

# Multi-wavelength observations of jet launch In real time in the changing-look AGN 1ES 1927+654

**Sibasish Laha**

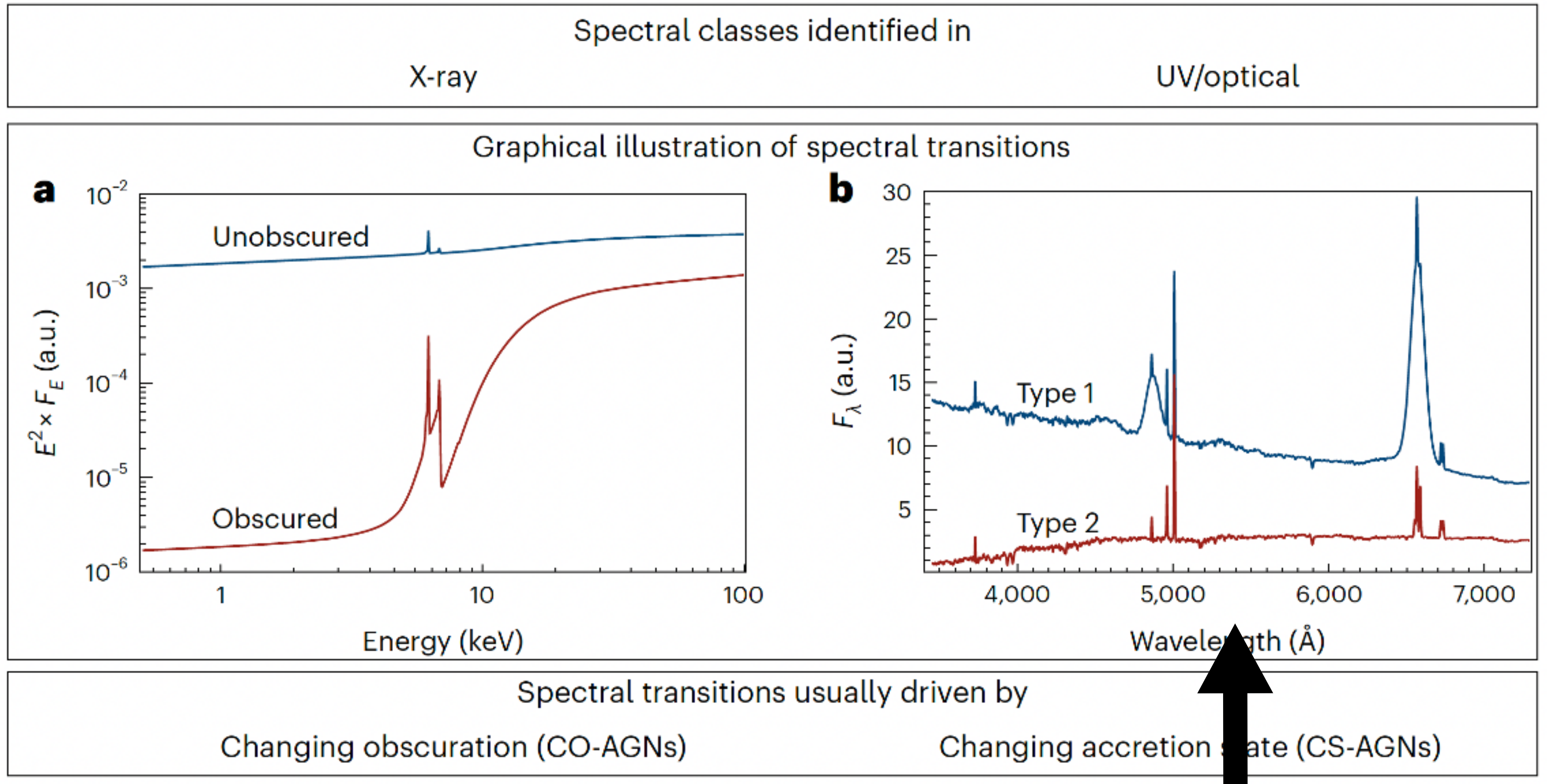
NASA Goddard Space Flight Center & University of Maryland, BC.

Collaborators....

**Eileen Meyer**, Onic Suvo, Dev Sadaula, (UMBC), **Matteo Guainazzi**, (ESTEC)....

**Claudio Ricci**, UDP, **Ehud Behar**, Technion, and many others....

# Changing Look AGN



The spectral state changes

Ricci and Traktenbrot, CL-AGN review, Nat\_As 2023.



# 1ES 1927+654

## The most enigmatic changing look AGN

Trakhtenbrot et al. 2019,

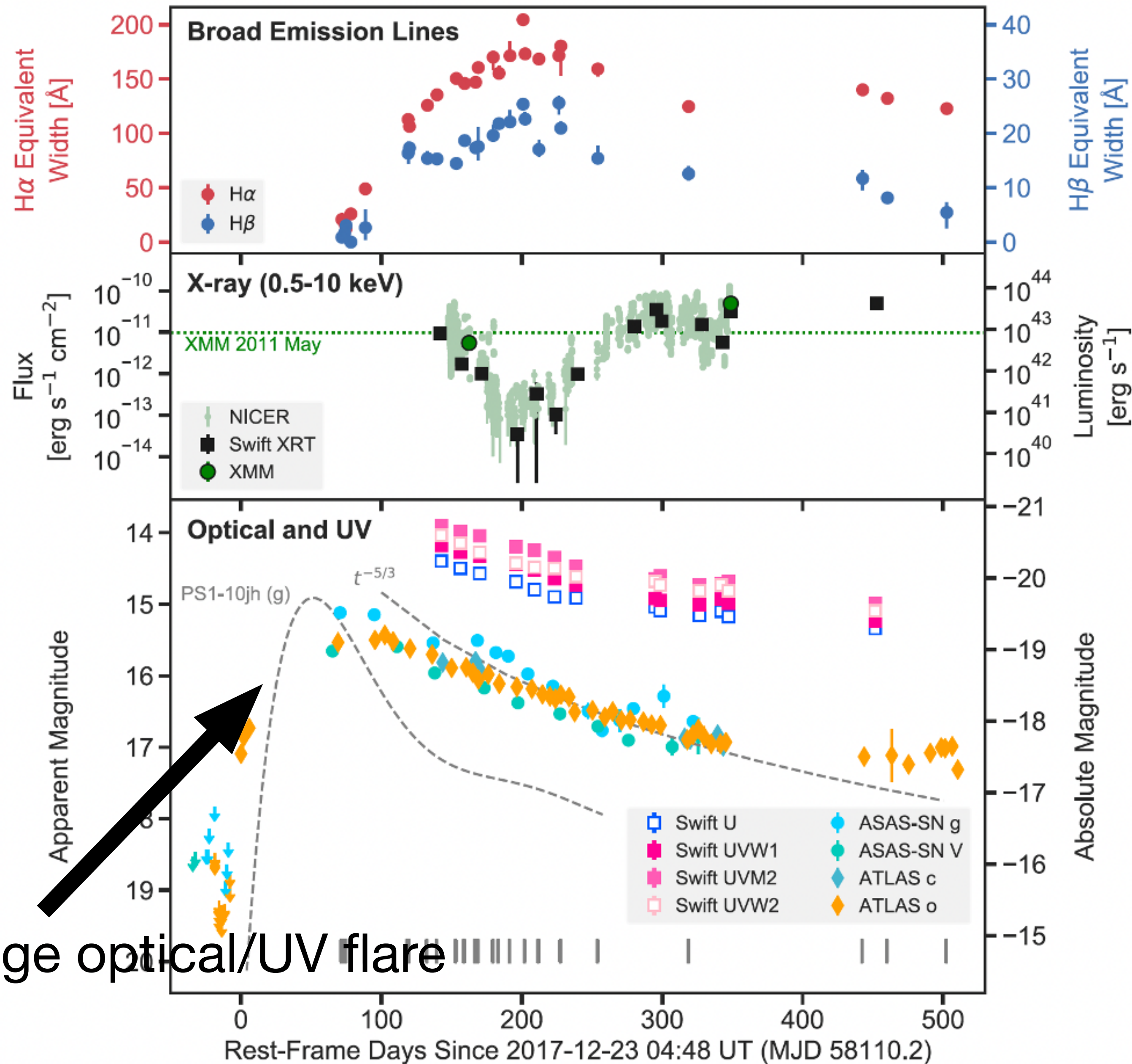
Ricci et al. 2020, 2021, 2023,

Laha et al. 2022

Masterson et al. 2022

Hinkle et al. 2022

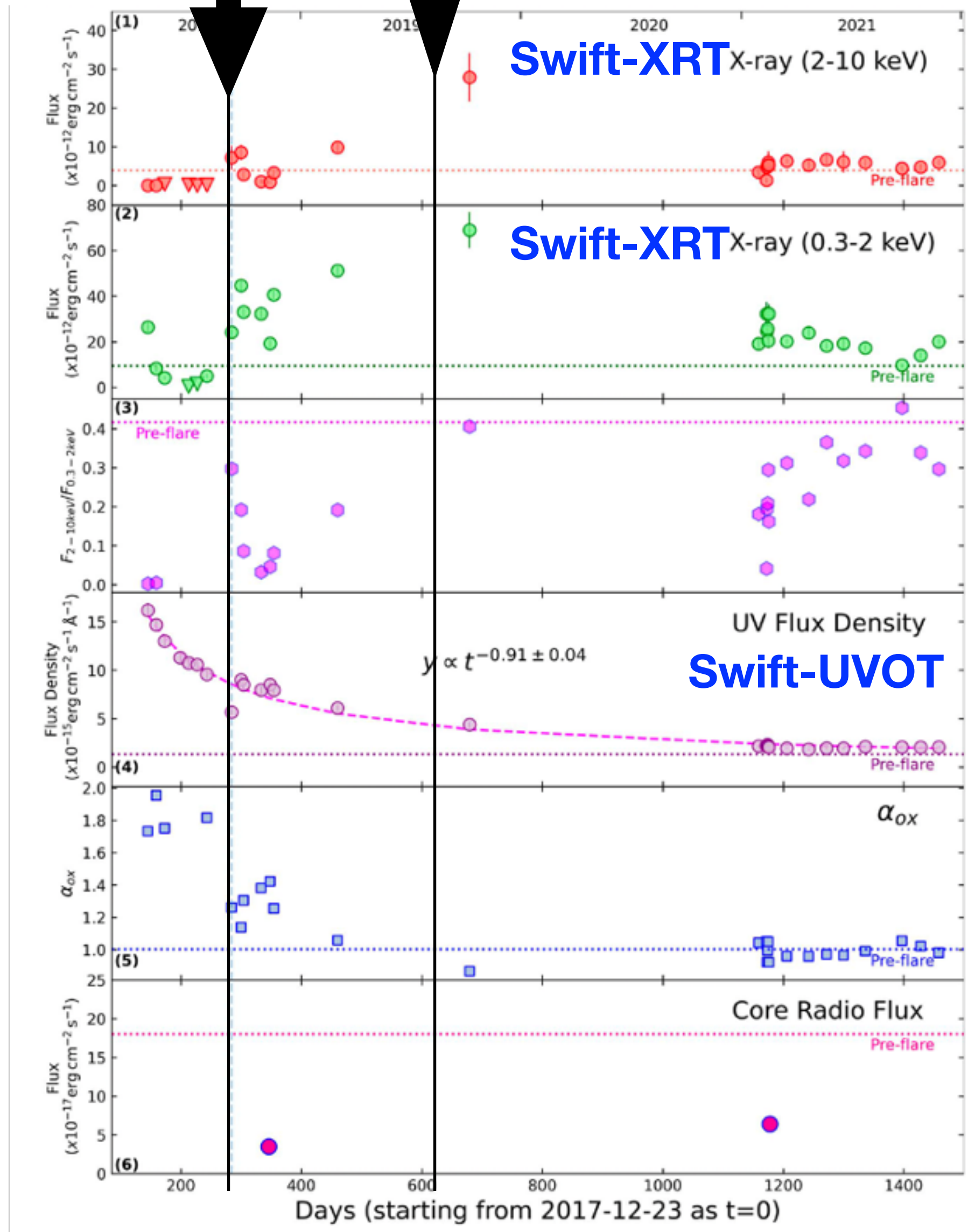
And many other....



Huge optical/UV flare

# Corona Vanished (Aug-Nov 2018)

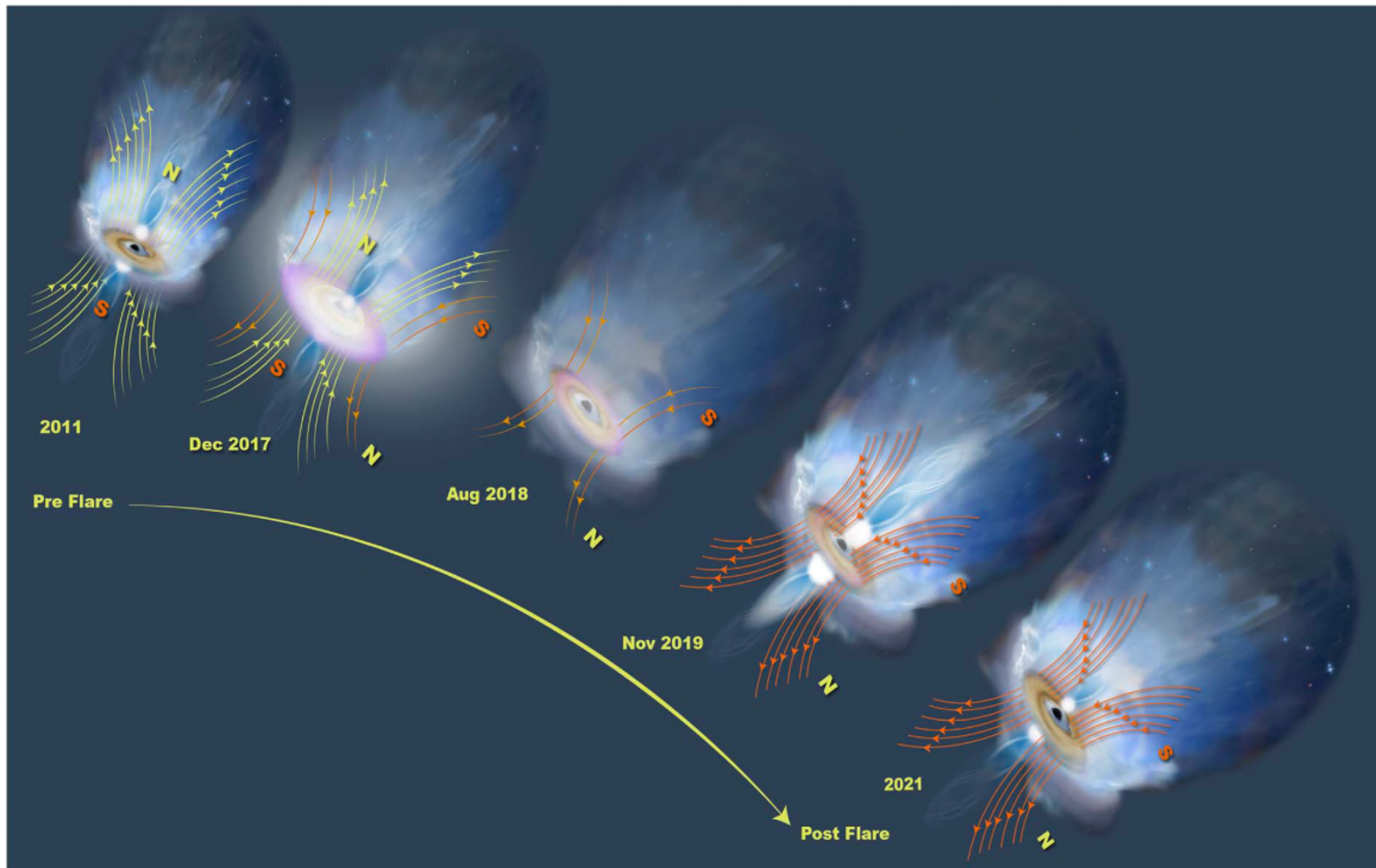
Corona 10 times the normal...



← UV continues to drop monotonically

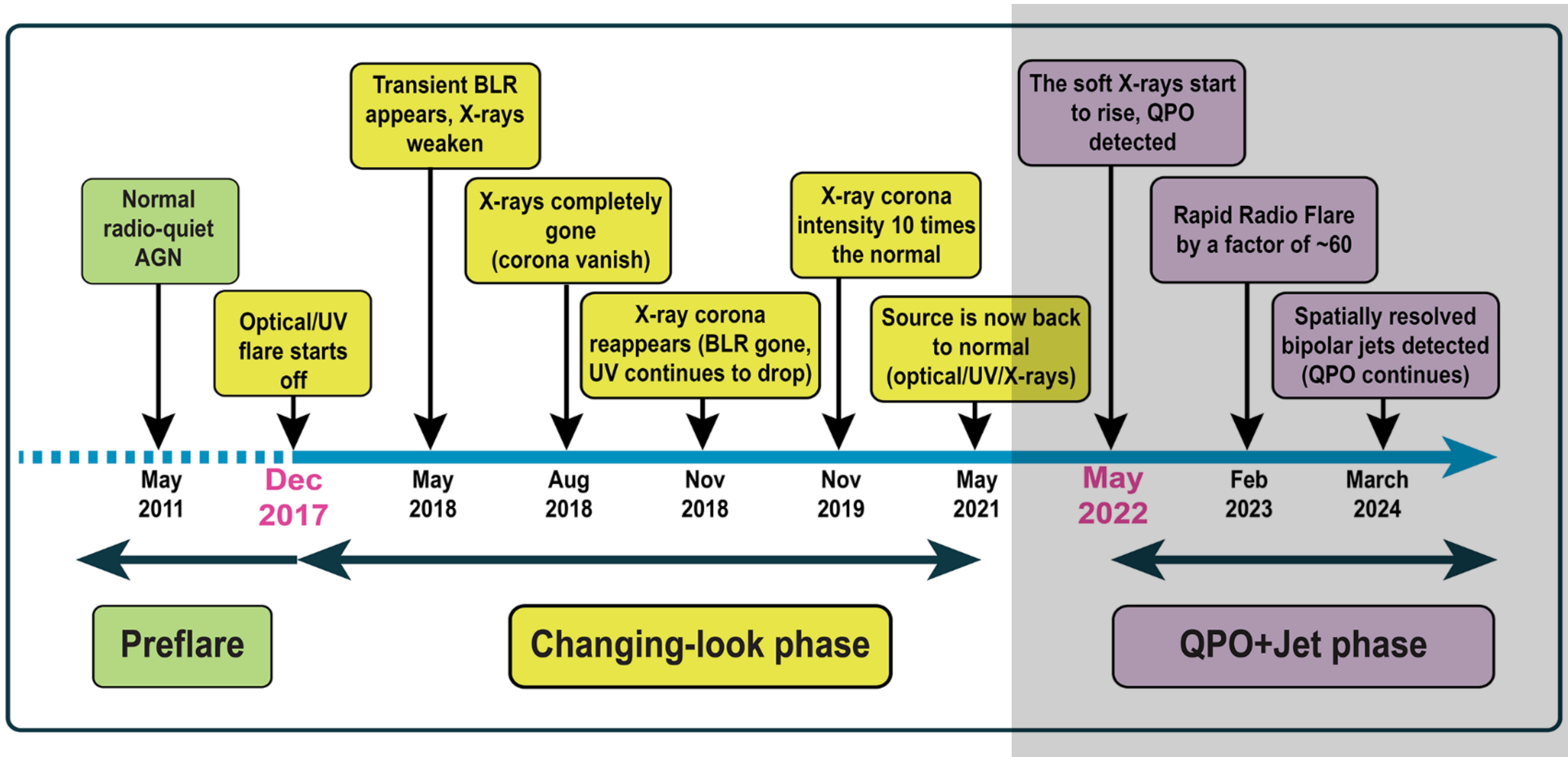
← Radio is minimum when corona vanished

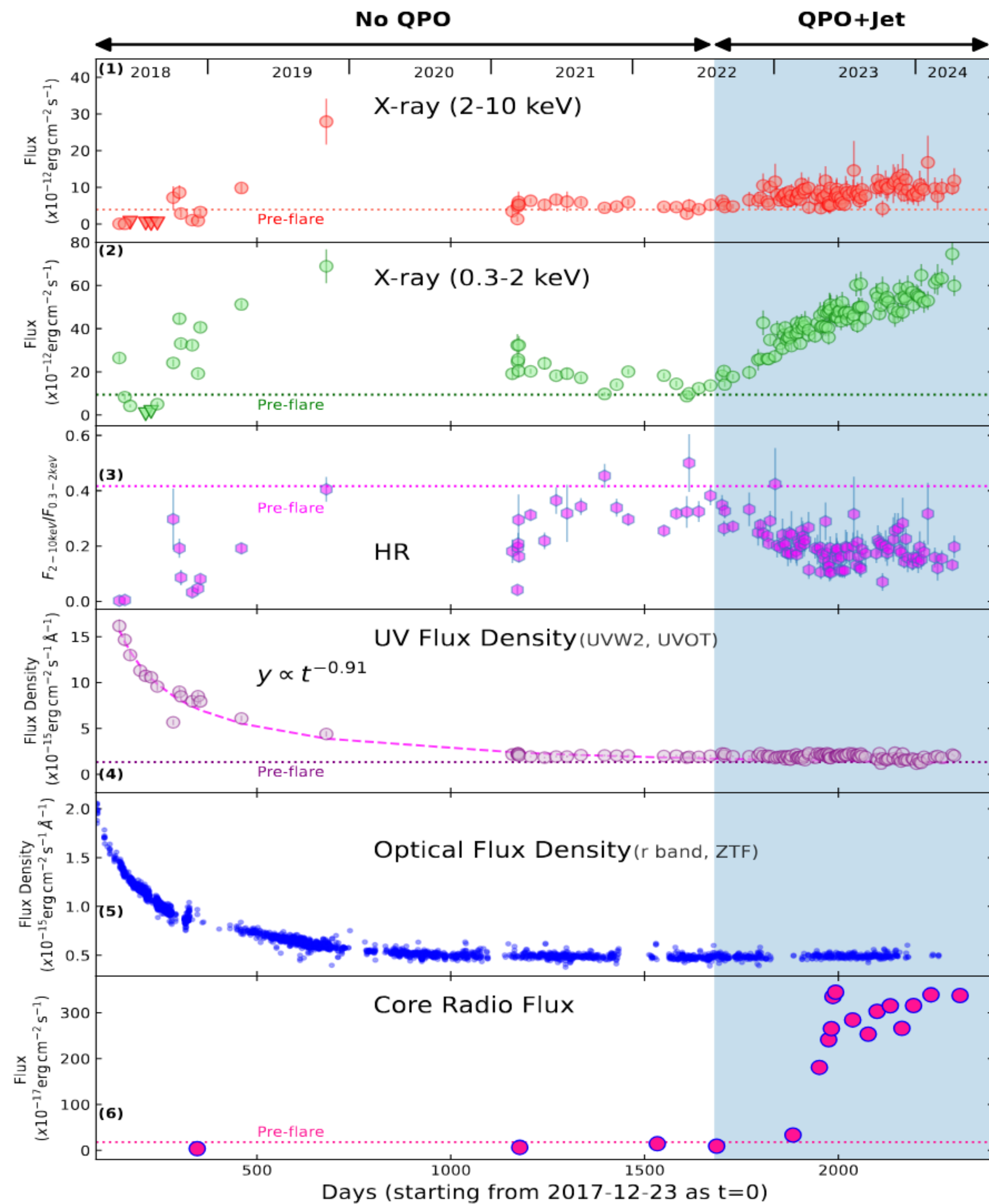




**Magnetic Pole Inversion:** Laha et al. 2022, Scepi et al. 2021



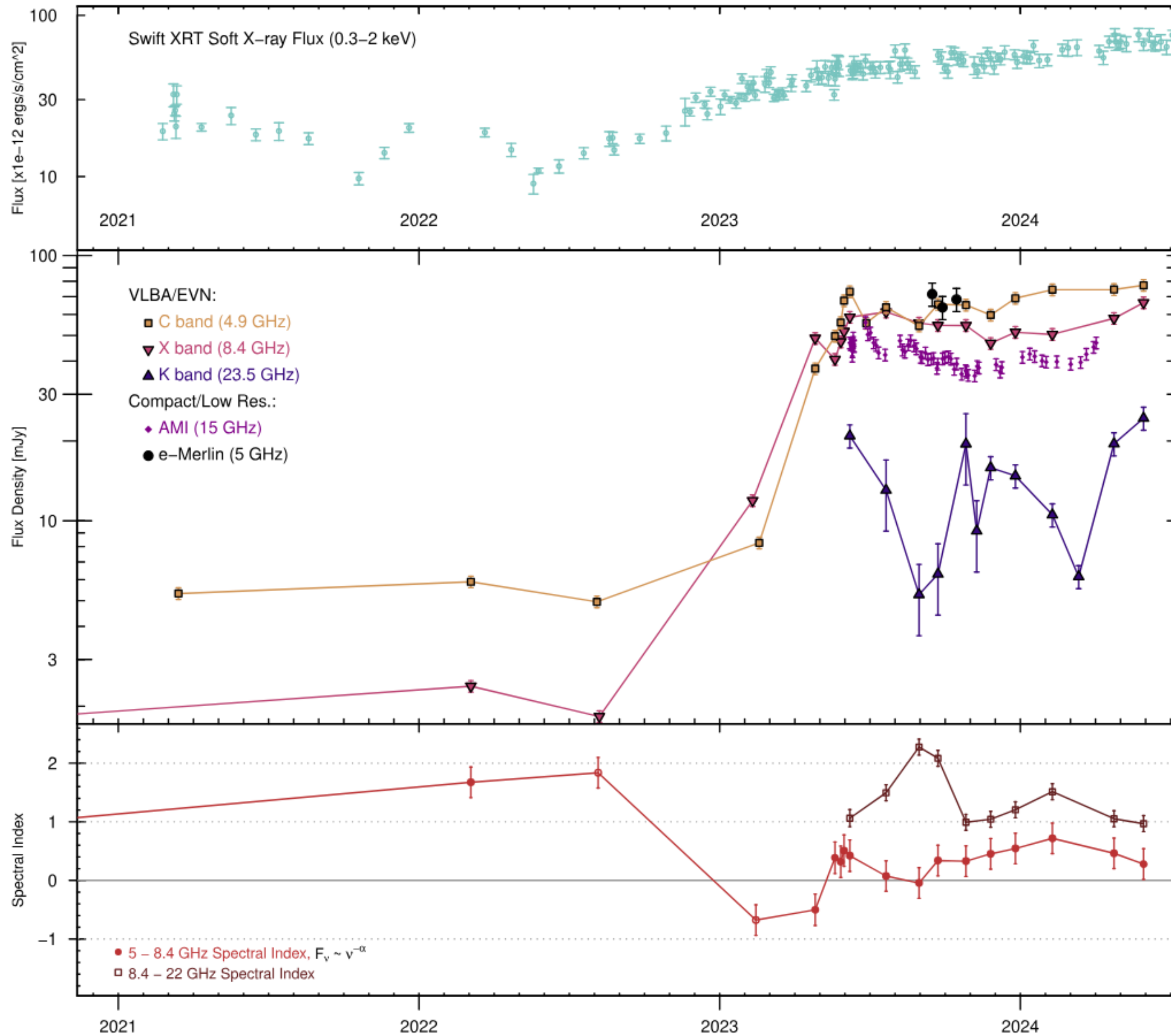




The long term light curve (Swift and VLBA)

Laha et al. 2025 ApJ...981..125L

# The unusual radio brightening... 60 times in just 6 months (Feb-Aug 2023)

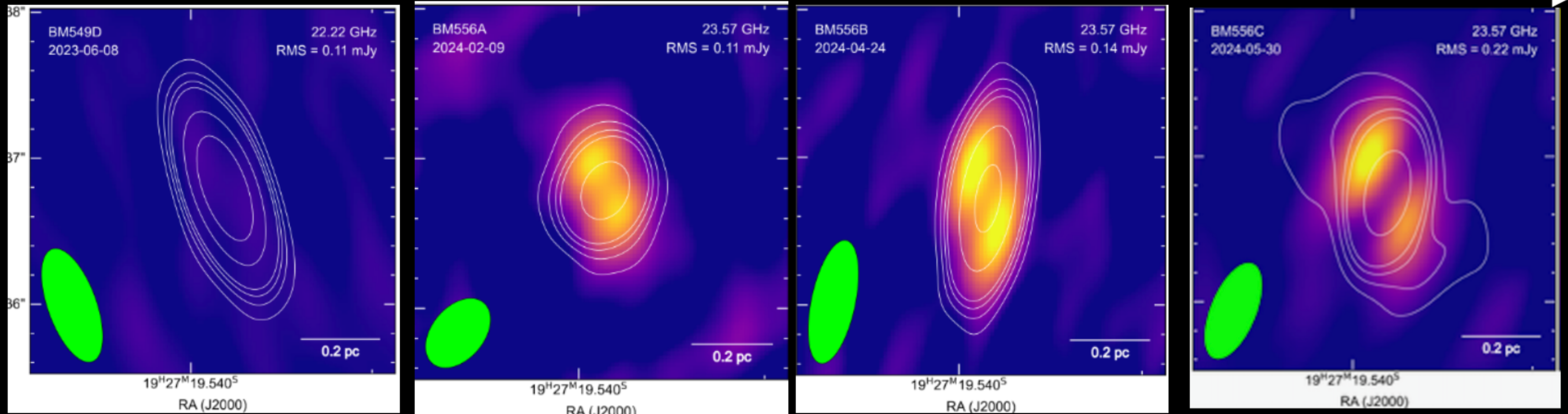


Soft X-ray rise (0.3-2 keV, Swift-XRT)

Multi-band radio light curve

Radio spectral slope evolution





**No Jet  
(A)**

**Jet appears  
(B)**

**Jet evolving at 0.2c  
(C)**

**Jet evolving at 0.2c  
(D)**

*The spatially resolved bilobed jet, traveling at a speed of 0.2c*

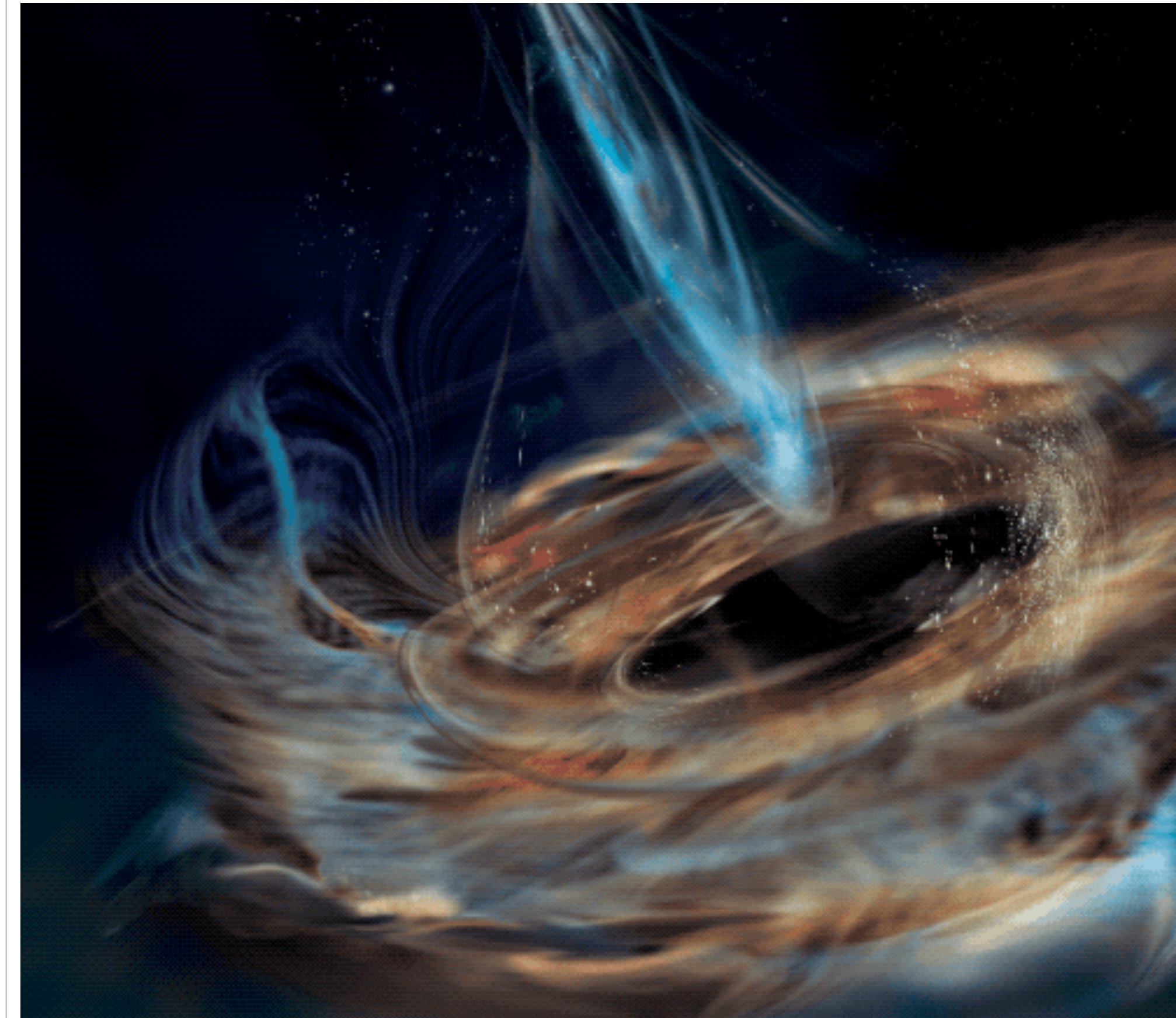
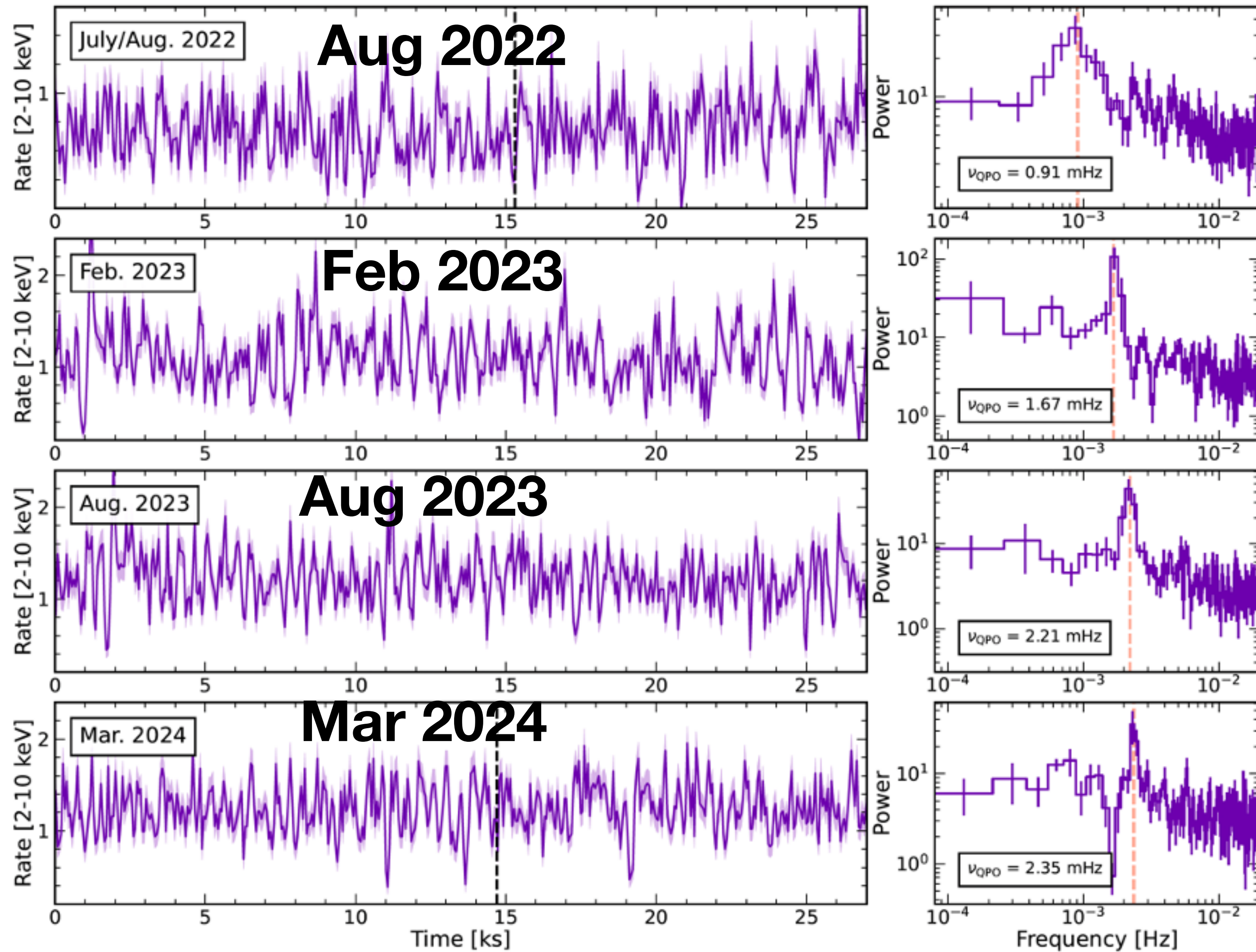
**Meyer et al. 2025 ApJ...979L...2M**

**Laha et al. 2025 ApJ...981..125L**

The unique X-ray QPO detection during the Jet formation....



# Quasi-Periodic-Oscillation...in X-rays (XMM-Newton light curves)

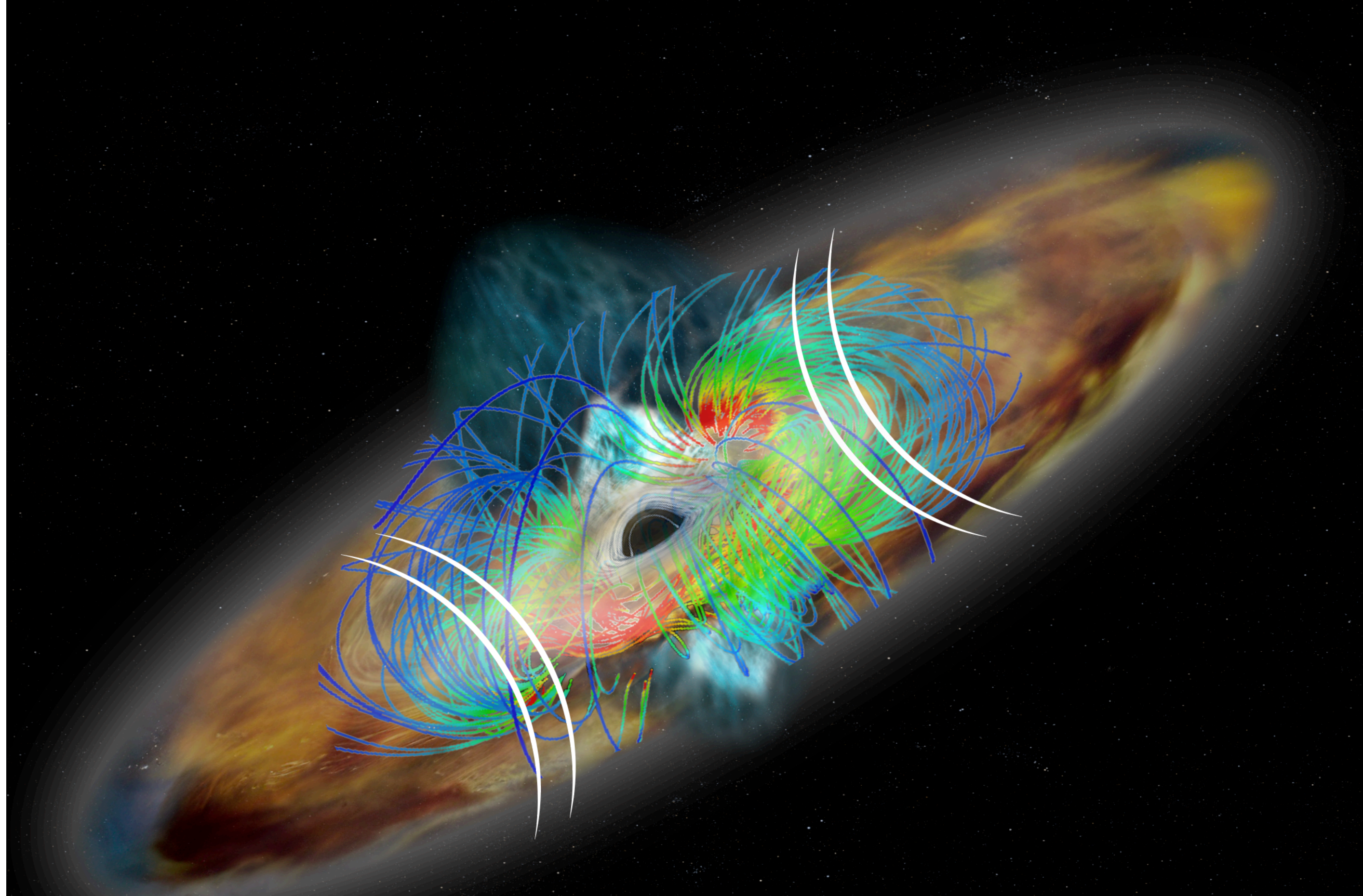
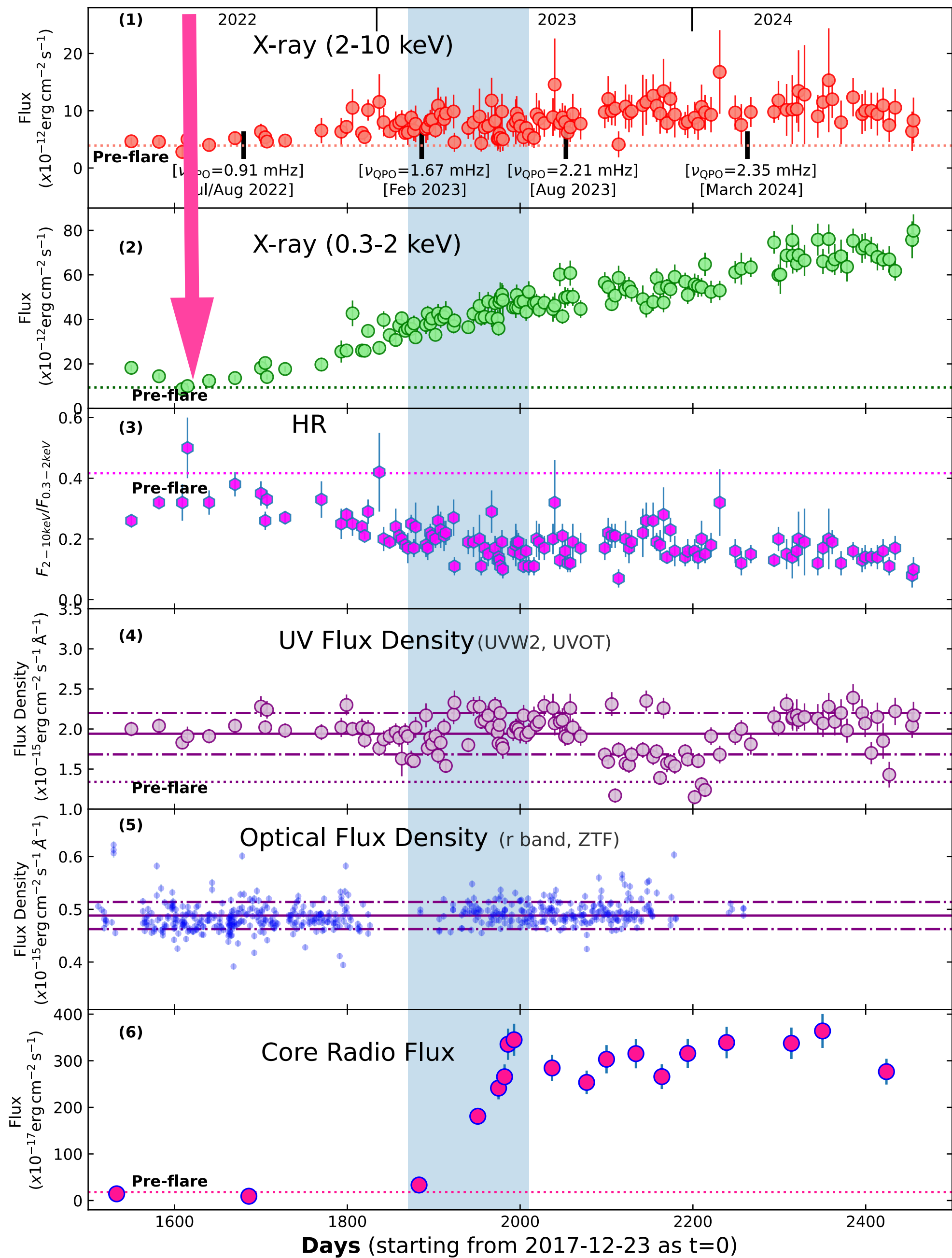


Masterson et al. 2025 Natur.638..370M



*Unfolding the story. . . . A multi wavelength view*

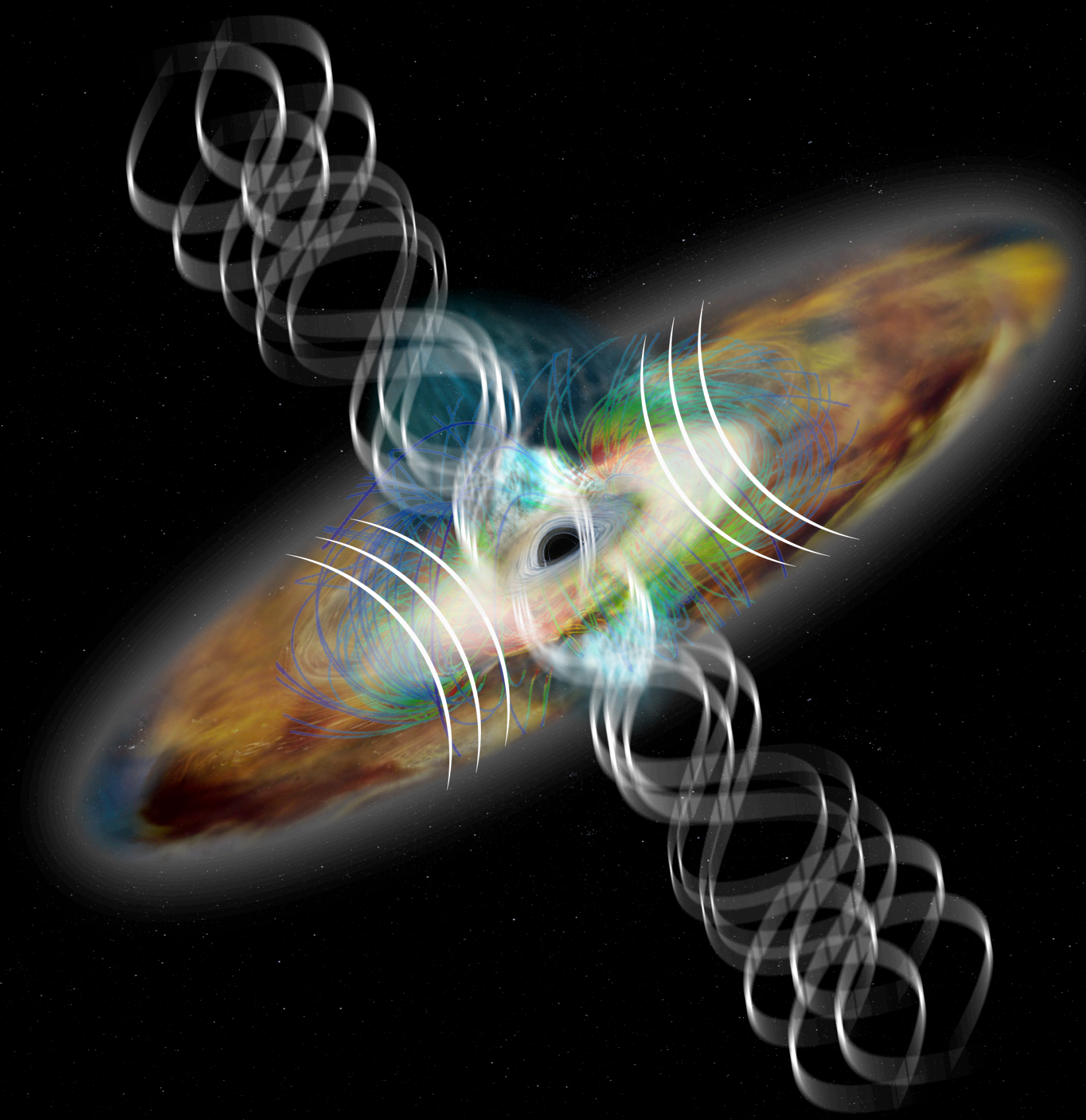
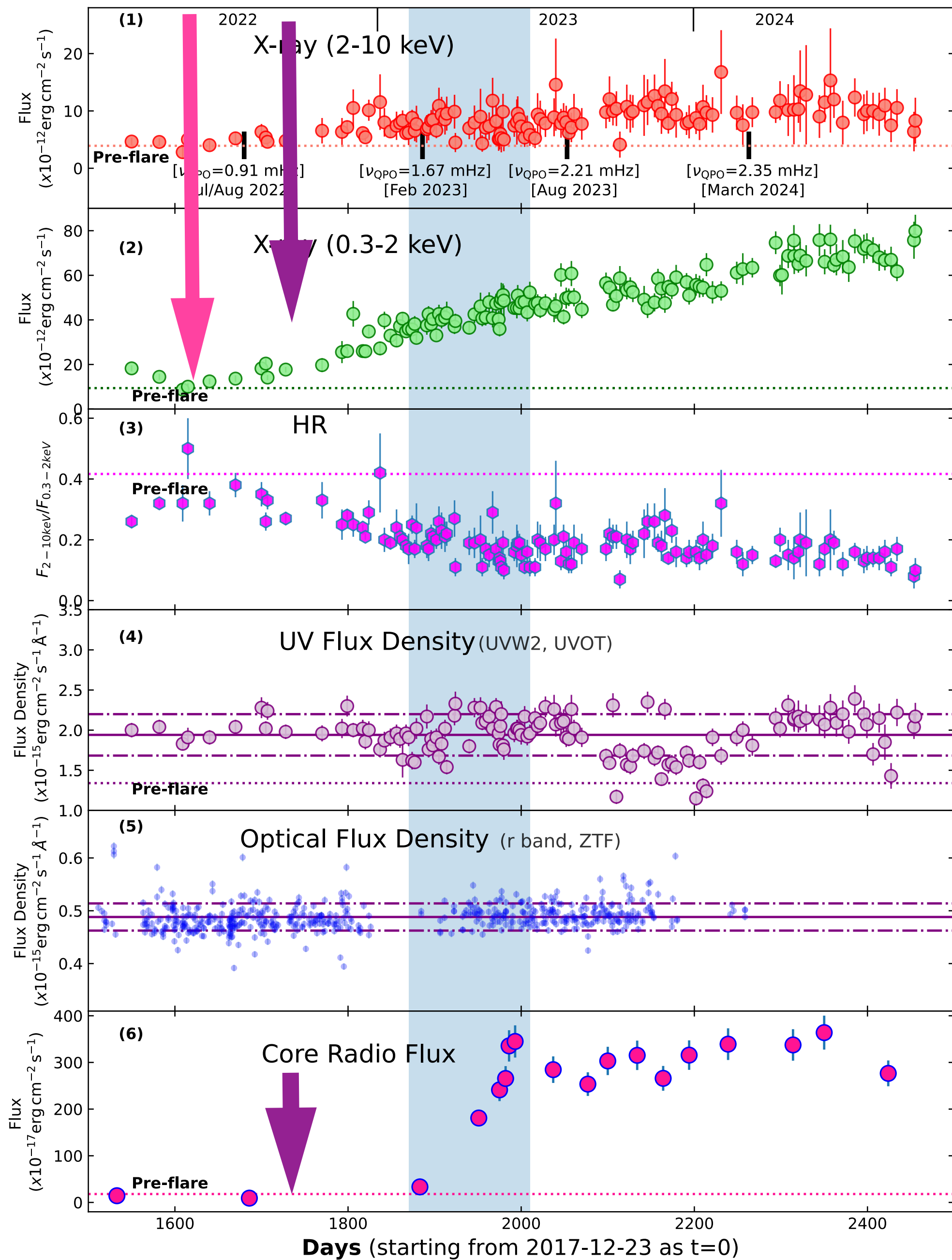




*The source was normal in May 2022....  
after which we found some enigmatic behavior*

**Laha et al. 2025, ApJ...981..125L**

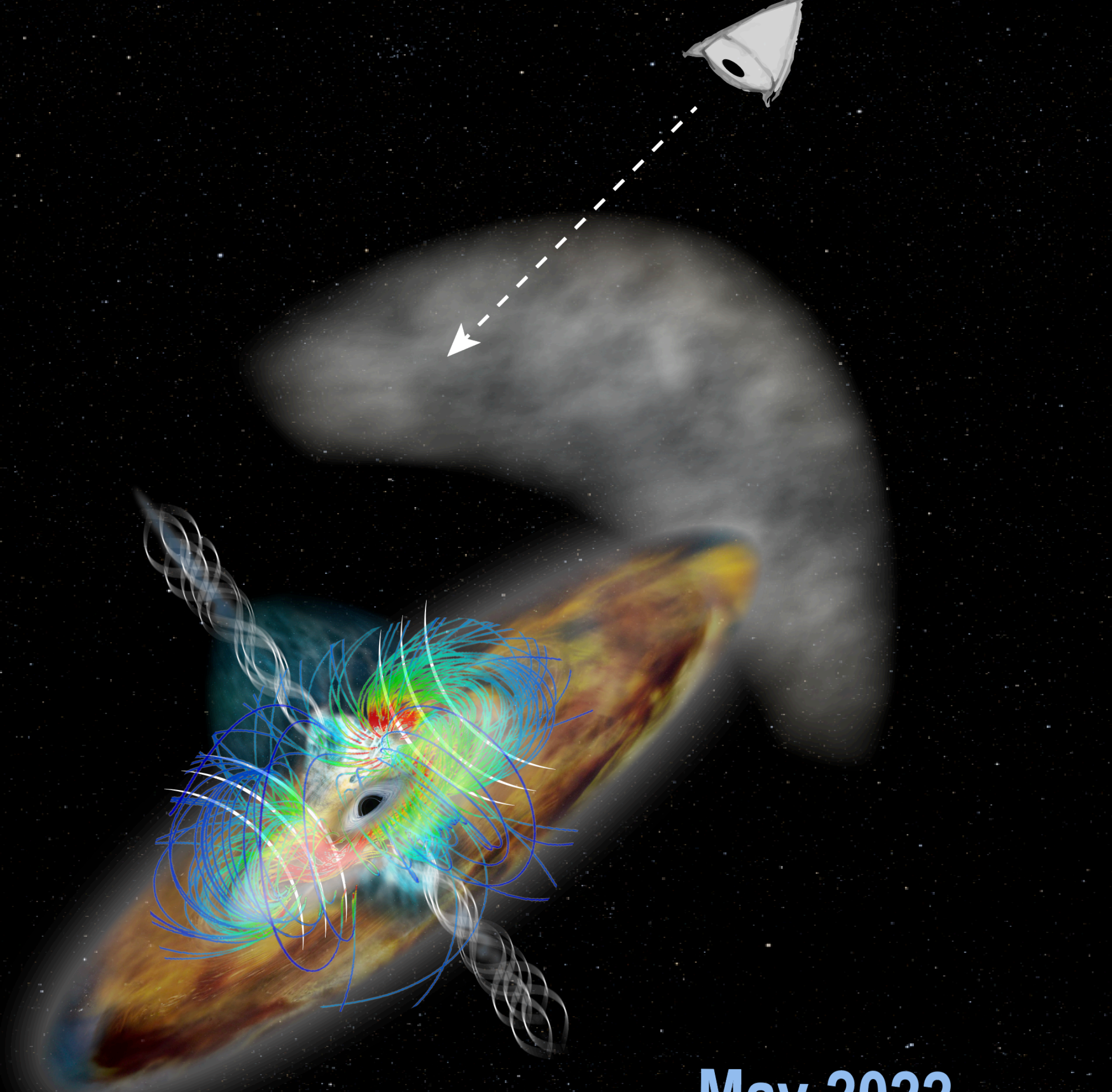
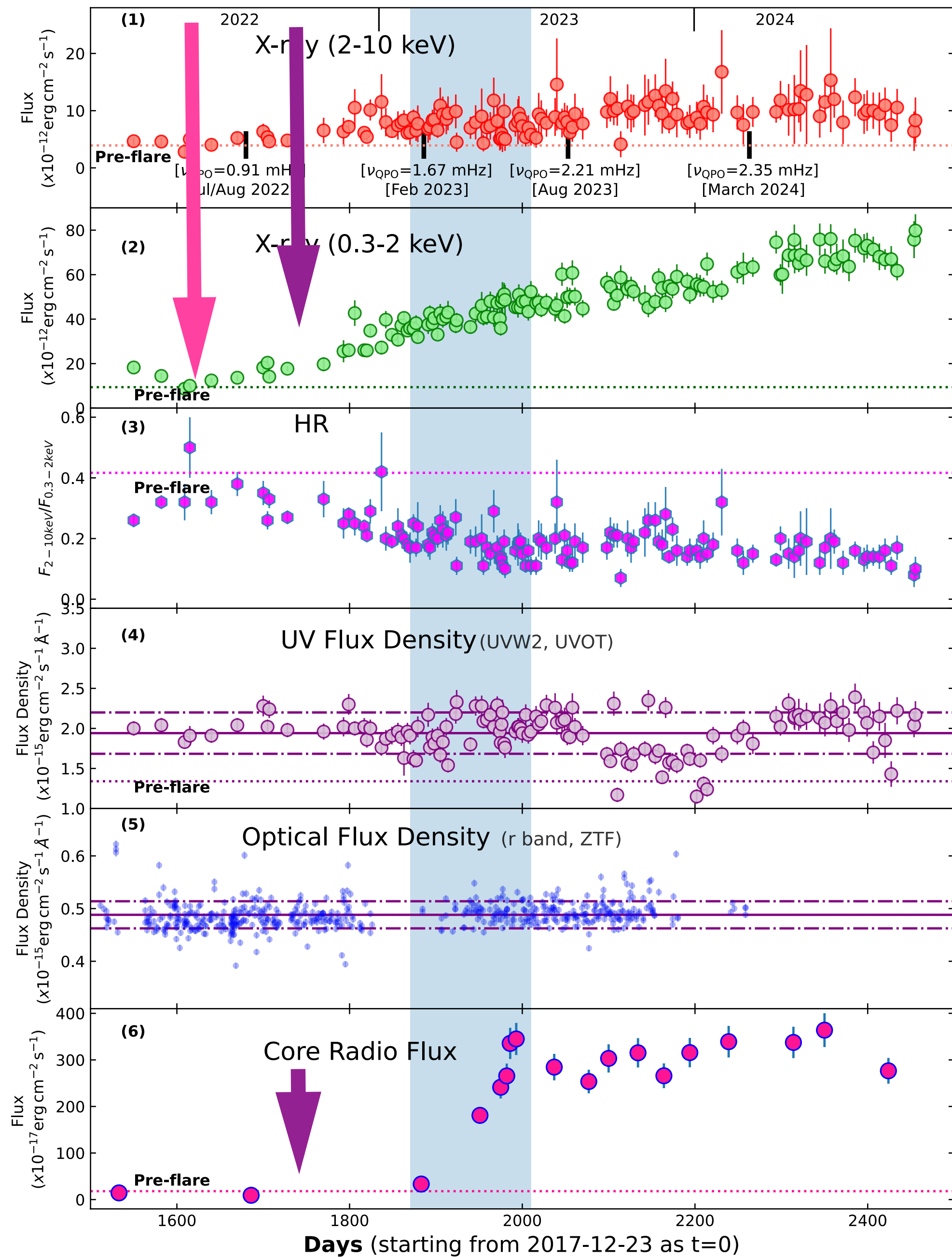




*The soft X-rays showed a continuous rise after May 2022  
Possibly the poloidal fields were advected.  
A jet was formed*

**Laha et al. 2025, ApJ...981..125L**



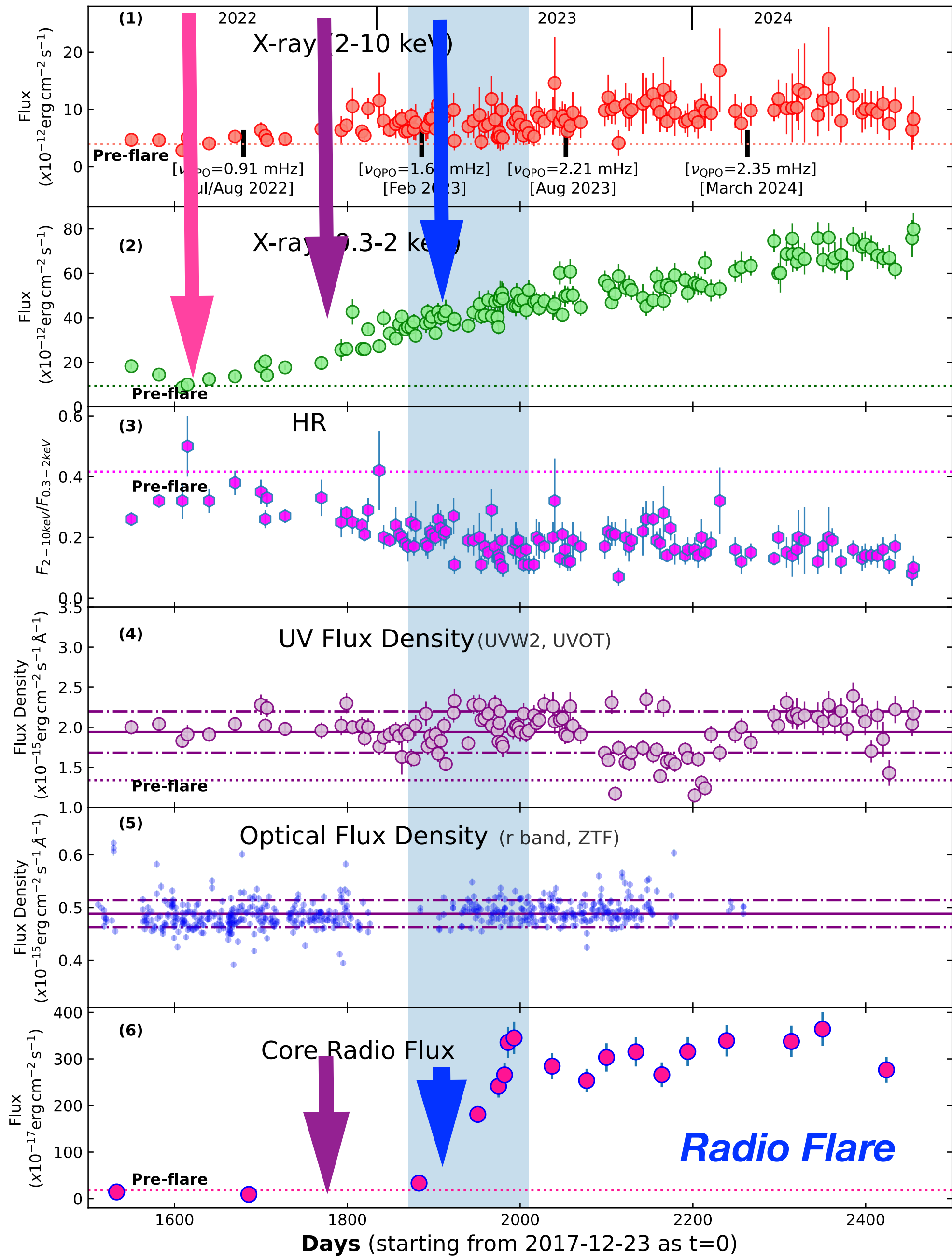


**May 2022**

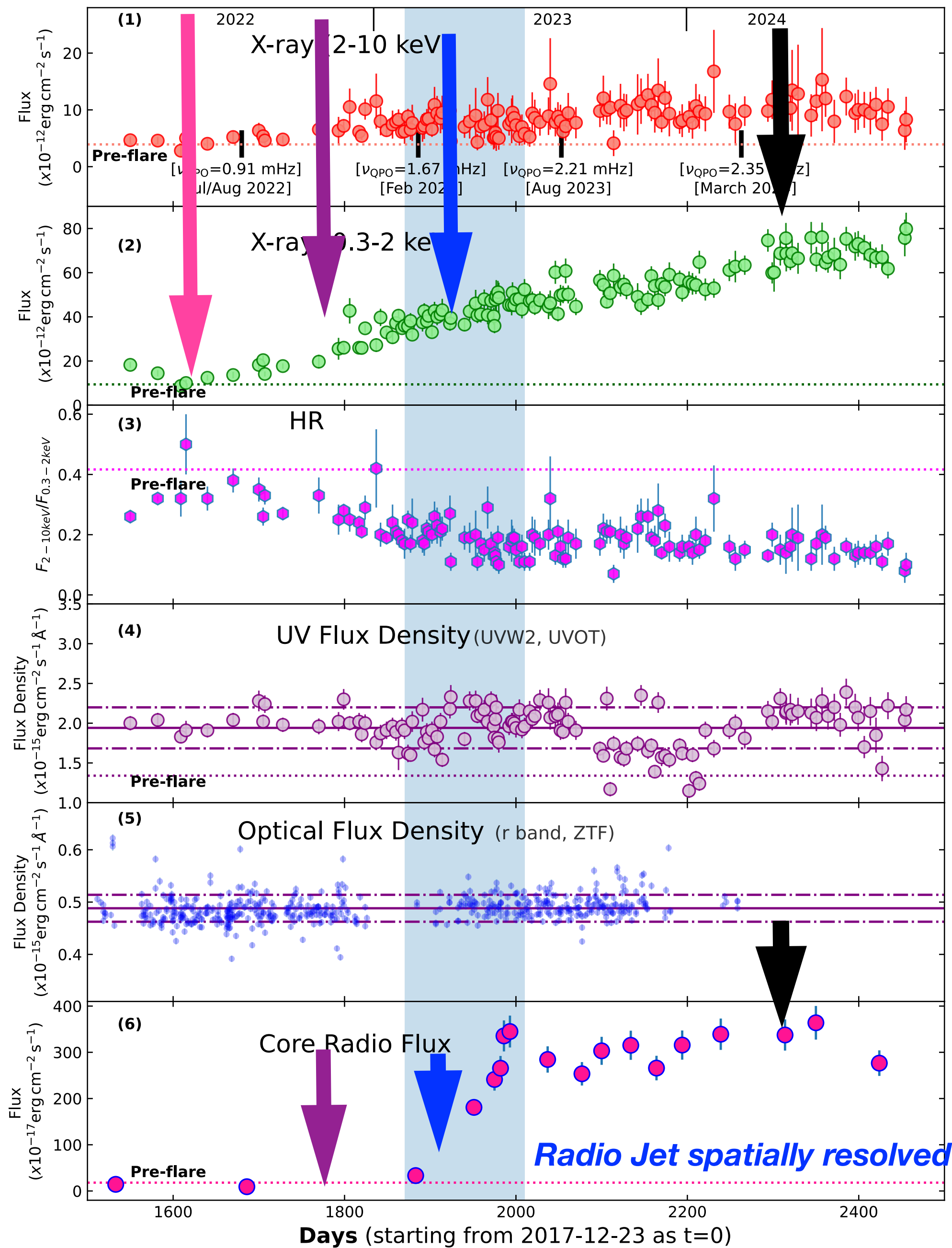
*Although we see the soft X-rays rise, we do not 'see' any signatures of jet, yet, because of a screening cloud.*

**Laha et al. 2025, ApJ...981..125L**

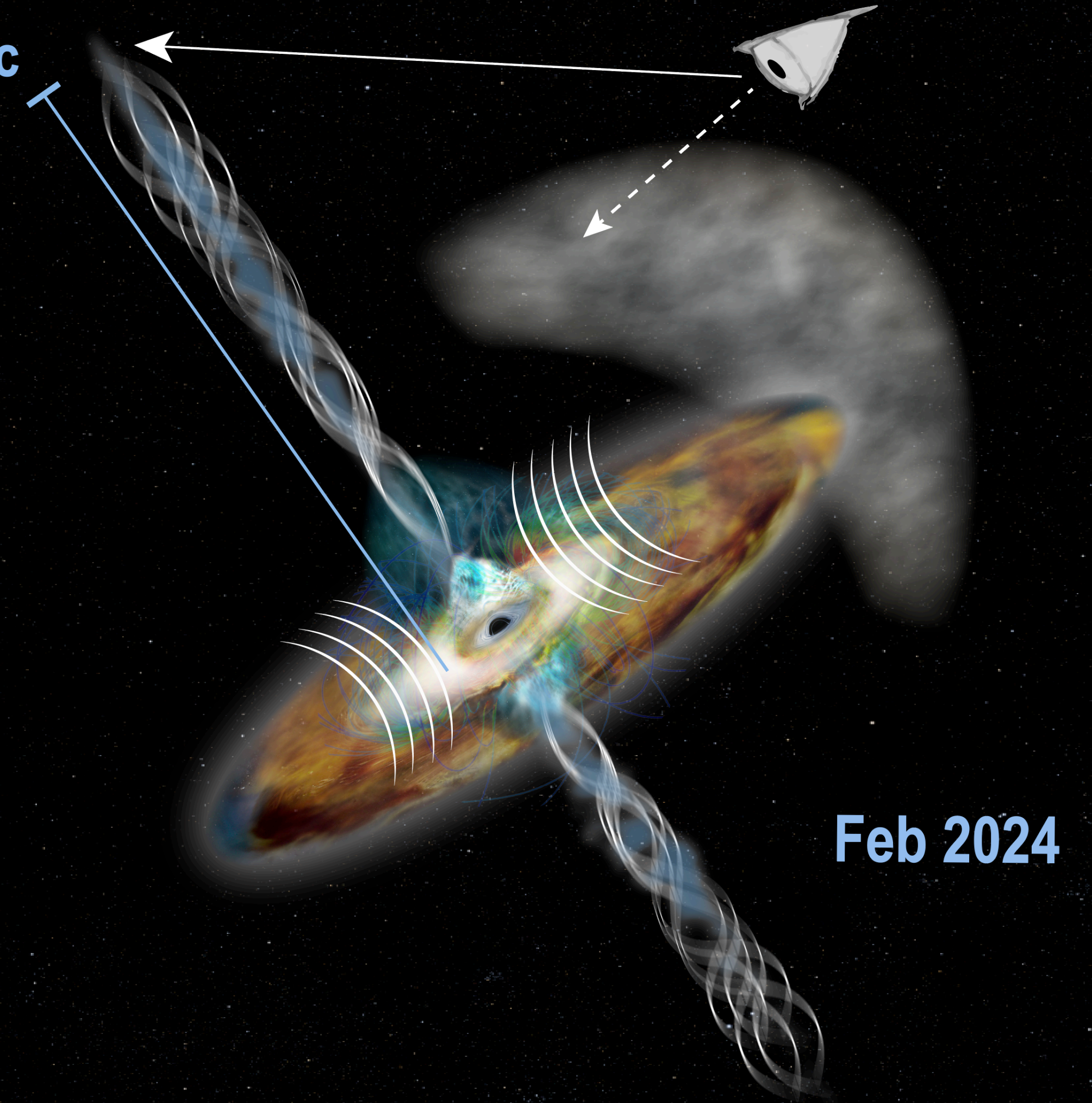








0.1 parsec



*We 'see' the spatially resolved jet, traveling at  $0.2c$*

**Laha et al. 2025, ApJ...981..125L**



# Conclusions

2 – 10 keV flux showed variation by a factor  $\lesssim 2$ . The weak variation of the 2 – 10 keV X-ray emission and the stability of the UV emission suggest that the magnetic energy density and accretion rate are relatively unchanged, and that the jet could be launched due to a reconfiguration of the magnetic field (toroidal to poloidal) close to the black hole. Advecting poloidal flux onto the event horizon would trigger the Blandford-Znajek (BZ) mechanism, leading to the onset of the jet. The concurrent softening of the coronal slope (from  $\Gamma = 2.70 \pm 0.04$  to  $\Gamma = 3.27 \pm 0.04$ ), the appearance of a QPO, and low coronal temperature ( $kT_e = 8_{-3}^{+8}$  keV) during the radio outburst suggest that the poloidal field reconfiguration can significantly impact coronal properties and thus influence jet dynamics. These extraordinary findings in real time are crucial for coronal and jet plasma studies, particularly as our results are independent of coronal geometry.

**Perhaps we are observing a Blandford-Znajek (B-Z) jet get formed, in real time!!**



# X-ray properties of coronal emission in radio quiet Active Galactic Nuclei

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FREDERIC MARIN <sup>8</sup> ROSTOM MBAREK <sup>9,1</sup> AND AMELIA HANKLA <sup>9</sup>

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(Accepted Review article in **Frontiers in Astronomy and Space Sciences**)

## Review article on Radio Quiet AGN Corona

Published in Frontiers of Astronomy and Space Sciences

**Laha et al. 2025 FrASS..1130392L**

### Heating Mechanisms

1. Magnetic Reconnection
2. Buoyancy-Instability in accretion disk.

### Cooling Mechanisms

1. Inverse Compton
2. Pair production
3. Synchrotron
4. Synchrotron Self-Compton

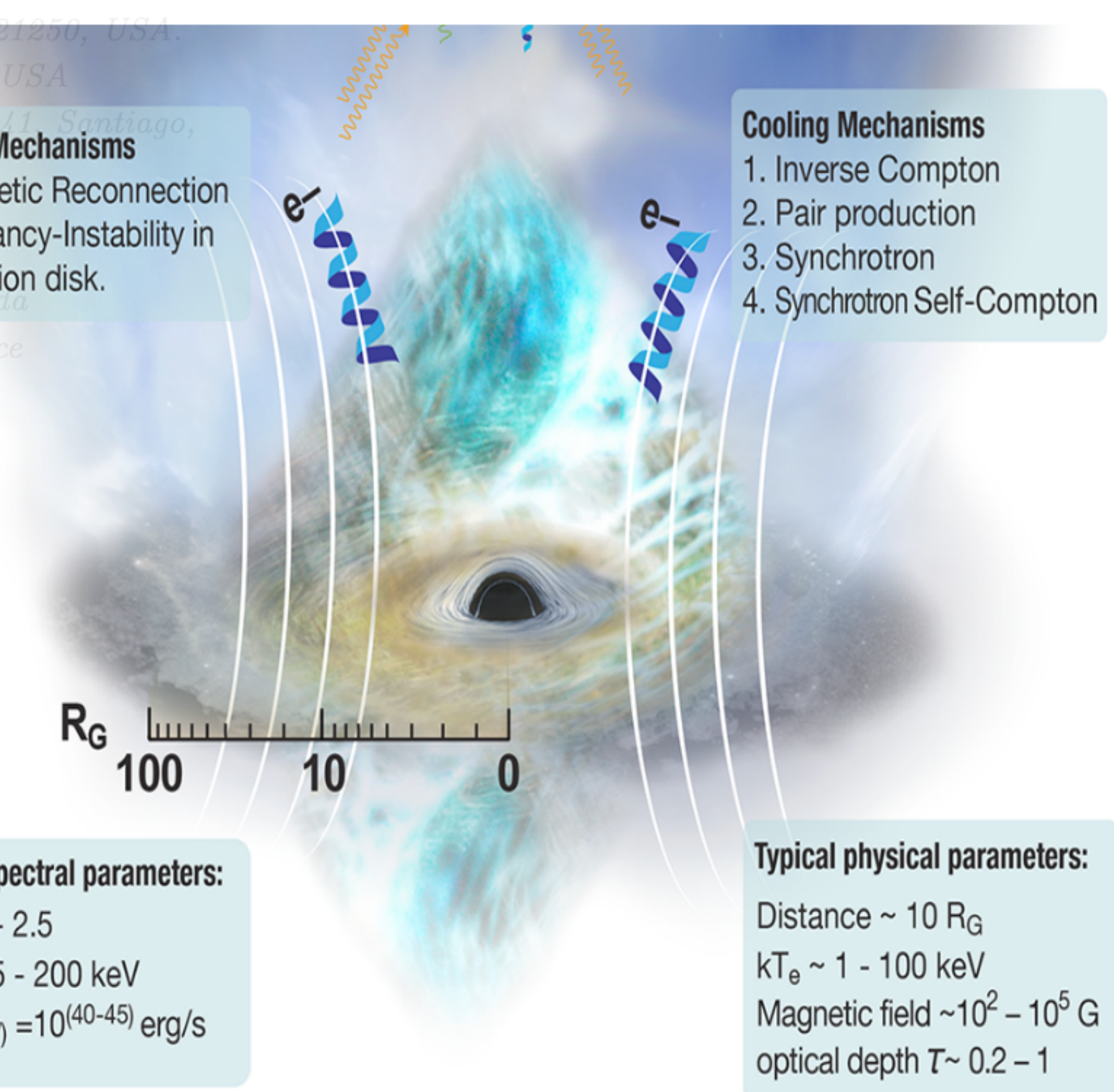
### Typical Spectral parameters:

$\Gamma = 1.5 - 2.5$   
 $E_{\text{cut}} = 15 - 200 \text{ keV}$   
 $L_{(2-10\text{keV})} = 10^{(40-45)} \text{ erg/s}$

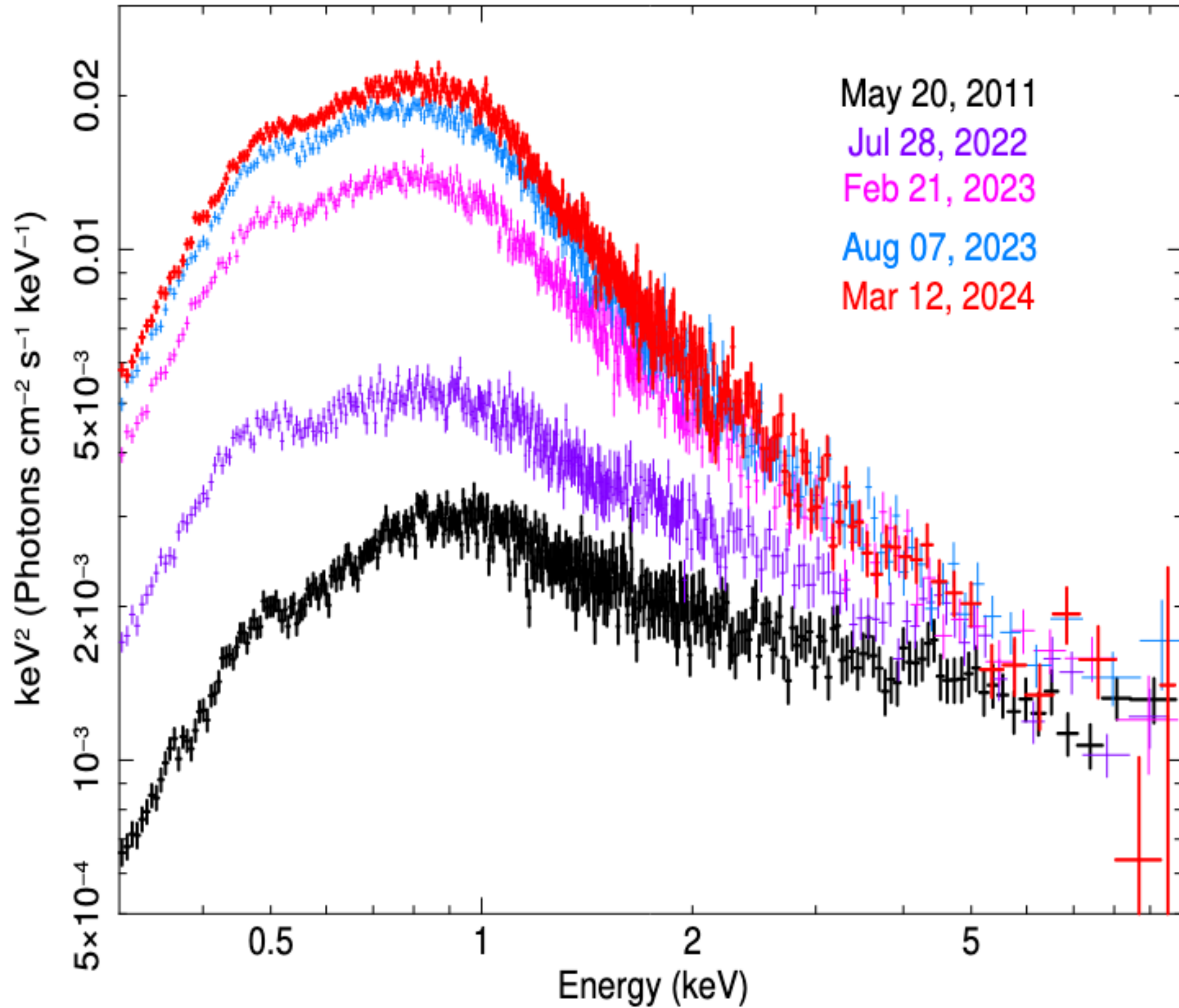
### Typical physical parameters:

Distance  $\sim 10 R_G$   
 $kT_e \sim 1 - 100 \text{ keV}$   
Magnetic field  $\sim 10^2 - 10^5 \text{ G}$   
optical depth  $\tau \sim 0.2 - 1$

$R_G$   
100 10 0





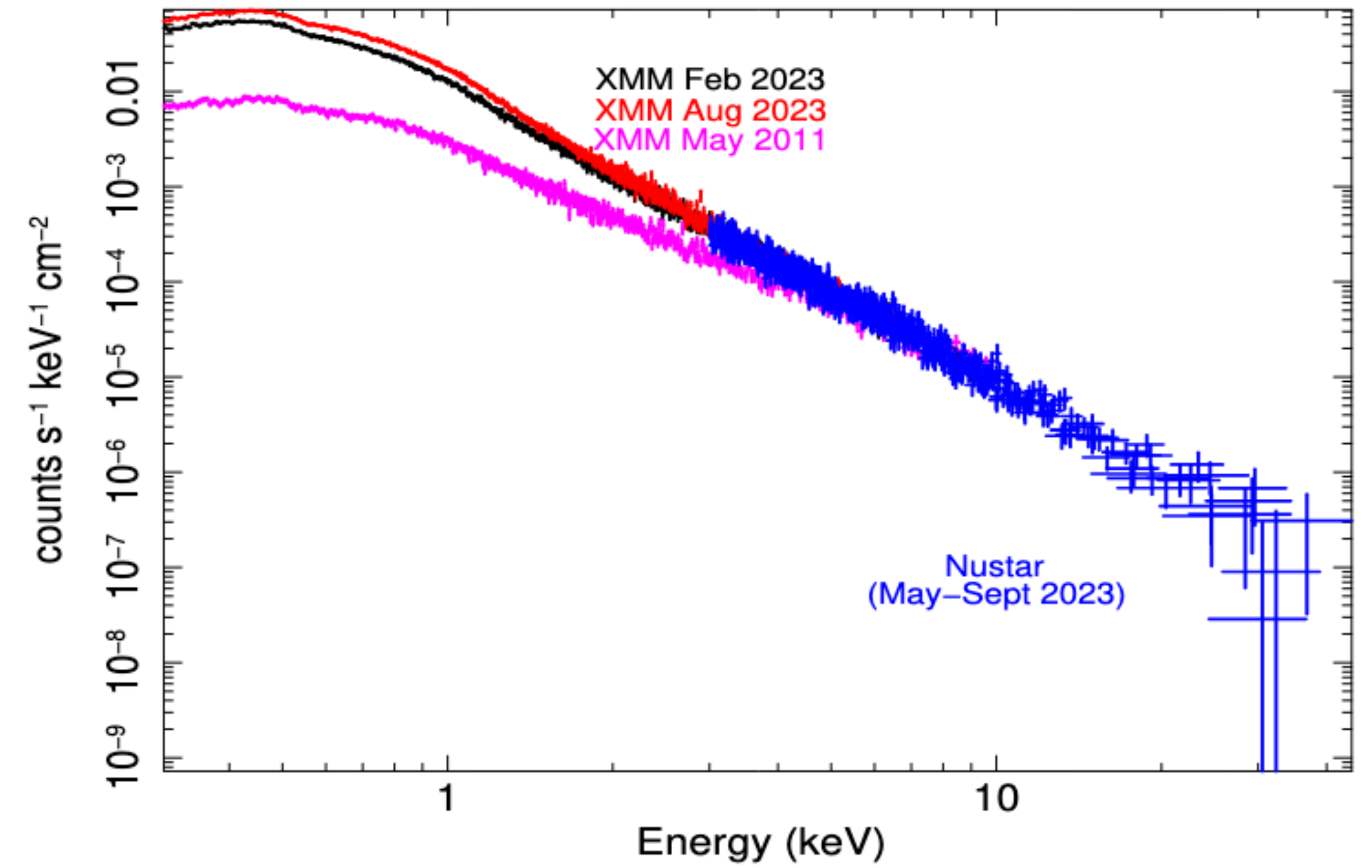
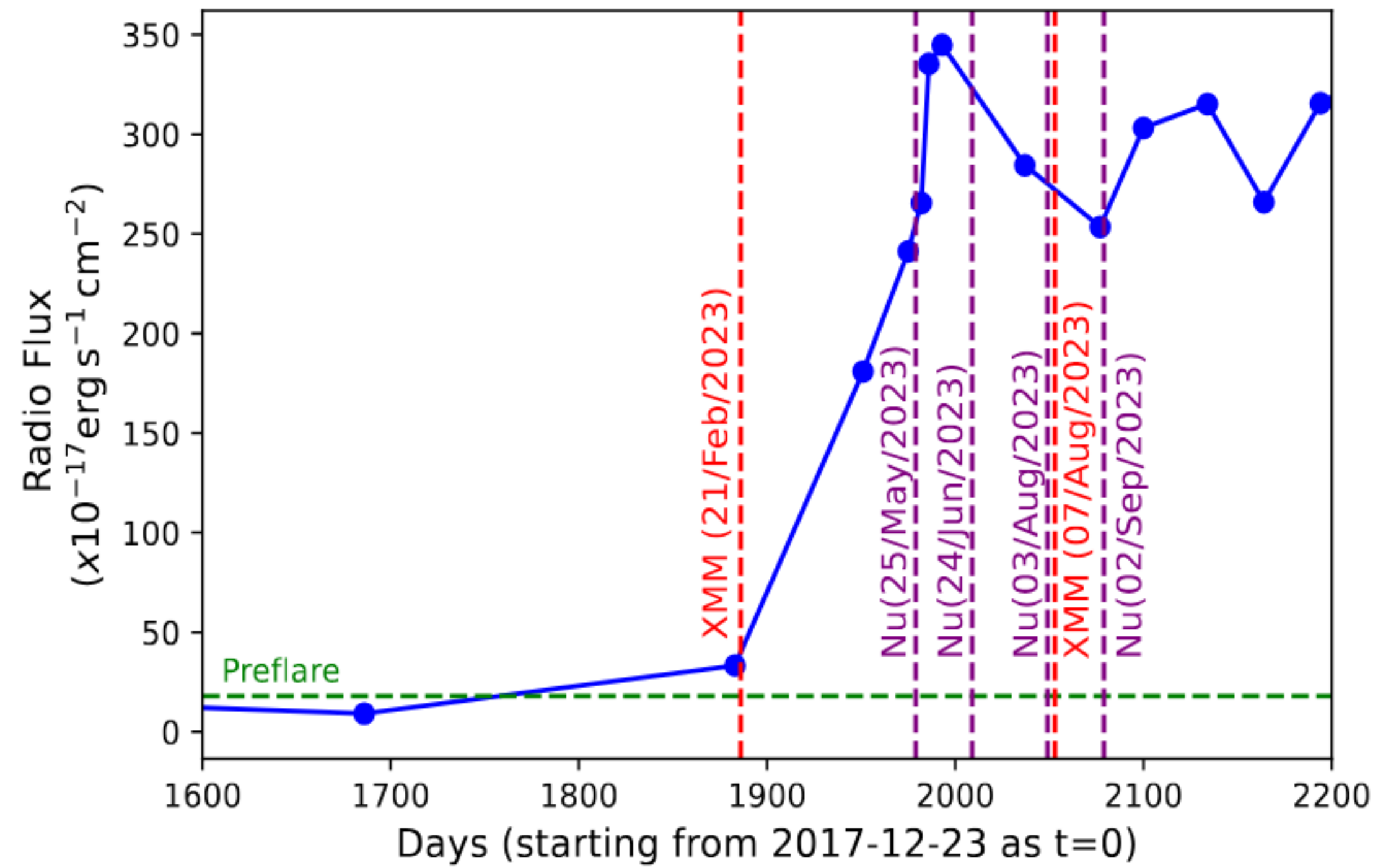


But the soft X-rays rise by ~8-9 times

This figure shows the increase in the net energy dissipated in the soft X-rays...

Coronal slope increase from 2.7 to 3.2

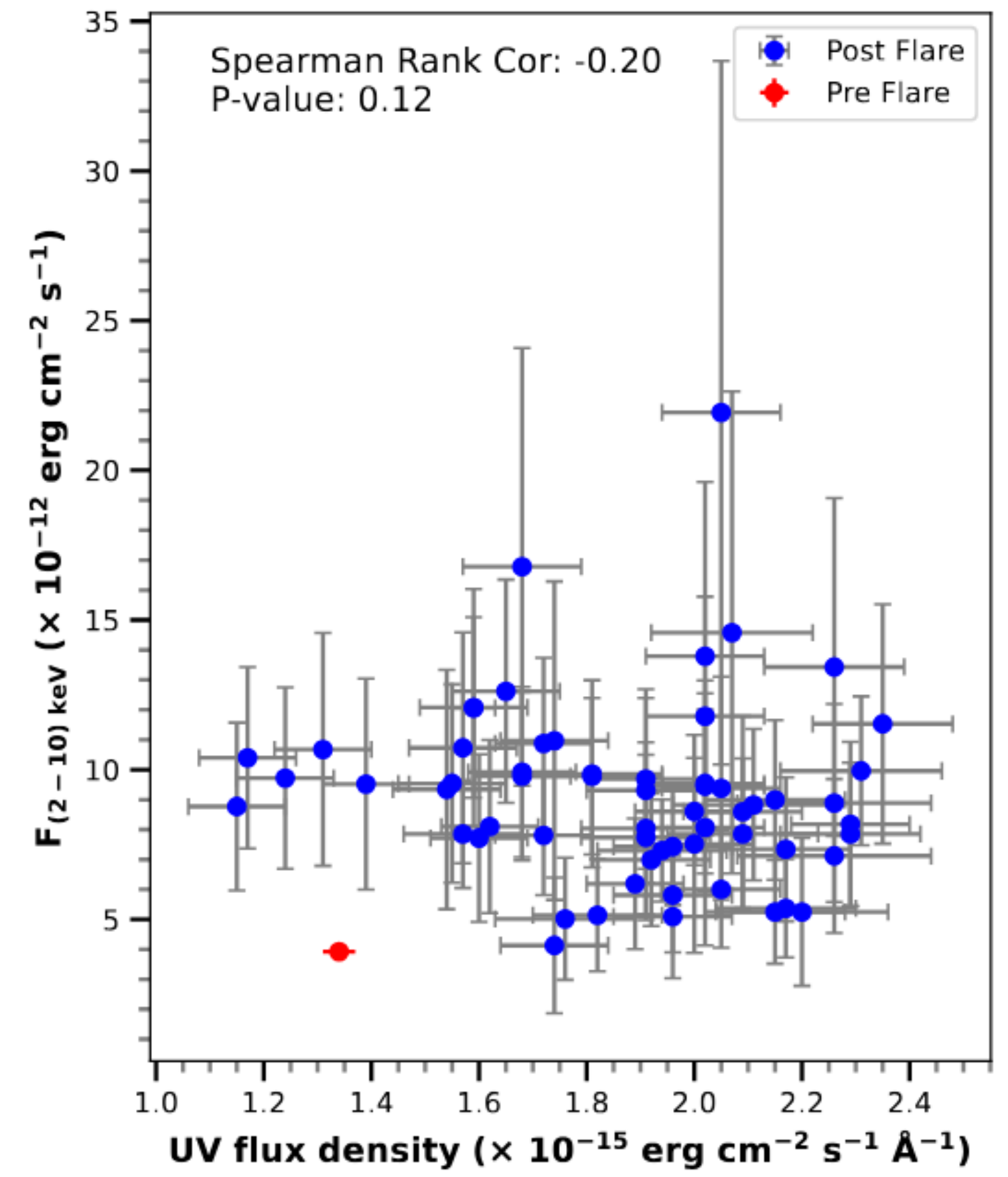
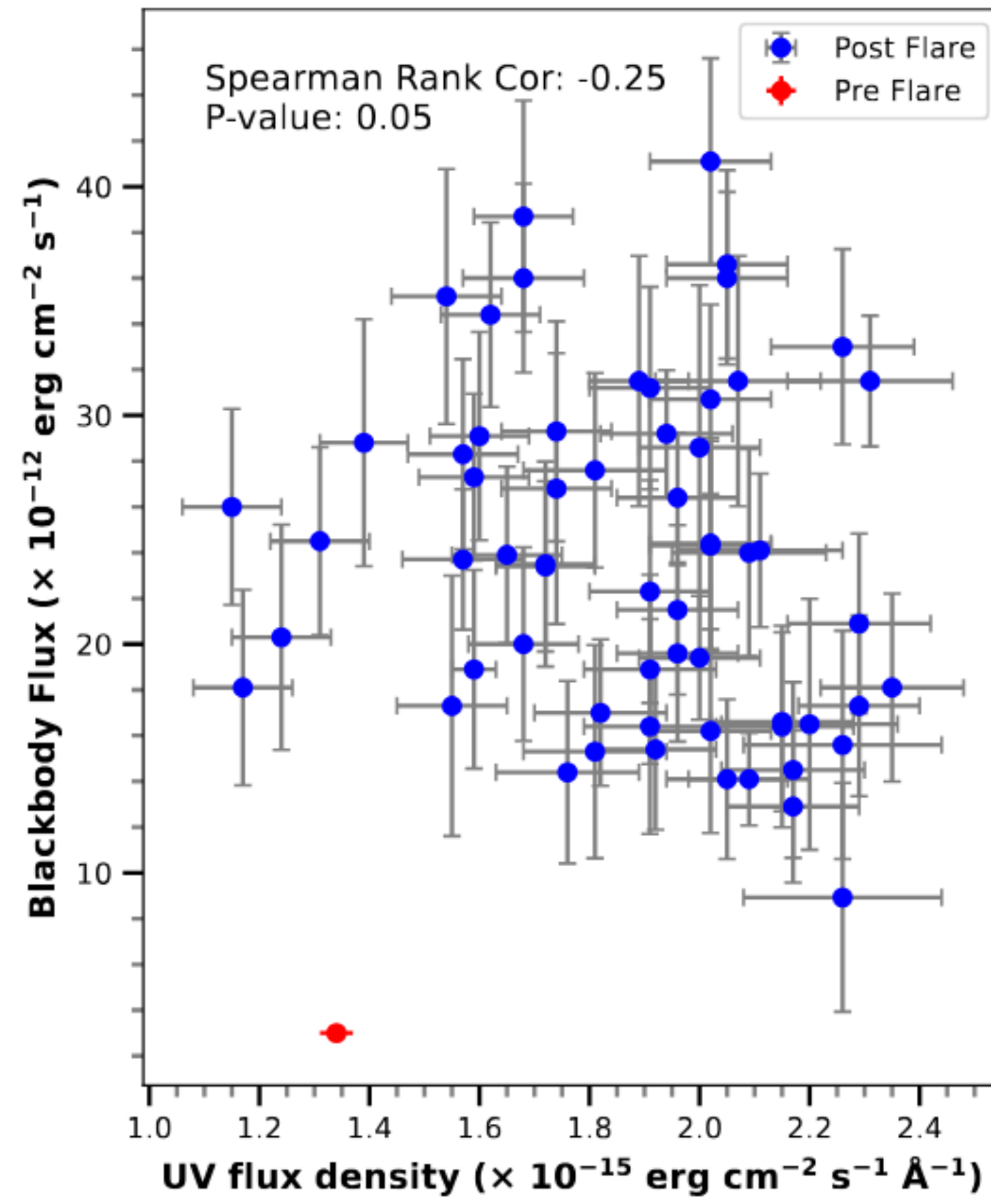
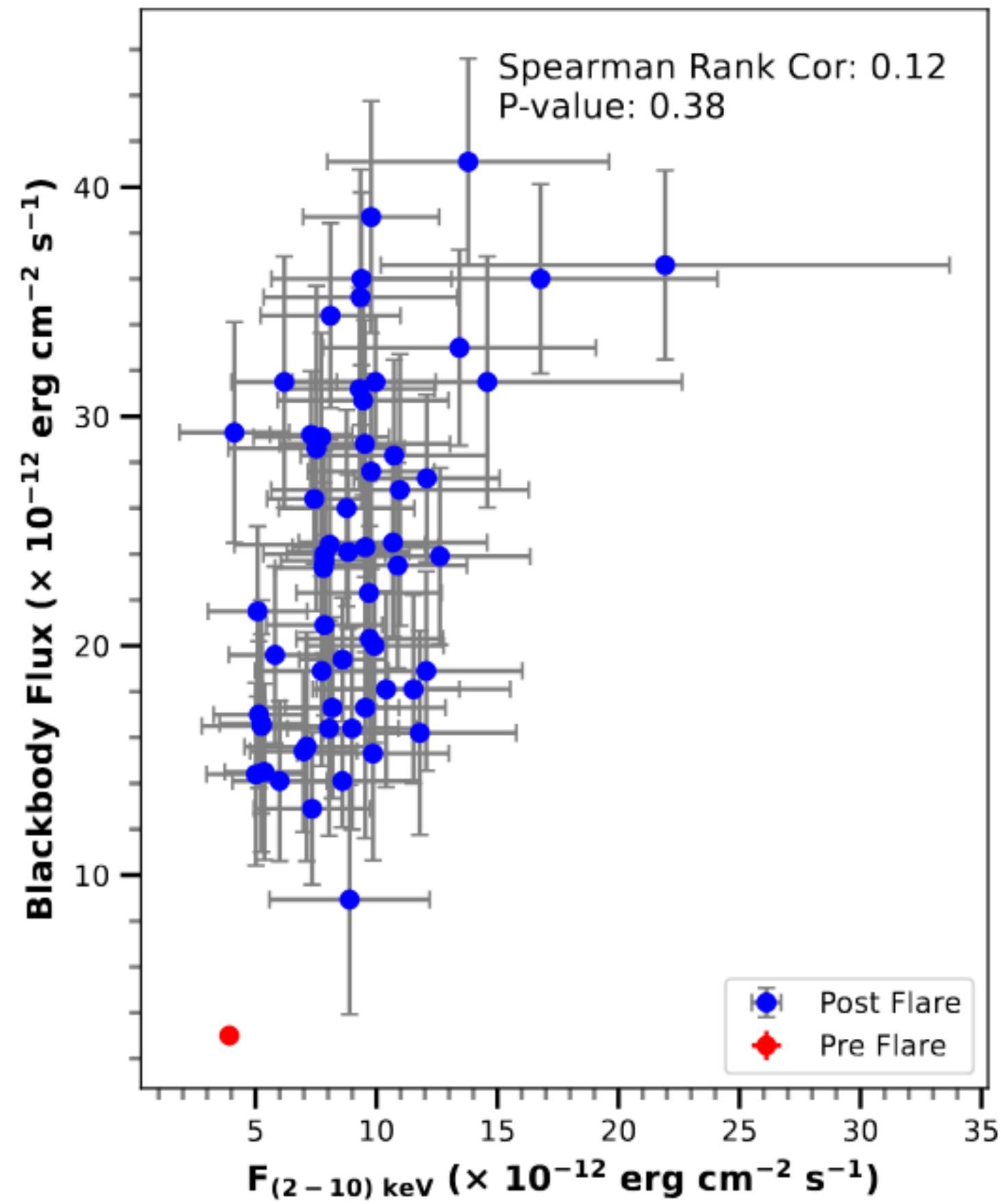




2-10 keV X-rays show no variation during the radio flare (NuSTAR+XMM)

**Laha et al. 2025 ApJ...981..125L**

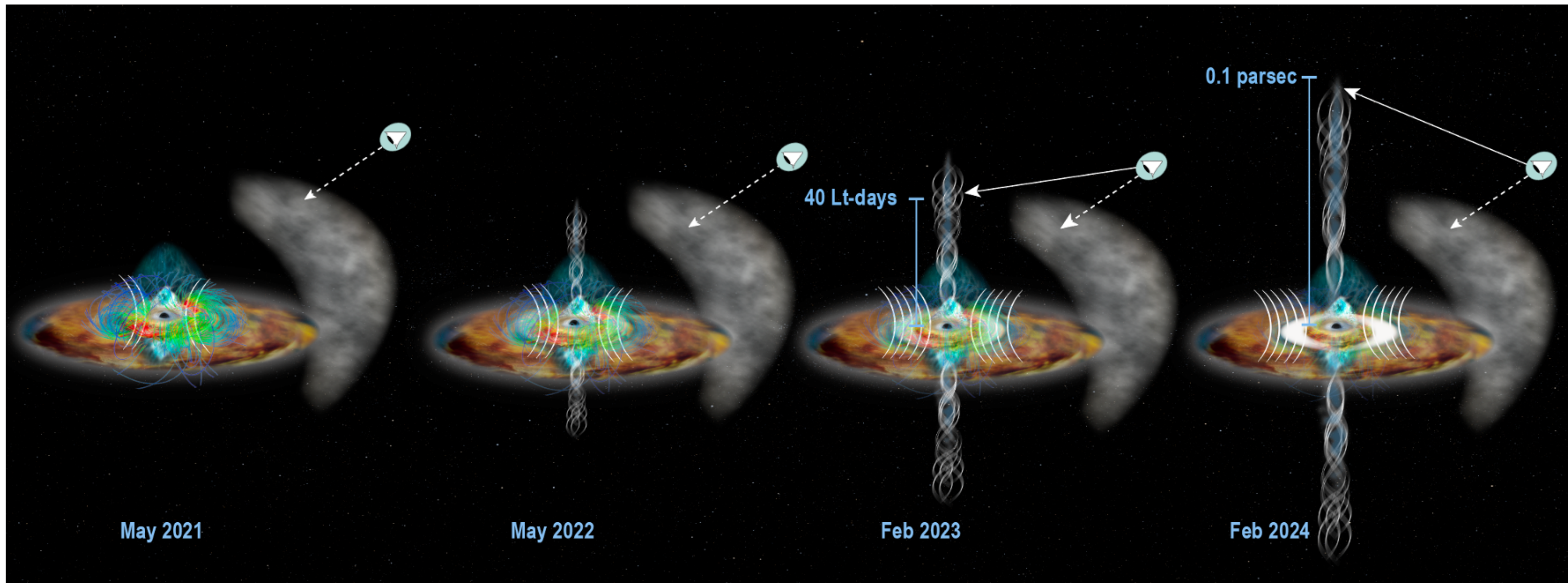




No correlation between UV, Soft X-rays and Hard X-rays



# Summary of what may have happened





# Media stories....

5 MIN READ

## Astronomers Catch Unprecedented Features at Brink of Active Black Hole



Francis Reddy

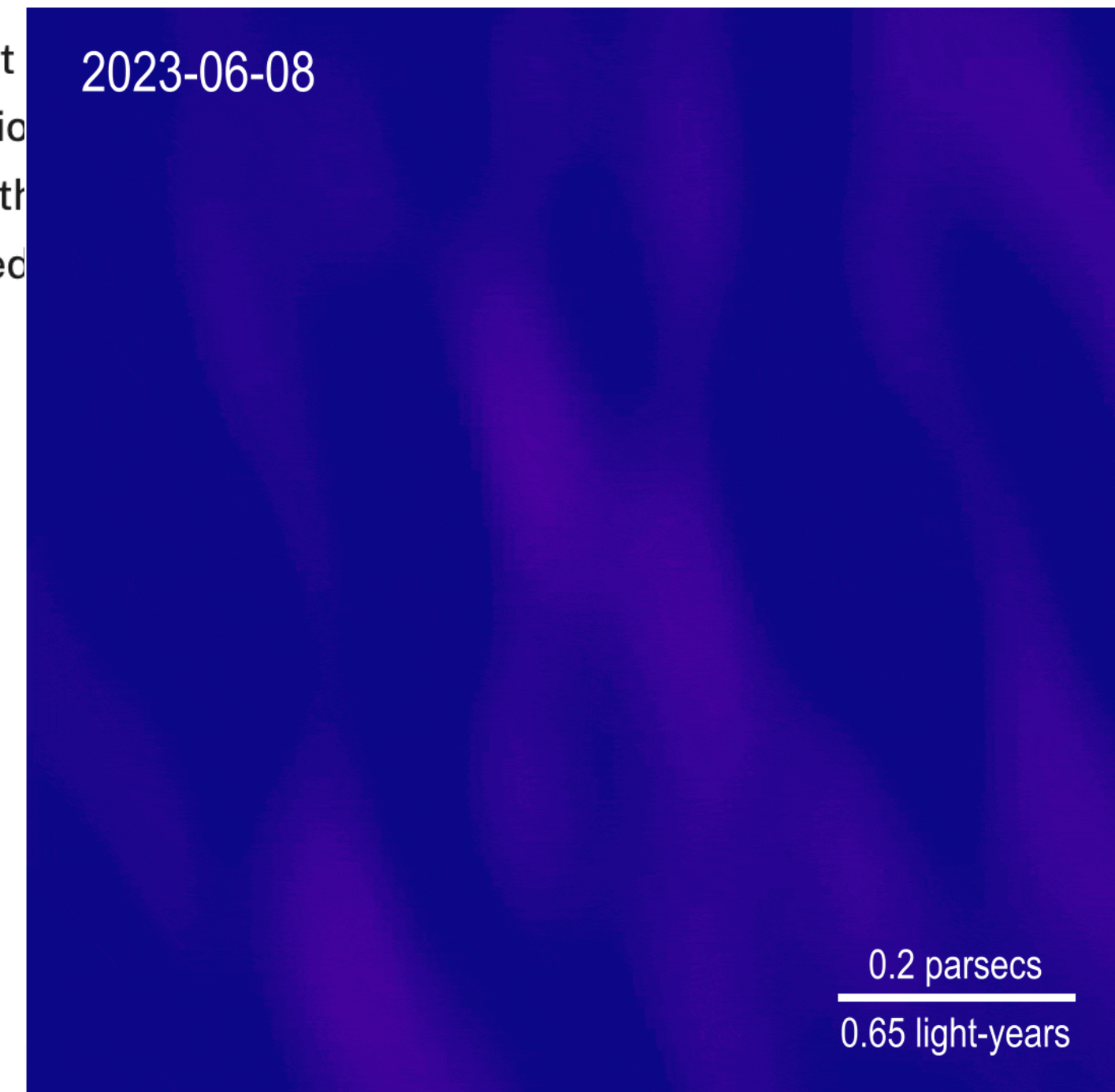
JUN 13, 2025

ARTICLE



International teams of astronomers monitoring a supermassive black hole in the heart of a distant galaxy have detected features never seen before using data from NASA missions and other facilities. The features include the launch of a plasma jet moving at nearly one-third the speed of light and unusual, rapid X-ray fluctuations likely arising from near the very edge of the black hole.

2023-06-08







*The first ever, real-time observation of a relativistic jet launch  
from a supermassive black hole*

*Meyer et al. 2025 ApJ...979L...2M  
Laha et al. 2025 ApJ...981..125L*



# News Coverage

## Multi-wavelength observations of a jet launch in real time from the post-changing-look Active Galaxy 1ES 1927+654

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J. A. ACOSTA-PULIDO,<sup>28,29</sup> SUVENDU RAKSHIT,<sup>30</sup> JIŘÍ SVOBODA,<sup>31</sup> LUIGI GALLO,<sup>32</sup> ADAM INGRAM,<sup>33</sup> AND  
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## Strange Pulsations From a Black Hole Due to Something in Orbit



Anton Petrov ✓  
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<https://www.youtube.com/watch?v=G9kfpAHAKmU&t=698s>





This artist's depiction shows a tidal disruption event around an active black hole. Whereas most active black holes that have jets are seen to possess those jets constantly, the first example of a jetless active black hole having a radio jet "turn on" has just been discovered. It may help unlock a new class of cosmic events. (Credit: Carl Knox/OzGrav, ARC Centre of Excellence for Gravitational Wave Discovery, Swinburne University of Technology)

✦ Member-only story

## Cosmic first: supermassive black hole caught "turning on" in real-time

Seven years ago, an outburst in a distant galaxy brightened and faded away. Afterwards, a new supermassive black hole jet emerged, but how?



Ethan Siegel · [Follow](#)

Published in [Starts With A Bang!](#) · 10 min read · Jan 21, 2025

Medium





**Accretion of matter is believed to power  
AGN, which also creates highly energetic  
outflows .....**

**Laha et al. 2021 NatAs...5...13L**  
*Nature Astronomy Review*