LONG-TERM BEHAVIOR OF THE
ECLIPSING BINARY PX CEPHEI

PX Cep is an eclipsing binary whose variability was discovered by Romano (1958a, 1958b) and was given the preliminary name GR31 (Kholopov 1978). According to the GCVS its photographic magnitude varies between $12^{m}2$ and $13^{m}7$. The position of the variable is given as $21^{h}34^{m}54^{s}+ 65°36'00''$ (B1950.0), but at this location no star brighter than 15^{m} can be found, neither on the Sonneberg astrograph plates, nor in the POSS database[1] (see Figure 1).
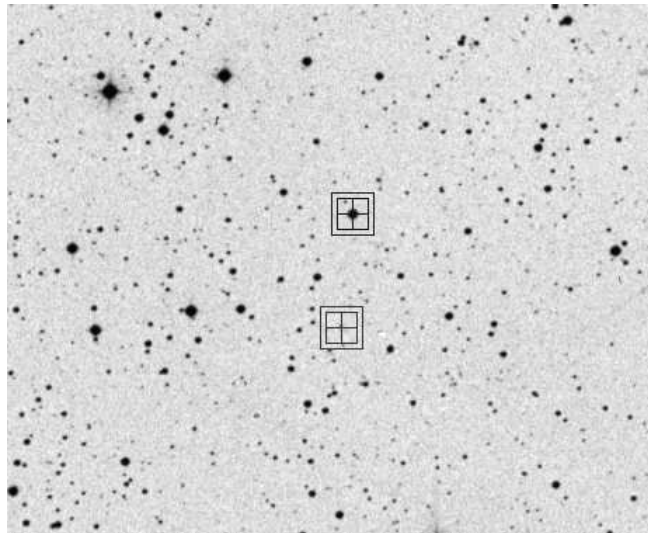

Figure 1. POSS section containing PX Cep (upper box) and its position as given in GCVS (lower box). The size of the field is approximately $13' \times 11'$. North at the top, East to the left.

Using the discoverer's finding chart, PX Cep was found at the coordinates

$$21^{h}34^{m}51^{s}8 \quad +65°38'14'' \quad (B1950.0)$$
$$\text{or} \quad 21^{h}35^{m}58^{s}1 \quad +65°51'43'' \quad (J2000.0), \quad \text{respectively,}$$

and is identical with GSC 4261_1335.

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[1] http://arch-http.hq.eso.org/cgi-bin/dss

In Table 1 we summarize the elements for PX Cep as given in the literature.

Table 1. Elements for PX Cep

epoch (HJD)	period (d)	mag	reference
2436098.33	unknown	12.2–13.7 (pg)	GCVS
2446270.440	3.126993	12.24–14.64 (V)	Boninsegna (1987)
2446680.402	3.126905	—	Borovička (1995)

Borovička (1995) collected all minima given in the literature. There is a large gap between 1959 and 1985, for which time interval no observations have been published so far. Borovička found an $O-C$, that suggested a changing period.

In an attempt to fill the gap in the data, PX Cep was measured on about 600 photographic plates from the Sonneberg plate collection, taken between 1957 and 1995. For the determination of the target's minima, Argelander's method was applied using the comparison stars as given by Romano (1958a, 1958b). On 48 plates PX Cep was found to be fainter than $13^{m}\!.0$ (see Table 2). As can be stated from inspection of the light curve published by Boninsegna (1987), the star reaches this magnitude approximately $0^{d}\!.1$ before minimum. Thus, any detection of the target to be fainter than $13^{m}\!.0$ provides the time of minimum within an accuracy of $0^{d}\!.1$, this is $\varphi = \pm 0.031$ (see dotted lines in Figure 2).

Table 2. Times of minima found on Sonneberg plates (HJD)

2436814.464	2439053.391	2441983.345	2446270.497
2436839.410	2439350.521	2442602.497	2446320.405
2437577.421	2439597.569	2442627.483	2446714.376
2438243.511	2439672.498	2443340.472	2448093.498
2438268.544	2440066.508	2444172.261	2448096.505
2438290.449	2440088.430	2444541.293	2448512.403
2438315.383	2440457.488	2444816.464	2448534.366
2438587.506	2440504.398	2444985.236	2448537.390
2438709.354	2440504.428	2445138.501	2448559.300
2438709.384	2440507.413	2445163.439	2448559.360
2438753.271	2441517.479	2445676.273	2449250.379
2439031.501	2441567.451	2445973.341	2449688.252

In order to obtain the period, all data points of the orbital light curve were analysed using the 'Analysis of Variance' algorithm adopted from Schwarzenberg-Czerny (1989). The epoch was derived from the resulting $O-C$ values. The following elements were obtained:

$$\text{Min} = \text{HJD } 2450163.486 + 3^{d}\!.126959 \times E$$
$$\pm 15 \qquad \pm 23$$

The $O-C$ curve for these elements is given in Figure 2. Our own data are in agreement with the assumption of a constant period within the accuracy of the measurement. The three $O-C$ values below the confidence interval were measured by Romano (1962). From the information provided in the literature it cannot be decided with certainty what the reason for these deviations might be. Two of these points obviously lie only on the shoulder
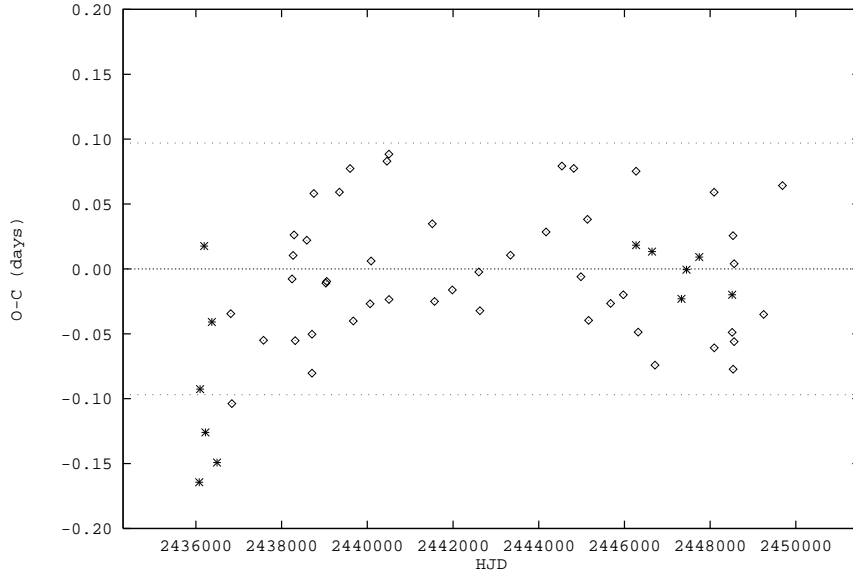
Figure 2. O−C for new elements. Minima found on Sonneberg plates are plotted with diamonds, star symbols are the times of minima as collected by Borovička (1995). The dotted lines mark the width of the light curve below $13^{m}\!.0$, as described in text.

of the minimum with magnitudes given as $12^{m}\!.8$ and $12^{m}\!.7$. The third one, $13^{m}\!.3$, cannot be explained assuming a constant period. Considering only the data collected by Borovička, a changing period is indeed suggested, but there is no convincing indication for that in the Sonneberg data.

Even if the individual error of one single intensity measurement derived from a photographic observation is quite large, the sheer number of our measurements and, moreover, the long time interval covered enable us to derive rather reliable elements, that can explain the behavior of PX Cep in the past 40 years within an accuracy of about $0^{d}\!.1$.

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