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Theory of Condensed Matter: Hard Condensed Matter

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Medienraum

Kyoung-Whan Kim
NIST CNST/UMD USA

Spin transport related to spin-orbit coupling

Magnetism is a promising candidate as the basis of next generation electronic devices. Electrical manipulation of magnetization would allow it to be controlled rapidly in spite of its non-volatile nature. As people pursue smaller and smaller sized devices, the effects of broken symmetries become more and more important. In particular, strong interface spin-orbit coupling as a consequence of inversion symmetry breaking shows a number of interesting features. In this talk, I present two topics related to spin-orbit coupling. First, despite its importance, our understanding of spinorbit coupling is still incomplete. In this work, we generalize an existing model for electron spin transport near interfaces to construct an analytic theory for interface spin-orbit coupling that can be applied to various systems, such as magnetic bilayers, topological insulators, and ferromagnetic insulators. The theory gives not only corrections to the existing theory, but also qualitatively different physics. Second, we demonstrate that the understanding of spin-orbit coupling effects in magnetic systems is also helpful for other systems. By utilizing a one-toone correspondence between textured magnetic systems and a spin-orbit coupling systems, we demonstrate the existence of an overlooked contribution to textured magnetic systems, which one can infer from knowledge of spin-orbit coupling effects. These two topics indicate that theoretical study of spin-orbit coupling in magnetic systems not only advances applications of spintronics in devices but also deepens our understanding of magnetic systems.

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