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Experimental techniques for quantum simulation and computation using trapped ions

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Quantum technologies, such as trapped atomic ions, have advanced to the point of carrying out proof-of-principle demonstrations of quantum computing and quantum simulation. A current focus of interest is exploring how quantum simulation tools can be exploited for nuclear physics related problems, such as the simulation of lattice gauge theories. This talk will present a broad overview of trapped ion quantum simulation experiments, describing the tools and techniques that have been demonstrated in a laboratory setting, and the current challenges in extending these results to more complex systems. Trapped ions are well suited for both "digital" quantum simulations, in which quantum logic gates are used to construct a unitary operator of interest, as well as "analog" simulations, in which the trapped ions are induced to obey dynamics analogous to a quantum system of interest, such as a spin chain. I will review existing protocols for using trapped ions to simulate spin-like and boson-like degrees of freedom and to control their interactions, as well as giving an outlook on near-term efforts to expand the capabilities of such experiments.