ESRF	Experiment title: Dynamical Structure Factor of Liquid and Solid Helium	**Experiment number:** HC -300
Beamline: ID16/BL21	**Date of Experiment:** from: 18. 10.95 to: 24. 10.95	**Date of Report:** **25. 2. 96**
Shifts: 18	**Local contact(s):** U. Bergmann	*Received at ESRF:* 29 FEB 1996

Names and affiliations of applicants:

C. Seyfert[1,3], D. Arms[2], E. Burke1[3], R. O. Simmons[2], H. Sinn[1,3]

[1] Inst. f. Angewandte Physik, FAU Erlangen
[2] Dept. o. Physics, University of Illinois
[3] FB Physik, Universität Restock

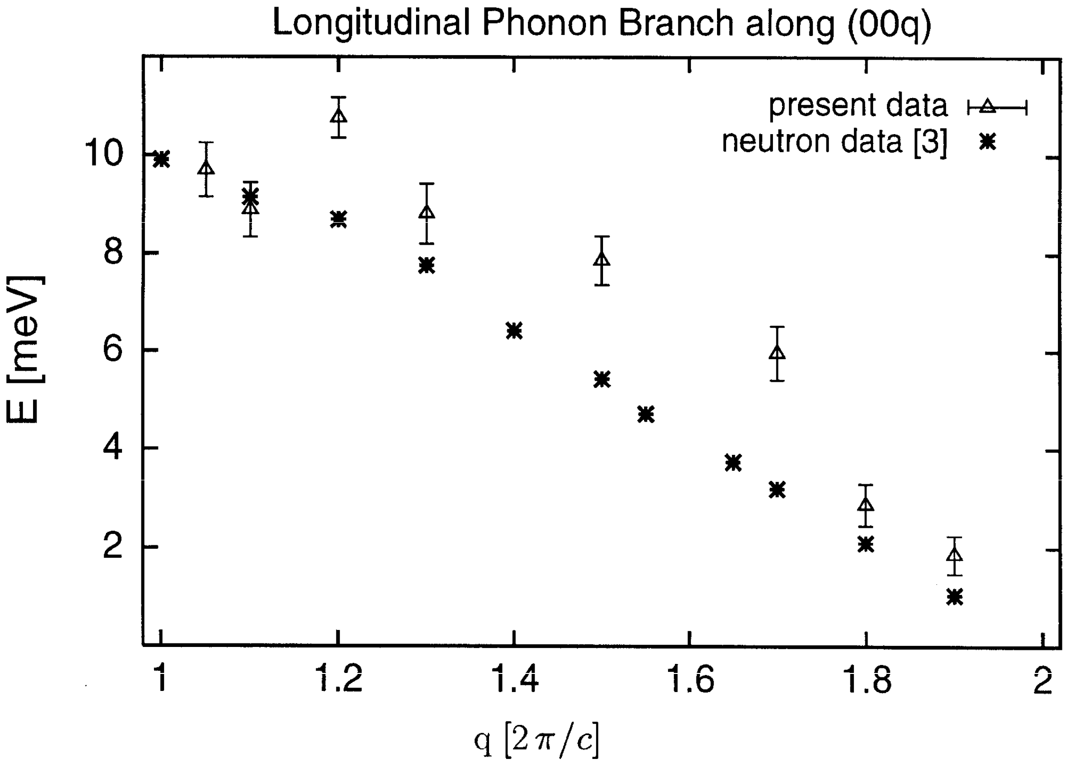
Report:

Inelastic neutron scattering has been employed to investigate many aspects of phonon excitations in solid helium [1]. However, at higher energy transfers the phonon groups observed with inelastic neutron scattering are anomalous and distorted [3], [4] and thus difficult to identify. Furtheron, only crystals of the isotope ^4He could be investigated, due to the large absorption cross section of ^3He for neutrons. High resolution inelastic X-ray scattering is a promising tool for studies on helium. There is no inherent difficulty to study high energy and momentum transfers and there is no absorption problem in the case of the isotope ^3He.

First measurements have been done with INELAX at HASYLAB [2] and proved the capability of this method to study excitations in solid and liquid ^4He. These measurements showed that a high photon flux at the sample is vital. Thus 18 shifts of beamtime at ESRF's inelastic scattering beamline ID16/BL21 were devoted to study part of the phonon dispersion relation in hcp ^4He.

Since helium only solidifies under low temperature and externally applied pressure the sample environment consists of a cryostat and a high pressure system. At 9 K and a pressure of 70 MPa a single crystal of hcp ^4He with a molar volume of 13.3(1) cm^3 was grown it situ. The crystal was oriented and energy scans at fixed momentum transfer were done along the (0 0 q)-direction. The energy resolution was 10 meV. Empty cell scans were performed to identify the background caused by scattering of the pressure cell and surrounding thermal shields.

The obtained dispersion relation for longitudinal phonons along the (O O q)-direction is shown in the figure. The preliminary data analysis was done describing the spectra with Voigt profiles using a standard least square algorhythm. Further data analyses are in process, including consideration of phonon line shapes. For comparison, closest relevant neutron data [3], measured at a different molar volume (16.0 cm^3), have been included in the figure. They have been scaled using a formula suggested by [3]. There is an obvious deviation of the overall shape of the dispersion relation obtained with x-rays and the neutron data. This fact requires further experiment al studies.



[1] H.R. Glyde, Excitations in *Liquid and Solid Helium,* Oxford University Press, Oxford (1994)

[2] N. Schell, R.O. Simmons and E. Burkel, *Röntgenmessungen an Heliumeinkristallen,* HASYLAB annual report 1993
C. Seyfert, M. Schwoerer-Böhning and E. Burkel, *Inelastische Röntgenstreuung an flüssigem und festem Helium,* HASYLAB annual report 1994

[3] R.A. Reese, S.K. Sinha, T.O. Brun, and C.R. Tilford, Phys. Rev A3(1971)1688

[4] V. J. Minkiewicz, T. A. Kitchens, G. Shirane, and E. B. Osgood, Phys. Rev A8(1973)1513