第16回トポロジカル物質科学セミナー
Topological Materials Science Seminar (16)

Topological states and spin textures in Rashba spin-orbit coupled curved nanostructures

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Abstract: Topological states of matter are at present one of the most challenging and active fields in condensed matter physics. Spin-orbit coupling is an important player for design of topological states not only for the search of Majorana edge states [1], but also for wider physical implications, as for instance the generation of unconventional spin-triplet pairing in Dirac semimetal [2], or for achieving robust edge states in superconductor based heterostructures [3], etc. Motivated by the excitement in both topological states of matter and novel shape deformed nanostructures, we have theoretically considered the possible interplay between non uniform Rashba spin-orbit coupling (RSOC) induced by curvature [4] 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 [5]. Then, I will present the intricate twist between spin texture and spin transport in shape deformed nanostructures. I show that nonuniform RSOC 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 [6].

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

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