Physics Colloquium

Wednesday

February 21

4:00 P.M.

Rm 118 NSH

Charge transport in artificial solids: from percolation to miniband conduction

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Nanoscience offers a unique opportunity to design electronic phases from the bottom up, via controlled assembly of nanoscale building blocks. By tuning the on-site energy, hopping integral, and charging energy of the nano units, we can navigate through the phase space of Anderson localization, delocalized minibands and Mott insulation in the assembled artificial solids. The first system I will discuss is quantum dot arrays. We experimentally imaged, for the first time, percolation conduction phenomena which are typical for electronic systems in the regime of strong localization. We further utilized this effect to fabricate a photodetector achieving the world's highest detectivity in the visible and near-infrared spectral range. The other experimental system is two-dimensional superlattices consisting of graphene on top of arrays of dielectric nanospheres. This hybrid material shows emergent superlattice minibands that can be tuned by controlling the nanoscale deformation of graphene. Carrier confinement modulations further lead to pronounced quantum oscillations which are characteristic of electron correlation and artificial Mott insulating states.

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