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X-ray spectroscopy of radio-loud versus radio-quiet AGNs

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Abstract. A systematic study of 30 Radio Loud AGNs available in the BeppoSAX archive has been carried out. The sample consists of 9 Broad Line radio Galaxies, 5 Steep Spectrum Radio Quasars and 16 Flat Spectrum Radio Quasars. These objects represent, according to Unified Models, objects with decreasing viewing angles. Our analysis shows considerable differences between FSRQs and BLRGs/SSRQS. As expected in the AGN Unified Model: i) the X-Ray spectrum of FSRQs is a simple power law with a hard spectral slope (the only exception being 3C273), ii) Broad Line and Steep Radio Spectrum AGNs show a steeper X-Ray continuum and Seyfert like features. We also find that the Fe line is weaker than in radio quiet objects. However no strong evidence emerges that a jet contamination may be the main responsible for the EW shrinking in BLRGs and SSRQs. Recent XMM-Newton observations of Pictor A, 3C445 and PKS 2152-69 confirm the nuclear BeppoSAX results and better constrain the Fe line parameters.

1. BeppoSAX and XMM-Newton observations of Radio Loud AGNs

Data of 30 Radio Loud AGNs 9 of which are Broad Line Radio Galaxies (BLRGs), 5 Steep Spectrum Radio Quasars (SSRQs) and 16 Flat Spectrum Radio Quasars (FSRQs) observed with BeppoSAX (0.1-100 keV) have been analyzed and compared to a sample of 7 Seyfert 1s studied by Perola et al. (2002). Data fits were done with a power law with a high energy cut-off (E_{cut}) plus an iron line equivalent width (EW) plus a reflection component (Ref). Average values for spectral parameters for each of the AGN classes (BLRGs , SSRQs, FSRQs and Seyfert 1s) are reported in Table 1. FSRQs show a continuum without reprocessing features (3C273 excepted) and an average spectral slope significantly flatter than in other Radio Loud classes. This is in agreement with a jet dominating model for BLAZARS. SSRQs and BLRGs show similar spectral slopes. The exposure times were too short to allow a detailed study of SSRQ spectral features, except for 4C74.26. However even for only one case (4C74.26) all relevant parameters are consistent with the BLRGs. While the continuum parameters (spectral slope and cut-off) are very similar in BLRGs/SSRQs and Seyfert 1s, the iron lines seem to be weaker in Radio Loud objects.

The XMM-Newton ($0.3 - 10$ keV) results on three BLRGs (Table 2) confirm the BeppoSAX results. The XMM-Newton data of Pictor A, PKS2152-69 and 3C445 provide more stringent limits for the Fe line feature, although the detection is still marginal in

Table 1: BeppoSAX Average Properties

Class	**BLRGs**	**SSRQs**	**FSRQ**	**Sey 1s**
Γ	1.74 ± 0.03	1.79 ± 0.01	1.54 ± 0.03	1.79 ± 0.05
$E_{cut}(keV)$	177 ± 42	[a] 203^{+248}_{-81}	[b] 467 ± 96	166 ± 30
Ref.	0.7 ± 0.2	[a] $0.9^{+0.4}_{-0.3}$		0.75 ± 0.04
EW (eV)	83 ± 19	[a] 82^{+31}_{-27}	[b] 41 ± 10	137 ± 18
	[c] 66 ± 12			
$L_{2-10\ keV}$	44.52 ± 0.27	45.56 ± 0.15	46.93 ± 0.56	43.41 ± 0.16

Table 2: XMM-Newton versus BeppoSAX

	XMM	**SAX**
	EW (eV)	EW (eV)
Pictor A	78^{+36}_{-54}	< 180
3C445	119^{+51}_{-39}	185^{+83}_{-69}
PKS2152-69	< 118	< 282

[a] These values refer to 4C74.26 only; [b] These values refer to 3C273 only;
[c] Without 3C445, a peculiar strongly absorbed BLRG ($N_H \sim 10^{23}$ cm^{-2})

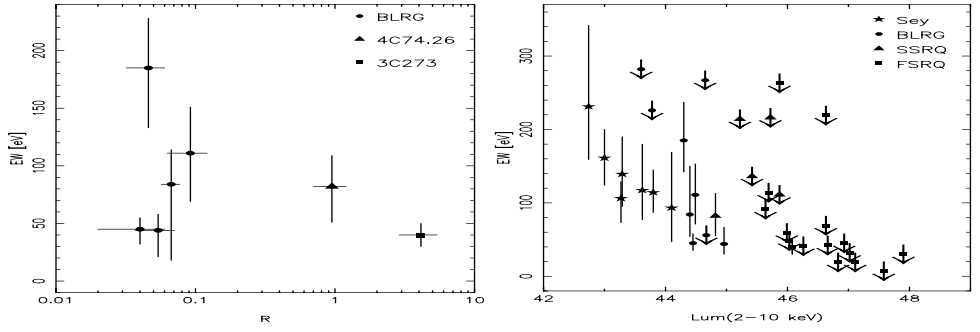

Figure 1. *Left panel*– EW versus beaming indicator R=$S_{core}/(S_{tot} - S_{core})$. No clear trend is evident. The correlation probability is 68%. *Right panel* – EW versus X-ray luminosity. A clear trend is evident. The correlation probability is larger than 99%

Pictor A and PKS 2152-69. For comparison the iron line EW of BeppoSAX are also reported in Table 2.

A basic question comes to mind: is the jet responsible for the weakness of the Fe Line in Radio Loud (non-blazar) AGNs ? This may be possible, but the X-ray continuum (spectral slope and high energy cut-off) are very similar in BLRG/SSRQ and Seyfert 1s. If a jet were present, effects on the continuum shape would be observed (note the flatness of the jet dominated FSRQs and the very high energy cut-off of 3C273). There is no clear correlation between the strength of the line (EW) and the orientation of the beamed radiation (R=$S_{core}/(S_{tot} - S_{core})$ at 5 GHz) as appeared in Fig 1 (*left panel*). In addition, the known anti-correlation between Fe EW and nuclear Luminosity (Baldwin Effect) is observed in both Radio Quiet and Radio Loud AGNs (Fig. 1 *right panel)* . It implies that the jet can not be the only cause of the EW decrease.

2. Conclusion

Spectral features of 30 Radio Loud AGNs observed with BeppoSAX, 3 of which also with XMM-Newton, are studied. In the unified scenario these objects represent AGNs viewed at different angles. No compelling evidence of jet influence on the continuum and consequent changes of Fe line EW in non BLAZAR type objects has been found.

References

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