SRI2024

Contribution ID: **831** Type: **Contributed talk**

The New Elettra 2.0 Diffraction Limited Storage Ring Facility

Tuesday 27 August 2024 12:30 (15 minutes)

The new Elettra 2.0 diffraction limited storage ring facility

The third-generation Italian synchrotron radiation facility Elettra is located on the outskirts of Trieste. It has been serving the national and international scientific and industrial community since 1993, and was upgraded in 2007-2009. The radiation beams, collected and tailored by in-vacuum optical systems, propagate through beamlines to reach experimental stations where an array of different analytical and processing techniques is available. The resulting light, ten billion times brighter than that supplied by conventional sources, enables a broad spectrum of users from academic institutions and industry to gain access to advanced research capabilities and techniques and conduct state-of-the-art experiments in physics, chemistry, biology, life sciences, environmental science, medicine, forensic science, and cultural heritage.
The design of a new, more advanced source than the current Elettra began in 2014. These studies analyzed the possibility and possible cost of creating a new very low emittance storage ring, called Elettra 2.0, which could operate in the same Elettra tunnel using the current injection system, therefore minimizing and infrastructure costs. A wide range of technical solutions for the lattice of the new machine were examined, from 4-bend achromat to 10-bend achromat, and the cost-performance ratio led to the choice of an enhanced 6-bend achromat type structure, which would allow reaching an emittance of 212 pm-rad, at 2.4 eV, therefore about 47 times lower than the current emittance. At the same time, energy consumption would decrease by approximately 25%.
The Elettra 2.0 project [1][2][3] was approved by the Italian Government in 2017, with plans for the new machine to commence serving external users in 2027. The design phase lead to a final version of Elettra 2.0 a fully transversely coherent source up to 0.5 keV-photon energy, more than doubling the total average current and increasing brightness by more than two orders of magnitude as compared to the current source, and maintaining a diversified beamline portfolio to allow experiments across a broad spectrum of photon energies, from a few tens of eV to several tens of keV, while substantially increasing the number of beamlines operating in the hard-X-ray range. In perspective, the possibility of producing picosecond-long light pulses at a MHz repetition rate across multiple beamlines simultaneously, without interference to standard multi-bunch operation is also being considered. Another important aspect of Elettra 2.0 is the high degree of transverse coherence in both the horizontal and vertical directions, projected to improve by a factor of 60 at 1 keV as compared to the current source.
The Elettra 2.0 project includes the construction of new beamlines and an extensive upgrade of most of the existing beamlines to fully exploit the high brightness and high degree of coherence offered by the new source. Over 40% of the entire investment budget is allocated to this purpose. Following this program, Elettra 2.0 is poised to host up to 32 new and upgraded beamlines, with a comprehensive list detailed in the subsequent sections of this paper.

[1] E. Karantzoulis, Elettra 2.0 —The diffraction limited successor of Elettra, Nucl Instrum Methods Phys Res A. 880 (2018) 158–165. https://doi.org/10.1016/j.nima.2017.09.057.
[2] E. Karantzoulis, W. Barletta, Aspects of the Elettra 2.0 design, Nucl Instrum Methods Phys Res A. 927 (2019) 70–80. https://doi.org/10.1016/j.nima.2019.01.044.
[3] E. Karantzoulis et al., Elettra 2.0 Conceptual Design Report - ST/M-17/01, 2017.

I plan to submit also conference proceedings

No

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Session Classification: Mikrosymposium MS 11/1: SR facilites: Updates and New Facilities

Track Classification: 11. Synchrotron radiation facilities: Facility updates and new facilities