Adler-Bell-Jackiw anomaly in Dirac metal \( \text{Bi}_{0.97}\text{Sb}_{0.03} \) single crystals

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Dirac metal (gapless semi-conductor) is believed to turn into Weyl metal when either time reversal symmetry or inversion symmetry is broken. However, no experimental evidence has been reported for the existence of Weyl fermions in three dimensions. Applying magnetic fields near the topological phase transition from a topological insulator to a band insulator in \( \text{Bi}_{1-x}\text{Sb}_x \), we observe not only the weak anti-localization phenomenon in magnetoconductivity near zero magnetic fields \((B < 0.4 \text{ T})\) [see Fig. 1: transverse magnetoconductance \((T-MC)\)] but also its upturn above 0.4 T only for \( E \parallel B \) [see Fig. 2: longitudinal magnetoconductance \((L-MC)\)]. We attribute the origin of this anomalous transport phenomenon to the Adler-Bell-Jackiw anomaly in the presence of weak anti-localization corrections. This “incompatible” coexistence between weak anti-localization and “negative” MC is supported further by our measurement of the Hall effect in the same geometry of fields and currents, where an anomalous Hall effect is shown to appear due to the topological \( \mathbf{E} \cdot \mathbf{B} \) term.

Fig. 1

Fig. 2