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Realize Dirac cones in compressed black phosphorus LI YANG, RUIXIANG FEI, VY TRAN, Department of Physics, Washington University — Using the k·p theory and first-principles simulations, we predict that applying a moderate uniaxial or hydrostatic pressure (>0.6GPa) on bulk or multilayer black phosphorus (BP) can diminish its bandgap and produce one-dimensional and even two-dimensional (2D) Dirac cones. Similar to topological insulators, these 2D Dirac cones result from two competing mechanisms: the unique linear band dispersion tends to open a gap via a "pseudo-spin-orbit" coupling, while the band symmetries preserve the material's gapless spectrum. In particular, these Dirac cones in BP are bulk states that do not require time-reversal symmetry, thus they can keep the high carrier mobility even in the presence of surface or magnetic perturbations. Finally, our predictions have been confirmed by recent experiments.

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