Lingzhen Guo, TFP, Karlsruhe Institute of Technology

Phase Space Crystals from Periodically Driven One-dimensional Systems

Abstract: Phase space crystals is a novel and mathematically rather challenging subject in physics. Phase space crystals can be created by driving suitable classical or quantum mechanical systems in a specific periodic way. In this way it is possible to create systems with a variety of effective Hamiltonians which are otherwise difficult to realize (such as quasicrystals), and they can be varied by tuning the driving parameters. Phase space crystals also provide a new way to study topological phenomena in physics. They differ from lattices in real space since their coordinate systems, i.e., the phase space, has a non-commutative geometry, which naturally produces phases like those arising from magnetic fields. In this way topological insulators, which have attracted much attention recently, can be engineered. Still another option provided by phase space engineering is a controlled transition between one-dimensional and two-dimensional crystals in an effective magnetic field. The famous Hofstadter-butterfly structure in the energy spectrum thus can be realized in one-dimensional systems. The primary physical system to create phase space crystals are ultracold atoms in optical lattices.