Controlling momentum-dependent spin textures in insulating antiferromagnets

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The effect of spin-orbit coupling (SOC) is one of the most actively studied topic in recent years, responsible for numbers of emergent phenomena such as spin-momentum locking, spin Hall effect and Kitaev spin liquids. Since the SOC arises when the crystal loses its spatial inversion symmetry (SIS), the similar effect can be expected in magnetic insulators with SIS breaking. However, the phenomena in ferro or ferromagnets lacks abundance compared to electron-SOC systems, since the electrons have up and down spin degrees of freedom that couple to momentum by the SOC, whereas in ferromagnets there is only a single species of magnon. I will talk about the theoretiacal framework we constructed recently that resolves this issue; the staggered magnetic moments on the magnetic two-sublattices generate two species of manons that form a pseudo-spin degrees of freedom, following an $SU(2)$ algebra. The framework enables us to explore as rich physics in arbitray insulating antiferromagnet, and indeed we find a variety of momentum-dependent spin textures, anomalous thermal Hall effect, and topological edge states are actually found in a typical antiferromagnet on a square, honeycomb, and even in the antiferromagnetic insulating state of the Kitaev-type models.

Refs:
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