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Kontsevich's Star-product up to Order Seven for Affine Poisson Brackets, or: Where are the Riemann Zeta Values?

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Noncommutative associative star products are deformations of the usual product of functions on smooth manifolds; in every star product, its leading deformation term is a Poisson bracket. Kontsevich's star products on finite-dimensional affine Poisson manifolds are encoded using weighted graphs with the ordering of directed edges. The associativity is then obstructed only by the Jacobiator (and its differential consequences) for the bi-vector which starts the deformation. Finding the real coefficients of graphs in Kontsevich's star-product expansion is hard in practice; conjecturally irrational Riemann zeta values appear from the fourth order onwards.

In joint work with R.Buring (arXiv:2209.14438 [q-alg]), we obtain the seventh-order formula of Kontsevich's star-product for affine Poisson brackets (in particular, for linear brackets on the duals of Lie algebras). We discover that all the graphs near the Riemann "zetas of concern"assimilate into differential consequences of the Jacobi identity so that all the coefficients in the star-product formula are rational for every affine Poisson bracket. Thirdly, we explore the mechanism of associativity for Kontsevich's star product for generic or affine Poisson brackets (and with harmonic propagators from the original formula for the graph weights): here, we contrast the work of this mechanism up to order six with the way associativity works in terms of graphs for orders seven and higher.

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