Newsletter of the AAVSO Short Period Pulsator Section

Number 5

Northern Spring/Southern Autumn 2025

Since I am finishing my stint as SPP science advisor, let's take a brief look at the history of AAVSO observations of short-period pulsating stars. Comments and suggestions about the newsletter remain welcome and can be emailed to me, Horace Smith (smithhh@msu.edu).

RR Lyraes and Cepheids

Advancing Variable Star Astronomy, the wonderful book by Thomas Williams and Michael Saladyga, tells the fascinating story of the AAVSO and its predecessors up to the organization's centennial in 2011. Through its first half-century, AAVSO members made mainly visual estimates of variable star brightnesses. Long-period and eruptive variables, with amplitudes of several magnitudes, were frequent targets. However, in the 1960s, Margaret Mayall sought to expand the types of variables observed by the AAVSO.

Thomas Cragg formed the Classical Cepheid committee in 1967, and the following year Marvin E. Baldwin formed the RR Lyrae committee. The RR Lyr program included a number of Delta Sct stars since many of these stars were originally classified as RR Lyrae. Marv (who was also involved in the beginning of the EB program) had begun to observe selected RR Lyrae variables and he encouraged a few other skilled observers to give RR Lyraes a try. He headed the RR Lyrae committee from 1968 until 2007.

During the RR Lyrae program's first three decades, almost all observations continued to be visual. Targets were mainly bright RR Lyrae stars which became the basis of the ongoing RR Lyrae legacy program. A goal of this program is to keep these variables under regular observation, ensuring that cycle-count errors do not lead to erroneous O-C diagrams and, thus, erroneous observed period changes (see Newsletter number 2 for more on O-C diagrams). Observed period changes can be compared with those predicted by stellar evolution theory to check whether

observation and theory match. Observers also watch for other changes in these stars, such as alterations in the period and amplitude of the Blazhko effect.

Since RR Lyrae stars have V-band amplitudes of about a magnitude, observing them visually often proved a challenge for those new to variable star work. Nonetheless, a series of observations, continued for three or four hours with a cadence of one observation every ten minutes or so, often sufficed to establish a well-defined observed time of maximum light (O). Observed times of maximum could be compared to those predicted by an adopted ephemeris (C), the difference in the two being the O-C value for that date. As noted, period changes can be determined by the run of O-C values versus time. It was soon confirmed that the period changes of some RR Lyrae stars were too large, of the wrong sign, or too abrupt to be explained by smooth evolution through the instability strip.

Beginning in the late 1960s, observers gave special attention to the RR Lyrae variable XZ Cygni (Baldwin 1971 JRASC 65, 307; Baldwin 1973 JAAVSO 2, 14; Taylor 1975 JAAVSO 4, 25; Smith 1975 PASP 87, 465). In the 1960s and 1970s, the fundamental mode period of XZ Cyg underwent striking increases and decreases, while its Blazhko effect changed in amplitude and period (Baldwin and Samolyk 2003 Observed Maxima Timings of RR Lyrae Stars No. 1; LaCluyze et al. 2006 Astronomical Journal 127, 1653; see also SPP Newsletter 2). The Journal of the AAVSO began in 1972, facilitating the publication of papers on interesting short-period variables such as XZ Cyg.

The arrival of the 21st century saw an increase in CCD observations, and they gradually replaced visual ones. Although CCD data are much more accurate, the old visual data, and even older photographic data from the early 20th century, remain important. They are the only record of what these variables were doing back then. The 2001 annual report of the RR Lyrae committee noted that 4900 observations of 61 RR Lyrae had been received, with Gerry Samolyk contributing about 1,000 CCD observations. The RR Lyrae committee report for 2005-2006 stated that CCD observations had almost entirely replaced visual ones, allowing greater attention to be given to multiple-mode stars.

Gerry became involved with both the EB and RR Lyrae programs, transitioning from the era of visual to digital photometry. Williams and Saladyga (p. 252) commented on Samolyk's efficient technique for making visual observations: "When these [eight] telescopes were not otherwise in use, Samolyk would arrange them in a circle [each pointing to a different variable]…and then walk around the circle recording

observations every few minutes…" Gerry became the chair of the RR Lyrae Committee in 2007, after Baldwin gave up the helm. He became a co-chair of the SPP section in 2008, when the AAVSO observing sections were formed. Gerry is, of course, still very involved in the SPP program and in the annual publication of ephemerides for legacy program stars.

Thomas Cragg's Classical Cepheid program also anticipated goals of the SPP section. Cragg (1972 JAAVSO 1, 9) stated that "the primary purpose of this program is to investigate classical Cepheids with periods greater than 10.0 days for the possibility of slow period changes which might be associated with evolutionary changes in these stars." Although observations were mainly visual, they were made at random phases. Observations over 1,000 day intervals were combined to make phased light curves to track period changes. Cragg's last report of the Classical Cepheid committee appeared in 1994. In it, he noted that photoelectric observations were making visual observations obsolete and that the Classical Cepheid committee could be disbanded. Williams and Saladyga list Cragg as head of the Classical Cepheid program from 1967 until 1994.

In the 1960s and 1970s, Dorrit Hoffleit frequently invited her summer students to AAVSO meetings, where they would tell of their work at the Maria Mitchell Observatory. Though such students were not usually members of the AAVSO, their presentations often dealt with short-period pulsating stars. For example, at the fall, 1969, meeting, future AAVSO director Janet Akyüz described her photographic work on "RR Lyrae type variables with two periods" (AAVSO Abstracts, Fall 1969). She found that such stars had experienced abrupt period changes. These student presentations added to AAVSO member interest in short period pulsating stars.

When the AAVSO created observing sections in 2008, the council combined the RR Lyraes and Cepheids into a new section. Originally called the short period variable section, Dave Hurdis (the original co-chair with Gerry) pointed out that there are other short period variables (including EB stars). Dave was the person who coined the term Short Period Pulsators and the SPP section was named.

Recent SPP Papers

Today, the SPP section exists at a time when ground-based surveys and space missions are changing the roles of amateur observers. Ongoing wide-field surveys include many field RR Lyrae, but usually with only a few observations per night (i.e.

as in the All-Sky Automated Survey for Supernovae, ASAS-SN). In contrast, space programs such as TESS, provide uninterrupted rapid-cadence data on targeted stars, but those stars remain targeted for limited intervals of time. SPP observers can contribute important observations to supplement both ground-based and space-based surveys. The SPP section will, however, need to remain nimble to keep its relevance in this changing observational environment. I conclude by noting a few papers to which SPP observers have recently contributed to illustrate some of the variety of SPP projects:

1. Kaneshiro, Smith, and Samolyk 2021 JAAVSO 49, 19. *An Update on the Periods and Period Changes of the Blazhko RR Lyrae Star XZ Cygni*
   Abstract: "XZ Cygni is an RR Lyrae variable that underwent relatively large changes in its primary and Blazhko periods during the 20th century. Here we use AAVSO photometry obtained between 2001 and 2019 to extend previous studies of this star. Whereas XZ Cygni's fundamental mode and Blazhko periods changed dramatically between 1965 and 1979, those periods have been more stable since the 1980s, although the fundamental period has not been entirely constant. We compare the period change behavior of XZ Cygni with theoretical predictions of period change." [Observations since 2019 show that changes in the period of XZ Cyg have not ended yet.]

2. Carrell et al. 2024 Astrophysical Journal, 973, 157. *Caught in the Act: Observations of the Double-mode RR Lyrae V338 Boo during the Disappearance of a Pulsation Mode*
   Abstract: "New results on the behavior of the double-mode RR Lyrae V338 Boo are presented. The Transiting Exoplanet Survey Satellite (TESS) observed this star again in 2022, and an observing campaign of the American Association of Variable Star Observers (AAVSO) was completed after the TESS observations as a follow-up. We find that the first overtone pulsation mode in this star completely disappears during the TESS observing window. This mode reappears at the end of the TESS observations, and the AAVSO observing campaign shows that in the months that followed, the first overtone mode was not only present but was the dominant mode of pulsation. This star, and potentially others like it, could hold the key to finally solving the mystery of the Blazhko effect in RR Lyrae."

3. Samolyk 2024. JAAVSO 52, 116. *Recent Maxima of 81 Short Period Pulsating Stars*
   Abstract: This paper contains times of maxima for 89 short-period pulsating stars (primarily RR Lyrae and δ Scuti stars). This represents the CCD observations received by the AAVSO Short Period Pulsator (SPP) Section in 2023. [The AAVSO maxima for RR Lyrae are also included in the GEOS database http://rr-lyr.irap.omp.eu/dbrr/ . GEOS is an important interface for RR Lyrae data that has, at various times, been maintained by Jean-Francois Le Borgne, Anton Paschke, Massimiliano Martignoni, and Jacqueline Vandenbroere. Those who wish to use GEOS data in a publication should not forget to give proper credit, following the guidance on the GEOS website. See also Le Borgne et al. 2007, Astronomy and Astrophysics 476, 307.]

XZ Dra: An RR Lyrae in the Legacy Program

(RA 19 09 42.6 DEC +64 51 32 J2000)

Consistent with this newsletter's focus on the origins of the SPP program, our featured star, XZ Dra, has a long observational history. Discovered almost a century ago, its 0.476496 day primary period and 76 day Blazhko period have both been seen to change over time (Jurcsik, Benko, and Szeidl 2002 Astronomy and Astrophysics 396, 539).

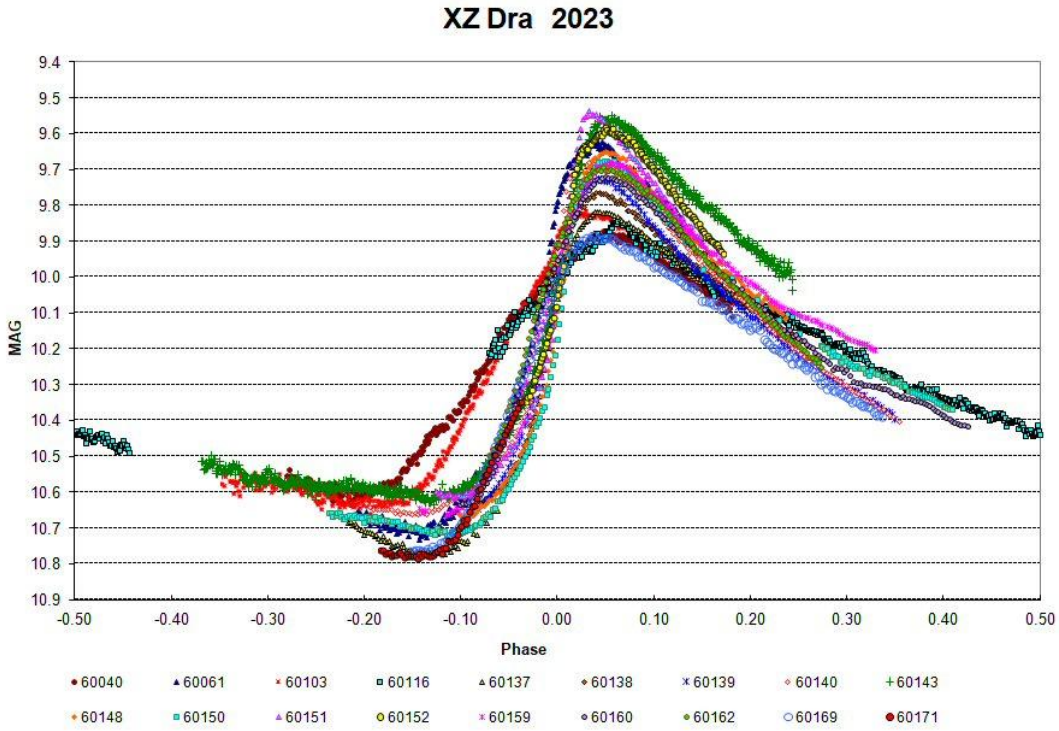

Figure 1. The half-day fundamental mode light curve of XZ Dra is modulated over a 76-day secondary, or Blazhko period. V-band observations courtesy of G. Samolyk.

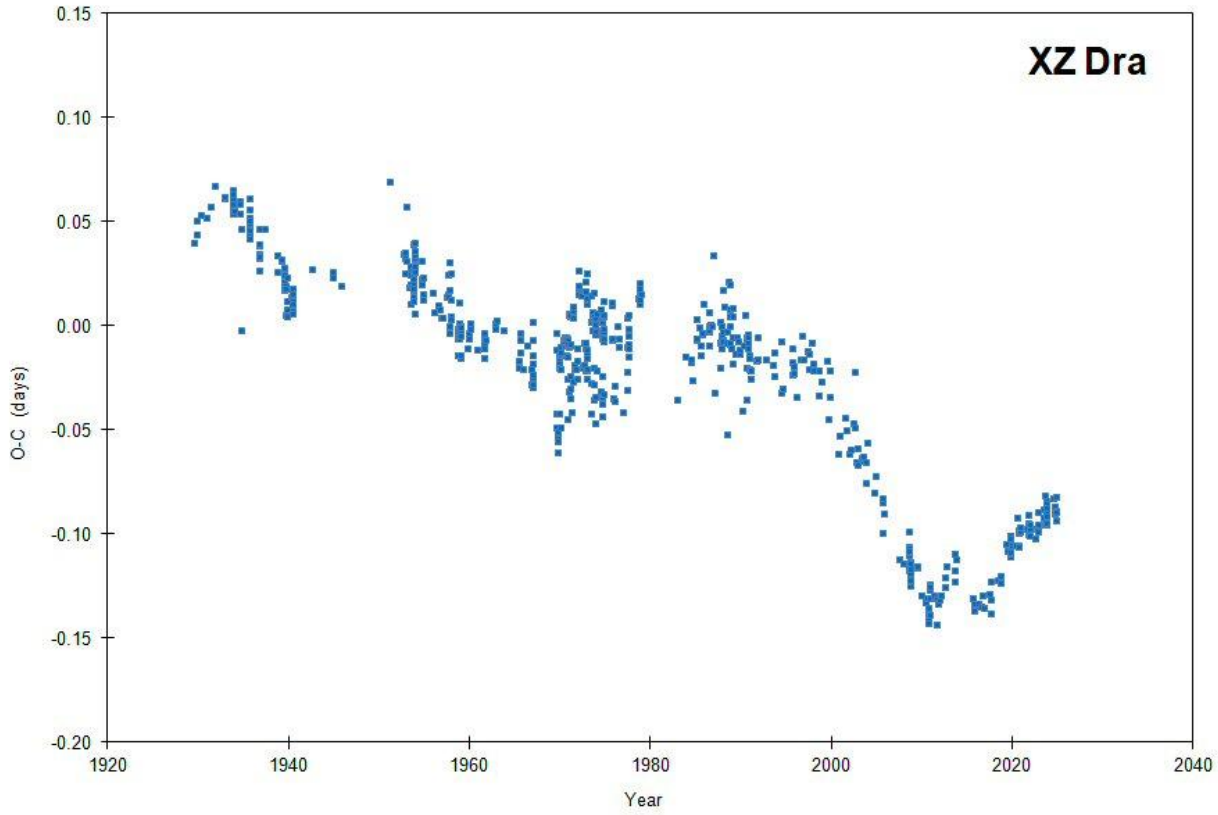

Figure 2. The O-C diagram for maxima of XZ Dra, where the C values are calculated adopting a constant period of 0.476497 day. The fluctuations in the O-C values indicate that something in addition to continuous nuclear burning is changing the period of the star in what appears to be an unpredictable fashion. It is important to keep XZ Dra under observation, so that gaps do not confuse the interpretation of the diagram. Courtesy of G. Samolyk.