

Young Astronomers Meeting 2026

X-ray Spectral Analysis of AGN

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Topic: ‘X-Ray Fingerprints of Accreting Compact Objects’

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What is AGN?

- AGN or Active Galactic Nuclei are massive structures located at the center of the galaxies
- AGNs have a supermassive black hole at the center with a disk around them which is shrouded by a Torus
- They emit radiation all across the electromagnetic spectrum and the regions closer to the supermassive black hole are expected to emit high energy radiation.

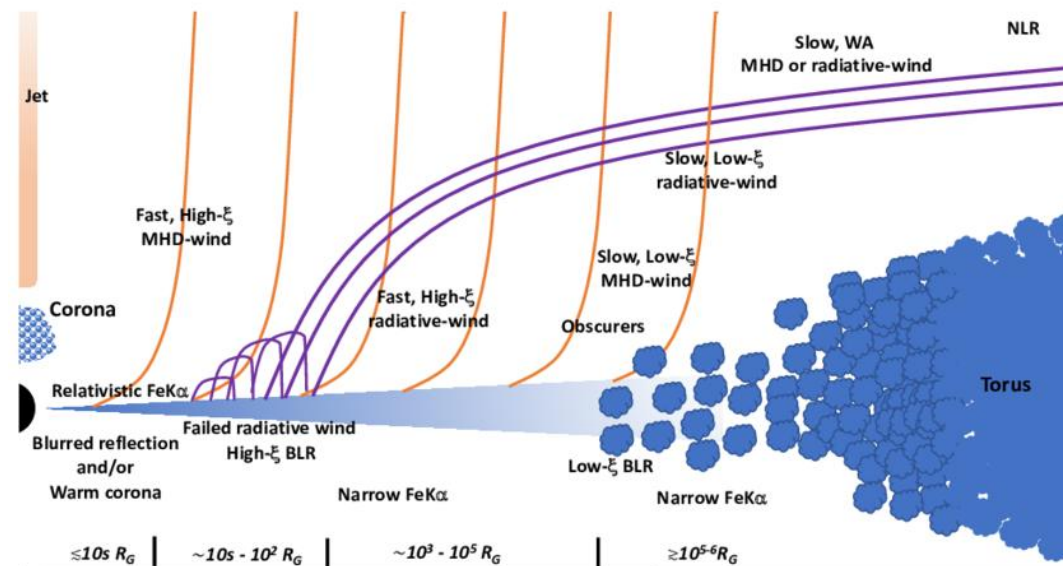


Fig 1: Different regions of an AGN

How do we Observe them?

- Different observatories are built in different wavelengths as depicted in Fig. 2.
- As AGN emits throughout the electromagnetic spectrum we observe them using different observatories.
- In X-rays, we use XMM-Newton, Chandra, Swift, Nustar as well as legacy data from ASCA, Suzaku and various other observatories to study AGNs.
- X-ray range in Wavelength:
0.01 nm (100 keV) – 10 nm (0.1 keV)
1/100000th of the human hair.

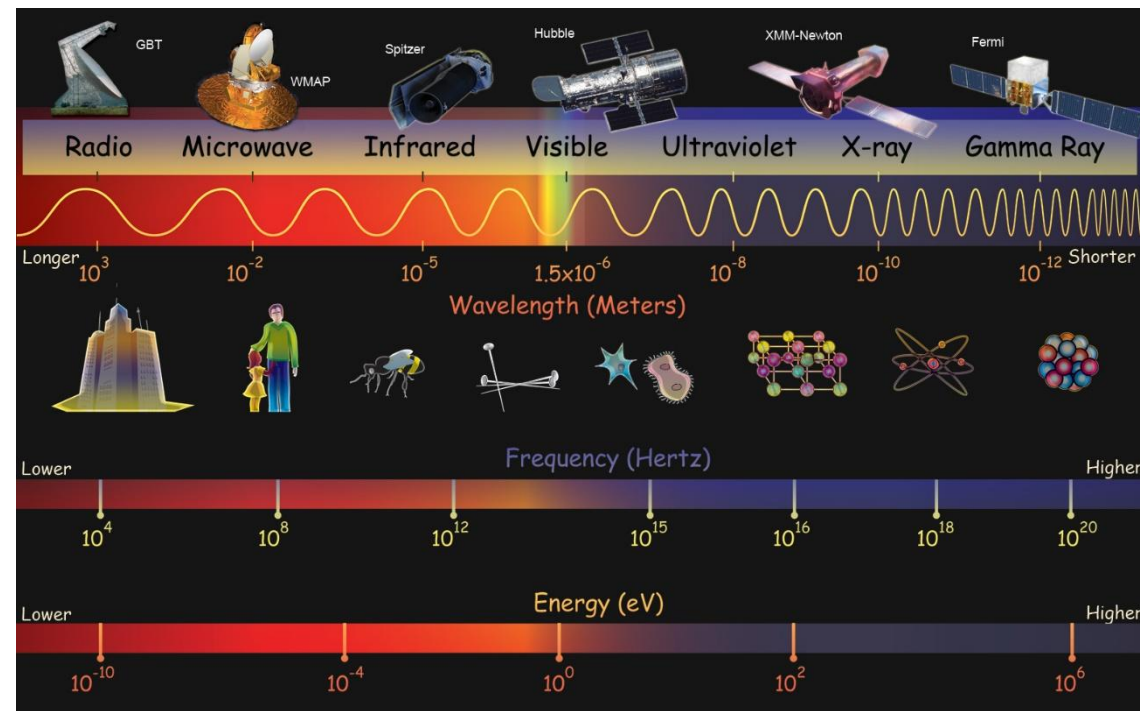


Fig 2: Wavelength/Frequency/Energy Distribution of a photon.

Example: XMM-Observation

Data/Model 

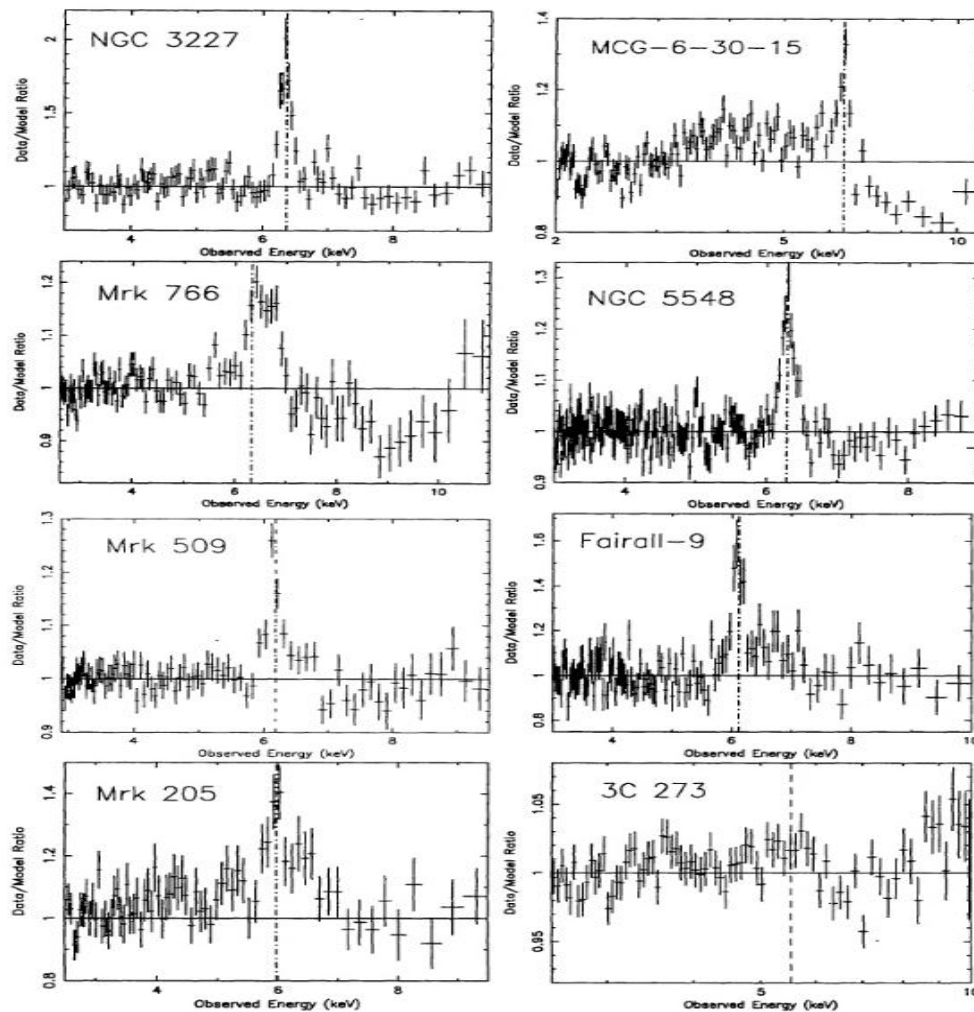
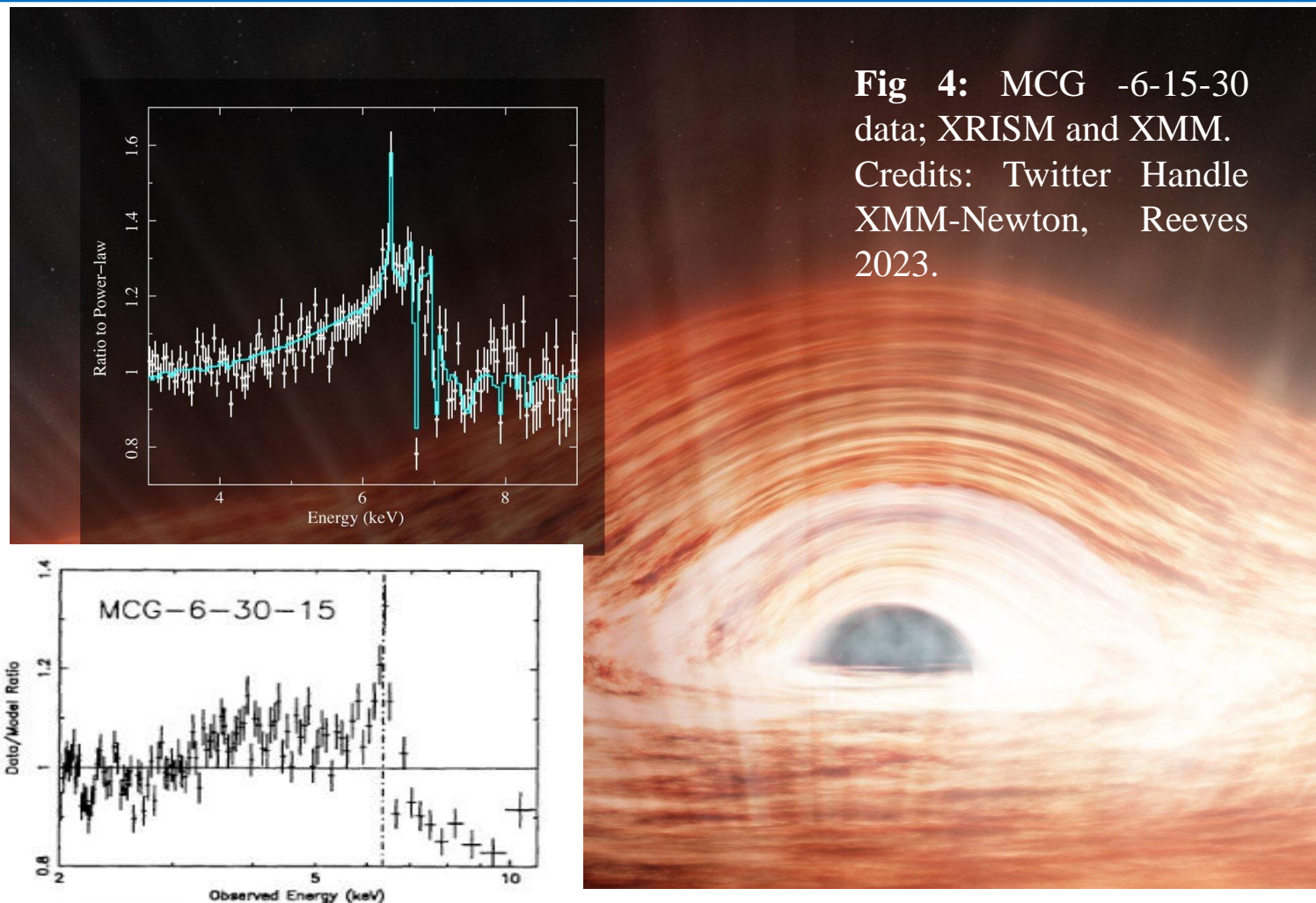
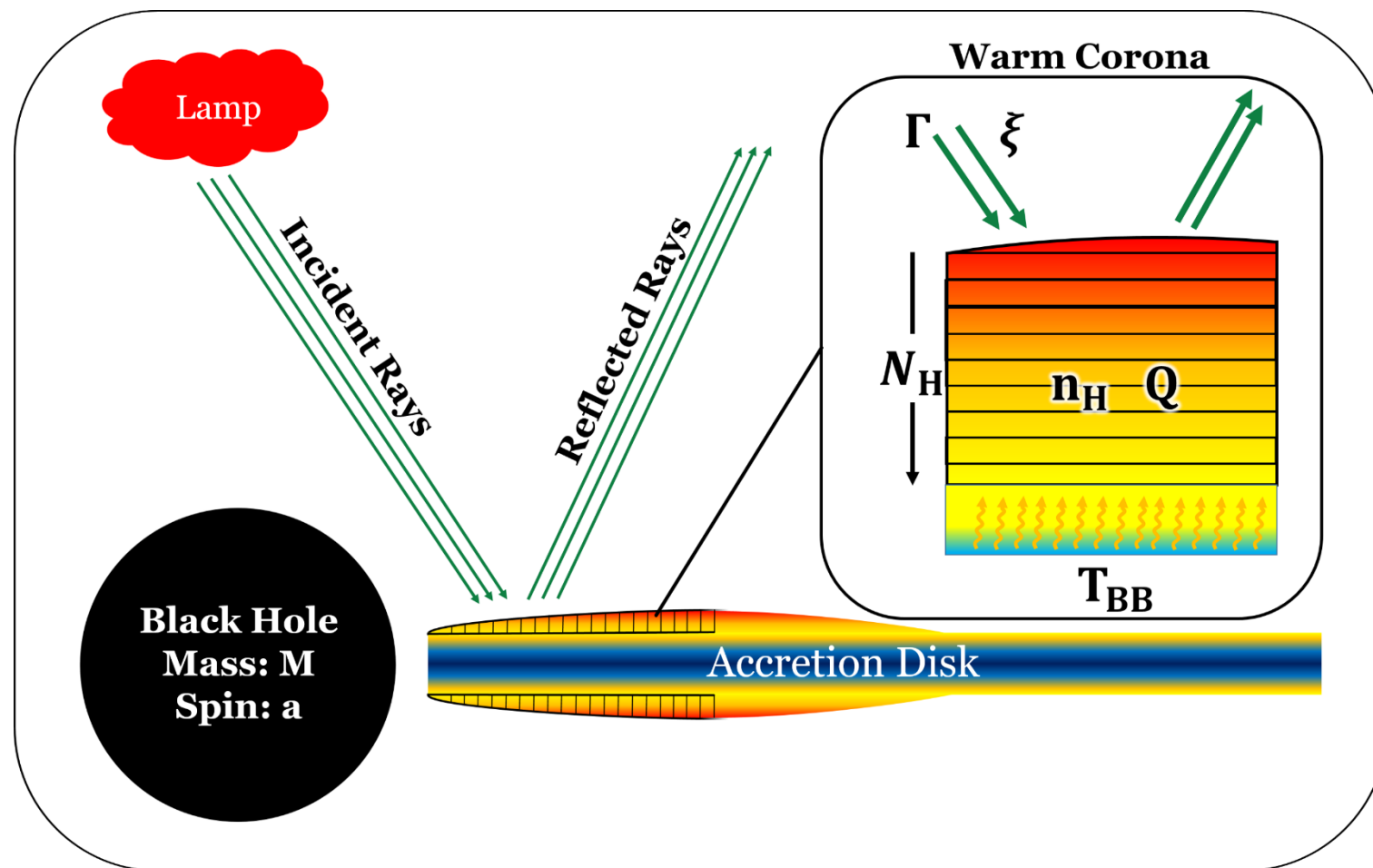


Fig 3: Iron Line depiction of different AGN sources. (Reeves 2003, ASPC 290, 35R)

Example: XRISM and XMM-Observation



Geometry of an AGN



Formation of Iron Line Complex

- The two major iron line complexes that are studied in this project are the fluorescent iron line and the thermal iron line.
- At high energies the K shell electron is ejected and the electron from the L shell transits to K shell emitting a radiation of 6.4 keV which is called the fluorescent line

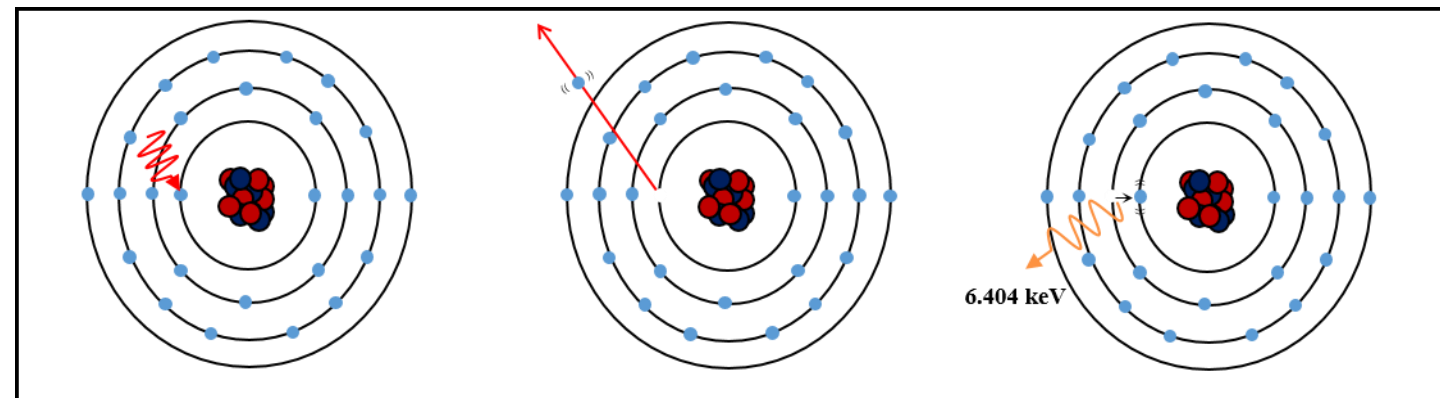
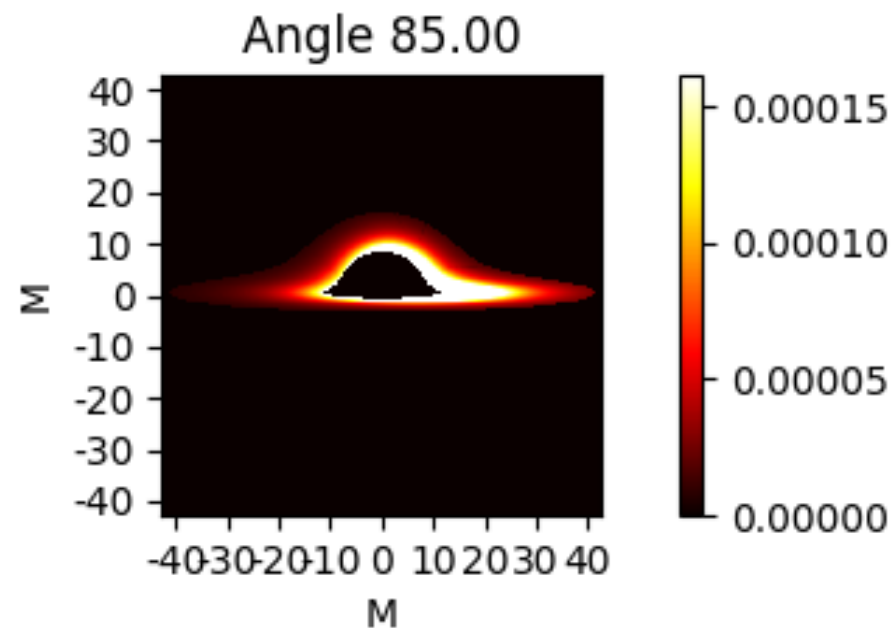
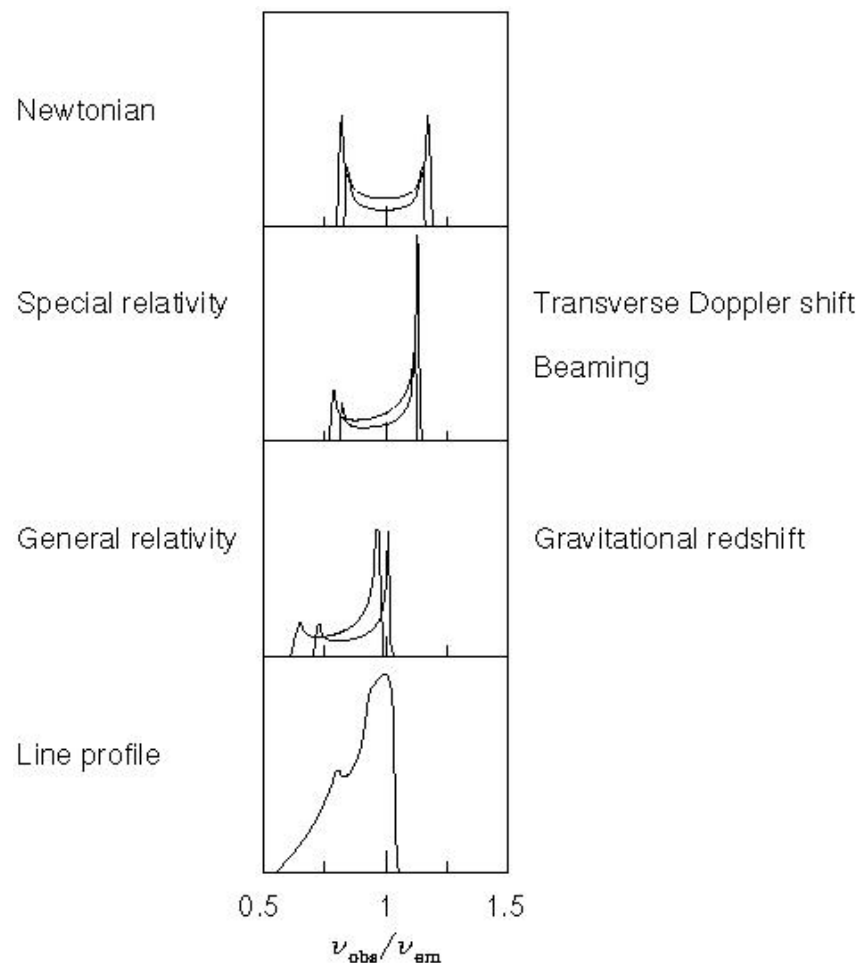


Fig 2: Fluorescent emission of Iron Line



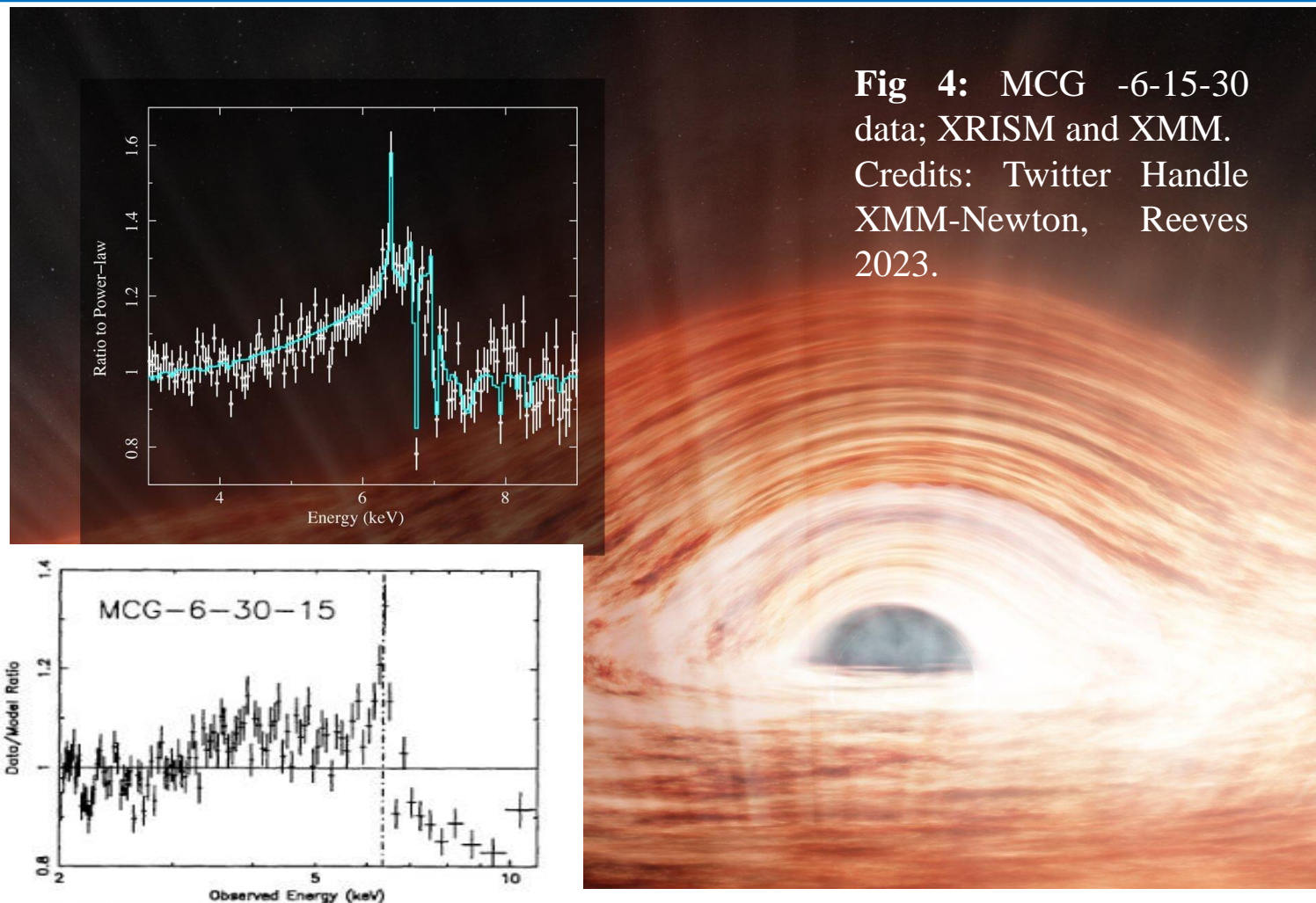
Geometry of an AGN



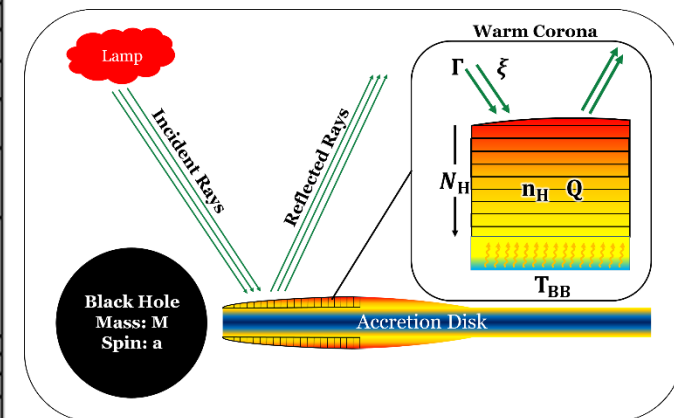
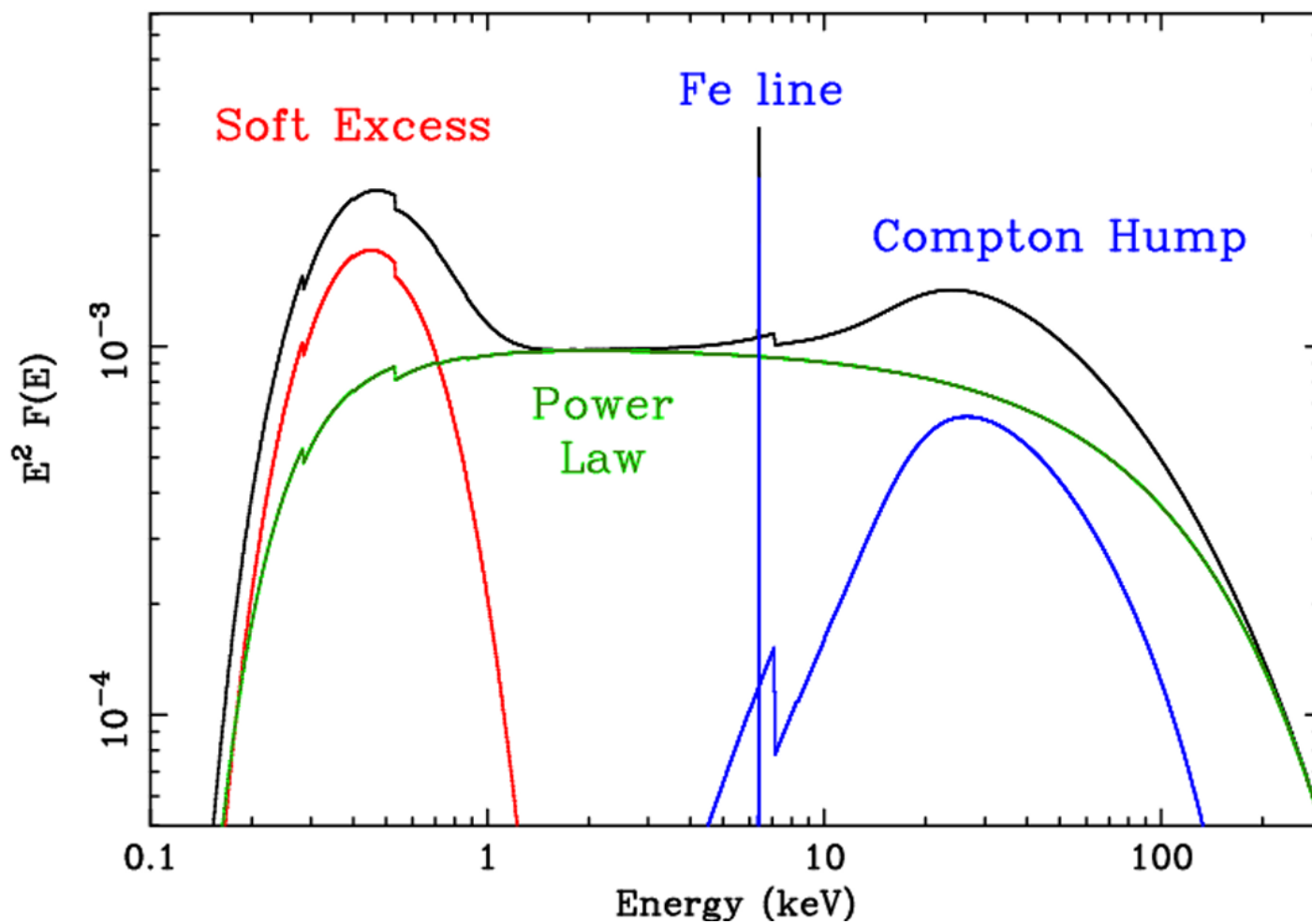
NOTE:

Not a Gaussian but double peaked due to relativistic speed of the disk unlike star surfaces where the velocity is still low in the Newtonian regime.

XRISM and XMM-Observation



Geometry of an AGN





Summer Project

- A Potential Summer project to deal with sources with soft X-ray excess.
- Tentative work:
 - Reduce data using XMM's SAS software.
 - Analysis using XSPEC
 - Compare with Soft excess in the simulations



Questions?!