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Statistics of Feynman integrals at high loop order

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Recent progress in understanding the algebraic structure of Feynman integrals has lead to a new "tropical" numerical integration algorithm introduced by Borinsky and collaborators. For the first time, it is possible to systematically study the numerical values of very many Feynman integrals from a relatively broad class. I will present the findings of such a study that involved all subdivergence-free vertex-type Feynman graphs of phi^4 theory in 4 dimensions up to 13 loops, and partial data up to 18 loops. In total, more than 1.5 million vacuum integrals have been computed, amounting to over 20 million vertex-type integrals. The resulting data indicates that at high loop order, most Feynman integrals follow a smooth distribution, but higher moments of that distribution diverge. This has severe consequences for the accuracy of randomly sampling Feynman graphs. Moreover, this study has lead to new numerical data for the subdivergence-free contribution to the beta function up to 18 loops, confirming a longstanding prediction for the leading asymptotic growth of these coefficients.
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Keyword-3

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