# Rydberg quantum optics in ultracold Ytterbium gases

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Mapping the strong interaction between Rydberg excitations in ultracold atomic ensembles onto single photons paves the way to realize and control high optical nonlinearities at the level of single photons [1]. Demonstrations of photon-photon gates or multi-photon bound states based on this concept have so far primarily employed ultracold alkali atoms [2,3]. Two-valence electron species, such as Ytterbium, offer unique novel features namely narrow-linewidth laser-cooling, optical detection and ionization, and long-lived nuclear-spin memory states [4].

On this poster, we present our ultracold Ytterbium apparatus designed for few-photon Rydberg quantum optics experiments. The system is optimized for fast production of large, thermal ytterbium samples, to study the interactions between a large number of Rydberg polaritons simultaneously propagating through a medium with extremely high atomic density. Specifically, we discuss our two-chamber setup with 2D/3D two-color MOT configuration, and our progress towards Rydberg excitation of optically trapped Ytterbium atoms.

## References

[1] O. Firstenberg, C. S. Adams and S. Hofferberth, Journal of Physics B: Atomic, Molecular and Optical Physics 49, 152003 (2016)
[2] D. Tiarks et al., Nature Physics 15, 124-126 (2019)
[3] N. Stiesdal et al., Nature Communications 12, 4328 (2021)
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## Figures

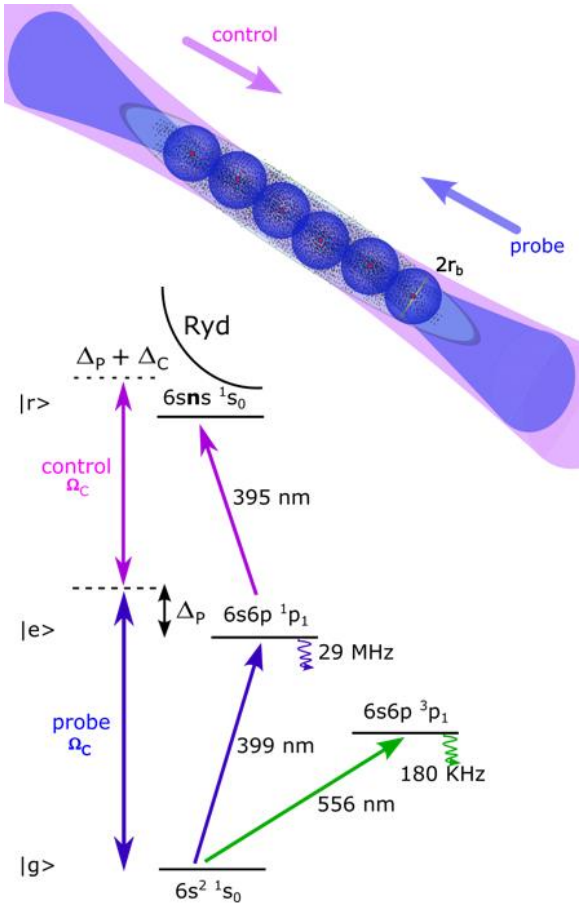


**Figure 1:** Experimental scheme to generate photon-photon interactions in an Ytterbium gas