Searching for Binary White Dwarfs

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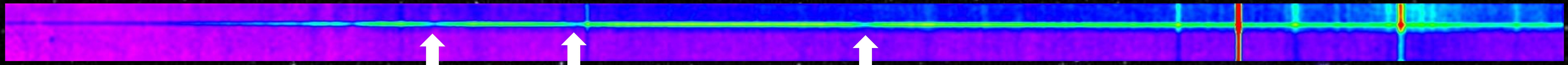


Example of a star spectra after data reduction.

Hδ

Hλ

Absorption Lines visible as small gaps

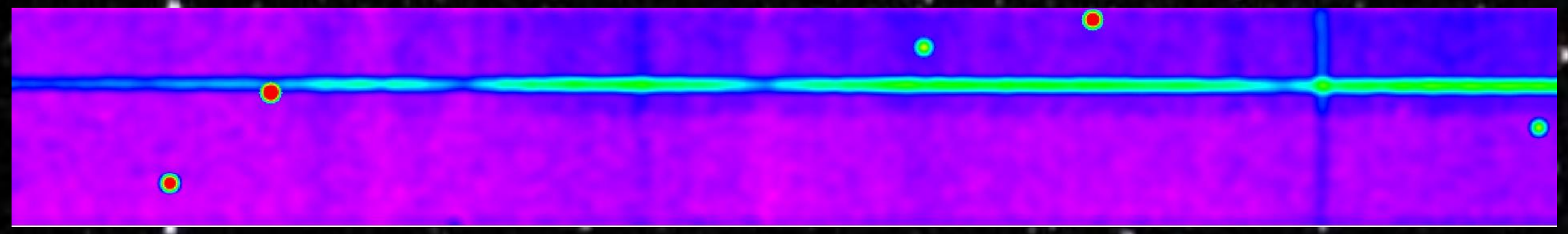
Hβ

Emission Lines

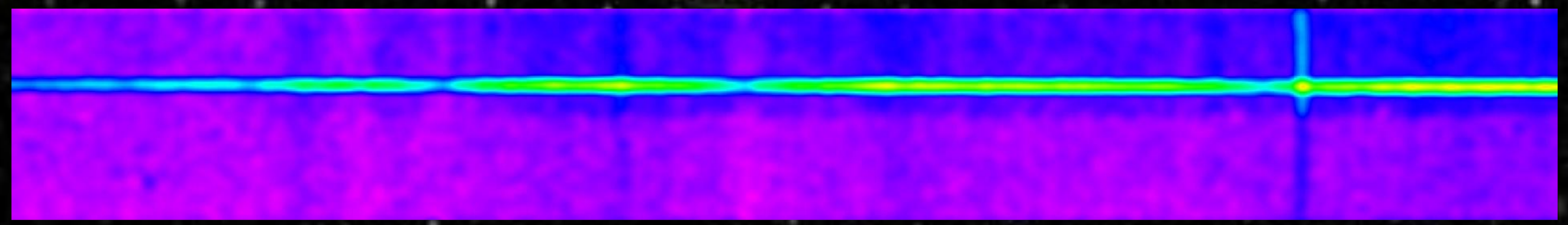
Background

The universe contains an innumerable amount of stars, coming in many sizes and at various stages in the stellar life cycle. A white dwarf is the final stage of a star's life, forming after the core of a star in the red giant phase becomes dense enough due to gravitational collapse to reach electron degeneracy pressure. The core cannot contract afterwards and begins to rapidly increase in temperature, eventually beginning helium fusion. Heavy elements begin to build up in the star's core, and if the mass of the star is small enough, the outer layers of the red giant will be ejected away into space. The result is a planetary nebula and a white dwarf.

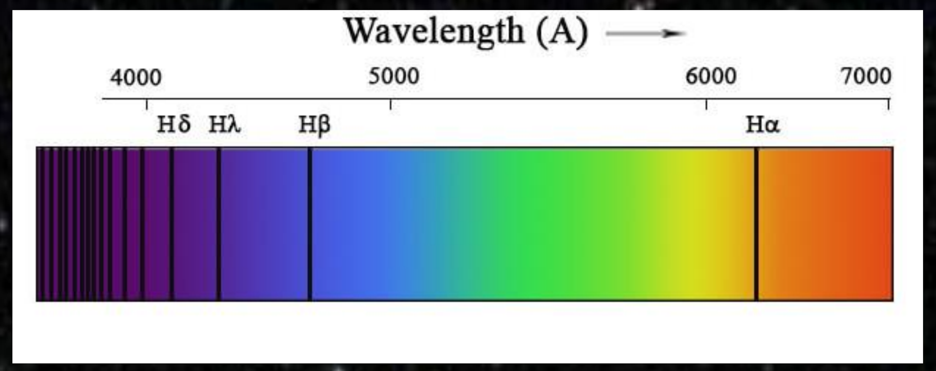
Purpose: Out of the billions of stars in the Milky Way Galaxy, only approximately 20,000 stars have been confirmed to be white dwarf stars [1]. Only a tiny fraction of the white dwarfs discovered have been confirmed to be binary white dwarfs with the potential to merge in the future. The rare occurrence of a stellar merger can result in the formation of a new star, or the result could be a Type IA supernova.



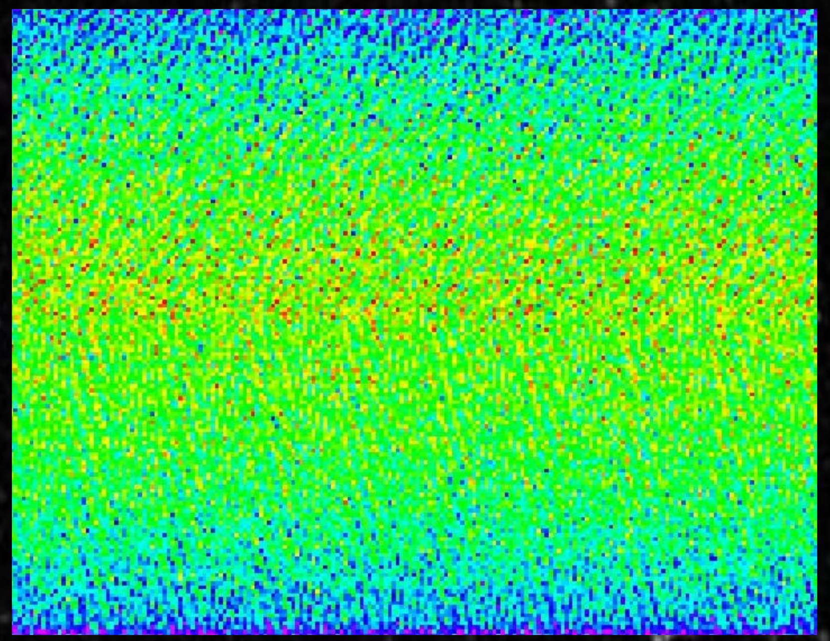
Cosmic rays appear as small dots on an uncleaned spectra



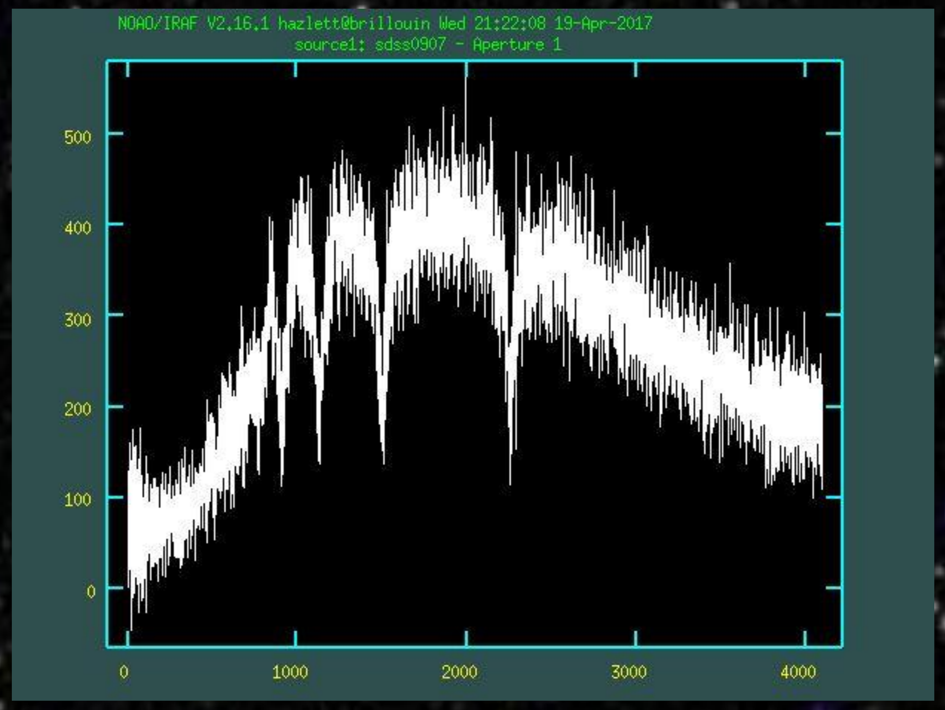
Spectra with cosmic rays removed



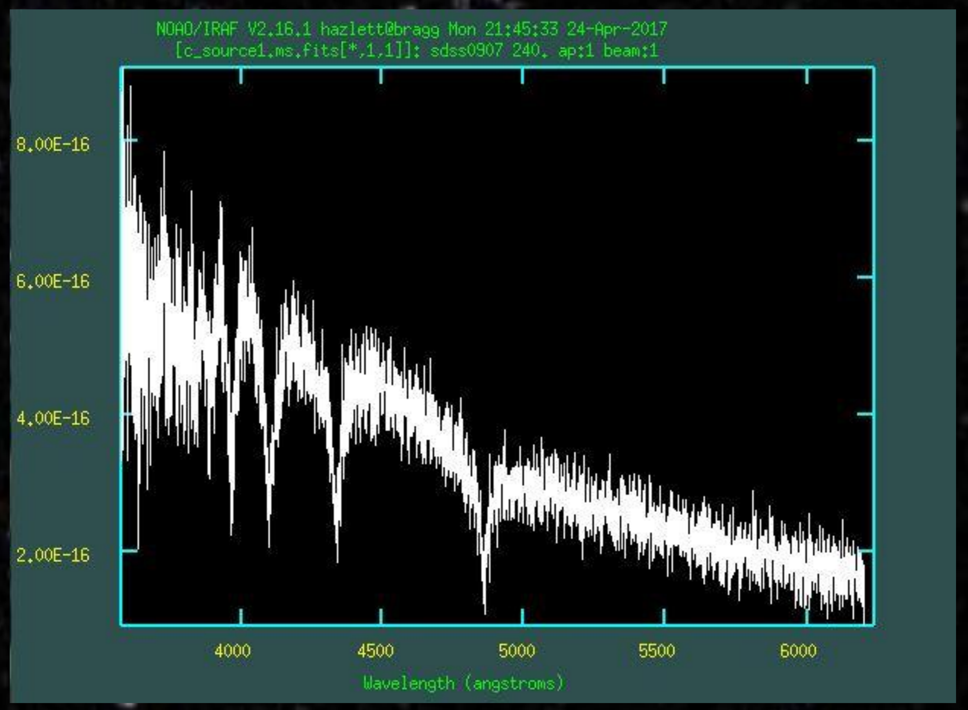
Absorption lines of Hydrogen



Section of a bias frame for a single observation, color added after analysis indicates different initial levels of charge in the electronics of the CCD.



Before Wavelength and Flux calibration



After Wavelength and Flux calibration

Method

Data reduction performed on observational data obtained with charged-couple device (CCD) using the Image Reduction and Analysis Facility software .

1. Bias Correction

The bias is an amount of charge present because of the electronics in the CCD.

2. Flat Field Correction

Corrects for variations in sensitivity across the CCD.

3. Extract and Clean Spectra

The source and background regions are identified and cosmic rays are removed.

4. Wavelength Calibration of Spectra

Pixel to wavelength calibration before analysis of the spectral lines of the source.

5. Flux Calibration of Spectra

Standardizes spectra by comparing observations to observations of a standard star, converting units of flux to a scale with scientific meaning.

6. Analysis of Radial Velocities

Differences in radial velocity are observed as changes in wavelength of light due to the relativistic doppler effect

Acknowledgments

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References

[1] Kleinman, S. J., Kepler, S. O., & Koester, D. et al. 2013, ApJS, **204**, 5