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Evidence for the chiral anomaly in the Dirac semimetal Na_3Bi[1]

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Chiral symmetry describes the conservation of handedness of massless chiral fermions in high-energy physics. Such symmetry can be broken by the coexistence of electric ($\vec{E}$) and magnetic ($\vec{B}$) fields, known as the chiral (Adler-Bell-Jackiw) anomaly. This anomaly describes an axial current pumped between left-handed and right-handed Weyl fermions. In condensed matter physics, the recent development in both theory and experiments has confirmed the existence of Weyl nodes in the Dirac and Weyl semimetals. Generated by the $\vec{E} \cdot \vec{B}$ term, the axial current could induce negative magnetoresistance in the Dirac and Weyl semimetals. Here we report the observation of a large, negative longitudinal magnetoresistance in the Dirac semimetal Na_3Bi. By rotating both the direction of $\vec{E}$ and $\vec{B}$, we found that the small deviation of $\vec{E}$ from $\vec{B}$ greatly suppresses the observed negative magnetoresistance. We will discuss its consistency with the predicted chiral anomaly effect in the Dirac/Weyl semimetal.

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