The connection between mm and γ-ray flares in Fermi/LAT blazars

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Abstract:

By comparing the 1FGL and Metsähovi 37 GHz light-curves in a sample of 60 northern blazars, we find that:

✪ The correlation between quasi-simultaneous 37GHz and γ-ray fluxes is significant for FSRQ and absent for BL Lacs.

✪ The brightest gamma-ray events in the 1FGL light curves coincide with the initial stages of a mm-flare.

✪ The average delay from the mm-flare inception to the peak of the most intense gamma-ray flare is **70 days**.

The S_{37GHz} – $S_{\gamma\text{-ray}}$ correlation

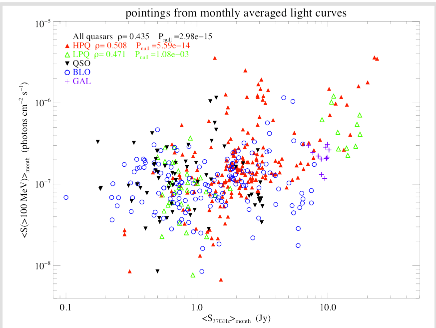

Figure 1. Monthly flux-flux relation for the combined sample of 60 northern AGN. The different types of sources are symbol coded as shown in the legend, the correlations coefficients are shown only when the significance is > 99.9 %

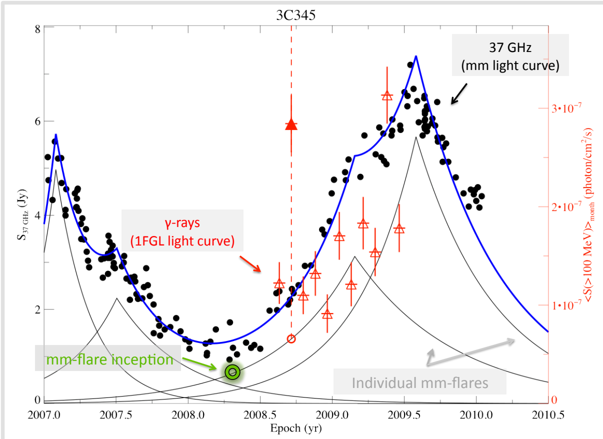

Figure 2. Recent 37 GHz flux history and the 1FGL monthly light curve for 3C 345. The vertical dashed line is drawn to highlight that the sharp γ-ray flare in the 1FGL period occurred during the rising state of the individual mm-flare.

Ongoing mm-flares and γ-ray peaks

We have decomposed the mm light curves into individual exponential flares, each of which corresponds to a new disturbance created in the jet and is often detectable as a new VLBI component. We further calculate the phase of the mm-flare when the most prominent maxima in the 1FGL light curves occurred.

Our analysis shows that the strongest γ-ray flares tend to occur during the rising or peaking stages of a mm-flare. See Figure 2 for a glimpse of this connection on 3C 345.

The location of the strongest γ-ray flares.

For each source we estimate the time delay between the time of mm-flare inception (*green circle in Fig.2*) and when the γ-ray peak occurs (*filled triangle in Fig.2*). The observed time delay has a distribution centered around **70 days** with the inception of the mm-flare preceding the γ-ray peak.

After converting the time delays to linear distances from the region where the mm-outburst begins (i.e. the radio-core) to the region of the γ-ray production, our estimates lead us to conclude that in our sample the average location of the γ-ray emission region is about **7 parsecs** downstream the radio-core.

Statistically speaking , the strongest γ-ray flares occur during the rising/peaking stages of a mm-flare and originate in the same disturbances (shocks) that produce the mm outburst around, or more likely, downstream of the radio-core and far outside the classical BLR.

For details and references see Leon-Tavares et al. 2011, submitted to A&A, arXiv:1102.1290