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The puzzle of metallic and insulating phases at the surface of 1T-TaSe2

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In the layered transition-metal dichalcogenide 1T-$TaSe_2$ the formation of a star-of-David charge density wave results in a half-filled band at the Fermi surface that is sensitive to electron correlations. Interestingly, while the bulk material remains a metal, the surface displays a mix of different phases, ranging from insulating to metallic, all with the same in-plane charge ordering.
We used microfocus ARPES to investigate the quasiparticle dispersion in these different spatial domains. Insulating areas show characteristics of a band insulator, while metallic regions exhibit a chiral Fermi surface. Additionally, within the metallic phase, we found a series of bands varying in number and energy position. A direct comparison to DMFT calculations considering slabs of different thickness allows us to reconcile this puzzle as the combined effect of stacking faults between the layers and quantum confinement.

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