Synthetic dimensions and geometries with ultracold atoms

Abstract

In this talk, I will present two different ideas that are suitable for simulating interesting phenomena with ultracold fermionic atoms. The first is the concept of synthetic dimension, that to say the use of coherently coupled spin degrees of freedom as translational degrees of freedom. This flexible tool is not restricted to fermions, and it is favorable for simulating topological model in different dimensions and for observing the edge modes, as well as for simulating topological lattices. The second idea concerns the simulation of deformed artificial graphene in optical lattices, in such a way to reproduce the propagation of artificial Dirac fermions in artificially curved spacetimes. Such set-up allows for instance for the simulation of Unruh effect by performing a quantum quench of the tunneling terms of atoms in the lattice.