CPM pairs from LSPM so far not WDS listed – Part III

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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 which as of the end of 2016 are not listed in the WDS catalog. After our first two reports on in total about 70 such objects (Knapp and Nanson 2017) the next paper with about 25 additional potential common proper motion pairs is presented here.

Introduction

Similar to our first two 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.

During the work on this report, we found WDS catalog object UC 752 near one of the selected LSPM objects and included this object in our project for a counter-check.

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:

- Three rating factors are used: Proper motion vector direction, proper motion vector length, and size of position error in relation to proper motion vector length
- 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

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.

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. In case of components fainter than SDSS 15 mag 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 were 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 Ic-mags to be able to estimate the spectral class range of the components based on our own image material, again using the above mentioned table.

The image processing followed our usual procedure: 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 also first plate solved with URAT1 as reference catalog for the astrometry results and then again plate solved 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 2016 with our own new images.

Results of Our Research

In Table 1 below 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:

- LSPM gives the LSPM ID of the selected object 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

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

  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 cat-

alogs 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 and Me indicates the WDS code for the used observation method (for GAIA calculated equivalent circular surface diameter)
- Date is the Bessel 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 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 24 objects checked for CPM
- 15 objects received a triple AAA or a AAB rating based on position comparison, in most cases between 2MASS and GAIA DR1 (according to the method presented in Knapp/Nanson 2017), which means a solid CPM candidate
- A surprising large number 6 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
- 2 objects including counter-checked UC 752 got a CCC rating meaning most certainly not CPM
- 1 object remained as suspect due to missing evidence for the secondary – bogus assumed.

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

Acknowledgements

The following tools and resources have been used for this research:
- 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

Special thanks to Brian Skiff for his instruction how and when to use SDSS g- and r-mag values for estimating Vmag.

Special thanks to Herbert Raab/Astrometrica for adding the feature of I-band photometry to the current beta version of his software.

Special thanks also to Brian Mason for his advice regarding spectral ranges reflecting the V-I color index error range.

References

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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)

LSPM	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J0117 +1942	01 17 56.552	+19 42 48.341			16.29	17.82	19.21	-271.36	11.21	23.49	-273.27	11.21	>M4	>M4				AAA	Solid CPM candidate
	19.485042	19.718194	3.109	114.718											1.2	Pp	1954.759		POSSI.O
	19.485333	19.715528	3.296	109.499			24.00	-229.00		30.00	224.00				1.2	Pp	1987.649		POSSII.J. PM estimates based on comparison with POSSI.O
	19.485800	19.715115			15.17										1.2	Pp	1990.716		GSC 2.3. M1 is GSC 2.3 Vmag; secondary not identified
	19.485546	19.714571	3.930	117.673	14.90	15.60									1.3	E2	1999.833		2MASS. M1 and M2 are from 2MASS J and K magnitudes
	19.485546	19.714195	3.979	118.066	16.40	17.80									2.5	Es	2004.707		SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0)
	19.485626	19.713558	3.749	118.324	14.74	14.79	20.30	-274.37	12.79	6.68	-268.83	12.70			0.2	Eu	2013.172	AAA	URAT1. M1 and M2 are URAT1 f.mags. PM data calculated from position comparison with 2MASS
	19.485632	19.713428	4.001	117.608	15.18	16.25	28.31	-268.35	0.28	31.64	-266.61	0.28			0.96	Hg	2015.000	BBA	GAIA DR1. M1 and M2 are GAIA Gmags. PM position calculated from comparison with SDSS DR9
	19.485632	19.713428	4.001	117.608	15.18	16.25	19.21	-271.36	11.21	23.49	-273.27	11.21			0.96	Hg	2015.000	AAA	GAIA DR1.M1 and M2 are GAIA Gmags. PM position calculated from comparison with 2MASS
	19.485654	19.713283	3.861	118.629	16.29	17.82									0.61	C	2016.817		iT24 0.61m 1x60s V-filter. SNR B <20
	19.485633	19.713111	4.031	117.158	13.69	14.70							>M4	>M4	0.61	C	2016.817		iT24 0.61m 1x60s I-filter. Spc based on V-I color index
																			Notes: Neither component identified in WISE
J0131 +2009	01 31 05.798	+20 09 19.289			15.43	16.71	272.21	3.80	10.86	275.29	10.88	23.69	>M4	F5-K1				AAB	Reasonably solid CPM candidate. Vector length error of secondary in middle of B range (between .05 and .10%) in 2MASS/GAIA comparison
	22.769042	20.155417	5.957	327.067											1.2	Pp	1954.759		POSSI.O
	22.772025	20.155627	5.203	321.800	14.15										1.2	Pp	1989.185		GSC2.3. M1 is GSC2.3 Vmag. Epoch shown is the average for the primary (1990.716) and secondary (1987.653)
	22.771917	20.155722	5.565	329.599			232.00	26.00		242.00	21.00				1.2	Pp	1990.713		POSSII.F. PM estimates based on comparison with POSSI.O
	22.722930	20.155342	5.994	328.188	13.80										1.3	E2	1999.752		2MASS. M1 calculated from J and K magnitudes. Position errors for B notably higher than usual (.27 and .24)
	22.773639	20.155348	6.046	329.236	15.50	16.70									2.5	Es	2009.057		SDSS DR9. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0)
	22.773753	20.155389			13.79												2010.500		WISE. M1 from WISE J and K mags, secondary not identified in WISE
	22.774026	20.155362	6.050	329.578	13.81	16.45	269.50	5.21	12.04	275.94	14.14	26.23			0.2	Eu	2013.512	AAB	URAT1. M1 and M2 are URAT1 f.mags. PM data calculated from position comparison with 2MASS
	22.774158	20.155358	6.062	329.103	14.01	16.70	295.27	6.12	0.48	291.79	7.32	0.48					2015.000	ACA	GAIA DR1. M1 and M2 are GAIA Gmags. PM position calculated from comparison with SDSS DR9
	22.774158	20.155358	6.062	329.103	14.01	16.70	272.21	3.80	10.86	275.29	10.88	23.69			0.96	Hg	2015.000	AAB	GAIA DR1. M1 and M2 are GAIA Gmags. PM position calculated from comparison with 2MASS
	22.774296	20.155383	5.948	328.292	15.43	16.71									0.61	C	2016.817		iT24 0.61m 1x60s V-filter
	22.774304	20.155367	5.974	329.550	12.40	16.13							>M4	F5-K1	0.61	C	2016.817		iT24 0.61m 1x60s I-filter. SNR B <20. Spc based on V-I color index. B might be a white dwarf
																			NOTES: No data for either star in SDSS DR7

Table 1 continues on next page.

Table (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)

LSPM	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J0156 +4215	01 56 40.207	+42 15 06.977			12.90	19.38	148.95	-71.25	6.47	152.45	-69.23	6.47	K7-M1	>M4				AAA	Solid CPM candidate
	29.164250	42.253056	8.917	3.569											1.2	Pp	1953.998		POSSI.E
	29.166135	42.252648	9.172	7.500	12.51										1.2	Pp	1989.756		GSC2.3. M1 is GSC2.3 Vmag. Epoch shown is the average for the primary (1989.768) and secondary (1989.743)
	29.166000	42.252222	8.825	4.329			111.00	-72.00		114.00	-74.00				1.2	Pp	1995.865		POSSII.N. PM estimates based on comparison with POSSI.E
	29.166731	42.252220	9.153	7.292	12.60	16.30									1.3	E2	2000.743		2MASS. M1 and M2 calculated from J and K magnitudes
	29.167248	42.251990	8.954	7.645	12.60	16.30	141.20	-84.90		144.20	-105.90				0.4	Hw	2010.500		WISE. PM position calculated from comparison with 2MASS. M1 and M2 calculated from J and K magnitudes
	29.167450	42.251966	9.167	7.442	12.88		149.98	-71.50	7.22	152.28	-70.79	7.23	K6.0		0.2	Eu	2013.500	AAA	URAT1. M1 is URAT1 Vmag. Spc1 is B-Vmag value. PM data calculated from position comparison with 2MASS
	29.167528	42.251938	9.188	7.579	12.24	17.22	148.95	-71.25	6.47	152.45	-69.23	6.47			0.96	Hg	2015.000	AAA	GAIA DR1. M1 and M2 are GAIA Gmags. PM position calculated from comparison with 2MASS
	29.167667	42.251894	9.269	7.018	11.25	15.69							K7-M1	>M4	0.61	C	2016.817		iT24 0.61m 1x60s I-filter. Spc based on V-I color index
	29.167567	42.251917	9.071	4.774	12.90	19.38									0.61	C	2016.820		iT24 0.61m 1x180s V-filter. SNR B <20
																			Notes: Neither component identified in SDSS DR7 and DR9
J0210 +2253	02 10 44.156	+22 53 10.424			14.65	20.46							M3->M4	K7-M1				?	Potential CPM candiate, but absence of data for secondary in 2MASS, URAT1, and GAIA DR1 makes it impossible to get a CPM rating. Very obvious parallel motion from 1953 to 1993 in POSSI and POSSIi images
	32.680500	22.885139	7.333	174.593											1.2	Pp	1953.779		POSSI.O
	32.682683	22.885723	7.765	183.900	13.57	18.98									1.2	Pp	1990.793		GSC 2.3. M1 and M2 are GSC2.3 Fmags (Vmag for primary is 14.31, no Vmag for secondary). Epoch shown is the average for the primary (1990.866) and secondary (1990.719)
	32.682708	22.885556	6.801	181.164			175.00	36.00		155.00	48.00				1.2	Pp	1993.642		POSSII.J. PM estimates based on comparison with POSSI.O
	32.683025	22.885839			13.04										1.3	E2	1997.800		2MASS. M1 calculated from J and K magnitudes. Secondary not identified by 2MASS
	32.683425	22.886014	6.902	177.900	14.96	19.85									2.5	Es	2004.724		SDSS DR7. M1 and M2 are gmag+rmag/2 (used when gmag > 15.0)
	32.683429	22.886008	7.291	185.100	14.96	20.52									2.5	Es	2004.724		SDSS DR9. M1 and M2 are gmag+rmag/2 (used whe gmag > 15.0).
	32.683897	22.886191			14.62		185.70	81.40					M3.0		0.2	Eu	2013.378		URAT1. M1 is URAT1 Vmag, pmRA1 and pmDec1 are URAT1 numbers, Spc1 is B-Vmag value. Secondary not identified by URAT1
	32.683985	22.886229			13.42										0.96	Hg	2015.000		GAIA DR1. M1 is GAIA Gmag data, secondary not identified by GAIA
	32.684100	22.886256	7.270	183.051	14.65	20.46									0.61	C	2016.820		iT24 0.61m 1x180s V-filter. SNR B <5 - resolution a bit questionable, not repeatable with 360s image
	32.684088	22.886278	7.079	182.909	12.12	18.87							M3->M4	K7-M1	0.61	C	2016.820		iT24 0.61m 1x180s I-filter. SNR B<5 - resolution a bit questionable, not repeatable with 360s image. Spc based on V-I color index
																			Notes: Secondary not identified in 2MASS, URAT1, GAIA DR1, and WISE

Table 1 continues on next page.

Table (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)

LSPM	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J0211 +0815	02 11 31.963	+08 15 04.144			10.74	18.89	161.37	-69.34	14.79	171.87	-67.01	15.52	K4-K7	>M4				AAB	Reasonably solid CPM candidate. Vector length error of secondary in middle of B range (between .05 and .10%) in 2MASS/URAT1 comparison
	32.880833	8.252139	12.635	257.197											1.2	Pp	1954.893		POSSI.E
	32.882625	8.251306	13.860	257.075			152.00	-72.00		124.00	-79.00				1.2	Pp	1991.685		POSSII.F. PM estimates based on comparison with POSSI.E
	32.883178	8.251116	14.910	261.500	10.57	17.39									1.2	Pp	1995.845		GSC 2.3. M1 and M2 are GSC2.3 Vmags. Epoch shown is the average for the primary (2000.0) and secondary (1991.689)
	32.883220	8.251101	13.648	254.878	10.30	15.70									1.3	E2	2000.735		2MASS. M1 and M2 calculated from J and K magnitudes
	32.883801	8.250854	13.599	255.129	10.52	16.15	161.37	-69.34	14.79	171.87	-67.01	15.52	K4.0		0.2	Eu	2013.264	AAB	URAT1. M1 is URAT1 Vmag, M2 is URAT1 f.mag. Spc1 is B-V value. PM data calculated from position comparison with 2MASS
	32.883180	8.251151			10.16		162.04	-77.62							0.96	Hg	2015.000		GAIA DR1. M1 is GAIA Gmag data; pmRA1 and pmDec1 are GAIA pm data. Secondary not identified by GAIA
	32.883954	8.250792	13.580	254.846	9.50	15.14							K4-K7	>M4	0.61	C	2018.817		iT24 0.61m 1x60s I-filter. Spc based on V-I color index
	32.883921	8.250917	13.489	250.963	10.74	18.89									0.61	C	2016.820		iT24 0.61m 1x180s V-filter. SNR B <20
																			Notes: Neither component identified in SDSS DR7 and DR9, secondary not identified GAIA DR1 or in WISE
J0219 +5039	02 19 13.169	+50 38 56.886			14.90	17.00	119.30	100.89	5.57	118.84	102.01	5.57	>M4	>M4				AAA	Solid CPM candidate
	34.801542	50.647583	8.871	52.504											1.2	Pp	1953.913		POSSI.O
	34.803292	50.648639	9.446	48.168			95.00	91.00		95.00	112.00				1.2	Pp	1990.937		POSSII.F. PM estimates based on comparison with POSSI.O
	34.803620	50.648456	9.209	50.700	14.80	16.99									1.2	Pp	1990.940		GSC 2.3. M1 and M2 are GSC2.3 Vmags
	34.804073	50.648708	9.218	50.609	13.10	14.20									1.3	E2	1999.776		2MASS. M1 and M2 calculated from J and K magnitudes
	34.804779	50.649090	9.220	50.503	13.43	15.00	117.42	102.59	6.19	116.81	103.72	6.19			0.2	Eu	2013.487	AAA	URAT1. M1 and M2 are URAT1 f.mags. PM data calculated from position comparison with 2MASS
	34.804869	50.649135	9.224	50.500	13.65	15.11	119.30	100.89	5.57	118.84	102.01	5.57			0.96	Hg	2015.000	AAA	GAIA DR1. PM position calculated from comparison with 2MASS. M1 and M2 are GAIA DR1 Gmag data
	34.804967	50.649203	9.214	50.265	14.90	17.00									0.61	C	2016.817		iT24 0.61m 1x60s V-filter
	34.804971	50.649178	9.150	50.095	12.28	13.67							>M4	>M4	0.61	C	2016.817		iT24 0.61m 1x60s I-filter. Spc based on V-I color index
																			Notes: Neither component identified in SDSS DR7 and DR9, secondary not identified in WISE

Table 1 continues on next page.

Table (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)

LSPM	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J0222 +6130	02 22 17.924	+61 30 37.642			14.78	15.75							K7-M2	M0-M2				?	GAIA separation vector is a good match for non-existent secondary in 2MASS as well as POSSI.O.image dated 1952.706 (resulting ellipsoid in Aladin is an excellent match for the GAIA separation vector). Otherwise, the two stars are blurred so badly in all the POSS images that it's impossible to disentangle them in order to get coordinates
	35.574589	61.511443			13.75										1.2	Pp	1989.968		GSC 2.3. Secondary not identified in GSC2.3. M1 is GSC2.3 Vmag
	35.574238	61.511059	3.491	69.400	13.86										1.3	E2	2000.126		2MASS. M1 is from 2MASS J and K magnitudes. Secondary not identified in 2MASS
	35.574684	61.610524			14.51								>M4.0		0.2	Eu	2013.530		URAT1. Secondary not identifed by URTA1. M1 is URAT1 Vmag. Spc1 is B-V from URAT1 data for the primary (16.099-14.508 = 1.591)
	35.574684	61.510456	3.494	60.400	13.86	15.11									0.96	Hg	2015.000		GAIA DR1. M1 and M2 are GAIA Gmags
	35.574925	61.510397	2.500	63.635	14.78	15.75									0.61	C	2016.817		iT24 0.61m 1x60s V-filter
	35.574863	61.510406	2.702	64.572	13.02	13.88							K7-M2	M0-M2	0.61	C	2016.817		iT24 0.61m 1x60s I-filter. Spc based on V-I color index
																			Notes: Neither star indentified in SDSS DR7 and DR9; secondary not identified in GSC 2.3, 2MASS, URAT1, and WISE. Both stars are so blurred into one in all the POSS images that there's no point in trying to get coordinates on the pair – any effort would be pure guess work
J0226 +3248	02 26 34.676	+32 48 22.518			15.64	18.01	179.30	-10.54	6.64	183.61	-10.00	6.64	K4-K7	K7-M1				AAA	Went with the 2MASS-GAIA DR1 PM rating due to apparent position error for the secondary in URAT1
	36.640500	32.806528	3.402	182.124											1.2	Pp	1954.757		POSSI.E
	36.642843	32.806065			14.92										1.2	Pp	1986.907		GSC2.3. M1 is Vmag. Secondary not identified by GSC2.3
	36.642917	32.806556	3.200	180.000			174.00	2.00		177.00	7.00				1.2	Pp	1995.649		POSSII.N. PM estimates based on comparison with POSSI.E. Difficult to un-entangle the blurred stars in all POSS images
	36.643475	32.806305	3.930	182.162	15.80										1.3	E2	1997.958		2MASS. M1 calculated from J and K magnitudes
	36.644397	32.806268	3.508	179.219	15.48		180.06	-8.71	7.30	185.52	17.69	7.03	K2.0		0.2	Eu	2013.758	CBA	URAT1. PM position calculated from comparison with 2MASS. M1 is URAT1 Vmag, Spc1 is from URAT1 B-Vmag data. Appears to be a position error for the secondary in URAT1 as well as an unusually large URAT1 position error for the secondary (0.105")
	36.644485	32.806255	3.919	181.095	15.24	17.54	179.30	-10.54	6.64	183.61	-10.00	6.64			0.96	Hg	2015.000	AAA	GAIA DR1. PM position calculated from comparison with 2MASS
	36.644654	32.806289	4.113	182.284	14.43	16.41							K4-K7	K7-M1	0.61	C	2016.817		iT24 0.61m 1x60s I-filter. Spc based on V-I color index
	36.644583	32.806228	3.770	179.617	15.64	18.01									0.61	C	2016.820		iT24 0.61m 1x180s V-filter. Plate solving for astrometry GAIA DR1 and for photometry URAT1. SNR B<20
																			Notes: Neither of the pair identified in SDSS DR7 and -DR9, secondary not identified in WISE or GSC2.3

Table 1 continues on next page.

Table (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)

LSPM	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J0231 +4003	02 31 54.155	+40 03 51.354			15.05	15.07	202.59	-2.99	6.17	201.83	-1.05	6.17	>M4	>M4				AAA	Solid CPM candidate. Magnitudes of primary and secondary are almost identical - chose to go with the original LSPM choice of the primary as the northern star of the pair
	37.970792	40.064556	6.000	180.000											1.2	Pp	1951.969		POSSI.O. Centroids a bit difficult to pin down precisely in all POSS images
	37.973667	40.064444	5.505	177.610			189.00	-10.00		194.00	2.00				1.2	Pp	1993.801		POSSII.J. PM estimates based on comparison with POSSI.O
	37.974454	40.064278	5.850	179.676	13.141	13.125									1.3	E2	1998.782		2MASS. M1 and M2 calculated from J and K magnitudes
	37.975246	40.064292	5.757	180.795	13.141	13.125	186.20	4.30		176.60	12.30				0.4	Hw	2010.500		WISE. PM position calculated from comparison with 2MASS. M1 and M2 calculated from J and K magnitudes
	37.975518	40.064266	5.814	179.709	13.276	13.255	200.52	-2.93	6.84	199.62	-0.47	7.38			0.2	Eu	2013.422	AAA	URAT1. PM position calculated from comparison with 2MASS. M1 and M2 are URAT1 f.mags
	37.975647	40.064265	5.819	179.798	13.516	13.518	202.59	-2.99	6.17	201.83	-1.05	6.17			0.96	Hg	2015.000	AAA	GAIA DR1. PM position calculated from comparison with 2MASS. M1 and M2 are GAIA DR1 Gmags
	37.975754	40.064286	5.981	179.230	15.05	15.07									0.61	C	2016.817		iT24 0.61m 1x60s V-filter
	37.975742	40.064297	5.971	179.229	11.81	11.82							>M4	>M4	0.61	C	2016.817		iT24 0.61m 1x60s I-filter. Spc based on V-I color index
																			Notes: GSC 2.3 identified only of the two stars, but impossible to tell which since the marker is midway between them; neither of the pair is identifed by SDSS DR7 or -DR9
UC 752	02 32 00.46	+40 12 37.1	51.4	17	12.90	15.30	73	10		54	-7						2010		WDS 02320 +4013 data per begin of 2017. Object in same image as J0231+4003. A comparison of the GSC2.3, 2MASS, WISE, URTA1, and GAIA data show a slow but steady decrease in separation and a steady change in PA to the north, indicating divergent motion between the primary and secondary
	38.002316	40.210344			13.47	15.66	83.88	3.80	6.67	60.62	-13.79	6.67	M2->M4	>M4				CCC	Data shown here is the combination of GAIA and Vfilter data which is normally shown on the top line of the LSPM objects
	38.000417	40.210528	52.615	18.140											1.2	Pp	1951.969		POSSI.O
	38.001650	40.210332	51.760	17.200	13.11	15.37									1.2	Pp	1989.672		GSC2.3. M1 and M2 are GSC 2.3 Vmags
	38.001375	40.210389	51.854	16.954			63.00	-12.00		33.00	-21.00				1.2	Pp	1995.791		POSSII.N. PM estimates based on comparison with POSSI.O. Aladin photo function used to locate centroids of primary and secondary on both POSS images
	38.001821	40.210327	51.635	17.031	13.00	14.50									1.3	E2	1998.782		2MASS. M1 and M2 calculated from J and K magnitudes
	38.002161	40.210350	51.367	16.809	13.00	14.50	79.80	7.10		56.80	-9.80				0.4	Hw	2010.500		WISE. PM position calculated from comparison with 2MASS. M1 and M2 calculated from J and K magnitudes
	38.002263	40.210342	51.289	16.747	13.48		82.52	3.60	7.35	58.95	-13.83	7.34	M1.0-M2.0		0.2	Eu	2013.502	CCC	URAT1. PM position calculated from comparison with 2MASS. M1 is URAT1 Vmag. Spc1 is URAT1 B-Vmag
	38.002316	40.210344	51.252	16.722	12.67	14.59	83.88	3.80	6.67	60.62	-13.79	6.67			0.96	Hg	2015.000	CCC	GAIA DR1. PM position calculated from comparison with 2MASS. M1 and M2 are GAIA DR1 Gmag data.
	38.002354	40.210344	51.205	16.720	13.47	15.66									0.61	C	2016.817		iT24 0.61m 1x60s V-filter. WDS objekt near J0231+4003
	38.002338	40.210361	51.271	16.965	11.20	12.98							M2->M4	>M4	0.61	C	2016.817		iT24 0.61m 1x60s I-filter. Spc based on V-I color index. WDS objekt near J0231+4003 - code "R" seems to in error
																			Notes: Neither component identified in SDSS-DR7 and -DR9

Table 1 continues on next page.

Table (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)

LSPM	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J0258 +1647	02 58 28.877	+16 47 31.157			14.13	17.92	183.40	-4.44	10.66	186.51	-4.73	10.66	K3-K5	M2-M4				AAB	Good CPM candidate. PM Vector length error just slightly outside the error range for an A rating
	44.616583	16.792083	6.689	193.659											1.2	Pp	1951.903		POSSI.O
	44.618981	16.791972	6.958	194.500	13.96	16.92									1.2	Pp	1989.842		GSC2.3. M1 and M2 are GSC 2.3 Fmags
	44.619292	16.792083	6.918	194.424			223.00	0.00		219.00	-5.00				1.2	Pp	1998.880		POSSII.N. PM estimates based on comparison with POSSI.O
	44.619514	16.791988	7.130	195.218	14.10	17.00									1.3	E2	1999.842		2MASS. M1 and M2 calculated from J and K magnitudes
	44.620236	16.791975	7.123	195.263	14.13		183.75	-3.46	11.93	183.29	-2.90	11.92	G7.0		0.2	Eu	2013.387	AAB	URAT1. PM position calculated from comparison with 2MASS. M1 is URAT1 Vmag, Spc1 is from URAT1 B-Vmag data
	44.620321	16.791969	7.122	194.843	13.85	17.10	183.40	-4.44	10.66	186.51	-4.73	10.66			0.96	Hg	2015.000	AAB	GAIA DR1. PM position calculated from comparison with 2MASS. M1 and M2 are Gaia Gmags
	44.620446	16.791989	7.298	196.696	13.01	15.71							K3-K5	M2-M4	0.61	C	2016.817		iT24 0.61m 1x60s I-filter. SNR B<20. Spc based on V-I color index
	44.620433	16.791983	7.346	195.766	14.13	17.92									0.61	C	2016.820		iT24 0.61m 1x180s V-filter
																			Notes: Neither component identified in SDSS DR7 and -DR9
J0302 +6121	03 02 27.582	+61 21 30.913			15.66	18.85	58.99	-134.93	5.61	56.87	-131.66	5.61	M1-M3	>M4				AAA	Solid CPM candidate
	45.612667	61.360944	8.640	53.821											1.2	Pp	1954.072		POSSI.O
	45.613958	61.359389	8.877	52.533			53.00	-134.00		55.00	-126.00				1.2	Pp	1993.943		POSSII.F. PM estimates based on comparison with POSSI.O
	45.614157	61.359391	9.030	59.400	14.64	17.11									1.2	Pp	1993.943		GSC2.3. M1 and M2 are GSC 2.3 Fmags.
	45.614406	61.359154	8.560	52.090	14.50	16.40									1.3	E2	1999.869		2MASS. M1 and M2 calculated from J and K magnitudes
	45.614874	61.358658	8.589	51.820	15.56		59.72	-131.99	6.28	59.59	-128.39	6.28			0.2	Eu	2013.386	AAA	URAT1. PM position calculated from comparison with 2MASS. M1 is URAT1 Vmag
	45.614923	61.358587	8.566	51.697	14.54	17.02	58.99	-134.93	5.61	56.87	-131.66	5.61			0.96	Hg	2015.000	AAA	GAIA DR1. PM position calculated from comparison with 2MASS. M1 and M2 are Gaia Gmags
	45.614988	61.358542	8.572	51.725	13.61	15.90							M1-M3	>M4	0.61	C	2016.817		iT24 0.61m 1x60s I-filter. Spc based on V-I color index
	45.614963	61.358514	8.624	56.657	15.66	18.85									0.61	C	2016.842		iT24 0.61m 1x300s V-filter. SNR B<10
																			Notes: Neither component identified in SDSS-DR7 and -DR9, primary only identified in WISE
J0349 +5937	03 49 08.450	59 37 40.84			15.33	16.03	141.23	-86.51	6.27	138.13	-83.84	6.27	>M4	>M4				AAA	Solid CPM candidate
	57.28004167	59.62983333	6.023	348.379											1.20	Pp	1954.012		POSS I.O estimates
	57.28345400	59.62857200	6.240	345.489	14.09	15.22									1.20	Pp	1992.834		GSC 2.2. M1 and M2 are R-band
	57.28337500	59.62852778	6.304	345.367			141.93	-109.95		133.05	-105.27				1.20	Pp	1996.758		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	57.28397100	59.62839500	6.374	346.423	13.63	14.37									1.30	E2	1999.050		2MASS. M1 and M2 estimated from J- and K-band
	57.28508470	59.62805830	6.428	345.934	14.9		140.50	-83.90		136.60	-81.60				0.20	Eu	2013.448		URAT1
	57.28520859	59.62801173	6.427	346.085	13.89	14.54	141.23	-86.51	6.27	138.13	-83.84	6.27			0.96	Hg	2015.000	AAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS
	57.28531250	59.62795278	6.431	346.358	15.33	16.03									0.61	C	2016.817		iT24 0.61m 1x60s V-filter
	57.28532500	59.62796667	6.416	346.535	12.76	13.42							>M4	>M4	0.61	C	2016.817		iT24 0.61m 1x60s I-filter. Spc based on V-I color index

Table 1 continues on next page.

Table (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)

LSPM	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J0351 +5439	03 51 54.944	54 39 06.49			11.65	16.07	248.12	16.96	6.00	-2.35	3.54	6.00	K4-K7	M3->M4				CCC	Comparison of POSS.I and POSS.II images shows large proper motion for the "primary" but the assumed secondary seems to be rather stationary. Optical pair
	57.9720000	54.65188889	5.395	94.252													1954.746		POSS:I O. Sep and PA from estimated centroids
	57.97712300	54.6517330	3.802	252.591	11.50	12.35									1.30	E2	2000.856		2MASS. M1 and M2 estimated from J- and K-band
	57.97880802	54.6517996	7.293	259.513	11.21	14.80	248.12	16.96	6.00	-2.35	3.54	6.00			0.96	Hg	2015.000	CCC	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS
	57.97900833	54.6518111	7.569	259.649	11.65	16.07									0.61	C	2016.817		iT24 0.61m 1x60s V-filter
	57.97893333	54.6518028	7.694	259.592	10.38	13.63							K4-K7	M3->M4	0.61	C	2016.817		iT24 0.61m 1x60s I-filter. Spc based on V-I color index
J0400 +3125	04 00 07.396	31 25 16.36			14.89	16.99							>M4	>M4				?	Probably solid CPM canditate with lack of data for reliable CPM rating - with an estimated 2MASS position for B the result would be AABB
	60.02670833	31.42447222	2.827	64.885											1.20	Pp	1955.857		POSS I.O estimates
	60.02954167	31.4222500	3.179	67.824			217.91	-200.29		227.52	-200.29				1.20	Pp	1995.800		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	60.02965300	31.4220790	4.099	71.279	12.8										1.30	E2	2000.856		2MASS. Position for B estimated based on the 2MASS image. M1 estimated from J- and K-band
	60.03081721	31.4212116	4.002	73.351	13.38	15.55									0.96	Hg	2015.000		GAIA DR1. M1 and M2 are G-band
	60.03094167	31.4211083	3.722	72.970	14.89	16.99									0.61	C	2016.817		iT24 1x60s V-filter
	60.03092917	31.4211083	3.813	71.815	12.24	14.15							>M4	>M4	0.61	C	2016.817		iT24 1x60s I-filter. Spc based on V-I color index
																			Comparison POSS.I O to POSS II N shows clearly fast parallel proper motion but neither 2MASS nor other catalogs besides GAIA DR1 include an object for B
J0435 +5821	04 35 12.841	58 21 04.76																	Bogus or much closer as indicated by LSPM
	68.802192	58.352274	0.660	83.110		16.94									2.50	Es	2004.949		SDSS9. M1 and M2 estimated from g- and r-mags
	68.80345000	58.3511833			13.48										0.61	C	2016.842		iT24 1x180s V-filter. No resolution of B, not even a slightest hint for an elongation. B either fainter than 19.5Vmag or bogus
	68.80350417	58.3513222			10.85								>M4	0	0.61	C	2016.842		iT24 1x180s I-filter. No resolution of B, not even a slightest hint for an elongation. B either fainter than 17.5Imag or bogus
																			SDSS shows some elongation and SDSS9 lists two objects here with quite smaller separation than LSPM but similar PA - yet this seems rather questionable. Aladin Phot tool gives a plain circle indicating single star disk. Also POSS I and II images offer no hint of an elongation, same for 2MASS J-band

Table 1 continues on next page.

Table (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)

LSPM	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J0443 +2226	04 43 08.579	22 26 37.55			15.54	20.96	209.62	-110.10	5.95	207.40	-109.46	5.95	M1-M3	>M4				AAA	Solid CPM candidate
	70.78425000	22.4445000	16.230	27.469											1.20	Pp	1995.909		POSS II.N Aladin centroids. No resolution of B in POSS I.O
	70.78484800	22.4442010	16.169	27.715	14.85	17.55									1.30	E2	2000.741		2MASS. M1 and M2 estimated from J- and K-band
	70.78566920	22.4438061	16.086	27.424	15.56		210.10	-109.20		202.00	-112.20				0.20	Eu	2013.736		URAT1
	70.78574633	22.4437649	16.162	27.601	14.57	18.50	209.62	-110.10	5.95	207.40	-109.46	5.95			0.96	Hg	2015.000	AAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS
	70.78581250	22.4436639	16.776	24.875	15.54	20.96									0.61	C	2016.844		iT24 1x180s V-filter. SNR B <10
	70.78584583	22.4437028	16.124	28.278	13.58	17.23							M1-M3	>M4	0.61	C	2016.844		iT24 1x60s I-filter. SNR B<20. Spc based on V-I color index
J0451 +4643	04 51 10.862	46 43 56.59			12.78	16.59	182.10	-86.00	6.00	182.66	-87.79	6.00	K5-K7	M3->M4				AAA	Solid CPM candidate
	72.79108333	46.7340278	8.031	222.723											1.20	Pp	1953.771		POSS I.O estimates
	72.79375000	46.7327500	7.473	220.289			152.48	-106.60		166.78	-101.97				1.20	Pp	1996.922		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	72.79421600	46.7327230	7.922	222.401	12.47	14.67									1.30	E2	2000.856		2MASS. M1 and M2 estimated from J- and K-band
	72.79525989	46.7323851	7.936	222.237	12.07	15.03	182.10	-86.00	6.00	182.66	-87.79	6.00			0.96	Hg	2015.000	AAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS
	72.79539167	46.7323667	7.837	222.806	12.78	16.59									0.61	C	2016.817		iT24 1x60s V-filter
	72.79540417	46.7323278	7.974	222.599	11.43	14.09							K5-K7	M3->M4	0.61	C	2016.817		iT24 1x60s I-filter. Spc based on V-I color index
J0459 +1613	04 59 35.276	16 13 02.12			19.18	19.81							>M4	K1-K5				?	Comparing DSS image positions with GAIA DR1 positions suggests strongly CPM even if data points required for CPM rating are missing
	74.89641667	16.2178056	4.222	166.185											1.20	Pp	1996.843		POSS II.N estimates
	74.89698431	16.2172548	4.299	165.700	17.32	19.44									0.96	Hg	2015.000		GAIA DR1. M1 and M2 are G-band
	74.89702083	16.2172000	3.864	161.302	19.18	19.81									0.61	C	2016.847		iT24 1x300s V-filter. SNR B<20
	74.89705833	16.2171944	4.082	164.863	16.17	18.87							>M4	K1-K5	0.61	C	2016.847		iT24 1x300s I-filter. SNR B<10. Spc based on V-I color index
																			No resolution of both components in POSS I.O. No SDSS objects for both components. No 2MASS and URAT1 object for B

Table 1 continues on next page.

Table (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)

LSPM	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J0505 +1928	05 05 17.867	19 28 43.66			18.91	19.08	204.25	-93.03		204.25	-97.92		K2-K5	K4-K7				?	Visual evidence suggests strongly CPM even if data points required for CPM rating are missing
	76.32062500	19.4802778	8.410	325.130											1.20	Pp	1955.879		POSS I.O estimates
	76.32308333	19.4792222	8.247	324.336			204.25	-93.03		204.25	-97.92				1.20	Pp	1996.728		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	76.32444603	19.4787943	8.003	322.681	18.41	18.55									0.96	Hg	2015.000		GAIA DR1. M1 and M2 are G-band
	76.32438750	19.4788333	7.783	329.417	18.91	19.08									0.61	C	2016.847		iT24 1x300s V-filter. SNR B<20
	76.32456250	19.4788528	7.468	321.324	17.87	17.90							K2-K5	K4-K7	0.61	C	2016.847		iT24 1x300s I-filter. Spc based on V-I color index
																			No SDSS objects for both components. No 2MASS and URAT1 object for B
J0508 +2038	05 08 55.267	20 38 49.35			11.52	17.10	-67.39	-191.36	6.00	-72.70	-191.23	6.00	G8-K4	>M4				AAA	Solid CPM candidate
	77.23187500	20.6494722	5.367	315.077											1.20	Pp	1953.023		POSS I.O estimates
	77.23083333	20.6481111	5.126	314.609			-90.16	-125.89		-86.55	-131.03				1.20	Pp	1991.945		POSS II.J estimates. PM estimates based on comparison with POSS I.O
	77.23056200	20.6477930	5.942	319.178	11.1	15.0									1.30	E2	2000.856		2MASS. M1 and M2 estimated from J- and K-band
	77.23027907	20.6470411	5.993	318.646	10.60	15.68	-67.39	-191.36	6.00	-72.70	-191.23	6.00			0.96	Hg	2015.000	AAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS
	77.23030833	20.6471472	5.275	315.156	11.52	17.10									0.61	C	2016.847		iT24 1x300s V-filter. SNR B<5. Heavily overlapping star disks. Centroid A oversaturated
	77.23021667	20.6469694	5.445	320.642	10.75	14.52							G8-K4	>M4	0.61	C	2016.817		iT24 1x300s I-filter. Overlapping star disks. SNR B<20. Spc based on V-I color index
J0511 +2056	05 11 22.055	20 56 38.45			14.02	18.41	35.23	-161.81	4.95	42.16	-167.34	4.95	K4-K7	>M4				AAA	Solid CPM candidate
	77.84133333	20.9449167	3.990	167.838											1.20	Pp	1993.924		POSS II.N estimates
	77.84171400	20.9447860	4.771	169.031	13.62	17.57									1.30	E2	1997.841		2MASS. M1 and M2 estimated from J- and K-band
	77.84189382	20.9440147	4.888	167.876	13.6	17.7	35.23	-161.81	4.95	42.16	-167.34	4.95			0.96	Hg	2015.000	AAA	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS
	77.84191667	20.9439389	4.490	168.483	14.02	18.41									0.61	C	2016.847		iT24 1x300s V-filter. SNR B<20
	77.84187083	20.9439361	4.994	166.701	12.85	15.73							K4-K7	>M4	0.61	C	2016.844		iT24 1x180s I-filter
																			No resolution of B in POSS I.O. No object for B in URAT1. No SDSS object for A or B
J0535 +4148	05 35 50.757	41 48 41.49			17.52	17.65	54.30	-186.17		57.31	-196.97		M0-M2	M1-M3				?	Despite lacking data points for CPM assessment a solid CPM candidate based on visual impression comparing POSS images as well as 2MASS image with GAIA DR1 positions
	83.96020833	41.81472222	2.987	314.673											1.20	Pp	1953.026		POSS I.O estimates
	83.96095833	41.8128056	2.634	310.190			54.30	-186.17		57.31	-196.97				1.20	Pp	1990.088		POSS II.N estimates. PM estimates based on comparison with POSS I.O
	83.96148903	41.8115259	2.814	308.258	16.54	16.79									0.96	Hg	2015.000		GAIA DR1. M1 and M2 are G-band
	83.96158750	41.8114306	2.945	308.910	17.52	17.65									0.61	C	2016.817		iT24 1x60s V-filter. SNR A and B <20
	83.96147083	41.8114694	2.480	307.502	15.65	15.68							M0-M2	M1-M3	0.61	C	2016.817		iT24 1x60s I-filter
																			No object for B in 2MASS and URATR1. No SDSS objects for both components

Table 1 concludes on next page.

CPM pairs from LSPM so far not WDS listed – Part III

Table (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)

LSPM	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J0548 +7233	05 48 49.497	72 33 31.25			13.26	17.46	66.39	-147.88	12.21	63.50	-154.36	12.21	K5-M0	>M4				AAB	Despite the rather large 2MASS position error a solid CPM candidate
	87.20454167	72.5595	4.442	202.620											1.20	Pp	1998.896		POSS II.N estimates
	87.20526100	72.5593340	4.318	199.744	13.29	14.06									1.30	E2	1999.102		2MASS. M1 and M2 estimated from J- and K-band
	87.20623924	72.5586810	4.431	199.855	12.7	16.9	66.39	-147.88	12.21	63.50	-154.36	12.21			0.96	Hg	2015.000	AAB	GAIA DR1. M1 and M2 are G-band. PM data calculated from position comparison with 2MASS
	87.20642500	72.5585806	3.815	198.410	13.26	17.46									0.61	C	2016.847		iT24 1x180s V-filter. Overlapping star disks. SNR B<20
	87.20642917	72.5586306	3.957	199.929	11.82	14.62							K5-M0	>M4	0.61	C	2016.844		iT24 1x60s I-filter. Overlapping star disks
																			No resolution of B in POSS I.O. No object for B in URAT1. No objects for A and B in SDSS

CPM pairs from LSPM so far not WDS listed – Part III

Appendix

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

- 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 $\sqrt{[dVmag^2 + (2.5*Log_{10}(1+1/SNR))^2]}$
- SNR as signal to noise ratio for the given object

Table 2. Error estimations for the iT24 in Table 1 provided measurements for the given objects.

Name		RA	Dec	dRA	dDec	Err Sep	Err PA	Err Mag	SNR	dmag	Date	Notes
J0117 +1942	A	01 17 56.557	19 42 47.82	0.06	0.06	0.085	1.259	0.045	51.04	0.04	2016.817	iT24 0.61m 1x60s V-filter. SNR B <20
	B	01 17 56.797	19 42 45.97					0.083	14.43			
	A	01 17 56.552	19 42 47.92	0.08	0.08	0.113	1.608	0.151	83.33	0.15	2016.817	iT24 0.61m 1x60s I-filter. Spc based on V-I color index
	B	01 17 56.806	19 42 46.08					0.152	46.91			
J0131 +2009	A	01 31 05.831	20 09 19.38	0.07	0.07	0.099	0.954	0.033	83.28	0.03	2016.817	iT24 0.61m 1x60s V-filter
	B	01 31 05.609	20 09 24.44					0.042	37.17			
	A	01 31 05.833	20 09 19.32	0.07	0.06	0.092	0.884	0.150	178.31	0.15	2016.817	iT24 0.61m 1x60s I-filter. SNR B <20. Spc based on V-I color index. B might be a white dwarf
	B	01 31 05.618	20 09 24.47					0.163	16.57			
J0156 +4215	A	01 56 40.216	42 15 06.90	0.11	0.08	0.136	0.859	0.050	192.65	0.05	2016.820	iT24 0.61m 1x180s V-filter. SNR B <20
	B	01 56 40.284	42 15 15.94					0.161	6.62			
	A	01 56 40.240	42 15 06.82	0.08	0.07	0.106	0.657	0.130	218.70	0.13	2016.817	iT24 0.61m 1x60s I-filter. Spc based on V-I color index
	B	01 56 40.342	42 15 16.02					0.134	34.22			
J0210 +2253	A	02 10 44.184	22 53 10.52	0.07	0.07	0.099	0.780	0.040	196.74	0.04	2016.820	iT24 0.61m 1x180s V-filter. SNR B <5 - resolution a bit questionable, not repeatable with 360s image
	B	02 10 44.156	22 53 03.26					0.451	1.95			
	A	02 10 44.181	22 53 10.60	0.07	0.08	0.106	0.860	0.130	264.37	0.13	2016.820	iT24 0.61m 1x180s I-filter. SNR B<5 - resolution a bit questionable, not repeatable with 360s image. Spc based on V-I color index
	B	02 10 44.155	22 53 03.53					0.299	3.56			
J0211 +0815	A	02 11 32.141	08 15 03.30	0.07	0.11	0.130	0.554	0.090	214.60	0.09	2016.820	iT24 0.61m 1x180s V-filter. SNR B <20
	B	02 11 31.282	08 14 58.90					0.128	11.49			
	A	02 11 32.149	08 15 02.85	0.09	0.07	0.114	0.481	0.140	262.77	0.14	2016.817	iT24 0.61m 1x60s I-filter. Spc based on V-I color index
	B	02 11 31.266	08 14 59.30					0.141	53.38			
J0219 +5039	A	02 19 13.192	50 38 57.13	0.06	0.06	0.085	0.528	0.061	99.82	0.06	2016.817	iT24 0.61m 1x60s V-filter
	B	02 19 13.937	50 39 03.02					0.070	30.37			
	A	02 19 13.193	50 38 57.04	0.07	0.07	0.099	0.620	0.120	193.85	0.12	2016.817	iT24 0.61m 1x60s I-filter. Spc based on V-I color index
	B	02 19 13.931	50 39 02.91					0.120	106.66			
J0222 +6130	A	02 22 17.982	61 30 37.43	0.10	0.10	0.141	3.238	0.061	85.72	0.06	2016.817	iT24 0.61m 1x60s V-filter
	B	02 22 18.295	61 30 38.54					0.066	40.13			
	A	02 22 17.967	61 30 37.46	0.10	0.09	0.135	2.851	0.120	131.39	0.12	2016.817	iT24 0.61m 1x60s I-filter. Spc based on V-I color index
	B	02 22 18.308	61 30 38.62					0.121	65.62			
J0226 +3248	A	02 26 34.700	32 48 22.42	0.10	0.06	0.117	1.772	0.061	106.55	0.06	2016.820	iT24 0.61m 1x180s V-filter. Plate solving for astrometry GAIA DR1 and for photometry URAT1. SNR B<20
	B	02 26 34.702	32 48 18.65					0.096	13.89			
	A	02 26 34.717	32 48 22.64	0.10	0.09	0.135	1.873	0.112	53.72	0.11	2016.817	iT24 0.61m 1x60s I-filter. Spc based on V-I color index
	B	02 26 34.704	32 48 18.53					0.130	15.18			
J0231 +4003	A	02 31 54.181	40 03 51.43	0.07	0.09	0.114	1.092	0.052	78.59	0.05	2016.817	iT24 0.61m 1x60s V-filter
	B	02 31 54.188	40 03 45.45					0.052	74.57			
	A	02 31 54.178	40 03 51.47	0.08	0.08	0.113	1.086	0.130	155.26	0.13	2016.817	iT24 0.61m 1x60s I-filter. Spc based on V-I color index
	B	02 31 54.185	40 03 45.50					0.130	143.49			
UC752	A	02 32 00.565	40 12 37.24	0.07	0.09	0.114	0.128	0.050	159.73	0.05	2016.817	iT24 0.61m 1x60s V-filter. WDS objekt near J0231+4003
	B	02 32 01.851	40 13 26.28					0.053	64.45			
	A	02 32 00.561	40 12 37.30	0.08	0.08	0.113	0.126	0.130	276.22	0.13	2016.817	iT24 0.61m 1x60s I-filter. Spc based on V-I color index. WDS object near J0231+4003 - code "R" seems to in error
	B	02 32 01.867	40 13 26.34					0.130	109.25			
J0258 +1647	A	02 58 28.904	16 47 31.14	0.10	0.11	0.149	1.159	0.090	128.07	0.09	2016.820	iT24 0.61m 1x180s V-filter
	B	02 58 28.765	16 47 24.07					0.101	22.95			
	A	02 58 28.907	16 47 31.16	0.10	0.08	0.128	1.005	0.130	118.04	0.13	2016.817	iT24 0.61m 1x60s I-filter. SNR B<20. Spc based on V-I color index

Table 2 concludes on next page.

CPM pairs from LSPM so far not WDS listed – Part III

Table 2 (conclusion). Error estimations for the iT24 in Table 1 provided measurements for the given objects:

Name		RA	Dec	dRA	dDec	Err Sep	Err PA	Err Mag	SNR	dmag	Date	Notes
J0302 +6121	A	03 02 27.591	61 21 30.65	0.13	0.13	0.184	1.221	0.063	60.07	0.06	2016.842	iT24 0.61m 1x300s V-filter. SNR B<10
	B	03 02 28.593	61 21 35.39					0.156	7.03			
	A	03 02 27.597	61 21 30.75	0.08	0.08	0.113	0.756	0.120	125.53	0.12	2016.817	iT24 0.61m 1x60s I-filter. Spc based on V-I color index
	B	03 02 28.533	61 21 36.06					0.123	37.22			
J0349 +5937	A	03 49 08.475	59 37 40.63	0.08	0.08	0.113	1.008	0.062	78.10	0.06	2016.817	iT24 0.61m 1x60s V-filter
	B	03 49 08.275	59 37 46.88					0.064	50.77			
	A	03 49 08.478	59 37 40.68	0.08	0.07	0.106	0.949	0.120	163.82	0.12	2016.817	iT24 0.61m 1x60s I-filter. Spc based on V-I color index
	B	03 49 08.281	59 37 46.92					0.120	110.57			
J0351 +5439	A	03 51 54.962	54 39 06.52	0.08	0.09	0.120	0.911	0.050	244.94	0.05	2016.817	iT24 0.61m 1x60s V-filter
	B	03 51 54.104	54 39 05.16					0.058	35.91			
	A	03 51 54.944	54 39 06.49	0.09	0.08	0.120	0.897	0.120	283.80	0.12	2016.817	iT24 0.61m 1x60s I-filter. Spc based on V-I color index
	B	03 51 54.072	54 39 05.10					0.121	86.03			
J0400 +3125	A	04 00 07.426	31 25 15.99	0.06	0.06	0.085	1.306	0.061	107.56	0.06	2016.817	iT24 1x60s V-filter
	B	04 00 07.704	31 25 17.08					0.073	25.24			
	A	04 00 07.423	31 25 15.99	0.08	0.08	0.113	1.700	0.110	145.23	0.11	2016.817	iT24 1x60s I-filter. Spc based on V-I color index
	B	04 00 07.706	31 25 17.18					0.114	36.15			
J0435 +5821	A	04 35 12.828	58 21 04.26	0.12	0.11	0.163	#WERT!	0.061	82.56	0.06	2016.842	iT24 1x180s V-filter. No resolution of B, not even a slightest hint for an elongation. B either fainter than 19.5Vmag or bogus
	B							#DIV/0!				
	A	04 35 12.841	58 21 04.76	0.12	0.11	0.163	#WERT!	0.121	59.40	0.12	2016.842	iT24 1x180s I-filter. No resolution of B, not even a slightest hint for an elongation. B either fainter than 17.5Imag or bogus
	B							#DIV/0!				
J0443 +2226	A	04 43 08.595	22 26 37.19	0.12	0.12	0.170	0.580	0.052	75.71	0.05	2016.844	iT24 1x180s V-filter. SNR B <10
	B	04 43 09.104	22 26 52.41					0.450	1.96			
	A	04 43 08.603	22 26 37.33	0.10	0.10	0.141	0.503	0.120	104.56	0.12	2016.844	iT24 1x60s I-filter. SNR B<20. Spc based on V-I color index
	B	04 43 09.154	22 26 51.53					0.153	10.97			
J0451 +4643	A	04 51 10.894	46 43 56.52	0.11	0.10	0.149	1.087	0.051	152.52	0.05	2016.817	iT24 1x60s V-filter
	B	04 51 10.376	46 43 50.77					0.068	23.35			
	A	04 51 10.897	46 43 56.38	0.10	0.09	0.135	0.967	0.120	174.13	0.12	2016.817	iT24 1x60s I-filter. Spc based on V-I color index
	B	04 51 10.372	46 43 50.51					0.121	72.41			
J0459 +1613	A	04 59 35.285	16 13 01.92	0.07	0.08	0.106	1.576	0.104	20.36	0.09	2016.847	iT24 1x300s V-filter. SNR B<20
	B	04 59 35.371	16 12 58.26					0.125	11.94			
	A	04 59 35.294	16 13 01.90	0.05	0.05	0.071	0.993	0.131	91.90	0.13	2016.847	iT24 1x300s I-filter. SNR B<10. Spc based on V-I color index
	B	04 59 35.368	16 12 57.96					0.228	5.32			
J0505 +1928	A	05 05 17.853	19 28 43.80	0.10	0.09	0.135	0.990	0.105	19.92	0.09	2016.847	iT24 1x300s V-filter. SNR B<20
	B	05 05 17.573	19 28 50.50					0.113	15.25			
	A	05 05 17.895	19 28 43.87	0.09	0.07	0.114	0.875	0.138	22.25	0.13	2016.847	iT24 1x300s I-filter. Spc based on V-I color index
	B	05 05 17.565	19 28 49.70					0.136	26.79			
J0508 +2038	A	05 08 55.274	20 38 49.73	0.10	0.10	0.141	1.536	0.070	195.10	0.07	2016.847	iT24 1x300s V-filter. SNR B<5. Heavily overlapping star disks. Centroid A oversaturated
	B	05 08 55.009	20 38 53.47					0.402	2.27			
	A	05 08 55.252	20 38 49.09	0.11	0.09	0.142	1.495	0.121	95.01	0.12	2016.817	iT24 1x300s I-filter. Overlapping star disks. SNR B<20. Spc based on V-I color index
	B	05 08 55.006	20 38 53.30					0.141	14.03			
J0511 +2056	A	05 11 22.060	20 56 38.18	0.08	0.09	0.120	1.536	0.070	191.23	0.07	2016.847	iT24 1x300s V-filter. SNR B<20
	B	05 11 22.124	20 56 33.78					0.103	13.85			
	A	05 11 22.049	20 56 38.17	0.10	0.10	0.141	1.622	0.120	153.72	0.12	2016.844	iT24 1x180s I-filter
	B	05 11 22.131	20 56 33.31					0.127	25.72			
J0535 +4148	A	05 35 50.781	41 48 41.15	0.08	0.08	0.113	2.200	0.094	16.97	0.07	2016.817	iT24 1x60s V-filter. SNR A and B <20
	B	05 35 50.576	41 48 43.00					0.098	15.42			
	A	05 35 50.753	41 48 41.29	0.09	0.08	0.120	2.779	0.125	31.63	0.12	2016.817	iT24 1x60s I-filter
	B	05 35 50.577	41 48 42.80					0.126	28.97			
J0548 +7233	A	05 48 49.542	72 33 30.89	0.07	0.09	0.114	1.712	0.050	252.07	0.05	2016.847	iT24 1x180s V-filter. Overlapping star disks. SNR B<20
	B	05 48 49.274	72 33 27.27					0.087	14.68			
	A	05 48 49.543	72 33 31.07	0.10	0.11	0.149	2.152	0.130	138.83	0.13	2016.844	iT24 1x60s I-filter. Overlapping star disks
	B	05 48 49.243	72 33 27.35					0.136	27.76			