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The Gromov-Hausdorff distance in noncommutative geometry: convergence of spectral triples

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We present a distance on the class of metric spectral triples. It thus becomes possible to formally discuss the idea of approximating a spectral triple with others: for instance, to approximate a spectral triple on the 2-torus by means of natural spectral triples on the finite dimensional so-called fuzzy tori.

A spectral triple induces an extended pseudo-metric on the state space of its underlying C^* -algebra, which under reasonable conditions, gives rise to a quantum compact metric space. In addition, the Dirac operator of a spectral triple, as a self-adjoint operator, generates a 1-parameter unitary group. Putting these ideas together in a covariant version of the propinquity for modules, we obtain a well-defined, well-behaved metric on spectral triples. In addition to the convergence of spectral triples on fuzzy tori, or the approximations of the spectral triples on some fractals by means of spectral triples on graphs, we also prove that convergence for the spectral propinquity implies a natural convergence of the spectra of the Dirac operators, and under mild conditions, of the associated spectral actions.

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