

Astrometric Measurement of WDS 03117+8128 STF 327 AB

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Abstract: We report CCD astrometric measurements of the double star system WDS 03117+8128 STF327AB using the iTelescope network. We found the relative position to be $\rho = 20.26 \pm 0.12$ arc-sec and $\theta = 289.1 \pm 0.39$ degrees at epoch 2016.84. When combined with the historical data over the last 114 years the trend suggests the decreasing of the distance between the AB pair.

Introduction

We used the Washington Double Star Catalog (WDS) to identify a binary pair on which to conduct angle (Theta) and separation (Rho) measurements. The double star system was selected based on the following requirements:

- Observable from the Northern hemisphere in the autumn
- Angular separation greater than six arc seconds
- Magnitude difference of no more than 5

The catalog star WDS 03117+8128 (STF 327 AB) satisfied these criteria.

The A star in STF 327 is a spectroscopic binary (WDS Notes). The B star is not part of the spectroscopic pair. The primary has a spectral type of A7III-IV (Sordiglioni, G.). That means the star is a (A) white (IV) subgiant. The difference in magnitude between the A and B stars is 4.75 with the primary star having a magnitude of 5.914 in the visible and the secondary star having a magnitude of 10.7 in the visible, per SIMBAD data. The first position angle and separation measurements taken in 1902 were 282° and 25 arc-seconds, respectively. The last measurements were 289° and 21.2 arc-seconds, respectively, in 2003.

Equipment, Observations, and Data Reduction Procedures

CCD images were taken using the T7 and T18 telescopes, part of the iTelescope network. T7 is a Correct-

ed Dall-Kirkham Astrograph with an aperture of 431mm, a focal length of 2929mm, and a F/Ratio of f/6.8. The CCD for the T7 is a SBIG STL-11000M (ABG) with a resolution of 0.63 arc-secs/pixel housing an array 4008 by 2672 (10.7 Mega pixels) with a FOV of 28.2 x 42.3 arc-mins located in Nerpio, Spain.

Additional images were taken using the T18 telescope, also located in Nerpio, Spain, using a Planewave 0.32-m f/8.0 reflector equipped with a 3072 by 2048 array imaging at a pixel scale of 1.69". Both cameras can easily resolve separations above five arc-seconds.

A total of six images were acquired between epochs 2016.816 and 2016.854. Two images were taken with the T7 Telescope, each with red (1-90sec, 1-120sec). Four images were taken with the T18 Telescope, two images each with the red (1-90sec, 1-120sec), hydrogen alpha (1-120sec, 1-180sec). An additional 11 images were excluded due to tracking quality of the observations.

The remaining 6 images were preprocessed (dark and flat correction) by the iTelescope data reduction pipeline. MaximDL v6 was used to insert World Coordinate System (WCS) positions into the FITS headers through comparison of the image star field against the Fourth U.S. Naval Observatory CCD Astrograph Catalogue (UCAC4).

During this process MaximDL typically used approximately 400 stars out of a database of 3000 stars for this star field. Mirametrics Mira Pro x64 was used to compute accurate position angles and separations of the component stars. The A and B stars were identified,

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Table 1. Results of Mira Pro astrometric measurements of WDS 03117+8128.

| WDS 03117+8128 STF 327AB | | | |
|------------------------------------------------------------------|--------------------|--------------------|---------------------|
| Telescope: (number of images per filter) | Epoch 2016.84 | θ (degrees) | ρ (arcseconds) |
| T07: (2 R) T18: (2 R), (2 H-alpha) | Mean | 289.1 | 20.26 |
| | Standard deviation | 0.39 | 0.12 |
| | Std. error of mean | 0.065 | 0.02 |
| 2003.87 measurement (Last one previous to this investigation) | | 288.5 | 21.2 |

marked, and then measured using the algorithms of Mira Pro to find the centroids of each component. The telescopes and filters used for the 6 images measured gave consistent results so we calculated a master average of ρ and θ .

Results

Table 1 shows our calculated angular separation and position angle for STF327AB, Figure 1, and the uncertainty in each. We find a mean and position angle of $289.1^\circ \pm 0.06^\circ$ and an angular separation of $20.26'' \pm 0.02''$, slightly but significantly larger than the 2003.87 measurement of $21.2''$.

Discussion

Astrometry, derived from six images, are plotted together with historical data from the WDS (Figure 2). Further observations over the next several decades may reveal whether STF327AB angular separation will continue to increase or reach a maximum. Microsoft Excel was used to develop a scatter plot of the historical and our measured XY coordinate position of the AB pair based on the data in Table 2. The results are shown in Figure 2. The measurements from this activity are indicated by a red triangle.

Conclusions

We obtained astrometry of the double star system WDS 03117+8128 STF 327AB using the T7 and T18 telescopes of the iTelescope network. We have demonstrated that this system is fairly easy to observe with small-to-moderate sized telescopes. Astrometric observations of such systems as their relative path on the sky approaches maximum separation and curvature can improve their fitted orbits.

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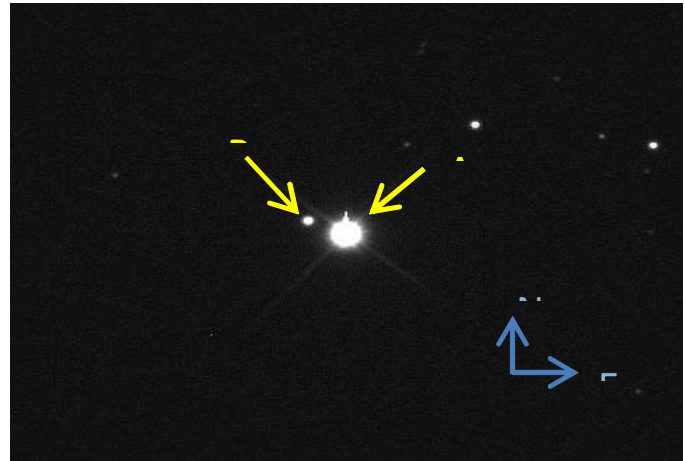


Figure 1. Image from T18 of WDS 03117+8128. Cropped to show target stars.

Table 2. Historical and latest astrometric measurements of WDS 03117+8128.

| 03117+8128 | Position Angle | Separation |
|------------|----------------|---------------|
| Epoch | (degrees) | (arc-seconds) |
| 1902.73 | 281.9 | 25.01 |
| 1904.84 | 281.6 | 24.64 |
| 1925.30 | 283.8 | 23.72 |
| 1935.63 | 284.1 | 23.71 |
| 2000.76 | 288.3 | 20.99 |
| 2003.87 | 288.5 | 21.20 |
| 2016.84 | 289.1 | 20.26 |

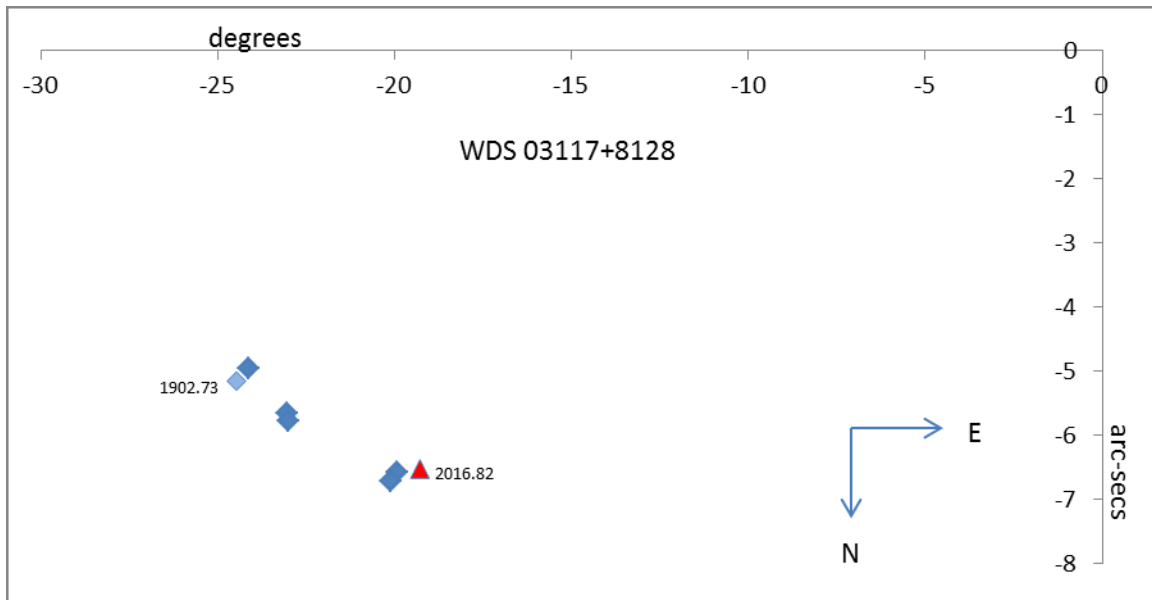
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Figure 2. Distance between components A and B

scope system and remote server and software. The authors thank Russell Genet for providing guidance.

References

- Frey, Thomas G, Johnson, Jolyon, Almich, Christopher J., and Genet, Russell M. 2010. Visual Double Star Measurements with Equatorial and Alt-Azimuth Telescopes. *Small Telescopes and Astronomical Research*. Chapter 10, eds Russell M. Genet, Jolyon M. Johnson, and Vera Wallen. Collins Foundation Press.
- Genet, R.M., Johnson, J.M., and Wallen, V. 2010. *Small Telescopes and Astronomical Research*. Dr. Vera Wallen Chief Editor
- Mason, B. and Hartkopf, W. The Washington Double Star Catalog, October 2015. Astrometry Department, U.S. Naval Observatory. <http://ad.usno.navy.mil/wds/wds.html>. Department, U.S. Naval Observatory.
- Sordiglioni, Gianluca Stella Doppie, Double Star Catalog. <http://stelledoppie.goaction.it/index2.php?iddoppia=11209>.