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A new intrinsic intrinsic 3 parameter correlation in Gamma Ray Bursts

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An analysis of 176 GRBs with known redshift observed by Swift which present afterglow plateau revealed a new tri-parameter correlation ($L_{\text{peak}}, L_x, T_a$) where L_{peak} is the peak luminosity in the prompt emission, L_x is the luminosity at the end of the plateau emission and T_a is the rest frame time at the end of the plateau emission. We have already proven the intrinsic nature of the $L_x - T_a$ (Dainotti et al. 2013a) and the $L_{\text{peak}} - L_x$ correlation (Dainotti et al. 2015b) through the Efron & Petrosian (1992) method.

We here show the intrinsic slope of this new correlation whose intrinsic scatter is 10% less than the one for the $L_x - T_a$ correlation, therefore this new relation can be more useful as a cosmological tool.

In addition, we show how the separation between categories of GRB-SNe, X-ray Flashes and short GRBs with extended emission are displayed in the 3D space. It is advisable to divide the categories before using this correlation for cosmological study.

Finally, we also present the $L_{\text{peak}} - T_{90}$ correlation, where T_{90} is the time where the 90% of the prompt emission is emitted between 5% and 95%. This correlation is weaker than the $L_{\text{peak}} - T_a$ one, thus favoring the choice of T_a as a preferred time as a third parameter in the 3D mentioned correlation.

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