Interacting Rydberg Atoms : from Dense Clouds of Rydberg Atoms to Quantum Simulation with Circular Atoms

Tigrane Cantat-Moltrecht
Laboratoire Kastler-Brossel
Collège de France, ENS, UPMC Univ Paris 6, CNRS
11 place Marcelin Berthelot, 75005, Paris, France

Interacting many-body quantum systems are at the heart of contemporary research in quantum physics. The understanding of such systems is crucial to the development of condensed-matter physics. Many research efforts aim at building a "quantum simulator": a platform which allows to model a hard-to-access quantum system with a more controllable one.

Ensembles of Rydberg atoms, thanks to their strong dipolar interactions, make for an excellent system to study many-body quantum physics. Studies were conducted by our team on the excitation of a dense cloud of interacting Rydberg atoms, thanks to an experimental setup mixing on-chip cold atoms techniques with Rydberg atoms manipulation techniques.

The result of these studies led us to make a full-fledged proposal for the realisation of a quantum simulator, based on trapped circular Rydberg atoms. The proposed simulator is particularly promising due to its flexibility and to the long simulation times for which it would allow.

Finally, I will give a detailed description of the first experimental step towards building such a simulator: the on-chip excitation of circular Rydberg atoms.

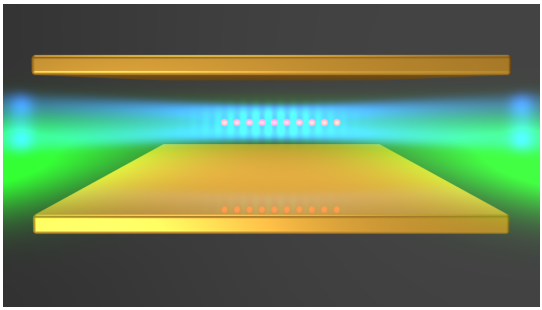

FIG. 1. Conceptual scheme of the proposed simulator : a chain of circular Rydberg atoms trapped in a laser beam, inside a capacitor.