Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Observation of an insulating to conducting transition in an artificial quantum dot lattice NEAL STALEY, NIRAT RAY, MARC KASTNER, Physics Department, Massachusetts Institute of Technology, MICAH HANSON, ARTHUR GOSSARD, Materials Department, University of California Santa Barbara — In a single quantum dot, where the electron occupation is controlled by the interplay between the geometry, and thus charging energy of the dot, and the externally applied gate voltage it is possible to observe a mesoscopic analog to a neutral atom. If one were to create a lattice of these "artificial atoms" with sufficiently low disorder it would be possible to create an artificial solid with tunable properties. Electrical transport measurements on quantum dot lattices have thus far been dominated by disorder. We fabricated quantum dot lattices on GaAs using electron beam lithography and reactive ion etching to define the boundary of each dot, with the electron density controlled by a global top gate. For single quantum dots fabricated using this technique we observe "Coulomb diamond" features characteristic of single electron charging into the dot when the device is depleted into the few electron regime. For lattices however we observe a striking transition from a high resistance (low current) state to low resistance (high current) as a function of increasing source drain bias. This transition occurs over a large range in gate voltage, and temperature and could be an indication of collective phenomena occurring within these artificial quantum dot lattices.

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Date submitted: 15 Nov 2013 Electronic form version 1.4