GeoSoilEnviroCARS *The University of Chicago*

Structure of Liquid Iron at High Pressure

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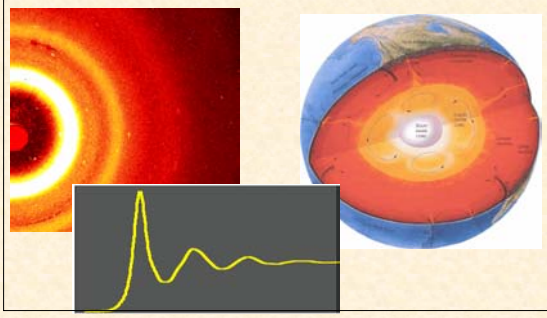
- **Liquid iron shows a simple close packed liquid at high pressure. The determined structure factor preserves essentially the same shape along the melting curve.**
- **The results place important constraints on the thermodynamic and transport properties of liquid iron and the melting curve of iron.**

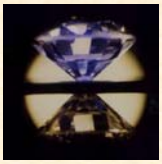
Motivation

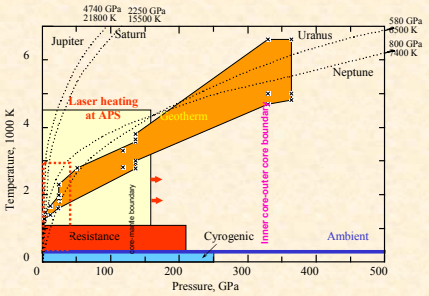
- The dominant composition of the Earth's core is iron, with a liquid outer core and a solid inner core.
- Structural information of crystalline and molten iron at high pressure and high temperature conditions provide a basis for understanding the Earth's core, from geomagnetism, geodynamo, to seismic anisotropies.
- The high pressure melting curve of iron provides a vital constraint to understand the thermal and dynamic nature in the core.

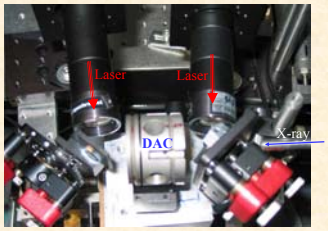


Techniques

- Diamond anvil cell for generating high pressures.
- Laser heating for generating high temperatures.
- X-ray scattering for determining atomic arrangements of samples.







A geothermal together with P-T ranges accessible by static techniques. The P-T range reached by the laser heating system at GSECARS is shown in an in situ x-ray diffraction measurement on iron.

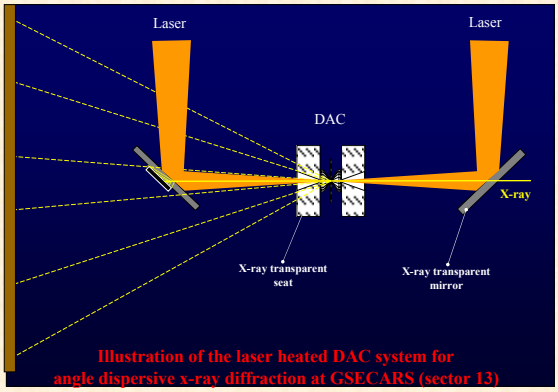
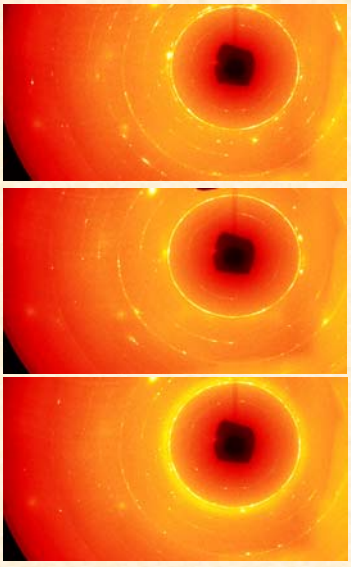


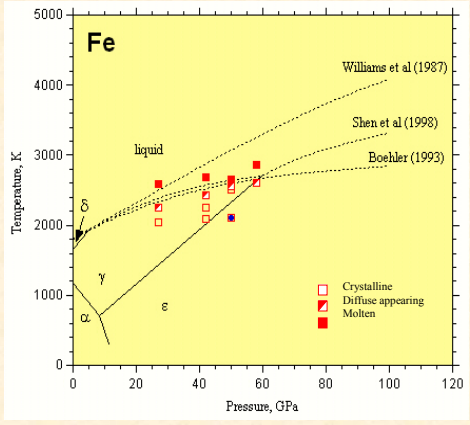
Illustration of the laser heated DAC system for angle dispersive x-ray diffraction at GSECARS (sector 13)

Results

- The diffuse scattering from molten iron has been successfully measured in a laser heated diamond anvil cell.
- The definitive recognition of a molten state is used to constrain the melting curve of iron.
- The x-ray scatterings before and after melting have been used for studying the structures of both crystalline and molten iron along the melting curve.
- The pressure range so far is up to 58 GPa.

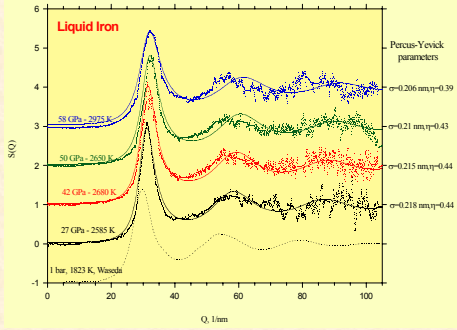


X-ray scattering of iron at 50 GPa



Phase diagram of iron, with experimental points from this study.

Structure factors of liquid iron along the melting curve



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