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OUTBURST PHOTOMETRY OF DX And

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DX And is a well-known dwarf nova with a long orbital period ($P = 0^{\rm d}.4405$, Bruch et al. 1997). DX And is also famous for its long outburst recurrence time (270–330 d, Simon 2000). Only few known cataclysmic variables (CVs) have similar characteristics. The best known among these CVs is the famous old nova GK Per, which at the same time shows dwarf nova-type outbursts. GK Per is also known as an intermediate polar (IP). The dwarf nova outbursts of GK Per is unique in that they show standstills during their rises (cf. Kim et al. 1992). Another noteworthy feature of GK Per is the presence of quasi-periodic oscillations (QPOs) with periods 2–30 min in outburst (Kato et al., in preparation). Since DX And has similar system and outburst parameters, we attempted to search for the possible existence of similar modulations during an outburst of DX And. The outburst we studied was the 1996 December one, whose initial rise was detected on December 10 by R. J. Modic at visual magnitude of 13.9. We undertook CCD observations starting on the next night.

The observations were done on eight nights between 1996 December 11 and 1997 January 3, using a CCD camera (Thomson TH 7882, 576×384 pixels, on-chip 2×2 binning adopted) attached to the Cassegrain focus of the 60-cm reflector (focal length = 4.8 m) at Ouda Station, Kyoto University (Ohtani et al. 1992). An interference filter was used which had been designed to reproduce the Johnson V band. The exposure time was 30–50 s depending on the brightness of the object. The frames were first corrected for standard de-biasing and flat fielding, and were then processed by a microcomputer-based aperture photometry package developed by one of the authors (TK). The magnitudes were determined relative to GSC 3242.510 ($V = 12.72$, $B - V = +0.47$), whose constancy was confirmed using GSC 3242.216 ($V = 13.33$, $B - V = +0.38$). The magnitudes are taken from Misselt (1996). A total of 355 useful frames were obtained. Barycentric corrections to observed times were applied before the following analysis. Table 1 lists the log of observations, together with nightly averaged magnitudes.

Figure 1 shows the light curve drawn from the data in Table 1. The decline from the maximum was quite linear, at a mean rate of 0.35 mag $\rm d^{-1}$. This value would be useful in further calibration of the Bailey's relation (cf. Szkody and Mattei 1984). On JD 2450438–2450439, we undertook a long time-series to search for possible QPOs. The exposure times were 30 s, yielding a net time resolution of 37 s. Figure 2 shows the enlarged light curve. The upper panel shows the raw observations. The lower panel shows averaged

Table 1: Nightly averaged magnitudes of DX And

start[a]	end[a]	mean mag[b]	error[c]	N[d]
50428.889	50428.892	0.637	0.008	5
50438.856	50439.006	0.296	0.002	330
50439.861	50439.862	0.597	0.013	3
50440.853	50440.854	1.037	0.058	3
50441.855	50441.856	1.419	0.049	3
50443.009	50443.010	1.796	0.059	3
50444.877	50444.879	2.356	0.024	5
50451.870	50451.872	2.289	0.020	3

[a] BJD − 2400000
[b] Magnitude relative to GSC 3242.510
[c] Standard error of nightly average
[d] Number of frames

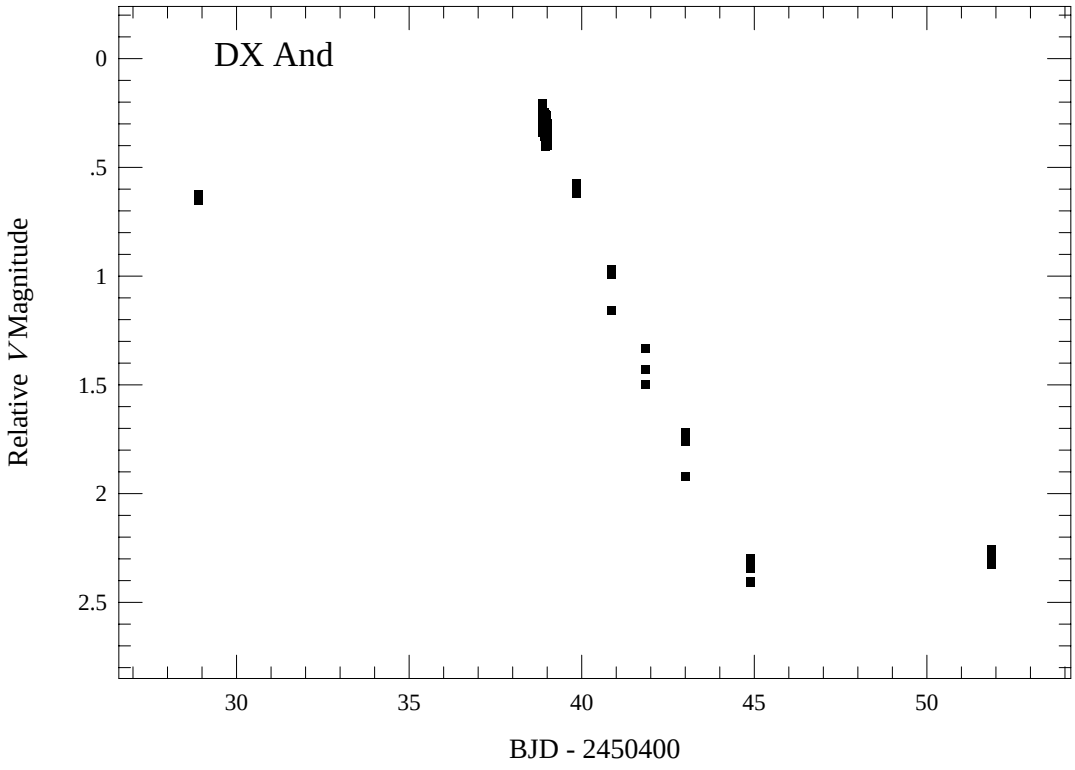

Figure 1. Light curve of the 1996 December outburst of DX And

observations in 0.008-d bins, after subtracting the linear decline. Except for slow, small-amplitude variations with a characteristic time-scale of $0^d.05$ (Figure 2, lower panel), no significant periodicity was found between $0^d.001$ and $0^d.1$. This observation excludes the presence of large-amplitude QPOs as seen in GK Per.

Both GK Per and DX And show slowly developing outbursts, likely explained by inside-out propagation of disk instability (Kim et al. 1992; Simon 2000). There may be a chance that unique features (e.g. QPOs) during outbursts of GK Per is reproduced in DX And, if the origin of such features is related to the outburst mechanism. The present observation, however, does not support this possibility, and suggests that the manner of development of disk instability may not be the major cause of QPOs during outbursts of GK Per. Alternately, the IP-nature may play a more important role in producing the QPOs in GK Per. The consequence of the IP-nature on the disk oscillations still needs to be investigated, both observationally and theoretically.

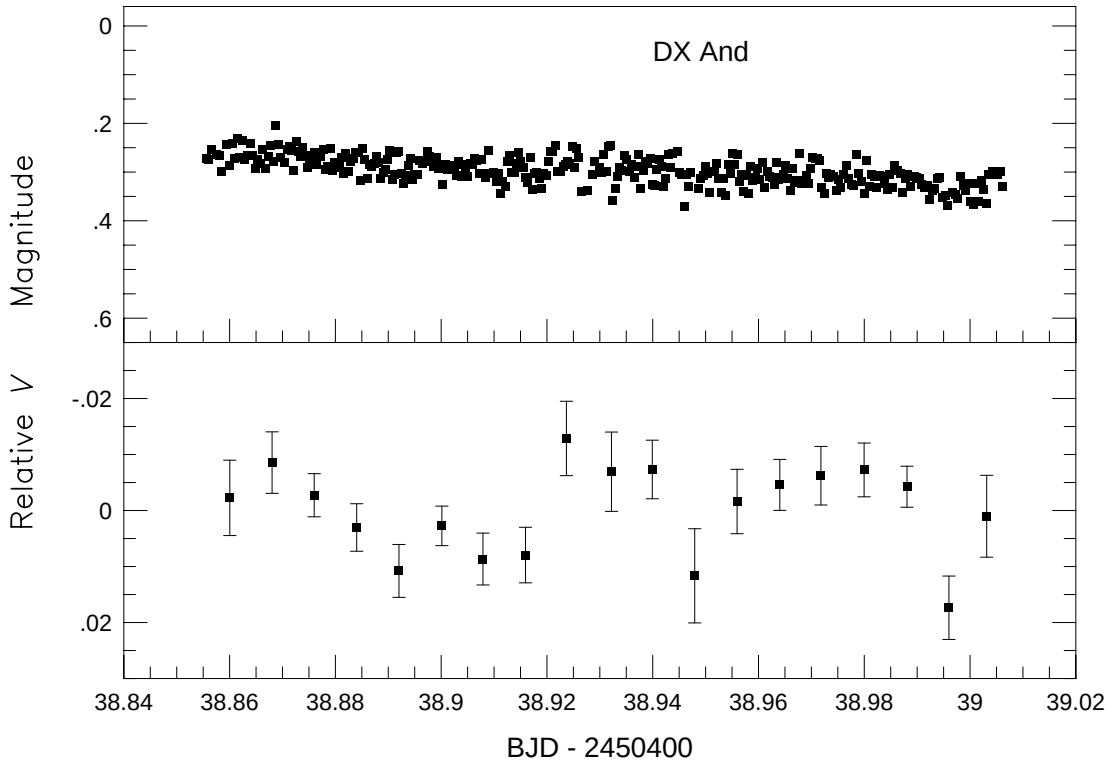

Figure 2. Enlarged light curve of DX And. The upper panel shows raw individual observations. The lower panel shows the averages and standard errors in 0.008-d bins, after subtracting the linear decline

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