XMM-Newton spectral analysis of Swift J1727.8-1613 across the soft-to-hard transition.

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Charles University

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Credit John Paice

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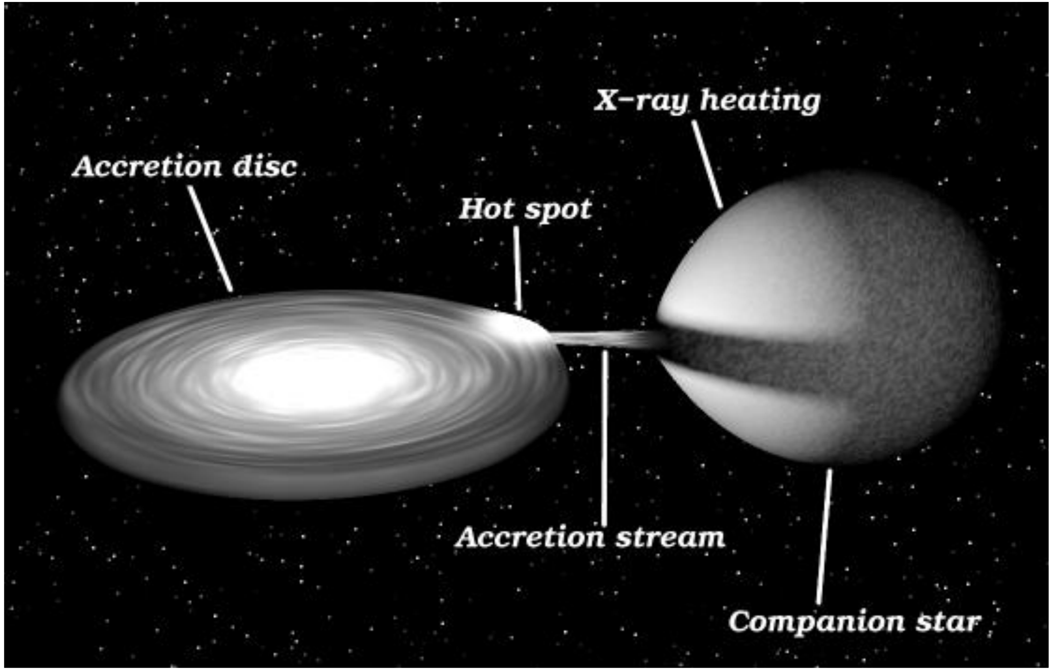
The source: the LMXB Swift J1727.8 – 1613



Credits: Hynes, http://www.astro.soton.ac.uk/ ~rih/.

❑ Low Mass X-ray binary (LMXB)

- $d = 3.4 - 5.5^{+1.4}_{-1.1}$ kpc
- $i \leq 74°$
- Porb = 10.8 h

Burridge et al. 2025
Mata Sanchez et al. 2024, 2025
Wood et al. 2024

Early K-type star

- $0.6\ M_\odot < M_{star} < 0.9\ M_\odot$

Stellar Black hole

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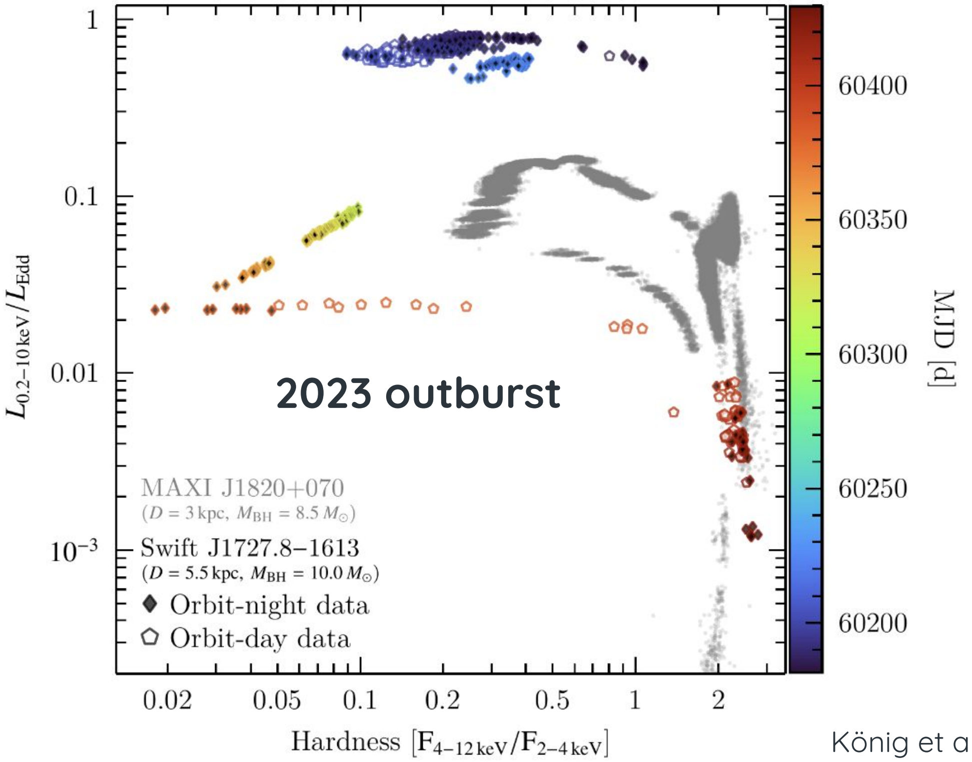

König et al. 2026

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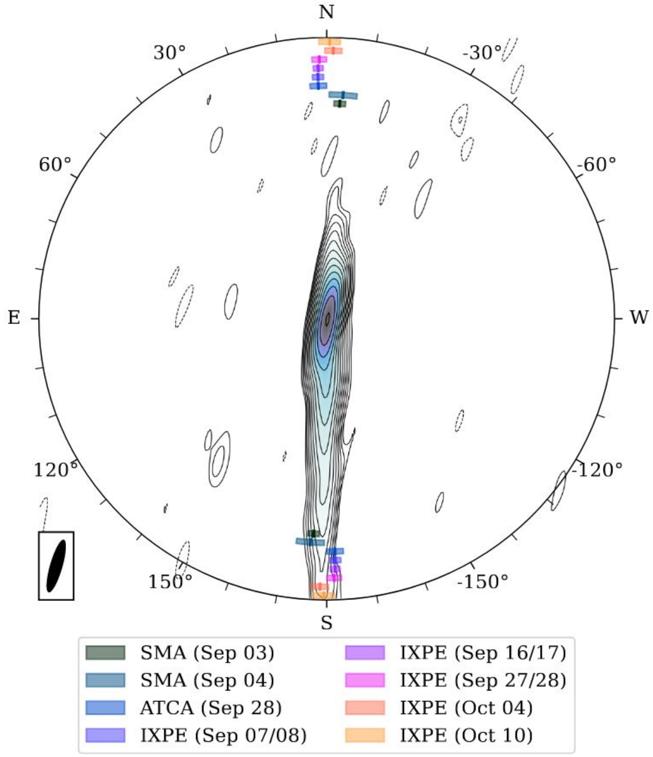

radio jet

Wood et al. 2024

- Low Mass X-ray binary (LMXB)
  - $d = 3.4 - 5.5^{+1.4}_{-1.1}$ kpc
  - $i \leq 74°$
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Burridge et al. 2025
Mata Sanchez et al. 2024, 2025
Wood et al. 2024

Early K-type star

- $0.6\ M_\odot < M_{star} < 0.9\ M_\odot$

Stellar Black hole

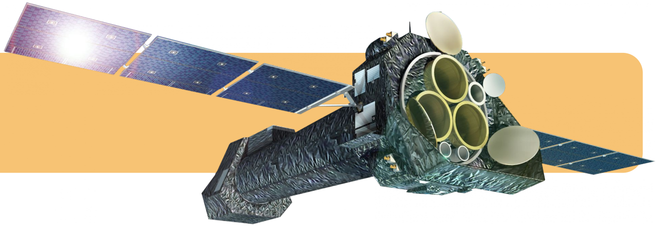
OBSERVATIONS

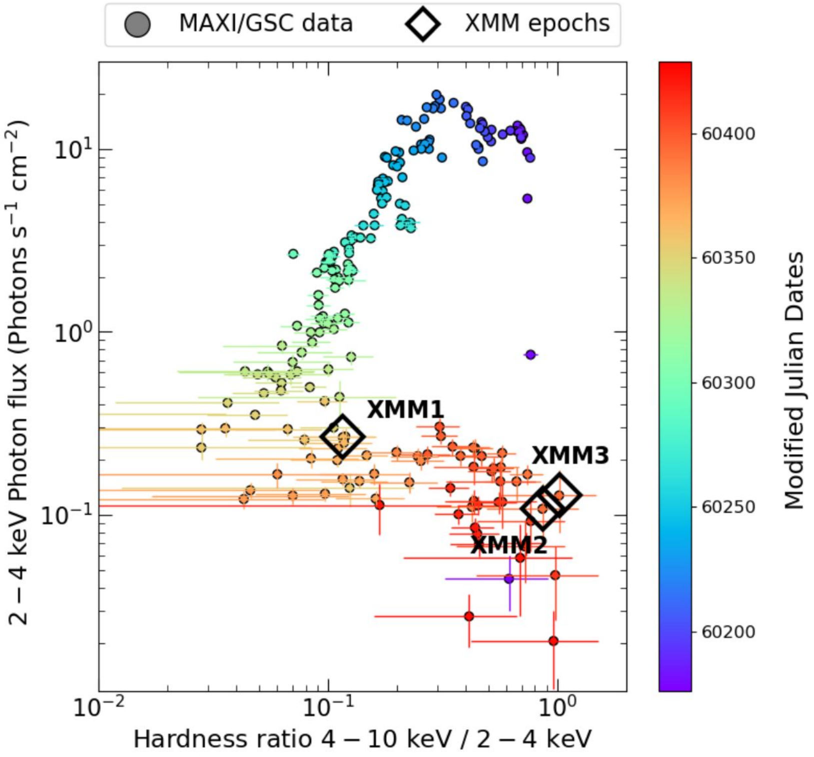
with XMM-Newton

Multi-λ Epochs	X-Shooter VIS, (559.5-1024 nm)	XMM – Newton ~ 0.15 - 12 keV
1	2023-08-27T00:10:18.635	-
2	2023-09-04T01:12:32.849	-
3	2023-09-14T00:41:44.378	-
4	NTT Data 2023-09	-
5	2023-09-26T00:12:08.807	-
6	2023-10-01T23:26:04.648	-
7	2023-10-07T23:48:45.286	-
8	2023-10-14T00:17:43.073	-
9	2023-10-17T00:10:29.920	-
10a	2023-10-21T23:56:36.653	-
10b	2023-10-22T00:12:49.093	-
11	2024-02-29T08:54:11.836	2024-02-26T14:03:35
12	2024-03-24T08:29:31.612	2024-03-24T23:26:04 2024-03-27T11:57:40

See Castro Segura et al. 2026

Observations with XMM-Newton





- ★ 3 observations with XMM: 61ks, 20ks, 50ks
- ★ soft-to-hard transition
- ★ Lx ~ 1.5 x 10−9 erg s−1 cm−2

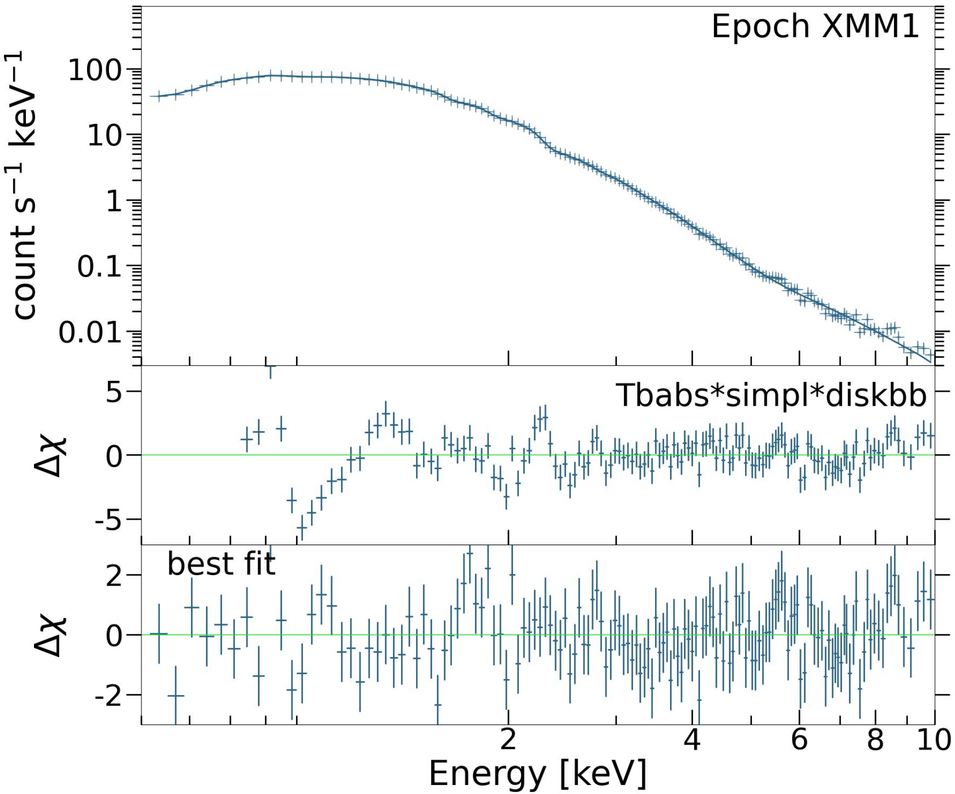
EPIC-PN MODELLING

of the EPIC-pn spectra to fit the continuum

Epoch XXM1

TbFeO * nthComp * KYNBB * xillverCp

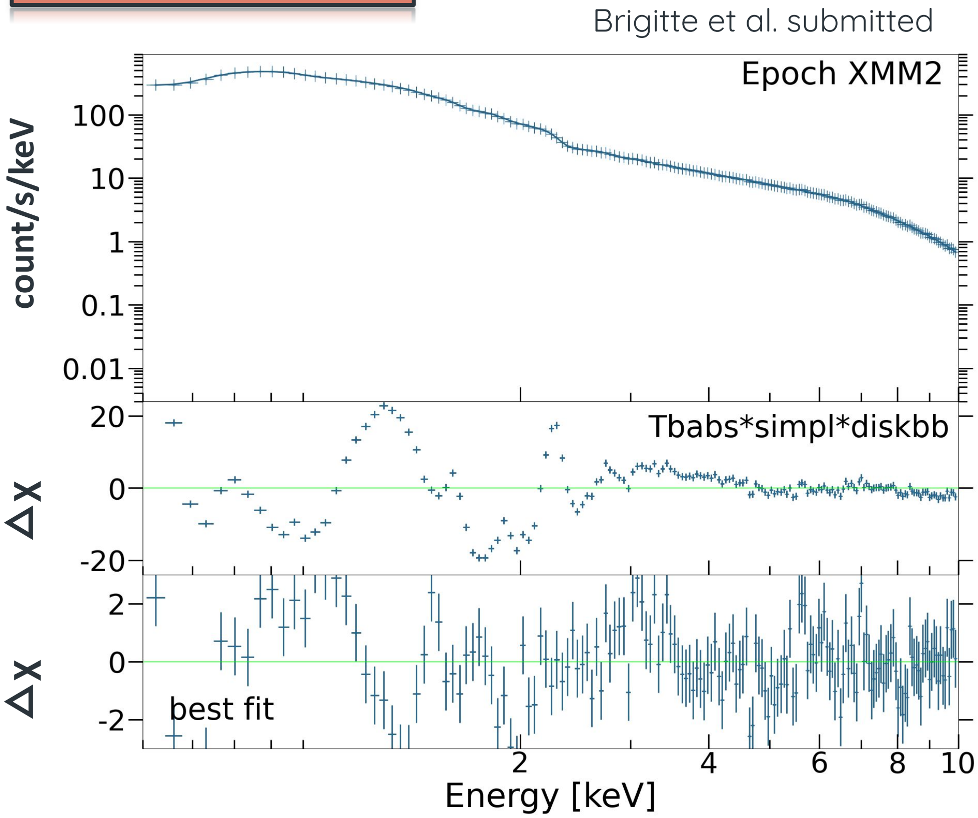
Brigitte et al. submitted



χ2 /dof ≈ 1.06		
Component	Parameter [units]	Value
TbFeO	nH [10^{22} cm-2] O Fe	0.2 (f) 0.8 (f) 0.8 (f)
nthComp	Γ kTe [keV] kTbb [keV] N	**2.1 ± 0.2** 100 (f) 0.3 (f) **0.0186 ± 5e-04**
KYNBB	a/M θ [°] Rin [r_G] M_{BH} [$M_\odot$] acc rate [Medd]	0.87 (f) 40.7 ° (f) **6.00 ± 0.05** 10 (f) **0.012 ± 0.001**
xillverCp	log ξ N	– –

Epoch XXM2

TbFeO * nthComp * KYNBB * xillverCp

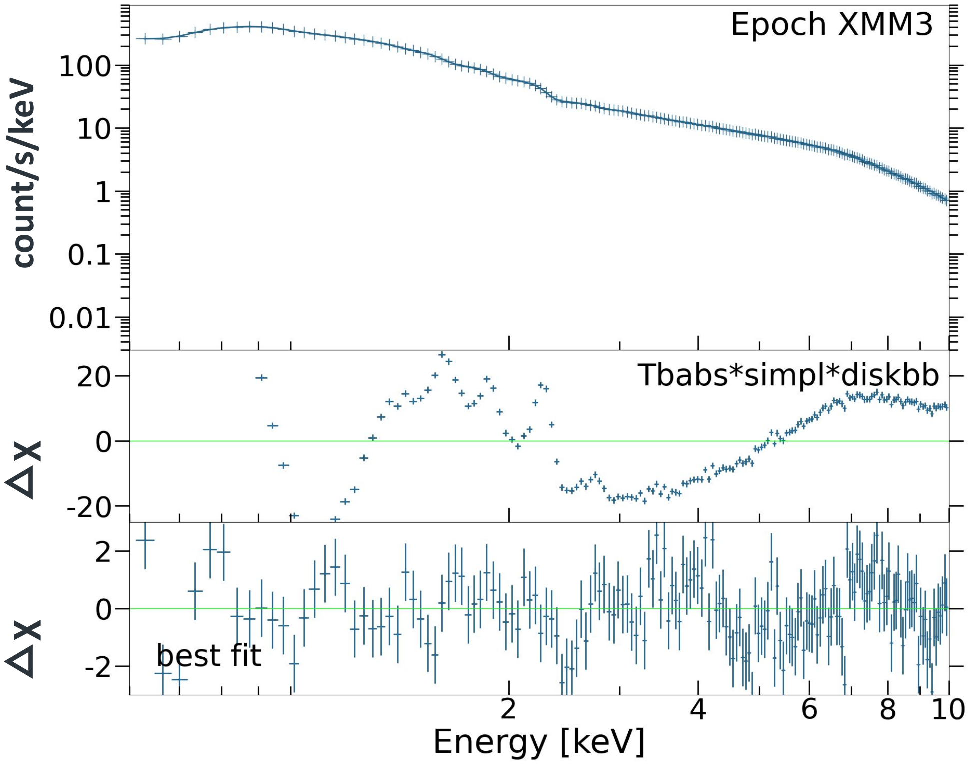


χ^2 /dof ≈ 1.91		
Component	**Parameter [units]**	**Value**
TbFeO	nH [10^{22} cm-2] O Fe	0.2 (f) 0.7 (f) 0.5 (f)
nthComp	Γ kTe [keV] kTbb [keV] N	**1.998 ± 0.006** 250 (f) 0.1 (f) **0.465 ± 0.005**
KYNBB	a/M θ [°] Rin [r_G] M_{BH} [$M_\odot$] acc rate [Medd]	0.87 (f) 40.7 ° (f) **8.8 ± 0.3** 10 (f) **0.004 ± 0.001**
xillverCp	log ξ N	**2.6 ± 0.4** **2e-04 ± 8e-05**

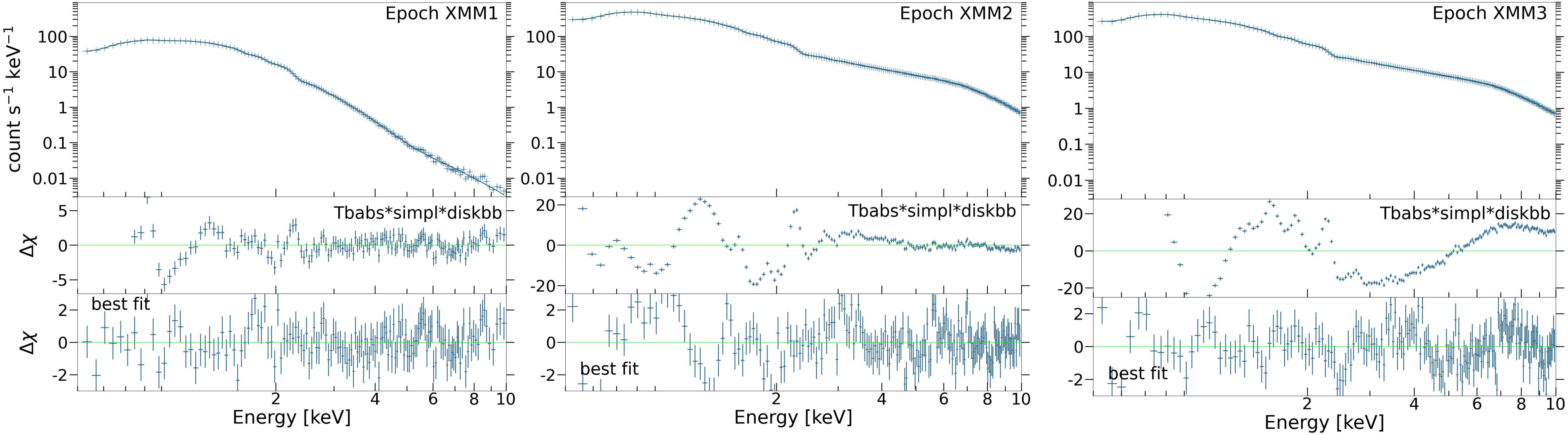
Epoch XXM3

TbFeO * nthComp * KYNBB * xillverCp

Brigitte et al. submitted



χ^2 /dof ≈ 1.37		
Component	Parameter [units]	Value
TbFeO	nH [10^{22} cm-2] O Fe	0.2 (f) 0.9 (f) 0.5 (f)
nthComp	Γ kTe [keV] kTbb [keV] N	**1.74 ± 0.01** 250 (f) 0.1 (f) **0.25 ± 0.02**
KYNBB	a/M θ [°] Rin [r_G] M_{BH} [$M_\odot$] acc rate [Medd]	0.87 (f) 40.7 ° (f) **8.9 ± 0.1** 10 (f) **0.004 ± 0.002**
xillverCp	log ξ N	**3.3 ± 0.1** **0.001 ± 1e-04**



Γ ~ 2.1
NComp ~ 0.02
Rin ~ 6 rG
Acc rate ~ 0.01

Γ ~ 1.99
NComp ~ 0.46
Rin ~ 8.8 rG
Acc rate ~ 0.004

Γ ~ 1.74
NComp ~ 0.25
Rin ~ 8.9 rG
Acc rate ~ 0.004

From soft to hard: Γ decreases, Rin increases and accretion rate decreases

→ Higher contribution from the corona emission, disk more truncated

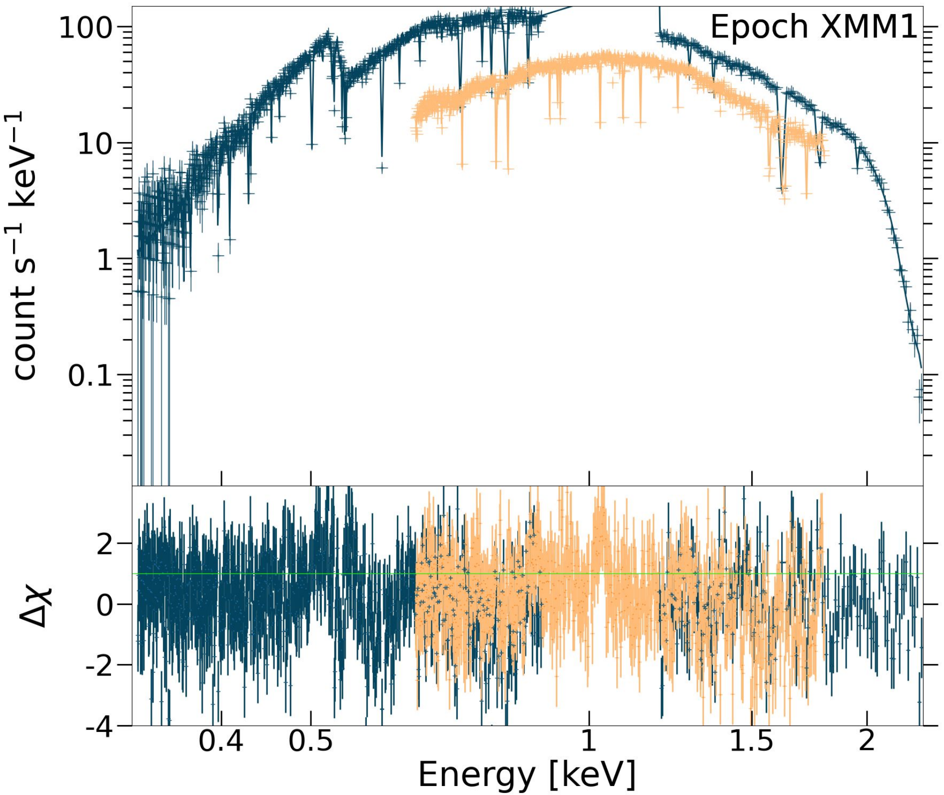
RGS MODELLING

of the RGS spectra to fit the absorption and emission lines

Epoch XXM1

TbFeO * nthComp * KYNBB * xillverCp

Brigitte et al. submitted

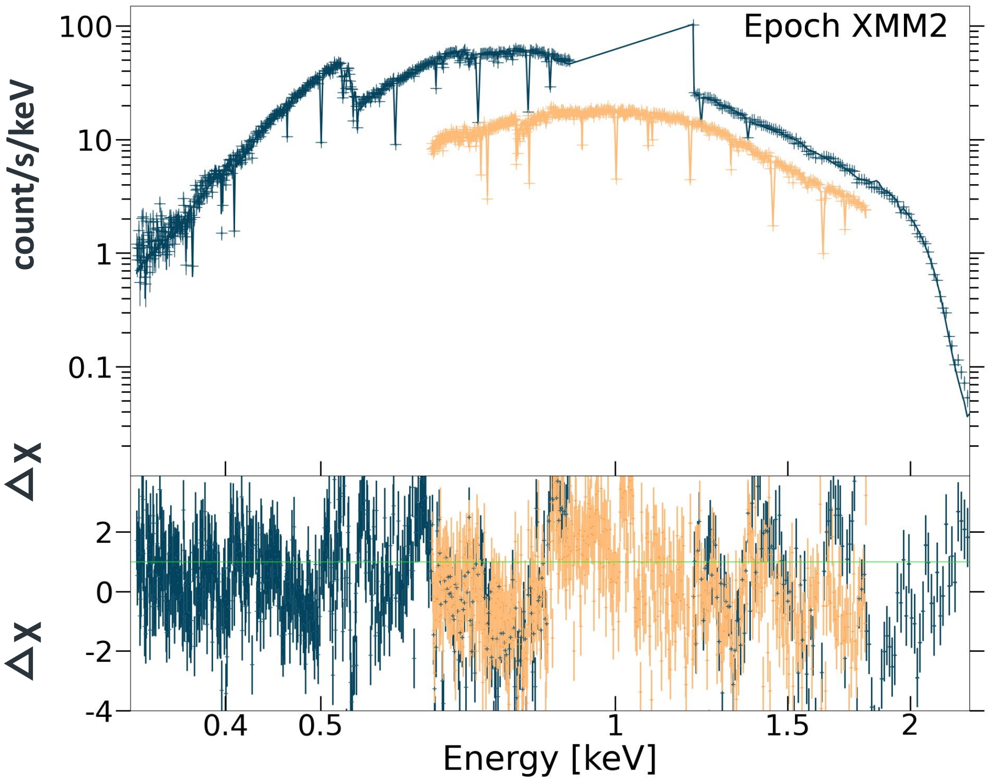


χ2 /dof ≈ 1.38		
Component	Parameter [units]	Value
TbFeO	nH [10^{22} cm-2] O Fe	**0.2 ± 0.1** **0.8 ± 0.1** **0.8 ± 0.1**
nthComp	Γ kTe [keV] kTbb [keV] N	2.1 ± 0.2 (f) 100 (f) 0.3 (f) 0.0186 (f)
KYNBB	a/M θ [°] Rin [r_G] M_{BH} [$M_\odot$] acc rate [Medd]	0.87 (f) 40.7 ° (f) 6.00 ± 0.05 (f) 10 (f) 0.012 ± 0.001 (f)
xillverCp	log ξ N	– –

Epoch XXM2

TbFeO * nthComp * KYNBB * xillverCp

Brigitte et al. submitted

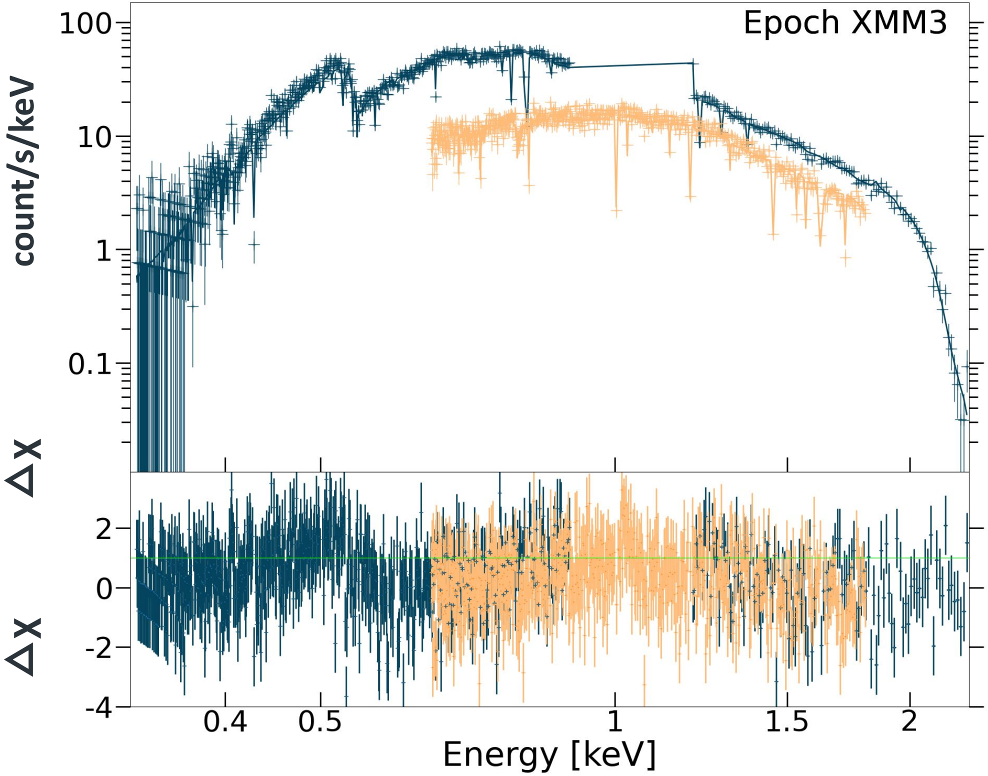


χ2 /dof ≈ 2.0		
Component	Parameter [units]	Value
TbFeO	nH [10^{22} cm-2] O Fe	**0.2 ± 0.1** **0.7 ± 0.1** **0.5 ± 0.2**
nthComp	Γ kTe [keV] kTbb [keV] N	1.998 (f) 250 (f) 0.1 (f) 0.465 (f)
KYNBB	a/M θ [°] Rin [r_G] M_{BH} [$M_\odot$] acc rate [Medd]	0.87 (f) 40.7 ° (f) 8.8 (f) 10 (f) 0.004 (f)
xillverCp	log ξ N	2.6 (f) 2e-04 (f)

Epoch XXM3

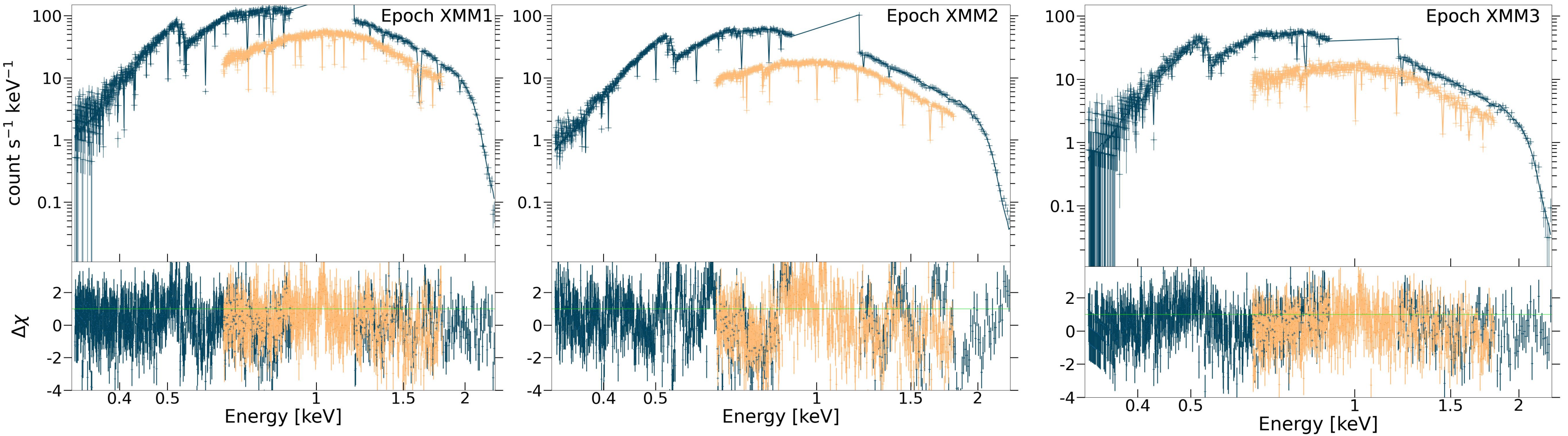
TbFeO * nthComp * KYNBB * xillverCp

Brigitte et al. submitted



χ^2 /dof ≈ 1.15

Component	Parameter [units]	Value
TbFeO	nH [10^{22} cm-2] O Fe	**0.2 ± 0.1** **0.9 ± 0.1** **0.5 ± 0.2**
nthComp	Γ kTe [keV] kTbb [keV] N	1.74 (f) 250 (f) 0.1 (f) 0.25 (f)
KYNBB	a/M θ [°] Rin [r_G] M_{BH} [$M_\odot$] acc rate [Medd]	0.87 (f) 40.7 ° (f) 8.9 (f) 10 (f) 0.004 (f)
xillverCp	log ξ N	3.3 (f) 0.001 (f)



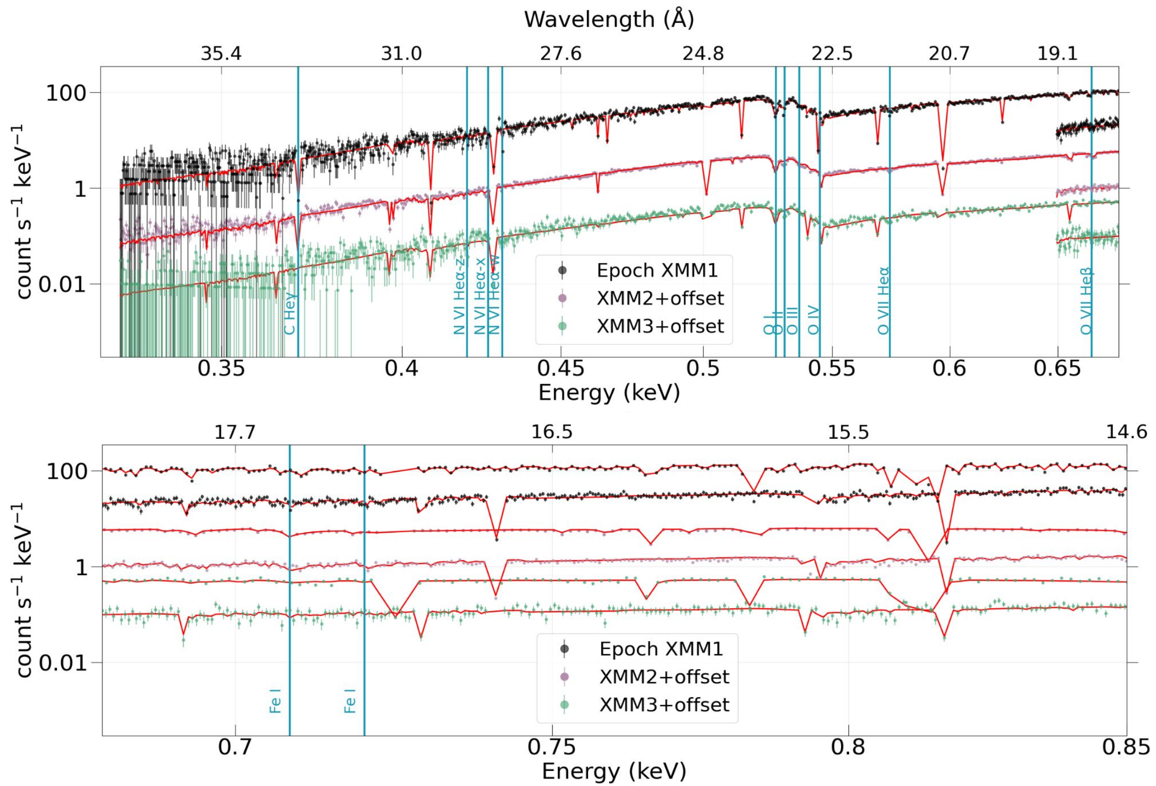
nH ~ 0.26 x 10^{22} cm-2
O ~ 0.8
Fe ~ 0.8

nH ~ 0.26 x 10^{22} cm-2
O ~ 0.7
Fe ~ 0.5

nH ~ 0.26 x 10^{22} cm-2
O ~ 0.9
Fe ~ 0.5

⇨ ISM absorption consistent except for the Fe abundance, most probably instrumental

RGS SPECTROSCOPY



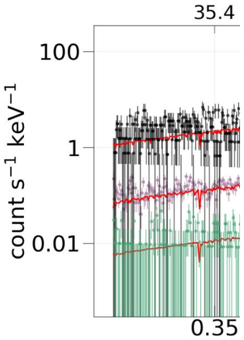
- ❖ Absorption lines:
- ❖ C He
- ❖ N VI
- ❖ O edge
- ❖ Fe I

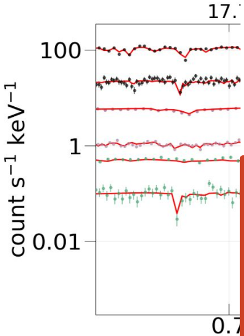
- ❖ Vshift < 100 km/s

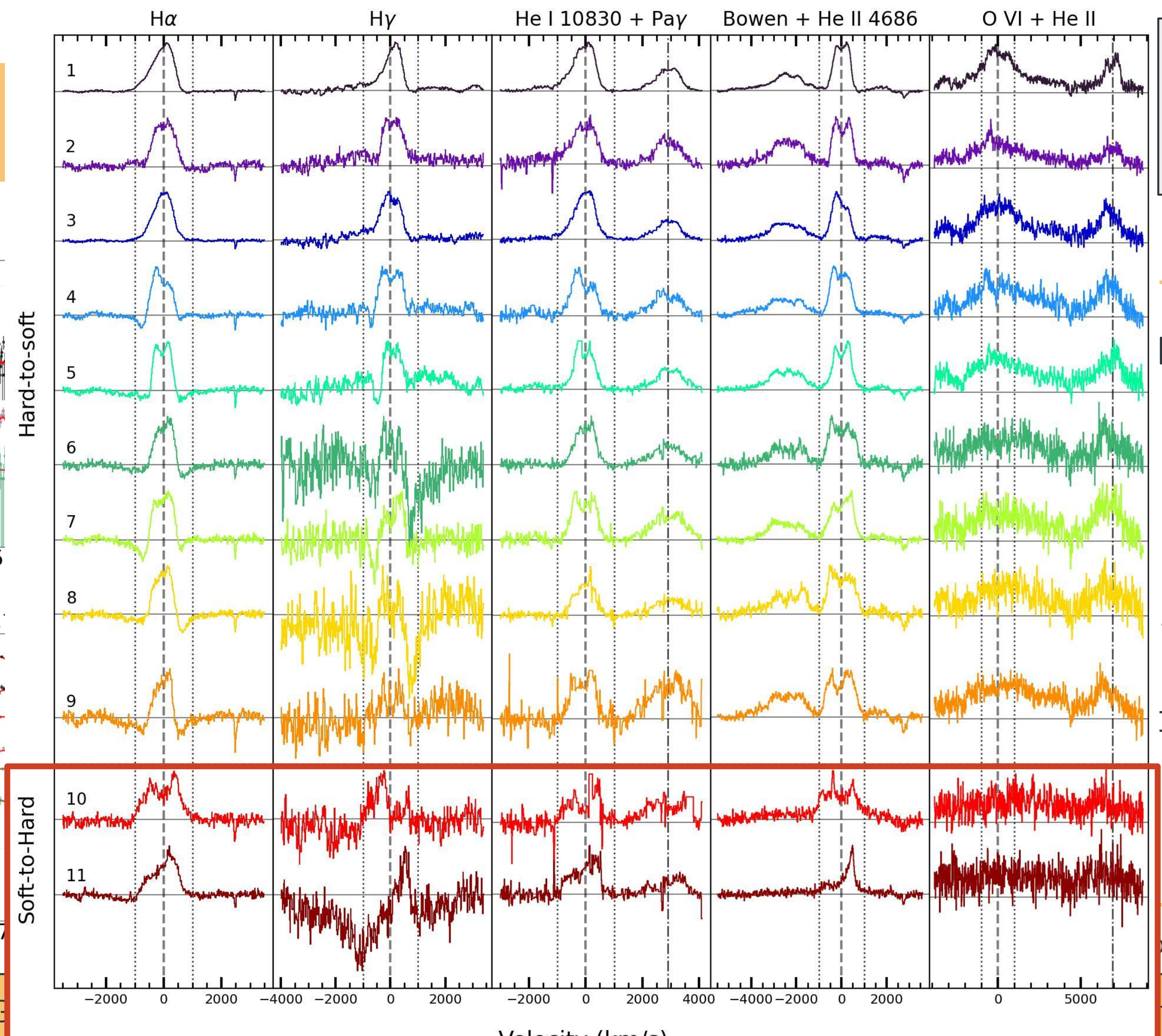
- ❖ ISM gas and low-ionization gas

Brigitte et al. submitted

RGS







see Castro Segura et al. 2026

ption lines:

e

< 100 km/s

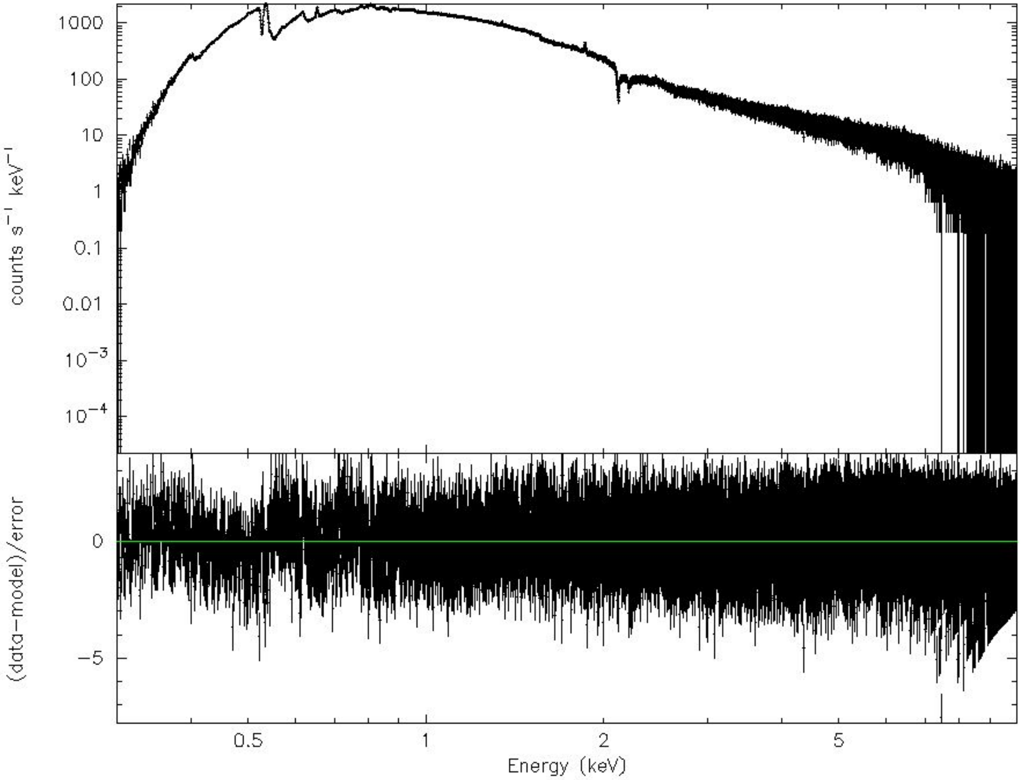
as and
nization gas

omitted

NEW ATHENA

prospects with the X-IFU spectrograph

SIMULATIONS OF SWIFT J1727 WITH X-IFU



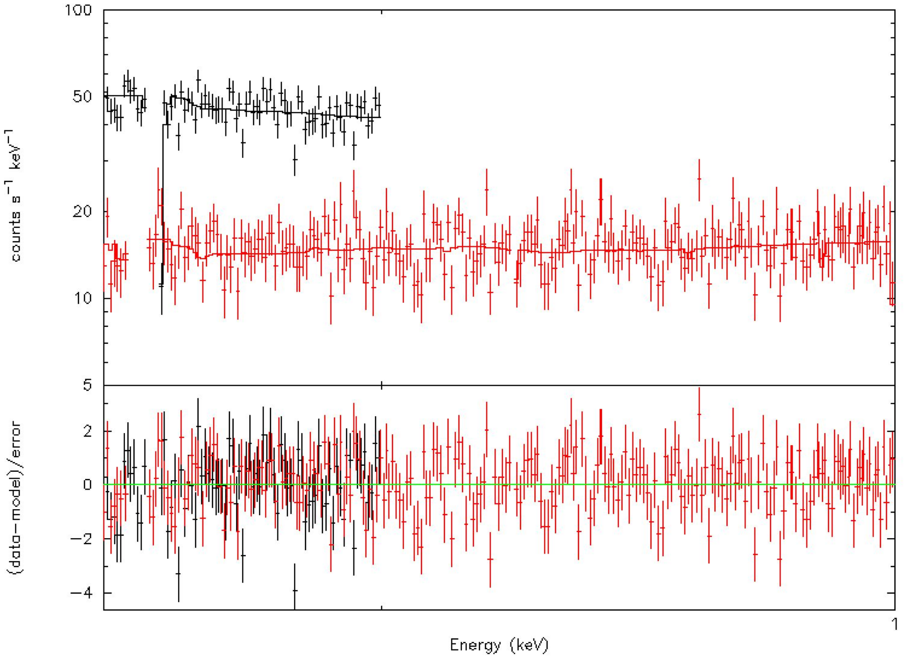
- In the soft-to-hard transition
- 5ks of exposure time
- Lx ~ 5e-10 erg/cm2/s (2–10 keV)
- SNR ~ 42

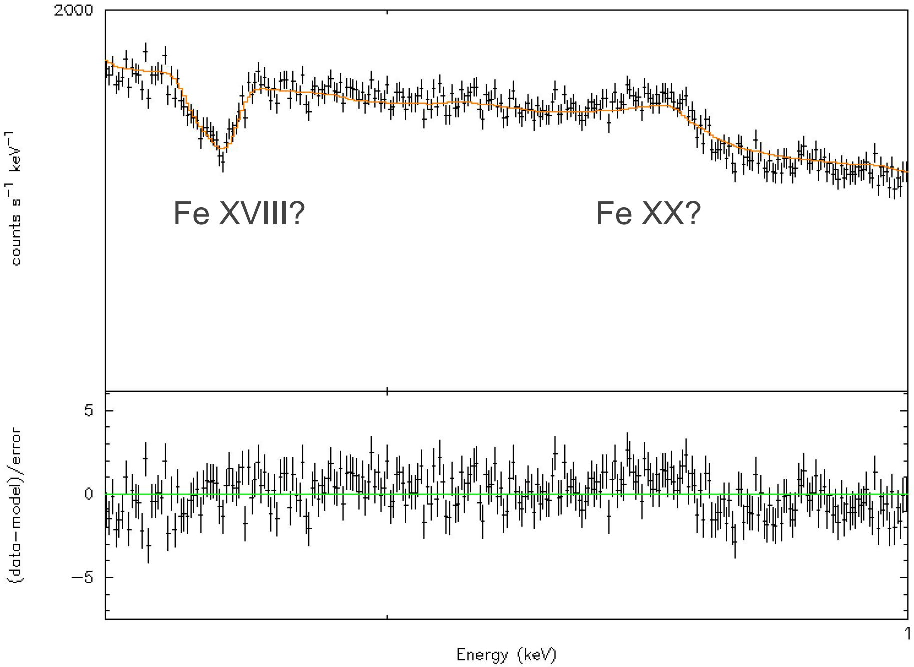
SIXTE

- Neon, Magnesium complex
- Emission lines can trace an ionised outflow

0.85–1 keV

REGIONS OF INTEREST



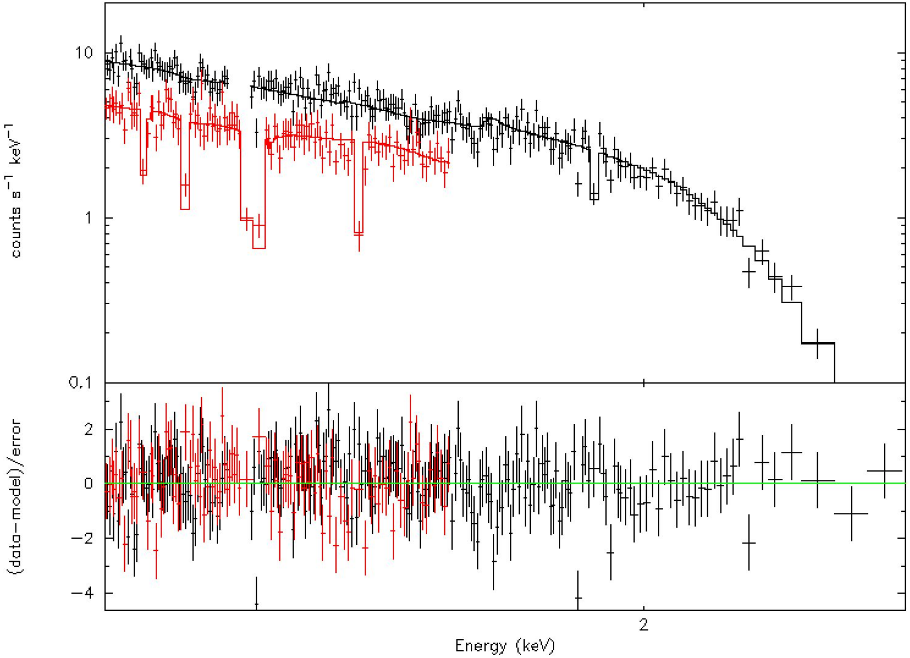


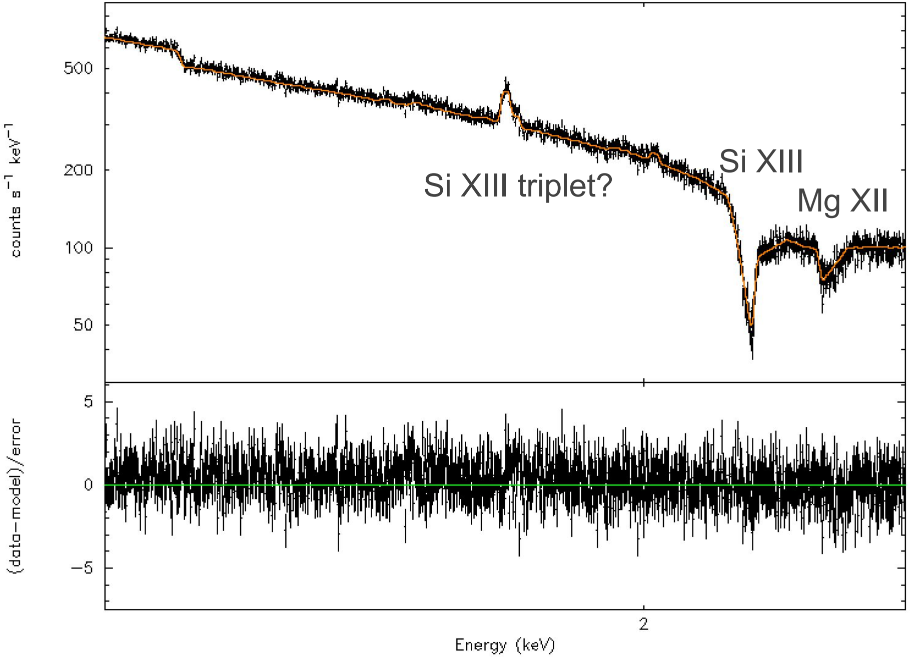
- Silicon complex and Aluminium complex

⇨ O, Ne, Mg, Si absorption edges trace the column density and ionization of the absorbing material

1.5–2.3 keV

REGIONS OF INTEREST





ISM ABSORPTION

- Real variation or from calibration?
- O, Fe abundances
- O edge
- Dust
- Clean separation from intrinsic absorption

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R_{in} EVOLUTION

- Model dependent
- Truncation evolution in the lower branch of the HID even in transitional states

ISM ABSORPTION

- Real variation or from calibration?
- O, Fe abundances
- O edge
- Dust
- Clean separation from intrinsic absorption

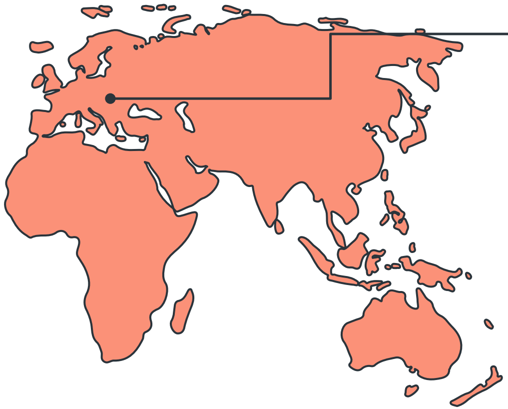
$R_{\rm IN}$ EVOLUTION

- Model dependent
- Truncation evolution in the lower branch of the HID even in transitional states

DISK WIND LINES

- Better spectral resolution for weak winds
- Lower exposure time can access weak lines from weakly-ionised gas

NEW ATHENA UPCOMING CONFERENCE IN PRAGUE



NewATHENA science conference

2027, April, 19-23
Institute of Physics of Prague

THANK YOU FOR YOUR ATTENTION

Image credit: ESA