## Rydberg Atoms I

In the early 20th century, the knowledge about quantum mechanical light matter interaction was limited to thought experiments which, at that time, were not expected to be realizable in the near future. After the development of the Laser and progress in other experimental techniques, Serge Haroche's group at *Laboratoire Kastler Brossel* was one of the first to observe and control the interaction of single atoms with single photons.

The key aspects of accessing the strong coupling regime were a superconducting Fabry-Perot cavity of unprecedentedly high finesse as well as the excitation of Rubidium atoms to the n=50 circular Rydberg state, which has a large dipole coupling to the cavity mode (scaling with $n^2$) . Since the spontaneous emission rate of the circular state is antiproportional to the cube of the main quantum number, these states fulfil the condition to have a lifetime much longer than the timespan needed to cross the setup and interact with the cavity.

In the dispersive regime, Quantum Non-Demolition measurements of the photon number confirmed the quantized nature of the electromagnetic field and allowed to determine the amplitude of coherent states. On resonance, excitations can be swapped between the atomic internal state and the cavity mode - a technique that allows for the implementation of quantum gates. We present the basic setup as well as the relevance of Rabi oscillations and Ramsey interferometry in the context of the novel field cavity QED.