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Evaluating 'elliptic' master integrals at special kinematic values: using differential equations and their solutions via expansions near singular points

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An algorithm to find a solution of differential equations for master integrals
in the form of an ϵ-expansion series with numerical coefficients
is presented. The algorithm is based on using generalized power series expansions near singular points
of the differential system, solving difference equations for the corresponding coefficients in these expansions
and using matching to connect series expansions at two neighboring points.
Four-loop generalized sunset diagrams with three massive and two massless propagators
are considered as an example. Analytical results for the three master integrals at threshold,
$p^2 = 9m^2$, in an expansion in
ep up to
ep^1 are obtained.
This is done with the help of the presented algorithm which us used to
obtain high precision values, with the accuracy of 20000 digits.
Then the PSLQ algorithm is applied to obtain results in an analytical form.
They are expressed in terms of multiple polylogarithm values
at sixth roots of unity.

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