Relativistic spin-momentum locking in magnetic systems

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Spin–momentum locking in altermagnets has been deeply explored in the nonrelativistic limit[1]. Including spin–orbit coupling, the spin-momentum locking differs among the three spin components, S_x, S_y, and S_z, forming the relativistic spin-momentum locking. We considered orthorhombic YVO_3 and hexagonal MnTe, for which we perform density functional theory calcultions. For YVO_3, the relativistic locking comprises s-, d_{xy}-, and d_{xz}-wave. In MnTe, the dominant component S_y of MnTe inherits the polarized charge distribution and the nonrelativistic spin-momentum locking bulk g-wave, but the breaking of the C_{6z} rotational symmetry by the Néel vector lowers the symmetry from g-wave to d-wave. The relativistic spin-momentum locking for MnTe is composed of d_{xz}-, d_{yz}- and s-wave. Despite small magnitudes in real space, the canted spin components contribute significant spectral weight in k-space, impacting k-space properties[2]. We extend these results to the non-centrosymmetric altermagnetic phase [3] and to ferromagnetic phases[4], where we prove the relativistic spin-mometum locking even for spin-components which are not allowed by symmetry in the real space.

References:

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