Counter-Checking Tycho Double Stars with the SDSS DR9 Catalog

Wilfried R.A. Knapp
Vienna, Austria
wilfried.knapp@gmail.com

Abstract: As already reported (Knapp and Gould 2016), most Tycho Double Star objects in the WDS catalog are unconfirmed. Small separation and faint components make these objects hard to resolve either by visual observation or by imaging in the V-band and only few public domain star catalogs offer resolution for stars with less than 2-3 arcseconds. One exception is the SDSS DR9 catalog based on images with a resolution of 0.396 arcseconds per pixel. This report shows that SDSS DR9 is of good use for counter-checking double stars down to a separation of 1.5 arcseconds or even less.

Introduction

Looking for star catalogs reliable enough to deliver star coordinates suitable for proper motion calculations, I found in many cases SDSS DR9 of good use besides 2MASS and URAT1, especially for smaller separations. The SDSS DR9 catalog should, from the technical parameters, be suitable for resolving faint double stars with separations less than 2 arcseconds - keeping in mind that the SDSS covers only a part of the sky. To check this possibility, I selected Tycho Double Stars in Boötes (Boo) and Canes Venatici (CVn) (both constellations are covered by SDSS) with separation larger than 1.5 arcseconds, confirmed and unconfirmed ones, to check both situations to see how reliable this setup might be.

Further Research

First I selected the objects in CVn and checked SDSS images and SDSS DR9 catalog data for these objects. The results are shown in Table 1. Next I selected the following objects in Boo and checked SDSS images and SDSS DR9 catalog data for these objects. The results are shown in Table 2.

Summary

These results show the reliability of SDSS DR9 data to counter-check Tycho Double Stars down to separation of 1.5 arcseconds provided that SDSS covers the sky region in question. A quick check for TDS9213 in Boo (WDS confirmed with 1.4" separation) indicated that SDSS DR9 is probably also reliable for separations somewhat smaller than 1.5".

Potential Further Research

Boo and CVn are only a small portion of the sky covered by SDSS DR9. This offers the opportunity to counter-check hundreds of more Tycho Double Stars so far unconfirmed.

Acknowledgements

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

Washington Double Star Catalog as data source for the selected objects
Aladin Sky Atlas v9.0
SIMBAD, VizieR
SDSS Photometric Catalog, Release 9
2MASS All Sky Catalog
URAT1 Survey (preliminary)
AstroPlanner v2.2 for object selection

References

R. Buchheim, 2008, "CCD Double-Star Measurements at Altimira Observatory in 2007", *Journal of Double Star Observations*, **4**, 27-31.

Knapp, Wilfried; Gould, Ross, 2016, "Visual Observation and Measurements of some Tycho Double Stars", *Journal of Double Star Observations*, **12**, 427-436.

Table 1: All TDS objects in CVn with separation 1.5 arcseconds or larger so far not confirmed are according to the SDSS DR9 catalog to be considered as bogus. Only one object was already confirmed in the WDS catalog and was clearly also confirmed by SDSS DR9. Separation and PA calculated with the formulae provided by Buchheim 2008

CVn TDS objects not confirmed in the WDS catalog per beginning of 2016								
WDS ID	**Name**	**RA**	**Dec**	**Sep**	**M1**	**M2**	**PA**	**Counter-Check Result**
12152+5118	TDS8286	12:15:11.151	+51:18:07.8	2.1	12.17	13.27	180	SDSS9 obviously single, bogus assumed
13516+3851	TDS9002	13:51:35.151	+38:50:54.4	2.0	11.26	13.24	246	SDSS9 multiple spikes suggest multiple star - but all spikes suggest same centroid. Bogus assumed
13017+4617	TDS8649	13:01:42.029	+46:16:52.4	2.3	10.45	12.82	79	SDSS9 multiple spikes suggest multiple star - but all spikes suggest same centroid. Bogus assumed
12332+4802	TDS8432	12:33:13.081	+48:01:49.9	2.6	11.73	12.85	187	SDSS9 multiple spikes suggest multiple star - but all spikes suggest same centroid. Bogus assumed
13141+3712	TDS8741	13:14:06.311	+37:12:13.5	2.6	11.37	12.79	236	SDSS9 multiple spikes suggest multiple star - but all spikes suggest similar centroid. Bogus assumed
CVn TDS object already confirmed in WDS per begin of 2016								
13411+3719	TDS718	13:41:04.851	+37:18:41.6	1.7	11.82	11.8	221	SDSS objects for A (J134104.87+371841.7) and B (J134104.77+371840.5). Separation 1.673" and PA 222.799°. Observation epoch 2004.075

Counter-Checking Tycho Double Stars with the SDSS DR9 Catalog

Table 2. Five out of seven TDS objects in Boo with separation 1.5 arcseconds or larger so far not confirmed are according to the SDSS DR9 catalog to be considered as bogus but two could be confirmed. Seven objects were already confirmed in the WDS catalog and with one exception also clearly confirmed by SDSS DR9. Separation and PA calculated with the formulae

Boo TDS objects not confirmed in the WDS catalog per begin of 2016:								
WDS ID	**Name**	**RA**	**Dec**	**Sep**	**M1**	**M2**	**PA**	**Counter-Check Result**
14503+4520	TDS9320	14:50:19.682	+45:19:34.5	2.2	12.15	12.18	22	SDSS9 obviously single star. Bogus assumed
14040+1154	TDS9082	14:03:59.890	+11:54:23.4	2.6	11.36	12.73	88	SDSS9 multiple spikes suggest multiple star - but all spikes suggest same centroid. Bogus assumed
15335+4126	TDS9547	15:33:29.719	+41:26:13.4	2.6	12.32	12.53	214	SDSS9 objects for A (J153329.70+412613.4) and B (J153329.58+412611.1). Separation 2.645" and PA 210.953°. Observation epoch 2003.406
13542+0802	TDS9025	13:54:12.478	+08:02:22.7	1.5	11.25	11.81	185	SDSS9 objects for A (J135412.48+080222.3) and B (J135412.47+080220.7). Separation 1.595" and PA 184.100°. Observation epoch 2002.221
14374+3924	TDS9249	14:37:23.350	+39:24:18.9	1.5	11.13	12.88	348	SDSS9 obviously single star. Bogus assumed
14523+4437	TDS9330	14:52:19.769	+44:37:20.1	2.3	10.69	12.29	30	SDSS9 obviously single star. Bogus assumed
14187+5232	TDS9160	14:18:44.801	+52:32:08.3	2.1	11.21	12.32	123	SDSS9 obviously single star. Bogus assumed
Boo TDS objects already confirmed in WDS per begin of 2016:								
WDS ID	**Name**	**RA**	**Dec**	**Sep**	**M1**	**M2**	**PA**	**Counter-Check Result**
14560+3807	TDS9348	14:55:59.592	+38:07:19.2	1.6	11.21	11.47	81	SDSS9 multiple spikes suggest multiple star but no SDSS DR9 objects. Estimations from centroids using spikes as crosshairs: Separation 1.58" and PA 55.265°. Observation epoch 2003.226
15271+5127	TDS9521	15:27:07.439	+51:26:53.9	3.3	11.87	12.40	136	SDSS9 objects for A (J152707.41+512654.2) and B (J152707.67+512651.8). Separation 3.321" and PA 135.148°. Observation epoch 2002.437
14198+3016	TDS9165	14:19:48.281	+30:15:37.3	3.0	11.75	12.00	173	SDSS9 objects for A (J141948.28+301537.2) and B (J141948.31+301534.1). Separation 3.114" and PA 173.809°. Observation epoch 2004.283
13585+1409	TDS9050	13:58:30.959	+14:08:36.4	9.9	12.03	12.19	264	SDSS9 objects for A (J135830.95+140836.3) and B (J135830.27+140835.2). Separation 9.940" and PA 264.034°. Observation epoch 2003.409. Comparing the positions between 2MASS epoch 2000.157 and URAT1 epoch 213.751 suggests common proper motion because of ident proper motion vector direction of 332° and very similar proper motion vector length of ~600mas
14312+3426	TDS9227	14:31:09.931	+34:25:32.7	1.9	10.02	11.74	172	SDSS9 multiple spikes suggest multiple star - but all spikes suggest same centroid. Only one SDSS DR9 object. Also no hint of elongation in 2MASS J-band image. Bogus assumed despite confirmation recorded in WDS catalog
13433+1235	TDS8944	13:43:18.150	+12:35:24.7	3.0	10.98	11.12	25	SDSS9 objects for A (J134318.21+123523.4) and B (J134318.25+123527.6). Separation 4.337" and PA 7.963°. Observation epoch 2003.223
14415+4953	TDS9271	14:41:28.239	+49:53:10.5	2.2	11.06	11.86	20	SDSS9 objects for A (J144128.24+495310.4) and B (J144128.32+495312.2). Separation 1.976" and PA 21.123°. Observation epoch 2002.350