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Trapped Circular Rydberg Atoms for Quantum Simulation TIGRANE CANTAT-MOLTRECHT, THANH LONG NGUYEN, RODRIGO CORTINAS, CLÉMENT SAYRIN, SERGE HAROCHE, MICHEL BRUNE, JEAN-MICHEL RAIMOND, Laboratoire Kastler-Brossel, Collège de France, CNRS, ENS, PSL Research University, UPMC, Sorbonne Universités — Condensed-matter systems are interesting and important to understand but they are difficult to study, even numerically, given the significant sizes of their Hilbert space. Quantum simulation proposes to mimic those out-of-reach quantum systems with more controllable and accessible ones. The high polarizability of Rydberg atoms allows for strong and tunable short-range interactions, making them nice candidates for a quantum simulation platform. However, low angular momentum Rydberg atoms cannot be efficiently laser-trapped and their lifetimes would limit the scope of such a quantum simulator. We propose instead to use circular Rydberg atoms (of maximum angular momentum) which can be laser-trapped and whose lifetimes can be extended to the one minute range by placing them in a spontaneous emission-inhibiting capacitor. We aim at the deterministic preparation of a 1D-chain of 40 atoms, trapped in a Laguerre-Gauss hollow laser beam, with a collective lifetime of 2 seconds. With exchange rates in the $10-100$ kHz range, this would provide a platform able to simulate quantum many-body physics for more than 10^4 exchange times. In this talk I will present this novel quantum simulation platform and our latest experimental results in the laser-trapping of circular Rydberg atoms.

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