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Ricci Curvature in Noncommutative Geometry

Motivated by Gilkey's local formulae for asymptotic expansion of heat kernels in spectral geometry, we propose a definition of Ricci curvature in noncommutative settings. The Ricci operator of an oriented closed Riemannian manifold can be realized as a spectral functional, namely the functional defined by the zeta function of the full Laplacian of the de Rham complex, localized by smooth endomorphisms of the cotangent bundle and their trace. We use this formulation to introduce the Ricci functional in a noncommutative setting and in particular for curved noncommutative tori. This Ricci functional uniquely determines a density element, called the Ricci density, which plays the role of the Ricci operator. The main result of this paper provides an explicit computation of the Ricci density when the conformally flat geometry of the noncommutative two torus is encoded by the modular de Rham spectral triple. Joint work with R. Floricel and A. Ghorbanpour.