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**Unconventional bulk three-dimensional Fermi surface in Kondo insulating SmB<sub>6</sub>**

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We report the observation of a paradoxical insulator with a bulk state which is electrically insulating and simultaneously yields quantum oscillations typical of good metals. We present high field measurements of conductivity and magnetic torque in high purity single crystals of the Kondo insulator SmB<sub>6</sub> which reveal an activated behavior characteristics of an insulator with an energy gap at the Fermi energy in the former and quantum oscillation of frequencies characteristics of a large three-dimensional conduction electron Fermi surface similar to the metallic rare earth hexaborides such as PrB<sub>6</sub> and LaB<sub>6</sub> in the latter. The quantum oscillations observed in the magnetic torque measurements are characteristic of an unconventional Fermi liquid – the amplitude strongly increases at low temperatures in a stark contrast to the saturating Lifshitz-Kosevich behavior in conventional metallic states.