THE XMM-NEWTON VIEW OF SDSS BALQSOs

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Broad Absorption Line Quasars (BALQSOs) show the clearest evidence for the presence of massive winds/outflows from the inner regions of AGN. X-ray studies of BALQSOs can probe the complex outflowing absorbers harbored in the inner regions of these objects and thus help to constrain the physical mechanisms responsible for launching and accelerating AGN winds. Until now only a few number of BALQSOs have been spectrally studied in the X-ray band, mainly because of their typically low X-ray flux. XMM-Newton has serendipitously observed a large number of BALQSOs, so allowing for statistical and spectral studies to be performed. We drew a large sample of 55 BALQSOs at medium/high redshift in order to investigate their optical/X-ray properties and get insight into the physics of AGN winds. We performed moderate quality X-ray spectral analysis on the 22 sources with best statistics, while a hardness ratio analysis has been performed on the remaining sources.

The Sample

We cross-correlated the Sloan Digital Sky Survey DR5 (SDSS DR5) Quasar Catalog (Schneider et al. 2007) with the Second XMM-Newton Serendipitous Source Catalog (2XMM, Watson et al. 2008) and found 55 sources classified as BALQSOs according to Trump et al. 2006 and/or to Shen et al. 2008. The redshift distribution of the sources is shown in Figure 1 and covers the range $0.8 < z < 3.8$.

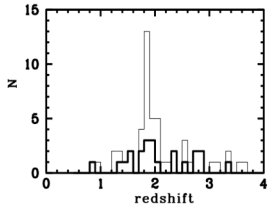

FIG. 1. Redshift distribution of the 55 BALQSOs of the sample. The 22 sources for which direct spectral analysis has been performed are marked by bold histograms, while the other 33 sources have been studied via hardness ratio analysis.

Data Analysis Results

Baseline model : a power-law absorbed by Galactic neutral hydrogen plus neutral absorption at the redshift of the source.

Outline: Spectral analysis of XMM-Newton EPIC pn and MOS data performed in the 0.2-10 keV band for 22/55 BALQSOs. EPIC pn 0.2-2 keV/2-8 keV hardness ratio analysis performed for 33/55 BALQSOs.

The sample mean photon index is $\langle \Gamma \rangle = 1.87 \pm 0.21$ and thus compatible with the typical values of radio quiet type 1 AGN (Fig.2).

The measured column densities are rather low: 28/55 sources have intrinsic $N_H \leq 10^{22}$ cm^{-2} and 7/22 have $N_H < 4 \times 10^{21}$ cm^{-2} (Fig.3).

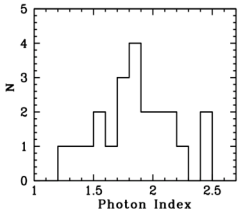

FIG. 2. Best-fit photon index distribution of the 22 BALQSOs for which direct spectral analysis could be performed.

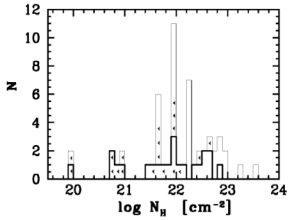

FIG. 3. Number distribution of column densities.Bold histograms refer to the 22 sources for which spectral analysis could be performed. Arrows indicate upper limits at 90% confidence level for these 22 BALQSOs, at 68% confidence level for the remaining 33 BALQSOs.

The optical/X-ray spectral index α_{ox} computed at 2500 Å and 2 keV are rather typical of radio-quiet, unabsorbed type 1 AGN (Fig.4).

We found no correlation between the maximum outflow velocity and $\Delta\alpha_{ox}$, the difference between the observed α_{ox} and the one expected on the basis of the most updated 2500 Å luminosity density-α_{ox} correlation for radio-quiet type 1 AGN (Fig.5).

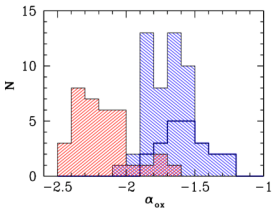

FIG. 4. Optical/X-ray spectral index α_{ox} distribution for the 35 LBQS BALQSOs of Gallagher et al. 2006 (red) and for the 55 SDSS/2XMM BALQSOs of this work (blue). Highlighted are the 22 BALQSOs for which we performed spectral analysis.

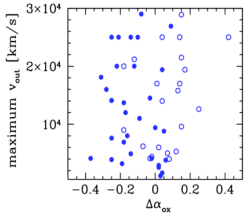

FIG. 5. Maximum UV outflow velocity versus the difference between the measured α_{ox} and the one expected from the l2500-α_{ox} correlation of Just et al. 2007. Empty circles are the 22 sources for which we performed X-ray spectral analysis, filled circles are the 33 sources analyzed via hardness ratios.

- **We found a large fraction of the SDSS/2XMM BALQSOs unabsorbed in X-rays.**
- **Overall the amount of neutral intrinsic absorption is lower than expected from both previous observational results and radiatively driven accretion disk wind models.**
- **None (but one) of the SDSS/2XMM BALQSOs is formally "soft X-ray weak".**
- **Is the shielding gas ionized and/or partially covering the source?**
- **Are we probing the X-ray bright tail of the known population? Or are these powerful UV outflows launched by mechanisms different than in soft X-ray weak BALQSOs?**

REFERENCES:

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Just et al. 2007, ApJ, 655, 1004

Schneider et al. 2007, AJ, 134, 102

Shen et al. 2008, ApJ, 680, 169

Trump et al. 2006, ApJS, 165, 1

Watson et al. 2008, arXiv:0807.1067