An X-ray analysis of high-z blazar candidates

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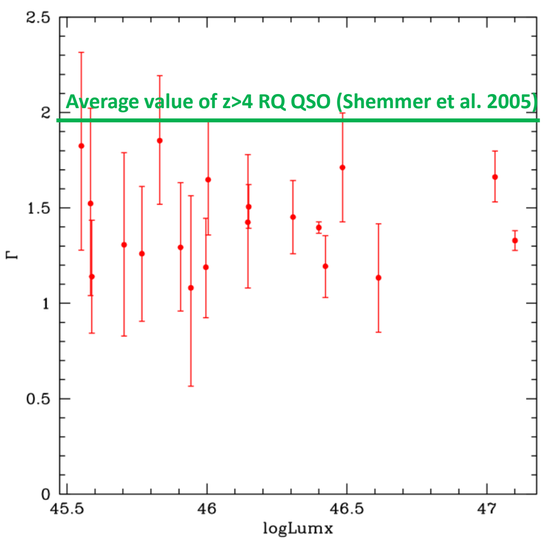
Abstract: We present the results of a systematic X-ray analysis of a complete and well-defined sample of 23 high-z (z=4-5.5) blazar candidates selected from the CLASS radio survey. In particular, we have complemented the existing archival data (mostly Chandra) with dedicated Swift-XRT observations reaching an almost complete X-ray coverage of the sample. Our aim is the determination of the nature of all the objects in the sample using X-ray data, since a strong and flat (Γ <1.5) X-ray emission is a striking signature of the presence of an oriented relativistic jet.

General properties

Photon Index

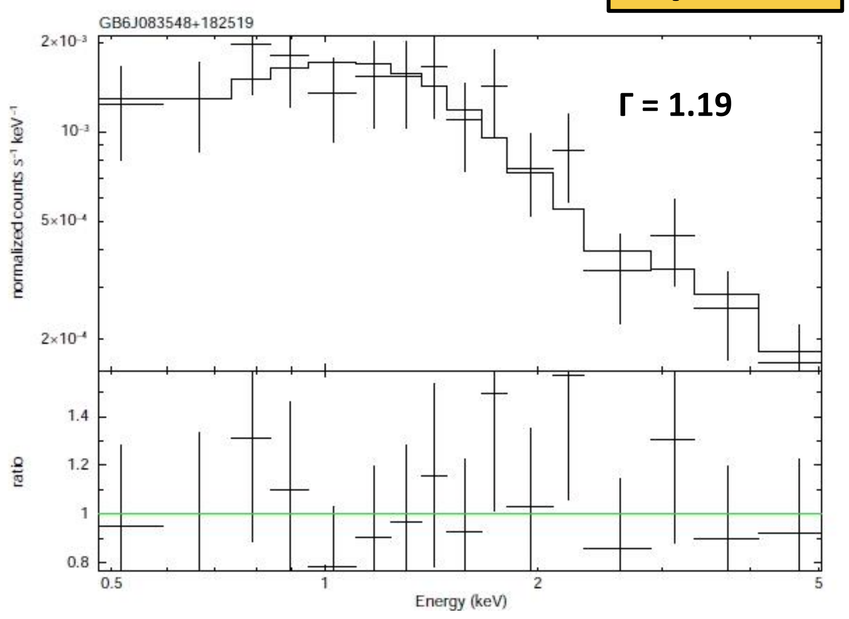
An estimate of the photon index has been computed for almost all blazar candidates. For 4 sources, due to the limited number of detected photons, we have fixed the photon index (Γ= 1.5, typical of blazars) in order to evaluate their fluxes and luminosities.

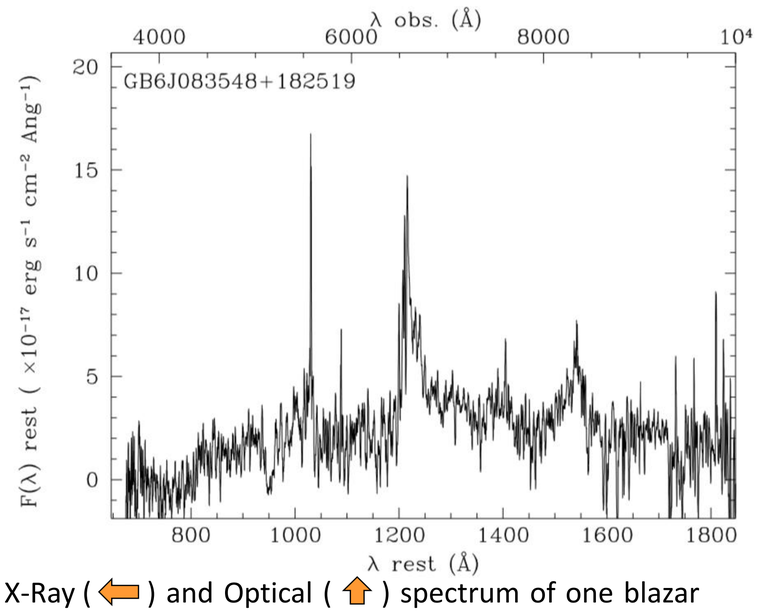
$$\bar{\Gamma} = 1.42^{+0.33}_{-0.32}$$



Γ vs Luminosity [2-10]KeV, for 19 out of the 23 sources

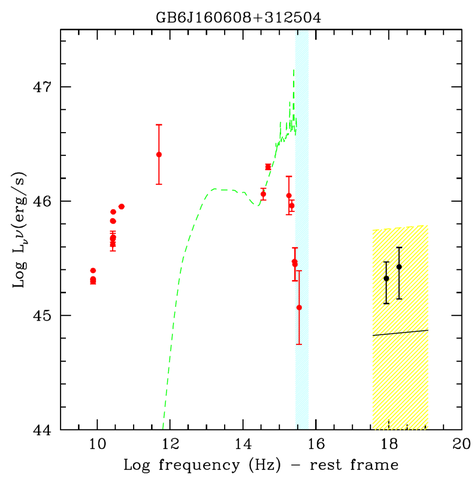
Spectra

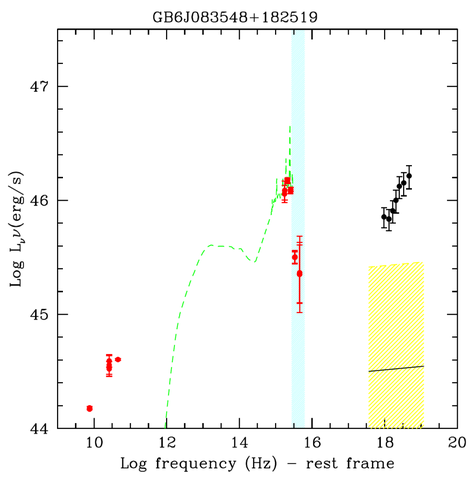




X-Ray (⬅) and Optical (⬆) spectrum of one blazar candidate. To fit the X-ray spectrum we have used an absorbed power law only considering the galactic absorption. We report its SED below (⬋)

SEDs

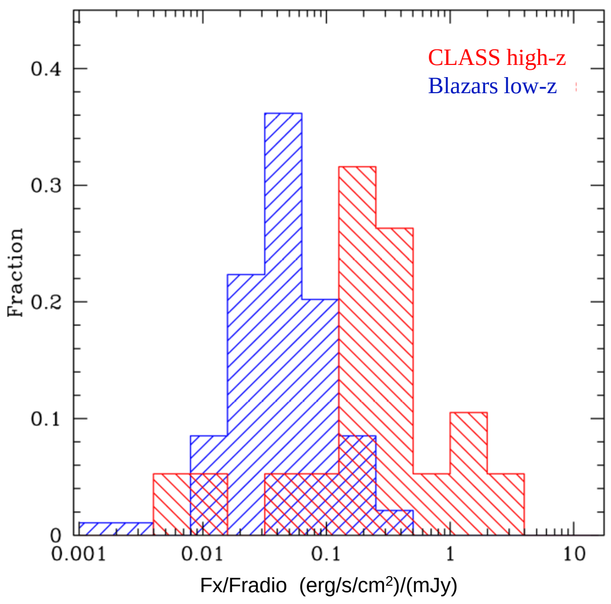




The green dashed line is a QSO template while the light-blue shaded bar indicates the region with a significant dropout of the flux caused by the Lyman absorption. The black solid line shows the expected X-ray emission (2-10keV) from the corona for a typical RQ QSO: the slope is the average value observed in z>4 RQ QSO (photon index Γ =1.97, Shemmer et al. 2005, ApJ, 630, 729) while the normalization (and its uncertainty σ, in yellow) depends on the value of the observed luminosity at 2500 Å according to the α_{OX} vs L(2500 Å) relation discussed in Strateva et al. (2005, ApJ, 130, 387).
In the right image the X-ray emission is clearly stronger than the one expected from the corona (i.e. from a RQ), confirming the blazar nature of the source. Whereas the first source has a X-ray emission consistent with the value expected from the corona, hence not supporting the presence of an oriented relativistic jet.

Comparisons

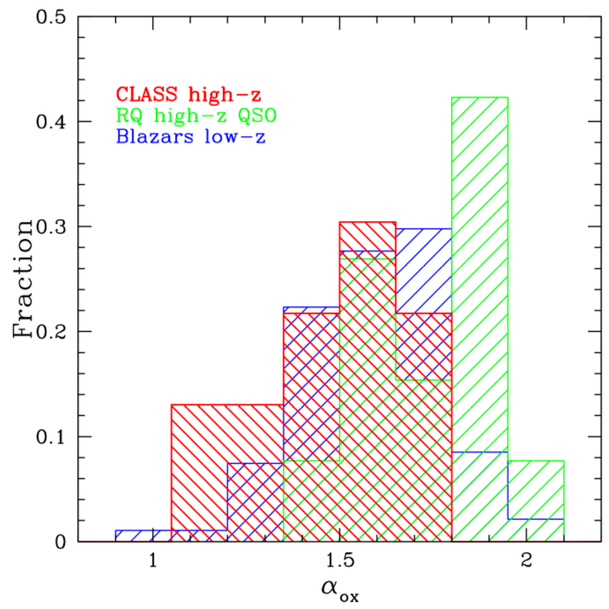
X-ray/Radio



Comparison of the X-Radio flux ratio (k-corrected) with a sample of blazars (FSRQ) from the BZCAT (Massaro et al. 2009, A&A, 495, 691) at lower redshifts (z = 0.3-2.5) and with an almost complete X-ray coverage. We have considered the x flux in the range [0.1-2.4]KeV and the radio one at 1.4GHz.

- X-ray/Radio ratio of CLASS sources are shifted towards higher values compared to low-z blazars.

X-ray/Optical



Comparison between the α_{ox}[1] of our sample with the same sample of low-z blazars from the BZCAT and a sample of Radio-quiet AGNs (Vignali et al. 2005, ApJ, 129,2519; Shemmer et al. 2006, ApJ, 644, 86). Since there are indications that the values of α_{ox} in radio-quiet QSO depend on the UV luminosity (e.g. Strateva et al. 2005, ApJ, 130, 387), in this comparison we have considered only the QSO in the same range of L(2500 Å) (46.4-47.2 erg/s) observed in the CLASS high-z sources.

[1] $\alpha_{ox} = -0.3838 \log\left(\frac{f_{2KeV}}{f_{2500Å}}\right)$

Conclusions:

- The sample presents an overall average photon index flat: $\bar{\Gamma} = 1.42^{+0.33}_{-0.32}$ which is significant flatter that observed in RQ high-z QSO ($\bar{\Gamma}$=1.97). This suggests that most of the CLASS high-z sources are dominated by the (flat) non-thermal emission from the jet;
- Our sample presents a greater X-ray/Radio ratio than the low-z blazars, in particular, from the comparison of the two histograms, it seems that CLASS objects have a weaker radio emission and/or a stronger x-ray luminosity;
- The values of X-ray/optical ratio (α_{ox}) are consistent with those measured in lower z blazars, and they are usually flatter (i.e. more X-ray-loud) than high-z RQ QSO thus confirming the presence of an extra emission (likely from the jet) in most objects. However, a number of sources in the sample have an α_{ox} relatively steep (>1.5) that could be still consistent with the coronal emission of RQ QSO;
- Overall, the X-ray analysis confirms the blazar nature of about 60% of the CLASS high-z sources. More data (e.g. VLBI) are necessary to establish the nature of the remaining 40% of the sample.

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