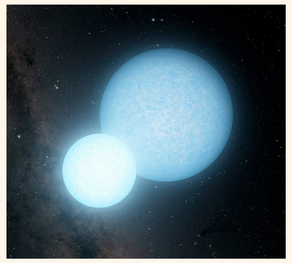

# A COMPREHENSIVE SURVEY OF DOUBLE-LINED WHITE DWARF BINARIES

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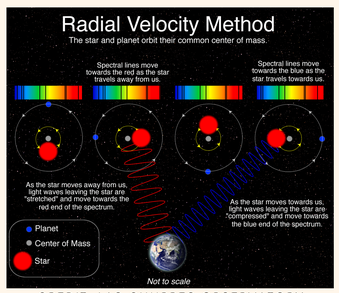
## BACKGROUND

In this survey, we look at 1 of 12 potential double-lined binary white dwarf systems in hopes to increase the sample of known binary white dwarf systems, which currently resides at about 20. For this specific survey, we use 14 sets of spectroscopy data of the white dwarf *WD1129+155* given by the Gemini North 8m telescope on the Big Island of Hawaii. We use spectroscopy, or the measurements of the wavelengths emitted from the white dwarf, as a method for calculating the radial velocities. From these calculations, we will be able to determine whether or not a second, smaller white dwarf is present, which causes significant variations in the radial velocities due to their gravity on the larger white dwarf.

In all, the research of binary white dwarf systems allows for understandings of the formations of helium stars and type Ia supernovae. Increasing the amount of known binary systems will allow for accurate testing about the synthesis of such systems.

## OBJECTIVES

- Use concise data on python to graph and find the best fit H-alpha line for each of the 14 sets of data
- Use the center of the H-alpha line to calculate the radial velocity of each data set, determining whether or not *WD1129+155* is a double-lined binary or not



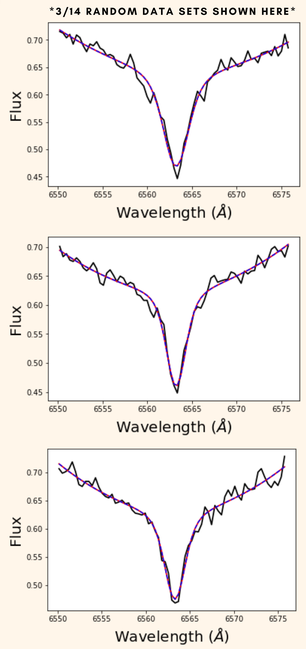

CREDIT: LAS CUMBRES OBSERVATORY

### RADIAL VELOCITY METHOD

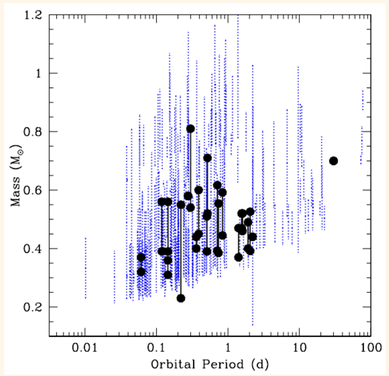
Here, the Doppler Effect is shown with a star and a planet, similar to a large white dwarf and a smaller one. If there is a smaller entity in the system, the gravity of the smaller entity will pull the larger entity towards and away from the Earth, causing it to appear red when moving away and blue when moving towards. These shifts in wavelength can then be recorded and used to determine the radial velocity of the larger entity.

## RESULTS

*3/14 RANDOM DATA SETS SHOWN HERE*




GOAL: add more black dots/black lines to this graph




Shown here is a graph of the masses and orbital distributions of all known double-lined binary white dwarfs.
purple lines = predictions
black dots/black lines = actual binary system

VELOCITY OF EACH DATA SET

| data set | g1_center | velocity (km/s) |
|---|---|---|
| contwd1129p155feb07S0221.txt | 6563.14932 | 15.922 |
| contwd1129p155feb12S0074.txt | 6563.22936 | 19.581 |
| contwd1129p155feb13S0187.txt | 6563.24199 | 20.158 |
| contwd1129p155feb14S0087.txt | 6563.22002 | 19.154 |
| contwd1129p155feb14S0088.txt | 6563.2318 | 19.692 |
| contwd1129p155feb14S0290.txt | 6563.3409 | 24.68 |
| contwd1129p155feb15S0038.txt | 6563.29531 | 22.596 |
| contwd1129p155feb20S0076.txt | 6563.40125 | 27.438 |
| contwd1129p155feb20S0079.txt | 6563.22307 | 19.293 |
| contwd1129p155feb20S0080.txt | 6563.30256 | 22.927 |
| contwd1129p155feb20S0081.txt | 6563.40491 | 27.606 |
| contwd1129p155feb20S0082.txt | 6563.22117 | 19.206 |
| contwd1129p155feb20S0084.txt | 6563.30148 | 22.878 |
| contwd1129p155feb20S0085.txt | 6563.30885 | 23.214 |

Shown here, there is a lack in significant variation among the radial velocities of each data set

Not shown:
lambda = 6562.801

velocity equation
[(g1_center - lambda)/lambda] c

## METHODS

*GRAPHING*

Each data set had over 6000 lines of spectra data, causing the first step to be narrowing each set down to the 25 lines closest to the center. After completing that for each of the 14 data sets, I then uploaded each new file into a python-running software, Jupyter Notebooks, and used code designed to run a quadratic Voigt Model to find the best H-alpha line fit. This code also gave the center value of the line fit (g1_center), which I used in my later calculations.

*COMPUTATION*

Using the center value for each data set given by the python code (g1_center), I utilized the central wavelength value (lambda) and the speed of light to find the radial velocities of each data set.

## CONCLUSIONS

- From the lack of variation among the calculated velocities, we were able to conclude that *WD1129+155* is likely not a double-lined binary white dwarf system.
- We are still working on computing a more accurate and reliable error for each of the data sets

## FUTURE DIRECTIONS

WD1129+155 is the 1st of 12 white dwarfs in the full survey, allowing for future research to be done with the other white dwarfs in hopes of increasing the sample of known binary white dwarf systems

REFERENCES
MUKREMIN KILIC , A. BÉDARD, P. BERGERON. 2021. A COMPREHENSIVE SURVEY OF DOUBLE-LINED WHITE DWARF BINARIES, P. 7