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Bayesian Analysis and Hubble Tension in Bulk Viscous Cosmological Model in f(R, L_m) Gravity

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In this work, we investigate the cosmic expansion history and address the Hubble tension within a bulk-viscous cosmological model in 𝒇(𝑹,𝑳𝒎) modified gravity. Considering the specific functional form 𝒇(𝑹,𝑳𝒎) = αR + β𝑳𝒎, we derive the modified field equations using a flat Friedmann-Lemaitre-Robertson-Walker (FLRW) metric in a matter-dominated era with bulk viscosity 𝜻 = −3 𝜻 𝑯. We utilize recent independent observational datasets, including Cosmic Chronometers (CC), Pantheon+SH0ES Type Ia Supernovae, and DESI Baryon Acoustic Oscillations (BAO), to perform a robust Bayesian learning analysis via the PyMC3 library. The dynamical features of the model—including the effective energy density, cosmic pressure, effective equation of state (EOS) parameter, and deceleration parameter—are reconstructed using the extracted best-fit parameters. Our findings show a smooth transition from a decelerating phase (𝒒 > 0) to an accelerating phase (𝒒 < 0), yielding a transition redshift of 𝒛𝒕 = 0.725 for the DESI dataset and 𝒛𝒕 = 0.898 for the joint compilation. Finally, the physical viability of the model is confirmed by verifying the energy conditions, where the Strong Energy Condition (SEC) is characteristically violated at late times, matching experimental limits.

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