We report the detection of pulsations at 552 Hz in the rising phase of two type-I (thermonuclear) X-ray bursts observed from the accreting neutron star EXO 0748-676 in 2007 January and December, by the Rossi X-ray Timing Explorer. The fractional amplitude was 15% (rms). The dynamic power density spectrum for each burst revealed an increase in frequency of 1-2 Hz while the oscillation was present. The frequency drift, the high significance of the detections and the almost identical signal frequencies measured in two bursts separated by 11 months, confirms this signal as a burst oscillation similar to those found in 13 other sources to date. We thus conclude that the spin frequency in EXO 0748-676 is within a few Hz of 552 Hz, rather than 45 Hz as was suggested from an earlier signal detection. Consequently, Doppler broadening must significantly affect spectral features arising from the neutron star surface, so that the narrow absorption features previously reported from an XMM-Newton spectrum could not have arisen there. The origin of both the previously reported 45 Hz oscillation and the X-ray absorption lines is now uncertain.

A well-studied burst source

Few thermonuclear burst sources have been as intensively observed as EXO 0748-676. The source exhibits X-ray dips or eclipses at the 3.82 hr orbit, indicating high inclination. Frequent bursting activity is generally observed, despite an atypically small inferred accretion rate. Short-recurrence burst “doubles” and “triples” are frequently seen; the details of the mechanism for these events remains unknown. Perhaps most excitingly, a summed XMM-Newton burst spectrum exhibited narrow absorption line features, which were attributed to highly-ionised Fe at the neutron star surface (Cottam et al. 2002). This identification led to a measurement of the surface redshift, of $z = 0.35$.

An unusually slow rotator?

The XMM-Newton lines were narrow, such that – had they arisen from the neutron star surface – the spin in EXO 0748-676 must be much slower than the 200–600 Hz typical for other accreting neutron stars. Support for this hypothesis came in the form of a weak 45 Hz pulsation detected in the summed Fourier power spectra of 38 bursts (Villarreal & Strohmayer, 2004). However, subsequent observations did not detect the absorption lines (Cottam et al. 2008)

No: another burst oscillation!

The Fourier power spectra of two bursts observed by RXTE during 2007 revealed evidence for significant excess power at 552 Hz (Figure 1). The high signal power in each burst, as well as the similar signal frequencies (in two bursts separated by 11 months) confirms the detection, with a formal estimated significance of at least $10^{-11}$, equivalent to 6.3σ. A dynamic power density spectra of each burst reveals a slight increase in the signal frequency, similar to that observed in most other burst oscillation sources (Figure 2). This oscillation is however remarkably infrequent, detected strongly in only two of 157 bursts observed by RXTE from this source! This detection strongly suggests the spin in EXO 0748-676 is close to 552 Hz, rather than 45 Hz, as was previously thought.

References