Bridging Topological Insulators, Skyrmions and Graphene (spin-orbit + topology with two-D electrons)

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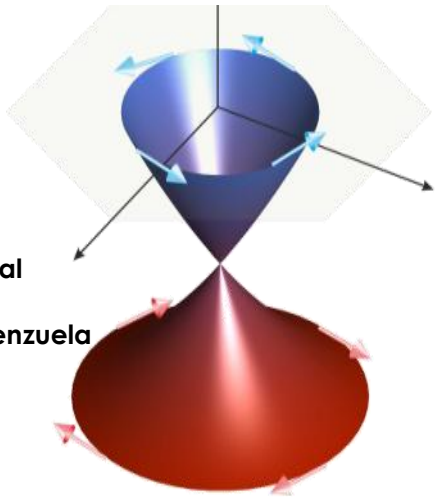
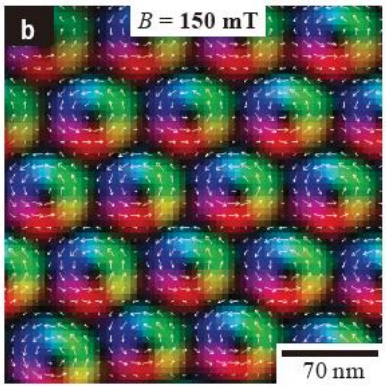
After the discovery of the outstanding properties of the electrons in **graphene,** the recent years have also seen the emergence of fascinating phenomena in other two-dimensional (2D) electron systems in which they are induced by spin-orbit coupling (SOC), breaking of inversion symmetry and topology [1]. The list includes the surface/interface states of **topological insulators**, **Rashba states, ultra-thin films with** interface-induced **magnetic skyrmions** and **2D materials** as, for example, **transition metal dichalcogenides**.

I will begin by a review of the recent advances on topological insulators, Rashba systems, skyrmions … and I will describe the resulting perspective of applications that can be anticipated for the next decade. In pure graphene the SOC is very small but recent results have shown how it can be enhanced in heterostructures based on graphene to combine the high mobility of the electrons in graphene with phenomena induced by SOC. I will describe the resulting perspective.



Topological Insulator (from Valenzuela 2012)



Skyrmions (from Yu et al, 2010)

Graphene

References

[1] Review in Soumyanarayanan *et al*, Nature **539**, 509 (2016).