Now Is the Time to Revisit V725 Sagittarii

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Abstract The puzzling behavior through 1996 of the unique variable star V725 Sagittarii is summarized.

1. Introduction

V725 Sagittarii is a unique variable whose puzzling behavior has never been satisfactorily explained. Its variability was discovered by Henrietta Swope (1936), who subsequently used plates in the Harvard collection to reconstruct its photometric behavior from 1889 to 1935. Until 1926, it appears to have varied irregularly or semiregularly, with amplitudes varying from practically zero to 0.7 magnitude in 1898, and with a slow rise in mean brightness from $B = 13.6$ in 1889 to 12.9 in 1914. However, from 1920 to 1935, the mean brightness dropped again by a magnitude. At the same time, a regular pulsation began in 1928 and continued through 1935, with amplitudes reaching almost two magnitudes. During this time the period increased rapidly from 12 days in 1926 to 21 days in 1935. Later, Tzesevich (1964) examined Harvard plates taken between 1936 and 1949, and Plaut observed the star in 1956 and 1959. Both reported no variations larger than 0.15 magnitude. A good summary can be found in Demers (1973).

2. Observations from 1968 through 1996

Since then, the star has been observed on several occasions by Demers. Photoelectric two- and three-color measurements were obtained in 1968 and 1969 (Demers 1973), and additional photoelectric and photographic observations were made in 1973 (Demers and Madore 1974). During this time only low-amplitude semiregular variations were observed. Demers observed the star again during the 1974–1975 season, and more magnitudes were obtained photoelectrically in 1981 and 1982, and with a CCD in 1995 and 1996.

The observations from 1974 through 1996 are listed in Table 1. Except for the 1995 data, only differential measures were made relative to star 1 (see the chart in Demers 1973), such that $\Delta V = V(\text{V725}) - V(\text{star 1})$, where V(star 1) is taken to be 12.235. Thus most of the values of V listed in Table 1 were computed from the measured values of ΔV as listed in that table.

A light curve based on the 1981 V magnitudes is shown in Figure 1. Note that the period of 69 days is much longer than the periods of the pulsations observed in the 1920s and 1930s. The authors have learned that the star has also been monitored visually since 1964 by members of the AAVSO and the Royal Astronomical Society of New Zealand. We hope to use these additional data to piece together a better history of the long-term photometric behavior of the star.

3. Discussion

The classification of this variable is still uncertain and will require spectroscopic observations. The two-color photometry of V725 Sgr showed it to be relatively red with colors which varied from 1.25 through 1.49. The star is situated in a crowded region of the Milky Way in which the interstellar reddening is non-uniform. Demers (1973) found the most likely intrinsic $B–V$ to be close to 1 magnitude, a color compatible with that of an RV Tauri star or semiregular variable.

While many RV Tauri-like stars exhibit puzzling behavior (Percy *et al.* 1991), we know of none very similar to V725 Sgr. We hope that renewed interest in this star will give us a clearer picture of what is happening.

4. Addendum, 2006

Since this paper was written, members of the AAVSO have continued to make observations of V725 Sgr. Plots of V observations in 1993 and 1997 are shown in a second paper by Wehlau *et al.* (1998). Analyses by Percy and Molak of data collected between 1985 and 2004 indicate that the period has continued to increase and is now about 90 days. In addition, recent spectra are consistent with that of a red semiregular variable instead of that of a yellow supergiant as observed in 1973, perhaps indicating that the star underwent a thermal shell flash and has now moved back to the AGB (Percy *et al.* 2006).

5. Acknowledgements

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References

Demers, S. 1973, J. *Roy. Astron. Soc. Canada*, **67**, 19.
Demers, S., and Madore, B. 1974, *Inf. Bull. Var. Stars*, No. 870.

Percy, J. R., Molak, A., Lund, H., Overbeek, D., Wehlau, A., and Williams, P. F. 2006, *Publ. Astron. Soc. Pacific*, **118**. 805.
Percy, J. R., Sasselov, D. D., Alfred, A., and Scott, G. 1991, *Astrophys. J.*, **375**, 691.
Swope, H. H. 1936, *Ann. Harvard Coll. Obs.*, **105**, 499.
Tzesevich, V. P. 1964, *Astron. Tsirk.*, No. 311.
Wehlau, A., Atcheson, T., and Demers, S. 1998 in *A Half Century of Stellar Pulsation Interpretations*, eds. P. A. Bradley and J. A. Guzik, ASP Conference Series, Astron. Soc. Pacific, San Francisco, 135, 171.

Table 1. Photometry of V725 Sgr from 1974 through 1996.

JD 2400000+	*V*	Δ*V*	*B–V*	Δ*B–V*	*JD 2400000+*	*V*	Δ*V*	*B–V*	Δ*B–V*
42309.52	12.535	0.30			44765.75	12.945	0.71		
42328.50	12.425	0.19			44770.74	12.825	0.59		
42329.50	12.405	0.17			44781.77	12.485	0.25		
42336.51	12.595	0.36			44786.72	12.385	0.15		
42337.50	12.585	0.35			44795.72	12.229	–0.01		
42338.50	12.605	0.37			44802.72	12.345	0.11		
42339.50	12.585	0.35			44803.58	12.305	0.07		
42340.51	12.555	0.32			44817.75	12.785	0.55		
42478.86	12.315	0.08			45199.64	12.237	0.092		
42479.88	12.325	0.09			45203.54	12.535	0.30	–0.20	
42480.89	12.395	0.16			49989.62	12.471	0.274	1.316	–0.230
42481.88	12.365	0.13			49992.50	12.386	0.169	1.375	–0.243
42482.90	12.315	0.08			50013.52	12.571	0.340	1.473	–0.106
42483.90	12.345	0.11			50017.50	12.731	0.477	1.538	–0.042
44696.88	12.665	0.43			50019.52	12.815	0.58		
44701.88	12.675	0.44			50392.56	11.985	–0.25	–0.09	
44708.89	12.605	0.37			50393.54	11.995	–0.24	–0.10	
44721.91	12.385	0.15			50394.54	11.985	–0.25	–0.13	
44751.71	12.585	0.35			50395.54	12.015	–0.22		
44761.75	12.865	0.63							

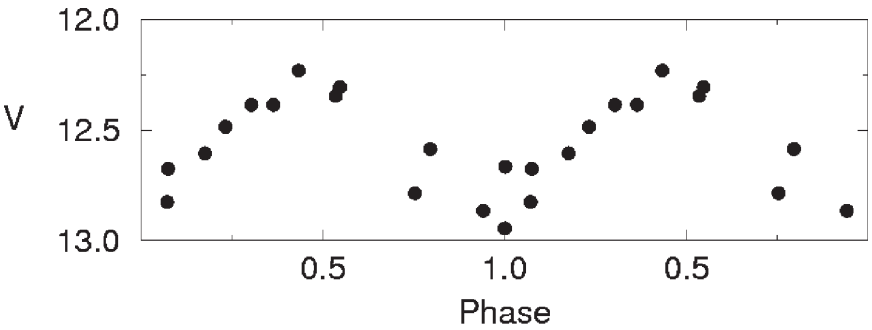

Figure 1. *V* light curve of V725 Sgr in 1981. P = 69 days.