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High-Q Superconducting Mm-wave Cavities for Rydberg Cavity Quantum Electrodynamics[1] AZIZA SULEYMANZADE, MARK STONE, ALEXANDER ANFEROV, LIN SU, SHIV AGRAWAL, JONATHAN SIMON, DAVID SCHUSTER, University of Chicago — We will outline our progress towards a cryogenic hybrid experimental system for engineering strong interactions between single optical and mm-wave photons using Rydberg atoms as an interface. Bulk 3D cavities in the microwave regime routinely reach quality factors above 10ˆ7 at single photon powers and even in some case as high as 10ˆ10. At the same time there has been far less study of resonators at millimeter wave frequencies close to 100GHz. We present experimental results of superconducting fundamental mode niobium cavities at 100GHz, with quality factors exceeding 10ˆ7 at single photon levels. We will also present experiments showing tuning the cavity frequency in-situ, to be able to exactly match Rydberg transitions. Together with our two-mirror optical cavity, these results bring us closer to manipulating atoms inside of a hybrid mm wave- optical system.

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