

High-Pressure Neutron Diffractometer, PLANET, for Observing Hydrogen in Materials under High-Pressure and High-Temperature Conditions

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PLANET is a neutron powder diffraction beamline dedicated to high-pressure experiments[1] (Fig.1), which was constructed at the Materials and Life Science Experimental Facility in J-PARC. The most characteristic feature is the capability of structure analysis on crystals, liquids and amorphous solids under high-pressure and high-temperature condition ($<10\text{GPa}$, 2000K) using a large multi-anvil press “ATSUHIME[2]” specially designed for pulsed neutron diffraction experiments. Additionally, the high-pressure experiments can be performed at low temperatures ($>77\text{K}$) using various types of presses. Because of these unique characters, the PLANET is used in various fields of sciences, such as geophysics and materials science [3]. The details will be introduced in the presentation.

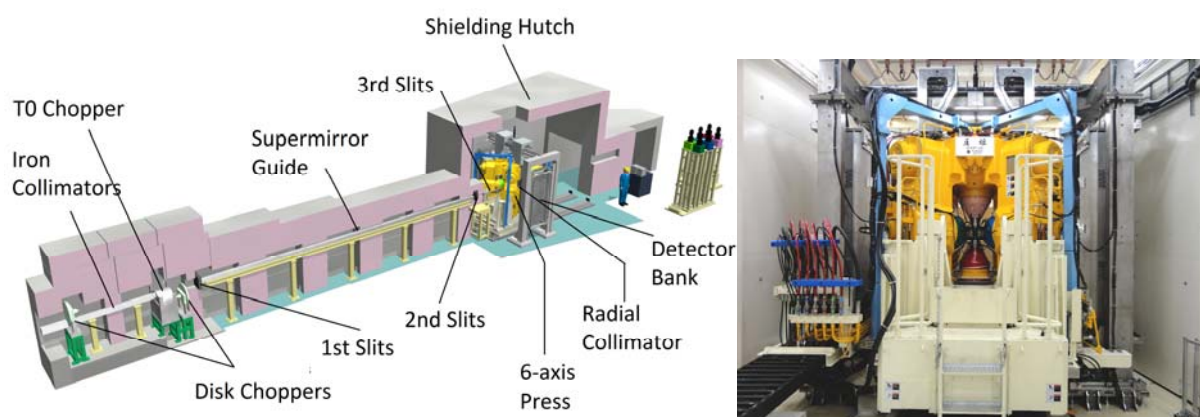


Fig. 1 (Left) High-Pressure Neutron Diffractometer PLANET, (Right) Six-axis press installed there.

Application to geoscience

Water is abundant in sea, but large amount of water (2-10 times amount of the sea water) is also believed to exist in the interior of the Earth as a hydroxyl ion or crystalline water in minerals. The “water” tends to reduce hardness and the melting temperature of minerals, which strongly affects physical properties of the Earth. Despite its importance, the mechanisms are still unknown. We are trying to reveal them by the neutron experiments at the high- PT condition relevant to upper mantle’s condition.

Application to planetary science

NASA’s Hubble Space Telescope has observed water vapor above Jupiter’s moon Europa, providing the first strong evidence of water plumes erupting off the moon’s surface. This implies the existence of sea in the interior. To reveal the inner structure of the icy planets, such as Jupiter, Saturn and their moons, the states of ice have been investigated under low-temperature and high-pressure conditions.

Bibliography

- [1] T. Hattori *et al.*; Nuclear Instrum. Meth. A, **780**, 55 (2015).[on the instruments of PLANET].
- [2] A. Sano-Furukawa *et al.*; Rev. Sci. Instrum., **85**, 113905 (2014). [on the 6-axis press].
- [3] T. Hattori *et al.* ; Rev. High Press. Sci. Technol. **26**, 89 (2016).(in Japanese)[on recent results].

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<http://mlfuser.cross-tokai.jp/ja/bl11.html>