Topological Quasiparticles: Magnetic Skyrmions

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Magnetic skyrmions are topologically distinct spin textures and can be stable with quasi-particle like behavior, such that they can be manipulated with very low electric currents. This makes them interesting for extreme low-power information technologies [1], where data is envisioned to be encoded in topological charges, instead of electronic charges as in conventional semiconducting devices. Using magnetic multilayers we demonstrated that inhomogeneous charge currents allow the generation of skyrmions at room temperature in a process that is remarkably similar to the droplet formation in surface-tension driven fluid flows [2]. Micromagnetic simulations reproduce key aspects of this transformation process and suggest a possible second mechanism at higher currents that does not rely on preexisting magnetic domain structures [3]. Indeed, we demonstrated this second mechanism experimentally using non-magnetic point contacts. Using this approach, we demonstrated that the topological charge gives rise to a transverse motion on the skyrmions, i.e., the skyrmion Hall effect [4], which is in analogy to the ordinary Hall effect given by the motion of electrically charged particles in the presence of a magnetic field.

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