

Measurements of 40 Double Stars with an 8-inch Telescope

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Abstract

This article presents measurements of 40 double stars using the “lucky imaging” technique. The stars were selected from the Washington Double Star Catalogue maintained by the United States Naval Observatory. The observations were made with an 8-inch Schmidt-Cassegrain telescope

1. Introduction

This paper presents the results of measurements made between March and September 2021, from Llubí (Majorca, Balearic Islands), an urban environment with moderate to severe light pollution. The pairs selection criterion has been a minimum of 6 years without measurements recorded in WDS, pairs considered physical or of uncertain nature, and an angular separation greater than 2 arc seconds. The local conditions, 70 m above sea level, severe light pollution below 50° elevation, usual high humidity and atmospheric turbulence, have greatly limited the number of nights available. Therefore, the pairs choice, although previously planned, has often followed the criterion of mere opportunity. We collected astrometric measurements of the double star system WDS 06412-4021 (hereafter referred to as HJ 5443). The criteria outlined for the selection of this system were that it must in the spring, have an angular separation greater than six arcseconds, and not have been observed in recent years. Following the determination of several candidates, the system HJ 5443 was chosen. Figure 1 and historical data was requested from the United States Naval Observatory (USNO) to do primary analysis. Located in the constellation Puppis, the system has a right ascension of 06^h 41^m 14.17^s and a declination of 40° 20' 59.5", placing it in the southern hemisphere. In addition, the primary star is of the spectral class B4V (blue white).

2. Equipment and Methods

A Celestron C8 XLT SC telescope has been used at an approximate focal length of 2032 mm (f/10) without filter, and a HEQ5 Pro mount. The images were taken with a ZWO ASI290MM camera (CMOS IMX290, 2.9um x 2.9um). The resulting resolution was 0.29 arc seconds/pixel. *FireCapture* has been used to capture images, saving them in FIT format. A 60/240 finder with another CMOS camera has also been used as a guide telescope. The set was remotely controlled via LAN and the control of the telescope, including the transfer of coordinates to the mount control, has been carried out by means of an *ad-hoc* script written in Python language.

As calibration systems we have used several of those proposed in *Observación de Estrellas Dobles (Observation of Double Stars, 2017, Benavides et al.)* in Annex VII, consulting the latest data offered by GAIA EDR3, and estimating the position data at the current epoch according to the proper motion values. In each observation, between four and seven calibration stars have been taken, taking advantage of their close passage to the meridian, and averaging the obtained results.

For each pair, including the calibration pairs, a minimum of three and a maximum of six series of 1000 images have been taken at the shortest possible exposure time. The pairs were taken close to the meridian at the time of the shots. Each series of shots has been processed with *Reduc v. 5.36*, sometimes previously

aligning and choosing the images step by step, or using the *ELI* algorithm. Finally, the *AutoReduc* utility has been used with the selected images. The measurements with the largest deviations have been discarded, and each series results of the same system have been averaged to obtain the final value. Some of the systems have been observed only one night, although for some of them up to three observations have been carried out in different nights with the mentioned method, to average them later.

3. Data

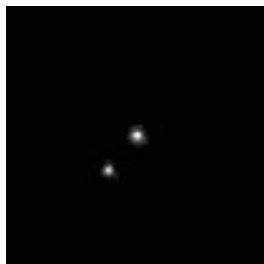
Table 1 shows the results of the measured systems in the considered period. In the columns σ PA and σ Sep the averaged value of the residuals has been included. Table 2 shows images of the measured pairs taking north at the top and east on the left as reference.

WDS	Pair	Mag A	Mag B	PA	Sep	σ PA	σ Sep	Julian Date	N	
12021+1521	WFC 122	10,24	10,61	140,97	8,152	0,47	0,066	2021,2441	1	
12104+3055	SEI 529	11,95	11,67	356,47	18,535	0,21	0,067	2021,2441	1	
12119+2024	HJ 2601	10,31	11,45	66,60	26,717	0,19	0,089	2021,2442	1	
12133+3013	SKF 65	11,20	11,70	177,27	7,612	0,42	0,065	2021,2442	1	
13038+4056	HJ 1226	11,32	11,21	190,88	12,083	0,28	0,069	2021,2443	1	
14222+5452	HJ 2717	10,40	11,20	295,67	9,452	0,37	0,059	2021,4083	1	
14229+4623	HJ 2716	10,60	11,18	86,15	5,471	0,50	0,067	2021,4467	2	
14409+3828	ALI 860	11,38	11,79	290,36	13,857	0,25	0,061	2021,4083	1	
14474+6321	STI 775	11,50	12,00	171,22	8,323	0,48	0,078	2021,4467	2	
14592+0649	HJ 1263AC	11,37	11,44	104,19	17,185	0,33	0,087	2021,4467	2	
15076+0313	BAL2404	10,97	11,60	211,72	6,990	0,61	0,063	2021,4467	2	
15236+2113	GRV 905	11,64	12,41	15,29	14,661	0,27	0,071	2021,4086	1	
15249+1359	HJ 252AB	9,88	10,86	96,55	11,582	0,46	0,093	2021,4467	2	
15266+2749	UC 3004	10,80	11,10	130,33	6,838	0,56	0,071	2021,4083	1	
15368+2404	POU3195	11,89	12,00	17,56	12,994	0,31	0,075	2021,4087	1	
15551+2529	BRT3309	10,73	11,58	286,37	3,266	0,46	0,072	2021,4087	1	
16255+1944	WFC 174	10,58	10,68	340,21	7,967	0,49	0,078	2021,4086	1	
16260+1322	BRT1283	11,34	11,74	144,19	3,280	0,32	0,062	2021,4086	1	
17013+6935	HEI 244	10,60	11,70	282,30	2,645	0,49	0,059	2021,5424	2	
17062+1809	GRV1259	10,30	11,70	25,80	10,180	0,37	0,085	2021,5424	2	
17099+1532	DAM 928	10,70	11,70	134,08	3,954	0,47	0,056	2021,4468	1	
17279+0051	BAL1186	10,50	11,50	116,10	8,330	0,43	0,071	2021,485	1	1
17362+0646	GAU 16	10,40	11,05	175,44	8,414	0,53	0,094	2021,5424	1	
17400+4046	ES 9003	9,80	10,20	51,26	10,186	0,37	0,078	2021,5425	1	
17447+1020	BRT1290	10,70	11,70	36,59	3,087	0,55	0,057	2021,485	1	
17592+0304	BAL2464	10,30	10,70	230,76	2,996	0,70	0,082	2021,5425	1	
18158+4107	ES 1651	11,19	12,36	5,25	2,504	0,46	0,058	2021,5426	1	
18185+2749	COU1008	10,37	11,39	92,37	2,017	0,55	0,057	2021,4469	2	
18298+1747	BRT2447	10,80	10,80	358,98	2,781	0,60	0,073	2021,447	1	
18328+1054	HEI 561	10,83	11,09	190,49	2,373	0,46	0,095	2021,4851	2	
18471+1515	HJ 1344	9,52	10,90	206,64	13,016	0,38	0,059	2021,5427	1	
18495+3512	POP 44	10,62	12,30	229,68	9,734	0,30	0,074	2021,5427	1	
18596+3530	GRV 244	11,50	12,40	152,67	14,596	0,24	0,066	2021,5427	1	2
19048+2829	COH 1	10,83	11,13	314,39	9,443	0,41	0,060	2021,5427	1	
19114+3144	GRV 249	12,24	12,42	207,18	14,561	0,29	0,057	2021,5428	1	
19209+3826	SEI 591	10,93	12,08	259,83	20,873	0,25	0,056	2021,5428	1	
21249+4336	BRT1150	11,76	11,62	59,66	2,857	0,60	0,044	2021,7122	1	3
21326+1351	HEI 286AB	10,81	12,40	268,32	2,186	0,50	0,057	2021,7123	1	4
21326+1351	HEI 286AC	10,81	10,91	280,02	34,033	0,07	0,040	2021,7123	1	
22335+4552	ES 1286	10,22	11,10	352,80	3,280	0,46	0,028	2021,7124	1	5

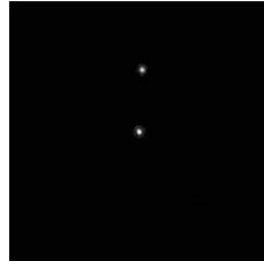
Table 1. List of measurements. Separations (Sep) are in arc seconds, position angles (PA) are in degrees. σ PA and σ Sep are the averaged value of the residuals. N is the number of nights.

Notes:

- 1 - Gaia EDR3 : pm 22,93 and 9,44, parallax 3,19 and 1,23.
- 2 – EDR3 2092795795064170496 appears in the same field of the image in Table 2.
- 3 - Gaia EDR3: pm 7.38 and 5.70. Last data in WDS Sep = 3", PA = 65° (1994).
- 4 - Last measurement in WDS: 2000.
- 5 - Gaia EDR3: pm 15.95 and 14.96. Latest data in WDS Sep = 2.7", PA = 353° (1998).



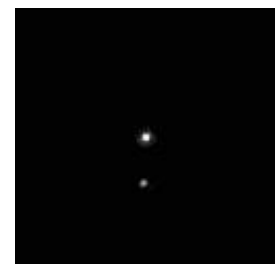
WFC 122



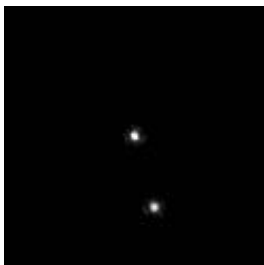
SEI 529



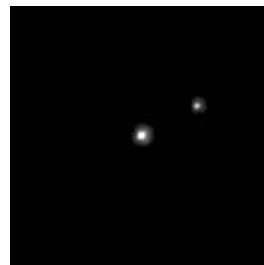
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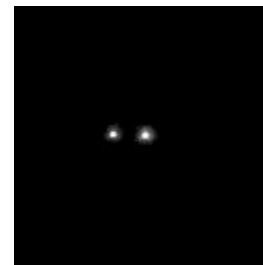
SKF 65



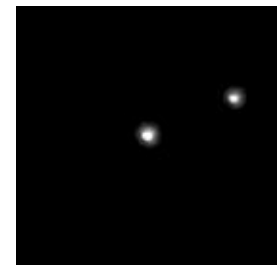
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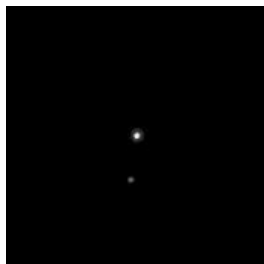
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HJ 2716



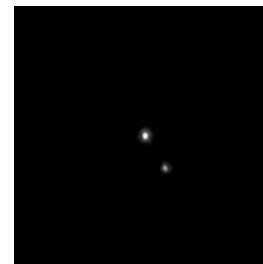
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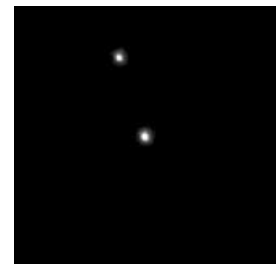
STI 775



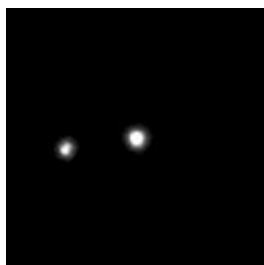
HJ 1263AC



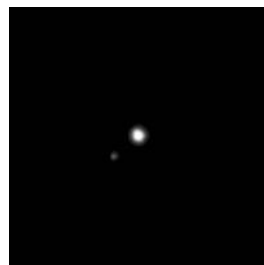
BAL 2404



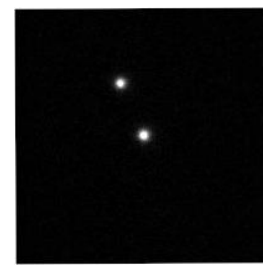
GRV 905



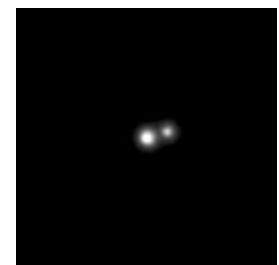
HJ 252AB



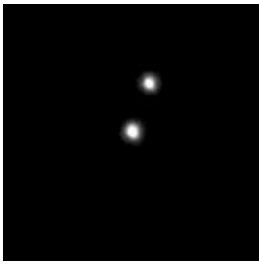
UC 3004



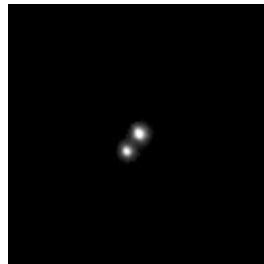
POU 3195



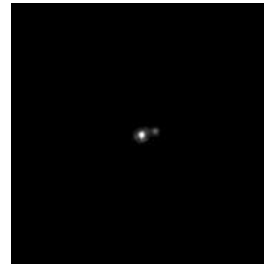
BRT 3309



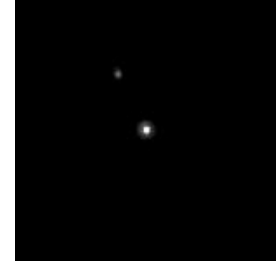
WFC 174



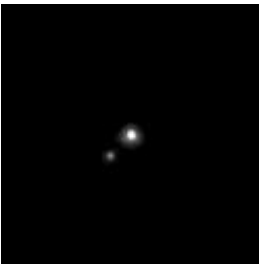
BRT 1283



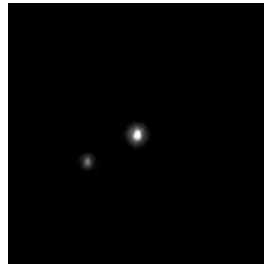
HEI 224



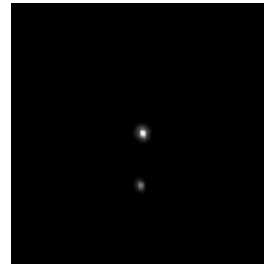
GRV 1259



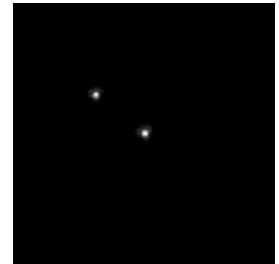
DAM 928



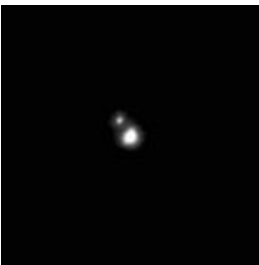
BAL 1186



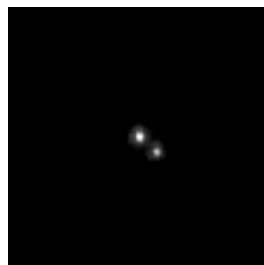
GAU 16



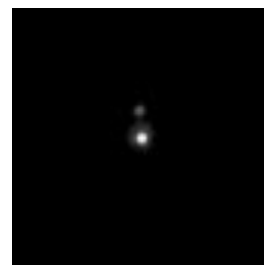
ES 9003



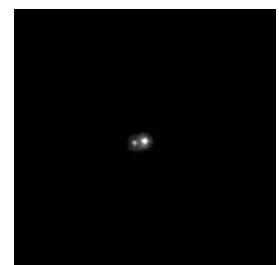
BRT 1290



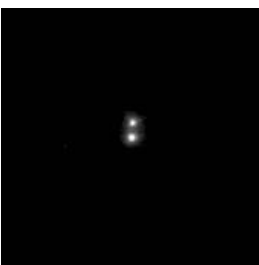
BAL 2464



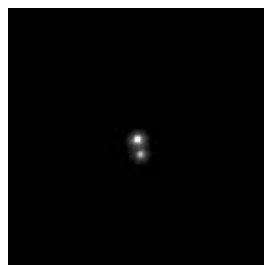
ES 1651



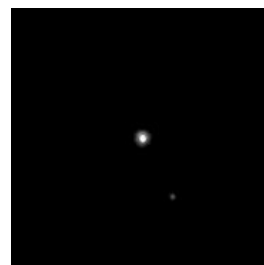
COU 1008



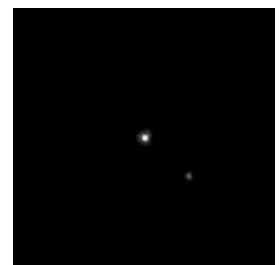
BRT 2447



HEI 561



HJ 1344



POP 44

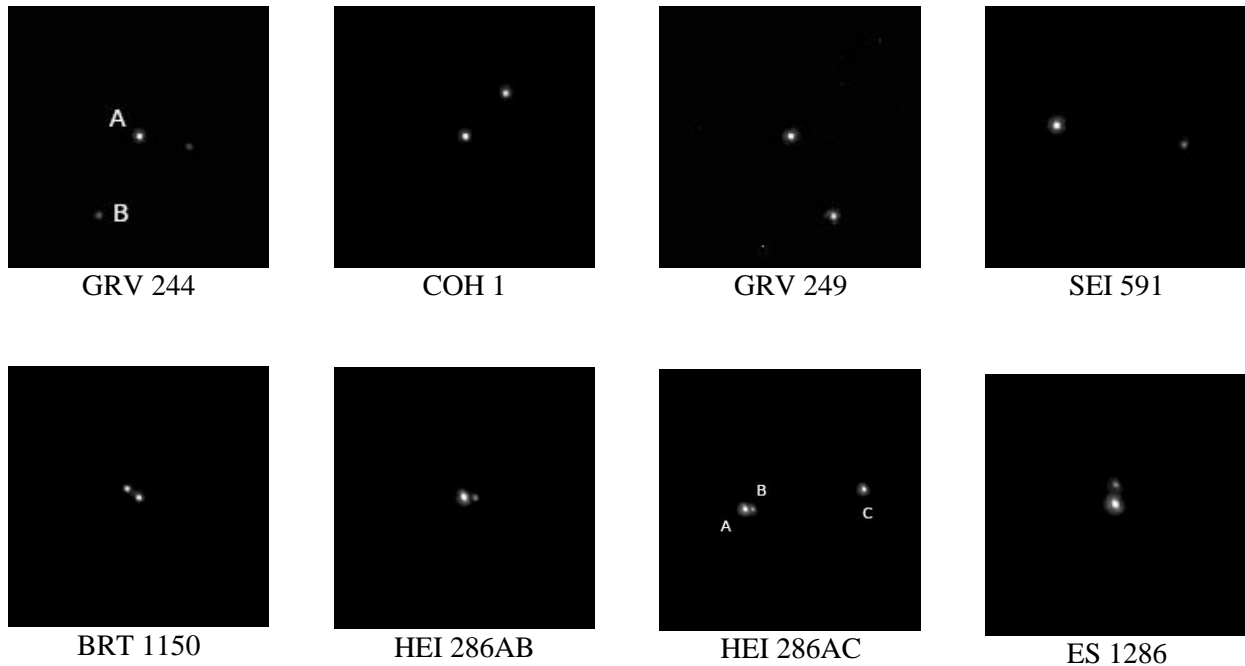


Table 2. Images (north at the top and east on the left)

6. Acknowledgements

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Nuevo Catálogo Comellas, <https://sites.google.com/site/nuevocatalogocomellas/home>

Gianluca Sordiglioni. Stelle Doppie - <http://www.stelledoppie.it>

Florent Losse. Reduc - <http://www.astrosurf.com/hfosaf/>