Novel topological optical lattices for ultracold atoms

Gediminas Juzeliūnas
Institute of Theoretical Physics and Astronomy, Vilnius University, Lithuania

A talk is on new ways of creating topological optical lattices for ultracold atoms. In an introductory part a background material will be presented on optical lattices and ways to induce a magnetic flux in such lattices. Subsequently I will present a novel way of creating an optical lattice affected by a non-staggered magnetic flux for ultracold atoms [1]. The method involves laser-induced transitions between a pair of atomic internal states characterized by energies with opposite gradients in one spatial direction. The states are coupled by a pair of multi-frequency laser beams counter-propagating in a direction perpendicular to the energy gradient. Such a multi-frequency perturbation effectively creates a square optical lattice affected by a non-staggered magnetic flux. Calculations show that the energy bands of the lattice can be characterized by unit Chern numbers [1]. In the second part I shall talk on the ways of creating the non-staggered magnetic flux for ultracold atoms by employing atomic internal degrees of freedom acting as an extra dimension [2,3]. We shall consider the properties of such semi-synthetic optical lattices which can be characterized by both square [2] and non-square [3] geometry.

1. T. Andrijauskas, I.B. Spielman and G. Juzeliūnas, in preparation.
2. A. Celi, P. Massignan, J. Ruseckas, N. Goldman, I. B. Spielman, G. Juzeliūnas, and M. Lewenstein, Phys. Rev. Lett. 112, 043001 (2014)
2. E. Anisimovas, M. Račiūnas, C. Sträter, A. Eckardt, I. B. Spielman, G. Juzeliūnas, Phys. Rev. A 94, 063632 (2016).