Quantum Oscillations and Quantum Hall Effect in Topological Insulator Material Bi$_2$Se$_3$ HELIN CAO, IRENEUSZ MIOTKOWSKI, TIAN SHEN, YONG CHEN, Department of Physics, Purdue University, West Lafayette, IN 47907 USA — Bi$_2$Se$_3$ has attracted strong attention recently as a prototype topological insulator material. We have measured magneto-transport in metallic Bi$_2$Se$_3$ crystals. At high magnetic field (B), the longitudinal resistance (R$_{xx}$) displays characteristic Shubnikov–de Haas (SdH) oscillations (periodic in 1/B). The measurements in tilted magnetic field show the SdH oscillations are only controlled by the perpendicular component of B, indicating 2D nature of charge carriers. We also observed quantized plateaus in Hall resistance (R$_{xy}$) concomitant with the minima in R$_{xx}$. From the temperature dependence of the SdH oscillations, we extract a Fermi velocity $\sim 5.9 \times 10^5$ m/s, and an effective mass $\sim 0.14 m_e$ ($m_e$ is the electron mass). We discuss possible relations of our observations to topological surface states, as well as contributions from individual 2D quintuple layers of Bi$_2$Se$_3$. 

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