Searching for tidal disruption events at an unexplored wavelength

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3XMM-DR7

Abstract

When a star approaches too close to a black hole, the star can be torn apart by the gravitational forces and approximately half the matter falls towards the black hole, causing the luminosity to increase by several orders of magnitude. Such an event is known as a tidal disruption event (TDE). These events can help us locate black holes which would be otherwise too faint to be detected and help us understand the mass function of these objects.

To date only a small sample of candidate TDEs have been detected (~70*), either in the optical or in soft X-rays. However, four TDEs have been observed with hard X-ray spectra (Bloom et al. 2011, Burrows et al. 2011, Cenko et al. 2012, Brown et al. 2015, Saxton et al. 2017). In order to determine if these hard TDEs are the result of a different mechanism to those detected at lower energy, we search for similar events in the 3XMM catalogue. Using spectral and timing characteristics determined from the hard TDEs and cross-correlating 3XMM with other catalogues, we have developed a methodology with which to identify new hard TDEs. In this poster we describe the characteristics used to search for previously undiscovered hard TDEs and present the results of this search and the resulting constraints on the central mechanism in TDEs.

Method

Two samples were formed from the 3XMM-DR7 catalogue using two different sets of constraints :

1. First sample :

- Undetected by ROSAT and at least one XMM detection above 10^{-13} erg.s^{-1}.cm^{-2} (0.2 – 2.0 keV, corresponding to ROSAT upper-limit)
- Consistent with the centre of a galaxy (identified with SDSS)
- Constraints on the hardness ratios derived from the study of previously discovered hard TDEs

2. Second sample :

- Sources outside of the galactic plane
- Multiple detections
- At least one detection with a flux> 10^{-13} erg.s^{-1}.cm^{-2} (2.0 – 12 keV)
- Flux variation of the source > 20 (2.0 – 12 keV)

Manual screening of the source candidates was performed as well as spectral fitting using XSPEC.

Results

1. First sample : 91 unique sources

➔ A lot of AGNs and X-ray binaries were identified in the first sample, highlighting the similarities between TDEs and these objects in the hard X-ray band.

2. Second sample : 469 unique sources

➔ 212 sources already identified as other objects using multi-wavelength observations.

4 possible hard TDE candidates have been found

(See Figure 1 and Figure 2)

This research has made use of data obtained from the 3XMM XMM-Newton serendipitous source catalogue compiled by the 10 institutes of the XMM-Newton Survey Science Centre selected by ESA.

http://xmmssc.irap.omp.eu/Catalogue/3XMM-DR7/3XMM_DR7.html

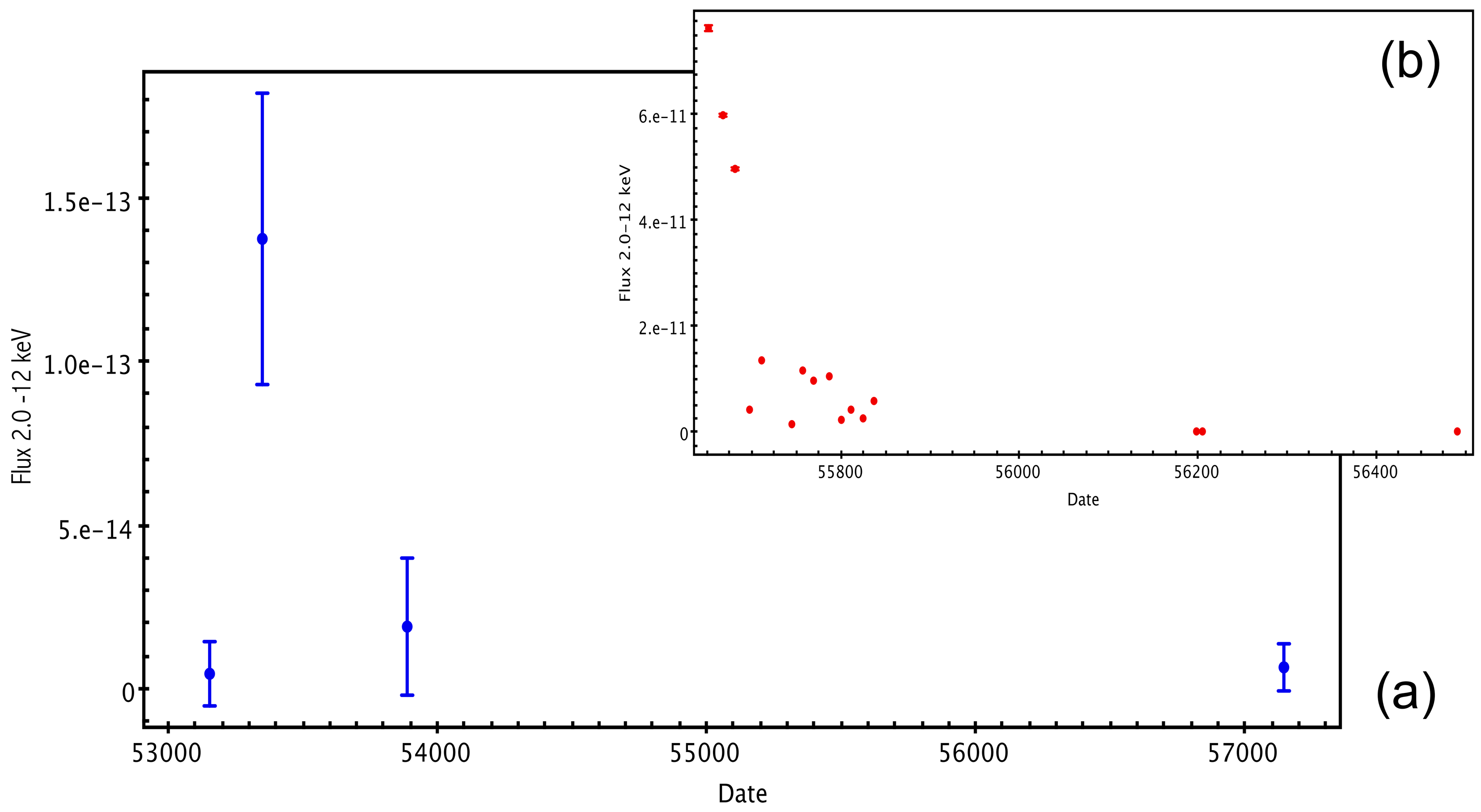

Figure 1 : (a) *XMM-Newton* X-ray lightcurve (2.0 – 12 keV) of Candidate 3
(b) *XMM-Newton* X-ray lightcurve (2.0 – 12 keV) of the hard TDE Sw J1644+57 (Bloom et al., Burrows et al.) as a comparison

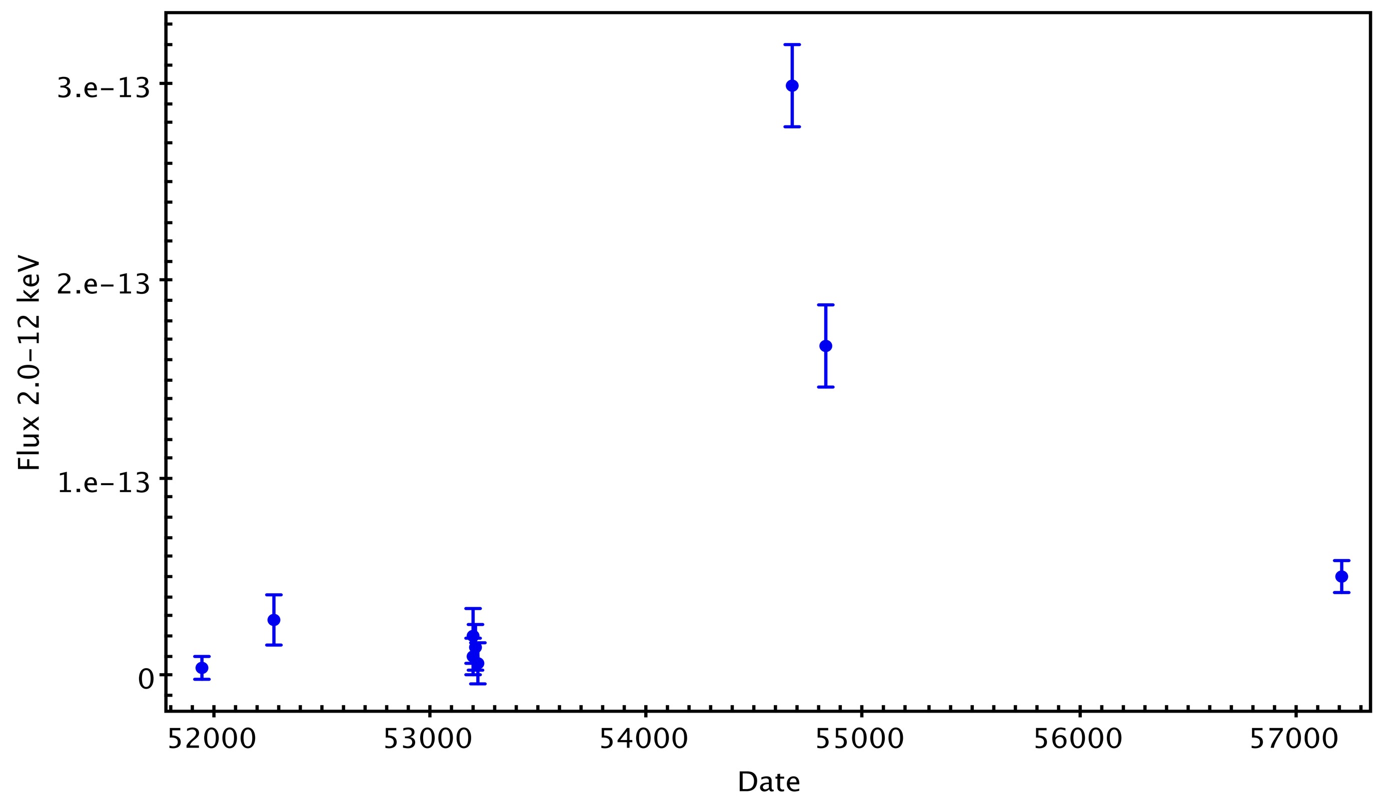

Figure 2 : *XMM-Newton* X-ray lightcurve (2.0 – 12 keV) of Candidate 1

Future work

- Further investigation still to be performed on the four possible candidates
- The identification of the remaining 257 sources in the second sample is still ongoing
- Sources with a unique detection but observed multiple times will be added to the second sample and analyzed using the upper-limit server

References :

Bloom, J.S., et al. 2011, Science, 33, 203
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Burrows, D.N., et al. 2011, Nature, 476, 421
Cenko, S.B., et al. 2012b, ApJ, 753, 77
Saxton R.D., Read A.M., Komossa S., Lira P., Alexander K.D., Wieringa M.H., 2017, A&A, 598, A29
* https://tde.space