ESRF	**Experiment title:** Structure and Dynamics of Colloidal Liquids and Crystals with magnetic Dipole-Dipole Interaction	**Experiment number:** SC-891
Beamline: ID10/ID02	**Date of experiment:** from: 4.10.01/1.12.01 to: 10.10.01/4.12.01	**Date of report:** 18.2.02
Shifts: 18/8	**Local contact(s):** Aymeric Robert / Pierre Panine	*Received at ESRF:*

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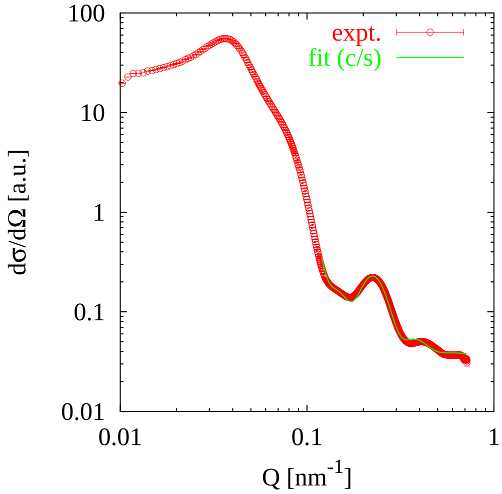
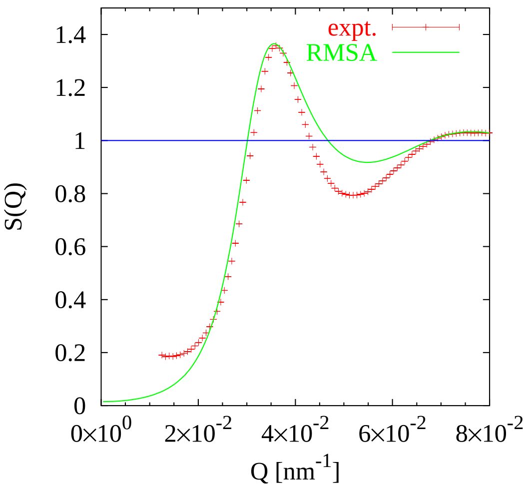
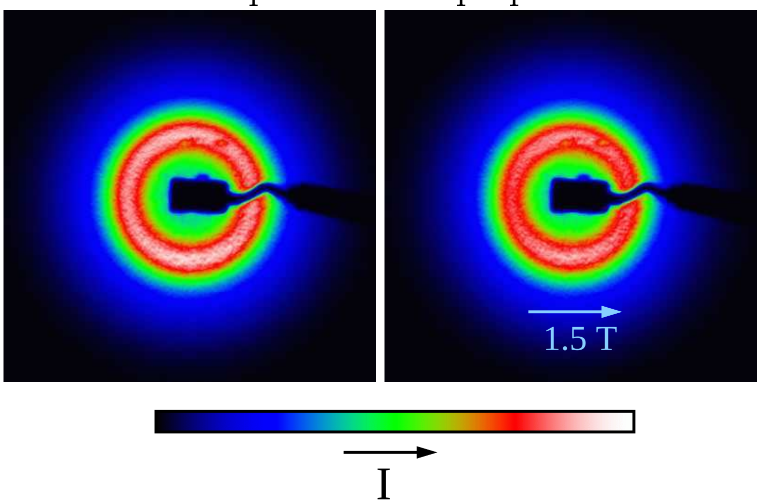
Report:

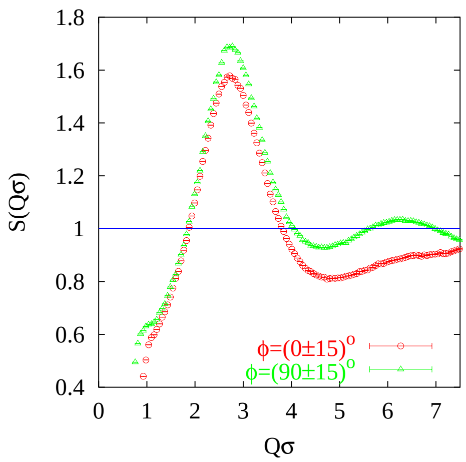
The structure and dynamics of colloidal core-shell particles consisting of $CoFe_2O_4$ and SiO_2 dispersed in water/glycerol was investigated by means of SAXS and XPCS in dependence of an external magnetic field. Without external field, the magnetic moments of the particles freely rotate and the average magnetic contribution to the interaction equals zero. In this case, the interparticular ordering visible as a pronounced maximum in $S(Q)$ at $Q_{max} = 3.5 \times 10^{-2} nm^{-1}$ results from a Yukawa type interaction of equally charged silica particles. The core-shell structure of the particles becomes evident by the form factor at large Q, wich can be described with a core diameter $\sigma_c = 13.6\,nm$, a total diameter $\sigma = 89.4\,nm$ and a relative polydispersity $\langle\sigma - \bar{\sigma}\rangle^2 / \bar{\sigma}^2 = 0.01$. The structure factor is described by a RMSA calculation assuming a repulsive Yukawa interaction with an effective charge of $Z_{eff} = 70$ and a density of $\rho = 1.2 \times 10^{20} m^{-3}$ corresponding to $\phi = 0.045$.





In presence of an external magnetic field in the saturation region, the magnetic moments of the particles are aligned parallel to the applied magnetic field. In this configuration, a magnetic dipole-dipole interaction in addition to the Yukawa monopole interaction appears: the scattering signal becomes anisotropic. Hereby, the intensity in the structure factor maximum increases perpendicular to the applied field and decreases parallel to the applied field; the shape of the pattern, however, remains nearly circular. This becomes even more evident in sector averages, where Q_{max} only slightly changes. These effects can be explained by an additional repulsion perpendicular and an attraction parallel to the direction of magnetic dipoles. In the first case, the still dominating monopole repulsion is enhanced, in the second case, it is reduced by an additional dipole contribution. As consequence, the superstructure is more pronounced perpendicular to the field than parallel to the field.





The correlation functions decay qualitatively faster for $\vec{Q}$ parallel to the magnetic field vector $\vec{H}$ than perpendicular. This is in accordance to the effects on the static structure factor: the mean interparticular distances are weakly influenced, whereas the fluctuations around the equilibrium position are enlarged parallel and reduced perpendicular to the field direction. For a quantitative evaluation of a de-Gennes narrowing, however, better count statistics are required. Finally, Bragg reflections resulting from colloidal crystals were observed. Similar to the liquid-like ordered samples, field-induced changes of the equilibrium structure are very small. However, a splitting of several bragg peaks indicating a decrease of symmetry could be observed in presence of an external field.