Condensed Matter & Biophysics Seminar

THURSDAY

APRIL 14

4:00 P.M.

RM 184 NSH

Understanding the magnetoresistance behaviors in WTe_2

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Tungsten ditelluride (WTe2) is a layered transition metal dichalcogenide (TMD) compound with metal layers sandwiched between adjacent insulating chalcogenide layers, so it is typically considered to be a two dimensional (2D) material. WTe2 was recently discovered to have extremely large magnetoresistance (XMR) [1] at low temperatures and exhibits a transformative 'turn-on' temperature behavior: when the applied magnetic field is above a certain value, the resistivity versus temperature ρ(T) curve shows a minimum at a field dependent temperature T*(H). This 'turn-on' temperature behavior has been interpreted as a magnetic-field-driven metal-insulator transition or attributed to an electronic structure change. In this talk I will report on two scaling behaviors of the magnetoresistance in WTe2. The first shows that the angle dependence of the magnetoresistance follows a conventional 3D mass anisotropy scaling and hence reveals the electrical 3D nature of WTe2 [2]. The second demonstrates that the ρ(T,H) curves can be scaled with Kohler's rule [3]. The Kohler's rule scaling can quantify the 'turn-on' temperature behavior and excludes the possible existence of a magnetic-field-driven metal-insulator transition or significant contribution of an electronic structure change to the low-temperature XMR in WTe2. The necessary factors required for observing the XMR effect in semimetals will be discussed.

In collaboration with L. R. Thoutam, Z. L. Xiao, J. Hu, S. Das, Z. Q. Mao, J. Wei, R. Divan, A. Luican-Mayer, G. W. Crabtree, and W. K. Kwok

References:

[1]M. N. Ali, et al., Large, non-saturating magnetoresistance in WTe2. Nature 514, 205 (2014)
[2] L. R. Thoutam, Y. L.Wang et al., Temperature-Dependent Three-Dimensional Anisotropy of the Magnetoresistance in WTe2 Phys. Rev. Lett. 115, 046602 (2015)
[3] Y. L. Wang et al., Origin of the turn-on temperature behavior in WTe2. Phys. Rev. B 92, 180402(R) (2015)

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