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Examining the Hubble tension with differences in supernova and host galaxies properties

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The Hubble constant H_0 corresponds to the present time (z=0) value of the Hubble parameter $H(z)$, giving us the Universe's local expansion rate and providing crucial information about its age and history. When comparing the different results of the H_0 from the early-time measurements using the standard ΛCDM cosmological model, and the ones estimated directly from late-time measurements using the Cepheid-based Cosmic Distance Ladder, a persistent 4-6σ disagreement between both estimations emerges. This discrepancy, known as the Hubble tension, represents a significant crisis in cosmology and can indicate the need for new physics, or, at the very least, unexpectedly large systematic errors in either or both of the two principal measurements. The accuracy of the distance ladder method relies on the precise matching of the supernovae population properties and their host environments in the calibration and the Hubble Flow (HF) galaxies, which is taken for granted in almost all studies using this technique.

In this project, we investigate and compare the supernovae characteristics as well as their host galaxy properties of both the calibration and Hubble Flow samples, concluding that the stellar mass (M) and specific star formation rate (sSFR) distributions of the calibration sample supernovae might not be representative of the ones in the Hubble Flow sample. We also obtain a subsample from the HF sample that better matches the calibration sample to understand the impact in the Hubble parameter estimation and derive a more accurate correction for SNe Ia luminosities. However, we conclude that there is no noticeable relation between the better concordance between the different properties distributions of the SNe and their host galaxies and the estimated correction parameters, and that a subsample from the Hubble Flow sample capable of independently reducing the Hubble tension may not exist.

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