Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

The Coulomb Impurity Problem in Graphene VITOR PEREIRA, JOHAN NILSSON, ANTONIO CASTO NETO, Boston University — We address the problem of an unscreened Coulomb charge in graphene and calculate the local density of states and displaced charge as a function of energy and distance from the impurity. This is done nonperturbatively in two different ways: (1) solving the problem exactly by studying numerically the tight-binding model on the lattice and (2) using the continuum description in terms of the 2D Dirac equation. We show that the Dirac equation, when properly regularized, provides a qualitative and quantitative low energy description of the problem. The lattice solution shows extra features that cannot be described by the Dirac equation: namely, bound state formation and strong renormalization of the van Hove singularities.
[Reference: Phys. Rev. Lett. 99, 166802 (2007)].

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Date submitted: 20 Nov 2007 Electronic form version 1.4