Sitting on the lowest X-ray luminosity state in a Supergiant Fast X-ray Transient

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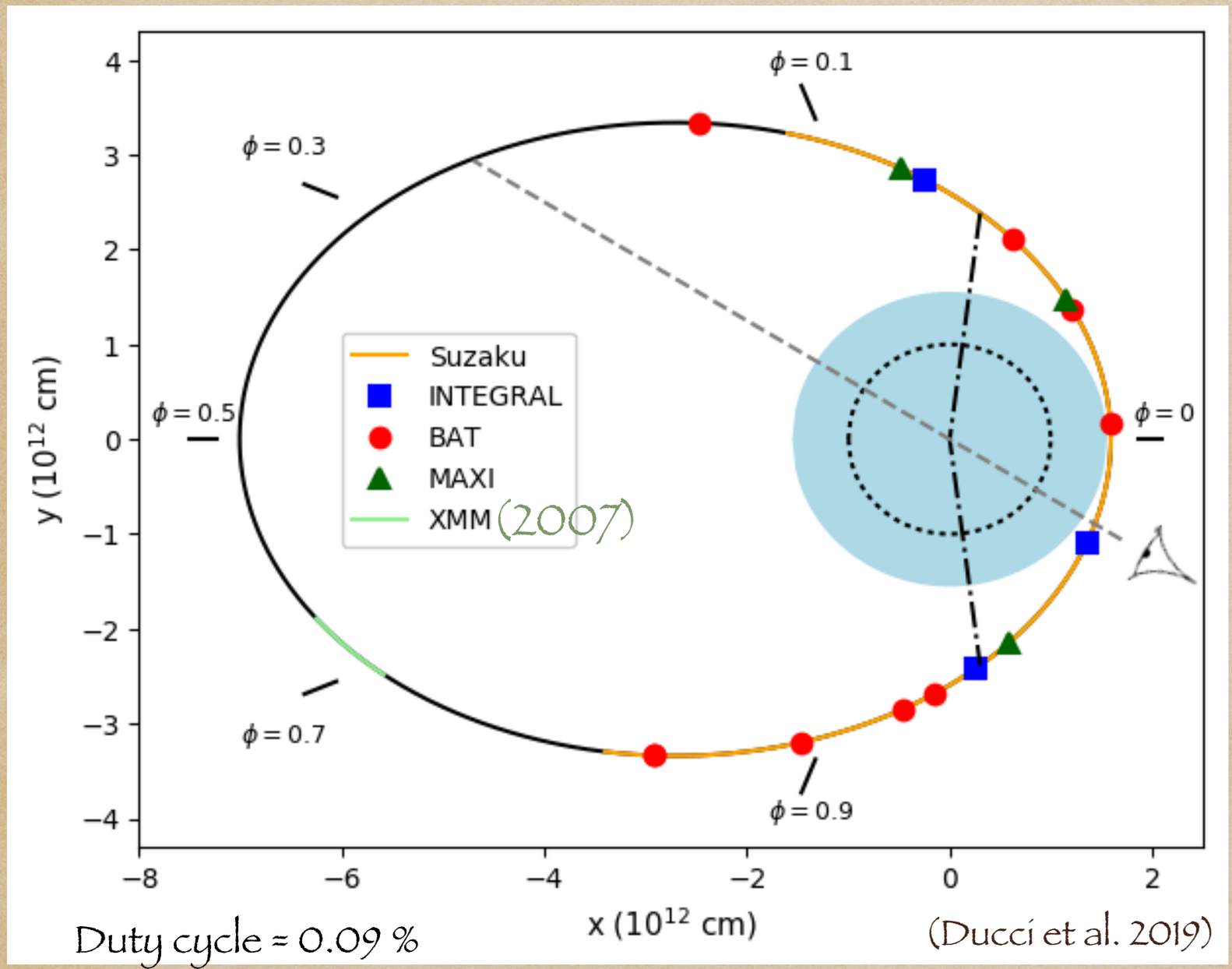
IGR J08408-4503

Discovered by Goetz et al. 2006

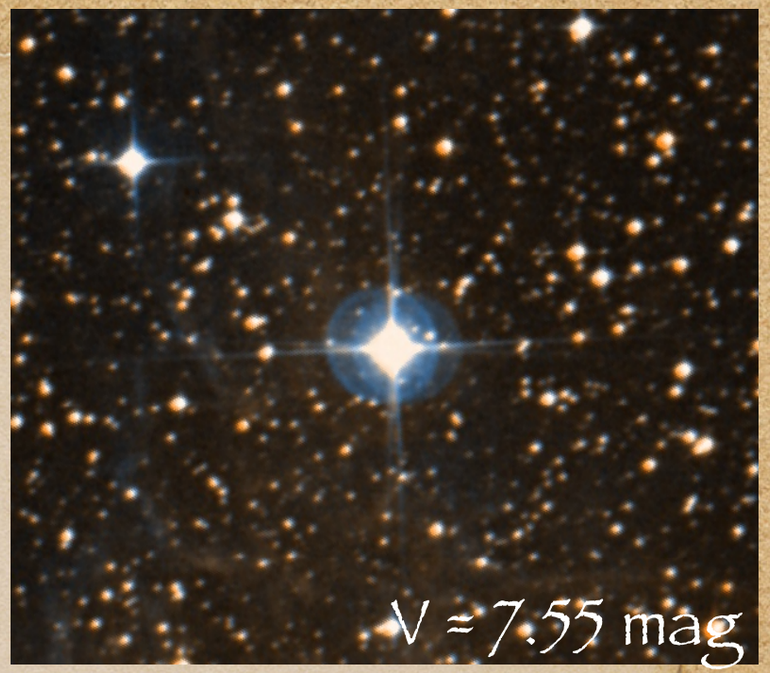
Recognized as a recurrent transient by Mereghetti et al. 2006.



Duty cycle = 0.09 %

(Sidoli & Paizis 2018)

(Ducci et al. 2019)



LM Vel

O 8.5Ib-II(f)p

(Kennea & Campana 2006, Masetti et al. 2006)

Porb = 9.54 days

ecc = 0.63

(Gamen et al. 2015)

dist = 2.2 kpc

IT IS **THE SFXT** WITH THE **LOWEST ABSORPTION** & A **WELL KNOWN ORBIT**AL GEOMETRY

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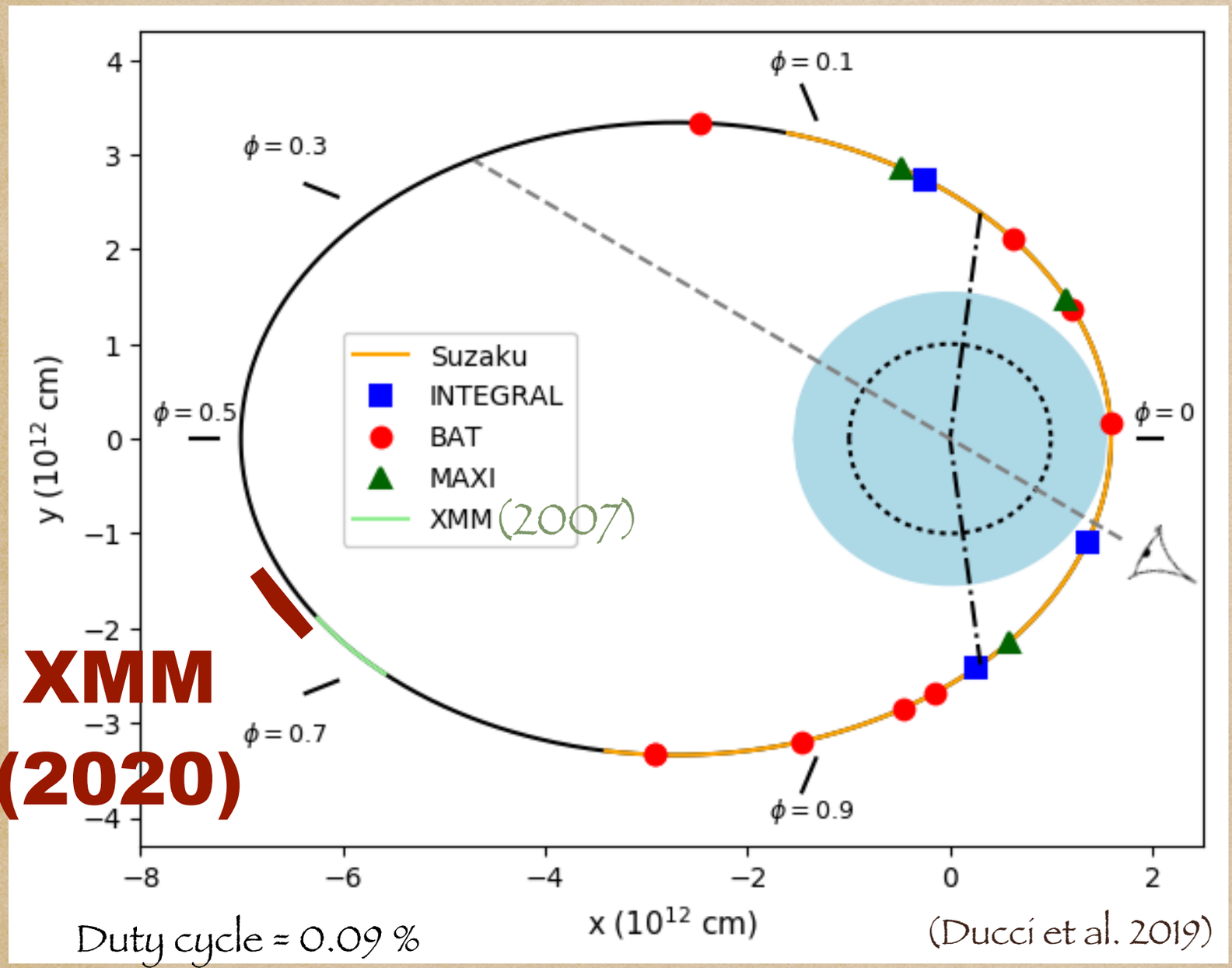

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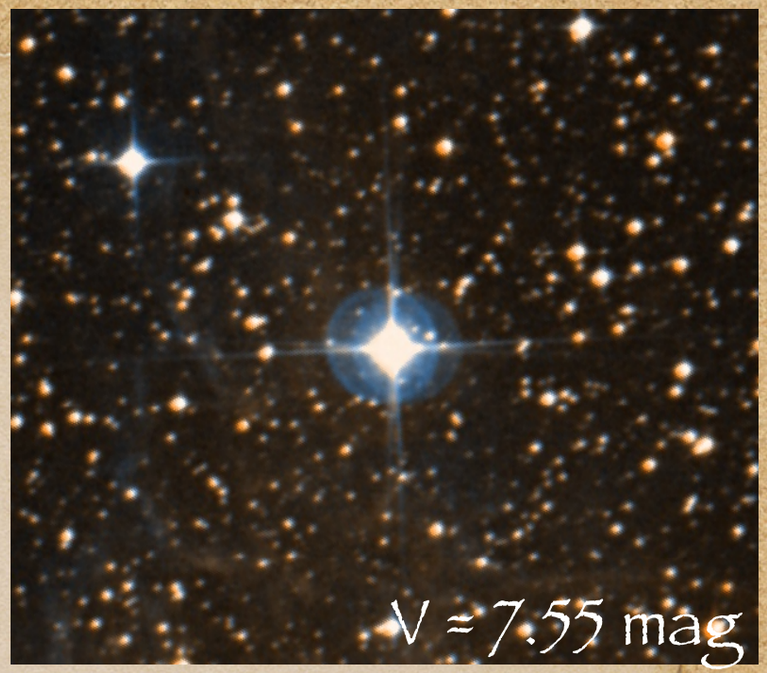

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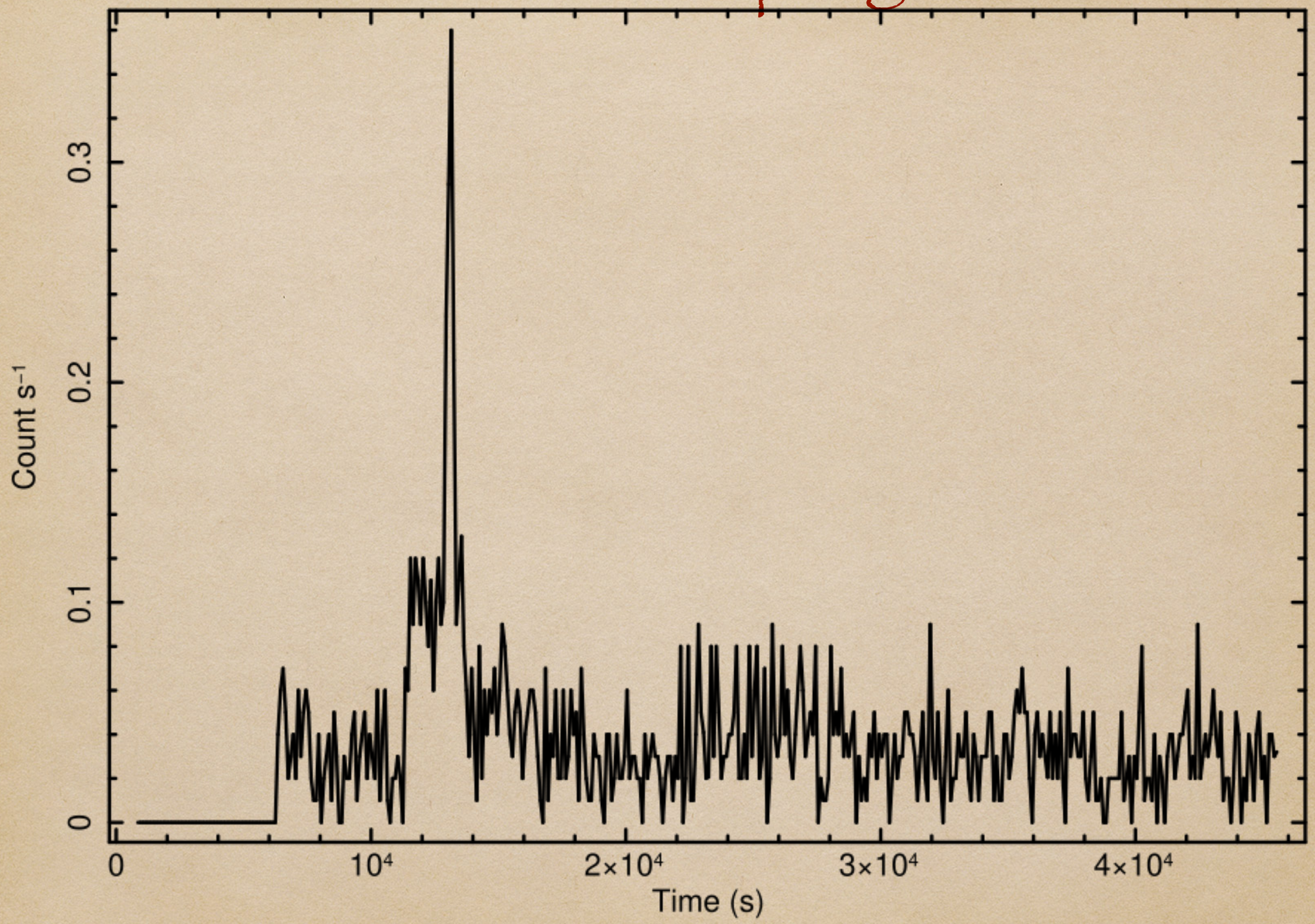
XMM-Newton EPIC pn light curve



Sidoli et al. 2021

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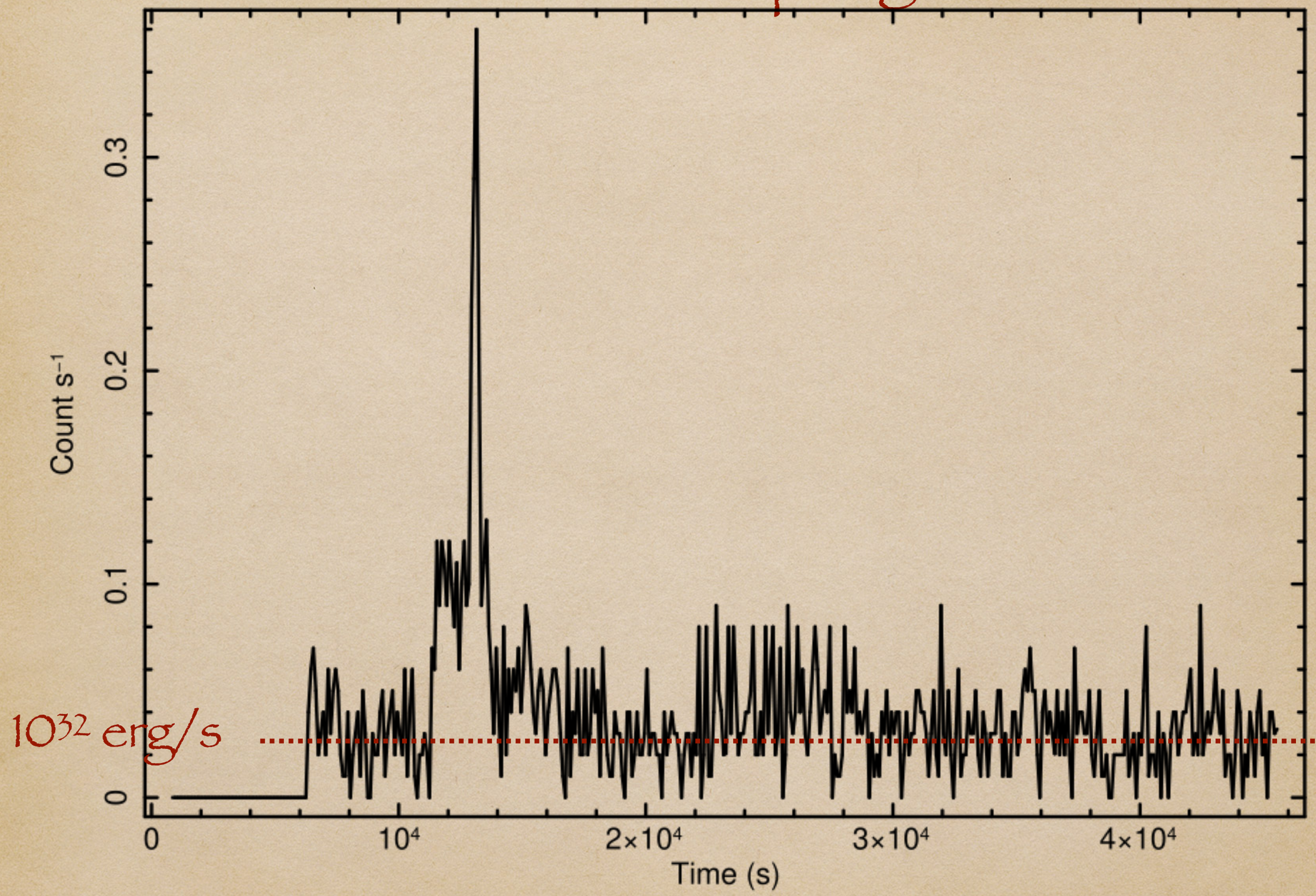
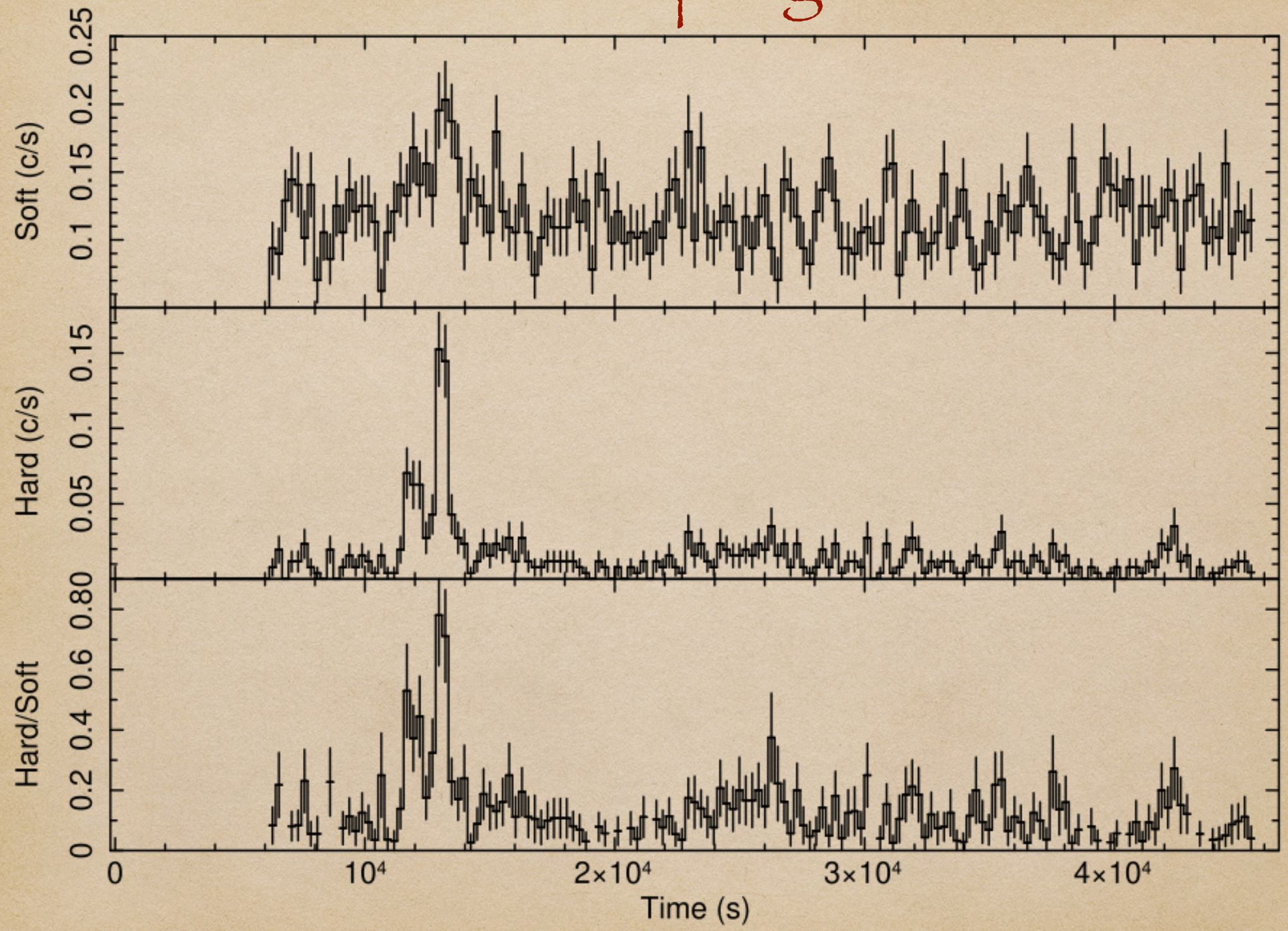


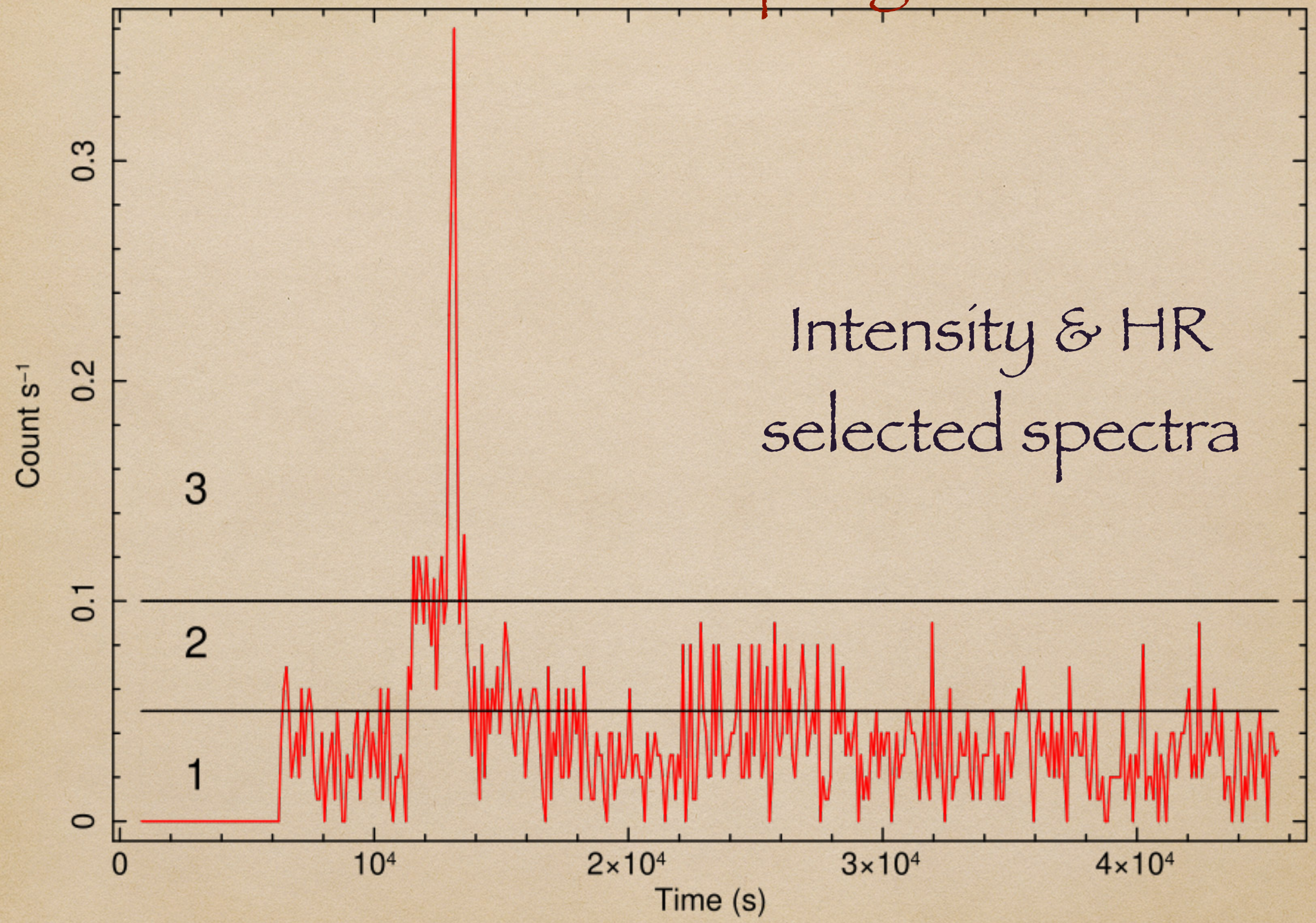
Sidoli et al. 2021

XMM-Newton EPIC pn light curve & HR



Sidoli et al. 2021

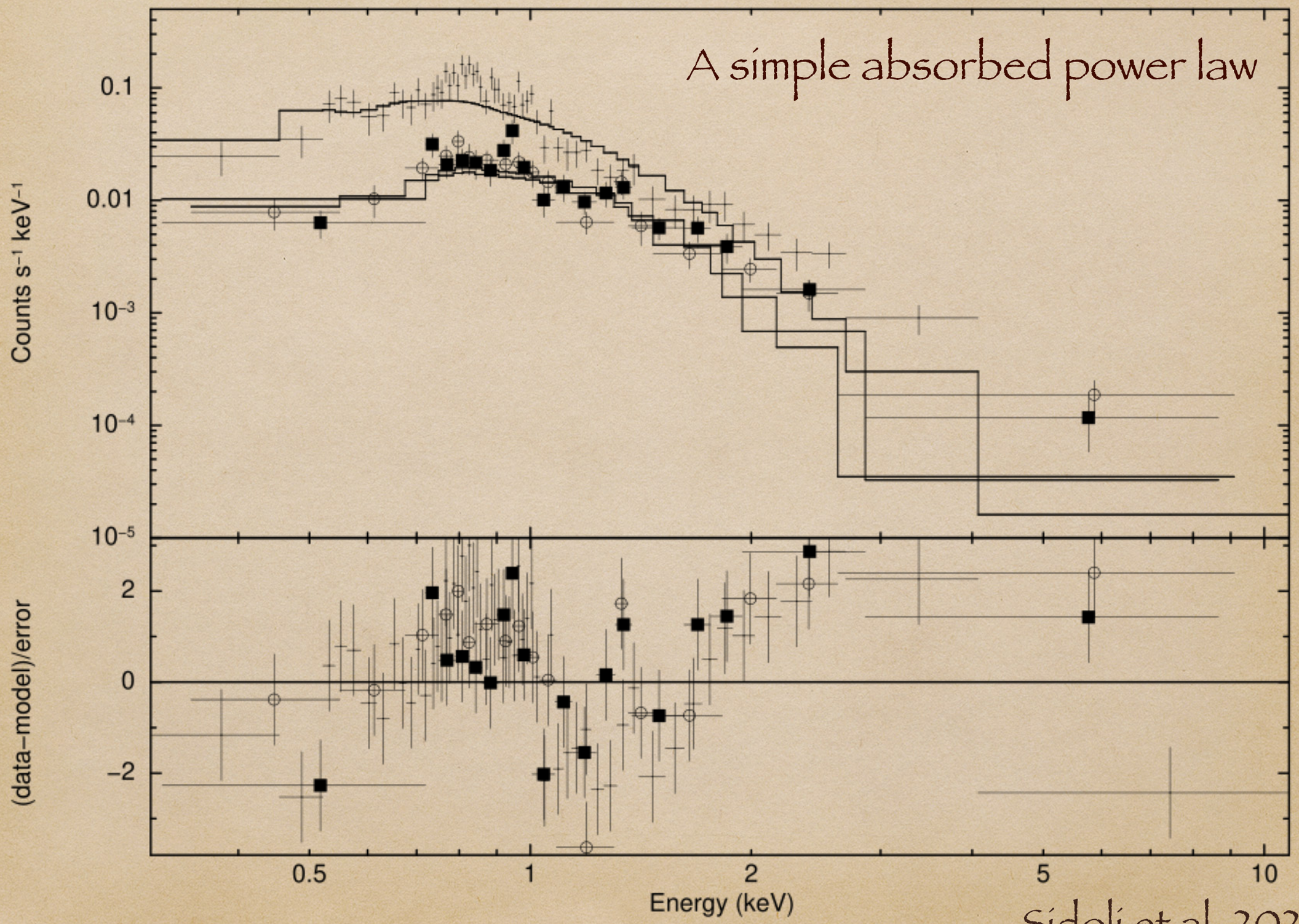
XMM-Newton EPIC pn light curve



Intensity & HR selected spectra

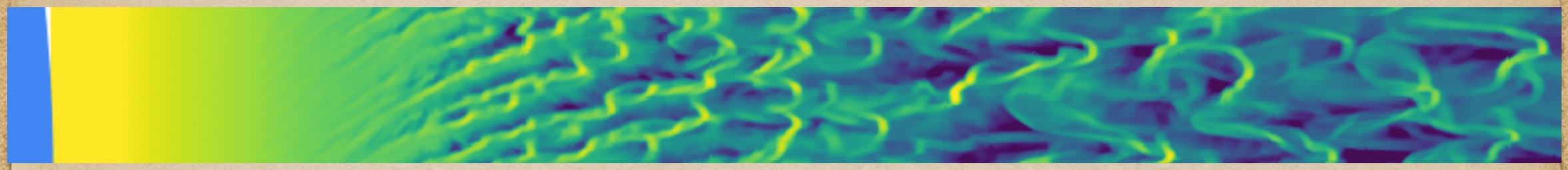
Sidoli et al. 2021

Spectroscopy of the lowest emission (1)



Sidoli et al. 2021

LM Vel is by itself an intrinsic source of X-rays



The shocked wind plasma
emits thermal X-rays

Typically O-type supergiants display a double component thermal emission with

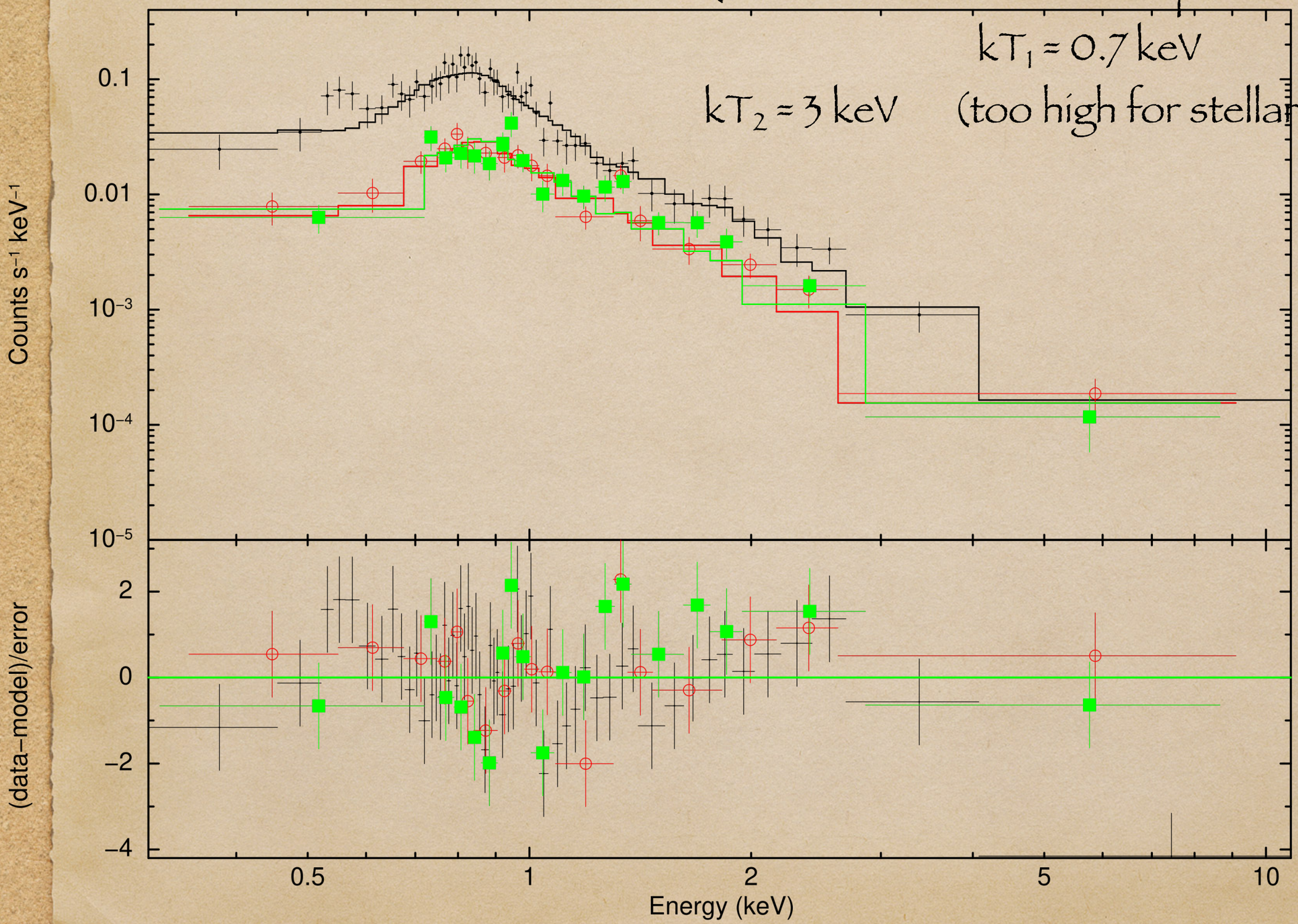
$kT_1 = 0.2\text{-}0.3$ keV

$kT_2 = 0.7\text{-}0.8$ keV

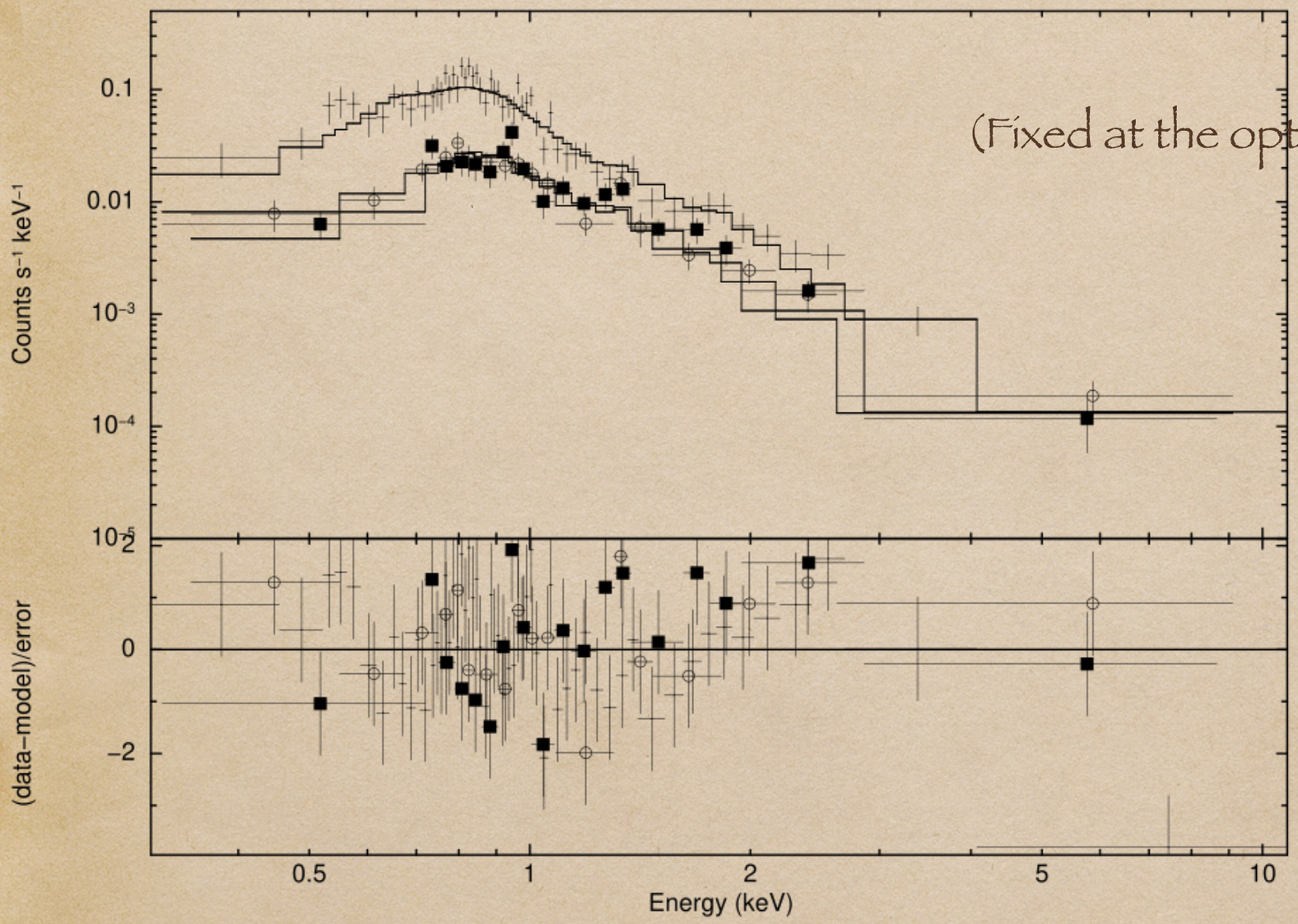
$Lx = 10^{31} - 10^{32}$ erg / s

A good fit, BUT: $N_H < 5 \times 10^{20}$ cm^{-2}

(too low! Lower than the optical extinction)



Spectroscopy of the lowest emission (1)
2 APEC models + power law



$N_H = 3.9 \times 10^{21}$ cm^{-2}

(Fixed at the optical extinction, Av = 1.364 mag)

$kT_1 = 0.24$ keV

$kT_2 = 0.76$ keV

Powerlaw

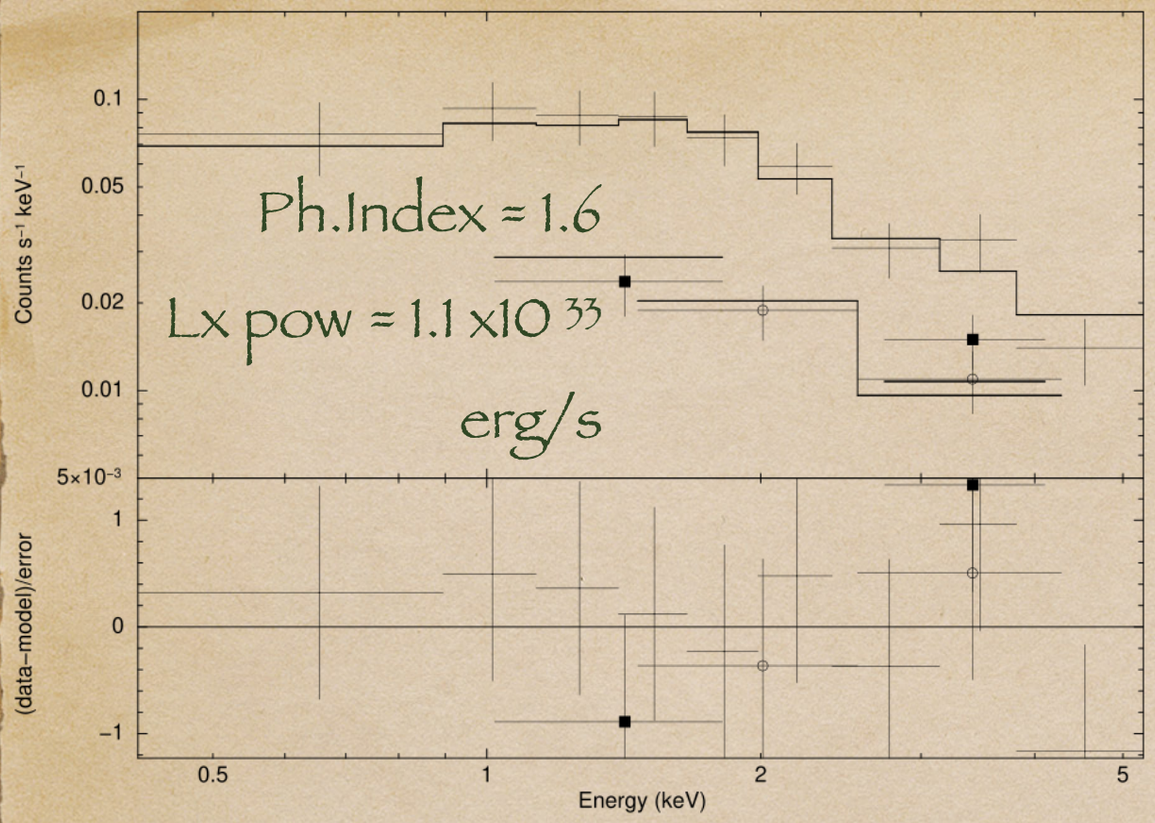
ph.index = 2.6

Lx = 4.8 x 10^{31} erg/s

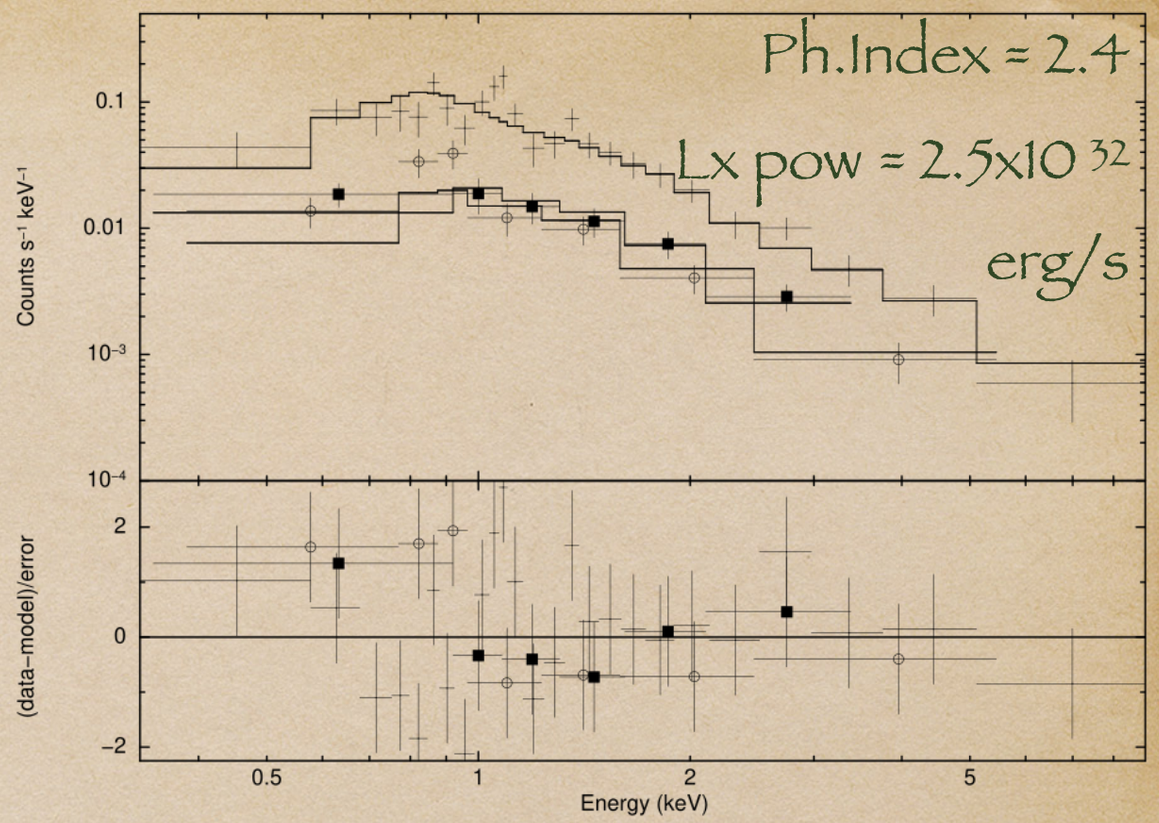
(POW ONLY!)

Interpreted as residual accretion

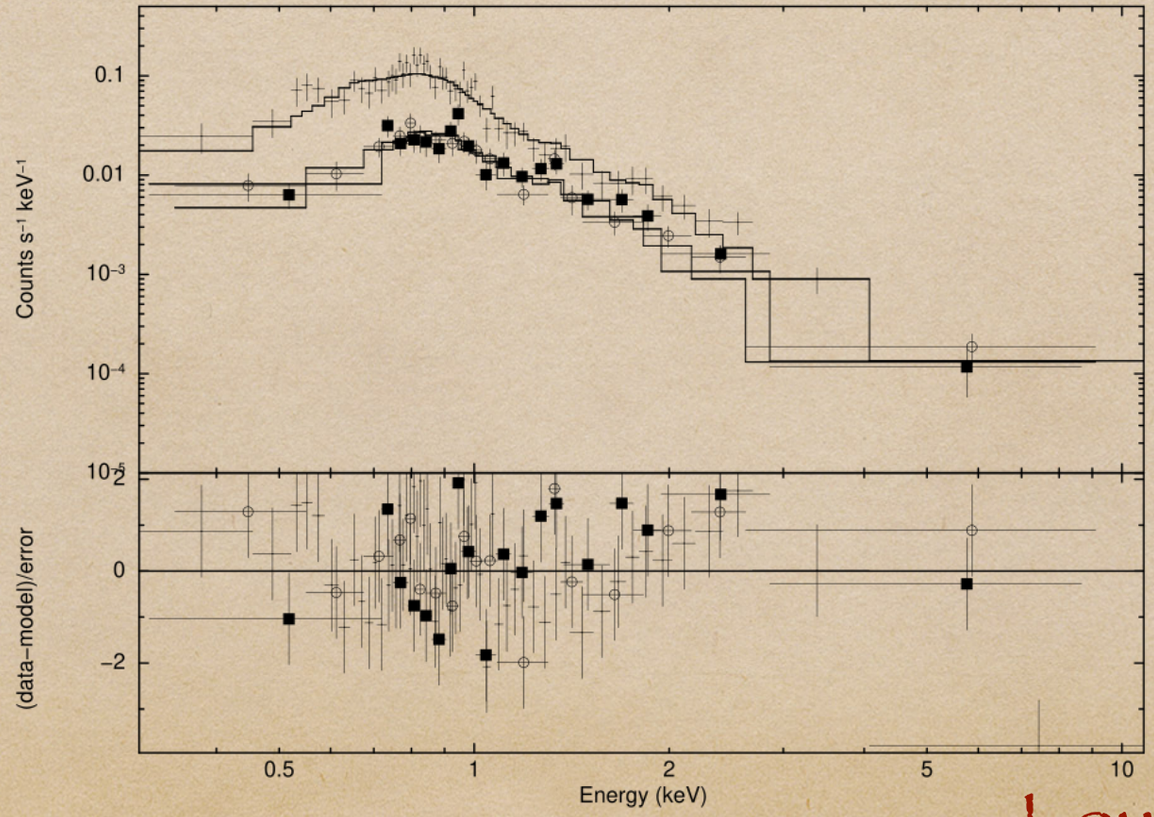
Faint Flare (3)



Intermediate level (2)



Intensity selected spectroscopy: fixing the 2 APEC params, the power law hardens and becomes brighter and brighter

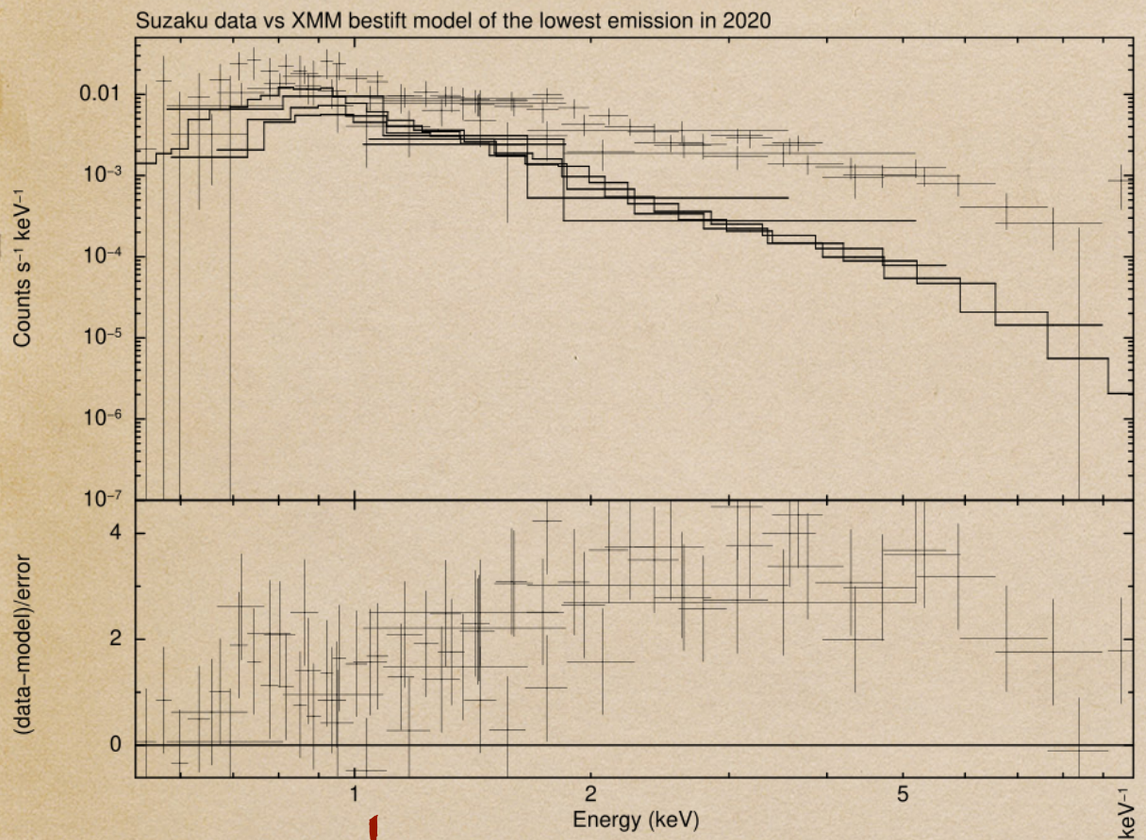


Ph.Index = 2.6

Lx pow=4.8x10 31 erg/s

Lowest emission (1)

Comparison with previous observations during faint X-ray states of IGR J08408

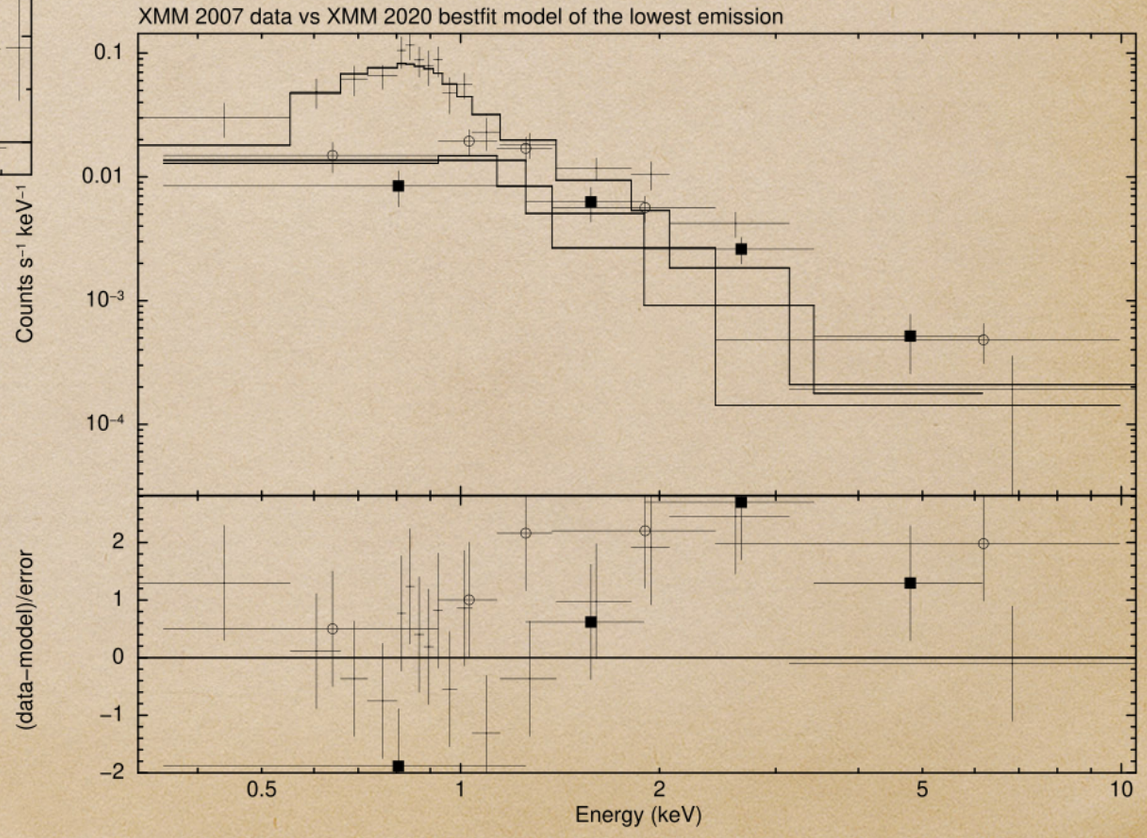


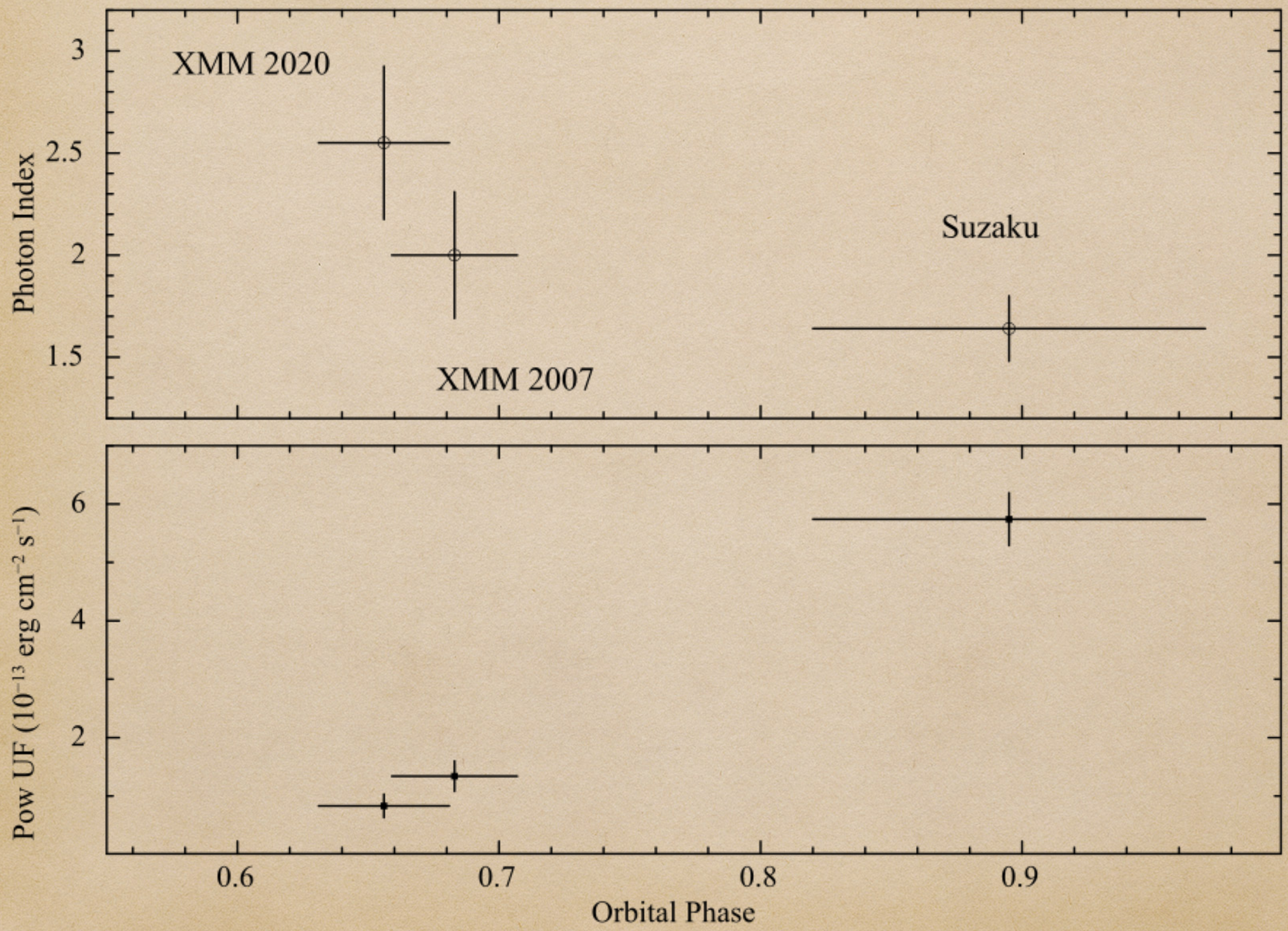
Suzaku

The X-ray emission from both previous observations is brighter and harder (but the softest region is well accounted for by the 2 APEC models of the XMM 2020 observation)

Residuals fixing spectral params at the best-fit of lowest state in the XMM 2020 observation

XMM (2007)




XMM 2020
XMM 2007
Suzaku
Photon Index
3
2.5
2
1.5
Pow UF (10^{-13} erg cm^{-2} s^{-1})
6
4
2
0.6
0.7
0.8
0.9
Orbital Phase

Conclusions

- We have investigated the SFXT IGR J08408-4503 during its lowest luminosity state (caught by an XMM observation in June 2020)
- The very **low N_H** towards the SFXT, the sensitive **XMM** observation **and the dim X-ray state**, **allowed us**:
- **1)** - to study the intrinsic X-ray emission from the **O-type donor** LM Vel
- **2)** - to identify **the lowest X-ray luminosity state** ever observed from the compact object in a SFXT of $L_X = 4.8\ (+/-1.4) \times 10^{31}$ erg/s