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Nonanalytic spin susceptibility of interacting fermions away and near a ferromagnetic quantum phase transition DMITRII MASLOV, University of Florida, ANDREY CHUBUKOV, University of Wisconsin — We study nonanalytic paramagnetic response of an interacting Fermi system both away and in the vicinity of a ferromagnetic quantum phase transition (QCP). Previous studies found that the spin susceptibility χ scales linearly with either the temperature T or magnetic field H in the weak-coupling regime and that the interaction in the Cooper channel affects this scaling via logarithmic renormalization of prefactors of the T, $|H|$ term. We show that Cooper renormalization becomes effective only at very low energies, which get even smaller near a QCP. We derive the thermodynamic potential as a function of magnetization and show that it contains, in addition to regular terms, a non-analytic $|M|^3$ term, which becomes M^4/T at finite T. We consider the vicinity of a ferromagnetic QCP by generalizing the Eliashberg treatment of the spin-fermion model to finite magnetic field, and show that the $|M|^3$ term crosses over to a non-Fermi-liquid form $|M|^{7/2}$ near a QCP. The prefactor of the $|M|^{7/2}$ term is negative, which indicates that the system undergoes a first-order rather than a continuous transition to ferromagnetism. We compare two scenarios of the breakdown of a continuous QCP: a first-order instability and a spiral phase and show that in a model with a long-range interaction in the spin channel first-order transition occurs before the spiral instability.

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