DYNAMICS OF MAGNETIC NANOPARTICLE ASSEMBLY

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The assemblies of magnetic nanoparticles provide an opportunity to develop new materials with characteristics beyond traditional solids and bring plausible benefits in *'figures of merits'* for advanced technology and therapy. In particular, several laboratory tasks, e.g., injection, sample preparation, manipulation, reaction control, detection, separation etc, can be integrated in a single nano-magnet assembly, i.e., 'lab on a chip' system, cf. [1, 2] and refs. therein. In this contribution we consider analytical tools employed to specify, quantify and analyze such devices in respect with magnetodynamics.

At increasing the density of nano-magnets the assembly structure changes from superpara- (SPM) to superferro-magnetism (SFM) [1] inducing, thereby, jerky magnetodynamics with sharp discontinuities in the array magnetization process [2]. For a description of such noisy magnetodynamics of magnetic nanoparticle arrays we employ the randomly jumping interacting moments (RJIM) model [2] including quantum fluctuations due to the discrete level structure, inter-dot coupling and disorder. Magnetic state equation of such a system is demonstrated to exhibit spinodal regions in *{disorder, magnetic field}*-plane and the critical points. Exploring correlations of noise amplitudes represents then convenient analytical tool for quantitative definition, description and study of various processes in a nano-magnet assemblies emphasizing, thereby, the conditions of self-organized criticality. Further implications of proposed tools will allow to specify and study quantitatively the possibility of manipulations by magnetic materials, in particular, ligand (e.g. oleic acid) stabilized nanocrystals of iron series transition metals with enhanced magnetic moments which represent promising candidates for the magnetically responsive component of macro-molecule beads, significant for advanced therapy.

References

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