Topological spin textures and topological Hall effects

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Versatile spin textures, beyond the simple ferromagnetic and antiferromagnetic spin arrangements, in a magnetic solid have recently been attracting great interest, since they host unconventional magneto-electric and magneto-transport properties, such as magnetically induced ferroelectricity and large anomalous Hall effect; these are relevant to the magnetic twist (vector/scalar spin chirality) coupled with the quantum Berry phase and/or spin-orbit interaction.

Among them, of renewed interst are a class of helimagnets derived from the Dzyaloshinskii-Moriya(DM) interaction on a non-centrosymmetric crystal; prototypical examples are the B20 type (FeSi type) transition-metal silicide and germanide families. Recently, the Skrymion lattice was confirmed to form in a narrow temperature(*T*) -magnetic field(*B*) region near the hlimagnetic to paramagnetic transition boundary. By contrast, thin films of B20 type *M*Si (*M*=Mn or $Fe_{1-x}Co_x$) or *M*Ge (*M*=Mn, Fe), whose thickness is smaller than the helical spin modulation period (=10-100nm), ubiquitously form the two-dimensional (2D) Skyrmion crystal with magnetic fields (*B*) applied normal to the film plane over a wide *T*-*B* region. The implication of such a 2D Skyrmion crystal in the magneto-transport properties is discussed, such as the spin-chirality- induced topological Hall effect.