Towards a topological dressed atom into a temporal crystal-lattice

Thomas Zanon*[1]

[1]Laboratoire de Physique Moleculaire pour l'Atmosphere et l'Astrophysique (LPMAA) – CNRS : UMR7092, Université Pierre et Marie Curie [UPMC] - Paris VI – France

Résumé

In Condensed Matter, free electrons are interacting with a spatial periodic potential due to the crystal lattice in which they move. Strong modifications of these electronic Bloch waves are occurring where renormalization effect leads for example to their effective masses when moving into a metallic or alloy structure. When these Bloch electrons are simultaneously submitted to a perpendicular static magnetic field and confined into a two-dimensional square lattice, electronic energy values formed a fractal set called an "Hofsadter butterfly" governed by rational or irrational values of magnetic fluxes through unit cells of the periodic potential. In Atomic Physics, quantum simulators of many-body interactions are now tested within optical lattices where artificial gauge on cold atomic systems are applied to simulate charged particles moving into a strong magnetic field through a spatially dependent optical coupling between internal states to observe exotic energy bands and Dirac cones. We propose to replace spatial dimensions by temporal directions in order to use analogue of Bloch waves, i.e Floquet waves to control and drive quantum states by external electromagnetic frequencies tuning polarization, periodicity, phase and amplitude of EM fields. Few oscillatory fields reproduce solid-state structure on atomic or molecular spin systems where lattice sites are simulated by Fourier components of the wave-function realizing an artificial temporal crystal with an exotic energy spectrum.

*Intervenant