Visual Measurements of the Double Star 23 ORI

Crystal Collins[1], Sadie Wessel[1]. Samantha Brown[1], Dylan Head[1], Alex McCombe[2], Garrett Hosier[2], Russ Genet[2], Jo Johnson[3], Joseph Carro[2], Thomas J. Hollis[1, 2]

1. Atascadero High School, Atascadero, California
2. Cuesta College, San Luis Obispo, California
3. University of Washington, Seattle

Abstract A team of students from Atascadero High School and Cuesta College measured the separation and position angle of the double star 23 ORI (WDS 05228+0333). The students analyzed the data and calculated a separation of 32.3 arc seconds and a position angle of 30°.

Introduction

In the spring semester of 2015, eight students from Atascadero High School and Cuesta College researched past observations and collected new measurements on the double star listed in the Carro Double Star Catalog as 23 ORI (WDS 05228+0333). The team was led by Hollis and Carro, shown in Figure 1. The research team made visual measurements of the double star on March 21, 2015. Observations were made on top of Star Hill just outside of Santa Margarita, California. Weather conditions were optimal once the sky had cleared.

Figure 1: Thomas Hollis (left) and Joseph Carro (right)

The goals of this project were to: (1) accurately measure the separation and position angle of the double star 23 ORI, (2) properly record and process data with statistical calculations, and (3) compile these measurements along with past measurements on this star into a scientific paper. This project was designed to give students hands-on experience in conducting authentic astronomical research.

Past Observations of 23 ORI

The first recorded measurements of double star 23 ORI were published by William Herschel in 1782 (Figure 2). Herschel was born in Hanover, Germany but later moved to England with his sister Caroline, who recorded and later contributed observations. In 1781 the Herschels discovered the planet Uranus, bringing fame and fortune. William was appointed "King's Astronomer" and Caroline was appointed "Assistant to the King's Astronomer." Together, William and Caroline discovered hundreds of double stars.

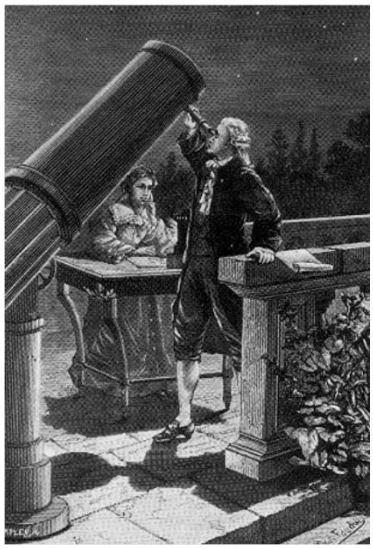

Figure 2: William Herschel (front) and Caroline Herschel (back). Caroline likely recorded William's discovery and measurements of 23 ORI.

Herschel's first observations were concentrated on pairs of stars visually close together. The Herschels started a systematic search for binary stars in October of 1779 by observing double stars multiple times to identify changes in separation of position angle. William Hershel compiled these measurements into two catalogues which he presented to the Royal Society, the first in 1782 with almost 270 doubles or multiple systems, the second in 1784 with almost 435 systems. A third catalogue, published in 1821, contained discoveries of 145 double stars by the astronomers Friedrich Wilhelm Struve, James South, and John Herschel. The theoretical and observational work of the Herschels led the way to current binary research. Figure 3 shows the locations of many double stars discovered by the Herschels.

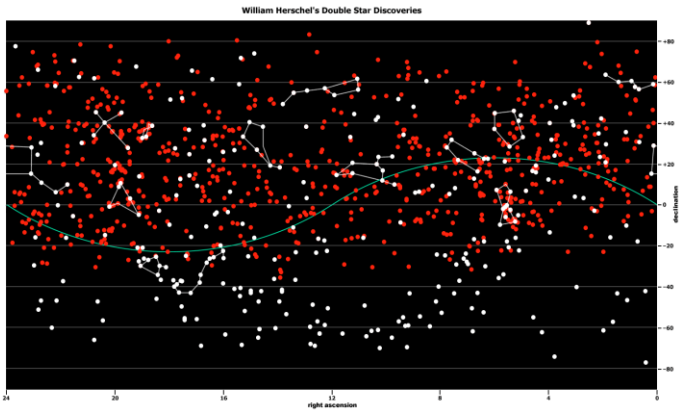

Figure 3: The locations in the sky of many double stars discovered by the Herschels.

Double Star 23 ORI

The Atascadero research team selected double star 23 ORI from the Carro Double Star Catalog. This star was selected because the magnitude and separation of the two stars are such that observations and accurate measurements could be done using an 8-inch telescope with a Celestron Micro Guide eyepiece. The magnitudes of the primary and secondary are 4.96 and 6.76, respectively. In the Washington Double Star Catalog (WDS), the most recently reported separation is 31.5 arc seconds and the most recently reported

position angle is 30°. Table 1 presents some observational history and physical parameters for double star 23 ORI as listed in the WDS.

Modern Designation	Const.	Ori
	WDS	05228+0333
	Discoverer	STF 696
Discovery Date	Herschel	10/02/1782
Observations	Latest	2014
	Total	73
Separation (arc seconds)	First	32.8
	Latest	32.5
	Change	-0.3
Position Angle (degrees)	First	31
	Latest	28
	Change	3
Magnitudes	Primary	4.95
	Secondary	6.76
Spectral Type (Primary)	B1V	
Right Ascension	5 h 22 m 50 s	
Declination	+3° 32 m 40 s	

Table 1: Observational history of 23 ORI and its known physical parameters.

Methods and Equipment

An 8-inch f10 equatorial mounted Schmidt-Cassegrain telescope was used to collect measurements of double star 23 ORI. The telescope was motorized, allowing tracking of the binary stars. A Celestron Micro Guide eyepiece was used for making measurements. This eyepiece contains both a linear scale and a protractor. Separation of the binary stars was recorded by orienting both stars on the linear scale and counting the division marks between the stars. The position angle was recorded by placing the primary star in the center of the eyepiece and rotating the eyepiece until the secondary star was also on the linear scale. Then the telescope's tracking system was turned off. This allowed the primary star to drift down the linear scale and to the outer protractor. Where the primary crossed the protractor was recorded and 90° was subtracted to compensate for the offset of the eyepiece. Both of these observations were made three times by each of the six team members and their average calculated.

Results and Analysis

Table 2 shows the average measured separation and position angle as compared to 10 historical observations (Carro 2012), including Herschel's original. The average separation measurement was 32.3″, only 0.2″ more than the average of 9 post-Herschelian measurements, 32.1″. The average position angle measured was 30°, which is 0.9° less than the average of 9 post-Herschelian measurements, 30.9°.

23 ORI (WDS 05228+0333)	Sep (arc seconds)	PA (degrees)
Herschel 1782	32.8	31.0
Tobal 2003 - 1974 data	32.0	34.0
Tobal 2003 - 1980 data	32.0	33.0
Tobal 2003 - 1992 data	31.3	30.1
Tobal 2003 - 1993 data	31.8	32.5
Eagle Creek (Muenzler 2003)	32.0	28.0
Arnold 2006	32.6	29.1
WDS 2009	31.5	30.0
WDS 2012	31.9	30.0
Team's Data 3-21-2015	32.3	30

Table 2. The measured separation and position angle of 23 ORI compared to historical data.

According to the WDS catalog, the primary star has proper motion vectors of +25 milliarc seconds right ascension and +24 milliarc seconds declination per year. The secondary star has vectors of +20 milliarc seconds right ascension and +21 milliarc seconds declination per year (Mason 2012). These numbers are similar and suggest that the two stars may form a true binary star system, though the separation and position angle have hardly changed since 1782.

Conclusions

The participants of this research group, with the help of Joseph Carro, effectively gathered a set of measurements of the double star 23 ORI using a Schmidt-Cassegrain telescope with a Celestron MicroGuide eyepiece. The average separation of the primary and secondary star during the time of the observation was 32.3″. The average position angle was 30°. These measurements will help track the movement of the binary star over time.

References

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