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Reconstruction of f(R) Gravity in Kaniadakis Holographic Dark Energy Model

Kaniadakis Holographic Dark Energy extends the standard holographic dark energy (HDE) model by integrating Kaniadakis entropy, a generalization of the classical Bekenstien-Hawking entropy. Kaniadakis entropy incorporates relativistic statistical mechanics into standard HDE model and is characterized by a deformation parameter K. This study aims to construct a new form of f(R) gravity theory by inserting the Kaniadakis holographic dark energy within the framework of the FLRW metric. The proposed model is then evaluated for its effectiveness in explaining the phenomenon of late-time cosmic acceleration. The viability of the model is assessed through several key criteria: the positivity of the effective gravitational coupling to avoid ghost instabilities; stability under cosmological perturbations and positivity of the scalar mode to preclude tachyonic behavior; consistency with the ΛCDM limit in the high-curvature regime; the emergence of a stable de Sitter phase at late times; and compatibility with local gravity tests via a chameleon mechanism. This work collectively tries to test and ensure the theoretical soundness and observational relevance of the reconstructed f(R) framework.

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