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Discovery of a Three-dimensional Topological Dirac Semimetal, Na3Bi Y.L. CHEN, Oxford University, Z.K. LIU, Stanford University, B. ZHOU, Oxford University, Y. ZHANG, Lawrence Berkeley National Lab, Z.J. WANG, H.M. WENG, Chinese Academy of Science, D. PRABHAKRAN, Oxford University, S.-K. MO, Lawrence Berkeley National Lab, Z.X. SHEN, Stanford University, Z. FANG, X. DAI, Chinese Academy of Science, Z. HUSSAIN, Lawrence Berkeley National Lab, OXFORD TEAM, STANFORD COLLABORATION, CHINESE ACADEMY OF SCIENCE COLLABORATION — Three-dimensional (3D) topological Dirac semimetals (TDSs) represent a novel state of quantum matter that can be viewed as "3D graphene". In contrast to two-dimensional (2D) Dirac fermions in graphene or on the surface of 3D topological insulators, TDSs possess 3D Dirac fermions in the bulk. The TDS is also an important boundary state mediating numerous novel quantum states, such as topological insulators, Weyl semi-metals, Axion insulators and topological superconductors. By investigating the electronic structure of Na3Bi with angle resolved photoemission spectroscopy, we discovered 3D Dirac fermions with linear dispersions along all momentum directions for the first time. Furthermore, we demonstrated that the 3D Dirac fermions in Na3Bi were protected by the bulk crystal symmetry. Our results establish that Na3Bi is the first model system of 3D TDSs, which can also serve as an ideal platform for the systematic study of quantum phase transitions between rich novel topological quantum states.

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