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Field Dependence of Magnetic Disorder in Nanoparticles

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Being intrinsic to nanomaterials, disorder effects crucially determine the properties of magnetic nanoparticles, such as their heating performance [1-3]. However, despite the great technological relevance and fundamental importance, a quantitative interpretation of the three-dimensional magnetic configuration and the nanoscale distribution of spin disorder within magnetic nanoparticles remains a key challenge.
Here, I will present our recent studies on the intraparticle magnetization distribution in ferrite nanoparticles [4]. In contrast to the classical, static picture of a collinearly magnetized particle core with a shell of structurally and magnetically disordered surface spins, we establish a significant field dependence of the nanoparticle moment and demonstrate how magnetic order overcomes structural disorder. In our study, polarized SANS [5] extends the traditional macroscopic characterization by revealing the local magnetization response and allows us to quantitatively separate surface spin disorder from intraparticle disorder. Finally, we elucidate the intraparticle distribution of the spin disorder energy, giving indirect insight into the structural defect density in magnetic nanoparticles.

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Primary authors: ZAKUTNA, Dominika (Institut Laue-Langevin); BARNSLEY, Lester (Jülich Centre for Neutron Science); BABCOCK, Earl; SALHI, zahir (JCNS); FEOKTYSTOV, Artem; HONECKER, Dirk (Institut Laue-Langevin); DISCH, Sabrina (Universität zu Köln)

Presenter: ZAKUTNA, Dominika (Institut Laue-Langevin)

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