SWEDNESS/LINXS DOCTORAL COURSE ON NEUTRON IMAGING

LUND INSTITUTE OF ADVANCED NEUTRON AND X-RAY SCIENCE LINXS

LUND INSTITUTE OF ADVANCED NEUTRON AND X-RAY SCIENCE

LINXS

www.linxs.se

LINXS Mission & Goals

ESTABLISH

LINXS as a world leading advanced study institute for all scientific and technological disciplines which can benefit from the use of neutrons and x-rays.

ATTRACT

outstanding scientists for short-term focused research visits to contribute to excellent science. The goal is to further research collaboration within national and international research networks, especially for early career researchers.

PROMOTE

science and education focusing on use of neutrons and x-rays in research and development, and help educate potential users of ESS, MAX IV and other major research infrastructures to enable ground-breaking research.

CREATE

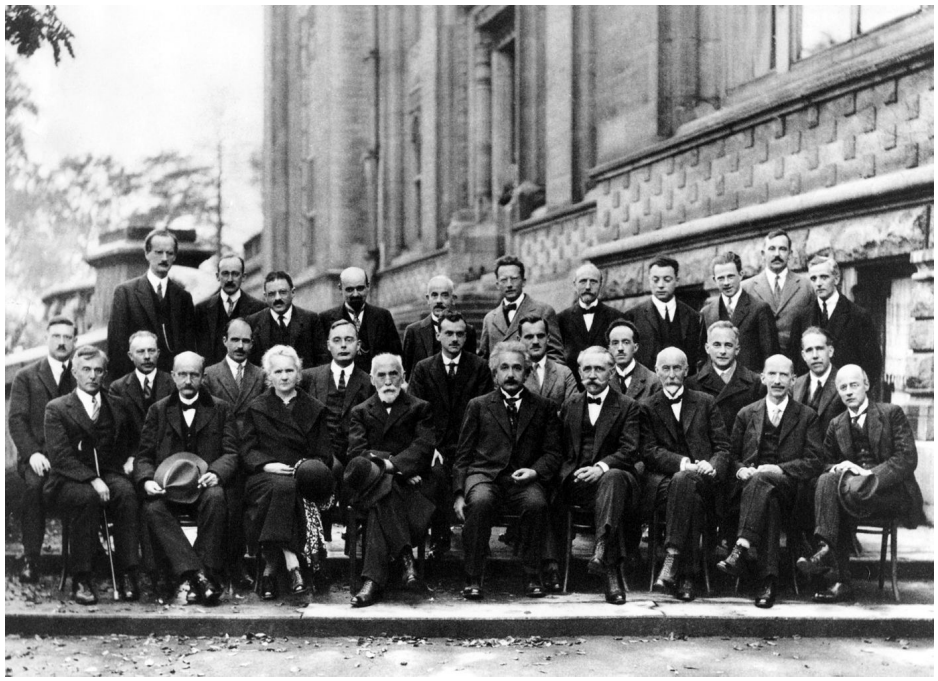
international networks and enhance the visibility of Sweden internationally in the use of neutrons and x-rays. We want to invigorate the dialogue between academia and society in all aspects of large-scale research infrastructures using neutron and x-rays. The goal is to become a nucleus for local, national and international activities in Science Village Scandinavia and a think-tank initiating new ideas and themes.

LINXS:

AN ADVANCED STUDY INSTITUTE

- advance science through new trans-disciplinary synapses.
- advance research by involving theoreticians and modellers in discussions with experimentalists.
- advance cutting-edge research questions by bringing leading researchers together and providing space, time and freedom to discuss.
- advance and widen science by involving groups not yet involved in research with neutrons and x-rays,
- advance communities through education of both new and experienced researchers

Bringing the right people together!



Fifth Solvay Conference, Brussels, 1927

(image: Wikipedia)

SWEDNESS/LINXS Doctoral Course on Neutron Imaging

Lecturers / Organisers

Stephen Hall
Division of Solid Mechanics,
Lund University,
LINXS (director),
SWEDNESS Local Study Director
(Lund)

Robin Woracek
ESS

Anders Kaestner
PSI
(Switzerland)

Nikolay Kardjilov
HZB
(Germany)

SWEDNESS/LINXS Doctoral Course on Neutron Imaging

- To introduce different neutron imaging modalities
  - Build awareness of different possibilities with neutron imaging
  - To provide the theoretical background to the methods
- To demonstrate the use of neutron imaging in research through real examples
- To provide the opportunity to discuss with experts in the field and with fellow researchers
- To enable effective use of neutron imaging in research
  - identification of the best methods
  - understand the strengths of different facilities
  - understand the importance of data analysis
- Gain insight into the future possibilities in neutron imaging

SWEDNESS/LINXS Doctoral Course on Neutron Imaging

Course assessment

- 3 ECTS
- Summary notes for each topic (3-4 pages, with references and examples)
  - Foundations of neutron imaging
  - Neutron Tomography (including ”extreme” and dual modality methods)
  - Energy-selective methods
  - Scattering-contrast methods
  - **Submit 18/06/21 to stephen.hall@solid.lth.se**
- Image analysis challenges
- Beamtime proposal (group work and individual follow up)

SWEDNESS/LINXS Doctoral Course on Neutron Imaging

Group work
- Note rearranged groups!

Group 1
Axel Henningsson
Yuzhu Fan
Karthikeyan Thalavai Pandian

Group 2
Sara Johansson
Jinshan Pan
Asim Siddique

Group 3
Emanuel Larsson
Yueer Li
Lisa Larsson

Group 4
Fernando Vieira Lima
Nitesh Raj Jaladurgam
Ahmet Bahadir Yildiz

Group 5
Edvin Tobias Bokvist Wrammerfors
Rodrigo Sanchez Pires
Linda Squillaci

SWEDNESS/LINXS Doctoral Course on Neutron Imaging

https://indico.linxs.lu.se/event/220/

SWEDNESS/LINXS Doctoral-level course on neutron imaging

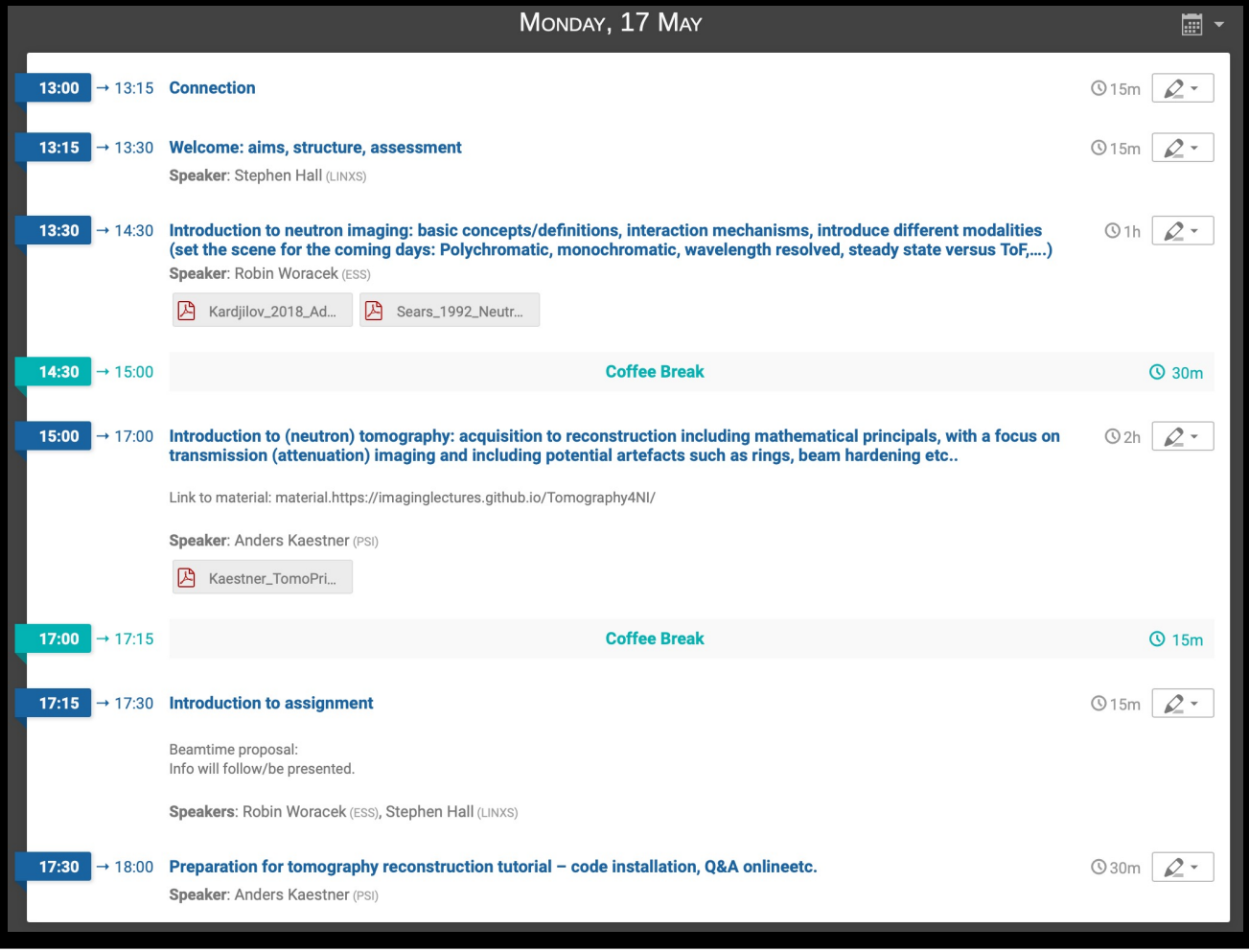
17 May 2021, 10:00 → 21 May 2021, 15:00 Europe/Stockholm

All lectures and practicals will be carried out via zoom

- Please keep you microphones off during the lecures
- During the lectures, feel free to ask questions in the chat
- Or turn on your microphone to ask during breaks

Group work: we will have “break out rooms” open during the scheduled lecture sessions (including coffee breaks), but outside of these times you should organise between yourselves to meet/discuss via e-mail and you own zoom sessions)

SWEDNESS/LINXS Doctoral Course on Neutron Imaging



Monday, 17 May

13:00 → 13:15 **Connection** — 15m

13:15 → 13:30 **Welcome: aims, structure, assessment** — 15m

Speaker: Stephen Hall (LINXS)

13:30 → 14:30 **Introduction to neutron imaging: basic concepts/definitions, interaction mechanisms, introduce different modalities (set the scene for the coming days: Polychromatic, monochromatic, wavelength resolved, steady state versus ToF,....)** — 1h

Speaker: Robin Woracek (ESS)

Kardjilov_2018_Ad... Sears_1992_Neutr...

14:30 → 15:00 **Coffee Break** — 30m

15:00 → 17:00 **Introduction to (neutron) tomography: acquisition to reconstruction including mathematical principals, with a focus on transmission (attenuation) imaging and including potential artefacts such as rings, beam hardening etc..** — 2h

Link to material: material.https://imaginglectures.github.io/Tomography4NI/

Speaker: Anders Kaestner (PSI)

Kaestner_TomoPri...

17:00 → 17:15 **Coffee Break** — 15m

17:15 → 17:30 **Introduction to assignment** — 15m

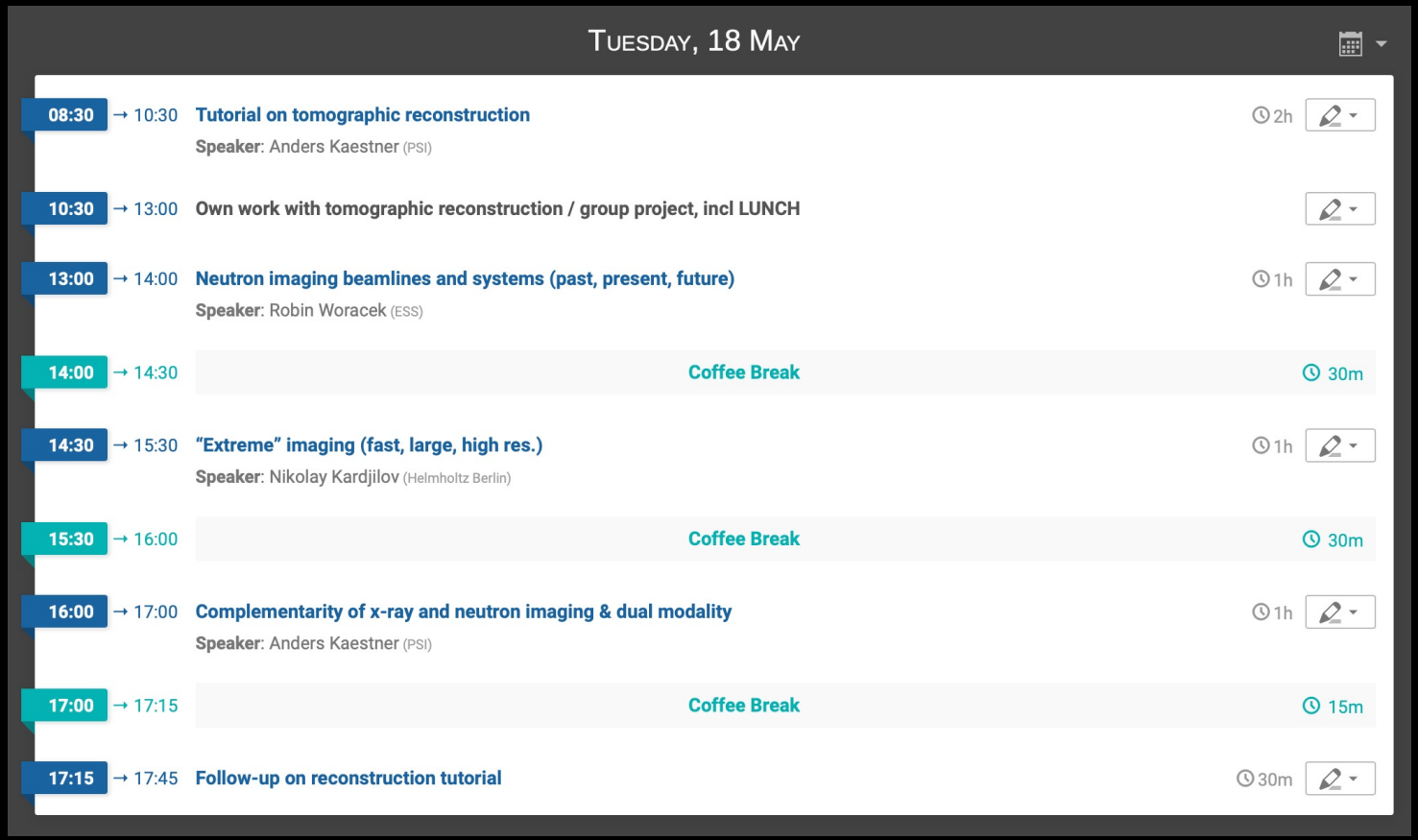
Beamtime proposal:
Info will follow/be presented.

Speakers: Robin Woracek (ESS), Stephen Hall (LINXS)

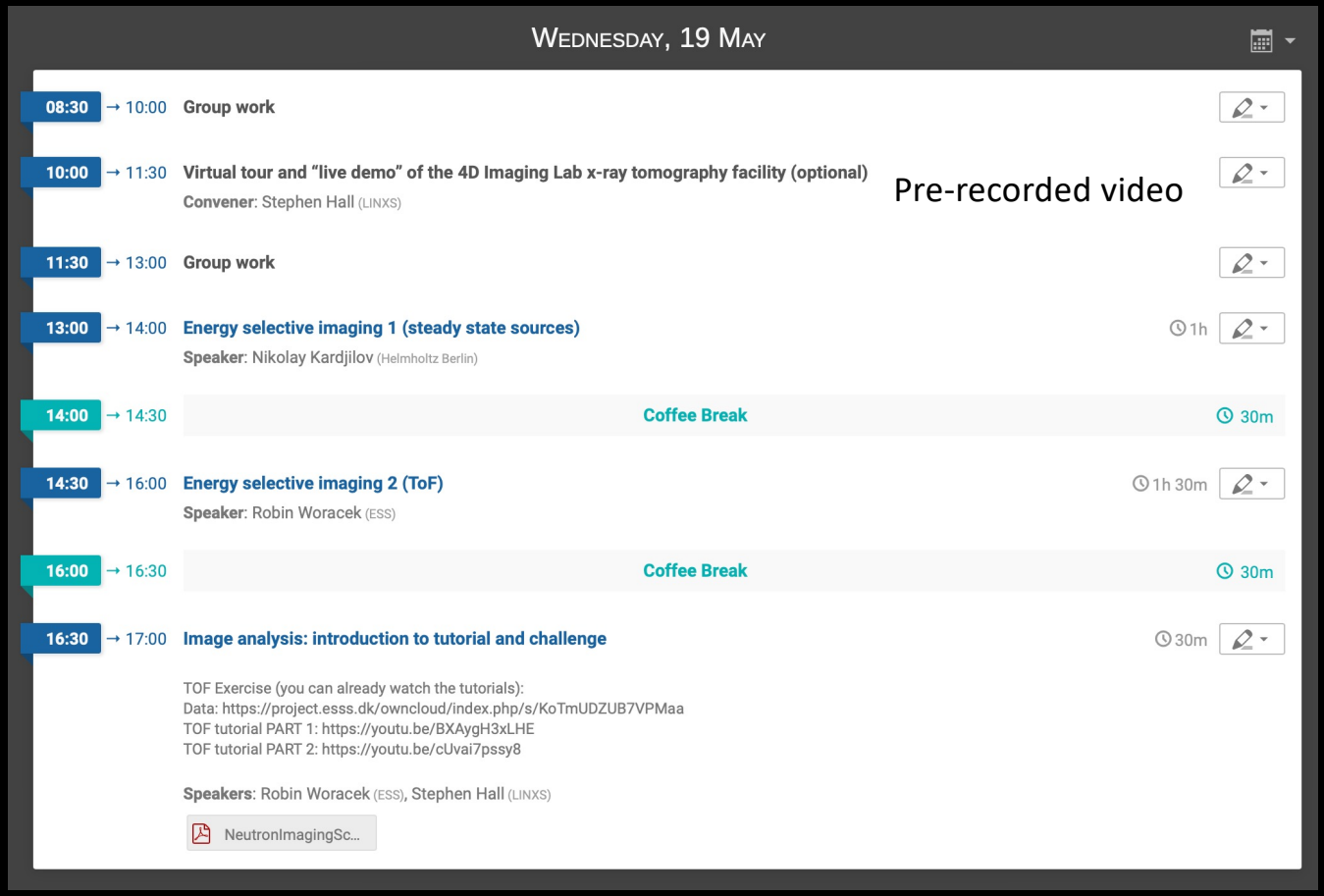
17:30 → 18:00 **Preparation for tomography reconstruction tutorial – code installation, Q&A onlineetc.** — 30m

Speaker: Anders Kaestner (PSI)

SWEDNESS/LINXS Doctoral Course on Neutron Imaging



SWEDNESS/LINXS Doctoral Course on Neutron Imaging



Wednesday, 19 May

08:30 → 10:00 **Group work**

10:00 → 11:30 **Virtual tour and "live demo" of the 4D Imaging Lab x-ray tomography facility (optional)**
Convener: Stephen Hall (LINXS)

Pre-recorded video

11:30 → 13:00 **Group work**

13:00 → 14:00 **Energy selective imaging 1 (steady state sources)** 1h
Speaker: Nikolay Kardjilov (Helmholtz Berlin)

14:00 → 14:30 **Coffee Break** 30m

14:30 → 16:00 **Energy selective imaging 2 (ToF)** 1h 30m
Speaker: Robin Woracek (ESS)

16:00 → 16:30 **Coffee Break** 30m

16:30 → 17:00 **Image analysis: introduction to tutorial and challenge** 30m

TOF Exercise (you can already watch the tutorials):
Data: https://project.esss.dk/owncloud/index.php/s/KoTmUDZUB7VPMaa
TOF tutorial PART 1: https://youtu.be/BXAygH3xLHE
TOF tutorial PART 2: https://youtu.be/cUvai7pssy8

Speakers: Robin Woracek (ESS), Stephen Hall (LINXS)

NeutronImagingSc...

SWEDNESS/LINXS Doctoral Course on Neutron Imaging

Thursday, 20 May

09:00 → 13:00	**Own work with image analysis / group project**	
13:00 → 14:30	**Scattering and magnetic contrast: Phase contrast, grating interferometry, SEMSANS, polarized imaging** **Speaker**: Nikolay Kardjilov (Helmholtz Berlin)	1h 30m
14:30 → 15:00	**Coffee Break**	30m
15:00 → 16:30	**Neutron tomography application examples from archeology and food to battery processes and strain evolution in metals** **Speakers**: Robin Woracek (ESS), Stephen Hall (LINXS)	1h 30m
16:30 → 17:00	**Coffee Break**	30m
17:00 → 17:30	**Follow-up on image analysis tutorial**	30m

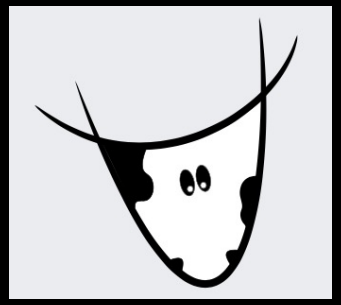
Friday, 21 May

09:00 → 13:00	**Group work**	
13:00 → 14:15	**Project presentations** **Speakers**: Robin Woracek (ESS), Stephen Hall (LINXS)	1h 15m
14:15 → 15:00	**Summary and wrap-up** **Speaker**: Stephen Hall (LINXS)	45m

SWEDNESS/LINXS Doctoral Course on Neutron Imaging

- Fiji /ImageJ

https://fiji.sc



- muhrec from Anders Kaestner at PSI: https://github.com/neutronimaging/imagingsuite/wiki/User-manuals-MuhRec-FirstRecon (and test data: http://dx.doi.org/10.17632/g5snr785xy.2)

- Matlab will also be needed for the image analysis part