Nuclear Theory

Second-order quasiparticle interaction in nuclear matter with chiral two-nucleon interactions

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We employ Landau's theory of normal Fermi liquids to study the quasiparticle interaction in nuclear matter in the vicinity of saturation density. Realistic low-momentum nucleon-nucleon interactions evolved from the Idaho N3LO chiral two-body potential are used as input potentials. We derive for the first time exact results for the central part of the quasiparticle interaction computed to second order in perturbation theory, from which we extract the L=0 and L=1 Landau parameters as well as some relevant bulk equilibrium properties of nuclear matter. The accuracy of the intricate numerical calculations is tested with analytical results derived for scalar-isoscalar boson exchange and (modified) pion exchange at second order. The explicit dependence of the Fermi liquid parameters on the low-momentum cutoff scale is studied, which provides important insight into the scale variation of phase-shift equivalent two-body potentials. This leads naturally to explore the role that three-nucleon forces must play in the effective interaction between two quasiparticles.

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