

专题学术讲座

Anomalous Hall and Nernst effects in Dirac materials



Speaker: Sergei Sharapov

Head of the laboratory of Strongly Correlated Low-dimensional Systems
Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine

讲座摘要:

It is known that the Shubnikov – de Haas oscillations can be observed in the Hall resistivity, although their amplitude is much weaker than the amplitude of the diagonal resistivity oscillations. Employing a model of two-dimensional massive Dirac fermions that exhibits anomalous Hall effect, we demonstrate that the amplitude of the Shubnikov – de Haas oscillations of the anomalous Hall conductivity is the same as that of the diagonal conductivity. We argue that the oscillations of the anomalous Hall conductivity can be observed by studying the valley Hall effect in the graphene superlattices and the spin Hall effect in the low-buckled Dirac materials. The second part of the talk deals with a strong spin Nernst effect expected in silicene and other low-buckled Dirac materials. These Dirac materials can be considered as being made of two independent electron subsystems of the two-component gapped Dirac fermions. For each subsystem the gap breaks a time-reversal symmetry and thus plays a role of an effective magnetic field. Accordingly, the standard Kubo formalism has to be altered by including the effective magnetization in order to satisfy the third law of thermodynamics. We explicitly demonstrate how the correct thermoelectric coefficient emerges both by the explicit calculation of the magnetization and by a formal cancellation in the modified Kubo formula.

主讲嘉宾:

Sergei Sharapov obtained his PhD degree (1996) at the Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine, Kyiv. The PhD thesis was devoted to the high-temperature superconductivity. He had postdoctoral positions at the University of Pretoria (South Africa), the University of Neuchatel (Switzerland), the Institute for Scientific Interchange, Torino (Italy), McMaster University, Hamilton (Canada). He obtained Dr. habil. degree in 2010 at the Bogolyubov Institute for Theoretical Physics and became a head of the laboratory of Strongly Correlated Low-dimensional Systems from 2011. He is a co-author of over 70 scientific papers, two reviews, one textbook, and many popular articles. Since 2004 his main topic of research is magnetotransport, optical, magneto-optical and thermoelectric properties of graphene and other Dirac materials. His paper on quantum Hall effect in graphene is cited about 1000 times. He also predicted nonstandard features of the quantum magnetic oscillations that were observed in the experiments on graphene. He received the State Prize of Ukraine for his studies on graphene.

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主持人: Alexey Kavokin教授