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Quantum Dot Array for Simulating the Hubbard Model CHING-TZU CHEN, DENNIS M. NEWNS, CHANG C. TSUEI, IBM Thomas J Watson Research Center, JEFFREY J. URBAN, The Molecular Foundary, Lawrence Berkeley National Lab — As the simplest theory that incorporates strong onsite Coulomb repulsion, the Hubbard model is fundamental to the understanding of phenomena in strongly correlated systems, e.g. the metal-insulator transition in transition-metal oxides. It is further widely believed that the 2D square-lattice Hubbard model captures the puzzling physics of high-temperature superconductivity. Since an analytical solution of the model is not viable, we propose to study its properties through a "quantum simulator" made from quantum dot arrays (QDAs). In this talk, we first demonstrate the correspondence between the Hubbard Hamiltonian and the simplified model for the QDA. We then address the scaling of the crucial parameters for designing a practical simulator. Two systems for implementing the QDA are proposed – the self-assembled nanocrystal arrays, and the lithographically defined 2D-electron-gas QDA. Preliminary experimental results derived from these systems will be presented.

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