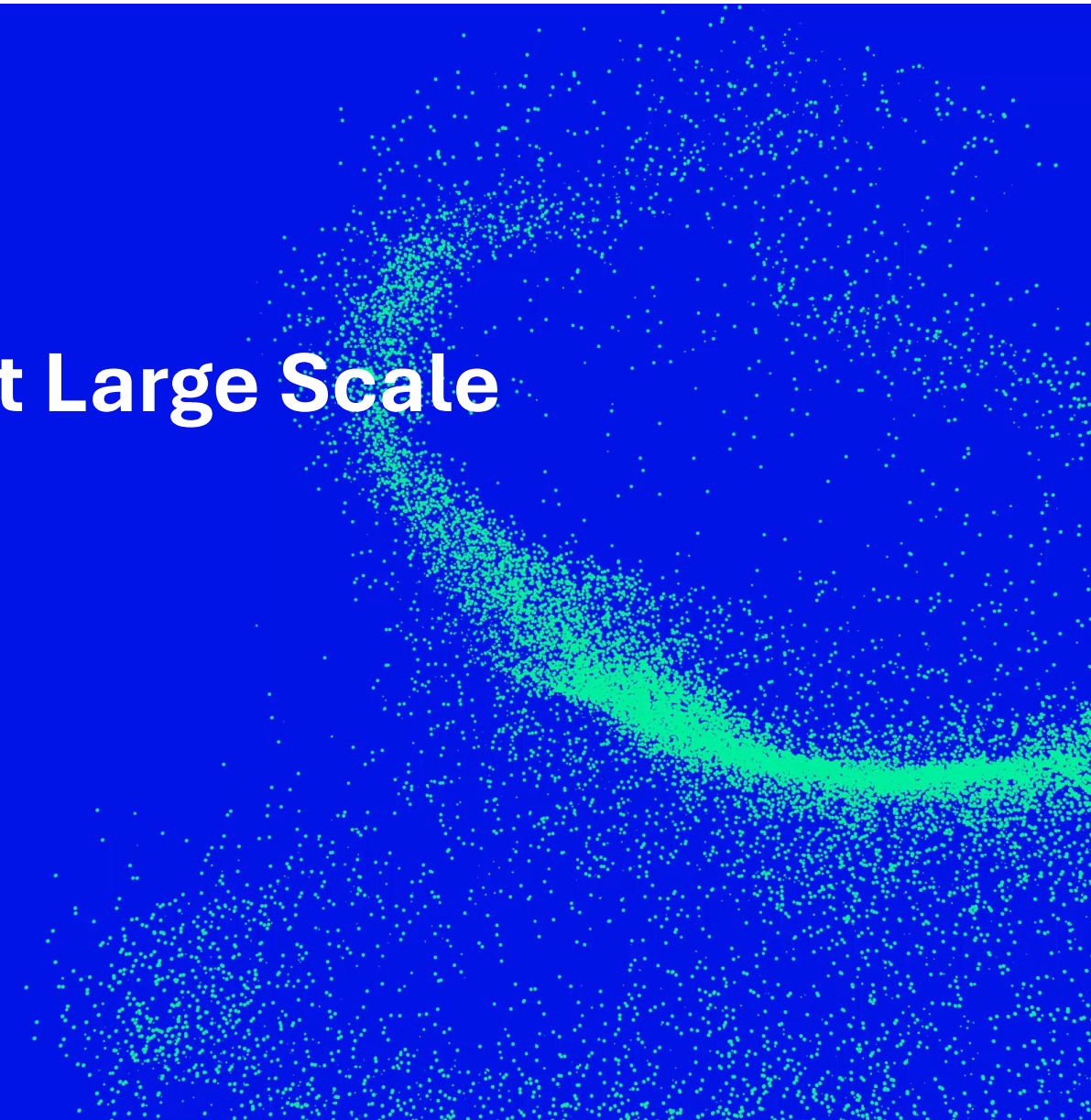


PSI Center for
Photon Science

Materials Science at Large Scale Facilities

Introduction

Steven Van Petegem
EPFL course MSE-435



Introduction

Paul Scherrer Institute: Structure and mechanics of advanced materials (SMAM)

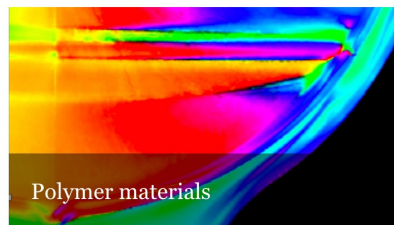
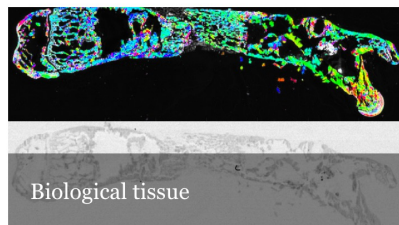
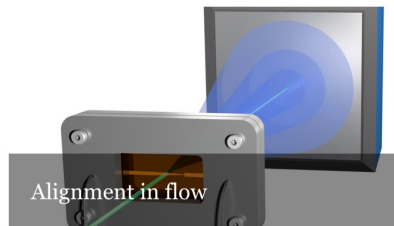
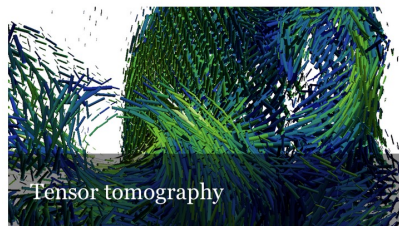
EPFL: Laboratory for the X-ray characterization of Materials (camX)

Prof. Marianne Liebi (marianne.liebi@epfl.ch)

- X-ray Scattering and Scanning Imaging
- Soft and bio materials
- *in situ*: microfluidic devices and in-situ 3D printing for ink-based soft materials

Dr. Steven Van Petegem (steven.vanpetegem@epfl.ch)

- X-ray & Neutron Diffraction and Imaging
- Metals & alloys
- *in situ*: mechanical testing & laser powder bed fusion device for 3D printing of metals



Teaching Assistant



Dominique Olivier
Windisch
dominique.windisch@epfl.ch

Bachelor: Health Sciences and Technology (ETH Zürich)

Masters: Health Sciences and Technology with major in Medical Technology (ETH Zürich), focusing on biomedical imaging and image analysis, biomechanics and tissue engineering.

MS thesis: *In vitro* tumor-targeting validation of magnetically enhanced *E. coli* (ETH Zürich)

PhD: Multi-scale characterization of mineralized biological tissue using small-angle X-ray scattering tensor tomography and complementary imaging modalities (birefringence microscopy, micro-CT) (at EPFL and PSI since 2025)

Goal of the course

- This course provides a broad introduction into materials research using synchrotron X-rays and neutrons.
- The exercises will include the writing of a beamtime proposal for one specific material system.
- What can we learn about materials from a broad range of methods at large-scale facilities?
- Which scientific or engineering questions can be answered using large scale facilities?
- Interaction of X-rays/Neutrons with Matter
- About large scale facilities
 - synchrotron, XFEL, neutron sources
 - Beamlines & Detectors
- Scattering
 - Diffraction
 - Small-Angle Scattering
 - Magnetic Scattering
- Spectroscopy
 - Fluorescence spectroscopy
 - X-ray Absorption Near-edge Structure
 - Extended X-ray Absorption Fine Structure
 - Photo emission spectroscopy
- Imaging and Tomography
 - X-ray absorption and phase contrast Imaging
 - Neutron Imaging
 - Coherent imaging

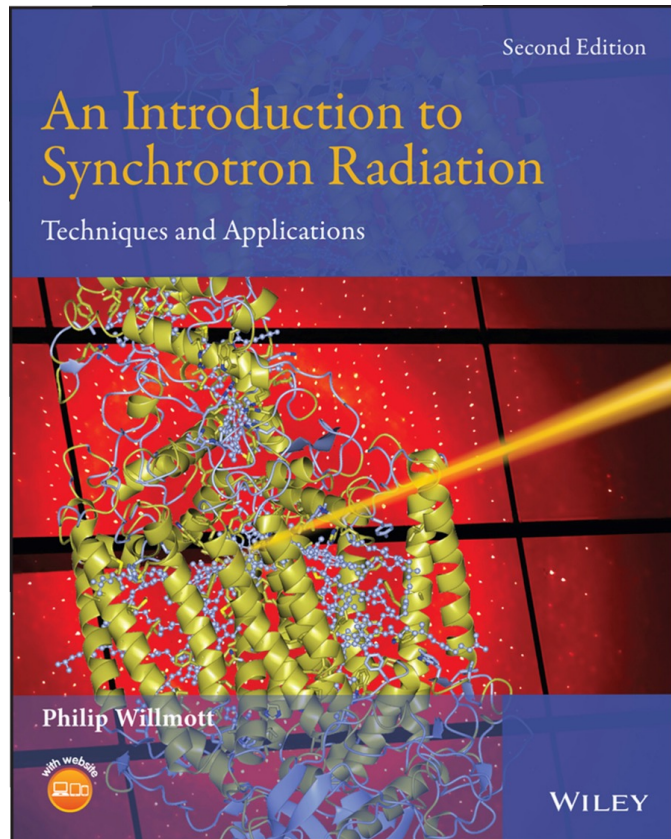
Not part of this course

- The detailed physical and mathematical description of all the methods
- No exhaustive list of methods at large scale facilities
- The basics of data analysis of selected methods will be touched on, but no details or full analysis methods
- “Material Science rather than condensed matter physics”

Course program

Month	Week	Day	Course content	Lecturer
September	37	8	Introduction, sources, beamlines, detectors	Steven Van Petegem
	38	15	Excursion to PSI	Marianne Liebi
	39	22	Holiday	
	40	29	Interaction with matter	Steven Van Petegem
October	41	6	Fluorescence	Marianne Liebi
	42	13	X-ray absorption spectroscopy	Marianne Liebi
	43	20	Break	
	44	27	Diffraction I	Steven Van Petegem
November	45	3	Small angle scattering	Marianne Liebi
	46	10	Diffraction II	Steven Van Petegem
	47	17	Phase contrast / Tomography	Steven Van Petegem
	48	24	Coherent imaging	Marianne Liebi
December	49	1	Neutron imaging	Steven Van Petegem
	50	8	PEEM / Magnetic scattering	Steven Van Petegem
	51	15	Case study presentations	Steven Van Petegem / Marianne Liebi

Literature

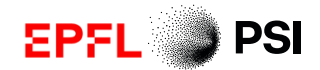


[Link to publisher](#)



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Excursion to PSI - September 15



09:50 Meeting at the West entrance (Bus stop Villigen, PSI West)

10:00 Introduction and overview of PSI

10:45 Tour at Swiss Spallation Neutron Source

11:45 Lunch in Restaurant Park Innovaare

13:00 Tour Swiss Light Source

14:00 Tour at SwissFEL

15:00 End of visit

Please sign up in Moodle until September 11th at 12.00

Tickets need to be bought individually and will be reimbursed after

24 hours in a synchrotron



24 hours in a synchrotron

https://www.youtube.com/watch?v=UsJ1j4_1Di0