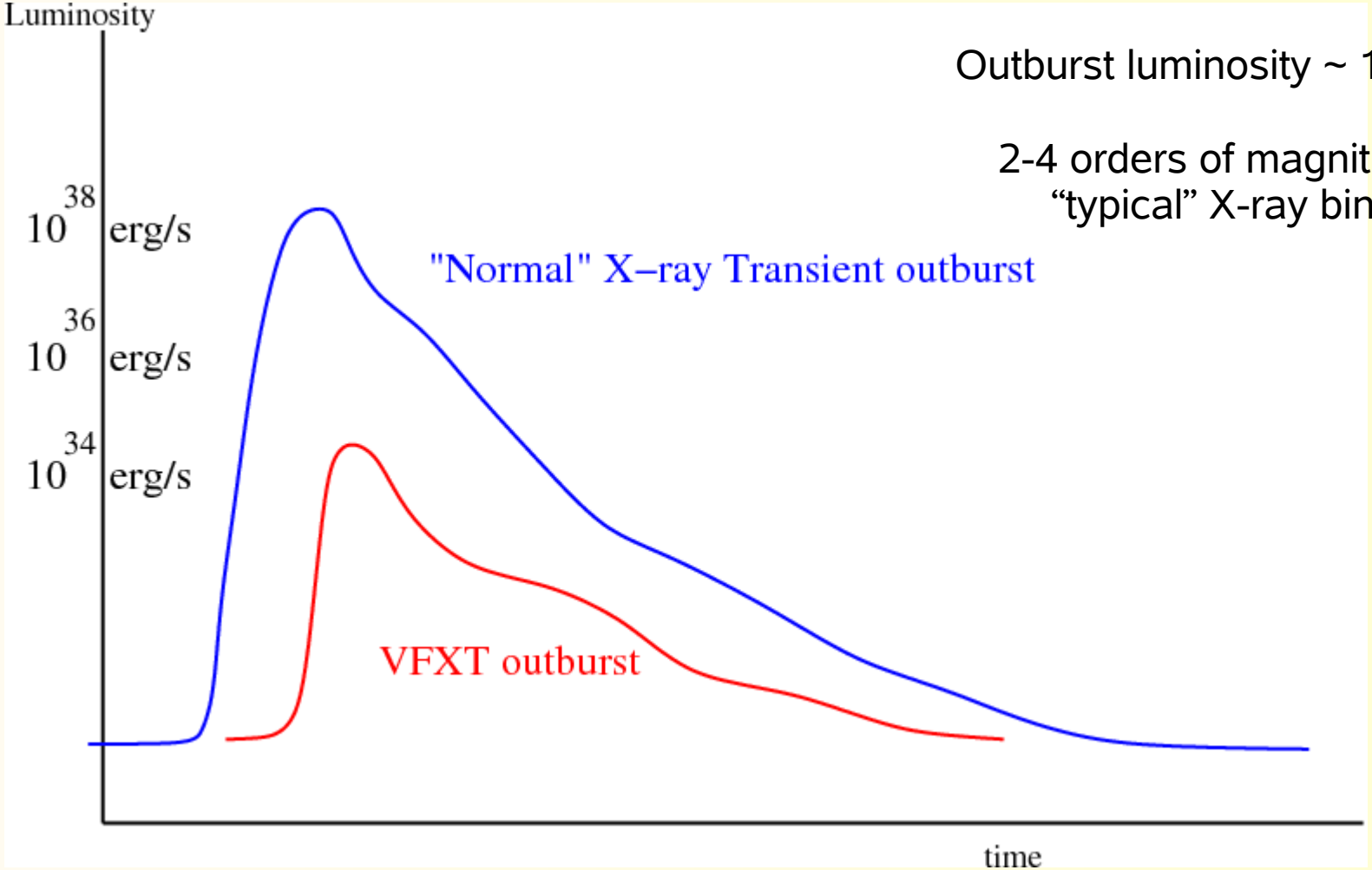
Accrescimento a bassissimo tasso: l'enigma del risparmio nei transienti X deboli

Lara Sidoli

AstroSiesta, IASF-MI, 6 maggio 2010

Transienti X deboli
(Very Faint X-ray Transients, VFXTs)



Outburst luminosity ~ 1E34-1E36 erg/s

2-4 orders of magnitude fainter than "typical" X-ray binaries in outburst

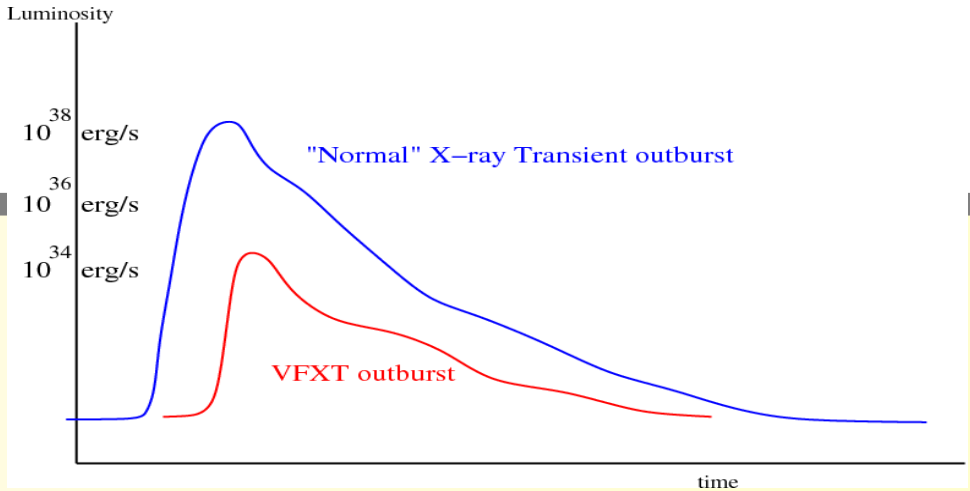
Transienti X deboli
(Very Faint X-ray Transients, VFXTs)

1)- Lx implies NS or BH in binaries

2)- Low duty cycles together with low **average** accretion rates imply extremely low accretion rates: Mdot ~ 1E-13 solar masses/yr

3)- The nature of several VFXTs is unknown: probably a not homogeneous class of sources

4)- Duty cycle ?



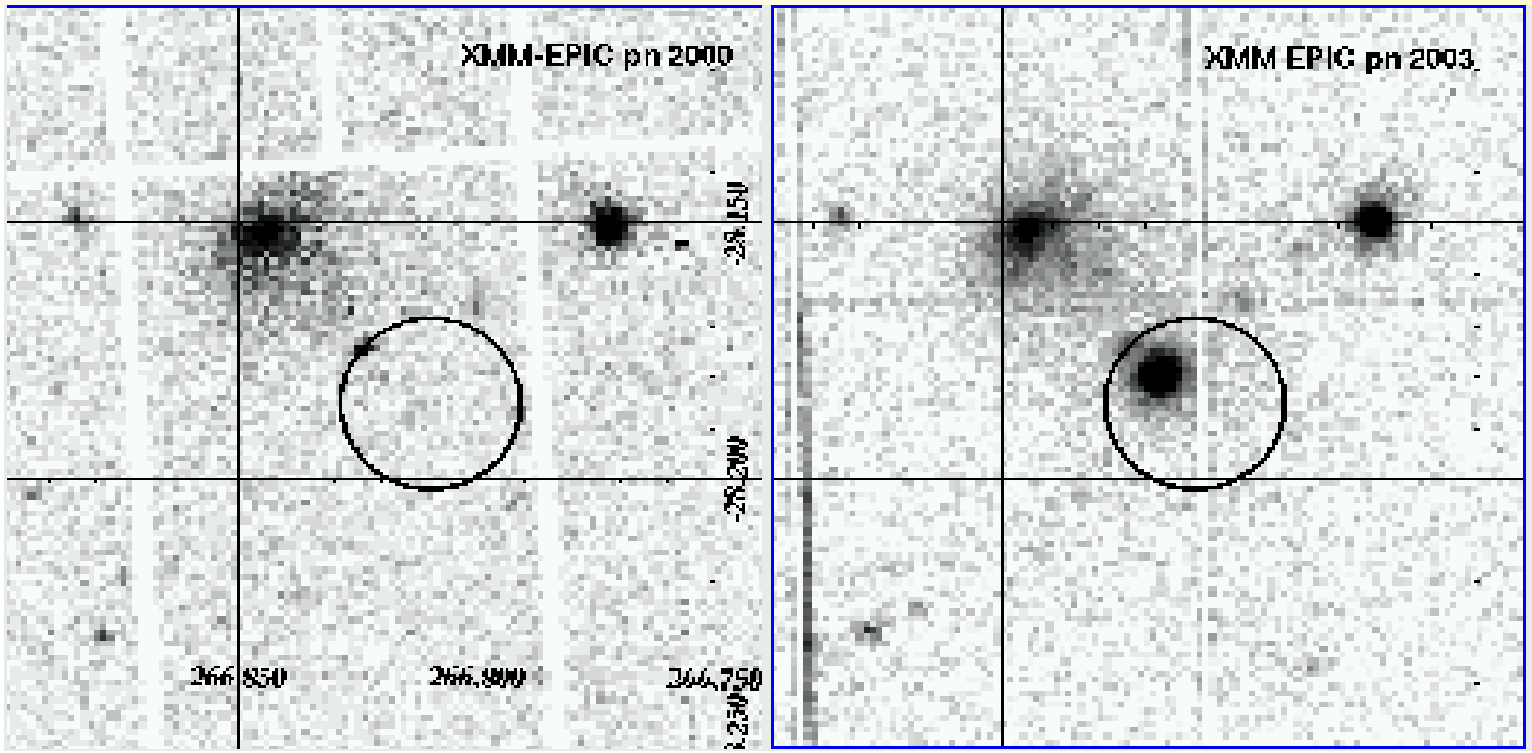
RXTE, ASCA, Chandra, XMM-Newton

their catalogs contain faint or
very faint X-ray transients located in the GC region (assumed distance ~ 8 kpc)
with faint outbursts,
the nature of which is still completely unknown

N ~ 30 sources

XMMU J174716.1-281048

Sidoli & Mereghetti 2003, Atel 147

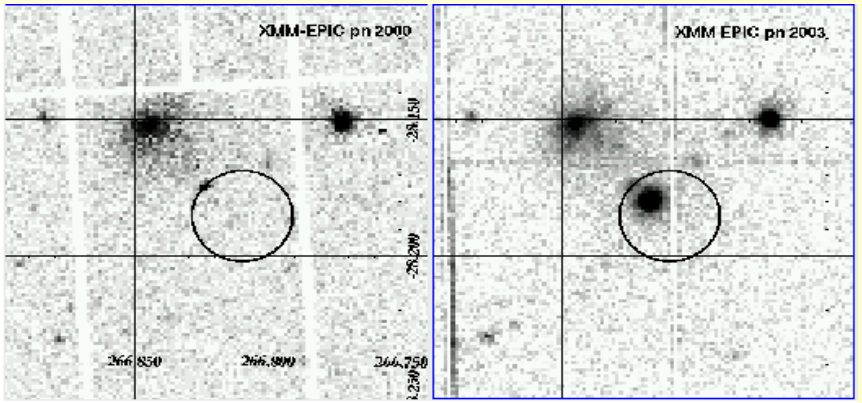


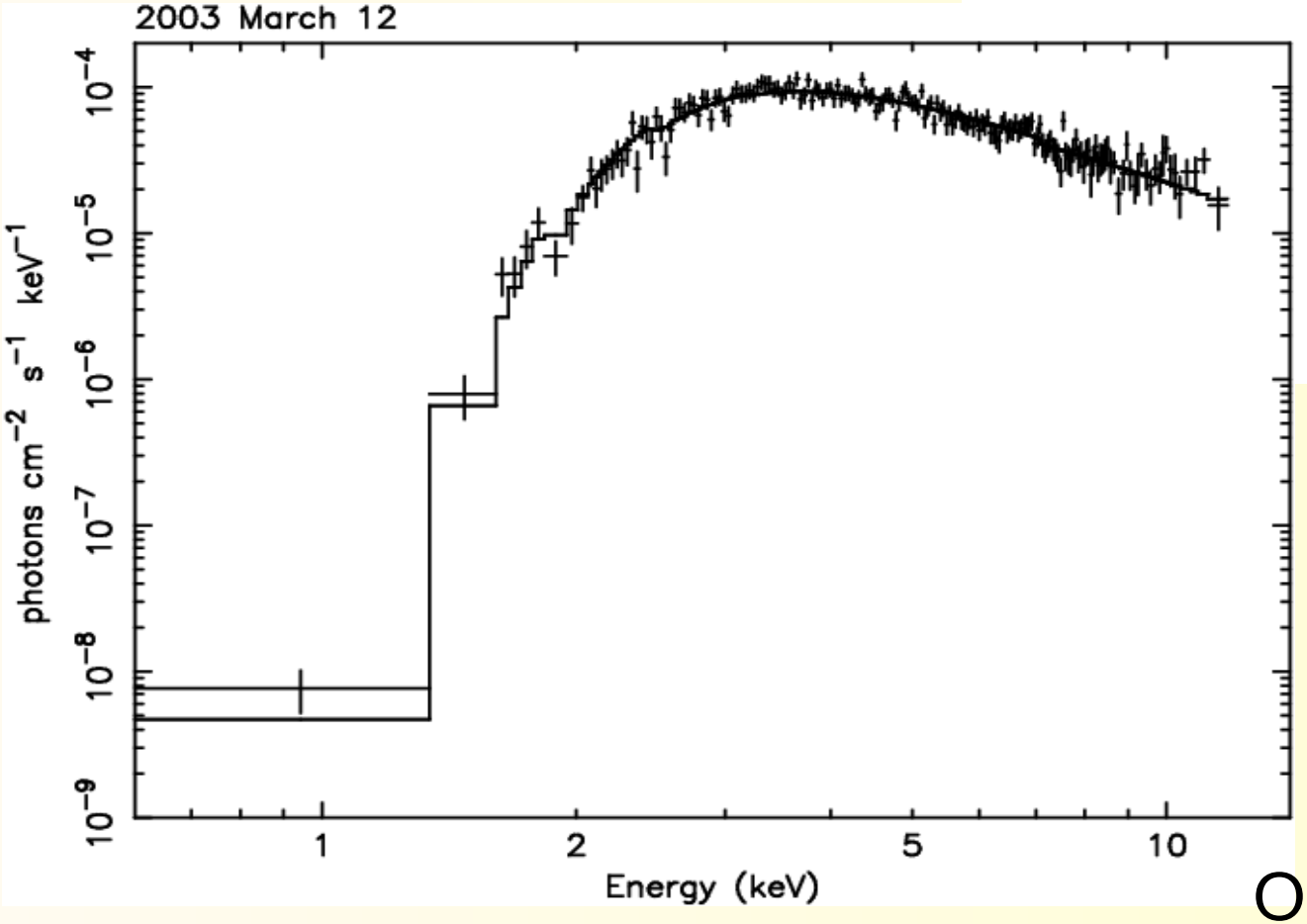
2000

2003

Del Santo, Sidoli, Mereghetti et al. 2007

XMMU J174716.1-281048





Outburst Luminosity
Lx ~ 5E34 erg/s

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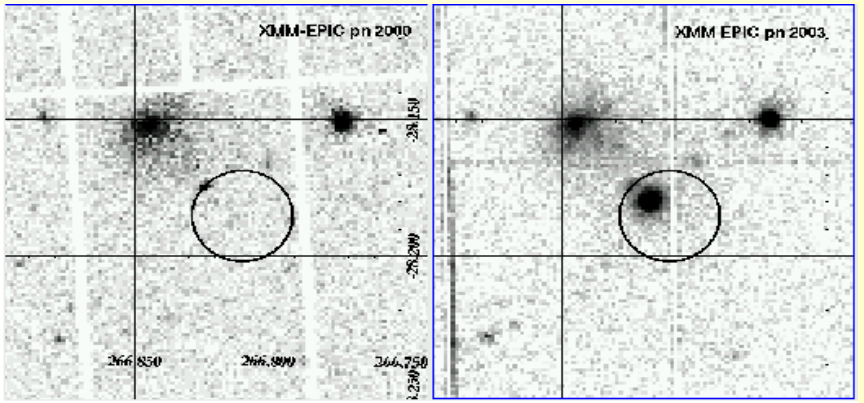
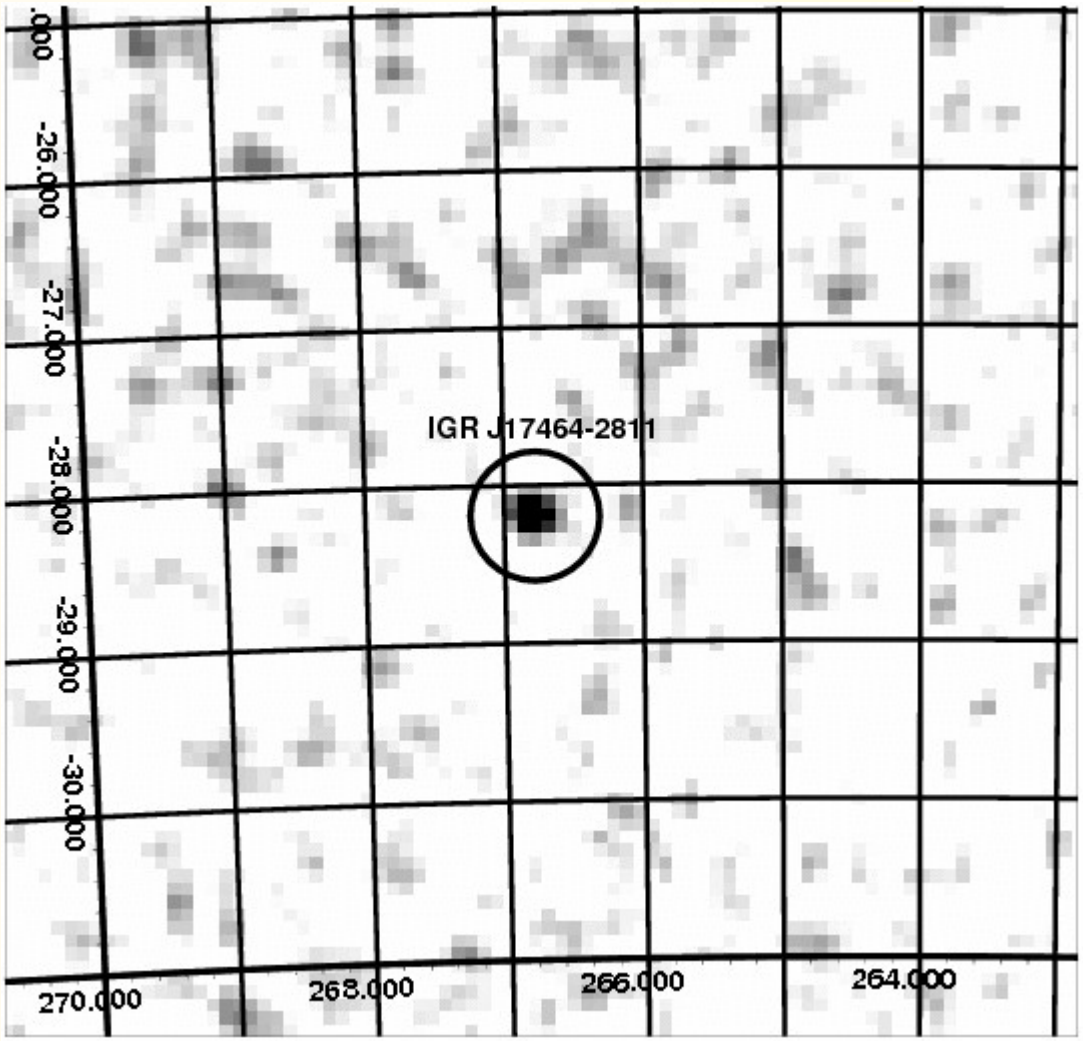
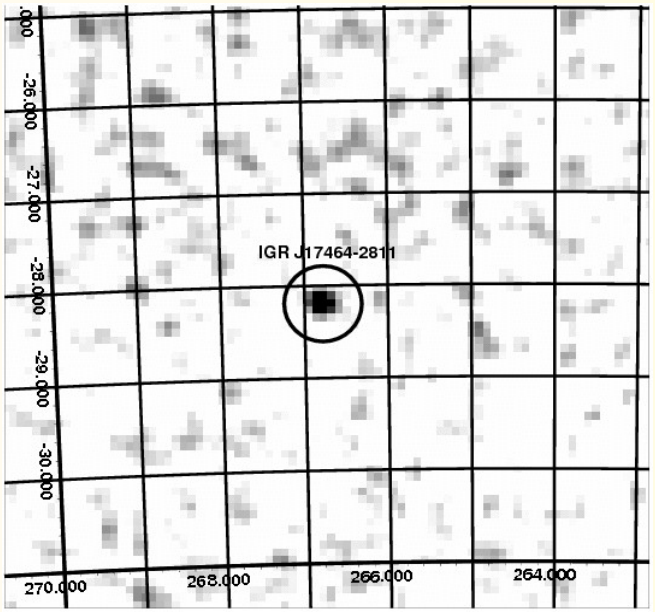


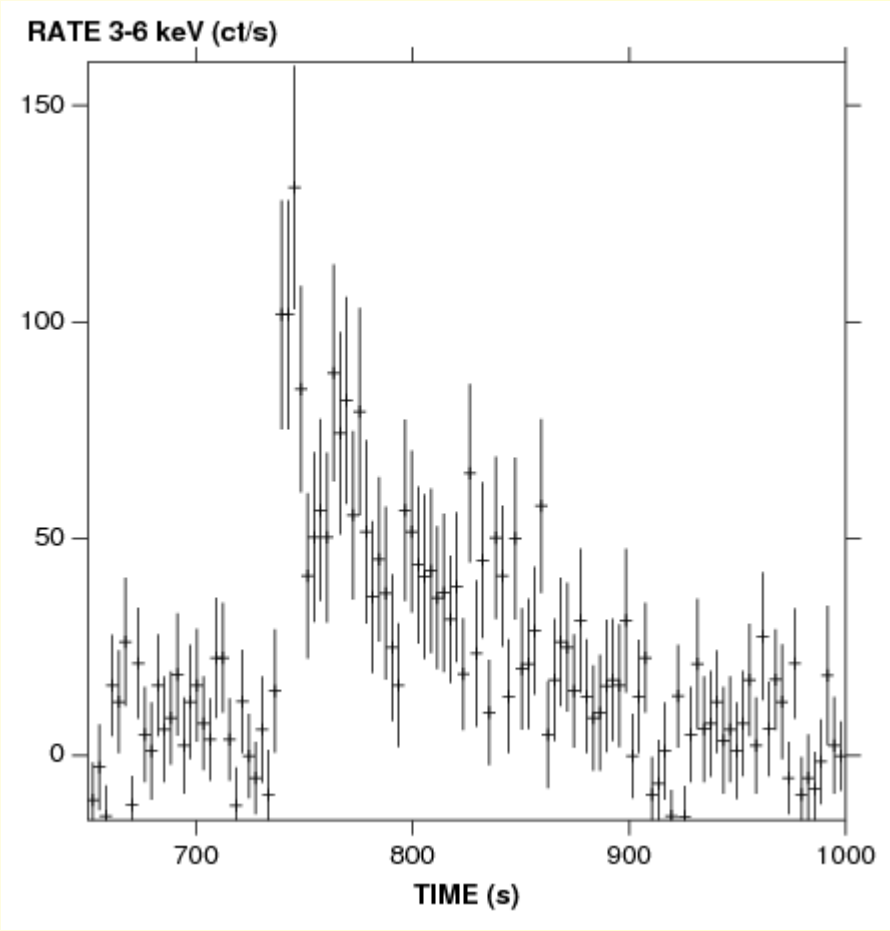


type I burst

= IGRJ17464-2811

XMMU J174716.1-281048





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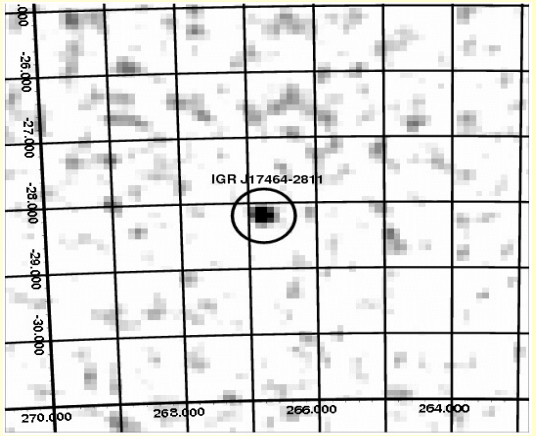
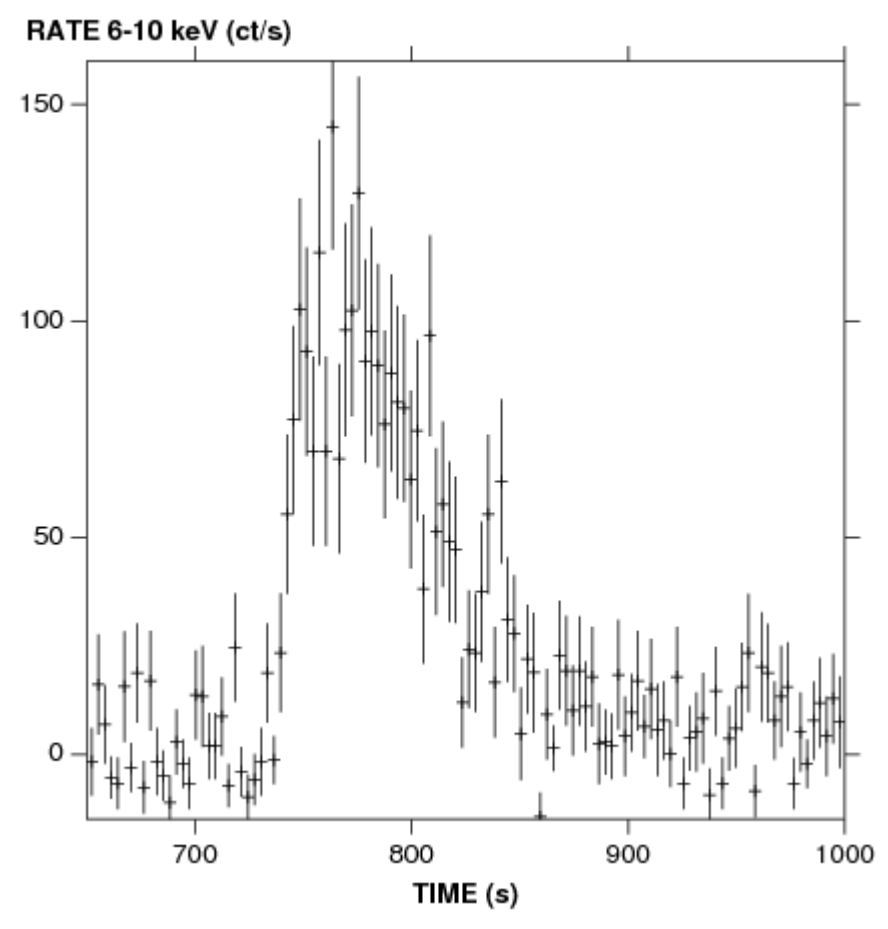
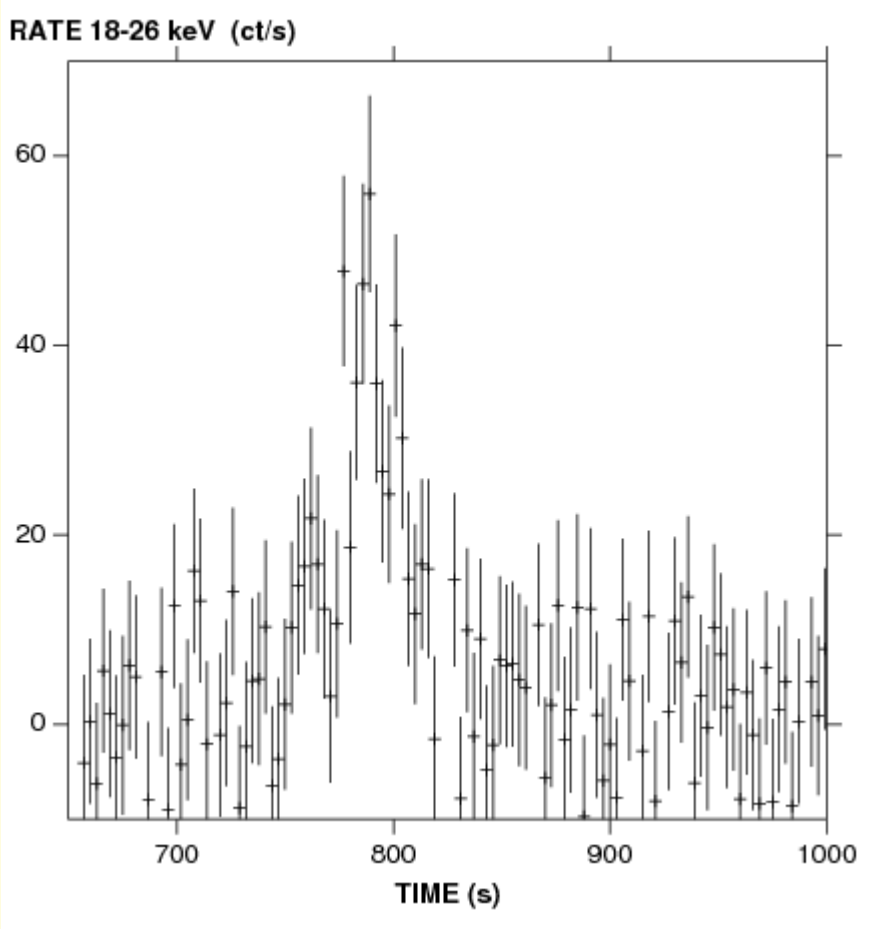
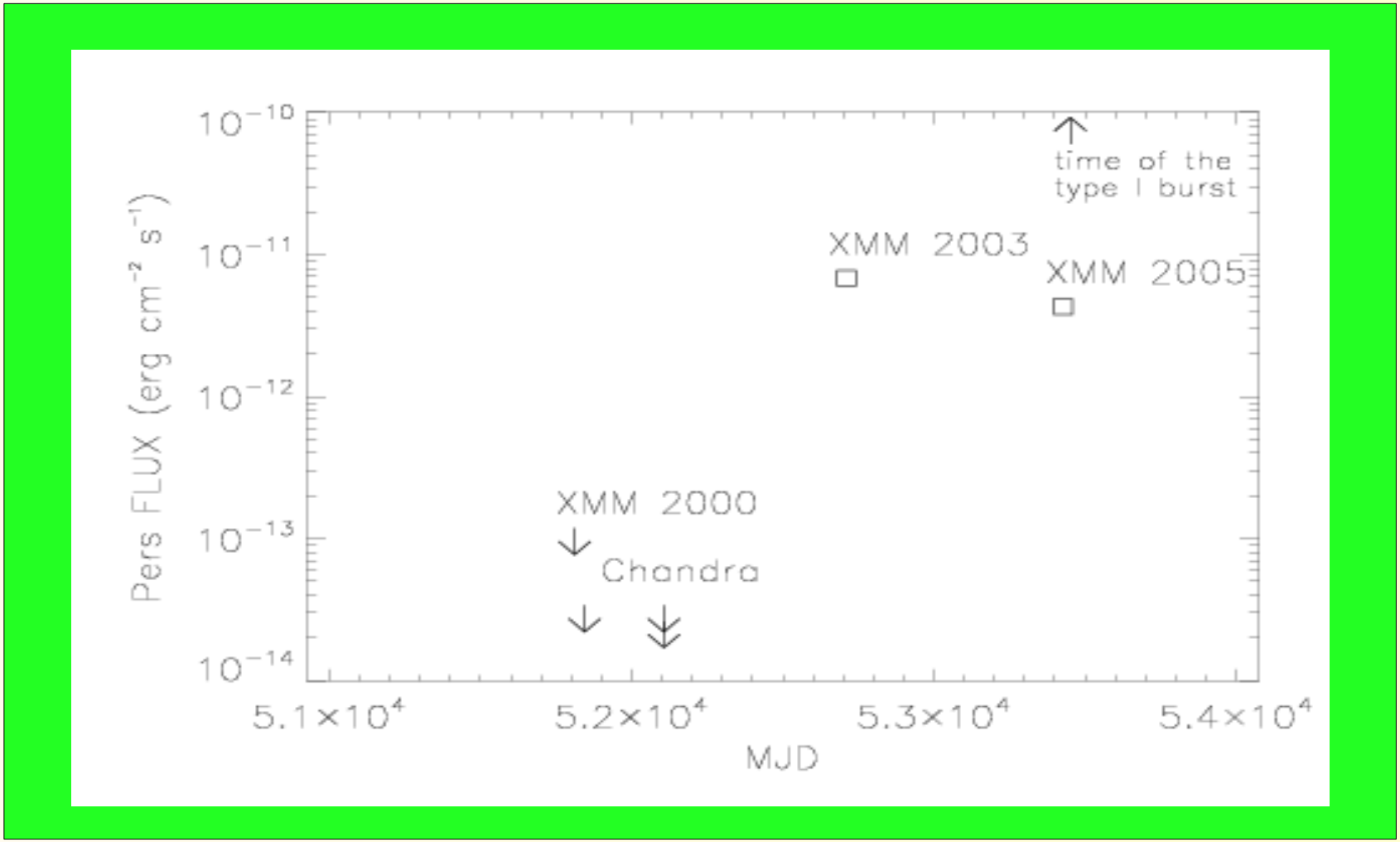






Del Santo, Sidoli, Mereghetti et al. 2007

XMMU J174716.1-281048: a “quasi-persistent” transient ?

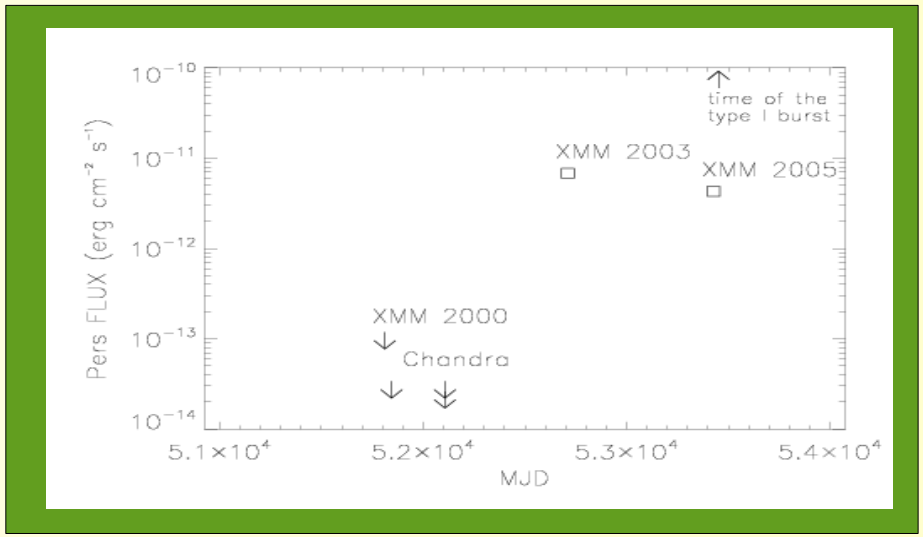


Del Santo, Sidoli, Mereghetti et al. 2007

XMMU J174716.1-281048: a “quasi-persistent” transient ?

Type I X-ray burst

$$\alpha = L_{\mathrm{pers}} \times t_{\mathrm{rec}} / E_{\mathrm{burst}}$$



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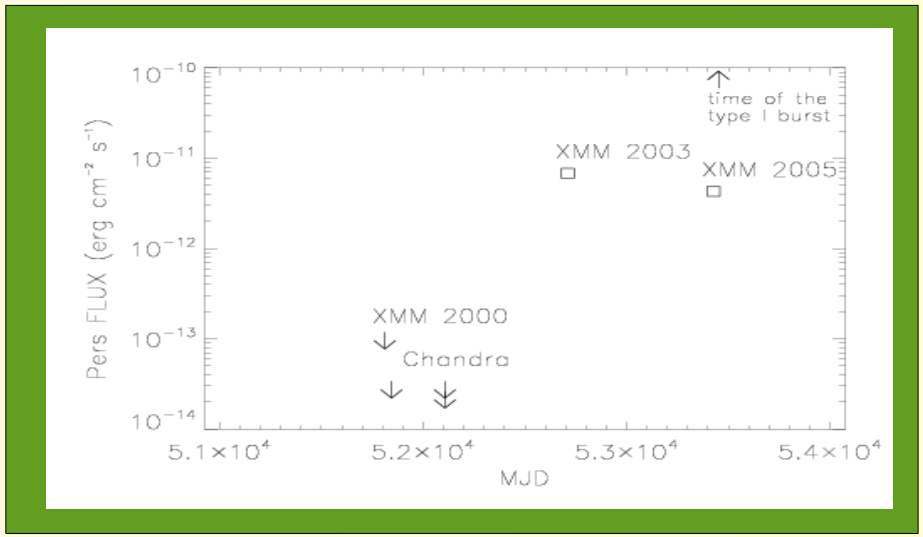

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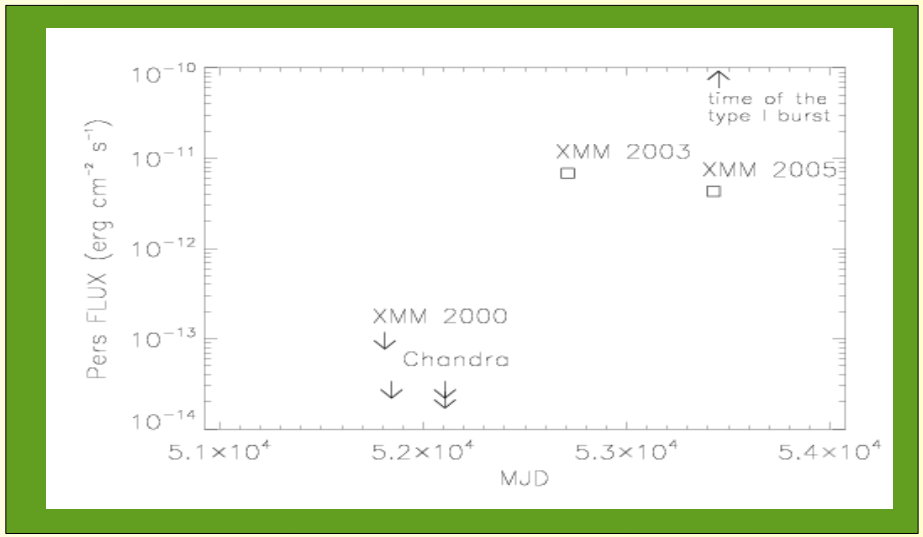

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$$E_{\rm burst} \sim 2.7 \times 10^{40} \text{ erg}$$

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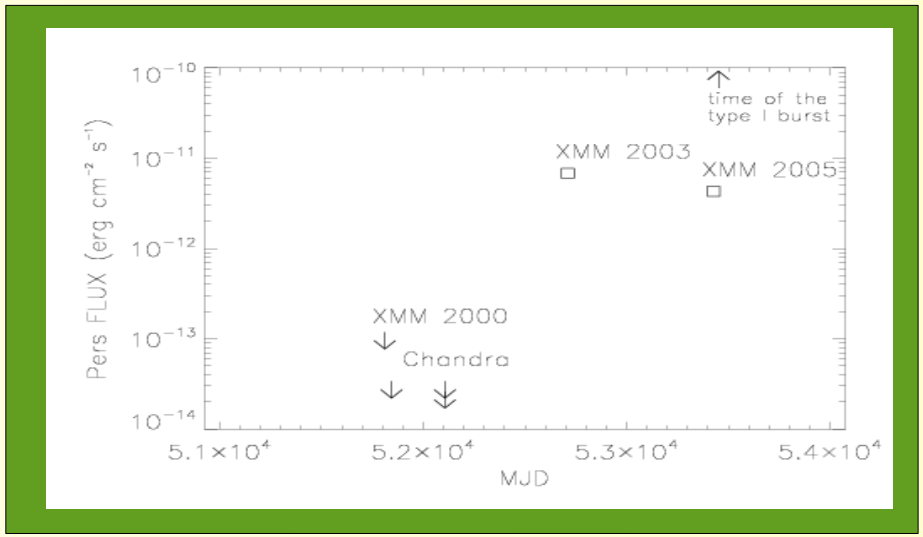

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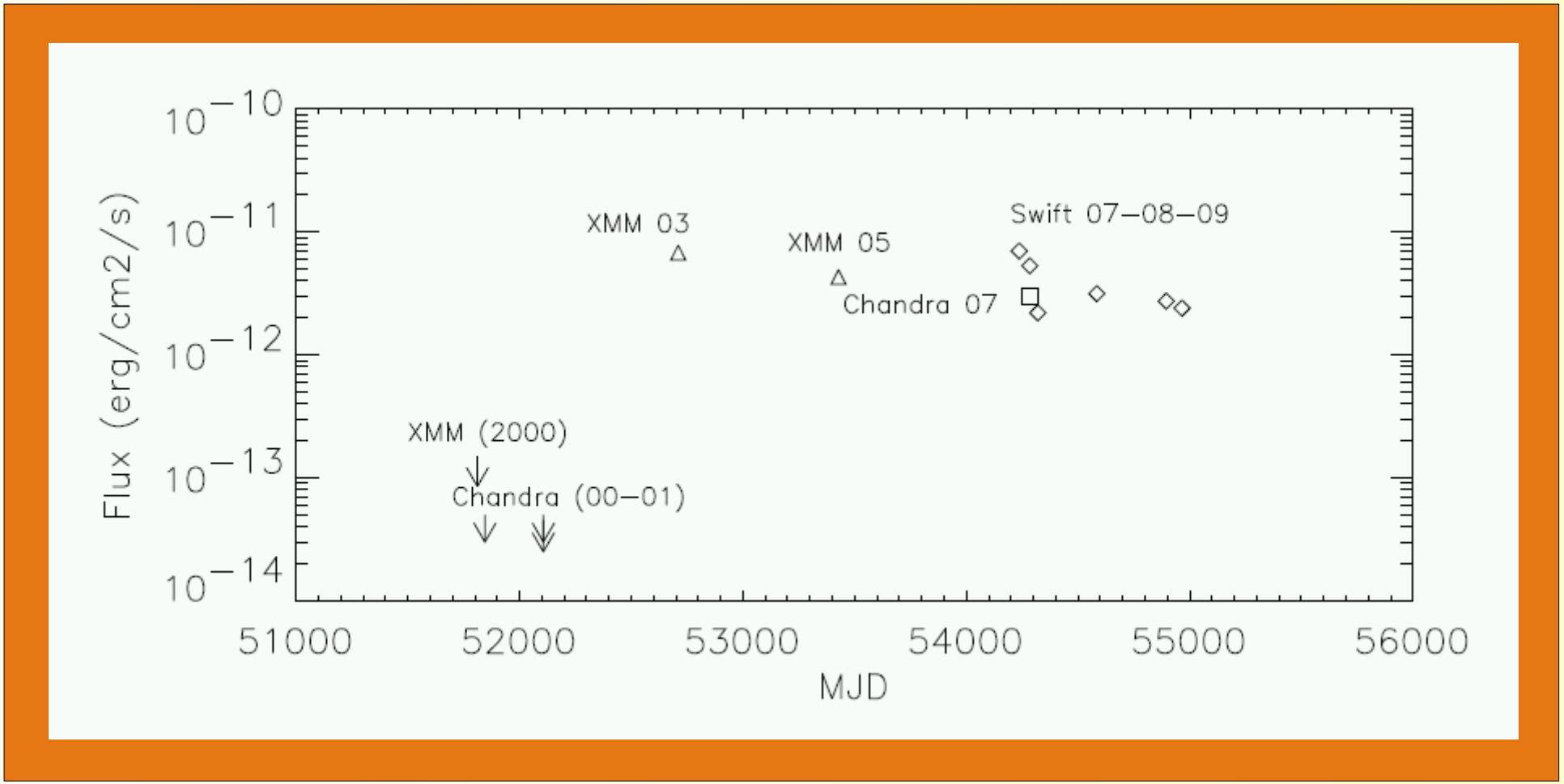
$$E_{\rm burst} \sim 2.7 \times 10^{40} \text{ erg}$$

$$t_{\rm rec} \sim 3 \times (\alpha/40) \text{ yr.}$$

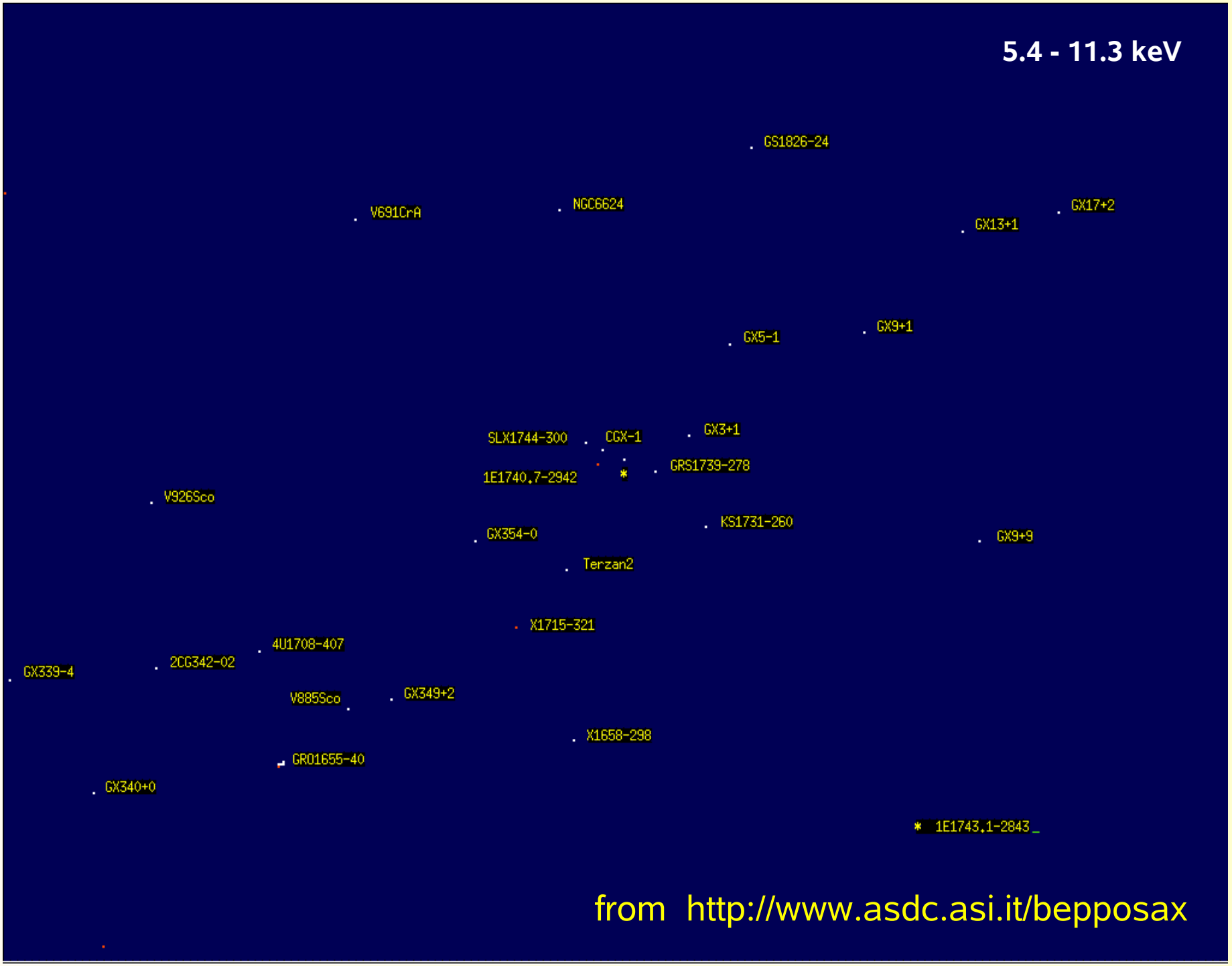
The two observations in 2003 and in 2005 very likely caught the **SAME outburst**

XMMU J174716.1-281048: a “quasi persistent” transient !

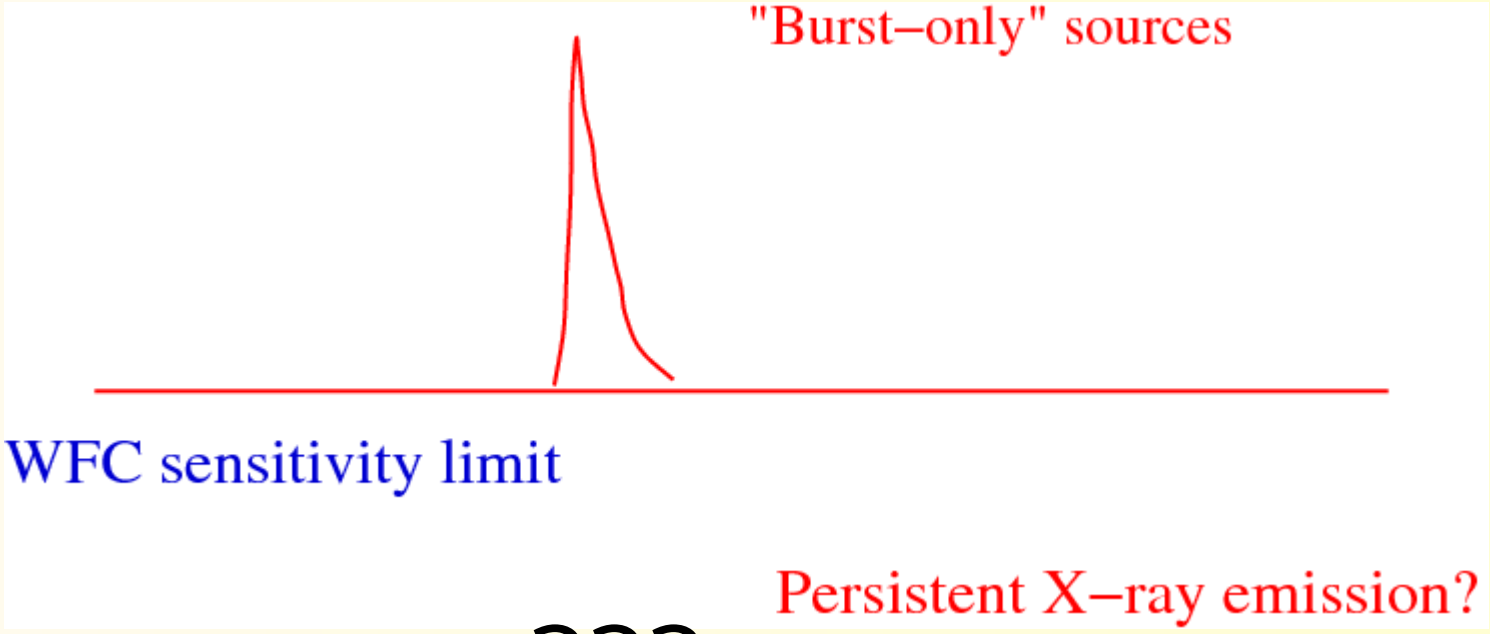
The first quasi-persistent Very Faint X-ray Transient !



BeppoSAX **WFC** image of the Galactic Center region (40 deg x 40 deg)



BeppoSAX **WFC**

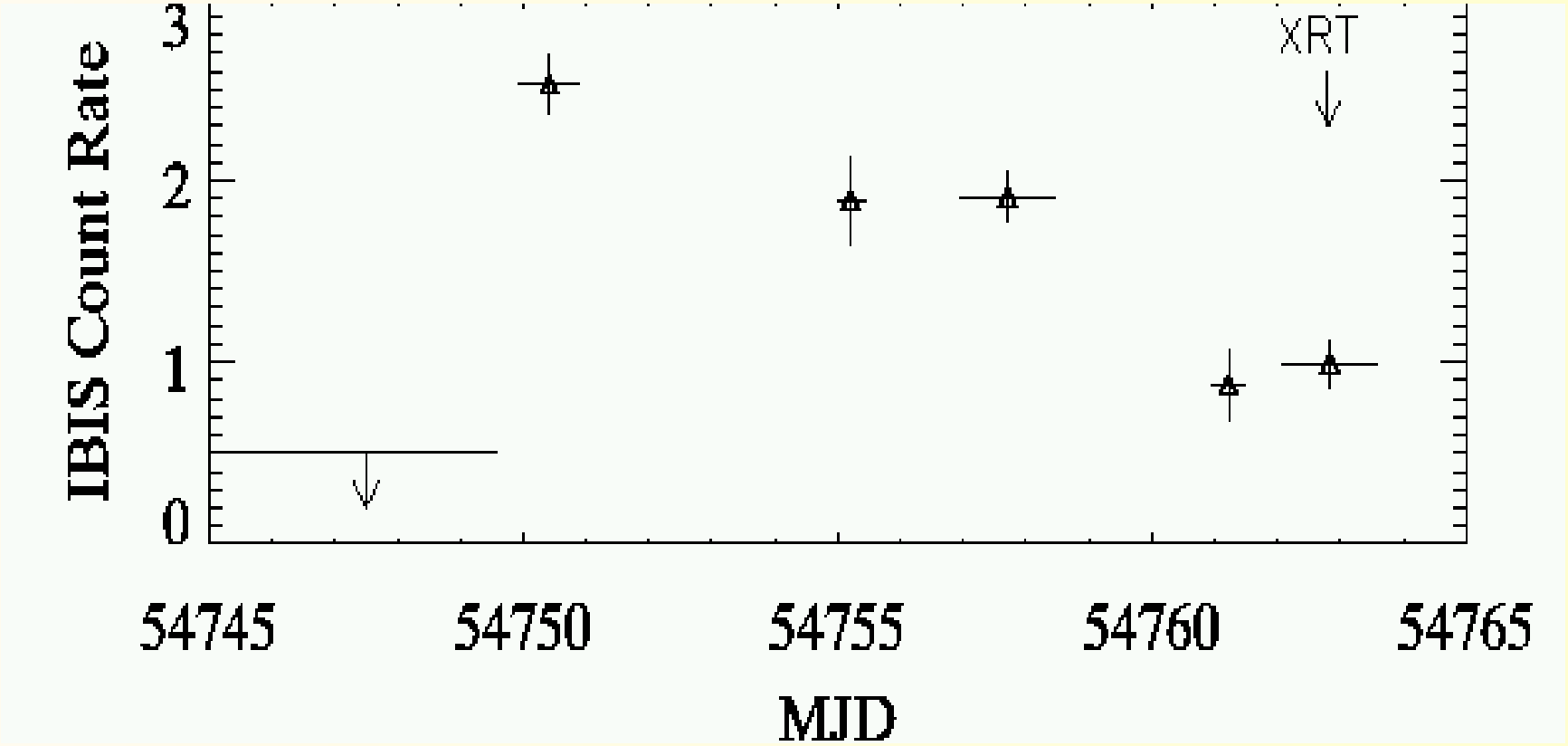


???

"Burst-only sources"
X-ray sources
which displayed only type I X-ray bursts
(no persistent emission was detected -> Lx < 1E36 erg/s)

SAX J1753.5-2349

First persistent broad spectrum from a “burst-only” source



INTEGRAL Key Programme data GC region

Del Santo, Sidoli, et al. 2010

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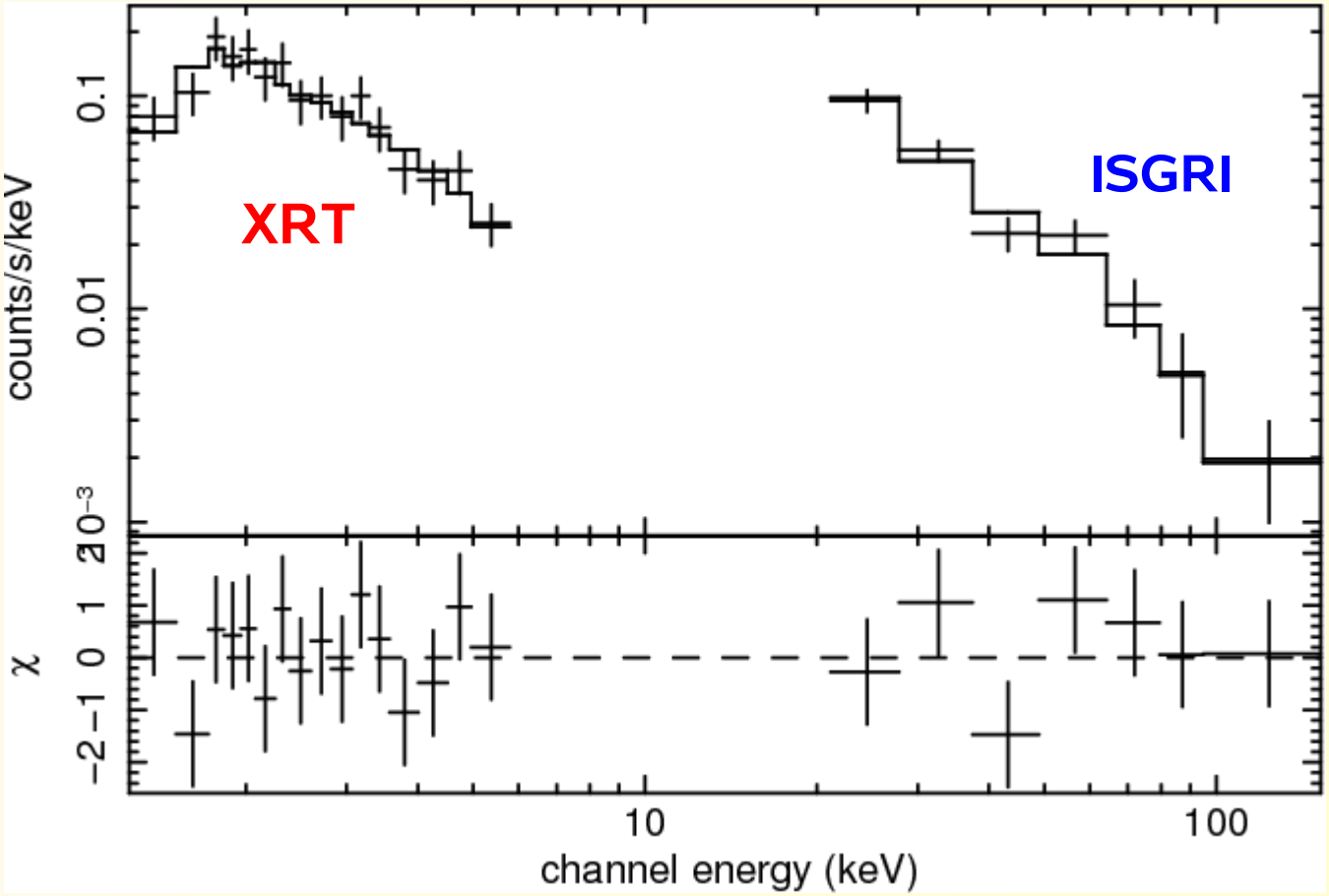
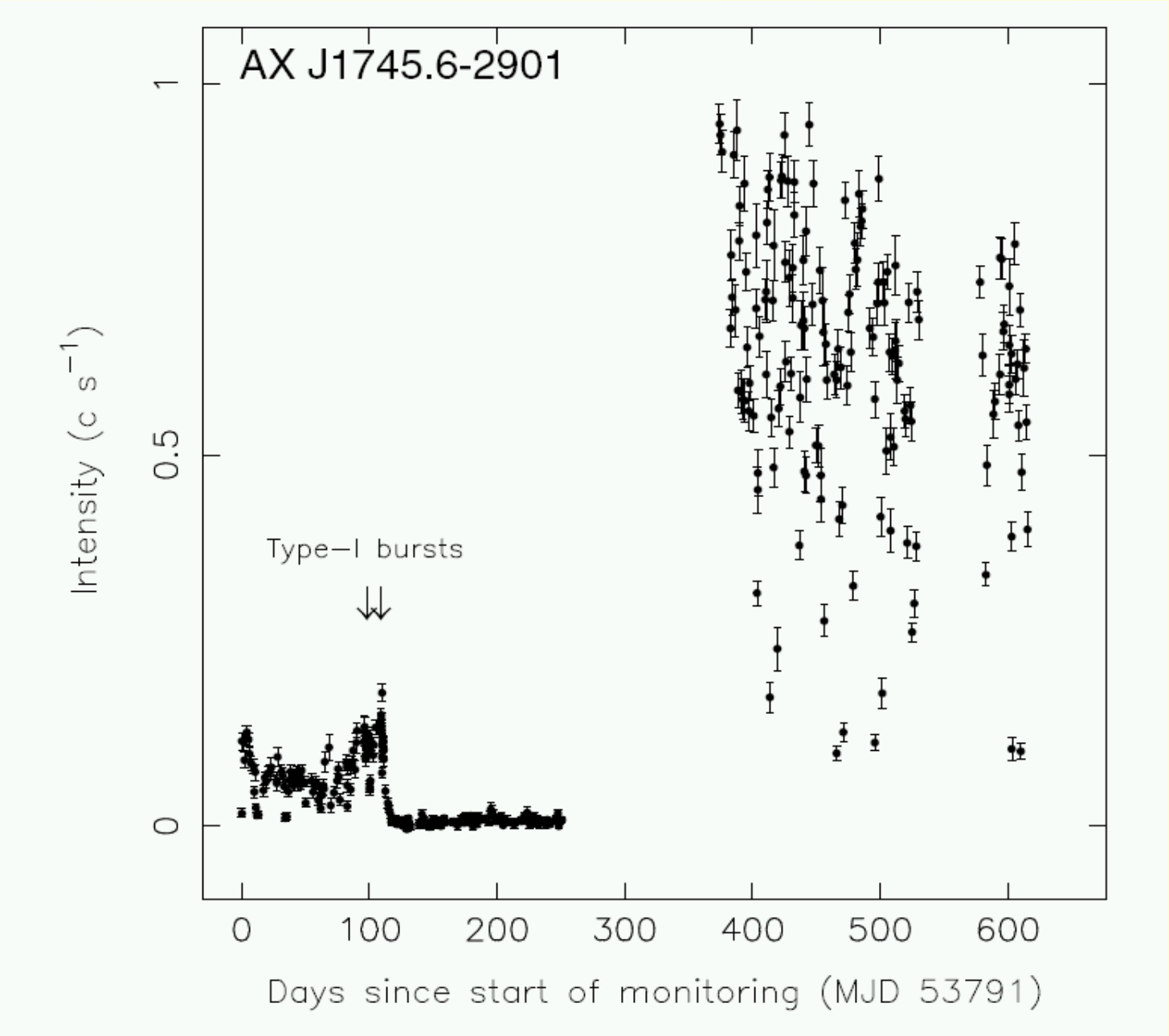


Del Santo, Sidoli, et al. 2010

VFXTs display very peculiar behaviours: an example



Degenaar & Wijnands 2009

VFXTs: high concentration in the Galactic Center region

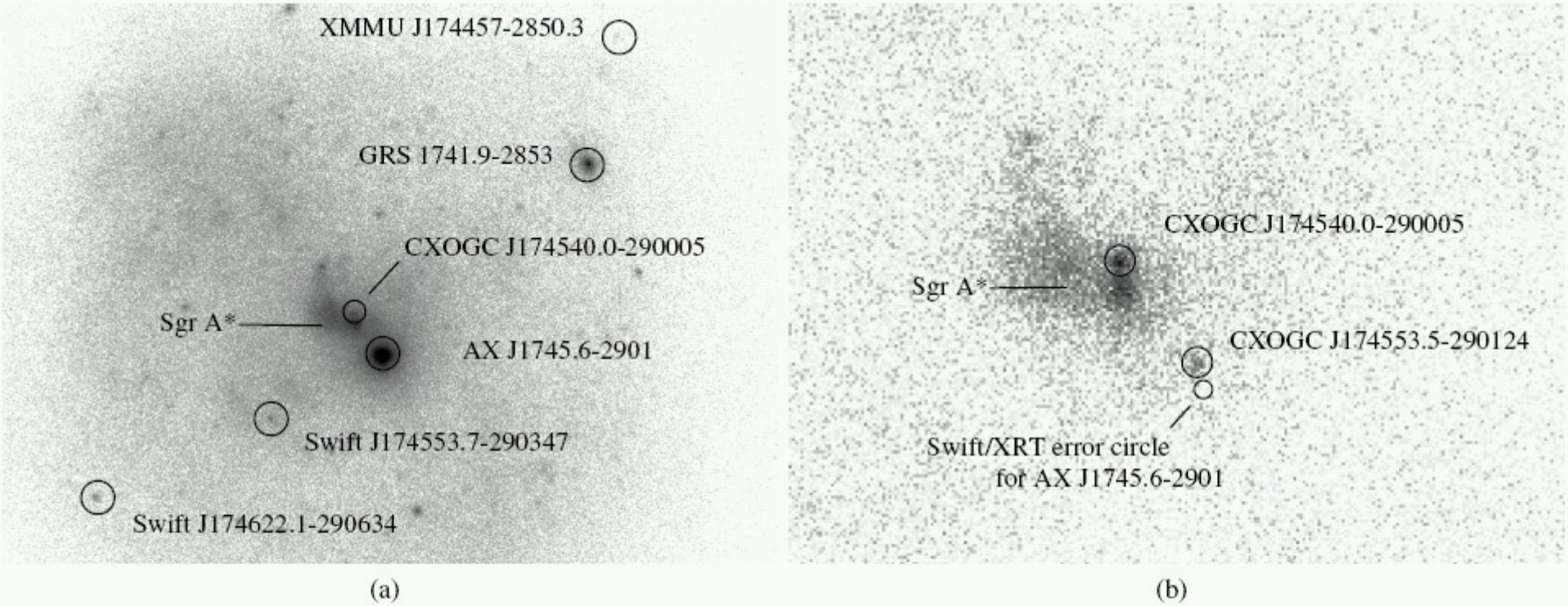


Fig. 1. X-ray images (0.3–10 keV) of the GC obtained with *Swift*/XRT (North is up and East is to the right). **a)** Merged image of all PC mode observations carried out in 2006 and 2007. The known X-ray transients AX J1745.6-2901, CXOGC J174540.0-290005, GRS 1741.9-2853 and XMM J174457-2850.3, as well as the newly discovered subluminous X-ray transients Swift J174553.7-290347 and Swift J174622.1-290634 can be seen in this image. **b)** Zoomed image of the inner region around Sgr A* of the epoch June–November 2006, during which CXOGC J174535.5-290124 and CXOGC J174540.0-290005 were both detected in an active state. The *Swift*/XRT position for AX J1745.6-2901 is also plotted, to show that the active object does not coincide with the coordinates of AX J1745.6-2901 and is in fact a distinct source.

Degenaar & Wijnands 2009

VFXTs:

not only bursters (1/3 VFXTs are bursters) !!!

but also unidentified sources ...

VFXTs: a few open issues ...

low average accretion rates

a) - wind-fed systems to get arbitrarily faint outbursts..

BUT

1)- optical observations of VFXTs exclude massive companions

2)- 1/3 VFXTs are bursters (LMXBs)

(King 2000
King & Wijnands 2006)

VFXTs: a few open issues ...

low average accretion rates

b) – Roche lobe overflow in a LMXB..?

BUT

1)- the mass tranfer rate should drop to values
< 1E-13 solar masses/yr within a Hubble time...
some problems for the evolution of a typical LMXB

(King 2000
King & Wijnands 2006)

VFXTs: a few open issues ...

low average accretion rates

imply low current companion masses m2
m2 < 0.014 m1 ^ (-1/7) (hydrogen rich donor) or
m2 < 0.0068 m1 ^(-1/7) (hydrogen poor)

(King & Wijnands 2006)

Possibilities:
1)- VFXTs are born with very low companions
2)- VFXTs evolve more rapidly than what previously thought
3)- True source duty cycles are larger
4)- Larger accretor masses: intermediate mass BHs?
BUT 1/3 are bursters! They are not BH

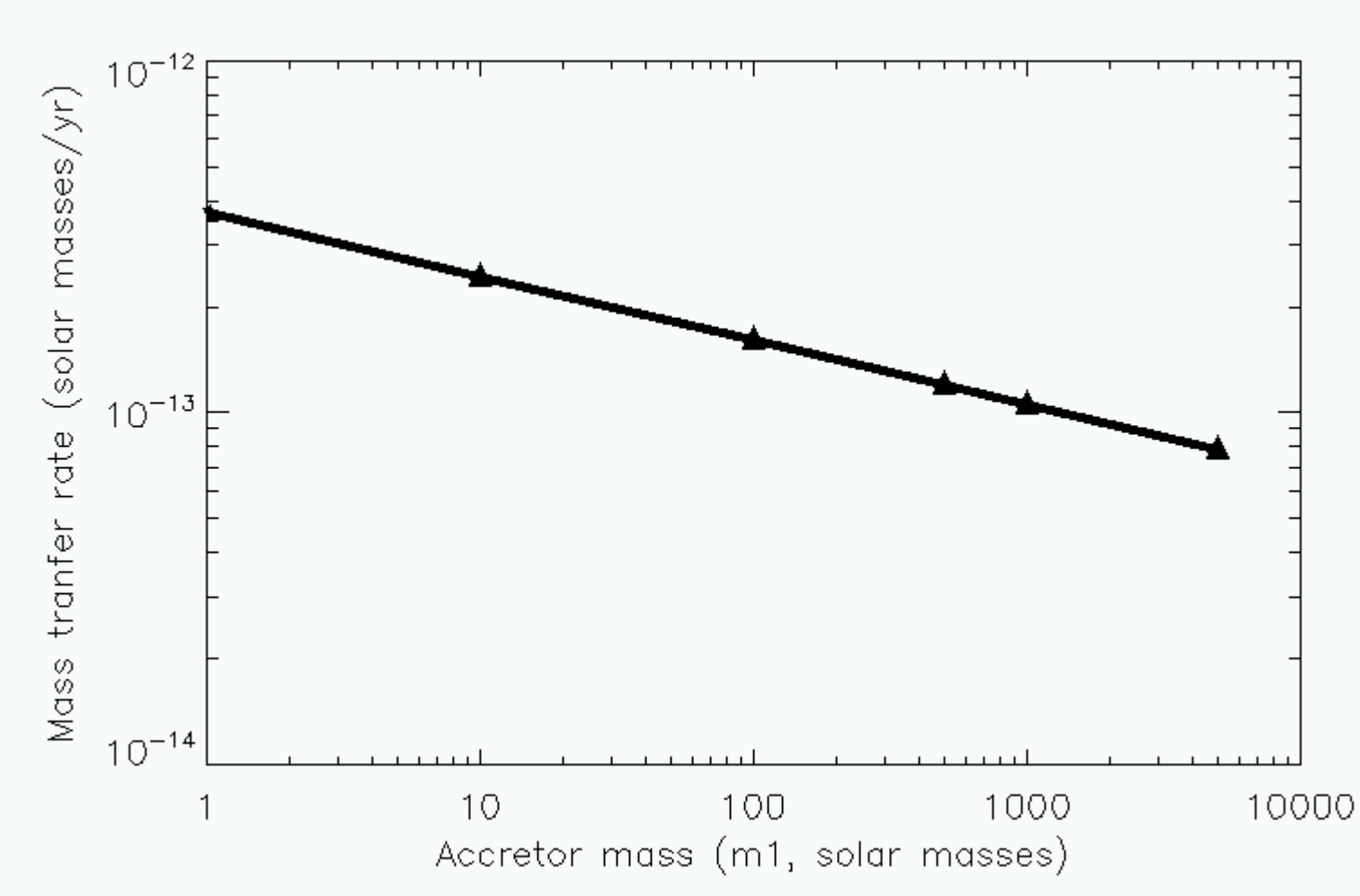
(King 2000
King & Wijnands 2006)

Larger accretor masses (m1) ?

intermediate mass BHs?

$$-\dot{m}_2 = 2 \times 10^{-13}(1+X)^{20/11} m_1^{-2/11} (t_{10})^{-14/11}\ \mathrm{M}_\odot\ \mathrm{yr}^{-1}$$

(King & Wijnands 2006)



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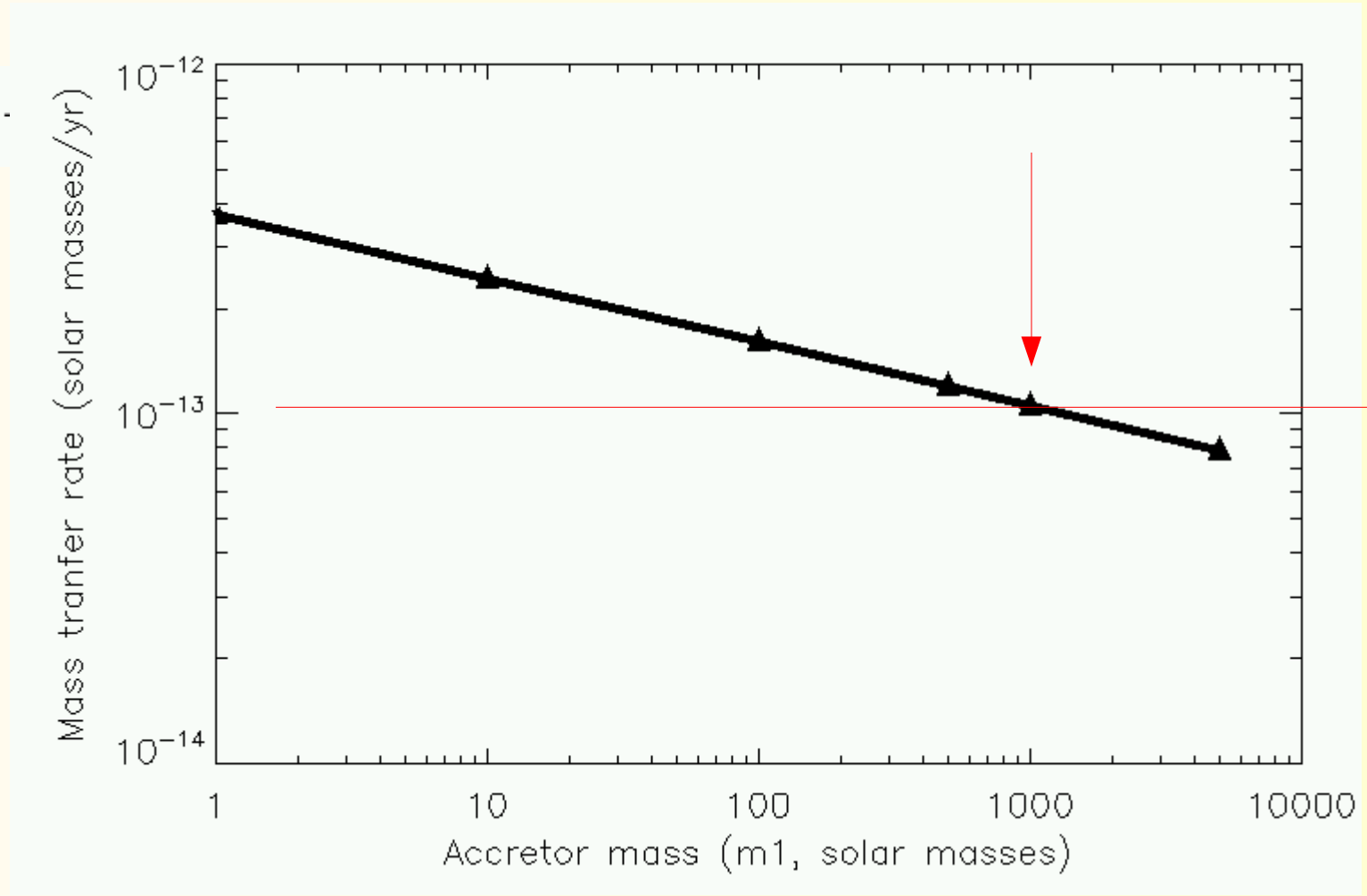

GRAZIE !!!