

Klein tunneling and Dirac potentials in trapped ions

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We propose the quantum simulation of the Dirac equation with potentials, allowing the study of relativistic scattering and Klein tunneling. This quantum relativistic effect permits a positive-energy Dirac particle to propagate through a repulsive potential via the population transfer to negative-energy components. We show how to engineer scalar, pseudoscalar, and other potentials in the 1+1 Dirac equation by manipulating two trapped ions. The Dirac spinor is represented by the internal states of one ion, while its position and momentum are described by those of a collective motional mode. The second ion is used to build the desired potentials with high spatial resolution.

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