MAS17-2017-000123

Abstract for an Invited Paper
for the MAS17 Meeting of
the American Physical Society

Artificially Structured Semiconductors to Model Novel Quantum Phenomena[1]

ARON PINCZUK, Columbia Univ

Research in this project seeks to design, create and study a class of tunable artificial potentials superimposed on two-dimensional systems in semiconductor quantum structures of high perfection. This project started about four years ago with studies of 'artificial graphene' (AG) in semiconductor quantum wells in which a set of quantum dots are positioned in the pattern of a honeycomb lattice. Among major achievements are the realizations of very small period artificial lattices with honeycomb topology in wells. These milestones define a new state-of-the-art in fields of research and nano-fabrication of GaAs. In optical experiments we uncovered evidence that free electrons in these small period AG lattices support massless Dirac fermions (MDF) at the K-points in the Brillouin zones of the artificial lattices [3]. The appearance of MDF's are key features that arise from the symmetry of the honeycomb lattice. The successful modulation doped GaAs quantum wells. In our recent work the periods of the 'artificial graphene' (AG) lattices extend down to a=40 nm [1,2]. The small periods achieved are about three times smaller than previously reported in GaAs quantum modulation of electron states by superimposed nanoscale potentials offers opportunities for creation of quantum simulators in advanced semiconductor quantum structures. [1] D. Scarabelli, S. Wang et al., J.Vac. Sci. Technol. B 33, 06FG03 (2015). [2] S. Wang, D. Scarabelli, Y. Y. Kuznetsova et al., Appl. Phys. Lett. 109, 113101 (2016). [3] S. Wang, D. Scarabelli, Lingjie Du, Yuliya Y. Kuznetsova, Loren N. Pfeiffer, Ken West, Geoff C. Gardner, Michael J. Manfra, Vittorio Pellegrini, Shalom J. Wind, and Aron Pinczuk, Nature Nanotechnology, accepted for publication.

[1]Supported by USDOE Award DE-SC0010695