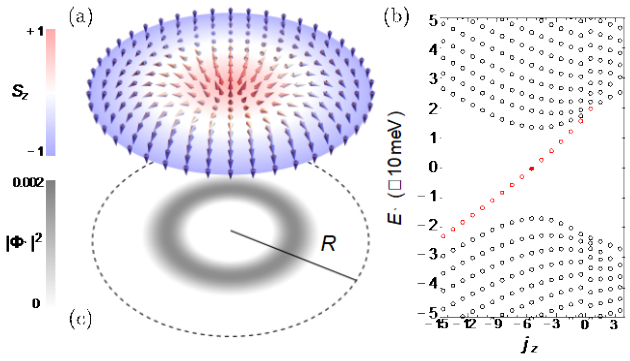
## Twisted magnetic topological insulator: When momentum-space topology meets real-space topology?

Since the discovery of topological insulator in the first decade of the 21st century, modern development of topological physics has created a storm in quantum matter physics, and it has even changed some of our understanding in earth science. Its impact still continues in many different ways.

When we talk about topological insulator or topological semimetals these days, we often refer to the band structure topology in the momentum space. Really, topology can enter physical systems from several other perspectives. The well-known counterpart would be Xiao-Gang Wen's paradigm of topological order that describes a family of strongly interacting quantum many-body systems such as fractional quantum Hall effects and some quantum spin liquids. Apart from that, the real space topological objects such as domain walls, skyrmion textures, et al, were actually discussed much earlier in condensed matter physics.

In a recent PhysRevReseach work of August 13th 2021, Dr. Gang Chen and his student (Xu-Ping Yao), postdoc (Chao-Kai Li) from the physics department of the University of Hong Kong studied "twisted magnetic topological insulator" where both momentum space topology and real-space topology are present. The Dirac fermion on the surface of topological insulator is protected by topology in the momentum space. They show, the magnetic sector contains more interesting spiral order and the skyrmion lattice. While the ferromagnetic order could convert the Dirac fermion into the famous quantum anomalous Hall effect, the spiral order and the skyrmion lattice generate interesting domain modes. There exist alternating chiral domain modes across each spiral period. The skyrmion is a topologically robust object in real space. It reconstructs the topologically protected surface Dirac fermion in the momentum space. Considering one single magnetic skyrmion, they show there exists one chiral mode bound to each skyrmion. They might be analogous to the anomalous quantum vortex that was recently proposed in FeTeSe superconductor by Xi Dai and Ziqiang Wang. These results could inspire further experiments such as scanning tunneling microscopy measurements.




Chiral mode bound to a Neel skyrmion

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