T_CSUH Bi-Weekly Seminar

Texas Center for Superconductivity at the University of Houston

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Electronic Mechanism of Two-Dimensional D-Wave Superconductivity

Friday, March 28, 2008
Room 102, University of Houston Science Center
12:00 Noon – 1:00 p.m.

Abstract

Motivated by high-temperature superconductors, it is useful to discuss a BCS-like effective Hamiltonian for a two-dimensional d-wave superconductor independent of the origin of the pairing potential and to explore the consequences of such a model. A particular aspect of this model which has so far not received adequate attention is the intrinsic instability of the charge carriers towards phase separation. Such an instability can lead to phenomenologies strikingly similar to those observed in the cuprates including inhomogeneous superconductivity and the 'pseudogap' phase diagram. This raises the issue of how much of the cuprate phenomenology is independent of the origin of the pairing potential. In the case of the s-wave superconductors, it is well-known that most of the properties of the superconductors can be explained by an effective Hamiltonian which contains an attractive pairing potential which might or might not be mediated by phonons.

As an example of electronic mechanism for d-wave pairing, we have studied a model inspired by an idea proposed by W. A. Little in the sixties. In this model, a charge moving in a conduction plane can induce charge polarization in polarizable molecules surrounding the conduction plane. This polarization can in turn attract a second charge carrier thus establishing an effective attractive interaction between two carriers. For certain choice of parameters, the model does seem to exhibit d-wave superconductivity. Interestingly, the model also seem to exhibit phase separation.

For the cuprates, a more likely origin of the pairing force is probably interlayer polarization. Theoretical as well as experimental arguments will be presented to support this speculation.

Persons with disabilities who require special accommodations in attending this lecture should call (713) 743-8210 as soon as possible.