

New frontiers and new tools in High Pressure Physics: an illustration with results on hydrogen rich systems

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High pressure physics is an old field which is advancing by the implementation of new tools. At least three facts can explain the great dynamism of the high pressure field. The frontier of exploration is now pushed up to the TPa (10 million bars), that is the pressure domain of planetary interiors. A different periodic table of atoms exists under a million bars and new materials can thus be synthesized, some with remarkable properties. Many measurements have been developed, particularly in front of synchrotrons, which enable a fine and detailed characterization of the properties of materials under extreme pressures almost as if at ambient pressure.

We will illustrate this renewal of the high pressure domain by focusing on some results around dense hydrogen systems. This theme is pushing the development of new experimental approaches and has implications for fundamental physics, materials science and astrophysics. In particular, we will discuss: hydrogen metallic phase; super-hydrides which are superconductors at high temperature; the superionic forms of water ice; the miscibility of H/He mixtures in the conditions of planetary interiors.