Orbital Hall effect in Two-dimensional Materials

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The field of spintronics blossomed in the last decade, driven by the use of spin-orbit coupling to generate and manipulate spin currents in non-magnetic materials. In these systems, the efficient conversion between charge and spin currents is mediated by spin-orbit. Great progress in the manipulation of the orbital angular momentum of light has also been achieved in the last decades, leading to a large number of relevant applications. Still, electron orbitals in solids were less exploited, even though they are known to be essential in several underlying physical processes in material science.

Recently, a renewed interest in orbital magnetism and other orbital effects in solids gave origin to various theoretical studies on orbitronics[1], raising expectations that orbital angular degrees of freedom may be eventually employed to process information in logic and memory devices. The orbital-Hall effect (OHE), similarly to the spin-Hall effect (SHE), refers to the creation of a transverse flow of orbital angular momentum that is induced by a longitudinally applied electric field. I will discuss different aspects of the OHE in multi-orbital 2D materials, such as transition metal dichalcogenides. This intrinsic property emerges from the interplay between orbital attributes and crystalline symmetries and does not rely on the spin-orbit coupling. Our results [2,3,4] indicate that multi-orbital 2D materials can display robust OHE that may be used for orbital current orbital torque transfer that are of great interest for developing novel spin-orbitronic devices.

References

[1] Dongwook Go, Daegeun Jo, Hyun-Woo Lee, Mathias Kläui, Yuriy Mokrousov, Arxiv: 2107.08478.
[2] Luis M. Canonico, Tarik P. Cysne, Tatiana G. Rappoport, R. B. Muniz, Phys. Rev. B 101(2020) 075429
[3] Luis M. Canonico, Tarik P. Cysne, Alejandro Molina-Sanchez, R. B. Muniz, Tatiana G. Rappoport, Phys. Rev. B 101 (2020) 161409
[4] Tarik P. Cysne, Marcio Costa, Luis M. Canonico, M. Buongiorno Nardelli, R. B. Muniz, Tatiana G. Rappoport Authors, Phys. Rev. Lett. 126 (2021) 056601

Figures

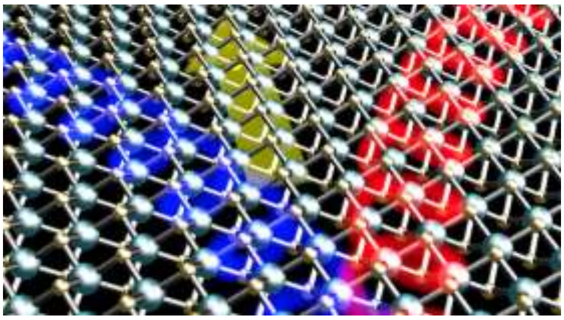

Figure 1: Illustration of the orbital Hall effect in transition metal dichalcogenides.