

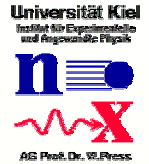
First Surface Inelastic X-ray Scattering Experiment

B. M. Murphy, J. Stettner, M. Müller, W. Press*

Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität, D-24098 Kiel, Germany

Contact: murphy@physik.uni-kiel.de

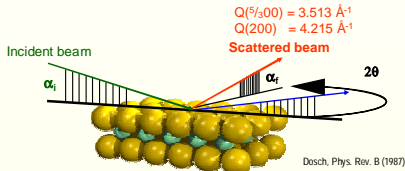
* Institut Laue-Langevin, 6 rue Jules Horowitz, BP 156, F-38042 Grenoble Cedex 9, France



H. Requardt, M. Krisch

ESRF, Grenoble, France

Surface scattering geometry



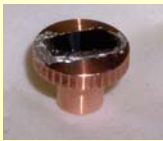
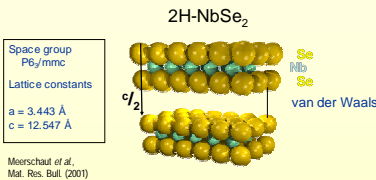
Dosch, Phys. Rev. B (1987)

NbSe₂ @ 15.817 keV ($\alpha_c = 0.18^\circ$)

$\alpha_i = \alpha_c - 0.03^\circ$; penetration depth ~23 Å
 energy resolution 5.5 meV

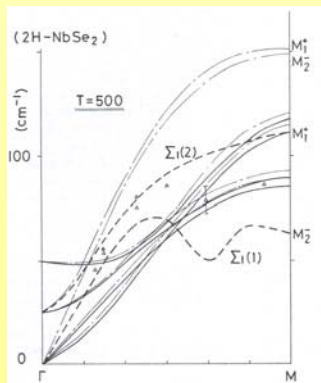
NbSe₂ sample

Layered structure, 2D-like behaviour



Sample cleaved in air and then held under vacuum

- charge density wave transition at 33.3K
- complete phonon softening at transition temperature
- **Kohn anomaly** visible at room temperature: lowered phonon frequency at 2/3 of Brillouin zone

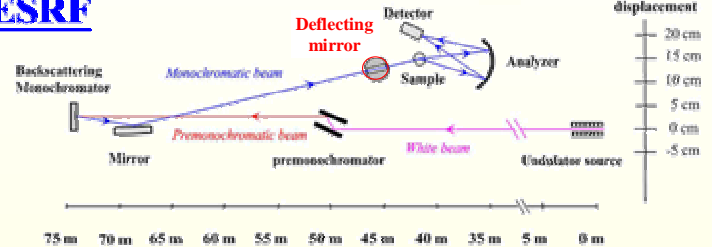


Calculated phonon dispersion at room temperature

K. Mizutani et al., J. Phys. Soc. Jpn. (1984)

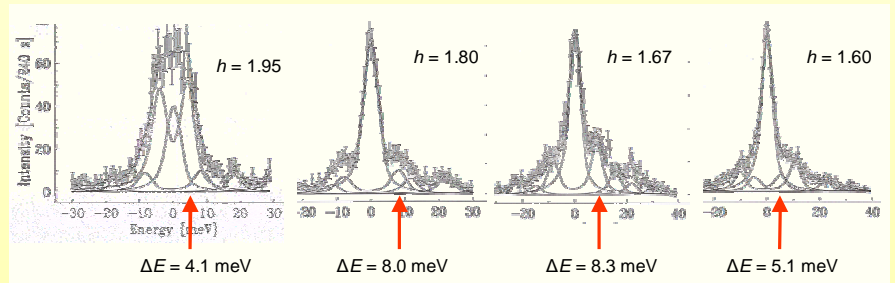


ID28 IXS Beamline geometry



NbSe₂ IXS surface phonon spectra

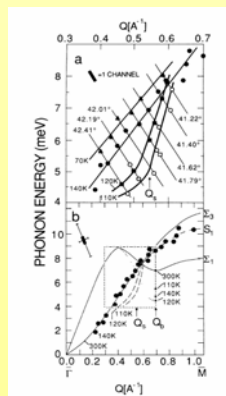
- measured at 200 surface reflection along $h00$
- room temperature
- preliminary fits with damped harmonic oscillator



Previously observed TaSe₂ surface phonon anomaly

Helium atom scattering:

- Kohn anomaly at 1/2 of Brillouin zone at surface (2/3 of Brillouin zone in bulk)
- interpretation as competing symmetries of surface and bulk



K. Benedek et al., Phys. Rev. Lett. (1988)

Surface inelastic X-ray scattering:
 It works!