**Quantum simulation of lattice gauge theories in AMO systems: challenges and perspectives**

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Lattice gauge theories constitute a fully non-perturbative framework for the investigation of gauge theories. It has lead to notable progresses on the way towards the understanding of basic interactions underlying the standard model, and to the interpretation of fractionalized states of matter in strongly correlated electronic systems. However, paradigmatic phenomena such as the real-rime dynamics and finite-density regimes of cornerstone theories such as quantum chromodynamics are not amenable to efficient classical algorithms, which are usually biased by the so-called sign problem affecting MonteCarlo simulation.

In the last few years, quantum simulators have been proposed as an alternative route to tackle such problems. In this talk, I will review the basic idea of quantum simulation, following the original intuition by Feynman tracking back to the eighties, and discuss its main properties and differences with respect to classical simulations. Against this background, I will then illustrate our recent progresses regarding the quantum simulation of lattice gauge theories using ultracold atoms: in particular, I will focus on simulations of Abelian gauge theories in both quantum link and Wilson formulations in one spatial dimension, and briefly discuss alternative schemes for higher—dimensional situations, and non-Abelian theories. >From the cold atom side, the discussion will involve a variety of systems, ranging from Bose-Fermi mixtures, to Rydberg atoms in optical lattices.