Spin and orbital texture of the Weyl semimetal $MoTe_2$ studied by spin-resolved momentum microscopy

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Weyl semimetals host chiral fermions in solids as a pair of non-degenerate linear dispersions with band crossing points in bulk [1]. These Weyl points are protected by topology, forming a Fermi arc, which is a connection between a pair of Weyl points with opposite chirality at the surface. 1T_d $MoTe_2$ can be classified into an unconventional type-II Weyl semimetal, which is characterized by a strongly tilted cone as shown in Fig. 1 (a) [2]. Momentum microscopy [3] provides two dimensional photonelectron maps of the in-plane crystal momentum over the whole Brillouin zone, simultaneously. As an example, Fig. 1 (b) shows a measured Fermi-surface contour of 1T_d $MoTe_2$. Together with an imaging spin filter [4], we have revealed the spin-resolved electronic structure of the type-II Weyl semimetal 1T_d $MoTe_2$ in the full Brillouin zone. Combined with the use of differently polarized light, we have revealed the spin texture and the orbital texture of the Weyl cones in comparison with first-principles calculations. We give evidence that a pair of Weyl cones exhibits a strong circular dichroism with reversed sign, indicating the different chiral charge of the respective Weyl points in the Fermi surface.

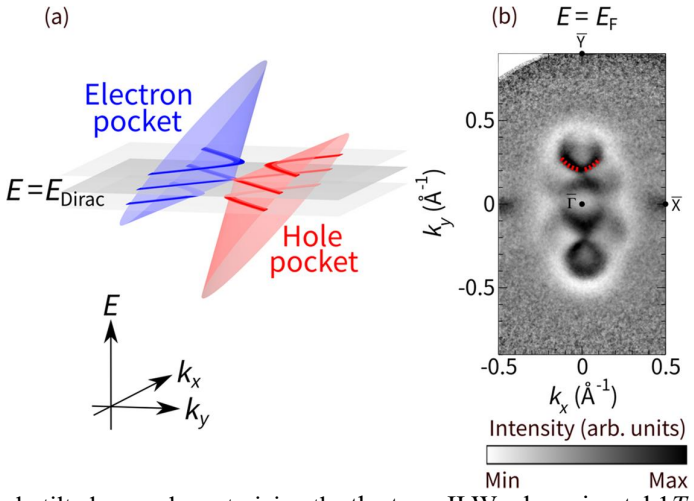

Figure 1. (a) Strongly tilted cone characterizing the the type-II Weyl semimetal 1T_d $MoTe_2$. The Weyl points appear at the boundary between the electron and hole pocket. (b) Measured Fermi-surface contour of 1T_d $MoTe_2$ by use of momentum microscopy. High symmetry points of the surface Brillouin zone are indicated by the corresponding labels. Red dotted line indicates the Fermi arc as a guide to the eye.

References

[1] N. Armitage *et al.,* Mod. Rev. Phys. **90**, 015001 (2018).
[2] A. A. Soluyanov *et al.,* Nature **527**, 495 (2015).
[3] C. Tusche *et al.,* e-J. Surf. Sci. Nanotechnol. **18**, 48 (2020)
[4] C. Tusche *et al.,* Appl. Phys. Lett. 99, 032505 (2011).