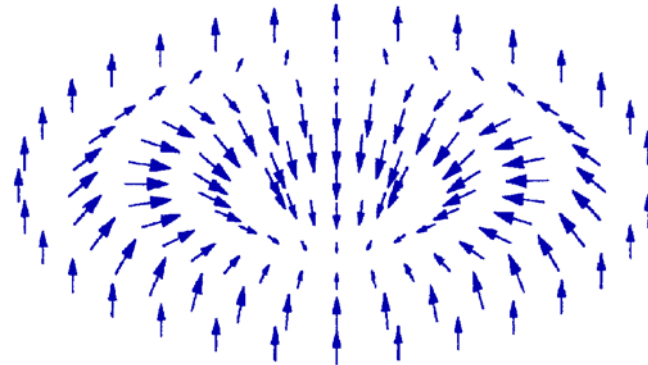


Frustrated magnets in technology: skyrmions

Skyrmions in magnetic media

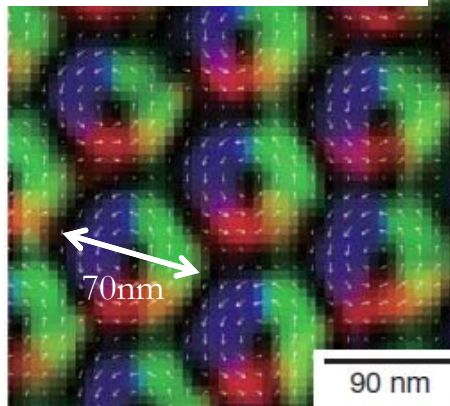
Predicted in 80's: The magnetization rotates in the same sense



A. N. Bogdanov & D. A. Yablonskii, *Sov. Phys. JETP* **68**, 101 (1989).

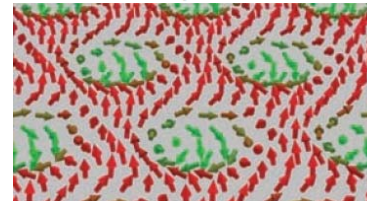
Experimental discovery

Lorentz TEM image

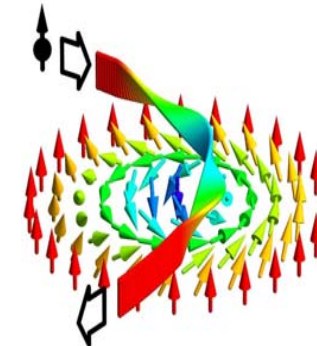


X. Z. Yu *et al* *Nature* **465**, 901 (2010).

$T = 26.45$ K, $B = 0.164$ T.



S. Mühlbauer *et al*
Science **323**, 915 (2009)



A. Neubauer *et al* *PRL* **102**, 186602 (2009).
M. Lee *et al* *PRL* **102**, 186601 (2009).
F. Jonietz *et al* *Science* **330**, 1648 (2010).
A. Fert *et al* *Nature Nanotech.* **8**, 152 (2013).
J. Sampaio *et al* *Nature Nanotech* **8**, 839 (2013).

Free energy of skyrmions

- ✦ Calculate thermodynamical quantities of skyrmions?
 - Specific heat
 - Entropy
 - Free energy
- ✦ Use cutting edge Monte Carlo numerical simulation
 - Wang Landau sampling
 - Parallel tempering
- ✦ Material oriented approach based on density functional theory (DFT).
- ✦ Contact: bertdupe@uni-mainz.de