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Atomistic Simulations of the Magnetic Neutron Scattering from Nanoparticles

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We consider a dilute ensemble of randomly-oriented noninteracting spherical nanomagnets and investigate its magnetization structure and ensuing neutron-scattering response by numerically solving the Landau-Lifshitz equation. Taking into account the isotropic exchange interaction, an external magnetic field, a uniaxial magnetic anisotropy for the particle core, and in particular the Neel surface anisotropy, we compute the magnetic small-angle neutron scattering cross section and pair-distance distribution function from the obtained equilibrium spin structures. The numerical results are compared to the well-known analytical expressions for uniformly magnetized particles and provide guidance to the experimentalist. Moreover, the effect of a particle-size distribution function is modeled.

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Primary author: Mr ADAMS, Michael (University of Luxembourg)

Co-authors: Prof. MICHELS, Andreas (University of Luxembourg); Prof. KACHKACHI, Hamid (University of Perpignan)

Presenter: Mr ADAMS, Michael (University of Luxembourg)

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