Non-equilibrium Many-Body Physics with ultra-cold Rydberg atoms

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Atoms excited to Rydberg states with high principal quantum numbers have exaggerated properties such as large size, strong dipole-dipole interaction, large values of polarisability and longer lifetimes compared to atoms in their ground state. These exotic characteristics and a high degree of controllability make ultra-cold Rydberg atoms versatile atomic building blocks for various regimes of Quantum Technologies such as scalable quantum information networks, precision Quantum Sensing and Quantum Simulation of Many-body physics.

In this talk, I will give an overview of Quantum Technologies with Rydberg atoms and present our recent results on Doppler-enhanced Quantum magnetometry using Rydberg atoms. I will also present our measurements of the effects of inter-atomic interaction on Autler-Townes splitting in highly-excited cold Rydberg atoms due to strong-field coupling. We explain our observations using theoretical modelling and numerical simulations and find good agreement with our measurements. Finally, I will present our recent progress and future perspectives on Quantum Computing and non-equilibrium Quantum Many-body physics with ultra-cold Rydberg atoms.