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THE NEW X-RAY PULSAR J1802.7–2017 OBSERVED BY BEPPOSAX

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We report on the serendipitous discovery of a new X-ray source, SAX J1802.7–2017, $\sim 22'$ away from the bright X-ray source GX 9+1, during a BeppoSAX observation of the latter source on 2001 September 16-20.

The source was outside the FOV of the BeppoSAX/LECS. We have verified its presence in both the MECS2 and MECS3 images, which probably excludes that this was a ghost image of a source outside the MECS FOV. Moreover, we can be sure that the source was within the PDS FOV, because the source X-ray pulsations were detected also in the PDS data (see below). We searched for known X-ray sources in a circular region of $30'$ centered at GX 9+1 in the SIMBAD data base. We found no known sources with a position compatible with that of the faint source; we therefore designate this serendipitous source as SAX J1802.7–2017.

To study possible delays in the pulse arrival times, or, equivalently, pulse period variations we divided the whole data set into 35 consecutive intervals each having a length of about 10 ks. We found that only 27 of these intervals had enough statistics to carry out the analysis described below. A folding search was performed in each interval for a range of trial periods centered around the 139 s. The corresponding best periods were obtained by fitting the χ^2 versus trial period curve with a Gaussian function. The best periods varied significantly and with continuity between 139.44 s and 139.86 s with an average value of 139.608 s. We checked whether the modulation of the phase delays could be explained by the propagation delays due to the orbital motion of the X-ray pulsar around a companion star by fitting the phases with

$$\Delta\phi = a_0 + a_1\, t_n + B \cos\left[\frac{2\pi(t_n - T_{\pi/2})}{P_{orb}}\right]. \qquad (1)$$

The results of the fit are reported in Table 1. The χ^2_{red} was 1.3 confirming our hypothesis.

TABLE 1

ORBITAL PARAMETERS OF SAX J1802.7–2017. ERRORS ARE AT 1 σ CONFIDENCE LEVEL.

Parameter	Value
a_0	$0.04^{+0.12}_{-0.09}$
a_1	0.02 ± 0.03 days^{-1}
B	$0.50^{+0.07}_{-0.05}$
P_{orb}	$4.6^{+0.4}_{-0.3}$ days
$a_x \sin i$	70^{+10}_{-7} lt-s
$T_{\pi/2}$	$52168.22^{+0.10}_{-0.12}$ MJD
P_{pulse}	$139.612^{+0.006}_{-0.007}$ s

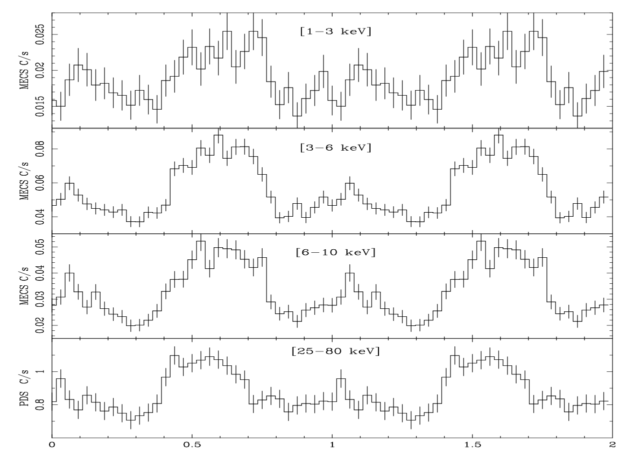

Fig. 1. Folded lightcurves in four different energy bands. From the top to the bottom: 1–3 keV, 3–6 keV, 6–10 keV (MECS), 25–80 keV (PDS). The folding is obtained for a pulse period of 139.612 s and the zero epoch was assumed at the superior conjunction $T_{\pi/2} = 52168.22$ MJD.

Using the estimated pulse period we folded the MECS lightcurves in the energy bands 1–3 keV, 3–6 keV and 6–10 keV, and the PDS lightcurves in the energy band 25–80 keV. The main pulse of the modulation presents a peak around phase 0.6. A secondary peak is visible around phase 0.1, which appears to be more prominent at higher energies (see Fig. 1). Our data are compatible with a circular orbit, although an eccentricity could be present but not appreciated because of the relatively low statistics of our data.

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