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CONFIRMATION OF PG 1510+234 AS A DWARF NOVA WITH A SHORT OUTBURST CYCLE LENGTH

PG 1510+234 was discovered as an ultraviolet excess object and was confirmed to be a cataclysmic variable by subsequent spectroscopy (Green et al. 1982, 1986). The identification of this object with a possible variable star NSV 06990 classified as RR: (Kukarkin et al., 1982) has been noticed by us by good positional coincidence and absence of a short-period variable star in this field (present study). The same identification was independently given by Downes and Shara (1993). However, the nature of the variability of this object remained unclear.

This object was again examined by spectroscopy by Ringwald (1993). He noticed strong broad Balmer emission lines at one time, and weaker at another time. Together with continuum variability on a time scale of days, he suggested this star to be a dwarf nova. Follow-up time-resolved photometry was undertaken by Misselt and Shafter (1995). They again reported strong nightly variation from their six-night observations. The orbital period has not been suggested from these studies.

Following these findings, we have started a long-term photometric coverage in order to reveal the nature of the strong variability. Most of the observations were done by Iida with a 16-cm reflector with an unfiltered ST−6 CCD camera. Additional V-band CCD observations were obtained by a 60-cm reflector at the Ouda Station, Kyoto University (for a detail of the instruments, see Ohtani et al., 1992). Total frames obtained by Iida and at the Ouda Station are 34 and 130, respectively, in the course of this coverage.

The frames at Ouda were first corrected for standard de-biasing and flat fielding, and were then processed by a microcomputer-based automatic-aperture photometry package developed by one of the authors (T.K.). The frames by Iida were processed following the same procedure by his microcomputer-based aperture photometry program. The magnitudes were determined relative to C_1 (Figure 1), and the estimated errors for a single measurement do not exceed 0.10 mag for Iida's observation and 0.04 mag for the Ouda data in the course of these observations. The results were combined to a single light curve after subtracting a systematic difference of 0.70 mag from Iida's data. Although this correction may introduce a small bias to the resultant light curve due to the different bandpasses, the effect is expected to be negligible in interpreting the long-term behavior of a suspected dwarf nova.

The resultant light curve is shown in Figure 2. The star showed two well-defined outbursts separated by nine days. The present photometric observations thus clearly demonstrate the dwarf nova nature of this cataclysmic variable. The recurrence time ($\sim$ 9 days) is one of the shortest known except some SU UMa-type dwarf novae. The range of variability determined from the Ouda data is $14\overset{\mathrm{m}}{.}8 - 17\overset{\mathrm{m}}{.}9$ in the V band. In addition, the light curve implies this variable has an extremely long duty cycle (larger than 0.5), which is larger than most well-observed dwarf novae except ER UMa stars (Kato, Kunjaya 1995, Nogami et al. 1995 and references therein).

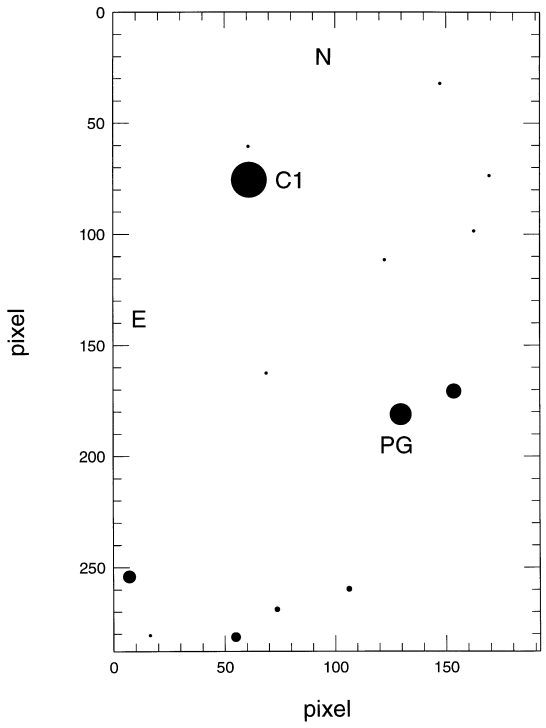

Figure 1. Field map of PG 1510+234. The field of view is about 6×9 arcmin. The variable (PG) and comparison (C_1) are marked.

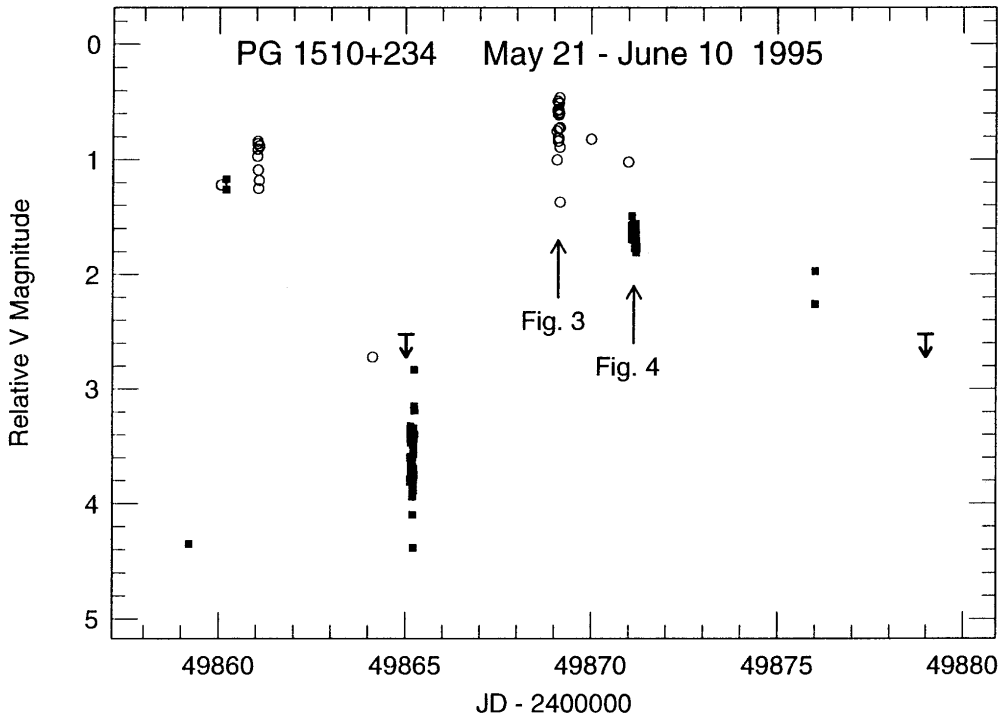

Figure 2. A general light curve constructed from all the CCD observations. Two well-defined outbursts occurred with a recurrence time of nine days. The small arrows indicate upper limits. Open circles and filled squares are points by Iida and Ouda, respectively.

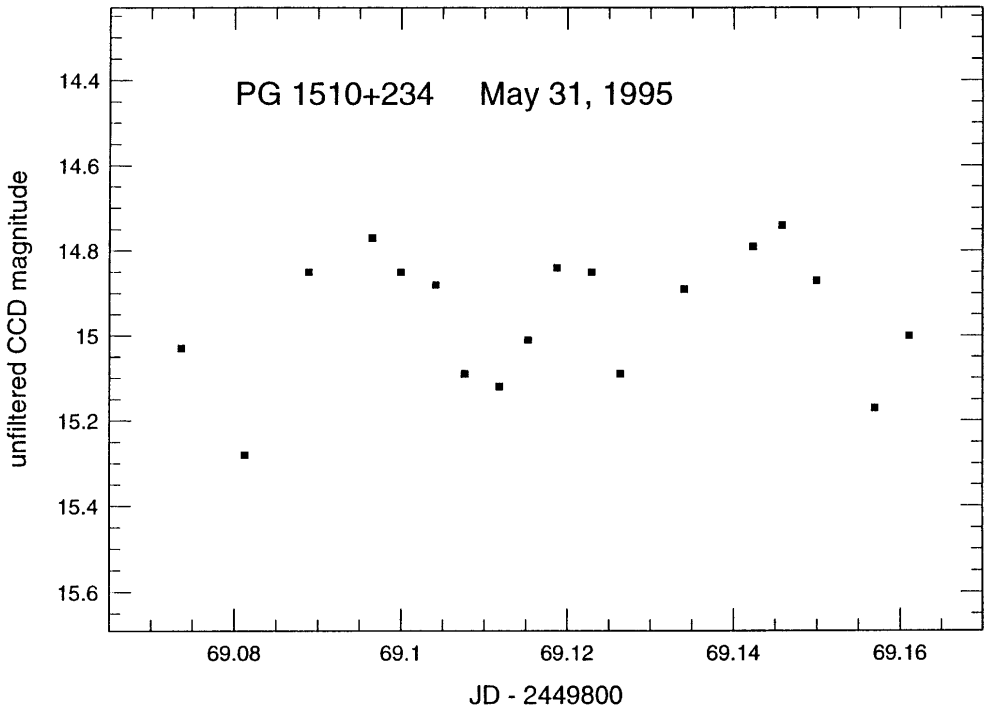

Figure 3. Time-resolved photometry by Iida on May 31. This observation at outburst maximum suggests a short-term variability with a time scale of $\sim$ 2 hours. The ordinate is the unfiltered CCD magnitude.

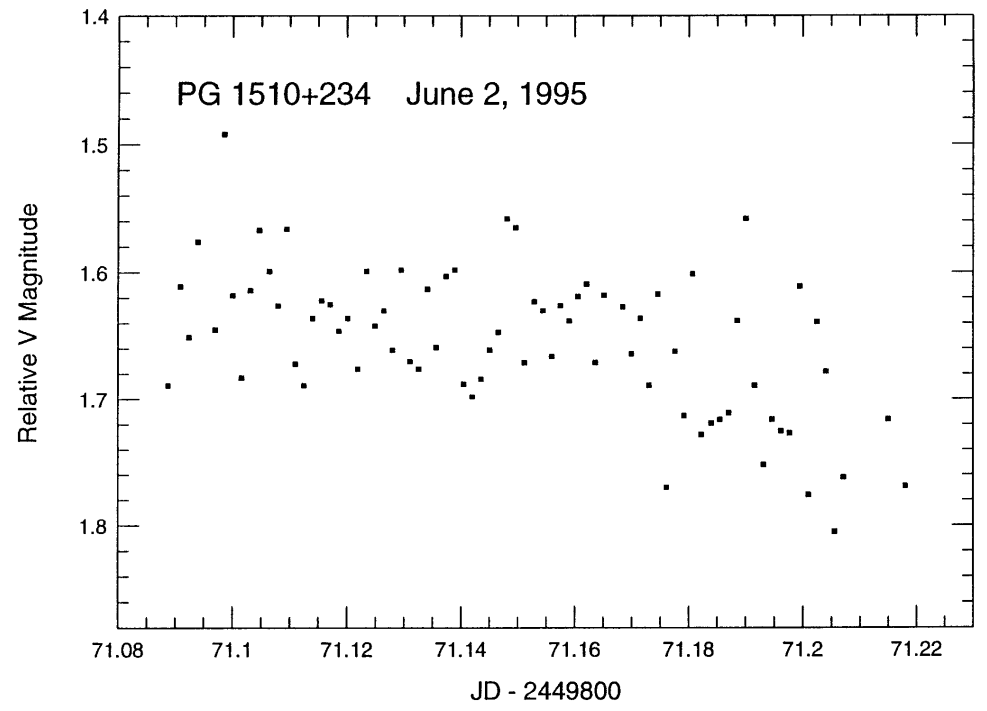

Figure 4. A short-term light curve at the Ouda Station on June 2. There is no evidence of periodic oscillations with an amplitude larger than expected error for a single measurement. Low altitude is responsible for the relatively large scatter in the last 0.04 day light curve.

Some time-resolved photometry was also undertaken during outbursts to search for any periodicity. The data by Iida taken on May 31 suggest a modulation with a time scale of $\sim$ 2 hours (Figure 3). This finding was not confirmed by the Ouda data taken on another occasion (Figure 4). Confirmation of short-term variation observed by Iida and interpretation of such a large duty cycle should await further observations.

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References:

Downes, R.A., Shara, M.M., 1993, *PASP*, **105**, 127

Green, F., Ferguson, D.H., Liebert J., Schmidt, M., 1982, *PASP*, **94**, 560

Green, R.F., Schmidt, M., Liebert, J., 1986, *ApJS*, **61**, 305

Kato, T., Kunjaya, C., 1995, *PASJ*, **47**, 163

Kukarkin, B.V., Kholopov, P.N., Artiukhina, N.M., Fedorovich, V.P., Frolov, M.S., Goranskij, V.P., Gorynya, N.A., Karitskaya, E.A., Kireeva, N.N., Kukarkina, N.P., Kurochkin, N.E., Medvedeva, G.I., Perova, N.B., Ponomareva, G.A., Samus, N.N., Shugarov, S.Yu., 1982, New Catalogue of Suspected Variable Stars, ed. P.N. Kholopov et al. (NAUKA MOSCOW)

Nogami, D., Kato, T., Masuda, S., Hirata, R., Matsumoto, K., Tanabe, K., Yokoo, T., 1995, submitted to PASJ letter

Misselt, K.A., Shafter, A.W., 1995, *AJ*, **109**, 1757

Ohtani, H., Uesugi, A., Tomita, Y., Yoshida, M., Kosugi, G., Noumaru, J., Araya, S., Ohta, K. et al., 1992, *Memoirs of the Faculty of Science, Kyoto University, Series A of Physics, Astrophysics, Geophysics and Chemistry*, **38**, 167

Ringwald, F.A., 1993, Ph. D. thesis, Dartmouth College