

# CCD Double Star Measures: Jack Jones Memorial Observatory Report #1

James L. Jones

3190 SW Douglas Circle  
Lake Oswego, OR 97035

nt7t@centurytel.net

**Abstract:** This paper reports on 63 CCD measurements of 58 multiple star systems observed between 2003 and 2007. It also reports on delta mag(V) measurements of selected doubles. Measurements were made using a CCD camera and 8" or 11" SCT. A brief description of methods used is provided.

This paper reports observations and measurements of double stars made between late 2003 and 2007. In all cases except one, observations were made using an 11-inch (28 cm) f/10 SCT with a Meade f/6.3 focal reducer/field flattener. The single exception was made with an 8-inch (20 cm) f/10 SCT. A SBIG ST7 camera with a KAF401E non anti-blooming (NAB) sensor was used for all observations. All observations made after 2004.664 utilized a Schuler V filter.

At least 20 images were taken of each double on each observing session. Images were calibrated with dark frames and flat fields. Five to ten images were selected from the original 20 and analyzed. Pre-selection of images provides an opportunity to remove images that were degraded by seeing, drive tracking, cosmic rays or other potential problems.

Exposure times were normally 20 or 30 seconds. Exposure times were shortened to 10 seconds to observe doubles with bright primaries to avoid saturation. In some cases, images were stacked in order to reduce the effects of scintillation in short exposures or to increase the SNR of dim stars. MaxIm DL was used to stack images.

Images were analyzed using Herbert Raab's "Astrometrica" program. The UCAC-2 catalog was used in most cases for analysis. Where UCAC-2 was unavailable or didn't provide adequate reference stars, USNO-B1.0 was used. The precision of each

observation was quantified and reported by calculating the standard deviation of the image set.

Delta magnitude measurements were made of selected pairs utilizing a Schuler V filter (540+/-115 nm). These measurements are summarized in Table 1. The error stated in Table 1 was calculated by taking the standard deviation of multiple images and thus represents the precision of the measurement. It does not include systematic errors.

A negative entry in Table 1 indicates that, as listed in the WDS, the secondary is brighter than the primary.

Color corrections were made to instrumental magnitudes where reliable B-V data was available for both stars. The V transform coefficient for the author's system has been calculated from observations of a wide range of different colored stars in M67 (Henden, 2000).

Position Angle and separation measurements are summarized in Table 2. Errors in separation (SEPerr) and Position Angle (PAerr) were calculated as the standard deviation of multiple images. They represent the precision of the measurement and do not include systematic errors.

Observations made in different observing seasons are reported as separate measurements.

Che 146 (WDS: 10002+2058, Rho = 29.6, Theta = 212, mags 10.5, 11.4) appears to consist of

## CCD Double Star Measures: Jack Jones Memorial Observatory Report #1

GSC1418.231 (mag  $11.93 \pm 0.41$ ) and GSC1418.168 (mag  $13.48 \pm 0.41$ ). The delta V magnitude of this pair was measured as  $-1.52 \pm 0.02$  mag as stated in Table 1. It appears that a PA reversal is in order.

Che 143 (WDS: 09585+2159, Rho = 22.9, Theta = 137, mags 10.3, 11.4) appears to consist of GSC1418.966 (mag  $12.96 \pm 0.41$ ) and GSC1418.958 (mag  $11.48 \pm 0.41$ ). The delta V magnitude of this pair was measured as  $-1.22 \pm 0.02$  as stated in Table 1. Again, the phase angle appears to be reversed.

Che 412 (WDS: 22449+3221. Rho = 29.1, Theta = 251, mags 10.52, 12.0) was discovered by P.S. Chevalier in 1910 and not observed since. The WDS does

not include a Precise Coordinate for this pair. The author measured the position of the primary as RA = 22:44:48.7 ( $\pm 0.0004$ ), Dec = +32:20:15.0 ( $\pm 0.004$ ).

### Acknowledgements

This paper has made use of the Washington Double Star Catalog maintained at the U.S. Naval Observatory.

### References

Henden, Arne A., 2000, *Journal of the American Association of Variable Star Observers*, Vol. 29, No. 1, 35-43

RA/DEC	NAME/COMP	DeltaM	N	Filter	error	epoch
09585+2159	CHE 143	-1.22	2	540 $\pm$ 115	0.02	2006.109
10002+2058	CHE 146	-1.52	2	540 $\pm$ 115	0.02	2006.124
15550+2953	HJ 2797	1.08	2	540 $\pm$ 115	0.01	2006.342
15333+3827	HJ 2786	3.57	1	540 $\pm$ 115	0.01	2006.358
15503+3224	HJ 574AB	2.92	2	540 $\pm$ 115	0.01	2006.358
15503+3224	HJ 574AC	1.57	2	540 $\pm$ 115	0.01	2006.358
20404+3758	SEI1212	2.37	1	540 $\pm$ 115	0.02	2006.616

**Table 1:** Delta magnitudes for selected doubles. Negative DeltaM indicates that secondary is brighter than the primary.

*Table 2 begins on next page.*

### CCD Double Star Measures: Jack Jones Memorial Observatory Report #1

NAME	RA DEC	MAGS	PA	PAerr	SEP	SEPerr	DATE	N	NOTES
HLM 12	18581+3308	10.5 11.5	356.9	0.10	14.00	0.02	2004.625	1	
GYL 13	19011+3210	10.00 10.45	304.9	0.02	34.93	0.04	2004.625	1	
SEI1554	22042+3507	10.5 11.0	294.9	0.06	16.28	0.03	2004.682	1	
CHE 391	22429+2958	12.53 13.50	52.5	0.06	28.51	0.03	2004.581	1	
STF3005	23215+2457	8.9 12.2	23.6	0.13	20.64	0.02	2003.732	1	1
ALI 890	19316+3820	11.9 11.9	115.0	0.05	15.05	0.01	2004.551	1	
GYL 48	21059+3232	10.0 10.2	180.1	0.04	31.65	0.02	2004.556	1	
HJ 2767	15095+3208	10. 11.	263.0	0.16	11.48	0.04	2005.192	1	
HJ 815	09300+3254	9.2 12.8	150.1	0.09	15.50	0.07	2006.122	1	
HJ 1628	21157+3235	10.24 11.44	251.7	0.05	15.17	0.01	2004.551	1	
HJ 2872AC	19290+0343	9.1 13.0	229.7	0.07	13.20	0.02	2004.541	2	
SEI1443	21125+3217	10.36 11.48	139.8	0.09	25.47	0.06	2004.541	1	
SEI1423	21102+3151	10.22 12.18	225.6	0.07	13.62	0.01	2004.551	1	
SLE 122	18436+4020	10.74 11.95	151.3	0.06	17.90	0.01	2004.576	1	
SLE 92	18404+4028	9.8 12.0	99.0	0.05	15.96	0.02	2004.576	1	
SLE 94	18413+4102	10.4 10.4	102.6	0.04	15.95	0.01	2004.626	1	
SLE 187	18310+3857	9.7 10.8	210.7	0.05	23.41	0.03	2004.626	1	
CHE 415	22451+3003	11.17 12.81	231.2	0.06	11.72	0.03	2004.581	1	
CHE 422	22458+2957	10.8 12.3	311.7	0.08	8.78	0.02	2004.581	1	
BU 1528	23121+4517	9.9 10.6	191.2	0.04	33.84	0.04	2004.600	1	
CHE 287	20180+1501	11.0 11.5	135.0	0.04	27.20	0.03	2004.600	1	
CHE 303	20190+1456	9.97 11.0	259.4	0.06	20.50	0.03	2004.600	1	
CHE 451	23246+4244	9.82 10.69	295.1	0.02	36.42	0.01	2004.600	1	
HJ 1794	22383+4659	9.4 11.0	317.3	0.02	16.42	0.02	2004.600	1	
HJ 1793	22383+4702	11.38 12.36	288.7	0.08	15.40	0.02	2004.600	1	
HJ 1815	22494+4528	9.5 9.8	30.9	0.05	10.09	0.01	2004.600	1	
HJ 1841AB	23029+4610	9.69 10.18	344.2	0.02	18.22	0.01	2004.600	1	
HJ 1841AC	23029+4610	9.69 10.42	285.5	0.01	33.65	0.01	2004.600	1	
HJ 2962	20263+1743	10.0 11.0	103.8	0.06	13.36	0.02	2004.600	1	
HO 499	19265+2722	9.3 12.6	177.6	0.04	14.56	0.02	2004.600	1	
ES 499AB	20110+4536	8.2 12.2	332.1	0.15	13.62	0.05	2004.582	1	
ES 499AC	20110+4536	8.2 13.2	84.9	0.05	25.90	0.04	2004.582	1	
HJ 1488	20107+4547	11.86 11.77	131.9	0.08	12.99	0.09	2004.576	1	
CHE 386	22428+3021	10.93 12.30	270.1	0.13	10.72	0.02	2004.616	1	
HJ 2651	13256+2116	11.0 11.5	339.1	0.13	13.79	0.03	2005.192	1	

Table 2: Measures of double stars.

*Table 2 continued on next page*

### CCD Double Star Measures: Jack Jones Memorial Observatory Report #1

NAME	RA DEC	MAGS	PA	PAerr	SEP	SEPerr	DATE	N	NOTES
POU3130	12402+2430	12.5 12.7	104.4	0.14	11.45	0.01	2005.200	1	
HJ 514	12028+2841	10. 11.	87.7	0.03	21.04	0.03	2005.192	1	
KU 130	21057+3215	10.21 11.36	57.9	0.04	19.35	0.01	2004.551	1	
ES 2569	18107+3903	9.5 10.0	275.4	0.11	9.94	0.02	2004.620	1	
CHE 143	09585+2159	10.3 11.4	317.3	0.07	22.89	0.03	2006.109	2	2, 3
CHE 144	09585+2119	10.6 11.0	85.8	0.01	27.28	0.01	2006.120	3	
CHE 145	09596+2122	10.8 11.4	302.9	0.06	27.10	0.06	2006.124	2	
HJ 415AB	07178+3328	11.1 12.1	291.3	0.09	14.57	0.02	2006.122	1	
HJ 415AC	07178+3328	10.9 12.9	308.6	0.12	26.39	0.04	2006.122	1	
CHE 146	10002+2058	12.0 13.3	35.5	0.09	29.71	0.08	2006.124	2	2, 3
SMA 68	07014+2941	11.5 11.7	195.5	0.07	10.04	0.01	2006.122	1	
POU3096	11077+2308	13.2 14.0	154.3	0.14	13.23	0.04	2006.325	2	
POU3088	10458+2354	11.3 12.9	111.6	0.07	14.24	0.03	2006.333	2	
HJ 2797	15550+2953	10.82 11.99	77.2	0.01	34.23	0.01	2006.342	2	3
POU3098	11148+2257	10.5 10.9	128.7	0.10	8.45	0.01	2006.325	2	
HJ 2786	15333+3827	8.3 11.7	169.6	0.04	26.52	0.03	2006.358	1	3
HJ 574 AB	15503+3224	9.3 11.3	93.5	0.05	15.81	0.02	2004.339	1	
HJ 574 AB	15503+3224	9.3 11.3	93.5	0.03	15.77	0.01	2006.358	2	3
HJ 574 AC	15503+3224	9.30 10.90	96.4	0.01	76.42	0.02	2006.358	2	3
HJ 574 AC	15503+3224	9.30 10.90	96.4	0.04	76.43	0.02	2004.339	1	
SEI1212	20404+3758	10.3 11.8	194.3	0.09	19.51	0.04	2006.616	1	3
SEI1170	20340+3737	10.0 11.0	28.4	0.12	17.30	0.03	2006.617	1	
SEI1178	20350+3757	10.0 11.0	173.2	0.10	18.90	0.02	2006.616	1	
POU 340	03592+2338	12.9 13.3	28.8	0.08	20.17	0.03	2006.756	2	
HJ 2672	13422+2307	11.49 13.0	311.4	0.02	39.63	0.03	2007.304	2	
HJ 2678	13460+1216	11.39 13.39	119.9	0.04	25.46	0.02	2007.377	2	
LDS 949	13488+1244	12.5 13.4	28.9	0.04	16.65	0.006	2007.395	1	
CHE 412	22449+3221	10.52 12.0	250.3	0.02	30.49	0.05	2007.736	1	4

Table 2 (continued)

## Notes:

1. 8 inch SCT
2. Significant PA reversal
3. DeltaMag: See Table 1
4. Primary Position 224448.7+322015.0