

HD-123: High frequency dynamics of liquid cesium under high pressure -- Allocated time: 24 shifts at ID16

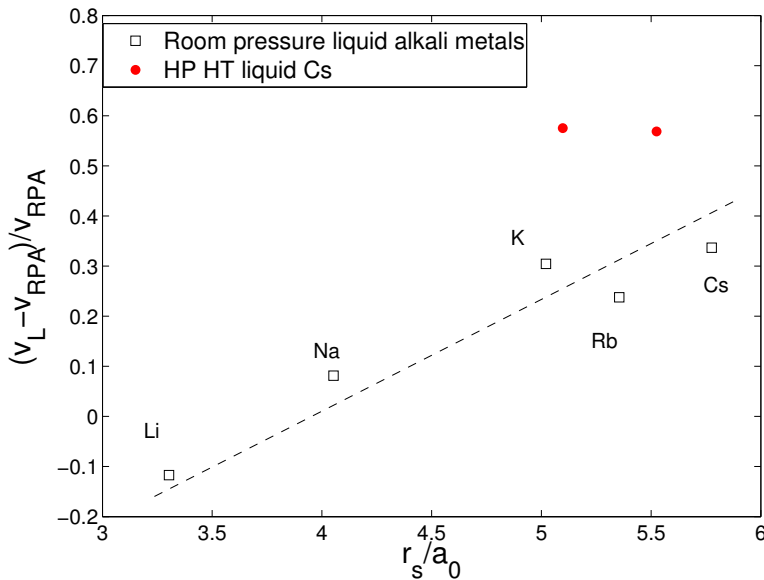
Liquid cesium was studied by inelastic x-ray scattering at 500 K and at different pressures. The aim of the experiment was to investigate the validity of a unitary description of the high frequency dynamics of liquid alkali metals based on only one parameter.

The simple random phase approximation (RPA) based on a nearly-free electron gas picture predicts a universal scaling that only depends on the electronic density, usually represented by the radius r_s of the free electron volume. Until now, the high frequency dynamics of liquid alkali metals has been studied at room pressure and melting temperature and on liquid alkali alloys, in order to study the dependence on r_s (r_s going from 3.3 to 5.8). It has been found that, while the RPA prediction is not correct, the deviation from it still seems to be a function of only the electronic density [1].

The aim of this experiment was to study the density dependence of the high frequency dynamics, tuning the density by means of pressure, thus exploring a wider and finely tuned density range. Cesium was chosen because of its high compressibility and high atomic number. Furthermore, a liquid-liquid phase transition reported at ~3.9 GPa makes this system even more interesting.

The sample was loaded in a membrane diamond anvil cell and brought to high temperature by means of an external resistive heater. Pressure was measured by monitoring the pressure induced displacement of the structure factor main peak.

The good matching of the sample thickness and attenuation length allowed us to use the Si(11 11 11) reflection to gain in resolution. However, even with an integration time as long as 550 s per energy point, the signal-to-noise ratio turned out to be too low to go beyond a simple analysis based on the damped harmonic oscillator (DHO) model. This motivated us to change the configuration in order to use the Si (999) reflection, gaining in intensity but losing a factor of two in energy resolution.



We collected data at two pressure points, both located below the liquid-liquid phase transition, i.e. 0.3 and 1.2 GPa. We also measured the empty cell signal, which is quite low with respect to the sample's one but still not completely negligible at ~18 keV.

As a preliminary step, the spectra have been fitted by a DHO model. As expected, sound velocity increases with pressure. However, once our results are reported together with those for the room pressure liquid alkali

metals, it appears that the deviation from the RPA cannot be described in terms of r_s . Indeed, as shown in the figure, our high pressure points deviate from the nearly linear behavior of the data on alkali metals at room pressure. This is then a strong evidence that a more complex theoretical model is needed for a correct description of the alkali metals high-frequency dynamics.

A more detailed analysis in this direction is currently underway

(1) T. Scopigno, G. Ruocco and F. Sette, Rev. Mod. Phys. 77, 881 (2005)