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Layer-by-layer entangled spin-orbital texture of the topological surface state in Bi_2Se_3 ZHIHUAI ZHU, C.N. VEENSTRA, G. LEVY, I.S. ELFIMOV, A. DAMASCELLI, Quantum Matter Institute, UBC, Canada, M.W. HAVERKORT, MPI, Stuttgart, Germany, A. UBALDINI, Univ. of Geneve, Switzerland, P. SYERS, N.P. BUTCH, J. PAGLIONE, CNAM, Univ. of Maryland, USA — With their spin-helical metallic surface state, topological insulators (TI) define a new class of materials with a strong application potential in quantum electronic devices. Technological exploitation depends on the degree of spin polarization of the topological surface state (TSS) - assumed to be 100% in phenomenological models. Yet in real materials, spin- and angle-resolved photoemission spectroscopy (ARPES) showed that the TSS spin polarization varies over a wide range: 20-85%. This striking variation in TSS spin polarization has remained unexplored, leaving an undefined application prospect of TIs. Here we present a light-polarization study of ARPES momentum maps to unveil the entangled spin-orbital texture of the TSS in Bi_2Se_3. By determining the layer-by-layer evolution of this spin-orbital entanglement, we solve the puzzle of the observed TSS spin polarization and also provide means to manipulate the spin polarization of photoelectrons and photocurrents in TI devices.

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