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Extrinsic spin-orbit coupling and density dependent weak antilocalization in three-dimensional topological insulators WEIZHE LIU, School of Physics, The University of New South Wales, Sydney 2052, Australia, PIERRE ADROGUER, Institut für Theoretische Physik und Astrophysik, Universität Würzburg, 97074 Würzburg, Germany, XINTAO BI, ICQD, Hefei National Laboratory for Physical Sciences at the Microscale, University of Science and Technology of China, Hefei, Anhui 230026, China, EWELINA HANKIEWICZ, Institut für Theoretische Physik und Astrophysik, Universität Würzburg, 97074 Würzburg, Germany, DIMITRIE CULCER, School of Physics, The University of New South Wales, Sydney 2052, Australia — Topological insulators (TIs) have revolutionized our understanding of insulating behaviour. Three-dimensional TIs are insulators in the bulk but conducting along their surfaces. Much of recent researches on 3D TIs focus on overcoming the *transport bottleneck*, namely the fact that surface transport is overwhelmed by bulk transport stemming from unintentional doping. The key to overcoming this bottleneck is identifying unambiguous signatures of surface state transport. We will discuss one such signature: weak antilocalization, meaning that coherent backscattering increases the electrical conductivity. The features of this effect, however, are rather subtle, because in TI the impurities have also strong spin-orbit coupling. I will show that spin-orbit coupled impurities introduce an additional time scale, which is expected to be shorter than the dephasing time, and the resulting conductivity has a distinguished part with linear dependent on the carrier number density. The result we predict is directly observable experimentally.

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