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FERO (Finding Extreme Relativistic Objects): statistics of relativistic broad Fe Kα lines in AGN

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Abstract. The properties of the relativistically broadened Fe Kα line emitted in Active Galactic Nuclei (AGN) are still debated among the AGN community. Recent works seem to exclude that the broad Fe line is a common feature of AGN. We present stacked spectra of a large sample composed by 157 archival observations of AGN, expanding the work presented in Guainazzi et al. 2006.

Key words. Galaxies: Active – X-ray Lines–Iron

1. Introduction

The detection of a broadened and skewed Fe Kα line in AGN spectra is generally interpreted as an effect on X-ray photons due to the gravitational field of the black hole. Measuring the parameters of broad Fe lines provides therefore a diagnostic of the accretion disc structure (Fabian & Miniutti 2005 for a review). Recent works on large samples of AGNs converged to say that the broad line is more common in low luminosity AGN (Nandra et al. 1997, Streblyanska et al. 2005, Jimenez-Bailòn et al. 2005, Guainazzi et al. 2006), but there is no agreement on the line parameters as intensity and disc inclination. Using a collection of 107 AGN from the XMM-Newton archive, Guainazzi et al. 2006 found a detection fraction of relativistic Fe line of 25% . The mean EW was inferred to be ~200 eV and the strongest lines were found in the sources with low 2-10 keV luminosity, as inferred by the stacked spectra.

2. This work: preliminary results from the stacked spectra

We have expanded the work by Guainazzi et al. by improving the baseline model and including more sources. The final sample is made by 157 type 1 radio-quiet AGN with N_H<$10^{22.5}$ cm^{-2} (see Bianchi et al. 2007 for more details on the sample). We assume a baseline model made by the following spectral components: X-ray power law, Compton reflection, 4 narrow emission lines corresponding to Kα transitions from Fe I, XXV, XXVI and Kβ from Fe I. A Gaussian line of 50 eV width is added to fit the Compton Shoulder. Absorption from ionized gas is also included to take into account any spectral curvature at 6-7 keV induced by warm

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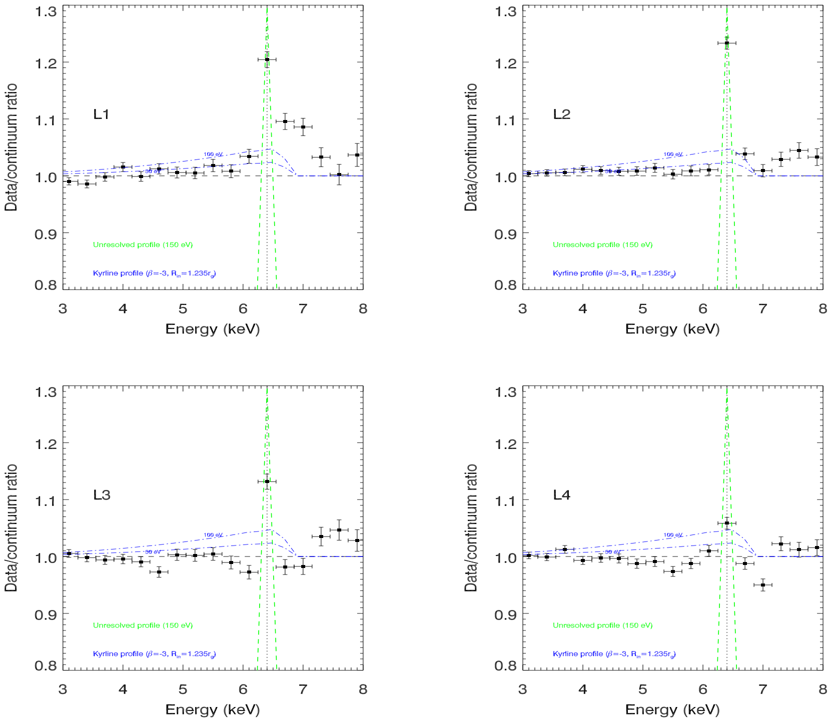

Fig. 1. Evolution of the residuals corresponding to the Iron line profile with hard X-ray luminosity (in ergs/s). From top to bottom and from left to right (L1): Lx < 10^{43}; (L2): 10^{43} < Lx < 5×10^{43}; (L3): 5×10^{43} < Lx < 1.5×10^{44}; (L4): Lx > 1.5×10^{44}.

absorbing gas. The *kyrline* model (Dovčiak et al. 2004) was adopted for fitting the relativistic disc line. The presence of an additional reflection component blurred by gravity was extensively tested, but the two continua could not be distinguished in the data within *XMM-Newton* bandpass. Thus, a single reflection component is included in the final baseline model. The broad lines detection fraction is found to be of the order of 10% when considering a significance threshold of 5σ (De la Calle et al. in prep.). As pointed out by Guainazzi 2006, broad lines are mostly detected in well-exposed sources, i.e. in spectra with a large number of 2-10 keV X-ray counts (the limit between under and well-exposed sources was arbitrarily chosen to be 10^5 counts). To gather information on the remainder of the spectra, we stacked the spectral ratios of sources where no detection of broad line was found. The ratio plots were obtained assuming the continuum (with no emission features) as a baseline model. Fig. 1 shows the stacked plots for the sources divided in 4 luminosity groups. The prominent peak at 6.4 keV is produced by the narrow Fe Kα. The intensity of the line seems to diminish with increasing luminosity. By comparing the profile of the stacked ratios to the theoretical broad line profile (blue curve in the plots), it can be concluded as a qualitative estimate that the line intensity is not higher than 10^2 eV. More details will be presented in a forthcoming paper (Longinotti et al. in prep.)

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