Condensed Matter Theory Center Seminar

Friday, February 25
11am-12:30pm
2205 Physics Building

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"The anomalous Hall effect in the insulating regime"

The anomalous Hall effect (AHE) is a central topic in the study of ferromagnetic materials for a long time. In the metallic regime and according to the linear response theory, the contribution to AHE can be separated into skew scattering, side jump and intrinsic mechanisms. The scaling relation between the anomalous Hall conductivity (AHC) and longitudinal one for these mechanisms can be determined according to the dependence of the AHC and longitudinal conductivity on the Bloch state life time. On the other hand, the experiments on AHE in the insulating regime has shown the qualitatively different behavior which can be characterized by a new scaling relation between the AHC and longitudinal conductivity: \sigma_{xy}\sim\sigma_{xx}^(1.40~1.75). The theory of metals employing perturbation expansion in terms of the small parameter 1/(k_FL) is invalid for the insulating regime since k_FL>>1 is no longer satisfied for insulators. Basing our theory on the phonon-assisted hopping mechanism and percolation theory, we derive a general formula for the AHC, and show that the AHC scales with the longitudinal conductivity as \sigma_{xy}^{AH}\sim\sigma_{xx}^\gamma with \gamma predicted to be 1.38<\gamma<1.76, quantitatively in agreement with the experimental observations. Our result provides the understanding of the AHE in the insulating regime.

All are welcome to attend.

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