Anomalous electronic transport of the Weyl metal $Bi_{0.96}Sb_{0.04}$: breakdown of Ohm's law

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The $Bi_{1-x}Sb_x$ is a classical system, which has been studied for several decades because of its interesting band structure. Recently, this system has become an intensive focus of research in the context of three-dimensional (3D) topological insulator (TI) since the discovery of its non-trivial topological structure for $x > 0.07$ [1]. In this talk, we introduce a 3D Weyl metallic state realized in $Bi_{1-x}Sb_x$ and its chiral anomaly at $x \sim 0.03$, where a topological phase transition occurs from a band insulator for $x < 0.03$ to the "3D TI" for $x > 0.03$. After explaining some peculiar features of this state, we discuss anomalous electric transport phenomena originating from chiral anomaly [2], together with similar observations in other Dirac and Weyl metals. In particular, we present breakdown of Ohm's law as a hallmark of the Weyl metallic state, originating in chiral anomaly and charge pumping. These modify electron distribution in the pair of Weyl bands beyond linear response, producing nonlinear conductivity contribution proportional to E^2 (E is the electric field). We further discuss its implications and possible experiments to detect completely new phenomena in the electrical transport of the Weyl metal.

[1] Liang Fu and C. L. Kane, Phys. Rev. B 76, 045302 (2007).
[2] Heon-Jung Kim et al., Phys. Rev. Lett. 111, 246603 (2013).