High Energy Physics - Theory

Quantum field theory, gravity and cosmology in a fractal universe

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We propose a model for a power-counting renormalizable field theory living in a fractal spacetime. The action is Lorentz covariant and equipped with a Stieltjes measure. The system flows, even in a classical sense, from an ultraviolet regime where spacetime has Hausdorff dimension 2 to an infrared limit coinciding with a standard D-dimensional field theory. We discuss the properties of a scalar field model at classical and quantum level. Classically, the field lives on a fractal which exchanges energy-momentum with the bulk of integer topological dimension D. Although an observer experiences dissipation, the total energy-momentum is conserved. The field spectrum is a continuum of massive modes. The gravitational sector and Einstein equations are discussed in detail, also on cosmological backgrounds. We find ultraviolet cosmological solutions and comment on their implications for the early universe.

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