ESRF	**Experiment title:** Space and time-resolved studies of sliding charge-density-wave distortions in $NbSe_3$.	**Experiment number:** HS 961 B
Beamline: ID10 A	**Date of experiment:** from: 29 03 2000 to: 03 04. 2000	**Date of report:** 1 aug. 2000
Shifts: 18 (partial)	**Local contact(s):** G. Detlefs	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):
P. Monceau (1)*, H. Requardt (2)*
F.Ya Nad (1,3)*, R. Currat (4),
J.E. Lorenzo (5)*, D. Rideau (1,4)*.
(1) CRTBT/CNRS, Grenoble,
(2) Max-Planck-Institut für Metallforschung, Stuttgart,
(3) Institute of Radioengineering and Electronics, Moscow,
(4) ILL, Grenoble,
(5) Laboratoire de Cristallographie/CNRS, Grenoble.

Report:

In CDW materials, such as $NbSe_3$, in which the wavelength of the CDW is incommensurate with the underlying lattice, sliding of the CDW is made possible by the application of an electrical current exceeding a threshold value I_T. The collective motion of the CDW condensate requires conversion from free electrons to CDW condensate, at the current electrodes. This conversion is mediated by phase slip processes which play a similar role as vortices in type II superconductors or superfluids. Experimentally one observes a stretching (compression) of the CDW periodicity near the injection (extraction) contact (i.e. a shift of the position in reciprocal space of the CDW satellite peak).

We report here the second part of the experiment HS961, which was rescheduled due to a front end failure on ID10. The purpose of this experiment was twofold:
- to complete the results obtained in Exp. HS961 A, on the deformation profile of a sliding CDW in $NbSe_3$ *between current contacts.*

- to explore the time-resolved relaxation of the CDW satellite upon switching off the driving current, for different temperatures.

The stationary measurements of the sliding CDW distortion were performed on ID10 A using a 30 μm-wide X-ray spot (sample cross-section: 15 μm x 5 μm). Fig. 1 shows the intensity map $I(x, Q)$ of the CDW satellite peak as a function of beam position, x, along the sample and longitudinal coordinate, Q, in reciprocal space; for I=0 mA (*lhs*), and in the sliding state, for I=3 mA (I/I_T=3) (*rhs*); $T = 90$K. The vertical lines show the contact boundaries. One sees the occurence of a finite phase gradient (i.e. a shift of the CDW satellite) in the near-contact regions. This distortion is associated with the local deviation of the normal carrier concentration. In the central section, the CDW periodicity is essentially unaffected by the electrical current. This feature is consistent with the one-dimensional theory of the carrier conversion process at a normal-metal/ CDW-condensate interface, recently developed by Brazovskii *et al.* [1].

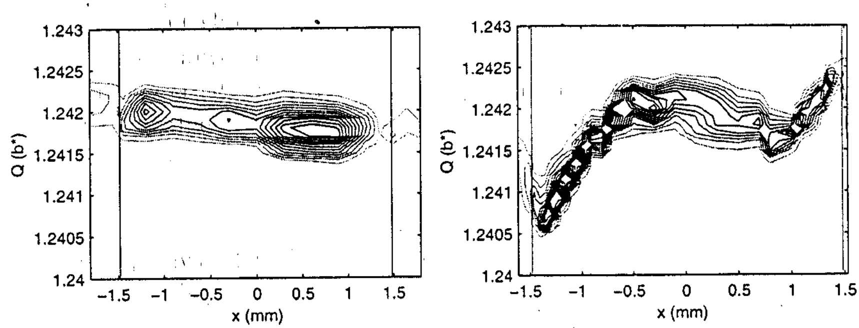

FIG. 1 Intensity maps $I(Q, x)$ (arbitrary units) of the CDW satellite peak as a function of position, x, and longitudinal coordinate, Q, in reciprocal space: in the pinned state (*lhs*), for I=0 mA; in the sliding state, for I=3 mA (I/I_T=3) (*rhs*); Beam width: 30 μm, $NbSe_3$, T=90K.

The transient structure of the sliding state has been investigated by monitoring the *longitudinal* shift of the CDW satellite peak position after a current pulse, at 105 K and 90 K (see attached proposal). The relaxation of the satellite shift after the pulse follows a stretched exponential decay: $q(t) = q_0 exp(-(t/\tau)^{\mu})$. At T=90K typical values are $\tau \approx 1.3$ s and $\mu \approx 0.15$. The relaxational time scale, τ, seems to vary strongly with T, although a systematic study could not be performed during the allocated beam time (18 shifts in 16-bunch mode instead of the 2/3-fill mode as originally scheduled).

References

[1] S. Brazovskii *et al.*, Phys. Rev. B **61**, 10640 (2000).