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Generalised Kontsevich-Vishik trace associated with a graph

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I shall report on ongoing work with S. Scott and B. Zhang by which we generalise regularised spectral zeta functions to a generalised Kontsevich-Vishik trace associated with a Feynman graph. These in turn generalise Feynman amplitudes on a Riemannian manifold studied by Dang and Zhang [JEMS 2021] in two ways. Whereas they consider graphs decorated by a single Riemannian Laplacian on a Riemannian manifold, we consider a general closed manifold and decorate the edges of the graph with arbitrary classical pseudo-differential operators. Whereas Dang and Zhang use complex powers of the Laplacian to regularise, we consider general holomorphic perturbations of the operators decorating the edges. Similarly to their approach, our method involves several complex parameters in the spirit of analytic renormalisation by Speer. We claim that the resulting regularised Feynman amplitudes admit analytic continuation as meromorphic germs with linear poles in the sense of the works of Guo, Paycha and Zhang. We give an explicit determination of the affine hyperplanes supporting the poles, which only depends on the Betti number of the graph and the orders of the operators. Neither the poles nor the method by which we determine them make use of the underlying geometry of the manifold.

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