Reduced models for domain walls in soft ferromagnetic films

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Abstract

Domain walls are transition layers that separate domains of constant magnetization in a ferromagnet. In weakly anisotropic films of moderate thickness, a type of domain wall (the "asymmetric Néel wall") may be favored that exhibits a two-scale structure, combining a narrow, divergence-free wall core with long-range tails that complete the rotation between neighboring domains.
In this talk, we present a reduced model for the internal structure of an isolated domain wall in an infinitely extended ferromagnetic film (joint work with R. Ignat and F. Otto), as well as its generalization to periodic systems of parallel walls with potentially interacting tails. Both results have been obtained by Gamma-convergence, starting from the Landau-Lifshitz energy.
The reduced models describe the amount of rotation in the wall core as a function of the strength of an external magnetic field and the (suitably non-dimensionalized) film thickness. In the case of interacting walls, also a prediction of the average magnetization in the direction of the field in the domains is available. This prediction additionally depends on the domain width and, for CoFeB films, agrees well with experimental data, provided the film thickness is not too large (joint work with C. Hengst, F. Otto and R. Schäfer).

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