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GeV Gamma-Ray Detection from Intense GRB 240529A During the Afterglow's Shallow Decay Phase

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X-ray light curves of gamma-ray burst (GRB) afterglows exhibit various features, with the shallow decay phase being particularly puzzling. While some studies report absence of the X-ray shallow decay for hyper-energetic GRBs, recently discovered GRB 240529A shows a clear shallow decay phase with an isotropic gamma-ray energy of 2.2×10^{54} erg, making it a highly unusual case compared to typical GRBs.
In order to investigate the physical mechanism of the shallow decay, we perform the Fermi -LAT analysis of GRB 240529A along with Swift-XRT analysis. We find no jet break feature in the X-ray light curve and then give the lower bound of the collimation-corrected jet energy of $>10^{52}$ erg, which is close to the maximum rotational energy of a magnetar. Our LAT data analysis reveals GeV emission with a statistical significance of 4.5σ during the shallow decay phase, which is the first time for hyper-energetic GRBs with a typical shallow decay phase.
The GeV to keV flux ratio is calculated to be 4.2 ± 2.3. Together with X-ray spectral index, this indicates an inverse Compton origin of the GeV emission. Multiwavelength modeling based on time-dependent simulations tested two promising models, the energy injection and wind models. While the energy injection model shows a tension with LAT data, both models can explain the X-ray and GeV data.
We present our results along with the future prospects of the current or next generation gamma-ray telescopes for distinguishing between the shallow decay models.

Collaboration(s)

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