

It has long been said that 'all the easy experiments have been done'. Areas for growth mainly stem from advanced instrumentation, new materials, software developments and sophisticated sample environment equipment.

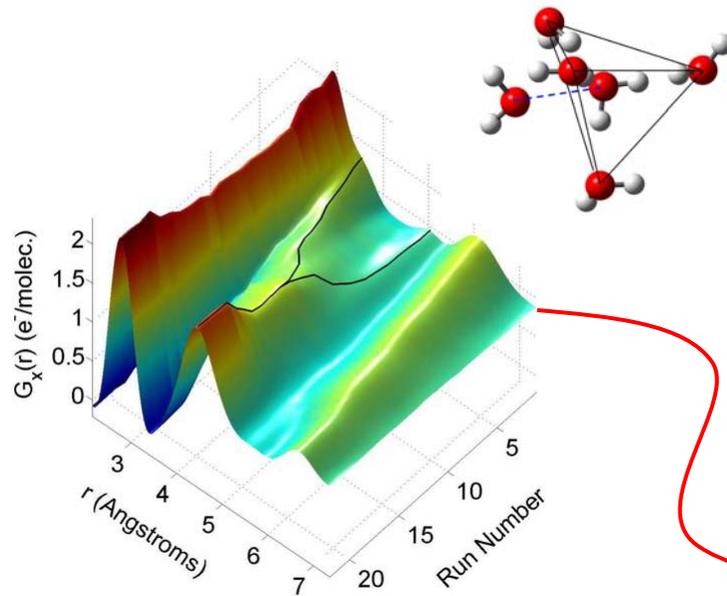
Instrumentation.

The PDF technique has been most successful using the high energy and low angle combination for both neutrons and x-rays.

In the liquid and amorphous field the main requirements for accurate measurements are instrument stability and low background. Both need to be improved for 2D detectors, especially for studying low-Z materials.

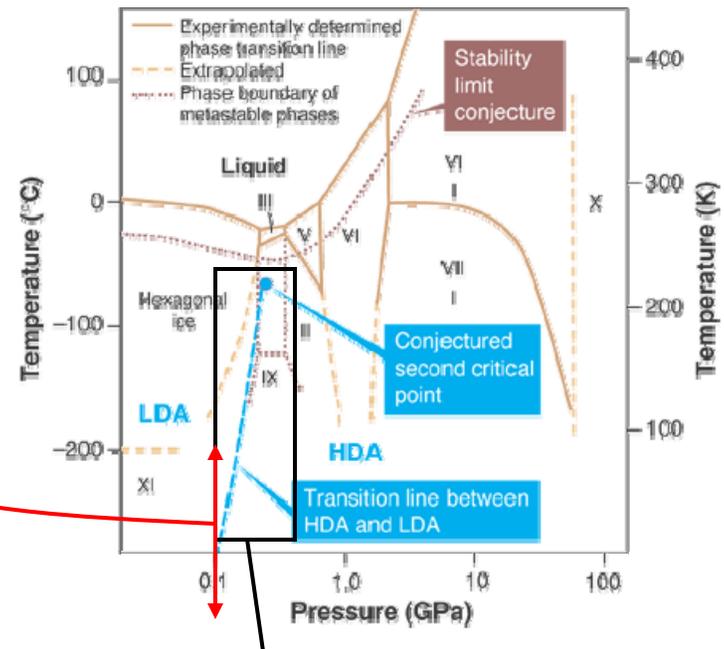
Mapping out phase transition lines requires a fast detection system and *in-situ* control of external variables.

Accurate data are needed to pin down structural mechanisms associated with the transition.



Amorphous ice. Currently x-ray diffraction has only been able to follow the transition at normal pressure due to the weak signal.

Tulk et al PRL 97 (2006) 115503.



Region of interest – is there a second critical point ?

A. K. Soper *Science* 2002 (297) 1288.

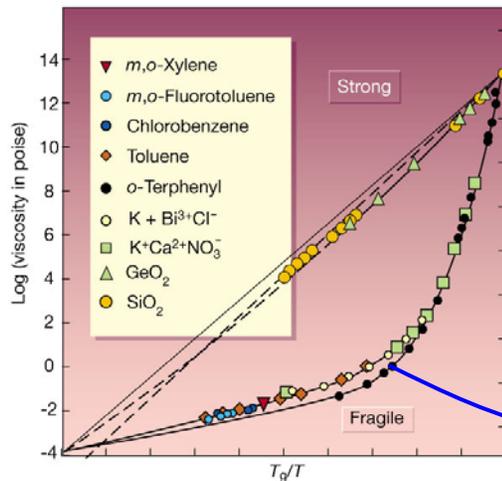
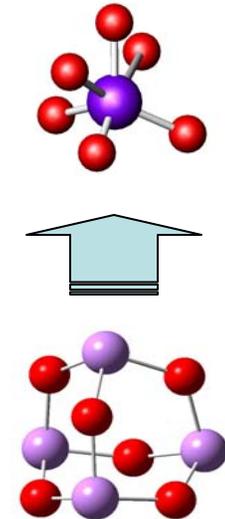
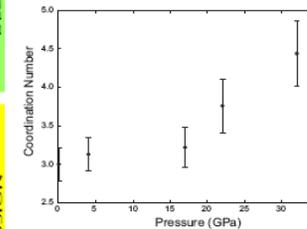
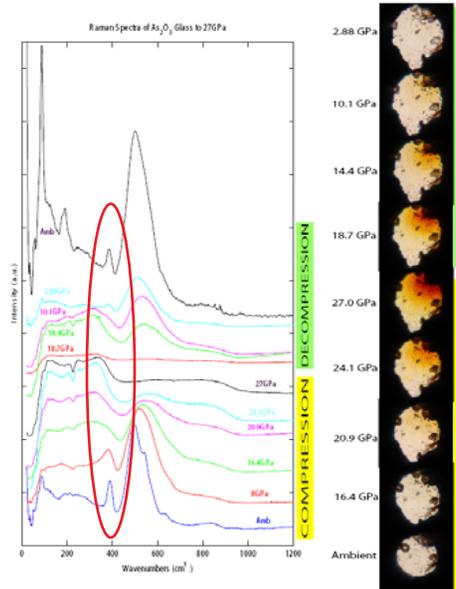
Sample environment. Extreme conditions : temperature, pressure, magnetic field etc.
Cover a wide range of P and/or T space and know exactly where you are !

Structure/property relations – combining techniques. Multiple techniques are needed to solve structural phase transitions in disordered materials. Dual technique beamlines x-ray diffraction/micro-Raman or calorimetry are needed.

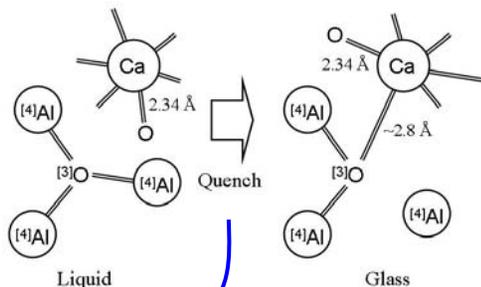
Glassy As_2O_3 undergoes a colour change from transparent to red at ~20GPa.

This is associated with the break up of molecular cages, the $378cm^{-1}$ mode in Raman ... and an increase in coordination number in XRD.

Mei *et al.* J. Phys. Conden. Matt. 19 (2007) 415103.



Raman Colour change XRD = Overall transition

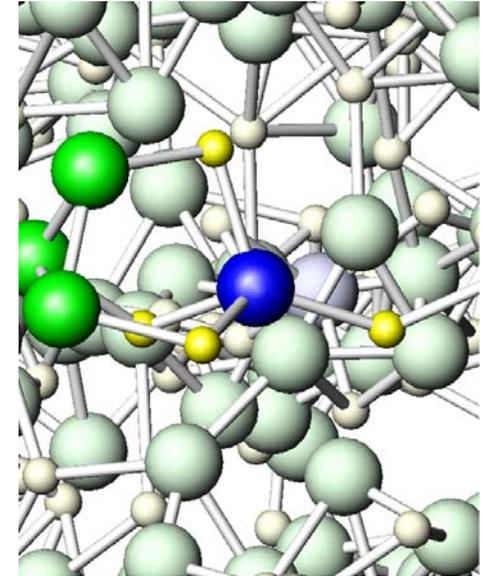
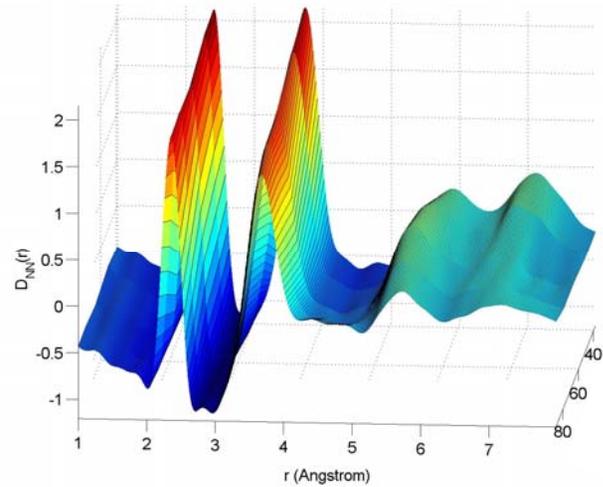
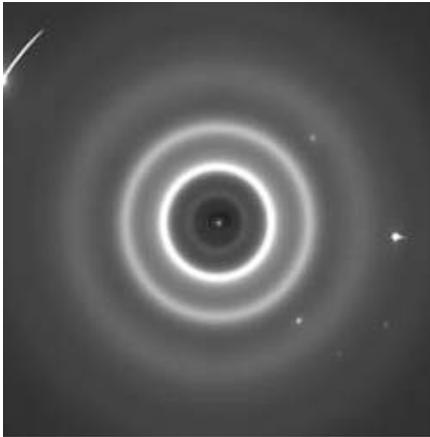


Containerless systems enable access metastable states e.g. aerodynamic levitation.

XRD studies of fragile calcium aluminate glasses (optical fibres) provide evidence of the breakup of tetrahedral oxygen triclusters upon quenching a glass from the melt.

Can this be related to thermodynamic measurements of fragility ?

Software. At the neutron science software initiative 2003 it was proposed that :
'the time spent on data analysis should be comparable with that for data collection'.



Need on the fly data analysis so the experiment isn't being run blind.

Need to fully analyze data before next beamtime starts!

To achieve this 10-20% of the budget for building a new instrument should be allocated to software and developing data reduction and visualization procedures.