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Comprehension of jet physics from the analysis of Swift Gamma-Ray Bursts

The first observation of a short Gamma-Ray Burst in association with a Gravitational Wave opened a new era in the high energy astrophysics. The measured T90 of GRB170817A, of about 2 s, reinforces the necessity of a new way of classification. For this reason, we analyse at the Swift-BAT prompt emission data by applying a classification procedure that uses a machine learning technique that searches for similarities in the light curves. Two distinct groups could be identified, although still correlated with standard T90 duration. Since a jet viewed off-axis could explain the emission from GRB170817A, the modelling of this kind of sources is of great importance. A public code called JetFit, based on the "boosted fireball"model, is applied to fit Swift-XRT afterglow light curves of short and long Gamma-Ray Bursts, with known redshift, from 2005 to 2021. JetFit does not model the flaring activity. For this reason, a new procedure to remove the flaring phases has been developed. The distributions of the best-fit parameters, grouped according to the classification given by the machine learning algorithm, describe the physics of our sample. The mean values of the JetFit parameters can be used to compute the Synchrotron part of a typical Gamma-Ray Bursts afterglow emission model. Given the Synchrotron mechanism, it is possible to obtain a prediction on the Synchrotron Self-Compton high-energy component by building a general model based on physical parameters of the afterglow.

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