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Emerging challenges in high pressure neutron scattering

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Neutron scattering, in its multiple forms is one of the chief techniques in the study of the structure of materials. However, owing to its relatively poor scattering cross section, it traditionally required significantly large samples, especially when compared with most other techniques. This limitation has been particularly felt in the context of high pressure, where - almost by definition - elevated pressures require small samples. All that has changed in the recent past. Indeed, novel neutron sources coupled with innovative neutron guide geometries are enabling the delivery much greater fluxes to small samples. In parallel, new developments in high pressure devices are allowing developments that were only dreamt of a decade ago.

Benefiting from – as well as driving - this wave of new possibilities is the SNAP instrument. This is a neutron diffractometer located at the Spallation Neutron Source and is currently the United States sole neutron diffractometer dedicated to high pressure research.

In this talk it will be described how the SNAP instrument, evolved from a "conventional" neutron scattering instrument to a unique tool for high pressure research, able to reach record high pressure at a wide range of temperatures [1]. Such evolution included the design of radically different cell designs, including a new diamond anvil cell custom designed for SNAP, a significant overhaul in data reduction that can eliminate single crystal contamination from the anvils, and methodologies for data collection that allow Rietveld refinement at record high pressures [2]. In the development process a number of science challenging scientific problems were tackled, ranging from experiments at very low-to-moderate gas pressures in MOFs, magnetism in oxides and, in the limit, measurements of water phases at record high pressures [3].

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