

Abstract Submitted  
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**Electronic Properties of Graphene in Strong Static Electric Field<sup>1</sup>**

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Georgia State Univ — We study the dynamics of electrons in an ultra-strong static electric field (a few V/Å) and obtain an analytical solution for the Wannier-Stark (WS) states and corresponding energy spectrum of graphene within the two-band tight binding model. Electron states in graphene have a WS ladder structure with energy levels separated by the Bloch frequency, which is proportional to both the electric field and the lattice period of graphene in the direction of electric field. The strength of the band mixing is determined by the magnitude of the interband dipole matrix element, which for graphene has distinct wave vector dependence seen neither in metals nor in insulators. Namely, at the Dirac points, the dipole matrix elements have sharp peaks due to strong interband coupling leading to redistribution of carrier density and very strong mixture of conduction and valence bands whereas, away from the Dirac point, it shows a broad maximum. As a result of such mixing, the energy spectrum of graphene shows anticrossing points, which are characterized by the corresponding anticrossing gaps. It is shown that the anticrossing gaps are proportional to electric field at the corresponding anticrossing points with the calculated values  $2.54/l$  (eV), where  $l=1,2,\dots$  is the order of the anticrossing point. The largest anticrossing gap  $\approx 2.54$  eV corresponds to the anticrossing point  $l = 1$  at the electric field  $\approx 3.59$  V/Å. The achieved results will promisingly draw further attentions toward graphene-based Field Effect Transistors (g-FET).

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