A Catalogue of XMM-Newton BL Lacs
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An XMM-Newton Catalogue of BL Lac X-ray properties (Álvarez Crespo et al. in prep.) is presented based on the cross-correlation with the 1374 BL Lacs objects listed in the 13th edition of the Véron-Cetty & Véron Catalogue (VVC 2010). This catalogue was crossmatched with the XMM-Newton archive up to April 2018. Finding 443 observations that correspond to 137 different BL Lacs. Data from the three European Photon Imaging Cameras (EPIC) and Optical Monitor (OM) were homogeneously analysed using the latest XMM-Newton SAS software. Images, lightcurves and spectral models are produced for those sources detected in any of the three EPIC cameras. OM fluxes are computed where available.

The results of the analysis are presented as a catalogue of X-ray spectral properties of the sample in the 0.3-10 keV energy band and in the V/UV band. Multimwavelength information at radio and high and very high gamma-ray energies complete the catalogue.

INTRODUCTION

According to the unified scheme of active galactic nuclei (AGNs), a Blazar is a radio-loud AGN that displays highly variable, beamed, non-thermal emission covering a broad range from radio to γ-ray energies. The observed properties point to a relativistic jet oriented at a small angles with respect to the line of sight. There are two blazar classes according to their optical spectral properties: BL Lacs show weak or no emission lines (EW < 5 Å) and flat spectrum radio quasars (FSRQ) that show broad emission lines. Here we focus on the former class.

The spectral energy distribution (SED) of BL Lacs show two distinctive broad bumps. The interpretation of the first component is due to synchrotron radiation of relativistic electrons moving along the jet, and the second peak is the result of inverse Compton (IC) scattering of the synchrotron photons by the very same relativistic electrons (Synchrotron Self Compton, SSC). BL Lacs presenting the first peak at frequencies $\nu_{\text{peak}} > 10^{14}$ Hz are referred to High-synchrotron peaked (HSP), those at $10^{12} < \nu_{\text{peak}} < 10^{15}$ Hz are Intermediate-synchrotron peaked (ISP) and those presenting their synchrotron peak frequency at $\nu_{\text{peak}} < 10^{12}$ Hz are Low-synchrotron peaked (LSP).

The shape of the X-ray spectrum can give a fundamental hint for revealing the emission components since X-ray emission is probably originated in the inner part of the relativistic jet. Here we present a catalogue of 443 observations of 137 different BL Lacs, summarise their spectral properties and their light curves.

DATA SAMPLE

- Catalogue: 442 XMM-Newton observations corresponding to a 137 BL Lacs (Fig. 1).
- BL Lac SED: classification: ASDC SED builder tool source by source to calculate $\nu_{\text{peak}}$.

Instruments:
- EPIC: 3CCD cameras for X-ray imaging and spectroscopy.
- OM: optical/UV imaging.

CROSS-CORRELATION XMM-NEWTON AND VCAV10 BL LAC

FIG. 1. In black points VCAV10 BL Lacs. In red crosses the XMM-Newton catalogue of BL Lacs.

FIG. 2 Histogram of the redshifts in the XMM-Newton catalogue of BL Lacs.

DATA EXTRACTION AND ANALYSIS

Sample uniformly analysed with the Science Analysis System (SAS) software (v. 15.0) and the most updated calibration files:
- 1. Identification of the public XMM-Newton fields where BL Lacs from the VCAV10 Catalogue are present.
- 2. Source detection algorithms in all selected fields, both for EPIC and OM, and cross-correlate the detected sources with the BL Lacs listed in the VCAV10 catalogue.
- 3. Extract EPIC and OM images, EPIC lightcurves and spectra and OM fluxes and magnitudes.
- 4. Extract variability parameters from EPIC lightcurves.
- 5. Fit all the extracted EPIC spectra with the two baseline models:
  - Power law: $N(E) = \varepsilon^{\alpha} E^{-\gamma}$
  - Log-parabola: $N(E) = \varepsilon^{\alpha} E^{-\gamma} H_{\alpha}(E/E_0)^{2\alpha}$

Each one with the absorption column $N_{\text{H}}$ set of variations:
- $N_{\text{H}}$ fixed to $N_{\text{H,gal}}$
- $N_{\text{H}}$ free > $N_{\text{H,gal}}$
- $N_{\text{H}}$ fixed < $N_{\text{H,gal}}$
- $N_{\text{H}}$ free < $N_{\text{H,gal}}$

CATALOGUE INFORMATION

- Description of the XMM-Newton BL Lac catalogue (tabular extract)

![Diagram](image1.png)

FIG. 7 X-ray luminosity distribution of all BL Lacs in the catalogue (green bars), HSPs (black line), DPs (red line) and LPS (green line).

SUMMARY AND ON-GOING WORK

The XMM-Newton catalogue of BL Lac X-ray properties is produced by searching the XSA archive for X-ray counterparts of the 1374 BL Lacs listed in the 13th Edition of the Véron-Cetty & Véron Catalogue (VVC 2010). This catalogue contains 442 observations for 137 BL Lac sources with X-ray images, light curves and spectral information, and optical fluxes and magnitudes. This catalogue will be available on ViSer.

- Variability timescales and the dependence of this variability with flux, energy or other properties could allow to disentangle the possible physical mechanisms behind.
- A statistical study is presented to clarify which spectral model and statistics should be used to fit spectra in an homogeneous way when dealing with a sample of different statistical quality.

In the future, the information in the catalogue, together with information at other wavelengths, will allow us to identify BL Lac candidates at TeV energies.