

Rydberg Cavity QED

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Atoms in a state of large principal quantum number (Rydberg states) exhibit some exaggerated properties that make them particularly appealing in the fields of quantum computing and sensing : They are relatively stable, with lifetimes on the order of a few milliseconds. They strongly interact with each other through their large induced dipole moments generated by vast distribution of the electron cloud. And, the transition dipole matrix elements between adjacent states are large, leading to relatively strong coupling with external electromagnetic fields in the microwave regime. In this project, we use Rubidium-87 in Rydberg states inside of a microwave resonator tuned on resonance with a selected transition. Interactions with the Cavity mode have a number of applications that we wish to explore. Mainly, we hope to build a tunable room temperature MASER (Microwave Amplification through Stimulated Emission). We also hope to create an ultrastrong coupling probe in the microwave regime, where effects such as ground state virtual photons, the diamagnetic interaction, and potentially polaritons become important, and detectable.

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