Observation of string breaking on a (2+1)D Rydberg quantum simulator

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Fundamental forces of nature are described by gauge theories, and the interactions of matter with gauge fields lead to intriguing phenomena like the confinement of quarks in quantum chromodynamics. Separating a confined quark-anti-quark pair incurs an energy cost that grows linearly with their separation, eventually leading to the production of additional particles by an effect that is called string-breaking.

In this talk, I will discuss how similar phenomenology can be probed using Rydberg atom arrays. In particular, I will explain how the Rydberg blockade constraint on a suitable two-dimensional lattice geometry allows us to interpret the native Rydberg Hamiltonian as a confining U(1) lattice gauge theory. In collaboration with QuEra, we have realised this proposal using their device “Aquila”, operating as an analog quantum simulator. I will present both theoretical and experimental results concerning the physics of confinement and string-breaking in this setup, including equilibrium state preparation as well as non-equilibrium quench dynamics.