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Experimental Evidence of the Nontrivial Topological Order in the Semiconducting Bi(111) Thin Films DONG QIAN, MENGYU YAO, Shanghai Jiao Tong University — Bismuth is one of the most extensively studied elements in solid state physics because of its unique electronic properties. In the last five year, Bi becomes the key element that provides the spin-orbital interaction in the field of topological insulators (TIs) that, as a new quantum phase of matter, have attracted a great deal of attentions due to its many exotic properties and potential applications. Bulk Bi is a semi-metal with novel surface states. The topological order of bulk Bi is thought to be trivial though there are still some debates. Very interestingly, Bi(111) thin films of certain thickness ($>$ 19nm) were recently found to be an semiconductor with robust metallic conduction channel on the surface. In this work, using state-of-art angle resolved photoemission spectroscopy, in the first time we directly identified the nontrivial topological order of the semiconducting Bi(111) thin films. Fermi energy inside the bulk gap is found to intersect the surface states an odd number of times, which reveals that the semiconducting Bi(111) is a three dimensional topological insulator.

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