Astrometric Measurements of WDS 00198+7518 (HJ 1950) and WDS 01373+6344 (MLB 383AD)

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Abstract: CCD astrometric measurements of the double star systems WDS 00198+7518 HJ 1950 and WDS 01373+6344 MLB 383AD are reported. In conjunction with historical observations the new data suggest that both systems are optical doubles.

Introduction

The systems were selected based on these constraints: right ascension between 00 and 08 hours, declination of greater than +40 degrees, less than six magnitude difference between primary and secondary stars, and a minimum separation of 5.5 arcseconds. To satisfy these criteria the authors chose WDS 00198+7518 (also known as HJ 1950) and WDS 01373+6344 (also known as MLB 383AD).

The renowned double star astronomer J. F. W. Herschel, son of William Herschel, discovered HJ 1950 in Cepheus in 1831. Since then there have been ten observations made with the most recent in 2010. From 1831 to 2010 the position angle (Theta) was measured to change from 71 degrees to 67 degrees while the separation (Rho) varied from 12 to 22.3 arcseconds. The magnitudes of the primary and secondary star are 10.2 and 12.6, respectively. The spectral type of the primary star is K2, a yellow-orange color star. According to Stelle Doppie the relative proper motion (rPM) of HJ 1950 is 1.03 (Stelle Doppie). Relative proper motion is a calculation that roughly indicates whether a system is optical or physical. An rPM greater than 0.8 is predicted to be optical therefore the rPM of 1.03 for HJ 1950 means that the system is predicted to be an optical double (Stelle Doppie).

MLB 383AD is a component of a quadruple system in Cassiopeia. The AD components were the focus of the measurements because the separation between the A and B components was too minimal to be properly imaged by the available equipment. In addition, the authors decided it would be best to focus analysis on AD components rather than the AC components because the AC components had only 4 observations which was deemed insufficient to draw any meaningful conclusions. MLB 383 was first discovered by T. E. Espin and W. Milburn in 1898, and the AD component was first observed in 1898 (Urban, Corbin, Wycoff, et al 1998). Since then there have been nine observations made of the AD components with the most recent in 2015. From 1898 to 2015 Theta was measured to change from 169 degrees to 175 degrees while Rho varied from 30.7 to 31.8 arcseconds. The magnitudes of the primary and secondary star are 10.47 and 11.35, respectively. The spectral type of the primary star is B8, a blue-white color star. According to past measurements it is possibly an optical double as its rPM was found to be 1.09 (Stelle Doppie).

Materials and Methods

Images of HJ 1950 were taken on December 9, 2016 by iTelescope's New Mexico T21 Planewave 17" CDK telescope which uses a FLI-PL6303E CCD camera with a pixel scale of 0.96 arcseconds. The images of MLB 383AD were taken on November 30, 2016 and were provided by iTelescope's New Mexico T11 Planewave 20" CDK telescope which uses a FLI ProLine PL11002M CCD camera with a pixel scale of 0.81 arcseconds. MAXIM DL6 was used to provide WCS coordinates for the FITS images and MIRA Pro x64 was used to measure the separations and position angles.

Results

For HJ 1950 Table 1 shows the new calculated position angle and separation, and Table 2 shows a historical comparison to the most recent prior observation and the first observation. These new measurements are consistent with those made by Cutri et al (2010) with a difference of 1 degree in position angle and 0.47 arcseconds in separation. The results are plotted together with historical observations in Figure 1.

For MLB 383AD, Table 3 shows the new calculated position angle and separation, and Table 4 shows a historical comparison to the most recent prior observation and the first observation. The position angle and separation are slightly greater but consistent with the previous values reported by Harshaw (2016) by +0.55 degrees and +0.11 arcseconds, respectively. The results are plotted together with historical observations in Figure 2.

Table 1. Astrometry results for WDS 00198+7518 HJ 1950

WDS 00198+7518 (HJ 1950) Astrometry for Epoch 2016.9390			
Measurement	**Theta (degrees)**	**Rho (arcseconds)**	**Telescope: (number of images used in each filter)**
Mean	65.5	22.78	iTelescope T21 (1 luminance, 2 Hydrogen-alpha)
Standard Deviation	0.48	0.04	
Standard Error of Mean	0.28	0.02	

Table 2. Historical comparisons for WDS 00198+7518 HJ 1950

WDS 00198+7518 (HJ 1950) Historical Comparison		
Epoch	**Theta (degrees)**	**Rho (arcseconds)**
1831.84 (Discovery)	71.3	12.
2010.5589 (Last one previous to this investigation)	66.5	22.31
2016.9390 (The authors' measurement)	65.5	22.78

Table 3. Astrometry results for WDS 01373+6344 MLB 383AD

WDS 01373+6344 (MLB 383AD) Astrometry for Epoch 2016.9090			
Measurement	**Position Angle (degrees)**	**Separation (arcseconds)**	**Telescope: (number of images used in each filter)**
Mean	165.2	31.90	iTelescope T11 (2 luminance, 1 hydrogen-alpha)
Standard Deviation	0.18	0.05	
Standard Error of Mean	0.10	0.03	

Table 4. Historical comparisons for WDS 01373+6344 MLB 383AD

WDS 01373+6344 (MLB 383AD) Historical Comparison		
Epoch	**Theta (degrees)**	**Rho (arcseconds)**
1898.97 (Discovery)	169.4	30.695
2015.877 (Last one previous to this investigation)	164.819	31.752
2016.9090 (The authors' measurement)	165.2	31.90

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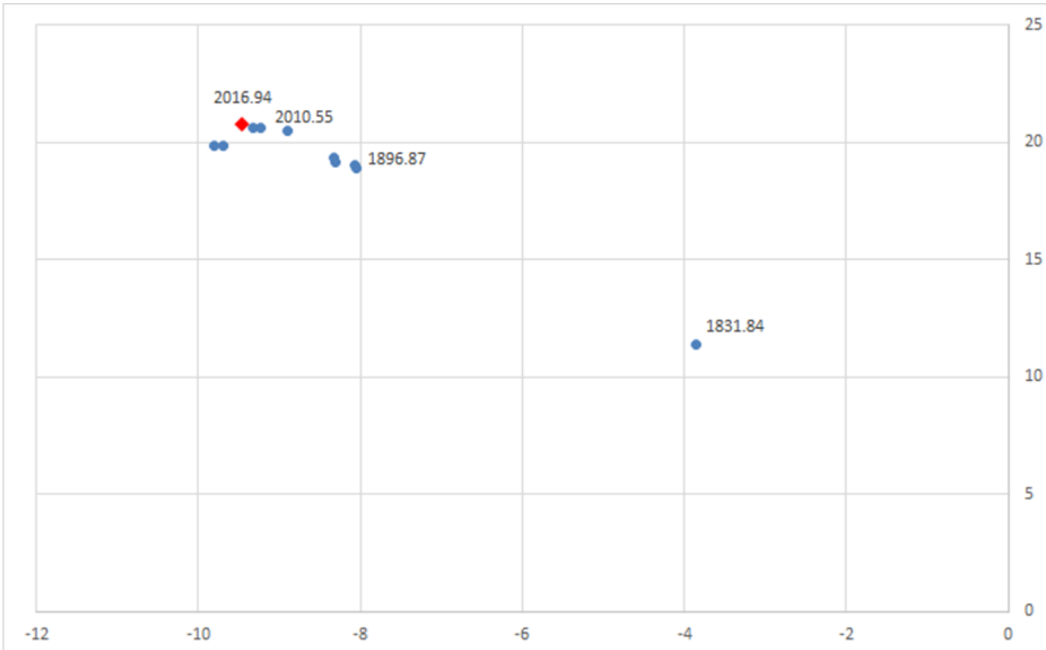

Figure 1. Historical observations of WDS 00198+7518 HJ 1950 with B component plotted with respect to the A component at (0, 0).

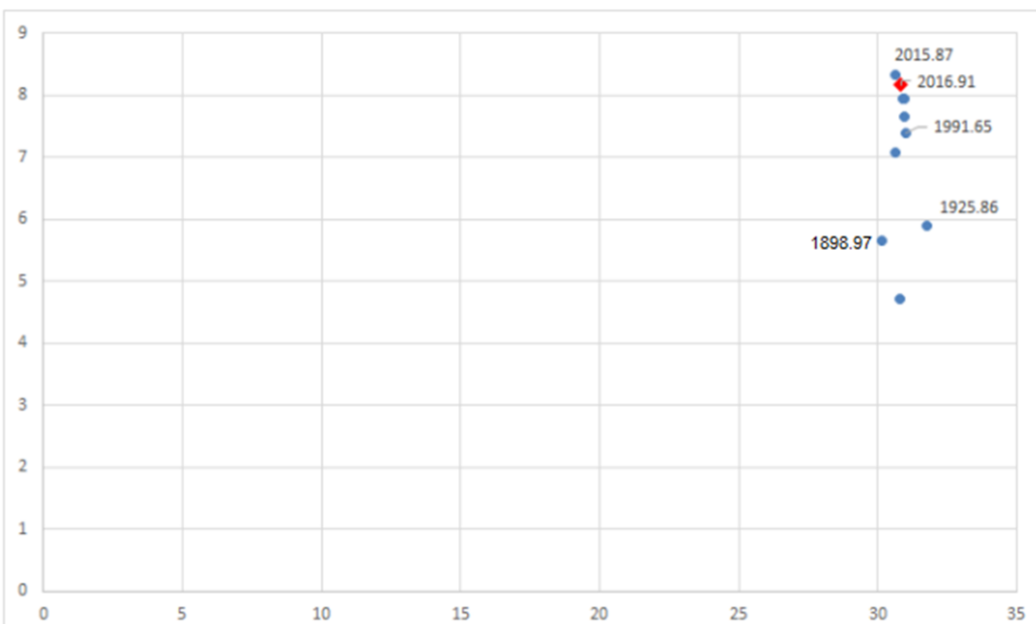

Figure 2. Historical observations of WDS 01373+6344 MLB 383AD with B component plotted with respect to the A component at (0, 0).

Discussion

The graph of WDS 00198+7518 HJ 1950 indicates that the secondary component remains in the same general area as the other measurements if the first measurement in 1831 is considered an outlier. The graph of WDS 01373+6344 MLB 383AD suggests the continuation of a linear trend in motion.

When considered in combination with previous measurements, these results indicate that neither of the two systems currently exhibit the change in position over time characteristic of orbital motion that may indicate a physical double system. These measurements, suggesting the systems are likely continuing their historic linear trends, are important because they contribute to the collection of data in the WDS catalog that can be used to eliminate or confirm physical doubles. Either set of data may or may not represent a small snapshot of a very large orbital path that would require many centuries of measurements to understand accurately. It is possible that either or both of the systems could be long-period physical doubles. An accurate measurement of distance between the components of each system as could be provided by an astrometric satellite would help determine whether or not the stars are close enough to be physical binaries.

Conclusion

A current area of astronomical research is the analysis of double star candidates, such as those identified in the WDS catalog, with the goal of evaluating their status as physical or optical doubles. Specifically, the most recent measurements agree with predictions of a linear trend in motion. Future measurements will help establish the true nature of this system.

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