ESRF	**Experiment title:** **Study of the dynamical structure factor of deeply supercritical Neon at high density**	**Experiment number:** **HS 372**
Beamline: ID16	**Date of experiment:** from: 25/8/97 to: 9/2/97	**Date of report:** 26/2/98
Shifts: 21	**Local contact(s):** Alain Mermet	*Received at ESRF:*

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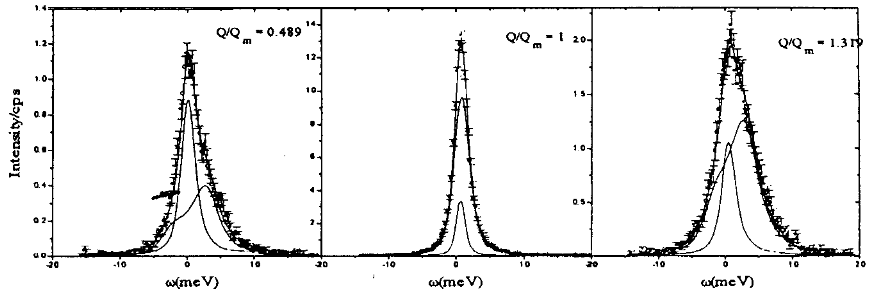
Report:

During the period between 25/8/97 and 2/9/97 some experimental determination of the $S(Q,\omega)$ of a sample of **dense** Neon have been performed with IXS techniques at ID16; the general purpose of such a study was to follow at different densities the transition of the dynamics between hydrodynamical to single particle regimes. During the 21 shifts 5 different sound dispersion curve have been determined at different densities and pressures at the constant temperature of 3 1 K and in a Q range which spanned from 3 to 3 1 nm^{-1}. The sample environment consists on a high pressure cell connected to a cryostat head and a heater. The pressures investigated spanned in a range between 3 and 480 bar, at T=3 1 K, i.e. along an isothermal which cross the liquid gas transition. Four of the five tested pressure, namely 480 bar, 350 bar, 200, bar and 50 bar were in the liquid region, while the last one, 3 bar, was in the gaseous one. The system cryostat- high pressure cell has been maintained in vacuum; we relied upon a temperature stability better than 0.4 K during the time covered by all the experiment and a pressure stability better than 10 bar at all the working pressures. Typically each scan took a time of half a day. We used the Si(11, 11, 11) reflection as an incident radiation, corresponding to an energy of 21747eV and we rely on an energy resolution of 1.5 meV. The obtained spectra have been analysed with the Damped Harmonic Oscillator as a theoretical model for the inelastic peaks, with a lorentzian for the central peak,

As a result we were able to successfully address few controversial issues. Namely:

- Capability of the three *mode approximation* to describe the $S(Q,\omega)$ up to the Q of the first maximum of S(Q), Q_m (23.5 nm^{-1}). We claim to have given a contribution to this debate question which is still at the moment an open controversy. In the following picture three spectra have been reported as an example of the evolution of the experimental $S(Q,\omega)$ for P=3 50 bar T= 3 1 K. The three corresponding Q are, from the left 11.5 nm^{-1}, 23.5 nm^{-1} and 31 nm^{-1}. The picture suggests the existence of a typical three mode structure at Q below and above Q_m. At Q_m a narrowing of the lineshape is evident and the shift of the inelastic contributions seems to move to zero energy transfer.



- Existence of a clear minimum in the extended sound dispersion curve near Q_m at all the investigated pressure. In the low Q region the curve presents a linear dispersion, in agreement with the prediction of the hydrodynamics theory.
- The longitudinal sound velocity, i. e. the slope of the curve in the low Q limit, is a little higher than the adiabatic sound velocity at the corresponding thermodynamical point this indicating a positive dispersion of the velocity of sound at these high frequencies. In a previous experiment, such positive dispersion was found for a supercritical sample.
- There is no substantial difference in cosidered dynamics at the liquid-gas transition
- The dependence on density of the obtained curves is not evident in the explored density range.
- The minimum appears sharper in the undercritical than in the supercritical fluid region.