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Picard–Fuchs Equations of Dimensionally Regulated Feynman Integrals

Monday, 3 June 2024 11:30 (1 hour)

Feynman integrals are relative period integrals. In this lecture, I will discuss various algorithms for determining the D-module of differential equations satisfied by the Feynman integrals. In integer dimension, we have a (relative) period of a rational differential form. One approach is the use of the Griffiths-Dwork algorithms, which have been adapted to the case of non-isolated singularities, generically present for Feynman integrals. The analysis will be illustrated with a class of two-loop Feynman integrals. The study of the geometry and Hodge theory of the cubic hypersurfaces attached to two-loop Feynman integrals for generic physical parameters will be presented. We will demonstrate that the Hodge structure associated with planar two-loop Feynman graphs decomposes into mixed Tate pieces and the Hodge structures of families of hyperelliptic, elliptic, or rational curves, depending on the space-time dimension. In general dimensions, we have a twisted differential form. We will then explain how to extend the Griffiths-Dwork reduction, making particular use of the properties of the graph polynomials entering the definition of the integrand. We will examine the manner in which the twist is incorporated into the Picard-Fuchs operators.

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