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GeV emission from a compact binary merger

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The origin of gamma-ray bursts (GRBs) is still mysterious. We believe that binary neutron star (BNS) mergers produce short GRBs, while long GRBs are associated to the collapse of massive stars.

This GRB dichotomy, based on the duration of the prompt pulse, was recently challenged by the detection of the bright and relatively close (z=0.076) GRB 211211A. Despite its long duration (~30 s), the discovery of an optical-infrared kilonova (KN) points to a compact object binary merger origin.

We have analysed the radio-to-GeV afterglow emission of this source. In particular, the analysis of the high energy (HE, 0.1-10 GeV) data, provided by Fermi/LAT, revealed a significant emission (> 5sigma) detected in two epochs at late times (~10^3 and ~10^4 s after the burst) with approximately constant flux (~5e10 erg/cm^2/s).

The multi-wavelength afterglow emission is well modelled by synchrotron emission from electrons accelerated in the forward shock (FS). The model includes also the optical/NIR KN emission, which accounts for the excess in the r-band, and synchrotron-self-Compton, which is not dominant at these energies (< 10 GeV).
Nonetheless, the LAT emission in the second epoch (~10^4 s) is in substantial excess with respect to the FS+KN best-fit model.

This intrinsically faint excess (Liso~10^46 erg/s) was never observed before in neither short nor long GRB populations.

We interpret this new spectral component as external Inverse Compton (EIC) emission from KN optical photons and electrons accelerated in the low-power jet.

The discovery of the late-time HE excess in GRB 211211A strongly challenges our current understanding of emission processes occurring in gamma-ray burst, especially at high energies, and opens a new observational window for kilonovae, which can possibly be observed also in the ~GeV spectrum.

Track

GRBs

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