Scheda INAF (RSN4)
SFXT-HMXB

Studio dell'accrescimento in Supergiant Fast X-ray Transients e altri tipi di High Mass X-ray Binaries

Coordinatrice: Lara Sidoli
(INAF-IASF Milano)

Audizione 10 maggio 2022

SFXT-HMXB: Team

Programma di ricerca in itinere

Team collaudato da anni di collaborazione:

Staff INAF:

Lara Sidoli, Nicola La Palombara, Martino Marelli (IASF-Milano)

Vito Sguera (OAS-Bologna)

Associati: Paolo Esposito (IUSS Pavia)

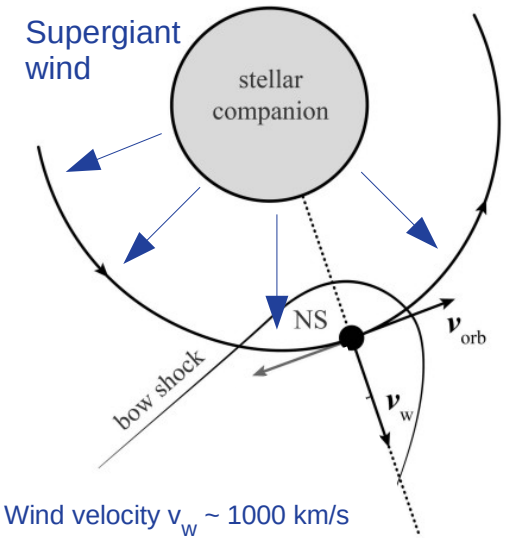
Tutti i membri sono staff

FTE totali: 1.75 (2022), 1.85 (2023), 1.85 (2024)

Per la maggioranza del team questa e' l'attivita' di **ricerca prevalente**

SFXT-HMXB: Aspetti scientifici

- **High Mass X-ray Binary**: a compact object (usually a strongly magnetized **neutron star**, NS) accreting from the wind of a **massive star** (M>10 $M_\odot$)



Wind velocity v_w ~ 1000 km/s

Bondi-Hoyle accretion from the wind
→ X-ray luminosity prop to wind density / vrel^3

(Mushtukov & Tsygankov 2022)

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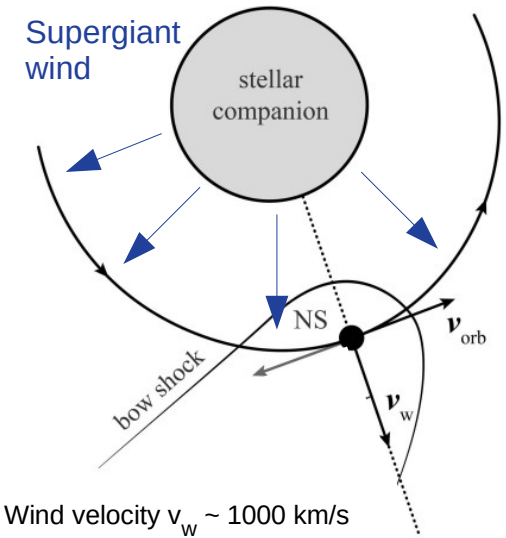

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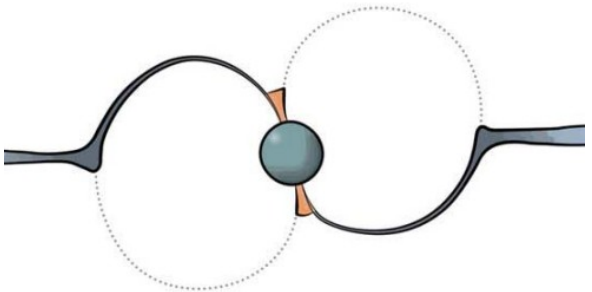
Often, but **not always**:
X-ray pulsar (10 s – 1e4 s)
NS magnetic field ~ 10^{12} G



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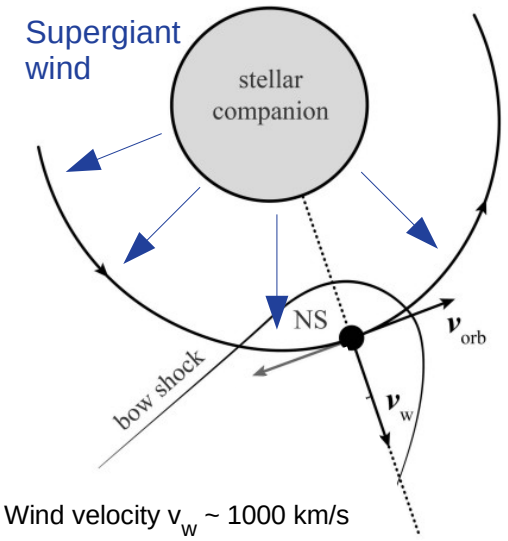

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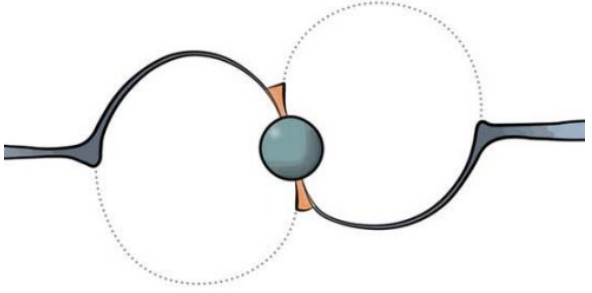

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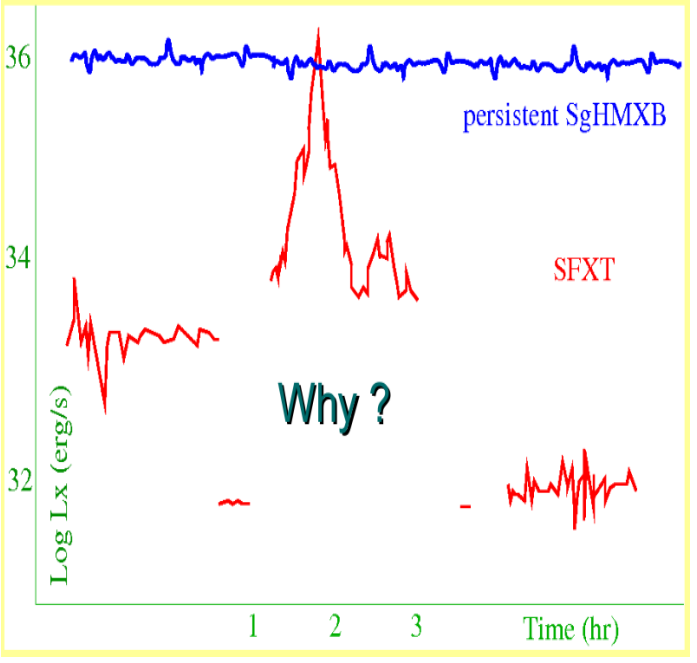


→ **a new class** of HMXBs: the **SFXTs** (Sguera et al. 2005)

SFXT-HMXB: Aspetti scientifici

The main competing models explaining SFXTs (propeller vs quasi-spherical settling accretion regime) predict that accretion can be halted most of the time, depending on the properties of the neutron star and the donor wind

But in **S**upergiant **F**ast **X**-ray **T**ransients:

- the **neutron star** properties (B field and Pspin) are mostly unknown
- the clumpy **supergiant wind** properties are mostly unknown
- Last, but not least, the orbital geometry...is mostly unknown too

SFXT-HMXB: Strategia (programmazione e prospettive)

Trying to explain **S**upergiant **F**ast **X**-ray **T**ransients involves:

An observational approach *to get info on the* ***neutron star*** *and* ***supergiant wind properties****, reducing the number of unknowns:*

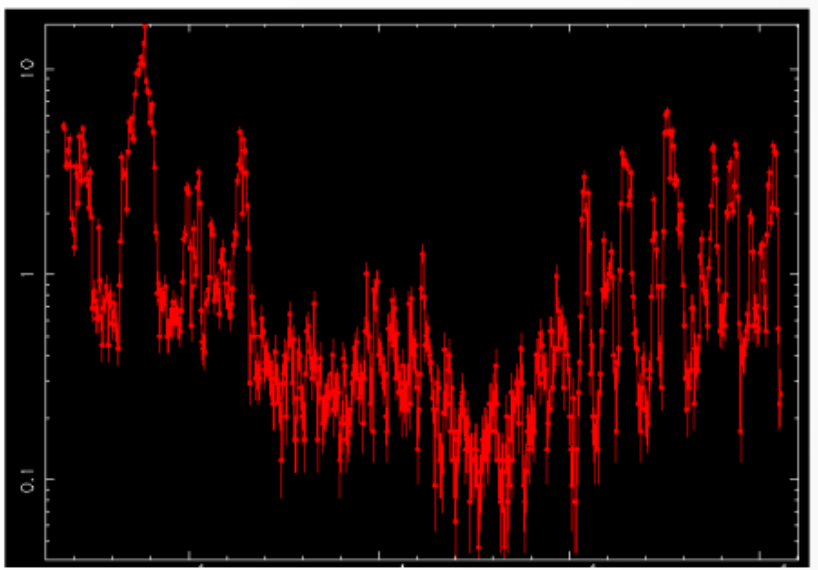
- X-ray observations: new proposals + data mining
  - (INTEGRAL, XMM-Newton→ EXTraS project, Chandra→ CATS@BAR project, NuSTAR, Swift…)
- Investigation of **single** interesting sources **+** studies of **samples**
- Identifying **new members of the SFXT class**
- **Multiwavelength studies**: optical/IR + mm + radio (ongoing international collaborations with **experts of winds** from **supergiant stars**)

A theoretical approach*: ongoing international collaborations with experts of* ***accretion theory***

SFXT-HMXB: Risultati recenti (I)

Characterizing **SFXT flare** properties

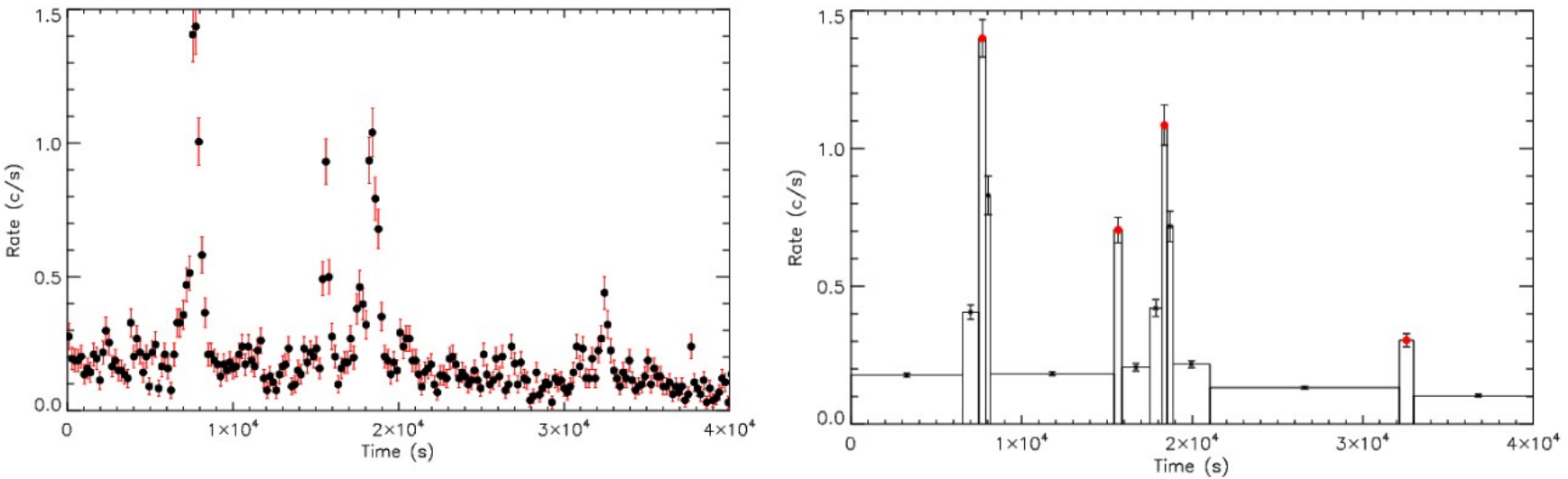
(rise and decay time, waiting time, flare duration, peak luminosity, emitted energy)
Example of an SFXT light curve from an XMM-Newton observation



Aim: Selecting flares from an SFXT light curve and **compare** flare properties **with theoretical models**

SFXT-HMXB: Risultati recenti (I)

Selecting flares in SFXTs lightcurves can be a difficult task.
Therefore we made use of the XMM lightcurves, segmented in **Bayesian blocks** made publicly available by the **EXTraS** project



This allowed us to pick out **144 flares** from **9 SFXTs** in the **XMM archive**

Flare properties seem to favor the quasi-spherical settling accretion model (Sidoli et al. 2019)

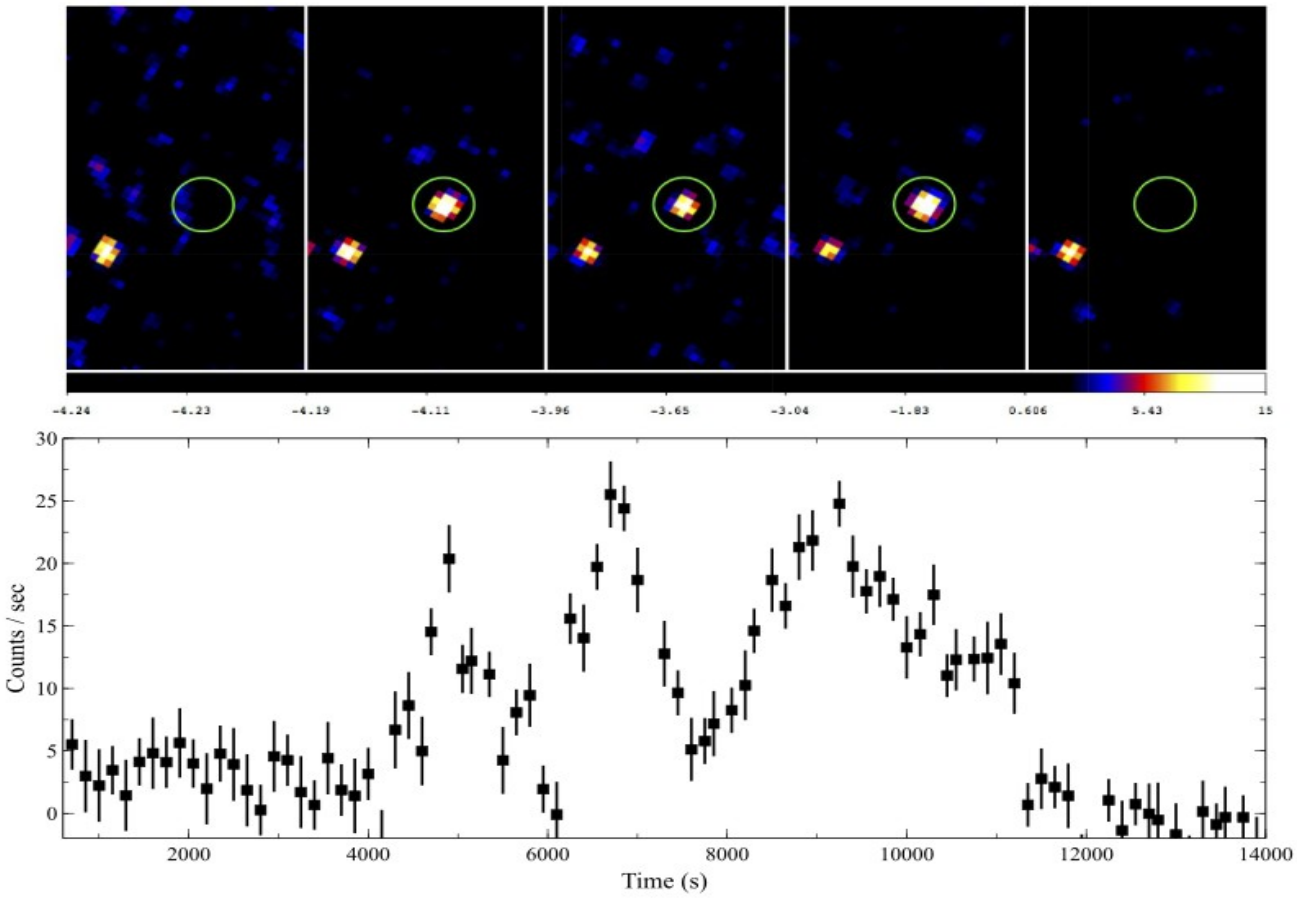
We have applied for funding to continue this project (using more recent XMM public data)

SFXT-HMXB: Risultati recenti (II)

Searching for **new candidate SFXTs** in INTEGRAL observations

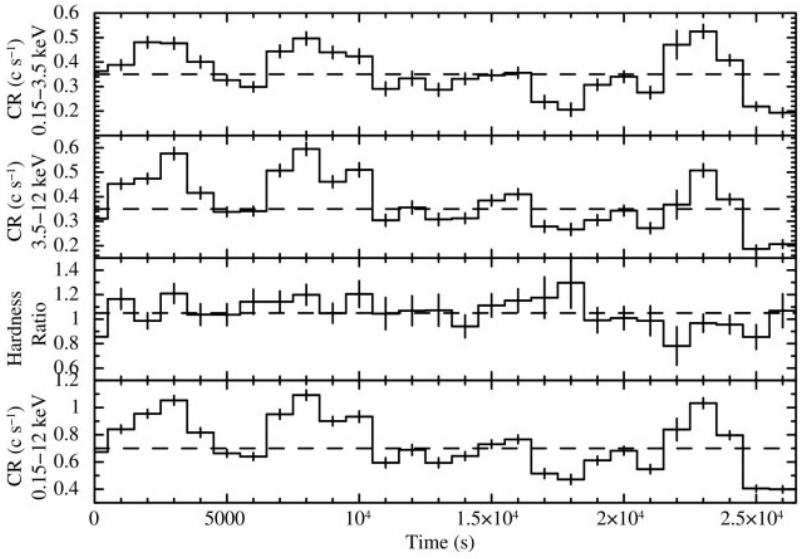
(from Sguera et al. 2005 - the discovery of the class - to Sguera et al. 2020 INTEGRAL observations are an efficient machine for the discovery of new candidate SFXTs)

Swift monitoring +
Accepted XMM ToO program



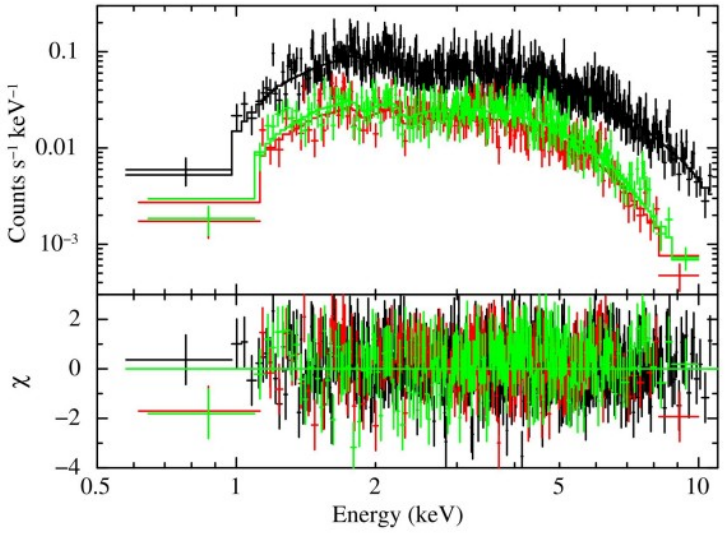
SFXT-HMXB: Risultati recenti (III)

It is crucial to compare the SFXTs properties with other types of HMXBs **persistent supergiant HMXBs** and **Be/X-ray binaries**, to put all systems into context



The BeXRB pulsar CXOU225355.1+624336

XMM-Newton



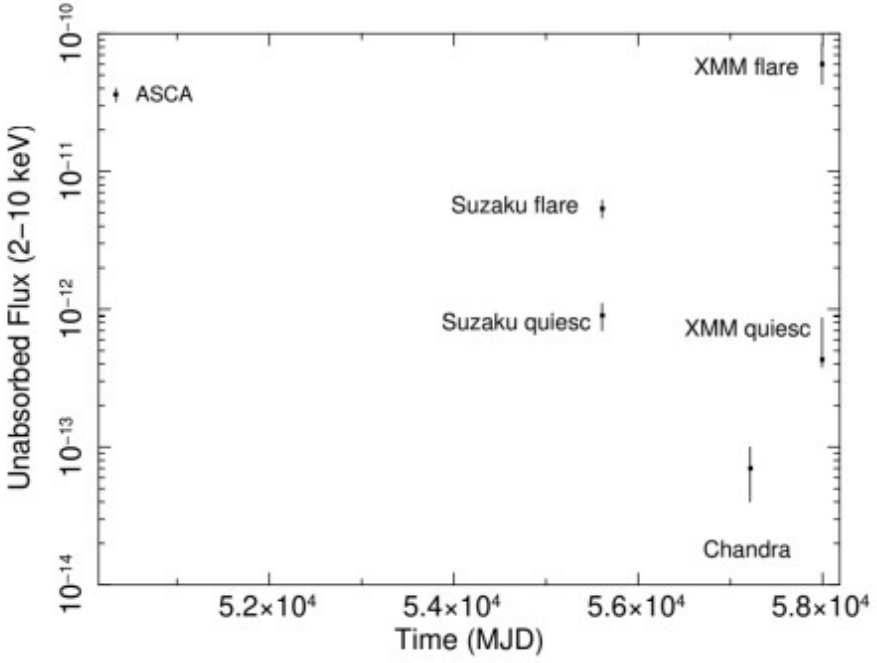
(La Palombara et al. 2021)

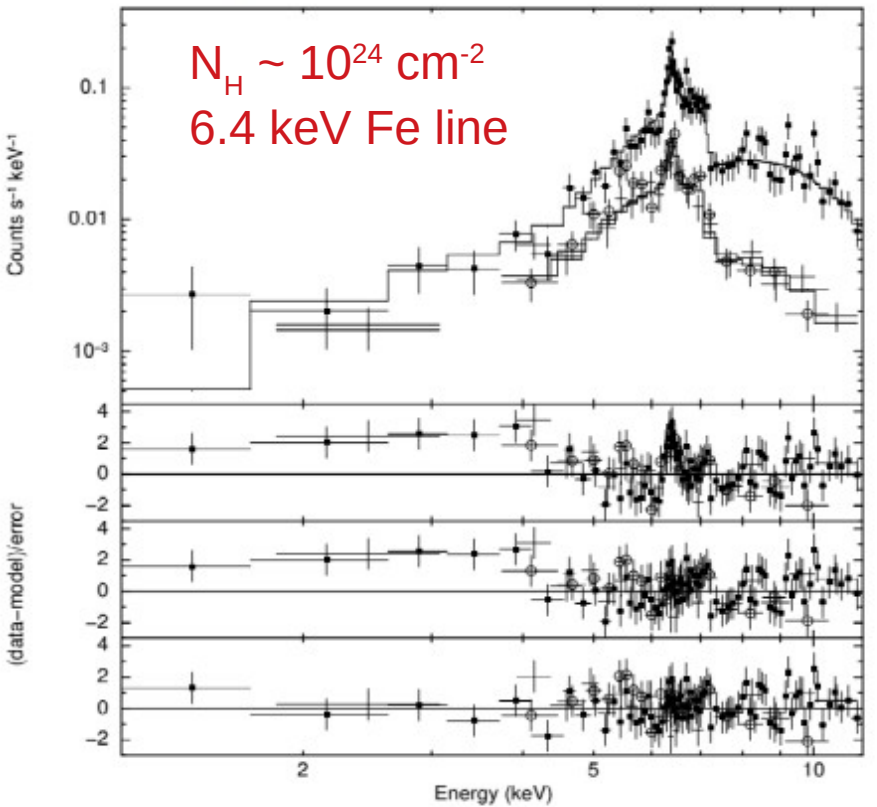
SFXT-HMXB: Risultati recenti (IV)

Our most recent published result:
The discovery of a very high obscuration in the candidate SFXT *AXJ1714.1-3912*

*We found an hidden pearl in the **XMM public archive***

(Sidoli, Sguera, Esposito et al. 2022)





SFXT-HMXB: Fondi

- Attualmente il nostro programma di ricerca non ha finanziamenti
- Abbiamo sottomesso una richiesta di finanziamento come mini-grant per lo sfruttamento ulteriore di osservazioni d'archivio XMM-Newton di SFXTs

SFXT-HMXB: Leadership

- Il nostro team svolge un ruolo di **leadership a livello internazionale** nello studio delle High Mass X-ray Binaries e delle **Supergiant Fast X-ray Transients** in particolare

SFXT-HMXB: Punti critici

- Attualmente il principale punto critico e' la mancanza di **fondi** per poter mantenere vive le nostre collaborazioni internazionali (congressi e riunioni) e iniziarne di nuove

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- E infine, sembra scontato dirlo: servono **piu' osservazioni**

Grazie per l'attenzione !