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Development of a method for computing approximate solutions to linear evolution equations with application to the calculation of the heat kernel

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We propose a new method for computing approximate solutions of linear evolution equations with slowly varying coefficients. Using this method, we obtain an expansion of the heat kernel. We refer to this expansion as a derivative expansion because each subsequent term contains derivatives of the slowly varying coefficients of a higher order than the previous one does. We also propose a new operator approach for calculating the small-time asymptotic expansion of the heat kernel. It is possible to derive a non-diagonal small-time expansion up to an arbitrary order with this operator method. We explicitly obtain analytical expressions up to the second order in the time variable.

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