CPM Pairs from LSPM so far not WDS Listed

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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 2016) there are still many potential CPM pairs indicated in LSPM which as of the beginning of 2016 are not listed in the WDS catalog. A first part of about 40 such objects is presented here.

Introduction

CPM pairs seem to us interesting enough to deserve their own catalog, but so far the WDS catalog is the only regularly maintained data base for these objects, so we checked the LSPM catalog for potential CPM pairs currently not WDS listed. 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 arcseconds. We then found that in most cases such pairs were identical with LSPM objects with the same object ID, but with E/W/S/N added for differentiation of close objects with large proper motion. Next came a quick first check if such pairs show similar proper motion properties in terms of direction and speed. Assuming that star characteristics are distributed by random according to the general frequency regardless of distance one would expect that only a small part would show the characteristics of common proper motion. But to our surprise most of the pairs checked suggested CPM, which means that if two close stars have large proper motion then speed and direction is mostly very similar – the reason for this "rule" is rather unclear to us.

We then checked as many sources available to us via Aladin for data for these CPM candidates beginning with visual comparison of POSS I and POSS II images. Then if possible we used the Aladin centroid feature to get precise position coordinates in the POSS images allowing the calculation of separation and PA and the PM data based on the comparison between POSS I and POSS II. If the Aladin centroid feature did not work (stars too faint or too close) we then resorted to visual estimations of the centroids. Next came the check of other existing catalog data for the given field of view, especially 2MASS, URAT1, SDSS, WISE, UCAC4, GSC, NOMAD1, APASS etc., for data on both components with 2MASS and URAT1 the most important data source for calculating the PM data by comparison of the positions in 2MASS and URAT1 allowing a CPM rating according to Knapp/Nanson 2016. If URAT1 data was available, then we also checked the VizieR I/330 catalog from Nicholson 2015 (meanwhile, no longer available) based on URAT1 preliminary PM data to show the difference of the estimated PM errors compared to the 2MASS position error based on calculated PM error estimation.

As was to be expected we stumbled over several catalog data quality issues providing some good riddles. SDSS for example provides the currently best available image resolution of ~0.4 arcseconds and delivers with the SDSS DR9 catalog for most objects excellent precise RA/Dec with an unbelievable small position error of 0.001" but suddenly some objects have curious large position errors of ~0.5". Yet it would be of high interest to have SDSS covering the full sky instead of the currently given about a third. SDSS DR9 includes also for many objects PM data based on comparison of different SDSS observations, with a time distance of about 6 years. Despite this rather short time frame, most provided PM data seems with some exceptions rather pre-

cise but in nearly all such cases PM data only for the A component was available. Position comparison between 2MASS and SDSS was quite often less satisfying due to the too short time distance but even in cases with 5 or 6 years the calculated PM values were often not very useful.

Another catalog with good RA/Dec precision is WISE even if based on a technical resolution of only ~1.4 arcseconds per pixel. But also this catalog covers so far only a part of the sky and the observation epoch is a bit unclear due to a mix of observation dates. We had here to resort to the NASA/ IPAC Infrared Science Archive to get a precise average observation date. Similar to SDSS we often used WISE position data if available for both components for comparison with 2MASS but the calculated PM values were often not very useful.

Next very annoying errors are PM errors in URAT1 – sometimes you can only wonder what positions Aladin shows in the images for the URAT1 objects, only to realize that Aladin shows as standard epoch J2000 and calculates the URAT1 positions from 2013 back to J2000 with the given PM data. Moving the epoch slider to epoch 2013 shows then the effectively measured URAT1 positions.

We tried also to get the visual magnitudes for each of the components from the various catalogs we used. In the absence of Vmags, where J- and K-band values were available, we used a spreadsheet to estimate Vmags with formulas based on the works of Caldwell et al 1993 and Warner 2007 (http://brucegary.net/dummies/method0.html) provided -0.1 < (J-K)< 1.0.

Spectral class data was scarce in the available catalogs so 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).

As far as possible (mostly depending on the altitude and availability of each object at the time of our research) we tried then to provide recent precise measurements for position, separation, position angle and visual magnitudes based on images taken with remote telescopes using our usual procedure: stacking with 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 60 seconds and even then some components were too faint to be resolved.

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 2016 with own new images.

Results of Our Research

In Table 1 we present for the selected objects (plus one Tycho object found by chance as potential CPM during comparing POSS images for another object) as much data as we could find in the images and catalogs available to us including our own measurements of objects in reasonable altitude for imaging with remote telescope iT24. Shown 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 URAT1 coordinates of the A component 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 " and PA ° give separation and position angle in the data lines
- 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 for A and B usually based on the B-V color index if available
- Ap indicates in the data lines the used aperture for the observation listed and Me indicates the WDS code for the used observation method
- 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 between 2MASS and URAT1 in the header line and the corresponding data line (usually URAT1)
- Source/Notes finally indicates in the header line the overall assessment for the object in question and in the data lines the used source (images and catalogs) and additional explanations if considered necessary.

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Table 1: Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J0448+3511	04 48 42.584	+35 11 08.21					221.9	9.2	15.8	212.3	-3.0	20.4						BAB	PM values so far not very precise - but comparison of POSS images strongly suggest CPM
	72.17329167	35.1854444	4.4	335.3											1.2	Pp	1955.857		POSS I.O estimates
	72.17591667	35.1854722	4.5	334.4			193	3		190	5				1.2	Pp	1995.813		POSS II.J estimates. PM values estimated by comparison with POSS I.O
	72.17631700	35.1855580	4.306	332.493	12.4	13.0									1.3	E2	1998.081		2MASS. Vmags estimated from J- and K-mag values
	72.17714600	35.1855890	4.117	333.106			221.9	9.2	15.8	212.3	-3.0	20.4			0.4	Hw	2010.164	BAB	WISE. PM data calculated from position comparison with 2MASS. Large WISE position error results in large PM error
J0709+3217/3218	07 09 38.458	+32 17 50.67					56.56	-127.02	6.26	60.53	-134.20	11.47						ABB	PM data so far not fully convincing, but a potential CPM candidate
	107.40958333	32.2980833	16.7	19.0											1.2	Pp	1987.890		POSS II.J estimates
	107.41008333	32.2975000	17.1	18.2			127	-176		117	-142				1.2	Pp	1999.855		POSS II.N estimates. PM values estimated by comparison with POSS II.J
	107.41022200	32.2974470	16.854	18.605	17.2	17.9									1.3	E2	1998.895		2MASS. M1 and M2 estimated from J- and K-band
	107.41049580	32.2969272	16.760	18.949			56.56	-127.02	6.26	60.53	-134.20	11.47			0.2	Eu	2013.684	ABB	URAT1. PM data calculated from position comparison with 2MASS
J1225+2836	12 25 46.782	+28 36 03.35					-96	-212		-112	-205							?	PM values so far only estimated - but comparison of POSS images strongly suggest CPM
	186.4507917	28.6074722	15.8	55.6											1.2	Pp	1955.290		POSS I.E estimates
	186.4495417	28.6050556	16.1	55.6			-96	-212		-112	-205				1.2	Pp	1996.308		POSS II.N estimates. PM values estimated by comparison with POSS I.E
	186.4451800	28.6015590	16.042	54.889						-80	-260	4.2			2.5	Es	2005.050		SDSS DR9. No PM data for A
J1233+3518	12 33 25.745	+35 18 25.02					-184	48		-197	48							?	PM values so far only estimated - but comparison of POSS images strongly suggest CPM
	188.3604583	35.3064167	2.9	247.8											1.2	Pp	1950.362		POSS I.O estimates
	188.3580833	35.3069167	3.4	250.9			-184	48		-197	48				1.2	Pp	1988.205		POSS II.J estimates - no resolution, but elongation and similar pm obvious
	188.3572010	35.3069200	3.502	266.582			-155	53	2.8						2.5	Es	2004.283		SDSS DR9. No PM data for B

Table 1 continues on the next page.

Table 1: Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1234+3014	12 34 26.789	+30 14 43.66					-81.20	-154.80	8.70	-90.80	-162.90	10.10						ACB	2MASS error a bit high, ditto vector length difference. Comparison POSS I.E with POSS II.N suggests CPM. Difference in proper motion vector length might be a hint for an orbit
	188.612750	30.247611													1.2	Pp	1950.272		POSS I.O estimate. Secondary not visible in image.
	188.611542	30.234500	5.522	243.400											1.2	Pp	1997.414		POSS II.N estimate
	188.611670	30.245541	5.057	240.900	14.400										1.3	E2	1998.170		2MASS. M1 estimated from J- and K-band, J- and K-band values for M2 not suited for Vmag calculation
	188.611580	30.245399					-88.00	-155.00							0.2	Eu	2000.000		UCAC4. Secondary not shown in UCAC4.
	188.611522	30.245238	5.261	240.888			-82	-154	2.8	-93.93	-175.57	23.98			2.5	Es	2004.957		SDSS-DR9. PM data for A from SDSS DR9 catalog and for B calculated from position comparison SDSS DR9 with 2MASS.
	188.611264	30.244873	5.345	239.893	15.450		-81.20	-154.80	8.70	-90.80	-162.90	10.10	K0		02	Eu	2014.013	ACB	URAT1. Spc1 from V-R values. PM data calculated from position comparison with 2MASS
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1300+5027	13 00 04.529	+50 27 15.08					-196.1	-39.3	6.2	-200.6	-37.9	6.2						AAA	Solid CPM candidate
	195.022292	50.454889	2.320	54.381			-196.1	-39.3	6.2	-200.6	-37.9	6.2			1.2	Pp	1953.289		POSS I.O estimate. Secondary very hard to identify in POSSI image, possible the coordinates for it are off slightly as a result.
	195.091667	50.454333	4.015	68.064			-162	-45		-119	-41				1.2	Pp	1995.233		POSS II.J estimate. PM data calculated from position comparison with POSSI.
	195.018868	50.454189	4.529	62.904	14.400	16.200									1.3	E2	2000.026		2MASS. M1 and M2 estimated from J- and K-band
	195.018552	50.454148	4.544	62.849			-184	-34	5.7	-148.59	-28.52	32.43			2.5	Es	2003.087		SDSS-DR9. PM data for A from SDSS DR9 catalog and for B calculated from position comparison SDSS DR9 with 2MASS.
	195.017706	50.454041	4.481	62.319			-196.1	-39.3	6.2	-200.6	-37.9	6.2			0.2	Eu	2013.615	AAA	URAT1. PM data calculated from position comparison with 2MASS.
	195.017700	50.454000	4.480	62.300			196.1	-39.3	6	-200.7	-37.9	6.3			0.2	Eu	2013.615		I/330 MPN 4259 from URAT1.
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1301+4057	13 01 13.196	+40 57 11.08					259.94	-576.54	31.38	257.20	-593.96	31.38						AAA	Comparison of POSS images strongly suggests CPM
	195.2999583	40.9618333	4.3	211.5											1.2	Pp	1950.430		POSS I.O estimate
	195.3040417	40.9552778	4.4	214.7			265	-563		259	-560				1.2	Pp	1992.380		POSS II.J estimates - no resolution, but elongation and similar pm obvious
	195.3045080	40.9538730	4.741	216.039	13.1										1.3	E2	1998.290		2MASS. M1 estimated from J- and K-band
	195.3049820	40.9530790	4.819	215.566			259.94	-576.54	31.38	257.20	-593.96	31.38			2.5	Es	2003.248	AAA	SDSS 9. PM data calculated from position comparison with 2MASS

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1331+3821	13 31 37.727	+38 21 41.35					132.44	-98.65	5.52	127.98	-100.31	5.48						AAA	Solid CPM candidate
	202.9051250	38.3629167	10.9	185.6											1.2	Pp	1950.461		POSS I.E estimates
	202.9066250	38.3618333	10.5	183.8			93	-85		100	-79				1.2	Pp	1996.219		POSS II.J estimates. PM values estimated by comparison with POSS I.E
	202.9071160	38.3615340	10.415	186.239	14.3	16.7									1.3	E2	1998.295		2MASS. M1 and M2 estimated from J- and K -band
	202.9073520	38.3614110	10.450	186.514			132.67	-88.18	16.90	121.99	-93.92	16.90			2.5	Es	2003.316		SDSS DR9. PM data calculated from position comparison with 2MASS
	202.9078000	38.3611000	10.46	186.5			132.5	-98.6	5.3	128	-100.3	5.3			0.2	Eu	2013.725		I/330 MPN4526 from URAT1
	202.9078377	38.3611125	10.457	186.526			132.44	-98.65	5.52	127.98	-100.31	5.48			0.2	Eu	2013.725	AAA	URAT1. PM data calculated from position comparison with 2MASS
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1347+0746	13 47 18.815	+07 46 12.03					-157.1	27.2	13.9	-152.7	31.3	6.4						AAB	Solid CPM candidate based on URAT1-2MASS comparison; PM from POSSII.J estimate below not dependable -- see note under POSSI.O estimate.
	206.830417	7.769639	14.916	170.247											1.2	Pp	1950.297		POSS I.O estimate. Primary and secondary too faint to register for Aladin PHOT tool; secondary very hard to distinguish in POSSI image.
	206.828667	7.770194	11.563	170.381			-142	45		-155	120				1.2	Pp	1994.042		POSS II.J estimate. PM data calculated from position comparison with POSSI. See note on POSSI.
	206.828813	7.769966	11.240	172.300	18.820										1.2	Pp	1993.316		GSC2.3. M1 is GSC Vmag.
	206.828387	7.770011	11.495	171.883	16.200	16.800									1.3	E2	2000.231		2MASS. M1 and M2 estimated from J- and K -band
	206.828280	7.770051	11.446	171.560			-160	24	4.2	-163	13	5.7			2.5	Es	2003.319		SDSS-DR9. PM data from SDSS DR9 catalog
	206.827969	7.770100	11.245	171.463			-148.1	31.8	13.0	-143.5	57.6	13.5			0.4	Hw	2010.298		WISE. PM data calculated from position comparison with 2MASS. Large WISE position error results in large PM error
	206.827800	7.770100	11.440	171.600			-157.1	27.2	6.2	-152.7	31.3	6.4			0.2	Eu	2013.515		I/330 MPN 4663 from URAT1.
	206.827804	7.770111	11.442	171.644			-157.1	27.2	13.9	-152.7	31.3	6.4			0.2	Eu	2013.525	AAB	URAT1. PM data calculated from position comparison with 2MASS
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1351+4337	13 51 24.343	+43 37 10.24					-173.00	23.56	13.29	-168.11	24.20	14.24						AAB	Despite the rather large 2MASS position error a solid CPM candidate
	207.8548750	43.6188611	6.8	43.0											1.2	Pp	1955.279		POSS I.E estimates
	207.8512500	43.6195833	6.6	48.0			-224	62		-219	48				1.2	Pp	1997.368		POSS II.N estimates. PM values estimated by comparison with POSS I.E
	207.8514100	43.6195140	6.337	45.219	15.11	16.95									1.3	E2	2000.313		2MASS. M1 and M2 estimated from J- and K -band
	207.8512680	43.6195730	6.405	45.407			-184	10	4.2	-105.36	83.87	65.81			2.5	Es	2003.232		SDSS 9. PM data for A from SDSS DR9 catalog and for B calculated from position comparison with 2MASS
	207.8508500	43.6196440	6.728	48.516			-143.7	46.1	33.8	-90.4	45.4	10.9			0.4	Hw	2010.466		WISE. PM data calculated from position comparison with 2MASS. Large WISE RA position error makes pm values suspect
	207.8505206	43.6196017	6.380	45.467	15.987		-173.00	23.56	13.29	-168.11	24.20	14.24	M0		0.2	Eu	2013.757	AAB	URAT1. PM data calculated from position comparison with 2MASS. Spectral class A based on B-V color index
	207.8505000	43.6196000	6.38	45.5			-173.0	23.6	6.0	-168.1	24.2	6.2			0.2	Eu	2013.757		I/330 MPN4696 from URAT1
	207.8503458	43.6196167			15.939										0.61	C	2016.519		iT24 1x60s. No resolution of B

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1414+5920	14 14 17.570	+59 20 20.98					19.9	-167.3	5.8	10.3	-173.9	6.1						BAA	Solid CPM candidate even if PM direction seems slightly different
	213.572333	59.341556	9.640	50.900											1.2	Pp	1953.202		POSS I.O estimate. Secondary almost impossible to see in image, tagged manually.
	213.572917	59.339361	9.478	52.270			24	-179		-16	-297				1.2	Pp	1997.530		POSS II.N estimate. PM data calculated from position comparison with POSSI. Secondary tagged manually, results checked twice to confirm PM results.
	213.573205	59.339105	10.160	48.600	11.740								M0		1.2	Pp	1998.765		GSC 2.3. M1 is Vmag. Epoch shown is mean epoch (Epoch of primary is 2000.000; Epoch of secondary is 1997.529).
	213.573199	59.339203	9.508	51.726	11.700	17.200									1.3	E2	1999.123		2MASS. M1 and M2 estimated from J - and K-band
	213.573357	59.338526	9.406	51.089			19.9	-167.3	5.8	10.3	-173.9	6.1			0.2	Eu	2013.369	BAA	URAT1. PM data calculated from position comparison with 2MASS.
	213.573400	59.338500	9.510	51.100			19.9	-167.3	5.5	10.3	-173.9	6.3			0.2	Eu	2013.369		I/330 MPN 4915 from URAT1.
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1417+7031	14 17 58.064	+70 31 47.52			14.12	15.51	-141	136		-141	134							?	PM values so far only estimated - but comparison of POSS images strongly suggests CPM
	214.4975417	70.5281667	4.8	340.4											1.2	Pp	1955.386		POSS I.O estimates
	214.4926250	70.5297500	4.7	340.0			-141	136		-141	134				1.2	Pp	1997.289		POSS II.N estimates. PM values estimated by comparison with POSS I.O
	214.4899917	70.5303056	3.414	344.540	14.122	15.509									.61	C	2016.505		iT24 stack 5x10s. Err_Sep=0.022", Err_PA=0.375°, Err_M1=0.036, Err_M2=0.053
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1418+3219	14 18 29.115	+32 19 26.95			10.37	16.40	112.22	-150.90	11.30	108.48	-151.18	10.99						AAB	Despite the rather large 2MASS position error a solid CPM candidate
	214.6185000	32.3266111	6.9	129.6											1.2	Pp	1950.278		POSS I.E estimates
	214.6208333	32.3244167	6.4	132.5			158	-176		144	-174				1.2	Pp	1995.146		POSS II.N estimates. PM values estimated by comparison with POSS I.E
	214.6212500	32.3242230	6.203	134.794	10.4	15.0									1.3	E2	1998.341		2MASS. M1 and M2 estimated from J - and K-band
	214.6215040	32.3240410	6.316	137.524											2.5	Es	2004.291		SDSS DR9
	214.6218203	32.3235750	6.244	135.319	10.323		112.22	-150.90	11.30	108.48	-151.18	10.99	G0		0.2	Eu	2014.016	AAB	URAT1. PM data calculated from position comparison with 2MASS. Spectral class A from B-V color index
	214.6218000	32.3236000	6.24	135.3			112.2	-150.8	5.3	108.5	-151.2	5.1			0.2	Eu	2014.016		I/330 MPN4963 from URAT1
	214.6219625	32.3233806	5.628	134.437	10.368	16.395									0.61	C	2016.519		iT24 1x60s. Overlapping star disks. SNR B <20. Err_Sep=0.028", Err_PA=0.288°, Err_M1=0.030, Err_M2=0.076

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1418+3634	14 18 55.328	+36 34 29.50					-202.19	45.13	9.76	-198.50	45.76	9.85						AAA	Solid CPM candidate
	214.7349583	36.5738333	12.0	189.8											1.2	Pp	1950 .362		POSS I.E estimates
	214.7318750	36.5744722	12.0	189.8			-212	55		-212	55				1.2	Pp	1992 .380		POSS II.N estimates. PM values estimated by comparison with POSS I.E
	214.7316100	36.5746690	11.928	189.797	15.8	17.1									1.3	E2	1998 .301		2MASS. M1 and M2 estimated from J - and K-band
	214.7312520	36.5746900	11.912	189.542			-206.35	15.07	29.91	-195.40	16.51	29.91			2.5	Es	2003 .316		SDSS 9. PM data calculated from position comparison with 2MASS
	214.7305350	36.5748617	11.911	189.391			-202.19	45.13	9.76	-198.50	45.76	9.85			0.2	Eu	2013 .598	AAA	URAT1. PM data calculated from position comparison with 2MASS
	214.7303167	36.5749083			18.063										0.61	C	2016 .519		iT24 1x60s. SNR A <20. No resolution of B
	214.7302917	36.5748611			18.371										0.61	C	2016 .521		iT24 1x60s. SNR A <20. No resolution of B
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1422+5111	14 22 18.413	+51 11 56.53			16.58	17.19	-164.1	69.8	5.9	-161.5	65.8	6						AAA	Solid CPM candidate
	215.580333	51.198306	4.856	194.573											1.2	Pp	1953 .278		POSS I.O estimate. Both stars tagged manually; Aladin centroid located midway between the pair.
	215.576750	51.198972	5.071	189.603			-183	54		-175	48				1.2	Pp	1996 .536		POSS II.N estimate. PM data calculated from position comparison with POSSI. Both stars tagged manually; Aladin centroid located midway between the pair.
	215.577164	51.198918	4.907	190.100	15.390										1.2	Pp	1994 .442		GSC2.3. M1 is Vmag.
	215.576766	51.199024	5.145	190.740	14.600	15.200									1.3	E2	1999 .390		2MASS. M1 and M2 estimated from J - and K-band
	215.576536	51.199086	5.186	190.350			-175.3	75.4	28.7	-166.1	59.6	28.7			2.5	Es	2002 .350		SDSS-DR9. PM data calculated from position comparison with 2MASS. Time frame too short to allow for reliable PM results
	215.575940	51.199279	5.125	189.757			-168.2	82.9	13.3	-160.1	83.2	17.7			0.4	Hw	2010 .465		WISE. PM data calculated from position comparison with 2MASS
	215.575722	51.199302	5.198	190.029			-164.1	69.8	5.9	-161.5	65.8	6			0.2	Eu	2013 .691	AAA	URAT1. PM data calculated from position comparison with 2MASS
	215.575700	51.199300	5.200	190.000			-164.1	69.8	5.6	-161.6	65.8	5.7			0.2	Eu	2013 .691		I/330 MPN 4993 from URAT1.
							-161.2	68.3	2.6	-160.3	67.4	2.8			0.2	Eu	2013 .691		PM data calculated from position comparison SDSS DR9 to URAT1
	215.575533	51.199350	5.331	191.699	16.580	17.190									0.61	C	2016 .519		iT24 1x60s. Err Sep = 0.014, Err PA = 0.152, Err M1 = 0.039, Err M2 = 0.050.

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1511+0912	15 11 33.050	+09 12 23.70					-107	27		-111	23							?	Comparison of POSS images suggests CPM. PM data estimated
	227.889083	9.206194	3.023	136.703											1.2	Pp	1951.518		POSS I.E estimate. Both stars tagged manually
	227.887750	9.206528	3.077	141.269			-107	27		-111	23				1.2	Pp	1995.624		POSS II.N estimate. Both stars tagged manually
	227.887696	9.206590			15.680										1.3	E2	2000.272		2MASS. M1 and M2 estimated from J - and K-band, secondary not identified in 2MASS.
	227.887582	9.206693	3.427	140.000											2.5	Es	2003.245		SDSS-DR9. No secondary in 2MASS for PM comparison
	227.887153	9.206882					-144.2	78.5							0.2	Eu	2013.655		URAT1. Secondary not identified in URAT1.
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1524+3146	15 24 34.482	+31 46 48.79			14.35	19.02	-206.4	43.2	6.0	-214.2	39.1	5.9						AAA	Solid CPM candidate
	231.148167	31.780306	4.823	258.033											1.2	Pp	1954.482		POSS I.O estimate. Both centroids tagged manually.
	231.145458	31.780750	5.808	255.032			-198	38		-219	26				1.2	Pp	1996.309		POSS II.N estimate. Both centroids tagged manually.
	231.145380	31.780588	5.695	253.890	14.300	17.200									1.3	E2	1998.246		2MASS. M1 and M2 estimated from J - and K-band
	231.145027	31.780644	5.880	253.679			-193	43	4.2	-247.0	25.6	18.2			2.5	Es	2003.314		SDSS-DR9. PM data for A from SDSS DR9 catalog and for B calculated from position comparison with 2MASS.
	231.144336	31.780774	5.851	253.720			-206.4	43.2	6.0	-214.2	39.1	5.9			0.2	Eu	2013.779	AAA	URAT1. PM data calculated from position comparison with 2MASS. Attention: Aladin shows URAT1 J2000 positions in image wrong due to wrong URAT1 PM data
	231.144192	31.780825			14.323										0.61	C	2016.505		iT24 stack 5x10s. No resolution of B. Err M1 = 0.100.
	231.144204	31.780817	4.861	250.784	14.351	19.016									0.61	C	2016.516		iT24 1x60s. SNR B <10. Err Sep = 0.089, Err PA = 1.054, Err M1 = 0.061, Err M2 = 0.236.
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1524+3942	15 24 17.987	+39 42 22.16			15.72	18.12	-41.18	178.93	5.92	-44.28	176.05	5.95						AAA	Solid CPM candidate
	231.0755417	39.7042222	6.7	140.1											1.2	Pp	1955.244		POSS I.O estimates
	231.0748333	39.7061389	6.8	138.6			-47	164		-41	164				1.2	Pp	1997.412		POSS II.N estimates. PM values estimated by comparison with POSS I.O
	231.0749560	39.7061270	6.630	137.832	13.913	15.735									1.3	E2	1999.393		2MASS. M1 and M2 estimated from J - and K-band
	231.074778	39.7066740	6.363	136.965			-44.7	178.5	21.3	-54.5	202.3	9.5			0.4	Hw	2010.423		WISE. PM data calculated from position comparison with 2MASS. Large WISE position error results in large PM error
	231.0747000	39.7068000	6.64	138.4			-41.1	179.0	5.7	-44.2	176.1	5.7			0.2	Eu	2013.693		I/330 MPN5488 from URAT1
	231.0747428	39.7068397	6.644	138.413			-41.18	178.93	5.92	-44.28	176.05	5.95			0.2	Eu	2013.693	AAA	URAT1. PM data calculated from position comparison with 2MASS
	231.0747042	39.7069750	6.485	138.141	15.715	18.116									0.61	C	2016.519		iT24 1x60s. SNR B <20. Err_Sep=0.014", Err_PA=0.125°, Err_M1=0.043, Err_M2=0.088

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1532+1733	15 32 33.356	+17 33 18.20			16.67	18.17	-294.50	81.00	7.50	-300.20	77.30	7.30						ABA	Solid CPM candidate. Difference of PM vector length might be a hint for an orbit
	233.144042	17.553861	2.417	24.468											1.2	Pp	1950.291		POSS I.O estimate. Center of secondary difficult to locate because image is blurred with primary.
	233.140708	17.555250	2.738	18.265			-259.00	113.00		-263.00	122.00				1.2	Pp	1994.450		POSS II.N estimate. PM data calculated from position comparison with POSSI.
	233.140220	17.554731	4.274	26.879	15.000	16.000									1.3	E2	1999.133		2MASS. M1 and M2 estimated from J - and K-band
	233.139269	17.555085	4.573	32.102			-291.0	113.6	15.1	-246.7	119.1	6.9			0.4	Hw	2010.349		WISE. PM data calculated from position comparison with 2MASS
	233.138983	17.555055	4.171	24.909			-294.50	81.00	7.50	-300.20	77.30	7.30			0.2	Eu	2013.704	ABA	URAT1. PM data calculated from position comparison with 2MASS
	233.138733	17.555067			16.670										.61	C	2016.510		iT24 stack 5x10s. No resolution of B. SNR A <20. Err M1 = 0.084.
	233.138754	17.555097	4.399	29.190	16.673	18.168									.61	C	2016.516		iT24 1x60s. SNR B <20. Err Sep = 0.042, Err PA = 0.553, Err M1 = 0.056, Err M2 = 0.092.
																			NOTE: No UCAC4 data for this pair.
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1604+4620	16 04 12.236	+46 20 15.94			9.98	15.14	-160.7	-76.3	11.2	-165.8	-75.7	11.3						AAB	Solid CPM candidate despite the rather large 2MASS position error
	241.051027	46.337776	6.481	58.448	9.200	11.700									1.3	E2	1999.349		2MASS. M1 and M2 estimated from J - and K-band
	241.050973	46.337744	6.152	57.226											2.5	Es	2001.375		SDSS-DR9. Time frame too short to allow for reliable calculated PM results with 2MASS and SDSS DR9 position error in this case far too large to make a useful PM calculation SDSS DR9 to URAT1
	241.050343	46.337500	6.225	57.579			-154.4	-90.2	8.3	-178.7	-95.1	26.8			0.4	Hw	2010.362		WISE. PM data calculated from position comparison with 2MASS. Large WISE position error results in large PM error
	241.050100	46.337500	6.450	58.100			-160.7	-76.3	5.7	-165.8	-75.7	5.8			0.2	Eu	2013.630		I/330 MPN 5773 from URAT1.
	241.050099	46.337472	6.448	58.064			-160.7	-76.3	11.2	-165.8	-75.7	11.3			0.2	Eu	2013.630	AAB	URAT1. PM data calculated from position comparison with 2MASS
	241.050033	46.337383	6.517	55.085	9.928	15.292									.61	C	2016.519		iT24 1x60s. Overlapping star disks. Err Sep = 0.028, Err PA = 0.249, Err M1 = 0.050, Err M2 = 0.059.
	241.049967	46.337289	6.420	53.600	9.975	15.135									.61	C	2016.521		iT24 1x60s. Overlapping star disks. Err Sep = 0.061, Err PA = 0.543, Err M1 = 0.050, Err M2 = 0.069.
																			Note: Primary and secondary in POSS images merged in glare of primary, not possible to separate the two for measurements.

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1638+1658	16 38 33.088	+16 58 12.27			16.40	19.38	40.02	-162.37	5.30	39.71	-158.60	5.32						AAA	Solid CPM candidate
	249.6371667	16.9725278	4.5	113.4											1.2	Pp	1950.204		POSS I.O estimates
	249.6377083	16.9706667	4.6	111.6			44	-159		48	-157				1.2	Pp	1992.317		POSS II.N estimates. PM values estimated by comparison with POSS I.O
	249.6378370	16.9701860	5.253	112.826	15.0	16.5									1.3	E2	1997.561		2MASS. M1 and M2 estimated from J - and K-band
	249.6379070	16.9698960	5.272	112.269			35.83	-155.18	12.61	41.46	-149.29	12.61			2.5	Es	2004.289		SDSS 9. PM data calculated from position comparison with 2MASS (catalog PM data for A seems suspect)
	249.6380000	16.9695000	5.22	112.1			40.0	-162.3	5.1	39.8	-158.6	5.2			0.2	Eu	2013.539		I/330 MPN6001 from URAT1
	249.6380231	16.9694639	5.219	112.144	16.231		40.02	-162.37	5.30	39.71	-158.60	5.32	M0		0.2	Eu	2013.539	AAA	URAT1. PM data calculated from position comparison with 2MASS. Spectral class A based on B-V color index
	249.6380750	16.9693222	5.400	113.576	16.401	19.378									.61	C	2016.519		iT24 1x60s. SNR B <10. Err_Sep=0.014", Err_PA=0.150°, Err_M1=0.046, Err_M2=0.192
LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1644+4153	16 44 28.918	+41 53 02.18			12.54	16.33	34.15	-225.45	5.60	32.49	-227.83	5.60						AAA	Solid CPM candidate
	251.1195417	41.8879722	7.1	40.3											1.2	Pp	1953.379		POSS I.O estimate
	251.1203018	41.8847909	6.592	39.357	12.52		36.9	-222.4		214.1	-8.2		M0		0.2	Eu	1988.835		UCAC4 mean epoch. PM values obviously wrong, probably typo. Spectral class A from B-V color index
	251.1202300	41.8853390	6.916	36.008											1.2	Pp	1990.610		GSC2.2 mean epoch
	251.1199583	41.8852222	7.0	40.8											1.2	Pp	1993.379		POSS II.F estimates
	251.1203750	41.8850556	7.3	37.6			52	-243		49	-234				1.2	Pp	1996.618		POSS II.N estimates
	251.1202970	41.8848950	7.285	38.528	12.2	14.1									1.3	E2	1998.429		2MASS. M1 and M2 estimated from J - and K-band
	251.1203790	41.8847430	7.177	38.693											2.5	Es	2001.290		SDSS DR7
	251.1204917	41.8839381	7.263	38.362	12.52		34.15	-225.45	5.60	32.49	-227.83	5.60	M0		0.2	Eu	2013.638	AAA	URAT1. PM data calculated from position comparison with 2MASS. Spectral class A from B-V color index
	251.1205208	41.8838444	6.985	38.456	12.592	16.407									.61	C	2016.499		iT24 stack 5x5s. SNR B<20. Err_Sep=0.085", Err_PA=0.701°, Err_M1=0.041, Err_M2=0.095
	251.1204917	41.8838639	7.151	39.348	12.542	16.328									.61	C	2016.510		iT24 stack 5x10s. SNR B<20. Err_Sep=0.085", Err_PA=0.685°, Err_M1=0.051, Err_M2=0.092

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1647+1501	16 47 10.643	+15 01 15.33					-155.1	-26.6	6.9	-157.8	-23.4	7.4						AAA	Solid CPM candidate
	251.796250	15.021667	12.214	357.281											1.2	Pp	1950.376		POSS I.O estimate. Secondary tagged manually.
	251.794542	15.021139	12.621	356.710			-135	-43		-138	-34				1.2	Pp	1992.317		POSS II.N estimate. PM data calculated from position comparison with POSSI. Secondary tagged manually.
	251.794804	15.021013	12.820	355.600	14.670										1.2	Pp	1989.256		GSC2.3. M1 is Vmag.
	251.794330	15.020923	12.532	355.863	14.500	17.900									1.3	E2	2000.321		2MASS. M1 and M2 estimated from J - and K-band
	251.794135	15.020893	12.756	355.814			-150	-29	2.8	-173.2	-16.22	24.78			2.5	Es	2004.316		SDSS-DR9. PM data for A from SDSS DR9 catalog and for B calculated from position comparison with 2MASS.
	251.793736	15.020825	12.575	355.652			-155.1	-26.6	6.9	-157.8	-23.4	7.4			0.2	Eu	2013.685	AAA	URAT1. PM data calculated from position comparison with 2MASS
	251.793700	15.020800	12.580	355.700			-155.2	-26.5	6.1	-157.8	-23.4	6.4			0.2	Eu	2013.685		I/330 MPN 6063 from URAT1.
	251.793688	15.020742			14.933										.61	C	2016.506		iT27 stack 5x10s. SNR A <20, no resolution of B. Err M1 = 0.111
	251.793813	15.020897			14.935										.61	C	2016.522		iT27 stack 5x10s. SNR A <20, no resolution of B. Err M1 = 0.118
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1708+3558	17 08 48.075	+35 58 04.19			16.10	16.73	11.17	147.21	6.45	11.04	149.21	6.48						AAA	Solid CPM candidate
	257.1997917	35.9660556	5.2	237.4											1.2	Pp	1954.507		POSS I.O estimates
	257.2001667	35.9675278	5.2	237.4			28	136		28	136				1.2	Pp	1993.489		POSS II.N estimates. PM values estimated by comparison with POSS I.O
	257.2003060	35.9677620	5.738	236.917	14.2	14.6									1.3	E2	1998.355		2MASS. M1 and M2 estimated from J - and K-band
	257.200312	35.9678610	5.756	236.906											2.5	Es	2001.225		SDSS 9. No catalog PM data available. Time distance to 2MASS too short to make reasonable PM data calculations
	257.200407	35.9682860	5.587	236.612			24.9	159.8	13.8	37.0	164.7	11.7			0.4	Hw	2010.162		WISE. PM data calculated from position comparison with 2MASS. Large WISE position error results in large PM error
	257.2004000	35.9684000	5.73	237.1			11.2	147.2	5.3	11.1	149.2	5.3			0.2	Eu	2013.678		I/330 MPN6235 from URAT1
	257.2003649	35.9683900	5.729	237.101			11.17	147.21	6.45	11.04	149.21	6.48			0.2	Eu	2013.678	AAA	URAT1. PM data calculated from position comparison with 2MASS
	257.2003708	35.9685167	5.742	237.149	16.101	16.730									.61	C	2016.519		iT24 1x60s. Err_Sep=0.022", Err_PA=0.223°, Err_M1=0.035, Err_M2=0.041

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1714+0517	17 14 45.267	+05 17 43.19			18.19	19.37	-18.70	-145.60	15.20	-31.40	-144.40	15.90						BAC	Relatively large 2MASS errors make it hard to come to a conclusion, but visual comparison of POSS images strongly suggests CPM
	258.689333	5.297389	5.420	157.305											1.2	Pp	1950.523		POSS I.O estimate. Aladin picks central point between the two stars as centroid, so ineffective in this case; estimates done manually here, also for POSSII image.
	258.688625	5.295555	4.514	152.401			-54	-141		-54	-120				1.2	Pp	1997.281		POSS II.F estimate. PM data calculated from position comparison with POSSI.
	258.688746	5.295443	4.418	154.100											1.2	Pp	1997.281		GSC2.3 (same epoch for both stars)
	258.688611	5.295315	4.415	154.616	17.61	18.51									1.3	E2	2000.403		2MASS. M1 and M2 estimated from J- and K-band
	258.688611	5.295315	4.324	156.453			-18.70	-145.60	15.20	-31.40	-144.40	15.90			0.2	Eu	2013.527	BAC	URAT1. No Vmag for either component. PM data calculated from position comparison with 2MASS
	258.688533	5.294658	4.037	167.393	18.185	19.368									.61	C	2016.516		iT24 1x60s. SNR A <20 and B <10. Err Sep = 0.071, Err PA = 1.003, Err M1 = 0.087, Err M2 = 0.197.
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1723+0425	17 23 51.722	+04 25 31.81					-115	-103		-112	-103							?	PM values so far only estimated - but comparison of POSS images strongly suggest CPM
	260.9671667	4.4269722	5.0	302.8											1.2	Pp	1950.524		POSS I.O estimates
	260.9656667	4.4256389	4.9	303.8			-115	-103		-112	-103				1.2	Pp	1997.281		POSS II.F estimates - no resolution, but elongation and similar pm obvious
	260.9654920	4.4254900	4.560	302.628	10.4										1.3	E2	2000.441		2MASS. Vmag estimated from J- and K-mag values
	260.9649625	4.4250556			10.341										.61	C	2016.505		iT24 stack 5x10s. No resolution of B
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1756+0931	17 56 58.420	+09 31 52.84					-86	-222		-93	-234							?	PM data only estimates but POSSI/POSSII comparison suggests strongly CPM
	269.244417	9.534639	2.835	170.994											1.2	Pp	1950.376		POSS I.O estimate. Secondary tagged manually.
	269.243375	9.531972	3.303	177.433			-86	-222		-93	-234				1.2	Pp	1993.527		POSS II.F estimate. Secondary tagged manually.
	269.243409	9.531318			13.154										1.3	E2	2000.411		2MASS. M1 and M2 estimated from J- and K-band. Secondary not shown in 2MASS.
	269.243143	9.530490			13.521		-71.2	-224.1					M0		0.2	Eu	2013.703		URAT1. PM data from URAT1 data, M1 is URAT1 Vmag, Spc1 is from URAT1 B-V data. Potential secondary shown in URAT1 is located too far away at 10.43" and has an f.mag of 17.11, no PM data shown for it.
	269.243083	9.530311			13.542										.61	C	2016.505		iT24 stack 5x10s. No resolution of B. Err M1 = 0.042.
	269.243046	9.530294			13.617										.61	C	2016.516		iT24 1x60s. No resolution of B. Err M1 = 0.110.
																			Notes: Secondary not identified in SDSS-DR9, primary identified appears to be wrong star also based on magnitude; secondary not identified in WISE.

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1801+1754	18 01 55.661	+17 54 22.33					-30.4	-204.5	6.8	-25.2	-202.9	6.8						AAA	Solid CPM candidate
	270.482333	17.909306	4.655	101.147											1.2	Pp	1952.539		POSS I.O estimate. Both POSSI and POSSII tagged manually; Aladin phot tool places centroid midway between the two stars.
	270.482208	17.906806	3.570	88.395			-10	-204		-32	-181				1.2	Pp	1993.699		POSS II.F estimate. PM data calculated from position comparison with POSSI. Obvious sign of tandem motion for this pair from POSSI to POSSII images. Differences in PA and PM are result of secondary's shift in position of one full pixel between images.
	270.481918	17.906191	4.923	92.179	14.300	14.900									1.3	E2	2000.193		2MASS. M1 and M2 estimated from J - and K-band
	270.481875	17.905689	5.050	91.184			-14.7	-180.2	14.8	-1.7	-172.0	20.1			0.4	Hw	2010.220		WISE. PM data calculated from position comparison with 2MASS. Large WISE RA position error makes pm values suspect
	270.481800	17.905400	4.990	92.100			-30.4	-204.5	6.1	-25.2	-202.8	6			0.2	Eu	2013.725		I/330 MPN 6605 from URAT1.
	270.481798	17.905424	4.991	92.075			-30.4	-204.5	6.8	-25.2	-202.9	6.8			0.2	Eu	2013.725	AAA	URAT1. PM data calculated from position comparison with 2MASS
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1820+3122	18 20 14.124	+31 22 42.11			11.81	17.96	-10.55	186.16	5.49	-14.56	185.11	5.60						AAA	Solid CPM candidate
	275.0587917	31.3759722	14.4	353.4											1.2	Pp	1951.520		POSS I.O estimates
	275.0586667	31.3782778	14.3	352.3			-9	188		-14	186				1.2	Pp	1995.695		POSS II.N estimates. PM values estimated by comparison with POSS I.O
	275.0588580	31.3782770	14.091	351.584	11.581	15.765									1.3	E2	1998.295		2MASS. M1 and M2 estimated from J - and K-band
	275.0588000	31.3791000	14.03	351.3			-10.5	186.2	5.3	-14.5	185.1	5.4			0.2	Eu	2013.595		I/330 MPN6710 from URAT1
	275.0588050	31.3790758	14.029	351.308	11.787		-10.55	186.16	5.49	-14.56	185.11	5.60	K6		0.2	Eu	2013.595	AAA	URAT1. PM data calculated from position comparison with 2MASS. Spectral class A from B-V color index
	275.0587875	31.3792222	14.131	351.348	11.806	17.964									.61	C	2016.519		iT24 1x60s. SNR B <20. Err_Sep=0.092", Err_PA=0.374°, Err_M1=0.030, Err_M2=0.070

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1827+5016	18 27 40.643	+50 16 13.06			10.63	13.87	199.40	86.70	10.22	184.01	83.21	6.47						ABA	Solid CPM candidate despite some PM vector length difference (hint for orbit?)
	276.9137917	50.2691667	4.6	223.8											1.2	Pp	1950.382		POSS I.O estimates
	276.9178333	50.2703056	4.8	229.6			211	93		200	98				1.2	Pp	1994.464		POSS II.N estimates. PM values estimated by comparison with POSS I.O
	276.9180260	50.2699280	4.651	235.863	10.3	10.8									1.3	E2	1998.487		2MASS. M1 and M2 estimated from J - and K-band
	276.9193444	50.2702944	4.860	236.865	10.567		199.40	86.70	10.22	184.01	83.21	6.47	M0		0.2	Eu	2013.739	ABA	URAT1. PM data calculated from position comparison with 2MASS. Spectral class A based on B-V color index
	276.9195792	50.2703639	4.750	237.102	10.631	13.867									.61	C	2016.510		iT24 stack 5x10s. Err_Sep=0.014", Err_PA=0.171°, Err_M1=0.020, Err_M2=0.027
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1852+3058	18 52 58.852	+30 58 10.31					-61.6	-191.9	5.6	-64.5	-191.2	5.6						AAA	Solid CPM candidate
	283.245833	30.972306	10.301	359.285											1.2	Pp	1951.507		POSS I.O estimate. Secondary tagged manually.
	283.245167	30.969861	10.607	357.915			-47	-200		-52	-193				1.2	Pp	1995.550		POSS II.N estimate. Secondary tagged manually.
	283.245153	30.969385	13.670	0.400		13.960									1.2	Pp	1992.446		GSC2.3. M2 is Vmag. Epoch shown is mean epoch (Epoch of primary is 1995.554; Epoch of secondary is 1989.338).
	283.245251	30.969620	10.446	356.714	11.000	13.300									1.3	E2	1998.306		2MASS. M1 and M2 estimated from J - and K-band
	283.245214	30.969539	9.911	355.900	11.351		-63.1	-195.1		-58	-198		M0		0.2	Eu	2000.167		UCAC4. M1 is Vmag, Spc1 is from UCAC4 B-V data. Epoch shown is mean epoch of RA of Primary (2000.38), Dec of primary (1999.67), and RA and Dec of secondary (2000.000)
	283.245031	30.968980	10.489	357.166			-56.7	-192.5	7.8	-50.0	-188.6	17.8			0.4	Hw	2010.274		WISE. PM data calculated from position comparison with 2MASS
	283.245000	30.968800	10.450	356.500			-61.6	-191.9	5.5	-64.4	-191.2	5.4			0.2	Eu	2013.384		I/330 MPN 7003 from URAT1.
	283.244950	30.968817	10.452	356.468			-61.6	-191.9	5.6	-64.5	-191.2	5.6			0.2	Eu	2013.384	AAA	URAT1. PM data calculated from position comparison with 2MASS

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1859+3054	18 59 50.054	+30 54 36.89			15.65	20.40	-42.57	-211.50	5.56	-43.94	-206.76	5.59						AAA	Solid CPM candidate
	284.9592917	30.9139167	6.0	58.9											1.2	Pp	1950.458		POSS I.O estimates
	284.9587917	30.9112500	6.0	62.0			-34	-213		-31	-220				1.2	Pp	1995.550		POSS II.N estimates. PM values estimated by comparison with POSS I.O
	284.9587690	30.9111440	6.199	62.543	14.5	16.4									1.3	E2	1998.309		2MASS. M1 and M2 estimated from J - and K-band
	284.9585586	30.9102472	6.227	61.723			-42.57	-211.50	5.56	-43.94	-206.76	5.59			0.2	Eu	2013.527	AAA	URAT1. PM data calculated from position comparison with 2MASS
	284.9585417	30.9100528			15.781										.61	C	2016.499		iT24 stack 2x5s. SNR A<20. No resolution of B. Err_M1=0.078
	284.9585292	30.9100750	5.360	62.678	15.654	20.400									.61	C	2016.508		iT24 1x60s. SNR B<10. Err_Sep=0.092", Err_PA=0.985°, Err_M1=0.043, Err_M2=0.497
	284.9585125	30.9100556			15.737										.61	C	2016.510		iT24 stack 5x10s. No resolution of B. Err_M1=0.073
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1901+3132	19 01 15.072	+31 32 17.67			12.98	17.91	-200.30	23.90	5.60	-201.00	26.10	5.60						AAA	Solid CPM candidate
	285.316917	31.537833	8.468	112.936											1.2	Pp	1950.458		POSS I.O estimate.
	285.314562	31.538058	9.201	113.400	12.620										1.2	Pp	1987.472		GSC2.3. M1 is Vmag.
	285.313833	31.538083	9.216	111.650			-215.00	20.00		-197.00	18.00				1.2	Pp	1994.499		POSS II.N estimate. PM data calculated from position comparison with POSSI.
	285.313788	31.538141	9.113	114.531	12.500	15.500									1.3	E2	1998.309		2MASS. M1 and M2 estimated from J - and K-band
	285.313662	31.538156	8.690	115.400	12.409	16.501									0.2	Eu	2001.905		UCAC4. M1 and M2 are UCAC4 f.mags. Epoch shown is mean for A, epoch for secondary is 2000.
	285.313003	31.538192	8.878	112.255			-201.2	15.3	7.9	-207.3	50.5	25.2			0.4	Hw	2010.282		WISE. PM data calculated from position comparison with 2MASS. Large WISE position error results in large PM error
	285.312799	31.538242	9.096	114.355	12.963		-200.30	23.90	5.60	-201.00	26.10	5.60			0.2	Eu	2013.442	AAA	URAT1. M1 is Vmag. PM data calculated from position comparison with 2MASS
	285.312604	31.538258	8.875	114.639	12.942	18.123									.61	C	2016.510		iT24 stack 5x10s. SNR B <10. Err Sep = 0.099, Err PA = 0.639, Err M1 = 0.061, Err M2 = 0.147.
	285.312596	31.538258	9.131	113.903	12.975	17.906									.61	C	2016.516		iT24 1x60s. Err Sep = 0.092, Err PA = 0.578, Err M1 = 0.040, Err M2 = 0.071.
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1905+3237	19 05 07.578	+32 37 52.60			12.51	15.05	-156.11	-180.37	5.55	-154.97	-181.34	5.58						AAA	Solid CPM candidate
	286.2852917	32.6345833	4.4	233.7											1.2	Pp	1951.518		POSS I.O estimates
	286.2828750	32.6323056	4.8	235.4			-166	-186		-175	-188				1.2	Pp	1995.624		POSS II.N estimates. PM values estimated by comparison with POSS I.O
	286.2828460	32.6318860	4.562	242.355	12.2	13.6									1.3	E2	1998.312		2MASS. M1 and M2 estimated from J - and K-band
	286.2827418	32.6318084	5.103	239.251											0.2	Eu	2000.580		UCAC4 with averaged observation epoch
	286.2820594	32.6311206	4.537	242.170			-156.11	-180.37	5.55	-154.97	-181.34	5.58			0.2	Eu	2013.552	AAA	URAT1. PM data calculated from position comparison with 2MASS
	286.2819167	32.6309694	4.503	242.778	12.512	15.052									.61	C	2016.510		iT24 stack 5x10s. Err_Sep=0.071", Err_PA=0.900°, Err_M1=0.081, Err_M2=0.101

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1906 +1652	19 06 52.110	+16 52 07.20			15.40	17.10	21	132		35	169							?	No final CPM conclusion due to lack of data but comparison POSS images suggests CPM
	286.716375	16.866279	2.438	10.173											1.2	Pp	1953. 623		POSS I.O estimate. Both stars tagged manually.
	286.716625	16.867778	4.027	14.448			21	132		35	169				1.2	Pp	1994. 439		POSS II.N estimate. Both stars tagged manually.
	286.716928	16.867865	3.750	13.700	13.771	14.799									1.3	E2	1997. 531		2MASS. M1 and M2 estimated from J- and K-band
	286.717088	16.868706			15.515										.61	C	2016. 502		iT24 stack 5x10s. SNR A<20. No resolution of B - has to be fainter than 16.5mag. Err M1 = 0.087.
	286.717138	16.868650	3.566	15.885	15.399	17.055									.61	C	2016. 505		iT24 stack 5x10s. SNR B<20. Err Sep = 0.036, Err PA = 0.579, Err M1 = 0.068, Err M2 = 0.110.
	286.717142	16.868653	3.645	15.064	15.343	17.037									.61	C	2016. 505		iT24 1x60s. Err Sep = 0.028, Err PA = 0.445, Err M1 = 0.071, Err M2 = 0.082.
	286.717129	16.868661	3.604	13.825	15.395	17.102									.61	C	2016. 508		iT24 1x60s. Err Sep = 0.028, Err PA = 0.450, Err M1 = 0.062, Err M2 = 0.075.
																			Notes: Neither of the pair is identified in SDSS-DR9; secondary is identified in WISE, but not primary. Neither star identified in GSC 2.3 or UCAC4; only one star identified in URAT1, which appears to be the secondary.
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1909 +5659	19 09 00.342	+56 59 48.77			14.36	19.25	-200	-21		-202	-16							?	Visually comparison of POSS images suggests CPM but hard facts are missing
	287.255833	56.997472	4.576	91.252											1.2	Pp	1952. 569		POSS I.E estimate. Hint of pointed elongation manually tagged
	287.251958	56.997250	4.495	88.725			-200	-21		-202	-16				1.2	Pp	1990. 505		POSS II.N estimate. Hint of pointed elongation manually tagged. PM data calculated from position comparison with POSSI
	287.251399	56.996876			13.445										1.3	E2	2000. 327		2MASS. M1 estimated from J- and K-band. Secondary not identified in 2MASS.
	287.250400	56.996650			14.379		-149.4	-62							0.2	Eu	2013. 432		URAT1. M1 is Vmag. B component not identified in URAT1.
	287.250063	56.996564			14.343										.61	C	2016. 502		iT24 stack 5x10s. No resolution of B - has to be fainter than 16.5mag. Err M1 = 0.045.
	287.250167	59.996600	4.019	93.424	14.360	19.248									.61	C	2016. 508		iT24 1x60s. SNR B <5. Err Sep = 0.022, Err PA = 0.319, Err M1 = 0.042, Err M2 = 0.433.
																			Notes: Secondary not shown in GSC 2.3, USNO B1, and UCAC4; neither of the two stars is identified by SDSS-DR9; secondary not identified in WISE.

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1910+0937	19 10 17.367	+09 37 18.58																??	No final CPM conclusion due to lack of data. Own imaging suggests that the assumed secondary does not exist
	287.572348	9.621815	3.365	210.800	13.40	13.52									1.3	E2	1999.590		2MASS. M1 and M2 estimated from J- and K-band. VizieR data includes a note that the photometry for both components is unreliable, probably because of overlapping star disks.
	287.572863	9.622258					128.8	112.5							0.2	Eu	2013.781		URAT1. Secondary not identified in URAT1.
	287.573000	9.622386			14.266										.61	C	2016.502		iT24 stack 5x10s. No resolution of B. Err M1 = 0.065.
	287.572979	9.622336			14.215										.61	C	2016.508		iT24 1x60s. No resolution of B. Err M1 = 0.061. The faintest stars resolved in this image are around 19mag and it seems rather implausibly that there is not even a hint of an elongation for a secondary of similar brightness with the given separation. Companion has to be extremely faint, might be even bogus
																			Notes: Comparison of POSS I.O and POSS II.N images shows proper motion of the primary but no trace of the secondary. Neither of the pair is identified in SDSS-DR9; secondary not identified in WISE, URAT1, GSC2.3 and UCAC4.
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1916+3753	19 16 20.514	+37 53 24.85					66.25	172.92	6.08	65.22	169.29	6.10						AAA	Solid CPM candidate
	289.0839583	37.8881111	11.4	71.0											1.2	Pp	1955.378		POSS I.O estimates
	289.0853750	37.8901944	10.7	74.3			108	202		96	180				1.2	Pp	1992.552		POSS II.N estimates. PM values estimated by comparison with POSS I.O
	289.0854400	37.8901600	10.943	74.135	13.86	14.23									1.3	E2	1998.399		2MASS. M1 and M2 estimated from J- and K-band
	289.0856030	37.8904930	10.932	74.451			66.2	172.9	6.1	65.2	169.3	6.1			2.5	Es	2005.435		SDSS 9. PM data calculated from position comparison with 2MASS
	289.0857400	37.8907390	10.862	74.270			71.6	175.1	9.9	65.6	171.2	9.1			0.4	Hw	2010.302		WISE. PM data calculated from position comparison with 2MASS
	289.0858000	37.8909000	10.91	74.4			66.3	172.9	5.4	65.3	169.3	5.4			0.2	Eu	2013.529		I/330 MPN7467 from URAT1
	289.0857933	37.8908878	10.908	74.424			66.25	172.92	6.08	65.22	169.29	6.10			0.2	Eu	2013.529	AAA	URAT1. PM data calculated from position comparison with 2MASS

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J1926+4421	19 26 03.485	+44 21 36.55			10.30	15.33	67.97	209.89	5.59	62.59	207.41	5.71						ABA	Solid CPM candidate despite some PM vector length difference which might be a hint for an orbit
	291.5120417	44.3560833	6.0	28.7											1.2	Pp	1951 .518		POSS I.O estimates
	291.5132917	44.3586111	6.1	28.2			73	206		73	209				1.2	Pp	1995 .624		POSS II.J estimates - no resolution, but elongation and similar pm obvious
	291.5134020	44.3587720	6.032	30.885	10.4	14.3									1.3	E2	1998 .435		2MASS. Vmags estimated from J- and K-mag values
	291.5134280	44.3588598	6.821	30.794											0.2	Eu	2000 .580		UCAC4. Epoch averaged
	291.5138031	44.3596575	5.892	30.552	10.32		67.97	209.89	5.59	62.59	207.41	5.71	G0		0.2	Eu	2013 .466	ABA	URAT1. PM data calculated from position comparison with 2MASS. Spectral class A based on B-V color index
	291.5138833	44.3598528	5.849	29.312	10.301	15.331	68.57	215.36	4.70	55.68	211.10	4.70			.61	C	2016 .502		iT24 stack 4x10s. SNR B<10. PM values calculated by comparison with 2MASS positions
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1937+4445	19 37 52.430	+44 45 14.53			16.38	18.88	-8.00	171.80	5.60	-8.00	172.20	5.70						AAA	Solid CPM candidate. This object is meanwhile included in the WDS catalog as DEA 288
	294.468208	44.751861	11.908	203.739											1.2	Pp	1951 .518		POSS I.O estimate.
	294.468292	44.753944	11.633	203.330			5.00	188.00		5.00	195.00				1.2	Pp	1995 .624		POSS II.J estimate. PM data calculated from position comparison with POSSI.
	294.468533	44.753600	11.780	204.900											1.2	Pp	1991 .453		GSC2.3
	294.468462	44.753963	11.725	204.653	15.300	17.000									1.3	E2	1998 .448		2MASS. M1 and M2 estimated from J- and K-band
	294.468458	44.754204					-9.00	172.00							0.2	Eu	2000 .000		UCAC4. Secondary not shown in UCAC4.
	294.468415	44.754681	11.737	204.622			-8.00	171.80	5.60	-8.00	172.20	5.70			0.2	Eu	2013 .444	AAA	URAT1. PM data calculated from position comparison with 2MASS
	294.468488	44.754850			16.517										.61	C	2016 .510		iT24 stack 5x10s. Err M1 = 0.061.
	294.468417	44.754822	11.426	208.087	16.377	18.876									.61	C	2016 .516		iT24 1x60s. SNR B <10. Err Sep = 0.022, Err PA = 0.112, Err M1 = 0.036, Err M2 = 0.121.
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J1959+3432	19 59 46.938	+34 32 24.20					-51.4	-123.3	5.6	-47	-121.1	5.7						AAA	Solid CPM candidate
	299.946208	34.542028	4.635	166.120											1.2	Pp	1950 .603		POSS I.O estimate. Both stars tagged manually.
	299.945452	34.540333	4.030	172.956			-53	-138		-67	-127				1.2	Pp	1994 .513		POSS II.N estimate. Both stars tagged manually.
	299.945585	34.540258	4.391	167.600											1.2	Pp	1991 .593		GSC2.3.
	299.945603	34.540112	4.624	167.104	15.500	16.600									1.3	E2	1998 .358		2MASS. M1 and M2 estimated from J- and K-band
	299.945300	34.539600	4.580	166.000			-51.4	-123.3	5.5	-47	-121.1	5.5			0.2	Eu	2013 .460		I/330 MPN 7967 from URAT1.
	299.945339	34.539590	4.579	165.952			-51.4	-123.3	5.6	-47	-121.1	5.7			0.2	Eu	2013 .460	AAA	URAT1. PM data calculated from position comparison with 2MASS

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J2021+1622	20 21 54.918	16 22 29.86					164.90	-41.38	6.78	172.51	-43.67	6.70						ABA	Solid CPM candidate despite some PM vector length difference - hint for an orbit?
	305.4762500	16.3756111	4.5	15.0											1.2	Pp	1951 .513		POSS I.O estimates
	305.4782917	16.3750278	4.4	13.2			181	-54		177	-54				1.2	Pp	1990 .472		POSS II.J estimates. PM values estimated by comparison with POSS I.O
	305.4788160	16.3749620	4.559	12.158	17.0	17.0									1.3	E2	1999 .822		2MASS. M1 and M2 estimated from J - and K-band
	305.4795000	16.3748000	4.55	13.9			164.9	-41.4	6.20	172.5	-43.7	6.10			0.2	Eu	2013 .505		I/330 MPN8123 from URAT1
	305.4794656	16.3748056	4.551	13.857			164.90	-41.38	6.78	172.51	-43.67	6.70			0.2	Eu	2013 .505	ABA	URAT1. PM data calculated from position comparison with 2MASS
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J2035+0711	20 35 50.843	+07 11 24.28			14.39	15.37	131.00	-66.20	6.60	120.20	-66.00	6.80						ACA	Visual comparison of POSS images suggests CPM. Significant difference in pm vector length might be a hint for an orbit
	308.959833	7.191000	3.737	293.664											1.2	Pp	1951 .602		POSS I.O estimate.
	308.961667	7.190306	4.716	293.761			148.00	-57.00		128.00	-48.00				1.2	Pp	1991 .695		POSS II.F estimate. PM data calculated from position comparison with POSSI.
	308.961849	7.190067	4.134	296.100	13.990		138.00	-65.00		84.70	-39.40		M0		0.2	Eu	2000 .000		UCAC4. Epoch shown is for primary. Secondary has a mean epoch of 1999.095 (RA = 1998.97, Dec = 1999.22).
	308.961862	7.190070	4.145	297.124	13.100	13.800									1.3	E2	2000 .444		2MASS. M1 and M2 estimated from J - and K-band
	308.962150	7.189922	4.349	293.568			104.0	-53.9	13.3	74.0	-69.1	25.8			0.4	Hw	2010 .337		WISE. PM data calculated from position comparison with 2MASS. Large WISE position error results in large PM error
	308.962333	7.189834	4.330	296.338	14.040		131.00	-66.20	6.60	120.20	-66.00	6.80			0.2	Eu	2013 .052	ACA	URAT1. M1 is URAT1 Vmag. PM data calculated from position comparison with 2MASS.
	308.962458	7.189772	4.226	296.565	14.389	15.367									.61	C	2016 .511		iT24 stack 5x10s. Err Sep = 0.028, Err PA = 0.383, Err M1 = 0.028, Err M2 = 0.039.
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J2044+5042	20 44 07.570	+50 42 33.08			17.17	18.29	-102.76	121.69	6.01	-95.51	121.00	5.96						AAA	Solid CPM candidate
	311.0331667	50.7078333	4.1	170.6											1.2	Pp	1954 .486		POSS I.O estimates
	311.0320000	50.7093333	4.3	175.0			-66	134		-73	127				1.2	Pp	1994 .655		POSS II.N estimates. PM values estimated by comparison with POSS I.O
	311.0315670	50.7091710	4.606	173.063	15.3	15.6									1.3	E2	1999 .467		2MASS. M1 and M2 estimated from J - and K-band
	311.0310960	50.7096150	4.590	170.596			-98.0	145.9	19.6	-80.3	149.9	22.7			0.4	Hw	2010 .421		WISE. PM data calculated from position comparison with 2MASS. Large WISE position error results in large PM error
	311.0309308	50.7096481	4.614	171.928			-102.76	121.69	6.01	-95.51	121.00	5.96			0.2	Eu	2013 .638	AAA	URAT1. PM data calculated from position comparison with 2MASS
	311.0308292	50.7098083			17.198										.61	C	2016 .510		iT24 stack 5x10s. SNR A<20. Err_M1=0.166
	311.0308083	50.7097278	4.441	172.255	17.170	18.289									.61	C	2016 .516		iT24 1x60s. SNR B <20

Table 1 continues on the next page.

Table 1 (continued). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
J2110+1038	21 10 43.446	+10 38 28.05			16.82	17.47	-20	-222		-23	-231							?	PM data so far only estimated, as WISE PM data seems s bit suspect - but certainly a potential CPM candidate
	317.68100000	10.6443056	4.5	13.2											1.2	Pp	1951.575		POSS I.O estimates
	317.68075000	10.6415833	4.1	12.5			-20	-222		-23	-231				1.2	Pp	1995.712		POSS II.N estimates. PM values estimated by comparison with POSS I.O
	317.68102400	10.6410970	4.586	11.571	14.9	15.3									1.3	E2	2000.502		2MASS. M1 and M2 estimated from J- and K-band
	317.68101800	10.6410920	4.574	11.512											2.5	Es	2000.740		SDSS DR9. Observation epoch difference with 2MASS far too small to calculate reliable PM values
	317.68103300	10.6405570	4.535	10.427			3.2	-197.0	9.0	-6.8	-200.3	12.3			0.4	Hw	2010.369		WISE. PM data calculated from position comparison with 2MASS
	317.68095417	10.6401639	4.658	11.132	16.819	17.473									.61	C	2016.508		iT24 1x60s. Err_Sep=0.014, Err_PA=0.174°, Err_M1=0.049, Err_M2=0.067
LSPM	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDE1**	**e_pm1**	**pmRA2**	**pmDE2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
J2124+1323	21 24 05.343	+13 23 59.11			15.59	16.31	80.6	159.5	6.2	72.1	154.7	6.2						AAA	Solid CPM candidate
	321.020250	13.396972	4.296	37.686											1.2	Pp	1951.576		POSS I.O estimate. Both centroids tagged manually.
	321.021125	13.398778	4.652	41.202			69	147		79	150				1.2	Pp	1995.698		POSS II.N estimate. Both centroids tagged manually.
	321.021577	13.398770	4.431	34.500	14.31	15.01									1.3	E2	1998.880		2MASS. M1 and M2 estimated from J- and K-band
	321.021640	13.398866	4.409	34.300		15.12	73	139						M0	0.2	Eu	2000.720		UCAC4. M2 is Vmag, Spc2 is from UCAC4 B-V data. Epoch shown is mean epoch (Epoch of primary is 2000.000, Epoch of secondary is 2001.44).
	321.021816	13.399184	4.331	33.521			85.0	151.3	9.4	72.9	147.3	9.4			2.5	Es	2008.372		SDSS-DR9. PM data calculated from position comparison with 2MASS
	321.021835	13.399311	4.436	35.520			78.6	169.4	13.6	84.3	165.9	22.9			0.4	Hw	2010.381		WISE. PM data calculated from position comparison with 2MASS
	321.021890	13.399373	4.338	33.691			80.6	159.5	6.2	72.1	154.7	6.2			0.2	Eu	2013.438	AAA	URAT1. PM data calculated from position comparison with 2MASS. Attention: Aladin shows URAT1 J2000 positions in image wrong due to wrong URAT1 PM data. All URAT1 mag data besides fmag ident for both components and thus obviously wrong for at least one component
	321.021958	13.399494	3.943	33.715	15.526	16.463									.61	C	2016.502		iT24 stack 10x10s. SNR B<20. Err Sep = 0.071, Err PA = 1.027, Err M1 = 0.062, Err M2 = 0.099
	321.021967	13.399492	4.248	33.808	15.592	16.310									.61	C	2016.505		iT24 stack 5x10s. Err Sep = 0.028, Err PA = 0.381, Err M1 = 0.053, Err M2 = 0.066.

Table 1 concludes on the next page.

CPM Pairs from LSPM so far not WDS Listed

Table 1 (conclusion). Research results for potential common proper motion pairs found in the LSPM catalog. Headline object position based on URAT1 J2000 coordinates for A (with exception of J1906+1652 – in lack of URAT1 data we had to use the average value of our own measurements)

LSPM	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDE1	e_pm1	pmRA2	pmDE2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
TYC-4030-00975-1	01 14 58.386	+60 41 35.55					22.32	-21.1	5.87	21.46	-21.49	5.90						AAC	Despite the in relation to the PM vector length rather large pm error a solid CPM candidate
	18.74258333	60.6935278	12.6	126.5											1.2	Pp	1952 .706		POSS I.O estimates
	18.74325000	60.6935556	12.7	126.1			29	2		32	2				1.2	Pp	1993 .683		POSS II.N estimates. PM values estimated by comparison with POSS I.O
	18.74331200	60.6931750	12.394	126.837											1.2	Pp	1990 .275		GSC 2.2 mean epoch
	18.74326200	60.6932140	12.578	126.577	10.5	13.9									1.3	E2	1999 .020		2MASS. M1 and M2 estimated from J - and K-band
	18.74330450	60.6931784	12.557	126.641	10.706		20.9	-13.3		26.5	-15		G0		0.2	Eu	2000 .203		UCAC4 mean epoch
	18.74335000	60.6931640	12.399	127.359			14.0	-16.3	29.0	-8.1	-18.9	8.6			0.4	Hw	2010 .087		WISE. PM data calculated from position comparison with 2MASS with a somewhat suspect result
	18.74344500	60.6931294	12.570	126.631	10.665		22.32	-21.1	5.87	21.46	-21.49	5.90	G0		0.2	Eu	2013 .441	AAC	URAT1. PM data calculated from position comparison with 2MASS

CPM Pairs from LSPM so far not WDS Listed

(Continued from page 141)

Summary

Of the 47 objects checked for CPM

- 22 got a triple A rating based on position comparison between 2MASS and URAT1 (according to the method presented in Knapp/Nanson 2016), which means solid CPM
- 15 got a rating between AAB to BAC, which means probably CPM with caveats but all of them with CPM confirmation by comparison of POSS images
- 9 remained without rating due to missing URAT1 positions for the secondary
- 1 remained as suspect due to missing evidence for the secondary.

One object (J1937+4445) was during the research for this report added to the WDS catalog as CPM pair DEA 288 but we kept this object in the report to provide the additional observations we found in the diverse catalogs or made ourselves.

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
- UCAC4 catalog
- URAT1 catalog
- WISE catalog
- SDSS catalog
- IGSL catalog
- LSPM catalog
- VizieR I/330 catalog
- Aladin Sky Atlas v9.0
- SIMBAD, VizieR
- AstroPlanner V2.2
- NASA/ IPAC Infrared Science Archive

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References

Buchheim, R., 2008, "CCD Double-Star Measurements at Altimira Observatory in 2007", *Journal of Double Star Observations*, **4**, 27 - 31. Formulas for calculating Separation and Position Angle from the RA Dec coordinates given as

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

in radians and

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

in radians depending on quadrant

Knapp W. and Nanson J., 2016, "A New Concept for Counter-Checking of Assumed CPM Pairs, *JDSO*, **13**, 31 - 51.