Preprint Series in Particles and Cosmos Physics

nº IPARCOS-UCM-24-001

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The Dark Energy Survey Supernova Program: Cosmological Analysis and Systematic Uncertainties on a quantum computer with direct encoding

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January 2024

Plaza de las Ciencias, 1 28040 Madrid, Spain

www.ucm.es/iparcos/

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Abstract

We present the full Hubble diagram of photometrically-classified Type Ia supernovae (SNe Ia) from the Dark Energy Survey supernova program (DES-SN). DES-SN discovered more than 20,000 SN candidates and obtained spectroscopic redshifts of 7,000 host galaxies. Based on the light-curve quality, we select 1635 photometrically-identified SNe Ia with spectroscopic redshift 0.10<z<1.13, which is the largest sample of supernovae from any single survey and increases the number of known z>0.5 supernovae by a factor of five. In a companion paper, we present cosmological results of the DES-SN sample combined with 194 spectroscopically-classified SNe Ia at low redshift as an anchor for cosmological fits. Here we present extensive modeling of this combined sample and validate the entire analysis pipeline used to derive distances. We show that the statistical and systematic uncertainties on cosmological parameters are σΛCDMΩM,stat+sys=0.017 in a flat ΛCDM model, and (σΩM,σw)wCDMstat+sys=(0.082, 0.152) in a flat wCDM model. Combining the DES SN data with the highly complementary CMB measurements by Planck Collaboration (2020) reduces uncertainties on cosmological parameters by a factor of 4. In all cases, statistical uncertainties dominate over systematics. We show that uncertainties due to photometric classification make up less than 10% of the total systematic uncertainty budget. This result sets the stage for the next generation of SN cosmology surveys such as the Vera C. Rubin Observatory's Legacy Survey of Space and Time.

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