ESRF	**Experiment title:** Fluctuations of highly oriented phospholipid membranes near and at the unbinding transition	**Experiment number**: SC-561
Beamline:	**Date of experiment**: from: 12.05.1999 to: 19.05.1999	**Date of report**: 25.08.1999
Shifts:	**Local contact(s)**: Dr. D. Thiaudière	*Received at ESRF:*

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Report:

We have investigated structural properties of fully hydrated highly oriented multilamellar phospholipid membranes near and at the unbinding transition temperature. This unbinding transition is extensively examined theoretically [1] but has never been observed experimentally. We have investigated highly aligned films of dimyristoyl-glycero-phosphocholine (DMPC) and oleoyl-palmitoyl-glycero-phosphocholine (POPC) on silicon substrates. For this purpose we kept the samples in a temperature controlled chamber which allows the samples to be fully hydrated. The measurements were carried out at an energy of 20 keV to transverse a distance of 18 mm of water and to prevent possible radiation damage.
The measurements in the plane of incidence have been performed using a cyberstar detector. The reflectivity curves in Fig. 1a show that the higher order Bragg peaks vanish with increasing temperature (even far below the unbinding temperature) and that the highest order peak is not a singularity any more in agreement with Caillè's theory. Due to the high resolution of the measurements a lineshape analysis of the radial Bragg Peaks could be performed, which is necessary to determine the elastic properties of the samples (see Fig 1b.). The position of the Bragg peaks remain almost constant within the whole range in temperature and vanish above the unbinding temperature which proves the unbinding transition to be discontinuous.
For the investigation of small lateral structures a study of the diffuse scattering at large lateral momentum transfer and small incident angles is necessary. A condition which can not be satisfied in the plane of incidence. Therefore we used an out-of-plane setup according to [2]. In order to get as much information of the diffuse scattering as possible we used a 2-

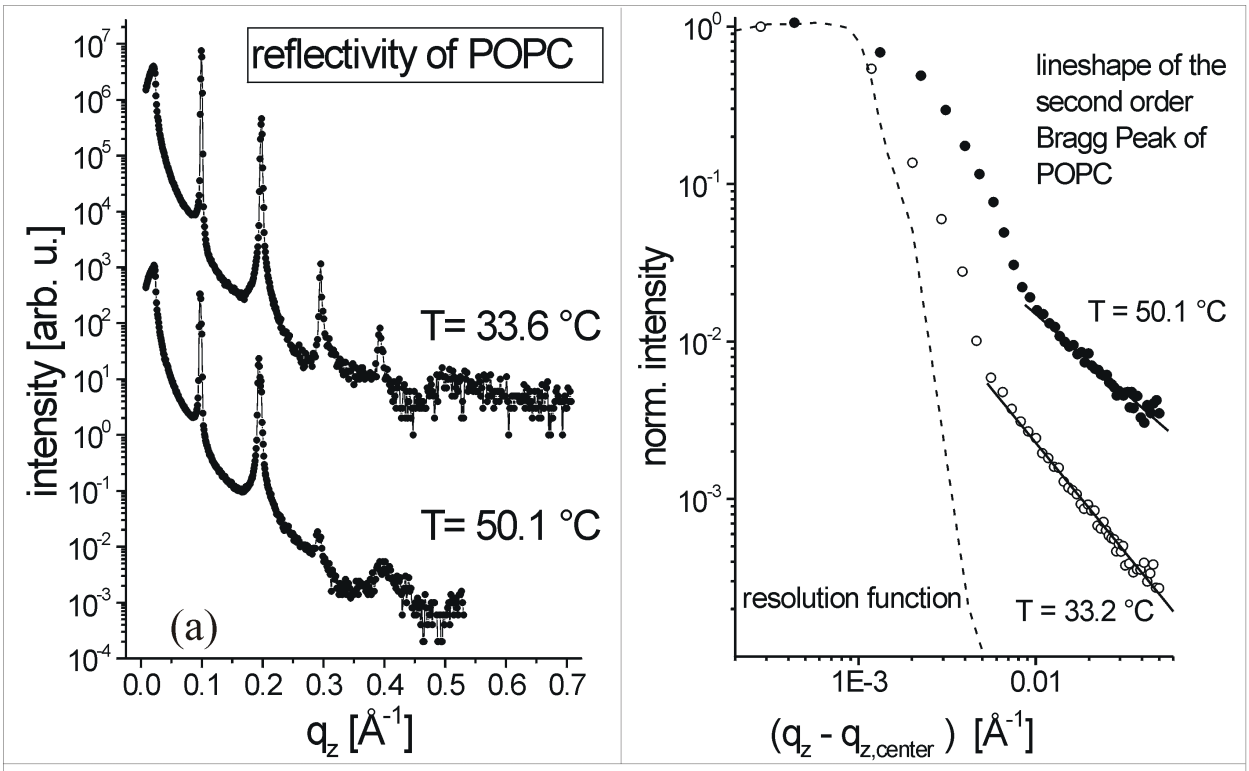

Fig 1a: reflectivity curves of POPC at T= 33.6 °C and 50.1 °C
Fig 1b: lineshape of the second Braggpeak of POPC at T= 33.6 °C and 50.1 °C exhibiting different slopes for the tails

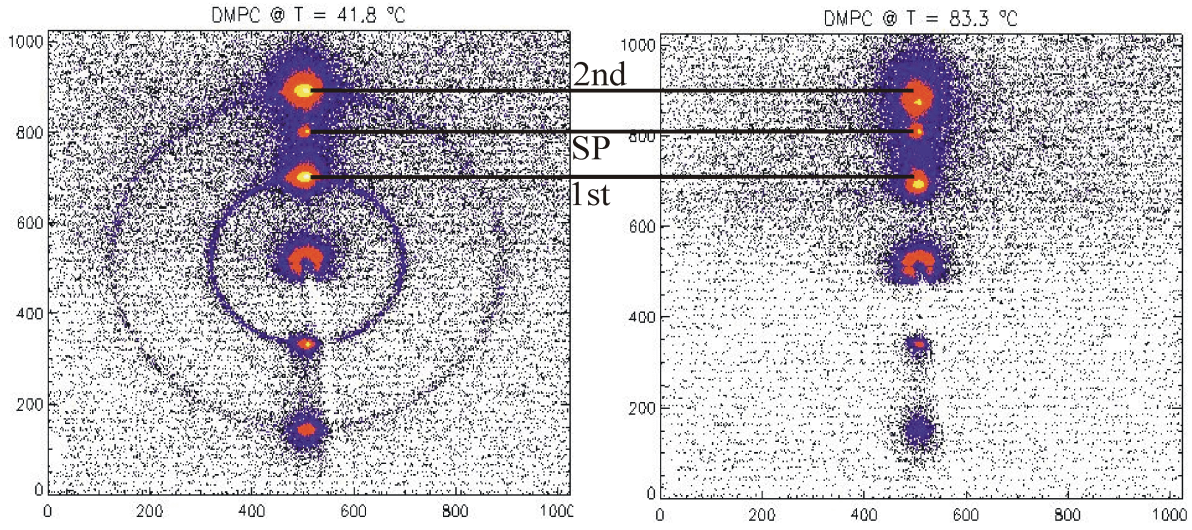

Fig 2: Diffuse scattering of multilamellar POPC membranes at T = 41.6 °C and 83.3°C. The shift of the 1st and 2nd order Braggsheets is clearly visible while the position of the specular Peak (SP) remains constant.

dimensional detector positioned perpendicular to the plane of incidence. Fig. 2 shows the diffuse scattering of the first and second order Bragg sheet at low and high temperature for POPC. Above the unbinding transition temperature (which is about 80 °C for POPC and about 95 °C for DMPC in agreement with prior experiments) the diffuse Bragg sheets vanish and the membranes unbind.

[1] R. Lipowsky, S. Leibler, PRL 56, 2541 (1986) and R. Netz, R. Lipowsky, PRL 71 (1993)
[2] T. Salditt, C:Münster, J.Lu, M. Vogel, W. Fenzl, Phys.Rev.E, in press.
[3] M. Vogel, C. Münster, W. Fenzl, T. Salditt, Phys.Rev.Lett., in press.