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The delivery of the ESRF EBS and its Upgrade Programme

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The ESRF has been carrying out a major reconstruction programme, which started in 2009 and ended in 2023. This programme, referred to as the ESRF Upgrade Programme, is grounded on ESRF role and mission of pioneering synchrotron science to the benefit of Europe and society at large. Synchrotron based science has in fact continued growing and is increasingly associated with innovative applications and supporting industrial programmes.

In 2004, together with Jose Goulon, I pointed out the growing importance of convergence among X-ray imaging and microscopy methods with established X-ray science scattering and absorption techniques, which had the potential to open innovative approaches on the exploration of the micro- and nano-world, and enable much more powerful investigations on the different structural hierarchies present in many complex materials and in living matter.

To this purpose, new adapted concepts – enhancing X-ray source and instrument performance to explore with high spatial resolution condensed and living matter – had to be developed. These considerations rapidly became the basis of a powerful Science Case supporting what then became the ESRF Upgrade Programme.

The implementation of the ESRF Upgrade Programme, divided in two phases – Phase I (2009-2015, ESRF Purple Book – 2007) and EBS (2015-2023, ESRF Orange Book – 2014), has enabled an almost complete reconstruction of the ESRF facility, with 27 new beamlines, a new storage ring-based X-ray synchrotron source (EBS the Extremely Brilliant Source), and new scientific and IT infrastructures and instruments.

Th new EBS storage ring came to operation with revolutionary performance in August 2020, enabling and opening new frontiers in X-ray science, and becoming the new role model for modern X-ray synchrotron sources around the world. Since summer 2024, a second EBS-like machine, the APS-U, in Argonne National Laboratory, has started operation, and with the ESRF-EBS is contributing marking the new paradigm of synchrotron science.

I will present a summary of the ESRF programme with some particular emphasis to the recent construction and commissioning of the EBS storage ring [1], and on its impact to new opportunities in X-ray science and applications.

References

1. Raimondi, P., Benabderrahmane, C., Berkvens, P., Sette, F. *et al.,* The Extremely Brilliant Source storage ring of the European Synchrotron Radiation Facility, Commun. Phys. 6 (2023) 82. https://doi.org/10.1038/s42005-023-01195-z