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Cosmology with Type Ia supernovae: Searching for systematics and model independent reconstructions

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We analyze the Joint Light-curve Analysis (JLA) Type Ia supernovae (SN Ia) compilation implementing the non-parametric iterative smoothing method. We explore the SN Ia light-curve hyperparameter space and find no dark energy model dependence nor redshift evolution of the hyperparameters. We also analyze the more recent Pantheon SN Ia compilation to search for possible deviations from the expectations of the concordance Λ CDM model. We demonstrate that the redshift binned best fit parameter values oscillate about their full dataset best fit values with considerably large amplitudes. At the redshifts below $z \approx 0.5$, we show that such oscillations can only occur in 4 to 5% of the simulations. This might be a hint for some behavior beyond the predictions of the concordance model or a possible additional systematic in the data. In addition, we develop a non-parametric approach using the distribution of likelihoods from the iterative smoothing method. It determines consistency of a model and the data without comparison with another model. Simulating future WFIRST-like data, we show how confidently we can distinguish different dark energy models using this approach.

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