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XMM-NEWTON VIEW OF THE ECLIPSING BURSTER LOW-MASS X-RAY BINARY AX J1745.6-2901

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Abstract. From March 31 to April 4, 2007, three XMM-Newton observations were performed to monitor the X-ray activity of Sgr A* and its neighboring X-ray transient sources. Two X-ray transient sources in outburst were detected during this multi-wavelength observation campaign. We focus here on the transient source in outburst located at about 1.5′ South-West from Sgr A*, which exhibited deep eclipses and type-I X-ray bursts. We identify this source with the eclipsing burster low-mass X-ray binary discovered by ASCA, AX J1745.6-2901. These XMM-Newton observations allow us to refine the period of the eclipse and the position of AX J1745.6-2901. Finally, we observed with XMM-Newton several dips from AX J1745.6-2901, which is the first dipper of the Galactic center region.

1 Introduction

From March 31 to April 4, 2007, three XMM-Newton observations were performed to monitor the X-ray activity of Sgr A* and its neighboring X-ray transient sources (Porquet et al. 2008). Two X-ray transient sources in outburst were detected during this multi-wavelength observation campaign (Porquet et al. 2007).

2 Astrometry

The X-ray transient source in outburst located at about 1.5′ South-West from Sgr A* is inside the 6″-radius error box of Swift J174535.5-290135.6, which was detected by the Swift X-Ray Telescope in late February 2006 (Kennea et al. 2006), and simultaneously detected with JEM-X aboard INTEGRAL (Chenevez et al. 2006). In the three observations, the error box of the XMM-Newton source encloses the 0.2″-radius error box of the Chandra source CXOGC J174535.6-290133 (Muno et al. 2003). A renewed activity of Swift J174535.5-290135.6 has been reported by Swift and INTEGRAL on mid-February 2007 (Kuulkers et al. 2007; Wijnands et al. 2007). Therefore, these XMM-Newton observations indicate an outburst duration of at least 7 weeks for this X-ray transient.

The ASCA source AX J1745.6-2901 (hereafter AX), with an estimated positional uncertainty of 24″ in radius, is located at 36″ of the XMM-Newton source. AX is an eclipsing X ray burster with an eclipse period of 8.356±0.008 h (Maeda et al. 1996).

3 X-ray light curves

Figure 1 shows the X-ray light curves obtained in the 2–10 keV energy range with the EPIC pn spectro-imager. We observed seven deep eclipses –with a period consistent with the period of AX– as well as four type-I X-ray bursts. Type-I X-ray burst are thermonuclear flashes of the matter accreted on the surface of a weakly magnetized neutron star (Joss 1977, 1978). Therefore, we identify this XMM-Newton source with the eclipsing X-ray burster AX. Several dips are also observed before the eclipses. Dipping phenomena and eclipses are present together when the X-ray binary is viewed under an elevated inclination ($\sim 75° - \sim 80°$), i.e., close to an edge-on view (Frank et al. 1987). In this viewing configuration, at each orbital rotation, the bulge of the accretion disk passes in front of the compact object, followed by the low-mass donor star, causing first dips and then an eclipse in the X-ray light curve.

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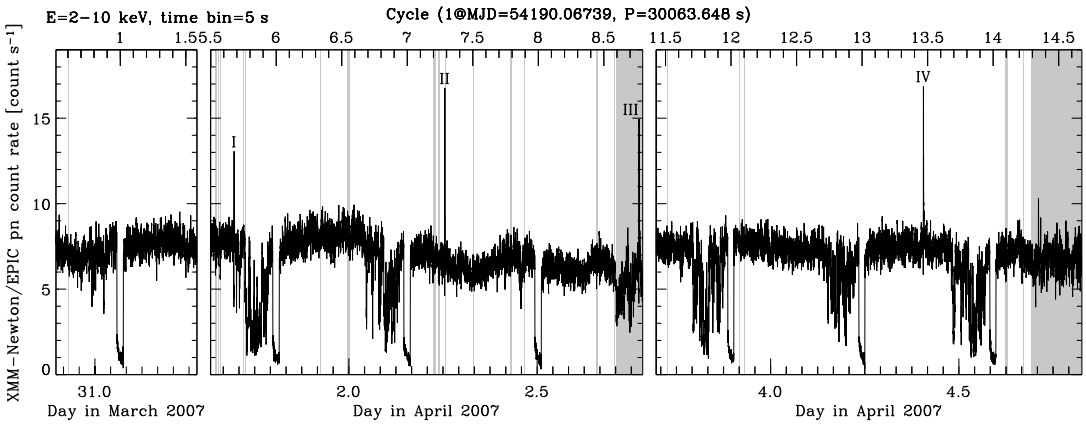

Fig. 1. EPIC pn X-ray light curve of AX J1745.6-290. The grey vertical stripes indicate the time intervals of high flaring-background where the scientific mode was switched off. Type-I X-ray bursts are labelled with Roman numbers.

4 Orbital period

We evaluate using a light curve folding method an orbital period of 30063.8 s with a 90% confidence error of 0.5 s. This level of accuracy allows us to track back the eclipse phase down to the epoch of the first observation of the X-ray eclipse with ASCA in 1994 (Maeda et al. 1996). We find that it corresponds to cycle -13161, which helps us to refine the orbital period to: 30063.648 s (i.e., 8.351013 h) with an uncertainty of 0.004 s. Our improved linear ephemeris of the eclipse allows us to identify an unnoticed egress in a short Chandra observation of CXOGC J174535.6-290133 in June 2006. Therefore, we unambiguously identify the Chandra source with the ASCA source.

5 Summary

We have unambiguously identified AX with CXOGC J174535.6-290133 (Porquet et al. 2007), which provides a better determination of the position of this low-mass X-ray binary for multi-wavelength follow-up observations. We have also improved the accuracy of the orbital period, and the linear ephemeris of the eclipse center.

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