Introduction

Already during the Compton mission, our team studied the connection between gamma-ray emission and radio emission in blazars. Our work (e.g., Valtaoja et al. 1995; Lähteenmäki et al. 2000, 2001, 2003; Tornikoski et al. 1999, 2000, 2002) has shown that there seems to be a connection between the high frequency and gamma-ray activity.

In Lähteenmäki & Valtaoja (2003) we showed that both the EGRET detection probability and the strength of the gamma-ray emission depend on the concurrent high-frequency radio state of each source. The sources detected during individual EGRET pointings had ongoing radio flares, and especially the strongest gamma-ray detections occurred during the rise or the peak of the radio flare (Fig. 1).

Activities during the GLAST Mission

During the GLAST mission we will investigate the relationship between radio and gamma-ray emission in blazars in more detail. With a sensitivity exceeding EGRET by two orders of magnitude, GLAST is likely to revolutionize our understanding of high energy processes in AGNs.

Currently our team is developing methods for identifying the true synchrotron SED components from real observations instead of pure theoretical models (see the poster by Lindfors et al. for more details). We will use actual, observed synchrotron SEDs compiled from multifrequency monitoring data, for tracing the evolution of the synchrotron components. We can also use VLBI observations to improve SED modelling by providing the spectra of individual jet components (Fig. 2).

By combining multifrequency radio monitoring data with VLBI, we can study the details of the shock formation. Dense total flux density and VLBI monitoring can reveal the temporal relationship between the new shocks and the gamma ray flares.

In order to fully understand the various emission mechanisms at work, we also need information about the physical parameters of the emitting region. By providing unsurpassed spatial resolution, high frequency VLBI can reveal directly the sites of electron acceleration and enhanced synchrotron emission. From the data we can extract such parameters as bulk Lorentz factor, Doppler factor, and the angle between the jet and our line of sight (Jorstad et al. 2005; Savolainen et al. 2006). Our group is planning to perform a detailed case study of 3C273 with the VLBA during the first years of GLAST operations.

It is possible, from simultaneous multifrequency VLBI observations, to deduce the magnetic field density in the core and along the jet, as well as the energy density of the emitting particles and the anticipated amount of synchrotron self-Compton emission (see e.g. Marscher 1987). Extracting spectral information from multifrequency VLBI data is a notoriously difficult task, but our recent work indicates that by using the VLBA and a model-fit based analysis method, high quality spectra of different emission features in the parsec scale jets can be extracted (Savolainen, 2006; Savolainen et al. 2007). In order to study the relation between the gamma-ray activity and various intrinsic physical parameters of the jet, multifrequency VLBI observations of a complete sample of AGNs is desirable. Feasibility of such a campaign during the GLAST era is being studied (a pilot VLBA programme by Y. Y. Kovalev et al. (BK134)).

Our long term monitoring studies have provided us with detailed information about the variability timescales of a large number of AGNs (Hovatta et al. 2007). We will use our radio flare database and the associated statistical studies to predict (or at least, to make educated guesses) when a source is going to be in an active state. As stated above, the high-frequency radio and the gamma-ray activity should be closely related, and thus we can define triggering criteria for detecting certain blazars in an active gamma state with GLAST.

Conclusions

- The strongest gamma-ray emission in AGNs originates downstream the relativistic jet, within the same shocks that produce the synchrotron radio flares.
- The present models for gamma-ray production are inadequate, since they typically model the gamma-ray inverse Compton flux as coming from the jet, with significant disk or BLR external Compton components.
- During the GLAST mission we will concentrate on improving our model by using the true, observed total flux density monitoring and multifrequency VLBI data, and the physical parameters that can be extracted from them.

References:

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