The Blazar Times

A Research Newsletter Dedicated to the BL Lac and Blazar Phenomena

No. 65 — December 2004 Editor: Travis A. Rector (blazar@uaa.alaska.edu)

TABLE OF CONTENTS

Conference Announcement

Blazar Variability Workshop II: Entering the GLAST Era

10-12 April, 2005
Florida International University
Miami, Florida USA

Conference goals are to review existing observations, present new observations, discuss theoretical models and speculate on the future paths of Blazar Variability and high energy research. The conference will include 14 invited talks, many contributed oral talks and poster papers. The venue is optimized for participant interaction and time is allowed for discussion of the observations, theoretical developments and problems in the field of Blazars.

Conference web site: www.fiu.edu/∼webbj/confer.htm

Journal Abstracts

On the Duty–Cycle of γ-ray Blazars

Stefano Vercellone[1], Simona Soldi[1,2,3], Andrew W. Chen[1,2] and Marco Tavani[4,2,5]

[1] IASF-CNR Sezione di Milano, Via Bassini 15, 20133 Milano, Italy
[2] CIFS, Viale Settimio Severo 63, Torino, 10133, Italy
[3] ISDC, Chemin d'Ècogia 16, 1290 Versoix, Switzerland
[4] IASF-CNR Sede di Roma, Via del Fosso del Cavaliere 100, Roma, 00133, Italy
[5] Dipartimento di Fisica, Università di Tor Vergata, Roma, 00133, Italy

We study several properties of blazars detected in the γ-ray energy range by comparing the *EGRET* sources with a sample of radio blazars which can be considered possible γ-ray candidates. We define three classes: non-γ-ray blazars, blazars with quasi-steady γ-ray emission, and γ-ray blazars with substantial activity level. We find that, on average, BL Lacs show a relatively steady γ-ray emission, when detected. On the other hand, most FSRQs show substantial γ-ray variability. We attribute a γ-ray activity index $\psi = \psi_{-7} \times 10^{-7}\,\mathrm{cm}^{-2}\mathrm{s}^{-1}$ to all *EGRET* blazars, and show

that FSRQs dominate the sample with non-zero ψ in the range $0 < \psi_{-7} < 0.035$. By combining the information of detected and candidate AGNs, we characterise the blazar activity, including the discovery of a region of consistency between the γ-ray flaring duty–cycle and the recurrence time between flares. We also find a possible relation between the activity index of FSRQs and their black hole mass. More optical and γ-ray data are crucially important to test this relation.

Accepted by MNRAS: MNRAS 2004, Volume 353, Issue 3, pp. 890-902

For preprints contact: stefano@mi.iasf.cnr.it

Nonthermal Radiation Processes in X-Ray Jets

Charles D. Dermer[1] **& Armen Atoyan**[2]

[1] E. O. Hulburt Center for Space Research, Code 7653, Naval Research Laboratory, Washington, DC 20375-5352
[2] Centre de Recherches Mathématiques, Université de Montréal, CP6128, Succursale Centreville, Montreal, PQ H3C 3J7, Canada

Analytic approximations for synchrotron, synchrotron self-Compton (SSC), and external Compton (EC) processes are used to constrain model parameters for knot and hot-spot emission in extended jets of radio galaxies. Equipartition formulas are derived that relate the Doppler factor d and the comoving magnetic field B assuming a nonthermal synchrotron origin of the radio emission and synchrotron, SSC, and EC origins of the X-ray emission. Expressions are also derived for d and B that minimize the total jet powers of the emitting region in synchrotron, SSC, and EC models for the X-ray emission. The results are applied to knot WK7.8 of PKS 0637Δ752. Predictions to test two-component synchrotron and EC models are made for Chandra and the Gamma-Ray Large Area Space Telescope.

ApJ **611**, L9 (2004)

For preprints contact: dermer@gamma.nrl.navy.mil

For additional information: http://xweb.nrl.navy.mil/gamma/∼dermer/default.htm

Shear Acceleration in Relativistic Astrophysical Jets

Frank M. Rieger[1] **& Peter Duffy**[1]

[1] Dept. of Mathematical Physics, University College Dublin, Belfield, Dublin 4, Ireland

We consider the acceleration of energetic particles due to a velocity shear in the relativistic background flow containing scattering centers. Three possible acceleration sites for astrophysical jets are identified: (1) gradual velocity shear parallel to the jet axis such as a velocity profile decreasing linearly outward with radial coordinate, (2) gradual velocity shear perpendicular to the jet axis such as intrinsic jet rotation, and (3) non-gradual/discontinuous, longitudinal velocity shear at the jet side boundary. We determine the characteristic acceleration timescales, specify the conditions for efficient acceleration and discuss observational features with respect to each process. In particular, it is shown that in the case of (2) the higher energy emission is expected to be concentrated closer to the jet axis, while in the case of (1) and (3) the higher energy particles are likely to be located near the edges of the jet thus possibly leading to some form of limb-brightening.

ApJ in press

For preprints contact: frank.rieger@ucd.ie

For preprints via ftp or WWW: http://xxx.lanl.gov/abs/astro-ph/0410269

On the Geometrical Origin of Periodicity in Blazar-Type Sources

Frank M. Rieger[1]

[1] Dept. of Mathematical Physics, University College Dublin, Belfield, Dublin 4, Ireland

Periodicities in blazar light curves may be related to helical trajectories in extragalactic radio jets by differential

Doppler boosting effects. We consider ballistic and non-ballistic (i.e., radial) trajectories and discuss three possible periodic driving mechanisms for the origin of helical jet paths, namely, orbital motion in a binary black hole system (BBHS), jet precession, and intrinsic jet rotation. It is shown that precessional-driven ballistic motion is unlikely to result in observable periods of less than several tens of years. We demonstrate that for non-ballistic helical motion the observed period is generally strongly shortened relative to the real physical driving period because of light-travel time effects. Internal jet rotation may thus account for observed periods $P_{\rm obs} \leq 10$ days. Periodicity due to orbital-driven (non-ballistic) helical motion, on the other hand, is usually constrained to periods of $P_{\rm obs} \geq 10$ days, while Newtonian-driven precession is unlikely to be responsible for periodicity on a timescale $P_{\rm obs} \leq 100$ days but may well be associated with periods of $P_{\rm obs} \geq 1$ yr.

ApJ Letters in press

For preprints contact: frank.rieger@ucd.ie

For preprints via ftp or WWW: http://xxx.lanl.gov/abs/astro-ph/0410188

The Sedentary Survey of Extreme High Energy Peaked BL Lacs. II. The Catalog and Spectral Properties

Paolo Giommi[1], Silvia Piranomonte[1] Matteo Perri[1] and Paolo Padovani[2,3]

[1] ASI Science Data Center, ASDC, Agenzia Spaziale Italiana c/o ESRIN, via G. Galilei 00044 Frascati, Italy
[2] Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA
[3] Current address: ST-ECF, European Southern Observatory, Karl-Schwarzschild-Str. 2, D-85748 Garching bei München, Germany

The multi-frequency 'Sedentary Survey' is a deep, statistically complete, radio flux limited sample comprising 150 BL Lacertae objects distinguished by their extremely high X-ray to radio flux ratio , ranging from five hundred to over five thousand times that of typical BL Lacs discovered in radio surveys. This large excess of high energy photons compared to radio emission is thought to be due to synchrotron radiation that in these sources reaches the UV or the X-ray band. The name 'Sedentary Survey' originates from the multi-frequency technique used to select the sample that was expected to be so efficient as to allow the conduction of some preliminary statistical studies even without the need to identify the candidates through optical spectroscopy. The details of the selection criteria and the preliminary results have been published in Giommi, Menna & Padovani (1999). In this paper we present the final, 100% identified, catalog together with the optical, X-ray and broad-band Spectral Energy Distributions (SED) constructed combining literature multi-frequency data with non-simultaneous optical observations and *Beppo*SAX X-ray data, when available. The SEDs confirm that the peak of the synchrotron power in these objects is located at very high energies. *Beppo*SAX wide band X-ray observations show that, in most cases, the X-ray spectra are convex and well described by a logarithmic parabola model peaking (in a $\nu f(\nu)$ *vs* ν representation) between 0.02 to several keV.

Although detailed X-ray spectral data are available for only about one fifth of the sources the observed peaks never reach energies well above 10 keV (as in Mkn 501 during the large X-ray flare of April 1997 and in 1ES 2344+514 in December 1996) implying that hard X-ray synchrotron peak energies are rare and probably associated with strong flaring events.

Owing to the high synchrotron energies involved most of the sources in the catalog are likely to be TeV emitters, with the closest and brightest ones probably detectable by the present generation of Cherenkov telescopes. However, only 50% (3 out of 6) of the presently established TeV BL Lacs are actually included in the survey suggesting that the hardest peaks may be associated with secondary synchrotron components that can be detected only above the soft X-ray band. The existence of secondary emission regions is suggested by the strong X-ray spectral curvature that in some objects predicts an optical flux much below the observed emission.

The optical spectrum of about one fourth of the sources is totally featureless hampering any red-shift or luminosity determination. Because this implies that the non-thermal nuclear emission must be well above that of the host galaxy, these objects are likely to be the most powerful sources in the survey and therefore be examples of the yet unreported *high radio luminosity–high energy peaked* BL Lacs. The existence of such objects would be at odds with the claimed inverse proportionality between radio power and synchrotron peak energy known as the "blazar sequence".

At the low-power end of the luminosity dynamical range, where the non-thermal optical continuum falls below the emission from the host galaxy, recognition issues start becoming important since BL Lacs in this luminosity regime can hardly be recognized as such, but rather as *radio galaxies* or simply as *elliptical galaxies*. We have found a small sample of bright nearby elliptical galaxies that are candidate low radio power high energy peaked BL Lacs.

Accepted by A&A

For preprints contact: paolo.giommi@asi.it

Abstract Guidelines

Abstracts for "The Blazar Times" are solicited for papers that have been recently accepted for publication by a refereed journal, and for recent Ph.D. theses. Please do not submit an abstract before it has been accepted, nor after it is published. Abstracts from papers which are not refereed (e.g., conference proceedings) are not accepted.

The subject matter should pertain directly to the BL Lac and/or blazar phenomenon in general. Both observational and theoretical abstracts are appropriate. Abstracts from papers dealing with other classes of AGN will generally not be included unless they explicitly discuss their relevance to the blazar phenomenon; however exceptions to this rule will be considered.

A monthly call for abstracts will be issued and abstracts received by the last day of the month will usually appear in the following month's newsletter. Announcements of general interest to the BL Lac and blazar communities may also be submitted for posting in the newsletter. These might include (but are not restricted to) the following: (i) *Job Openings* directed toward blazar researchers, (ii) announcements of *Upcoming Meetings*, (iii) announcements of *Upcoming Observing Campaigns* for which participation is solicited from the community at large, (iv) reviews of *New Books*, and (v) *General Announcements* that provide or request research-related information.

To subscribe, please send your name and email address to:

`blazar@uaa.alaska.edu`

Contributions and all other correspondence relevant to the newsletter should also be sent to the above address. Please note that I respect the privacy of subscribers; therefore I will not distribute *under any circumstance* the subscriber email list.

To contribute, please use the appropriate LaTeX abstract and thesis templates, which can be obtained from "The Blazar Times" web page at:

`http://hosting.uaa.alaska.edu/aftar/blazar/`

Abstracts which are not in this template format cannot be accepted. Both templates are stand-alone LaTeX documents; and I ask that you compile them with LaTeX to check for any errors before submitting. This will save me tremendous efforts in solving any problems; and will assure that your abstract will appear in the newsletter as you had intended. Important: If you use any specially defined characters be sure to include their definitions as well.