Spin-orbit driven emergent phases in quantum materials.

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Abstract

Spin–orbit coupling (SOC) is a relativistic effect, which may be thought of as an interaction between the intrinsic spin moment of an electron and the magnetic field generated in the rest frame of the electron either due to its orbital motion around the positively charged nucleus or due to a gradient of electrostatic potential in non-centrosymmetric systems. As an example of the first case we shall consider strongly correlated Mott insulators with a d4 electronic configuration where the interplay between spin-orbit coupling (SOC) and superexchange interactions can give rise to magnetism, defying the expected formation of atomic J = 0 nonmagnetic singlets leading to unconventional magnetic ground states promoted by anisotropic orbital interactions.[1],[2],[3] In addition, we shall show the emergence of Rashba and Dresselhaus spin–orbit interactions in non-centrosymmetric systems that exhibit characteristic spin textures, in particular persistent spin-textures important for spintronics research. [4],[5],[6]

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