

# SWEDNESS/LINXS DOCTORAL COURSE ON NEUTRON IMAGING

Stephen Hall

*Division of Solid Mechanics, Lund University, Sweden*

*LINXS, Lund University, Sweden*

*SWEDNESS Local Study Director (Lund)*



LUND INSTITUTE OF ADVANCED  
NEUTRON AND X-RAY SCIENCE

LINXS



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[www.linxs.se](http://www.linxs.se)

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LUND INSTITUTE OF ADVANCED  
NEUTRON AND X-RAY SCIENCE

LINXS

LINXS - an advanced study  
institute focused on neutron  
and x-ray based sciences

- Setting the stage for optimal  
use of ESS and MAX IV

We are dedicated to becoming the nucleus for national and international scientific activities in Science Village Scandinavia situated between MAX IV and ESS.

The LINXS project will develop a national competence centre, research networking hub and think tank for the education of future generations of neutron source and synchrotron users.

The institute will rely on a stream of highly motivated world-leading scientists who are invited for short-term focused topical research visits in the spirit of a Kavli institute.



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NEUTRON AND X-RAY SCIENCE

The future research facility landscape in Lund



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## LUND INSTITUTE OF ADVANCED NEUTRON AND X-RAY SCIENCE



2017 – 10/2018:  
Central Lund - Gamla Kirurgen



11/2018 - 2022:  
Ideon delta 5  
Visitor offices, meeting rooms,  
large seminar room

SCIENCE  
VILLAGE  
SCANDINAVIA



## LUND INSTITUTE OF ADVANCED NEUTRON AND X-RAY SCIENCE

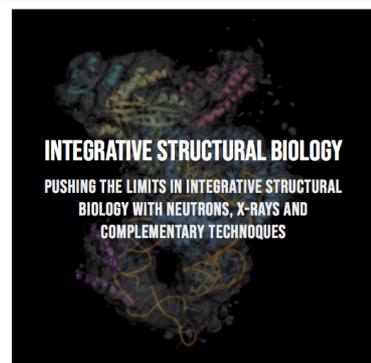
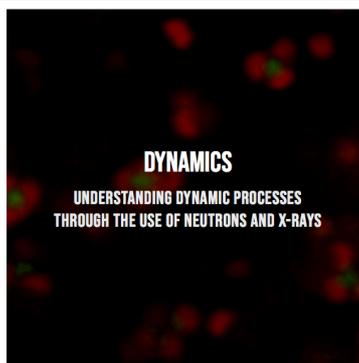
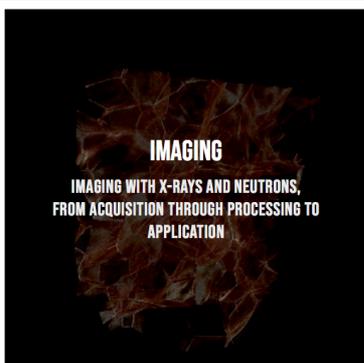
Long-term:  
Science Village Scandinavia  
40-80 Desks, Lounge,  
Meeting rooms



## LUND INSTITUTE OF ADVANCED NEUTRON AND X-RAY SCIENCE

Current THEME areas:

- Imaging
- Dynamics
- Integrative Structural Biology



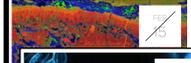


# LUND INSTITUTE OF ADVANCED NEUTRON AND X-RAY SCIENCE

## Previous events:



**Imaging thematic symposium**  
Mon, Dec 18, 2017, 12:00 – Tue, Dec 19, 2017, 15:00  
Lund Institute of Advanced Neutron and X-ray Science



**X-ray Fluorescence imaging - how to plan and execute the perfect**



**Workshop - Dynamics of biological macromolecules**

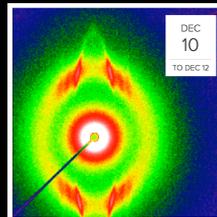


**Satellite Meeting - The Future of Chemistry with MAX IV and ESS**



**Workshop - Dynamics of membranes and their constituents**  
Wed, Sep 12, 2018, 12:00 – Fri, Sep 14, 2018, 13:00  
LINXS Workshop - Dynamics of Membranes and their constituents. With this Dynamics workshop, our goal is to bring together leading experts in the field of membrane dynamics, with a particular focus on neutrons and X-rays, but also complementary techniques including NMR, single molecule spectroscopy and computer modeling.

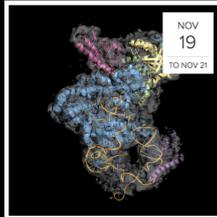
## Upcoming events:



### Workshop - Scattering and Dynamics of Flowing Soft Material

Mon, Dec 10, 2018, 12:00 – Wed, Dec 12, 2018, 13:00  
Elite Hotel Ideon (map)

The Lund Institute of Advanced Neutron and X-ray Science (LINXS) is organizing its first thematic workshop titled Scattering and Dynamics of Flowing Soft Material. The goal is to bring together leading experts in the field of flows of soft materials, with a particular focus on neutrons and X-rays, but also complementary techniques including NMR, confocal microscopy, theory and computer modeling.



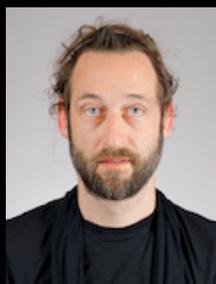
### First symposium - Integrative Structural Biology

Mon, Nov 19, 2018, 12:00 – Wed, Nov 21, 2018, 12:00

The first symposium, which is the kick-off event for the new LINXS theme, will focus on advanced, cutting-edge research in the fields of macromolecular crystallography, Cryo-EM, small angle scattering, electron diffraction, mass-spectroscopy, NMR, and use of XFELs etc. The target group is primarily from academia but also from several large-scale facilities (MAX IV, ESS, etc) and industry.

- Joint SWEDNESS/LINXS Doctoral course on Neutron Imaging
- *QuantIm* 3D image analysis Hackathon
- ...

## Lecturers / Organisers



Markus Strobl  
PSI



Anders Kaestner  
PSI



Nikolay Kardjilov  
HZB



Robin Woracek  
ESS



Stephen Hall  
Lund U.



Erika Tudisco  
Lund U.

## Course aims

- 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

## Course assessment

- 3 ECTS
- Summary notes for each topic
  - Neutron Tomography
  - Scattering-contrast methods
  - Energy-selective methods
  - Polarised neutron imaging
- Beamtime proposal

<https://indico.linxs.lu.se/event/62/>

## SWEDNESS/LINXS Doctoral Course on Neutron Imaging

 1 Oct 2018, 10:00 → 4 Oct 2018, 17:00 Europe/Stockholm

 Puffendorf Institute Lund

 Stephen Hall (LINXS)

Stephen Hall  [stephen.hall@solid.lth.se](mailto:stephen.hall@solid.lth.se)

<https://indico.linxs.lu.se/event/62/>

### MONDAY, 1 OCTOBER

10:00 → 10:30	Arrival	 30m
10:30 → 11:00	<b>Welcome: aims, structure assessment</b> Speaker: Stephen Hall (LINXS)	 30m 
11:00 → 12:00	<b>Introduction to neutron imaging</b>  basic concepts/definitions, interaction mechanisms, introduce different modalities (set the scene for the coming days: Polychromatic, monochromatic, wavelength resolved, steady state versus ToF,...)  Speaker: Prof. Markus Strobl (PSI)	 1h 
12:00 → 13:00	Lunch	 1h
13:00 → 14:00	<b>Neutron imaging beamlines and systems (past, present, future)</b> Speaker: Prof. Markus Strobl (PSI)	 1h 
14:05 → 16:05	<b>Introduction to (neutron) tomography</b>  acquisition to reconstruction including mathematical principals, with a focus on transmission (attenuation) imaging and including potential artefacts such as rings, beam hardening etc..  Speaker: Dr. Anders Kaestner (PSI)	 2h 
16:15 → 17:00	<b>Introduction to tomography reconstruction tutorial</b>  - code installation, etc.  Speaker: Dr. Anders Kaestner (PSI)	 45m 

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MONDAY, 1 OCTOBER

10:00 → 10:30	Arrival	30m
10:30 → 11:00	<b>Welcome: aims, structure assessment</b> Speaker: Stephen Hall (LINXS)	30m
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12:00 → 13:00	Lunch	1h
13:00 → 14:00	<b>Neutron imaging beamlines and systems (past, present, future)</b> Speaker: P <b>MuhREC</b> <a href="https://github.com/neutronimaging/imagingsuite/releases">https://github.com/neutronimaging/imagingsuite/releases</a>	1h
14:05 → 16:05	<b>Introducti</b> acquisition   beam harde	
16:15 → 17:00	<b>Introduction to tomography reconstruction tutorial</b> - code installation, etc. Speaker: Dr. Anders Kaestner (PSI)	45m

<https://indico.linxs.lu.se/event/62/>

TUESDAY, 2 OCTOBER

09:00 → 10:30	<b>Tutorial on tomographic reconstruction part I</b> Speaker: Dr. Anders Kaestner (PSI)	1h 30m
10:30 → 11:00	Coffee	30m
11:00 → 12:00	<b>"Extreme" imaging (fast, large, high res.)</b> Speaker: Dr. Nikolay Kardjilov (HZB)	1h
12:00 → 13:00	Lunch	1h
13:00 → 14:30	<b>Scattering contrast: Phase contrast, grating interferometry, SESANS, 3DND...</b> Speaker: Prof. Markus Strobl (PSI)	1h 30m
14:30 → 15:00	Coffee	30m
15:00 → 16:30	<b>Energy selective imaging 1 (steady state sources)</b> Speaker: Dr. Nikolay Kardjilov (HZB)	1h 30m

<https://indico.linxs.lu.se/event/62/>

WEDNESDAY, 3 OCTOBER			
09:00 → 10:30	<b>Polarised neutron imaging</b> Speaker: Dr. Nikolay Kardjilov (HZB)	🕒 1h 30m	
10:30 → 11:00	Coffee	🕒 30m	
11:00 → 12:30	<b>Tutorial on tomographic reconstruction part II</b> Speaker: Dr. Anders Kaestner (PSI)	🕒 1h 30m	
12:30 → 13:30	Lunch	🕒 1h	
13:30 → 15:00	<b>Energy selective imaging 2 (ToF)</b> Speaker: Dr. Robin Woracek (ESS)	🕒 1h 30m	
15:00 → 15:30	Coffee	🕒 30m	
15:30 → 17:00	<b>2D, 3D and 4D image analysis</b> Speaker: Dr. Stephen Hall (LINXS)	🕒 1h 30m	

<https://indico.linxs.lu.se/event/62/>

THURSDAY, 4 OCTOBER			
09:00 → 10:00	<b>Complementarity of x-ray and neutron imaging &amp; dual modality</b> Speaker: Dr. Anders Kaestner (PSI)	🕒 1h	
10:00 → 10:30	Coffee	🕒 30m	
10:30 → 11:30	<b>Planning &amp; running a neutron imaging experiment</b> Speaker: Dr. Robin Woracek (ESS)  Proposal_template...	🕒 1h	
11:30 → 12:30	<b>2D, 3D and 4D image analysis: practical session</b> Speakers: Dr. Erika Tudisco (Lund University), Dr. Stephen Hall (LINXS)	🕒 1h	
12:30 → 13:30	Lunch	🕒 1h	
13:30 → 14:15	<b>Neutron imaging in material science</b> Speaker: Dr. Robin Woracek (ESS)	🕒 45m	
14:15 → 15:00	<b>Neutron imaging in mechanics</b> Speaker: Dr. Erika Tudisco (Lund University)	🕒 45m	

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THURSDAY, 4 OCTOBER

09:00	→ 10:00	<b>Complementarity of x-ray and neutron imaging &amp; dual modality</b>	1h
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11:30	→ 12:30	<b>2D, 3D and 4D image analysis: practical session</b>	1h
Speakers: Dr. Erika Tudisco (Lund University), Dr. Stephen Hall (LINXS)			
12:30	→ 13:30	Download beamtime proposal form:	1h
13:30	→ 14:15	<b>Neutron imaging in material science</b>	45m
Speaker: Dr. Robin Woracek (ESS)			
14:15	→ 15:00	<b>Neutron imaging in mechanics</b>	45m
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Speakers: Dr. Erika Tudisco (Lund University), Dr. Stephen Hall (LINXS)			
12:30	→ 13:30	Lunch	1h

1. Presentation on basics for planning an experiment and proposal writing
2. split into 3-4 groups
3. Each group will get the same number of proposals (but not their own) and read it. They should make quick evaluation with ratings. (35min)
4. Each group prepares a presentation with good and bad examples of the proposals they reviewed.
5. Each group presents
6. Based on feedback refine proposal and submit 1 week after course ends