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**INTRODUCTION**

According to the unlined scheme of active galactic nuclei (AGNs), a Blazar is considered to be any radio-loud AGN that displays highly variable, beamed, nonthermal emission covering a broad range from radio to $\gamma$-ray energies. The observed rapid variability and radio properties of these objects imply that they have relativistic jets whose axes may deviate significantly with respect to the line of sight. Low-luminosity BL Lacs (High-energy peaked BL Lacs, or HBLs) present the first peak of their SED at UV-soft X-ray band, and the second one between the GeV and the TeV band (Padovani & Giommi 1995), while their higher luminosity counterparts present the first peak around IR/Optical energies (Low-energy peaked BL Lacs, or LBLs).

In general, Blazar emission is dominated by a broad, featureless continuum, believed to originate in the relativistic jet. Observationally, the SED of Blazars, in a $\gamma$-$\gamma$ representation, shows two broad distinctive peaks (Giommi & Padovani 1994). The first hump, peaking anywhere in the IR-soft X-ray range, is due to synchrotron emission, while the origin of higher energy one (usually at $\gamma$-ray frequencies) is still to be defined between processes of leptonic (Ghisellini 1999, Sikora 2001) or hadronic (Mücke 2003) nature.

The purpose of the present investigation is to contribute to the study of BL lac spectral characteristics, by extracting the public available information on the X-ray (band pass 0.2-10 keV). We have focused only on the EPIC pn camera data and try to establish the best fit model for the sample in the catalogue, although all the information for the rest of the models will be available.

**DATA SAMPLE**

The sample used here is the result of the cross-correlation of the BL Lac sub-sample given in the Véron-Cetty & Véron Catalogue (2010, VCL10) with all public observations available in the XMM-Newton archive up to May 2013. This BL Lac sub-sample consists of 1374 confirmed, probable or possible BL Lacs with or without a measured redshift. The initial cross-correlation of 1374 BLACO sources fall inside any given XMM-Newton field of view. This match, yielded a total of 373 XMM-Newton observations corresponding to a potential 106 different sources.

After the screening processes, 366 good observations remain. The discarded observations include: 11 where the source is outside the field of view, and 6 bad observations. In 254 observations 90 different sources are detected and positively identified with the radio source, while in 102 observations no X-ray counterpart is detected and upper limits to the flux are derived for 14 different sources. 39/90 of the detected sources in our sample correspond to XMM-Newton targets.

**MODEL SELECTION**

For each case, we performed fits with three different treatments of the absorption: a) with the absorption component fixed to the galactic column density $N_{H_{gal}}$ (with $N_{H_{gal}} = 0$ taken from Leiden/Argentine/Bonn (LAB) Survey of Galactic HI, b) with the galactic column density let to vary free ($N_{H_{gal}} > 0$), c) with two contributions $N_{H_{gal}}$ fixed to the galactic column density and $N_{H_{int}}$ let to vary free but always higher than $N_{H_{gal}}$. $N_{H_{int}}$ accounts for any internal source absorption, and is hence a function of the redshift.

**STATISTICS SELECTION**

In models with absorption component, the choice of the appropriate statistic is crucial. The correct model selection and which properties could provide important information about conditions at the X-ray emitting region. The statistic on which the goodness of fit (GOF) has been calculated with the $\chi^2$ test statistics.

$\chi^2 = \sum_{i=1}^{N} \frac{(O_i - E_i)^2}{E_i}$

where $O_i$ is the observed number of counts in the $i$th channel, $E_i$ is the expected number of counts in the $i$th channel, and $N$ is the total number of channels.

For the intermediate and highcounts ranges, all statistics behave in a similar manner, the averaged model parameters are within errors.

For the low counts range, the best fit is obtained using the Powerlaw model with the absorption component fixed to the galactic column density $N_{H_{gal}}$ (with $N_{H_{gal}} = 0$). This model is the most reliable option even in the low count rate range.

Regarding the GOF, we see that both Powerlaw and Logpar models with the absorption component fixed to the galactic column density $N_{H_{gal}}$ provide on average better fits than with $N_{H_{int}}$ fixed. It is supported by their fit statistics summaries, whose values are considerably lower (better fits).

The study of the stacked spectra residuals confirms this (Fig. 4).

We point out the following consideration when comparing $\chi^2_{H_{int}}$ vs $\chi^2_{H_{gal}}$: The free component of the model with absorption component is limited to never be lower than $N_{H_{gal}}$. This can introduce a bias in this extra contribution towards higher net values, which is translated into a bias in the power law index.

It is clear that, in the case Powerlaw vs Logpar, the values of the alpha parameter are not truncated (Fig. 5). It means that the Powerlaw vs Logpar models are significantly higher. The reason for this behaviour is that the net free component of this model is limited to the galactic value, therefore if XSPEC is not able to make that parameter lower, then it compensates by making the alpha value higher in the fitting process.

The inclusion of beta (curvature) in Logpar models introduces complexity that it is not significantly required by the data.

**SUMMARY AND FUTURE WORK**

An XMM-Newton catalogue of BL Lac X-ray properties has been produced by searching the XSA archive for X-ray counterparts of the 1374 BL Lac listed in VCL10 Catalogue.

This catalogue is processed with different statistical methods for fitting X-ray spectra using $\chi^2$ statistic as the best option to fit that the various X-ray spectra. It is the most reliable option even in the low count rate range.

The selection of the best fit model is based on the averaged $\chi^2$ statistic, the stacked spectra residuals and averaged parameter properties. For that reason, we have chosen the Powerlaw model with a free component of nh to be the preferred model.

The same study developed in this work should be done for the data combined from the three EPIC cameras (pn, MOS1 and MOS2) using the 3 cameras combined would increase our statistics.

To develop the same templates as in XSPEC for XIS to work with ungrouped spectra and run it in a systematic way over the whole sample.

The information in the catalogue, together with information at other wavelengths, will allow us to identify Blazar candidates at TeV energies.