ESRF	**Experiment title:** X-ray Diffraction Measurement on Expanded Fluid Alkali Metals	**Experiment number:** SC-366
Beamline: ID-30	**Date of experiment:** from: 28-Oct-97 to:03-Nov-97	**Date of report:** 12-Jan-98
Shifts: 18	**Local contact(s):** Daniel Hausermann	*Received at ESRF:* 02 MAR. 1998

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Report:

The aim of our experiment was a detailed investigation on the density dependence of the liquid-structure for rubidium if it is expanded with increasing p and T from the dense melt up to conditions close to the liquid-vapour critical point (p_c=124bar, T_c=2017K). The electronic properties change gradually during this expansion, culminating in a metal to nonmetal transition close to the critical point /l/. It is obvious that the continuous decrease in density also cause the interatomic interactions to change successively. If the density of the liquid is sufficiently reduced the varying interatomic forces favour the formation of molecular aggregates similar to those known from the dilute vapour. Indications for such particles have already been obtained from inelastic neutron scattering experiments /2/. Contributions from molecular form factors to the scattering law have not been observed in preceding measurements of S(Q) on expanded liquid alkali-metals /3,4/. These experiments were carried out using the technique of elastic neutron scattering but the obtained Q-range and the quality of the obtained scattering laws were not sufficient to extract information about molecular structures in the expanded liquid. Highly accurate scattering laws for liquid alkali metals are now possible due to the combination of high intense high quality x-rays from third generation synchrotrons, newly developed techniques to perform x-ray scattering experiments under conditions of high temperatures and simultaneously applied high pressures /5/ and the highly sensitive detection system at ID-30 used in this experiment.

The scattering law for liquid rubidium could be determined between 473K and 1473K in steps of 100” and corresponding pressures close to the liquid vapour coexistence line in our experiment. Two preliminary results of our work at 873K and 1373K are exemplary given in figure 1 compared with older S(Q) measurements /3/ at similar conditions. Not only the improvement in statistical error is apparent, although the duration of a single experiment took only 10s it should also be noted that S(Q) can finally be measured over an extended Q-range. Bearing in mind that our results are obtained using a highly accurate imaging plate system it is interesting to recognise that slight differences in the position of the first peak appear compared to the older results. However, due to unexpected technical problems with our heating devices we could not extend our measurements to temperatures above 1473K. It is therefore desired to bring up measurements at higher T in a succeeding experiment.

/1/ F. Hensel, Physica Scripta T25,283 (1989)
/2/ W.-C. Pilgrim, M. Ross, L.H. Yang, F. Hensel, Phys. Rev. Lett. 78,3685 (1997)
/3/ G. Franz, W. Freyland, W. Glaser, F. Hensel and E. Schneider, J. Physique 41, C8-C194 (1980)
/4/ R. Winter, F. Hensel, T. Bodensteiner and W. Glaser, Ber. Bunsenges. Phys. Chem. 91, 1327 (1987)
/5/ S. Hosokawa, T. Matsuoka and K. Tamura, J. Phys.: Condens. Matter 3,4443 (1991)

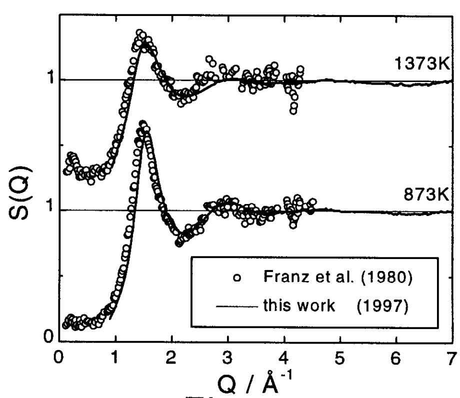

Figure 1