Resonance scattering and spatial variation of the order parameter in superconducting alloys

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The problem of spatial variation of the order parameter in the neighborhood of a nonmagnetic impurity with broadened d levels is investigated near the superconducting critical temperature. It is shown that, due to resonance scattering, a long-range-order variation (compared to the coherence length) actually occurs and several expressions, obtained through different methods of calculation, are given and analyzed. This spatial variation leads to a small increase of the critical temperature as compared to its magnitude calculated using the average value of the order parameter; the analytical expression for this increase is given explicitly. The physical implications of the theoretical results are discussed on the basis of Anderson's theorem, and the main conclusion is that the incoherent d-state admixture at the Fermi level yields a much more important contribution to the change in thermodynamic properties, because of the presence of impurities, than the one due to the spatial variation o