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Report:

Dynamic Behaviour of Magnetic Fluids

The aim of the experiment was study the dynamic behaviour of magnetic colloidal suspensions in an applied external magnetic field as well as in the field free case by using static Small Angle Scattering (ID2) and X-ray Photon Correlation Spectroscopy (ID10A). We have used 2 types of samples: nanoparticular (1000 Å size) particles of Fe304 coated with oleic acid and suspended in glycerol and charge stabilized particles (100 Å size) suspended in silicon oil at various concentrations (l-4 vol%). Figure 1 (right colum) shows a selection of static SAXS patterns taken at ID2 at 12.4 keV for one 1000 Å sample in zero field (top) and in horizontally applied magnetic fields of about 0.2 Tesla (middle) and at 0.4 Tesla (bottom). The scattering in zero field is isotropic while the in-field data reveal a strong field dependent anisotropy. Detailed analysis and modelling of the SAXS data is under progress showing both evidence for reorientation of the particles at high q values and agglomeration at low q as well as a considerable polydispersity at least for one batch of the investigated samples.

Dynamic XPCS data have been taken in wide the bandpath coherent scattering set-up at ID10A. All samples show sufficiently strong scattering (confirming the initial intensity estimates) and allow to collect correlation functions down into the millisecond regime. Figure 1 (left column) shows dynamic XPCS data. Plotted is the correlation rate gamma versus the square of the momentum transfer. The no-field case

reveals two slopes indicating different diffusion constants in the low q and the high q regime. First qualitative conclusions from the in-field data (middle and bottom) are: The diffusion in the presence of an external magnetic field is slowed down. Diffusion parallel to the field direction is faster than perpendicular to the external field and the diffusion constants depend on the field strength. Detailed analysis of the dynamic data is in progress.

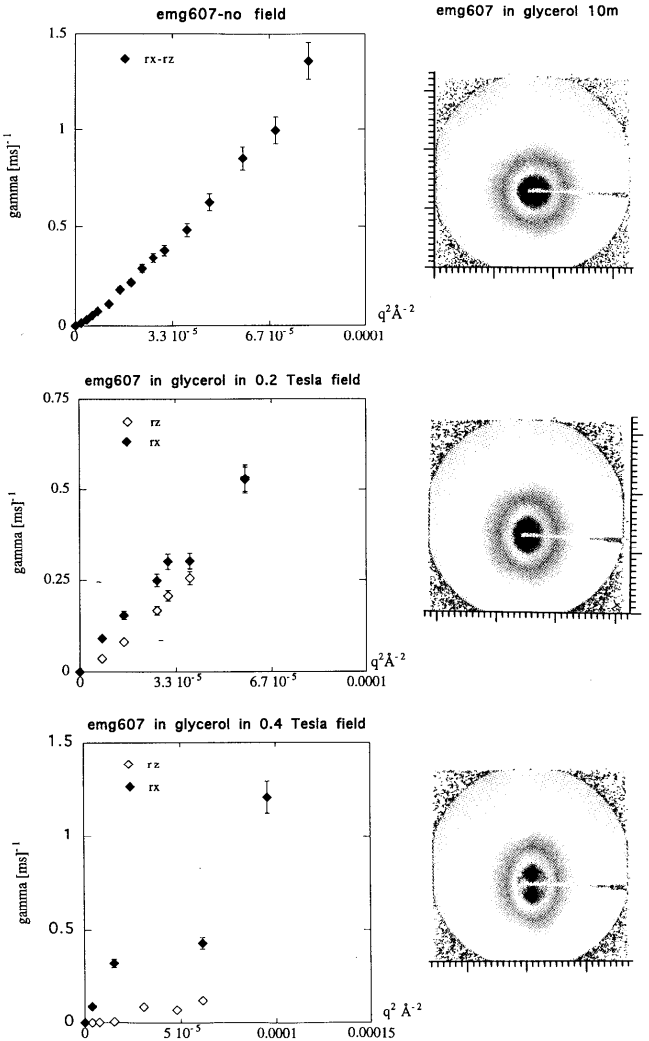

Figure 1. XPCS and SAXS measurements in varying magnetic fields.