Newsletter of the AAVSO Short Period Pulsator Section

Number 1

Northern Spring/Southern Autumn 2024

We are introducing a section newsletter in hopes of improving communication among SPP section observers, or anyone interested in the SPP program. Let us know what you think of it, and also let us know what you might like to see in future newsletters. Comments and suggestions can be emailed to Horace Smith (smithhh@msu.edu). To begin we look at some interesting RR Lyrae stars well-placed for observing in coming months. Kenneth Carrell and Gerry Samolyk came up with two RR Lyrae variables in Bootes definitely worth observing.

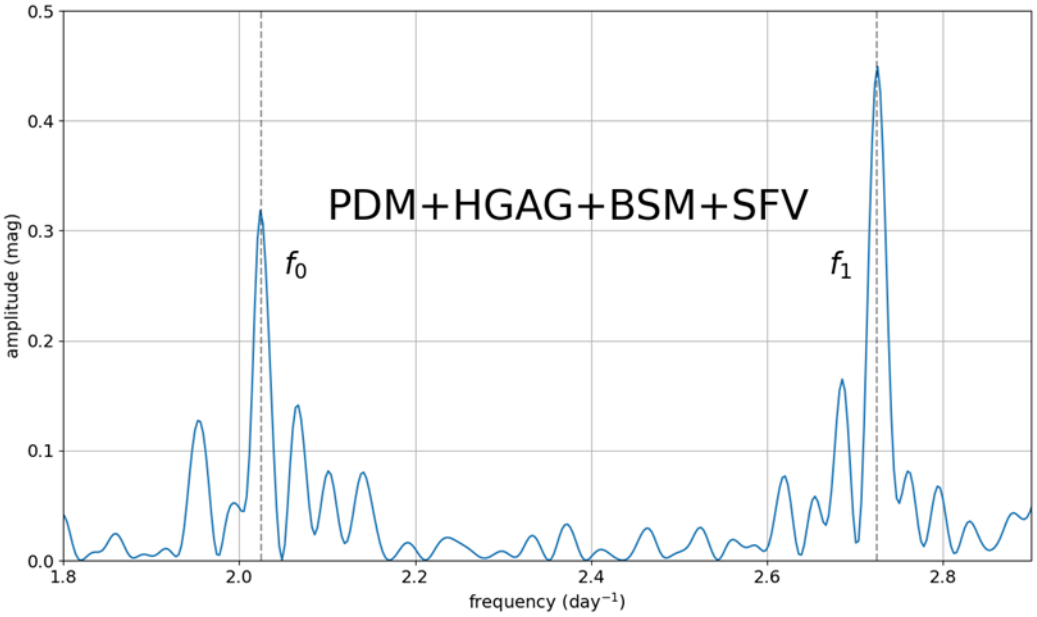
V338 Boo An Oddly Behaving Double-mode RR Lyrae

For almost two decades, V338 Boo has been known to be a double-mode RR Lyrae star, which is to say a star pulsating simultaneously in two modes. In this case, those modes are the fundamental and first-overtone radial modes, which have periods of 0.4939 and 0.3670 day, respectively. Ground-based observations suggested that the two pulsation modes might be slowly changing over time. When V338 Boo was observed with the Transiting Exoplanet Survey Satellite (TESS) in the spring of 2020, its behavior was shown to be even odder than suspected. Dramatic changes in the strengths of both modes were detected in observations spanning only 54 days (Carrell et al., 2021, ApJL, 916, L12).

What was going on? Theorists had not predicted such changes. During the middle of the summer of 2022, Dr Carrell asked for help. Alert Notice 786 was posted for observations of V338 Boo. TESS was going to reobserve this star in the spring of 2022, and he wanted ground-based follow-up observations to give a longer baseline for understanding its strange behavior. The AAVSO community stepped up and submitted almost 10,000 individual brightness measurements by 23 different observers from mid-July to mid-August. Almost 2/3 of those measurements were in the *V* band and had small errors. Importantly, there were 4 AAVSO observers who took brightness measurements in the *V* band on 7 or more nights during the campaign, which gave an excellent set of data for a quality frequency analysis.

The TESS data from 2022 showed that the first-overtone pulsation mode completely disappeared during those observations, and there were hints that the mode was returning in the last days of the TESS observing window. The AAVSO observations clearly showed both pulsation modes during the summer, which confirmed that the mode returned. Carrell and his collaborators are in the final stages of preparing a new publication on this star, which will give a more complete picture of its odd behavior. AAVSO observers will be included as co-authors or acknowledged in the credits, depending upon the degree to which they contributed photometry.

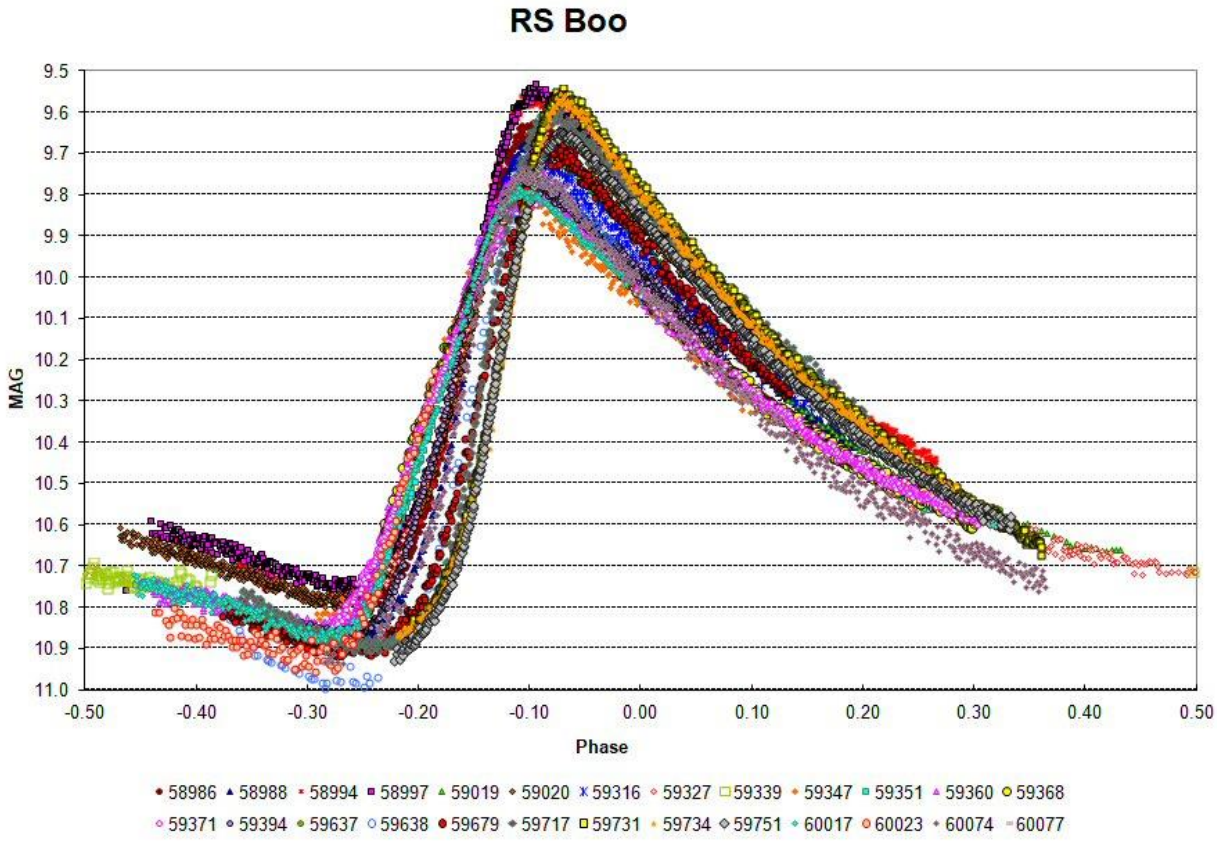
TESS will again observe V338 Boo this spring (2024), and another set of AAVSO observations over the summer are needed to give a longer baseline once more to probe the odd behavior and confirm what is seen in the TESS observing window. What will help the most are long runs of observations over multiple nights and in the *V* band. Dr Carrell noted that multiple nights by each observer gives us the chance to find any offsets in the magnitudes from one observer to the next, and a longer baseline gives us a much better frequency analysis. The cadence of observations should be rapid, once every 1-3 minutes. The observing recommendations in AAVSO Alert Notice 786 are still good.



Frequency analysis of observations of V338 Boo taken for Alert Notice 786 by observers PDM, HGAG, BSM, and SFV. The fundamental mode frequency is f_0; the first-overtone mode is f_1.

RS Boo A Blazhko Effect RR Lyrae Star with a Changing Period

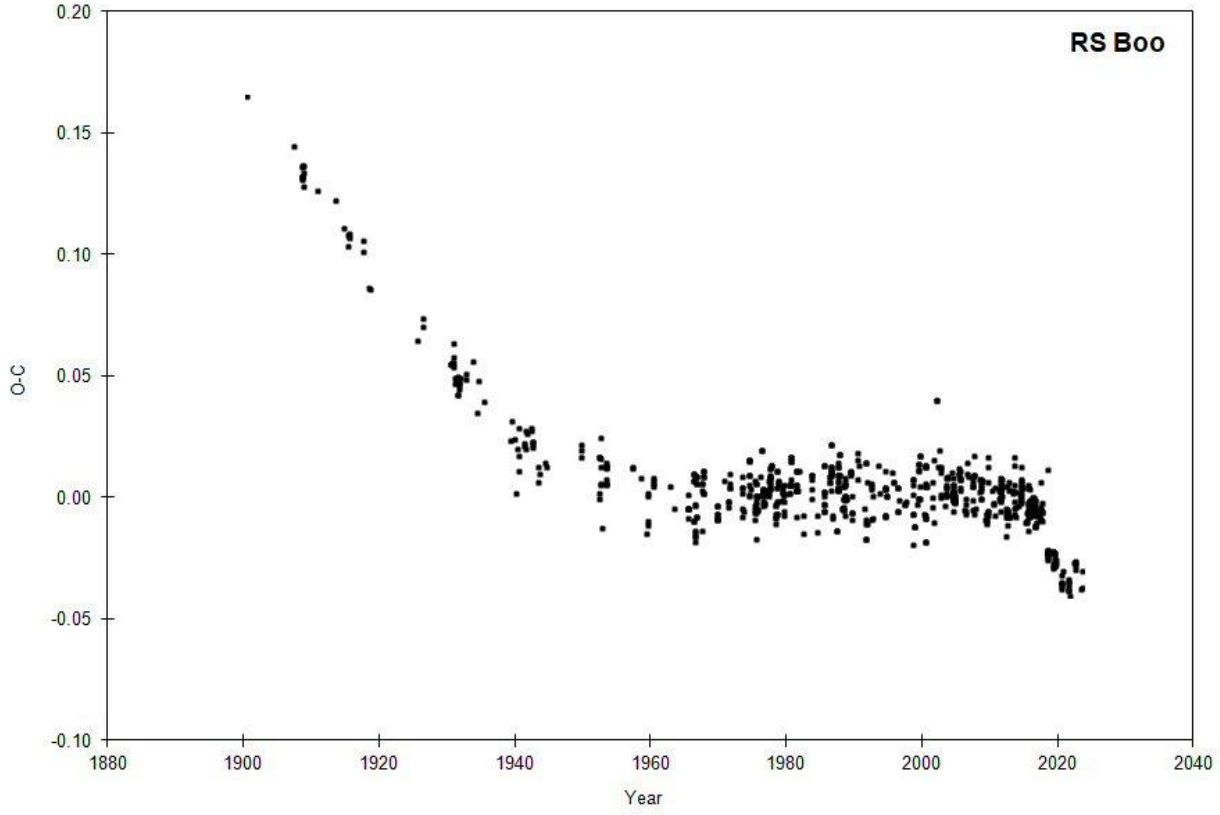
Our second variable has been a long-time target of observers, with data going back 120 years. RS Boo has a primary pulsation period near 0.3773 day. However, as shown below, its light curve changes shape from cycle-to-cycle. This is the Blazhko Effect.



The changing V band light curve of RS Boo. Gerry Samolyk notes "My records show a long Blazhko period of 533 days. The phase plot light curve covers almost 1100 days so it covers a couple of Blazhko cycles. Because the period is about 9 hours, most of a period can be observed in a single night for observers at northern latitudes."

The Blazhko Effect is not, however, the only change happening with RS Boo. Its primary pulsation period is also changing, as shown in Gerry's O-C diagram. While nuclear burning in the stellar core is expected to cause period changes in RR Lyrae stars, the more abrupt period changes revealed by the O-C diagram of RS Boo show that something else must be going on, too. As usual for RR Lyrae stars, multi-hour

runs of observations at a cadence faster than 3 minutes are more useful than scattered individual data points.



Observed minus calculated times of maximum light, assuming a constant period. Clearly, the period of RS Boo is not constant! A constant period would produce a straight line in this figure.

Thus, we have two mysterious RR Lyrae stars to observe in the next several months. Southern hemisphere observers may complain, however, that both are best seen by northern observers. Alas, that is true, and we shall have to emphasize some more southerly stars in future newsletters. However, there are also a number of interesting southern stars in the SPP program observable now. Among them is SZ Hya, another Blazhko Effect RR Lyrae with a changing period, and certainly worth continued observation.