

# *The Blazar Times*

A Research Newsletter Dedicated to the BL Lac and Blazar Phenomena

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### *Journal Abstracts*

#### **X-ray Flares from Markarian 501**

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Motivated by the recent finding of hierarchical X-ray flaring phenomenon in Mrk 421, we conducted a systematic search for X-ray flares from Mrk 501, another well-known TeV blazar, by making use of the rich *RXTE* archival database. We detected flares over a wide range of timescales, from months down to minutes, as in the case of Mrk 421. However, the flares do not seem to occur nearly as frequently in Mrk 501 as in Mrk 421 on any of the timescales. The flaring hierarchy also seems apparent in Mrk 501, suggesting that it might be common among TeV blazars. The results seem to imply a scale-invariant physical origin of the flares (large or small). The X-ray spectrum of the source shows a general trend of hardening toward the peak of long-duration flares, with indication of spectral hysteresis, which is often seen in TeV blazars. However, the data are not of sufficient quality to allow us to draw definitive conclusions about spectral variability associated with more rapid but weaker flares. We critically examine a reported sub-hour X-ray flare from Mrk 501, in light of intense background flaring activity at the time of the observation, and concluded that the flare is likely an artifact. On the other hand, we did identify a rapid X-ray flare that appears to be real. It lasted only for about 15 minutes, during which the flux of the source varied by about 30%. Sub-structures are apparent in its profile, implying variabilities on even shorter timescales. Such rapid variabilities of Mrk 501 place severe constraints on the physical properties of the flaring region in the jet, which have serious implications on the emission models proposed for TeV blazars.

Accepted by ApJ

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*For preprints via ftp or WWW:* <http://arxiv.org/abs/astro-ph/0412226>

#### **VLBA Polarization Observations of Markarian 421 After a Gamma-Ray High State**

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We present four high dynamic range, dual-circular polarization, Very Long Baseline Array (VLBA) observations at 22 GHz of Markarian 421, taken throughout the year following the source's unprecedented gamma-ray high state in early 2001. These four new VLBA observations are combined with data from our earlier 1999 paper and archival VLBA data-sets that have become available since 1999 to produce a combined 28 epoch VLBA data-set on Mrk 421 spanning the years 1994 to 2002. No new component associated with the 2001 flares was seen on the total intensity images, but the combined data-set allowed precise measurements of the apparent speeds of the existing components. The peak measured apparent speed was for component C5, which has an apparent speed of  $0.1 \pm 0.02 c$  ( $H_0 = 71 \text{ km s}^{-1} \text{ Mpc}^{-1}$ ,  $\Omega_m = 0.27$ , and  $\Omega_\Lambda = 0.73$ ). No counterjet is seen with a limit on the jet to counterjet brightness ratio  $J > \sim 100$ . These observed VLBI properties of Markarian 421 are consistent with a jet with a bulk Lorentz factor  $\Gamma \sim 2$  and an angle to the line-of-sight  $\theta \sim 1^\circ$ , suggesting a jet that decelerates between the gamma-ray producing region and the parsec scale. Although a limb-brightened structure is seen in some transverse slices across the jet, it is not seen consistently, inhibiting interpretation in terms of the fast-spine/slow-layer model that has been invoked for other sources. The VLBI core and inner jet (component C7) have fractional polarizations of  $\sim 5\%$ , and an electric vector position angle (EVPA) aligned with the jet axis. Component C5 (at 1.5 mas from the core) has a higher fractional polarization of  $\sim 15\%$ , and an EVPA nearly orthogonal to the jet axis. Significant variability is detected in the EVPA of component C6, which at two of the four epochs shows an EVPA aligned with the jet axis, possibly a sign of propagating disturbances that are only visible on the polarization images. If these propagating disturbances are linked to the 2001 gamma-ray high state, then their inferred apparent speed is between 1 and 3  $c$ .

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## Optical follow-up of BL Lac candidates in the 2BL sample

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We investigate the nature of the BL Lac candidates in the northern part of the 2BL sample ([?]) searching for optical variability by means of  $R_C$  band photometry with the Asiago 1.8 and Loiano 1.5 meter telescopes during years 2002, 2003 and 2004. We also made aperture photometry of the candidates on the plates available on the web from the Palomar and UK Schmidt telescopes. No significant variability was detected for the majority of the objects without detected radio and/or X-ray emissions, while clear variability was found for the few sources of the sample with strong radio and/or X-ray emission, which is a constant feature of the "classical" BL Lacs. Some considerations on the nature of the 2BL sources are made, taking into account their most recent data available in proper motions catalogues (SuperCOSMOS, USNO-B1) and in the Sloan Digital Sky Survey.

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## Linear Accelerating Superluminal Motion Model

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Accelerating superluminal motions were detected recently by multi-epoch Very Long Baseline Interferometry (VLBI) observations. Here, a Linear Accelerating Superluminal Motion (LASM) model is proposed to interpret the observed phenomena. The model provides a direct and accurate way to estimate the viewing angle of a relativistic jet. It also predicts that both Doppler boosting and deboosting effects may take place in an accelerating forward jet. The LASM

model is applied to the data of the quasar 3C 273, and the initial velocity, acceleration and viewing angle of its three components are derived through modelfits. The variations of the viewing angle suggest that a supermassive black holebinary system may exist in the center of 3C273. The gap between the inner and outer jet in some radio loud AGNs may be explained in terms of Doppler deboosting effects when the components accelerate to ultra-relativistic speed.

ApJ 616L 95Z

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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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