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THE PERIOD OF V2109 Cyg REVISITED

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V2109 Cyg is a variable star discovered by the Hipparcos mission (ESA 1997), and classified as an RRc with a maximum magnitude of 7.49 and variation amplitude of 0.16 mag in the V band. The following ephemeris was also determined:

$$\text{Max.} = \text{BJD } 2448500.0280(1) + 0^{\text{d}}.1860656(3) \times \text{E}$$

Nevertheless, the real physical nature of this star, based only in the morphology of its light-curve and its period, is controversial. Its period, which falls outside the typical observed range for RRc variables, and its light curve morphology, are similar to those displayed by the largest amplitude δ Sct stars. Thus, Kazarovets *et al.* (1999) classified V2109 Cyg as a δ Sct variable, and Rodríguez *et al.* (2000) included this object in their catalogue of δ Sct variables according to photometric data published by Hauck and Mermilliod (1998), who in turn extracted them from the work by Olsen (1983). In addition to this, Kiss *et al.* (1999) observed V2109 Cyg photometrically and spectroscopically, and indicated that it is a monoperiodic RRc star which probably pulsates in the second overtone mode. More recent photometric and spectroscopic observations indicate that this star is, again, a δ Sct variable (Rodríguez 2002).

In their work, Kiss *et al.* also performed a period analysis and found for this object a slightly shorter period ($0^{\text{d}}.186049(5)$) than the one detected by the Hipparcos mission. They concluded that a sudden period change had taken place between 1991 and 1998. However, V2109 Cyg had been observed in the V band for six nights a year before, between 16 July and 5 September 1997 from Mollet Observatory (unpublished data), by using an automatic 8-cm telescope. After merging Mollet Observatory data with the satellite photometry the results obtained by that time matched the period obtained by the Hipparcos mission. As a consequence, if there were a period change, it had to happen in the one-year interval between 1997 and 1998. To check this possibility, V2109 Cyg was observed again from Mollet Observatory with a 10-cm telescope for 7 nights, between 1 and 19 July 2001.

The new observations were consistent with those taken in 1997, ruling out any period shortening. Figure 1 plots V2109 Cyg photometric data obtained by the Hipparcos satellite and from Mollet Observatory in 1997 and 2001 folded with the $0^{\text{d}}.186049$ period. It can be seen that the phase light-curve cannot be adequately reconstructed.

In order to search for a more consistent period, an analysis of the $O-C$ residuals based on maximum timings was performed. In this analysis those maximum timings obtained

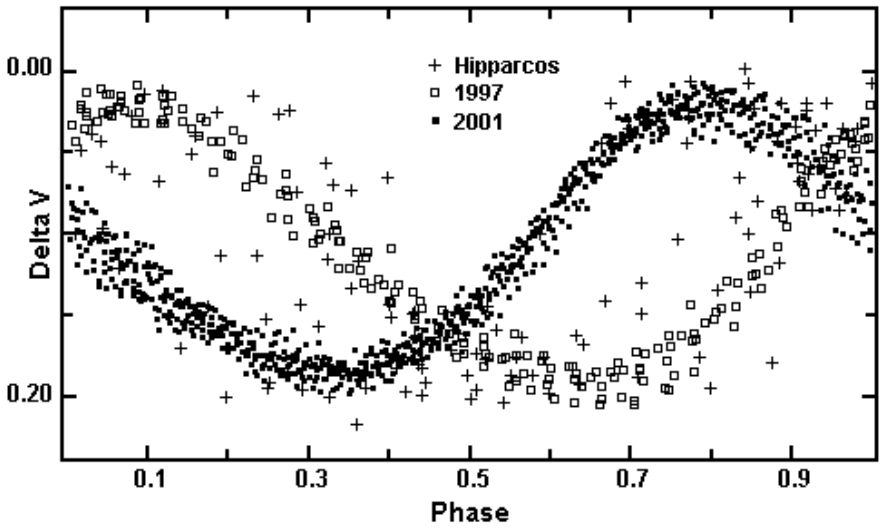

Figure 1. Light curve of V2109 Cyg folded on the $0^{d}.186049$ period.

by Kiss *et al.* were also included. Figure 2a is a plot of $O-C$ residuals according to the Hipparcos ephemeris, where it can be seen that the Hipparcos period is slightly shorter than the real one as displays the trend of increasingly positive residuals. The new period was computed to correct the trend shown in Figure 2a by assuming a constant period throughout the entire 1991-2001 interval, and therefore a linear increase of $O-C$ residuals based on the satellite ephemeris. For such a purpose, a least-squares linear fit was performed on the $O-C$ data. The corrected period is $0^{d}.18606637(22)$, and Figure 2b shows the resulting $O-C$ diagram after using the new value. Figure 3 shows the phase curve for V2109 Cyg after folding the data according to the 0.18606637-day period. This time the phase curve could be satisfactorily reconstructed.

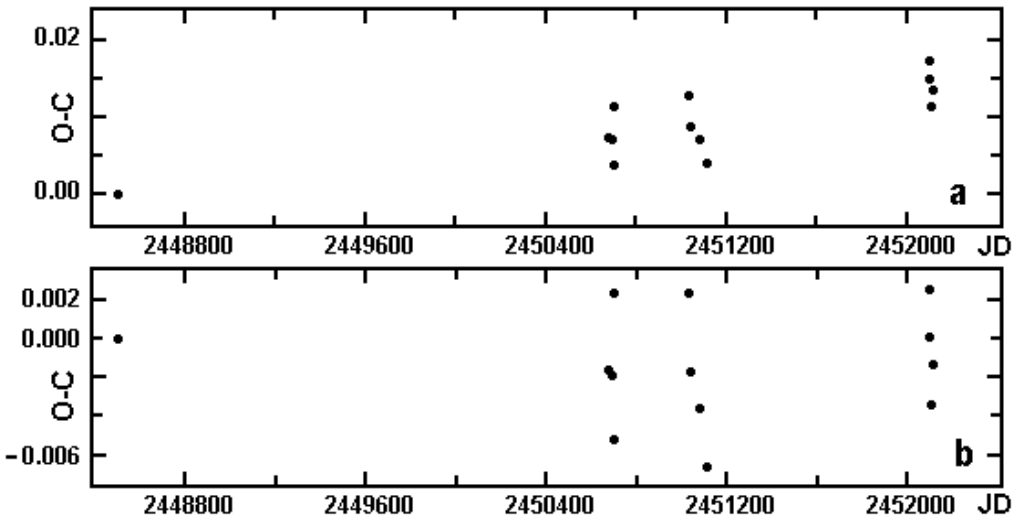

Figure 2.

In conclusion, the data seem to be consistent with a constant period in the 1991-2001 interval. Table 1 gives, as a summary, a list of all known timings and $O-C$ residuals after using the $0^{\rm d}.18606637(22)$ period.

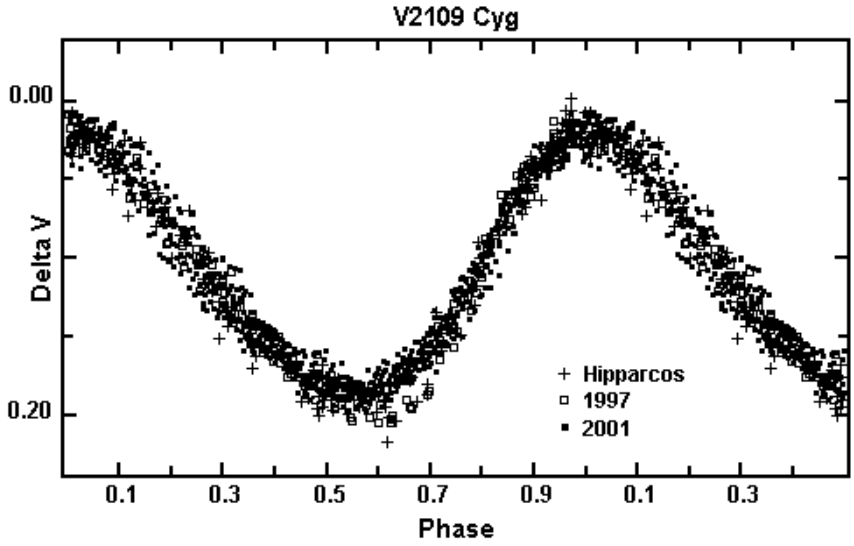

Figure 3. Light-curve of V2109 Cyg folded on the $0^{\rm d}.18606637$ period.

Table 1

Maximum	Epoch	$O-C$	Source
2450673.4677	11681	−0.0026	present paper
2450689.4691	11767	−0.0019	present paper
2450695.6135	11800	+0.0023	present paper
2450697.4666	11810	−0.0052	present paper
2451032.3936	13610	+0.0023	Kiss *et al.* (1999)
2451037.4134	13637	−0.0017	Kiss *et al.* (1999)
2451080.3928	13868	−0.0036	Kiss *et al.* (1999)
2451110.3465	14029	−0.0066	Kiss *et al.* (1999)
2452093.5303	19313	+0.0025	present paper
2452098.5517	19340	+0.0001	present paper
2452101.5252	19356	−0.0035	present paper
2452110.4585	19404	−0.0013	present paper

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