Contribution ID: **512** Type: **Invited talk**

High-Throughput and High-Resolution Instrumentation for Time-Resolved Resonant Inelastic X-ray Scattering at SCS, European XFEL

Wednesday 28 August 2024 11:40 (20 minutes)

The European X-ray Free-Electron Laser Facility (European XFEL) in Schenefeld, Germany enables research with free-electron laser (FEL) radiation of unique properties. The superconducting accelerator can deliver up to 27,000 electron bunches per second, used to generate ultra-short and highly coherent x-ray pulses of high average brilliance [1]. European XFEL hosts currently seven instruments for soft, tender and hard x-ray studies. The soft x-ray Spectroscopy and Coherent Scattering (SCS) instrument is optimized for x-ray spectroscopy and x-ray diffraction.

The User Consortium Heisenberg RIXS (hRIXS) spectrometer was designed and built in order to explore photoexcitation dynamic with Resonant Inelastic X-ray Scattering (RIXS) close to the transfer limit of a monochromatic FEL source [2]. RIXS is powerfull tool for microscopic studies of condensed matter, because it reveals details on charge, spin, orbital and nuclear degrees of freedom. At FEL facilities photoexcitation dynamics and novel transient states can be explored [3-6]. Initial studies were suffering from limitations due to low signal levels.

The high-repetition rate of the European XFEL, together with the unique properties of the SCS instrument, provide the ideal conditions to host a high-resolution RIXS instrument [1,2,6,7]. The mechanical design of the hRIXS spectrometer enables studies in the photon range from 400 eV up to 1500 eV and variation of the scattering angle. First results demonstrate the high stability of the instrument and feasibility of time-resolved RIXS down to 100 fs in time resolution and up to 10,000 in energy resolving power. SCS and hRIXS offer sample environment for two large user communities, one with focus on quantum materials (e.g. high-temperature superconductors) and one with focus on chemical systems/ liquid jets (e.g. photoactive catalysts). The instrument has been in regular user operation since 2022-II.

References
1. T. Tschentscher et al., Appl. Sci. 7, 592 (2017).
2. J. Schlappa at al., arXiv:2403,08461 (2023).
3. P. Wernet et al., Nature 520, 78 (2015).
4. M. P. M. Dean at al., Nature materials 15 601 (2016).
5. M. Mitrano et al., Science advances 5, eaax3346 (2019).
6. E. Paris et al., NPJ Quantum materials 6:51 (2021).
7. N. Gerasimova at al., J. Synchrotron Radiat. 29, 1299 (2022).
8. https://www.xfel.eu/facility/instruments/scs/index_eng.html

I plan to submit also conference proceedings

No

Primary authors: SCHLAPPA, Justine (Eur.XFEL (European XFEL)); VAN KUIKEN, Benjamin (Eur.XFEL (European XFEL)); PARCHENKO, Sergii (Eur.XFEL (European XFEL)); TEICHMANN, Martin (European XFEL); DELITZ, Jan Torben (Eur.XFEL (European XFEL)); GERASIMOVA, Natalia (Eur.XFEL (European XFEL)); Prof. YIN, Zhong

(Eur.XFEL (European XFEL)); MIEDEMA, Piter (Eur.XFEL (European XFEL)); MERCURIO, Giuseppe (Eur.XFEL (European XFEL)); MOLODTSOV, Serguei (Eur.XFEL (European XFEL)); MERCADIER, Laurent (European XFEL); CARLEY, Robert (Eur.XFEL (European XFEL)); BROERS, Carsten (xfel gmbh); ADRIANO, Luigi (Eur.XFEL (European XFEL)); STUPAR, Marijan (Eur.XFEL (European XFEL)); BARANASIC, Bernard (Eur.XFEL (European XFEL)); HICKIN, David (Eur.XFEL (European XFEL)); GESSLER, Patrick (Eur.XFEL (European XFEL)); IZQUIERDO, Manuel (Eur.XFEL (European XFEL)); HOANG, Le Phuong (Eur.XFEL (European XFEL)); GHODRATI, Nahid (Eur.XFEL (European XFEL)); REICH, Alexander (Eur.XFEL (European XFEL)); SCHERZ, Andreas (Eur.XFEL (European XFEL)); PENG, Yingying (Politecnico di Milano); MERZONI, Giacomo (Politecnico di Milano, European XFEL); MARTINELLI, Leonardo (Politecnico di Milano); GHIRINGHELLI, Giacomo (Politecnico di Milano); SENF, Friedmar (Helmholtz Zentrum Berlin); SIEWERT, Frank (Helmholtz Zentrum Berlin); GWALT, Grzegorz (Helmholtz-Zentrum Berlin); BÜCHNER, Robby (Universität Potsdam); ECKERT, Sebastian (Helmholtz-Zentrum Berlin); LIU, Chun-Yu (Helmholtzzentrum Berlin); Dr VAZ DA CRUZ, Vinicius (Helmholtz-Zentrum Berlin); WENIGER, Christian (Helmholtz-Zentrum-Berlin); PIETZSCH, Annette (Helmholtz-Zentrum Berlin); NEPPL, Stefan (Universität Potsdam); FÖHLISCH, Alexander (Helmholtz-Zentrum Berlin); HUOTARI, Simo (University of Helsinki); SREEKANTAN NAIR LALITHAMBIKA, Sreeju (FS-SCS (Strukturdynamik Chemischer Systeme)); REUSS, Torben (FS-SCS (Strukturdynamik Chemischer Systeme)); TECHERT, Simone (FS-SCS (Strukturdynamik Chemischer Systeme)); LAARMANN, Tim (FS-PS (FS-PS Fachgruppe FCP))

Presenter: SCHLAPPA, Justine (Eur.XFEL (European XFEL))

Session Classification: Mikrosymposium MS 12/1: Time Resolved Techniques

Track Classification: 12. Time resolved techniques