Quantum Simulations with Trapped Ions

Lucas Lamata (Universidad del País Vasco UPV/EHU Bilbao, Spain)

We will review the research we have been developing at UPV/EHU Bilbao regarding quantum simulations in trapped ions. We will explain the possibility to simulate relativistic quantum mechanics in trapped ions, including the Dirac equation and Zitterbewegung [1,2], Klein's paradox [3,4], two interacting Dirac particles [5], and the Majorana equation [6]. Then, we will describe a scalable approach towards the simulation of quantum field theories in trapped ions [7], and also the realization of interacting fermion lattice models in an efficient manner [8]. Finally, we will propose an implementation of protected qubits in trapped ions by means of Majorana fermions [9], and further developments in our group.

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