

Investigating the Peculiar Obscured State of GRS 1915+105 with XMM-Newton and NuSTAR

C. Miceli^{1,2}, T. Di Salvo³, M. Del Santo², R. Iaria³, A. Anitra^{2,3}, L. Burderi⁴, S. Motta⁵ et al.

¹ Universitat Politècnica de Catalunya (UPC) ² IASF/INAF Palermo ³ Università degli Studi di Palermo ⁴ Università di Cagliari ⁵ INAF, Osservatorio Astronomico di Brera

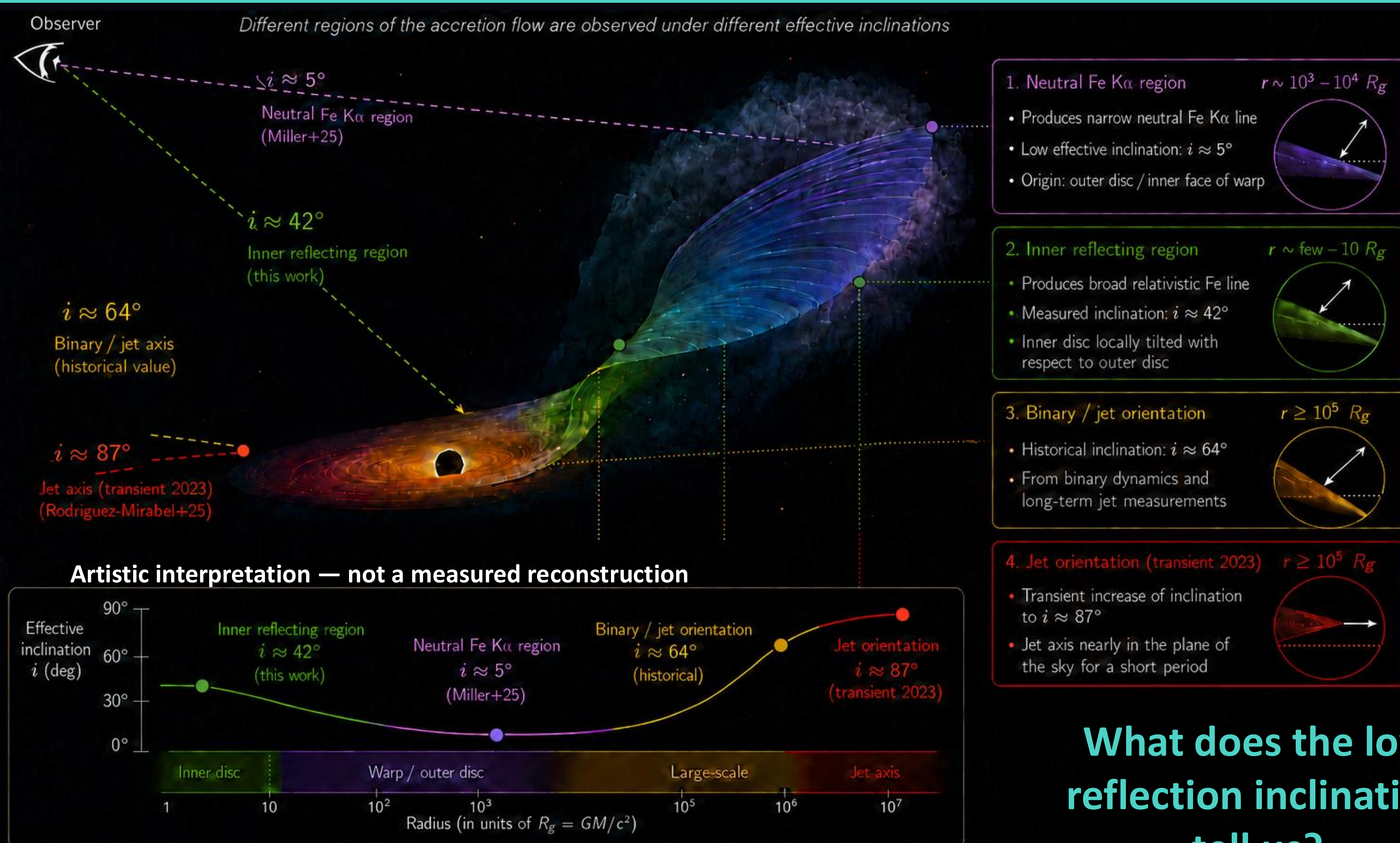
CENTRAL RESULT

$i = 42^\circ$

$+2^\circ / -7^\circ$ (90% confidence)

significantly below the binary/jet value

$64^\circ \pm 4^\circ$

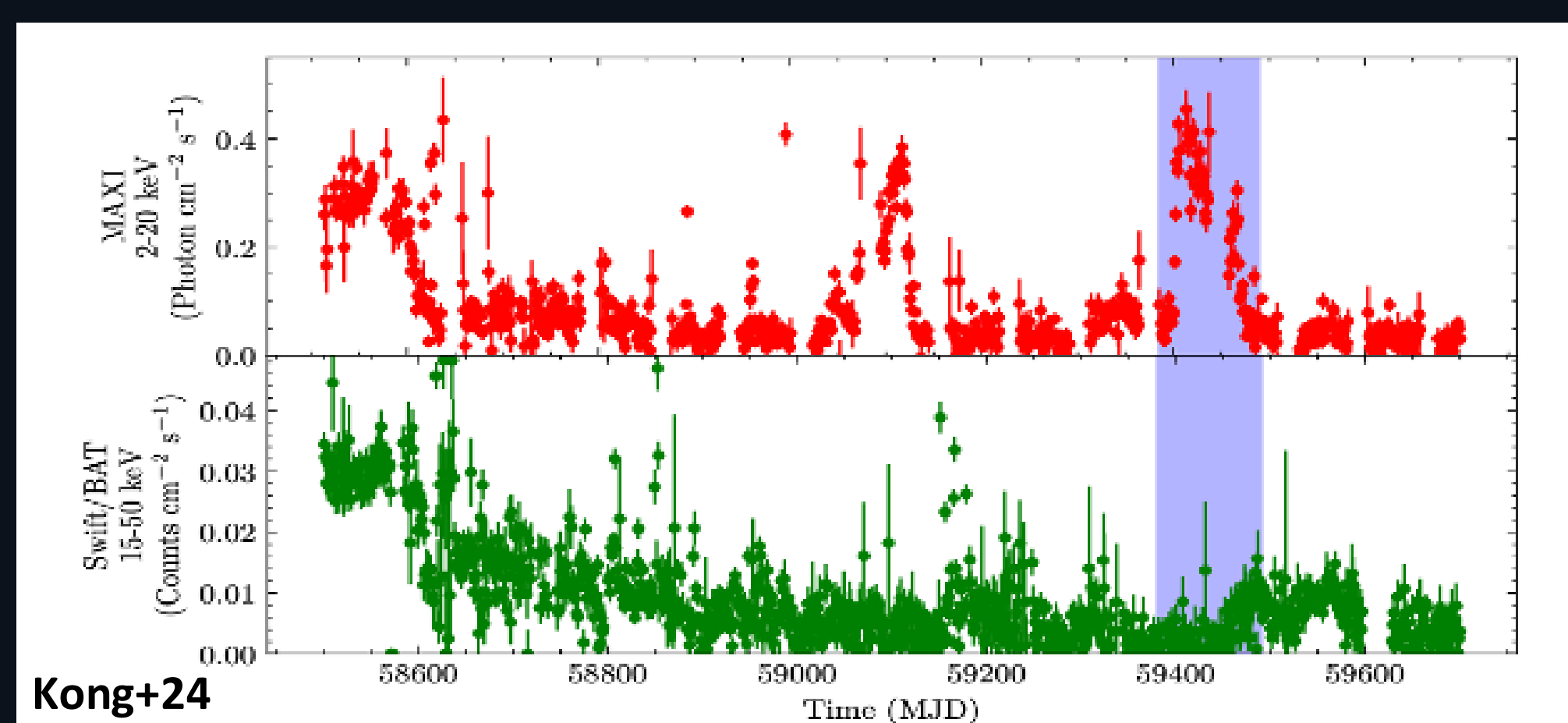


What does the low reflection inclination tell us?

01 WHY THIS OBSERVATION?

A variable microquasar entered a heavily obscured phase

- Relativistic jets and highly variable X-ray/radio emission.
- Since 2018: strong local absorption, obscuration and radio flaring.
- July 2021 soft X-ray re-brightening motivated the XMM-Newton + NuSTAR study.



02 DATA & SPECTRAL MODEL

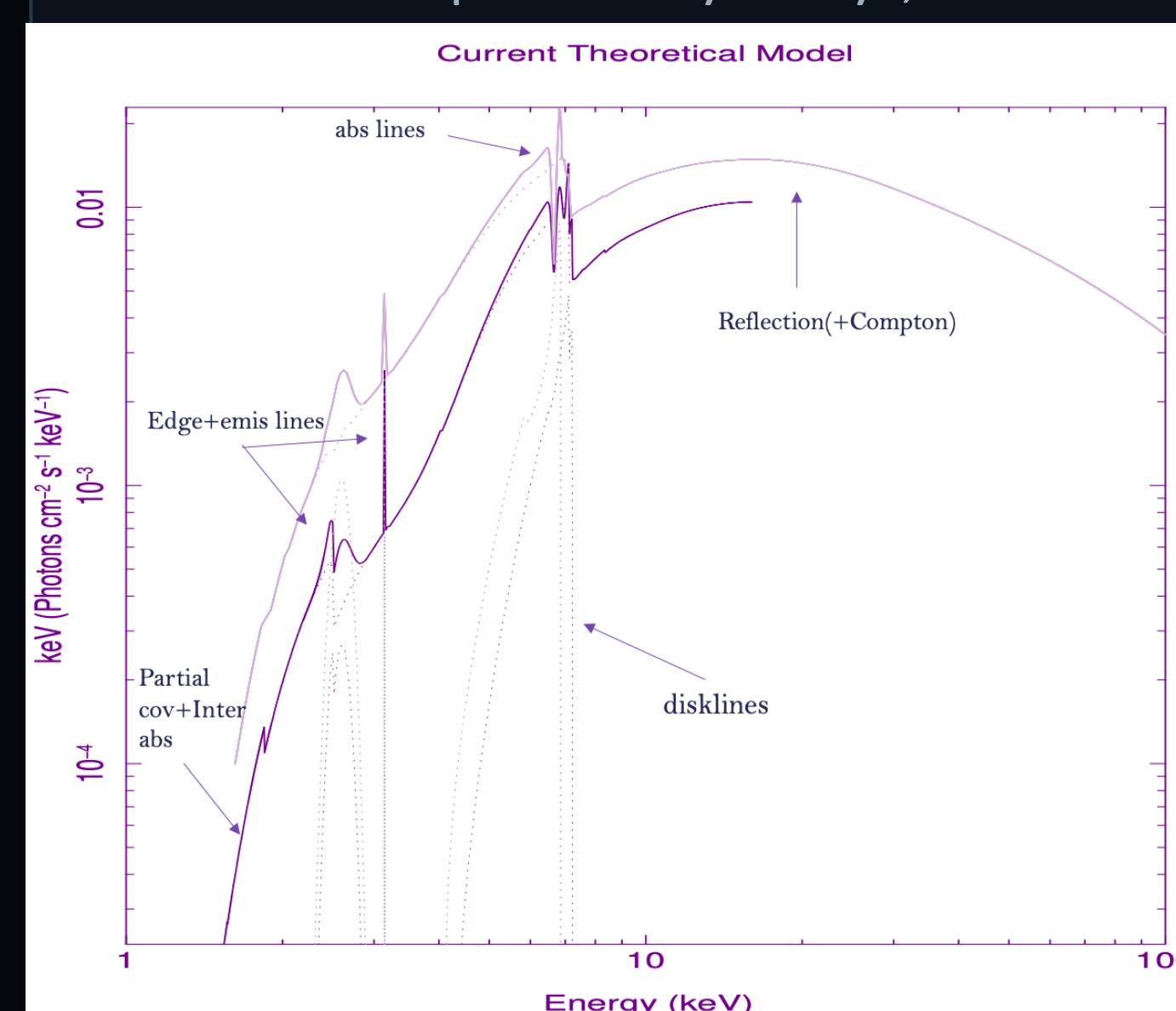
XMM-Newton / EPIC-pn

2–10 keV • 9 Oct 2021

NuSTAR / FPMA-FPMB

3–70 keV • 30 Sep 2021

Separated by 9 days; absorber and continuum were allowed to differ.



FINAL MODEL

TBabs × edge × pcfabs × (diskline + Gaussians + relxillCp)

- Partial covering isolates strong local absorption.
- Relativistic reflection models the Fe-K band and hard excess.

03 XMM-NEWTON & NUSTAR RESULTS

XMM

$N_h = 7.9 \times 10^{23} \text{ cm}^{-2}$

covering fraction 0.95 ± 0.01

XMM - Fe K α

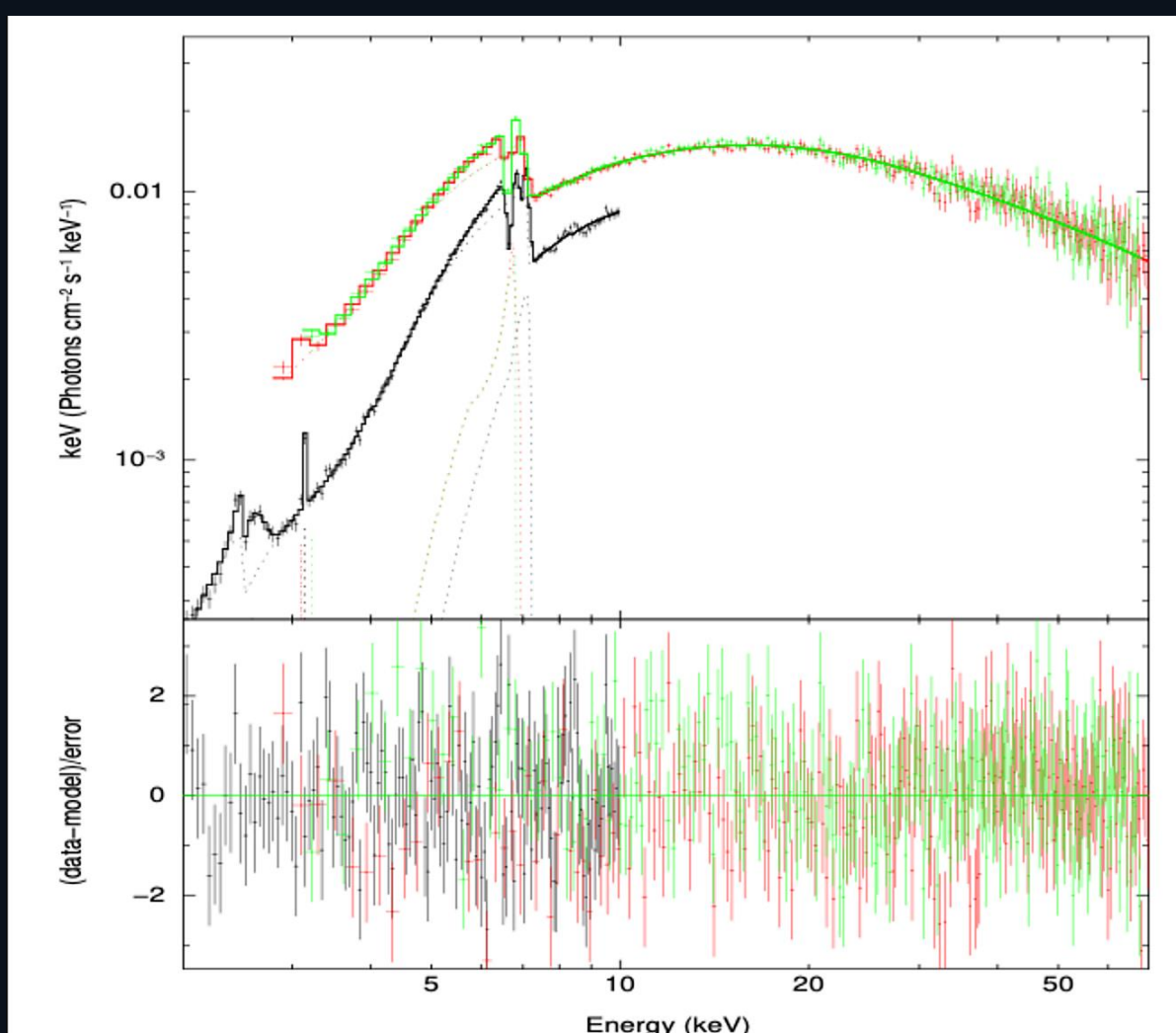
$6.81 \pm 0.02 \text{ keV}$

highly ionized reflector

INCLINATION

$42^\circ (+2^\circ/-7^\circ)$

below literature values $>60^\circ$



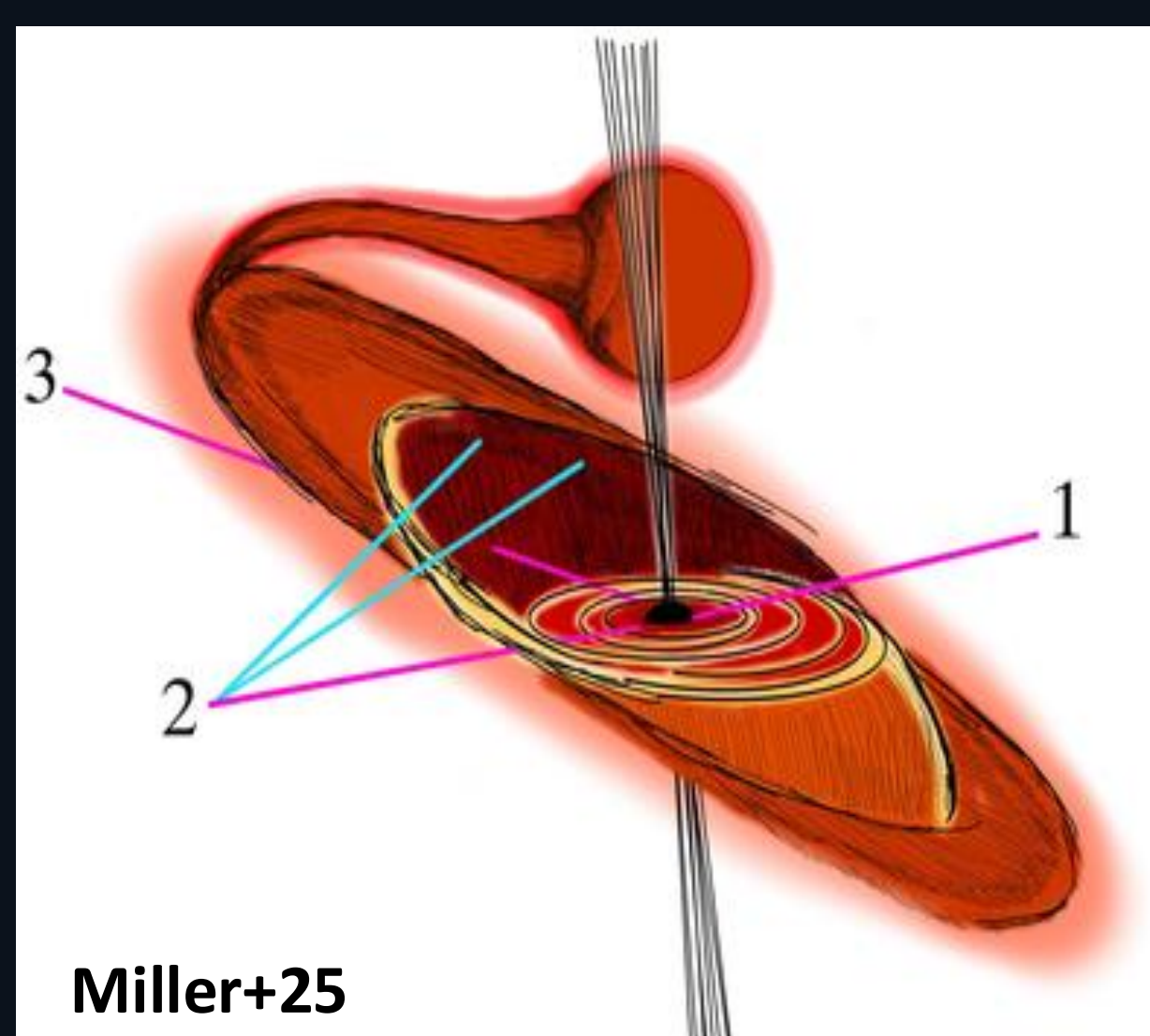
NARROW FEATURES — EPIC-pn

Feature	Energy (keV)	Type
S/Si-like	2.62	emission
Ar-like	3.29 ± 0.02	emission
S XV–XVI	2.50	absorption
Fe XXV	6.662 ± 0.007	absorption
Fe XXVI	6.97 (fixed)	absorption

XMM-Newton: $\log \xi = 3.6 (+0.4/-0.3)$, Fe line at 6.81 keV → highly ionized reflector
NuSTAR: $\log \xi = 2.3 \pm 0.3$, Fe line at 6.49 keV → less ionized reflection

Possible interpretations: evolution of the material or reflection at larger radii; Fe–K cross-calibration differences may contribute.

04 ONE SYSTEM, SEVERAL INCLINATIONS



42°

inner reflecting region
(this work)

$\approx 5^\circ$

neutral Fe K α -emitting region
(Miller et al. 2025)

$>60^\circ$

binary / jet and earlier reflection
estimates

WARPED-DISC SCENARIO

A warp could obscure the central engine while leaving the illuminated inner face visible. Our lower inclination is compatible with this picture, although we cannot exclude alternative explanations.

TAKE-HOME MESSAGE

GRS 1915+105 remained heavily obscured, but relativistic reflection still probes the inner flow.

The low inclination traces a local geometry, while the different XMM-Newton/NuSTAR ionization states reveal a possible evolving reprocessing environment.