Manifestation of superconducting correlations above the critical temperature

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Phase transition to the superconducting/superfluid state occurs when the gauge symmetry of a system spontaneously breaks down due to appearance of the complex order parameter $\psi = \chi e^{i\phi}$. Its amplitude χ corresponds to the density of Bose-Einstein condensed fermion pairs (manifested indirectly by energy gap at the Fermi level) whereas rigidity of the phase ϕ controlls coherent behavior of the pairs (for instance $\nabla\phi \neq 0$ generates the supercurrents). In the case of charged particles, such as e.g. conduction band electrons, ϕ couples to the vector potential of electromagnetic field and through the Higgs mechanism triggers the ideal diamagnetism (Meissner effect).
We shall discuss how similar phenomena might be observable upon approaching the true phase transition T_c form above. For this purpose we explore the short-range superconducting correlations between the preformed pairs (of whatever origin). Using nonperturbative method, originating from the numerical renormalization group procedure, we find evidence for the remnants of superconducting features such as the Bogoliubov-type quasiparticles, enhancement of the pairing susceptibility, residual diamagnetism as well as signatures of the collective Goldstone mode above T_c. We shall confront our study with the recent experimental data obtained for cuprate superconductors and ultracold fermion superfluids.