COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3688

Konkoly Observatory
Budapest
6 December 1991

*HU ISSN 0374 - 0676*

# 1991 V PHOTOMETRY OF CG CYG AND A POSSIBLE NEW VARIABLE

As part of our long term program of photometry of chromospherically active binary stars Zeilik *et al.* (1991) observed CG Cyg (=BD 34$^{o}$4217 =#142 in the catalog of Strassmeier *et al.* (1988)) at BVR during June 1991. They report the short term small amplitude fluctuations imposed on the eclipse and maculation wave that were earlier seen by Beckert *et al.* (1989, 1991) and Dapergolas *et al.* (1989, 1991).

To further investigate these fluctuations, and hopefully study them with very high time resolution we reobserved CG Cyg on August 2, 3, 4, and 5, 1991 UT. We used the 61-cm telescope at Mt. Laguna Observatory operated by San Diego State University. The photoelectric photometer was recently equipped with a red sensitive Hamamatsu GaAs tube operating at -1450V. Our comparison star was BD 34$^{o}$4216 not Yu's (1923) star (a) as used by Zeilik *et al.* (1991). We did however use star (a) as a check star and observed it frequently to see if it might vary. It appears to do so. To obtain the highest possible time resolution, we observed at V only. We used unbinned 30 second integrations (typically producing a few hundred thousand counts) and observed the sky and comparison roughly every 15 minutes. We plot the unbinned data in Figure 1. Because our observations were only at V, we did not have the B data needed to transform to the Johnson system. Hence, the data are in the instrumental system, which closely matches the Johnson V band. Note that the August data do not for the most part show the short term fluctuations seen in the June 1991 data. There is, however, one small fluctuation at phase ~0.75 that corresponds to a similar fluctuation at the same phase in the June data.

We also modeled the data using the technique of Budding and Zeilik (1987) and the same stellar parameters as Zeilik *et al.* (1991). We find a different star spot solution. We have one spot with the optimized parameters: longitude=87$^{o}$, latitude=57$^{o}$, and radius=18$^{o}$ (Figure 2). This result compares with the June 1991 solution for two spots: longitude= 46$^{o}$ & 238$^{o}$, radius= 5.6$^{o}$ & 6.9$^{o}$ with the latitude fixed at 45$^{o}$. To ensure that we had no problems with a non-unique solution we attempted to fit the August data with the June solution. The attempt failed. We can therefore reliably conclude that CG Cyg changed its spots significantly during July 1991. The change of spots could have removed the small amplitude rapid fluctuations seen in June 1991; so in light of the spot changes the lack of fluctuations in August is not surprising.

We must also consider the possibility that these fluctuations are caused by variability in Yu's star (a) used by Zeilik *et al.* (1991) and Beckert *et al.* (1989, 1991) as the comparison star. To test this hypothesis we frequently observed star (a) using BD 34$^{o}$4216 as a comparison. In addition on August 5 we observed it for about 1.5 hours. We find star (a) varys roughly 0.04 mag over time scales of about an hour. We plot our data in Figure 3, and note that the 3 inserts expanding small portions of the horizontal axis are not to the same scale. It is tempting to assume that this variability of star (a) explains the short term fluctuations observed in CG Cyg. However, the June 1991 data show no evidence for such variability in star (a), and the maximum amplitude of the fluctuations is about double the 0.04 mag variations we observed in star (a). In addition Dapergolas *et al.*

CG Cygni August 1991

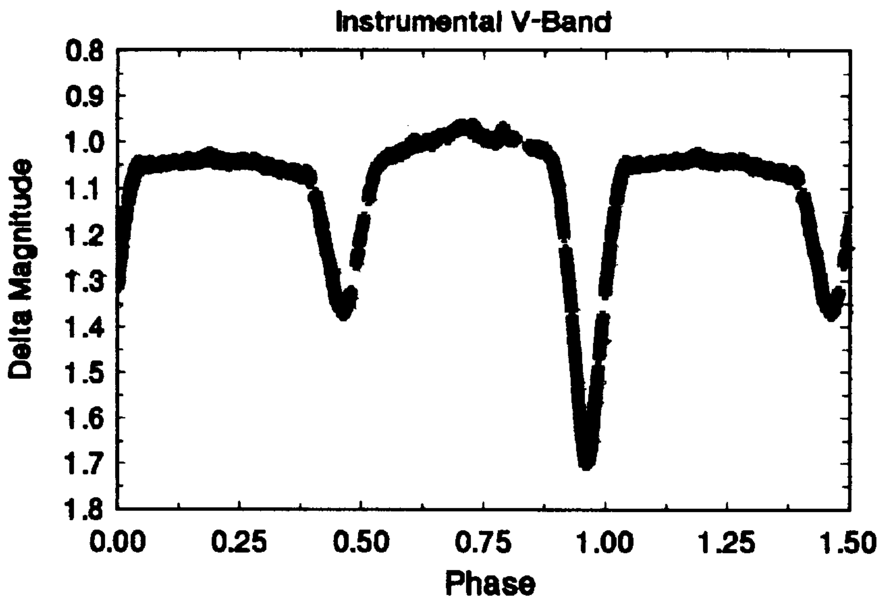


Figure 1

CG Cygni - 1 Spot Fit

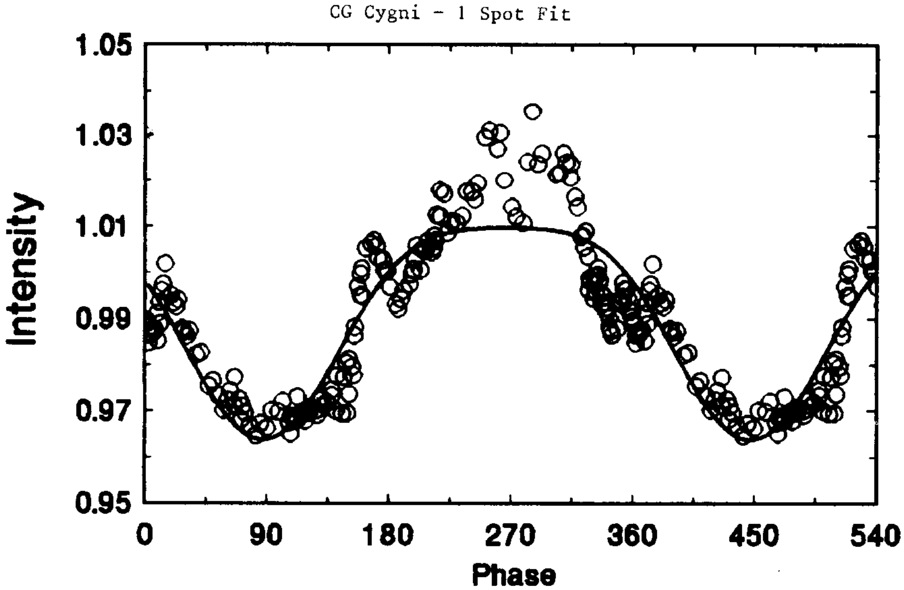


Figure 2

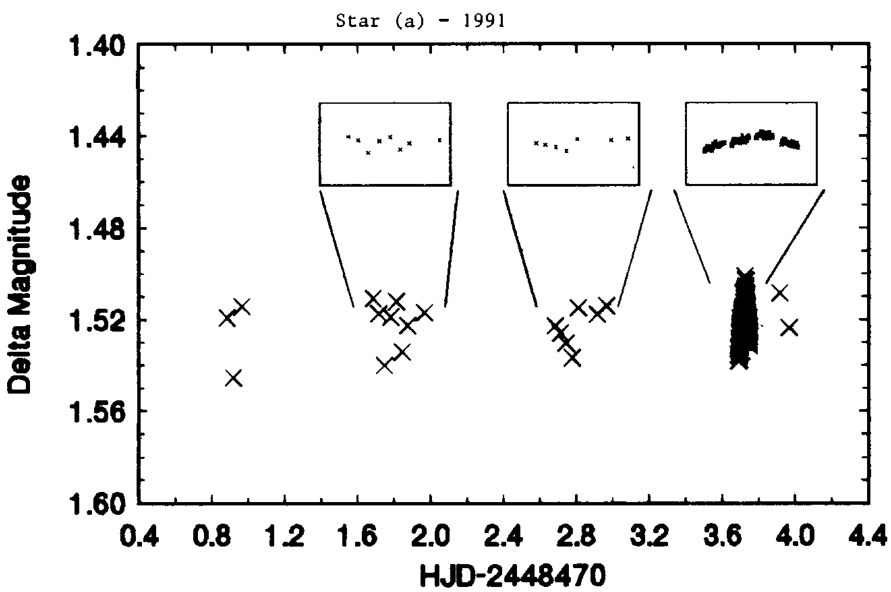


Figure 3

(1989, 1991) observed these fluctuations using BD 34°4216 rather than star (a) as a comparison.

The June 1991 CCD frames were reduced again using another star in the field as a check star. The data were considerably noisier because the check star was much fainter than either CG Cyg or star (a); however, to within the noise limits there appeared to be no systematic variations in star (a) (during June) sufficient to cause the observed fluctuations in CG Cyg. Perhaps star (a) has variable amplitude. In addition, these fluctuations do not appear during the eclipses for any of the light curves on which they appear as would be expected if they resulted from variations in star (a). The 1991 and 1989 data show fluctuations at the same phases, and the one fluctuation visible in the August 1991 data is at the same phase (~0.75) as one of the June 1991 fluctuations. This effect would be highly unlikely if the fluctuations were an effect of star (a), which would most likely have a different period. This likely period difference would also have smeared out the fluctuations in the June 1991 data, which were taken over a three week interval. Therefore, if the fluctuations were an artifact of star (a)'s variability, they would be unlikely to show up in the June 1991 data. Beckert *et al.* (1989 & 1991) give additional arguments for believing that these fluctuations arise from CG Cyg itself rather than from the comparison star (a). It therefore appears that the fluctuations observed in June 1991 are real rather than an effect of our observed variability in star (a). Additional investigations are needed to confirm the apparent variability in star (a) and to study the short term fluctuations in CG Cyg. With the current, data it appears that star (a) is variable but that this variability is insufficient to explain the observed rapid small amplitude fluctuations in CG Cyg.

If these short term fluctuations indeed arise from CG Cyg, we must consider the physical mechanism causing them. We note that they appear in June 1991 just before a major change in the spots on CG Cyg. Perhaps there is a physical connection. The short term fluctuations might be caused by small spots associated with either the breakup of the spots seen in June or the formation of the August spot. However, this hypothesis is unlikely because it does not easily explain the similarity in structure of the fluctuations for the 1989 and 1991 data or the depth of the fluctuations. Additional data are obviously needed to understand these short term out of eclipse fluctuations.

We would like to thank Ron Angione for scheduling generous amounts of telescope time at Mt Laguna. We acknowledge generous support from a Research Corporation grant to PAH and from a National Science Foundation grant AST-8901374 to MZ.

P.A. HECKERT
Dept. of Chemistry and Physics
Western Carolina University
Cullowhee, NC 28723
USA

M. ZEILIK
Institute for Astrophysics
University of New Mexico
Albuquerque, NM 87131
USA

References:

Beckert, D., Cox, D., Gordon, S. Ledlow, M., and Zeilik, M., 1989, *Inf. Bull. Var. Stars*, No. 3398.

Beckert, D., Gordon, S., Jaderlund, E., Mann, E., and Zeilik, M., 1991, *Inf. Bull. Var. Stars*, No. 3556.

Budding, E., and Zeilik, M., 1987, *Astrophys. J.*, 319, 827.

Dapergolas, A., Kontizas, E., and Kontizas, M., 1989, *Inf. Bull. Var. Stars*, No. 3322.

Dapergolas, A., Kontizas, E., and Kontizas, M., 1991, *Inf. Bull. Var. Stars*, No. 3609.

Strassmeier, K.G., Hall, D.S., Zeilik, M., Nelson, E., Eker, Z., and Fekel, F.C., 1988, *Astron. Astrophys. Suppl. Ser.*, 72, 291.

Yu, C.-S., 1923, *Astrophys. J.*, 58, 75.

Zeilik, M., Heckert, P., Ledlow, M., Rhodes, M., Summers, D.L., Jaderlund, E., and Boudreau, K. 1991, *Inf. Bull. Var. Stars*, No. 3663.