

Analytic Structure of all Loop Banana Amplitudes

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Using the Gelfand-Kapranov-Zelevinsk\{i} system for the primitive cohomology of an infinite series of complete intersection Calabi-Yau manifolds, whose dimension is the loop order minus one, we completely clarify the analytic structure of all banana amplitudes with arbitrary masses. In particular, we find that the leading logarithmic structure in the high energy regime, which corresponds to the point of maximal unipotent monodromy, is determined by a novel $\widehat{\Gamma}$ -class evaluation in the ambient spaces of the mirror, while the imaginary part of the amplitude in this regime is determined by the $\widehat{\Gamma}$ -class of the mirror Calabi-Yau manifold itself. We provide simple closed all loop formulas for the former as well as for the Frobenius κ -constants, which determine the behaviour of the amplitudes, when the momentum square equals the sum of the masses squared, in terms of zeta values. We extend our previous work from three to four loops by providing for the latter case a complete set of (inhomogenous) Picard-Fuchs differential equations for arbitrary masses. This allows to evaluate the amplitude as well as other master integrals with raised powers of the propagators in very short time to very high numerical precision for all values of the physical parameters. Using a recent p -adic analysis of the periods we determine the value of the maximal cut equal mass four-loop amplitude at the attractor points in terms of periods of modular weight two and four Hecke eigenforms and the quasiperiods of their meromorphic cousins.

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