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POSSIBLE DETECTION OF SOLAR-TYPE CYCLES IN CATACLYSMIC VARIABLES

Cataclysmic variables (CVs) are evolved close binary systems in which a low-mass,usually main sequence or near main sequence secondary is filling its Roche lobe and transfers matter onto a white dwarf primary. For reasonable mass transfer rates, most of the luminosity is produced by the release of gravitational energy of the transferred material inside the viscous accretion disc which is formed around the collapsed object. We suggest that the presence of solar type cycles in the secondaries of CVs can modulate the mass transfer rate on time scales of months and years and explain some of the peculiarities observed in the long term light curves of these binary systems. This idea is supported by the modern picture of solar cycles, in which a convective-pulsating phenomenon is responsible for the observed variations of the photospheric radius, the differential rotation and the magnetic cycle (Gilman 1986).

The presence of non-radial g-mode pulsations in the secondaries of some CVs and Low Mass X-Ray Binaries, capable of modulating the mass flow rate within these systems, has been proposed by Vogt (1980), Bianchini et al. (1986) and Priedhorsky (1986). In particular, Bianchini et al. (1986) have suggested that the 7 year modulation seen in the light curve of the old nova GK Per might be ascribed to the presence in the secondary of a genuine solar type cycle. According to Applegate and Patterson (1987) the presence of magnetic cycles in the cool components of binary systems could explain the period changes observed in V471 Tau, CVs, RS CVn and W UMa stars.

If we avoid the cases of disc instability phenomena or steady nuclear burning on the surface of the white dwarf, the continuous, apparently irregular, light variations observed in the long-term light curves of old-novae and nova-like systems can be attributed to mass transfer rate variations . Variations of mass transfer rate in dwarf nova systems, instead, are more clearly represented by changes in the time interval between the outbursts (Warner 1987). We then suggest that the presence of solar type cycles in the late-type secondaries of CVs can produce a more or less periodic variation of both : (i) the observed "quiescent" luminosities of old-novae and nova-like systems; and (ii) the time intervals between consecutive outbursts of dwarf-nova systems.

To detect periodicities in the long-term light curves of CVs we adopt the procedure suggested by Deeming (1975). The discrete Fourier transform of a data file (magnitudes or ΔT versus time) is then taken as the convolution of the true Fourier transform with the spectral

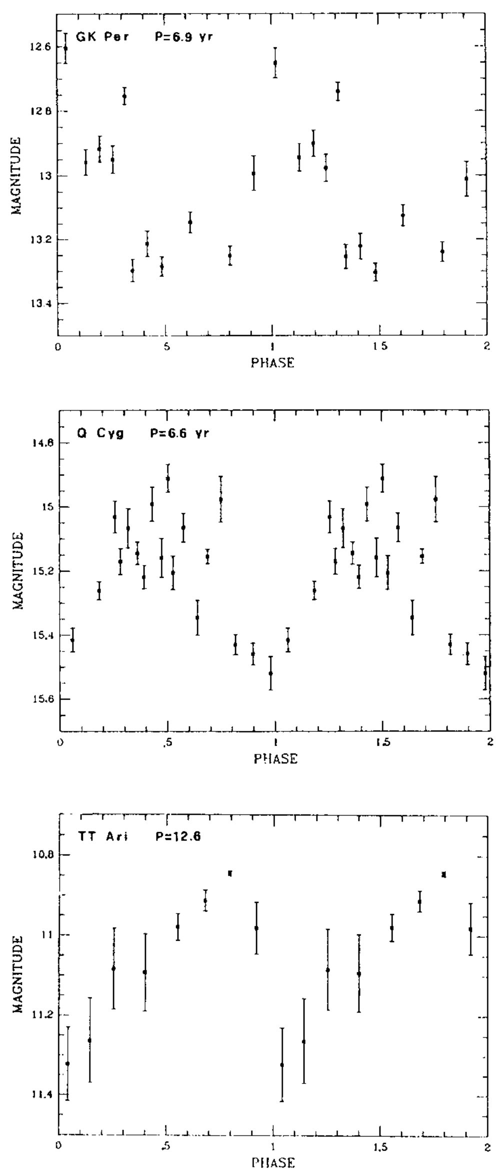

Figure 1. The folded light curves of GK Per, Q Cyg, and TT Ari and the folded ΔT-T (times) diagrams of SS Cyg and U Gem are shown. Filled squares represent averages over 90, 30, 11, 38 and 15 original datapoints respectively. Standard deviations are also given.

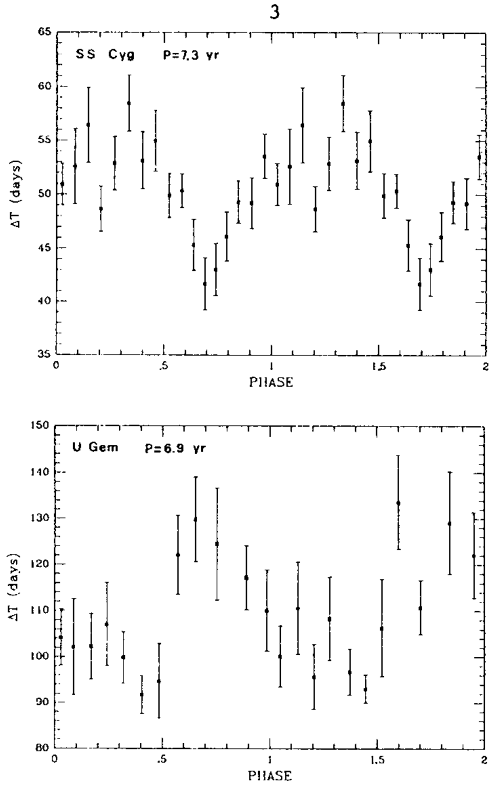

Figure 1 (cont.)

window (sampling) of the data. The methodology to discriminate between true and spurious periodicities is described by Barbieri et al. (1977). An additional test to avoid aliases has been done, in which each power spectrum of the original data has been compared with that obtained by correcting the data for the presence of one or more sinusoids. The main periodicities found have been finally shown by plotting in phase the original data and then averaging over bins as specified in the caption to Figure 1. This considerably reduces the irregular or random component in amplitude of single cycles.

We have analysed the light curves of the classical old-novae GK Per (1901), in the interval 1922-1948 (references in Sabbadin and Bianchini 1983); V841 Oph (1848) (same interval and references as for GK Per); Q Cyg (1876), in the interval 1950-1982 (Shugarov 1983); and of the nova-like variable TT Ari, in the period 1928-1982 (Hudec et al. 1984). We have also analysed the temporal variations of the time intervals between successive outbursts of the two well known dwarf-nova prototypes U Gem and SS Cyg (light curves by Mattei et al. 1985, 1987). The periods of the main cycles shown by these objects are of, respectively, 6.9, 3.3, 6.6, 12.6, 7.3 and 6.9 years. These results are shown in Figure 1. A more detailed analysis and discussion of solar-type cycles in CVs will be given in a forthcoming paper. We wish that this study can cast new light on the poorly understood long-term photometric behaviour of CVs and also contribute to the so-called "solar-stellar connection studies" (Rodono` 1986).

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