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A Ratio-Preserving Approach to Concordance Cosmology

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Cosmological observables are particularly sensitive to key ratios of energy densities and rates, both today and at earlier epochs of the Universe. Well-known examples include the photon-to-baryon and the matter-to-radiation ratios. Equally important, though less publicized, are the ratios of pressure-supported to pressureless matter and the Thomson scattering rate to the Hubble rate around recombination, both of which observations tightly constrain. Preserving these key ratios in theories beyond the Λ Cold-Dark-Matter (ΛCDM) model ensures broad concordance with a large swath of datasets when addressing cosmological tensions. We demonstrate that a mirror dark sector, reflecting a partial $\mathbb{Z}_2$ symmetry with the Standard Model, in conjunction with percent level changes to the visible fine-structure constant and electron mass which represent a *phenomenological* change to the Thomson scattering rate, maintains essential cosmological ratios. Incorporating this ratio preserving approach into a cosmological framework significantly improves agreement to observational data ($\Delta\chi^2 = -35.72$) and completely eliminates the Hubble tension with a cosmologically inferred $H_0 = 73.80 \pm 1.02$ km/s/Mpc when including the SH_0ES calibration in our analysis. While our approach is certainly nonminimal, it emphasizes the importance of keeping key ratios constant when exploring models beyond ΛCDM.

Mini Symposia (Invited Talks Only)

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