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Revisiting the Spectral-Energy Correlations of GRBs with {\it Fermi} Data I:\\ Model-wise Properties

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Gamma-ray bursts (GRBs) exhibit a diversity of spectra. Several spectral models (e.g., Band, cutoff power-law, and blackbody) and their hybrid versions (e.g., Band+blackbody) have been widely used to fit the observed GRB spectra. Here, we attempt to collect all the bursts detected by {\it Fermi}-GBM with known redshifts from July 2008 to May 2022, motivated to (i) provide a parameter catalog independent from the official \emph{Fermi}/GBM team and (ii) achieve a "clean" model-based GRB spectral-energy correlation analysis. A nearly complete GRB sample was created, containing 153 such bursts (136 long gamma-ray bursts and 17 short gamma-ray bursts). Using the sample and by performing detailed spectral analysis and model comparisons, we investigate two GRB spectral-energy correlations: the cosmological rest-frame peak energy ($E_{\rm p,z}$) of the νF_ν prompt emission spectrum correlated with (i) the isotropic-bolometric-equivalent emission energy $E_{\gamma,\rm iso}$ (the Amati relation), and (ii) the isotropic-bolometric-equivalent peak luminosity $L_{\rm p,iso}$ (the Yonetoku relation). From a linear regression analysis, a tight correlation between $E_{\rm p,z}$ and $E_{\gamma,\rm iso}$ (and $L_{\gamma,\rm iso}$) is found for both the Band-like and CPL-like bursts \textcolor{red}{(except for CPL-like burst $E_{\rm p,z}$-$E_{\gamma,\rm iso}$ correlation)}. More interestingly, the CPL-like bursts do not fall on the Band-like burst Amati and Yonetoku correlations, suggesting distinct radiation processes, and pointing towards the fact that these spectral-energy correlations are tightly reliant on the model-wise properties.

Primary authors: Mr LI, Liang (ICRANet, Piazza della Repubblica 10, I-65122 Pescara, Italy); Mr LI, Liang (ICRANet, Piazza della Repubblica 10, I-65122 Pescara, Italy)

Presenter: Mr LI, Liang (ICRANet, Piazza della Repubblica 10, I-65122 Pescara, Italy)

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