Proper Motion Comparison of some LDS Systems

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Abstract: We present a detailed analysis of the proper motion of the individual components of 26 LDS systems for which we have found discordant figures between the values quoted in the Washington Double Stars Catalogue (WDS) and those included in different astrometric databases. For some pairs, preliminary new proper motion values have been determined through the reduction of images downloaded from the STScI Digitized Sky Survey.

Introduction

During the course of our data mining program oriented to collecting and providing improved astrometric data of double stars in general, we have found large differences between the proper motions of the components of some LDS systems listed in the WDS and astrometric databases such as UCAC3 (Zacharias et al. 2009), NOMAD (Zacharias et al. 2005), PPMXL (Roeeser et al. 2010), and LSPM (Lepine & Shara, 2005).

Although it is quite usual for the components of Common Proper Motion Pairs (CPMP) to show differences in their individual values, the differences we encountered, which were larger than 80 mas/year, were significant enough to warrant further attention.

In general, differences of such magnitude would certainly jeopardize the CPMP nature of any system. One such case is that of LDS 1148. Taking into account the WDS data (May 11th, 2011), we may conclude that the total proper motion for the A component is on the order of 470 mas/yr in a position angle of 96 degrees, while for the B component the total proper motion is 336 mas/yr in a position angle of 260 degrees. With these values, the LDS 1148 components would not meet some of Halbwach's (1986) criteria and so LDS 1148 should be discarded from the CPMP lists. However, a detailed analysis of the area clearly shows that actually the two components of the system share a rather similar proper motion in their total amount as well as in their position angle. This situation could probably be the consequence of either a misidentification or of erroneous values in the databases themselves.

Search and Results

In order to check whether other LDS systems – besides LDS 1148- show similar differences in their

Proper Motion Comparison of some LDS Systems

individual proper motions, we isolated from the WDS those stars for which the difference in the proper motion between the A and the B component exceeds the 80 mas/yr limit. We only considered systems for which the WDS quotes a proper motion in both components. We found that approximately 250 systems meet this condition.

The next step was to use the Aladin facilities to explore visually in more detail the area around some of those systems. Onto the POSS1 and POSS2 images we superimposed different astrometric databases such us UCAC3, NOMAD, PPMXL, and LSPM. In all cases we also used the 2MASS Point Source (Cutri et al. 2003) to double check the real star detections. This was done in order to avoid false detection data, a rather common problem in databases constructed from the digitization of photographic surveys, mainly around bright stars or in crowded areas. In all cases, we considered the UCAC3, NOMAD, PPMXL, and LSPM detection closest to the 2MASS to be the correct identification of our target star.

The comparison of the proper motions quoted in the databases surveyed, in combination with the blinking of POSS1 and POSS2 images allowed us to confirm the large proper motion differences between the components of most of the systems. However, in some cases we found that the differences were the consequence of either a misidentification or very discordant proper motions between the databases checked and the actual displacement of the components suggested by the blinking of the images.

For some of the systems showing large differences in the proper motions of their components, and in order to confirm our finding, we determined a preliminary new proper motion through the reduction of first and second epoch images downloaded from STScI Digitized Sky Survey, with epoch differences of about 45 years. In most cases, the UCAC2 was used as a reference frame. We estimate the errors of our proper motion on the order of ±10 mas/yr to ±15 mas/yr. It should be stressed that although our proper motions seem to be in better agreement with the analysis of the blinking of POSS1 and POSS2 images and the values quoted in some of the astrometric databases checked, they should only be taken as indicative of the motion of the star of interest. By no means should they be regarded as definitive values.

Our results are presented in two tables. Table 1 shows the LDS – 2MASS cross identification. This is intended to provide a clear identification of the object we have taken as the A and the B component of each of the systems.

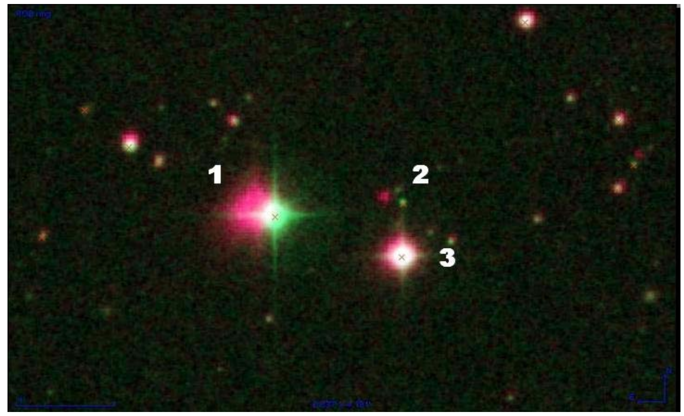

Figure 1: LDS 4339. The discordant proper motion quoted in the WDS for the B component seems to be the consequence of a misidentification problem. The WDS Sep and PA for 2004 (measured from star 1) point to star 3, when actually the object that shares the proper motion with star 1 is the star 2. The Sep and PA between objects 1 and 2 are in very good agreement with the WDS data for 1960. From the proper motion point of view, this pair seems to be formed by stars 1 (A) and 2 (B).

Table 2 presents the individual proper motions we were able to extract from the databases, along with our own determinations and the values quoted in the WDS. With the exception of LDS 3185 and LDS 4369, the remaining systems are included in the main part of the WDS as well as in the Neglected Double Lists, the latter often presenting different proper motions with respect to the values quoted in this Table 2.

Conclusions

By way of conclusion, we may say that the comparison of proper motions through various databases and the preliminary determination of new proper motions have allowed us to confirm the common proper motion nature of most of the systems included in this note. In general, these systems could not otherwise be considered CPMP.

In an attempt to provide an explanation for the inclusion of such discordant proper motion values into the WDS, we may assume that in some cases it is probably the result of a misidentification of one of the components of the systems, while in some other cases the problem may lie in the databases themselves.

As an instance of a possible misidentification process we could mention the case of LDS 4369. The WDS quotes the following coordinates for the A component: RA = 13 29 17.01, and Dec = +09 17 53.8, with a B component located at: Sep = 80.0 seconds of arc, and PA = 252 degrees (epoch 2004). With these parameters, the B component should be 2MASS

Proper Motion Comparison of some LDS Systems

13291175+0917290, whose NOMAD (object 0992-0232608) proper motion is -045 in RA and -012 in Dec, while the PPMXL (object 4355976815772898394) proper motion is -043 in RA and -012 in Dec (the NOMAD as well as the PPMXL proper motions are almost identical to the values quoted in the WDS). However, a detailed inspection of the area allowed us to conclude that the object that really shares the proper motion with the A component is 2MASS 13291170+0918020, which is located at a Sep of 79 seconds of arc in a PA of 276 degrees. These latter parameters are in very good agreement with the values included in the WDS for epoch 1960 (see Figure 1).

With regard to potentially erroneous values in the databases themselves, we mention the case of LDS 4330. For this system, the NOMAD as well as the PPMXL proper motion –though being in good agreement between them- are in a position angle 180 degrees apart from what is shown by the blinking of POSS1 and POSS2 images (see Figure 7).

Finally, the detailed analysis of each stellar image in conjunction with the astrometric and non-astrometric databases surveyed, has allowed us to announce a possible close companion to the A component of LDS 4055 (see López, 2008).

(Continued on page 253)

Table 1: LDS – 2MASS Cross Identification

LDS	2MASS	Notes	LDS	2Mass	Notes
1073 A	00134032+1356556		4055 A		2
1073 B	00133892+1356488		4055 B	11053027+1025345	
1129 A	02334712+2223189		4330 A		
1129 B	02334821+2223148		4330 B	13135831+1057015	3
1148 A	03425617+2515528		4369 A	13291700+0917537	
1148 B	03425324+2516381		4369 B	13291170+0918020	
3045 A	12284571+5054501		4494 A	14431906+1120548	
3045 B	12284608+5054324		4494 B	14432928+1124429	
3185 A	00382784+3824579		4730 A	17143617+3340055	
3185 B	00382756+3825041		4730 B	17143656+3340172	
3233 A	01064879+0148452		4970 A	22282013+0303534	
3233 B	01064249+0146175		4970 B	22281858+0303424	
3309 A	01475162+2147072		5155 A	00012270+2925589	
3309 B			5155 B	00010295+2925541	
3332 A	01594202+1737057		5191 A	04401459+4012125	
3332 B	01595762+1735164		5191 B	04401469+4012032	
3699 A	06234264+4820101		5353 A	01491017-0823175	
3699 B	06232708+4817564		5353 B	01492141-0823320	
3778 A	08141030+0234126		5386 A	02322843+5313459	
3778 B	08140953+0234193		5386 B	02323039+5313502	
3815 A			5610 A	04485860+2351591	
3815 B	08462298+4925387	1	5610 B	04485045+2350538	
3843 A	09004574+1707266		5829 A	14582278+4142585	
3843 B	09003909+1707053		5829 B	14583023+4142222	
3919 A			6055 A	23440296+0020407	
3919 B	09434692+2219485		6055 B	23440838+0020323	

Notes to Table 1:

1. **3815 B.** The WDS coordinates point to this component.
2. **4055 A**. This component seems to be double. There are two 2MASS detections, namely: 11051376+1026069 and 11051379+1026060. See note 11 to Table 2.
3. **4330 B**. The WDS coordinates point to this component.

Proper Motion Comparison of some LDS Systems

Table 2:. Proper Motion Comparisons

LDS	WDS		UCAC3		NOMAD		PPMXL		LSPM		This Study		Notes
	RA	Dec	RA	Dec	RA	Dec	RA	Dec	RA	Dec	RA	Dec	
1073 A	+117	-029	+117	-029	+117	-029	+116	-029					
1073 B	+014	-182			+014	-182	+029	-169			+123	-031	1
1129 A	+076	-094			+076	-094	+074	-097			+094	-112	
1129 B	-052	-222			-052	-222	-041	-214			+098	-118	2
1148 A	+471	-067	+471	-067	+470	-056	+469	-064	+471	-067	+485	-071	
1148 B	-330	-064							+471	-067	+489	-074	3
3045 A	+042	-002	-076	-144	+042	-002	+029	-009			-060	-132	
3045 B	-070	-138			-070	-138	-077	-140			-088	-136	
3185 A	+134	+086			+134	+086	+132	+076	+144	+080			4
3185 B	+074	+082			+074	+082	+104	+083	+144	+080			
3233 A	+248	-010			+248	-010	+254	-016	+258	-013	+258	+001	
3233 B	+186	-188			+186	-188	+190	-196	+260	+002	+250	+011	
3309 A	+006	-034	+175	+031	+006	-034	+044	-032	+182	+024	+182	+015	
3309 B	+172	+018			+172	+018	+172	+011	+182	+024	+173	+015	
3332 A	+078	-078	+103	-046	+078	-078	-034	+015			+125	-055	5
3332 B	+138	000		+138	000	+144	-005				+129	-003	6
3699 A	-010	-180	-005	-177	-010	-180	-019	-182	-005	-177	-015	-182	
3699 B	+136	-072			+136	-072	+039	-118			+010	-123	
3778 A	-052	+018	-064	-188	-052	+018	-054	+015	-064	-188			
3778 B	-056	-200			-056	-200	-059	-195	-064	-188			7
3815 A	+023	-249			+126	-290	+122	-295	+127	-295			
3815 B	+107	-296							+127	-295			8
3843 A	-014	-118					+057	-071			+071	-086	9
3843 B	+110	-052			+110	-052	+081	-047			+087	-058	
3919 A	+046	-018			+046	-018	+038	-020			-059	-088	10
3919 B	-036	-102			-036	-102	-042	-106			-057	-084	
4055 A	-154	-002	-168	-015	-154	-002	-165	-007					11
4055 B	-036	-258	-145	-086	-036	-258	-058	-244	-145	-086			12
4330 A	-110	-198			-110	-198	-120	-203	-126	-191	-119	-195	
4330 B	+036	+162			+036	+162	+021	+137	-126	-191	-112	-200	13
4369 A	-286	-059	-286	-059	-287	-059	-286	-060	-286	-059			
4369 B	-042	-013			-278	-056	-286	-061	-265	-065			
4494 A	-180	-122	-192	-115	-180	-122	-182	-125	-192	-115	-164	-115	
4494 B	000	-084	-208	-149	000	-084	-035	-102	-208	-149	-214	-131	
4730 A	-078	-012	-092	-006	-078	-012	-084	-012			-083	+004	
4730 B	+024	+024			+024	+024	+011	+016			-082	-004	14
4970 A	-252	-221	-252	-221	-260	-212	-261	-217	-252	-221			
4970 B	+252	-221	-252	-221	-260	-214	-260	-219	-252	-221			
5155 A	+080	-108	+127	+036	+080	-108	+088	-096			+127	+037	
5155 B	+130	+032			+130	+032	+131	+027			+119	+037	
5191 A	+213	+051	+213	+051	+054	+180			+213	+051			
5191 B	+213	-051	+213	+051	+198	+500	+188	+003	+213	+051			
5353 A	+052	-084			+052	-084	+054	-098			+048	-080	
5353 B	-012	+020					+036	-014			+052	-035	
5386 A	-094	+258	-082	+250	-094	+258	-093	+255	-082	+250			
5386 B	-170	+390	-082	+250	-092	+258	-093	+256	-082	+250			15
5610 A	+030	-038	+016	-047	+030	-038	+028	-043			+025	-055	
5610 B	-054	+022			-054	+022	-043	+011			+042	-058	16
5829 A	-057	-189	-123	+100	-056	-189	-018	-130	-123	+100			17
5829 B	-120	+150			-120	+150	-123	+147	-118	+150			
6055 A	-028	-164	-029	-161	-028	-164	-027	-169	-029	-161			
6055 B	-042	+020	-029	-161	-042	+020	-041	+006	-029	-161			18

Notes to Table 2:

1. **1073 B**. Neither NOMAD nor PPMXL proper motions for this component coincide with the analysis of the blinking of POSS1 and POSS2 images. See Figure 2.

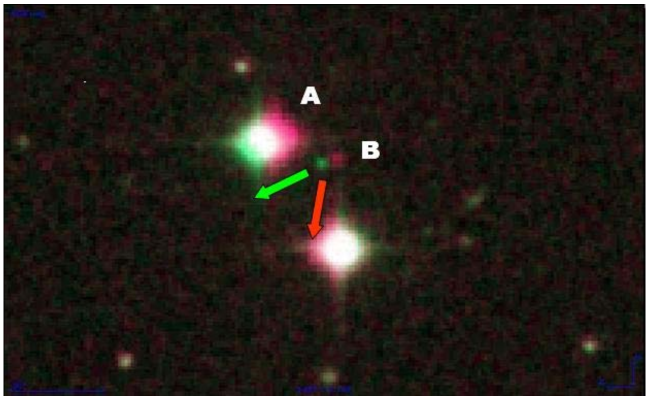

Figure 2: LDS 1073. For the B component both NOMAD and PPMXL proper motions are similar.

2. **1129 B**. Neither NOMAD nor PPMXL proper motions for this component coincide with the analysis of the blinking of POSS1 and POSS2 images. See Figure 3.

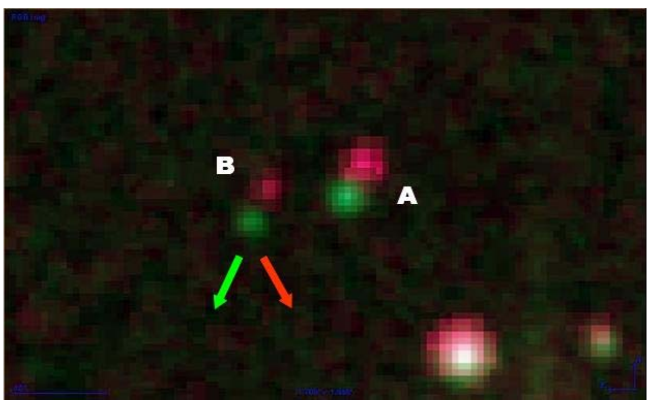

Figure 3: LDS 1129. For the B component both NOMAD and PPMXL proper motions are similar.

3. **1148 B**. There are two NOMAD detections at about 9 arc seconds –due West- of the 2MASS object listed in Table 1. They are: NOMAD 1152-0044564, whose proper motion is +088 and -013 in RA and Dec, respectively, and NOMAD 1152-0044563, whose proper motion is -330 and -064 in RA and Dec, respectively. Although the former proper motion is pointing in the direction of motion suggested by the blinking analysis of POSS1 and POSS2 images, its total value seems to be too small. The latter proper motion seems to be the one adopted by the WDS. It does not seem to be a PPMXL entry for this object.

4. **3185 A**. The NOMAD proper motion reported here corresponds to object 1284-0012623. However, at about 1.3 arc seconds to the W of the 2MASS detection is NOMAD 1284-0012622, whose proper motion is +280 and -610 in RA and Dec, respectively. The PPMXL proper motion for this component corresponds to object 2203279359639780718, which is the closet PPMXL object to the 2MASS detection included in Table 1. At approximately 0.5 arc seconds in a position angle of about 320 degrees is PPMXL 2203279359229867863, whose proper motions is +414 in RA and -590 in Dec, respectively.

5. **3332 A**. The NOMAD proper motion for this component corresponds to object 1076-0027894, which is the closet one to 2MASS 01594202+1737057. At about 8 arc seconds to the NW is NOMAD 1076-0027885, whose proper motion is -044 in RA and +026 in Dec, respectively. On the other hand, the PPMXL proper motions correspond to object 2129814251181514567, which is the closet PPMXL object to the 2MASS detection. This system is also included in the Neglected Doubles List III (equatorial subset) with the following proper motion for the A component: +154 in RA and +005 in Dec.

6. **3332 B**. The NOMAD (1075-0027731), as well as the PPMXL (2129814759623047233) proper motion for this component, corresponds to the closet detection to the 2MASS object quoted in Table 1. However, at about 2.5 arc seconds to the N of the 2MASS object are NOMAD 1075-0027729 (whose proper motion is +114 and +210 in RA and Dec, respectively) and PPMXL 2129814760024252657 (whose proper motion is +121 and +202 in RA and Dec, respectively).

7. **3778 B**. The NOMAD proper motion for this component corresponds to object 0925-0202966, which is the closet one to the 2MASS detection quoted in Table 1. On the other hand, at about 1.0 arc seconds to the W is NOMAD 0925-0202965, whose proper motion is -334 in RA and -048 in Dec, respectively. With regard to the PPMXL, the proper motion included in the Table corresponds to object 3248097631673996506, which is also the closet one to the 2MASS object. However, very close to the W is PPMXL 3248097633089368440, whose proper motion is -312 in RA and –052 in Dec, respectively.

8. **3815 B**. The NOMAD detection of this component is rather unclear. NOMAD 1394-0202440 lies almost on top of the POSS2 stellar image with zero proper motion on both coordinates. However, at about 2.8 arc seconds to the SE is NOMAD 1394-0202441, whose proper motion is +270 in RA and -410 in Dec, respectively which –prima facie- seems to be too large for the actual displacement

of the star from POSS1 to POSS2 images. With regard to the PPMXL there is no detection related with this component. The coordinates reported in WDS seem to point to this component instead of the A one.

9. **3843 A**. The NOMAD identification of this component is a real puzzle. There are two very close detections, namely: NOMAD 1071-0197548, whose proper motion is -014 in RA and -118 in Dec, respectively, and NOMAD 1071-0197549, whose proper motion is +164 in RA and -112 in Dec, respectively. Nevertheless, none of these proper motions seems to represent the actual displacement of the star. On the other hand, the PPMXL proper motion of this component is in very good agreement with the analysis of the blinking of POSS1 and POSS2 images. See Figure 4.

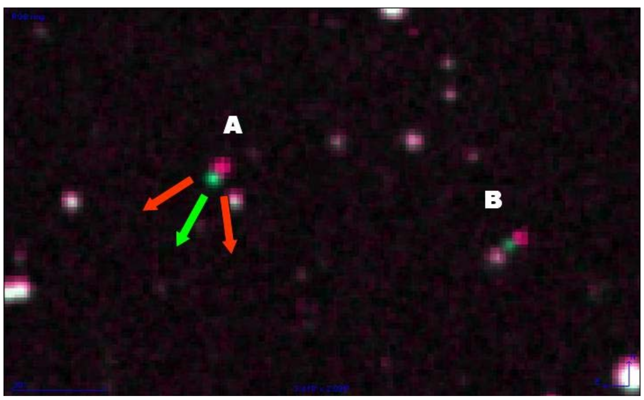

Figure 4: LDS 3843. The red arrows show the proper motion of the two very close NOMAD detections. The PPMXL proper motion vector almost coincides with the green arrow.

10. **3919 A**. Neither NOMAD nor PPMXL proper motions for this component seem to coincide with the analysis of the blinking of POSS1 and POSS2 images. See Figure 5.

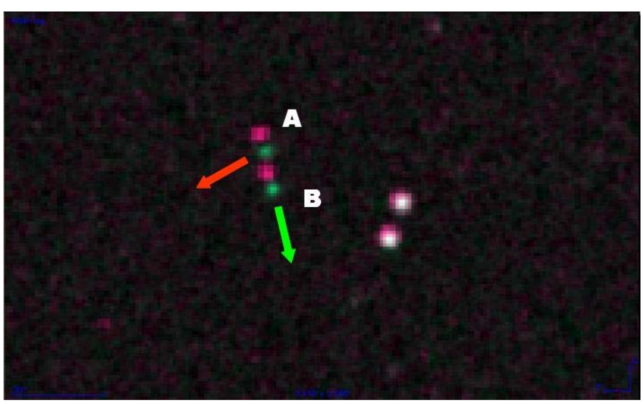

Figure 5: LDS 3919. For the A component both NOMAD and PPMXL proper motions are similar.

11. **4055 A**. Although not mentioned in the WDS, this component seems to be double itself. 2MASS shows two different detections: 11051379+1026060 and 1051376+1026069. NOMAD also includes data for two objects: 1004-0195750, whose proper motion is the one mentioned in the Table and 1004-0195748, whose proper motion is +008 and +012 in RA and Dec, respectively. However, this last proper motion value does not coincide with the analysis of the blinking of POSS1 and POSS2 images. PPMXL shows only one detection, whose proper motion is the one included in the Table. LSPM also reports data for two detections: J1105+1026S and J1105+1026N, both with exactly the same proper motion: +168 in RA and -015 in Dec.

12. **4055 B**. Neither NOMAD nor PPMXL proper motions for this component coincide with the analysis of the blinking of POSS1 and POSS2 images. See Figure 6.

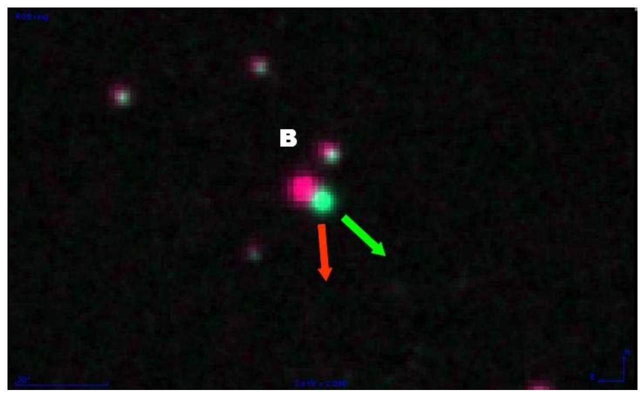

Figure 6: LDS 4055. For the B component both NOMAD and PPMXL proper motions are similar. The A component lies to the right, outside the frame.

13. **4330 B**. Neither NOMAD nor PPMXL proper motions for this component coincide with the analysis of the blinking of POSS1 and POSS2 images. See Figure 7.

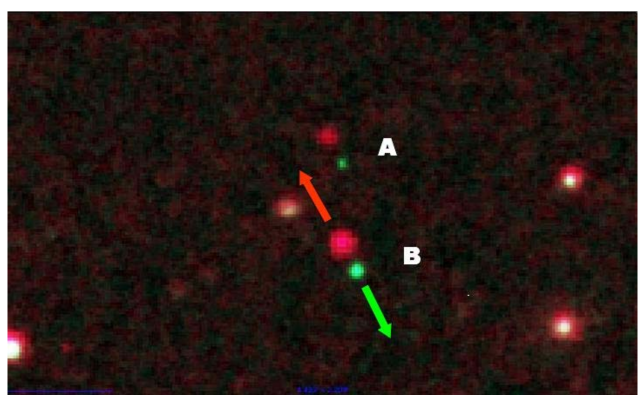

Figure 7: LDS 4330. For the B component both NOMAD and PPMXL proper motions are similar. This is one of the most discordant cases found in our search.

Proper Motion Comparison of some LDS Systems

14. **4730 B**. The NOMAD proper motion reported for this star corresponds to object 1236-0273801, which is the closest to 2MASS 17143656+3340172. The PPMXL reported for this component corresponds to object 5432409567246176096, which is the closest to the 2MASS detection. However, about 0.2 arc seconds to the NW is PPMXL 5432409567226225286, whose proper motion is -033 and -002 in RA and Dec, respectively.
15. **5386 B**. The UCAC3 proper motion included in the Table corresponds to object 287-047613, which is almost coincident with UCAC3 287-047612, whose proper motion is zero in both, RA and Dec. With regard to the NOMAD proper motion of this component, the reported value corresponds to object 1432-0095415, which is the closet to the 2MASS 02323039+5313502 detection; however, about 1 arc seconds to the NNW is NOMAD 1432-0095414, whose proper motion is -170 in RA and +390 in Dec, respectively.
16. **5610 B**. Neither NOMAD nor PPMXL proper motions for this component coincide with the analysis of the blinking of POSS1 and POSS2 images. See Figure 8.

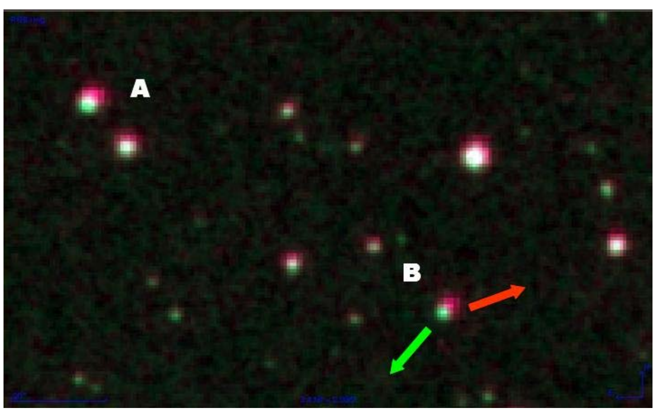

Figure 8: LDS 5610. For the B component both NOMAD and PPMXL proper motions are similar.

17. **5829 A**. The PPMXL reported corresponds to object 763026960042837972, which is the closet to the 2MASS object in Table 1. However, slightly over 2 arc seconds to the NNW is PPMXL 763026960077876492, whose proper motion is -127 in RA and +144 in Dec, respectively.
18. **6055 B**. The NOMAD (object 0903-0653263), as well as the PPMXL (object 1824338563692770783) proper motions included in the Table, corresponds to the NOMAD and PPMXL closet detection to the 2MASS object mentioned in Table 1. However, at about 7 arc seconds to the N of the 2MASS detection are located: NOMAD 0903-0653262, whose proper motion is -034 and -020 in RA and Dec, respectively and PPMXL 1824338564221168706, whose proper motion is -030 and -027 in RA and Dec, respectively.

Note to Figures: all the figures included in this note are Aladin composite (POSS1, red and POSS2, green) images. In all cases, with the exception of Figure 1, the green arrow shows the direction of the general displacement suggested by the blinking of POSS1 and POSS2 images, while the red one shows the approximate direction of the motion of the star taking into account the proper motion quoted in NOMAD and/or PPMXL databases. The arrows are not drawn to scale. North is up East to the left.

Proper Motion Comparison of some LDS Systems

(Continued from page 248)

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References

Cutri, R., Skrutskie M.F., Van Dyk S. et al. 2003 “The 2MASS All-Sky Catalog of Point Sources” VizieR Online Data Catalogue II/246.

Halbwachs, J. L. 1986 “Common proper motion stars in the AGK 3” Astronomy and Astrophysics Supplement Series **66**, 131.

Lepine, S. Shara, M. 2005 “A Catalog of Northern stars with annual proper motions larger than 0.15"” VizieR Online Data Catalogue I/298.

López, C. E. 2008 “New Common Proper Motion Stars in the LSPM-North Catalogue” *Revista Mexicana de Astronomía y Astrofísica (Serie de Conferencias)* **34**, 123.

Roeeser S., Demleitner M., Schilbach E. 2010 “The PPMXL catalog of positions and proper motions on the ICRS. Combining USNO-B1.0 and the two Micron All Sky Survey (2MASS)” VizieR Online Data Catalogue I/317.

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