Topological flux lattice from multi-frequency radiation

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Ultracold atomic gases are systems exhibiting various condensed matter phenomena. There are several possible ways to create artificial magnetic field for neutral ultracold atoms. These include rotation of an atomic cloud, laser-assited tunneling and shaking of optical lattices [1]. We theoretically analyze another way of creating a magnetic flux for ultracold atoms using a periodic sequence of laser pulses providing a multi-frequency perturbation that drives transitions between a pair of internal atomic spin states (Fig. 1). In conjuction with a magnetic field gradient, this dynamically generates a rectangular lattice with a non-staggered magnetic flux [2]. Our method is applied to ultracold atoms that are not initially in any optical lattice and there are no initial constraints on modulation frequency to avoid transitions between originaal Bloch bands. The resulting lattice produces several Landau-like lowest energy bands. Under certain choice of lattice parameters the lattice may also produce rich topological bands that have Chern numbers larger than one in modulus [3].

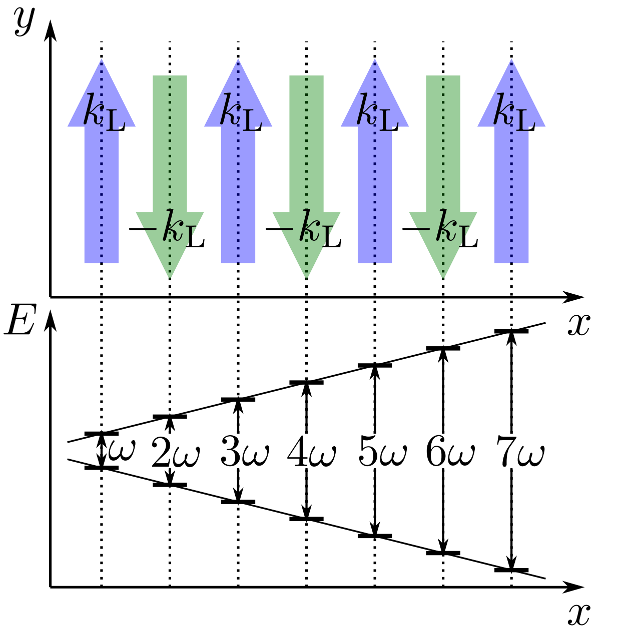

FIG. 1: Coupling of two linearly shifted internal atomic states with two frequency comb wave-packets. The first frequency comb propagates along the y direction and couples the internal states with even multiples of the Floquet frequency ω. The second frequency comb propagates in the opposite direction and couples the internal states with odd multiples of ω. Here the magnetic field gradient is along the x direction.

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