The Blazar Times

A Research Newsletter Dedicated to the BL Lac and Blazar Phenomena

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Journal Abstracts

Broad-band continuum and line emission of the γ-ray blazar PKS 0537–441

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PKS 0537–441, a bright γ-ray emitting blazar, was observed at radio, optical, UV and X-ray frequencies during various EGRET pointings, often quasi-simultaneously. In 1995 the object was found in an intense emission state at all wavelengths. BeppoSAX observations made in 1998, non-simultaneously with exposures at other frequencies, allow us to characterize precisely the spectral shape of the high energy blazar component, which we attribute to inverse Compton scattering. The optical-to-γ-ray spectral energy distributions at the different epochs show that the γ-ray luminosity dominates the bolometric output. This, together with the presence of optical and UV line emission, suggests that, besides the synchrotron self-Compton mechanism, the Compton upscattering of photons external to the jet (e.g., in the broad line region) may have a significant role for high energy radiation. The multiwavelength variability can be reproduced by changes of the plasma bulk Lorentz factor. The spectrum secured by IUE in 1995 appears to be partially absorbed shortward of $\sim$1700 Å. However, this signature is not detected in the HST spectrum taken during a lower state of the source. The presence of intervening absorbers is not supported by optical imaging and spectroscopy of the field.

In press in A&A

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The Accretion Rates and Spectral Energy Distributions of BL Lacertae Objects

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We investigate the relationship between accretion rates and the spectral energy distributions (SEDs) of BL Lac objects, using a sample of objects for which published information on the host galaxies, emission-line luminosities, and peak frequencies and luminosities of their SEDs are available. The sample is composed of 43 BL Lac objects which have a relatively continuous distribution of peak frequencies. Under the assumption that the observed emission lines are photoionized by the central accretion disk, we use the line luminosities to estimate the accretion luminosities and hence accretion rates. We find that low frequency-peaked BL Lac objects (LBLs) span a wide range of accretion rates, whereas high frequency-peaked BL Lac objects (HBLs) cover a more restricted range of lower values. There appears to be a continuous distribution of accretion rates between the two subclasses of BL Lac objects. We find that the peak frequency of the SED, $\nu_{\rm pk}$, correlates with the accretion rate, approximately with the form $\nu_{\rm pk} \propto \Lambda^{-3}$ in HBLs and $\nu_{\rm pk} \propto \Lambda^{-0.25}$ in LBLs, where $\Lambda \equiv L_{\rm lines}/c^2$. The peak luminosity of the SED is also correlated with Λ. These results suggest that the accretion rate influences the shape of the SED in BL Lac objects. They also support models which couple the jet and the accretion disk. We present a physical scenario to account for the empirical trends.

2002, ApJ, 579, November 10

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Time Dependent Modeling of the Markarian 501 X-ray and TeV Gamma-Ray Data Taken During March and April, 1997

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If the high-energy emission from TeV blazars is produced by the Synchrotron Self-Compton (SSC) mechanism, then simultaneous X-ray and gamma-ray observations of these objects are a powerful probe of the electron (and positron) populations responsible for this emission. Understanding the emitting particle distributions and their temporal evolution in turn allows us to probe physical conditions in the inner blazar jet and test, for example, various acceleration scenarios. Furthermore, by constraining the SSC emission model parameters, such observations enable us to predict the intrinsic (unabsorbed) gamma-ray energy spectra of these sources, a major uncertainty in current attempts to use gamma-ray observations to constrain the intensity of the Diffuse Extragalactic Background Radiation (DEBRA) at optical/infrared wavelengths. As a next step in testing the SSC model and as a demonstration of the potential power of coordinated X-ray and gamma-ray observations, we model in detail the X-ray and gamma-ray light curves of the TeV blazar Mrk 501 during its April-May 1997 outburst with a time dependent SSC model. Extensive, quasi-simultaneous X-ray and gamma-ray coverage exists for this period. We discuss and explore quantitatively several of the flare scenarios presented in the literature. We show that simple two-component models (with a soft, steady X-ray component plus a variable SSC component) involving substantial pre-acceleration of electrons to Lorentz factors on the order of $\gamma_{\rm min} = 10^5$ describe the data train surprisingly well. All considered models imply an emission region that is strongly out of equipartition and low radiative efficiencies (ratio between kinetic jet luminosity and comoving radiative luminosity) of 1 per-mill and less. Degeneracy in both, model variant and jet parameters, prevents us to use the time resolved SSC calculations to substantially tighten the constrains on the amount of extragalactic gamma-ray extinction by the DEBRA in the relevant 0.5-50 microns wavelength range, compared to earlier work.

Accepted by MNRAS

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The Guaranteed Gamma Ray Background

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The diffuse extragalactic gamma-ray background (EGRB) above 100 MeV encodes unique information about high-energy processes in the universe. Numerous sources for the EGRB have been proposed, but the two systems which are certain to make some contribution are active galaxies (blazars) as well as normal galaxies. In this paper, we evaluate the contribution to the background from both sources. The active galaxy contribution arises from unresolved blazars. We compute this contribution using the Stecker-Salamon model. For normal galaxies, the emission is due to cosmic-ray interactions with diffuse gas. Our key assumption here is that the cosmic-ray flux in a galaxy is proportional to the supernova rate and thus the massive star formation rate, quantified observationally by the cosmic star formation rate (CSFR). In addition, the existence of stars today requires a considerably higher ISM mass in the past. Using the CSFR to compute both these effects, we find that normal galaxies are responsible for a significant portion ($\sim 1/3$) of the EGRB near 1 GeV, but make a smaller contribution at other energies. Finally, we present a "minimal" two-component model which includes contributions from both normal galaxies and blazars. We show that the spectrum of the diffuse radiation is a key constraint on this model: while neither the blazar spectra, nor the galactic spectra, are separately optimal fits to the observed spectrum, the combined emission provides an excellent fit. We close by noting key observational tests of this two-component model, which can be probed by future gamma-ray observatories such as GLAST.

Reference: 2002 ApJL, 575, 5-8

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For preprints via ftp or WWW: http://arXiv.org/abs/astro-ph/0207253

Correlated Radio and Optical Variations in a Sample of AGN

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Radio light curves of 20 sources from the Metsähovi monitoring program are compared with optical light curves collected from the literature. The Discrete Correlation Function analysis is applied to the data sets. A new qualitative method to study correlations is introduced, where the radio light curves are replaced by model light curves consisting of exponential outbursts. The optical flux level is compared to the phase and flux level of the model flares. Seven sources show clear correlations using the DCF analysis with six more showing a possible correlation between optical and radio events with time lags from zero to several hundred days. For twelve sources at least one simultaneous optical and radio event is seen. For eleven sources, when comparing optical flux levels with the phase of the model radio outbursts, the optical flux levels were high at the peak of the model radio outbursts. For sixteen sources, when comparing the optical flux level with the radio model flare flux level, the optical flux level was high when radio flux level was high, as well.

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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.

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