Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Formation and Characterization of Correlated Electron States at Room Temperature in Graphene Bilayers[1] JOHN SHUMWAY, Department of Physics, Arizona State University, Tempe, AZ, MATTHEW GILBERT, Department of Electrical and Computer Engineering, University of Illinios at Urbana-Champaign, Urbana, IL — The small dimensions of graphene bilayers suggest that exotic quantum states may be sustainable at room temperatures. In this work, we use quantum many-body computer simulations techniques with experimentally verified inputs to establish the transition temperature of an excitonic condensate in bilayer graphene and explore its transport properties [1]. To make robust predictions of the thermodynamic and transport properties of bilayers. we perform path integral Monte Carlo (PIMC) simulations of electrons and holes in two graphene layers separated by a one-nanometer thick oxide layer, which suppresses tunneling between layers while allowing for strong Coulomb correlations between layers. Top and bottom gates induce electron and hole densities of 5×10^{12} cm^{-2} in the two layers. As we vary the temperature, we see excitonic formation and Bose condensation. We calculate excitonic superfluid density from the winding statistics and estimate $T_c \sim 800$ K, well above room temperature. [1] M. J. Gilbert and J. Shumway, J. Comput. Electron., **8**, 51-59 (2009).

[1]Work supported by SRC-NRI SWAN and the Army Research Office.

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Date submitted: 20 Nov 2009 Electronic form version 1.4