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GRB optical and X-ray plateau properties classifier using unsupervised machine learning

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The division of gamma-ray bursts (GRBs) into different classes, other than the 'short' and 'long', has been an active field of research. We investigate whether GRBs can be classified based on a broader set of parameters, including prompt and plateau emission ones. Observational evidence suggests the existence of more GRB subclasses, but results so far are either conflicting or not statistically significant. The novelty here is producing a machine-learning-based classification of GRBs using their observed X-rays and optical properties. We used two data samples: the first, composed of 203 GRBs, is from the Neil Gehrels Swift Observatory (Swift/XRT), and the latter, composed of 134 GRBs, is from the ground-based Telescopes and Swift/UVOT. Both samples possess the plateau emission (a flat part of the light curve happening after the prompt emission, the main GRB event). We have applied the Gaussian mixture model (GMM) to explore multiple parameter spaces and subclass combinations to reveal if there is a match between the current observational subclasses and the statistical classification. With these samples and the algorithm, we spot a few microtrends in certain cases, but we cannot conclude that any clear trend exists in classifying GRBs. These microtrends could point towards a deeper understanding of the physical meaning of these classes (e.g. a different environment of the same progenitor or different progenitors). However, a larger sample and different algorithms could achieve such goals. Thus, this methodology can lead to deeper insights in the future.

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