Electron Pair Currents in Electronic Ground States

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Electron transfer is possible in a symmetric molecular system if HOMO is degenerate and incompletely occupied. An infinite, repetitive system is conducting if it is delocalized and if the Fermi level is located in a continuous orbital energy band. In an ordinary metal, conductivity is due to electrons. Coupling to nuclear motion causes resistivity. Infinitely small excitations are always possible. In a superconducting system electron and nuclear motion are coupled so that there is an energy gap to the first excited state and hence no resistivity. Such coupling appears to be possible only if electron pairs are transferred.

Electron pair transfer in a molecular system is possible under certain conditions, which are quite obvious on the basis of the Marcus model. It is not hard to find systems where electron pair transfer is hindered by a large activation barrier or a small electronic factor. On the other hand, small barrier and large electronic factor occurs if two extended configurations (CDW and SDW) have nearly the same energy and if the reorganization energy is small.

In the talk I will show that the latter condition leads to currents in the ground state in a perpendicular magnetic field. I will also show that several square planar and linear systems, that have been found superconducting, fulfill the condition. A remaining problem is to show that the currents correspond to "perfect diamagnetism" and the Meissner-Ochsenfeld effect (in the square planar case). Another problem is to extend the theory to other types of structure.