ESRF	**Experiment title:** Structure and Dynamics of Colloidal Liquids and Crystals with Magnetic Dipole-Dipole Interaction	**Experiment number:** SC-1291
Beamline: ID10/ID02	**Date of experiment:** from: 31.10.03/5.11.03 to: 3.11.03/11.11.03	**Date of report:** 27.02.04
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Report:

As a continuation of proposal SC-1067, the structural and dynamic properties of magnetic colloidal particles were studied employing small angle X-Ray scattering. The particles consist of a magnetic core of $CoFe_2O_4$ surrounded by a SiO_2 shell. By a reduction of the nonmagnetic shell size, the magnetic interacions of the systems could further be enhanced.

We could observe an anisotropy induced by an external magnetic field comparable to the earths magnetic field, i.e. in the order of some $10^{-5}T$ when the field is applied perpendicular to the primary beam. If the field is applied parallel to the beam, even at $1.0T$ no anisotropy could be observed (Fig. 1).

We could prove, that the small anisotropy obseved in SC1067 disappears if the magnets are completely removed from the sample environment. The small effect is induced by the remaining field and not by a remanent magnetization of the samples.This is in accordance with the magnetization curve that does not show any hysteresis.

The anisotropy, that can be quantified by the angular variance of the scattered intensity $A(Q) =< I^2(Q) > / < I(Q) >^2 -1$ increases with the applied field and comes in a saturation limit at $H = 10\,mT$, which is also consitent with the magnetization curve. For less concentrated samples, the maximum visible anisotropy is very similar, with small fields, however, higher anisotropies can be induced.

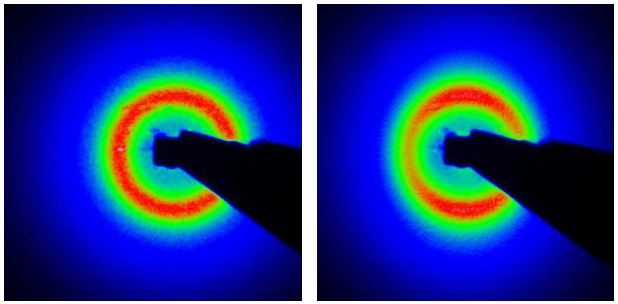

Fig. 1: Scattered Intensity without (left) and with magnetic field ($H = 1.0T$, perpendicular to the beam).

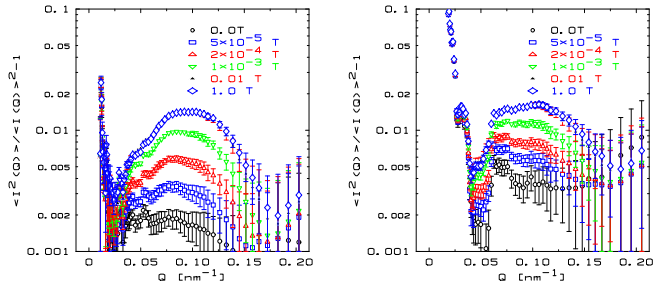

Fig. 2: Anisotropy of the scattered intensity in dependence of Q

Due to instabilities of the beam in the pink beam mode induced by the thermal bender, we were not able to study the field dependence of the short time diffusion by XPCS during SC1291. We observed, however an unexpected slow diffusion without presence of an external field that has to be attributed to hydrodynamic interactions. The obtained hydrodynamic function $H(Q)$ can neither be described by a pairwise additive approximation nor by the multiparticle Beenakker-Mazur theory. With a rescaled self part given by $\lim_{Q\to\infty} H(Q)$, however, the experimental data can quantitatively be described.

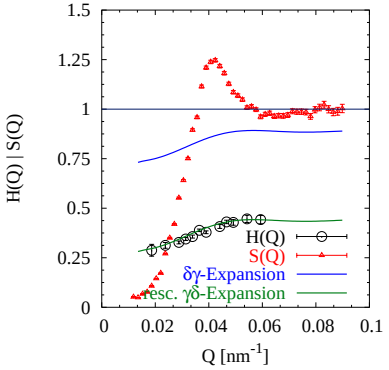

Fig. 3: Hydrodynamic function $H(Q)$ without external field