ESRF	**Experiment title:** ***Charge density wave in NbSe3 in the sliding mode***	**Experiment number**: He2053
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Report:

The goal of this experiment was to investigate the sliding motion of a Charge density wave under an external electric current by using coherent diffraction. CDW's are found in quasi-one-dimensional (1D) metallic compounds, and consist in the simultaneous modulation of the lattice and the charge density of the conducting electron at twice the Fermi wave vector $2k_F$. The lattice modulation gives rise to pairs of satellite reflections flanking the fundamental Bragg peaks at $\pm 2k_F$ in the x-ray spectra, the shape of the satellite reflections being related to the CDW phase-phase correlation function. Upon an electric field larger than a threshold, the CDW slides as a whole, hence carying a non-ohmic current. Prototypical CDW systems are the blue bronze $Rb_{0.3}MoO_3$ and $NbSe_3$, in which a CDW state is stabilized below 180 K and 145 K, respectively. However, the blue bronze is an insulator in the CDW state, while $NbSe_3$ still exhibits metallic properties. As the CDW can be considered as an electronic crystal, the presence of conducting electrons, which can screen CDW excitations make the two systems different and extremely interesting to compare.

We used the same experimental conditions as for our experiments HE1284 and HS2402. The sample has been mounted inside a He orange cryostat, with its (H0L) plane in the horizontal diffraction plane. The (0 1.241 0) incommensurate satellite reflection has been measured. In this report, we only show data obtained from a point detector. Indeed, the intensity of the superstructure reflection associated to the CDW in NbSe3 is weak compared to the blue Bronze system, which makes the measurement difficult with the CCD camera (a longer integration time is thus necessary which increases the role of the beam fluctuations). To get more intensity, the slits have been more opened than for usual coherent experiments. The data presented here are thus not due to the coherence properties of the X-ray beam.

This experiment has been devoted to the measurement of the superstrucure reflection versus the external current, for different beam positions on the sample.

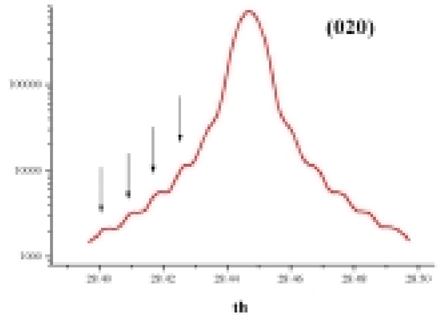

Fig1: Transverse scan of the fundamental (020) Bragg reflection showing regular fringes in the tails of the reflection due to the small sample thickness.

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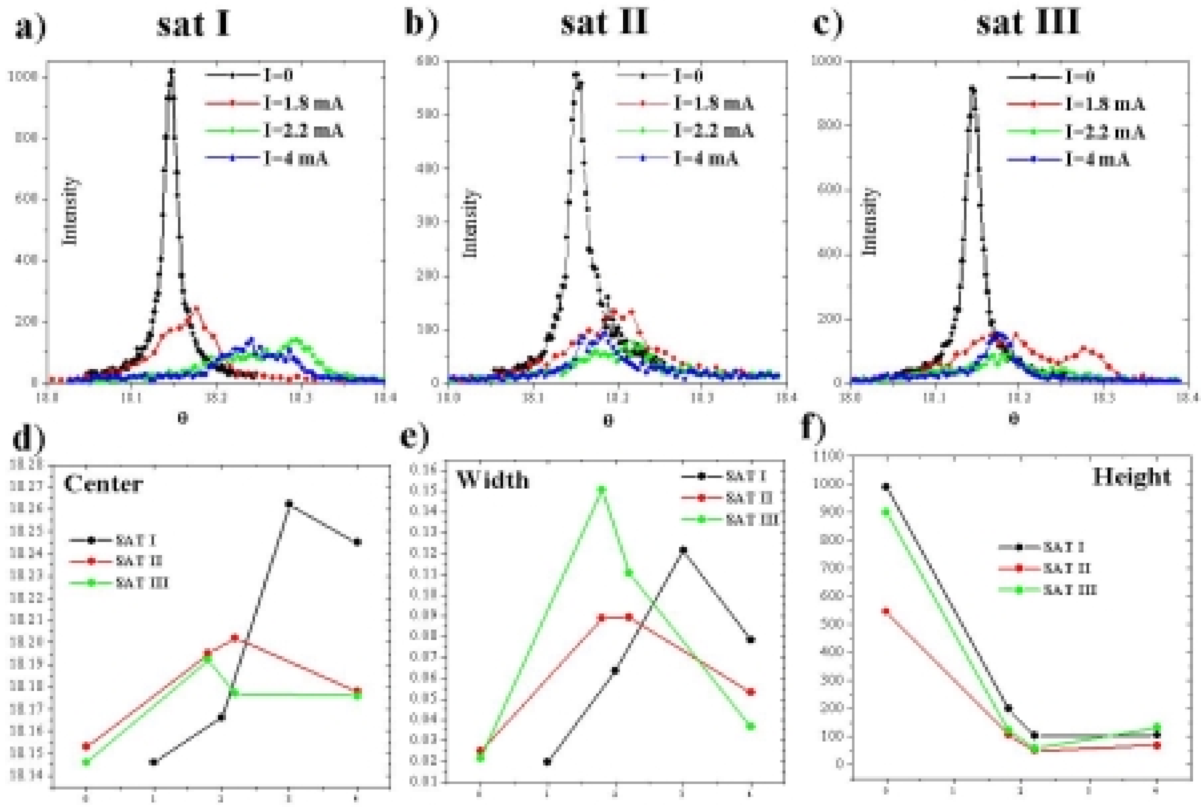

Fig 2: a) b) c) Profiles of the satellite reflection versus the external current for three beam positions on the sample. The satellite called “Sat II” is located close to the contact. d) e) f) Evolution of the center, width and height of the satellite after fitting by a single Lorentzienne at I=0mA and Gaussian profiles with the current.

Results:

The NbSe3 single crystal was a whisker, 3.1mm long, 20µm large and 2µm thick. It was lying on a Sapphire substrat (300µm thick). The initial sample resistance was 88 Ohms at 90K and the threshold value was 2mA at the same temperature.

In figure 1 is displayed the diffraction pattern of the (020) Bragg reflection. As for the Blue Bronze, the width along the transverse direction is 8. 10^{-3} degree and the image of the (020) Bragg reflection on the CCD is close to the direct beam which proves the crystal quality. In addition to the blue bronze however, regular fringes are observed due to the finite sample thickness (2µm).

The satellite reflection is vey sensitive to the current. Eventhough some differences exist between the three positions, in the three cases two regimes are clearly visible (see figure 2): below the threshold current (Is=2mA), the intensity is approximatively reduced by a factor 5, the width increases by the same factor and the center of mass is displaced at larger angles. Above the treshold current, the center shifted towards the original direction, the width decreases and the intensity increases again.

Note that the displacement of the satellite under current towards the larger angles can not be due to a heating effect induced by the external current.