Spectral and temporal properties of NGC 2992 across the years

FERO 10

Finding Extreme Relativistic Objects

Toulouse, 30 March -1 April, 2022

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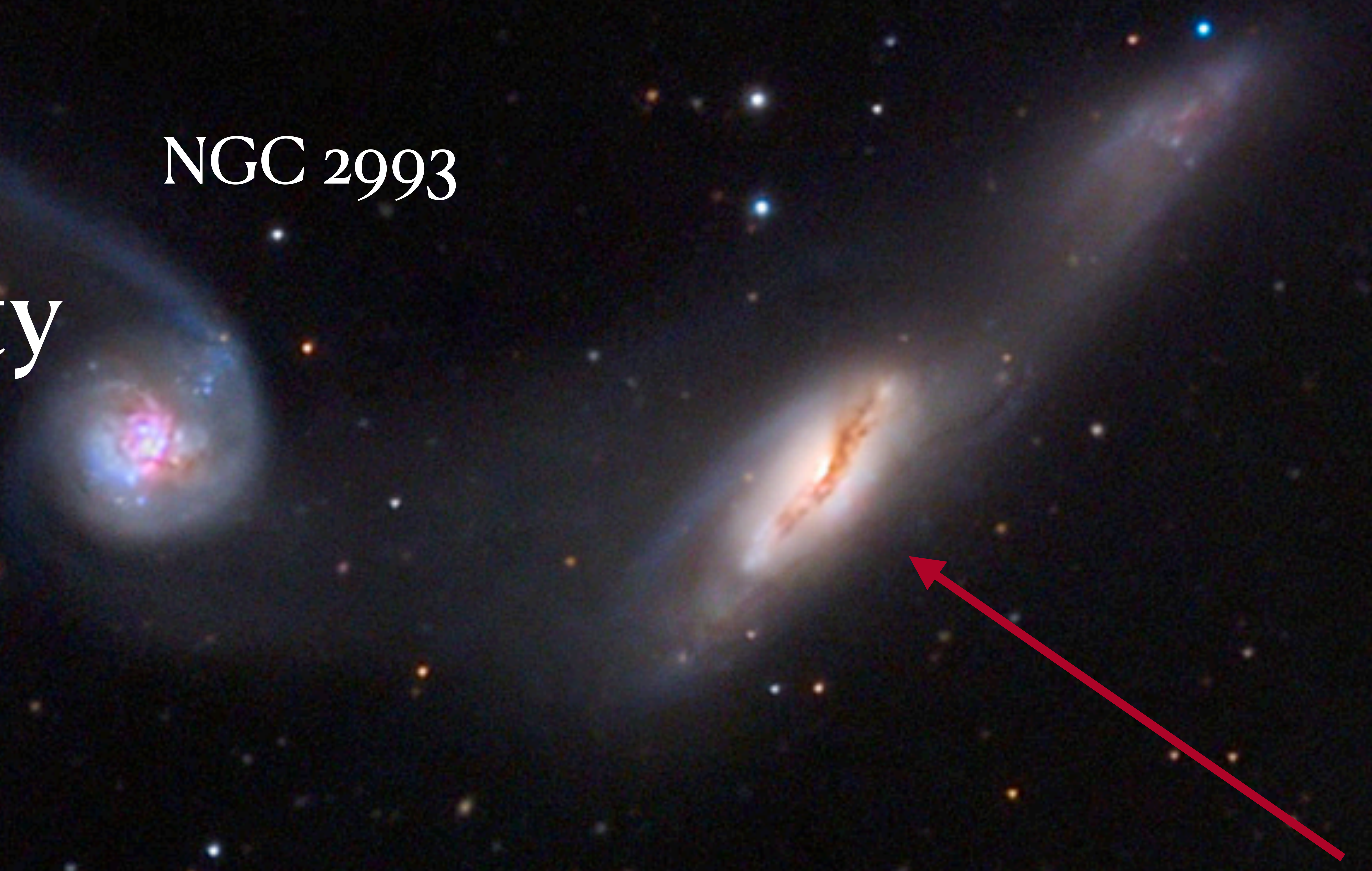
NGC 2992

z=0.00773

Outline

-Yearly variability
-Monthly variability
-Daily variability
-Ksec variability



NGC 2992: data availability

Rich dataset

~20 years of time coverage

XMM-Newton Science Archive

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Results #1

More than 10 XMM-Newton exposures

OBSERVATIONS (12)

Columns | Column units | Display selected | Add to Basket | Save table as | Send table to

Obs.ID	EPIC	RGS	BKGD	ESASky	Target	RA	DEC	Rev	Distance
0840920201					NGC 2992	09h 45m 42.04s	-14d 19' 35.0"	3555	0
0840920301					NGC 2992	09h 45m 42.04s	-14d 19' 35.0"	3556	0
0147920301					NGC 2992	09h 45m 41.99s	-14d 19' 35.0"	630	0.01
0654910301					NGC 2992	09h 45m 41.99s	-14d 19' 35.0"	1906	0.01
0654910401					NGC 2992	09h 45m 41.99s	-14d 19' 35.0"	1911	0.01
0654910501					NGC 2992	09h 45m 41.99s	-14d 19' 35.0"	1916	0.01
0654910601					NGC 2992	09h 45m 41.99s	-14d 19' 35.0"	1921	0.01
0654910701					NGC 2992	09h 45m 41.99s	-14d 19' 35.0"	1999	0.01
0654910801					NGC 2992	09h 45m 41.99s	-14d 19' 35.0"	2004	0.01
0654910901					NGC 2992	09h 45m 41.99s	-14d 19' 35.0"	2009	0.01
0654911001					NGC 2992	09h 45m 41.99s	-14d 19' 35.0"	2014	0.01
0701780101					NGC 2992	09h 45m 41.99s	-14d 19' 35.0"	2458	0.01

Space Science Data Center

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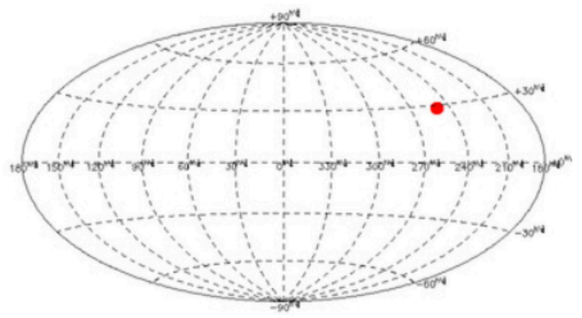
Multi-Mission Interactive Archive

Query results for: **NGC 2992**
RA = **146.425188** (deg); DEC = **-14.326361** (deg); EQUINOX = **2000**
Source name resolved by **SIMBAD**



Source Names

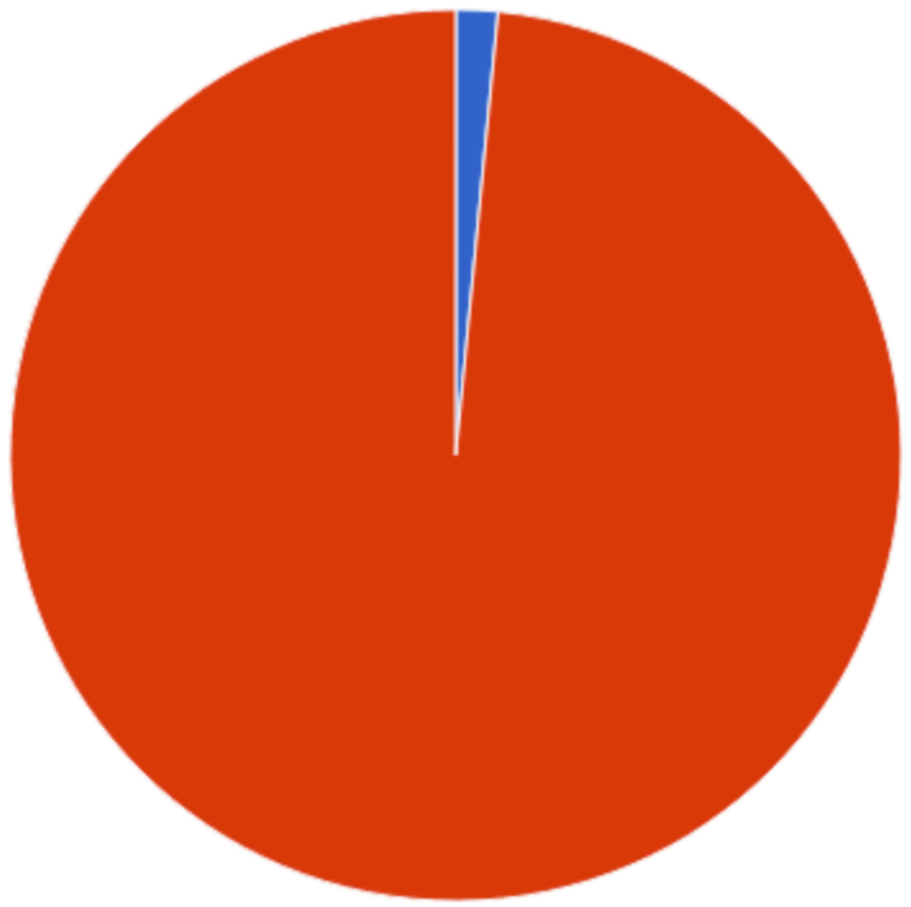
Bibliographic search

NGC2992

in time range between 1900 and 2022

By name via NED

By coordinates via ADS

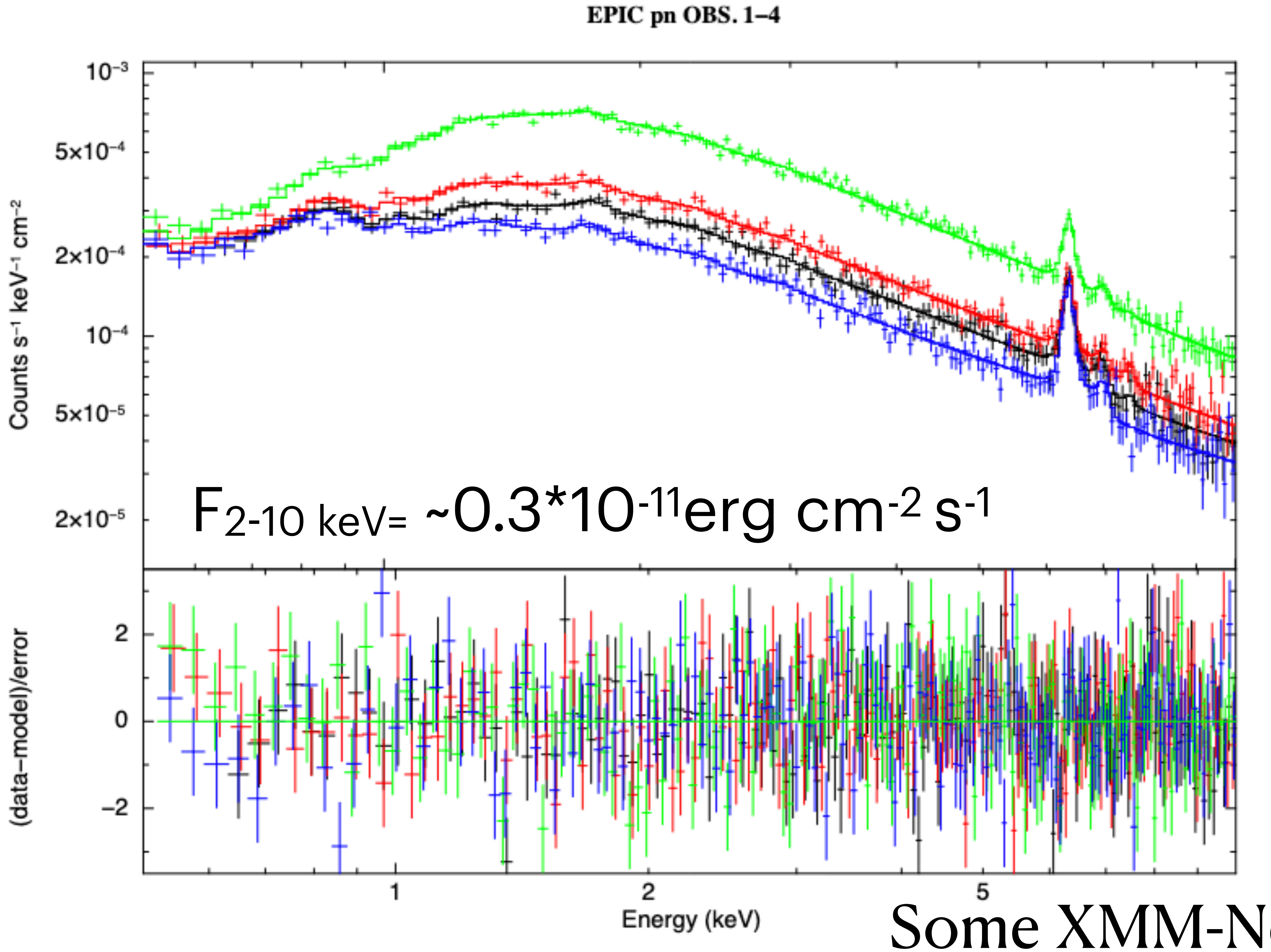


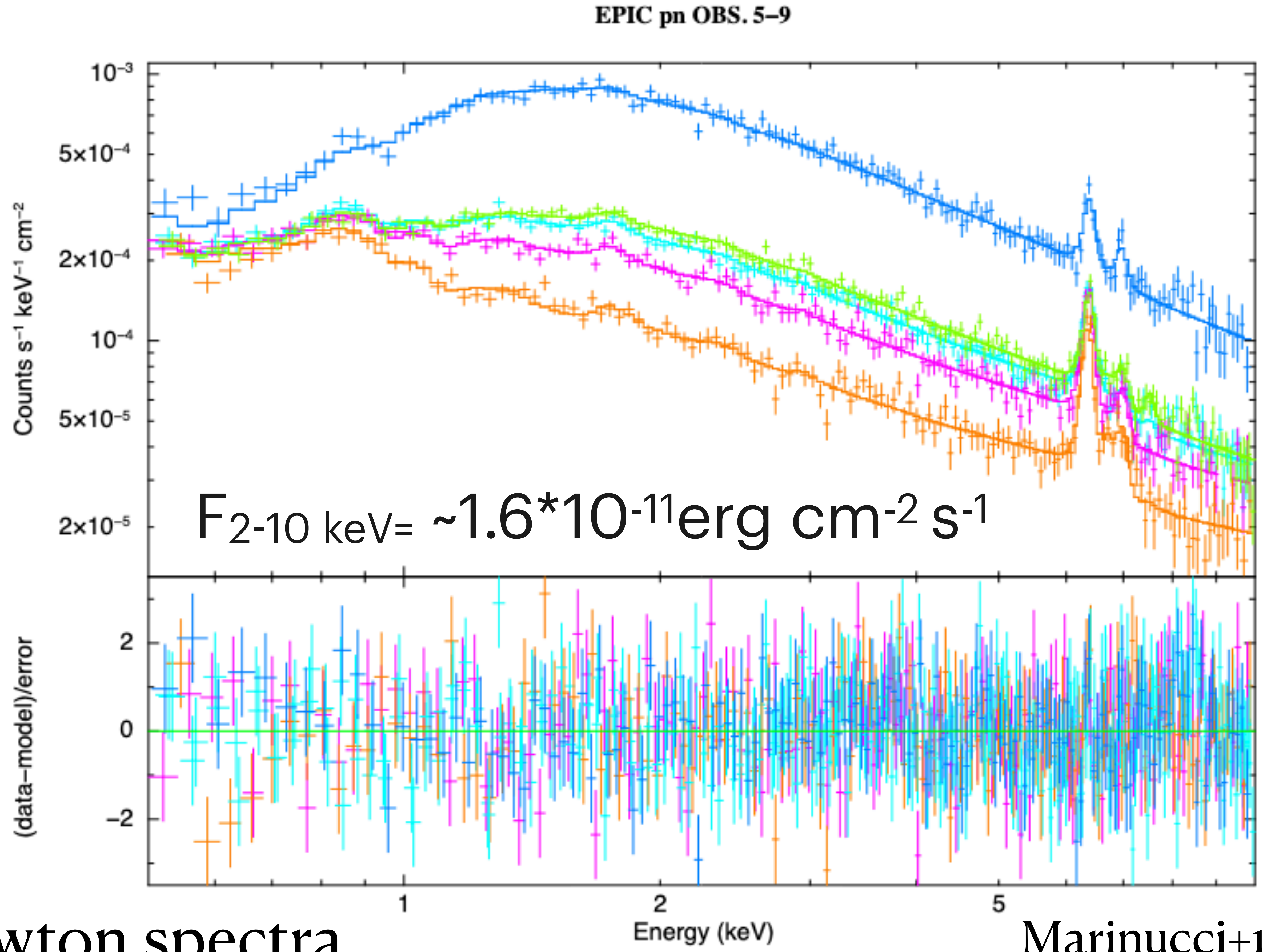
MISSION	ENTRIES
NUSTAR	2
SWIFT	130

NGC 2992: data availability

Rich dataset

~20 years of time coverage

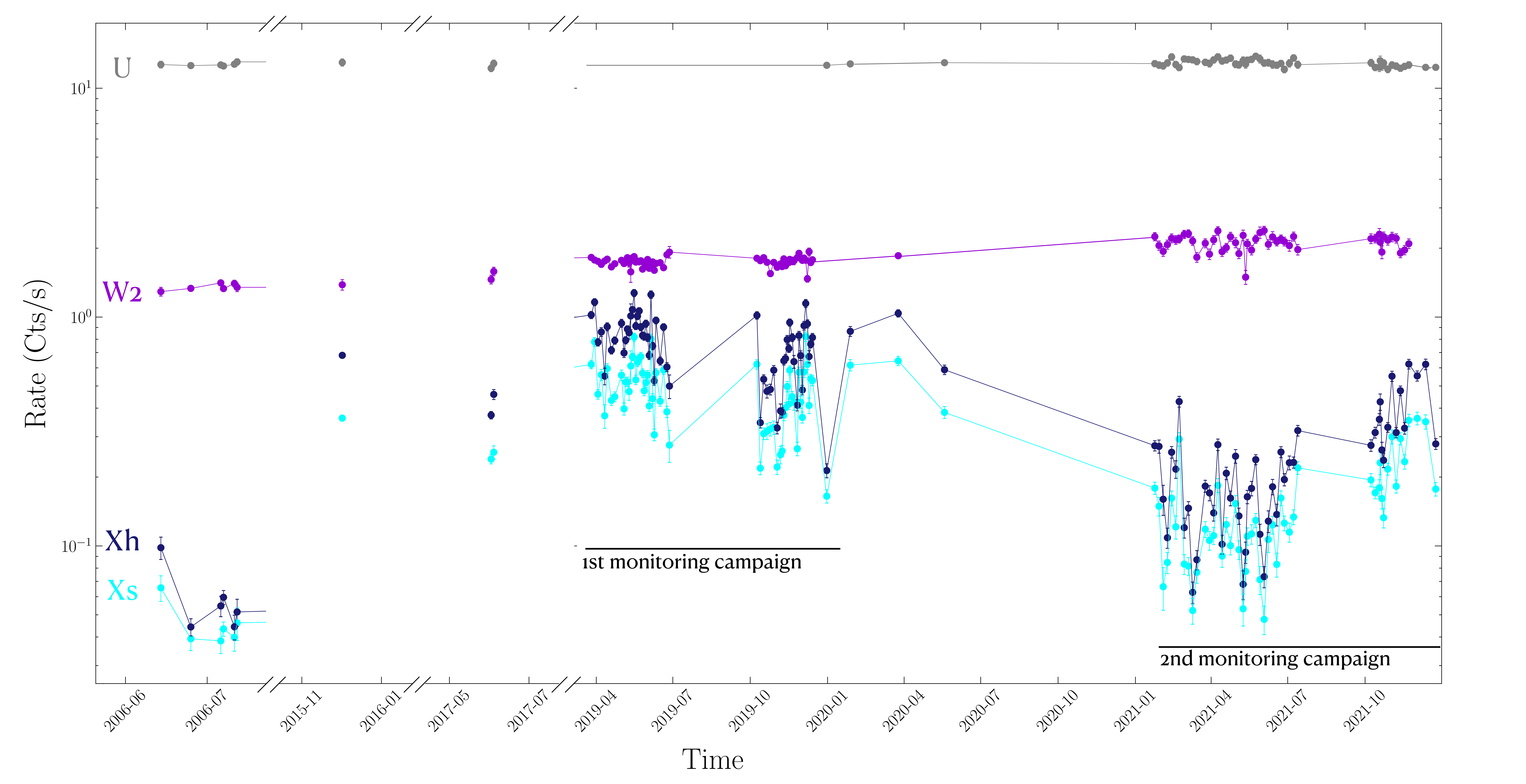




Some XMM-Newton spectra

Marinucci+18

NGC 2992 as observed by Swift: light curves



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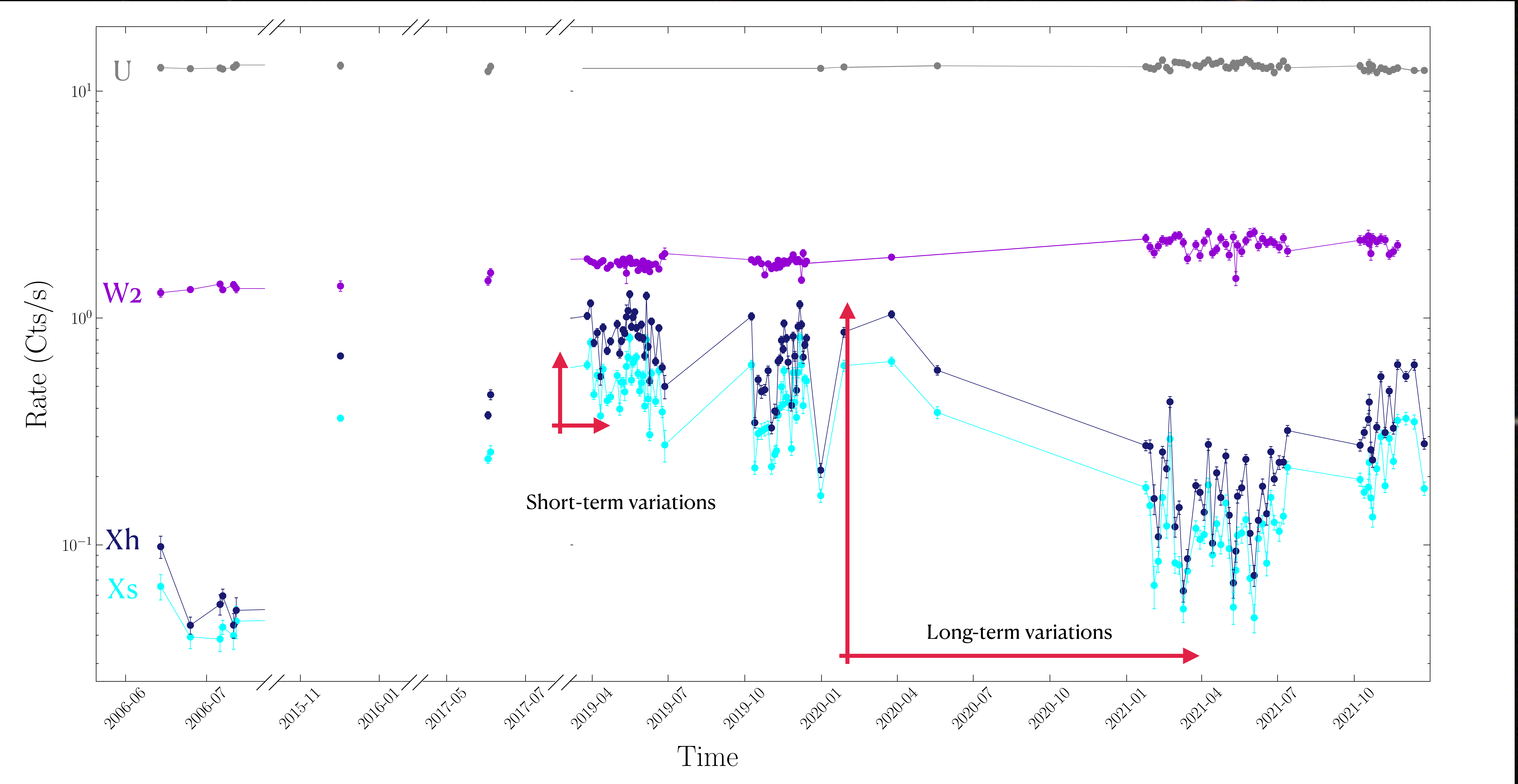

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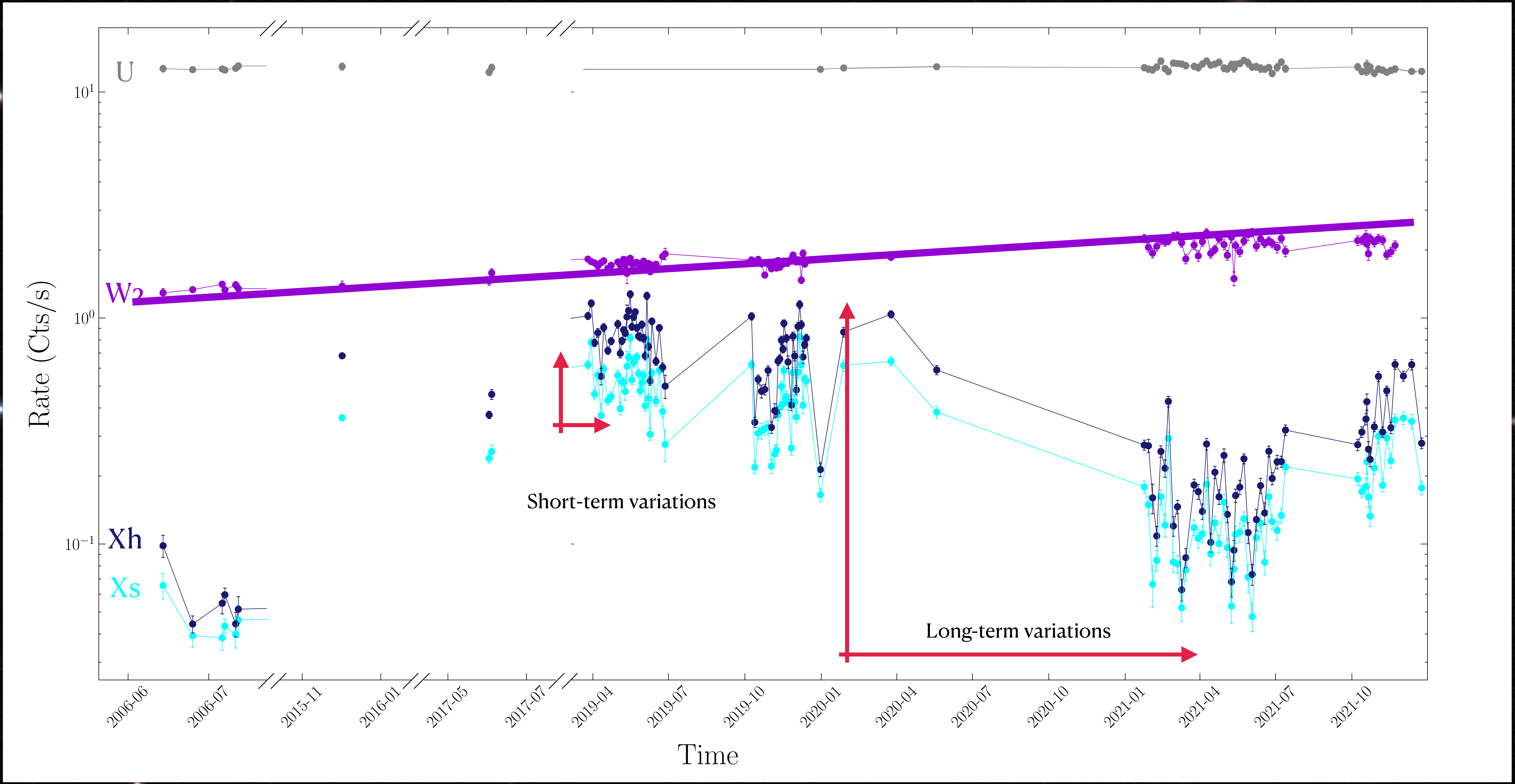
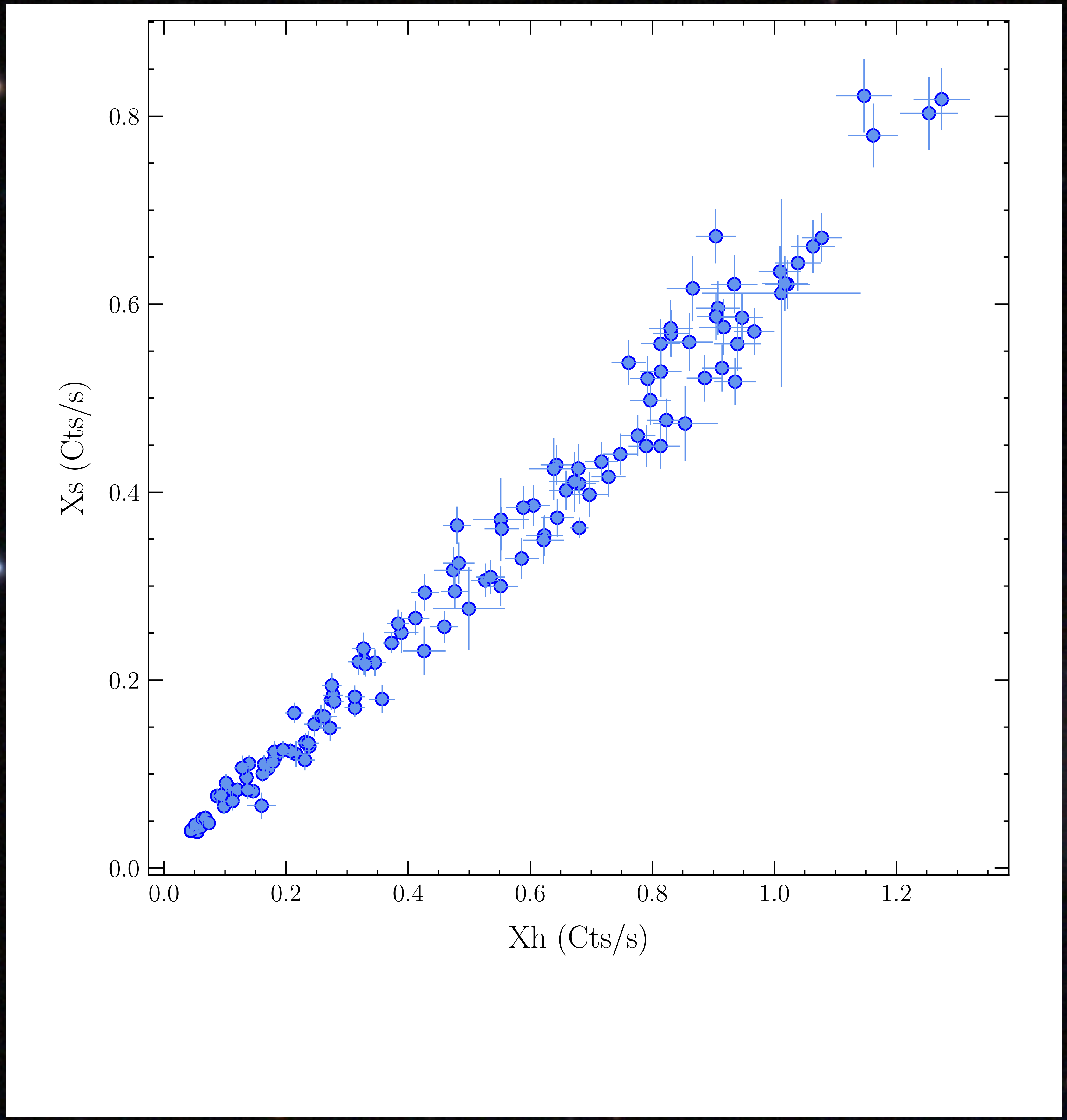


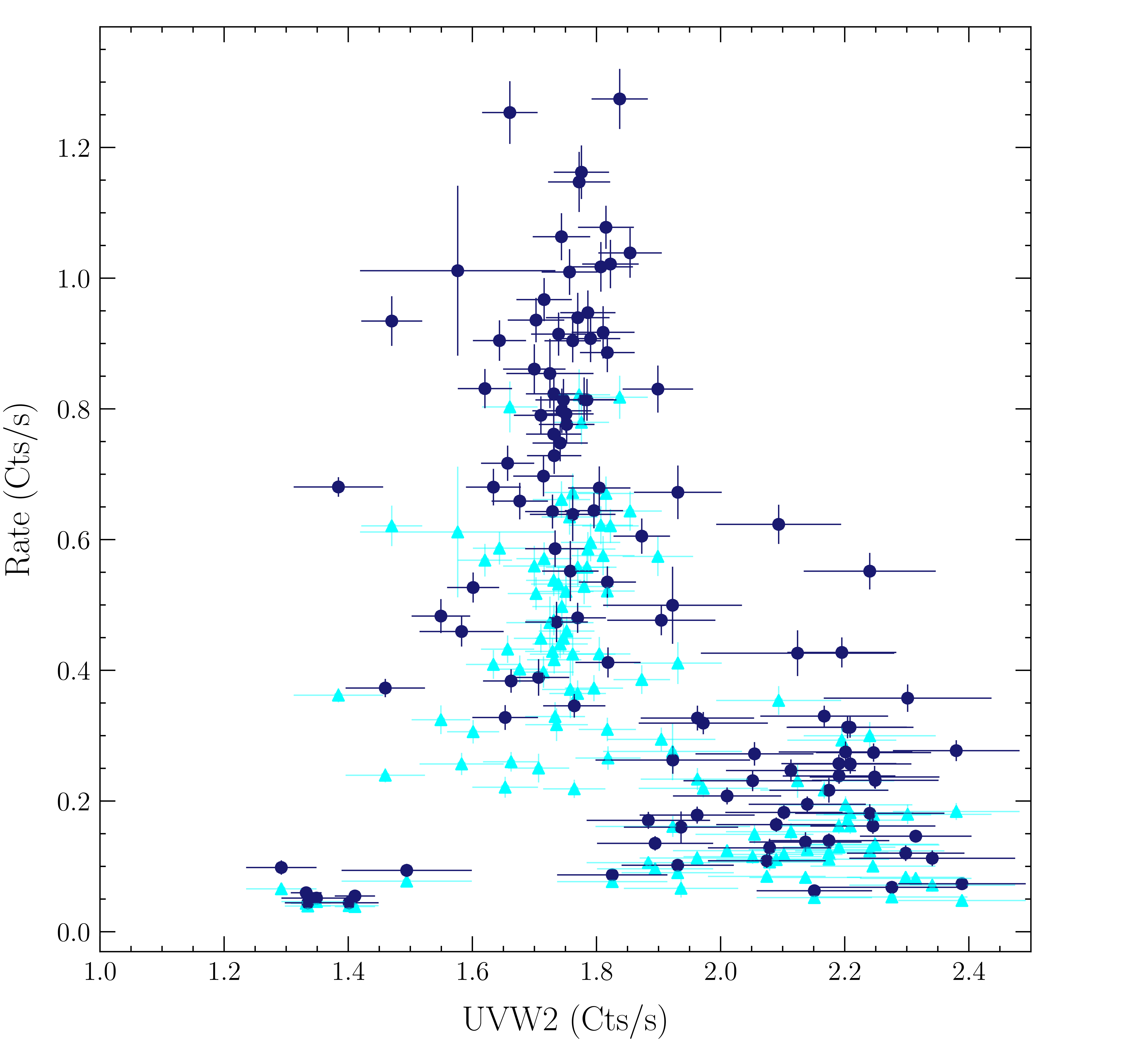
NGC 2992 as observed by Swift: correlations



We get a significant and strong correlation between the soft and the hard X–rays (P_{cc}=0.99, P(<r)<0.01)

This strongly suggests only 1 component is shaping the X-ray emission of NGC 2992

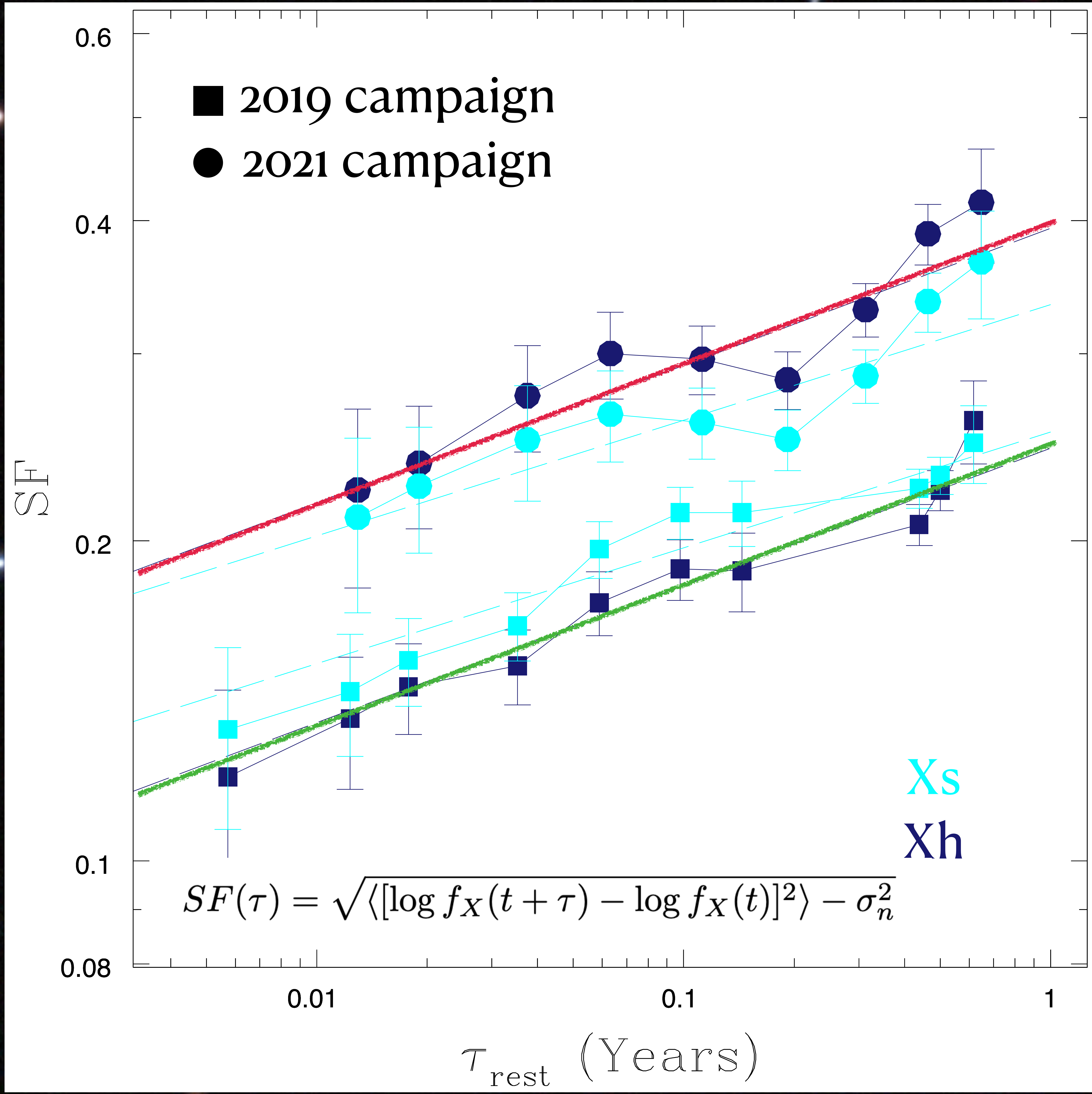
NGC 2992 as observed by Swift: correlations

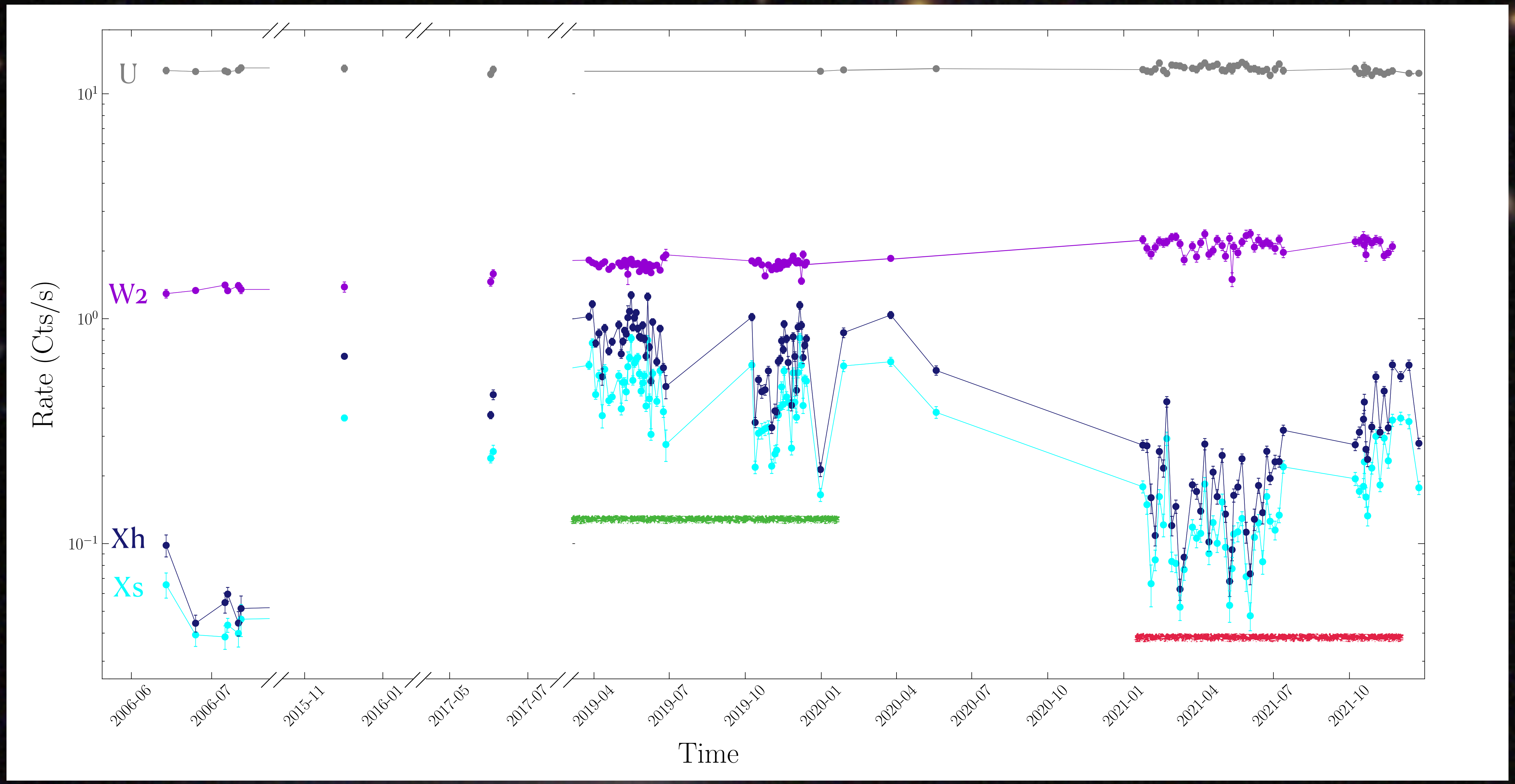


No correlation between soft/hard X-rays and UV

UV are absorbed by the host though a long term trend emerged from the light-curves

NGC 2992 as observed by Swift: yearly variations





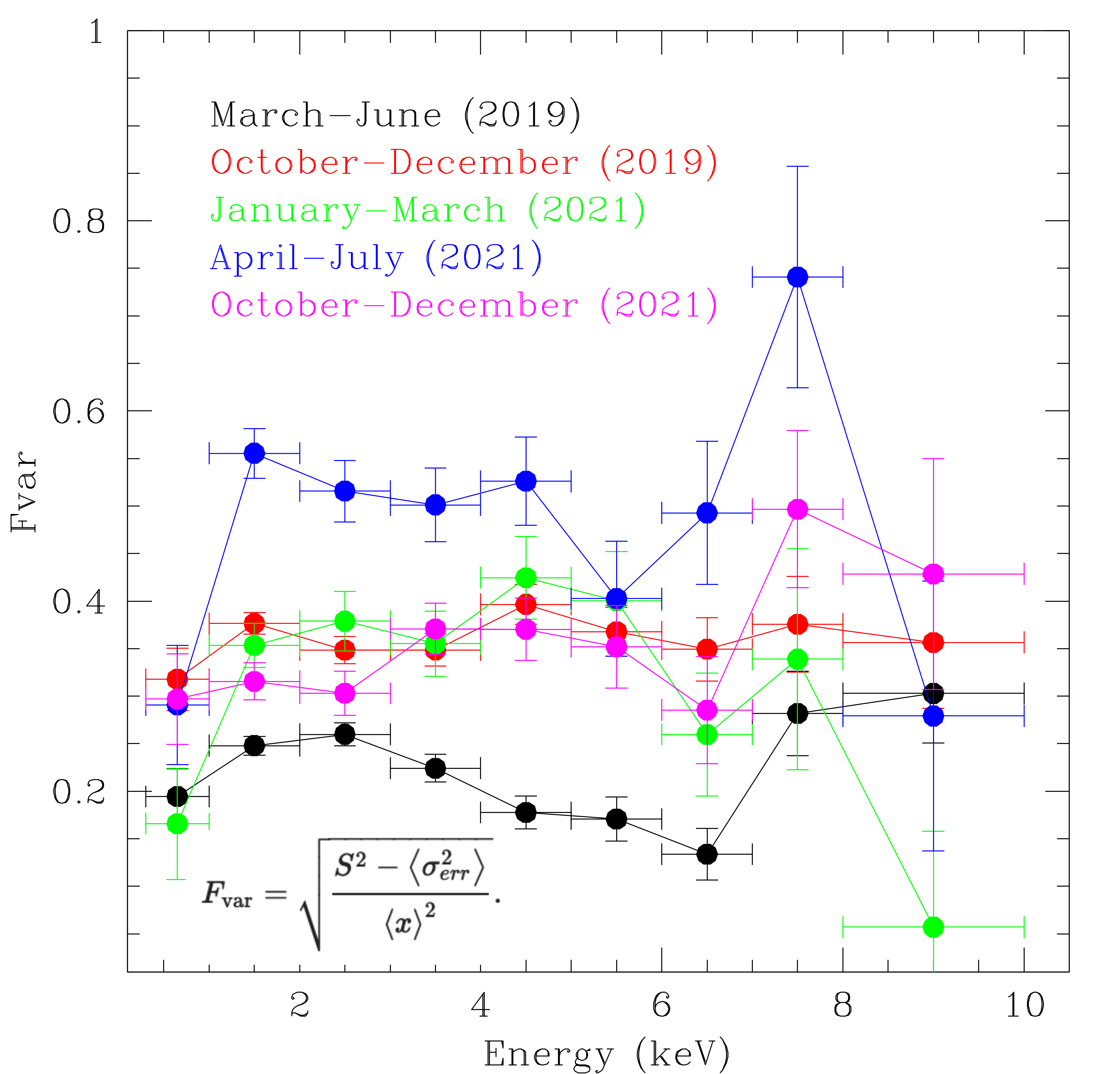
-Variations increase as a function of the observing time

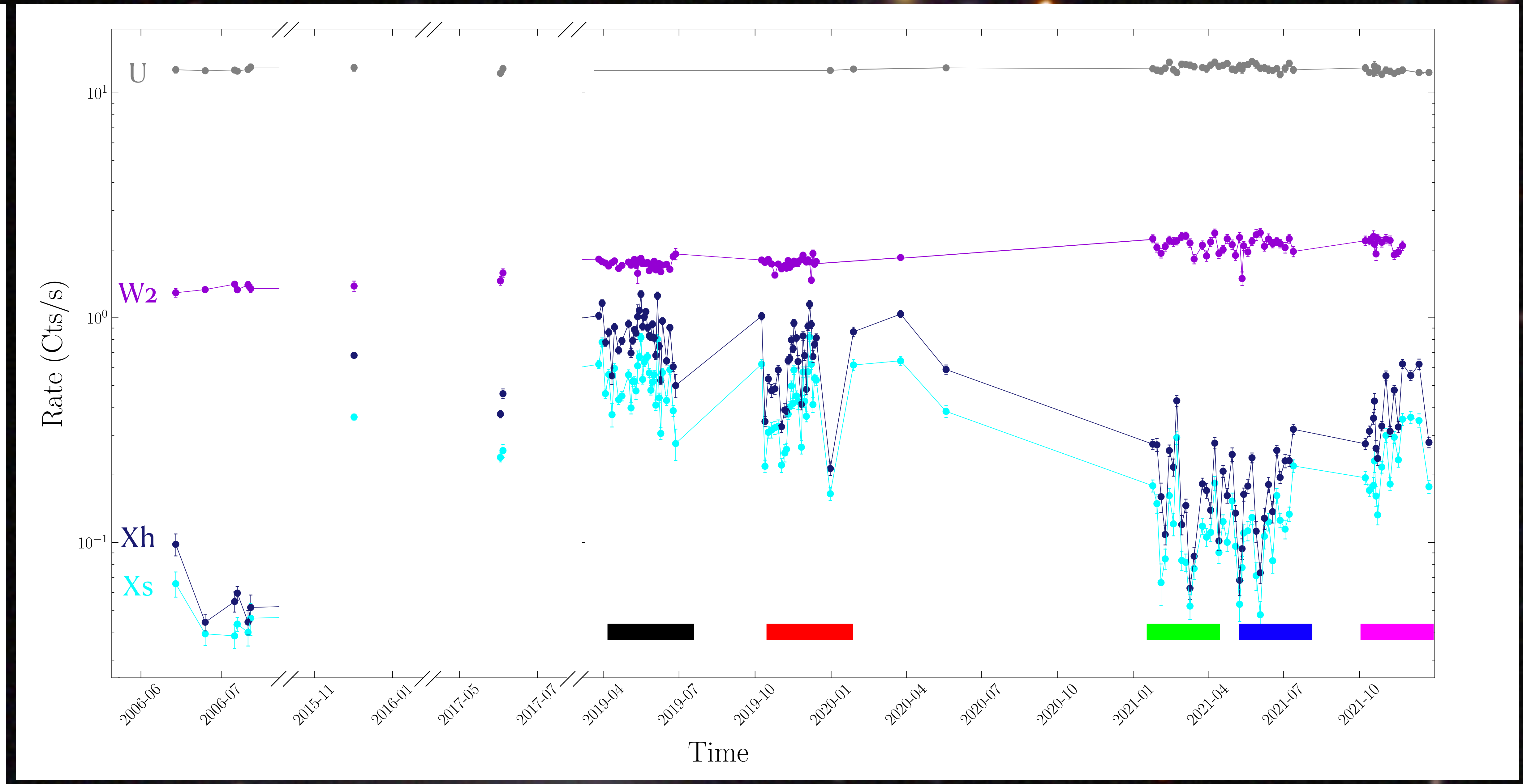
-A less variable state was observed in 2019

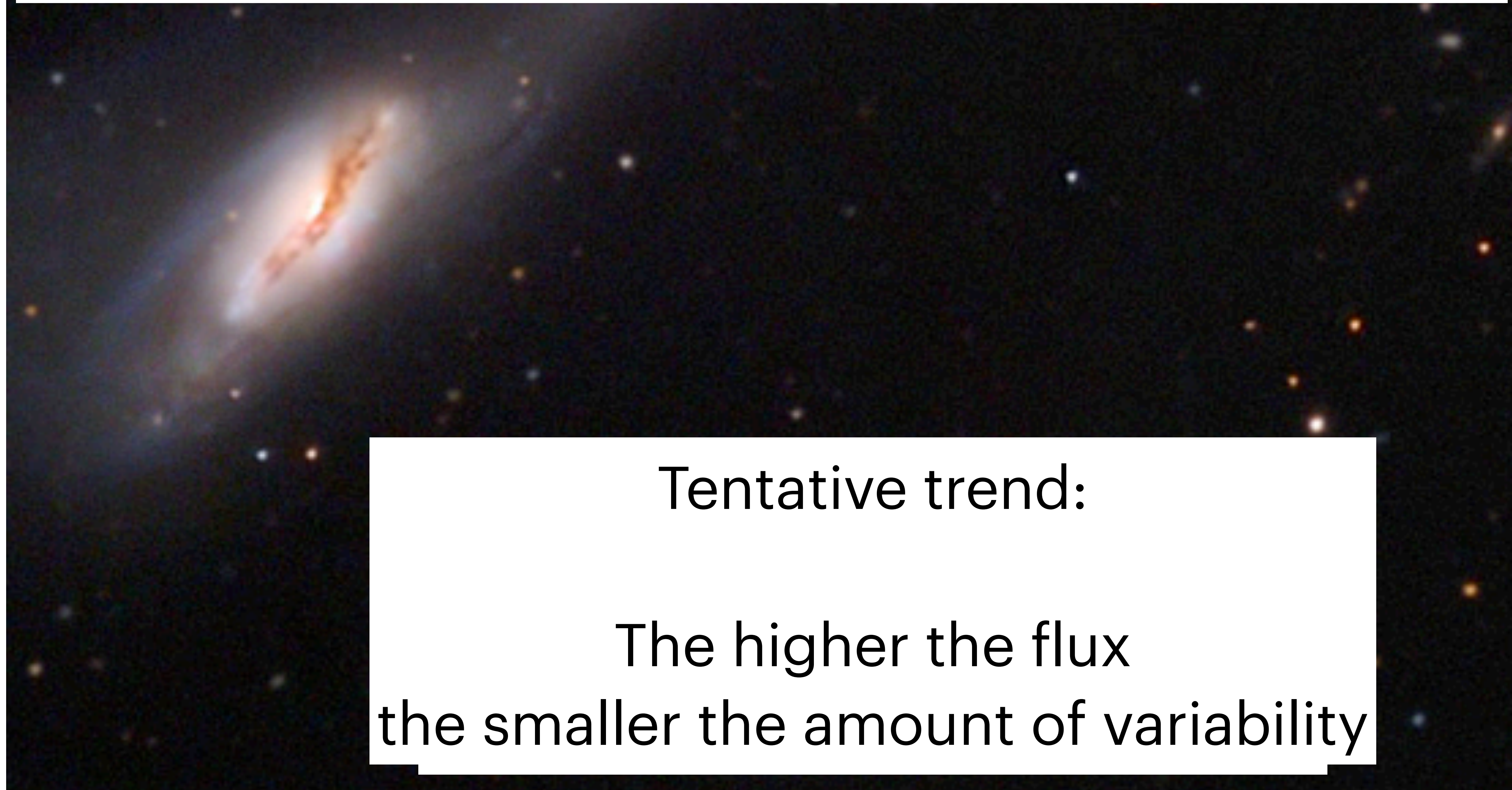
-A more variable state was observed in 2021

Tentative trend:
the higher the flux
the smaller the amount of variability

NGC 2992 as observed by Swift: monthly variations







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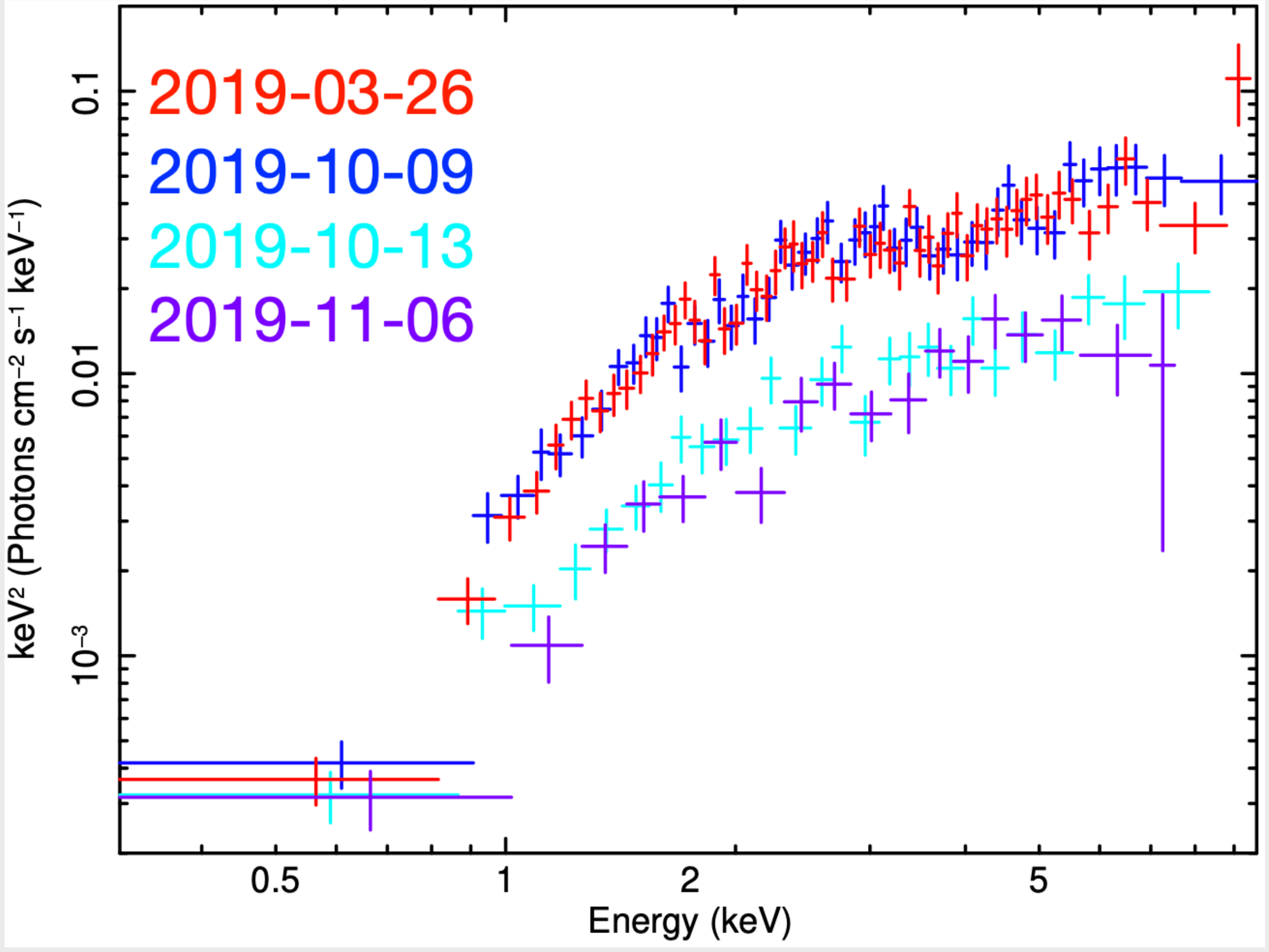
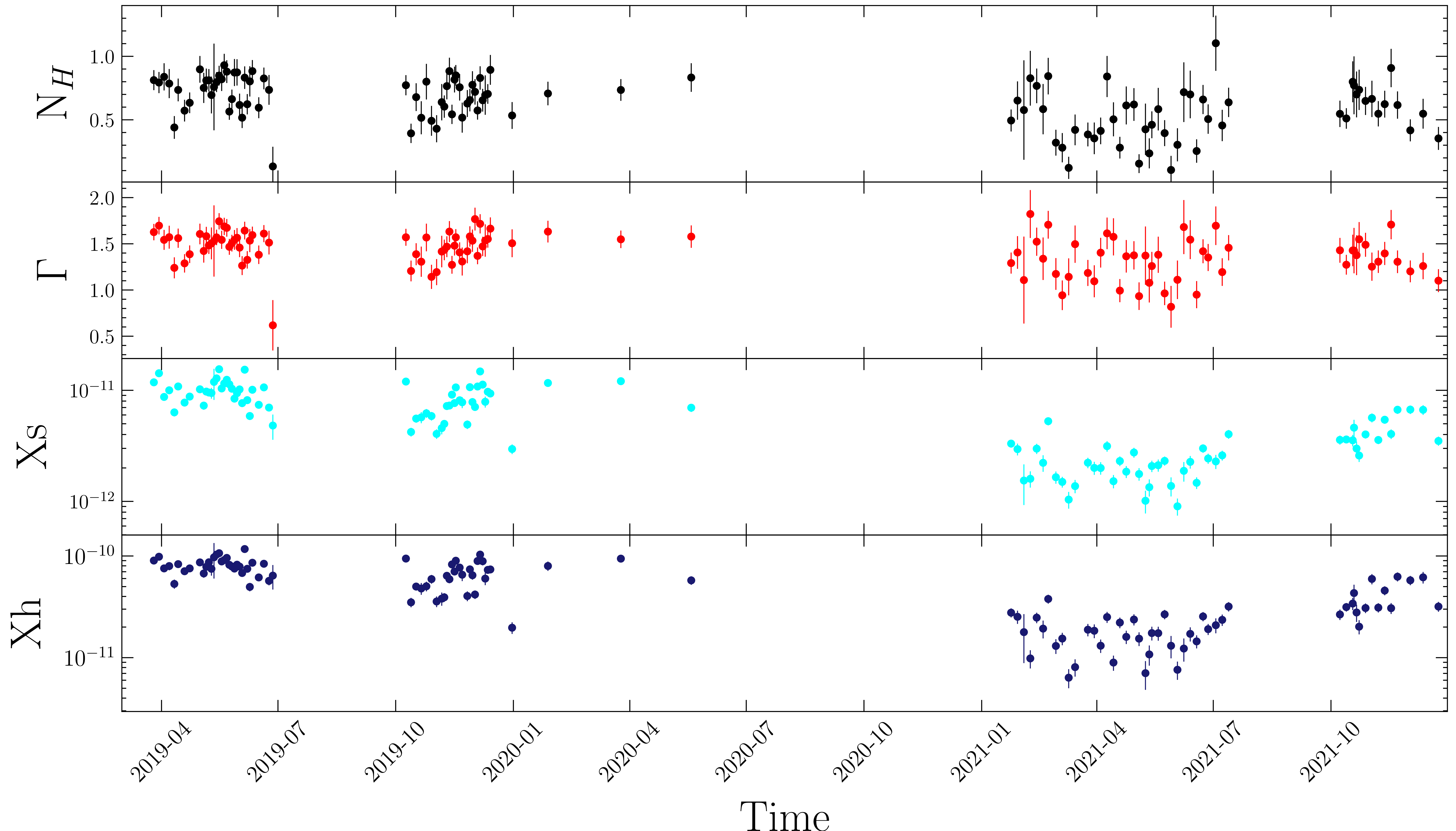
NGC 2992 as observed by Swift: spectral properties

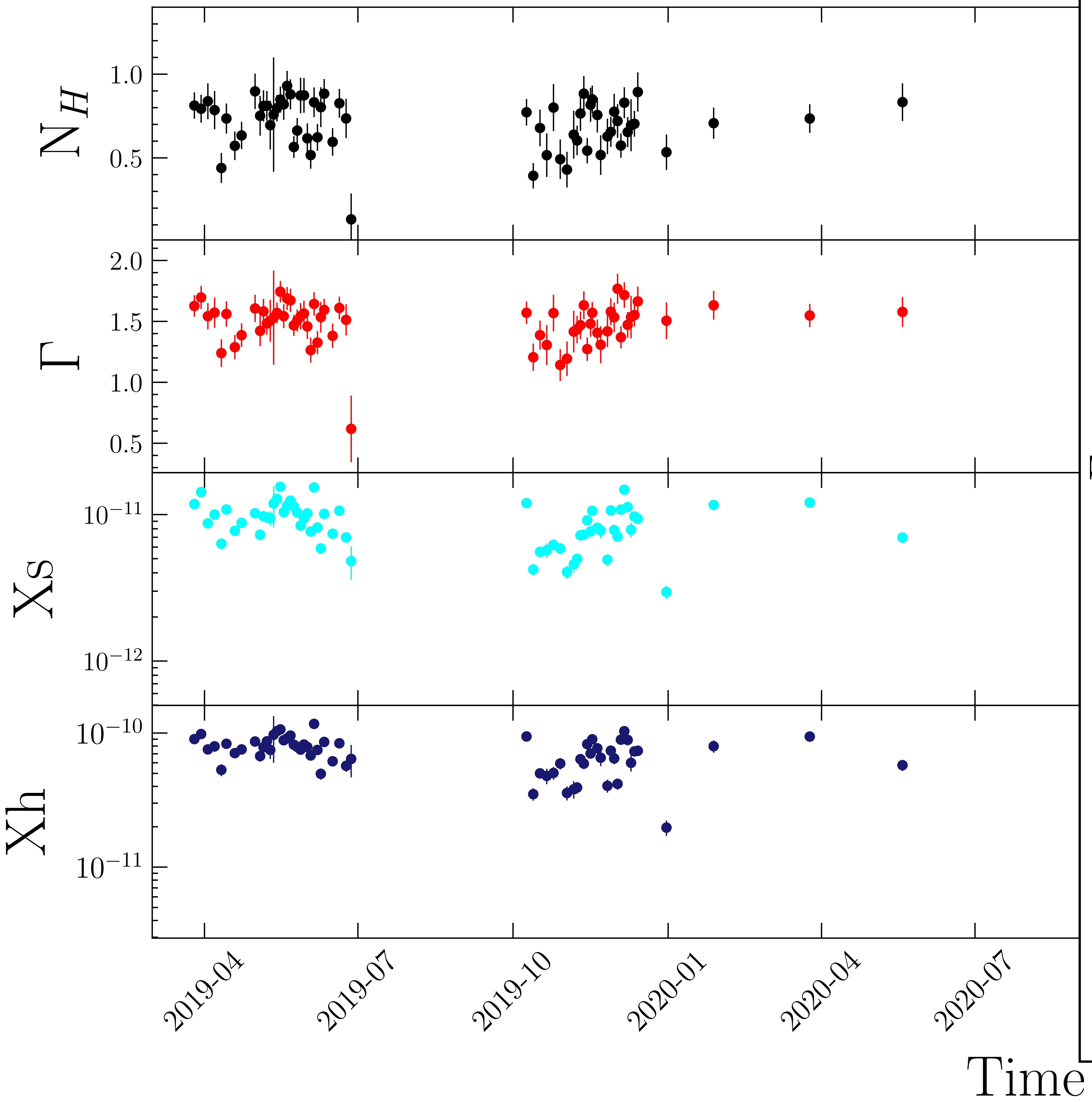


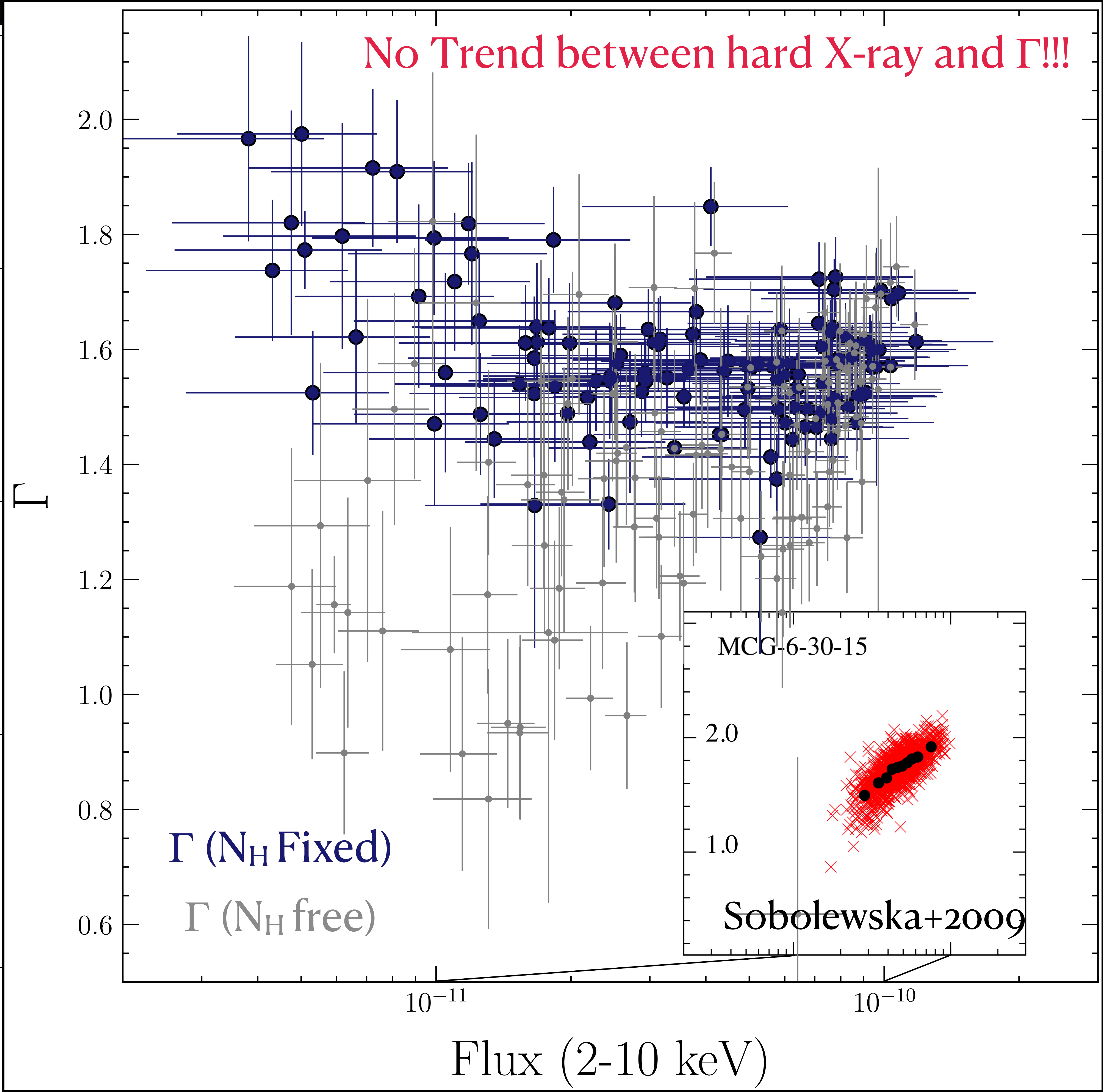


Degeneracy between N_H & Γ

No meaningful info can be extracted this way

NGC 2992 as observed by Swift: spectral properties

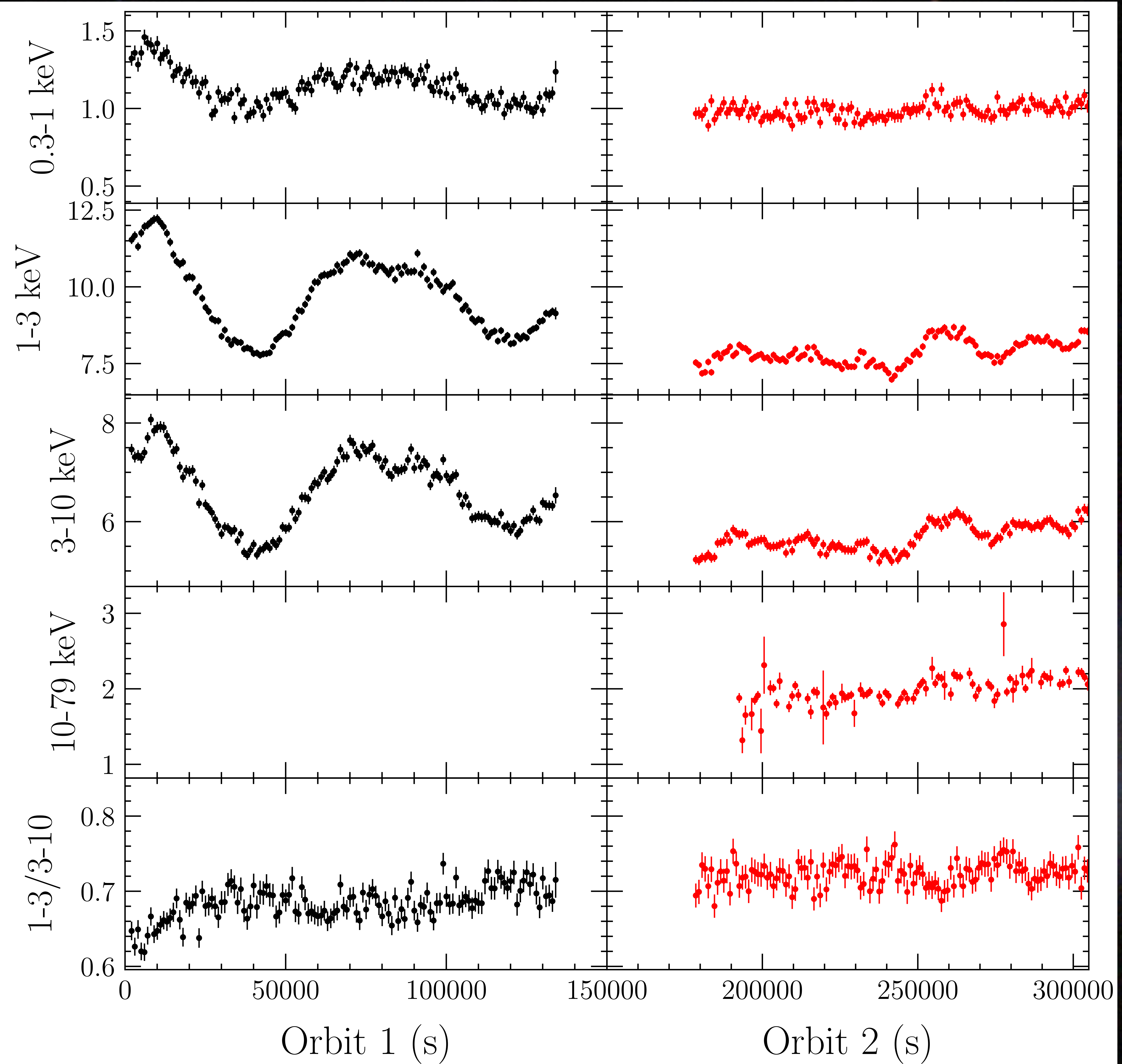




NGC 2992 as observed by XMM/NuSTAR:

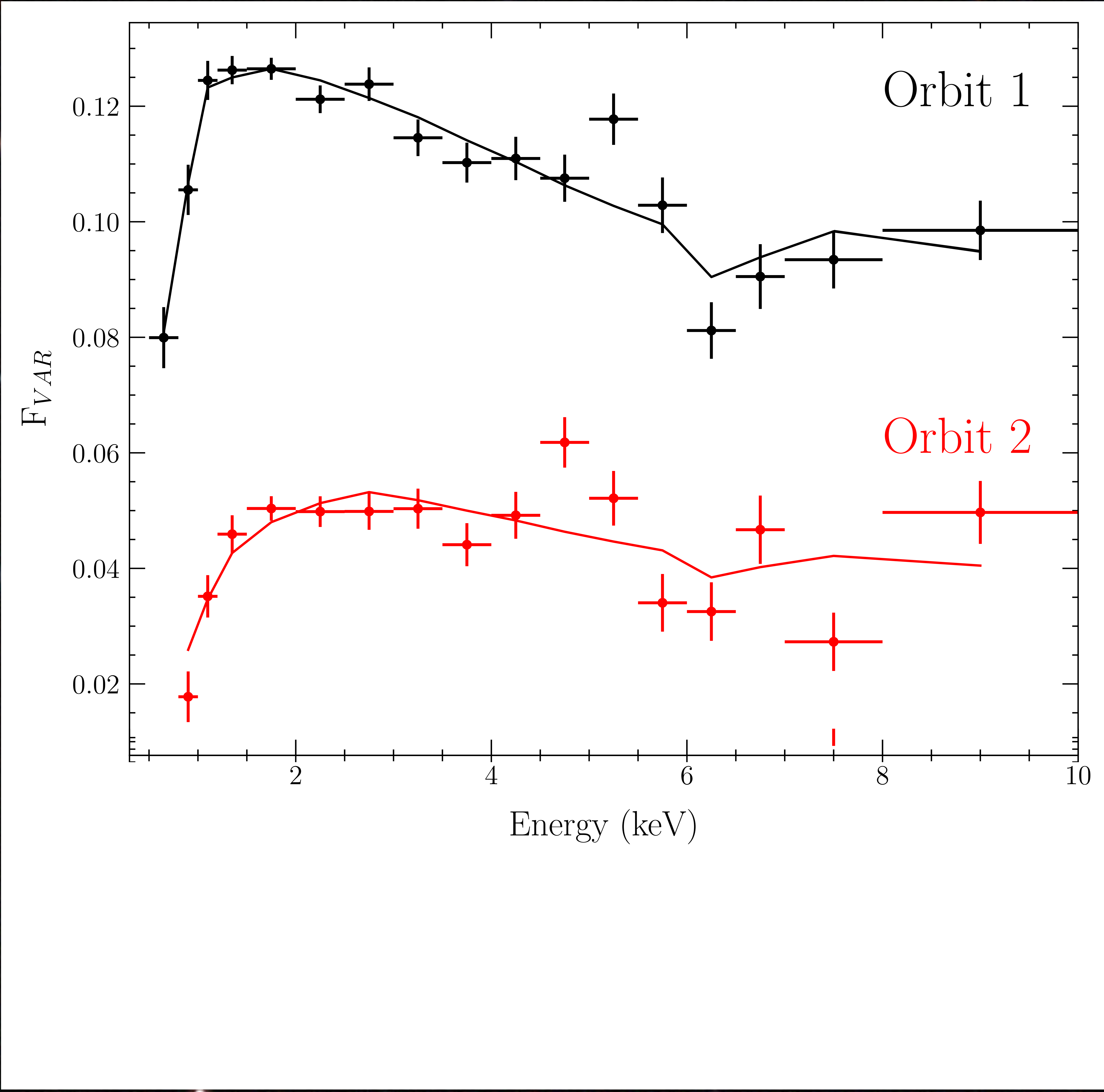
Two XMM-Newton orbits and a quasi-simultaneous NuSTAR exposure were triggered

NGC 2992 as observed by XMM/NuSTAR: light-curves



Observation 1 XMM-Newton only	Observation 1 XMM/NuSTAR
X-rays < 1keV ~constant	X-rays < 1keV: ~constant
X-rays in the 1-3 keV: highly variable	X-rays in the 1-3 keV: moderately variable
X-rays in the 3-10 keV: highly variable	X-rays in the 3-10 keV: moderately variable
X-ray ratio: fairly constant	X-rays in the 10-79 keV: moderately variable
	X-ray ratio: Constant

NGC 2992 as observed by XMM/NuSTAR: Fractional-variability

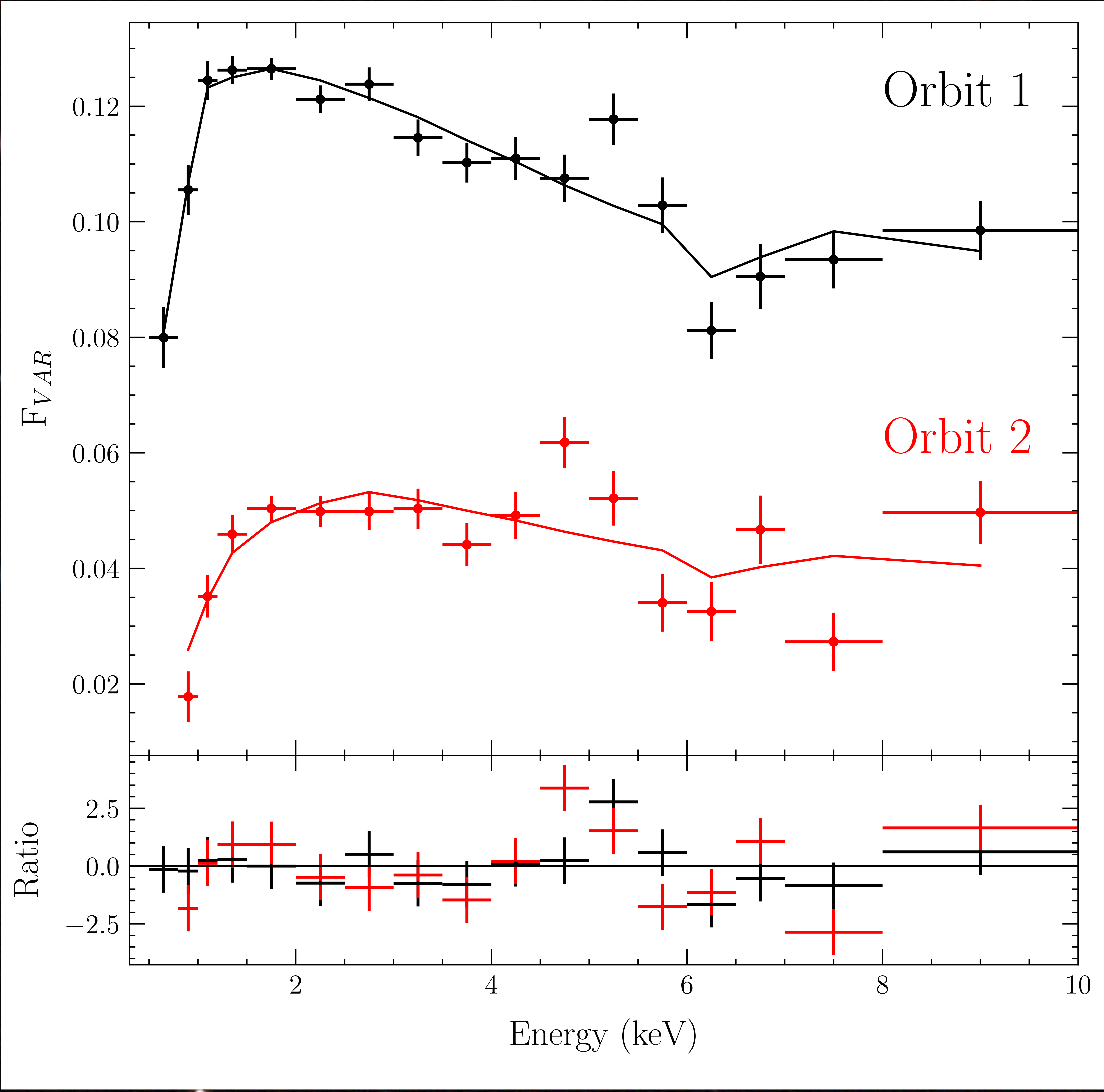


Tentative trend:

The higher the flux
The larger the amount of variability

Shot-models would account for this trend

NGC 2992 as observed by XMM/NuSTAR: Fractional-variability



We used three different components:
-1 for the primary continuum
-1 for the reflection component
1- for the soft photoionised emission

See Parker+2020 for details

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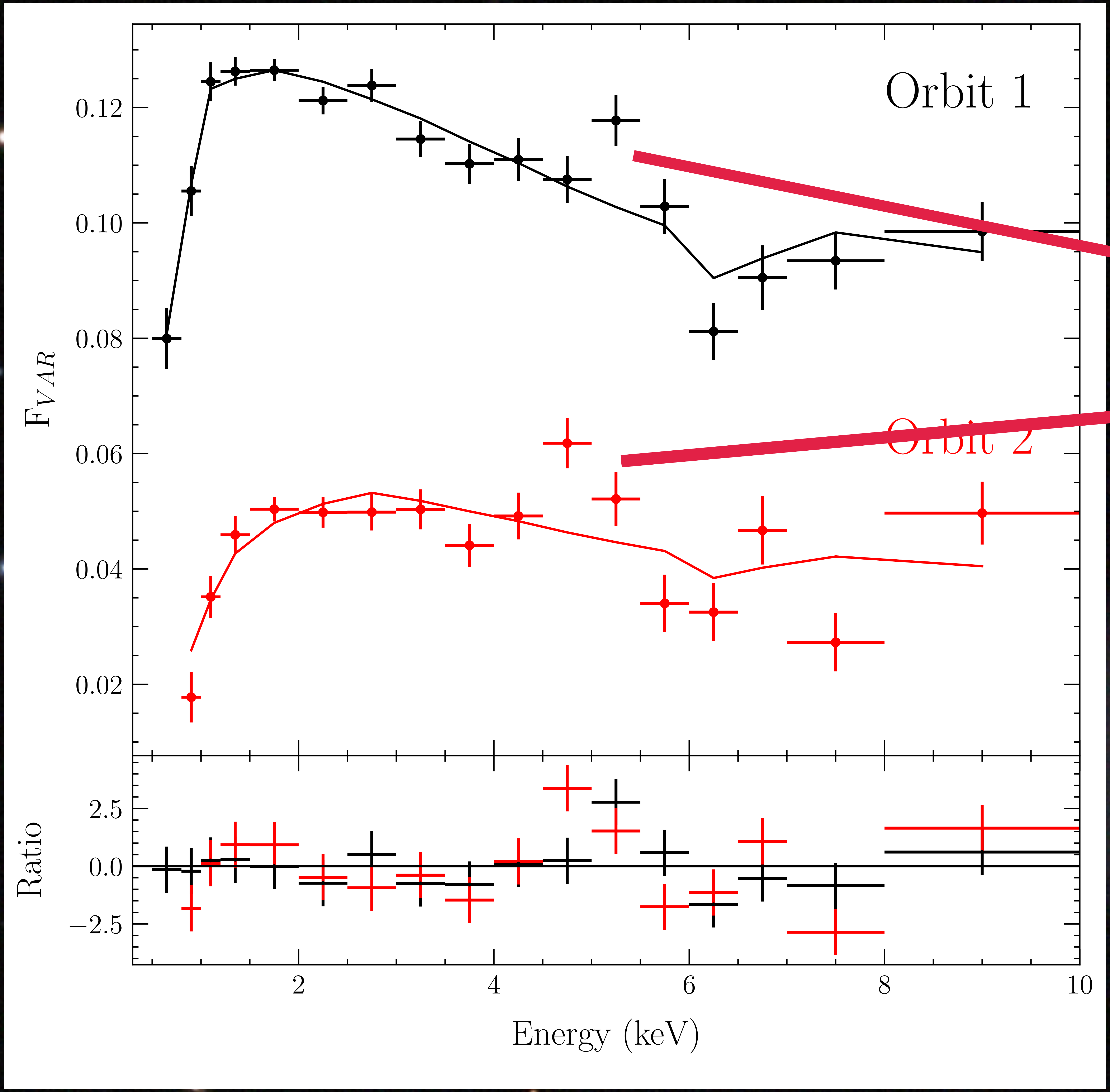
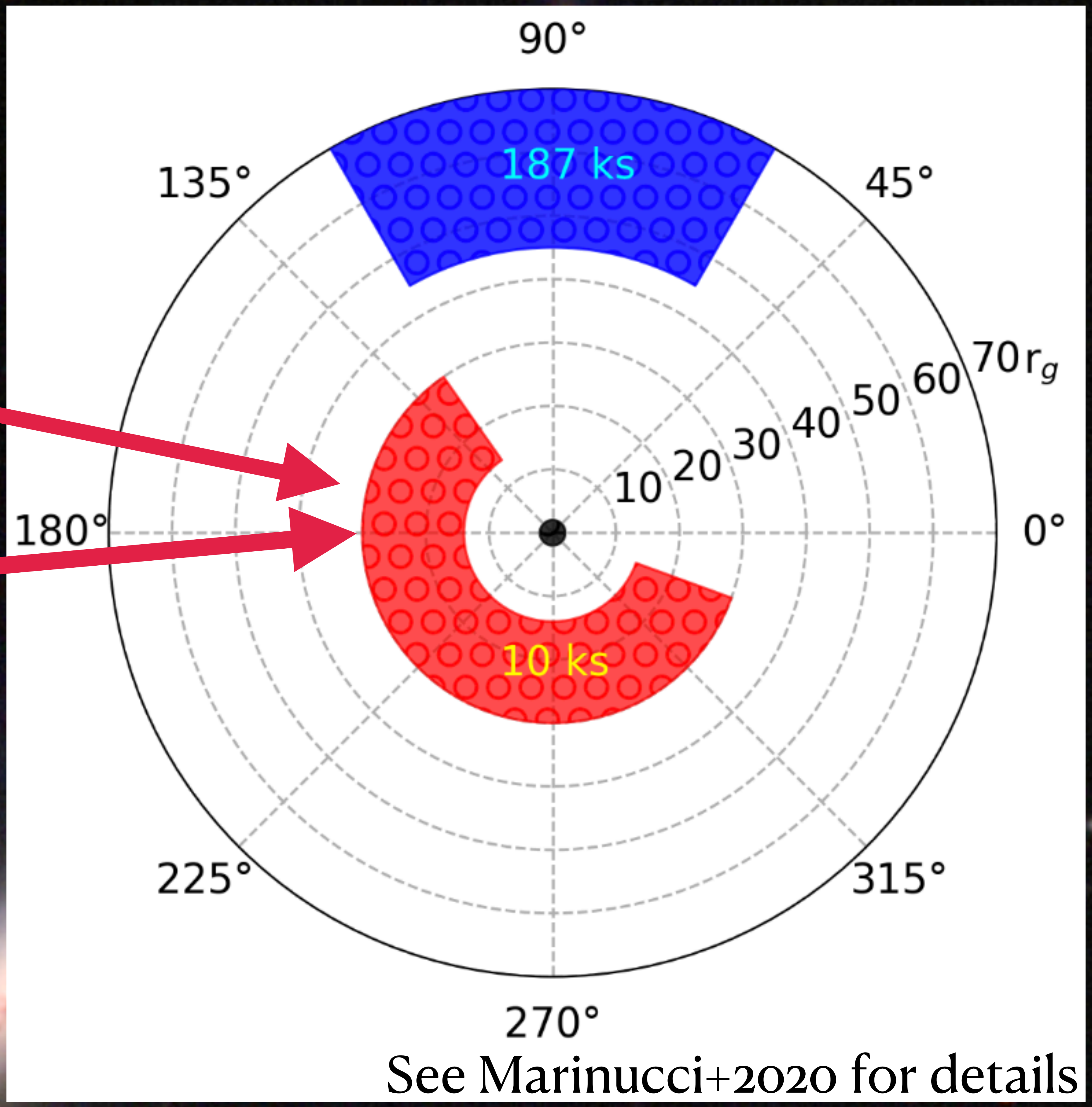
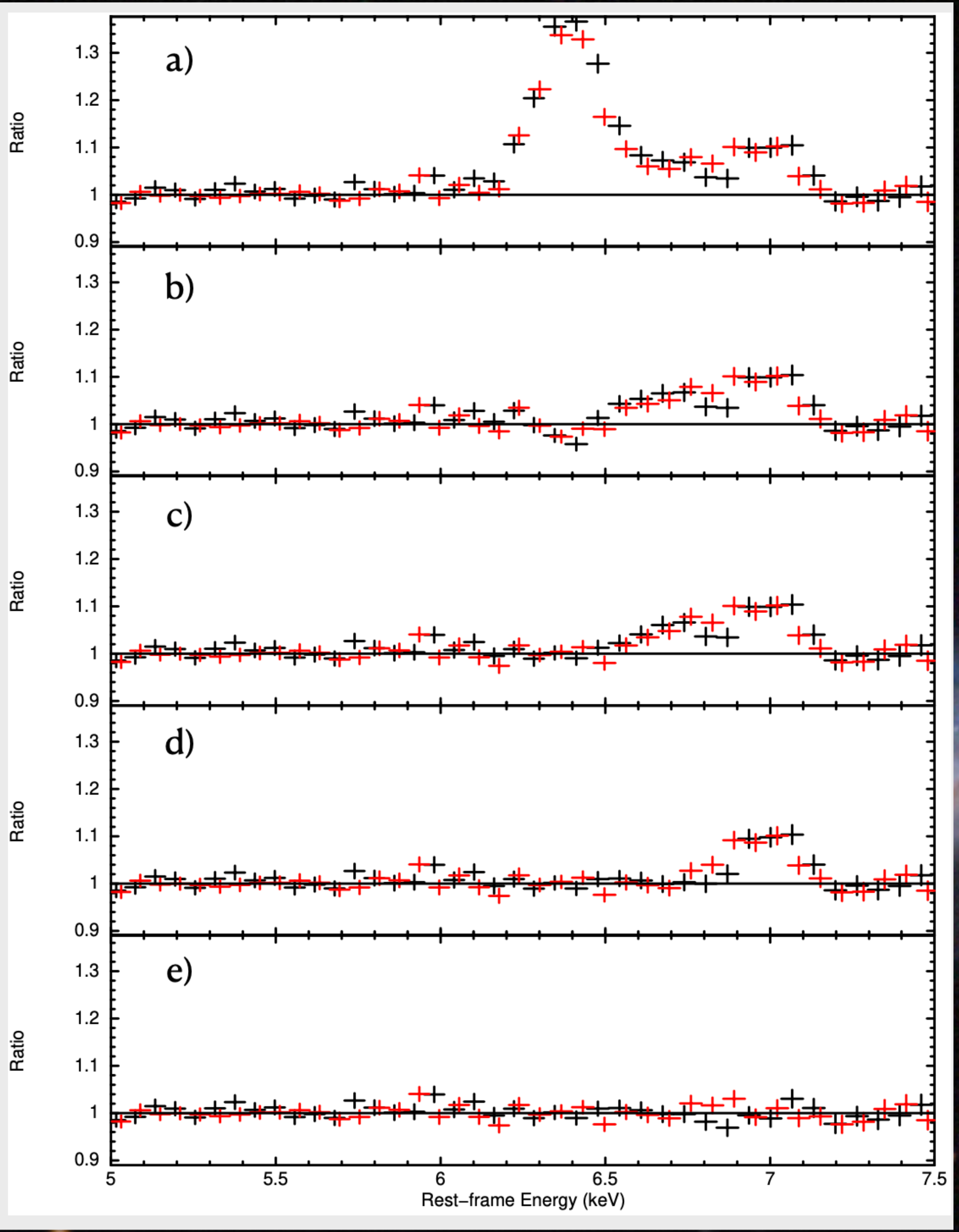
NGC 2992 as observed by XMM/NuSTAR: Fractional-variability





NGC 2992 as observed by XMM/NuSTAR: The Fe K complex



residuals to an absorbed power-law

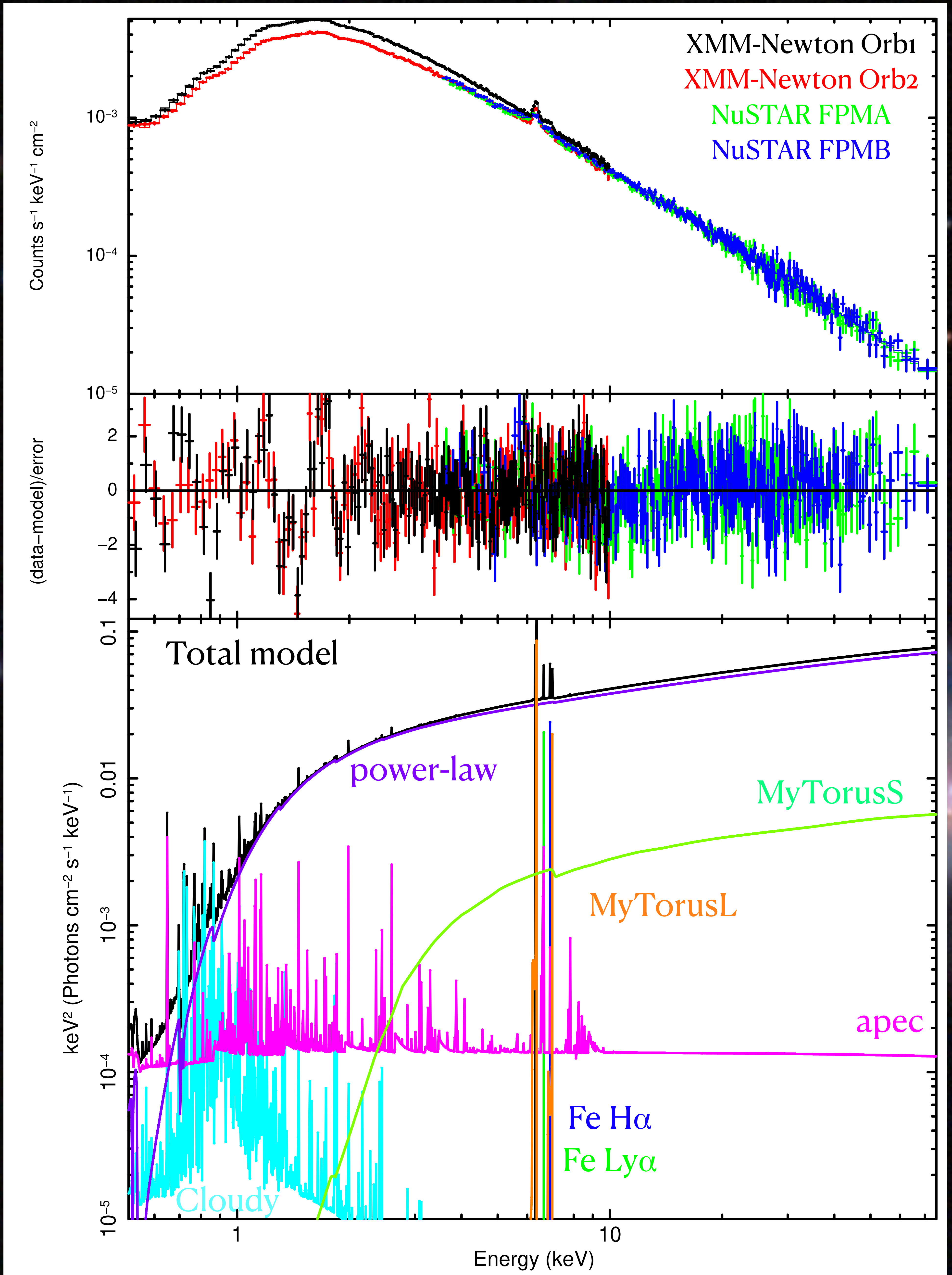
A narrow Fe Kα is added to the absorbed power-law

A small broadening of the Fe Kα is considered (~45 eV)

Adding the Fe Heα

Adding the Fe Lyα and the Fe Kβ

NGC 2992 as observed by XMM/NuSTAR: Spectral fitting 1 (time-average)



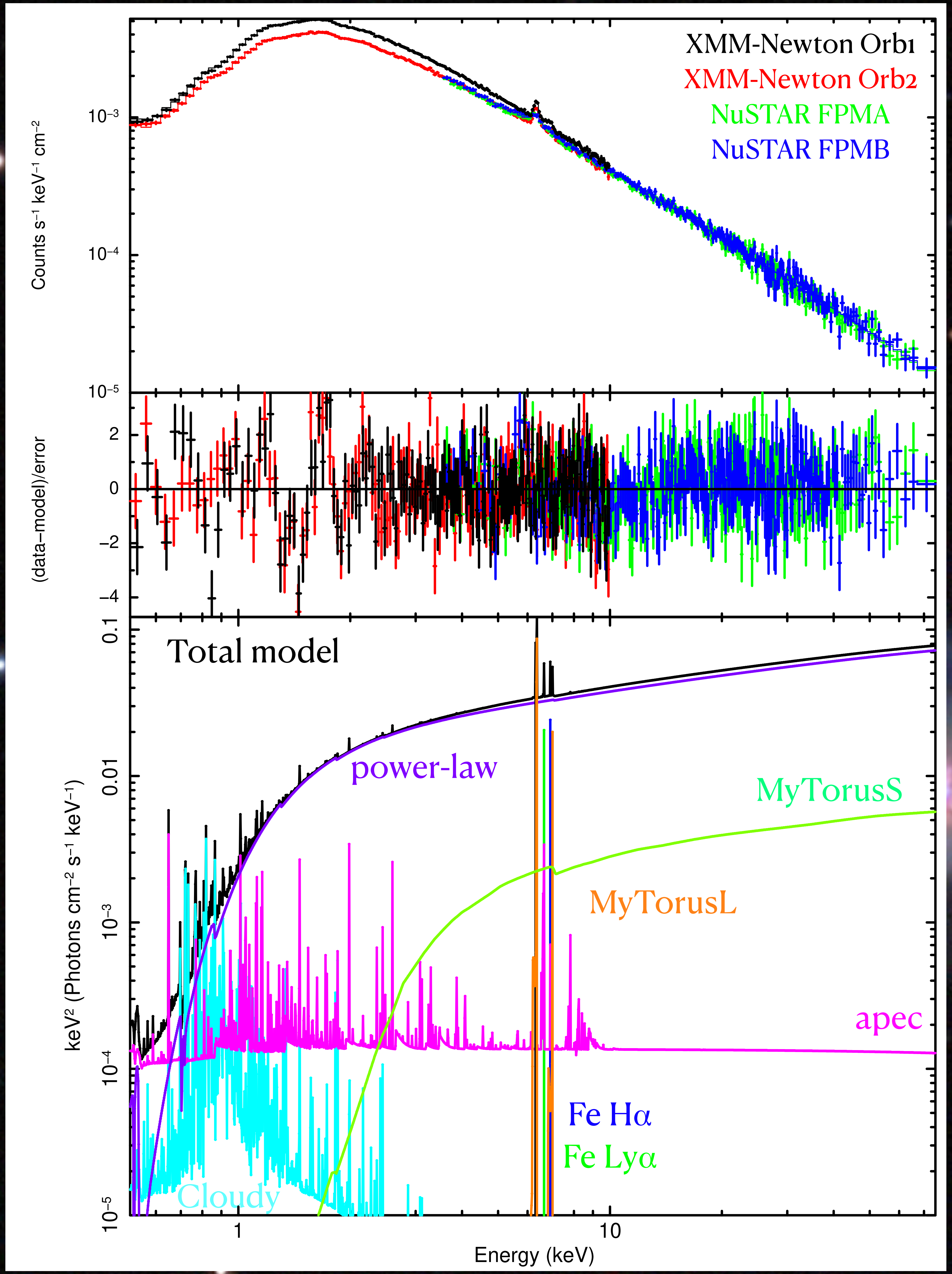
MyTorus+Power-law:

-photoionised emission due to hot plasma (2tables)

-Emission lines

N_{Habs}=7.8±0.2 (*10^{21} cm^{-2})
Γ=1.68+/-0.01
N_{Hmyt}=9.6±2.7 (*10^{22} cm^{-2})
E_{cut}*=300 keV
$F_{2\text{-}10\ keV}$= (8.6/7.5)*10^{-11}erg cm^{-2} s^{-1}

NGC 2992 as observed by XMM/NuSTAR: Spectral fitting 1b (time-average)



MyTorus+Power-law:

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E_{cut}*=300 keV

$F_{2\text{-}10\ keV}$= (8.6/7.5)*10^{-11}erg cm^{-2} s^{-1}

Borus:

N_{Habs}=7.8±0.1 (*10^{21} cm^{-2})

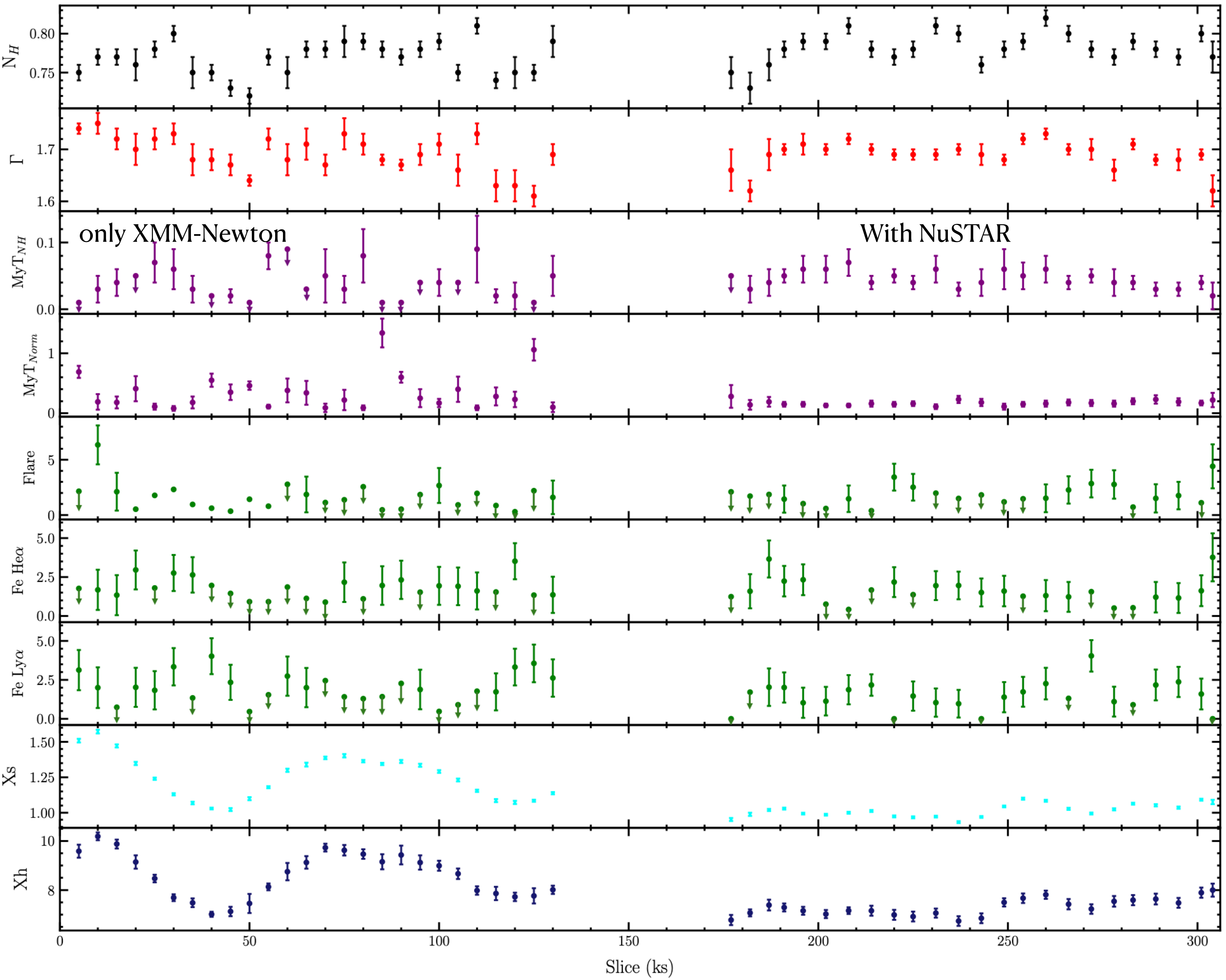
Γ=1.67±0.01

N_{Hmyt}=8.7±0.4 (*10^{22} cm^{-2})

E_{cut}>390 keV

kT_{corona} > 115 keV

NGC 2992 as observed by XMM/NuSTAR: Spectral fitting 2 (time-resolved)

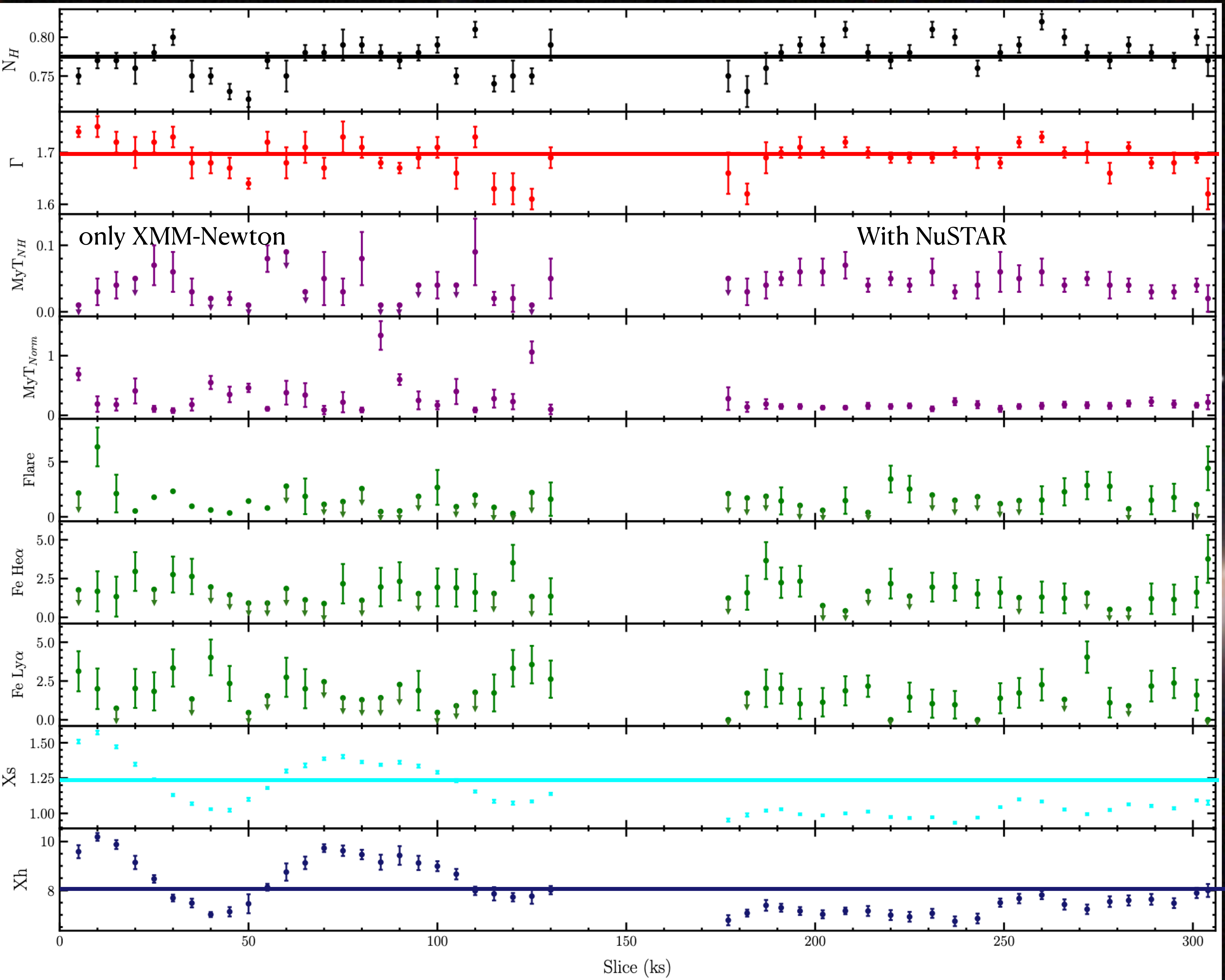


No correlations among the parameters (except for N_H&Γ, F_{soft}&F_{hard})

Note how NuSTAR data constraint the reflecting matter

We know that Γ and E_{cut} are tightly linked to the physics of the hot corona, why flux variations are not linked with spectral variations?

NGC 2992 as observed by XMM/NuSTAR: Spectral fitting 2 (time-resolved)



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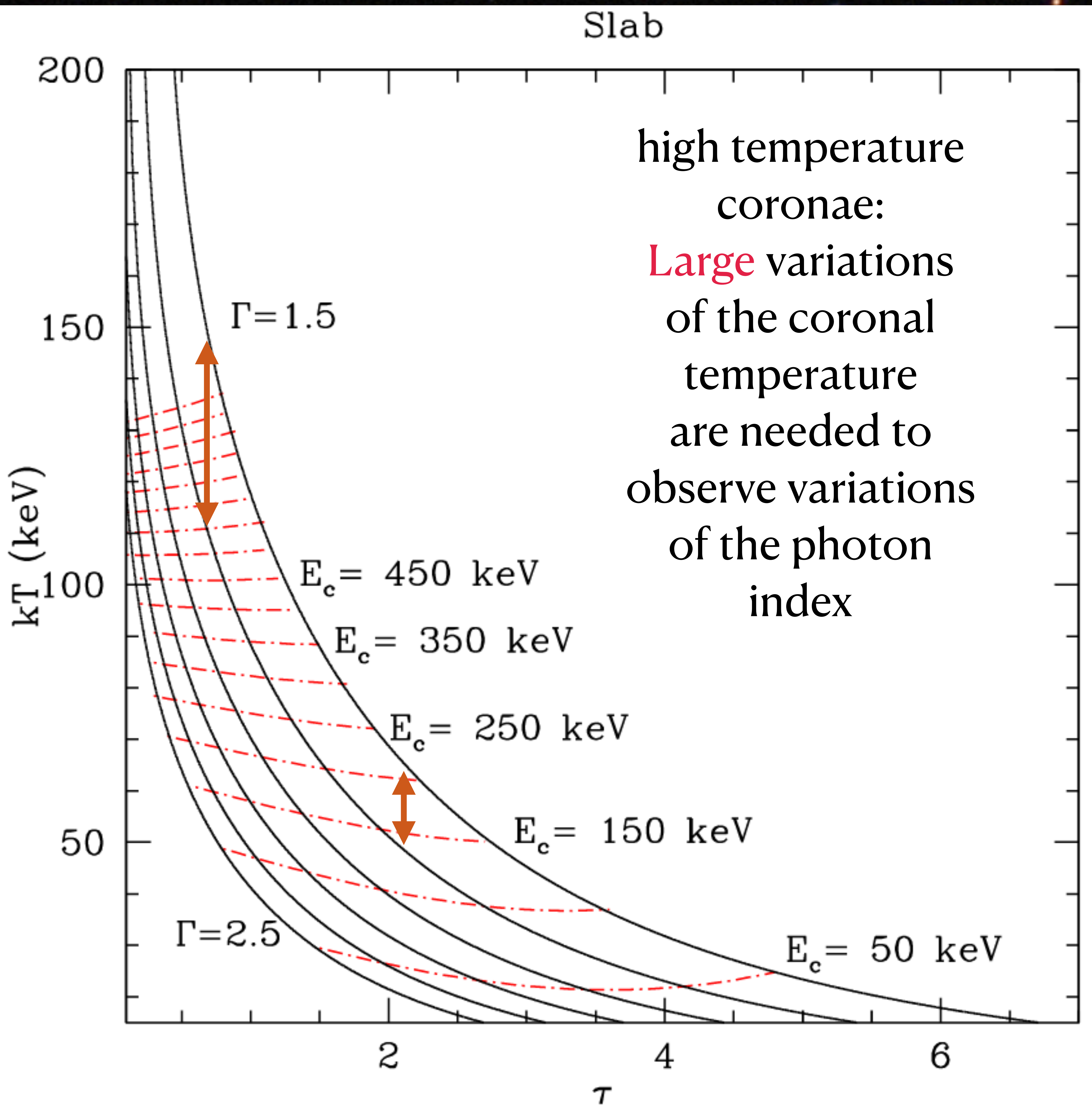
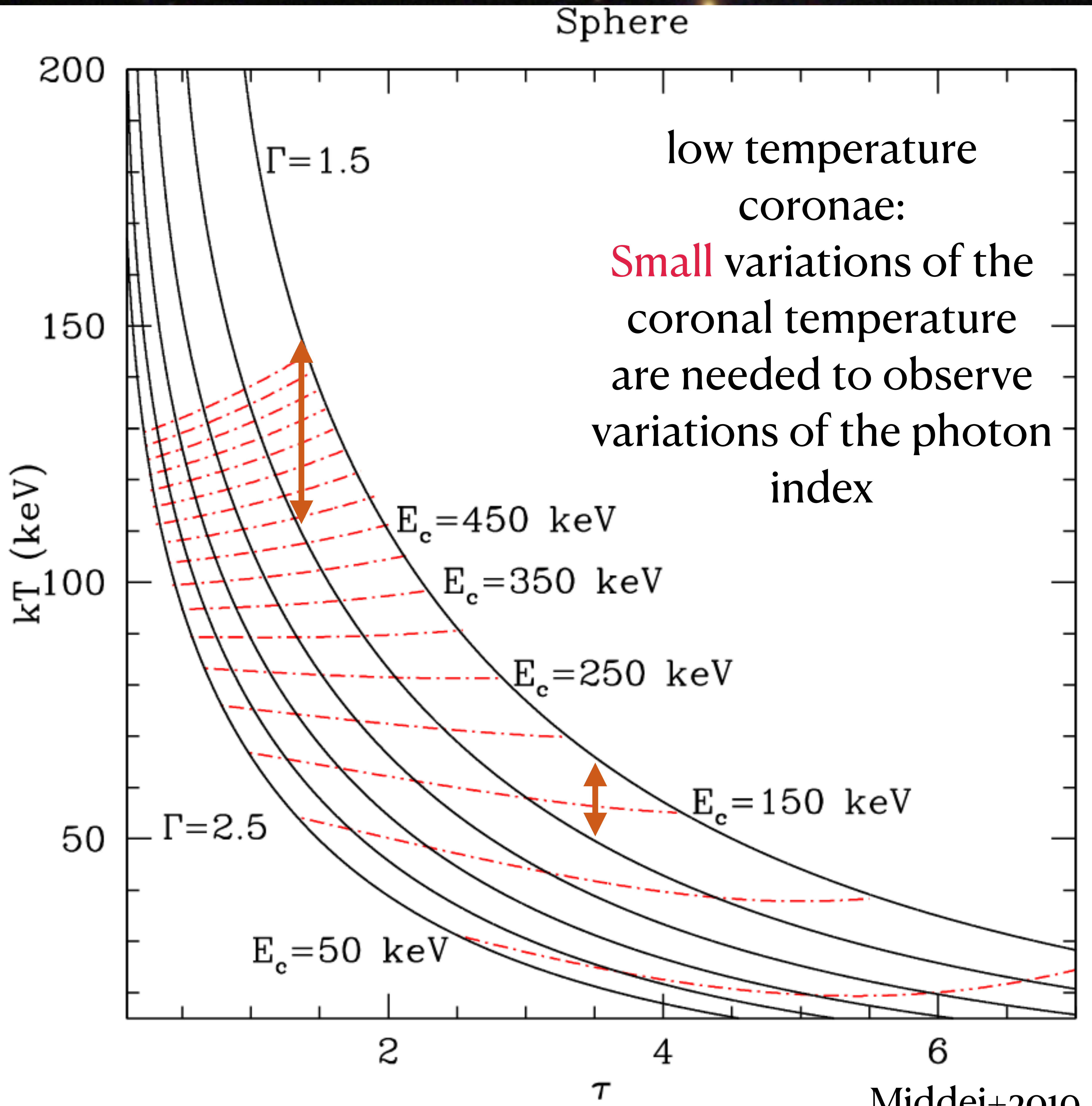
NGC 2992 as observed by XMM/NuSTAR: the hot corona



high temperature coronae: Large variations of the coronal temperature are needed to observe variations of the photon index



low temperature coronae: Small variations of the coronal temperature are needed to observe variations of the photon index

Middei+2019

Summary

NGC 2992 is a highly variable across different timescales (more than *10)

Fairly constant column of the absorbing and scattering matter (on years timescales)

The spectral component domination NGC 2992 is the continuum
(and its variable Fe K transients, see Marinucci+2020)

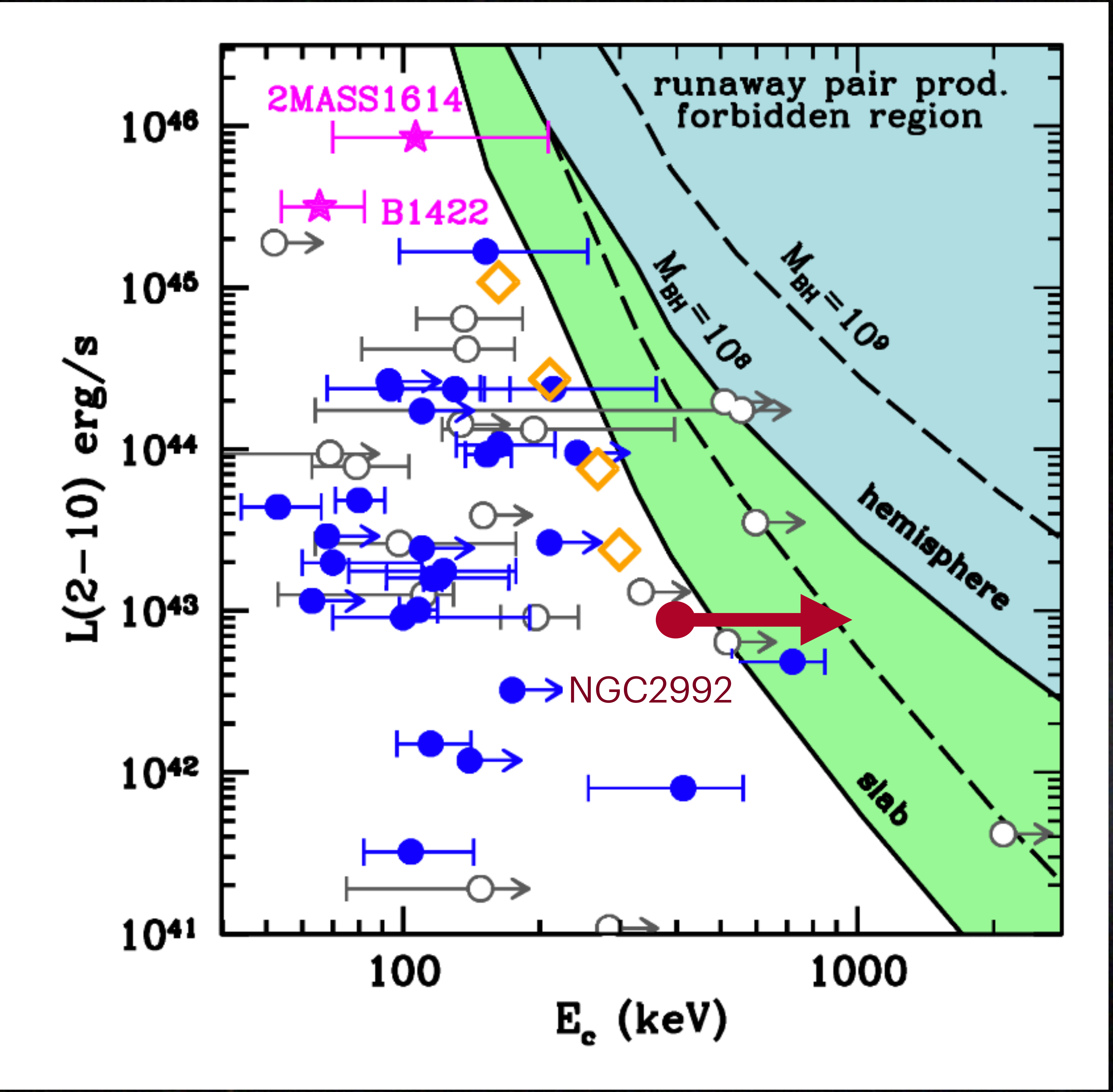
The NGC 2992 X-ray emission is consistent with being globally Compton-thin

Shot-models may explain the variability properties with some caveats

Decoupled spectral and flux variability may be the result of a very hot corona

Soon more on ARXIV, Middei+2022

NGC 2992 as observed by XMM/NuSTAR: the hot corona



Assuming the hot corona to be slab-like we are in full pair-production regime. Is this giving us suggestions on the coronal geometry?