

**Nonsymmorphic-symmetry-protected hourglass Weyl node, hybrid Weyl node,  
nodal surface, and Dirac nodal line in Pd<sub>4</sub>X (X=S, Se) compounds**

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A nodal surface can also carry a nonzero topological charge when it is protected by screw rotation and time reversal symmetry<sup>1,2</sup>. To demonstrate it, we calculate the Berry flux along  $k_z$ , finding that the topological charge is equal to +1 when  $k_z < 0$ , while it is equal to -1 when  $k_z > 0$  [See FigS1 (a)].

Regarding to the Dirac nodal line, as we know, generally, in the coexistence of inversion symmetry and time reversal symmetry, a nodal loop carries a quantized Chern number. However, our work does not have such a combined symmetry. We also calculate the Chern number along an arbitrary path, finding that the Dirac nodal line is the critical point where the Chern number changes its sign, which plays a role like a wall between two topological phases [See Fig.S1 (b)].

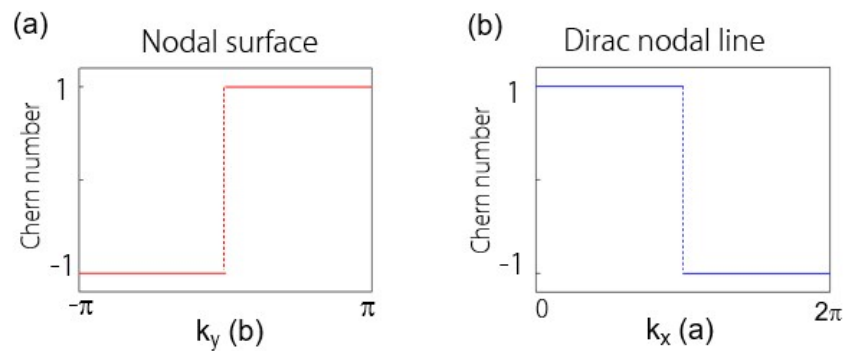


Figure S1 (a) and (b) are the Chern number of nodal surface and Dirac nodal line, respectively.

#### Reference

1. L. Liu, J. D. Joannopoulos, M. Soljačić, Nature Photonics, 2014, **8**, 821-829.
2. M. Xiao, S. H. Fan, Topological Charged Nodal Surface, 2018, arXiv:1709.02363.