ESRF	**Experiment title:** Smectic ordering and defect topology of 8CB liquid crystal	**Experiment number:** SC692
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Report:

The aim of the proposed experiment was to study the smectic ordering and defect topology of **8CB** liquid crystal (LC) films adsorbed on $\mathbf{MoS_2}$ substrates. The smectic S_A planes, close to the $\mathbf{MoS_2}$ interface, are perpendicular to the substrate ("*planar anchoring*"), whereas they are lying parallel to the LC/air interface ("*homeotropic anchoring*"). This competing geometry induces sets of ordered defects in the bulk that accommodate the two plane orientations. These defects can be imagined by optical microscopy and in thin films ($1\mu<e<20\ \mu$), they appear as straight parallel lines. In the framework of focal conics, these ordered defects could be modeled by a set of hemicylinders with their axes lying flat on the substrate. Our aim is to confirm and develop this model to study the LC conformation in confined geometry.

We have worked in a standard grazing incidence X-ray diffraction set-up at E=8.2 KeV ($\mathbf{MoS_2}$, critical angle θ_C= 6 mrad) with a vertically mounted sample to gain access to the whole reciprocal space of interest. The full beam spot (0.3x0.7 mm^2) was delimited, close to the sample, by a pair of slits to a typical size of 0.05x.0.5 mm^2 (horizontal x vertical gaps). The diffracted beam was detected by a small horizontal PSD detector (1x50mm^2 slits at 700 mm of the sample). Standard scans were rocking curves at the $\mathbf{MoS_2}$ critical angle to measure the smectic plane mosaicity and circle-scans at the smectic momentum transfer Q_S to resolve the LC defect topology and probe its thermal stability as a function of the LC film thickness.

We have aligned three freshly cleaved $\mathbf{MoS_2}$ substrates on which we have deposited **8CB** LC molecules. The sample organization was checked optically under the **TROIKA** microsocope and revealed the right patterns and textures of ordered defects. We have found that smectic planes were allways locked at 17.5° of the [100] $\mathbf{MoS_2}$ direction and we were able to follow successfully the diffracted intensity along the entire Q_S circle (fig.1a). The width of the diffracted signal is limited by the PSD-slit resolution except close to the critical angle where it becomes much broader: This broadening may come from resolution effects, diffuse scattering from correlated bent smectic planes or from a loose coupling between smectic defects and the interfacial monolayer structure. Further studies are needed to clarify this domain, for example by making complete sets of circle-scans at various Q values: for $Q \leq Q_S$, the diffuse scattering is very weak and featureless (fig 2b) but for $Q \geq Q_S$ we can clearly see a well defined diffuse scattering along a vertical ridge (fig 2a), i.e nearly independent of the $Q_{//}$ component of the full Q vector.

The total integrated intensity is almost constant in the intermediate part of the circle ($10° \leq \xi \leq 65°$) and it is reinforced in the "*homeotropic*" part ($\xi \leq 10°$) and at the critical angle ($65° \leq \xi \leq 80°$). The sample organization is diminished by the beam heat load (fig1b) after 6-10 hours, except close to the critical angle. This degradation can be clearly seen and controlled with an optical microscope. A small attenuation of the beam intensity ($e \approx .1$mm of Al, i.e $R_A=2.2$ at 8 KeV) has pushed the third sample lifetime up to nearly two full days, at the expense of longer counting times.

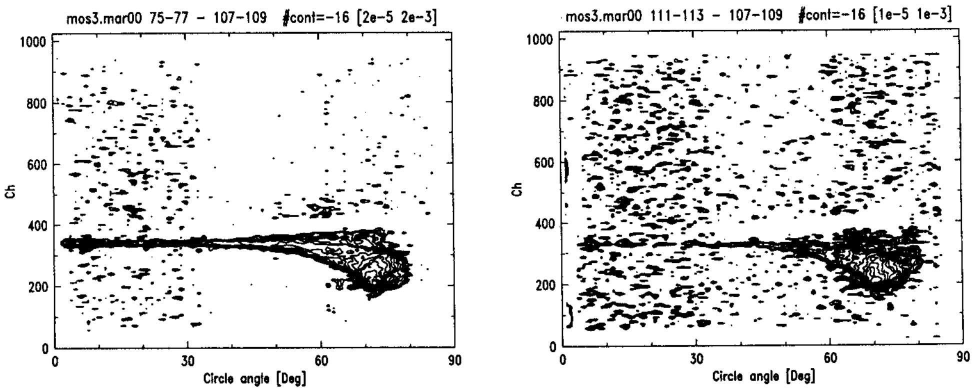

Fig 1: Diffracted intensity on a circle-scan at the smectic Q-vector, $Q_S=0.2$ Å^{-1}.The nominal symmetric geometry ($Q=Q_S$, $\alpha=\beta$) is obtained for Ch=320. $\xi=0°$ corresponds to the "*hometropic*" geometry ($Ch//Q_S$) and $\xi=90°$ to the "*planar*" one ($Ch \perp Q_S$). **(a) Left**: virgin sample and **(b) Right**: after a 10 h beam exposure.

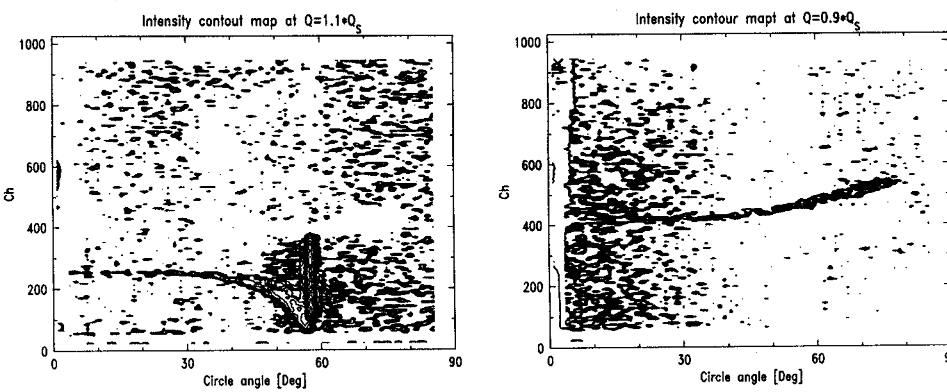

Fig 2: Diffuse intensity measured at $Q=(1.0\pm0.1)*Q_S$.The nominal symmetric geometry ($\alpha=\beta$) is obtained for the channel Ch=320. **(a) Left**: $Q=Q_S$ is obtained at ($\xi=0°$,Ch=230) and **(b) Right**: at ($\xi=0°$,Ch=410).