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Challenging ACDM with scalar-tensor f(R,T) gravity and thermodynamics of irreversible matter creation

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We investigate the possibility of gravitationally generated particle production via the mechanism of nonminimal curvature-matter coupling. An intriguing feature of this theory is that the divergence of the matter energy-momentum tensor does not vanish identically. We explore the physical and cosmological implications of the non-conservation of the energy-momentum tensor by using the formalism of irreversible thermodynamics of open systems in the presence of matter creation/annihilation. The particle creation rates, pressure, temperature evolution and the expression of the comoving entropy are obtained in a covariant formulation and discussed in detail. Applied together with the gravitational field equations, the thermodynamics of open systems lead to a generalization of the standard Λ CDM cosmological paradigm, in which the particle creation rates and pressures are effectively considered as components of the cosmological fluid energy-momentum tensor. We also consider specific models, and we compare the cosmology with a curvature-matter coupling with the Λ CDM scenario, and if it additionally gives rise to particle creation rates, creation pressures, and entropy generation through gravitational matter production in both low and high redshift limits.

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