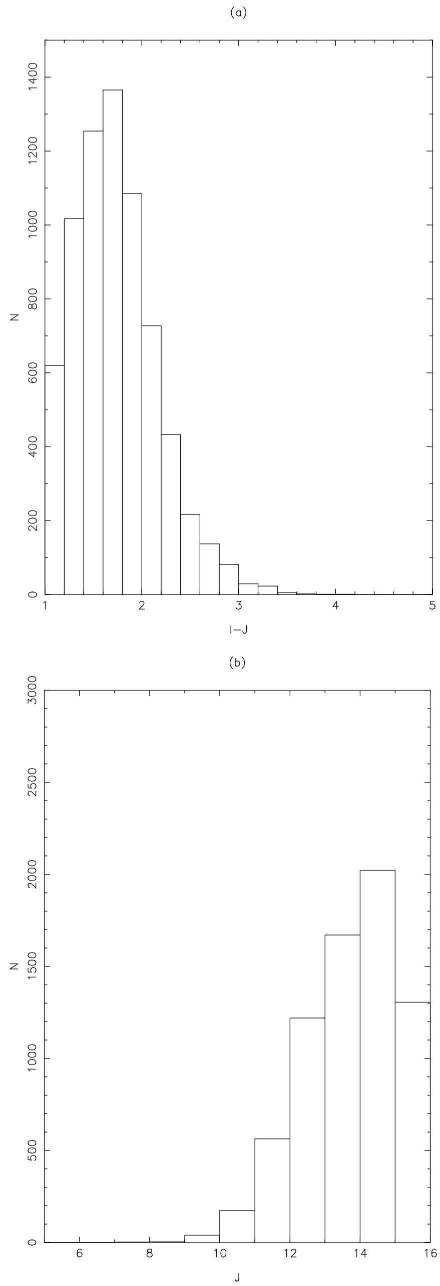

Fig. 2. Histograms showing the magnitude (J) and colour ($I-J$) of the objects found in this survey with proper motions between 0.1 and 0.5 arcsec per year.

3. Results

The objects found in this survey with $0.1''/{\rm yr} < \mu < 0.5''/{\rm yr}$ are shown in Table 7. Figure 2a shows an $I-J$ histogram for all objects in this sample, while Fig. 2b shows a histgram for J magnitudes. It is clear that the objects make up a large sample of mid-late M dwarfs.

Table 1. Objects with $I - J > 3.5$ found in this survey.

Name	μ (arcsecs/yr)	I	J	H	K_s	Previously found in
SIPS2255-5713	0.341	17.85	14.08	13.19	12.58	1
SIPS0128-5545	0.293	17.45	13.78	12.92	12.34	1
SIPS0719-5051	0.141	17.60	14.09	13.28	12.77	2
SIPS1625-2508	0.147	17.80	13.75	13.12	12.73	
SIPS0539-0059	0.363	17.84	14.03	13.10	12.53	3

Citation Key: [1] Kendall et al. (2006), [2] Reid et al. (in prep.), [3] Fan et al. (2000).

Table 2. Objects with photometry suggesting they are L dwarfs. Our photometric spectral classifications are based on the colours in Kirkpatrick et al. (2000).

Name	μ (arcsecs/yr)	I	J	H	K_s	Photometric Spectral Class	Previous Spectral Class	Previously found in
SIPS1753–6559	0.393	17.53	14.10	13.11	12.42	L2.5		
SIPS2045–6332	0.223	15.95	12.62	11.81	11.21	L0		
SIPS2255–5713	0.341	17.85	14.08	13.19	12.58	L1.5	L5.5	1
SIPS0128–5545	0.293	17.45	13.78	12.92	12.34	L1	L1	1
SIPS1341–3052	0.196	17.96	14.61	13.73	13.08	L2		
SIPS2026–2943	0.417	17.78	14.80	13.95	13.36	L1		7
SIPS0316–2848	0.206	17.88	14.58	13.77	13.11	L1.5	L0	2
SIPS0614–2019	0.308	17.90	14.78	13.90	13.38	L0.5		
SIPS1058–1548	0.249	17.61	14.16	13.23	12.53	L2.5	L3[4]	3
SIPS1228–1547	0.415	17.62	14.38	13.35	12.77	L2	L5[4]	3
SIPS0847–1532	0.246	16.42	13.51	12.63	12.06	L1	L2	2
SIPS0408–1450	0.256	17.44	14.22	13.34	12.82	L1	L2	2
SIPS0058–0651	0.304	17.67	14.31	13.44	12.90	L1	L0[2]	5
SIPS0539–0059	0.363	17.84	14.03	13.10	12.53	L1.5	L5	6

Citation key: [1] Kendall et al. (2006), [2] Cruz et al. (2003), [3] Delfosse et al. (1999), [4] Kirkpatrick et al. (1999), [5] Dahn et al. (2002), [6] Fan et al. (2000), [7] Cruz et al. (2007).

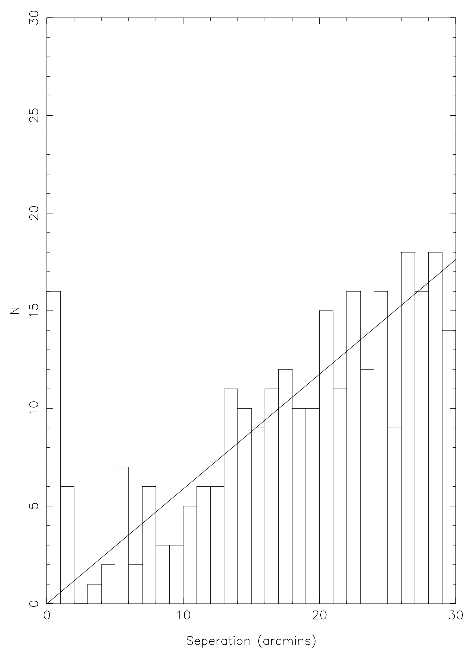

Fig. 3. A histogram showing the seperations of objects with common proper motions in the SIPS survey. The line shows the expected distribution of randomly distributed objects, d$n \propto r$dr.

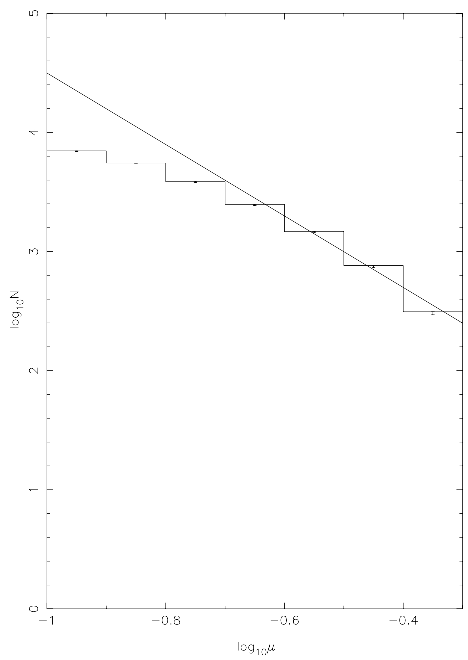

Fig. 4. The cumulitive number of objects with proper motions greater than the minimum limit of each bin. The solid line shows the $N \propto \mu^{-3}$ trend which would be expected for a totally complete sample. It is clear that the sample is incomplete below 0.2″/yr. The proper motion (μ) is in arcseconds/year.

Table 3. SIPS objects which share common proper motions with other SIPS objects. PA = Position Angle. For NLTT objects see Luyten, for LEHPM objects see Pokorny et al. (2003), for WT objects see Wroblewski & Torres (1991) and for [1] see Giclas et al. (1971). Pairs marked with * were identified as binaries by Luyten (1988). The pair marked with ** was found simulatiously by Artigau et al. (2007).

Name	Position	μ (″/yr)	PA (°)	σ_μ (″/yr)	I	J	H	K_s	Other Name
SIPS0650-7041	06 50 59.75 −70 41 37.6	0.253	2	0.025	16.85	14.67	14.00	13.51	
SIPS0651-7041	06 51 02.78 −70 41 38.8	0.253	1	0.013	15.49	13.57	12.97	12.67	
SIPS2241-5915b	22 41 54.36 −59 15 30.8	0.323	94	0.018	16.39	13.66	13.08	12.67	
SIPS2241-5915a	22 41 59.83 −59 15 12.4	0.334	91	0.016	11.25	9.83	9.28	9.01	LEHPM 5030
SIPS0630-5525a	06 30 19.69 −55 25 48.2	0.254	137	0.007	13.71	12.42	11.87	11.59	
SIPS0630-5525b	06 30 23.39 −55 25 34.6	0.267	136	0.014	16.35	14.22	13.68	13.28	
SIPS1917-5238b	19 17 02.31 −52 38 47.0	0.254	181	0.016	11.26	9.94	9.35	9.08	LDS 673b*
SIPS1917-5238a	19 17 05.65 −52 38 49.8	0.258	182	0.014	11.40	10.19	9.64	9.31	LDS 673a*
SIPS0358-5026	03 58 15.41 −50 26 36.6	0.179	34	0.022	16.73	14.69	14.10	13.75	
SIPS0358-5027	03 58 18.69 −50 27 39.8	0.179	31	0.011	14.65	13.24	12.69	12.40	
SIPS0126-5022	01 26 55.26 −50 22 37.9	0.144	109	0.020	17.16	14.61	14.05	13.68	**
SIPS0127-5023	01 27 02.59 −50 23 20.2	0.170	112	0.023	17.62	14.81	14.16	13.62	**
SIPS1131-4419	11 31 00.17 −44 19 08.9	0.111	269	0.011	12.11	11.03	10.40	10.15	
SIPS1131-4418	11 31 01.35 −44 18 54.4	0.120	267	0.009	14.04	12.69	12.05	11.77	
SIPS0207-4052b	02 07 54.69 −40 52 16.4	0.255	206	0.016	12.45	11.36	10.82	10.55	NLTT7110*
SIPS0207-4052a	02 07 55.77 −40 52 30.9	0.251	209	0.015	12.53	11.49	10.96	10.66	NLTT7107*
SIPS0116-4005b	01 16 13.97 −40 05 02.1	0.170	96	0.011	14.06	12.56	11.98	11.69	
SIPS0116-4005a	01 16 15.44 −40 05 12.1	0.157	95	0.011	16.10	14.36	13.78	13.40	
SIPS2145-3612	21 45 49.39 −36 12 25.9	0.121	151	0.020	13.47	12.42	11.81	11.56	
SIPS2145-3610	21 45 54.45 −36 10 55.8	0.119	153	0.021	15.56	14.26	13.66	13.41	
SIPS0252-3438a	02 52 32.11 −34 38 49.0	0.308	86	0.011	14.04	12.53	11.93	11.63	LEHPM 2856*
SIPS0252-3438b	02 52 33.26 −34 38 54.3	0.303	86	0.011	13.69	12.25	11.68	11.38	LEHPM 2857*
SIPS0118-2730	01 18 10.69 −27 30 39.0	0.117	90	0.011	15.86	13.90	13.27	12.95	
SIPS0118-2729	01 18 06.58 −27 29 03.3	0.115	85	0.014	13.94	12.45	11.90	11.61	
SIPS0215-2440	02 15 13.69 −24 40 06.2	0.177	89	0.010	14.89	13.23	12.61	12.36	LDS 3363b*
SIPS0215-2439	02 15 15.02 −24 39 43.6	0.181	90	0.010	14.14	12.54	11.97	11.66	LDS 3363a*
SIPS1018–2028a	10 18 12.27 −20 28 22.1	0.397	285	0.010	12.21	10.59	10.01	9.71	NLTT23954*
SIPS1018–2028b	10 18 14.01 −20 28 41.9	0.407	286	0.013	10.28	9.00	8.42	8.15	NLTT23956*
SIPS0427-1548	04 27 20.96 −15 48 33.2	0.170	111	0.021	17.19	14.48	13.71	13.28	
SIPS0427-1547	04 27 22.20 −15 47 59.0	0.160	112	0.009	13.48	12.07	11.48	11.17	
SIPS0229-1540	02 29 44.57 −15 40 34.6	0.156	122	0.030	15.86	13.86	13.29	12.98	
SIPS0229-1541	02 29 46.98 −15 41 47.6	0.145	127	0.011	16.11	14.32	13.72	13.35	
SIPS0441-1356	04 41 58.63 −13 56 05.4	0.292	86	0.028	12.63	11.43	10.87	10.60	NLTT 13776
SIPS0442-1356	04 42 00.44 −13 56 23.7	0.278	77	0.034	15.21	12.98	12.36	11.97	
SIPS0116-1318a	01 16 48.12 −13 18 19.4	0.130	103	0.021	15.19	14.16	13.57	13.32	
SIPS0116-1318b	01 16 49.11 −13 18 55.0	0.133	105	0.021	16.42	14.93	14.41	14.07	
SIPS1402-0312	14 02 22.81 −03 12 16.9	0.401	176	0.020	12.55	11.52	10.99	10.68	NLTT 36053*
SIPS1402-0311	14 02 24.01 −03 11 55.5	0.393	175	0.021	12.20	11.08	10.57	10.28	G 64-36[1]*
SIPS0820-0231	08 20 12.08 −02 31 09.2	0.202	166	0.031	13.24	12.13	11.60	11.29	LDS 3786a*
SIPS0820-0230	08 20 12.74 −02 30 59.5	0.170	174	0.034	13.65	12.33	11.79	11.45	LDS 3786b*
SIPS0005-0139	00 05 36.22 −01 39 39.7	0.331	67	0.015	14.30	12.88	12.35	12.06	NLTT 175*
SIPS0005-0139	00 05 36.73 −01 39 57.2	0.336	66	0.015	13.00	11.86	11.31	11.07	NLTT 176*
SIPS2315-0045a	23 15 43.90 −00 45 00.8	0.124	84	0.009	14.34	12.46	11.88	11.58	LDS 6019a*
SIPS2315-0044b	23 15 46.52 −00 44 06.5	0.130	84	0.009	14.69	12.81	12.20	11.92	LDS 6019b*

3.1. Higher proper motion objects

To prevent objects which had a proper motion below 0.5″/yr before the realtive astronometry correction, but above 0.5″/yr after it from slipping through the net, objects with proper motions just above our upper limit were also examined. Hence we also identified several objects with proper motions greater than our upper limit of 0.5″/yr, these are shown in Table 8.

3.2. Interesting objects

Rather than examine every object in detail we have sought to select interesting individual objects, the details of which are listed in the following three subsections.

3.2.1. Red objects

In order to identify potential L and T dwarfs, we selected every object found with $I - J > 3.5$. The photometry and proper motions of these objects are shown in Table 1. Comparing the $J - K_s$ colours with those for different spectral types in Kirkpatrick et al. (2000) it becomes clear that SIPS2255-5713, SIPS0128-5545 and SIPS0539-0059 are early-mid L dwarfs (i.e. earlier than L6). In fact Fan et al. (2000) spectroscopically identified that SIPS0539-0059 (SDSS 0539-0059) is an L5 dwarf. Additionally Reid et al. (in prep.) find that SIPS0719-5051 (2MASS J07193188-5051410) is an L0 dwarf. Kendall et al. (2006) identify SIPS2255-5713 and SIPS0128-5545 to be L5.5

Table 4. SIPS objects which share common proper motions with objects found in other studies which are not themselves SIPS objects. These pairings were found during the cross referencing process and should not be regarded as a complete list. PA = Position Angle. For LEHPM objects see Pokorny (2003), for NLTT objects see NLTT, [1] see Lasker et al. (1990), [2] see Gizis et al. (2000) and [3] see Schonfeld (1886). All pairs marked * were identified as common proper motion pairs by Luyten (1988).

Name	Position	μ (″/yr)	PA (°)	σ_μ (″/yr)	Other Name
SIPS0551-8116	05 51 54.60 −81 16 09.6	0.233	20	0.009	
NLTT 15903	05 52 38.16 −81 16 03.0	0.223	18	0.016	
SIPS2126-7337	21 26 20.62 −73 37 10.1	0.176	83	0.010	
GSC 09334-00112[1]	21 26 30.94 −73 38 23.2	0.184	85	0.016	
SIPS1954-6117	19 54 51.61 −61 17 05.5	0.214	163	0.033	
NLTT 48361	19 54 49.14 −61 19 19.1	0.190	177	-	
SIPS0447-5823	04 47 11.69 −58 23 21.0	0.279	30.263	0.029	
LEHPM 3838	04 47 13.38 −58 23 20.6	0.265	31.4	0.080	WT 155
SIPS1858-4513	18 58 21.39 −45 13 33.8	0.231	124	0.014	
NLTT 47218	18 58 16.68 −45 14 12.6	0.254	120	0.028	
SIPS0333-4324	03 33 18.57 −43 24 56.9	0.316	59	0.025	
NLTT 11245	03 33 18.03 −43 25 12.0	0.281	58	0.018	
SIPS0123-3507	01 23 24.56 −35 07 18.4	0.213	220	0.013	LEHPM 1491
NLTT 4642	01 23 29.93 −35 08 27.7	0.223	220	0.014	LEHPM 1492
SIPS0116-3342	01 16 31.19 −33 42 51.3	0.189	42	0.017	LDS 3257b*
NLTT 4263	01 16 32 78 −33 42 54.8	0.185	44	0.014	*
SIPS0933-2752	09 33 37.63 −27 52 47.4	0.328	297	0.022	
NLTT 22073	09 33 36.22 −27 52 25.0	0.311	289	0.017	
SIPS1917-2748	19 17 18.10 −27 48 54.0	0.209	133	0.028	LDS 4807b*
NLTT 47615	19 17 22.63 −27 47 32.26	0.195	141	0.008	*
SIPS0132-2744	01 32 35.91 −27 44 37.1	0.195	128	0.013	NLTT 5135*
NLTT 5136	01 32 37.48 −27 44 25.4	0.191	129	0.016	*
SIPS0028-2651	00 28 10.24 −26 51 24.7	0.189	208	0.015	NLTT 1492*
NLTT 1491	00 28 08.06 −26 52 25.8	0.198	207	0.021	*
SIPS2147-2644	21 47 44.64 −26 44 05.4	0.235	215	0.022	2MASSW J2147446-264406[2]
NLTT 52094	21 47 47.00 −26 42 52.7	0.252	211	0.012	
SIPS0227-2630	02 27 25.50 −26 30 07.8	0.165	56	0.012	NLTT 8057*
NLTT 8059	02 27 24.37 −26 29 42.1	0.159	60	0.022	*
SIPS1135-2017	11 35 05.43 −20 17 26.3	0.245	279	0.017	NLTT 27883*
NLTT 27884	11 35 05.03 −20 16 57.6	0.231	281	0.024	*
SIPS0133-1948	01 33 08.77 −19 48 34.3	0.307	65	0.021	NLTT 5169*
NLTT 5163	01 33 05.55 −19 50 22.7	0.322	67	0.022	*
SIPS1301-1848	13 01 51.64 −18 48 40.5	0.335	286	0.016	NLTT 32629*
NLTT 32636	13 01 42.64 −18 47 23.2	0.321	287	0.021	*
SIPS0532-1605	05 32 33.82 −16 05 53.2	0.272	186	0.023	
NLTT 15268	05 32 42.06 −16 06 00.3	0.289	189	0.025	
SIPS0536-1302	05 36 07.79 −13 02 09.4	0.199	162	0.013	NLTT 15357*
NLTT 15358	05 36 08.58 −13 02 40.1	0.202	174	0.025	*
SIPS2016-1100	20 16 49.26 −11 00 13.7	0.349	206	0.019	NLTT 48967*
NLTT 48973	20 16 55.72 −10 58 54.6	0.318	206	-	*
SIPS0321-0807	03 21 46.26 −08 07 13.7	0.118	72	0.014	
BD-08 638[3]	03 21 48.90 −08 06 10.58	0.127	76	0.019	
SIPS1402-0447	14 02 14.40 −04 47 53.2	0.231	254	0.018	NLTT 36042*
NLTT 36043	14 02 14.90 −04 48 09.0	0.214	250	0.021	*
SIPS0023-0342	00 23 30.92 −03 42 20.4	0.189	52.79	0.028	NLTT 1210*
NLTT 1213/1214	00 23 32.29 −03 42 28.4	0.232	55	-	*

and L1 respectively. It appears from the J, H, K_s colours that SIPS1625-2508 is a late M dwarf.

We also compared object's J, H, and K_S photometry with the values which Kirkpatrick et al. (2000) quote as typical for different spectral types. All objects redder in $J-H$, $J-K_S$, $H-K_S$ than Kirkpatrick's values for an M9 dwarf are listed in Table 2. These objects are given spectral types based on their colours and those given in Kirkpatrick et al. (2000). SIPS2255-5713, SIPS0128-5545 and SIPS0539-0059 appear in thesamples in both Tables 1 and 2.

3.2.2. Common proper motion objects

During the visual inspection phase of the data reduction process it became apparent that there were many SIPS objects which shared a common proper motion. However it is often difficult to distinguish coincidence objects with the same proper motion from gravitiationally bound wide binaries. To separate these two classes of objects we plotted the separations of objects which had proper motions within 2σ of each other. This is shown in Fig. 3. The straight line marks the expected distribution of coincidence objects randomly placed around the other object. Clearly the vast

Table 5. Objects in this sample with proper motions in the range $0.1''/\mathrm{yr} < \mu < 0.5''/\mathrm{yr}$ which have estimated distances closer that 20 pc.

Name	Position	Distance pc	μ ($''$/yr)	I	J	H	K_S	Other Name
SIPS1848-8214	18 48 51.35 −82 14 40.4	$14.26\pm^{8.50}_{5.33}$	0.272	14.373	11.482	10.922	10.503	
SIPS1731-7851	17 31 45.16 −78 51 23.3	$16.94\pm^{10.09}_{6.32}$	0.362	14.173	11.613	11.007	10.675	
SIPS0630-7643	06 30 46.68 −76 43 15.3	$8.69\pm^{5.18}_{3.25}$	0.483	10.738	8.894	8.275	7.923	SCR J0630-7643 [1]
SIPS1809-7613	18 09 06.96 −76 13 23.0	$15.92\pm^{9.55}_{5.97}$	0.156	11.615	9.817	9.275	8.989	
SIPS2016-7531	20 16 10.88 −75 31 04.8	$19.06\pm^{11.38}_{7.12}$	0.253	12.247	10.465	9.864	9.509	
SIPS0504-7401	05 04 26.15 −74 01 55.3	$19.03\pm^{11.36}_{7.12}$	0.359	12.147	10.346	9.778	9.469	
SIPS1826-6542	18 26 46.79 −65 42 37.7	$11.28\pm^{6.72}_{4.21}$	0.311	12.913	10.569	9.960	9.547	
SIPS2045-6332	20 45 02.28 −63 32 05.3	$15.15\pm^{9.03}_{5.66}$	0.223	15.950	12.619	11.807	11.207	
SIPS0152-6329	01 52 55.17 −63 29 30.2	$16.67\pm^{9.94}_{6.23}$	0.140	11.993	10.167	9.604	9.261	
SIPS2019-5816	20 19 49.82 −58 16 41.1	$13.66\pm^{8.14}_{5.10}$	0.347	12.868	10.664	10.104	9.715	
SIPS2255-5713	22 55 18.70 −57 13 04.0	$12.92\pm^{8.72}_{5.21}$	0.341	17.851	14.083	13.189	12.579	2M2255-57 [2]
SIPS0128-5545	01 28 26.76 −55 45 34.6	$15.24\pm^{9.79}_{5.96}$	0.293	17.447	13.775	12.916	12.336	2M0128-55 [2]
SIPS0139-3936	01 39 21.55 −39 36 05.8	$14.99\pm^{8.96}_{5.61}$	0.283	10.791	9.209	8.629	8.274	
SIPS1110-3731	11 10 27.98 −37 31 51.8	$10.72\pm^{6.41}_{4.01}$	0.103	9.041	7.651	7.041	6.774	TWA 3A [3]
SIPS0339-3525	03 39 34.82 −35 25 48.4	$9.95\pm^{5.96}_{3.73}$	0.405	13.288	10.725	10.017	9.548	APMPM J0340-3526 [4]
SIPS0604-3433	06 04 52.13 −34 33 38.6	$13.76\pm^{8.26}_{5.16}$	0.330	9.027	7.742	7.183	6.866	LP 949-15
SIPS0124-3355	01 24 30.52 −33 55 00.6	$18.85\pm^{11.28}_{7.06}$	0.222	12.445	10.555	10.009	9.682	LP 939-44
SIPS1346-3149	13 46 46.24 −31 49 26.7	$16.03\pm^{9.58}_{6.00}$	0.366	13.165	10.975	10.436	10.038	LP 911-56
SIPS1037-2746	10 37 45.41 −27 46 40.2	$18.13\pm^{10.86}_{6.79}$	0.322	9.936	8.595	8.035	7.719	CE 186
SIPS2351-2537	23 51 50.25 −25 37 37.8	$18.35\pm^{10.94}_{6.86}$	0.420	15.573	12.471	11.725	11.269	LEHPM 6334
SIPS1625-2508	16 25 49.66 −25 08 17.8	$8.62\pm^{16.80}_{5.70}$	0.147	17.800	13.745	13.117	12.728	
SIPS1042-2416	10 42 41.32 −24 16 06.2	$17.13\pm^{10.21}_{6.40}$	0.205	12.087	10.277	9.672	9.338	NLTT 25128
SIPS1504-2355	15 04 16.35 −23 55 55.8	$19.12\pm^{11.41}_{7.15}$	0.327	14.652	12.011	11.383	11.032	LP 859-1
SIPS1309-2330	13 09 21.85 −23 30 33.9	$15.64\pm^{9.35}_{5.85}$	0.383	14.514	11.785	11.082	10.669	CE 303
SIPS1155-2224	11 55 42.94 −22 24 58.2	$13.50\pm^{8.05}_{5.04}$	0.369	13.203	10.930	10.295	9.881	DENIS J115542.9-222458 [5]
SIPS1351-1758	13 51 57.20 −17 58 49.1	$18.18\pm^{10.85}_{6.80}$	0.222	12.815	10.823	10.210	9.927	LP 798-49
SIPS0931-1717	09 31 22.41 −17 17 41.8	$17.46\pm^{10.43}_{6.53}$	0.359	13.140	11.073	10.467	10.069	DENIS J093122.3-171742 [5]
SIPS0435-1607	04 35 15.97 −16 07 02.0	$14.25\pm^{8.55}_{5.34}$	0.355	12.341	10.406	9.779	9.352	LP 775-31
SIPS0440-0530	04 40 23.32 −05 30 07.8	$10.21\pm^{6.10}_{3.82}$	0.356	13.171	10.658	9.986	9.545	LP 655-48
SIPS1324-0504	13 24 46.44 −05 04 17.7	$17.18\pm^{10.25}_{6.42}$	0.328	11.043	9.465	8.861	8.563	G 14-52 [6]
SIPS1607-0442	16 07 31.25 −04 42 06.3	$15.06\pm^{8.99}_{5.63}$	0.462	14.866	11.896	11.187	10.717	2MASSW J1607312-044209 [7]
SIPS0109-0343	01 09 51.04 −03 43 26.3	$12.74\pm^{7.60}_{4.76}$	0.376	14.768	11.694	10.931	10.428	LP 647-13
SIPS1712-0323	17 12 04.49 −03 23 28.9	$15.13\pm^{9.02}_{5.65}$	0.385	14.482	11.607	10.994	10.637	
SIPS1614-0251	16 14 25.20 −02 51 03.5	$16.73\pm^{9.98}_{6.25}$	0.350	13.528	11.303	10.683	10.280	LP 624-54
SIPS0539-0059	05 39 51.86 −00 59 05.2	$11.29\pm^{7.68}_{4.57}$	0.363	17.836	14.033	13.104	12.527	SDSS J053951.9-005901 [8]

Citation key: [1] Subasavage et al. (2005), [2] Kendall et al. (2006), [3] Webb et al. (1999), [4] Reyle et al. (2002), [5] Phan Bao et al. (2003), [6] Giclas et al. (1971), [7] Gizis et al. (2002), [8] Fan et al. (2000). For objects designated NLTT or LP see Luyten's New Luyten Two Tenths catalogue (Luyten 1979b), for objects marked CE see Ruiz et al. (2001).

Table 6. Objects in this sample with proper motions above $0.5''/\mathrm{yr}$ which have estimated distances closer that 20 pc.

Name	Position	Distance pc	μ ($''$/yr)	I	J	H	K_S	Other Name
SIPS1241-3843	12 41 08.28 −38 43 11.0	$18.53\pm^{11.06}_{6.93}$	0.506	13.654	11.477	10.825	10.450	2MASSW J1241080-384312 [1]
SIPS1552-2623	15 52 44.51 −26 23 10.7	$12.98\pm^{7.73}_{4.84}$	0.525	12.313	10.258	9.676	9.315	LHS 5303 [2]
SIPS0853-0329	08 53 36.38 −03 29 30.8	$11.30\pm^{6.77}_{4.23}$	0.708	13.920	11.212	10.469	9.942	GJ 3517 [3]

Citation key: [1] Gizis et al. (2000), [2] Luyten Half arcsecond Catalogue (Luyten 1979a), [3] Gliese & Jahreiss (1979).

majority follow this pattern. However the higher that expected number of pairs with separations less than three arcminute indicates that a population of binaries also contributes to this. Hence we choose a maximum separation of three arcminutes for our binary sample. A list of SIPS objects with separations less than this and proper motions within 2σ of each other is shown in Table 3.

Additionally during the cross-referencing process, several objects which, while clearly not the target SIPS object, had a similar proper motion to it were found. These were further investigated and any companion found to have a SuperCOSMOS proper motion (Hambly et al. 2001b) differing by less than 2σ from the SIPS object and to be closer than three arcminutes to it is listed in Table 4. Note that due to the manual nature of this selection mechanism this list should not be regarded as complete.

In some cases it appears that the redder object of a particular pair is actually brighter than the bluer object. However closer examination reveals that these differences are not inconsistent

Table 7. An example section of Table 7 which contains all objects in the survey with 0.1″/yr > μ > 0.5″/yr. The full version of Table 7 along with a citation key is available from CDS.

Name	Position	μ ″/yr	PA °	σ_μ ″/yr	I	J	H	K_S	Other Name
SIPS1326-8714	13 26 48.130 −87 14 24.70	0.181	228.008	0.071	17.740	15.537	15.009	14.641	
SIPS0911-8641	9 11 6.260 −86 41 53.10	0.171	133.837	0.008	13.714	12.006	11.389	11.161	
SIPS0734-8637	7 34 23.230 −86 37 48.20	0.124	344.047	0.020	16.965	15.194	14.595	14.229	
SIPS1533-8613	15 33 54.290 −86 13 2.50	0.452	214.453	0.050	15.971	13.895	13.369	13.085	
SIPS1400-8541	14 0 57.770 −85 41 54.80	0.216	253.952	0.011	15.449	13.700	13.114	12.790	

Table 8. An example section of Table 8 which contains all objects in our overspill sample which have μ > 0.5″/yr. The full version of Table 8 along with a citation key is available from CDS.

Name	Position	μ ″/yr	PA °	σ_μ ″/yr	I	J	H	K_S	Other Name
SIPS0308-8212	3 8 53.460 −82 12 34.80	0.517	30.312	0.017	13.087	11.704	11.145	10.894	Duplicate, SIPSI
SIPS1240-8209	12 40 53.200 −82 9 3.90	0.533	275.885	0.025	12.490	10.855	10.196	9.933	Duplicate, SIPSI
SIPS0322-8159	3 22 57.750 −81 59 57.10	0.549	68.292	0.161	15.355	13.023	12.481	12.081	
SIPS0149-8038	1 49 41.720 −80 38 28.60	0.611	85.544	0.087	13.836	11.677	11.112	10.721	SCR J0149-8038 (7)
SIPS2037-7716	20 37 51.280 −77 16 9.90	0.504	170.140	0.028	15.555	13.760	13.205	12.885	

with the typical photometric errors of ~0.3 mag (Hambly et al. 2001c).

3.2.3. Potential nearby stars

In order to identify nearby objects within the sample, we estimated the distances of objects using the RECONS colour-absolute magnitude relations (Henry et al. 2004). These relations allowed us to calculate absolute K_S magnitudes of a star from the $I-J$, $I-H$ and $I-K_S$ colours. Each of these estimates could then be combined with the apparent magnitude to yield a distance modulus (and hence distance) for each star. However we needed to gain a clear picture of the potential errors in such a calculation. Hence we used these relations to calculate the distance modulii for the sample of nearby stars compiled by Reid using photometry from Leggett (1992) and Bessell (1991) (with an additional simulated error on the I band data to mimic the less accurate plate photometry) and compared them with those distance modulii calculated from their trigonometric parallaxes. We found that these three distance relations when combined produced distance modulii that were 0.3 mag too close, with each having an error of one magnitude. This error is then combined with the random error from each measurement to produce an estimate for the total error on the distance (after the 0.3 mag offset was removed) of each star.

The calculated distance estimates are shown in Table 5 for the sample with 0.1″/yr < μ < 0.5″/yr and in Table 6 for those objects with proper motions above 0.5″/yr. In total there are 12 stars with distance estimates closer than 20 pc which have not been found before.

3.3. Completeness

The final aim of this survey is to study the local space density, mass function and birthrate of cool dwarfs. If we are to properly examine these we must first estimate the completeness of the survey. Firstly there is the problem of crowded regions. These were excluded by utilising the proximity flag in the 2MASS data files. There will also be problems relating to the UKST images. The SuperCOSMOS software flags objects which are blended with other objects. These have been excluded along with those falling near bright stars. The incompletenesses caused by these three effects have been examined and are quantified in Sect. 5 of DHC.

There will also be incompleteness caused by both the limiting magnitudes of the survey and the short epoch separation on some plates. To illustrate this a histogram of the cumulative number of objects with proper motions greater than the minimum proper motion in each bin is plotted in Fig. 4. If the survey was totally complete it would be expected that the number of objects in each bin would scale as μ^{-3} (see the solid line). However it is clear that this is not the case and that the incompleteness is significant below 0.2″/yr.

In order to gain information on the mass function and birthrate of cool dwarfs all the sources of incompleteness mentioned in this section must be taken into account. In the third paper of this series we will detail the simulations which use both the crowding incompleteness calculated in DHC and the other selection effect to produce simulated samples. These will then used to constrain underlying distributions such as the birthrate and mass function.

4. Conclusions

Here we have presented a large sample of cool low mass objects. Within this sample we have identified 45 common proper motion systems of which 11 had neither candidate previously identified. In addition 38 objects (12 of them new) which may lie within 20 pc have been found, along with 4 new potential L dwarfs. It has been shown that the surevy is incomplete and that the sources of incompleteness must be taken into account before examining the constraints that can be set on the mass function and stellar birthrate.

In the next paper in this series we will model the low mass stellar population. This will allow us to take into account all the selection criteria and their effects, along with the various sources of incompleteness. This will allow us to constrain the underlying mass function and birthrate.

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