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 via the User Portal:

https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do

Reports supporting requests for additional beam time

Reports can 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.

Published papers

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:** Monitoring a 3D DNA Origami Lattice and its Structural Components by Small Angle X-Ray Scattering	**Experiment number**: MX-1909
Beamline: BM29	**Date of experiment**: from: 27.2.2017 to: 28.2.2017	**Date of report**: 05-01-18
Shifts: 3	**Local contact(s)**: Matthew Bowler	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):
Prof. Dr. Jan Lipfert, LMU Munich, Chair of Biophysics and Applied Materials
Dr. Linda Brützel*, LMU Munich, Chair of Biophysics and Applied Materials
M.Sc. Philipp Walker*, LMU Munich, Chair of Biophysics and Applied Materials

Report:

The beamtime allocated to proposal MX 1909 was used to perform solution SAXS measurements on three-dimensional heteromultimeric DNA origami objects. The studied objects comprised DNA origami rectangles that have shape complementary double-helical protrusions and recessions that can precisely dock into each other and form a 3D cube in the presence of 50 mM $MgCl_2$. The cubes can further assemble to create a 3D DNA origami lattice. For each SAXS measurement we carried out 10 runs in 'flow' mode using the automated sample roboter installed at BM29. Sample profiles were analyzed for radiation damage and matching profiles were averaged. Appropriate buffer profiles were averaged and subtracted from the sample profiles. We performed SAXS measurements on the DNA origami rectangle, cube and lattice objects at concentrations in the range of 50 nM and 100 nM. The obtained scattering data were of high quality with a dynamic range covering ~ 4 orders of magnitude in intensity and with features identifiable up to q-values ≈ 1 nm^{-1} (Figure 1). Comparison of scattering profiles from the DNA origami rectangle, cube and lattice revealed clearly identifiable structural differences. In contrast to the DNA origami rectangle, the cube and lattice structures display several intensity peaks resulting from the highly symmetric structural arrangement. This effect is even more pronounced in the DNA origami lattice structure. From the scattering data of the DNA origami lattice we could calculate the structure factor and fit the data with a rectangular lattice model. Based on the fit we could determine a lattice constant in the order of ~ 50 nm, which is in good agreement with values obtained from transmission electron microscopy (TEM) images of DNA origami cube objects.

In addition, we calculated theoretical scattering profiles based on atomistic models of the DNA origami structures generated from the software CanDo and compared and them to the experimental data. Although we observed slight shifts of the theoretical scattering curves with respect to the experimental data, the theoretical curves reproduce the observable intensity peaks. We are currently working on a manuscript to publish our data.

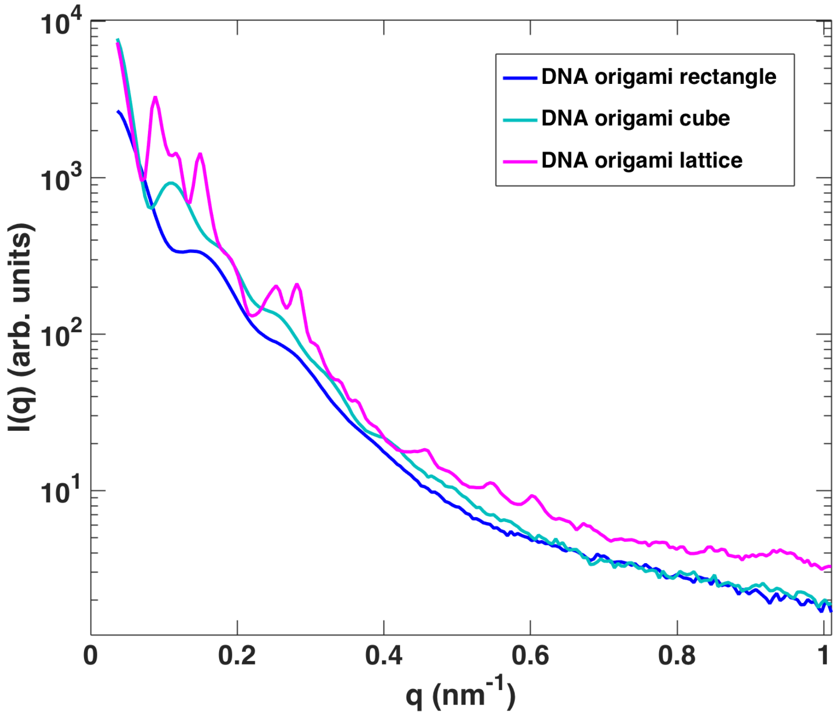

Figure 1 Scattering profiles of DNA origami rectangle, cube and lattice objects measured at a $MgCl_2$ concentration of 50 mM. Data are scaled with a constant factor.