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Two-Dimensional Mott-Hubbard Electrons in an Artificial Honeycomb Lattice[1] V. PELLEGRINI, M. GIBERTINI, B. KARMAKAR, NEST-CNR, and Scuola Normale Superiore, Pisa, S. YUAN, Radboud University Nijmegen, Netherlands, M. POLINI, NEST-CNR, and Scuola Normale Superiore, Pisa , G. VIGNALE, University of Missouri, Columbia, USA, M. KATSNELSON, Radboud University Nijmegen, Netherlands, A. PINCZUK, Columbia University, USA, L.N. PFEIFFER, K.W. WEST, Princeton University, USA, A. SINGHA, Bose Institute, Kolkata, India. — Artificial crystal lattices can be used to tune repulsive Coulomb interactions between electrons. We trapped electrons, confined as a two-dimensional gas in a gallium arsenide quantum well, in a nanofabricated lattice with honeycomb geometry [1,2]. In our most recent studies [3] we probed the excitation spectrum of electrons in the honeycomb lattice with lattice spacing ranging down to 90nm in a magnetic field identifying collective modes that emerged from the Coulomb interaction in the artificial lattice, as predicted by the Mott-Hubbard model. These observations allow us to determine the Hubbard gap and suggest the existence of a Coulomb-driven ground state [3]. The proposed research promises to further expand current realms of study of quantum simulators. While the experiments are challenging, 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] G. De Simoni et al. Appl. Phys. Lett. 97, 132113 (2010)
[3] A. Singha et al. Science 332, 1176 (2011)

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