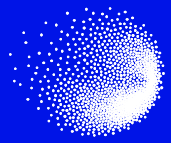


PSI Center for Photon Science

Materials Science at Large Scale Facilities

Introduction

Steven Van Petegem
EPFL course MSE-435

Introduction

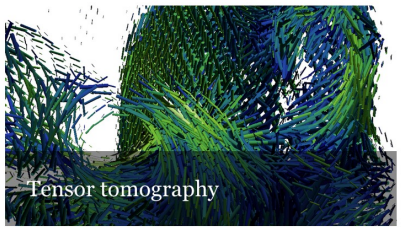
Paul Scherrer Insitute: Structure and mechanics of advanced materials (SMAM)
EPFL: Laboratory for the X-ray charaterization of Materials (camX)

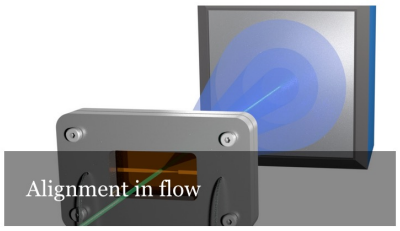
Prof. Marianne Liebi (marianne.liebi@epfl.ch)

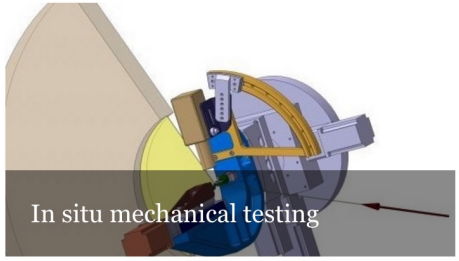
- X-ray Scattering and Scanning Imaging
- Soft and bio materials
- *in situ*: microfluidic devices and in-situ 3D printing for ink-based soft materials

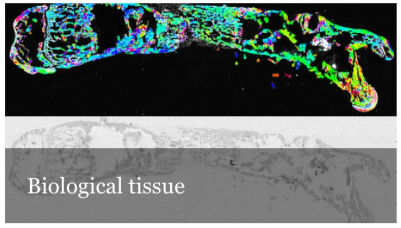
Dr. Steven Van Petegem (steven.vanpetegem@epfl.ch)

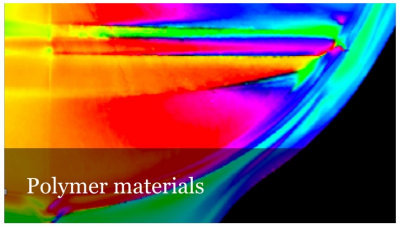
- X-ray & Neutron Diffraction and Imaging
- Metals & alloys
- *in situ*: mechanical testing & laser powder bed fusion device for 3D printing of metals











Teaching Assistants

Atreyee Acharya
atreyee.acharya@psi.ch

Bachelor: Mechanical engineering

Masters: Nanoscience and nanotechnology with specialization in nanobiotechnology (KULeuven, Belgium and Université Grenoble Alpes, France jointly).

MS thesis: Covalently conjugating carbon nanotubes and carbon nanodots (CIC BiomaGUNE, Spain)

PhD: Characterisation of various fibrotic tissues using X-ray scattering techniques, birefringence microscopy, X-ray fluorescence and other methods (PSI, since 2022)

Goal of the course

- This course provides a broad introduction into materials research using synchrotron X-rays and neutrons.
- The exercies 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, muon
  - 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

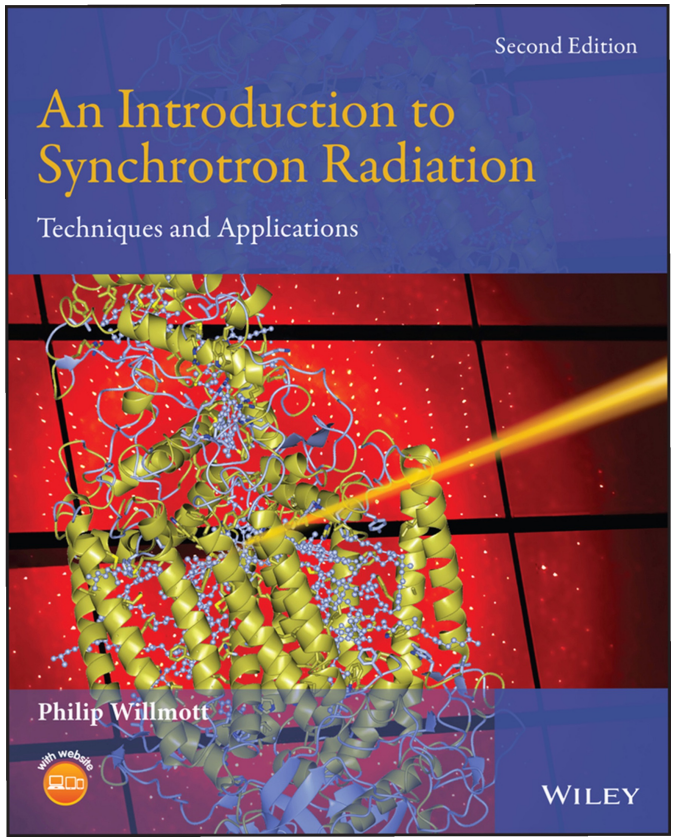
Not part of this course

- 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”

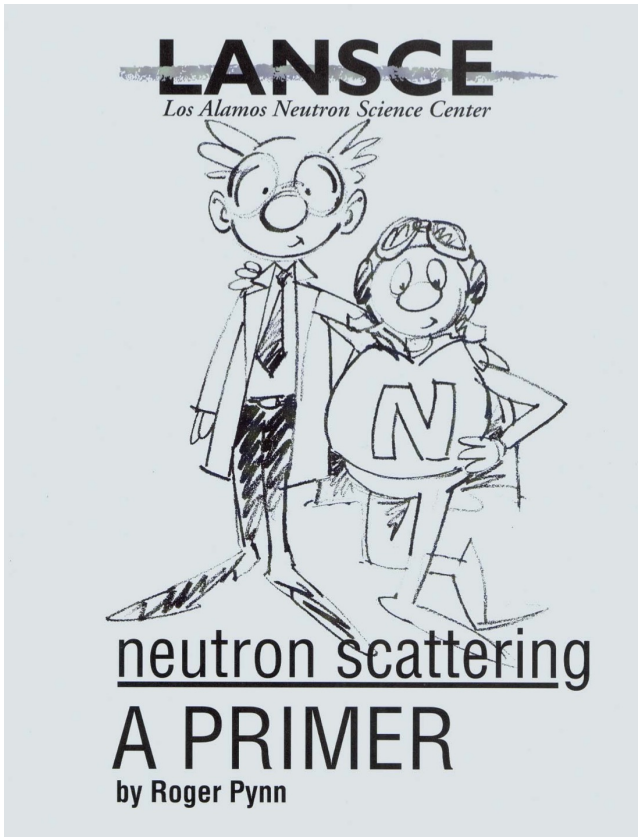
Course program

Month	Week	Day	Course content	Lecturer
September	37	9	Introduction, sources, beamlines, detectors	Steven Van Petegem
	38	16	Holiday	
	39	23	Excursion to PSI	Steven Van Petegem / Marianne Liebi
	40	30	Interaction with matter	Steven Van Petegem
October	41	7	Fluorescence	Marianne Liebi
	42	14	Diffraction I	Steven Van Petegem
	43	21	Break	
	44	28	Small angle x-ray scattering	Marianne Liebi
November	45	4	Diffraction II / Magnetic scattering	Steven Van Petegem
	46	11	XANES/EXAFS	Marianne Liebi
	47	18	Phase contrast / Tomography	Steven Van Petegem
	48	25	Coherent imaging	Marianne Liebi
December	49	2	Neutron imaging	Steven Van Petegem
	50	9	PEEM/Muon	Steven Van Petegem
	51	16	Case study presentations	Steven Van Petegem

Literature



https://www.wiley.com/en-us/An+Introduction+to+Synchrotron+Radiation%3A+Techniques+and+Applications%2C+2nd+Edition-p-9781119280392



https://www.ncnr.nist.gov/summerschool/ss16/pdf/NeutronScatteringPrimer.pdf

Excursion to PSI - September 23

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 Showroom Proton therapy
12:15 Lunch in Restaurant Park Innovaare
13:30 Tour Swiss Light Source
14:30 Transfer to PSI East
14:45 Tour at SwissFEL
15:45 End of visit
16:04 Bus nach Brugg

Please sign up in Moodle until September 16th at 10.00!
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