Hydrogen and hydrogen - containing materials studied by a combination of synchrotron and neutron techniques

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Hydrogen and hydrogen – containing materials exhibit many fascinating physical phenomena associated with quantum nature of hydrogen atoms in solids. A combination of synchrotron and neutron scattering techniques is the most powerful tool to study crystal structure and phase transitions in these systems. New pressure techniques, allowing to perform neutron and X-ray experiments on the same sample in the same thermodynamical conditions had been developed. The technique is suitable for both powder and single-crystal experiments.
We report our recent work on crystal structure of quantum broken-symmetry phase (BSP) in solid deuterium at pressures above 20 GPa [1]. Since discovery in 1980s by indirect optical probes, the crystal structure of the high pressure phases in solid hydrogen and deuterium had been subject of many speculations. Contrary to the most of theoretical predictions, our results suggest a *Pa3*-type local order and an incommensurate modulation in the BSP.
At the end, prospects for combined X-ray and neutron studies in the “light” hydrides such as AlH_3 are discussed, including a possibility of new stable (or quasistable) phases having potential interest for applications.

Reference

[1] - I. Goncharenko & P. Loubeyre, *Nature* **435**, 1206 (2005)