Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Zero-energy traps and magnetic flux read-out in graphene

CHARLES A. DOWNING, Univ of Exeter, KUMAR S. GUPTA, Saha Institute of Nuclear Physics, MIKHAIL E. PORTNOI, Univ of Exeter — There is a widespread belief that electrostatic confinement of graphene charge carriers, which resemble massless Dirac fermions, is impossible as a result of the Klein paradox. We show that full confinement is indeed possible for zero-energy states in pristine graphene with careful modulation of the strength of the trapping electrostatic potential. The addition of a magnetic flux tube to the system requires one to perform a one-parameter self-adjoint extension of the Dirac Hamiltonian to completely define the spectrum of the zero-modes, which can be carried out using the method of deficiency indices developed by von Neumann. We propose such a magnetic vector potential as an additional means to control these optimal quantum dots supporting zero-energy states and bring about confinement-deconfinement on demand. The considered system can be utilised in novel graphene-based magnetic read-out devices. C. A. Downing, D. A. Stone, and M. E. Portnoi, Phys. Rev. B 84, 155437 (2011). C. A. Downing, K. S. Gupta, and M. E. Portnoi (in preparation).

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Date submitted: 15 Nov 2013 Electronic form version 1.4