Abstract

This thesis in devoted to the theoretical analysis of the topological and out of equilibrium properties of one dimensional fermionic systems. After discussing the experimental signatures of topological bound states in spin-orbit coupled nanowires, we investigate transport phenomena in Dirac materials heterojunction. Furthermore, by analyzing the dynamical effects of quantum quenches, we predict the relaxation to a Generalized Gibbs Ensemble in an integrable system and its observability through optical measurement. We highlight the role of symmetries in both protecting and hiding topological states in a quenched topological insulator and we explore how a time dependent magnetic flux piercing a one dimensional insulating ring can generate a non linear current and dynamical quantum phase transitions. Finally, we show that the Berry phase of a quenched band insulator builds up a quantized response to a constant magnetic flux and we prove that the quantization is dictated by a dynamical topological invariant.