

## Student Observation of HR 2282 (Furud)

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**Abstract:** A selected team of 8th graders measured the separation and the position angle of double star HR 2282 also known as Furud. They used a 22-inch Newtonian Alt/Az telescope to determine the scale constant, separation, and the position angle. The separation angle was 169.6 arc seconds and the position angle was 339.7 degrees. The results were compared to the 1999 Washington Double Star Catalog and were found to be extremely close.

### Introduction

A three-day Double Star Workshop was hosted from March 11 through March 13, 2016 at Vanguard Preparatory School. Astronomers chose thirty-three eighth grade students attending Vanguard to participate in the workshop. The students were then split up into three teams and matched with an instructor. The astronomers who led the students were Chris and Reed Estrada (Green Team, see Figure 1), Mark Brewer (Red Team), and Sean Gillette (Purple Team).

### Equipment and Procedures

The Green Team used a 22-inch Newtonian Alt/Az telescope with a Celestron Micro Guide Eyepiece attached to a Bell and Howell High Definition Video Camera. The usage of the video camera counterbalanced the necessity for the drive motors and negated the field rotation in Alt/Az telescope.

The calibration star, Bellatrix (Gamma Orionis), was used to determine the scale constant on the date of B2016.186. The eyepiece was rotated so that the sky would drift parallel to the linear scale. Bellatrix was then positioned on the eastern edge of the linear scale; the star moved across the linear scale. The team of students determined the amount of time it took for the star to drift to the western edge of the linear scale using a stopwatch that read to the nearest 0.01 seconds. Ten drift times were used to determine the scale constant



Figure 1: Team that participated in the study of HR2282 (Green Team). Top Row (left to right): Astronomers Reed and Chris Estrada, Nick Varela, Charlie Colbert, Colin Mayo, Edward Dondelinger, and Jeremy Goodrow. Bottom Row (left to right): Tara Izadi, Peyton Anker, Destiny Barrientos, Lindsey Gillette, Sarah Stuart, and Jordan Milton.

using the equation

$$Z = \frac{15.0411t \cos(dec)}{D}$$

where  $Z$  was the scale constant in arc seconds per division; 15.0411 is the Earth's rotational rate in arcseconds per second;  $t$  was the average drift time in seconds (50.09);  $D$  was the number of division marks on the

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Figure 2: Nick Varela looking through telescope at Double Star HR 2282 (Furud).

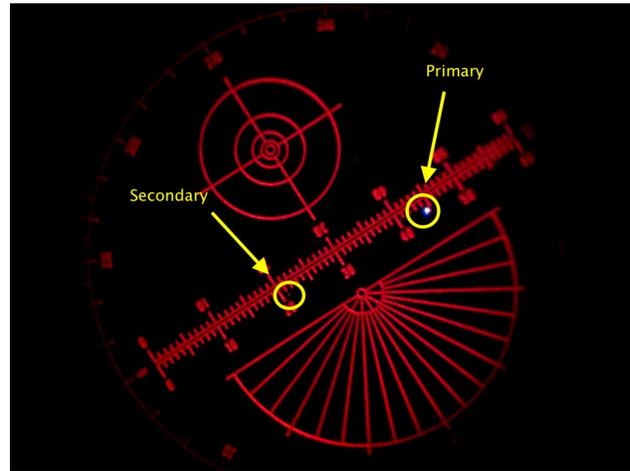


Figure 3: Primary and secondary star being measured.

linear scale (60). These determined that the scale constant for the 22-inch telescope was 7.02 arc seconds per division.

The telescope was pointed at HR 2282 on the date of B2016.186. A Bell and Howell DNV16HDZ Video Camera was used to capture images through the Celestron astrometric eyepiece to determine the position angle and separation of the double star. The videos were downloaded to a computer. Selected still images were taken of the separation and position angle of the star (see Figures 3 and 4.). The student team evaluated the gathered digital data. The average position value was multiplied by the scale constant to find the final separation. Ten measurements were then made to find the average position angle. Each student looked at a different picture of the double star along the astrometric eyepiece scale to allow for a statistical average of the separation measurement. The stars dithered or moved along the scale in real time as observed through the eyepiece of the telescope. To simulate this movement, and to get an average position, ten samples and ten pictures were taken. Each was observed by an individual student.

Results of the measurements are given in Table 1.

#### Conclusion

The students in the Vanguard Preparatory Double Star Workshop 2016 successfully measured the separation and position angle of the double star HR 2282. Their measurements compared well with the WDS catalogue with a difference of 1.7 arcseconds on the separation and a 2.6 difference of the position angle.

#### Acknowledgements

This research used the Washington Double Star Catalog maintained at the U.S. Naval Observatory. The

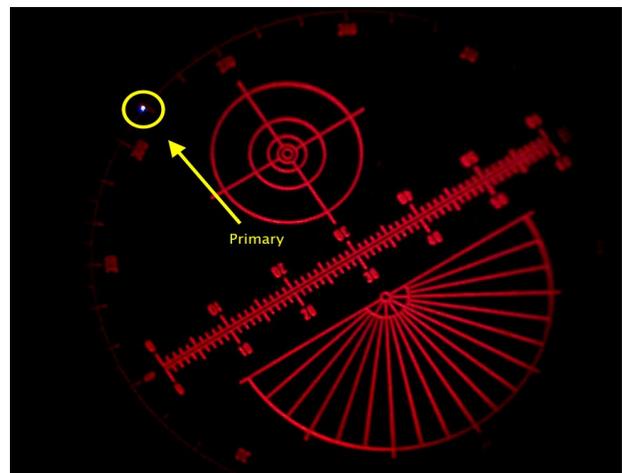


Figure 4: Position angle being measured

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**Student Observation of HR 2282 (Furud)***Table 1: Measurements of HR 2282 (Furud). Measurements were made on B2016.186.*

Parameters	# of Obs.	Average Values	Mean	SD	Standard Error of Mean	WDS Value (1999)	Difference	% Difference
Separation (a.s.)	10	169.6	29.3	1.5	0.4	173	3.4	1%
Position Angle (deg)	10	339.7	249.7	2.2	6.3	338	1.7	1%

**References**

Mason, Brian. 2012. *Washington Double Star Catalog*.  
Astronomy Department, U.S. Naval Observatory.  
Conner, Donald. "The Star Furud."

The Star Furud. (2013). Astronomy. Retrieved from  
<http://all-about-astronomy.blogspot.com/2013/11/the-star-furud.html>

