Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Quantum simulations of a Fermi-Hubbard model using a semiconductor quantum dot array TOIVO HENSGENS, TAKAFUMI FUJITA, LAURENS JANSSEN, Delft Univ of Tech, XIAO LI, Univ of Maryland, CHRISTIAN REICHL, WERNER WEGSCHEIDER, ETH Zurich, SANKAR DAS SARMA, Univ of Maryland, LIEVEN VANDERSYPEN, Delft Univ of Tech — Quantum dots hold a promise for quantum simulations of highly-correlated electronic phases as they readily adhere to a Fermi-Hubbard model in the elusive strong-interaction, low-temperature regime, where quantum correlations can span many sites. Working in solid-state inevitably entails disorder, however, which makes reaching homogeneity, even for small systems, rather difficult, and as such attempts at simulating Fermi-Hubbard physics in solid state have been few and far between. We describe a toolbox for semiconductor quantum dots based on interpreting well-known features in charge stability that allows for the independent tuning of site-specific energy offsets and tunnel couplings, and use this to map out the accessible parameter space of a triple quantum dot device up to a total of 12 electrons and from $t/U = 0.01$ to $t/U = 0.12$. As tunnel couplings are homogeneously increased, we witness the delocalization transition from Coulomb blockade to collective Coulomb blockade, a finite-size analogue of the Mott metal-to-insulator transition. A further automated application of these ideas, on larger and more homogeneous samples, will make the synthesis of tailor-made correlated-electronic phases possible in the near future.

Toivo Hensgens
Delft Univ of Tech

Date submitted: 11 Nov 2016 Electronic form version 1.4