Orbital origin of hidden spin textures in centrosymmetric PtSe2 monolayer and their proximity applications

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Harnessing the quantum degrees of freedom has become an essential paradigm for sustainable technological development. In 2D materials, the combination of spin-orbit coupling and reduced crystalline symmetries gives rise to the Rashba-Eddelstein which enables electrical control of the spin degree of freedom of electrons. It is a common belief that global inversion asymmetry is required to the existence of such effect. However, there is experimental data has confirmed this prediction and evinced the existence of opposite helical spin textures on the atomic planes of centrosymmetric 1T PtSe2 [1,2]. The 1T family of TMDs has not received as much attention as the other TMD polytypes and their topological aspects and properties are just being explored. Recent works from orbitronics -the orbital angular momentum analogue of spintronics- have inquired into their topological properties and demonstrated that the orbital angular momentum transport in these systems coexists with a higher-order topological phase [3]. In this work, we leveraged first-principles calculations and tight-binding models extracted from these, with symmetry analyses and large-scale transport simulations to demonstrate that the electrostatic origin of helical layer-localised spin and orbital textures and demonstrate their overlooked applicability for proximity effects and present an electrical probe for it.

References

[1] Yao, W., *et al. Nature communications*, *8,* 1, (2017), 14216.
[2] Clark, O. J., *et al.*, *Nature Communications*, *13,* 1, (2022), 4147.
[3] Costa, M., *et al. arXiv preprint, 2022, arXiv:2205.0099.*

Figures

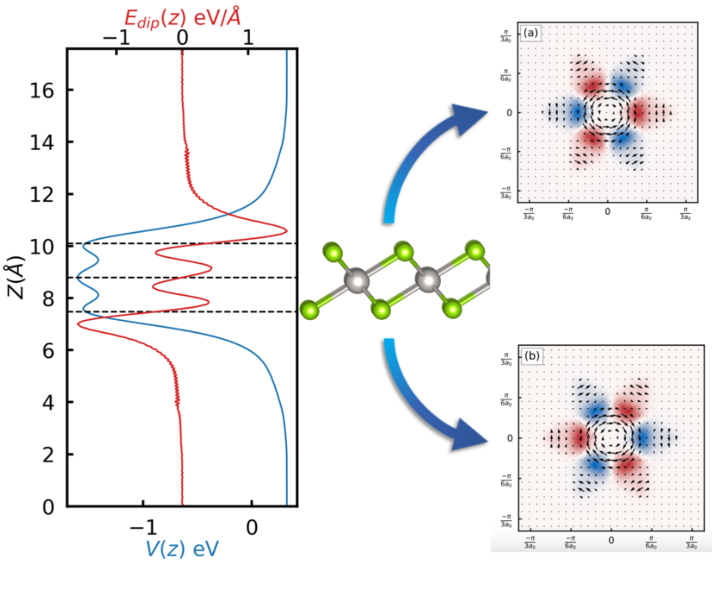

Figure 1: Real-space representation of the dipolar electric field in PtSe2 monolayers and schematic depiction of layer-projected spin textures.