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ESRF

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office using the **Electronic Report Submission Application:**

http://193.49.43.2:8080/smis/servlet/UserUtils?start

Reports supporting requests for additional beam time

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

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All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:** X-Ray Photon Correlation Spectroscopy of Soft Model Colloids in Aquaeus Solution on the Microsecond Time	**Experiment number**: SC1545
Beamline: ID10	**Date of experiment**: from: 8 Nov. 2004, 7:00 to: 14 Nov. 2004, 7:00	**Date of report**: 19.08.2005
Shifts: 18	**Local contact(s)**: Anders Madsen, Andrei Fluerasu	*Received at ESRF:*

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Report:

The fluorinated latex was prepared according to a standard soap-free emulsion polymerization[1].
The radius of the spheres was measured by means of dynamic light scattering and amounted to 80 nm. The solution was kept in contact with an ion exchange resin (Amberlite MB3 monobed resin, Sigma) for 10 hours in order to decrease its ionic strength. After this treatment the suspension has crystallized. From this stock solution two samples of total NaCl concentration amounting to 0.5 and 50 mM, respectively, were prepared by adding a small amount of concentrated NaCl solution. The final concentration of both samples amounted to 231 g/l. For XPCS experiments the samples were filled into quartz capillaries of a diameter of 1.5 mm and sealed with glue.
The experiment was performed at the Troika III of the Troika beamline ID10A at the European Synchrotron Radiation Facility (ESRF). A schematic view of the setup and experimental details are given elsewhere [2]. The synchrotron was running in a 2/3 filling mode with an average current of about 200 mA. Measurements were performed at 7.990 keV, λ= 1.55 Å.
The coherent beam is provided by a 12 μm pinhole placed at 25 cm from the sample. With this setup the primary beam intensity was about 10^9 photons/s/mA. The sample is mounted in an evacuated small-angle scattering chamber and the scattered photons are guided through a vacuum flight path to the detector stage, giving a sample-to-detector distance of 2.3 m. Photons are detected by a Bicron scintillation counter equipped with an adjustable pair of slits of 150x150 μm^2. Correlation functions are calculated in real time via an ALV-5000 digital correlator.

Results
The scattered x-ray intensity, I(q), was measured in a broad q range, Fig.1. The presence of multiple maxima in the I(q) curve indicates a very high monodispersity of the sample used.

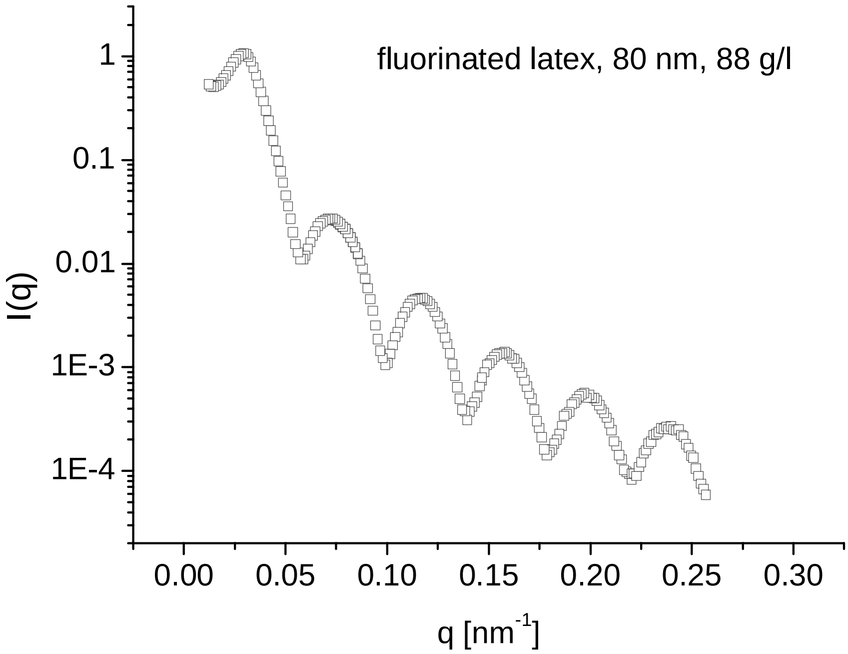

Figure 1. Static curve I(q), measured for a solution of fluorinated spheres at a concentration of 88 g/l.

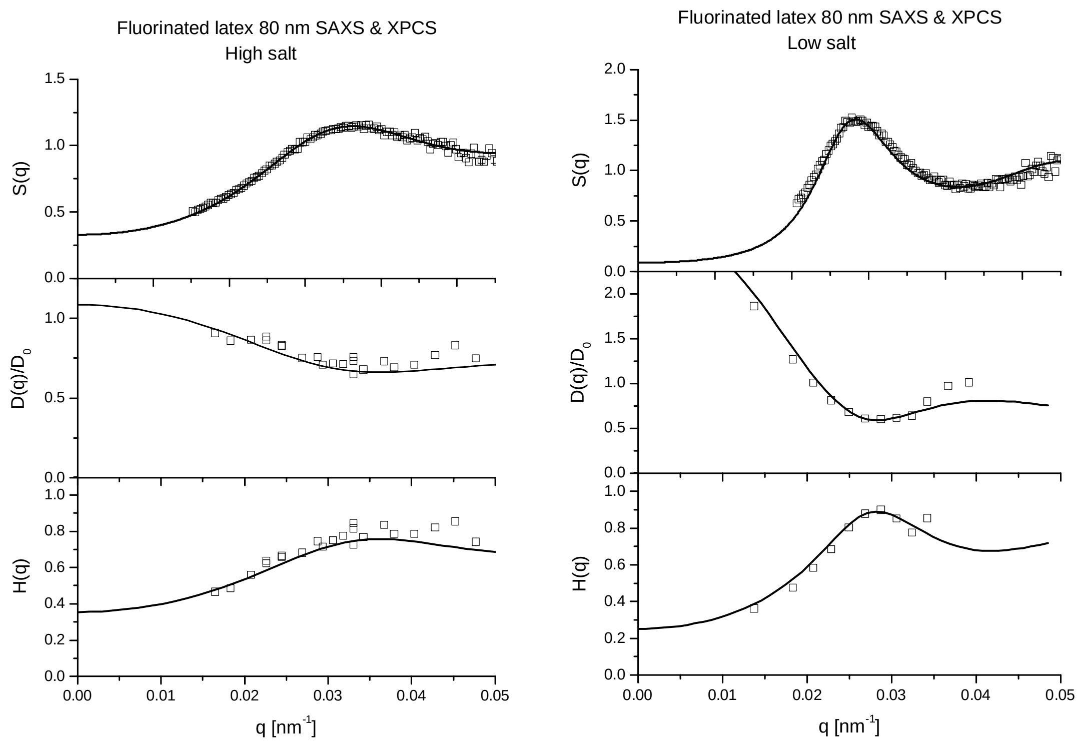

Figure 2. The static structure factor S(q), the normalized diffusion coefficient $D(q)/D_0$ and hydrodynamic function H(q) measured (symbols) and calculated (solid lines) using theoretical models, for low salt (0.5 mM NaCl) and high salt (50 mM NaCl) suspensions of fluorinated latex at a concentration of 231 g/l. Two more lower colloid concentrations (not shown) were measured at each salt conditions.

As one can see in Fig.2, the experimentally measured static structure factor S(q),the normalized diffusion coefficient, $D(q)/D_0$ and hydrodynamic function H(q) can be interpreted in terms of a theoretical scheme based on DLVO-type continuum model of charged colloidal suspensions, which accounts, in an approximate way, for many-body hydrodynamic interactions, in the same way as it was done for apoferritin [3]. This scheme combines computer simulations of the self diffusion coefficient with an analytical calculation of the distinct part of H(q) and it agrees quite well with computer simulation results of the full H(q). Our theoretical

calculations predict, that the peak of H(q) for charged spheres is higher than for neutral spheres at the same density. Similar data as shown in Fig.2 were also obtained for two more lower colloid concentrations at each salt concentration and a similar agreement with the theoretical model was found. This is in contrast to the conclusions of the work of Riese et al. [4] done on a similar system. They have reported, that screening of hydrodynamic interactions in strongly charged colloid suspensions in water/glycerol mixtures occurs [4]. We have not seen such an effect in our previous studies (see Fig.2 and ref.3). It is important to clarify this discrepancy and check if this screening will appear at lower ionic strengths than those used in our previous measurements. However, in our experiment a broader ionic strength range could not be covered because of lack of time. Therefore in a next experiment more beamtime is needed in order to extend the salt concentration range towards lower concentrations and measure more salt concentrations.

References:

[1] Koenderink, G. H.; Sacanna, S.; Pathmamanoharan, C.; Rasa, M.; Philipse, A. P.; *Langmuir* **17,**6086 (2001)

[2] Thurn-Albrecht, T.,Zontone, F. , Grübel, G., Steffen, W., Müller-Buschbaum, P., Patkowski, A.; *Phys. Rev. E* **68**, 031407 (2003).

[3] Gapinski,J.,Wilk,A.,Patkowski,A.,Haeussler,W., Banchio,A.J., Pecora,R. ,Naegele, G.; *J. Chem. Phys.* **123**, 054708 (2005).

[4] Riese, D. O., Wegdam, G. H. , Vos, W. L., Sprik, R. , Fenistein, D., Bongaerts, J. H. H. , Grübel, G.; *Phys. Rev. Lett*. **85**, 5460 (2000).