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Supergiant Fast X-ray Transients with LOFT

P. Romano[1], P. Esposito[2], E. Bozzo[3], C. Ferrigno[3],, and V. Mangano[1]

[1] INAF – IASF - Palermo, Via U. La Malfa 153, I-901461 Palermo, Italy
e-mail: romano@ifc.inaf.it
[2] INAF – IASF - Milano, Via E. Bassini 15, I-20133 Milano, Italy
[3] ISDC, University of Geneva, Chemin d'Écogia 16, 1290 Versoix, Switzerland

Abstract. Supergiant Fast X–ray Transients are HMXBs with OB supergiant companions, known for X–ray outbursts during which their luminosity increases by 3–5 orders of magnitude. LOFT, with its coded-mask Wide Field Monitor and its 10 m^2 class collimated X–ray Large Area Detector will provide simultaneous high S/N broad-band and time-resolved spectroscopy in several intensity states, long term monitoring that will yield new determinations of orbital and spin periods. We present an extensive set of simulations based on the *Swift* broad-band and detailed *XMM–Newton* observations we collected. Our simulations describe the outbursts at several intensities, the intermediate and most common state, and the low state. We also considered large $N_{\rm H}$ variations and the presence of emission lines.

Key words. X-rays: binaries – instrumentation

1. Introduction

Supergiant fast X–ray transients (SFXTs) are transient High-Mass X–ray Binaries (HMXB) that show hour-long flares peaking at observed 2–10 keV fluxes of 10^{-9} erg cm^{-2} s^{-1} (see Romano et al. 2013, for more information on the SFXT phenomenology).

LOFT, the Large Observatory For X–ray Timing (Feroci et al. 2011), is a space mission selected by ESA in February 2011 as one of the four M3 mission candidates that will compete for a launch opportunity at the start of the 2020s. LOFT will feature the Large Area Detector (LAD, Zane et al. 2012) and the Wide Field Monitor (WFM, Brandt et al. 2012). We expect that the WFM will catch bright outbursts of SFXTs, while the LAD will be best exploited with pointed observations down to lower fluxes and for line spectroscopy.

Send offprint requests to: P. Romano

2. The simulations set-up

The starting point of our simulations are the wealth of information gathered with several observatories as follows: *i)* the *Swift* broad-band spectroscopic observations (e.g. Romano et al. 2008); *ii)* the *XMM-Newton* emission line and quiescence observations (Bozzo et al. 2008, 2010, 2011); *iii)* the *Swift* long-term behavior (Romano et al. 2009b, 2011), including outbursts at several intensities ($F_{(2-10\,{\rm keV})}$ = 5.9×10^{-9} to 5.5×10^{-10} erg cm^{-2}), the intermediate and most common state (10^{-11} erg cm^{-2} s^{-1}), the low-level emission (1.2×10^{-12} to 5×10^{-13} erg cm^{-2} s^{-1}) and $N_{\rm H}$ variations (Romano et al. 2009a).

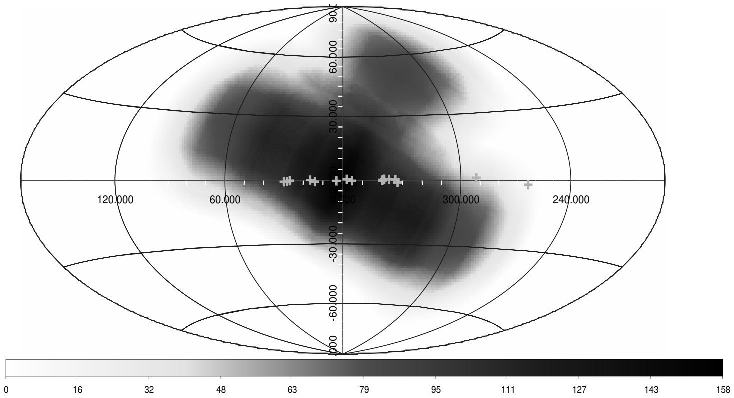

Fig. 1. The WFM FOV in Galactic coordinates for a simulated pointing towards the Galactic center. The crosses mark the known SFXTs and SFXT candidates, which can all be observed in one single pointing.

3. The simulations results

For the detailed treatment of our results, we refer to Romano et al. (2012) and Bozzo et al. (2013). Here we provide a brief summary.

WFM and Bright SFXT outbursts and intermediate flares: The WFM will be able to detect all SFXT flares within its field of view (FOV, see Fig. 1) down to a 15-20 mCrab in 5 ks; it will be ideal in catching bright outbursts ($F_{(2-10\,\mathrm{keV})} = 6 \times 10^{-9}$ erg cm^{-2}) where spectroscopy will yield $\Delta N_{\mathrm{H}}/N_{\mathrm{H}}$ and $\Delta\Gamma/\Gamma$ within $\sim$ 30 % in 1 ks, and within $\sim$ 20 % in 2 ks; it will also allow the study of intermediate flares ($F_{(2-10\,\mathrm{keV})} = 10^{-9}$ erg cm^{-2} s^{-1}) with $\Delta N_{\mathrm{H}}/N_{\mathrm{H}}$ and $\Delta\Gamma/\Gamma \gtrsim 50\%$ in 5ks. Based on the known SFTX duty cycles (Romano et al. 2009b, 2011), at least 110 outbursts from the confirmed sources in this class are expected to occur in the WFM FOV during the LOFT mission lifetime (5 yrs).

LAD and all SFXT states: The LAD will provide excellent time-resolved spectroscopy (in about 1 s) of bright flares ($F_{(2-10\,\mathrm{keV})} = 6 \times 10^{-9}$ erg cm^{-2} s^{-1}) yielding $\Delta N_{\mathrm{H}}/N_{\mathrm{H}}$ and $\Delta\Gamma/\Gamma$ within $\sim$ 1 % in 200 s; for the intermediate flares ($F_{(2-10\,\mathrm{keV})} = 5 \times 10^{-10}$ erg cm^{-2} s^{-1}) spectroscopy will yield $\Delta N_{\mathrm{H}}/N_{\mathrm{H}}$ and $\Delta\Gamma/\Gamma$ within $\sim$ 5 % in 1 ks; spectroscopy of the low states ($F_{(2-10\,\mathrm{keV})} = 1.2 \times 10^{-12}$ erg cm^{-2} s^{-1}) will be achievable within 10 ks. Furthermore, iron emission lines and cyclotron lines can be recovered in fairly good detail in about 1 ks ($F_{(2-10\,\mathrm{keV})} = 10^{-11}$ erg cm^{-2} s^{-1}).

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