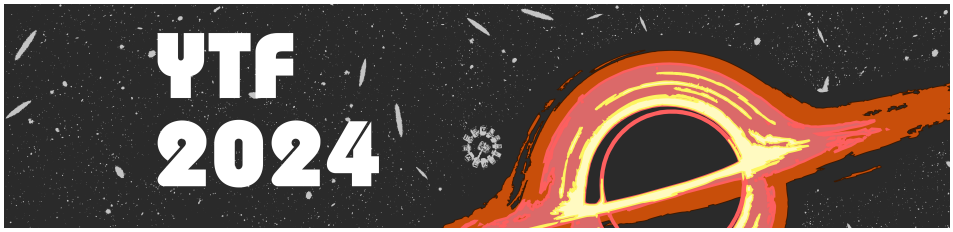

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Minimal Cuts and Genealogical Constraints on Feynman Integrals

Thursday, 19 December 2024 09:10 (30 minutes)

We introduce an efficient method for deriving hierarchical constraints on the discontinuities of individual Feynman integrals. This method can be applied at any loop order and particle multiplicity, and to any configuration of massive or massless virtual particles. The resulting constraints hold to all orders in dimensional regularization, and complement the extended Steinmann relations – which restrict adjacent sequential discontinuities – by disallowing ordered pairs of discontinuities from appearing even when separated by (any number of) other discontinuities. We focus on a preferred class of hierarchical constraints, which we refer to as genealogical constraints, that govern what singularities can follow from certain minimal cuts that act as the primogenitors of the discontinuities that appear in Feynman integrals. While deriving the full set of hierarchical constraints on a given Feynman integral generally requires identifying all solutions to the (blown up) Landau equations, these genealogical constraints can be worked out with only minimal information about what singularities may appear. We illustrate the power of this new method in examples at one, two, and three loops, and provide evidence that genealogical constraints restrict the analytic structure of Feynman integrals significantly more than the extended Steinmann relations.

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