CPM Pairs from LSPM so Far Not WDS Listed – Part IV

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Abstract: The LSPM catalog (Lepine and Shara 2005) is a rich source for CPM pairs we thought already exhausted – but as we found during research for our report "A New Concept for Counter-Checking of Assumed CPM Pairs" (Knapp and Nanson 2017), there are still many potential CPM pairs indicated in LSPM not listed in the WDS catalog. After our first three reports on about 100 such objects (Knapp and Nanson 2017 - CPM pairs from LSPM so far not WDS listed – Part I/II/III), this report with 30 additional potential common proper motion pairs is presented here.

Introduction

Similar to our first three reports on common proper motion pairs not listed so far in the WDS the selection from LSPM was done by sorting all LSPM objects by RA and then checking if the next LSPM object is nearer than 30 arc-seconds and so far not included in the WDS catalog. As a second criterion we selected all objects with an altitude suitable for imaging during the time of the research for this report with the intention of taking images with V- and I-filters in order to be able to determine as far as possible not only RA/Dec coordinates, separation, position angle, magnitudes and proper motion values, but also the spectral class range of all components according to the V-I color index.

Since GAIA DR1 coordinates are now available for most of the selected objects our most important CPM check analysis was done on the basis of comparison of 2MASS to GAIA DR1 positions. Because proper motion data listed directly in GAIA is still scarce and thus not available for both components of our objects, it was necessary to do our own calculations, which allowed a CPM rating according to Knapp/Nanson 2017 (see description Appendix A).

We also checked as many other sources as possible via Aladin for data for these CPM candidates beginning with visual comparison of POSS I and POSS II images. If the Aladin centroid feature did not work (as was usually the case) we then resorted to visual estimation of the centroids to determine separation, position angle and proper motion from POSS I to POSS II. Next came the check of other existing catalog data for the given field of view, especially URAT1, SDSS, WISE, UCAC4 and GSC.

Besides measuring Vmags in our own images we tried also to get the visual magnitudes for each of the components from the various catalogs we used.

When the 2MASS data with J- and K-band values were available, we used a spreadsheet to estimate Vmags with formulas found on the website of Bruce Gary (http://brucegary.net/dummies/method0.html) provided -0.1 < (J-K) < 1.0. For SDSS objects fainter than 15mag in g-band we estimated Vmag as (gmag+rmag)/2 based on advice from Brian Skiff that this might work rather well.

Spectral class data was scarce in the available catalogs so as already mentioned we had to resort to deriving the spectral class of the objects in question using the B-V color index provided we had these values listed in the same catalog. For this purpose we used a table provided by the Space Telescope Science Institute (http://www.stsci.edu/~inr/intrins.html).

Additionally we took images with I-filter to get Icmags to be able to estimate the spectral class range of the components on base of own image material again using the above mentioned table.

The image processing followed our usual proce-

dure: Stacking with AAVSO VPhot, plate solving and measuring positions and Vmags with Astrometrica using URAT1 as reference catalog and calculating Sep and PA with the formulas provided by Buchheim 2008. Due to the faintness of some objects we had to use exposure times up to 300 seconds and even then some components were too faint to be resolved. The I-filter images were first also plate solved with URAT1 as reference catalog for the astrometry results and then again plate solved using Astrometrica with USNO B1 as reference catalog for Ic-mags for the I-band photometry results.

In total we got in this way an observation history of each object beginning in most cases in the year ~1950 with POSS I and ending in 2017 with own new images.

Results of Our Research

In Table 1 we present for the selected objects as much data as we could find in the catalogs available to us including our own measurements based on images taken with remote telescope iT24. Given below is a description of the table content per column:

- Name gives the discoverer ID of the selected object with a running number in the header line
- RA and Dec give the recent precise coordinates of the A component (if available from GAIA DR1) in the header line in the traditional HH:MM:SS DD:MM:SS format and in the data lines for the sources referred to in the Notes column in decimal degrees format as these values are directly usable for calculating Sep and PA
- Sep gives separation in arcseconds in the data lines calculated as

$$Sep = \sqrt{\left[\left(\cos\left(RA_1 - RA_2\right)\cos\left(Dec_1\right)\right)^2 + \left(Dec_2 - Dec_1\right)^2\right]}$$

  in radians
- PA gives position angle in degrees in the data lines calculated as

$$PA = \arctan\left[\frac{\left(RA_2 - RA_1\right)\cos\left(Dec_1\right)}{Dec_2 - Dec_1}\right]$$

  in radians depending on quadrant
- M1 and M2 give measured Vmags in the header line for A and B and if available also in the data lines where we had often to resort to estimated values based on calculation from the J- and K-band values if available
- pmRA1 and pmDE1 with e_pm1 give the proper motion data for A and pmRA2, pmDE2 and e_pm2 for B in the header line as well as in the data lines calculated by comparison of positions between catalogs or directly from the catalogs (specified in the Notes column)
- Spc1 and Spc2 give the spectral class range for A and B usually based on the V-I color index taking into consideration also the error range of the measured Imags
- Ap indicates in the data lines the aperture used for the observation listed (for GAIA calculated equivalent circular surface diameter) and Me indicates the WDS code for the used observation method
- Date is the Julian epoch of the (averaged) observation date given in the data lines
- CPM Rat gives the rating of the CPM assessment based on comparison of positions (in most cases between 2MASS and GAIA DR1 if available) in the header line and the corresponding data line
- Source/Notes finally indicates in the header line the LSPM ID and the overall assessment for the object in question and in the data lines the source used (images and catalogs) and additional explanations if considered necessary.

Summary

From 30 objects checked for CPM

- 22 objects received a solid or at least good CPM candidate rating based on position comparison, in most cases between 2MASS and GAIA DR1 (according to the method presented in Knapp/ Nanson 2017)
- 4 objects could not be rated due to missing precise catalog positions for calculating CPM speed and direction – but in all cases visual evidence by comparing existing image material strongly suggested CPM
- 3 objects got a CPM rating for being most certainly not CPM
- 1 object remained unclear due to even missing visual evidence.

The issue of I-band photometry and using it for estimating the spectral class range was handled similarly to our part II&III report.

Follow Up

This report is our last one on this topic although we are convinced that there might be a lot more CPM pairs hidden in the LSPM catalog but with separations larger than 30 arcseconds thus not covered by our selection criterion up to this limit.

But we found in our image material for this report a number of WDS objects and will provide historical re-

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Table 1: Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
KPP n+1	05 44 41.239	21 20 51.39			15.27	18.00	-112.23	111.30	5.39	-112.22	112.60	4.96	>M4	>M4				AAAC	J0544+2120: Solid CPM candidate
	86.17387500	21.34600000	5.813	222.294											1.20	Pp	1951.849		POSS I.O estimates
	86.17216667	21.34736111	4.751	222.555			-123.92	106.01		-108.81	123.32				1.20	Pp	1998.072		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	86.17240200	21.34707800	5.720	224.514	13.88	15.43									1.30	E2	1997.883		2MASS. M1 and M2 estimated from J- and K-band
	86.17187360	21.34755720	5.704	224.706	15.2		-113.20	110.30		-112.10	110.60				0.20	Eu	2013.616		URAT1
	86.17182909	21.34760721	5.704	224.669	14.08	16.09	-112.23	111.30	5.39	-112.22	112.60	4.96			0.96	Hg	2015.000	AAAC	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS
	86.17172917	21.34767222	6.060	227.934	15.27	18.00									0.61	C	2017.081		iT24 1x60s V-filter
	86.17174583	21.34765556	5.563	223.878	12.66	14.55							>M4	>M4	0.61	C	2017.081		iT24 1x60s I-filter. Spc based on V-I color index
NSN n+1	06 11 56.179	33 25 43.03			14.98	18.60	133.37	-421.46	6.24	129.49	-412.57	6.20	>M4	M2->M4				AAAA	J0611+3325: Solid CPM candidate. M2 estimated, might be much fainter
	92.98300000	33.4308889	12.146	188.893											1.20	Pp	1999.057		POSS II.N estimates
	92.98329600	33.4307140	12.397	189.922	12.44	16.22									1.30	E2	1999.967		2MASS. M1 and M2 estimated from J- and K-band
	92.98390000	33.4291211	12.314	190.198	14.95		133.37	-421.46	6.24	129.49	-412.57	6.20			0.20	Eu	2013.609	AAAA	URAT1. PM data calculated from position comparison with 2MASS
	92.98405000	33.4286361			14.93										0.61	C	2017.084		iT24 1x60s V-filter. No resolution of B, has to be fainter than 18.5Vmag
	92.98410417	33.4287139	12.309	189.779	11.65	15.81							>M4	>M4	0.61	C	2017.076		iT24 1x60s I-filter. Spc based on V-I color index
																			Neither GAIA DR1 nor UCAC5/SDSS/WISE object for B available. Also no resolution of B in POSS I images
KPP n+2	06 12 20.450	37 21 07.32			16.13	17.48	-3.31	-130.34		0.00	-127.57		>M4	>M4					J0612+3721: Blinking POSS images suggests solid common proper motion
	93.08520833	37.35488889	2.412	185.674											1.20	Pp	1954.006		POSS I.O estimates
	93.08516667	37.3535833	2.303	182.968			-3.31	-130.34		0.00	-127.57				1.20	Pp	1990.066		POSS II.J estimates. PM estimates based on comparison with POSS I.O
	93.08521035	37.3520332	3.414	186.362	14.69	16.65									0.96	Hg	2015.000		GAIA DR1. M1 and M2 are G-band
	93.08506667	37.3519278	2.890	180.236	16.13	17.48									0.61	C	2017.209		iT24 1x300s V-filter. Heavily overlapping star disks
	93.08518333	37.3519194	3.100	179.339	13.47	14.51							>M4	>M4	0.61	C	2017.327		iT24 2x300s I-filter. Touching/overlapping star disks. Spc based on V-I color index
																			Neither 2MASS nor URAT1, UCAC5, SDSS or WISE object for B available

Table 1 continues on next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
NSN n+2	06 38 52.448	22 55 11.29			13.43	17.05	-143.37	-312.03	5.70	-152.51	-313.39	5.70	>M4	>M4				AAAA	J0638+2255: Solid CPM candidate
	99.72125	22.92580556	3.922	173.934											1.20	Pp	1949.900		POSS I.O estimates
	99.71920833	22.9215	4.502	178.241			-141	-323		-146.76	-335.36				1.20	Pp	1997.908		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	99.71923200	22.9212040	4.792	173.245	11.85	14.75									1.30	E2	1998.833		2MASS. M1 and M2 estimated from J- and K-band
	99.71853295	22.9198028	4.799	175.026	12.07	15.58	-143.37	-312.03	5.70	-152.51	-313.39	5.70			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS
	99.71843333	22.9196306	4.692	175.947	13.43	17.05									0.61	C	2017.209		iT24 1x300s V-filter. SNR B <20. Heavily overlapping star disks
	99.71848333	22.9196417	4.876	177.239	10.58	13.91							>M4	>M4	0.61	C	2017.084		iT24 1x180s I-filter. SNR B <20. Heavily overlapping star disks. Spc based on V-I color index
KPP n+3	06 44 39.062	28 55 26.32			14.05	16.28	194.37	-10.10	5.68	188.74	-14.20	5.68	M2-M4	M3-M4				AAAA	J0644+2855: Solid CPM candidate
	101.15866667	28.9241111	4.561	239.717											1.20	Pp	1953.933		POSS I.O estimates
	101.16120833	28.9240000	4.561	233.704			191	-10		198	-19				1.20	Pp	1995.797		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	101.16175800	28.9240230	5.625	234.698	12.88	14.63									1.30	E2	1998.762		2MASS. M1 and M2 estimated from J- and K-band
	101.16275963	28.9239774	5.738	234.683	13.00	15.00	194.37	-10.10	5.68	188.74	-14.20	5.68			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS
	101.16288750	28.9239389	5.590	238.749	14.05	16.28									0.61	C	2017.076		iT24 1x60s V-filter
	101.16289583	28.9239944	5.796	235.773	11.88	13.86							M2-M4	M3-M4	0.61	C	2017.076		iT24 1x60s I-filter. Spc based on V-I color index
NSN n+3	06 46 00.821	52 14 11.26			15.97	16.15							K5-M0	K7-M1					J0646+5214: DSS and 2MASS images show elongation but none of the checked catalogs showed an object for B. Comparison POSS I:O and II.J images shows clearly common proper motion
	101.50370833	52.2395000	2.102	357.495											1.20	Pp	1954.148		POSS I.O estimates
	101.50370833	52.2380278	2.108	355.000			0.00	-143.31		-2.48	-143.31				1.20	Pp	1991.131		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	101.50342083	52.2364611	2.301	357.941	15.97	16.15									0.61	C	2017.209		iT24 1x300s V-filter. Overlapping star disks
	101.50340000	52.2363556	2.381	358.231	14.56	14.55							K5-M0	K7-M1	0.61	C	2017.209		iT24 1x300s I-filter. Overlapping star disks
KPP n+4	06 54 37.555	17 08 03.57			15.22	16.36	-79.01	-141.89	7.18	-78.68	-143.10	7.18	M1-M3	M3-M4				AAAA	J0654+1708: Solid CPM candidate
	103.65787500	17.1371667	3.031	8.157											1.20	Pp	1951.849		POSS I.O estimates
	103.65687500	17.1348056	3.229	7.654			-71.64	-177.01		-71.64	-172.85				1.20	Pp	1999.868		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	103.65684300	17.1349470	3.692	8.250	13.12	11.73									1.30	E2	2000.854		2MASS. M1 and M2 estimated from J- and K-band
	103.65648118	17.1343261	3.674	8.373	14.08	15.18	-79.01	-141.89	7.18	-78.68	-143.10	7.18			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS
	103.65641667	17.1341917	3.768	6.992	15.22	16.36									0.61	C	2017.084		iT24 1x180s V-filter. Touching star disks
	103.65640000	17.1342417	3.334	8.157	13.61	14.36							M1-M3	M3-M4	0.61	C	2017.076		iT24 1x60s I-filter. Touching star disks

Table 1 continues on next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
NSN +4	06 59 03.303	56 31 00.57			15.64	18.57	-32.61	-139.66	5.31	-33.89	-138.09	5.31	K7-M1	M2-M4				AAAA	J0659+5631: Solid CPM candidate
	104.76458333	56.5192500	9.017	82.352											1.20	Pp	1954.072		POSS I.O estimates
	104.76370833	56.5174722	8.935	82.282			-40.56	-149.37		-42.49	-149.37				1.20	Pp	1996.919		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	104.76402500	56.5174450	8.622	82.684	14.88	16.72									1.30	E2	1999.011		2MASS. M1 and M2 estimated from J- and K-band
	104.76376245	56.5168247	8.605	82.501	14.75	17.15	-32.61	-139.66	5.31	-33.89	-138.09	5.31			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS
	104.76374167	56.5167556	8.380	84.522	15.64	18.57									0.61	C	2017.209		iT24 1x300s V-filter. SNR B <20
	104.76369167	56.5167611	8.703	84.594	14.06	16.31							K7-M1	M2-M4	0.61	C			iT24 1x60s I-filter. SNR B <20
KPP n+5	07 05 26.916	34 00 16.06			13.19	17.94	-62.12	-191.02		-73.08	-170.45		M1-M3	F1-G8					J0705+3400: DSS image shows the secondary but not 2MASS and none of the checked catalogs but GAIA DR1 showed an object for B. Comparison POSS I:O to II.J images suggests clearly common proper motion
	106.36279167	34.0075000	7.730	150.087											1.20	Pp	1953.862		POSS I.O estimates
	106.36208333	34.0056944	6.937	149.874			-62.12	-191.02		-73.08	-170.45				1.20	Pp	1987.890		POSS II.J estimates. PM estimates based on comparison with POSS I.O
	106.36215056	34.0044621	7.179	150.642	12.29	17.83									0.96	Hg	2015.000		GAIA DR1. M1 and M2 are G-band
	106.36215000	34.0043889	7.221	150.266	13.19	17.94									0.61	C	2017.084		iT24 1x180s V-filter. SNR B <20
	106.36210417	34.0043528	6.378	151.594	11.18	17.51							M1-M3	F1-G8	0.61	C	2017.209		iT24 1x300s I-filter. Touching star disks. SNR B <10. Spc based on V-I color index
NSN n+5	07 21 43.377	25 54 58.82			10.11	13.53	58.15	-164.33		29.08	-164.33		K2-K5	>M4					J0721+2555: No catalog data for CPM assessment available. Comparison POSS images suggests common proper motion
	110.429125	25.91922222	5.688	95.043											1.20	Pp	1954.970		POSS I.O estimates
	110.42979167	25.9175278	4.614	96.221			58.15	-164.33		29.08	-164.33				1.20	Pp	1992.090		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	110.43036800	25.9171160	3.354	87.785	10.06										1.30	E2	1998.888		2MASS. M1 estimated from J- and K-band
	110.43073750	25.9163389	4.778	88.441	10.11	13.53									0.61	C	2017.084		iT24 1x180s V-filter. Heavily overlapping star disks
	110.43070833	25.9163583	4.252	87.979	9.12	10.98							K2-K5	>M4	0.61	C	2017.076		iT24 1x60s I-filter. Heavily overlapping star disks. Spc based on V-I color index

Table 1 continues on next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
KPP n+6	07 23 20.006	25 36 09.88			16.56	18.45	-103.30	-218.28	5.01	-105.36	-219.07	5.44	M1-M3	M2->M4				AAAA	J0723+2536: Solid CPM candidate
	110.8352083	25.60658333	5.315	39.516											1.20	Pp	1954.970		POSS I.O estimates
	110.83391667	25.6042222	5.230	38.373			-113	-229		-117	-229				1.20	Pp	1992.090		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	110.83389900	25.6037710	5.571	38.273	15.9	17.4									1.30	E2	1998.066		2MASS. M1 and M2 estimated from J- and K-band
	110.83377300	25.6035930	5.520	38.137	16.58	18.62	-132.99	-208.34	27.59	-146.71	-218.87	29.97			2.50	Es	2001.142	ABCA	SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0). PM data calculated from position comparison with 2MASS
	110.83336020	25.6027442	5.539	38.074	15.60	17.37	-103.30	-218.28	5.01	-105.36	-219.07	5.44			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS
	110.83332917	25.6026056	5.179	35.809	16.56	18.45									0.61	C	2017.209		iT24 1x300s V-filter. SNR B <20
	110.83342500	25.6026833	5.179	36.925	14.49	16.28							M1-M3	M2->M4	0.61	C	2017.076		iT24 1x60s I-filter. SNR B <20. Spc based on V-I color index
NSN n+6	07 30 22.917	27 16 07.25			11.85	17.08	34.06	-199.43	5.43	68.11	-248.59	5.84	G8-K4	K4-K7				CCAA	J0730+2716: Seems rather optical despite significant very fast proper motion of both components
	112.5946667	27.27219444	5.602	349.025											1.20	Pp	1953.124		POSS I.O estimates
	112.59516667	27.2698889	5.015	347.719			41	-213		41	-228				1.20	Pp	1992.090		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	112.59532300	27.2695480	6.252	345.202	11.9	17.1									1.30	E2	1998.066		2MASS. M1 and M2 estimated from J- and K-band
	112.59537400	27.2693830	6.198	344.366		16.30	53.01	-192.96	27.56	29.11	-217.52	29.95			2.50	Es	2001.145	CBCA	SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0). PM data calculated from position comparison with 2MASS.
	112.59548940	27.2686819	5.343	348.622	11.86		34.06	-199.43	5.43	68.11	-248.59	5.84			0.20	Eu	2013.777	CCAA	URAT1. PM data calculated from position comparison with 2MASS
	112.59549167	27.2685222	5.365	346.637	11.85	17.08									0.61	C	2017.075		iT24 1x60s V-filter. SNR B <10. Heavily overlapping star disks
	112.59545417	27.2685000	5.741	340.461	11.05	15.78							G8-K4	K4-K7	0.61	C	2017.075		iT24 1x60s I-filter. SNR B <10. Heavily overlapping star disks. Spc based on V-I color index
KPP n+7	07 34 25.791	23 15 30.28			15.58	17.24	-230.22	-136.24	5.80	-225.98	-135.95	5.80	M3->M4	M3->M4				AAAA	J0734+2315: Solid CPM candidate
	113.6115	23.26105556	4.694	35.953											1.20	Pp	1954.970		POSS I.O estimates
	113.60841667	23.2592500	4.744	27.699			-226	-144		-239	-135				1.20	Pp	2000.027		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	113.60865000	23.2590580	5.181	32.995	13.9	15.3									1.30	E2	1997.924		2MASS. M1 and M2 estimated from J- and K-band
	113.60746139	23.2584118	5.225	33.631	14.28	15.87	-230.22	-136.24	5.80	-225.98	-135.95	5.80			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS
	113.60732083	23.2583000	5.473	37.184	15.58	17.24									0.61	C	2017.076		iT24 1x60s V-filter. SNR B <10. Identification of B a bit difficult due to a fore- or background star involved
	113.60728750	23.2583167	4.942	38.453	13.16	14.83							M3->M4	M3->M4	0.61	C	2017.076		iT24 1x60s I-filter. Touching star disks with B obviously optical double. SNR B <20. Spc based on V-I color index

Table 1 continues on next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
NSN +7	07 35 26.945	+48 14 33.16			11.66	16.86	94.35	-189.03	6.09	-24.46	20.81	10.75	M0-M2	G8-K4				CCCB	J0735+4814: Not a CPM candidate.
	113.8595420	48.2454170	6.703	1.708											1.2	Pp	1953.122		POSS I.O estimates.
	113.8611320	48.2438870			11.69										1.2	Pp	1991.820		GSC 2.3. M1 is GSC 2.3 Vmag, secondary not identified.
	113.8616740	48.2433400	6.677	349.406	11.10										1.3	E2	1999.857		2MASS. M1 estimated from J- and K-band, M2 not shown in 2MASS data.
	113.8608750	48.2435560	7.943	349.126			103.00	-166.00		63.00	-140.00				1.2	Pp	1999.863		POSS II.N estimates. PM estimates based on comparison with POSS I.O. Secondary very difficult to identify and separate in both POSS images.
	113.8617910	48.2431900	7.763	345.111	11.90	16.90									2.5	Es	2003.886	CCCB	SDSS DR9. Vmags estimated from (gmag+rmag)/2.
	113.8621914	48.2426403	9.831	342.752	11.70		90.08	-182.92	6.70	-32.39	22.26	11.80	K7		0.2	Eu	2013.642	CCCB	URAT1. M1 is URAT1 Vmag. SPC1 is URAT1 V-I value. PM data calculated from position comparison with 2MASS.
	113.8622699	48.2425449	10.200	342.738	10.75	16.47	103.32	-208.97	51.28	10.46	-7.60	0.26			0.96	Hg	2015.000	CCCB	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with SDSS DR9.
	113.8622699	48.2425449	10.200	342.738	10.75	16.47	94.35	-189.03	6.09	-24.46	20.81	10.75			0.96	Hg	2015.000	CCCB	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS.
	113.8623292	48.2424417	10.846	342.083	11.66	16.86									0.61	C	2017.076		iT24 1x60s V-filter
	113.8623667	48.2424528	10.149	343.884	9.82	16.03							M0-M2	G8-K4	0.61	C	2017.076		iT24 1x60s I-filter. SNR B <20. Spc based on V-I color index
																			Notes: Secondary not identified in WISE, neither of the components is identified in UCAC5.
KPP n+8	07 48 35.903	+37 12 9.47			10.41								K7-M1						J0748+3712: No conclusion possible due to absence of secondary in all databases consulted with the exception of 2MASS.
	117.1498090	37.2037510	5.867	91.758	10.20	13.30									1.3	E2	1998.272		2MASS. M1 and M2 estimated from J- and K-band
	117.1498300	37.2036290			10.64								>M4		1.2	Pp	2000.000		GSC 2.3. M1 is GSC 2.3 Vmag, Spc1 is GSC 2.3 B-V value. Secondary not identified in GSC 2.3.
	117.1495978	37.2026306			9.86		-39.10	-241.00							0.2	Eu	2002.021		UCAC5 with GAIA coordinates. Secondary not identified. M1 is from J and K values. PmRA1 and pmDec1 are from UCAC5 data.
	117.1497750	37.2034994			9.81										0.2	Eu	2002.021		UCAC5 coordinates used here. M1 is UCAC5 Gmag value.
	117.1496850	37.2029780			10.16										0.4	Hw	2010.500		WISE. M1 is from G-band value. Secondary not identified in WISE.
	117.1496017	37.2026961			10.43								K5		0.2	Eu	2013.943		URAT1. M1 is URAT1 Vmag. SPC1 is URAT1 B-V value. Secondary not identified in URAT1.
	117.1495978	37.2026307			9.81		-40.07	-239.06							0.96	Hg	2015.000		GAIA DR1. Secondary not identified in GAIA DR1. M1 is G-band, pmRA1 and pmDec1 data are GAIA DR1 values listed in Aladin.

Table 1 continues on next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
	117.1495333	37.2024806			10.41										0.61	C	2017.209		iT24 1x300s V-filter. No resolution of B
	117.1494958	37.2024667			8.83								K7-M1		0.61	C	2017.209		iT24 1x300s I-filter. No resolution of B. Spc based on V-I color index
																			Notes: There are five markers for the primary in SDSS-DR9, located 482 mas apart, so there's no way to be sure which is the primary – all values are similar – and the secondary is not identified. Not possible to locate secondary in the POSSI and POSSII images.
NSN n+8	07 51 01.841	+40 06 6.48			16.60	18.96	-126.61	-157.92	5.07	-122.78	-154.09	5.07	>M4	>M4				AAAA	J0751+4006: Solid CPM candidate.
	117.7604580	40.1044440	7.769	187.638											1.2	Pp	1953.198		POSS I.E estimates.
	117.7589620	40.1030200	7.107	185.782	15.68	17.86									1.2	Pp	1986.905		GSC 2.2. M1 and M2 are GSC 2.2 Rmags. Note: The GSC 2.2 Rmags are identical to the GSC 2.3 Fmags.
	117.7589620	40.1030200	7.107	185.782	16.27	17.86									1.2	Pp	1986.905		GSC 2.3. M1 is GSC 2.3 Vmag, M2 is GSC 2.3 Fmag.
	117.7584380	40.1025350	7.431	186.233	14.70	16.20									1.3	E2	1998.272		2MASS. M1 and M2 estimated from J- and K-band
	117.7581250	40.0124440	7.100	180.000			-150.00	-168.00		-126.00	-154.00				1.2	Pp	1999.172		POSS II.N estimates. PM estimates based on comparison with POSS I.E.
	117.7583310	40.1024470	7.373	185.680	16.68	19.04									2.5	Es	2000.244		SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0).
	117.7583310	40.1024470	7.373	185.680	16.68	19.04	-149.39	-160.62	43.02	-110.30	-135.07	43.02			2.5	Es	2000.244	BCCA	SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0). PM data calculated from position comparison with 2MASS.
	117.7576689	40.1018011			14.71		-103.30	-146.50							0.2	Eu	2002.118		UCAC5 with GAIA coordinates. Secondary not identified in UCAC5. M1 is from J and K values. PmRA1 and pmDec1 are from UCAC5 data.
	117.7581522	40.1023253			15.04										0.2	Eu	2002.118		UCAC5 coordinates used here. Secondary not identified. M1 is UCAC5 Gmag value.
	117.7578630	40.1020400	7.032	185.573	14.70	16.20	-132.10	-148.60	9.90	-121.70	-116.20	21.70			0.4	Hw	2010.500	BCCA	WISE. M1 from WISE J and K magnitudes. PM data calculated from position comparison with 2MASS.
	117.7576872	40.1018531	7.352	185.746	14.71	16.16	-132.98	-157.90	5.46	-128.28	-153.09	5.45			0.2	Eu	2013.828	AAAA	URAT1. M1 and M2 from URAT1 J and K values. PM data calculated from position comparison with 2MASS.
	117.7576688	40.1018012	7.361	185.791	15.04	16.97	-126.61	-157.92	5.07	-122.78	-154.09	5.07			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS.
	117.7575292	40.1016639	7.558	186.450	16.60	18.96									0.61	C	2017.209		iT24 1x300s V-filter
	117.7575542	40.1018056	7.365	186.350	13.86	15.78							>M4	>M4	0.61	C	2017.075		iT24 1x60s I-filter. SNR B <20. Spc based on V-I color index

Table 1 continues on next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
																			Notes: Secondary not identified in WISE, M1 J and K data in WISE appears to be unreliable since it results in a visual equivalent magnitude of 7.136. Only one object identified in URAT1, which doesn't appear to be either component based on URAT1 PM data.
KPP n+9	07 54 4.665	+13 05 53.48			15.50	16.09	170.41	-231.51	8.81	182.58	-241.61	6.06	G5-K3	K5-M0				BCAB	J0754+1305: Very difficult pair due to 13th magnitude star which overwhelms the 15th magnitude LSPM primary to the extent that most surveys fail to pick up the primary. Possibly a better PM candidate than the rating indicates.
						15.43				178.20	-247.50				0.2	Eu	2000.923		UCAC5. Primary not identified in UCAC5. M2 is UCAC5 Gmag, pmRA2 and pmDec2 are UCAC5 PM data.
	118.5189490	13.0988340	11.457	225.287	16.30	16.20									2.5	Es	2004.941		SDSS DR7. Vmags estimated from (gmag+rmag)/2. Three super-imposed objects at both primary and secondary positions, took the northernmost of the primary and used the object with the same epoch at the secondary location.
	118.5189590	13.0988730	11.571	224.916	16.10	16.20									2.5	Es	2004.951		SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0). Five superimposed objects at both primary and secondary locations, took the northernmost in each case (with same epoch).
	118.5194374	13.0981878	11.442	224.496	15.63	15.43	170.41	-231.51	8.81	182.58	-241.61	6.06			1.0	Hg	2015.000	BCAB	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with SDSS DR7.
	118.5194374	13.0981878	11.442	224.496	15.63	15.43	166.92	-245.48	6.76	181.88	-242.33	0.16			0.96	Hg	2015.000	CCAB	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with SDSS DR9.
	118.5192792	13.0982639	11.311	220.035	15.50	16.09									0.61	C	2017.076		iT24 1x60s V-filter. Star disk A overlaps with background star
	118.5196458	13.0979972	11.729	227.194	14.78	14.61							G5-K3	K5-M0	0.61	C	2017.076		iT24 1x60s I-filter. Star disk A overlaps with background star. Spc based on V-I color index
																			Notes: Primary not identified in 2MASS, WISE, GSC 2.2 and 2.3, and URAT1. Not possible to detect primary in POSSI and POSSII images – southeasterly motion of secondary is obvious, but no indication of an object moving southeasterly across the face of the 13th magnitude star that overwhelms the primary.

Table 1 continues on next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
NSN n+9	08 58 10.034	+52 27 14.55			17.04	17.56	-130.92	-135.43	5.59	-131.43	-130.54	5.59	>M4	>M4				AAAA	J0858+5227: Solid CPM candidate.
	134.5453750	52.4559170	5.480	288.071											1.2	Pp	1954.146		POSS I.E estimates.
	134.5432620	52.4549340	5.542	280.516	16.90	17.57									1.2	Pp	1991.110		GSC 2.3. M1 and M2 are GSC 2.3 Vmag values.
	134.5426250	52.4550830	5.126	281.250			-141.00	-70.00		-137.00	-87.00				1.2	Pp	1997.908		POSS II.J estimates. PM estimates based on comparison with POSS I.E.
	134.5427150	52.4546130	5.742	280.329	15.20	15.60									1.3	E2	1999.825		2MASS. M1 and M2 estimated from J- and K-band.
	134.5426720	52.4546280	5.773	281.001	17.10	17.70									2.5	Es	2000.245		SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0).
	134.5418925	52.4540978	5.756	280.956	15.56	15.22	-129.97	-133.59	6.11	-130.15	-128.96	6.11			0.2	Eu	2013.708	AAAA	URAT1. M1 and M2 from URAT1 J and K values. PM data calculated from position comparison with 2MASS.
	134.5418093	52.4540421	5.763	281.041	15.52	16.00	-128.26	-142.94	0.19	-127.58	-142.79	0.19			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with SDSS DR9.
	134.5418093	52.4540421	5.763	281.041	15.52	16.00	-130.92	-135.43	5.59	-131.43	-130.54	5.59			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS.
	134.5415583	52.4539611	5.596	282.802	17.04	17.56									0.61	C	2017.084		iT24 1x180s V-filter
	134.5417708	52.4539750	5.728	281.071	14.16	14.77							>M4	>M4	0.61	C	2017.076		iT24 1x60s I-filter. Spc based on V-I color index
																			Notes: Primary not identified in WISE. Neither of the components is identified in UCAC5.
KPP n+10	09 14 44.527	+18 06 15.48			15.89	19.20	-131.44	-94.38	5.89	-129.93	-94.32	5.89	M2-M4	M1-M3				AAAA	J0914+1806: Solid CPM candidate. M2 estimated as being 0.1 magnitude fainter than faintest stars resolved in V-filter image.
	138.6880000	18.1060000	11.300	112.917											1.2	Pp	1950.214		POSS I.O estimates.
	138.6861250	18.1051390	11.547	115.660			-150.00	-73.00		-150.00	-87.00				1.2	Pp	1990.088		POSS II.N estimates. PM estimates based on comparison with POSS I.O.
	138.6862500	18.1047450	11.177	112.258	16.08	19.37									1.2	Pp	1997.187		GSC 2.3. M1 is GSC 2.3 Vmag, M2 is GSC 2.3 f.mag.
	138.6861830	18.1047460	10.932	113.317	14.50	17.40									1.3	E2	1998.031		2MASS. M1 and M2 estimated from J- and K-band.
	138.6859340	18.1045600	10.915	113.293	16.00	20.60									2.5	Es	2005.053		SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0).
	138.6855836	18.1043353	10.977	113.052	15.80	17.42	-130.36	-93.97	6.36	-129.05	-93.97	6.48	>M4		0.2	Eu	2013.610	AAAA	URAT1. M1 is URAT1 Vmag, M2 is from URAT1 J and K values. Spc1 is URAT1 B-V value. PM data calculated from position comparison with 2MASS.
	138.6855312	18.1043011	10.955	113.258	14.66	18.30	-138.57	-93.69	0.16	-134.62	-94.66	3.02			0.96	Hg	2015.000	BBAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with SDSS DR9.
	138.6855312	18.1043011	10.955	113.258	14.66	18.30	-131.44	-94.38	5.89	-129.93	-94.32	5.89			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS.

Table 1 continues on next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM	Source/Notes
	138.6854333	18.1042194			15.89										0.61	C	2017.210		iT24 1x300s V-filter. No resolution of B, has to be fainter than 19.1Vmag
	138.6854667	18.1042667	10.942	112.514	13.66	17.11							M2-M4	M1-M3	0.61	C	2017.210		iT24 1x300s I-filter. Spc based on V-I color index. Vmag2 estimated 19.2
																			Notes: Neither of the components is identified in UCAC5 and WISE.
NSN n+10	09 25 27.696	+21 02 31.22			14.53	19.60	-138.70	-76.95	6.02	-146.97	-75.47	6.02	K7-M1	M3->M4				AAAB	J0925+2102: Solid CPM Candidate. M2 estimated as being 0.1 magnitude fainter than faintest stars resolved in V-filter image.
	141.3672500	21.0436940	17.760	17.904											1.2	Pp	1951.090		POSS I.E estimates.
	141.3657500	21.0425830	17.654	15.642			-118.00	-94.00		-134.00	-91.00				1.2	Pp	1999.205		POSS II.F estimates. PM estimates based on comparison with POSS I.E.
	141.3660550	21.0423600	17.341	14.566	14.27	19.20									1.2	Pp	1999.209		GSC 2.3. M1 is GSC 2.3 Vmag, M2 is GSC 2.3 f.mag.
	141.3659800	21.0423070	17.394	14.293	13.90	17.30									1.3	E2	2000.914		2MASS. M1 and M2 estimated from J- and K-band
	141.3657950	21.0422230	17.432	14.169	14.80	20.40									2.5	Es	2005.047		SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0).
	141.3656100	21.0421410	17.494	14.299	13.90	17.30	-132.00	-63.50	11.40	-129.20	-53.10	20.10			0.4	Hw	2010.332	BACB	WISE. M1 and M2 from WISE J and K magnitudes. PM data calculated from position comparison with 2MASS.
	141.3654563	21.0420264	17.412	14.069	14.92	17.32	-135.81	-77.97	6.55	-139.64	-74.80	6.51	>K4		0.2	Eu	2013.912	AAAB	URAT1. M1 is URAT1 Vmag, M2 is from URAT1 J and K values. Spc1 is URAT1 B-V value. PM data calculated from position comparison with 2MASS.
	141.3653985	21.0420059	17.385	13.903	13.66	18.35	-133.84	-78.51	7.27	-142.85	-81.12	7.85			0.96	Hg	2015.000	BCAB	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with SDSS DR9.
	141.3653985	21.0420059	17.385	13.903	13.66	18.35	-138.70	-76.95	6.02	-146.97	-75.47	6.02			0.96	Hg	2015.000	AAAB	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS.
	141.3653333	21.0419028			14.53										0.61	C	2017.209		iT24 1x300s V-filter. No resolution of B, has to be fainter than 19.5Vmag
	141.3653333	21.0419528	17.309	14.473	12.79	17.09							K7-M1	M3->M4	0.61	C	2017.209		iT24 1x300s I-filter. Spc based on V-I color index. Vmag2 estimated 19.6
																			Notes: Neither of the components is identified in UCAC5.
KPP n+11	09 47 43.251	+38 20 08.27			16.71	17.53	103.82	-298.99	5.07	104.24	297.76	5.07	>M4	>M4				AAAA	J0947+3820: Solid CPM candidate.
	146.9280000	38.3412220	4.929	291.420											1.2	Pp	1953.106		POSS I.O estimates
	146.9293400	38.3376020	5.267	291.534	15.62	16.29									1.2	Pp	1992.094		GSC 2.3. M1 and M2 are GSC 2.3 f.mag values.
	146.9292920	38.3374170	5.115	289.413			85.00	-320.00		80.00	-323.00				1.2	Pp	1997.166		POSS II.J estimates. PM estimates based on comparison with POSS I.O.
	146.9295970	38.3370210	5.376	291.282	14.90	15.40									1.3	E2	1998.255		2MASS. M1 and M2 estimated from J- and K-band.

Table 1 continues on next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM	Source/Notes
	146.9297780	38.3366220	5.373	291.540	16.80	17.60									2.5	Es	2002.999		SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0).
	146.9300320	38.3360650	5.321	290.061			101.70	-285.00	12.00	102.70	-295.50	17.60			0.4	Hw	2010.331	AABA	WISE. J and K magnitudes not listed in WISE. PM data calculated from position comparison with 2MASS.
	146.9301661	38.3357169	5.337	291.238	14.95	15.62	103.00	-300.90	5.44	104.83	-300.87	5.42			0.2	Eu	2013.889	AAAA	URAT1. M1 and M2 from URAT1 f.mag values. PM data calculated from position comparison with 2MASS.
	146.9302127	38.3356303	5.377	291.513	15.33	16.00	102.27	-297.48	0.13	101.92	-297.57	0.24			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with SDSS DR9.
	146.9302127	38.3356303	5.377	291.513	15.33	16.00	103.82	-298.99	5.07	104.24	297.76	5.07			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS.
	146.9303333	38.3354778	5.317	290.246	16.71	17.53									0.61	C	2017.084		iT24 1x180s V-filter. SNR B <20
	146.9302917	38.3350583	5.422	289.276	13.69	14.37							>M4	>M4	0.61	C	2017.076		iT24 1x60s I-filter. Spc based on V-I color index
																			Notes: Neither of the components is identified in UCAC5.
NSN n+11	09 54 39.40	+24 27 54.07			19.00		-191.64	-26.29	49.23	-191.35	-26.86	50.02	>M4					ABCA	J0954+2427: Possible PM candidate,but limited ability to reach a conclusion because secondary not identified in 2MASS, URAT1, and GAIA DR1. POSSI and POSSII data promising, but certainly not conclusive.
	148.6695000	24.4658060	4.460	199.676											1.2	Pp	1955.216		POSS I.E estimates.
	148.6675000	24.4653330	4.366	200.118			-153.00	-40.00		-153.00	-37.00				1.2	Pp	1990.209		POSS II.J estimates. PM estimates based on comparison with POSS I.E.
	148.6677960	24.4652080	4.740	194.944	18.30										1.2	Pp	1990.737		GSC 2.3. M1 is GSC 2.3 Vmag, no Vmag or f.mag shown for secondary.
	148.6669950	24.4651080	4.828	197.089	18.98	20.54	-191.64	-26.29	49.23	-191.35	-26.86	50.02			2.5	Es	2004.957	ABCA	SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0). PM data calculated from position comparison with GSC 2.3.
	148.6664914	24.4650306			16.26		-193.60	-40.50							0.2	Eu	2013.714		URAT1. M1 is from URAT1 J and K values, PM data is directly from URAT1 data. Secondary not identified in URAT1.
	148.6664176	24.4650203			17.13										0.96	Hg	2015.000		GAIA DR1. M1 is from GAIA G-band. Secondary not identified in GAIA.
	148.6663417	24.4650333			19.00										0.61	C	2017.210		iT24 1x300s V-filter. SNR A <10. No resolution of B, has to be fainter than 19.5Vmag
	148.6663375	24.4649889			15.34								>M4		0.61	C	2017.210		iT24 1x300s I-filter. No resolution of B, has to be fainter than 18.9 Imag. Spc based on V-I color index
																			Notes: Secondary not identified in 2MASS and WISE, neither of the components is identified in UCAC5.

Table 1 continues on next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
KPP n+12	10 01 19.938	+36 27 22.67			18.23	18.32	93.20	-160.27	9.95	89.12	-161.94	9.95	M0-M2	K7-M1				AABB	J1001+3627: Good PM candidate. Measures consistent in showing a slight disparity in motion in RA.
	150.3307500	36.4590560	5.001	1.382											1.2	Pp	1955.194		POSS I.E estimates. Secondary overlapping nearby star making it hard to identify centroid, PM results open to question.
	150.3322700	36.4574670	5.164	1.510	18.09	18.48							K2	K2	1.2	Pp	1988.949		GSC 2.3. M1 and M2 are GSC 2.3 Vmag values. Spc1 and Spc2 are GSC 2.3 V-N values.
	150.3325360	36.4570430	5.411	0.858	17.70	17.80									1.3	E2	1998.272		2MASS. M1 and M2 estimated from J- and K-band.
	150.3324170	36.4571670	5.101	1.355			113.00	-159.00		113.00	-157.00				1.2	Pp	1998.326		POSS II.N estimates. PM estimates based on comparison with POSS I.E.
	150.3326860	36.4568130	5.375	0.370	18.50	18.80	85.20	-166.54	29.08	78.03	-151.51	29.08			2.5	Es	2003.086	ABCA	SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0). PM data calculated from position comparison with GSC 2.3.
	150.3330700	36.4563169	5.367	359.743	17.74	17.81	98.21	-166.03	10.57	91.58	-168.89	10.58			0.2	Eu	2014.012	AABB	URAT1. M1 and M2 from URAT1 J and K values. PM data calculated from position comparison with 2MASS.
	150.3330745	36.4562983	5.383	0.136	17.49	17.76	94.41	-155.53	2.35	92.57	-154.86	2.38			0.96	Hg	2015.000	ABAB	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with SDSS DR9.
	150.3330745	36.4562983	5.383	0.136	17.49	17.76	93.20	-160.27	9.95	89.12	-161.94	9.95			0.96	Hg	2015.000	AABB	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS.
	150.3329750	36.4562306	5.659	8.954	18.23	18.32									0.61	C	2017.081		iT24 1x60s V-filter. SNR A and B <20
	150.3330375	36.4561806	5.441	1.143	16.44	16.63							M0-M2	K7-M1	0.61	C	2017.081		iT24 1x60s I-filter. Spc based on V-I color index
																			Notes: Secondary not identified in WISE, neither of the components is identified in UCAC5.
NSN n+12	10 23 15.586	+54 40 06.51			15.86	17.73	-66.05	-77.45	7.25	-68.91	-74.85	7.25	>M4	>M4				AABA	J1023+5440: Solid CPM candidate.
	155.8164580	54.6698610	8.754	258.802											1.2	Pp	1955.075		POSS I.O estimates.
	155.8154170	54.6690280	8.821	259.549			-51.00	-70.00		-53.00	-68.00				1.2	Pp	1997.346		POSS II.J estimates. PM estimates based on comparison with POSS I.O.
	155.8155390	54.6687900	8.988	258.658	14.76	16.70									1.2	Pp	1998.299		GSC 2.3. M1 and M2 are GSC 2.3 f.mag values.
	155.8154140	54.6687970	8.833	258.051	14.50	15.90									1.3	E2	2000.073		2MASS. M1 and M2 estimated from J- and K-band
	155.8153250	54.6687720	8.863	258.306	15.90	17.90									2.5	Es	2001.967		SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0).
	155.8149406	54.6684758			14.63		-66.10	-77.50							0.2	Eu	2003.123		UCAC5 with GAIA coordinates. Secondary not identified in UCAC5. M1 is from UCAC5 Gmag value. PmRA1 and pmDec1 are from UCAC5 data.

Table 1 continues on next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
	155.8153175	54.6687317			15.56		-66.10	-77.50							0.2	Eu	2003.123		UCAC5 coordinates used here. Secondary not identified. M1 is UCAC5 f.mag value. PmRA1 and pmDec1 are from UCC5 data.
	155.8151230	54.6685940	8.765	259.612	14.50	15.90	-59.10	-71.30	10.70	-57.10	-47.10	19.80			0.4	Hw	2010.326	CCCB	WISE. M1 and M2 from WISE J and K magnitudes. PM data calculated from position comparison with 2MASS.
	155.8149631	54.6685119	8.873	258.317	15.77	15.90	-68.31	-74.68	7.87	-71.72	-72.31	7.87	K7		0.2	Eu	2013.820	AABA	URAT1. M1 is URAT1 Vmag, M2 is visual estimate from URAT1 J and K values; Spc1 is URAT1 B-V value. PM data calculated from position comparison with 2MASS.
	155.8149405	54.6684759	8.867	258.354	14.63	16.27	-61.43	-81.80	0.11	-61.83	-81.31	0.33			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with SDSS DR9.
	155.8149405	54.6684759	8.867	258.354	14.63	16.27	-66.05	-77.45	7.25	-68.91	-74.85	7.25			0.96	Hg	2015.000	AABA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS.
	155.8148083	54.6684806	8.915	259.335	15.86	17.73									0.61	C	2017.155		iT24 1x180s V-filter
	155.8148125	54.6684806	8.982	257.265	13.21	14.79							>M4	>M4	0.61	C	2017.081		iT24 1x60s I-filter. Spc based on V-I color index
KPP n+13	10 34 49.131	+01 58 40.54			14.71	14.78	125.03	-150.88	5.70	123.58	-151.00	5.70	M1-M3	M1-M3				AAAB	J1034+0158: Solid CPM Candidate.
	158.7021250	1.9807222	8.762	124.974											1.2	Pp	1952.079		POSS I.O estimates
	158.7038900	1.9788790	8.888	124.742	13.67	13.68									1.2	Pp	1991.050		GSC 2.3. M1 and M2 are GSC 2.3 f.mag values.
	158.7040417	1.9787222	8.640	125.361			161.00	-168.00		158.00	-168.00				1.2	Pp	1995.091		POSS II.J estimates. PM estimates based on comparison with POSS I.O.
	158.7041930	1.9785520	8.989	124.940	13.60	13.80									1.3	E2	2000.106		2MASS. M1 and M2 estimated from J- and K-band
	158.7041430	1.9785340	8.984	124.935	14.80	14.90	97.95	-133.65	51.76	104.53	-142.17	51.76			2.5	Es	2000.343	ABCB	SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0). PM data calculated from position comparison with GSC 2.3.
	158.7045610	1.9781410	8.812	124.927	13.60	13.80	128.60	-143.80	12.60	114.30	-134.30	11.50			0.4	Hw	2010.399	ABBB	WISE. M1 and M2 from WISE J and K magnitudes. PM data calculated from position comparison with 2MASS.
	158.7046803	1.9779633	9.000	125.068	14.18	13.79	125.68	-151.92	6.08	124.57	-152.41	6.04	>M4		0.2	Eu	2014.110	AAAB	URAT1. M1 is URAT1 Vmag, M2 is visual estimate based on URAT1 J and K magnitudes, Spc1 is URAT1 B-V value. PM data calculated from position comparison with 2MASS.
	158.7047106	1.9779278	8.972	125.028	13.70	13.75	139.32	-148.90	1.16	138.19	-149.26	1.30			0.96	Hg	2015.000	AAAC	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with SDSS DR9.
	158.7047106	1.9779278	8.972	125.028	13.70	13.75	125.03	-150.88	5.70	123.58	-151.00	5.70			0.96	Hg	2015.000	AAAB	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS.
	158.7048000	1.9778278	9.000	125.295	14.71	14.78									0.61	C	2017.305		iT24 1x60s V-filter
	158.7048250	1.9778694	8.986	125.669	12.59	12.65							M1-M3	M1-M3	0.61	C	2017.305		iT24 1x60s I-filter. Spc based on V-I color index
																			Notes: Neither of the components is identified in UCAC5.

Table 1 continues on next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
NSN n+13	11 11 09.689	+02 21 06.80			16.14	19.20	-150.62	-143.33	8.24	-151.51	-143.44	8.98	>M4	M2->M4				AAAA	J1111+0221: Solid CPM candidate. M2 estimated as being 0.1 magnitude fainter than faintest stars resolved in V-filter image.
	167.7924170	2.3548610	7.830	282.539											1.2	Pp	1955.285		POSS I.E estimates.
	167.7910000	2.3530000	7.901	284.663			-119.00	-157.00		-110.00	-150.00				1.2	Pp	1995.151		POSS II.F estimates. PM estimates based on comparison with POSS I.E.
	167.7911910	2.3526890	7.883	285.088	15.13	19.45									1.2	Pp	1995.154		GSC 2.3. M1 and M2 are GSC 2.3 f.mag values.
	167.7909820	2.3524660	8.036	283.973	14.20	17.20									1.3	E2	2000.234		2MASS. M1 and M2 estimated from J- and K-band.
	167.7903706	2.3518881			14.62		-154.90	-139.40							0.2	Eu	2000.262		UCAC5 with GAIA coordinates. M1 is UCAC5 Gmag value. Secondary not identified. PmRA1 and pmDec1 are from UCAC5 data.
	167.7910053	2.3524589			14.21		-154.90	-139.40							0.2	Eu	2000.262		UCAC5 coordinates used here. M1 is from J and K values. Secondary not identified. PmRA1 and pmDec1 are from UCAC5 data.
	167.7909700	2.3524270	8.119	284.534	16.20	20.90									2.5	Es	2000.979		SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0).
	167.7905740	2.3520690	8.003	282.153	14.20	17.20	-144.10	-140.30	70.80	-146.50	-165.40	45.80			0.4	Hw	2010.423	BBCA	WISE. M1 and M2 from WISE J and K magnitudes. PM data calculated from position comparison with 2MASS.
	167.7904069	2.3519192	8.011	284.352	16.21	17.16	-155.93	-140.74	1.80	-152.18	-148.47	5.11	K7		0.2	Eu	2013.805	BAAA	URAT1. M1 is URAT1 Vmag, M2 is visual estimate from URAT1 J and K magnitudes; Spc1 is URAT1 B-V value. PM data calculated from position comparison with SDSS DR9.
	167.7904069	2.3519192	8.011	284.352	16.21	17.16	-150.62	-143.33	8.24	-151.51	-143.44	8.98	K7		0.2	Eu	2013.805	AAAA	URAT1. M1 is URAT1 Vmag, M2 is visual estimate from URAT1 J and K magnitudes; Spc1 is URAT1 B-V value. PM data calculated from position comparison with 2MASS.
	167.7902042	2.3518306			16.14										0.61	C	2017.324		iT24 1x300s V-filter. No resolution of B, has to be fainter than 19.1Vmag
	167.7902958	2.3517139	7.075	287.182	13.41	16.87							>M4	M2->M4	0.61	C	2017.324		iT24 1x300s I-filter. Touching star disks. Spc based on V-I color index with Vmag2 assumed 19.2
																			Notes: Secondary not identified in GAIA DR1.
KPP n+14	11 39 58.062	+34 54 21.18			15.15	17.23	176.72	-141.90	9.13	178.10	-143.32	9.13	>M4	>M4				AAAB	J1139+3454: Solid CPM candidate.
	174.9885420	34.9083890	8.275	101.149											1.2	Pp	1950.365		POSS I.E estimates.
	174.9905420	34.9072220	7.773	101.127			138.00	-98.00		127.00	-96.00				1.2	Pp	1998.326		POSS II.N estimates. PM estimates based on comparison with POSS I.E.
	174.9911550	34.9064770	8.120	99.467	14.73	16.91									1.2	Pp	1999.346		GSC 2.3. M1 and M2 are GSC 2.3 Vmag values.
	174.9910420	34.9064640	8.247	100.360	13.60	15.30									1.3	E2	2000.262		2MASS. M1 and M2 estimated from J- and K-band.

Table 1 continues on next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
	174.9919242	34.9058831			13.87		160.50	-143.20							0.2	Eu	2002.071		UCAC5 with GAIA coordinates. M1 is UCAC5 Gmag value. Secondary not identified. PmRA1 and pmDec1 are from UCAC5 data.
	174.9912211	34.9063975			13.57		160.50	-143.20							0.2	Eu	2002.071		UCAC5 coordinates used here. M1 is from J and K values. Secondary not identified. PmRA1 and pmDec1 are from UCAC5 data.
	174.9913410	34.9063250	8.257	100.500	15.20	17.30									2.5	Es	2004.283		SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0).
	174.9917660	34.9061210	8.079	101.125	13.60	15.30	210.80	-121.80	10.40	192.50	-129.30	20.80			0.4	Hw	2010.401	BABB	WISE. M1 and M2 from WISE J and K magnitudes. PM data calculated from position comparison with 2MASS.
	174.9918436	34.9059411	8.250	100.350	13.57	15.32	174.92	-139.14	9.94	176.11	-139.85	10.00			0.2	Eu	2013.753	AAAB	URAT1. M1 and M2 estimated from URAT1 J and K values. PM data calculated from position comparison with 2MASS.
	174.9919242	34.9058831	8.271	100.478	13.87	15.76	160.65	-148.45	0.13	162.00	-148.39	0.27			0.96	Hg	2015.000	AAAB	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with SDSS DR9.
	174.9919242	34.9058831	8.271	100.478	13.87	15.76	176.72	-141.90	9.13	178.10	-143.32	9.13			0.96	Hg	2015.000	AAAB	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS.
	174.9920875	34.9057806	8.135	100.124	15.15	17.23									0.61	C	2017.305		iT24 1x60s V-filter
	174.9920333	34.9058111	8.284	100.573	12.08	13.89							>M4	>M4	0.61	C	2017.305		iT24 1x60s I-filter. Spc based on V-I color index
NSN n+14	11 50 38.865	+31 42 23.61			11.90	15.54	-230.13	-12.00	10.13	-230.10	-7.95	10.13	K0-K4	K3-K5				AAAA	J1150+3142: Solid CPM candidate.
	177.6667080	31.7068610	4.577	257.380											1.2	Pp	1955.274		POSS I.E estimates.
	177.6632020	31.7066140	4.611	250.243	13.30										1.3	E2	1998.187		2MASS. M1 estimated from J- and K-band, M2 J and K data appears to be unreliable since it results in a visual equivalent magnitude of 7.136.
	177.6630420	31.7068060	4.624	249.758			-263.00	-5.00		-260.00	-19.00				1.2	Pp	1998.209		POSS II.N estimates. PM estimates based on comparison with POSS I.E.
	177.6619386	31.7065581			12.68		-235.30	-26.50							0.2	Eu	2001.441		UCAC5 with GAIA coordinates. M1 is UCAC5 Gmag value. Secondary not identified. PmRA1 and pmDec1 are from UCAC5 data.
	177.6629806	31.7066578			13.32		-235.30	-26.50							0.2	Eu	2001.441		UCAC5 coordinates used here. M1 is from J and K values. Secondary not identified. PmRA1 and pmDec1 are from UCAC5 data.
	177.6627520	31.7066320	4.580	250.533	14.10	18.70									2.5	Es	2004.316		SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0).
	177.6619387	31.7065579	4.588	251.041	12.68	16.53	-233.14	-24.95	7.81	-235.09	-21.61	7.81			0.96	Hg	2015.000	BBAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with SDSS DR9.
	177.6619387	31.7065579	4.588	251.041	12.68	16.53	-230.13	-12.00	10.13	-230.10	-7.95	10.13			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS.

Table 1 continues on next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
	177.6616792	31.7067611	4.976	256.401	11.90	15.54									0.61	C	2017.330		iT24 1x300s V-filter. Heavily overlapping star disks. SNR B <10
	177.6617000	31.7067389	4.969	256.737	11.02	14.41							K0-K4	K3-K5	0.61	C	2017.330		iT24 1x300s I-filter. Overlapping star disks. SNR B <20. Spc based on V-I color index
																			Notes: Secondary not identified in GSC 2.3 and WISE, M1 J and K data in WISE appears to be unreliable since it results in a visual equivalent magnitude of 7.136. Only one object identified in URAT1, which doesn't appear to be either component based on URAT1 PM data.
KPP n+15	12 07 03.579	+00 12 51.35			15.36	20.88	-172.32	25.40	6.73	-170.31	19.83	6.73	M2-M4	>M4				AAAA	J1207+0012: Solid CPM candidate.
	181.7677080	0.2137500	6.958	187.431											1.2	Pp	1955.296		POSS I.E estimates.
	181.7657500	0.2142220	7.031	191.070			-165.00	40.00		-175.00	40.00				1.2	Pp	1996.287		POSS II.F estimates. PM estimates based on comparison with POSS I.E.
	181.7658970	0.2140850	7.093	192.456	14.35	18.67									1.2	Pp	1996.290		GSC 2.3. M1 and M2 are GSC 2.3 f.mag values.
	181.7657090	0.2141180	7.358	193.064	15.40	20.30									2.5	Es	1999.221		SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0).
	181.7656240	0.2141590	7.302	193.543	14.20	17.40									1.3	E2	2000.134		2MASS. M1 and M2 estimated from J- and K-band.
	181.7649125	0.2142639			14.19		-184.20	35.30							0.2	Eu	2000.392		UCAC5 with GAIA coordinates. M1 is UCAC5 Gmag value. Secondary not identified. PmRA1 and pmDec1 are from UCAC5 data.
	181.7656597	0.2141208			14.18		-184.20	35.30							0.2	Eu	2000.392		UCAC5 coordinates used here. M1 is from J and K values. Secondary not identified. PmRA1 and pmDec1 are from UCAC5 data.
	181.7649672	0.2142397	7.347	193.186	15.31	17.38	-173.93	21.37	7.36	-173.19	17.60	7.43			0.2	Eu	2013.659	AAAA	URAT1. M1 is URAT1 Vmag, M2 estimated from URAT1 J and K values. PM data calculated from position comparison with 2MASS.
	181.7649124	0.2142639	7.376	193.167	14.19	18.03	-181.74	33.28	0.17	-182.81	32.37	3.66			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with SDSS DR9.
	181.7649124	0.2142639	7.376	193.167	14.19	18.03	-172.32	25.40	6.73	-170.31	19.83	6.73			0.96	Hg	2015.000	AAAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS.
	181.7647208	0.2143444	7.077	194.861	15.36	20.88									0.61	C	2017.330		iT24 1x300s V-filter. Barely resolved, SNR B <5
	181.7646417	0.2144056	7.532	188.474	13.15	16.90							M2-M4	>M4	0.61	C	2017.330		iT24 1x300s I-filter. SNR B <20. Spc based on V-I color index
																			Notes: Secondary not identified in WISE.

Table 1 concludes on next page.

Table 1 (conclusion). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on the most precise J2000 coordinates currently available for A (in most cases from the GAIA DR1 catalog)

Name	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
NSN n+15	12 45 22.960	+01 01 04.58			13.15	16.76	-199.25	-20.02	10.19	-189.78	-16.12	10.19	K5-K7	M3->M4				AABA	J1245+0101: Solid CPM candidate.
	191.3487920	1.0182500	5.636	334.802											1.2	Pp	1956.202		POSS I.O estimates.
	191.3462920	1.0182780	5.456	333.908			-211.00	2.00		-211.00	-2.00				1.2	Pp	1996.235		POSS II.N estimates. PM estimates based on comparison with POSS I.O.
	191.3464040	1.0180160	5.650	330.956	13.10	15.40									1.3	E2	2001.048		2MASS. M1 and M2 estimated from J- and K-band.
	191.3461310	1.0179660	5.711	330.967	13.30	16.90									2.5	Es	2006.331		SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0).
	191.3457369	1.0179475	5.663	331.449	13.14	15.42	-190.81	-19.60	11.29	-189.55	-16.97	11.39	K4-K5		0.2	Eu	2013.578	AABA	URAT1. M1 is URAT1 Vmag, M2 estimated from URAT1 J and K values. Spc1 is URAT1 B-V value (midway between K4 and K5). PM data calculated from position comparison with 2MASS.
	191.3456666	1.0179384	5.694	331.279	12.64	15.56	-192.83	-11.45	11.43	-188.76	-11.41	11.68			0.96	Hg	2015.000	ACBA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with SDSS DR9.
	191.3456666	1.0179384	5.694	331.279	12.64	15.56	-199.25	-20.02	10.19	-189.78	-16.12	10.19			0.96	Hg	2015.000	AABA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS.
	191.3455083	1.0179639	5.134	333.638	13.15	16.76									0.61	C	2017.305		iT24 1x60s V-filter. SNR B <10
	191.3455500	1.0179222	5.845	332.825	11.79	14.33							K5-K7	M3->M4	0.61	C	2017.305		iT24 1x60s I-filter. Spc based on V-I color index
																			Notes: Secondary not identified in GSC 2.3 and WISE, neither of the components is identified in UCAC5.

CPM Pairs from LSPM so Far Not WDS Listed – Part IV

(Continued from page 368)
search and measurements for these in a separate paper.

References:

Buchheim, R., 2008, "CCD Double-Star Measurements at Altimira Observatory in 2007", *Journal of Double Star Observations*, **4**(1), 28: Formulas for calculating Separation and Position Angle from the RA/ Dec coordinates

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Knapp W. and Nanson J., 2017, "CPM pairs from LSPM so far not WDS listed – Part III", JDSO, **13** (4), 538-552.

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- Washington Double Star catalog
- 2MASS All Sky catalog
- iTelescope: Images were taken with iT24: 610mm CDK with 3962mm focal length. CCD: FLI-PL09000. Resolution 0.62 arcsec/pixel. V-filter. Located in Auberry. California. Elevation 1405m
- AAVSO APASS
- GAIA DR1 catalog
- UCAC4 catalog
- URAT1 catalog
- WISE catalog
- SDSS catalog
- IGSL catalog
- LSPM catalog
- Aladin Sky Atlas v9.0
- SIMBAD, VizieR
- AstroPlanner V2.2
- NASA/ IPAC Infrared Science Archive
- Astrometrica 4.10.1.432

Appendix A

Description of the CPM assessment scheme according to Knapp/Nanson 2017 with extensions

Four rating factors are used: Proper motion vector direction, proper motion vector length, size of position error in relation to proper motion vector length and relationship of proper motion speed to angular separation:

- Proper motion vector direction ratings: "A" for within the error range of identical direction, "B" for similar direction within the double error range, and "C" for outside
- Proper motion vector length ratings: "A" for within the error range of identical length, "B" for similar length within the double error range, and C for outside
- Error size ratings: "A" for error size of less than 5% of the proper motion vector length, "B" for less than 10%, and "C" for a larger error size
- Relationship PM speed to angular separation: "A" for less than 100 years, "B" for less than 1000 years and "C" for above

To compensate for excessively large position errors resulting in an "A" rating despite rather high deviations an absolute upper limit is applied regardless of calculated error size:

- Proper motion vector direction: Max. 2.86° difference for an "A" and 5.72° for a "B"
- Proper motion vector length: Max. 5% difference for an "A" and 10% for a "B"

In some cases we could use SDSS DR9 coordinates instead of 2MASS with much smaller position errors with the consequence that the requirements to get an A or even B CPM rating were unreasonably hard so we had to modify our process somewhat:

- The position error resulting from the error estimation for proper motion vector direction and length is in this case calculated as root mean square from both position errors (instead of for only the larger 2MASS one)
- If the PM vector direction difference is larger than this calculated "allowed" error but still less than 0.5° then an "A" is given, a "B" is given for larger than 0.5 but less than 1 degree, and a "C" is given if above
- If the PM vector length difference is larger than this calculated "allowed" error but still less than 0.5% then an "A" is given, a "B" is given for larger than 0.5 but less than 1 percent, and a "C" is given if above.

Appendix B

The following Table 2 gives the plate solving errors for the used iT24 images and error information derived therefrom for the measurements provided in Table 1 and also the measured positions for both components:

Table 2. Error estimations for the in table 1 provided measurements for the given objects:
dRA and dDec = average RA and Dec plate solving errors in arcseconds
Err_Sep = separation error estimation in arcseconds calculated as SQRT(dRA^2+dDec^2)
Err_PA = position angle error estimation in degrees calculated as arctan (Err_Sep/Sep) assuming the worst case that Err_Sep points perpendicular to the separation vector
dmag as average mag plate solving error (Vmag for images with made V-filter and Imag for images made with I-filter)
*Err_Mag = magnitude error estimation calculated as SQRT(dVmag^2+(2.5*LOG10(1+1/SNR))^2)*
SNR as signal to noise ratio for the given object

Name		RA	Dec	dRA	dDec	Err Sep	Err PA	Err Mag	SNR	dmag	Date	Notes
J0544+2120	A	05 44 41.215	21 20 51.62	0.080	0.090	0.120	1.138	0.052	76.45	0.050	2017.081	iT24 1x60s V-filter. SNR B <20
	B	05 44 40.893	21 20 47.56					0.112	10.33			
	A	05 44 41.219	21 20 51.56	0.090	0.080	0.120	1.240	0.120	111.16	0.120	2017.081	iT24 1x60s I-filter. Spc based on V-I color index
	B	05 44 40.943	21 20 47.55					0.124	36.62			
J0611+3325	A	06 11 56.172	33 25 43.09	0.130	0.110	-	-	0.101	80.28	0.100	2017.209	iT24 1x300s V-filter. No resolution of B, has to be fainter than 18.5Vmag
	B	-	-					-	-			
	A	06 11 56.185	33 25 43.37	0.110	0.120	0.163	0.758	0.121	98.38	0.120	2017.076	iT24 1x60s I-filter. SNR B <20. Spc based on V-I color index
	B	06 11 56.018	33 25 31.24					0.129	22.43			
J0612+3721	A	06 12 20.416	37 21 06.94	0.120	0.120	0.170	3.361	0.092	58.74	0.090	2017.209	iT24 1x300s V-filter. Heavily overlapping star disks
	B	06 12 20.415	37 21 04.05					0.101	22.94			
	A	06 12 20.444	37 21 06.91	0.110	0.120	0.163	3.006	0.121	86.34	0.120	2017.327	iT24 2x300s I-filter. Touching/ overlapping star disks
	B	06 12 20.447	37 21 03.81					0.121	62.23			
J0638+2255	A	06 38 52.424	22 55 10.67	0.100	0.120	0.156	1.907	0.051	134.58	0.050	2017.209	iT24 1x300s V-filter. Heavily overlapping star disks. SNR B <20
	B	06 38 52.448	22 55 05.99					0.090	14.06			
	A	06 38 52.436	22 55 10.71	0.110	0.110	0.156	1.827	0.111	91.46	0.110	2017.084	iT24 1x180s I-filter. SNR B <20. Heavily overlapping star disks. Spc based on V-I color index
	B	06 38 52.453	22 55 05.84					0.133	14.19			
J0644+2855	A	06 44 39.093	28 55 26.18	0.120	0.120	0.170	1.739	0.061	90.07	0.060	2017.076	iT24 1x60s V-filter
	B	06 44 38.729	28 55 23.28					0.079	20.41			
	A	06 44 39.095	28 55 26.38	0.120	0.110	0.163	1.609	0.121	95.44	0.120	2017.076	iT24 1x60s I-filter. Spc based on V-I color index
	B	06 44 38.730	28 55 23.12					0.125	29.84			
J0646+5214	A	06 46 00.821	52 14 11.26	0.120	0.110	0.163	4.046	0.112	55.65	0.110	2017.209	iT24 1x300s V-filter. Overlapping star disks
	B	06 46 00.812	52 14 13.56					0.112	47.20			
	A	06 46 00.816	52 14 10.88	0.130	0.110	0.170	4.091	0.142	45.61	0.140	2017.209	iT24 1x300s I-filter. Overlapping star disks. Spc based on V-I color index
	B	06 46 00.808	52 14 13.26					0.142	44.37			
J0654+1708	A	06 54 37.540	17 08 03.09	0.110	0.120	0.163	2.474	0.073	50.54	0.070	2017.084	iT24 1x180s V-filter. Touching star disks
	B	06 54 37.572	17 08 06.83					0.084	22.77			
	A	06 54 37.536	17 08 03.27	0.130	0.120	0.177	3.038	0.142	47.80	0.140	2017.076	iT24 1x60s I-filter. Touching star disks. Spc based on V-I color index
	B	06 54 37.569	17 08 06.57					0.145	28.37			

Table 2 continues on next page.

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Table 2 (continued). Error estimations for the in table 1 provided measurements for the given objects

Name		RA	Dec	dRA	dDec	Err Sep	Err PA	Err Mag	SNR	dmag	Date	Notes
J0659+5631	A	06 59 03.298	56 31 00.32	0.070	0.080	0.106	0.727	0.051	103.84	0.050	2017.209	iT24 1x300s V-filter. SNR B <20
	B	06 59 04.306	56 31 01.12					0.077	17.94			
	A	06 59 03.286	56 31 00.34	0.130	0.110	0.170	1.121	0.112	55.91	0.110	2017.076	iT24 1x60s I-filter. SNR B <20. Spc based on V-I color index
	B	06 59 04.333	56 31 01.16					0.141	11.83			
J0705+3400	A	07 05 26.916	34 00 15.80	0.110	0.090	0.142	1.128	0.051	146.52	0.050	2017.084	iT24 1x180s V-filter. SNR B <20
	B	07 05 27.204	34 00 09.53					0.082	16.27			
	A	07 05 26.905	34 00 15.67	0.100	0.110	0.149	1.335	0.120	184.16	0.120	2017.209	iT24 1x300s I-filter. Touching star disks. SNR B <10. Spc based on V-I color index
	B	07 05 27.149	34 00 10.06					0.256	4.33			
J0721+2555	A	07 21 43.377	25 54 58.82	0.120	0.120	0.170	2.034	0.081	92.85	0.080	2017.084	iT24 1x180s V-filter. Heavily overlapping star disks
	B	07 21 43.731	25 54 58.95					0.088	29.09			
	A	07 21 43.370	25 54 58.89	0.110	0.100	0.149	2.002	0.101	84.89	0.100	2017.076	iT24 1x60s I-filter. Heavily overlapping star disks. Spc based on V-I color index
	B	07 21 43.685	25 54 59.04					0.105	34.76			
J0723+2536	A	07 23 19.999	25 36 09.38	0.120	0.110	0.163	1.800	0.092	61.61	0.090	2017.209	iT24 1x300s V-filter. SNR B <20
	B	07 23 20.223	25 36 13.58					0.134	10.47			
	A	07 23 20.022	25 36 09.66	0.120	0.110	0.163	1.800	0.116	29.57	0.110	2017.076	iT24 1x60s I-filter. SNR B <20. Spc based on V-I color index
	B	07 23 20.252	25 36 13.80					0.134	13.66			
J0730+2716	A	07 30 22.918	27 16 06.68	0.100	0.110	0.149	1.587	0.120	109.56	0.120	2017.075	iT24 1x60s V-filter. SNR B <10. Heavily overlapping star disks
	B	07 30 22.825	27 16 11.90					0.176	7.91			
	A	07 30 22.909	27 16 06.60	0.090	0.080	0.120	1.202	0.120	111.77	0.120	2017.075	iT24 1x60s I-filter. SNR B <10. Heavily overlapping star disks. Spc based on V-I color index
	B	07 30 22.765	27 16 12.01					0.163	9.30			
J0734+2315	A	07 34 25.757	23 15 29.88	0.110	0.100	0.149	1.556	0.058	37.33	0.050	2017.076	iT24 1x60s V-filter. SNR B <10. Identification of B a bit difficult due to a fore- or background star involved
	B	07 34 25.997	23 15 34.24					0.123	9.14			
	A	07 34 25.749	23 15 29.94	0.110	0.110	0.156	1.803	0.121	82.86	0.120	2017.076	iT24 1x60s I-filter. Touching star disks with B obviously optical double. SNR B <20. Spc based on V-I color index
	B	07 34 25.972	23 15 33.81					0.147	12.38			
J0735+4814	A	07 35 26.959	48 14 32.79	0.110	0.110	0.156	0.822	0.050	160.95	0.050	2017.075	iT24 1x60s V-filter
	B	07 35 26.625	48 14 43.11					0.068	23.11			
	A	07 35 26.968	48 14 32.83	0.110	0.110	0.156	0.878	0.130	116.94	0.130	2017.076	iT24 1x60s I-filter. SNR B <20. Spc based on V-I color index
	B	07 35 26.686	48 14 42.58					0.164	10.45			
J0748+3712	A	07 48 35.888	37 12 08.93	0.050	0.060	-	-	0.040	354.40	0.040	2017.209	iT24 1x300s V-filter. No resolution of B
	B	-	-					-	-			
	A	07 48 35.879	37 12 08.88	0.060	0.070	-	-	0.140	307.49	0.140	2017.209	iT24 1x300s I-filter. No resolution of B. Spc based on V-I color index
	B	-	-					-	-			
J0751+4006	A	07 51 01.807	40 06 05.99	0.080	0.110	0.136	1.031	0.043	69.54	0.040	2017.209	iT24 1x300s V-filter
	B	07 51 01.733	40 05 58.48					0.065	20.49			
	A	07 51 01.813	40 06 06.50	0.120	0.110	0.163	1.266	0.132	47.14	0.130	2017.075	iT24 1x60s I-filter. SNR B <20. Spc based on V-I color index
	B	07 51 01.742	40 05 59.18					0.152	13.16			
J0754+1305	A	07 54 04.627	13 05 53.75	0.120	0.110	0.163	0.825	0.074	24.54	0.060	2017.076	iT24 1x60s V-filter. Star disk A overlaps with background star
	B	07 54 04.129	13 05 45.09					0.066	39.55			
	A	07 54 04.715	13 05 52.79	0.120	0.110	0.163	0.795	0.127	25.12	0.120	2017.076	iT24 1x60s I-filter. Star disk A overlaps with background star. Spc based on V-I color index
	B	07 54 04.126	13 05 44.82					0.121	75.13			
J0858+5227	A	08 58 09.974	52 27 14.26	0.100	0.110	0.149	1.522	0.070	21.49	0.050	2017.084	iT24 1x180s V-filter
	B	08 58 09.377	52 27 15.50					0.067	24.24			
	A	08 58 10.025	52 27 14.31	0.120	0.110	0.163	1.628	0.104	39.32	0.100	2017.076	iT24 1x60s I-filter. Spc based on V-I color index
	B	08 58 09.410	52 27 15.41					0.112	20.97			
J0914+1806	A	09 14 44.504	18 06 15.19	0.070	0.080	-	-	0.061	107.01	0.060	2017.210	iT24 1x300s V-filter. No resolution of B, has to be fainter than 19.1Vmag
	B	-	-					-	-			
	A	09 14 44.512	18 06 15.36	0.060	0.090	0.108	0.566	0.100	197.22	0.100	2017.210	iT24 1x300s I-filter. Spc based on V-I color index. Vmag2 estimated 19.2
	B	09 14 45.221	18 06 11.17					0.109	24.36			

Table 2 concludes on next page.

CPM Pairs from LSPM so Far Not WDS Listed – Part IV

Table 2 (conclusion) Error estimations for the in table 1 provided measurements for the given objects

Name		RA	Dec	dRA	dDec	Err Sep	Err PA	Err Mag	SNR	dmag	Date	Notes
J0925+2102	A	09 25 27.680	21 02 30.85	0.060	0.120	-	-	0.031	164.66	0.030	2017.209	iT24 1x300s V-filter. No resolution of B, has to be fainter than 19.5Vmag
	B	-	-					-	-			
	A	09 25 27.680	21 02 31.03	0.070	0.080	0.106	0.352	0.120	240.45	0.120	2017.209	iT24 1x300s I-filter. Spc based on V-I color index. Vmag2 estimated 19.6
	B	09 25 27.989	21 02 47.79					0.124	32.64			
J0947+3820	A	09 47 43.280	38 20 07.72	0.110	0.110	0.156	1.676	0.069	22.41	0.050	2017.084	iT24 1x180s V-filter. SNR B <20
	B	09 47 42.856	38 20 09.56					0.109	10.77			
	A	09 47 43.270	38 20 06.21	0.040	0.010	0.041	0.436	0.131	69.60	0.130	2017.076	iT24 1x60s I-filter. Spc based on V-I color index
	B	09 47 42.835	38 20 08.00					0.132	42.50			
J0954+2427	A	09 54 39.922	24 27 54.12	0.070	0.090	-	-	0.061	20.05	0.030	2017.210	iT24 1x300s V-filter. SNR A <10. No resolution of B, has to be fainter than 19.5Vmag
	B	-	-					-	-			
	A	09 54 39.921	24 27 53.96	0.080	0.090	-	-	0.131	57.69	0.130	2017.210	iT24 1x300s I-filter. No resolution of B, has to be fainter than 18.9 Imag. Spc based on V-I color index
	B	-	-					-	-			
J1001+3627	A	10 01 19.914	36 27 22.43	0.070	0.060	0.092	0.933	0.089	14.17	0.050	2017.081	iT24 1x60s V-filter. SNR A and B <20
	B	10 01 19.987	36 27 28.02					0.093	13.33			
	A	10 01 19.929	36 27 22.25	0.080	0.060	0.100	1.053	0.148	21.73	0.140	2017.081	iT24 1x60s I-filter. Spc based on V-I color index
	B	10 01 19.938	36 27 27.69					0.154	16.43			
J1023+5440	A	10 23 15.554	54 40 06.53	0.080	0.100	0.128	0.823	0.042	92.13	0.040	2017.155	iT24 1x180s V-filter
	B	10 23 14.544	54 40 04.88					0.051	34.32			
	A	10 23 15.555	54 40 06.53	0.110	0.110	0.156	0.992	0.112	55.67	0.110	2017.081	iT24 1x60s I-filter. Spc based on V-I color index
	B	10 23 14.545	54 40 04.55					0.117	26.57			
J1034+0158	A	10 34 49.152	01 58 40.18	0.070	0.080	0.106	0.677	0.062	69.36	0.060	2017.305	iT24 1x60s V-filter
	B	10 34 49.642	01 58 34.98					0.062	73.92			
	A	10 34 49.158	01 58 40.33	0.090	0.110	0.142	0.906	0.130	126.17	0.130	2017.305	iT24 1x60s I-filter. Spc based on V-I color index
	B	10 34 49.645	01 58 35.09					0.130	139.16			
J1111+0221	A	11 11 09.649	02 21 06.59	0.120	0.120	-	-	0.046	47.22	0.040	2017.324	iT24 1x300s V-filter. No resolution of B, has to be fainter than 19.1Vmag
	B	-	-					-	-			
	A	11 11 09.671	02 21 06.17	0.120	0.120	0.170	1.374	0.131	56.67	0.130	2017.324	iT24 1x300s I-filter. Touching star disks. Spc based on V-I color index with Vmag2 assumed 19.2
	B	11 11 09.220	02 21 08.26					0.175	8.81			
J1139+3454	A	11 39 58.101	34 54 20.81	0.090	0.080	0.120	0.848	0.061	85.55	0.060	2017.305	iT24 1x60s V-filter
	B	11 39 58.752	34 54 19.38					0.073	25.84			
	A	11 39 58.088	34 54 20.92	0.080	0.090	0.120	0.833	0.120	165.32	0.120	2017.305	iT24 1x60s I-filter. Spc based on V-I color index
	B	11 39 58.750	34 54 19.40					0.121	75.03			
J1150+3142	A	11 50 38.803	31 42 24.34	0.120	0.120	0.170	1.953	0.130	157.75	0.130	2017.330	iT24 1x300s V-filter. Heavily overlapping star disks. SNR B <10
	B	11 50 38.424	31 42 23.17					0.231	5.21			
	A	11 50 38.808	31 42 24.26	0.110	0.090	0.142	1.638	0.140	106.20	0.140	2017.330	iT24 1x300s I-filter. Overlapping star disks. SNR B <20. Spc based on V-I color index
	B	11 50 38.429	31 42 23.12					0.170	10.69			
J1207+0012	A	12 07 03.533	00 12 51.64	0.120	0.090	0.150	1.214	0.100	123.07	0.100	2017.330	iT24 1x300s V-filter. Barely resolved, SNR B <5
	B	12 07 03.412	00 12 44.80					0.472	1.89			
	A	12 07 03.514	00 12 51.86	0.120	0.100	0.156	1.188	0.150	102.27	0.150	2017.330	iT24 1x300s I-filter. SNR B <20. Spc based on V-I color index
	B	12 07 03.440	00 12 44.41					0.162	17.38			
J1245+0101	A	12 45 22.922	01 01 04.67	0.100	0.100	0.141	1.578	0.061	120.61	0.060	2017.305	iT24 1x60s V-filter. SNR B <10
	B	12 45 22.770	01 01 09.27					0.121	9.88			
	A	12 45 22.932	01 01 04.52	0.080	0.090	0.120	1.180	0.130	194.45	0.130	2017.305	iT24 1x60s I-filter. Spc based on V-I color index
	B	12 45 22.754	01 01 09.72					0.131	59.25			