NGC 253 X-17: The first eclipsing X-ray binary outside the Local Group

We have discovered the first eclipsing X-ray binary outside the Local Group of galaxies. We used data from the XMM-Newton, Chandra, ROSAT and Einstein satellites to determine candidate orbital periods, time variability and X-ray spectrum.

Before the advent of the X-ray observatories XMM-Newton and *Chandra* the most distant eclipsing X-ray binary (XRB) known was source X-7 in the Local Group galaxy M 33 (distance 795 kpc) with an orbital period of 3.45 days (see Dubus et al. 1999, Pietsch et al. 2004). Already Fabbiano & Trinchieri (1984) detected with the *Einstein* observatory a source in the starburst galaxy NGC 253 in the Sculptor Group (distance 2.58 Mpc) that was found to be time variable during ROSAT observations (source X-17 in Vogler & Pietsch 1999). Twice, during an XMM-Newton EPIC observation in December 2000 (Figs. 1 and 2) and also during a *Chandra* observation one year earlier, this source, RX J004717.4-251811, was found to undergo changes from a low to a high state. The transitions are interpreted as egresses from eclipses of a compact

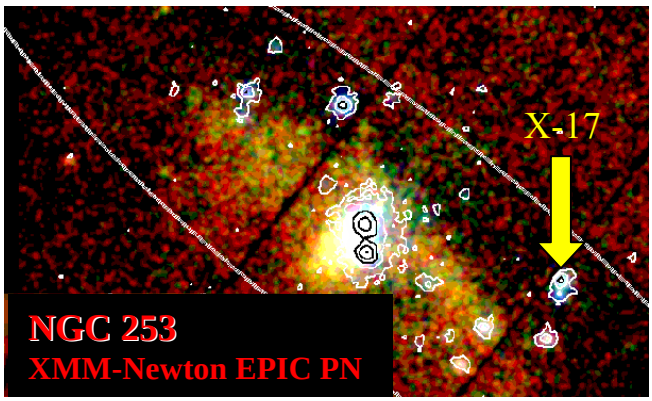

Fig. 1: *EPIC PN image of NGC 253. The eclipsing X-ray binary X-17 is the brighter source in the pair marked by an arrow.*

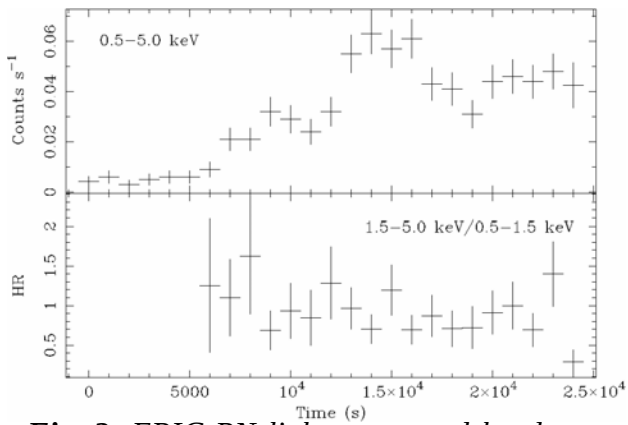

Fig. 2: *EPIC PN light curve and hardness ratio of X-17 on Dec 13/14, 2000, showing a transition from low to high state.*

object in a high mass XRB system. The binary period is determined to $P = (352.870 \pm 0.012)\mathrm{d}/n$ by the time difference between the two egresses and number n of periods in-between. Allowed periods can be further constrained by additional XMM-Newton, *Chandra,* ROSAT, and *Einstein* observations resulting in only seven acceptable periods with 1.47024 d and 3.20793 d most promising. No significant regular pulsations of the source in the range 0.3-1000 s were found. Fluctuations on time scales of 1000 s were observed together with extended intervals of low intensity. The energy spectrum during the bright state can be described by an absorbed flat power law (N_H=1.9 10^{21} cm^{-2}, Γ = 1.7). In the bright state, the source luminosity is 4 10^{38} erg s^{-1} in the (0.5-5) keV band, just compatible with the Eddington luminosity of a 1.4 M_{sun} neutron star.

References:
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