Charge density wave induced Kramers nodal line in $LaTe_3$

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A charge density wave (CDW) is a modulation of conduction electrons, generally accompanied by a periodic distortion of the lattice. It has been reported that the CDW in $LaTe_3$, a rare-earth trichalcogenide and a member of the RTe_3 (R represents a rare earth element) family with the highest CDW transition temperature of 670 K, is unidirectional with an incommensurate wave vector in which the Te bilayers host the CDW. In recent years, multiple fascinating findings in $LaTe_3$ have reignited the scientific interest of the community in this TRS preserving noncentrosymmetric material with very high carrier mobility. Using angle-resolved photoemission spectroscopy, density functional theory (DFT), and symmetry arguments, we demonstrate [1] that $LaTe_3$ is a Kramers nodal line metal - a recently predicted new topological phase of matter [2] - with a twofold degenerate nodal line connecting the time-reversal invariant momenta. In addition, calculations demonstrate that the nodal line imposes gapless crossings between the bilayer-split CDW-induced shadow bands and the main bands. The ARPES data confirm the existence of the Kramers nodal line and demonstrate that the crossings traverse the Fermi level, in excellent agreement with the DFT calculations. Furthermore, spinless nodal lines - completely gapped out by spin-orbit coupling - are formed by the linear crossings of the shadow and main bandswith a high Fermi velocity.

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Reference

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