Contribution ID: **75** Type: **not specified**

Flipping chiral edge states through nuclear spin S and spin modulating vector in topological insulators

Friday 8 September 2023 12:30 (30 minutes)

Non chiral spin texture gives rise to the topological Hall effects (THE). We analyze the topological property of one such spin texture, which was recently observed in van der Waals (vdW) magnet Fe3GeTe2. In this spin texture both the azimuthal and polar angle of the spin depend on the spatial coordinates. The Hamiltonian in strongly correlated regime with this spin texture for arbitrary large nuclear spin S is found. The large spin-S treatment is necessary as magnetic atoms of the vdW magnets can have spin S>1/2. It was found that on a honeycomb lattice for two band material the first Chern number depends on the spin S and azimuthal angle. For a fixed S as the spin modulating vector – related to the azimuthal angle – changes from 0 to π the sign of the Chern number changes multiple times. Physically, as the Chern number is related to the Hall conductivity, and the chiral edge states, sign change of Chern number will result in flipping of the former. We also argue that no matter how complex is the spin texture, the topological properties depends only on a single factor: the change in azimuthal angle between neighboring spins. It confers with the recent view that topological properties can occur with zero scalar spin chirality. We also discuss possible experimental ways to observe this effect.

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Session Classification: Parallel B