An Ultrafast Symmetry Switch in a Weyl Semimetal

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Discovery of topological materials has sparked a worldwide interest to harness the topological properties of quantum matter, with important applications in dissipationless electronics and fault-tolerant quantum computing. One prime example is WTe$_2$, which is a layered semimetal that crystallizes in a unique structure where the emergence of massless Weyl fermions in this system is sensitive to atomic-scale lattice distortions. In this talk, I will discuss the topological physics of WTe$_2$, and show that its topological invariants are highly tunable by means of interlayer shear strain, as crystallographically measured using relativistic electron diffraction [1]. We will discuss how ultrashort pulses of terahertz (THz) electromagnetic field can be used to drive the shear mode which in turn serves as an ultrafast, energy-efficient means to induce more robust, well-separated Weyl points or to annihilate all Weyl points of opposite chirality. These results define new methods for ultrafast manipulation of the topological properties in 2D materials that can operate at THz frequencies.

References