RR TAURI - ALIVE AND CHANGING!

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Abstract

The light variations of the interesting irregular variable RR Tauri are described.

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1. Introduction

RR Tauri is an irregular variable, classified as type Inas in the General Catalogue of Variable Stars (GCVS) (Kukarkin et al. 1969). While the term "Ina" refers to Orion-type variables of the early spectral classes O and A, like T Orionis, the "s" indicates rapid variations. These stars are connected with diffuse nebulae or are observed in the regions of such nebulae. RR Tauri can also be classified as an eruptive variable.

On the spectrum-luminosity diagram, such objects are situated either in the region of the main sequence or in the region of sub-giants. The spectral class is given in the GCVS as A2eII-III, corresponding to the intensity of the K line and the faint metal lines. Rossiger and Wenzel (1974) contend that RR Tau should more correctly be classified as B8-9e with a shell.

As indicated by a number of papers written on the subject, RR Tau has always generated interest among professional astronomers, going back at least to Jacchia (1930), who set the direction for future research. In the more recent past it was mainly Herbig (1954, 1960, 1972) who shed some light on the behavior of this star.

However, its light variations of about 4 magnitudes make RR Tau a very worthwhile target for amateurs equipped with a telescope having an aperture of 6 inches or greater. The spectral class indicates a bluish-white object. In connection with a good sequence provided by the American Association of Variable Star Observers (AAVSO), visual observers can truly provide very accurate brightness estimates throughout the entire magnitude range.

2. Finding RR Tauri

RR Tau is easy to find. Its 1950 coordinates are $\alpha = 05^h\ 36^m.4$ and $\delta = +26^\circ\ 21'$, which places the variable just about 0.5 north of the star 125 Tauri. Figure 1 shows the general region of RR Tau from AAVSO Variable Star Atlas (1980). A low-power eyepiece will show 125 Tau and the field of the variable. Figure 2 shows a portion of the AAVSO chart for RR Tau.

The star located about 9' southwest of RR Tau used to be a comparison star of magnitude 8.8. However, this star has recently been found to be an X-ray source, and it is now listed under the name A 0535+26. Its light variations in the visual range are small and require photometric equipment. On the other hand, since RR Tau becomes only about as bright as magnitude 10.5, elimination of this comparison star does not represent much of a loss for the sequence.

3. The Light Curve

Figure 3 shows the AAVSO light curve of RR Tau between 1926 and

1958. The time scale is too compressed to clearly show the day-to-day fluctuations which quickly become evident to even the casual visual observer. However, the AAVSO data do show an apparent cycle for the more pronounced minima of about 40 days. Rossiger and Wenzel (1974), citing Jacchia's earlier work, have determined a 20-day cycle for the deep minima, together with an amplitude of less than 2 magnitudes. These authors call this phenomenon "Component 3." They also determined two other types of variations. These variations are "Component 1," consisting of continuous, brief variations with a visual amplitude of A $\leq$0.2 magnitude and a cycle of approximately 10 days, and "Component 2," consisting of slow changes in the maximum brightness, modulated by Component 1, excluding the sharp minima of Component 3, a visual amplitude of A$\sim$1 magnitude, and a cycle of about 100 to 1000 days.

Figure 4 is the author's own light curve, with a larger scale. It shows the often quite significant daily light variations. Interestingly, the brightness seldom seems to remain at around magnitude 12. The star is either "faint" (around magnitude 13 to 14) or "bright" (around magnitude 10.5 to 11.5). The gaps in the light curve, of course, should be filled by other observers having clear sky conditions. It would be daring to draw a solid line connecting all the points recorded within the time frames shown in Figure 4.

4. Observing Program

Data on RR Tau are still not adequate for a thorough study. More observers should therefore follow this variable intensively. In active times, it is recommended that estimates should be made about once every hour with the time noted down to the nearest 15 minutes (0.01 days). Of course, RR Tau, one of the "The Young and the Restless" stars, is practically always active. This activity is what makes this star truly one of the most lively and fascinating variables in the AAVSO program. For this and purely scientific reasons, RR Tauri should be on the observing program of amateurs who can accurately reach about 14th magnitude.

REFERENCES

Herbig, G. H. 1954, IAU Transactions VIII, 805.

_____ 1960, Astrophys. Journ. Suppl. 43.

Herbig, G. H. and Rao, N. K. 1972, Astrophys. Journ. 174, 401.

Jacchia, L. 1930, Astron. Nach. 240, 121.

Kukarkin, B. V. et al. 1969, General Catalogue of Variable Stars, Moscow.

Rossiger, S. and Wenzel, W. 1974, Astron. Nach. 295, 1.

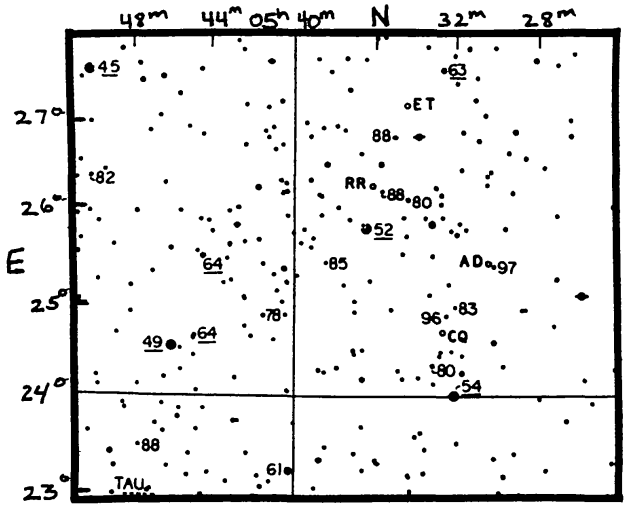

Figure 1. The general region of RR Tauri, from AAVSO Variable Star Atlas. North is up; East is to the left. Epoch is 1950.

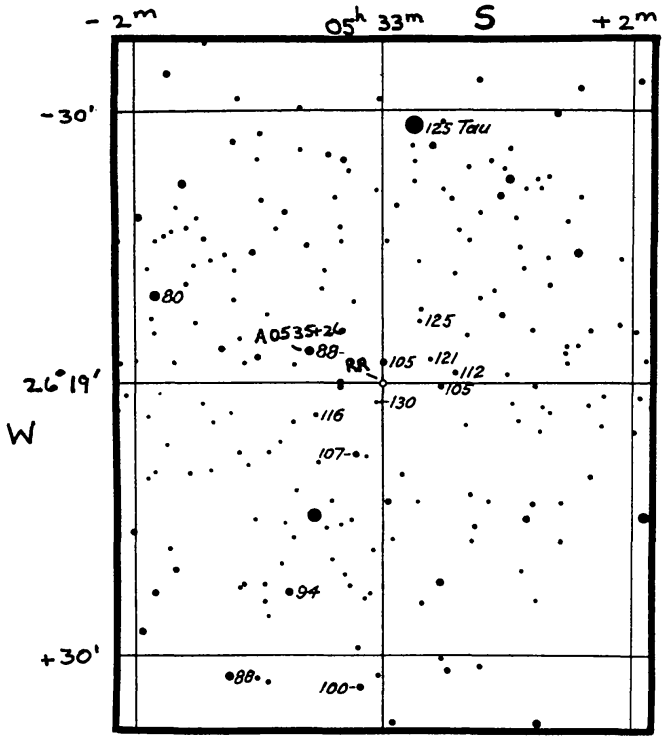

Figure 2. Finder chart for RR Tauri, from the "c" scale (40" = 1 mm) AAVSO standard chart. Also indicated are 125 Tau and A 0535+26. Epoch is 1900. South is up; West is to the left.

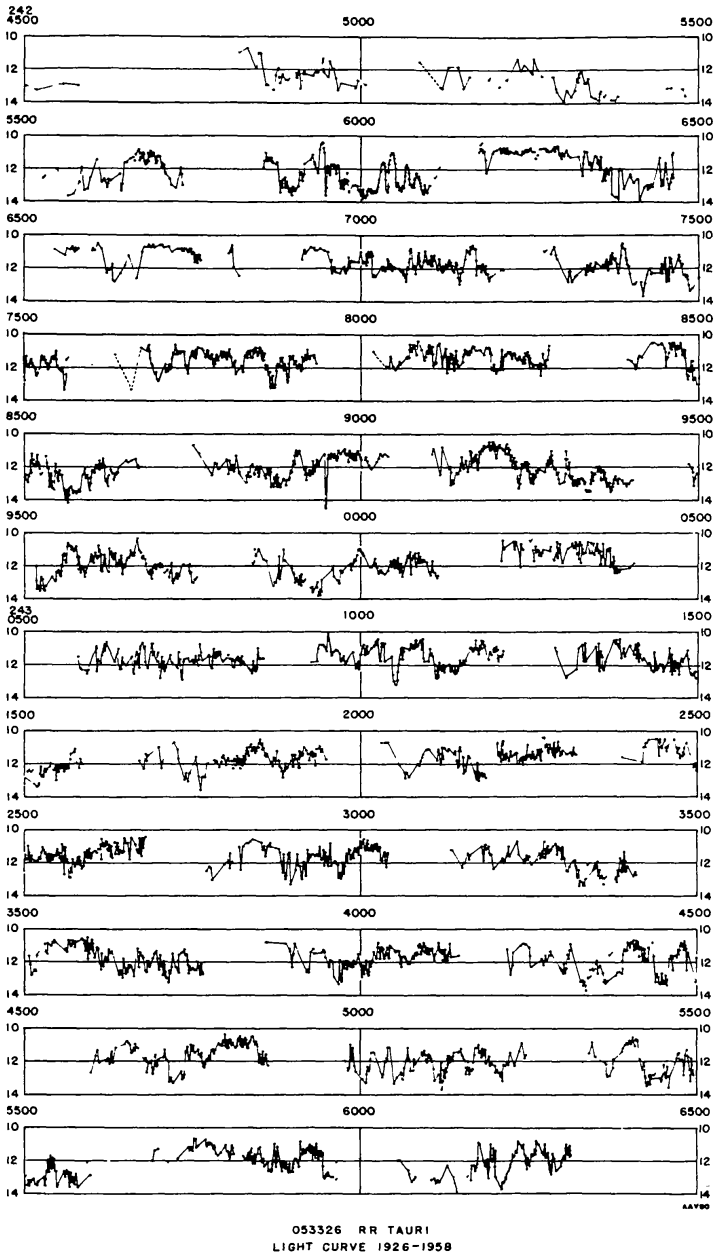

Figure 3. AAVSO long-term light curve for RR Tauri from 1926 to 1958. (courtesy of AAVSO)

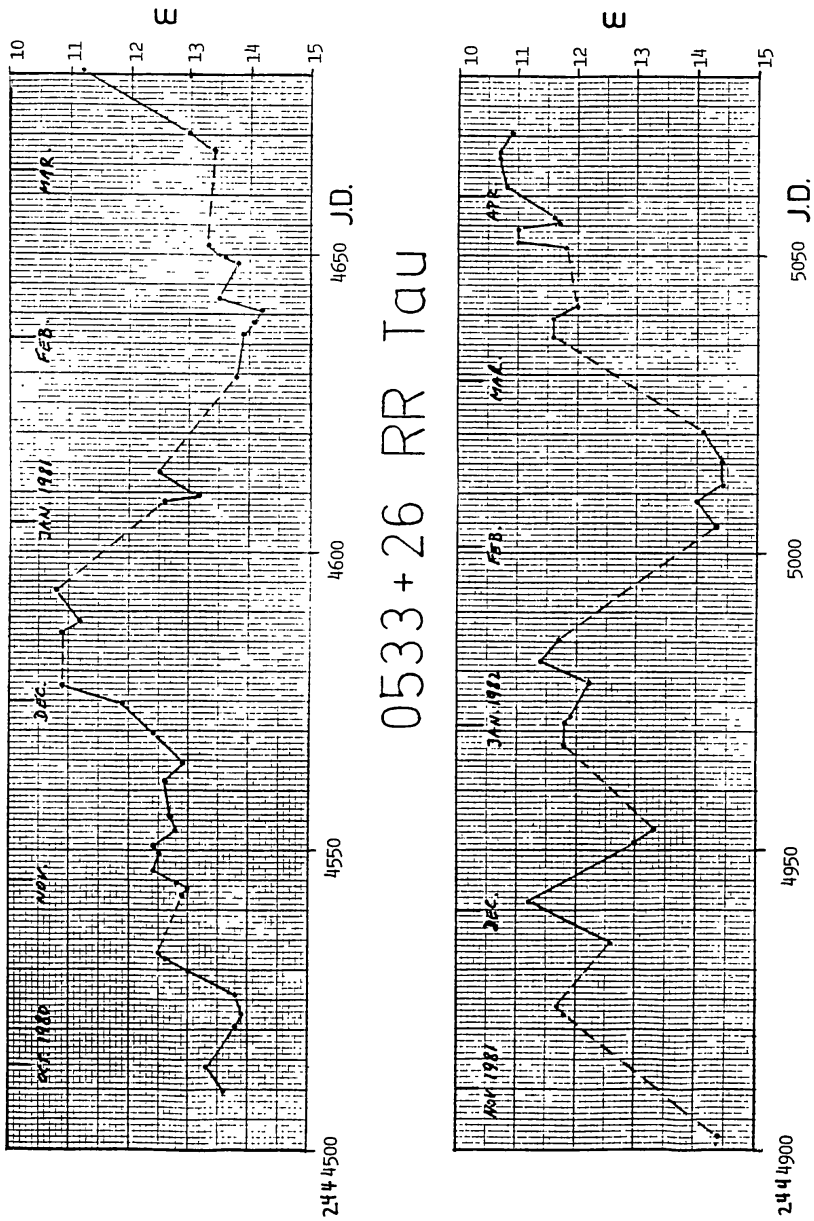

Figure 4. The author's light curve for RR Tauri, plotted approximately 20 days per inch versus 2 magnitudes per inch.