

Analysis of RR Lyrae Variable Stars

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Abstract

RR Lyrae stars have been known for being radial pulsators for quite some time. RR Lyrae are in the instability strip of the Hertzsprung-Russell Diagram (HRD) and can be classified as RRab, RRc, and RRd. Most of the analysis is done with RRc stars which are characterized as first-overtone pulsators. Interestingly, many RRc stars also exhibit a non-radial pulsation mode (denoted Fx) and it is currently not known what the mechanism is that drives this non-radial mode. Investigations into this mechanism has led to a possibility that the non-radial pulsation mode is driven by magnetic fields built up by turbulent flow in the hydrogen and helium ionization zones[1].

1 Introduction

Finding how the Fx mode changes and whether there is any periodicity in that change can help characterize the Fx mode which can help narrow down what the driving mechanism is. I will be using Period04[2], a computer program used for statistical analysis of large astronomical time series using fourier transforms to get frequencies, amplitudes, and phases. Using various light curve observations taken by the Transiting Exoplanet Survey Satellite (TESS)[3] I can upload time strings of RRc light curves into Period04.

Using these light curves I split the data of a sector (one time string file) into four sections with 20 cycles in each group if possible. I go through a process of prewhitening which filters out the primary radial pulsation mode and begins constructing a model with that. I then pick out the Fx mode and record its amplitude and with enough data we can see how the Fx mode is changing. I also closely analyze the subharmonic of Fx (denoted Fs) which is $F_x/2$ because of a possibility of an inverse proportionality between them. Other combinations of Fx also exist in the fourier spectrum generated by Period04 but they will not be considered.

References

- [1] Richard B. Stothers. A new explanation of the blazkho effect in rr lyrae stars. *The Astrophysical Journal*, 2006.

- [2] Patrick Lenz. Period04. <https://www.univie.ac.at/tops/Period04/>. accessed: 06-09-2022.
- [3] Transiting exoplanet survey satellite. <https://tess.mit.edu/>. accessed: 06-09-2022.