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Artificial lattices in nano-patterned GaAs Heterostructure[1]
LINGJIE DU, SHENG WANG, DIEGO SCARABELLI, SHALOM J. WIND, Department of Applied Physics and Applied Mathematics, Columbia University, LOREN N. PFEIFFER, KEN WEST, Department of Electrical Engineering, Princeton University, MICHAEL J. MANFRA, Department of Physics and Astronomy, and School of Materials Engineering, and School of Electrical and Computer Engineering, Purdue University, VITTORIO PELLEGRINI, Istituto Italiano di Tecnologia, Graphene Labs, and NEST, Istituto Nanoscienze-CNR and Scuola Normale Superiore, Italy, ARON PINCZUK, Department of Physics and Department of Applied Physics, Columbia University — Artificial lattices in semiconductors have been realized with honeycomb lattices superimposed on 2D electron systems in GaAs quantum well to serve as advanced quantum simulators for probing novel electron behavior in low dimensional systems. Here, we report on recent experimental progresses in artificial lattice studies using the cutting-edge fabrication technology and exploration of created electron states by optical spectroscopy experiments using photoluminescence and resonant inelastic light scattering at low temperature. Very short period (as small as 40 nm) honeycomb lattices realize massless Dirac-fermions in a highly tunable GaAs quantum well system. We also explore the triangular antidot lattice, where Dirac fermions occur at larger period. Control over carrier density and Fermi level to tune massless Dirac fermions, and the realization of topological insulator states in artificial lattices will be discussed.

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Lingjie Du
Columbia Univ

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