

The 5th Edition of The Roma-BZCAT@ASDC

C. Leto^{1,2}, E. Massaro^{3,4}, A. Maselli⁵, P. Marchegiani⁶, M. Perri^{1,2}, P. Giommi¹, S. Piranomonte²

1. ASI Science Data Center, ASI, Rome, Italy ; 2. Osservatorio Astronomico di Roma, INAF, Monteporzio Catone, Italy; 3. INAF, Istituto di Astrofisica e Planetologia Spaziali, Rome, Italy; 4. In Umam Sapientiam, Rome, Italy; 5. INAF, Istituto di Astrofisica Spaziale e Fisica Cosmica, Palermo, Italy; 6. School of Physics, University of the Witwatersrand, Johannesburg, South Africa

We present the 5th Edition of the Multifrequency Catalogue of blazars (Massaro et al. 2014), the Roma-BZCAT, that is one of the most complete lists of Active Galactic Nuclei whose emission properties are recognised as typical of blazars. It includes the list of sources and an essential compilation of multifrequency data from radio to gamma rays. The source list for the entire sky is available online at the ASDC website (<http://www.asdc.asi.it/bzcat>) where it is frequently updated to add new blazars and to improve the database.

Introduction

The work on the Roma-BZCAT (Massaro et al. 2009), which is a list of carefully checked blazars, started more than 10 years ago. It was originally conceived for developing a complete database from catalogue and literature data for the identification of counterparts to high-sources. The Fermi-LAT collaboration, in fact, used it at this purpose in various gamma ray source catalogues, like 1FGL (Abdo et al. 2010a), 1LAC (Fermi LAT AGN Catalog, Abdo et al. 2010b) and the subsequent 2FGL (Nolan et al. 2012) and 2LAC (Ackermann et al. 2011). However, considering that the sources reported in the catalogue were divided into few classes having a remarkable homogeneity, it was also successfully applied in new blazar researches and provided powerful selection criteria for surveys in other electromagnetic bands.

General organization of the Roma-BZCAT

Blazars are a relatively rare class of Active Galactic Nuclei (AGN) characterized by an electromagnetic emission over the entire energy spectrum, from the radio band to the most energetic gamma rays. Each source is identified by the number 5 (for the 5th Edition) followed by a three-letter code, where the first two letters are **BZ** for blazars and the third one specifies the type, followed by the truncated equatorial coordinates (J2000). The complete codes are:

- **5BZB**: BL Lac objects, used for blazars with a featureless optical spectrum, or having only absorption lines of galaxian origin, and narrow emission lines with an equivalent width lower than about 5Å; the same code is used for a small number of BL Lac candidates;
- **5BZG**: sources, usually reported as BL Lac objects in the literature, but having a SED with a significant dominance of the galaxian emission over the nuclear one;
- **5BZQ**: Flat Spectrum Radio Quasars, with an optical spectrum showing broad emission lines and dominant blazar characteristics;
- **5BZU**: Blazars of Uncertain type, adopted for a small number of sources having peculiar characteristics but showing blazar activity: for instance, occasional presence/absence of broad spectral lines features, transition objects between a radio galaxy and a BL Lac, etc.

For each source the following data are reported: equatorial coordinates (J2000); the apparent magnitude in the R band from USNO-B1 or in other filters or r from SDSS DR10; radio flux density at 1.4 GHz from NVSS or 0.843 GHz from SUMSS; radio flux density at 4.85 GHz from GB6 or PMN; microwave flux density at 143 GHz from PLANCK catalogue; the 0.1-2.4 keV X-ray flux from ROSAT archive or Swift-XRT catalogues; hard X-ray flux (15-150 keV) from Palermo BAT Catalogue (<http://www.bat.ifa.inaf.it>); γ -ray flux from 1FGL or 2FGL; redshift. Some synthetic notes are also given for a limited number of blazars (i.e. member of a galaxy cluster, detection of emission lines, etc...). The total number of sources presently listed in the Roma-BZCAT is **3561**, about 16% more than in the 3rd Edition of 2011. The catalogue has relevant changes in the sources' classification and has a new format for the notes in the table. In the 5th Edition the majority of sources are represented by FRSQs with 1909 objects. 1059 are confirmed BL Lac objects, while 92 are reported as candidates because optical spectra were not present in the literature. 274 blazars are classified as BZG, and 227 as BZU. Their distribution in the sky is shown in Fig.1.

Conclusions

The scientific goals that led us to the compilation of the Roma-BZCAT were: to have the most complete list of published blazars; to have a list of extragalactic objects useful for identifying the counterparts to high-energy sources and for investigating the populations of extragalactic sources in frequency bands such as in the microwaves or in the far and mid infrared; to have a population from which it will be possible to extract samples satisfying statistical criteria to investigate blazar properties and evolution.

An open problem is the completeness of the catalogue: there is in fact a deficiency of blazars in the Southern sky because of the smaller number of surveys in comparison to the Northern hemisphere. The continuation of large surveys covering many electromagnetic bands from radio wavelengths to the most energetic gamma rays and the development of much powerful observatories, like SKA or CTA, in the next decades will improve our knowledge of this very interesting class of active galactic nuclei.

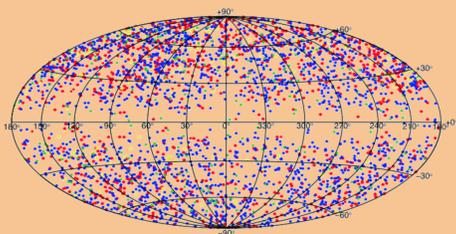


Fig.1 Hammer-Aitoff projection in Galactic Coordinates showing the sky distribution of Blazars included in the 5th Edition of the Roma-BZCAT. The dots' colours correspond to the following sources' type: BL Lacs and candidates (red), BZGs (yellow), FRSQs (blue), and Blazars of uncertain classification BZU (green).

Users who will make use of the Roma-BZCAT (5th Edition) in a publication, are kindly requested to acknowledge the source of the information by referencing the paper (Massaro et al. 2015) or the book which gives a full description of the catalogue.

References

- Abdo, A.A., Ackermann, M., Ajello, M. et al.: *Astrophys. J. Suppl. Ser.*, 188, 405 (2010a)
 Abdo, A.A., Ackermann, M., Ajello, M. et al.: *Astrophys. J.*, 715, 429 (2010b)
 Ackermann, M., Ajello, M., Allafort, A. et al.: *Astrophys. J.*, 743, 171 (2011)
 Massaro, E., Maselli, A., Leto, C. et al. *Astrophysics and Space Science*, 357, 75 (2015)
 Massaro, E., Maselli, A., Leto, C. et al.: "Multifrequency Catalogue of blazars 5th Edition", Aracne, Roma (2014)
 Massaro, E., Giommi, P., Leto, C. et al: *Astron. Astrophys.*, 495, 691 (2009)
 Nolan, P.L., Abdo, A.A., Ackermann, M. et al.: *Astrophys. J. Suppl. Ser.*, 199, 31 (2012)

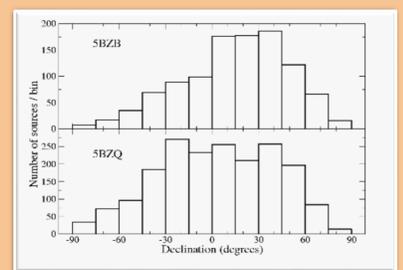
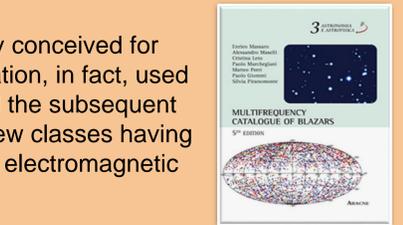


Fig.2 The Declination distributions of BL Lac objects (upper panel) and of Flat Spectrum Radio Quasars (lower panel) in the Roma-BZCAT.

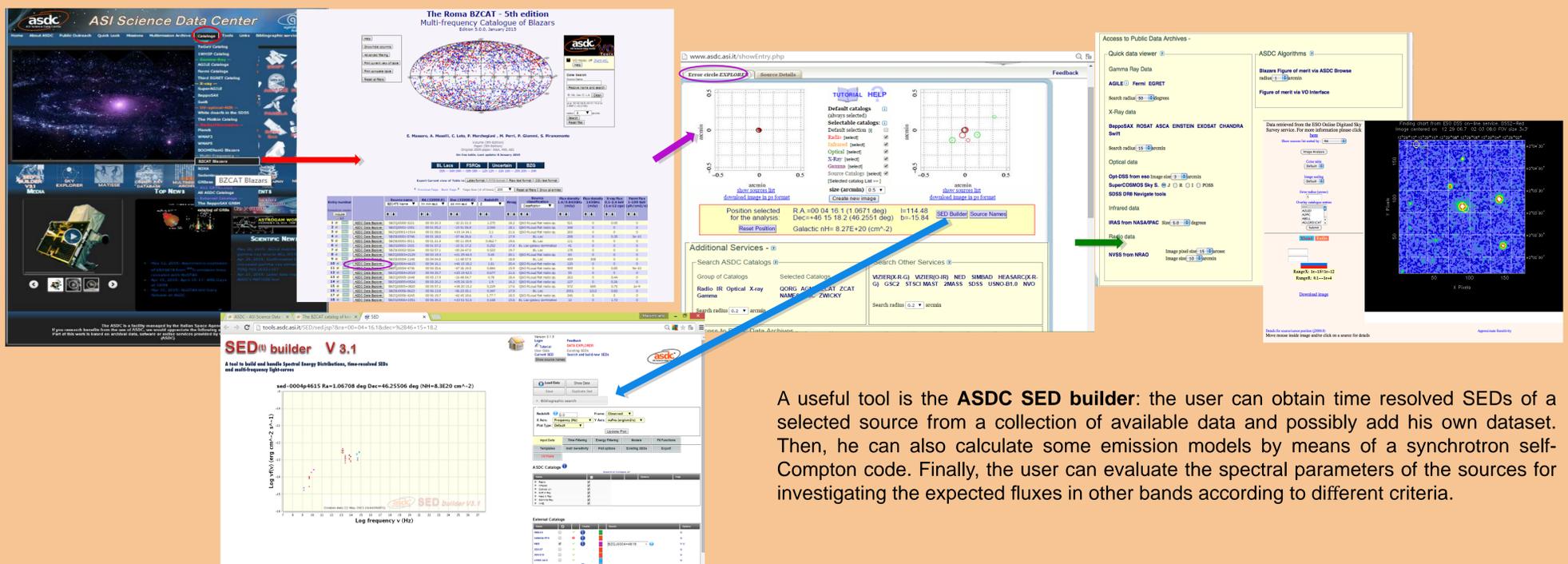
The on-line version of Roma-BZCAT

The 5th Edition of the Roma-BZCAT has been issued on December 2014 and is available at the ASI Science Data Center (ASDC) at the following address: <http://www.asdc.asi.it/bzcat>.

It includes 3561 sources with blazar characteristics and is updated regularly with newly discovered objects.

Scientific tools

The on-line version of the Roma-BZCAT provides access to useful tools developed at ASDC that can be easily accessed by clicking on the **ASDC Data Explorer** button. For instance it is possible to build sky maps of catalogued sources in the region surrounding the selected blazar or retrieve optical and radio images at different size scale. A large series of catalogues in many electromagnetic bands is available and all major databases can be accessed in a transparent way, including bibliographical services.



A useful tool is the **ASDC SED builder**: the user can obtain time resolved SEDs of a selected source from a collection of available data and possibly add his own dataset. Then, he can also calculate some emission models by means of a synchrotron self-Compton code. Finally, the user can evaluate the spectral parameters of the sources for investigating the expected fluxes in other bands according to different criteria.