Contribution ID: **533** Type: **Invited talk**

TOMCAT 2.0: Multiscale, Multimodal Dynamic Tomographic Microscopy

Tuesday 27 August 2024 16:50 (20 minutes)

For almost two decades, the TOMCAT beamline has been providing cutting-edge multiscale, multimodal dynamic tomographic microscopy to a heterogeneous international scientific community. To maintain and strengthen our role in this field –fully leveraging on the upcoming diffraction limited SLS2.0 machine [1] –our team is driving a major beamline upgrade project (TOMCAT 2.0) featuring a significant refurbishment of the current instrument (S-TOMCAT), based on a new high-field superconducting bending magnet as well as a brand-new beamline (I-TOMCAT) based on an insertion device of latest generation [2].

Starting in summer 2025, TOMCAT 2.0 will offer to a wide academic and industrial community improved dynamical, high-throughput multidimensional and multimodal imaging capabilities, with a broad range of spatial resolutions (from 100 nm up to 10 µm) and energies (from 8 up to 50-80 keV). TOMCAT 2.0 on SLS 2.0 will profit from a smaller source size and a higher photon flux at most energies, leading to an overall enhancement of image quality. The generalized increase in photon flux - depending on the energies up to a factor 1000 compared to the old instrument - will enable to simultaneously profit from both higher spatial and temporal resolutions, pushing different flavours (in-situ, operando, in-vivo and in-fieri) of dynamic tomographic imaging towards unexplored frontiers. High throughput capabilities without compromises on image quality or spatial resolution, for the (semi-) automatic analysis of hundreds of specimens will also become available. Photon hungry chemistry revealing techniques like fluorescence imaging are currently mostly limited to the 2D (radiographies or in the best case selected tomographic slices) case. The increased photon flux coupled to improved X-ray hyperspectral interpolating detectors will pave the way to rapid 3D chemical imaging, which might routinely complement the sample microstructure with spectroscopic information.

In this contribution, we will present the TOMCAT2.0 project and explain how we are deploying the multiscale, multimodal dynamic tomographic microscopy program across S- and I-TOMCAT. We will report first results towards the realization of an innovative, high-temperature superconducting undulator [2] as well as some new optical concepts to efficiently exploit the entire beam for full field X-ray microscopy [3], to perform X-ray scattering tensor tomography [4] as well as full-field X-ray fluorescence tomography [5]. We will also briefly introduce our efforts towards event-guided temporally super-resolved X-ray imaging [6].

References:

[1] https://www.psi.ch/de/sls2-0,(2024).
[2] Zhang, K., Pirotta, A., Liang, X. Y., Hellmann, S., Bartkowiak, M., Schmidt, T., Dennis, A., Ainslie, M., Durrell, J. & Calvi, M. Record Field in a 10 Mm-Period Bulk High-Temperature Superconducting Undulator. Supercond Sci Tech 36, (2023), doi: 10.1088/1361-6668/acc1a8
[3] Samadi, N., Vila-Comamala, J., Shi, X. B., Sanli, U. T., David, C., Stampanoni, M. & Bonnin, A. Refractive Axicon for X- Ray Microscopy Applications: Design, Optimization, and Experiment. Optics express 31, 2977-2988, (2023), doi: 10.1364/Oe.478114
[4] Kim, J., Kagias, M., Marone, F. & Stampanoni, M. X-Ray Scattering Tensor Tomography with Circular Gratings. Applied Physics Letters 116, (2020), doi: 10.1063/1.5145361
[5] Marone, F., Ferreira Sanchez, D., Bergamaschi, A. & Stampanoni, M., Towards Time Resolved Multi-Scale X-Ray Fluorescence Tomographic Microscopy at I-Tomcat, in Submitted to SRI 2024.(2024)
[6] Wang, H., Hadjiivanov, A., Blazquez, E., Schlepütz, C. M., Stampanoni, M. & Lovric, G., Event-Guided Temporally Super-Resolved Synchrotron X-Ray Imaging, in Submitted to SRI2024.(2024)

I plan to submit also conference proceedings

No

Primary author: STAMPANONI, Marco (ETH Zürich - Paul Scherrer Institut)

Co-authors: SCHWARB, André (Paul Scherrer Institut); BONNIN, Anne (Paul Scherrer Institut); BÄCHTOLD, Benjamin (Paul Scherrer Institut); SCHLEPUETZ, Christian Matthias (Paul Scherrer Institut); MEISTER, Dominik (Paul Scherrer Institut); MARONE, Federica (Paul Scherrer Institut); LOVRIC, Goran (Swiss Light Source); MOHACSI, Istvan (Paul Scherrer Institute (CH)); VILA-COMAMALA, Joan (Paul Scherrer Institut); HAX, Leonardo (Paul Scherrer Institut); SALA, Leonardo (Paul Scherrer Institut); CALVI, Marco (PSi); ZUPPIGER, Philipp (Paul Scherrer Institut); ROTUNDO, Renzo (Paul Scherrer Institut); GUNTLI, Simon (Paul Scherrer Institut); CELCER, Tine (Paul Scherrer Institut)

Presenter: STAMPANONI, Marco (ETH Zürich - Paul Scherrer Institut)

Session Classification: Mikrosymposium 7/2: Imaging and Cohrerence Applications

Track Classification: 7. Imaging and coherence applications