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Engineering Strong Interactions Between mm-wave and Optical Photons AZIZA SULEYMANZADE, MARK STONE, JEREMY ESTES, SCOTT EUSTICE, JONATHAN SIMON, DAVID SCHUSTER, University of Chicago — We propose an atomic interface of Rydberg atoms as a means of engineering effective strong interactions between single mm-wave and optical photons. The atomic sample resides at the intersection of a high-finesse optical cavity and a superconducting mm-wave cavity, where it can coherently interact with photons of both regimes. The use of mm-wave (100 GHz) frequencies allows strong coupling at higher temperatures and with less sensitivity to stray electric fields. A hybrid cryogenic vacuum chamber at 4 Kelvin enables access to superconductivity as well as a UHV environment with optical access necessary for cold atom experiments. Strong interactions between these separate quantum degrees of freedom has important applications in quantum computing as well as simulation of many-body interacting systems.

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