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Differential equations method for expansion of hypergeometric functions

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In quantum field theory an important role is played by various hypergeometric functions. Of particular interest is their close relationship with Feynman loop integrals. The latter are used to calculate higher corrections in perturbation theory to the measurable physical processes. Which becomes especially important now that the accuracy of measurements is increasing. There are many ways to solve Feynman loop integrals using hypergeometric functions. These solutions have the common property that the indices of the hypergeometric function linearly depends on a small parameter. And for practical calculations, it is necessary to obtain a Laurent expansion in this small parameter. In this case, it is desirable that the expansion elements be expressed in terms of well-defined functions that can be calculated with arbitrary precision.

In this work we study the expansion of various hypergeometric functions in a Laurent series with respect to a small parameter in terms of multiple-polylogarithms. For this purpose, we mainly use the differential equation method and the Lee algorithm. Specifically, we will be interested in the generalized hypergeometric functions, the Appell and Lauricella functions. In these calculations, a particularly important role is played by the replacement of the variable: rational in one direction and irrational in the other. This issue is discussed with special attention.

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