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Photoelectron spin-polarization control in the topological insulator Bi_2Se_3 ZHIHUAI ZHU, C.N. VEENSTRA, S. ZHDANOVICH, M.P. SCHNEIDER, G. LEVY, University of British Columbia, Vancouver, Canada, T. OKUDA, K. MIYAMOTO, S.-Y. ZHU, Hiroshima Synchrotron Radiation Center, Hiroshima, Japan, P. SYERS, N.P. BUTCH, J. PAGLIONE, University of Maryland, College Park, USA, M.W. HAVERKORT, Max Planck Institute, Dresden, Germany, I.S. ELFIMOV, A. DAMASCELLI, University of British Columbia, Vancouver, Canada — We study Bi_2Se_3 by angle-resolved photoemission spectroscopy (ARPES) and density functional theory. We find that the topological surface state (TSS) is characterized by a layer-dependent entangled spin-orbital texture, which becomes apparent through photoelectron interference effects in ARPES. This explains the discrepancy between the spin polarization obtained in spin-ARPES–ranging from 20% to 85%– and the 100% value assumed in phenomenological models [1]. We demonstrate how to probe the intrinsic spin texture of TSS by spin-ARPES, and continuously manipulate the spin polarization of photoelectrons and photocurrents all the way from 0 to +/-100% by an appropriate choice of photon energy, polarization, and angle of incidence [2]. As illustrated by a minimal two-atomic-layer model, photoelectron spin-polarization control is generically achievable in systems with a layer-dependent entangled spin-orbital texture as a direct manifestation of dipole selection rules, photoelectron interference, and TSS complex structure [2].

[1] Z.-H. Zhu et al., Phys. Rev. Lett. 110, 216401 (2013)
[2] Z.-H. Zhu et al., submitted to Phys. Rev. Lett. (2013)

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