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Ferromagnetic quantum phase transition in an itinerant three-dimensional system RONOJOY SAHA, DMITRII MASLOV, Dept. of Physics, University of Florida, Gainesville, FL 32611-8440, USA, ANDREY CHUBUKOV, Dept. of Physics, University of Wisconsin-Madison, 1150 University Avenue, Madison, WI 53706-1390, USA — The non-analytic behavior of the spin susceptibility both away and near the quantum critical point signals the breakdown of the Hertz-Millis scenario for a ferromagnetic quantum phase transition in itinerant systems. It is believed that in both 2D and 3D χ_s increases as a function of the magnetic field (H) or momentum (q), which indicates a tendency to either first order transition or ordering at finite q. We show that the 3D case is different from the 2D one. Away from the 3D critical point, the non-analytic part of χ_s can be of either sign, depending on microscopic parameters. The non-analyticity in 3D arises from two physically distinct processes: excitations of a single and three particle-hole pairs. Both processes contribute a $\max\{H^2, q^2\} \ln \max\{H^2, q^2\}$ term to χ_s, but the signs of these contributions are opposite. The single-pair process leads to an increase of χ_s with H, q whereas the three pair one corresponds to a decrease. In the paramagnon model, the three pair contribution always wins sufficiently close to the Stoner instability. We also discuss the behavior of χ_s in the immediate vicinity of the quantum critical point within the spin-fermion model.

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