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Modelling the impact of host galaxy dust on type Ia supernova distance measurements

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Abstract

Type Ia Supernovae (SNe Ia) are a critical tool in measuring the accelerating expansion of the universe. Recent efforts to improve these standard candles have focused on incorporating the effects of dust on distance measurements with SNe Ia. In this paper, we use the state-of-the-art Dark Energy Survey 5 year sample to evaluate two different families of dust models: empirical extinction models derived from SNe Ia data, and physical attenuation models from the spectra of galaxies. Among the SNe Ia-derived models, we find that a logistic function of the total-to-selective extinction RV best recreates the correlations between supernova distance measurements and host galaxy properties, though an additional 0.02 magnitudes of grey scatter are needed to fully explain the scatter in SNIa brightness in all cases. These empirically-derived extinction distributions are highly incompatible with the physical attenuation models from galactic spectral measurements. From these results, we conclude that SNe Ia must either preferentially select extreme ends of galactic dust distributions, or that the characterisation of dust along the SNe Ia line-of-sight is incompatible with that of galactic dust distributions.

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