Physics Colloquium

Tunable Berry Phase and Berry Curvature Effects in 2D and 3D Materials

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Berry phase played an important role in quantum mechanics and underlay the physics of a wide range of materials from topological phases of matters to various 2D materials. While the effect of Berry phase has been extensively shown as quantized conductance in transport experiment, the geometric aspect of wave function— determined by Berry curvature has remained much less understood experimentally. In this talk, I will use bilayer graphene as a model system to demonstrate effects of Berry phase and Berry curvature on materials' electronic and optical properties. I will first show our study of topological valley transport in the stacking domain walls of bilayer graphene, where near field infrared nanoscopy is combined with low temperature transport measurement. Then I will report our study of excitons in the tunable bandgap of bilayer graphene using advanced spectroscopy tools. These excitons obey unusual valley-dependent optical selection rules and very large magnetic moment, both originate from the tunable pseudospin and Berry curvature effect. Finally I will discuss our recent efforts on probing the low energy electron dynamics in Weyl semimetals, and the possibility of detecting related Berry phase effects in these 3D topological material.

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