Abstract Submitted
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Towards Hybrid Quantum Information Processing with Electrons on Helium ANDREAS FRAGNER, Department of Applied Physics, Yale University, DAVID SCHUSTER, Department of Physics, University of Chicago, MARK DYKMAN, Department of Physics, Michigan State University, STEPHEN LYON, Department of Electrical Engineering, Princeton University, LUIGI FRUNZIO, Department of Applied Physics, Yale University, ROBERT SCHOELKOPF, Department of Physics and Applied Physics, Yale University — Electrons above the surface of superfluid helium form a two-dimensional electron gas in which single-electron quantum dots can be defined using electrostatic gates submerged under the helium film. The quantized motion and spin state of such a trapped electron on helium can be coupled to a high finesse superconducting cavity in a hybrid circuit QED architecture [1]. The cavity is used for nondestructive readout and as a quantum bus mediating interactions between distant electrons or an electron and a superconducting qubit. Coupling between motional states and individual photons in the cavity is estimated at a Rabi frequency of $g/2\pi \sim 20$ MHz with coherence times exceeding 20 μs for charge and 1 s for spin [1, 2]. Here I will discuss recent experiments in which we successfully trap and detect a two-dimensional electron gas on helium in a dc-biased superconducting cavity. Experimental progress towards the single-electron regime will also be presented.

[1] D.I. Schuster, A.Fragner, M.I. Dykman, S. Lyon and R.J. Schoelkopf, Phys. Rev. Lett. 105, 040503 (2010)
[2] S. A. Lyon, Phys. Rev. A 74, 052338 (2006)

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