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Subgap states in dirty superconductors and their effect on dephasing in Josephson qubits ALESSANDRO SILVA, LEV IOFFE, Department of Physics and Astronomy, Rutgers University, Piscataway NJ 08854 — We present a theory of the subgap tails of the density of states in a diffusive superconductor containing magnetic impurities. We show that the subgap tails have two contributions: one arising from mesoscopic gap fluctuations, previously discussed by Lamacraft and Simons, and the other associated to the long-wave fluctuations of the concentration of magnetic impurities. We study the latter both in small superconducting grains and in bulk systems [$d = 1, 2, 3$], and establish the dimensionless parameter that controls which of the two contributions dominates the subgap tails. We observe that these contributions are related to each other by dimensional reduction. We apply the theory to estimate the effects of a weak concentration of magnetic impurities [$\approx$ 1p.p.m] on the phase coherence of Josephson qubits. We find that at these typical concentrations, magnetic impurities are relevant for the dephasing in large qubits, designed around a 10 μm scale, where they limit the quality factor to be $Q < 10^4 - 10^5$.

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