Activities at Elettra (Scientific Computing)

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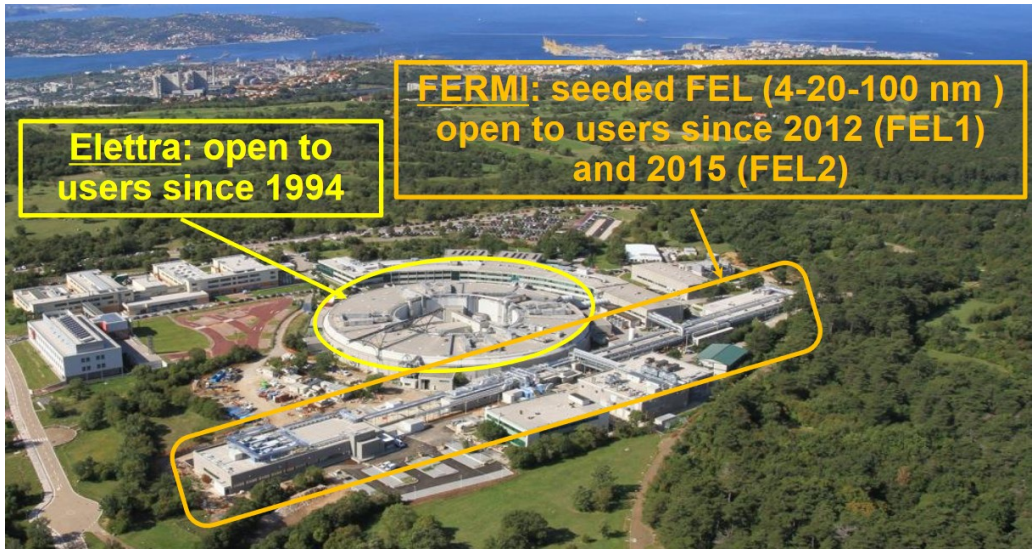
ELETTRA 2.0

- increase of the brilliance and coherence fraction
- Emittance reduction of the storage ring
- Provide a diffraction limited X-ray source also in the horizontal plane
- intense nano-beams in the range of VUV to X-rays
- Beam back in 2026 (14 months of black [1])
- Fermi 2.0 planned



[1] https://agenda.infn.it/event/17822/contributions/86487/attachments/63989/77191/Elettra20-ILO.pdf

Ongoing activities

- Original research on lossy compression of CT data [1]
- Basic research in nD signal compression (patented) [2]
- Compressive Sensing in X-ray Microscopy (XRF) [3,4]
- Other experiment specific encoding schemes

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[1] Mancini, L., Kourousias, G., Billè, F., De Carlo, F., & Fidler, A. (2018). *About a method for compressing x-ray computed microtomography data. Measurement Science and Technology*, 29(4), 044002.

[2] Kourousias, G., Pugliese, R., Curri, A. US20140328546A1/WO2013079516A1

[3] Kourousias, G., Billè, F., Borghes, R., Alborini, A., Sala, S., Alberti, R., & Gianoncelli, A. (2020). *Compressive Sensing for Dynamic XRF Scanning*. Scientific reports, 10(1), 1-8.

[4] Kourousias G., Billè F., Borghes R., Pascolo L., Gianoncelli A. *Megapixel scanning transmission soft X-ray microscopy imaging coupled with compressive sensing X-ray fluorescence for fast investigation of large biological tissues* Analyst, Vol. 146 - 19, pp. 5836-5842 (2021) doi: 10.1039/D1AN01074C

SMART-FIT project proposal (submitted)

- endorsed by LEAPS
- Currently under review (European Commission) for funding
- development of new green technologies for the next generation of X-Ray science facilities.
- develop concepts and building blocks for future imaging beamlines
  - scientific instrumentation
  - tools and methods for research infrastructures.
- taking into account
  - resource efficiency (e.g. energy consumption)
  - environmental (including climate-related) impacts

SMART-FIT project

Elettra tasks:

- Beamline models for digital twin (WP4)
- High throughput AI based analysis (WP4)
- Feedback to source/beamline control (WP4)
- Image quality estimation metrics for CT reconstruction and compression (WP5)

Other research activities

Currently working on:

- XRF data alignment/visualisation/fitting [1,2]
- XRF topography (ongoing research) [3]
- Ptychography (ongoing research) [4]

[1] Kourousias, G., Billè, F., and Gianoncelli, A. (2017) *Automated nonlinear alignment of XRF spectra*. X-Ray Spectrom., 46: 44– 48. doi: 10.1002/xrs.2725.

[2] Guzzi, F., Kourousias, G., Billé, F., Di Credico, G., Gianoncelli, A., Carrato, S, *Signal Alignment Problems on Multi-element X-Ray Fluorescence Detectors*, Lecture Notes in Electrical Engineering, vol 866. Springer, Cham (2021)

[3] Billè F., Kourousias G., Luchinat E., Kiskinova M., Gianoncelli A. *X-ray fluorescence microscopy artefacts in elemental maps of topologically complex samples: Analytical observations, simulation and a map correction method* Spectrochimica Acta - Part B Atomic Spectroscopy, Vol. 122, pp. 23-30 (2016) doi: 10.1016/j.sab.2016.05.012

[4] Guzzi F., Kourousias G., Gianoncelli A., Billè F., Carrato S, *A Parameter Refinement Method for Ptychography Based on Deep Learning Concepts*, Condensed Matter, Vol. 6 - 4, 36 (2021) doi: 10.3390/condmat6040036

THANK YOU

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