MAR13-2012-020316

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Superconducting states in graphene

BRUNO UCHOA, University of Oklahoma

In spite of the remarkable electronic properties of graphene, which include the existence of massless Dirac quasiparticles, the low density of states near the Dirac points seems to conspire against the formation of new many body ground states. In this context, the search for intriscic superconductivity in graphene has involved either combining graphene with other materials [1], or else exploring ways to modify the electronic density of states at the Fermi level. In this talk, after discussing the classification of symmetry states in the honeycomb lattice and analysing the general thermodynamic properties for Dirac fermion superconductors [2], I will describe a few promissing mechanisms to induce superconductivity in graphene. In particular, I will show that in the situation where strain effects lead to a reconstruction of the vacuum into a discrete spectrum of Landau levels due to pseudo magnetic fields, which preserve overall time reversal symmetry, superconductivity is quantum critical at integer filling of the Landau levels, when the system is incompressible. At partial filling, the quenching of the kinetic energy due to the Landau levels leads to a crossover to a non-Fermi liquid regime, where the critical temperature scales linearly with the coupling in the weak coupling limit. I will show that the critical temperature can be orders of magnitude larger than in conventional weak coupling superconductors, and may be triggered by phonons.

[1] B. Uchoa, A. H. Castro Neto, Physical Review Letters 98, 146801 (2007);
[2] V. N. Kotov, B. Uchoa et al., Reviews of Modern Physics 84, 1067 (2012).