

Abstract Submitted  
for the DAMOP17 Meeting of  
The American Physical Society

**Strongly Interacting mm-Wave and Optical Photons with Rydberg Atoms** AZIZA SULEYMANZADE, MARK STONE, SCOTT EUSTICE, JONATHAN SIMON, DAVID SCHUSTER, University of Chicago — We describe progress towards a hybrid experimental system for engineering strong interactions between single optical and mm-wave photons using Rydberg atoms as an interface. Entanglement between photons with gigahertz and optical frequencies creates a new platform to access exotic photonic quantum states as well as powerful new techniques in quantum computing and simulation. We will present recent experimental developments including trapping and cooling atoms in a cryogenic MOT, measuring high-Q superconducting cavities at 100 GHz and coupling atoms to an optical cavity inside a cryostat at 3 Kelvin.

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Date submitted: 29 Jan 2017

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