Newsletter of the AAVSO Short Period Pulsator Section

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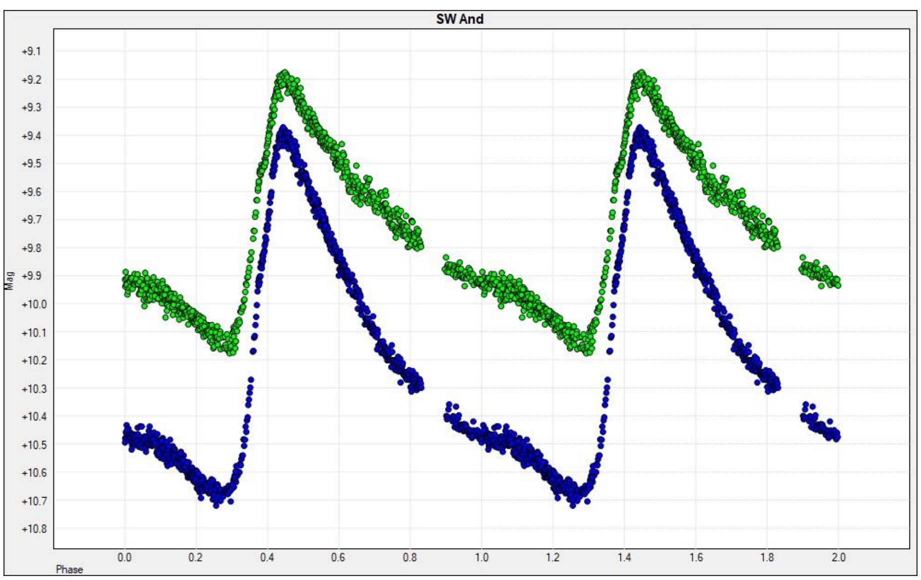
Northern Winter/Southern Summer 2025

In this Newsletter we answer a question from an SPP observer and feature a star well-placed for viewing at this time of year. Comments and suggestions about the newsletter remain welcome and can be emailed to Horace Smith (smithhh@msu.edu).

Observations in More Than One Filter

Observations of SPP stars through a single filter are very useful for period determinations of those stars, but more can be learned from observations in two or more filters. AAVSO observer Bill Tschumy obtained the light curves of the RR Lyrae star SW And shown in Figure 1 through B and V filters. He was interested in why the light curves through the two filters differ in the way that they do, so we'll take a quick look at that. Bill particularly noted that the star became bluer near maximum light, and that the B peak might come very slightly before the V.



Fig, 1. Bill Tschumy's V (green) and B (blue) light curves of SW And. Multiple nights of observation were phased with a period of 0.44227 days.

Although the spectra of RR Lyrae stars are not perfect thermal black-bodies, insight can be obtained by considering them as such idealized absorbers and emitters of light. The peak emission from a star radiating as a perfect black-body would obey Wien's Law, which states that the wavelength of peak emission is proportional to the inverse of the temperature: Peak wavelength = constant/Temperature in degrees Kelvin. Moreover, for two black-body emitters of equal size but different temperature, more energy will be emitted at every wavelength by the hotter one.

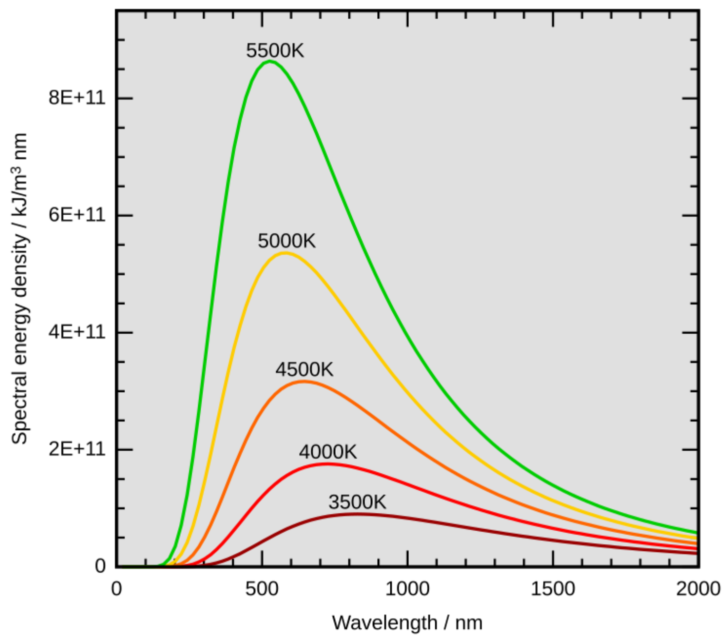


Fig. 2. Thermal emission as functions of temperature and wavelength for black-body objects. These are described by the Planck function formula. From Wikipedia. https: //creativecommons.org/licenses/by-sa/3.0/deed.en

The same rules apply to the actual B and V light curves. The decrease in B-V at maximum light compared to minimum is thus mainly a result of the change in surface temperature during the pulsation cycle. At maximum in B and V the effective temperature of an ab-type RR Lyrae star is about 7250 K, while at minimum it is about 6000 K. Interstellar dust can also dim B magnitudes more than V, but interstellar reddening is low for SW And, minimizing the effect.

Both the B and the V passbands are close enough to the peak of the Planck function that they scale roughly as T^4. In contrast, infrared observations are on the tail of the Planck function, so that the K-band brightness scales more like $T^{1.6}$. Effective temperature is not the only thing determining the brightness, however. The radius, R, of the RR Lyrae star also changes during the pulsation cycle, so that the brightness will also scale as R^2. R is not largest when the temperature is highest, and the R^2 term is more important at longer wavelengths. A consequence is that, as one goes from the B to the infrared K bands, the maximum brightness comes later. The difference is small, however, for the B versus V light curves.

Interestingly, SW And was reported to show a 36.83-day Blazhko effect in the past, a periodic modulation in the shape of the light curve. The effect appears to have been small in recent years.

AE UMa: A Short Period Variable with Two Periods

AE UMa (RA 09 36 53.2 DEC +44 04 00 J2000)

Our featured star, AE UMa, has a short period and has sometimes been classified as a Delta Scuti variable and sometimes as an SX Phe variable. AE UMa has a relatively high amplitude for such variables and pulsates simultaneously with more than one period. It has been studied with TESS as well as from the ground.

AE Uma has a main period so short that northern observers can record several cycles during a long winter night. Its strongest period is 0.086017 days, equal to 2.064 hours. One night's V-band light curve of AE Uma is shown below (Fig. 3). It will be apparent that the light curve does not perfectly repeat from cycle to cycle as plotted with that period. That is mostly because of interference with a lower-amplitude second period of about 0.06653 days. J. Daszyńska-Daszkiewicz, P. Walczak, W. Szewczuk, W. Niewiadomski (2023 MNRAS 526, 1951) performed an asteroseismology analysis of AE UMa and studied its period stability. TESS data indicated that both periods were increasing, perhaps at a rate greater than found by previous studies based upon observations from the ground. Continued observations will help with understanding how the periods of AE Uma are changing.

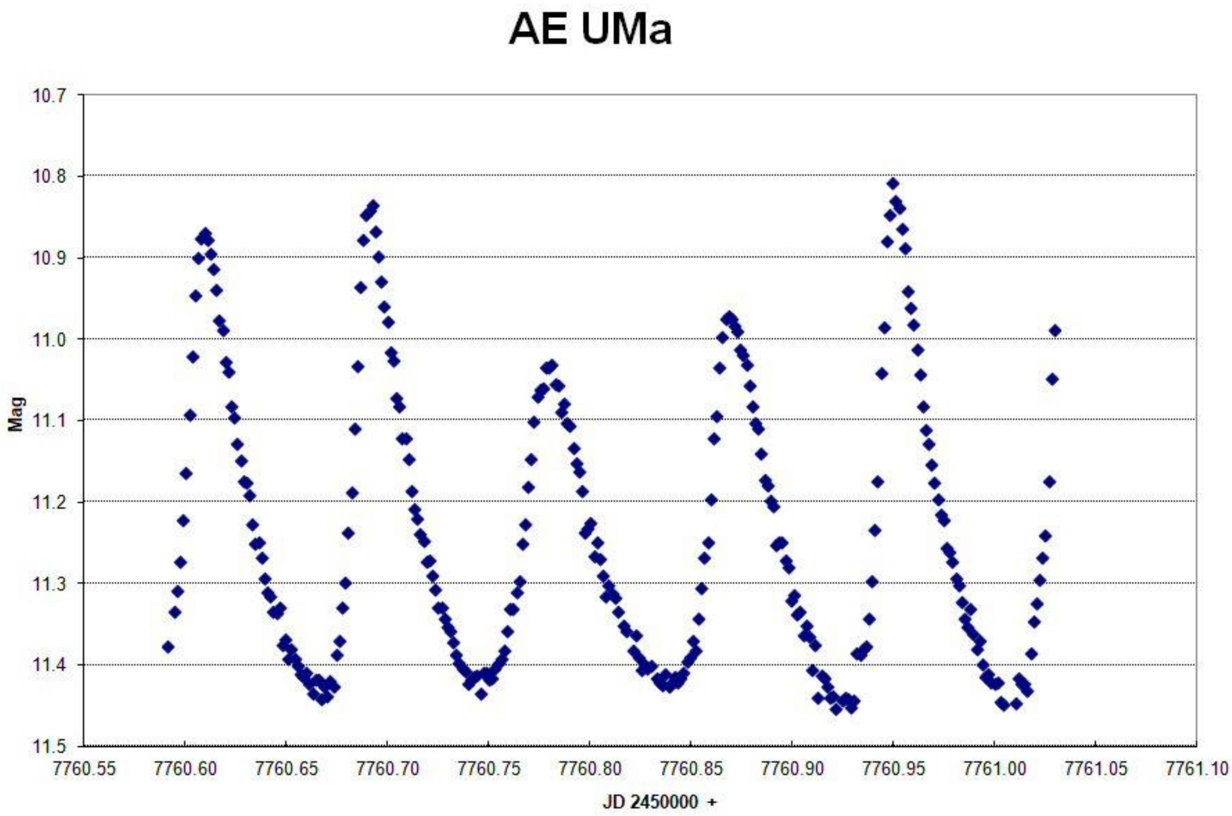


Fig. 3. One night's V-band photometry of AE UMa. Courtesy of G. Samolyk.