Theoretical modeling of topological microelectronic devices

Record number : OPR-1384

Overview

RESEARCH DIRECTION

Ion Garate, Professeur - Department of Physics

INFORMATION

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ADMINISTRATIVE UNIT(S)

Faculté des sciences
Département de physique

LEVEL(S)

2e cycle
3e cycle

LOCATION(S)

Université de Sherbrooke, campus principal

Project Description

Over the past 20 years, the discovery of topological insulators, superconductors, and semimetals has led to a new understanding of solids in terms of quantum mechanics and topology. In topological materials, electronic energy bands and wave functions are characterized by non-zero integers called topological invariants. These mathematical invariants manifest themselves physically in the form of unusual electronic states localized at the boundaries of samples. We now know that a large proportion of solids are topological.

In addition to being a major advance in fundamental science, recognized by the 2016 Nobel Prize, topological materials have very interesting potential applications, for example in microelectronics, energy recovery, detection, and quantum computing. A major challenge in this field is to realize these promises. Our team aims to contribute to meeting this challenge by developing original theoretical approaches for modeling topological devices, thereby linking fundamental theoretical physics to industrial physics.

Current research interests of the group include
(i) electrical transport in topological semimetal wires with an eye on interconnect applications,
(ii) generalization of the van Roosbroeck system of equations (which are central to today's microelectronic technology) to topological materials.
Some representative recent articles are :

https://journals.aps.org/prb/abstract/10.1103/PhysRevB.108.024301
https://www.nature.com/articles/s41535-022-00535-6
https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.133.226302

Discipline(s) by sector

Funding offered

Yes

Sciences naturelles et génie

Physique

The last update was on 2 March 2026. The University reserves the right to modify its projects without notice.