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Asymptotic regularization method. A constructive approach

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Abstract

We introduce a new regularization scheme for divergent integrals in quantum field theory. The framework is based on the structural decomposition of the integrand asymptotic expansion, which distinguishes between contributions that drive UV singularities and those that remain finite. This asymptotic regularization method isolates the genuinely singular sector and enables a consistent subtraction of divergences while maintaining covariance and gauge symmetry. In single-scale theories, we show that the renormalized quantities exhibit a non-local logarithmic dependence uniquely determined by the UV asymptotics, offering a derivation of logarithmic terms that is independent of standard renormalization-group flows. Because it relies only on asymptotic structure rather than on standard relativistic power counting, the method is naturally applicable to theories with modified dispersion relations and non-standard UV scaling. Although formulated here for ultraviolet divergences, the underlying strategy extends straightforwardly to infrared singularities.

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