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The commissioning of FIGARO

The commissioning of FIGARO with neutrons started in the last cycle of 2008. This year has seen the installation of the majority of the components of this new reflectometer, devoted to the study of soft matter and biology at horizontal surfaces. Reflectometry measurements started in December 2008, but the instrument will be delivered in its final configuration at the start of the first cycle of 2009. 70 days beamtime were allocated at the last proposal round. The current status of the instrument is described below.

Guide: During the long winter shutdown (early 2008) the H171 neutron guide that feeds FIGARO was extended out from the reactor hall right up to the instrument. The guide is coated with M=2 supermirrors on the sides while the coating changes progressively from M=2 to M=1 on the top/bottom surfaces and its section is 15 × 80 mm^2 (w × h) at the reactor exit and 30 × 80 mm^2 at the start of the instrument. The greater height at the instrument takes into account the vertical divergence of the beam. The guide geometry is tailored to the needs of the reflectometer and special attention has been paid to ensure the transport of a high intensity beam devoid of fast neutrons and radiation.

The installation was achieved in two phases by teams of technicians from the ILL DPT and guide manufacturers Swiss Neutronics. The end result was a high-performance guide delivered in time to commission FIGARO with a measured flux (1.5×10^{10} n/cm^2/s from gold foil measurements) about 10% above theoretical predictions.

Frame-overlap mirrors: Two frame-overlap mirrors with nickel-coated silicon mirrors inclined at 2° and 3° remove neutrons with wavelengths above 20 and 30 Å, respectively. The guides were installed during the summer and October shutdowns. It will be possible to switch remotely between the two mirrors during the course of an experiment.

Choppers: The four chopper discs and guides have been installed and tested with neutrons. In the final configuration, where the maximum TOF distance is 8 505 mm, chopper speeds of 960 - 1 560 rpm provide pulses of neutrons with a choice of 6 different $\Delta\lambda/\lambda$ values in the range 1.3 - 11.5 %.

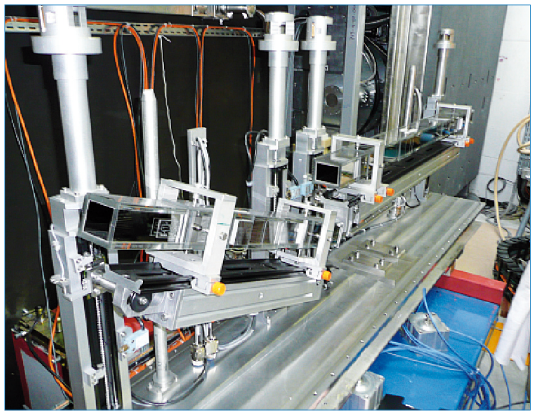

Figure 1: *The two deflecting guides*

Deflector mirrors: The two deflector mirrors were installed during the summer shutdown. The first guide is 1450 mm and the second 805 mm long. They are coated on all four internal faces with M = 4 supermirrors with reflectivities better than 0.8 to allow for reflection up or down at the sample position. They are both 50 mm high and focus the beam in the horizontal direction with a width decreasing linearly from 80 to 60 mm. **Figure 1** shows a picture of the guides being installed.

Collimation guide: The collimation guide was installed during the October shutdown. It is a two-metre guide focusing the beam from 60 to 40 mm in the horizontal direction thanks to M = 4 supermirrors. The reflectivity of the mirrors is about 0.8 everywhere. On the top and bottom faces, the guide is made of glass with B_4C blades stopping reflected neutrons. A µm-precision collimation slit is mounted at the start of the guide.

Figure 2: Sample area: The goniometer is visible on top of the vertical translation rig. The yellow lead door is closed during measurements.

Sample area: A purpose-built goniometer with horizontal translation drive was mounted on a vibration-damping stage (ILL high-precision super-stiff vertical drive) fitted in a 3 m pit below the sample position, isolated from the floor. Sample environments (with a weight capacity up to 1000 kg) will sit on an anti-vibration table (Halcyonics) and can be translated 500 mm in the direction perpendicular to the beam to enable automatic sample changing. An optical alignment device will help optimise reflection conditions during experiments with free liquids. A µm-precision slit and a monitor are situated in front of the sample. Another slit will be installed after the sample in front of the detector nose.

Sample environment: FIGARO will have a range of sample environments. A Langmuir trough, which is ready for measurements, will be used for the study of insoluble films at different surface pressures. Simultaneous images of lateral organisation may be acquired *in situ* using a Brewster angle microscope. A suite of 6 thermalised adsorption troughs will be available next year to enable the study of adsorption phenomena over a range of temperatures. The reflection-down configuration of the instrument will be used for the study of solid/liquid and liquid/liquid applications where it is important to have a horizontal geometry of the solid substrate. Work will also be carried out to develop a dynamic flow cell for the study of adsorption kinetics.

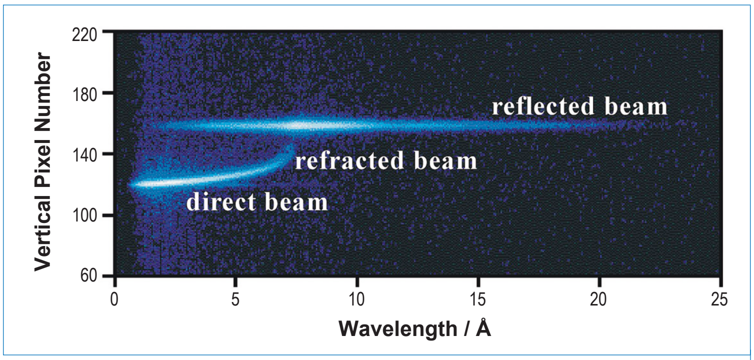

Figure 3: Time-of-flight reflectivity image of a free D_2O surface acquired at the beam axis incident angle of 0.67 degrees to the horizontal.

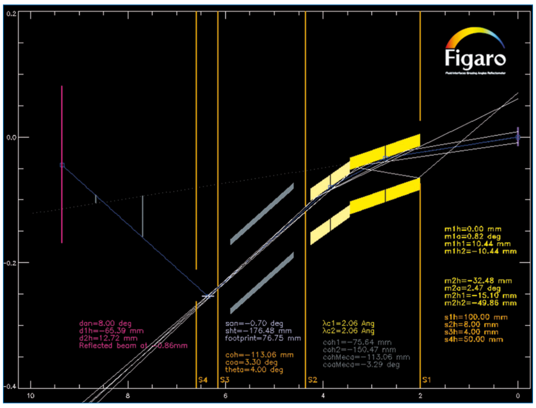

Figure 4: Output IDL programme which shows the positions of all the axes when the incoming angle is changed.

Detector: The 2D aluminium monoblock detector has been installed for commissioning, positioned two metres from the sample, but will be repositioned at three metres in the final instrument configuration from the first cycle of year 2009. The monoblock detector comprises 64 holes, 250 mm in length and with a 6.9 × 6.9 mm^2 square section. The block is filled with ^3He and provides a resolution along the tubes better than 2 mm. A Time-of-Flight reflectivity image of a free D_2O surface acquired at the beam axis incident angle of 0.64 degrees to the horizontal is shown in **Figure 3**.

Software: NOMAD software is being implemented on the instrument. All motors can be driven and data acquired with this software. A programme was written in IDL to calculate the motors positions that control the deflector mirrors, collimation guide, slits, sample and detector. **Figure 4** shows an example of the output from this programme.

We wish to thank everyone in the team for their effort and enthusiasm in building and commissioning the instrument.