VIENNA COMPUTATIONAL MATERIALS LABORATORY

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MULTI-SCALE MODELLING OF HIGH-TEMPERATURE MAGNETIZATION DYNAMICS.

A TALK BY DR. OKSANA CHUBYKALO-FESENKO,

SIMULATION OF MAGNETIC NANOSTRUCTURED MATERIALS, DEPARTMENT OF NANOSTRUCTURES AND SURFACES, MATERIAL SCIENCE INSTITUTE OF MADRID, SPANISH NATIONAL RESEARCH COUNCIL IN MADRID, SPAIN

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Multiple recent applications (heat-assisted magnetic recording, laser-induced magnetization dynamics, thermally-assisted domain wall motion etc.) are related to temperature dependent magnetization dynamics. For this purpose we suggest the use of a hierarchical multi-scale scheme [1]. First, the generalized Heisenberg Hamiltonian is parameterized via the ab-initio calculations. Next, we have developed several methods to evaluate temperature dependence of macroscopic parameters such as the macroscopic anisotropy [2] or the exchange stiffness [3]. Finally, these parameters are used as an input to large-scale micromagnetic modelling based on the Landau-Lifshitz-Bloch equation [1]. As an example, we will consider laser-induced magnetization dynamics when the temperature is often raised above the Curie temperature. We will present our recent results on modelling in Ni [4] and Gd [5] and compare them with experiments. The magnetization dynamics in Ni is quenched on the fs timescale and recovered on the timescale of 10 ps. Gd presents two-step demagnetization where the magnetization recovery occurs in 100 ps. We will also present some recent results on modelling of magnetization switching in a ferromagnetic compound CoFeGd.

References:

[1] N.Kazantseva et al Phys. Rev. B 77 (2008) 184428

[2] P.Asselin et al Phys. Rev. B 82 (2010) 134440

[3] U.Atxitia et al Phys. Rev. B 82 (2010) 054415

[4] U.Atxitia et al Phys. Rev. B 81 (2010) 174401

[5] U.Atxitia and O.Chubykalo-Fesenko Phys. Rev. B (2011)