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Blazar flares at the cosmic dawn: uncovering relativistic jets at z>4

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High-redshift blazars ($z > 3$) allow us to probe their jets at radio frequencies down to the central black hole due to reduced opacity in the rest frame of the source and to study the accretion processes and black hole growth in the early Universe. However, the detection of gamma-ray emission from these distant sources is difficult–only about a dozen have been detected by Fermi-LAT > 100 MeV. We designed a program utilizing Fermi-LAT data during gamma-ray flares to obtain quasi simultaneous multiwavelength data to study the activity of high-z blazars and ultimately determine the gamma-ray production sites and mechanisms and compare them to the blazars in the local Universe.
In our presentation we will discuss our findings for the blazars TXS 1508+572 ($z = 4.31$) and B3 1428+422 ($z = 4.71$) during extremely luminous gamma-ray flares, including jet kinematics features from a high-frequency VLBI campaign for TXS 1508+572. Based on gamma-ray luminosity, these flares are among the brightest detected with LAT so far. The multiwavelength data can be well described by a one-zone leptonic model with parameters in agreement with the VLBI data, and which requires black hole masses $> 10^9$ solar masses based on the signature from the accretion disk. In addition, we find that the observed flux variability is strongest in the infrared band, and we measure a significant fraction of polarization in the optical R band from the underlying synchrotron emission component.

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