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PT ANDROMEDAE: THE RECENT OUTBURST AND EARLIER ONES

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The first report on the reappearance of PT And in 1998 came to Sternberg Astronomical Institute from Abastumani Observatory as an announcement of an outburst of a possible nova in the galaxy M31 (Samus 1998). Our late colleague A.S. Sharov (deceased 1999 Apr. 19) then immediately identified the new object with PT And. At first this star was known as the nova N15 in M31 (Grubissich & Rosino 1959). After discovery of its repeated outbursts Sharov & Alksnis (1989) suggested that N15 R15 is a foreground dwarf nova of SU UMa type, and the star was named PT And (Kazarovets & Samus 1990).

We studied the light curve of the outburst 1998 of PT And on plates taken for search and study of novae in the galaxy M31 at the Crimean Station of the Sternberg Astronomical Institute and at the Baldone Observatory of the Institute of Astronomy, University of Latvia (Sharov *et al.* 2000).

Comparison stars are identified on the finding chart (Fig. 1) and their B magnitudes are listed in Table 1. Estimates of B magnitudes for PT And are presented in Table 2 along with the times of the mid-exposure, and the light curve is shown in Fig. 2. Our observations did not catch the brightness rise, they show only that this phase of the light curve was shorter than seven days. The shape of the light decline of the 1998 outburst is very similar to those observed in 1957 (Grubissich & Rosino 1959) and in 1986 (Sharov & Alksnis 1989), at least down to $B = 18^{\rm m}$.

The values $\log(100d)$ of the rate of light decline, usually used for description of novae, in the case of PT And are very similar to each other, namely, 0.98, 0.95, and 1.05 for the outbursts of the years 1957, 1986, and 1998, respectively. Therefore, these three light declines are fitted with one combined light curve in Fig. 2, using time shifts T indicated in the upper right corner. With these rates of brightness decline, which correspond to the fast novae, and with the maximum brightness of about $B = 16\overset{\rm m}{.}3$, PT And fits well in the relationship between the magnitude at maximum and the decline rate for novae in M31, demonstrated by Sharov *et al.* (1998).

Even scarcely observed outbursts of the years 1983 and 1988 might be fitted rather well to the combined light curve of the three well-observed outbursts. It turned out that a mistake of 30 days in Julian date (2445698 instead of the right value 2445668) for the observed maximum light ($B = 17\overset{\rm m}{.}2$) of the 1983 outburst had led to a wrong interpretation of the light curve (Sharov & Alksnis 1989). Therefore in Table 2 we repeat brightness estimates of the outburst of PT And in 1983, corrected and slightly supplemented. Further, the only two, and equal, magnitude estimates obtained during the 1988 outburst

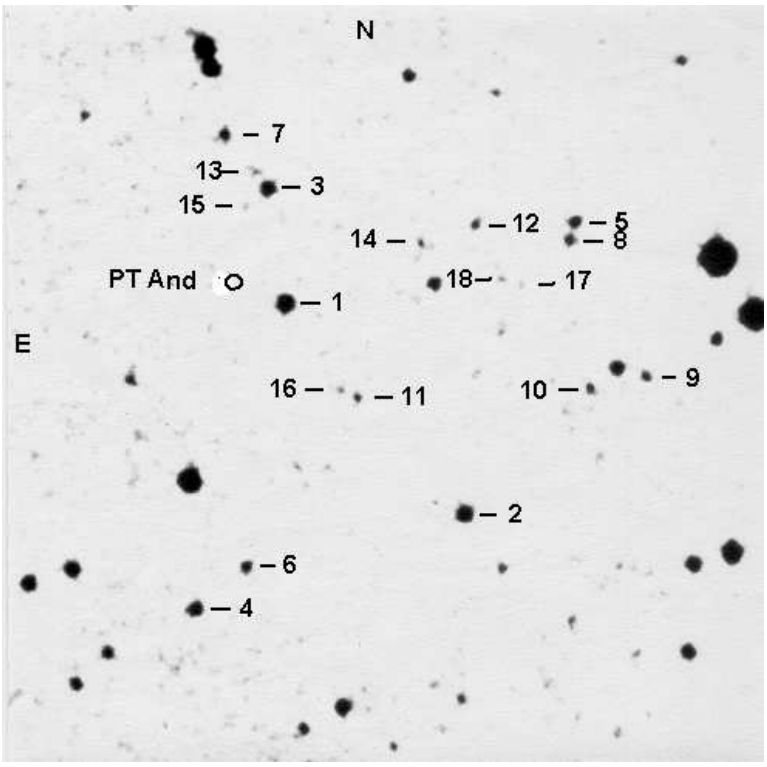

Figure 1. Finding chart for PT And and comparison stars

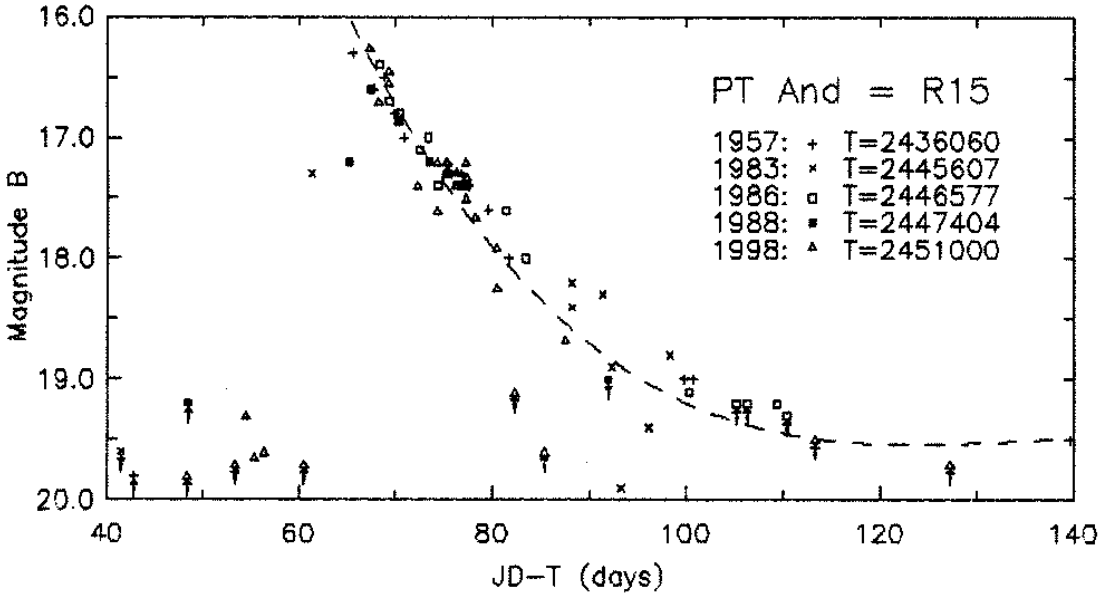

Figure 2. The light curve for five outbursts of PT And

Table 1: B magnitudes for comparison stars of PT And

Star No	B (mag)	Star No	B (mag)	Star No	B (mag)
1	16.16	7	18.5	13	19.4
2	16.44	8	18.6	14	19.4
3	17.16	9	18.7	15	19.6
4	17.44	10	18.8	16	19.7
5	17.77	11	18.9	17	19.7
6	18.0	12	19.2	18	19.7

Table 2: PT And brightness estimates for 1983 and 1998 outbursts

JD	B	JD	B	JD	B	JD	B
2400000 +	mag	2400000 +	mag	2400000 +	mag	2400000+	mag
45648.438	(19.6	51048.365	(19.8	51070.361	16.9	51076.353	17.3
45668.397	17.3	51053.375	(19.6	51072.288	17.4	51077.296	17.5
45695.185	18.4	51054.526	19.3	51074.302	17.2	51077.322	17.2
45695.235	18.2	51055.396	19.6	51074.337	17.6	51078.304	17.7
45698.396	18.2	51056.427	(19.6	51075.270	17.2	51080.478	17.9
45699.315	18.9	51060.532	(19.7	51075.313	17.3	51080.508	18.2
45700.273	19.9::	51067.289	16.2	51075.342	17.3	51082.317	(19.1
45703 181	19.4	51068.265	16.7	51075.391	17.2	51085.365	(19.6
45703.226	19.4	51069.269	16.6	51076.270	17.4	51087.507	18.7
45705.340	18.8	51069.310	16.4	51076.308	17.4	51113.293	(19.5
		51070.333	16.9	51076.311	17.3	51127.215	(19.7

might be considered as a pre-maximum observation and a post-maximum one. Thus, in Fig. 2 all brightness estimates of PT And made during the five outbursts mentioned are plotted.

According to the photometric properties discussed, PT And seems to be the best candidate for a recurrent nova in M31. The only other one candidate, although questioned by Sharov and Alksnis (1989), is the Nova R48 = R79, observed in outburst twice (Rosino 1973). Objections against the interpretation of PT And as a recurrent nova in M31 could be the two shortest (less than three years) time intervals between successive outbursts. For galactic recurrent novae they are usually tens of years and the shortest one observed has been nine years.

The decline rate (0.09 mag/d–0.11 mag/d at different outbursts) for PT And corresponds to that (0.11 mag/d) of the "plateau" phase of super-outbursts of SU UMa stars (Nogami *et al.* 1997). Contrary to the rapid decline (about 1 mag/d) phase, which typically follows the "plateau" phase of SU UMa stars, for PT And we observe reduced decline rate at later phase, as usual for novae. Neither have we detected normal outbursts, which would have been $0\overset{m}{.}5$–2^m fainter than super-outbursts, and would have recurred more frequently. Thus it seems unlikely that PT And belongs to SU UMa stars or other known subtypes of dwarf novae.

At its low state, PT And is beyond detection limit of our plates, $19\overset{m}{.}0$–$20\overset{m}{.}0$ on average, thus the amplitude of the brightness variation exceeds 3-4 mag. In few cases, not connected to the observed outbursts, an image of the star was noticed, however, un-

certainly and at the detection limit (Table 2 in Sharov & Alksnis 1989). We can add some other faint detections: JD 2442995.457 $19\overset{m}{.}6$:, 2449978.356 20^m:, 2449979.384 $20\overset{m}{.}5$:, 2449980.422 20^m:. These estimates may correspond either to faint outbursts or to brighter phases of the low state of the star. Remarkable is the detection of the star slightly above plate limit 12-13 days before the observed maximum in 1998. It reminds us of premaximum halt of novae.

More observations are needed to judge on the nature of this star: whether it is an unusual recurrent nova in M31 or a specimen of a variety of dwarf novae in the Galaxy.

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