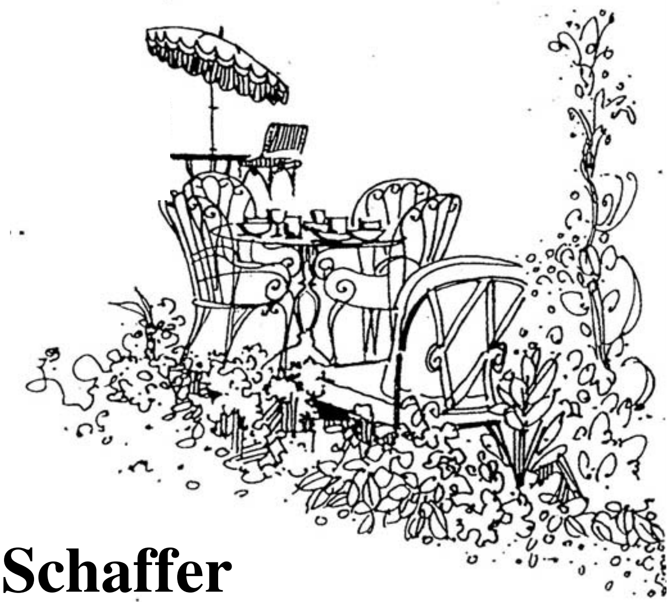
Chez Pierre

Presents ...



Friday, December 18, 2009

12:00pm

MIT Room 4-331

Annica Black-Schaffer

Nordita

"Superconductivity and Magnetism in Graphene: Effects of Electronic Correlations"

While not yet widely appreciated, electronic correlations appear to play an important role in graphene. In fact, already Pauling's resonance valence bond theory established that nearest-neighbor spin- singlet bond (SB) correlations are important in pp-bonded planar organic molecules of which graphene is the infinite extension. Through the use of a phenomenological Hamiltonian which includes SB correlations, we show that a superconducting time-reversal symmetry breaking d-wave state is possible at finite doping in graphene. DFT calculations are then used to study the charge transfer between graphene and sulfur, demonstrating that this d-wave superconducting state should be achievable in graphite-sulfur structures. We also show that in a d-wave contact SNS graphene Josephson junction the effects of the SB correlations are large even high above Tc. We therefore propose that such junctions will provide a promising experimental system for measuring the effective strength of the intrinsic SB correlations.

In addition, we study the magnetic properties of the same phenomenological Hamiltonian in undoped graphene and we show that here the SB correlations significantly enhance the RKKY coupling between two impurity magnetic moments. When matching our results to recent DFT calculations we not only establish that electronic correlations are essential to properly account for the behavior of the RKKY coupling but we also extract a surprisingly large value of the SB coupling constant, indicating that undoped graphene is very close to an antiferromagnetic instability.