Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Biased bilayer graphene: semiconductor with a gap tunable by electric field effect EDUARDO V. CASTRO, J.M.B. LOPES DOS SANTOS, CFP and Departamento de Física, Faculdade de Ciências Universidade do Porto, Portugal, N.M.R. PERES, Center of Physics and Departamento de Física, Universidade do Minho, Portugal, K.S. NOVOSELOV, S.V. MOROZOV, A.K. GEIM, Department of Physics and Astronomy, University of Manchester, UK, F. GUINEA, Instituto de Ciencia de Materiales de Madrid, CSIC, Cantoblanco, Spain, JOHAN NILSSON, A.H. CASTRO NETO, Department of Physics, Boston University, USA — A graphene bilayer with an electrostatic potential difference between layers – biased bilayer – has been experimentally realized recently. Using a tight binding description we demonstrate that the externally applied gate bias effectively controls the electronic gap between the valence and the conduction bands of bilayer graphene. Applying the theory to the description of magneto-transport data (Shubnikov-de Haas measurements of the cyclotron mass) we extract the value of the gap as a function of the electronic density. We show that the gap can be tuned between zero and mid-infrared energies using fields still below the electric breakdown of SiO_2. The opening of a gap is clearly seen in the quantum Hall regime, where the zero-energy double step characteristic to the anomalous quantum Hall effect in unbiased bilayer graphene, splits into two, giving rise to an additional plateau at zero Hall conductivity, besides the standard quantum Hall sequence.

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Date submitted: 02 Dec 2006 Electronic form version 1.4