X52a Simulating Galaxy Colors for Next-Generation Photometric Surveys

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Next-generation surveys such as the Rubin Observatory Legacy Survey of Space and Time (LSST) and the Subaru Hyper Suprime-Cam (HSC) Survey offer an unprecedented amount of data in the form of magnitudes and colors (differences in magnitudes at various wavelengths). Developing a physically consistent simulation encompassing multi-wavelength and multi-cosmic epoch observations is crucial to maximally infer galaxy formation physics from these surveys. However, replicating observed color distributions remains a significant challenge due to the wide range of timescales of the physical processes involved, spanning from approximately 10^7 to 10^{10} years. In this study, we extend the empirical galaxy formation model, UniverseMachine (Behroozi et al., 2019), to forward model observable color distributions in the optical regime for redshift < 0.1. More photometric bands, redshift ranges, and surveys are being implemented. Theoretical implications include an unbiased picture of the connection between galaxy and halo growth while self-consistently modeling dust and other observational effects. Implications for observers are accurate handling of selection functions and highly realistic mock catalogs for the next-generation large-volume surveys informed by the latest observations. The broader impacts are constraints on both cosmology and galaxy formation physics.