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Current Jets and Non-saturating Magnetoresistance in Disordered Semiconductors[1]

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The transverse, positive magnetoresistance of doped silver telluride and silver selenide changes linearly with field by thousands of percent, with no sign of saturation up to MegaGauss. The inhomogeneous distribution of excess/deficient silver atoms lies behind this anomalous magnetoresistive response, introducing spatial conductivity fluctuations with length scales independent of the cyclotron radius. Theoretical simulations of two and three-dimensional random resistor networks reveal distorted current flows that provide a linear contribution to the transverse magnetoresistance, but a pronounced negative longitudinal magnetoresistance. We show that a systematic investigation of the resistivity tensor in longitudinal field could be used to identify the spatial inhomogeneities in the silver chalcogenides and determine the associated length scale of the current distortion. The incorporation of macroscopic inhomogeneities to other semiconductors, such as InSb, opens the gate to artificial fabrication of conducting networks with micron scale unit size for enhanced magnetoresistive sensitivity.

[1]in collaboration with Meera M. Parish, J. B. Betts and T. F. Rosenbaum