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Numerical Methods for Finite Temperature Effects in Quantum Field Theory

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The basic structure of quantum field theory that is used to describe the Standard Model of fundamental interactions of nature is usually formulated for zero temperature. However, the effects of temperature are extremely important for understanding a number of physical processes such as the electroweak phase transition and quark-gluon plasma.
The extension of quantum field theory to non-zero temperature is achieved by modifying the propagators in loop integrations represented by Feynman diagrams.
The Python package pySecDec is designed for numerical calculation of dimensionally regulated loop integrals.
The research goal is to develop a methodology to numerically calculate loop integrations for finite temperature effects in quantum field theory by adapting pySecDec functions and implementing them for such a purpose.
In this study, the methodology is used on one-loop self-energy to achieve numerical calculation results. The pySecDec methodology is validated in comparison to existing analytic results for this topology.

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Theory

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