Traveling electrons in loosely bound layers

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Extremely large magnetoresistance (XMR) was recently discovered in WTe2, triggering extensive research on this material regarding the XMR origin. Since WTe2 is a layered compound with metal layers sandwiched between adjacent insulating chalcogenide layers, this material has been considered to be electronically two-dimensional. Here a team of users from Argonne's Materials Science Division and Northern Illinois University, working collaboratively with researchers at Argonne's Center for Nanoscale Materials, report two new findings on WTe2: (1) WTe2 is electronically three-dimensional with a mass anisotropy as low as 2, and (2) the mass anisotropy varies with temperature and follows the magnetoresistance behavior of the Fermi liquid state.

The results not only provide a general scaling approach for the anisotropic magnetoresistance but also are crucial for correctly understanding the electronic properties of WTe2, including the origin of the remarkable "turn-on" behavior in the resistance versus temperature curve, which has been widely observed in many materials and assumed to be a metal-insulator transition.

It remains to be seen whether this unique electronic behavior is the origin of WTe2's magnetoresistance—a property of interest for designing magnetic hard drives and sensors – but the result shows that the mechanical and electrical properties of a material are not always as closely linked as commonly assumed.

CNM facilities provided photolithographic patterning and deposition and morphological analysis via SEM. 4-probe resistivity measurements via

PPMS and quantum oscillations of resistivity were performed in MSD.

More information: "Temperature-Dependent Three-Dimensional Anisotropy of the Magnetoresistance in WTe_2"
arxiv.org/pdf/1506.02214.pdf

"Electrons Travel Between Loosely Bound Layers," Viewpoint in *Physics* 8, 71 (2015)

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