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GRB cosmology with the fundamental plane in optical and X-rays and feasibility of GRB samples for future cosmological constraints

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Cosmological models and the values of their related parameters are widely debated, due to tension in the results obtained by Planck measurements of the Cosmic Microwave Background (CMB) Radiation in the early universe, and Supernovae Type Ia (SNe Ia) data within the late universe. Therefore, we must also consider high-redshift cosmological probes to properly reconstruct a chronological cosmos and diminish discrepancy. We thus employ Gamma Ray Bursts (GRBs) as standardizable candles. To this end, we need to consider tight correlations among GRB physical properties. A good candidate to standardize GRBs is the 3D fundamental plane relation between the rest-frame end time of the X-ray emission plateau, its corresponding luminosity, and the peak prompt luminosity. This correlation has been also discovered in optical emissions. We use Baryon Acoustic Oscillations (BAOs), given their reliability as standard rulers, SNe Ia, as ideal standard candles, and GRBs with the purpose of extending the \textcolor{green}{cosmological} distance ladder \textcolor{green}{up to} high-z. We accurately constrain the matter content of the universe today, Ω_M, the Hubble constant H_0, and the dark energy parameter w for a wCDM model. We simulate additional GRBs using Monte Carlo methods to infer the number of which are needed to obtain parametric errors comparable to those obtained by SNe Ia data only. This approach allows us to set a time estimate on obtaining these results, and more importantly, the sample size needed in observational data collected by current and future satellites, telescopes, and deep space surveys.

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