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Final Technical Report

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1. **Multiwavelength Search for Correlated Time Variations in the Brightest EGRET Blazars**
2. **Understanding Blazar Emissions**
3. **Investigation of High Energy Gamma-Ray Emission from AGNs: A Deep Exposure at High Galactic Latitudes**
4. **Multiwavelength Blazar Studies**
5. **Investigation of High Energy Gamma-Ray Emission from AGNs: Deep Survey Observations at High Galactic Latitudes**

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All five sub-projects involved the multiwaveband observations of selected blazars that are being observed by the EGRET detector on the *Compton* Gamma Ray Observatory. These observations have been (and continue to be) carried out using the James Clerk Maxwell Telescope (millimeter and submillimeter wavelengths), the Owens Valley Millimeter Array, and the Very Long Baseline Array (radio imaging). These were coordinated with the EGRET observations and then combined with observations at other wavebands made by other groups in the collaboration to generate "snapshots" of the multiwaveband spectra at several times. The VLBA images were obtained at several epochs and compared to determine (1) the motions of any components in the jet relative to the core (apparent superluminal motion) and (2) the extrapolated date of emergence of the moving component from the core: is this the same as the epoch of a γ-ray flare?

The Boston University effort also included modelling of the multiwaveband spectra of the most interesting of these blazars using a sophisticated relativistic jet model. The synchrotron self-Compton spectrum was calculated and then fit to the observed spectrum. The size of the emitting region was compared with the maximum allowed from the timescale for substantial variation of the brightness. This was been done for γ-ray flares observed in 3C 279, Mkn 421, and PKS 0528+134, and the non-flaring spectrum of 3C 273. In the case of Mkn 421, the flare appears to have occurred only for the highest energy electrons. That is, the upper cutoff energy of the power-law distribution increased temporarily, causing a flare only in very high energy γ-rays (first-order self-Compton emission) and in keV X-rays (synchrotron radiation). The flares of the other objects appear to involve changes in the electron densities and magnetic fields.

We have found that the emission in the blazar jets is highly stratified, as evidenced by time delays between the peaks of the flares at different wavebands. This fits well with the predictions of the jet models. Not all of the blazars have yet been observed long enough with the VLBA to determine the motions of their components. However, for those 39 blazars for which this analysis is possible as of August 1997, the apparent superluminal speeds are very high, ranging from about 10 to 35c (for a Hubble constant of 65 km s^{-1} Mpc^{-1}. If this trend holds for the remainder of the sample (to be determined after the results of observations in July 1997 are analyzed along with those from previous epochs), the implication is that the EGRET-detected blazars have stronger relativistic beaming than does the general radio-bright blazar population.

The object 0954+556 has no components more compact than about 2 milliarcsec. It seems therefore unlikely that this is the correct identification of the EGRET source near this position.

The papers published, submitted, and in press thus far represent an ongoing effort to provide multiwaveband observational and theoretical support of the EGRET observations by the Key Project teams.

Graduate students Matthew Lister and Markos Georganopoulos worked on the project during the reporting period.

The following publications resulted from this project. Preprints and reprints not included with this report have been submitted along with the previous progress reports.

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