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Multiloop functional renormalization group study of the Fermi polaron problem

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Imbalanced mixtures of strongly correlated fermions have been investigated both theoretically and experimentally for several decades. A single impurity immersed in a Fermi gas is subject to a transition from a bound molecule of two different fermion species to a so-called 'Fermi polaron' where the impurity forms a quasiparticle with the surrounding fermions [1]. We study the Fermi polaron problem theoretically in three dimensions in an experimentally more realistic setup where there is a finite density of the impurity particles. For this, we apply the recently developed multi-loop functional renormalization group (mfRG) which is an extension of the conventional functional renormalization group equivalent to the diagrammatic parquet formalism [2]. To handle the complexity of the four-point vertex, we make use of a decomposition into processes mediated by single-boson exchanges (SBE) [3]. With this elaborate numerical method, we aim to provide more reliable theoretical predictions such as the lifetime of the polaron. [1] R. Schmidt, T. Enss, Phys. Rev. A 83, 063620 (2011). [2] F. B. Kugler, J. von Delft, Phys. Rev. Lett. 120, 057403 (2018). [3] E. Walter, M. Gievers, A. Ge, J. von Delft, F. B. Kugler, aXiv:2201.04878 (2022).

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