Berry Phase Effect on Bloch Electrons in Electromagnetic Fields

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Abstract

In this talk I will review the semi-classical theory of Bloch electrons, showing how the Berry curvatures modify the equations of motion and the phase space density of states. I will also report our recent progress on extending the theory to second order in the fields.

To our surprise, the basic structure of the first order theory is preserved, and we only need to add field corrections to the Berry curvature and the band energy. As applications, I will discuss the calculation of susceptibilities of the usual electric and magnetic kinds as well as their cross type.

About the speaker

Prof Qian Niu received his PhD from University of Washington in 1985. He joined the University of Texas in 1990 and has been appointed Trull Centennial Professor at the University of Texas since 2001. He currently holds the Visiting Chair Professorship at the International Center for Quantum Materials (ICQM) of Peking University and Honorary Adjunct Professorships at the Institute of Physics, Institute of Theoretical Physics, and Shanxi University in China.

Prof Niu's main research interests focus on Berry phase in condensed matter physics, physics of grapheme, nanostructures and quantum devices, semi-classical theory of Bloch electrons, transport in magnetic systems, anomalous Hall effect and Bose-Einstein condensation.

Prof Qian has more than 165 publications in refereed journals (5237 citations), including 59 in Physical Review Letters, two in Science, one each in Nature, Physics Today, and Physics World. He was the recipient of Blumberg Fellowship and Trull centennial Fellowship, and has been appointed the Fellow of the American Physical Society since 1999.