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Driving Ultrafast Spin and Energy Modulation in Quantum Well States via Photo-Induced Electric Fields[1] SAMUEL CIOCYS, ALESSANDRA LANZARA, University of California, Berkeley — The future of modern optoelectronics and spintronic devices relies on our ability to control the spin and charge degrees of freedom at timescale that can compete with traditional silicon-based devices, operating at speeds greater than 10 GHz. Rashba spin-split quantum well states, 2D states that develop at the surface of strong spin-orbit coupling materials, are ideal given the easy tunability of their energy and spin states. So far however, most studies have only demonstrated such control in a static way. In this study, we demonstrate ultrafast control of the spin and energy degrees of freedom of surface quantum well states on Bi_2Se_3 at picosecond timescales. By means of a focused laser pulse, we modulate the band bending, producing picosecond time-varying electric fields at the material's surface, thereby reversibly modulating the quantum well spectrum and Rashba Effect. These results open a new pathway for light-driven spintronic devices with ultrafast switching of electronic phases, and offer the interesting prospect to extend this ultrafast photogating technique to a broader host of 2D materials.

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Samuel Ciocys
University of California, Berkeley

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