

INVESTIGATION OF THE OPTICAL VARIABILITY OF RELATIVISTIC OBJECTS WITH HIGH TIME RESOLUTION

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1. Detection of nonthermal optical flares in low mass X-ray binaries. Eleven low-mass X-ray binaries have been observed with the MANIA (Multichannel Analysis of Nanoseconds Intensity Alteration) complex; X0420+32, A0620-00, X1728-169, X1813-14, X1957+11 in 1986 at the 6 m telescope of SAO [7], and 2S0921-630, 4U1543-475, 4U1636-536, 4U1559-487, MXB1735-44, 4U1822-371 in 1991 at the 2.15 m telescope of CASLEO (Argentina) [1]. Analysis of the data using the special y_2 and d_2 function formalism [4], [6] has shown no brightness variations on time-scales of $10^{-7} \dots 10$ s for all objects except A0620-00 and MXB1735-44.

A0620-00. The five millisecond flashes were detected on 1986 February 13 (Fig. 1). The first two flares have durations of 3 ms and 5 ms and their rise times were 1...2 ms. The other three events lasted 0.4...0.5 ms with rise times of about 0.1 ms. The lower limit of the flare amplitudes is 40 counts ms^{-1} and the corresponding brightness temperatures are $5 \cdot 10^9$ K

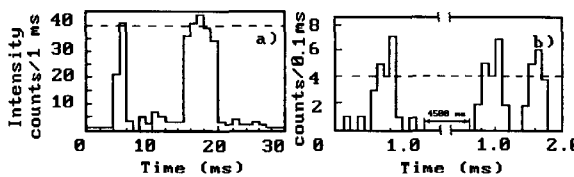


Figure 1. The ultrashort flares of A0620-00 on 1986 February 13, taken in white light with aperture 4.3 arcsec and seeing 1.5 arcsec; the dashed line marks the level of maximum intensity corresponding to the limiting transfer rate into the computer.

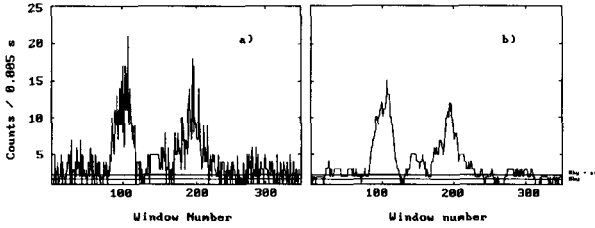


Figure 2. The white light curves (taken with aperture - 12 arcsec) of two flares of MXB1735–44. (a) Initial light curve, (b) smoothed light curve.

for the first two and $5 \cdot 10^{11}$ K for the others.

MXB1735–44. Two flares with duration of about 0.25 s were detected on 1991 May 9 (Fig. 2). The rise times of these flares are 110 ms and 120 ms (about 60 ms at the most steep parts) and their relative amplitudes are 32 and 17. The corresponding brightness temperatures are from $4 \cdot 10^7$ to $2 \cdot 10^8$ K. In order to study the fine structure of these events the detailed light curve, $I(t)$, was analyzed using the ‘splash method’ [1]. This method showed that both flares have fine structure on time-scales of 5...10 ms (Fig. 2a). The lower limit on the brightness temperatures of the fine structure is $2 \cdot 10^{10}$ K. We found a distance $D \approx 1$ kpc, $B \approx 19.3$ mag, $A_v \approx 1.2$ mag for A0620–00 [7] and $D \approx 7$ kpc, $B \approx 17.2$ mag, $A_v \approx 0.8$ mag for MXB1735–44 [1]. Thus, the brightness temperatures of the A0620–00 and MXB1735–44 flares ($10^8 \dots 10^{11}$ K) contradict a thermal mechanism for their generation and support a nonthermal model.

2. A search for optical pulses of the 6.1 ms binary radio pulsar PSR 1953+290. The observations of the 6.1–ms radio pulsar PSR 1953+290 [2] were carried out in 1992 at the 6 m telescope with a CCD photometer to identify the optical counterpart of the source using its radio position and the MANIA complex (white light with 7 arcsec diaphragm) to search for optical pulses. No optical pulses or any stochastic variability [5] have been detected. The upper limit for brightness in the B -band is 26.5 mag with a significance level $< 3\%$. By comparing the upper limit of the pulsar optical luminosity (taking into account the distance [2]) with the Crab pulsar luminosity gives us an upper limit for the magnetic field of $B \approx 10^8$ G.

References

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