Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Electron-hole asymmetry and band mass renormalization in bilayer graphene: elucidating the role of electron-electron interactions with first-principles GW calculations

LIANG Z. TAN, STEVEN G. LOUIE, Department of Physics, University of California at Berkeley and Materials Sciences Division, Lawrence Berkeley National Laboratory — The electron-hole asymmetry and the band masses of bilayer graphene are fundamental quantities in various phenomena and in the applications of this material. *A priori*, both of these quantities can depend on a number of microscopic mechanisms, including single-particle effects such as next-nearest neighbor hopping amplitude, as well as many-body effects such as the electron-electron interaction. We calculate the low energy electronic structure of bilayer graphene from first-principles, within the GW approximation. Our results indicate that both the electron-hole asymmetry and the band mass are strongly renormalized by electron-electron interactions. Our results are in good agreement with recent Shubnikov-de Haas experiments on bilayer graphene.

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Date submitted: 26 Nov 2011 Electronic form version 1.4