THE SCATTERED X-RAY SPECTRUM OF AGN: TESTING PHYSICAL SCENARIOS FOR THE REFLECTION FEATURES USING SIMULTANEOUS XMM-NEWTON AND NUSTAR DATA

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MOTIVATION

The typical scattered x-ray spectrum above ~3 keV of the active galactic nucleus is composed by the intrinsic continuum and reflection features. The primary x-ray emission, which originates in a corona close to the accretion disc, can be scattered by the surrounding medium, in structures such as the accretion disc, the broad line region, and/or the torus, originating features in the observed spectrum. By studyng the scattered X-ray spectrum we can derive the scatter medium and its physical properties, and also, some properties of the primary x-ray source.

AIM

Our aim is to determine the best physical scenario to explain the observed hard spectrum in the AGN, and if there is any relationship between the physical scenario of the reflection and the properties of the AGN (e.g. accretion rate, luminosity).

SUMMARY

We studied a sample of type-1 AGN, using simultaneous observations from XMM-Newton and NuSTAR, covering a spectral range from 3 keV up to 70 keV, and testing different physical scenarios with different available models in the XSPEC fitting package.

SAMPLE, BASELINE MODEL AND REFLECTION MODELS

In order to study the FeKα line and the compton hump (at ~6.4 and ~30 keV respectively), we selected a sample of 22 AGN with simultaneous XMM-Newton and NuSTAR observations

Then, we created a baseline model with the form:

Model = absorber*intrinsic + reflection

We modeled the first component with an absorbed power-law. For the reflection we considered two main scenarios: reflection by neutral material, and reflection by ionized material. We also considered the relativistic efects in the ionized scenario.

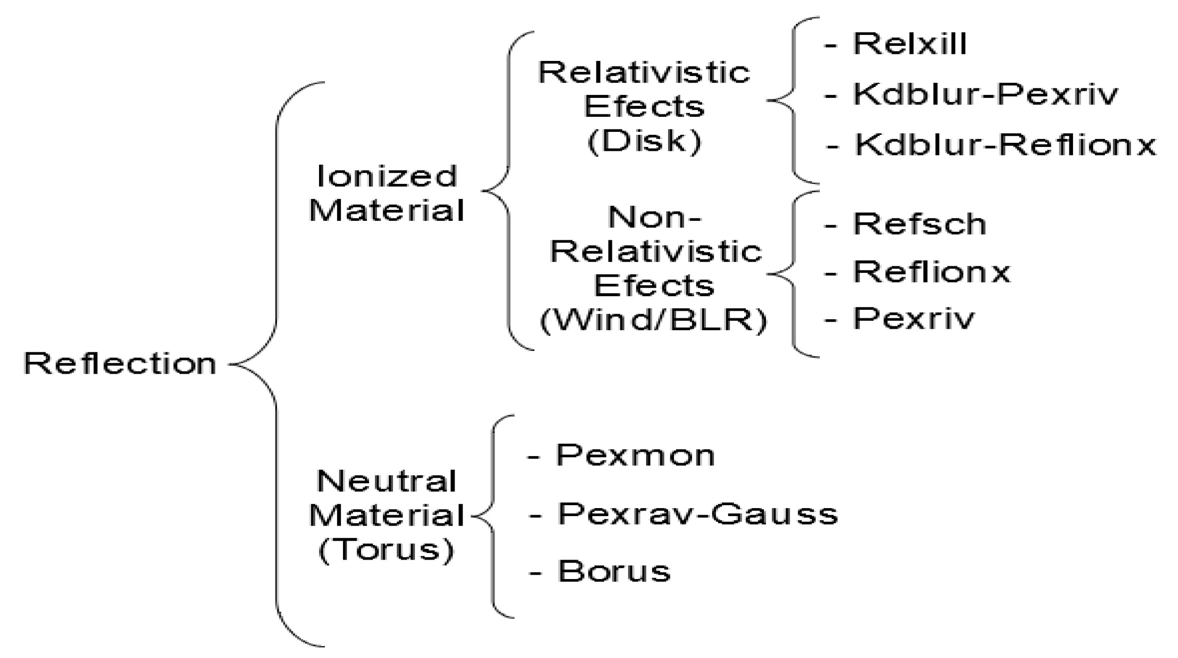

Fig. 1: Scheme of the physical scenarios considered.

PRESENCE OF THE REFLECTION COMPONENT

In order to check the presence of the reflection component we compared the spectral fits to the absorbed power-law and to that including the relxill component.
We found that four sources do not requiere the reflection component (Mrk382, IRAS13224-3809,Mrk841, and MR2251-178).
All cases it is clear that the data fit a power-law, except for IRAS13224-3809, which shows a noisy spectrum above ~15 keV. We discarded this object for the following analysis.

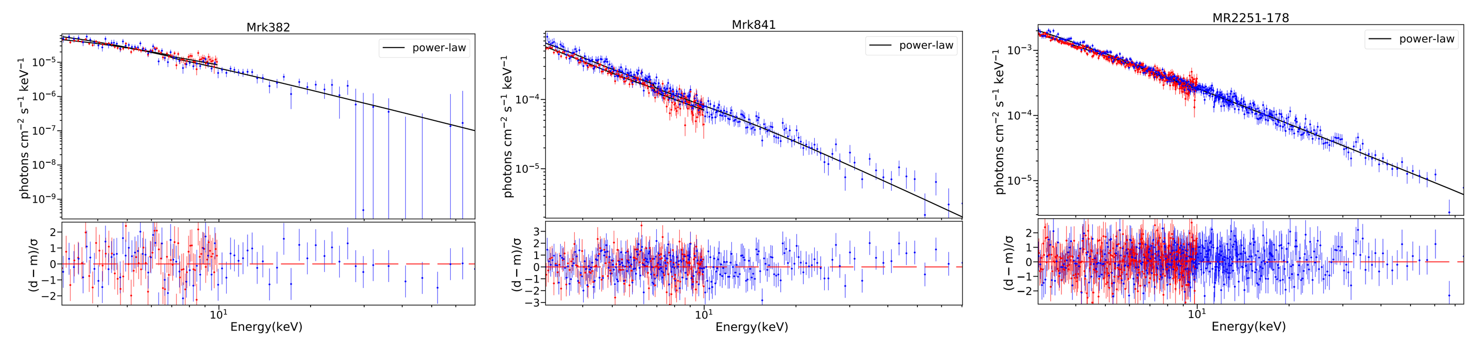

Fig. 2: Absorbed power-law fit to Mrk382,Mrk841, and MR2251-178

SPECTRAL FITTING TO TEST OBJECTS

We randomly selected five objects to which we fitted all the nine reflection models. We found that the best results was obtained with only two models: i)Pexrav+gauss (neutral reflection), ii)Relxill (relativistic reflection).

SPECTRAL FITTING TO THE FULL SAMPLE

We then used pexrav+gauss and relxill models to the 18 objects with evidence of the reflection component. Furthermore, we also try a combined model that uses both neutral and ionized relativistic reflector Finaly, we fitted the following three models to the full sample:

i)Neutral=absorber*power-law+(pexrav+gauss)
ii)Ionizedl=absorber*power-law+(relxill)
iii)Hybrid=l=absorber*power-law+(pexrav+gauss+relxill)

PRELIMINARY RESULTS

- The prefered models: i)**11** objects prefer the **hybrid** reflection model, ii)**3** objects prefer the **neutral** reflection model, iii)**2** objects prefer the **ionized** reflection model, iv)**2** equally prefer both the **neutral and ionized** reflection models, v) **4** objects do **not** require a **reflection** component.

- We looked for any **relationship** between the **physical scenario** and the **black hole mass**, the **luminosity**, and the **accretion rate**. We found that the objects that prefer an ionized scenario shows the highest accretion rate.

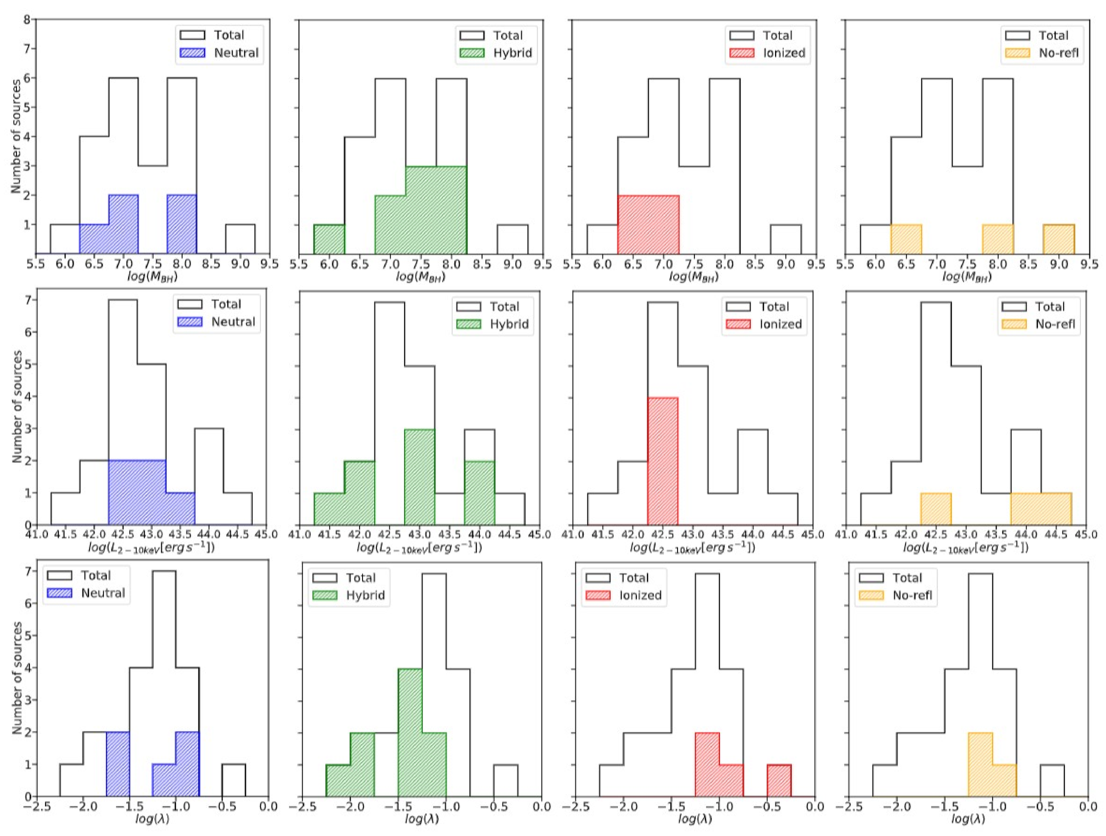

Fig. 3: Histograms of prefered models, black hole mass, luminosity and accretion rate distribution.

- **Γ vs λ**. We found that the objects that prefer the relativistic ionized scenario, in general, present higher photon index, and we find the rest of the objects towards lower indices.

- We also investigated a posible **cross-calibration issue** between the XMM-Newton and NuSTAR instruments. We found a difference of $\Gamma_{NuSTAR} - \Gamma_{XMM}$ = 0.12+-0.05.

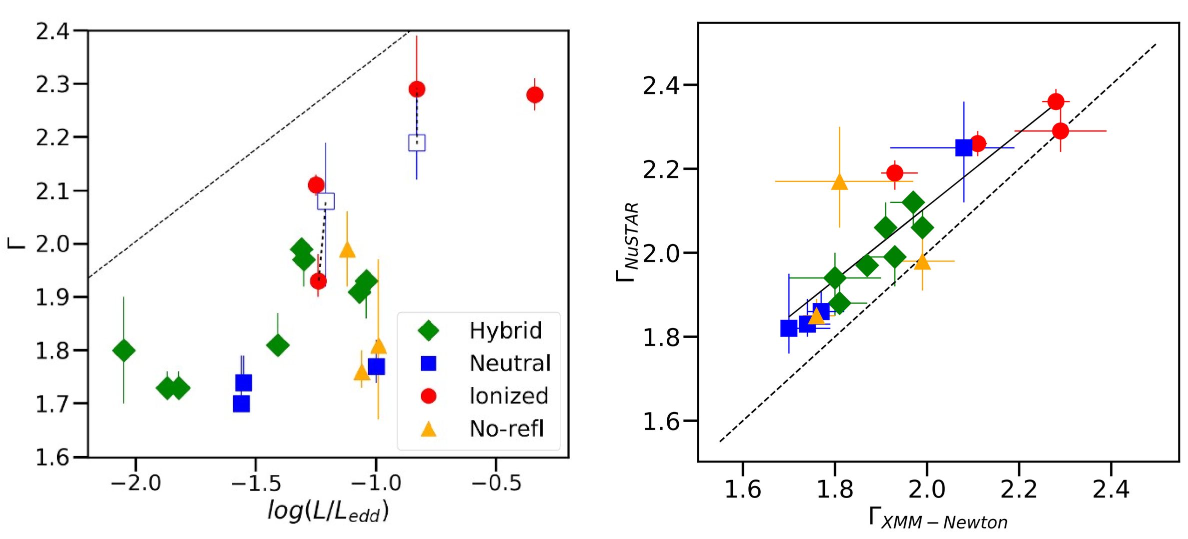

Fig. 4: Accretion rate vs photon index (left), and photon index obtained through XMM-Newton data vs photon index obatined through NuSTAR data (right).

REFERENCES
Magdziarz, P., & Zdziarski, A. A. 1995, MNRAS, 273, 837; Dauser, T., Wilms, J., Reynolds, C. S., et al. 2010,MNRAS, 409, 1534; Osorio-Clavijo, N., Gonz´alez-Mart´ın, O., Papadakis, I. E., et al. 2020, MNRAS, 491, 29; Trump et al. 2011

→ Preliminary results sugest a dependence of the reflection model and λ, and a relationship Γ vs λ , since the objects that prefer a ionization reflection scenario have higher λ and higher Γ. These results could represent an agreement with an accretion state scheme.