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Period evolution in very long period variables: the semiregulars.

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Abstract. The analysis of semiregulars (SRs) light curves using the wavelet is not easy due to the nature of these stars. But we were able to notice similarities with the Mira-type stars for the same range of period evolution (greater than 450 days): the LPV-SRs are unstable, moreover meandering and continuous changes have been detected. Nevertheless the presence of a sudden change is quite ambiguous. All these variations in the period evolution of the semiregulars may be the sign of the presence of physical processes such thermal pulses or convection for example. The related mass loss phenomenon could then be better investigated.

Key words. Stars: semi-regulars – period – light curves – Wavelet analysis

1. Introduction

The Semiregulars are red giant or supergiant pulsating stars, divided in different classes: SRa, SRb, SRc, SRd (supergiant) according their regularity. We chose stars with periods greater than 450 days to study the stability of these variables in the long run. The number of objects that comply with this criterion is not high, and using the database of the AAVSO[1] and the AFOEV [2] we found 26 stars. Once the wavelet analysis (developed by Foster in 1996) applied, only 11 remain. The data obtained allow a correct study of the period evolution as the possible changes are well defined. The problem occurring while dealing with semi-regulars is the proximity of the different modes, mainly the first and second overtones, which create frequence overlapping and aliasing effects.

2. Classification of the SRs

Using a linear fitting to quantify the period change over the time, we observed that the very long period semi-regulars were unstable with $dlnP/dt$ comprise between $|10^{-3}|$ and $|10^{-5}|\ yr^{-1}$ which is in the same order for the unstable Miras (Sabin et Zijlstra , 2005). Two principal trends can be derived.

– ST Psc presents a nearly straight increase gaining 90 days in 33 years. In contrast, S Aur and S Per show a slight decrease that could be associated to a meandering behaviour.

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[1] American Association of Variable Star Observers

[2] Association Francaise des Observateurs d'*é*toiles Variables

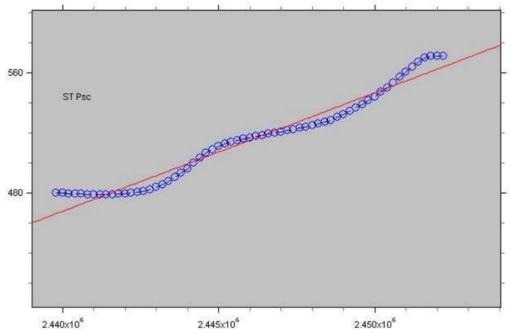

Fig. 1. Continuous change in ST Psc .

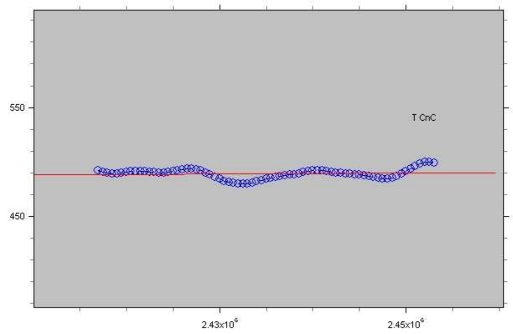

Fig. 2. Meandering motion in T Cnc .

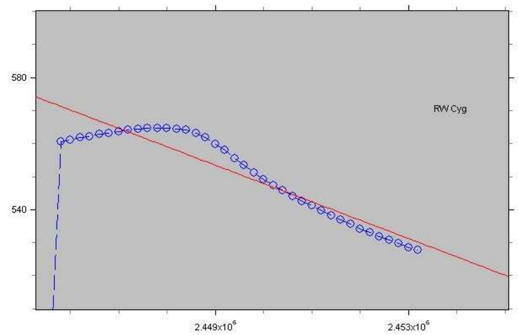

Fig. 3. A sudden change in RW Cyg ?

- T Cnc is an example of proper meandering variation mirroring the Mira-type variable V Cam .
- The period evolution of RW Cyg can be confusing as it seems presenting a sudden change like the mira R Cen. But, the observations have been made on a shorter timescale and the amplitude variation does not mimic the one of the mira maybe the sign that we cannot associate any phenomenon like a thermal pulse.

3. Conclusion and discussion

The study of the period evolution of semi-regulars with a period greater than 450 days shows the same characteristic trends as found for the Mira type stars. Then, continuous and meandering changes have been derived from the wavelet analysis. The presence of a sudden event is ambiguous. Nevertheless we have to be careful dealing with these data as the presence of close modes of pulsation alter more or less the analysis. The latter may also be responsible for the fact that SRs are quantitatively more unstable than their Mira-type counterparts. The nature of the changes is independent of the type of irregularity of the stars (SRa,SRb...etc).
Once these variations detected we need to know what is(are) the cause(s). The action of thermal pulses can be put forward as no extensive research on the presence of Tc^{99} for these stars has been carried. Only SW Gem and TW Peg have been found without the element by Lebzelter and Hron (2003). In the same way the action of the convection can be considered, particularly for the meandering behaviour. Like for the Miras, the unstable pulsational behaviour of the SRs may play a role on the mass loss and the distribution of the rings.

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