On a Direct Superconducting Pairing Mechanism

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We suggest that superconductivity can be traced back to a first-order interaction between the charge carriers which does not necessarily involve second-order electron-phonon coupling. For small molecular model systems it is demonstrated that the formation of Cooper pairs can lead to an attenuation of the destabilizing influence of the Pauli antisymmetry principle (PAP). We suggest that this attenuation of a fermionic quantum constraint is the driving force for the superconducting transition. Whenever the PAP is activated in single-particle hoppings of electrons, the corresponding moves reduce the electronic delocalization; they raise the ensemble energy. The stability of a fermionic system is enhanced with decreasing influence of the PAP. Moves of Cooper pairs are not influenced by any quantum constraint of the intersite type. This behaviour differs from the well-known fermionic constraints. The quantum statistics of Cooper pairs is of a mixed type combining a fermionic on-site and a bosonic intersite behaviour. It coincides with the quantum statistics of so-called hard core bosonic ensembles. In the present work Cooper pair formation has been studied for smaller molecular models. The electronic Hamiltonian employed is of the two-parameter Hubbard-type. The solid state phenomenon superconductivity is correlated with the molecular concepts of "antiaromaticity" and "aromaticity". Arguments are given which support the present interpretation.

Key words: Superconductivity; Possible First-Order Pairing Interaction; Quantum Statistics; Pauli Antisymmetry Principle; Superconductivity vs. Antiaromaticity and Aromaticity.