COMPARISON BETWEEN TWO OUTBURSTING GALACTIC BLACK HOLES

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ABSTRACT

The accreting Galactic Black Holes (BHs) H1743-322 and GX339-4 have been observed during their 2003 and 2004 outburst respectively with PCA/RXTE and SPI/INTEGRAL observatories. We studied the spectro-temporal evolution of H1743-322 during its transition state combined with a strong X and γ-ray flaring activity. We will compare this source with GX339-4 as a key source in the elaboration of alternative jet models.

Key words: Transient; BHC; hard X-ray emission.

1. INTRODUCTION

Outbursting Galactic BHs are known to go through a complex multistate which can be followed by studying its spectral and timing evolution. In the X/γ energy domain, their energy spectra consists of two main components which allow to characterise the state of the sources.

- In the high/soft state, the soft X-ray emission (below 10 keV) dominates the spectrum in the form of a blackbody component
- In the low/hard state, the hard X-ray emission (above 10 keV) dominates the spectrum in the form of a X-ray powerlaw component with an exponential cutoff around 100 keV

We refer to McClintock & Remillard (2003) for the complete spectro-temporal criteria used to define each state of a source. The main goal here, is to do a phenomelogical study of the outbursting Galactic BHs H1743-322 and GX339-4 by comparing their spectro-temporal characteristics along the transition state. We used data extracted from PCA/RXTE and SPI/INTEGRAL observations . A large part of this study are based on the results from the reference Joinet et al. (2005) where details about the data analysis as well as the discussion about the spectral modelisation of H1743-322 can be found.

2. TEMPORAL VARIABILITY AND STATE TRANSITION (LONG TERM VARIABILITY)

After a long period in quiescence (upper than 7 years for H1743-322 and almost 3 years for GX 339-4 from ASM/RXTE observations), these sources was found to exhibit a gradual increase of the X-ray luminosity. As seen from Figure 1, the light curves of both sources exhibit a complex temporal variability and multistate during the rise phase. The low/hard to high/soft state transition observed during their outburst can be interpreted in terms of a geometry evolution.

Particularly, we extracted several spectra of H1743-322 along this transition state (see Figure 2) and modelised them using a multicomponent model described in Joinet et al. (2005). Up to the beginning of the flaring activity (revolution 60), the blackbody emission grows progressively as it is expected when the accretion disk surface increases. In the same time, we note the decrease of the hard X-ray emission coming from the soft photons comptonised by a hot electron plasma (or corona) (see Joinet et al. (2005)). The decrease of the optical depth of the hot corona could be explained either by material ejection during the major radio ejection event (revolution 58) or by its condensation into an optically thick disk. The same relative hard to soft component evolution related to state transition was observed for GX339-4 (Figure 2).

3. THE FLARING ACTIVITY IN THE CASE OF H1743-322 (SHORT TERM VARIABILITY)

As shown in Figure 1, H1743-322 exhibited around the maximum of luminosity, correlated X and γ flare events within a timescale of about one day. From revolution 60, we separate periods for which the flux of the source is higher than 300 mCrab in the 20-36 keV energy range (flare events) from the other ones (no flare events). We can notice from extracted spectra (see Figure 3) and the associated fit parameters (see Table 5 in Joinet et al. (2005)) that the spectral shape remained unchanged (so the overall geometry of the source) while the luminosity of the source is multiplied by a factor of two during the

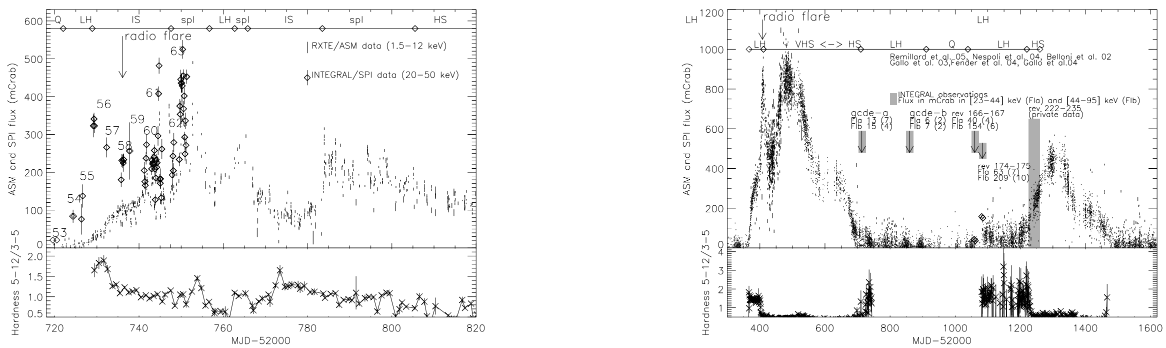

Figure 1. Left panel : Light curve of H1743-322 during its 2003-2004 outburst. We also give the revolution numbers corresponding to SPI data. The different states harboured by the source are summarized on the graph (using the classification of McClintock & Remillard (2003)): Q=quiescent, LH=Low Hard, IS= Intermediate, spl=Steep powerlaw or Very high, HS=High Soft. Right panel : Light curve of GX339-4 during its 2002-2004 outburst.

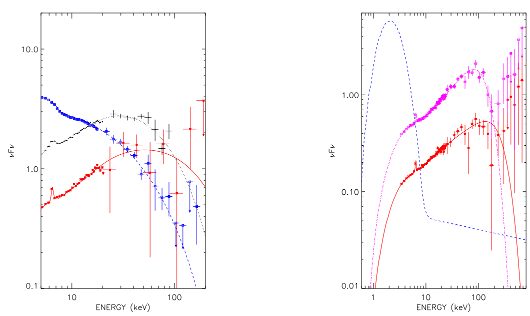

Figure 2. Spectra from simultaneous PCA and SPI observations. Left panel : H1743-322 during INTEGRAL's rev. 55, 56 and 58 (classified below 10 keV as the lower, middle and higher curve respectively). Right panel : GX339-4 in low/hard state during rev. 166 (red points) and 175 (pink circles) (Joinet et al., 2005b). The best model (blue dashed line) fitting the source data of 1998 outburst (Belloni et al., 1999) is drawn to indicate the spectral shape evolution during a low/hard to high/soft state transition which is similarly observed for H1743-322.

flaring period.

4. RELATIVISTIC RADIO JET AND STATE TRANSITION

A relativistic radio jet emission was observed in GX339-4 and H1743-322 during the rise phase of the outburst. In both cases, it is noticed from the ASM hardness in the 3-12 keV energy range (Figure 1), that just after this radio event, there is a clear softening of the source. Secondly, this occures during the low/hard to soft/state transition. Then, an extended radio jet emission was observed following the radio flare event for both sources: it could be explained by an interaction of the plasma ejected during the outbursting phase with the interstellar medium (Corbel et al., 2005)

To conclude, we have pointed out some spectro-temporal similarities between both outbursting Galactic BHs H1743-322 and GX339-4. The goal of such a study is the elaboration of a scheme to explain the radio flare event and its links with the state transition together with the observed chaotic events in X and γ-ray energy range (flaring activity) as the source reaches the maximum of luminosity. The modelisation of the radio jet contribution in the X and γ-ray energy range should be investigated.

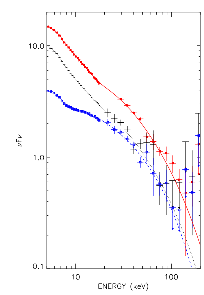

Figure 3. Spectra from simultaneous PCA and SPI observations of H1743-322 during rev. 58, 60-63 (no flare events) and 61-63 (flare events) (lower, middle and higher curve respectively).

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