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Spin-layer locking in globally centrosymmetric but locally non-centrosymmetric two dimensional materials

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In this talk, I will discuss a novel phenomenon called spin-layer locking and its physical consequence in a new class of two dimensional materials with the crystal structure that is globally centrosymmetric but locally non-centrosymmetric. I will give three examples: Mono-layer $PtSe_2$ film, a tri-layer $(LaO)_2(SbSe_2)_2$ film and a bi-layer $NbSe_2$ superconductors. Firstly, I will discuss a theoretical analysis of the recent surprising experimental observation of helical spin texture in a centrosymmetric mono-layer $PtSe_2$ film by the angle-resolved photoemission spectroscopy. This observation can be explained by dipole induced Rashba effect with spin-layer locking: Opposite spins are degenerate in energy, while spatially separated in the top and bottom Se layers. In my next example of a tri-layer $(LaO)_2(SbSe_2)_2$ film with a similar dipole induced Rashba effect and spin-layer locking, I will discuss a direct physical consequence, electrically tunable multiple Dirac cones, due to the narrow band gap in this system. Finally, I will discuss a two dimensional superconducting material, bilayer $NbSe_2$, and show that a finite momentum pairing (known as Fulde-Ferrell-Larkin-Ovchinnikov pairing) can be induced by in-plane magnetic fields due to the spin-layer locking.

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