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Double scaling limits of Dirac ensembles and Liouville quantum gravity

In this work we study ensembles of finite real spectral triples equipped with a path integral over the space of possible Dirac operators. In the noncommutative geometric setting of spectral triples, Dirac operators take the center stage as a replacement for a metric on a manifold. Thus, this path integral serves as a noncommutative analogue of integration over metrics, a key feature of a theory of quantum gravity. From these integrals in the so-called double scaling limit we derive critical exponents of minimal models from Liouville conformal field theory coupled with gravity. Additionally, the asymptotics of the partition function of these models satisfy differential equations such as Painlevé I, as a reduction of the KDV hierarchy, which is predicted by conformal field theory. This is all proven using well-established and rigorous techniques from random matrix theory. (Based on joint work with H. Hessam and N. Pagliaroli in arXiv:2204.14206)