DK Seminar

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TU Wien, Freihaus, green area, 4th floor, SEM 101C

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Spin diffusion effects in micromagnetics: Modeling and numerics

The classical theory of micromagnetism describes the dynamics of the magnetization in ferromagnetic materials in the absence of electric current. However, important scientific findings, e.g., the discovery of the giantmagnetoresistence in magnetic multilayers, have suggested that there is a strong interplay, usually referred to as spin transfer, between spin-polarized currents and the local magnetization. To understand those phenomena, different extensions of the micromagnetic model which takes the interaction of the magnetization with spin-polarized current into account have been proposed. In this talk, we consider a model which consists of a quasilinear diffusion equation for the evolution of the spin accumulation and an augmented version of the Landau-Lifshitz-Gilbert equation for the dynamics of the magnetization [1]. We discuss an effective numerical treatment of the resulting system of equations [2]. Despite the strong nonlinearity and the bidirectional coupling of the overall PDE system, the proposed integrator requires only the solution of two linear systems per time-step. Numerical experiments validates the model and are in agreement with our theoretical findings [3].

[1] C.J. Garca-Cervera and X.-P. Wang, *Spin-polarized transport: Existence of weak solutions*, Discrete Contin. Dyn. Syst. Ser. B, 7, 87-100, 2007.

[2] C. Abert, G. Hrkac, M. Page, D. Praetorius, M. Ruggeri and D. Suess, *Spin-polarized transport in ferromagnetic multilayers: An unconditionally convergent FEM integrator*,
Comput. Math. Appl., 68, 639-654, 2014.

[3] C. Abert, M. Ruggeri, F. Bruckner, C. Vogler, G. Hrkac, D. Praetorius and D. Suess, *Self-consistent micromagnetic simulations including spin-diffusion effects*, Submitted for publication, preprint available at arXiv:1410.6067, 2014.