Bourjaily, Jacob L.; Mcleod, Andrew J.; Vergu, Cristian; Volk, Matthias; Von Hippel, Matt; Wilhelm, Matthias

Embedding Feynman integral (Calabi-Yau) geometries in weighted projective space. (English) Zbl 1434.81033

Summary: It has recently been demonstrated that Feynman integrals relevant to a wide range of perturbative quantum field theories involve periods of Calabi-Yau manifolds of arbitrarily large dimension. While the number of Calabi-Yau manifolds of dimension three or higher is considerable (if not infinite), those relevant to most known examples come from a very simple class: degree-$2^k$ hypersurfaces in $k$-dimensional weighted projective space $\mathbb{P}^{1,...,1,k}$. In this work, we describe some of the basic properties of these spaces and identify additional examples of Feynman integrals that give rise to hypersurfaces of this type. Details of these examples at three loops and of illustrations of open questions at four loops are included as supplementary material to this work.

MSC:
81Q30 Feynman integrals and graphs; applications of algebraic topology and algebraic geometry
81T15 Perturbative methods of renormalization applied to problems in quantum field theory
14J32 Calabi-Yau manifolds (algebro-geometric aspects)
53Z05 Applications of differential geometry to physics

Keywords:
differential and algebraic geometry; scattering amplitudes

Software:
SageMath; PALP; two loop amplitudes

Full Text: DOI arXiv

References:

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