

Abstract Submitted  
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**Observation of Floquet-Bloch states on the surface of a topological insulator** YIHUA WANG, Stanford University, HADAR STEINBERG, PABLO JARILLO-HERRERO, NUH GEDIK, MIT — The unique electronic properties of the surface electrons in a topological insulator are protected by time-reversal symmetry. Circularly polarized light naturally breaks time-reversal symmetry, which may lead to an exotic surface quantum Hall state. Using time- and angle-resolved photoemission spectroscopy, we show that an intense ultrashort mid-infrared pulse with energy below the bulk band gap hybridizes with the surface Dirac fermions of a topological insulator to form Floquet-Bloch bands. These photon dressed surface bands exhibit polarization-dependent band gaps at avoided crossings. Circularly polarized photons induce an additional gap at the Dirac point, which is a signature of broken time-reversal symmetry on the surface. These observations establish the Floquet-Bloch bands in solids and pave the way for optical manipulation of topological quantum states of matter.

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