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Statistics and correlations of primitive Feynman integrals

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A Feynman integral is called “primitive” if it is superficially divergent and does not contain subdivergences. The “period” of a primitive graph is the coefficient of logarithmic energy dependence, or equivalently the simple pole in minimal subtraction. In recent work [2305.13506, 2403.16217] together with Kimia Shaban, we numerically computed the periods of 2 million Feynman integrals in phi^4 theory up to 18 loops. This allows us to examine their distribution, various statistical features, and the correlation between the value of the period and properties of the underlying Feynman graph. We show proof-of-concept results how those correlations can be used in a weighted Monte Carlo sampling algorithm to compute the sum of periods (which constitutes the primitive contribution to the beta function) very efficiently.

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