GRB 130427A: A Nearby Ordinary Monster

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The long-duration gamma-ray burst GRB 130427A, detected on 27 April 2013, is the most powerful GRB (gamma-ray burst) at $z < 0.9$ with the luminosity of $L \sim 3 \times 10^{53}$ erg s^{-1} and the redshift of $z = 0.34$. We performed multiwavelength observations with the Swift satellite and ground-based facilities (Liverpool telescope, Faulkes Telescope North, and MITSuME Telescopes) just after the trigger event, and studied the X-ray, UV, and optical light curves and spectral energy distributions, including γ-ray and radio data [1].

GRB 130427A was also detected by the Fermi Gamma-ray Burst Monitor (GBM) aboard the Fermi Gamma-ray Space Telescope, and the high energy γ-ray emission with the most energetic photon at 95 GeV was detected for 20 hours [2]. The Burst Alert Telescope (BAT) onboard the Swift satellite observed the highest fluence for a GRB with a total fluence of $4.985 \pm 0.002 \times 10^{-4}$ erg cm^{-2} in the 15–150 keV band. In the X-ray light curve, a break at 424 ± 8 s is detected between an initially steep decay with index $\alpha_{0,x} = 3.32 \pm 0.17$ and a flatter decay with index $\alpha_{1,x} = 1.28 \pm 0.01$ (see Figure 1). Then we found that a further break at 48 ± 22 ks is needed to interpret a further steep decay with index $\alpha_{2,x} = 1.35 \pm 0.02$. In the optical and UV light curves, a break at $37^{+4.7}_{-4.0}$ ks is detected among a decay with index $\alpha_1 = 0.96 \pm 0.01$ and a further steep decay with index $\alpha_2 = 1.36^{+0.01}_{-0.02}$. Assuming the break at $37^{+4.7}_{-4.0}$ ks as a jet break, we can derive the opening angle of $\theta_j \sim 3°$ and the collimation corrected energy of $E_\gamma = 10^{51}$ erg.

It follows the spectral energy correlations between the rest-frame peak energy E_{peak}(= 1028 ± 8 keV) and the isotropic peak luminosity which are typically seen in the powerful GRBs at higher redshifts of $z \sim 1$–2 [3]. This suggests that these huge explosions are driven by a common central engine from the early to the present universe. Then, a broad-lined Type Ic supernova, SN 2013cq, associated with GRB 130427A was detected [4], which suggests the existence of supernovae associated with the powerful and high-z GRBs.

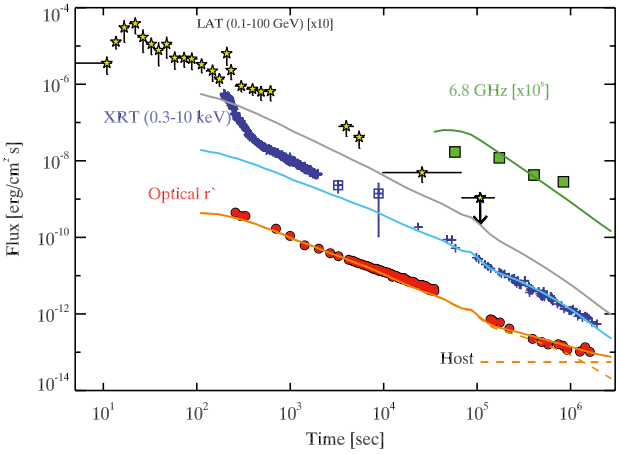

Figure 1: Multiwavelength light curves of GRB 130427A [1]. γ-ray data are from Fermi-LAT. X-ray data are from Swift-XRT and MAXI (Monitor of All-sky X-ray Image). Optical data are from ground-based facilities, including the Akeno Observatory (Tokyo Tech Akeno MITSuME Telescope), Okayama Astrophysical Observatory (NAOJ), and Ishigakijima Astronomical Observatory (Mizusawa VLBI Observatory, NAOJ). Radio data are from VLA (Karl G. Jansky Very Large Array) [5]. Solid lines represent the light curves predicted by the van Eerten et al. synchrotron model [6].

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