

STI2679 - Fr. Stein's Neglected Double-Double

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Abstract: I report the measurement of neglected double STI2679 and two new companion stars “C” and “D”. The CCD data images were taken with a 20in f/16.8 Ritchey-Chretien reflector. The observing run was conducted at the National Optical Observatory at Kitt Peak Visitor's Center Advanced Observer Program. Information about instrumentation, methodology, results and notes is included.

Introduction and Instrumentation

On October 1, 2009 I conducted an observing run measuring neglected doubles [Mason,2006] at the Kitt Peak Advanced Observer Program (AOP) [noao.edu] run by the National Optical Observatory Visitors Center. The results of that run were reported earlier [Smith, 2009]. One neglected double I did not report was STI2679. This double was first measured by Fr. Stein in 1917 [Daley, 2006]

When I returned home and viewed the FITS images of STI2679, it was apparent that double was a neat---and close --- double-double. The A-B components were well separated in the original images, but the “C” and “D” components were too close to reliably measure. The first observations were done on a RC Optical Systems 20 inch f/8.4 Ritchey-Chretien carbon truss reflector on a Paramount ME German equatorial mount. The CCD camera was a SBIG STL-6303E non-ABG. No filter was used. This setup gave an effective focal length of 4,103 mm, a field of view of 22 X 15 arc minutes, and a plate

scale of 0.45 arc seconds per pixel, which did not have enough image scale to measure the “C” and “D” components.

I contacted Kevin Bays, my observing guide from the AOP program, and asked if STI2679 could be re-imaged at a longer focal length. He kindly agreed and on July 11, 2009 took 15 images of the double. This run was done on the same telescope but with a 2X barlow, a clear filter and a ST-8 non-ABG CCD camera. This configuration gave an effective focal length of 8,229 mm and a field of view of 5.8 X 3.8 arc minutes. This was sufficient to make measurements of the two new components.

Methods

Fifteen unguided CCD exposures of 10 seconds with a clear filter were taken. A large number of exposures were taken as the 20in Optical Systems OTA pushes the limit of the Paramount ME mount for unguided exposures.

Despite the long focal length, only two images had elongated star images. Those were excluded as well as another image for which

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the measuring software could not reach a plate solution. Figure 1 is an image showing the four components.

MOP Canopus [Warner, 2006] was the primary measurement and plate solution software. Canopus produces an astrometry plate solution and also provides raw instrumental magnitudes produced by a photometry routine from its internal catalogs (USNO-V2.0 and TYCHO2 datasets) [Monet, 1998 and Schwekendiek, 2000]. The CCD images have been copied to archival CD-ROM and are available from the author.

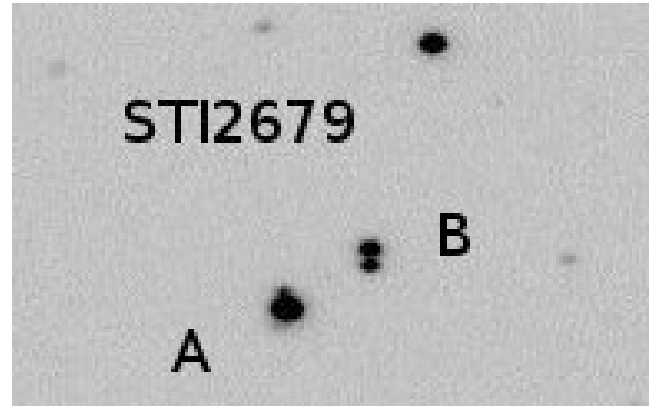


Figure 1: STI2679 shows four components in this CCD image.

Results

Table 1 reports the results of both imaging sessions of STI2679. It includes the WDS des-

ignation, arithmetic means of the separation and position angles of the A-B, A-C, and B-D

Table 1: Summary data for measures of neglected double star STI2679 at FL 4103 mm (top row) and 8229 mm (second row) are reported. WDS ID and Discoverer are the Washington Double Star Catalog identifier and discoverer codes. Magnitudes marked with an "*" are the arithmetic means of the raw instrumental magnitudes taken with a clear filter. They should NOT be considered precision photometry. PAsd and SEPsd are the standard deviations of the measures of position angle (PA) and separation (SEP) based on the number (No.) of CCD images measured. The date of discovery and number of previous measures are shown.

WDS ID	Discoverer	Mags*	PA	Sep	Epoch	No.	PAsd	SEPsd	Last	Prev	Notes
22171+5521	STI2679 A-B	A 12.13 B 13.60	305.9	13.70	2008.750	7	0.31	0.083	1917	1	#1
22171+5521	STI2679 A-B	A 12.13 B 13.60	307.5	13.86	2009.525	12	0.20	0.063			#2
	A-C	A 12.49* C 15.07*	20.3	2.24	2009.525	12	0.97	0.098		New	
	B-D	B 14.18* D 14.45*	180.9	2.05	2009.525	12	0.54	0.080		New	

Table Notes

1. I was originally puzzled by the difference in PA between the two measurement sessions. I eventually realized that at a focal length of 4.103 mm. both "B" and "D" components were merged so the software was reporting an average PA. This measure probably is similar to the conditions of the discovery measure, so I decided to publish both results.
2. At a focal length of 8.229 mm both "B" components are fully separated and the AB measure was taken between "A" and brighter "B" component at the "0" position angle of the BD pair.

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components, the epoch, the standard deviations of the measurements as well as the arithmetic means of the raw instrumental magnitudes of the "C" and "D" components.

The Canopus' photometry routine attempts to provide a useful estimate of star image magnitudes by comparing the computed raw instrumental magnitudes with its internal catalogs. Of course, the raw instrumental values and the catalogs have numerous systematic errors. For comparison purposes, the "A" component of STI2679 is TYCHO2 3986/1355, catalog magnitude 12.13. The arithmetic mean of Canopus' twelve estimates of the "A" component magnitude was 12.49.

Acknowledgments

The measurement of STI2679, the two new companions, and this article, would not have been possible but for Kevin Bays of the Kitt Peak AOP; who --- on his own time---took the CCD images supplying the data. I am very grateful for his time and effort. Thanks also to Dr. Brian Mason of the USNO who provided the original observing list as well as encouragement. Thanks as well to Brian C. Warner of MOP Canopus, who helped with some deep software instruction. Special

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