Modeling of White Dwarf Recurrent Helium Novae

Teagan Laws & Dr. Bill Wolf

Embry-Riddle Aeronautical University, University of Wisconsin - Eau Claire

Background

White dwarfs go through multiple thermonuclear runaways which is called recurrent novae or flashes as they burn through the matter accreted matter. During the burning phase of hydrogen, the white dwarf goes through varying stability and instability regimines dependent on its mass. Wolf et al (2013) states the mass range for stable hydrogen burning is 0.51 to 1.34 solar mass. Once the white dwarf flashes, properties can be investigated during the supersoft phase.

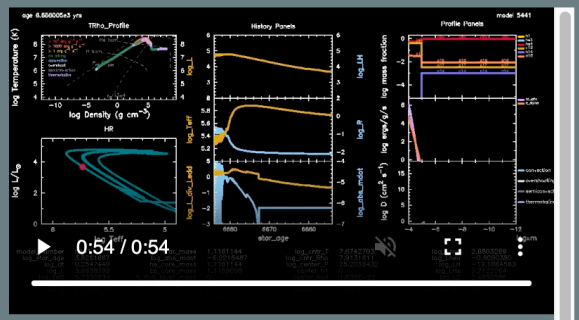
Methodology

We used the University of Wisconsin - Eau Claire's Blugold Center for High Performance Computing dual cluster environments. These supercomputers have the ability to do large computational models in hours instead of years. We specifically ran the astronomical software, Modules for Experiments in Stellar Astrophysics (MESA), to create models of recurrent white dwarfs.

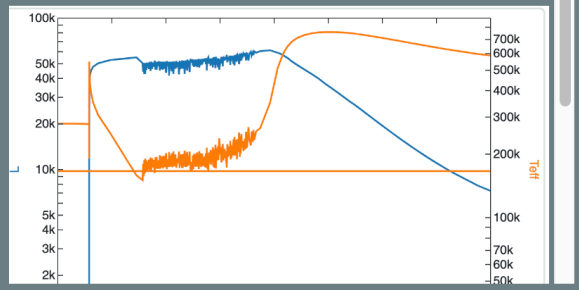
MESA

The white dwarf simulations are run for different masses over a range of 1.0 to 1.3 solar masses. The goal of each run is to find the instability of the helium-burning phases for three flashes of the white dwarf.

Results



The above movie is approximately 1.1 solar mass white dwarf simulated to three supernovae flashes during helium burning phase. (Playback increased by four times.)



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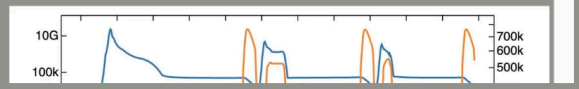
Background cont.

Greiner et al (2023) showed that helium-accreting white dwarfs have been discovered by their supersoft x-ray sources. Due to this confirmation, a process similar to Wolf et al (2013) can be done with the white dwarf's helium burning.



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Future Work and Acknowledgments

Next steps for the project would be to analyze white dwarfs from Wolf et al 2013 for their helium accretion range and run more simulations for different white dwarf mass models.

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