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Thermodynamic properties of ultra-small metallic grains in the presence of pairing and exchange correlations KONSTANTIN NESTEROV, YORAM ALHASSID, Center for Theoretical Physics, Sloane Physics Laboratory, Yale University, New Haven, CT 06520, USA — We study the heat capacity and spin susceptibility of chaotic nano-size metallic grains in the ballistic regime with a large dimensionless Thouless conductance in the presence of superconducting and ferromagnetic correlations. Our analysis is based on a low-energy effective Hamiltonian, the universal Hamiltonian, that contains a sample-specific one-body part modeled by the random-matrix theory, a BCS-like pairing term and a ferromagnetic Stoner-like spin exchange term. The exchange interaction is taken into account exactly by means of the spin projection technique, and the pairing interaction is treated in the static-path approximation with the random-phase approximation correction. The exchange interaction shifts the number-parity effects induced by pairing correlations to lower temperatures, and may suppress the reentrant behavior of the spin susceptibility for an odd number of electrons in the grain. If the exchange coupling constant is sufficiently large and the pairing gap Δ is comparable to the single-particle mean level spacing δ, the number-parity effects are suppressed by mesoscopic fluctuations. The fluctuations of the spin susceptibility are particularly large in the presence of exchange correlations at $\Delta/\delta < 1$. This work was supported in part by U.S. DOE grant No. DE-FG-0291-ER-40608.

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