Chen Chaoyu is a researcher at the Songshan Lake Materials Laboratory. In July 2013, he received a PhD in condensed matter physics from the Institute of Physics, Chinese Academy of Sciences. From 2013/09 to 2015/02, he served as a postdoctoral fellow at the French National Center for Synchrotron Radiation. From 2015/03 to 2018/10, he served as a permanent beamline scientist in the same unit. In 2018/10, he returned to China and joined Southern University of Science and Technology. Chen Chaoyu has been engaged in the study of electronic structures of quantum states. He has published more than 30 articles as the first author or corresponding author (including co-authors) in high-level journals such as Nature Physics, PRX, PRL, PNAS, Nature Communications, Advanced Materials, and National Science Review.

Previous theoretical efforts have predicted a type of unconventional antiferromagnet characterized by a crystal symmetry that connects antiferromagnetic sublattices in real space and simultaneously couples spin and momentum in reciprocal space. This results in a unique crystal-symmetry-paired spin-valley locking and related properties including piezomagnetism and noncollinear spin current even without spin-orbit coupling. However, most known unconventional antiferromagnets do not meet the necessary symmetry requirements for nonrelativistic spin current, and this limits applications in spintronic devices. Here, we demonstrate crystal-symmetry-paired spin-valley locking in a layered room temperature antiferromagnetic compound, Rb1-δV2Te2O. Spin-resolved photoemission measurements directly show the opposite spin splitting between crystal-symmetry-paired valleys. Quasi-particle interference patterns show the suppression of inter-valley scattering due to the spin selection rules that are a direct consequence of the spin-valley locking. These results suggest that Rb1-δV2Te2O is a potential room-temperature altermagnet candidate. Our observations highlight a methodology that enables both the advantages of layered materials and possible control through crystal symmetry manipulation for advancements in magnetism, electronics, and information technology.
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