Coronal properties of luminous quasars at cosmological redshifts

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Based on Kammoun et al., 2017, MNRAS, 465, 166

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ma per seguir virtute e canoscenza
SISSA

The X-ray emitting region (Corona)

Comptonization:

Relatively cold accretion disc emitting a BB spectrum (kT ~ few eV)

Hot relativistic electrons (kT_e~100-300 keV)

Resulting spectrum ≅ Power-law × high energy cutoff

$$\Gamma - 1 \simeq \left[\frac{9}{4} + \frac{m_e c^2}{kT_e \tau (1 + \tau/3)} \right]^{1/2} - \frac{3}{2}$$

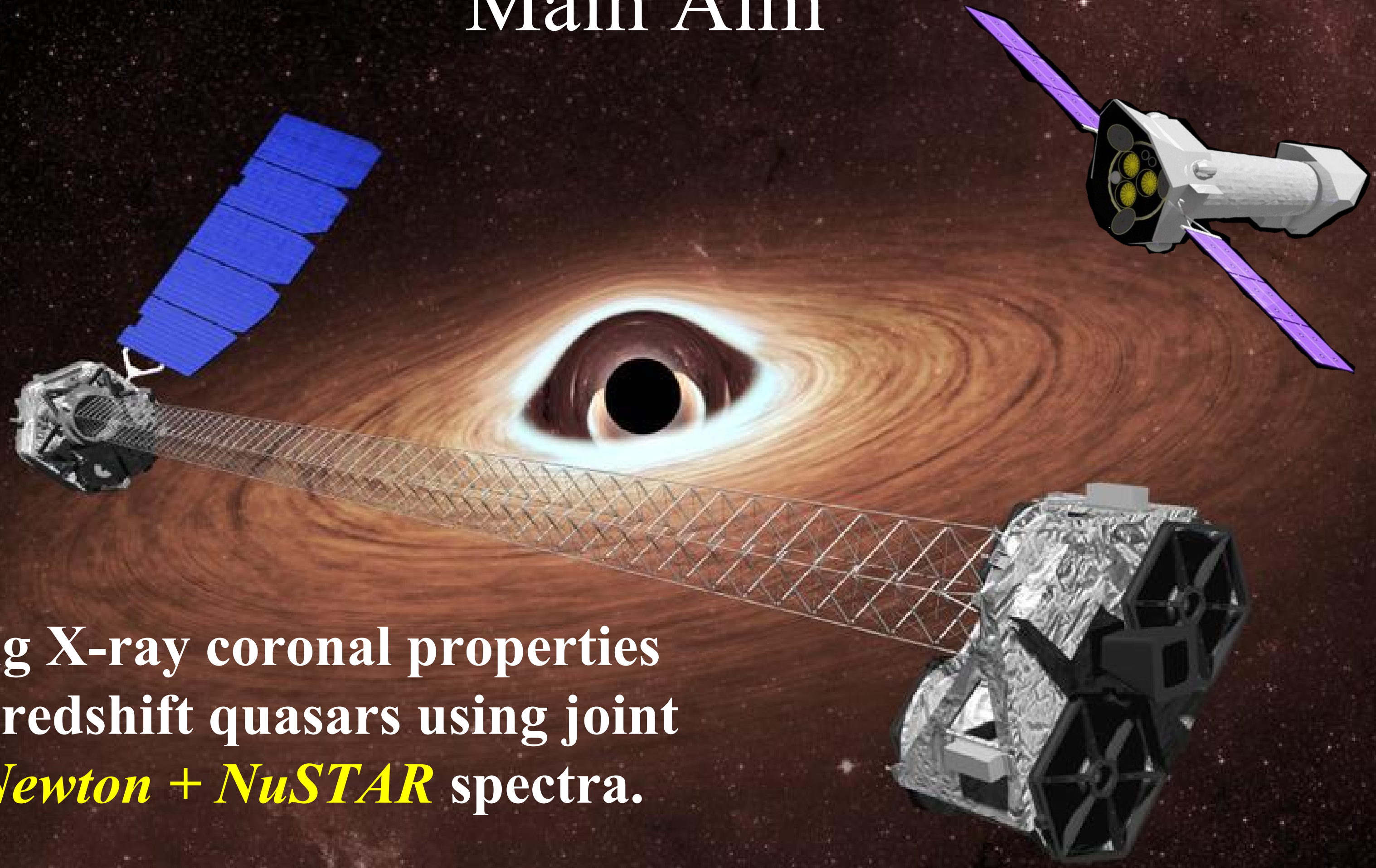
$$E_{cut} \sim 2\text{-}3 kT_e$$

The X-ray emitting region (Corona)

General questions:

- How to heat the corona?
- Magnetic field reconnection (similar to solar flares)?
- Geometry and size? Slab? Sphere? Point source (lamp-post)? Jet base? Aborted jet? ADAFs? Clumpy?
- Temperature? Importance of pair production? Dependence on luminosity?
- Corona - disc interaction?
- .....

Main Aim



Studying X-ray coronal properties of high-redshift quasars using joint *XMM-Newton* + *NuSTAR* spectra.

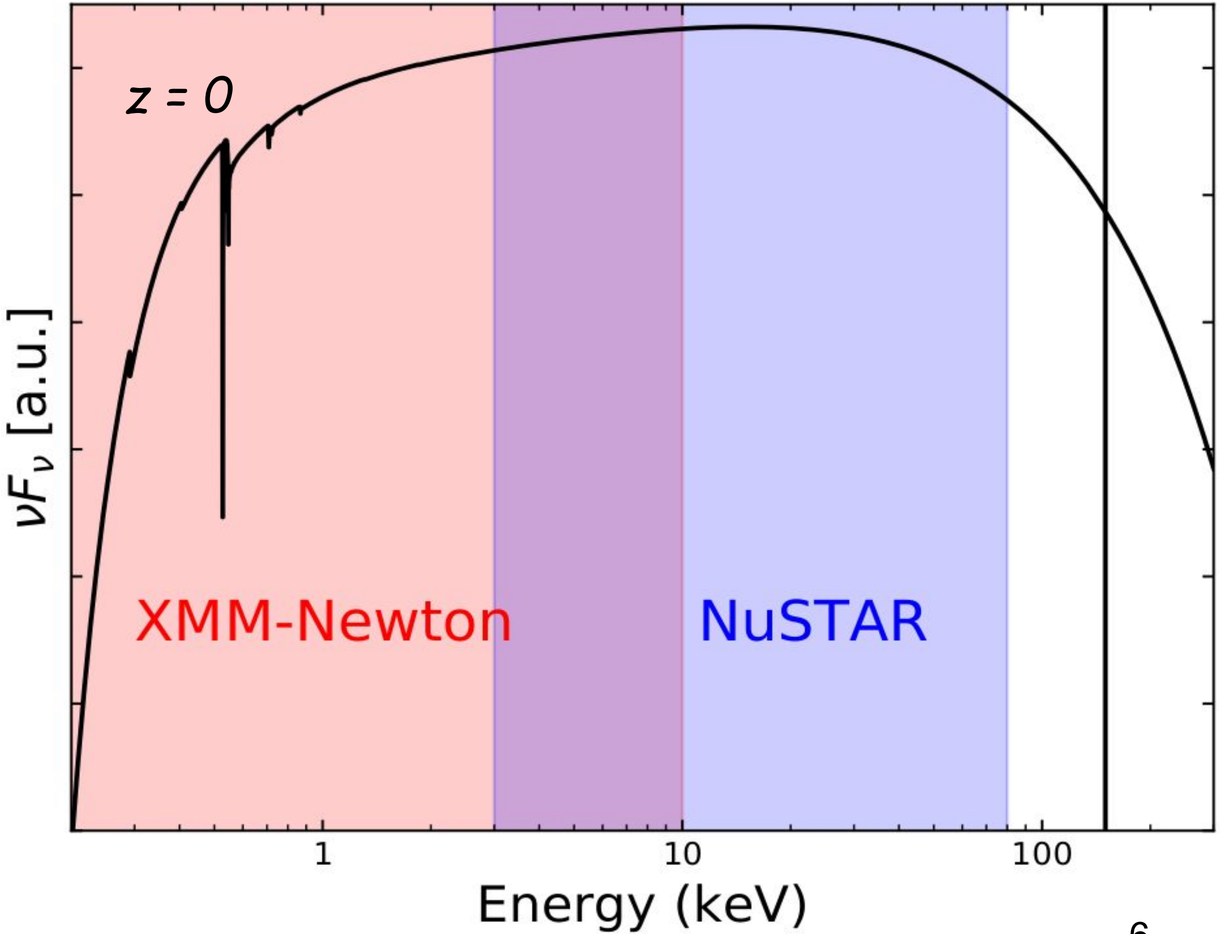
Objective

E_{cut} has been recently determined for local bright AGNs. However, it is complicated because of the need of high quality spectra, the complexity of the spectra, and the cutoff might not be seen.

Considering:

1. The **high luminosity and redshift** of the source.
2. The high sensitivity of joint *XMM-Newton* & *NuSTAR* observations in the 0.5-80 keV band.

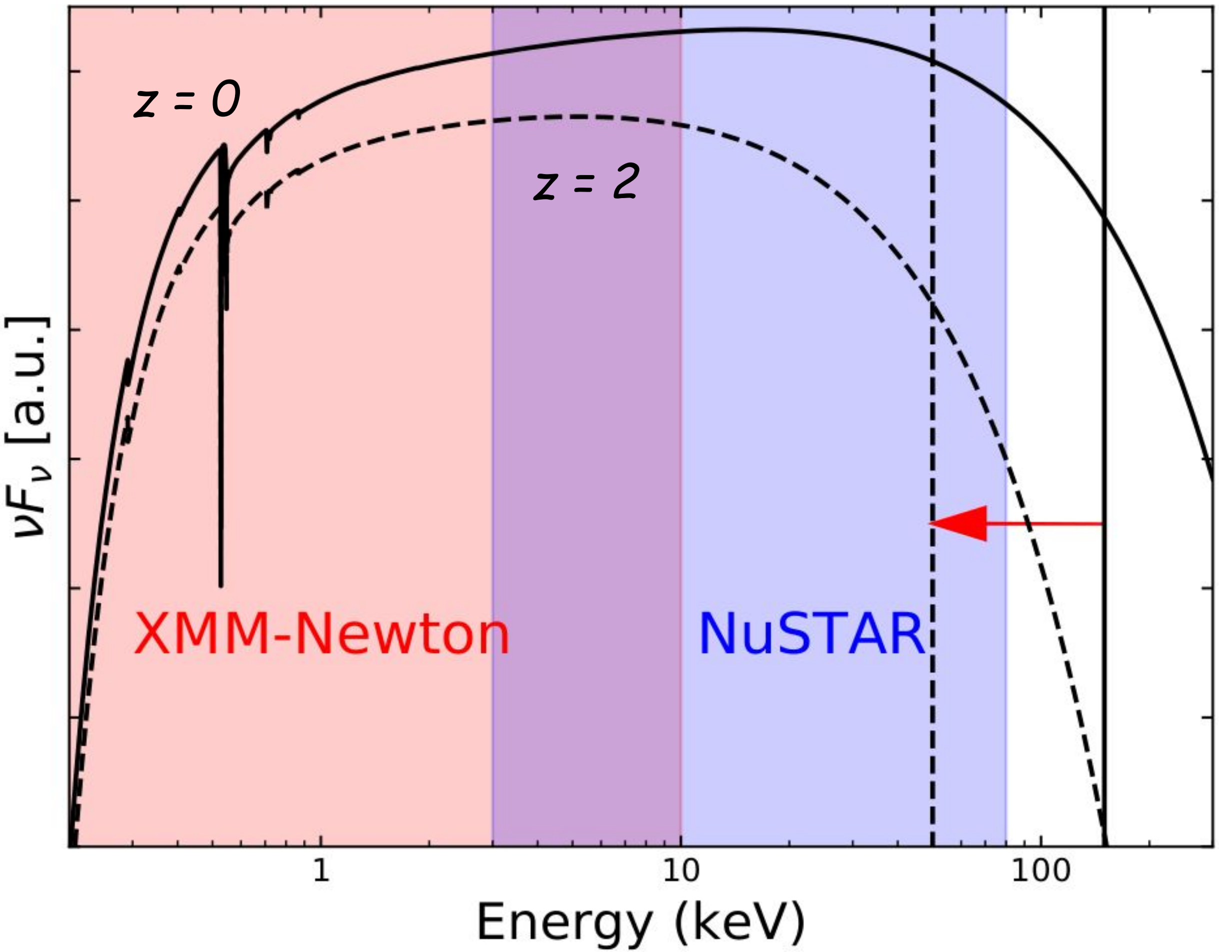
Objective



Objective

⇒ Redshift E_{cut} closer to the observed range

⇒ Better constraints on the coronal parameters / geometry/ dependence on luminosity



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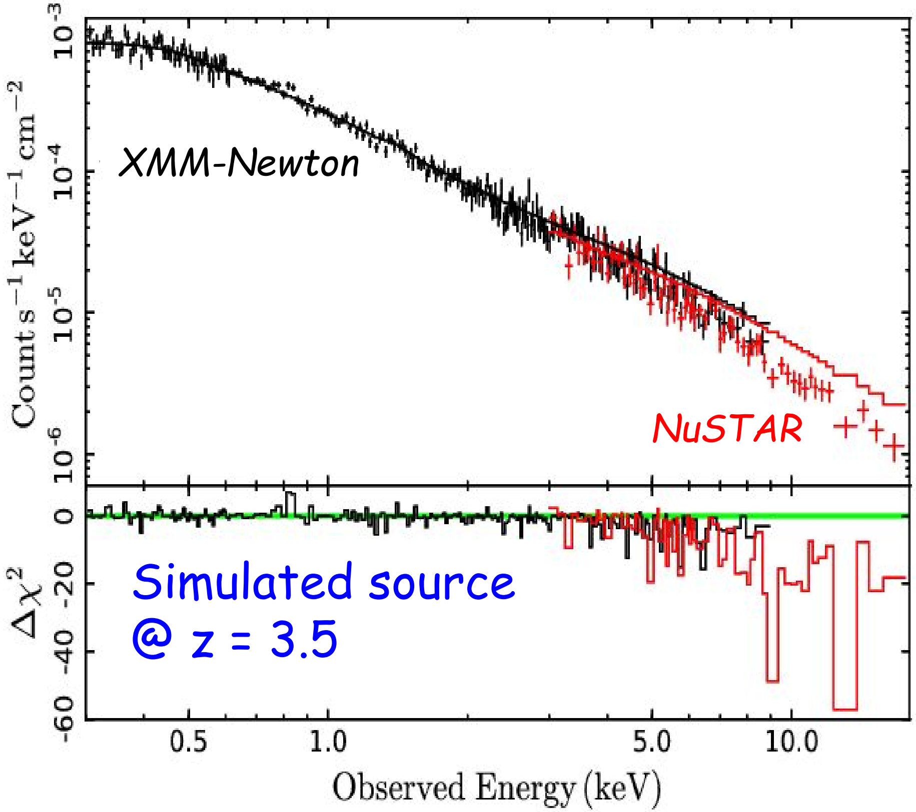
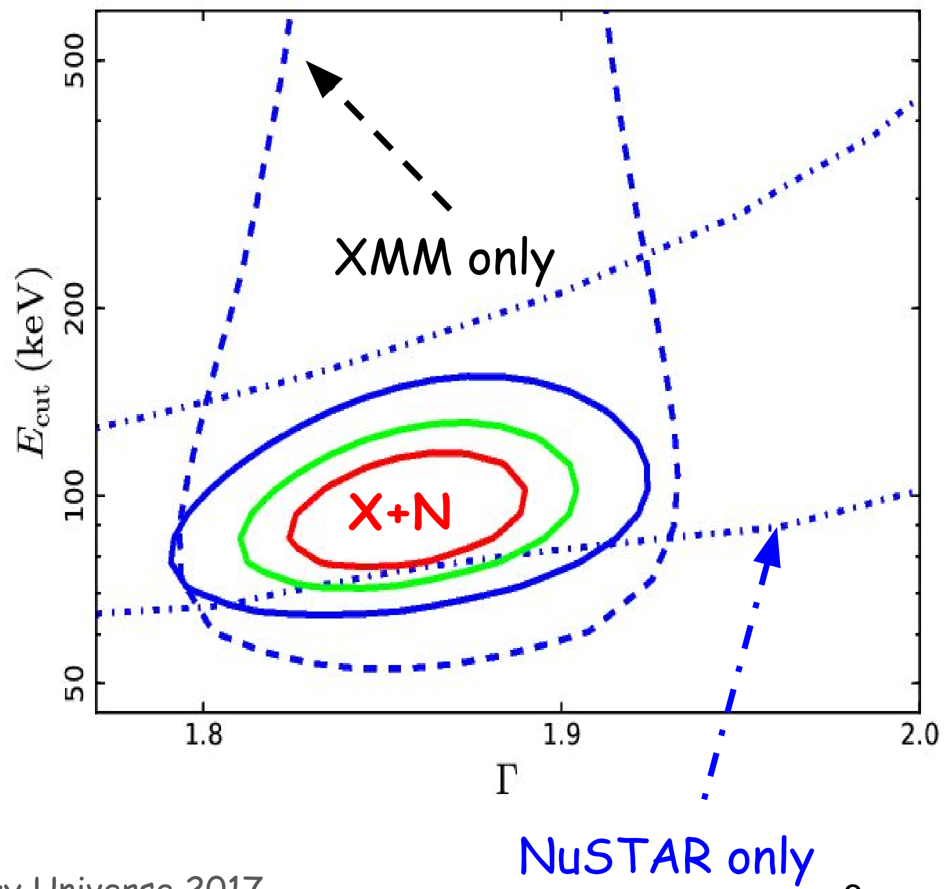
Why *XMM+NuSTAR?*





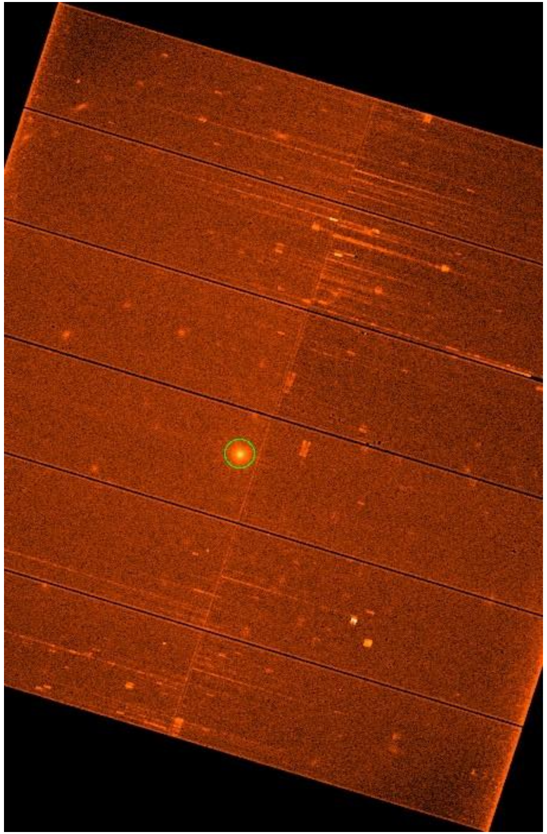
The case of QSO B2202-209

Name: QSO B2202-209 (aka PB 5062)

Type: Radio-Quiet Quasar

Luminosity: $L_{2\text{-}10} \sim 10^{46}$ erg/s

Redshift: $z = 1.77$



Back in 1987

Reboul et al. (1987):

2.4. P.B. 5062

This object is again a mixed pair from the Berger-Fringant catalogue (1980) where it is described as a 17.5 class II object with a faint companion (colour G, magnitude 19″, 3 southward).

A 60 minutes exposure has been made with the same equipment than for P.H.L. 6657–58. The spectrum of P.B. 5062 (Fig. 3) shows a broad emission feature. The most likely identification is C IV 1549 at a redshift of 1.77 which would affect to this quasar an absolute magnitude $M_B \sim -28.5$.

Back in 1987

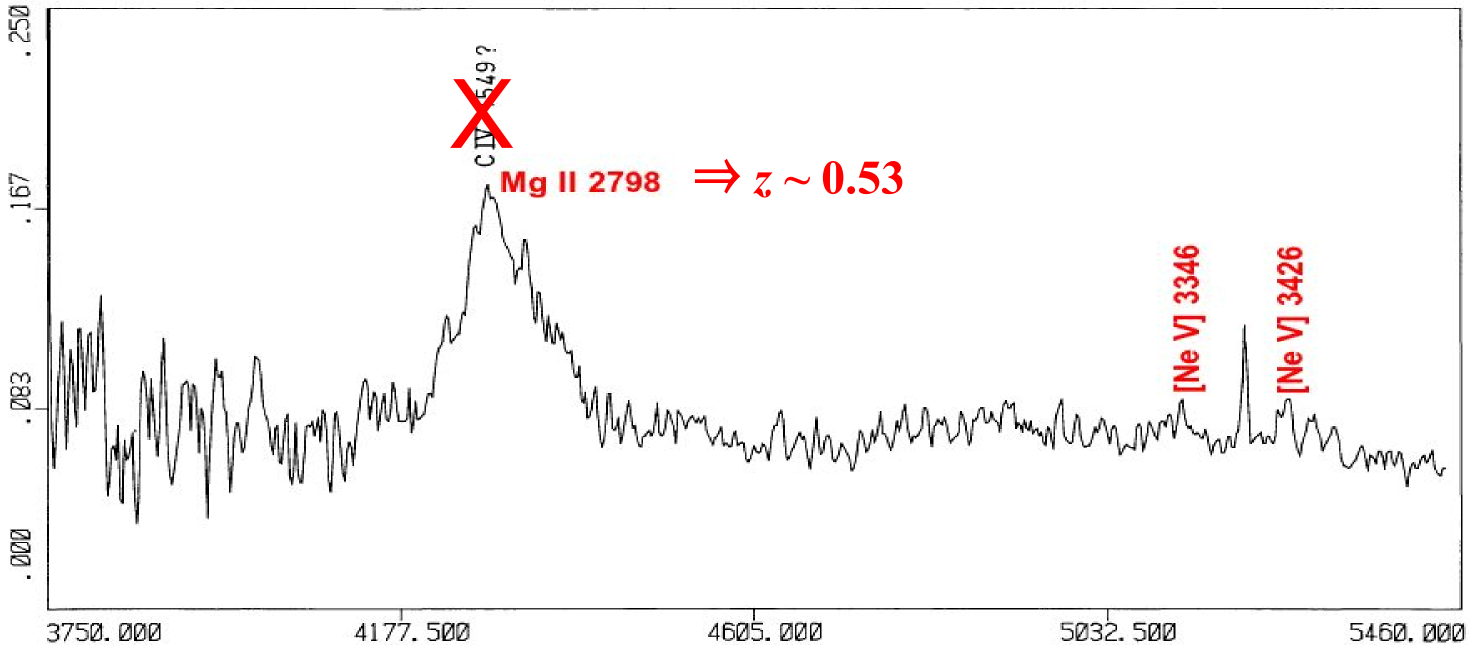
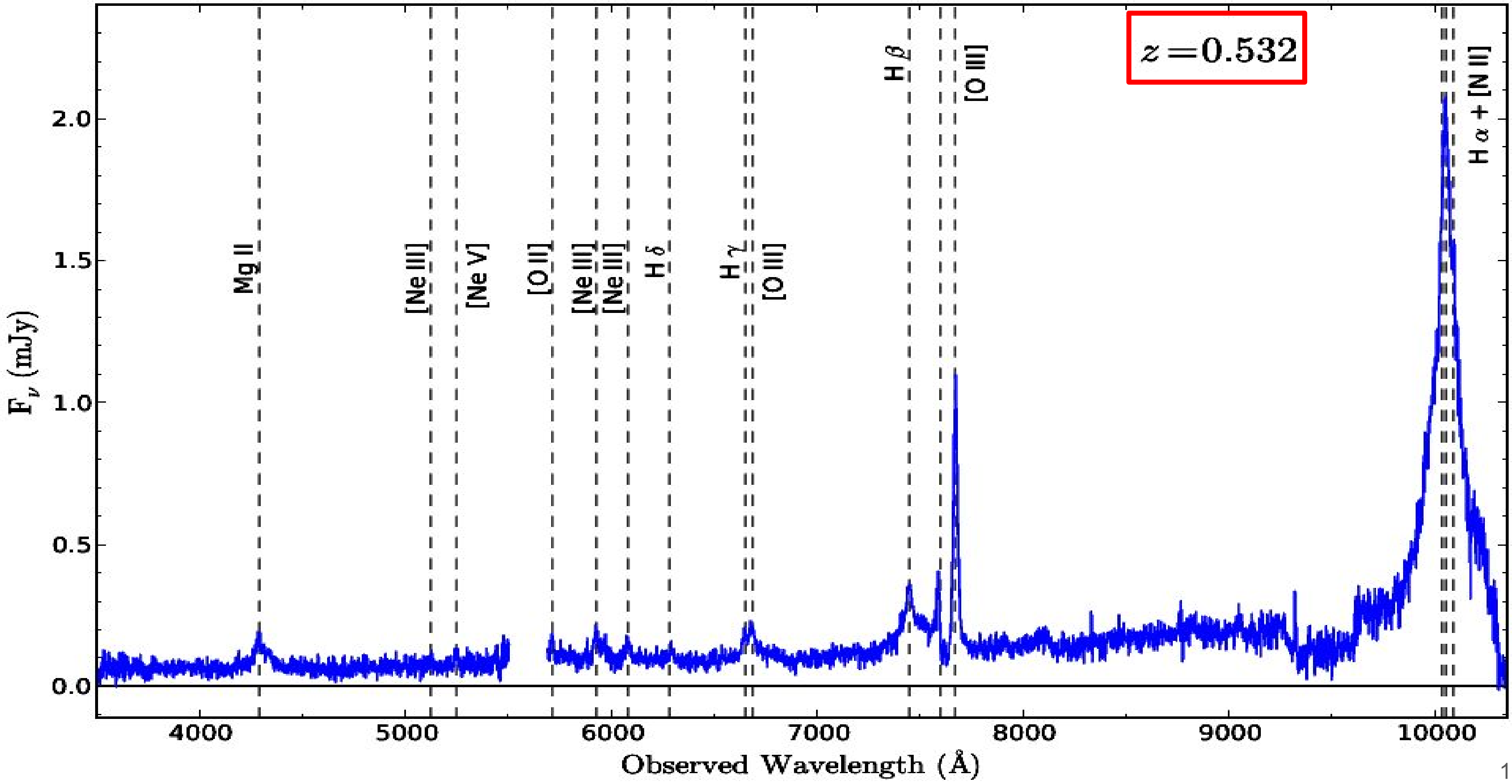


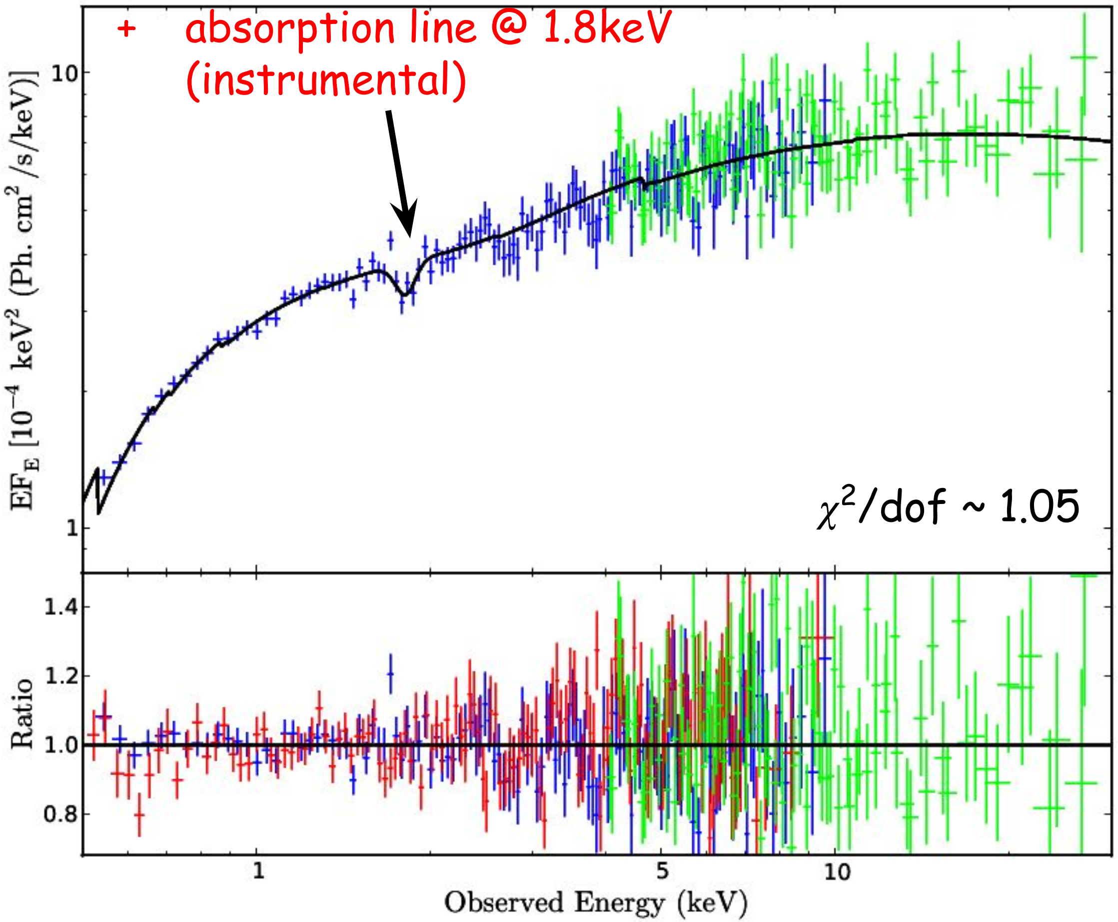
Fig. 3. Spectrum of P.B. 5062 (Bright Northern component). Arbitrary units in ordinate

Reboul et al. (1987)

Palomar - 2016 ⇒ New redshift



Spectral analysis

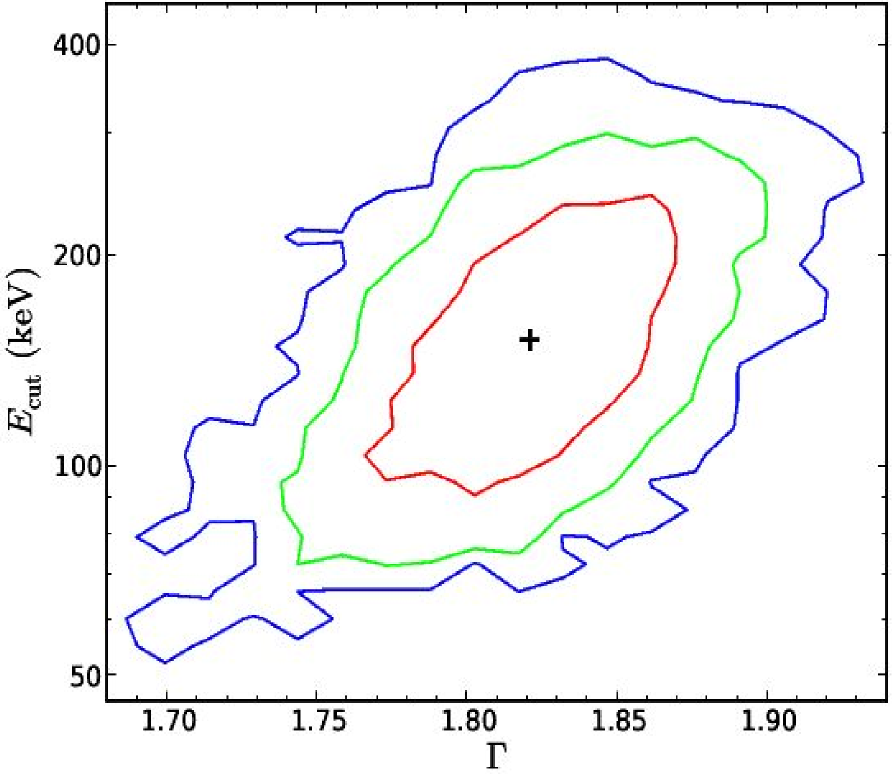


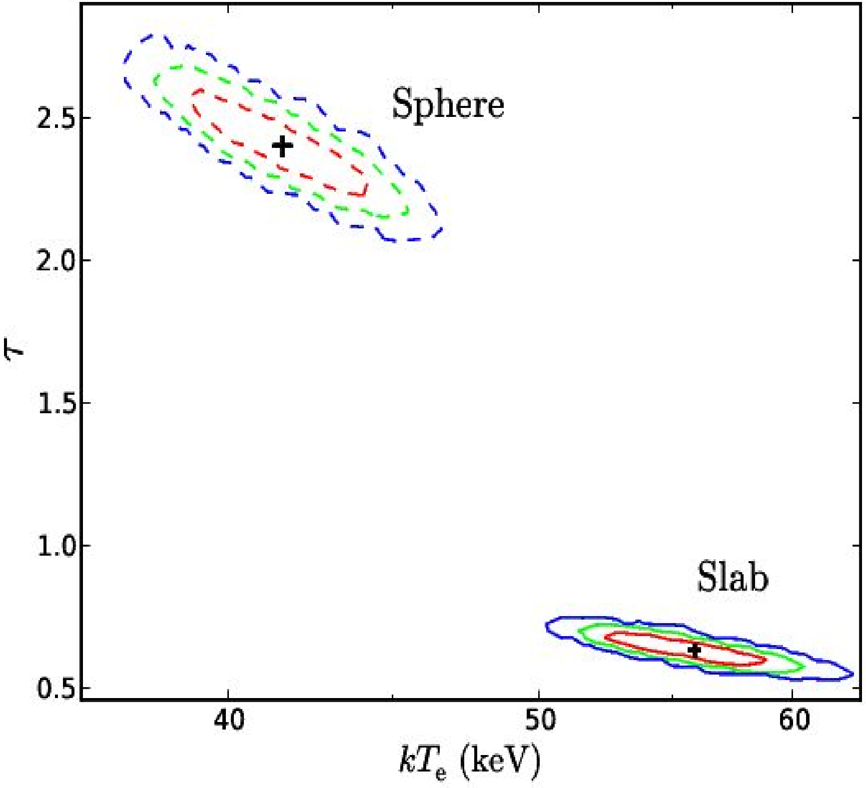
model(s):

- Galactic absorption (wabs)
- Neutral absorption (zwabs: N_H = 1.4E+21 cm^{-2})
- Ionized partially covering absorber (zxipcf: N_H = 2.3E+23 cm^{-2}; Log ξ= 0.4, CF = 30%)
- **high-energy Cutoff PL (phenomenological)**
- **Comptonisation (compTT)**

2017

B2202-209 *(z=0.532)*



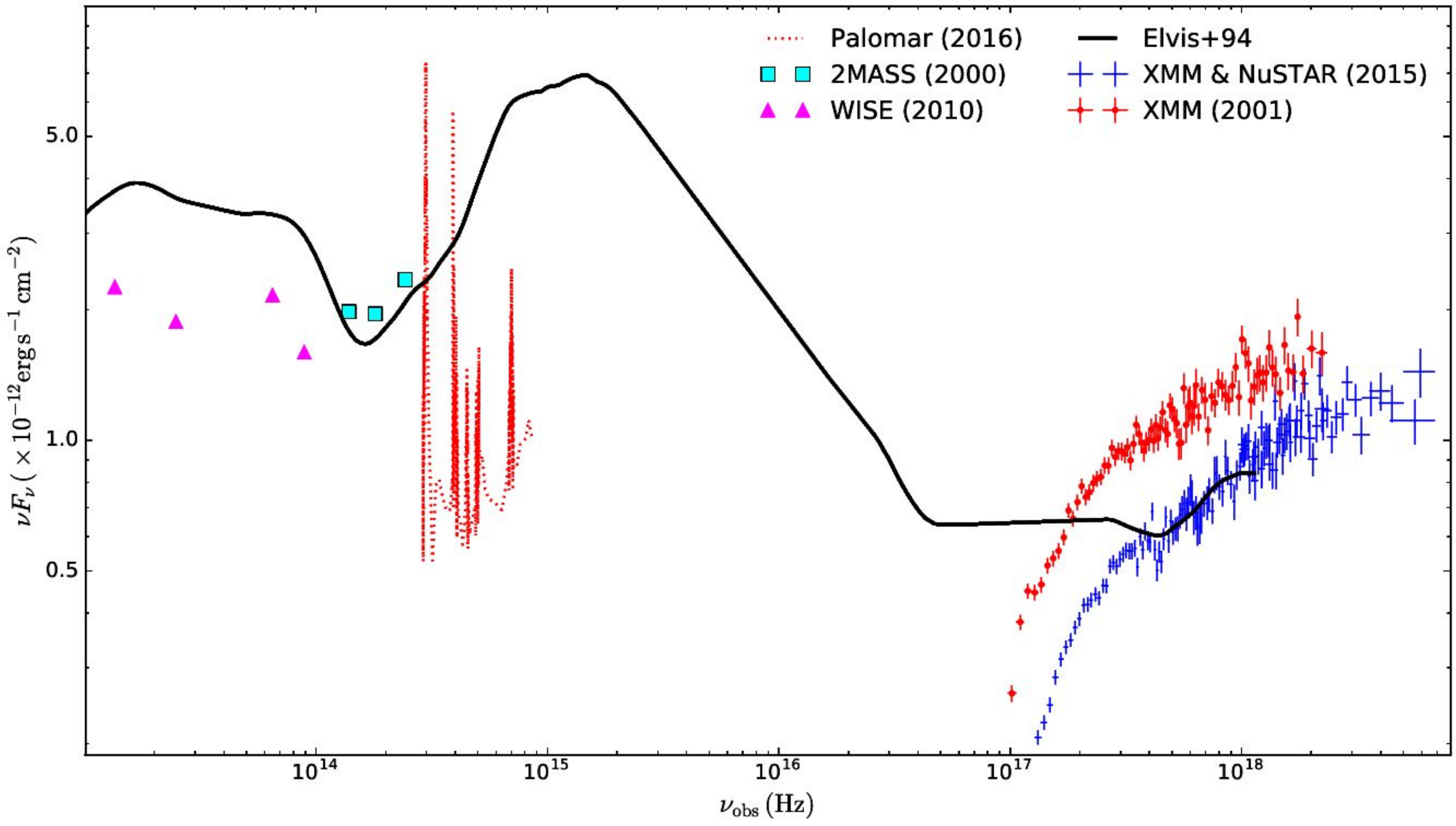


Conclusions

- **Optical spectrum**
  - $M_{BH} = 1.2 \times 10^9\ M_\odot \Rightarrow L_{Edd} = 1.56 \times\ 10^{47}$ erg/s
  - $L_{bol} \simeq 8\ \nu_B L_B \Rightarrow L_{bol} \simeq 0.04\ L_{Edd}$ (Marconi+04)
  - EW_{obs}([O III]λ5007) = 146 Å $\Rightarrow \cos\theta = EW^*/EW_{obs} \Rightarrow$ $\theta \simeq 85^o$

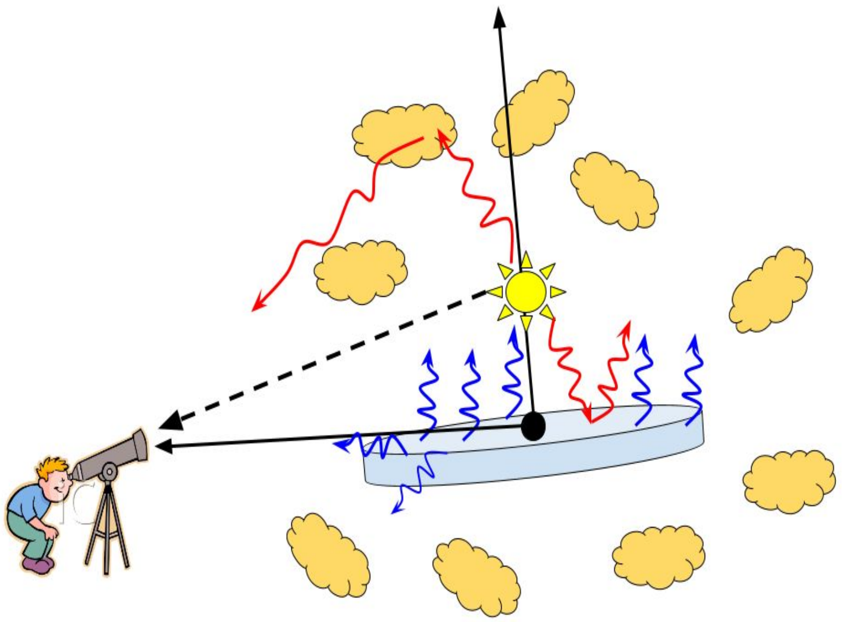
- **X-ray spectrum**
  - $L_X = 1.9 \times\ 10^{45}$ erg/s $\Rightarrow L_{bol} \simeq 1.15\ L_{Edd}$(Marconi+04)
  - Similar coronal properties compared to local AGNs:
    Relatively low KT, flat X-ray spectrum, low reflection fraction
    ⇒ universality in the X-ray emission, despite the high X-ray luminosity and mass.

Conclusions



Conclusions

Optical + X-ray spectra



- Optical-to-X-ray slope:

$\alpha_{OX} = 1.0 < \langle\alpha_{OX}\rangle = 1.6$ (Lusso & Risaliti, 2016)

✔ **Agreement** between the [O III]λ5007 and X-ray :

$$\log L_X = 1.22 \log L_{[OIII]} - 7.34$$ (Panessa+06)

✔ **High inclination**:

⇒ $L_{B,int} = L_{B,obs} / \cos\theta \Rightarrow \alpha_{OX,int} = 1.43$

⇒ Explain the low reflection fraction

\+ **Low amount of absorption**

\+ low IR emission, compared to standard SED

➡ ***Edge-on & Torus-free system***