第13回トポロジカル物質科学セミナー
Topological Materials Science Seminar (13)

Designing topological states, spin textures and spin interferometers by shape deformation

Dr Mario Cuoco
CNR-SPIN, Salerno and Dipartimento di Fisica,
Università di Salerno, Italy

Place: Room 525, Department of Physics, Kyoto University
Date: Aug. 1 (Mon), 2016
Time: 10:30-12:00

Abstract: Topological states of matter are at present one of the most challenging and active fields in condensed matter physics due to: i) the richness of physical phenomena they display, and ii) the foundational topological concepts on which they are built-in, which drive a broad cross-fertilization with different physics research areas. Low-dimensional semiconducting nanomaterials play a relevant role in the area of topological states of matter. However, apart from these conventional material geometries the most recent advances in nanotechnology have made it possible to have at hand an entirely novel family of low-dimensional nanostructures: flexible semiconductor nanomaterials which are bent into curved, deformable objects ranging from semiconductor nanotubes, to nanohelices. Motivated by the excitement in both topological states of matter and novel shape deformed nanostructures, we have now theoretically considered the possible interplay between curvature effects [1] on the electronic properties and the topological properties of the quantum states in low-dimensional nanomaterials. In this talk I will firstly discuss how geometric effects in low-dimensional nanomaterials can lead to metal-insulator transition and promote the generation of topological states of matter by considering the paradigmatic example of quantum wires with RSOC coupling, which are periodically corrugated at the nanometer scale [2]. Then, I will present the intricate twist between spin texture and spin transport in shape deformed nanostructures. I show that nonuniform Rashba spin-orbit coupling in shape deformed nanowires drives spin textures with a tunable topological character with windings around the radial and the out-of-plane directions. These topologically non trivial spin patterns affect the electron spin interference in the deformed ring, thereby resulting in different geometry-driven electronic transport behavior [3].

[Acknowledgements –EU- FET OPEN project "CNTQC" , grant agreement N. 618083 (http://www.nano2qc.eu/)]

1. P. Gentile, M. Cuoco, C. Ortix, SPIN, Vol. 3, No. 2, 1340002 (2013).
2. P. Gentile, M. Cuoco, C. Ortix, Phys. Rev. Lett. 115, 256801 (2015).
3. Z.-J. Ying, P. Gentile, C. Ortix, and M. Cuoco, arXiv:1603.04655, (to appear in Phys. Rev. B Rapid Communication)

Host: Y Maeno [Kyoto Univ. Core Research Group A01]
(075-753-3783 / maeno@scphys.kyoto-u.ac.jp)