Analytic integration methods in quantum field theory

03.01

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Abstract: A survey is given on the present status of analytic calculation methods and the mathematical structures of zero-, single- and two-scale Feynman amplitudes, which emerge in higher order perturbative calculations in Quantum Field Theories and associated effective field theories. Main methods are guessing in the zero- and single-scale case, the method of generalized hypergeometric functions, Mellin-Barnes integrals, hyperlogarithms, difference and differential equations, as well as the Almkvist-Zeilberger algorithm. We also will discuss the different function spaces and algebras, which have been revealed during recent calculations from harmonic sums to elliptic integrals and modular forms and beyond.