Disentangling the complex absorption spectrum of NGC 7314

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NGC 7314

- $z = 0.0047$

- Bright source from the Piccinotti sample
  - F(2-10 keV) ~ 3×10^{-11} erg cm^{-2} s^{-1}

- Optically classified as NLS1

- Seyfert 1.9 from the X-ray point of view
  - Significant absorption at soft X-rays

- Scarce presence in the literature
  - Mostly timing analysis of the Fe Kα

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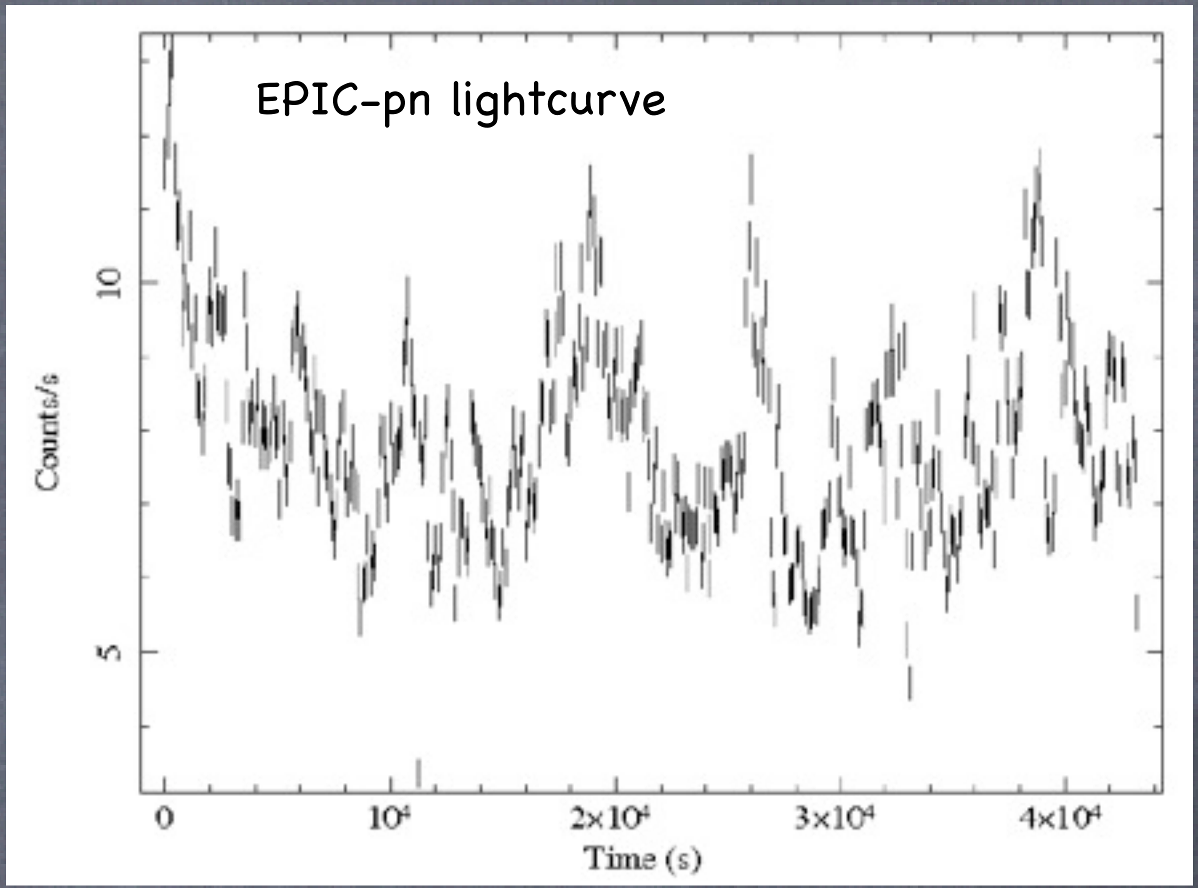
- Directly looking at the innermost regions of the AGN
- Fe Kα wings reported to vary with the continuum; core unchanged (Yaqoob +96)



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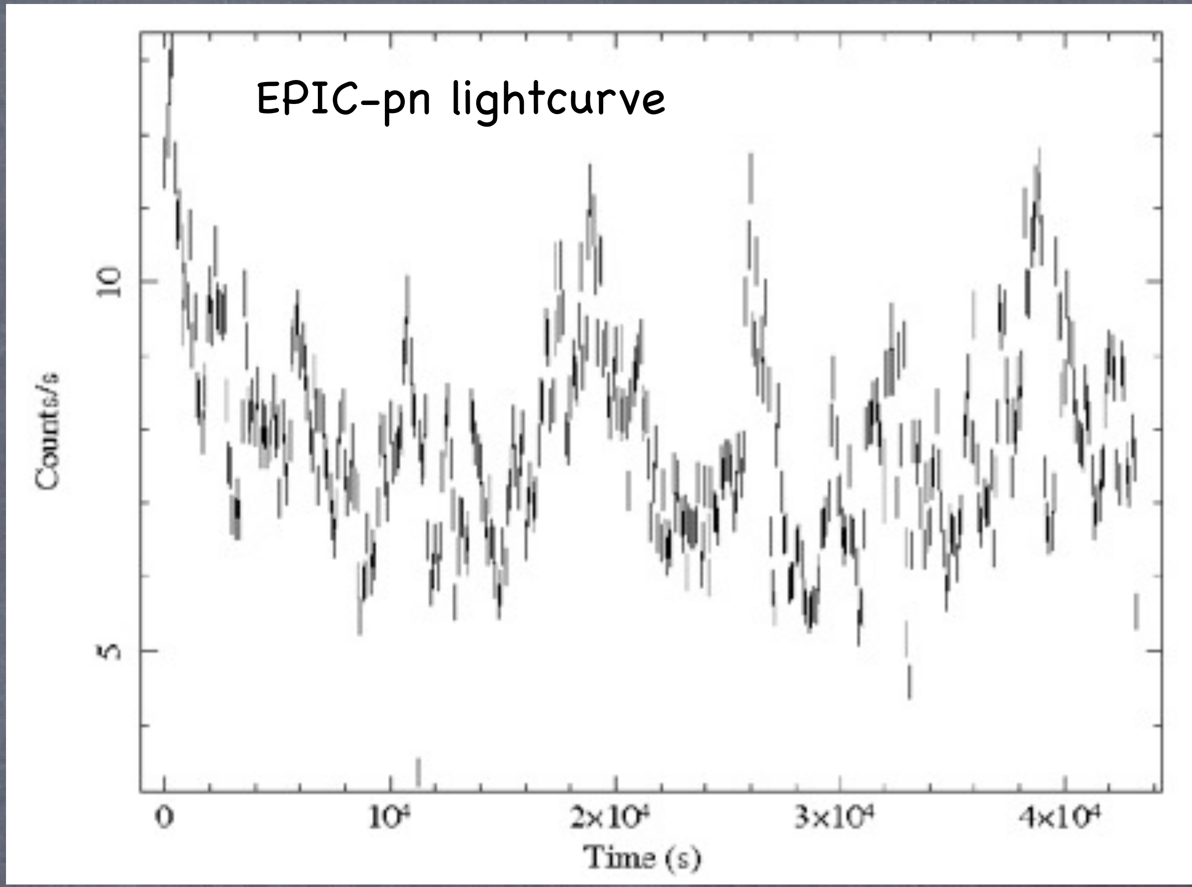

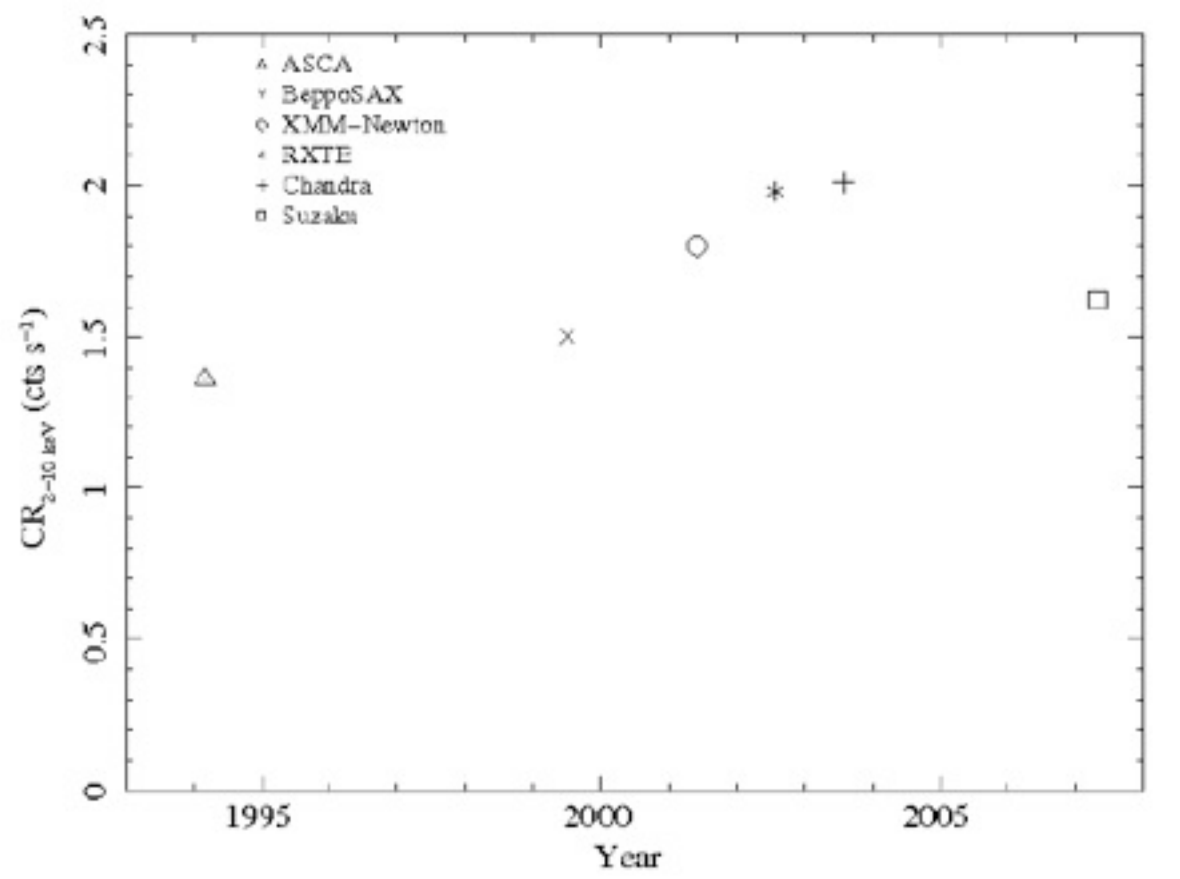

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- Variations in flux of ~20-30% over more than a decade

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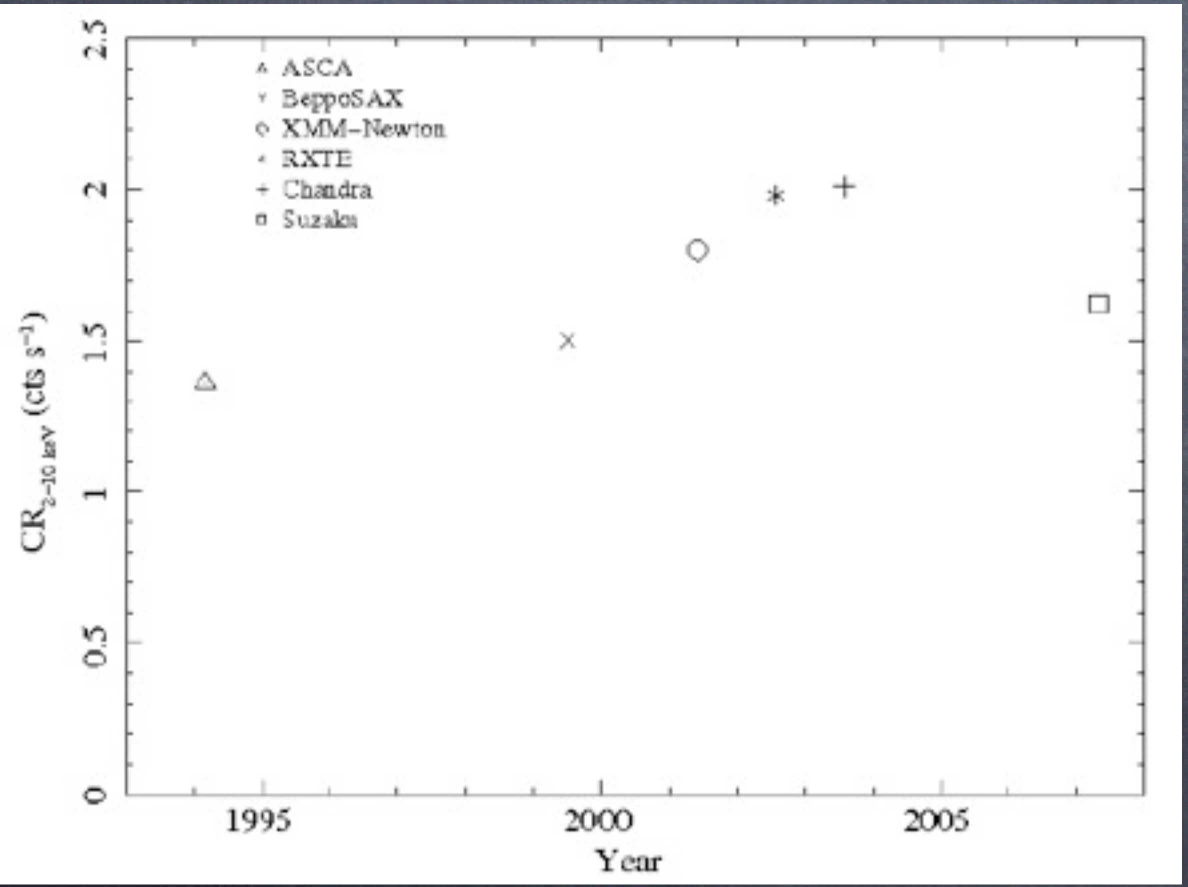
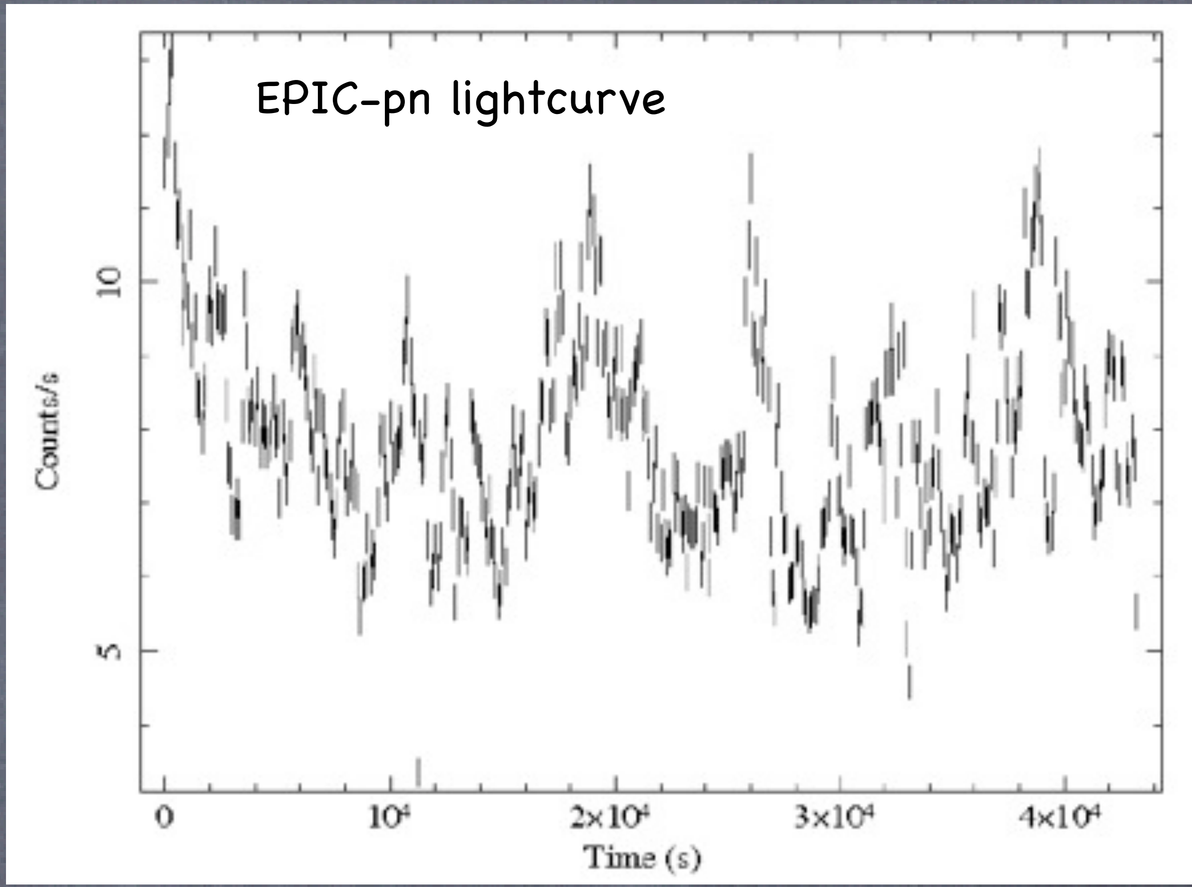




- Mild variability at longer timescales

- Variations in flux of ~20-30% over more than a decade

- Complex absorption at soft X-rays (Branduardi-Raymont+02)

The data

- We collected data from the archives

- XMM-Newton (2-5-2001):
  - EPIC-pn: ca. 40 ks
  - RGS: ca. 40 ks

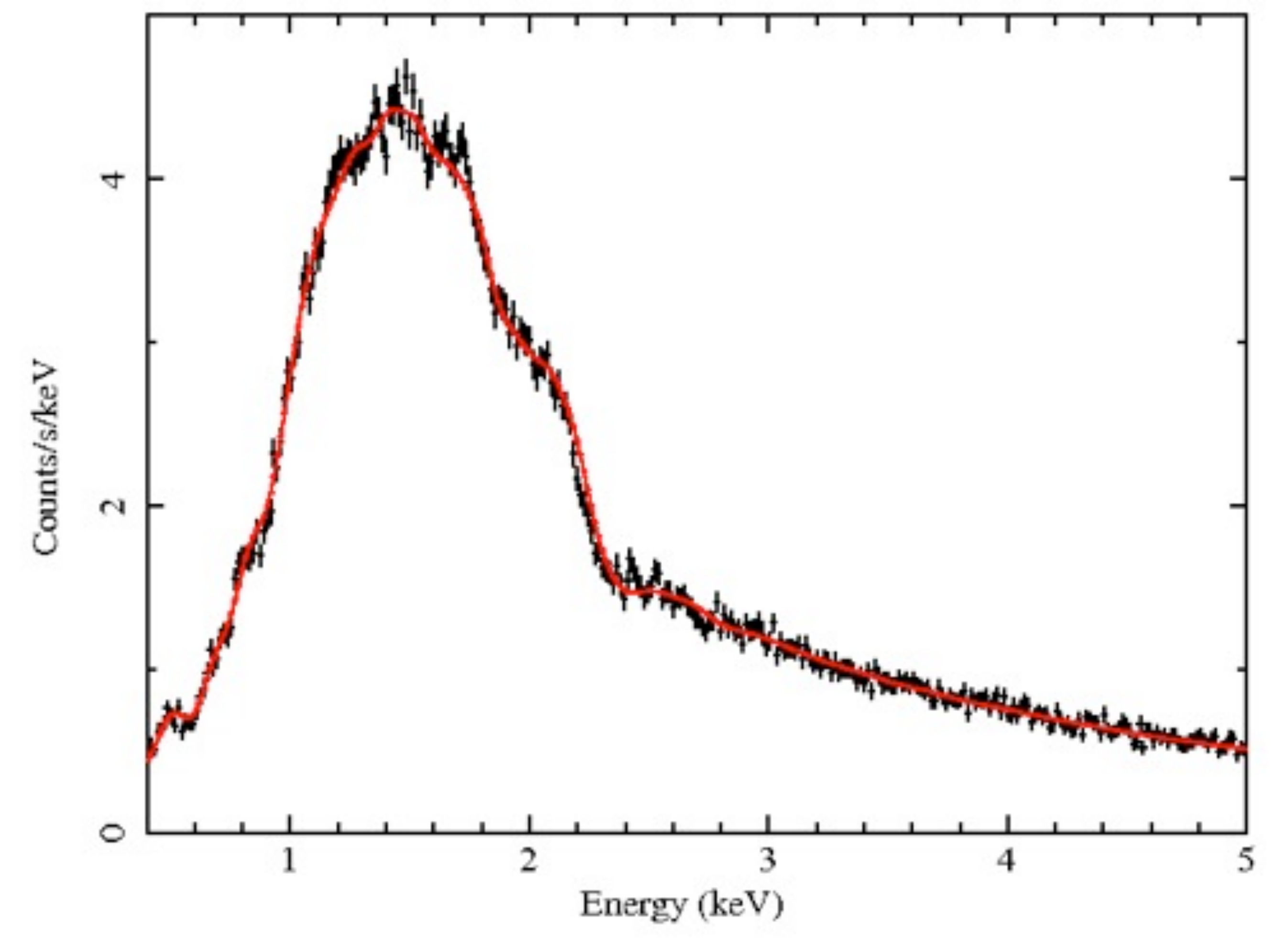
- Suzaku (25-4-2007):
  - XIS: ca. 80 ks

- ASCA (20-11-1994):
  - SIS/GIS: ca. 45 ks

- ASCA (18-5-1996):
  - SIS/GIS: ca. 40 ks

- We did not use the Chandra observations of 2002 as they were taken with the HETGS => low sensitivity in the soft waveband

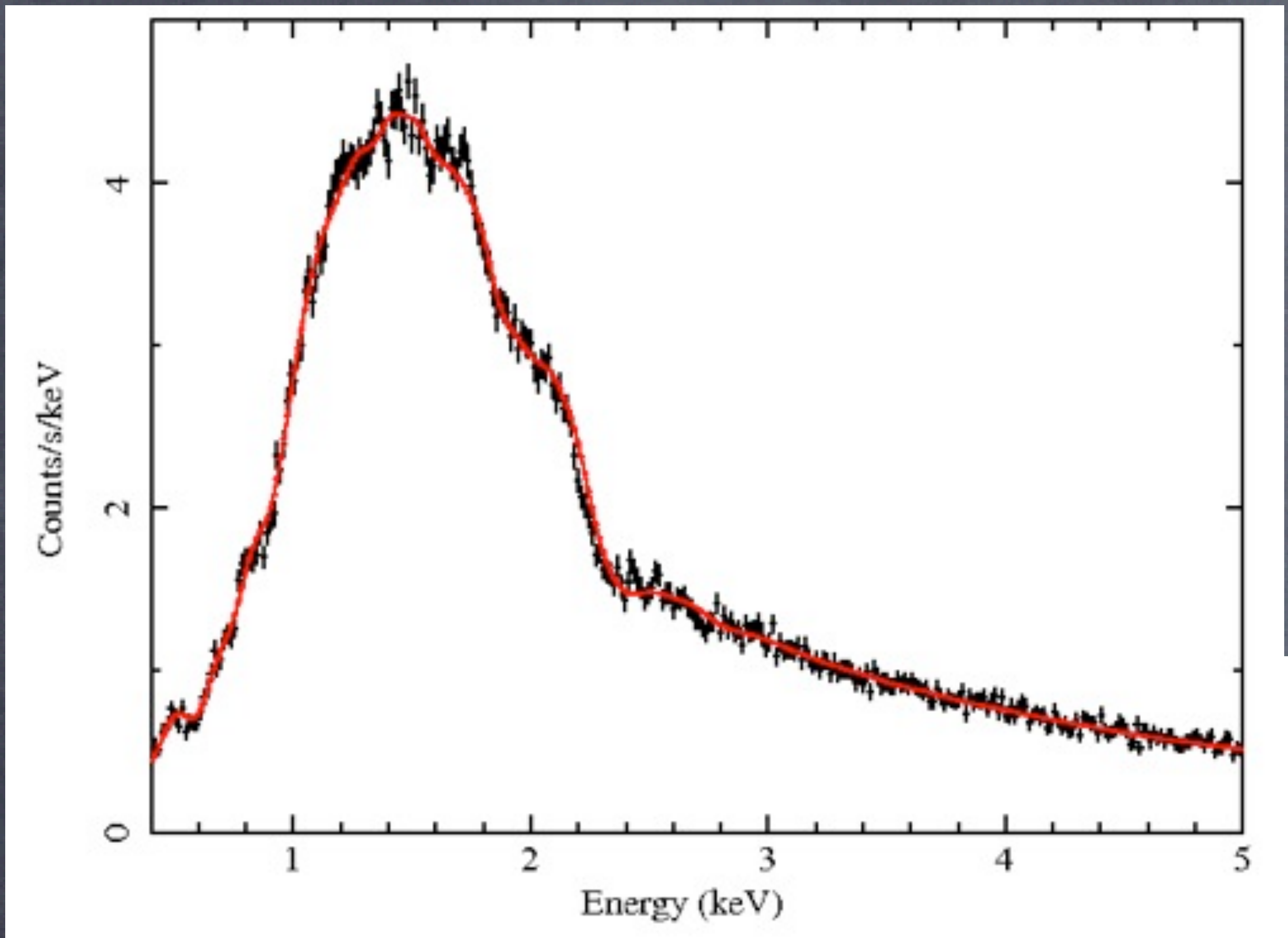
XMM-Newton EPIC-pn



Absorption modelling:

- Galactic absorption + Power law
- Intrinsic neutral absorption:
  - $N_H = 3.2 \pm 0.3 \times 10^{21}$ cm^{-2}
- At least two ionised absorbers:
  - $N_H = 1.2 \pm 0.2 \times 10^{22}$ cm^{-2} ; log ξ = 2.63 ± 0.04
  - $N_H = 4.0 \pm 0.3 \times 10^{21}$ cm^{-2} ; log ξ = 1.34 ± 0.08

XMM-Newton EPIC-pn



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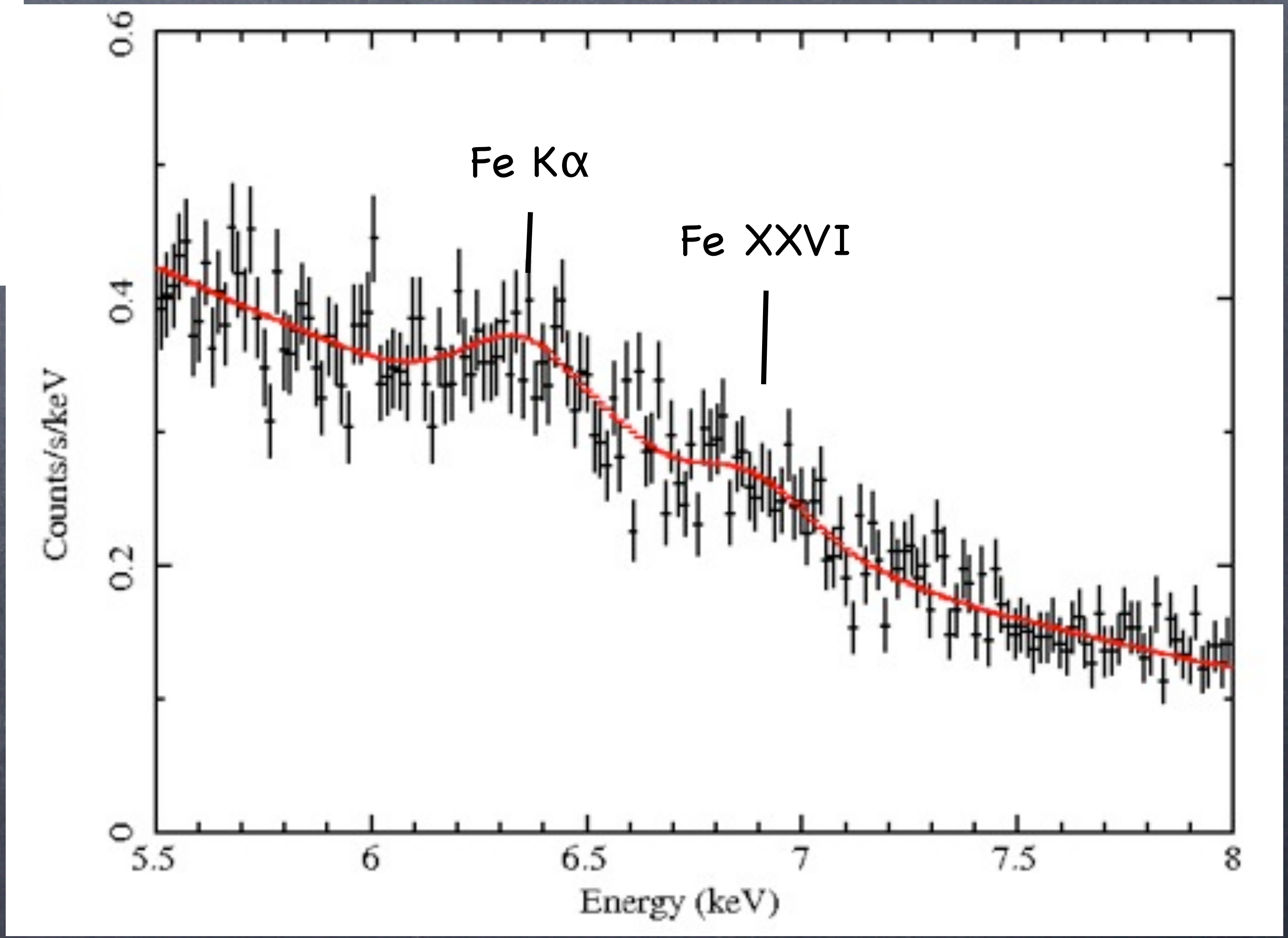
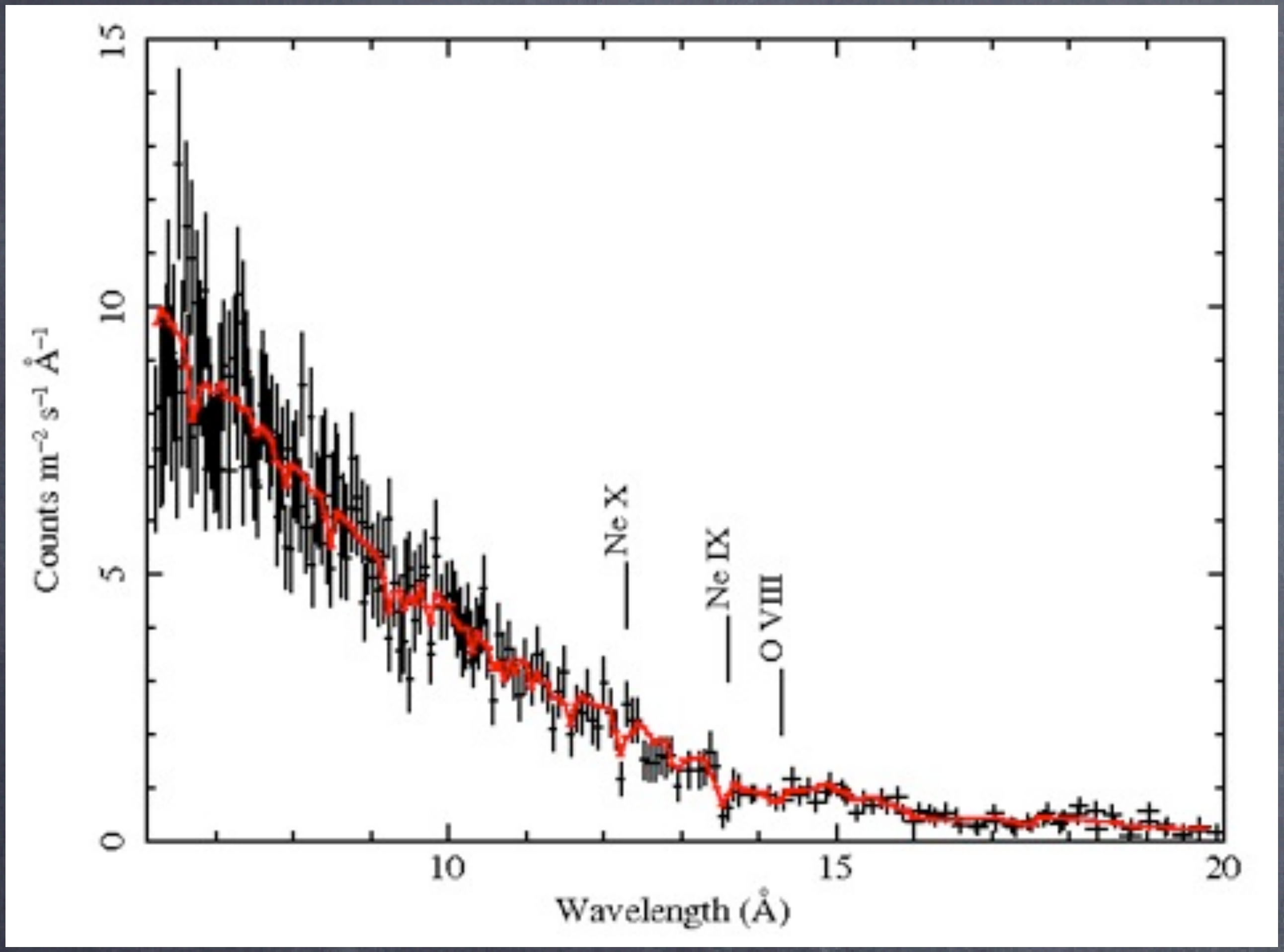


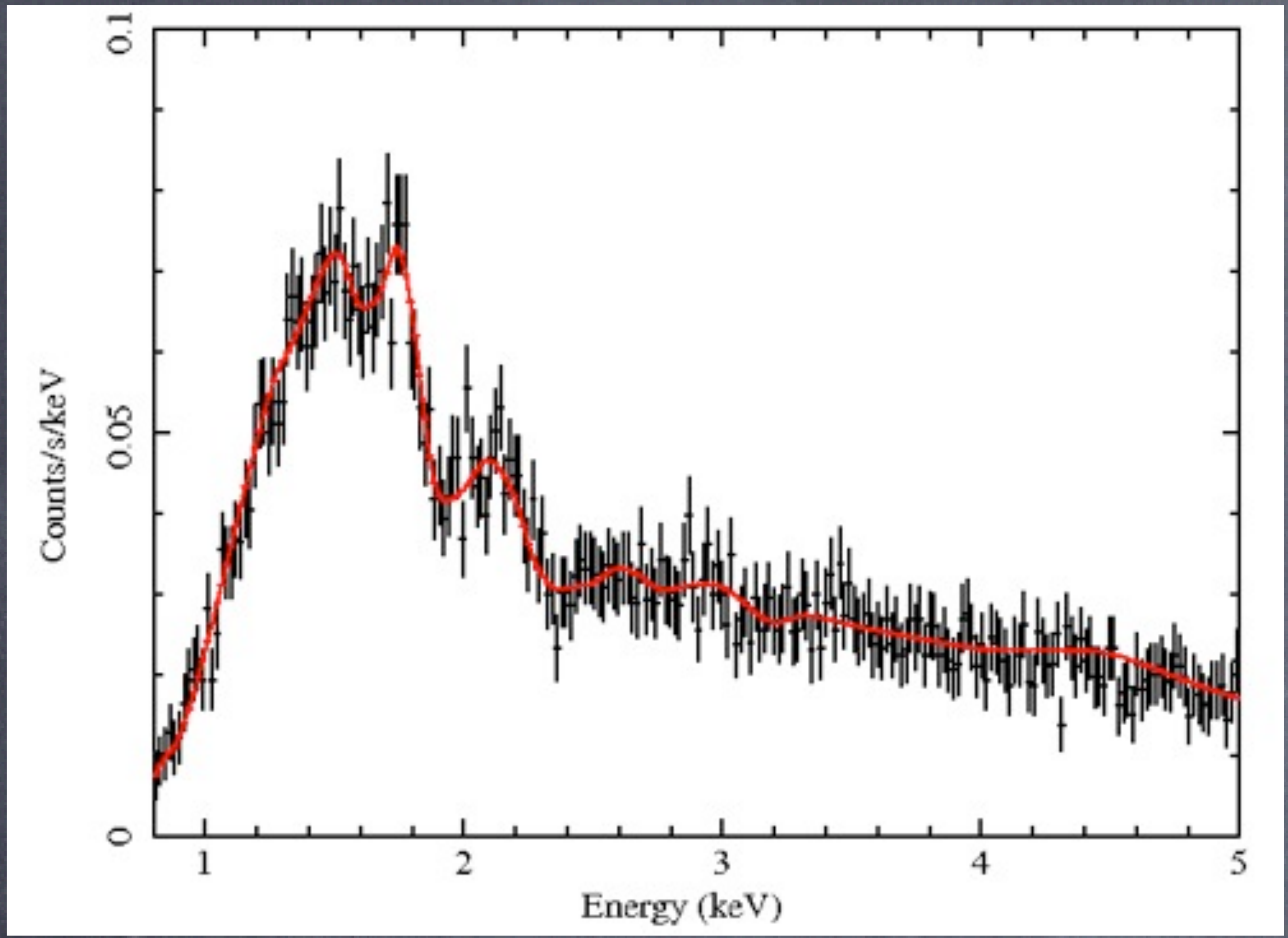
- Fe Kα
  - E = 6.40 ± 0.03 keV
  - FWHM = 0.26 ± 0.15 keV
- Fe XXVI
  - E = 6.91 ± 0.03 keV
  - FWHM = 0.26 ± 0.16 keV

XMM-Newton RGS



- High absorption severely affects RGS
- RGS consistent with pn best-fit
- At least three intrinsic absorbers
- Neutral:
  - $N_H = 6.0 \pm 0.5 \times 10^{21}$ cm^{-2}
- Ionised 1:
  - $N_H = 7.2 \pm 2.6 \times 10^{21}$ cm^{-2}
  - $\log \xi = 2.37 \pm 0.17$
- Ionised 2:
  - $N_H = 2.7 \pm 0.8 \times 10^{21}$ cm^{-2}
  - $\log \xi = 1.02 \pm 0.18$

Suzaku XIS



- Galactic absorption + Power law
- Intrinsic neutral absorption:
  - $N_H = 8.2 \pm 0.2 \times 10^{21}$ cm^{-2}
- No ionised absorber signatures

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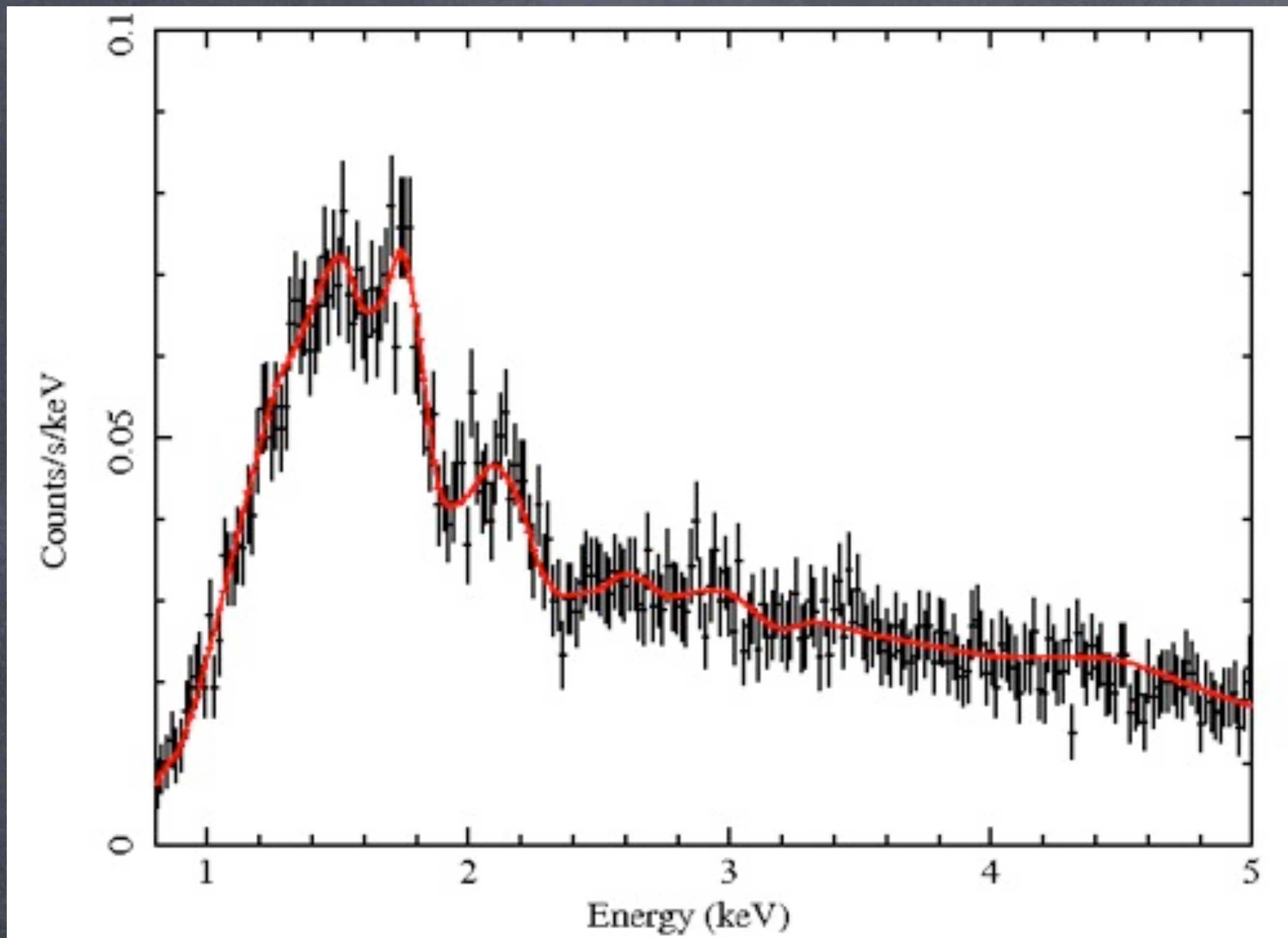

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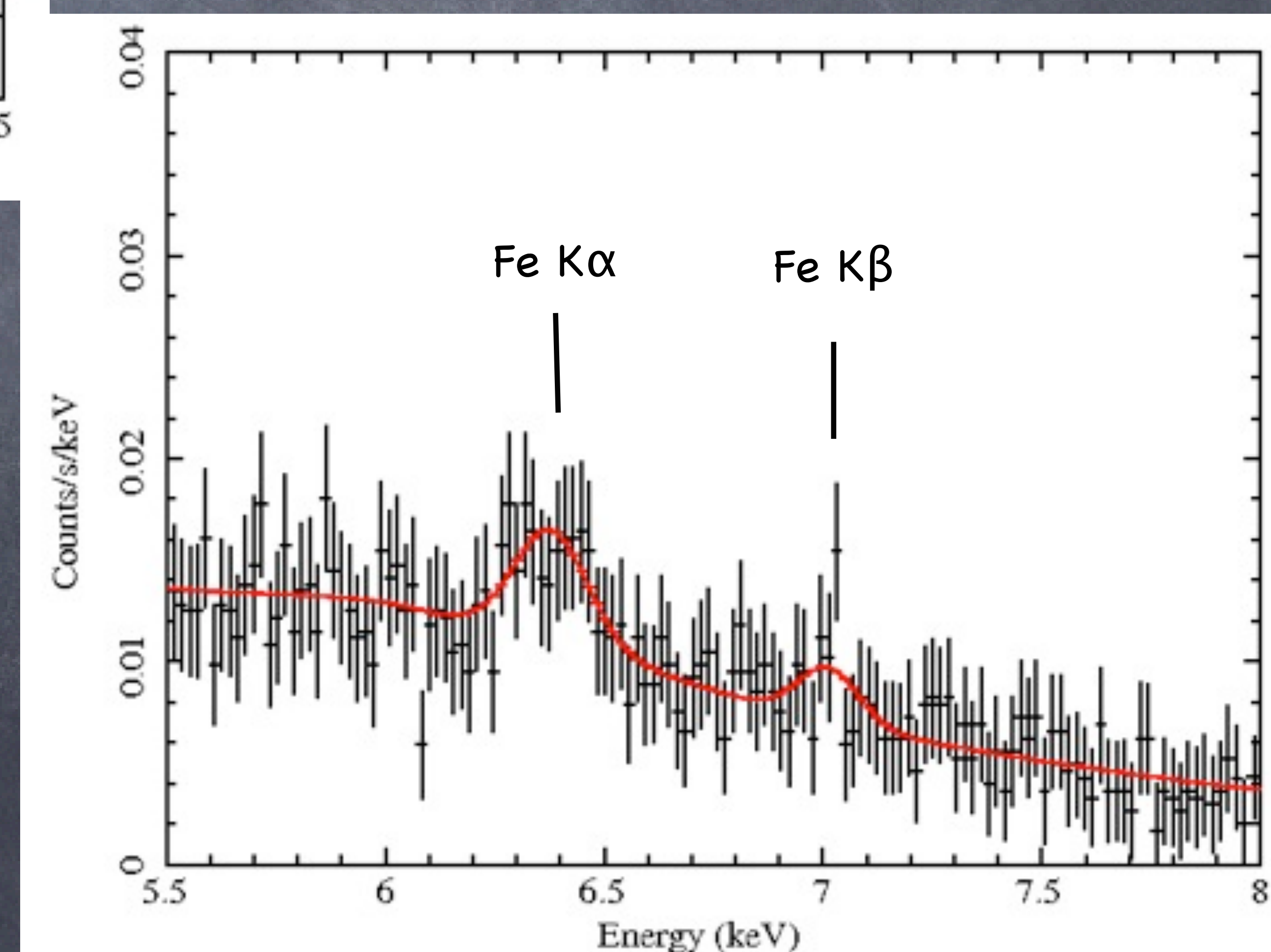
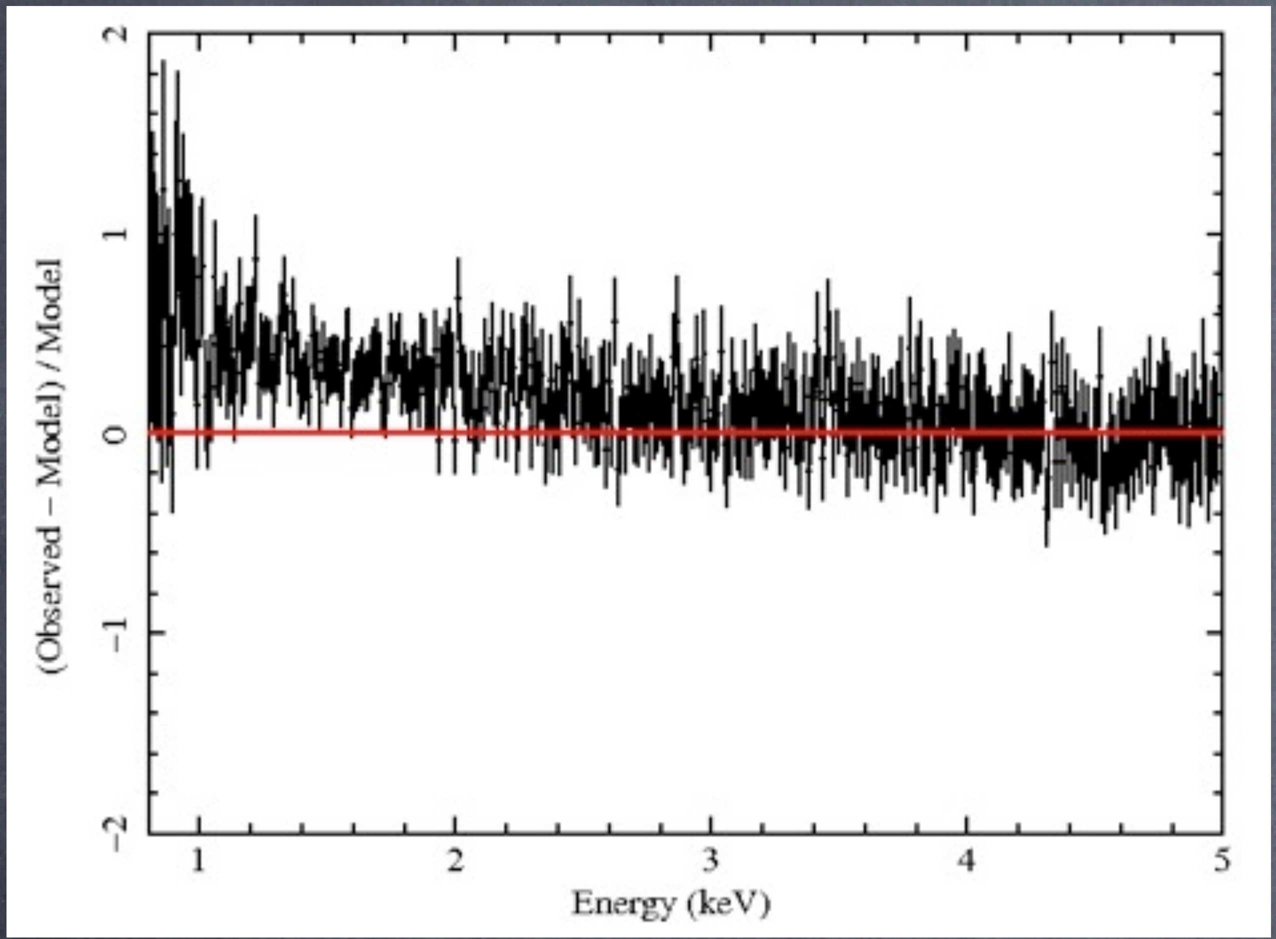


- Fe Kα
  - E = 6.41 ± 0.02 keV
  - FWHM = 0.12 ± 0.05 keV
- Fe Kβ
  - E = 7.05 ± 0.02 keV
  - FWHM < 0.05 keV

XIS vs pn



- pn best-fit on XIS data
- Rescaled to XIS continuum
- Model underpredicts data

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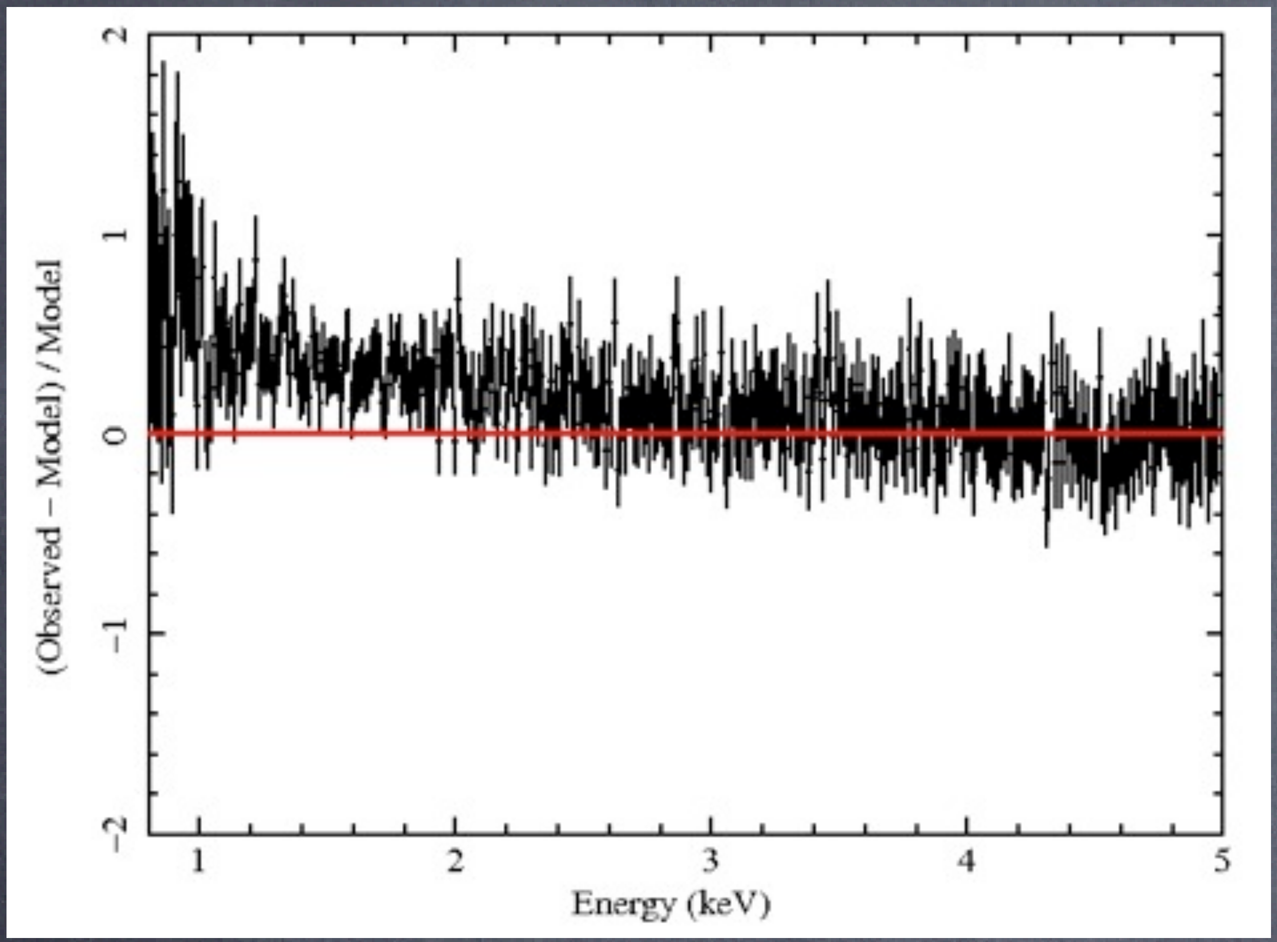

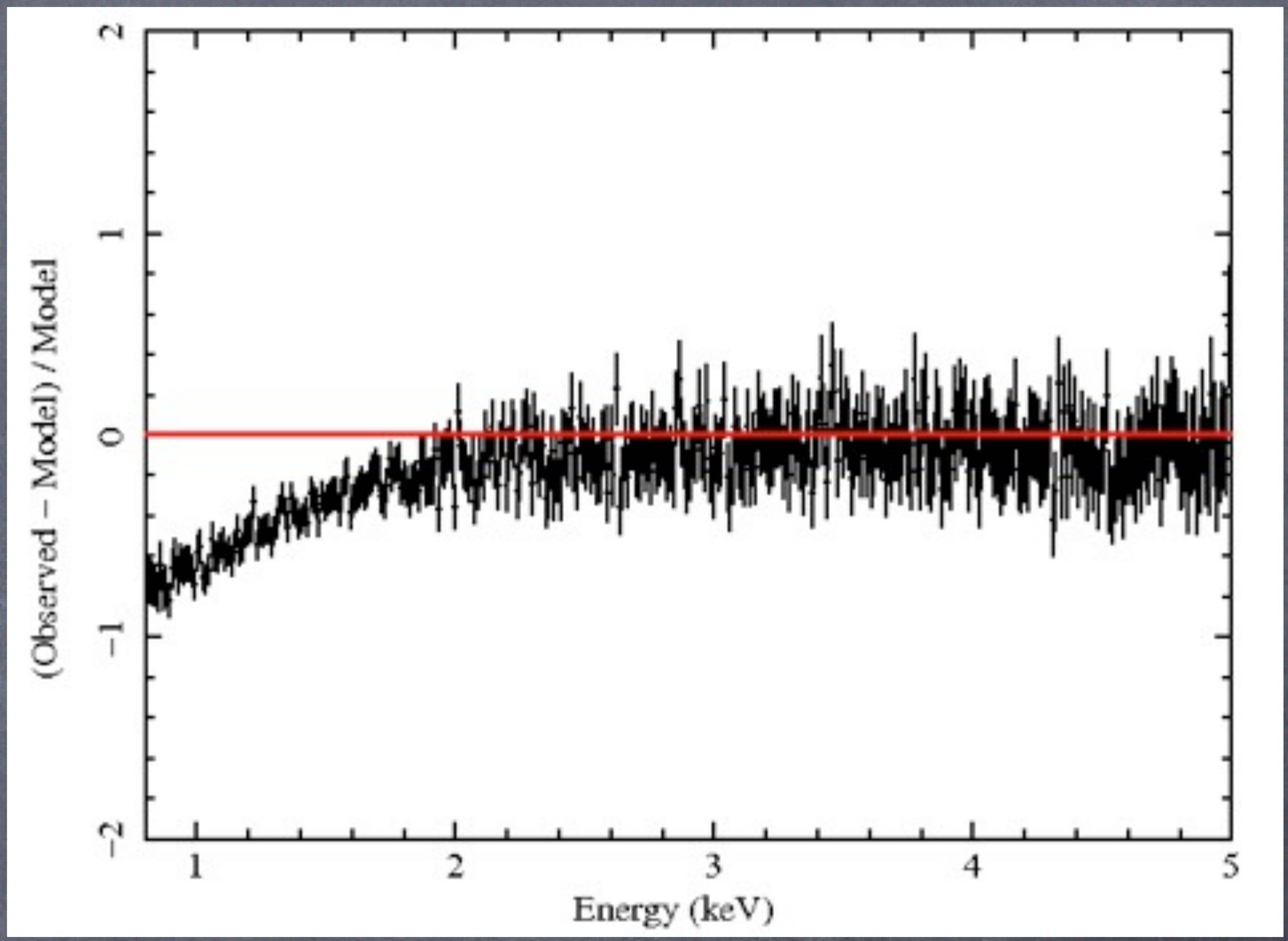

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- pn best-fit on XIS data with no xabs
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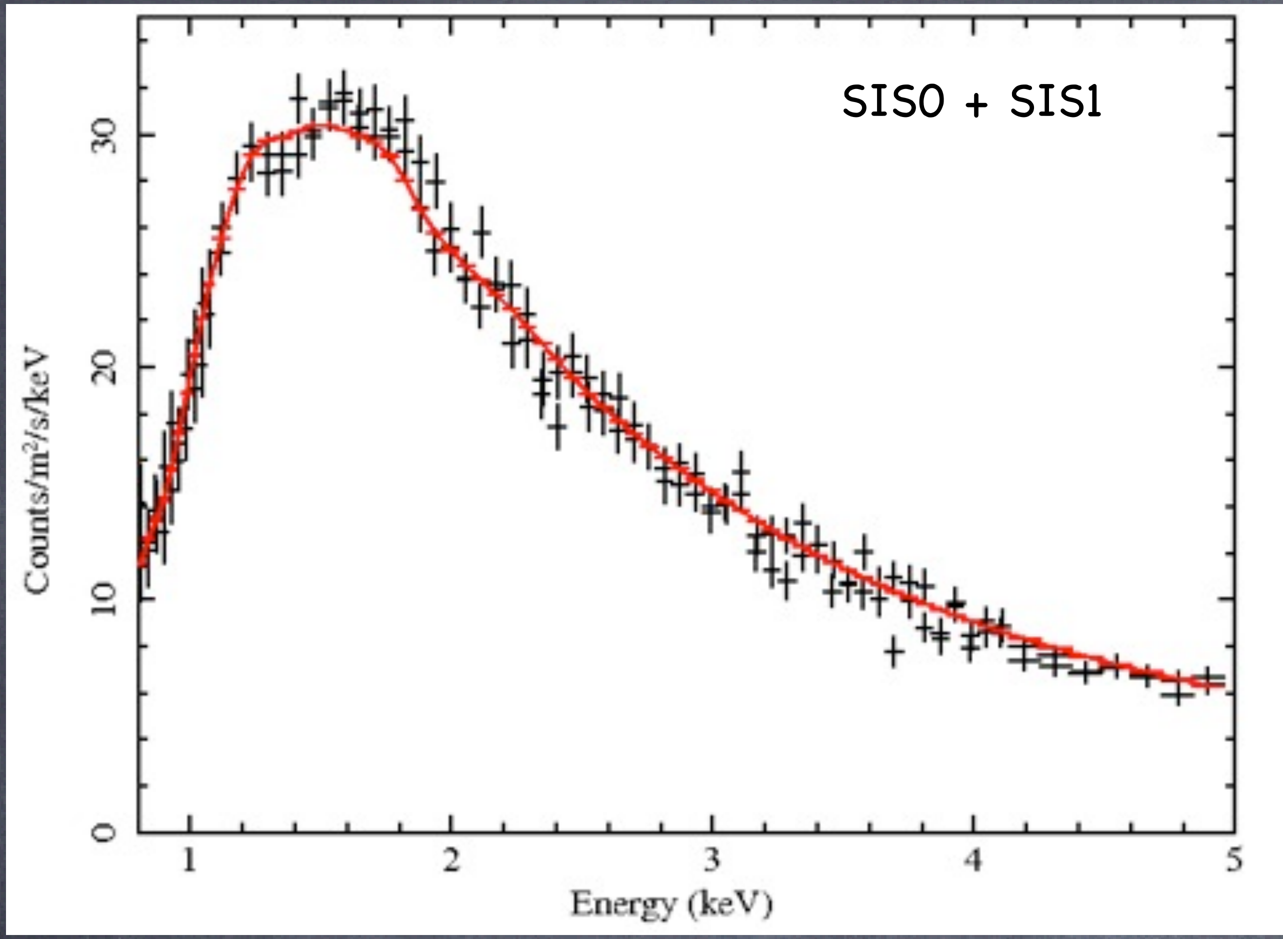

- Galactic absorption + Power law
- Intrinsic neutral absorption:
  - 1994: $N_H = 9.0 \pm 0.1 \times 10^{21}$ cm^{-2}
  - 1996: $N_H = 9.1 \pm 0.2 \times 10^{21}$ cm^{-2}
- No ionised absorber signatures

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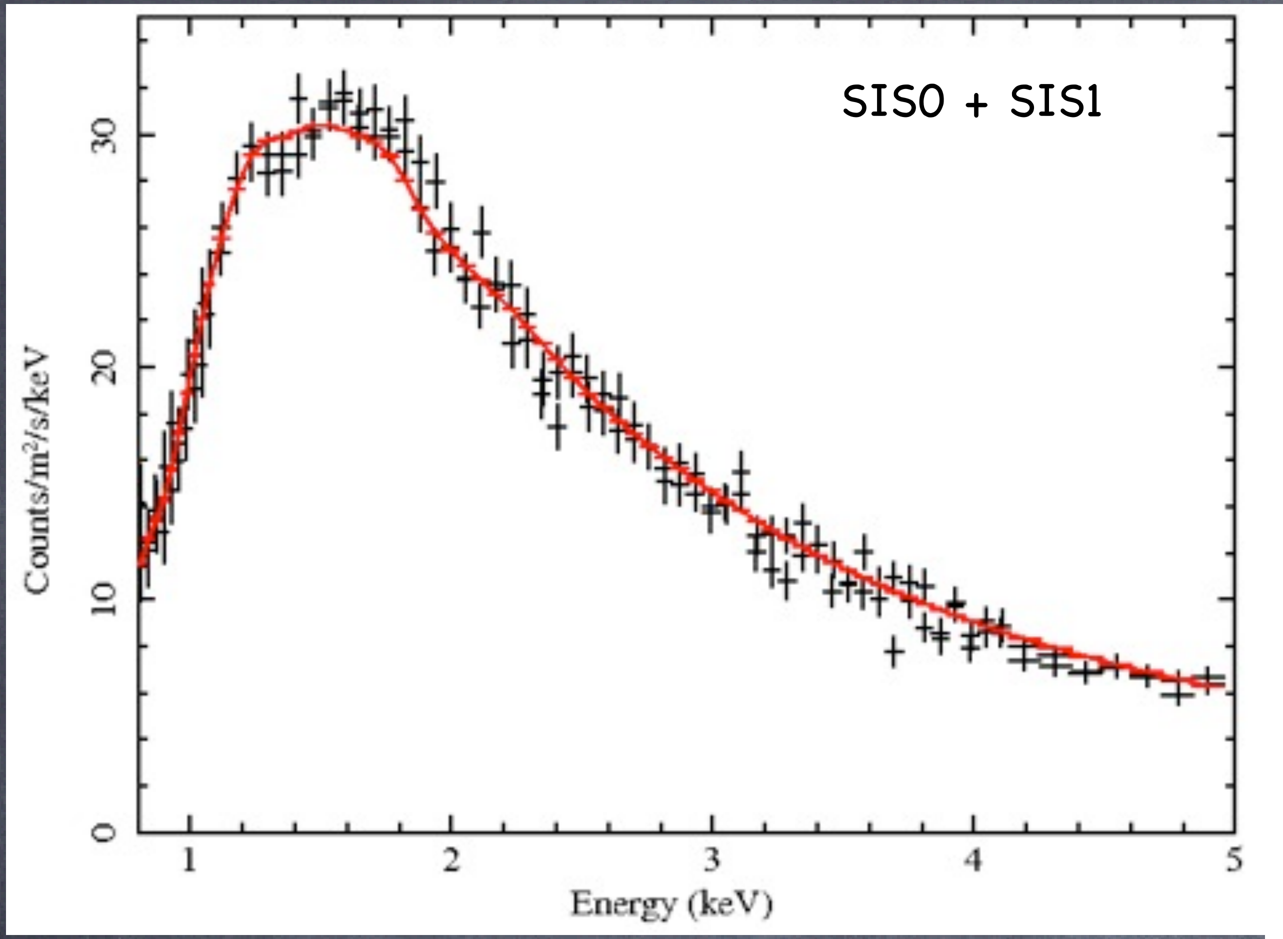

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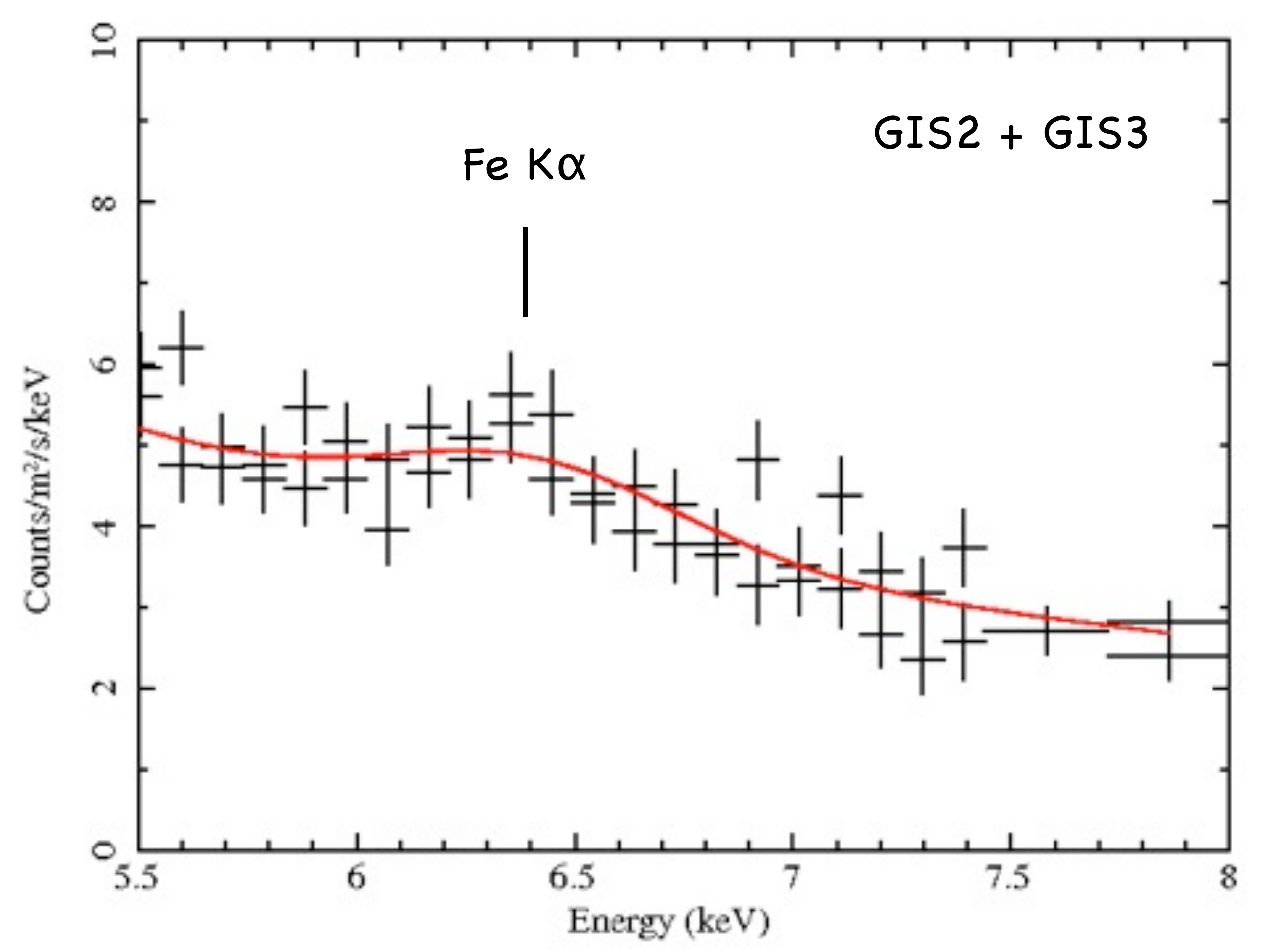
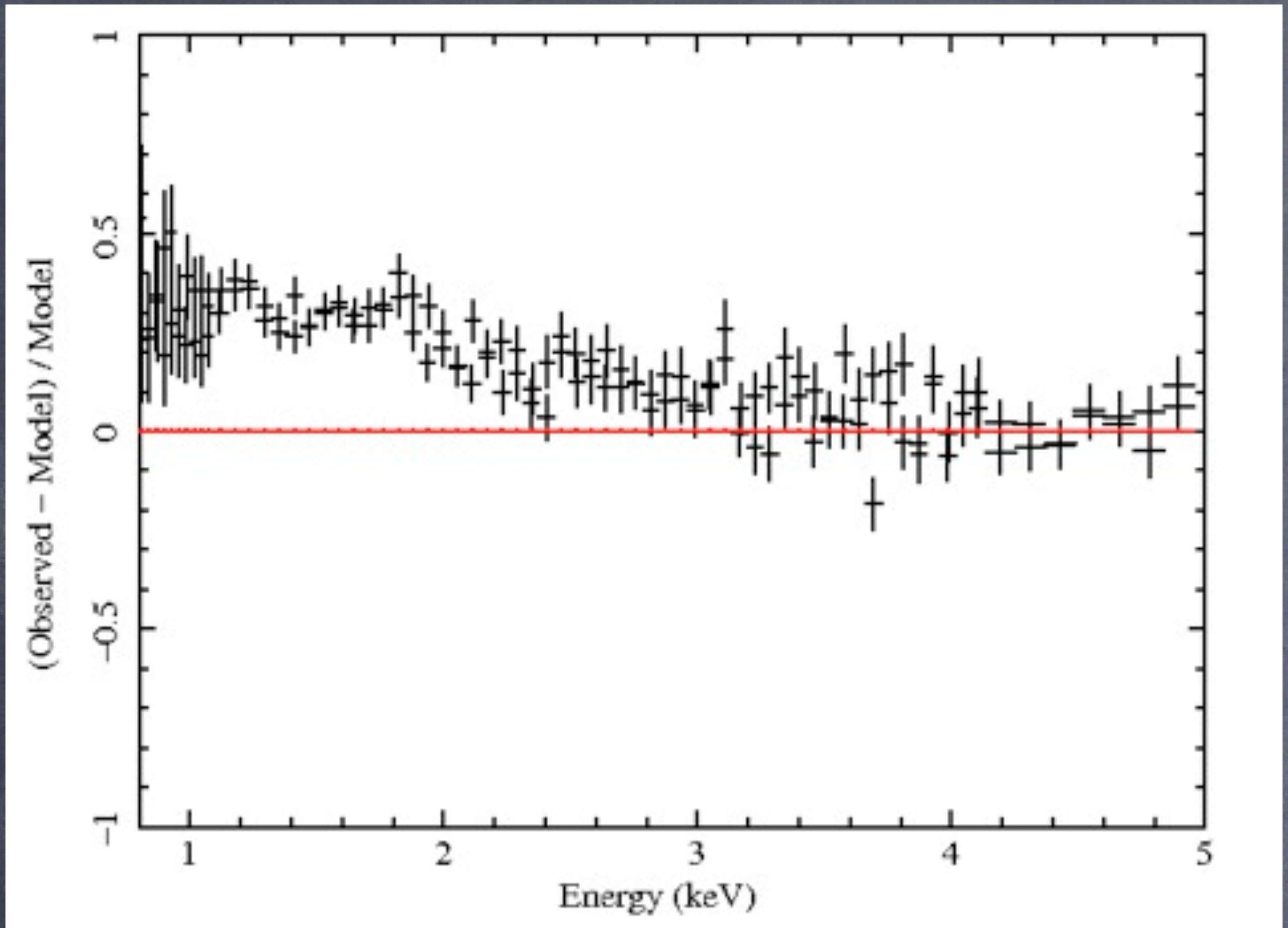


- Fe Kα (1994):
  - E = 6.44 ± 0.07 keV
  - FWHM = 0.6 ± 0.5 keV
- Fe Kα (1996):
  - E = 6.42 ± 0.09 keV
  - FWHM = 0.9 ± 0.3 keV

SIS vs pn



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- Rescaled to SIS continuum
- Model underpredicts data

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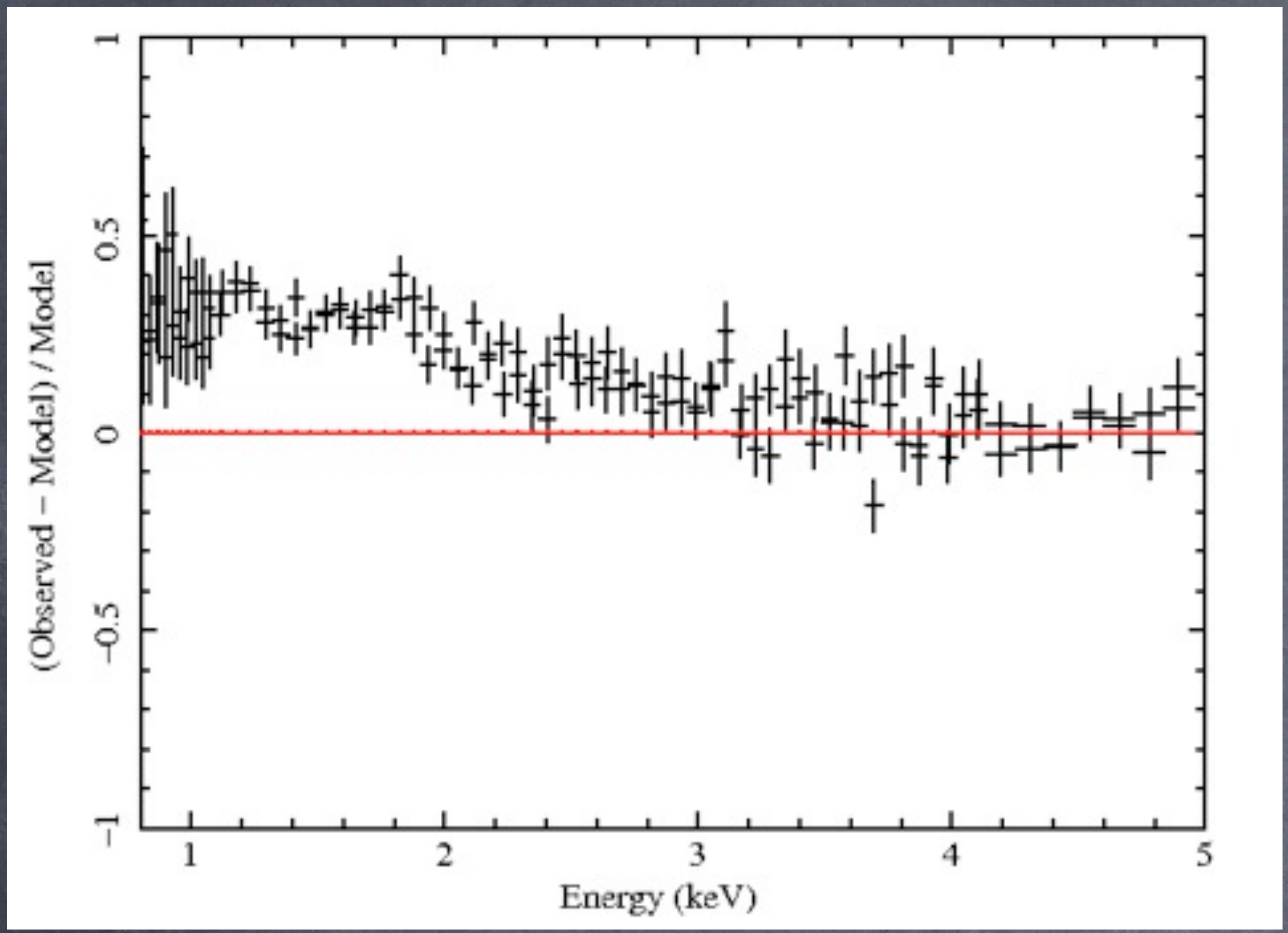

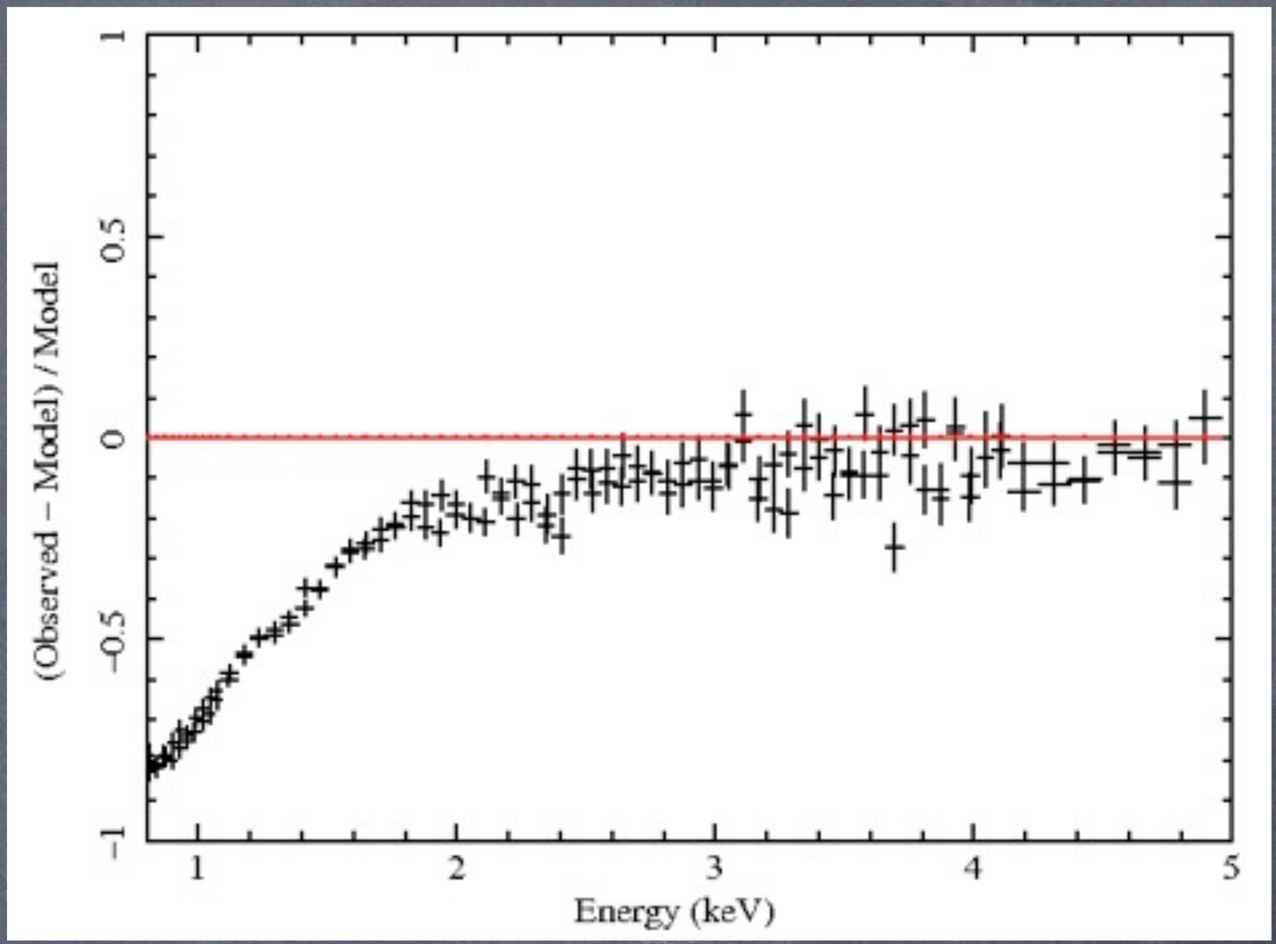

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- pn best-fit on SIS data with no xabs
- Rescaled to SIS continuum
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- Suzaku (2006)
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  - No ionised absorber
  - Narrow Fe Kα and Fe Kβ
- Very rapid variability at short timescales
  - Look into the disc/BLR

Interpretation: grazing the torus?

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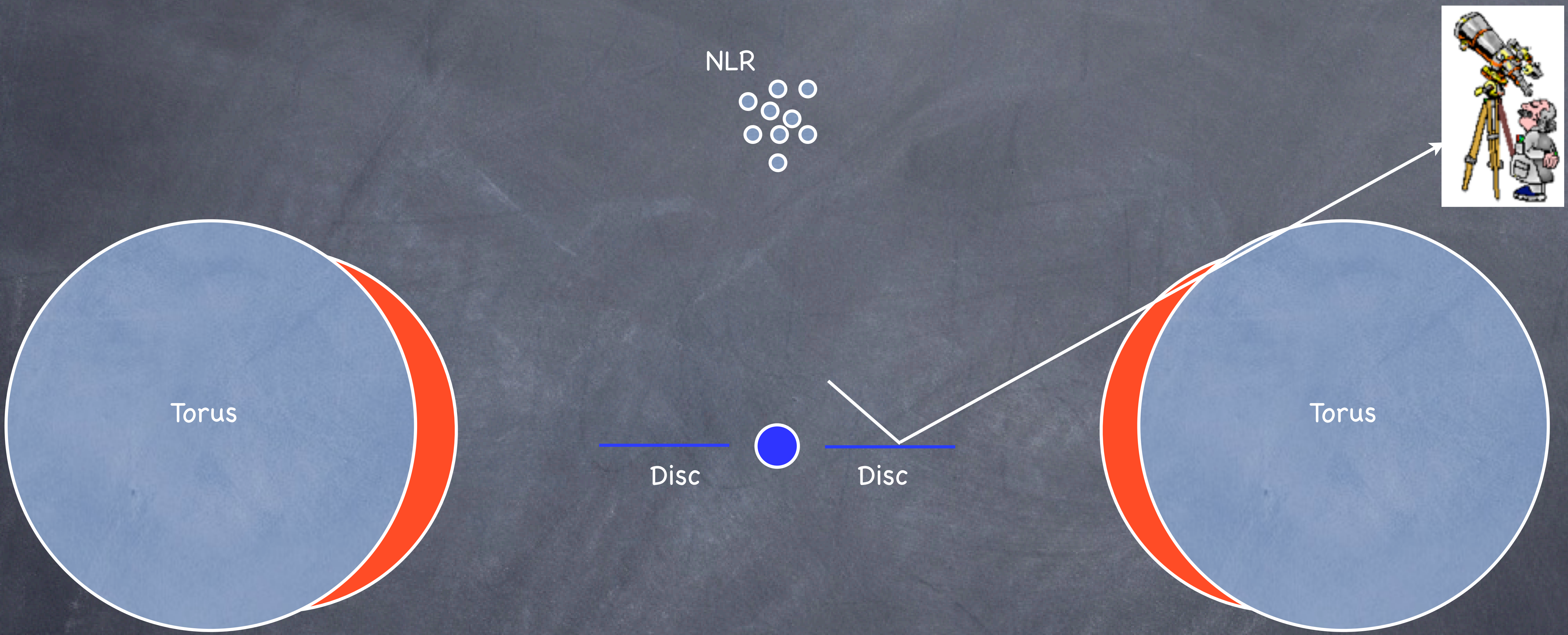

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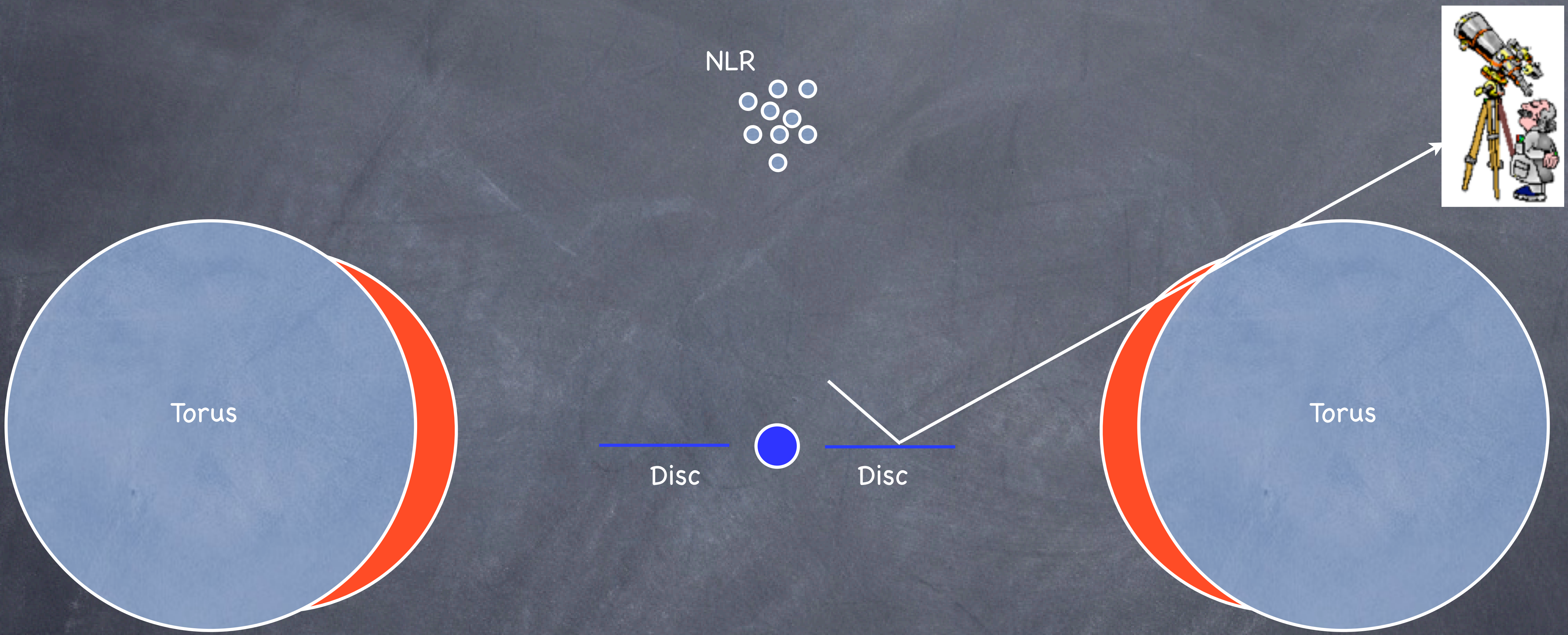

The torus is clumpy and is responsible for the neutral absorption.

The ionised gas is formed in the inner side of the torus or further in.

A cloud moves on => variations on N_H and detection of ionised absorber.

Broad Fe Kα wings.

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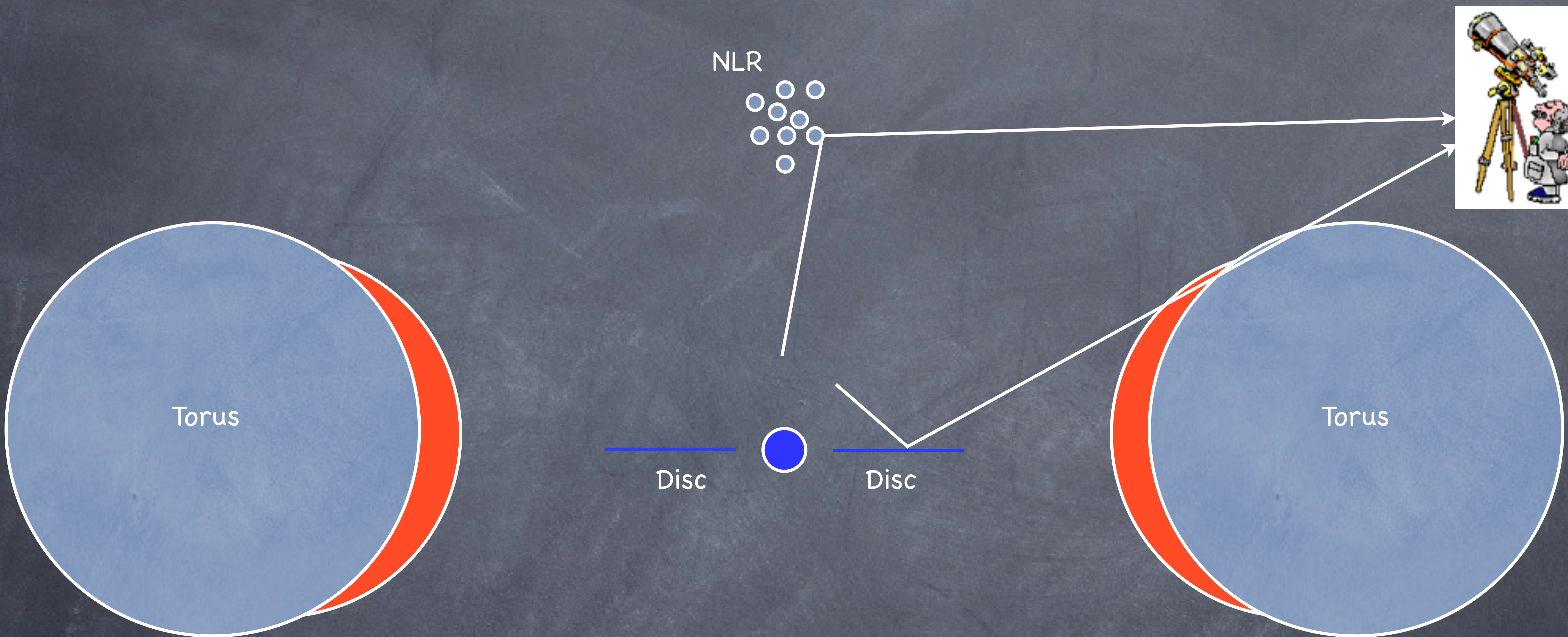

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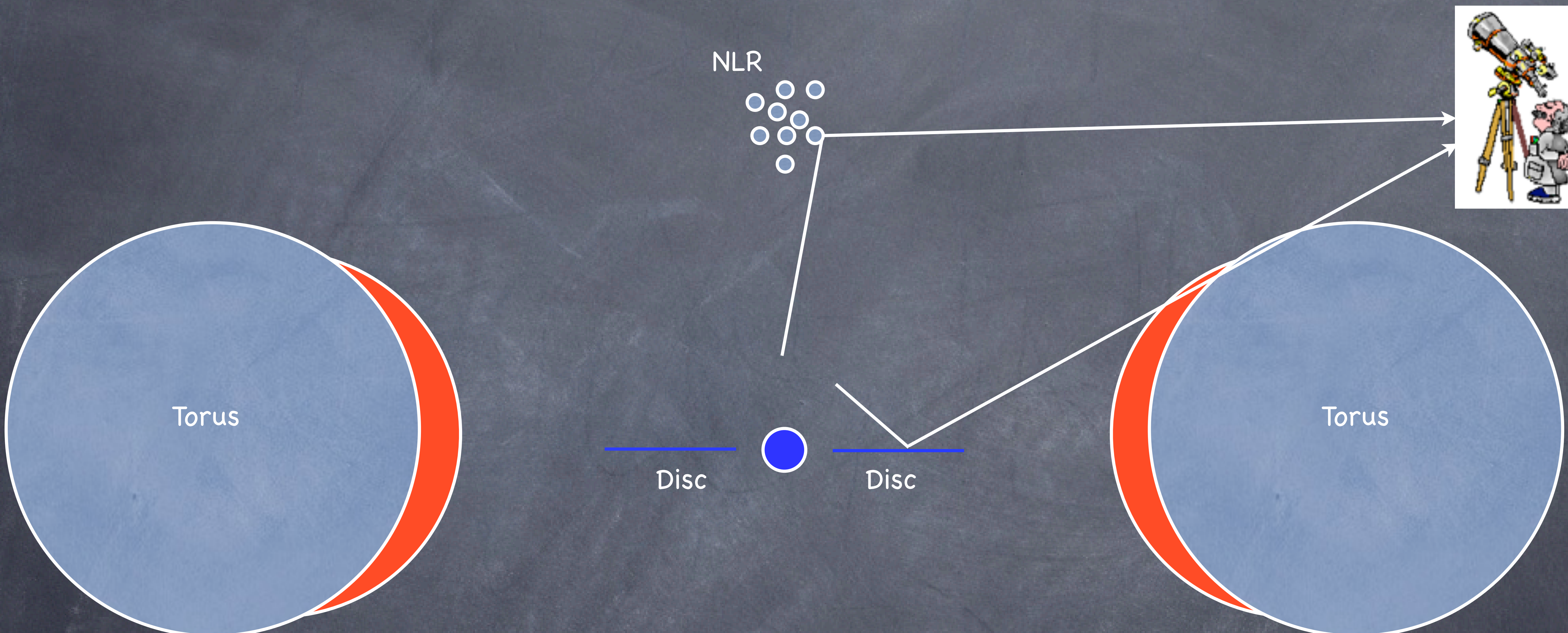

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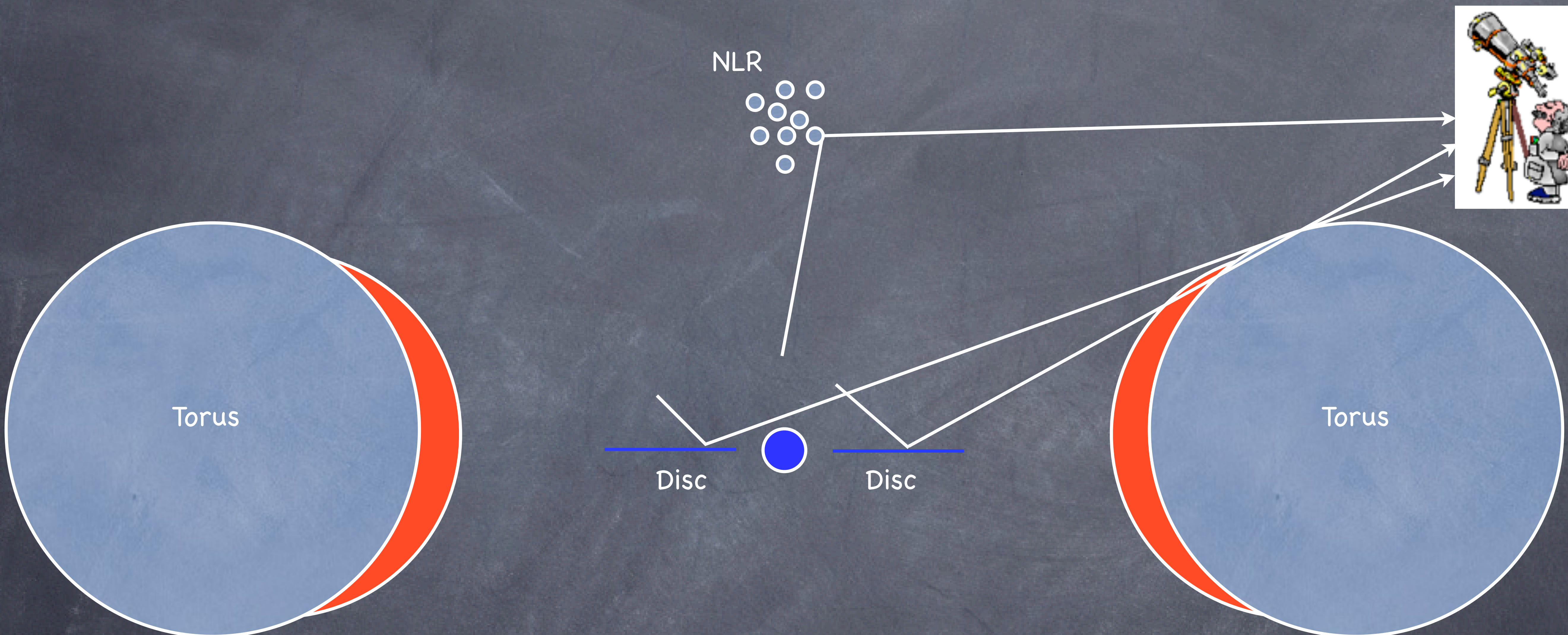

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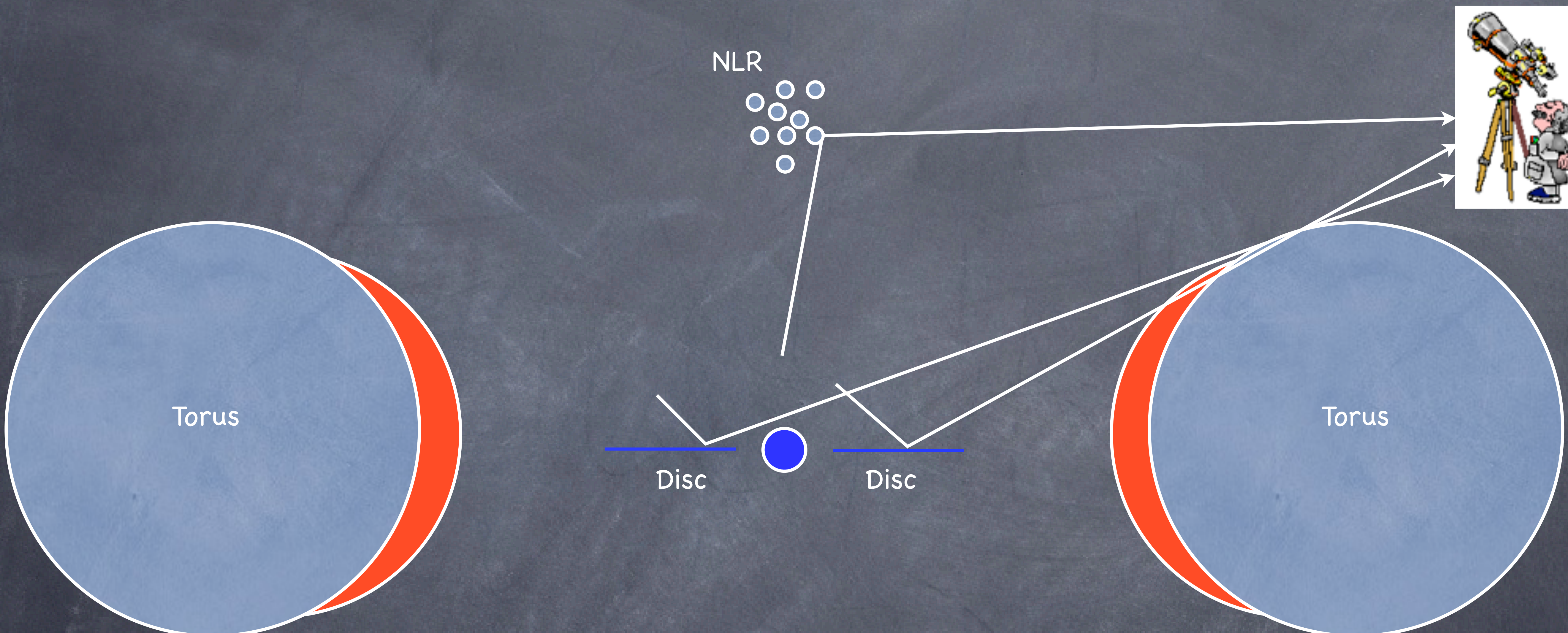

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The origin of the Fe XXVI line is likely the disc/ BLR (Reeves+01, Pounds+01, Yaqoob+03, Bianchi +05)

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Summary

- NGC 7314 shows a complex absorption spectrum
- Shows variable neutral column densities at long timescales (~years)
- Ionised absorption is detected in some cases (XMM) but not in others
- NGC 7314 spectrum is consistent with an scenario in which our line of sight grazes the torus
- It would be probably worth adding up a few tens of ks more!