Bulk-edge correspondence in topological materials -- emergence of surface states beyond de chiral ones

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Date: 10 April 2020, Friday
Time: 4:00 PM
Venue: Remote via Zoom Join (Meeting ID: 655 090 406, Password: 006760)
https://zoom.us/j/655090406?pwd=SWRlbzM1TC85N3NWUXdXNEQxUVpzQT09
Host: Associate Professor David Wilkowski

Abstract

Surfaces of topological materials, such as topological insulators or Weyl semimetals, are known to host metallic states due to the bulk-edge correspondence. In addition to the usual topologically protected chiral surface states, which do not depend on the specific form of the interface, several massive states appear if the interface width is larger than a particular intrinsic length (given by the bulk gap and the Fermi velocity). These states, first described by Volkov and Pankratov (VP) in the 1990ies [1], are intrinsically relativistic and can be related to Landau bands of relativistic fermions. We show that the gap variation can be interpreted precisely as a vector potential that is affected by an additional electric field in a relativistic manner [2]. The electric field can thus be used not only to dope electronically these massive surface states, but they become even more accessible due to the reduction of the Landau gap in the presence of an electric field. The effect is at the origin of an oscillating resistance measured as a function of the electric field in high-frequency experiments at ENS, Paris [3]. Furthermore, VP are expected to have a clear signature in magneto-optical spectroscopy [4]. We finish with a short discussion of how this “Landau-level approach” can also be used in the framework of Weyl semimetals and the description of Fermi arcs that play the role of chiral Landau bands here [5,6].


Short Biography

Mark Oliver Goerbig is a CNRS Research Director in the Theory Group of Laboratoire de Physique des Solides, Université Paris-Saclay. After a PhD on the fractional quantum Hall effect in 2004, his research is oriented towards graphene, two-dimensional semiconductors and topological materials. He is mainly interested in the experimental signatures, e.g. in magneto-optical spectroscopy and transport, of the relativistic and topological properties of novel materials as well as in the bulk-edge correspondence of topological quantum matter.

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