ESRF	**Experiment title:** High frequency dynamics of Gallium in different thermodynamic phases.	**Experiment number**: HS-1604
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Report:

The aim of the proposal was to measure the dynamic structure factor of liquid gallium at different termperatures. After few experimental troubles, we have been able to reach a first important target, accurately determining the dynamic scattering law at one temperature, just above the melting point ($T_m \approx$303 K).

The sample length was as close as possible to the absorption length in order to optimize the scattering efficiency, i.e. 50 μm. For this purpose we melted a gallium droplet between two sapphire discs. All the system was then kept under 10^{-6} dynamic vacuum in order to prevent elastic scattering from air.

We have been able to show the presence of collective high frequency acoustic modes that were not detected in previous neutron scattering investigations at similar temperature, probably due to the incoherent signal and to the kinematic limitations affecting this technique.

Despite the relatively high atomic number of the sample, the data look very nice, as the measured intensity profile shows a very good inelastic/elastic ratio, with the gallium excitations well far from the sapphire phonons. These excitations are propagating with a sound speed of about 3000 m/s, that lies above the isothermal value (2800 m/s) due to the presence of relaxation processes.

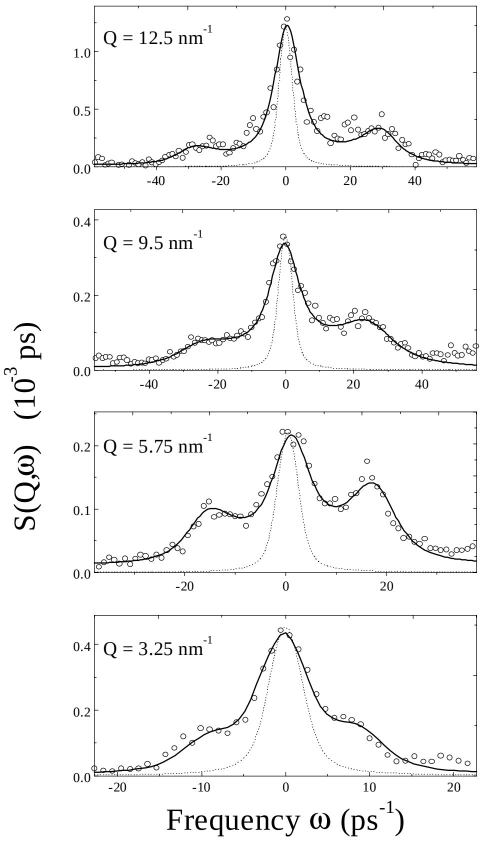
The quality of the spectra allowed as a lineshape analysis similar to the one already performed in liquid alkali metals based on a two relaxation times scenario (see Figs).

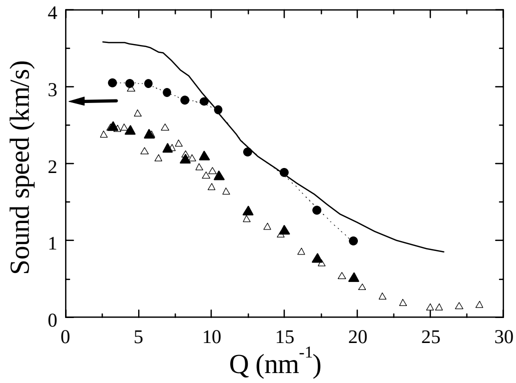
From the results of the present study we believe that further investigations should be addressed to the following points:

-An high temperature experiment to point out weather the acoustic properties are driven by the alpha process (diffusive motion-T dependent) as it happens in water-like systems rather than by the microscopic relaxation (vibrational motion-T-independent) as in the case of alkali metals.

-An high Q-experiment to verify the presence and the nature of a secondary mode reported in previous INS experiments (not observed in the present explored Q-range).

For these reason we are planning to ask for more beamtime as the natural continuation of the promising study that we performed on Gallium.





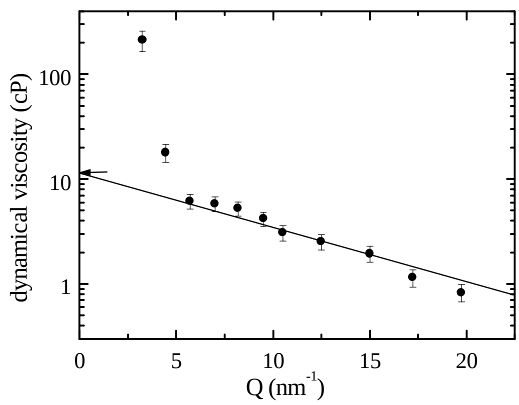


Fig. 1 - Dynamic structure factor of liquid Gallium at the melting point for several fixed values of the exchanged wavevector, the full line is the best fitted lineshape according to the generalized hydrodynamics prediction, the dotted line is the instrument resolution. Fig. 2 – Measured value of the sound speed (full dots) together with the high and low frequency limits predicted by structural data. Fig. 3 – Values of the generalized longitudinal viscosity, the low Q divergence is an artifact due to the finite instrument resolution. The arrow indicate the hydrodynamic prediction.