Control of superconducting pairing symmetries in monolayer black phosphorus

Motivated by recent experimental progress, we study the effect of mechanical deformations on the superconducting pairing symmetries in monolayer black phosphorus (MBP). Starting with phonon-mediated intervalley spin-singlet electron-electron pairing and making use of realistic band parameters obtained through first-principles calculations, we show that the application of weak mechanical strain in the plane of MBP can change the effective $s$-wave and $p$-wave symmetry of the superconducting correlations into effective $d$-wave and $f$-wave symmetries, respectively. This prediction of a change in the pairing symmetries might be experimentally confirmed through angular dependence high-resolution tunneling spectroscopy, the Meissner effect, and critical temperature experiments. The idea of manipulating the superconducting symmetry class by applying planar mechanical strain can be extended to other anisotropic materials as well and may help in providing important information of the symmetries of the order parameter, perhaps even in some high-$T_c$ superconductors.

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