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Synthetic topological matter with ultracold fermions in optical lattices[1] ZEJIAN REN, BO SONG, CHENGDONG HE, ELNUR HAJIYEV, QIANHANG JERRY CAI, GYU-BOONG JO, Hong Kong Univ of Sci Tech — Ultracold atoms in optical lattices provide a versatile platform to explore topological physics. In this poster, we present a set of experiments on spin-orbit coupled ytterbium fermions in bulk and in lattice, in which the band topology can be engineered on demand. Firstly, a novel symmetry-protected topological phase for ultracold fermions is realized in a Raman-dressed one-dimensional optical lattice. The topological invariant is measured in equilibrium across the topological phase transition, and the topological nature is further investigated in the spin-relaxation dynamics in non-equilibrium. Next, we report a new implementation of two-dimensional (2D) spin-orbit coupling in lattice resulting in 2D semimetal band structure. The tunable band topology is probed by the spin polarization measured within the first Brillouin zone. The semimetal behaviour is probed by measuring spin textures at different temperatures, showing an asymmetric quasi-momentum distribution when the Fermi level is properly tuned. Our work will further broaden our knowledge of the novel spin-orbit coupling (SOC) physics and pave the way to realization of the synthetic SOCs in a controlled manner.

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