

Abstract Submitted  
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**Electrons on Helium using circuit quantum electrodynamics**[1]

DAVID SCHUSTER, Yale University, MARK DYKMAN, Michigan State University, STEPHEN LYON, Princeton University, ROBERT SCHOELKOPF, Yale University — It is possible to form a two dimensional electron gas at the interface between superfluid helium and vacuum. This unique heterostructure has exceptional bulk properties including electron mobilities exceeding  $10^7$  cm<sup>2</sup>/Vs and electron spin coherence times estimated to exceed 100s. One of the first proposals [2] for quantum computation employed the *vertical* motional states of electrons on helium but coherent interactions have yet to be realized. I will describe a new proposal [3] which uses a high finesse superconducting transmission line cavity to detect and manipulate the *lateral* motional and spin states of a single trapped electron on helium. We estimate that it is possible to attain vacuum Rabi frequencies of  $g=10$  MHz and  $T_1 \sim T_2 \sim 1$  ms for the motional state and perhaps even longer coherence times if spin encoding is used.

- [1] Wallraff, et. al. Nature, 2004, 431, 162
- [2] Plattsman and Dykman, Science, 1999, 284, 1967
- [3] In preparation

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