

Extreme conditions X-ray diffraction and imaging beamline ID15B on the ESRF extremely brilliant source

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Abstract

In recent decades, high-pressure research has experienced a remarkable expansion, deepening our understanding of how materials behave under extreme compression. At the ESRF and other third-generation synchrotron facilities, X-ray studies under extreme conditions have become a major research focus. A broad range of techniques is now routinely applied: X-ray diffraction, inelastic and nuclear inelastic scattering, X-ray absorption and emission spectroscopy, magnetic circular dichroism, Compton and magnetic scattering, and more. These tools have enabled breakthroughs across many fields: from fundamental physics and Earth sciences to materials chemistry and even biophysics, shedding light on how life and biological systems might function under extreme conditions. With the launch of the ESRF-EBS (Extremely Brilliant Source) in August 2020, a new generation of synchrotron science has begun. Beamlines ID15B and ID27, dedicated to high-pressure crystallography, now benefit from dramatically improved beam coherence and focusing capabilities. Their recent upgrades, together with enhanced support from the High-Pressure Laboratory, make it possible to explore the structure of materials at pressures up to 3 Mbar and temperatures from 3 K to 6000 K—pushing the frontiers of extreme condition science.

We present in this overview, the main features of the ID15B beamline on the new ESRF Extremely Bright Source (EBS). The ID15B beamline was fully reconstructed in 2015, considering the new capabilities of the future EBS machine. We will introduce the ID15 project, the ID15B undulator X-ray source, the optical scheme and the experimental hutch. The beamline ID15B is mostly dedicated to the determination of structural properties of solids at high pressure using angle-dispersive diffraction with diamond anvil cells. We will present different selected research examples illustrating the capabilities of this instrument.

References

[1] G. Garbarino, et al, High Pressure Research, vol. 44 (2024) n. 3, pg 199–216
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