

The relationship between X-ray emission and accretion in X-ray selected AGNs

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Abstract. We study the link between the X-ray emission in radio-quiet AGNs and the accretion rate on the central Supermassive Black-Hole (SMBH) using a well-defined and statistically complete sample of 70 type1 AGNs extracted from the XMM-Newton Bright Serendipitous survey (XBS). To this end, we search and quantify the statistical correlations between the main parameters that characterize the X-ray emission (i. e. the X-ray spectral slope and the X-ray loudness), and the accretion rate, both absolute (\dot{M}) and relative to the Eddington limit (Eddington ratio, λ). Here, we summarize and discuss the main statistical correlations found and their possible implications on current disk-corona models.

Key words. active galaxies, X-ray properties, accretion rate

1. Introduction

It is now accepted that the engine of AGNs is powered by the accretion of matter onto the SMBH, placed in the center of the host galaxy: the matter is heated ($\sim 10^6$ K) through viscous and magnetic process and forms an accretion disk around the SMBH emitting in the UV-optical region. A fraction of energy is also emitted in the X-ray band with a spectrum that can be represented, at a zeroth order, by a power-law from 0.1 to 100 keV. It is believed that X-rays are produced in a hot corona ($\sim 10^8$ K) reprocessing the primary UV-optical emission of the disk via inverse-Compton mechanism (Haardt & Maraschi 1991). The main properties of X-ray emission change signifi-

cantly from source to source. Recent results suggest that the differences can be partly related to the value of accretion rate or to the black-hole mass (Grupe et al. 2010, Risaliti et al. 2009, Vasudevan & Fabian 2009). The aim of this work is to establish the actual link between X-ray properties and the parameters that quantify the accretion rate by analyzing a well defined sample of 70 type1 AGNs selected from the XMM-Newton Bright Serendipitous survey (XBS). In this work we study the spectral index Γ between 0.5 and 10 keV and the bolometric correction K_{bol} , defined as the ratio between bolometric luminosity and 2 – 10 keV luminosity. Γ gives direct information about the energy distribution of the electrons in the corona, while K_{bol} quantifies the relative importance between disk and corona. The approach followed is to search for statistically

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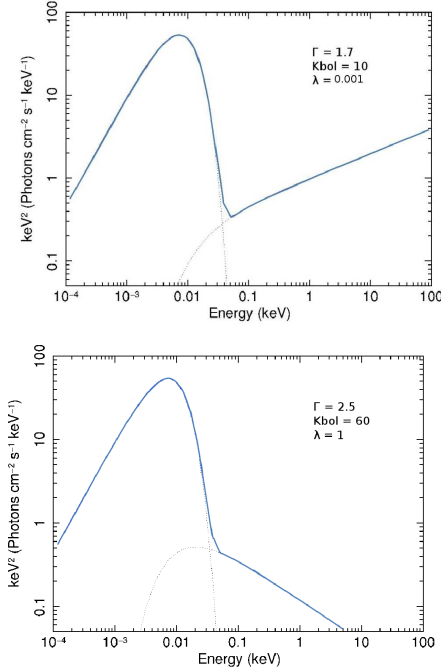


Fig. 1. Theoretical spectral energy distributions that represent two extreme cases of accretion: $\lambda \sim 10^{-3}$ (upper panel) and $\lambda \sim 1$ (lower panel). See text for more details.

significant correlations between these parameters and the value of accretion rate, absolute (\dot{M}) and normalized to Eddington limit (λ), presented in (Caccianiga et al. 2013).

2. Results

We find that Γ depends significantly on λ while the dependence on \dot{M} is weak. By using partial correlation we demonstrate that the observed correlations are not induced by redshift. We find a similar $\Gamma - \lambda$ correlation also using the hard 2 – 10 keV spectral index. Therefore the observed correlation is directly linked to the primary component of the X-ray emission and not due to secondary spectral component (e.g.

soft excess). We also find a correlation between K_{bol} and λ while, again, the dependence on \dot{M} is weak. We represent graphically the results of the $\Gamma - \lambda$ and $K_{bol} - \lambda$ correlations by showing the theoretical SEDs in two extreme cases of low and high Eddington ratios (Fig. 1): these SEDs were built using a Shakura & Sunyaev disk model plus a power-law in the range between 0.01 and 100 keV with a cut-off at 0.1 keV. The values of Γ and K_{bol} are taken from our fits of the $\Gamma - \lambda$ and $K_{bol} - \lambda$ correlations.

To simplify the comparison, we assume the same disk emission normalization in both cases. The comparison of the two SEDs suggests that the variation of K_{bol} could be entirely attributed to the variation of Γ . We also test this idea by using the partial correlation analysis and we conclude that the correlations observed in this work can be in principle explained by the $\Gamma - \lambda$ correlation alone. This result suggests a speculative interpretation based on the electron cooling of corona: for high values of λ , a large number of photons comes from the accretion disk and cools corona electrons rapidly, thus producing steep X-ray spectra and high values of K_{bol} . For low λ , less photons are available and this makes electron cooling inefficient, thus producing flat X-ray spectra and low values of K_{bol} .

Full details are reported in Fanali et al. (2013).

Acknowledgements. We acknowledge Francesco Haardt for the useful discussions and ASI (grant n. I/008/06/0) for financial support.

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