# Frontiers of High Pressure Research at the European Synchrotron Radiation Facility

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High pressure research at the European Synchrotron Radiation Facility has always played a central role. Today, more than 50 % of the beamlines are engaged in high pressure research, in various fields from earth sciences and physics to chemistry, biology and material science.

Recent years have seen technical breakthroughs in high pressure instrumentation at synchrotrons, with the development of laser heating of the Diamond Anvil Cell (DAC), resistively heated DACs, high pressure cryostats, nano-crystalline diamond anvils or double-stage DACs. These techniques have considerably extended the P-T domain towards higher pressures (~ 700 – 800 GPa, at ambient T) and temperatures (up to ~ 5000-6000 K). In parallel, the development of time resolved techniques in X-ray Absorption Spectroscopy, X-ray Diffraction and X-ray Imaging, in particular using single bunch acquisition, has opened the possibility to use synchrotron radiation to probe dynamically compressed matter generated by a high power laser or a high-energy projectile. These developments have pushed the beamlines toward their limit and triggered new projects.

ESRF-EBS (Extremely Brilliant Source), operational in 2020, will offer significantly higher flux density and higher coherence together with new experimental facilities, leading to important perspectives for extreme matter studies. The Matter at Extremes group is involved in three EBS-related projects: 1. A high flux nano-X-ray diffraction beamline for science at extreme conditions 2. Pushing the limits of nuclear resonant scattering in energy and spatial resolution and 3. a high brilliance EXAFS beamline optimized for time resolved and extreme conditions applications.

In parallel, we are building a platform - the High Power Laser Facility (HPLF) - dedicated to dynamic compression studies to probe matter at pressures and temperatures beyond the static limit of the DAC, and to investigate the dynamic behaviour of materials under high strain rates. The Phase I of this project foresees the coupling of a 100 J, nanosecond, laser to energy dispersive X-ray absorption spectroscopy. In 2018 several milestones were reached, with the design of the new clean room hosting the laser in 2020, the design of the laser beam transport into the experimental hutch and the successful commissioning of its 15J Front End.

In the first part of the presentation I will give an overview of static and dynamic compression activities and recent scientific results obtained at the ESRF. In the second part, I will present our future projects and the unique science opportunities offered by ESRF-EBS.