COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5344

Konkoly Observatory
Budapest
26 November 2002

HU ISSN 0374 – 0676

PERIOD CHANGE IN S SEXTANTIS

TEMPLETON, M. R.; MATTEI, J. A.

American Association of Variable Star Observers, 25 Birch St., Cambridge, MA 02138, USA; email: aavso@aavso.org

S Sextantis is a well-observed Mira variable, with a mean period of roughly 260 days. Merchán Benítez & Jurado Vargas (2000) found a strong period decrease in S Sextantis based upon AFOEV and VSOLJ data spanning JD 2442000 to 2451340 (1973 - 1999). They found that the period decreased monotonically from the GCVS period of 264.8 days to under 250 days, much larger than would be expected from "normal" cycle-to-cycle variations often found in Miras. From this, they hypothesized that S Sextantis had just undergone a helium shell flash. A few other variables are known to exhibit similar period changes, with T UMi being the most spectacular case (Gál & Szatmáry 1995; Mattei & Foster 2000)

We analyzed the S Sextantis data from the AAVSO International Database, which is well-covered from JD2427871 to JD2452433 (1935 - 2002), to determine whether this period change began prior to JD2442000. We used the *weighted wavelet transform* (Foster 1996) developed at AAVSO to study the time evolution of the pulsations. The wavelet transform produces a three-dimensional representation of the pulsation behavior with the amplitude as a function of both time and period.

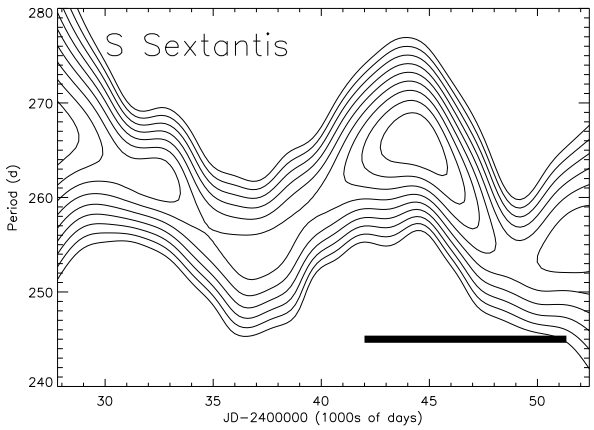

Figure 1. Wavelet transform of S Sextantis. Contours represent amplitude in magnitudes. The solid line at lower right represents the span of the Merchán Benítez & Jurado Vargas data.

The results of the wavelet transform are shown in Figure 1. We find that for the span of time analyzed by Merchán Benítez & Jurado Vargas, the AAVSO data reproduces their observed period change. However, we find that the behavior of the period over time is far from monotonic, instead appearing as a "sinusoid" with a period of roughly 50 years, and a full "amplitude" of the period change of nearly twenty days. We also find that the amplitude of pulsation has changed nearly in lockstep with the period, with lowest amplitudes corresponding to the shortest periods.

The behavior of S Sextantis with time is strange in comparison to most Mira variables. Although Miras can exhibit very large *cycle-to-cycle* period variations, they rarely exhibit changes that are as orderly as those seen here. Zijlstra & Bedding (2002) make note of a small group of Miras which exhibit long-term, orderly period changes, giving them the designation of "meandering Miras." In fact the pulsation behavior of S Sextantis is remarkably similar to that of that of T Cep and S Ori, both of which show evidence of the same sinusoidal variation in period. However, Zijlstra and Bedding note that at least 15 percent of Miras with periods longer than 400 days show evidence of meandering periods. Thus it isn't clear whether S Sextantis' behavior has the same cause, or whether this meandering behavior is limited to long-period stars. We show the period and amplitude variability of S Sextantis with T Cep, R Nor, and S Ori in Figure 2.

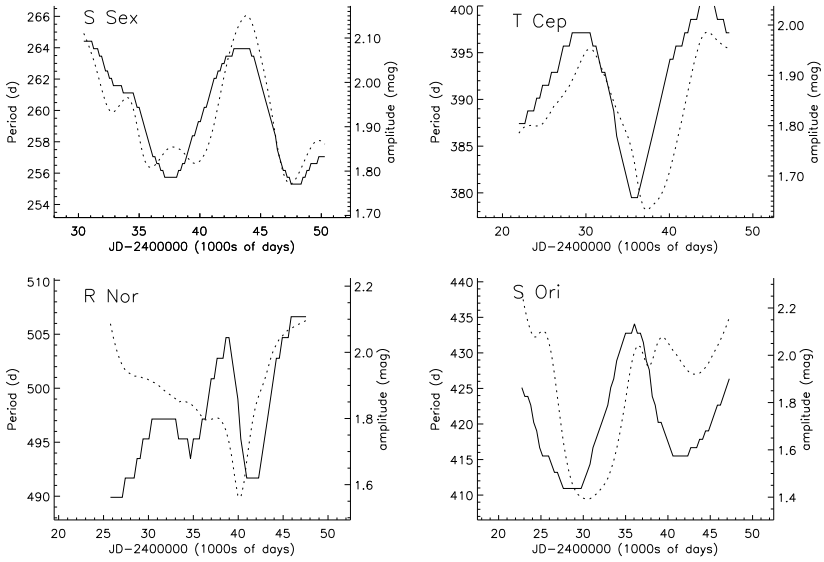

Figure 2. Period (solid lines) and amplitude (dotted lines) evolution in S Sextantis and three "meandering Miras:" T Cep, R Nor, and S Ori. Note how the period and amplitude changes appear to be correlated.

Given the nature of the period variation in S Sextantis, it is unlikely that evolution is the cause. The shell flash evolution models of Vassiliadis and Wood (1993) do not exhibit short-term oscillations in period like those observed here; stars undergoing shell flashes have excursions in period of several tens of percent, with timescales of $\sim$ 1000 y. As yet, we have no explanation of what might cause this period variation. Nonlinear interactions between two or more pulsation modes have been suggested as reasons for chaotic behavior in the semi-regular and irregular variables (Buchler et al. 1996), and a weakly-nonlinear process could be at work here. Mode-switching does not seem possible since the period

and amplitude variations are smooth, and the difference between maximum and minimum periods are smaller than the expected difference between radial overtones. Interaction with a binary does not seem likely as there is no mention of S Sextantis being a close binary or symbiotic star in the literature, although the sinusoidal nature of the variation is striking. We suggest that S Sextantis is an interesting target for further study.

We thank the 288 observers worldwide who contributed the observations that made this study possible.

References:

Buchler, J.R., Kolláth, Z., Serre, T., Mattei, J., 1996, *ApJ*, **462**, 489
Foster, G., 1996, *AJ*, **112**, 1709
Gál, J. & Szatmáry, K., 1995, *A&A*, **297**, 461
Mattei, J.A. & Foster, G., 2000, in *Variable Stars as Essential Astrophysical Tools*, C. Ibanoglu, ed., Kluwer: NATO Scientific Affairs Division, **544**, 485
Merchán Benítez, P. & Jurado Vargas, M., 2000, *A&A*, **353**, 264
Vassiliadis, E. & Wood, P.R., 1993, *ApJ*, **413**, 641
Zijlstra, A.A. & Bedding, T.R., 2002, private communication