MAR13-2012-020012
Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Mott-Hubbard Physics in a Patterned GaAs Heterostructure with Honeycomb Topology[1]

VITTORIO PELLEGRINI, NEST CNR-NANO and Scuola Normale Superiore, Pisa (Italy)

This talk considers efforts directed towards the design and exploration of novel collective electron states in artificial lattice structures that are realized in semiconductor heterostructures by nanofabrication methods. These studies reveal striking interplays between electron interactions and geometrical constraints (topology). We focus on the honeycomb topology, or "artificial graphene" (AG) [1,2], that supports Dirac fermions. Dirac fermions and the emergence of quantum phases, such as spin liquids and topologically protected states, can be studied by highly demanding inelastic light scattering methods and by electrical transport at low temperatures [3,4]. In particular, we probed the excitation spectrum of electrons in the honeycomb lattice in a magnetic field identifying collective modes that emerged from the Coulomb interaction [4], as predicted by the Mott-Hubbard model [5]. These observations allow us to determine the Hubbard gap and suggest the existence of a Coulomb-driven ground state [4]. Studies of electrons confined to artificial lattices should provide key perspectives on strong electron correlation in condensed matter science.

[1] M. Gibertini et al. Phys. Rev. B RC 79, 241406 (2009)
[2] C.H. Park and S.G. Louie, Nano Lett. 9, 1793 (2009).
[3] G. De Simoni et al. Appl. Phys. Lett. 97, 132113 (2010)
[4] A. Singha et al. Science 332, 1176 (2011)
[5] J. Hubbard. Proc. R. Soc. Lond. A 281, 401 (1964)

[1]Work done in collaboration with A. Singha, M. Gibertini, M. Polini, B. Karmakar, M. Katsnelson, S. Yuan, A. Pinczuk, G. Vignale, L.N. Pfeiffer, K.W. West