Bose-Einstein condensation of superlight bipolarons in high-temperature superconductors

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We have identified the long-range Froehlich electron-phonon interaction as the most essential for pairing in novel superconductors owing to a poor screening [1], as now confirmed by some ARPES studies. Low energy physics is that of *superlight* small polarons and bipolarons (real-space hole pairs dressed by phonons in a doped charge-transfer Mott insulator). They are itinerant quasiparticles existing in the Bloch states at temperatures below the characteristic phonon frequency. Applying a novel continuous-time quantum Monte-Carlo algorithm (CTQMC) we present exact coherent band dispersions and the density of states of lattice (bi)polarons in the region of parameters where any approximation might fail fully taken into account the realistic Coulomb and electron-phonon interactions. Many experimental observations have been predicted or understood in the framework of our "Froehlich-Coulomb" model, including pseudo-gaps, in-plane and c-axis normal state transport, anisotropy, isotope effects, upper critical fields, the normal state Nernst effect , diamagnetism, and the Hall-Lorenz numbers. Our parameter-free descriptions of normal state diamagnetism, T_c, upper critical fields and specific heat anomalies support the 3D Bose-Einstein condensation of preformed real-space pairs with zero off-diagonal order parameter above the resistive critical temperature T_c at variance with phase fluctuation scenarios of cuprates.

[1] A.S. Alexandrov, "Theory of Superconductivity: From Weak to Strong Coupling" (IoP Publishing, Bristol and Philadelphia, 2003).