NEUTRON SPIN-ECHO EVIDENCE OF INTER-PARTICLE SPIN CORRELATIONS OF FE(CU) NANOPARTICLES IN A AG MATRIX

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Giant magnetoresistance (GMR) alloys of technological interest are often produced in the form of a collection of nanometric magnetic particles randomly embedded in a metallic matrix. This leads to the existence of intrinsic *magnetic relaxation* phenomena of the nanoparticles, which naturally affect the GMR behavior. Usually, this magnetic relaxation is governed by the competition between the anisotropy and the thermal energies, and the outcome is particles with their atomic spins blocked or in which the net magnetization is flipping around the easy magnetic axis (*superparamagnetic regime*). This ideal situation is modified when the interparticle distance is reduced to a few nanometers; in such an arrangement, extra magnetic interactions are triggered and the relaxation behavior tends to be more collective [1]. Many examples have been given thanks to the interpretation of macroscopic magnetic data (AC-susceptibility, DC-magnetization, aging, etc.), but the *direct* observation of the relaxation phenomena is limited to a small number of microscopic techniques, as Mössbauer and muon spin relaxation, anyhow both presenting a limited spatial coherence.

Neutron spin-echo is a *unique* powerful technique to detect spin-spin correlations with spatial resolution through the measurement of the correlation function $S(q, t)$. In addition the intrinsic relaxation time of neutrons ($\approx 10^{-12}$ s) allows the fastest sampling time to detect spin coupling. We report here the results (0.034 Å$^{-1} \leq q \leq 0.156$ Å^{-1}, 20 K $\leq T \leq 300$ K) and analysis the *first experiment* using NSE on a metallic fine-particle system.

References:

[1] X. Battle and A. Labarta, J. Phys. D: Appl. Phys., **35** (2002) R15.