Non-BCS Superconductivity in Cuprates from Attraction of Spin Vortices

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We propose a non-BCS mechanism for superconductivity in hole-underdoped cuprates based on a gauge approach to the t-J model [1]. The gluing force is a long-range attraction between spin vortices centered on the empty sites of two opposite Néel sublattices, leading to pairing of charge carriers (spinless holons). In the presence of these pairs, a gauge force coming from the single occupancy constraint induces, in turn, an RVB pairing of the spin carriers (spinons), gapped by scattering against spin-vortices. This gives rise to a finite density of incoherent hole pairs, precursor to superconductivity, supporting a Nernst signal whose contour plot is qualitatively consistent with experiments [2]. The true superconducting transition occurs at a even lower temperature via a planar XY-type transition and it involves a kinetic energy gain due to lowering of the spinon gap. Since the short-range AF order and the holon pairing originate from the same term of the t-J model, this approach incorporates a strong interplay between AF and SC, giving rise to a universal relation between the energy of the resonance mode (bound state of spinons) and T_c, as observed in neutron scattering experiments [3]. [1] P.A. Marchetti et al. J. Phys. Cond. Mat. (2007) 125209; [2] Y. Wang et al., PR B 73 (2006) 024510; [3] G. Yu et al., Nat. Phys. 5 (2009) 873.