Soutenance du diplôme d'Habilitation à Diriger des Recherches

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Interacting Magnetic Nanoparticles: from Superspin Glass, Superferromagnetism to Energy Applications

Sawako Nakamae

Service de Physique de l'Etat Condensé, URA-CNRS 2464
IRAMIS, CEA Saclay 91191 Gif-sur-Yvette, Cedex France

sawako.nakamae@cea.fr

Magnetic nanoparticles have generated a great interest over the last twenty years in a broad range of industrial applications. For example, the superparamagnetic blocking phenomena and its associated high coercive field had been suggested for their use in information storage since its discovery. More recently, magnetic nanoparticles have been exploited in biomedical applications, where we have witnessed numerous technological breakthroughs. But since long before all such applications became available, the fundamental magnetism of nanoparticles has captivated the minds of many, and we continue to discover their surprising new properties, which are now termed "supermagnetism." One such example is the "Superspin Glass" state in highly interacting magnetic nanoparticles, characterized by collective and out-of-equilibrium behavior that bears much resemblance to atomic spin glasses.

In this presentation, salient features of magnetic properties of nanoparticles and their interaction effects as well as a short overview of (super)spin glass physics will be first given. Then two examples of experimental studies conducted at SPEC on the out-of-equilibrium dynamics in the superspin glass state of frozen ferrofluids addressing certain open questions in spin glasses will be presented; namely, the dynamic correlation length growth and the fluctuation-dissipation theorem violation in the glassy state. Current research activities and perspectives on magnetic nanoparticles in the field of supermagnetism and energy science will also be discussed.