Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Coulomb impurity under magnetic field in graphene: a semiclassical approach YUHUI ZHANG, National High Magnetic Field Laboratory and Department of Physics, Florida State University, YAFIS BARLAS, National High Magnetic Field Laboratory, Florida State University, KUN YANG, National High Magnetic Field Laboratory and Department of Physics, Florida State University —
We address the problem of a Coulomb impurity in graphene in the presence of a perpendicular uniform magnetic field. We show that the problem can be solved below the supercritical impurity magnitude within the WKB approximation. Without impurity the semiclassical energy correctly reproduces the Landau level spectrum. For values below the supercritical impurity magnitude the energy spectrum still evolves as square root B with a renormalized fine structure constant. For a given Landau level the WKB energy depends on the absolute value of angular momentum in a way which is consistent with the exact diagonalization result. Below the supercritical impurity magnitude, the WKB solution can be expanded as a convergent series in powers of the effective fine structure constant. Relevance of our results to validity of the widely used Landau level projection approximation is discussed.

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Date submitted: 09 Nov 2011 Electronic form version 1.4