Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Strongly Interacting Optical and mm-Wave Photons using Rydberg Atoms MARK STONE, AZIZA SULEYMANZADE, AISHWARYA KUMAR, LAVANYA TANEJA, JASMINE KALIA, DAVID SCHUSTER, JONATHAN SIMON, University of Chicago — Strong interactions between optical and mm-wave photons hold great promise in developing new quantum technologies. Our experiment creates this dual-frequency interaction by hybridizing a cavity optical photon with an atomic Rydberg excitation, which is also strongly coupled to a superconducting 100 GHz cavity. We describe our results, using this high-quality factor mm-wave cavity and the large Rydberg dipole moment to generate nonlinearity on the optical transition. We discuss possible applications of the hybrid system, including optical to mm-wave frequency transduction and generation of atomic spin-squeezed states using the high single-atom cooperativity of the mm-wave transition.

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Date submitted: 02 Feb 2020 Electronic form version 1.4