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NLO quark self-energy and dispersion relation using the hard thermal loop resummation

Using the hard-thermal-loop (HTL) resummation in real-time formalism, we study the next-to-leading order (NLO) quark self-energy and corresponding NLO dispersion laws. In NLO, we have replaced all the propagators and vertices with the HTL effective ones in the usual quark self-energy diagram. Additionally, a four-point vertex diagram also contributes to the quark NLO self-energy. We calculate the usual quark self-energy diagram and the four-point vertex diagram separately. Using those, we express the NLO quark self-energy in terms of the three- and four-point HTL effective vertex functions. We express the integrals containing the three- and four-point HTL effective vertex functions in terms of the solid angles using the Feynman parametrization. After completing the solid angle integrals, we calculate the momentum integrals in the transverse part of the NLO quark self-energy numerically and plot them as a function of the ratio of momentum and energy. Using the NLO quark self-energy transverse part, we plot the transverse contribution of NLO dispersion laws.

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