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Flash talk: Beyond Λ CDM: Probing Structure Growth and Observational Viability of Generalized $f(Q, \mathcal{L}_m)$ Gravity

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$f(Q, \mathcal{L}_m)$ gravity is a well-known extension of $f(Q)$ gravity, obtained through non-minimal or additive minimal coupling in the action's Lagrangian density. Existing literature within the framework of $f(Q, \mathcal{L}_m)$ has explored the cosmographic scenario through various approaches, including background-level analyses and comparisons with Λ CDM (Myrzakulov et al., Phys. Lett. B 139506, 2025; Hazarika et al., Physics of the Dark Universe 50, 102092, 2025). In this work, we investigate the additive minimal coupling in a generalized power-law form, $f(Q, \mathcal{L}_m) = -Q^\mu + \alpha \mathcal{L}_m^\nu + \beta$, where μ , ν , α , and β are the extra degrees of freedom introduced by the model. We derive the key cosmological evolution equation, the Hubble function $H(z)$, by adopting a suitable novel parametrization. A distinctive feature of this theoretical framework is the non-conservation of the matter sector (a non-conserved continuity equation), which we highlight and study under the condition $\nu \neq 1$; this non-conservation is significant, as it effectively mimics a particle creation scenario. We constrain the model's free and extra parameters, and examine their effects on the cosmographic scenario, using Observational Hubble Data (OHD), Baryon Acoustic Oscillation (BAO) measurements from DESI DR2, and three Type Ia Supernovae (SNe Ia) catalogs (Pantheon+, Union3, and the Dark Energy Survey). Since our framework inherently involves non-conservation, we extend the analysis beyond the background level to the perturbative regime, deriving the perturbed field equations of $f(Q, \mathcal{L}_m)$ together with the perturbed Euler and continuity equations, and study the growth of structure and the impact of the non-conservation term on the growth equation, further performing a joint observational analysis incorporating the $f\sigma_8$ probe. To statistically assess our results, we performed a Bayesian evidence analysis, treating Λ CDM as the reference model; based on this analysis, our non-conservative model shows a statistical edge over Λ CDM in several cases, depending on the dataset combination used. These results position non-conservative $f(Q, \mathcal{L}_m)$ gravity as a physically motivated and observationally testable alternative to Λ CDM, rooted in an effective particle-creation mechanism.

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