ESRF	**Experiment title:** The high frequency dynamics of liquid gallium at high pressure	**Experiment number:** HD 440
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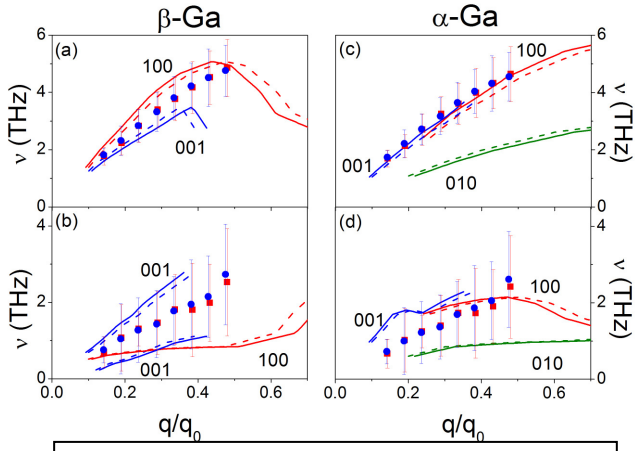
Report:

Liquid gallium was studied by IXS at 0.8 GPa, 295 K, and 6.1 GPa, 393 K. The aim of this experiment was to investigate the relationship between the microscopic dynamics and the local order in a non-simple liquid. Indeed, we recently reported that for a simple liquid metal like sodium the microscopic dynamics is strongly dictated by the local order: indeed both transverse and longitudinal modes are present in the IXS spectrum of the liquid, though the latter ones are hidden by the overall broadening of the spectral features. The results of a careful analysis is that the modes of both polarizations have the same acoustic dispersion as in the polycrystal with the same local order, while the broadening is larger due to the distribution of local orders [1]. In this experiment we investigated a non-simple,highly anisotropic liquid, gallium, at high pressure in order to enhance the visibility of transverse modes thanks to the higher speed of sound.



Comparison of the acoustic longitudinal (a,c) and transverse (b,d) dispersion in liquid Ga (symbols) and the two crystalline phases after a density scaling.

For this experiment Ga powder was loaded in a diamond anvil cell, in a rhenium gasket. The cell was contained in a vacuum chamber expressively designed for high pressure high temperature experiments, which is equipped with a resistive heater. The IXS spectra were collected using the (999) reflection of the Silicon monochromator, with an energy resolution of 3~meV. A counting time as long as 900s per energy point was needed to have the required statistical quality.

We have analysed our data using the quasi-crystalline model presented in [1], and compared the results with the known acoustic branches measured in the stable orthorhombic phase α-Ga and in the metastable monoclinic phase β-Ga, which is suggested to be closer to the liquid as for the local order. This comparison indeed shows that the acoustic dispersion of liquid Ga corresponds to the orientational average of the branches in β-Ga, while no compatibility is found with α-Ga (see figure). On one hand this result supports the identification of the local order of liquid Ga as more similar to the anisotropic monoclinic phase, on the other hand it reveals the strong predictive power of the quasi-crystalline model, as a clear connection is found between dynamics and local order.
These results have been recently published in Phys. Rev. B, 84, 052201 (2011).

[1] V. M. Giordano and G. Monaco, Proc. Natl. Acad. Sci. USA 107, 21985 (2010).