# High pressure science and recent developments at the ESRF in view of EBS programme

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In the last decades, we have witnessed an unprecedented surge in high-pressure research that has greatly improved our fundamental understanding of materials under high compression. The X-ray investigation of matter under extreme conditions has become one of the major activities at the ESRF and other 3rd generation synchrotron sources. The array of techniques, initially restricted to structural measurements using X-Ray diffraction, is now extended and includes many others such as Inelastic X-ray Scattering, Nuclear Inelastic Scattering, X ray absorption and emission spectroscopy, X ray magnetic circular dichroism, X-ray Compton scattering and X-ray magnetic scattering. As a direct consequence, many scientific breakthroughs have been achieved across fields ranging from Earth and planetary sciences to fundamental physics, chemistry and materials research, and extending into biophysics/biochemistry including questions concerning life and biological function under extreme conditions.

Since 2008, the ESRF started an ambitious upgrade programme. The phase I has been completed in 2015 and it has covered all aspects of the facility, including photon production, experimental facilities for users, user service, and X-ray technology development. This upgrade benefits all areas of X-ray applications: Imaging, Spectroscopy, and Diffraction. In the context of Phase II of this upgrade programme (2015-2023), the ESRF has launched the ESRF-EBS project (Extremely Brilliant Source). This project is primarily focussing on the construction of a new storage ring concept with the goal to reduce the horizontal emittance by a factor of 40. The subsequent linear increase in brilliance and coherence is expected to enable new applications of X-rays in the study of soft and hard condensed matter.

In this presentation, a status of the high pressure activity at he ESRF will be presented. A fast overview of the possible X ray experiments available will be given and a more exhaustive description of the on-site high pressure preparation dedicated laboratories will be presented. Moreover, in view of the EBS ESRF program, an ambitious and innovative modernisation project to upgrade ID27, one of the extreme conditions dedicated beamlines, has been launched. It consists to construct a long beamline with unique photon flux and focusing, time resolution and coherence capabilities. The details and status of this project will be developed.

A series of scientific examples will be discussed opening the possibilities of collaborations and discussions on particular scientific problems.