# Speckle Interferometry Observation of Binary Star WDS 05491+6248

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**Abstract**: We report a new observation of binary WDS 05491+6248 from the night of October 20, 2013, with the 2.1-meter telescope at Kitt Peak National Observatory. A new position angle of θ = 336.39° and separation of ρ = 0.802″ was determined.

## Introduction

Using Kitt Peak National Observatory's 2.1-meter telescope, the binary star WDS 05491+6248 was observed on October 20, 2013. Observations of this binary were made with a portable speckle interferometry camera by students from various schools in a research seminar (Genet et al. 2013). The observations were analyzed by a Cuesta College student team in an astronomy research seminar (Figure 1).

WDS 05491+6248 was chosen for our project due to its unique orbit derived from speckle interferometry data falling closely along the curve. Would the new observation conform to the current orbit, or would it deviate?

*Figure 1. Participants in Cuesta College's Astronomy Research Seminar, left to right: Eddy Bañuelos, Will Crooks, Jesse Wilson, Kelly Richardson, Frances Eunice Alviola Lim, Kyle Andrei De Matias, and Spencer Raines.*

## Methods

The Kitt Peak National Observatory is home to one of the largest arrays of astronomical telescopes in the world, including the 2.1-meter telescope used to observe our binary star. Originally built in the 1960's, this telescope has been used in many pioneering astronomical observations. It was initially equipped with a film imaging camera and spectrographs, but was later upgraded to include other instruments, including a CCD (Charge Coupled Device) imager.

Speckle interferometry is a technique devised by Antoine Labeyrie in 1970. It was known that, when viewing an astronomical object, there was a loss of resolution due to the poor seeing induced by the atmosphere. A Fourier transform of many short exposure images overcomes the seeing limitations (Labeyrie, 1970). Originally, the speckle interferometry techniques required high speed Tri-X film to make the observations, but with the introduction of CCD cameras, the process has been digitized and can efficiently gather larger amounts of data (Harshaw, 2015).

Before our data was reduced, the speckle interferometry camera was calibrated. A series of observations of binaries with known orbits was used to establish the camera angle with respect to celestial north and the camera's pixel scale. These values were -11.0492° and 0.01166"/px as reported by Wallace (2015).

To reduce our data, we used the speckle interferometry reduction program PlateSolve 3 (PS3) developed by David Rowe. The squares of each Fourier transform were computed and then averaged. The data was then processed, resulting in an autocorellelogram. This autocorellelogram shows the primary star in the center, and the secondary star on both sides (Rowe & Genet, 2015).

## Results

The resulting binary position angle, θ, was 336.39°, while the separation, ρ, was 0.802″. An image of the autocorellelogram of WDS 05491+6248 can be seen in Figure 2.

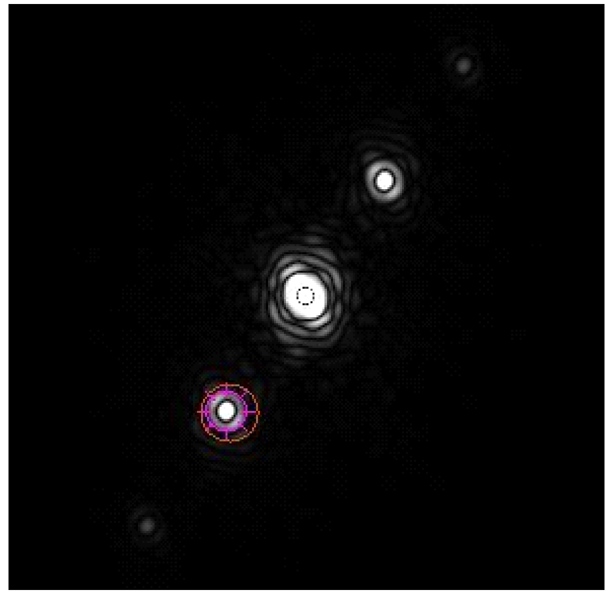

*Figure 2. The autocorellelogram of WDS 05491+6248*

## Discussion

Brian Mason from the U.S Naval Observatory provided data from previous observations. The first observation, made in 1831, was a visual observation made by Friedrich Georg von Struve with a filar micrometer.

Observations using speckle interferometry tend to be more accurate than visual observations. Our observation, a speckle interferometry observation, remains very close to the predicted orbit of the binary system.

Using CAD software, we plotted the position of our calculated observation. A cross was drawn with each leg having a length of 1/2 unit. The width and height of the cross had a total length of one unit. Then the bottom leg was deleted and redrawn to the separation length of 0.802″ or 0.802 units. Next, the bottom leg was rotated exactly 336.39 degrees counter clockwise. Once the exact location of the calculated observation had been laid out using this program, we overlaid the template

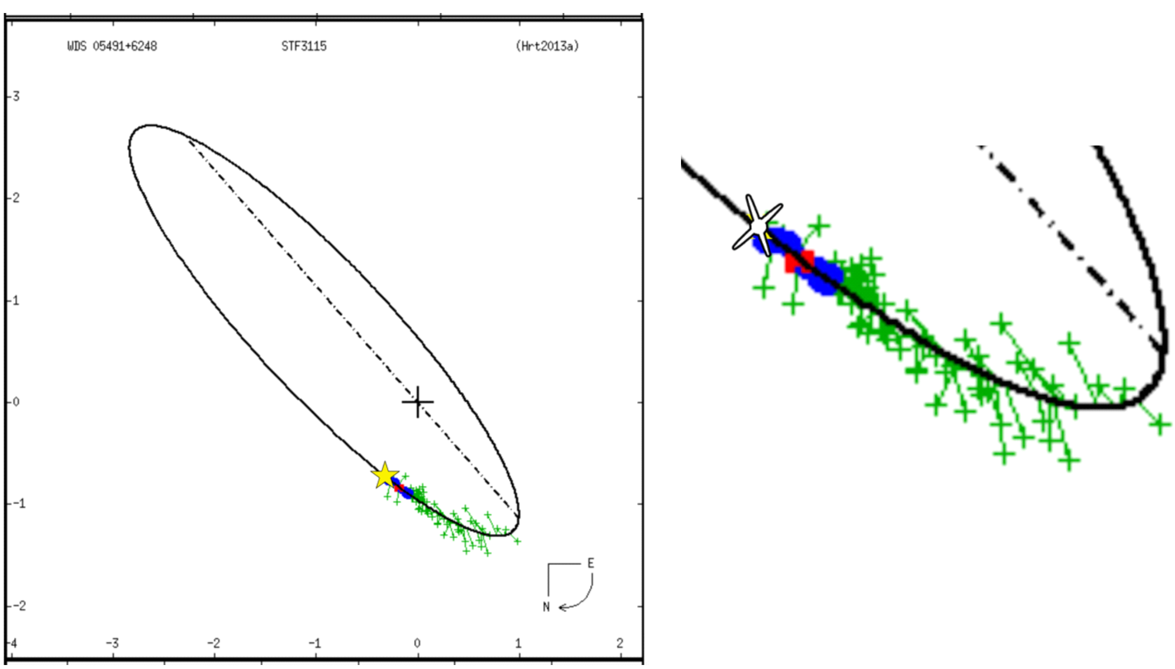


***Figure 2.*** *Orbital plot of all observations (left) and a close up view of our point (right).*

onto the current image of the binary's previous observations and estimated orbit. Scaling the template was accomplished by using the width of the plus sign to match the scale provided at the bottom of the orbit image. Once the scale had been accurately calibrated, the template was then moved so the cross in the template covered the cross in the orbit image. The resulting location of the tip of the rotated leg was the position of the calculated observation.

The location of our calculated observation placed it right on the predicted orbit. The new location was on track with the previous observations (Figure 2).

## Conclusion

Our team successfully calculated a new position angle and separation for the binary star WDS 05491+6248. Our data point was graphed along with past observations. The new θ and ρ values corresponded with the trend present in past observations, adding more validity to the calculated orbit of the binary, as well as further supporting that it is indeed a gravitationally bound system.

## Acknowledgments

We thank Kitt Peak National Observatory for the use of their 2.1-meter telescope which aided the collection of images from a speckle interferometry camera. We also thank Brian Mason from the US Naval Observatory for supplying past observations made by other astronomers for WDS 05491+6248. We also thank Jolyon Johnson for his advice, and Richard Harshaw and Vera Wallen for their external reviews.

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