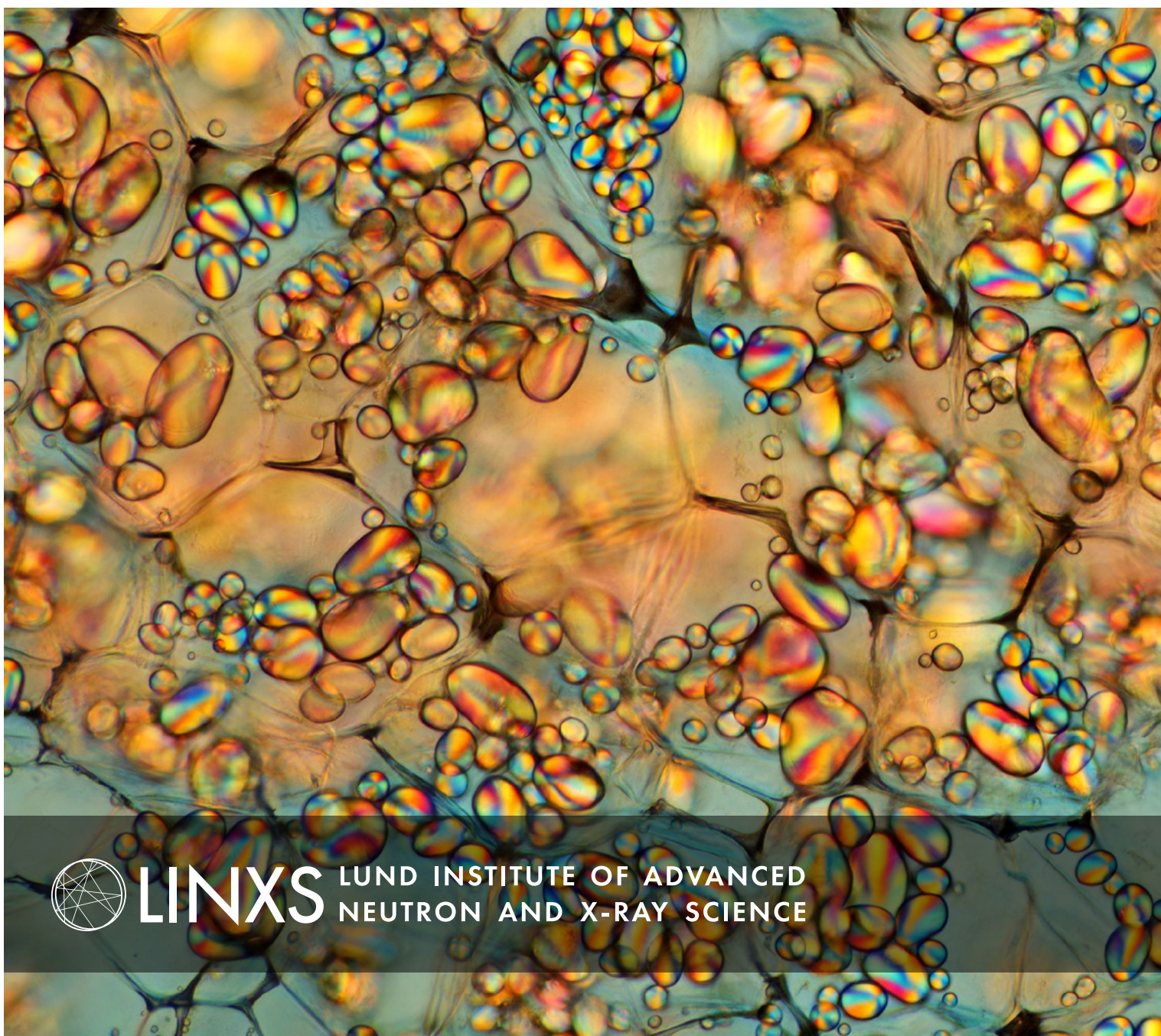


LINXS Annual Report 2021 Highlights



LINXS

LUND INSTITUTE OF ADVANCED
NEUTRON AND X-RAY SCIENCE

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Director's words

The continuation of the global pandemic meant that 2021 was again a year of mostly online activities. Nevertheless, we are very proud of the LINXS progress.

In the year the new theme "Integrative Pharmacology and Drug Discovery" was approved, focusing on pharmacology, going from structure-based drug design of both small molecules and macromolecular drugs to their interplay with tissue and its formulation, and macromolecular drugs such as antibodies. The initial 3 working groups active in the theme will explore the structure-function relationship of human drug target proteins and tissue both *in vitro*, *ex vivo*, and *in vivo*, utilizing X-rays and neutrons. The direction and topic of the theme was marked as a priority of the Scientific Advisory Board and has turned out to be very timely in the face of the pandemic, with the CSO of Pfizer part of the Core Group.

As the statistics show, the activities of LINXS were predominantly hybrid and online because of the continuing pandemic, and due to the shift in LINXS's strategy for achieving impact in the face of it. We were very pleased to host several schools, and continue with the very successful Webinar series "Co-Work" dedicated to the exploitation of the coherence properties of X-rays, and "Science at large scale research facilities" introducing the latest capabilities, scientific breakthroughs, and developments at large scale research facilities globally. We are seeing positive outcomes wider national collaborations as evidenced through national funding received by consortia connected to the Northern Lights on Food theme, as well as the GISANS initiative, which came out of the Dynamics theme.



Stephen Hall,
LINXS Director
2018–2021

A welcomed side effect of the pandemic has also been an accumulation of educational material, as LINXS undertakes to preserve talks and presentations and to act as a structured repository for such information. This repository grew significantly during the year to 120+ items – and is still growing rapidly. Going forward, LINXS will work to further improve accessibility and expand this information as a part of strategic efforts in providing educational tools to the research community.

Finally, on the 1st of December 2021 the new LINXS Director Trevor Forsyth started his position. This marked the end of a two-year strategic recruitment effort, unique in the history of Lund University, where two successive university leaderships and the faculties of Medicine, Science and Engineering, have all been instrumental in providing the basis. We are deeply grateful to all those involved for their unwavering vision and support.

Director's word – svensk sammanfattning

Den fortsatta globala pandemin innebär övervägande aktiviteter online 2021. Trots detta är vi väldigt stolta över LINXS utveckling. Det nya temat Integrative Pharmacology and Drug Discovery, IPDD godkändes. IPDD är fokuserat på farmakologi och de första tre arbetsgrupperna som är aktiva inom temat kommer att utforska struktur-funktionsförhållandet mellan humana läkemedelsmålproteiner och vävnad både *in vitro*, *ex vivo* och *in vivo*, med användning av röntgenstrålar och neutroner. Inriktningen och ämnet för temat har varit en prioritet för SAB och är mycket lägligt med tanke på pandemin, med Pzifers CSO som medlem i Core Group.

Vi kunde glädjas över värdskapet för flera skolor och fortsättningen av Co-work, den framgångsrika serien webinarier som avhandlar utnyttjandet av koherensgenskaperna hos röntgenstrålar, samt serien "Science at large scale research facilities" som introducerar de senaste funktionerna, vetenskapliga genombrott och utveckling vid

storskaliga forskningsanläggningar globalt. Vi ser positiva resultat av bredare nationella samarbeten, vilket exemplifieras av betydande nationell finansiering som tilldelas konsortier kopplade till temat Northern Lights on Food, samt GISANS-initiativet, som utvecklats inom temat Dynamics.

LINXS har åtagit sig att bevara föredrag och presentationer online och utgöra ett strukturerat arkiv av utbildningsmaterial online. Drygt 120 artiklar tillkom under året och som en del av strategiska ansträngningar för att tillhandahålla utbildningsverktyg till forskarsamhället kommer LINXS att ytterligare förbättra tillgängligheten.

I december 2021 välkomnade vi den nya LINXS-direktören Trevor Forsyth vilket innebär avslutet på en två-årig strategisk rekryteringsinsats. Vi är djupt tacksamma för alla inblandades orubbliga vision och stöd.

Stephen Hall, LINXS Director 2018–2021

Greetings from the new LINXS Director

I want to acknowledge the major effort that has gone into LINXS from Steve Hall over an extremely difficult period and to congratulate him on the amount of progress that he has made despite the obvious difficulties. The last three years of LINXS activity under Steve's Direction have shown that difficulties, however dire, can be turned to advantage and progress made even if not in the way planned. There is also a big tribute to be made to Peter Schurtenberger, the founding Director, who brought LINXS into existence, and without whom the opportunities we are seeking to exploit would not exist.

LINXS has a primary mission to provide a framework within which key thematic areas are identified and developed such as to exploit the major national and international infrastructures to which Sweden is committed. MAX-IV and ESS are of course massive investments for the country and it is essential that they are paralleled by investments in the scientific portfolios that will exploit them. I am deeply committed to a vision that further enhances the efforts of LINXS for the wider Swedish user community as well as deepening international interactions that will cultivate new scientific approaches and share/extend technological capability within the national infrastructures. A key aspect of this will be to broaden the composition of the LINXS theme membership and to add to the inclusiveness of the working model.



Trevor Forsyth, LINXS Director

It is an essential part of the LINXS mission to build up the engagement of younger scientists – PhD students, postdoctoral researchers, and new principal investigators – from centres throughout the country and also internationally, to broaden the impact and to develop the scientific user base. LINXS is committed to the provision and stimulation of this type of vibrant interdisciplinary environment, with themes developing towards funded initiatives and regular visits by high profile sciences within relevant areas. LINXS will end up positioned in Science Village (SV) at Brunnshög – and to my way of thinking as soon as possible!

Hälsningar från LINXS nya föreståndare

Jag vill ge en eloge till Steven Hall för det stora arbete som har utförts inom LINXS under en extremt svår period och gratulera honom till de framsteg som han har gjort trots de uppenbara svårigheterna. De senaste tre årens verksamhet under Stevens ledning har visat att svårigheter, hur svåra de än är, kan vändas till en fördel och framsteg kan göras även om det inte är på det sätt som planerats.

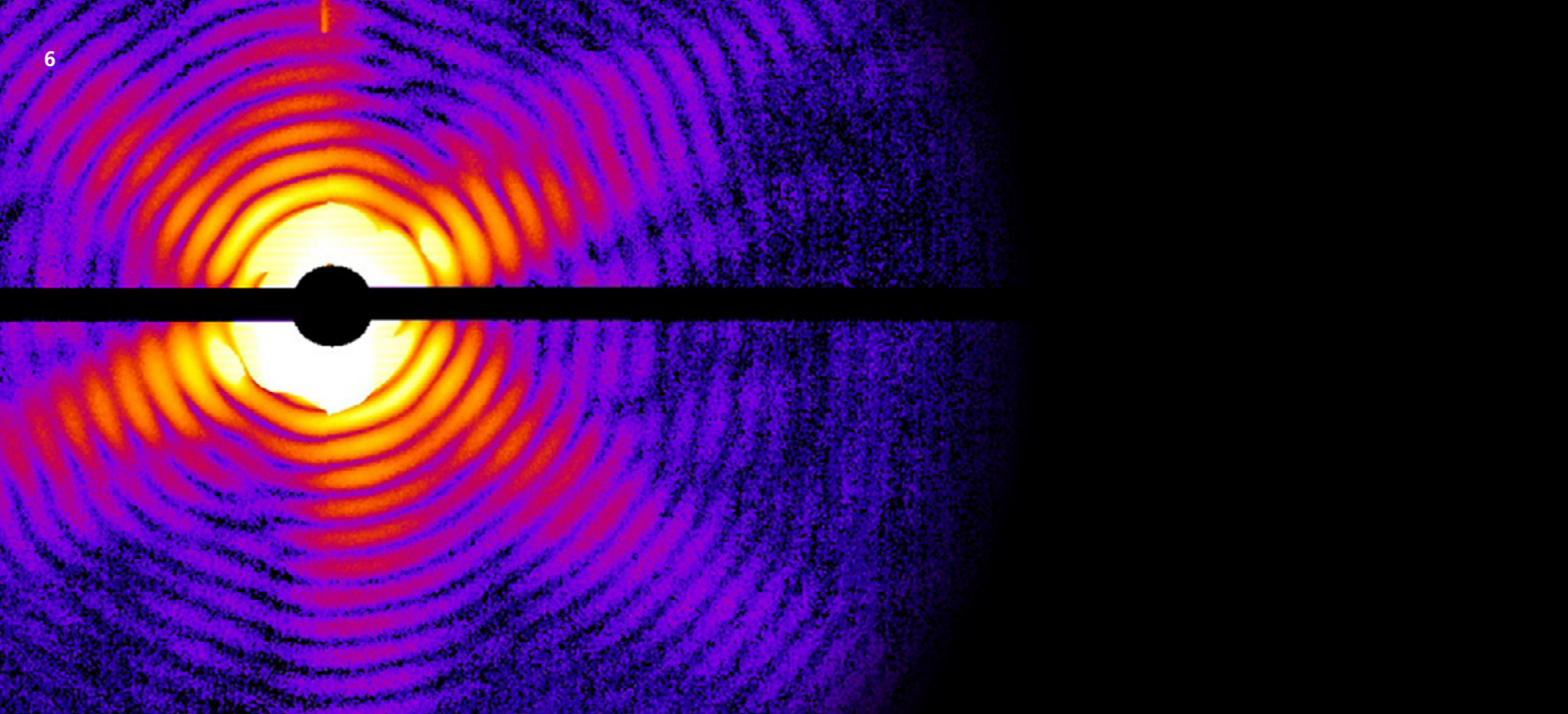
Jag vill också rikta en stor hyllning till Peter Schurtenberger, som grundade LINXS och skapade de möjligheter vi försöker utnyttja. LINXS har ett primärt uppdrag att tillhandahålla ett ramverk inom vilket viktiga tematiska områden identifieras och utvecklas, till exempel för att utnyttja de stora nationella och internationella infrastrukturer där har ett stort engagemang. MAX-IV och ESS är naturligtvis stora nationella investeringar för landet och det är viktigt att dessa möts med investeringar i vetenskapliga portföljer som kommer att utnyttja dem.

Jag är djupt engagerad i en vision som ytterligare ökar LINXS insatser för ett brett svenskt användardeltagande samt fördjupar internationella interaktioner för att skapa nya vetenskapliga tillvägagångssätt och utöka och dela

den tekniska förmågan inom den nationella infrastrukturen. En viktig aspekt av detta kommer att vara att bredda samsättningen av medlemskapet i LINXS-teman och öka delaktigheten i arbetsmodellen.

En viktig del av LINXS uppdrag är att bygga upp engagemanget hos yngre forskare – doktorander, postdoktorer och nya huvudforskare – från olika institutioner i hela landet och internationellt, för att bredda effekten och utveckla den vetenskapliga användarbasen. LINXS har åtagit sig att tillhandahålla och stimulera denna typ av levande tvärvetenskaplig miljö, med teman som utvecklas mot finansierade initiativ och regelbundna besök (både långa och korta) av högprofilerade forskare inom relevanta områden. LINXS kommer att flytta till Science Village (SV) i Brunnshög – och enligt mina resonemang så snart som möjligt!

Trevor Forsyth, LINXS Director



About LINXS

Established in 2017, LINXS is an advanced study institute whose mission is to advance science and education for all research fields that can benefit from the use of neutrons and X-rays. LINXS is dedicated to becoming a nucleus and think-tank for national and international scientific activities relating to research using neutrons and X-rays, both as a network and as a physical location providing an interaction

hub in close proximity to the large-scale research facilities MAX IV and ESS, in Lund, Sweden. LINXS brings together world-leading scientists for short-term focused research visits and creates international networks to be an international competence centre, research networking hub and focus-point for education of future generations of neutron and X-ray users.

LINXS mission

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.

Focus Areas

Soft Matter

Liquids, colloids, polymers, foams, gels, granular materials, liquid crystals, and a number of biological materials. These materials share an important common feature in that predominant physical behaviors occur at an energy scale comparable with room temperature thermal energy.

Life Science

Fields of science that involve the scientific study of living organisms – such as microorganisms, plants, animals, and human beings – as well as related considerations. While biology and medicine remains the centerpiece of the life sciences, technological advances in molecular biology and biotechnology have led to a burgeoning of specializations and interdisciplinary fields.

Hard Matter

Materials science and solid-state physics, the study of rigid matter, or solids, through methods such as quantum mechanics, crystallography, electromagnetism, and metallurgy. It is the largest branch of condensed matter physics. Solid-state physics studies how the large-scale properties of solid materials result from their atomic-scale properties. Thus, solid-state physics forms a theoretical basis of materials science. It also has direct applications, for example in the technology of transistors and semiconductors and all solid-state nanoscience.

Why join LINXS?

All researchers whose work can develop through the use of X-ray and neutron methods can benefit from being part of the LINXS community and participating in LINXS activities. LINXS is a place to explore new ideas and research questions, to discuss methods and approaches, as well as meet and collaborate with scientists from around the world and from different disciplines and organisations. There are many ways to interact with and join the LINXS community:

- Attend LINXS activities and participate in the scientific discussions.
- Join existing themes and working groups.
- Initiate new themes, working groups and research activities connected to the LINXS focus areas through collaboration.

As a member of a LINXS working group or theme, you get an opportunity to organise research activities connected to your area of interest, and to create new contacts and networks. LINXS offers administrative support to organise and run activities, disseminate information, and create a setting to highlight and discuss research developing and

exploiting X-ray and neutron methods, with an aim to further research collaboration within national and international research networks.

LINXS welcomes researchers from all disciplines and organisations worldwide to join the LINXS community.

“– It is important to host both technique-based graduate schools and more subject-based ones ..., to engage new users and seed an interest in X-rays and neutrons. Subject-based schools enable teachers and students to dig deeper into discussing which techniques are best suited to answer the specific scientific and experimental challenges of the subject areas. Such schools open discussions at an early stage in people’s career of what experiments might be best suited to their work and what analysis options are open to them.”

Stephen Hall, LINXS former Director

How LINXS works

Core group

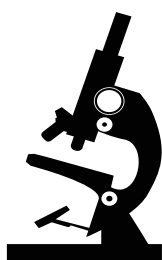
A theme is governed by a core group composed of prominent external and local researchers. One of the main missions of LINXS is to bring external excellence in to work with local and national researchers. A core group suggests to the management group how resources should be allocated for that theme.

Working group

Under the core group there are working groups working on specific activities. These range from conferences, workshops and schools to specific research programmes aided by external research fellows. Working groups are also formed via an application procedure, though this is shorter and more quickly evaluated than that for themes.

Activities

Each working group has a palette of budgeted activities to draw from that can be useful to its defined goals. The nominal budget enables planning of the scientific scope in relation to the total LINXS budget. The activities can be: conferences, research programmes, workshops, hackathons, sabbaticals, schools, seminars and training & outreach, for instance.



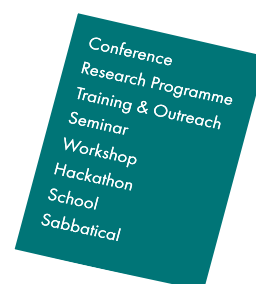
1. THEME



2. CORE GROUPS



3. WORKING GROUPS



4. ACTIVITIES

LINXS Themes and Working Groups 2021

Northern Lights on Food – NLF (Aug 2021 – Dec 2024)

WG 1 – Structure of Food Raw Materials

WG 2 – Food Colloids and Structured Interface

WG 3 – Structure of Food during Processing

WG 4 – Food Interactions on Surfaces

WG 5 – Food Structure and Health

New Materials (Sep 2020–Dec 2023)

WG 1 – Functional Magnetic Materials

WG 2 – Charge Transfer Materials

WG 3 – Light Harvesting Processes

WG 4 – Catalysis

WG 5 – Nanostructures and Interfaces

Integrative Structural Biology – ISB (Nov 2018–Dec 2021)

WG 1 – Biocompute and Artificial Intelligence & Machine Learning

WG 2 – Time-Resolved Structural Biology – New possibilities in a time of new facilities

WG 3 – Amyloid: An integrative approach

WG 4 – Membrane Proteins – Structural resolution and homology modelling

WG 5 – Lund Integrative Structural Biology Centre Initiative

Dynamics (Dec 2017–May 2021)

WG 1 – Dynamics and Structure of Biological Macromolecules

Research programme 1: Simulation, theory, and software development for anisotropic systems

Research programme 2: Antibodies in Solution

WG 2 – Characterizing soft matter with X-ray Photon Correlation Spectroscopy (XPCS)

WG 3 – Dynamics and Structure of Membranes and their Constituents

Research programme 1: Structure and dynamics utilizing the GISANS technique

Research programme 2: Sample environment and data evaluation of biological membranes

In 2021 LINXS fellows came from the following 51 organisations

Aarhus University, Denmark
 Alfa Laval Sweden
 Arwa Foodtech AB, Sweden
 Australian Synchrotron, Australia
 Centro de Física de Materiales (CSIC-UPV/EHU), Spain
 CFEL, Germany
 Chalmers University of Technology, Sweden
 CNRS, France
 Deutsches Elektronen-Synchrotron DESY, Germany
 Elettra – Sincrotrone Trieste SCpA, Italy
 European Molecular Biology Laboratory (EMBL) Hamburg, Germany
 European Spallation Source ESS AB, Sweden
 Forschungszentrum Juelich GmbH, Germany
 Fritz Haber Institute Berlin, Germany
 Georgetown University, USA
 Hamburg University, Germany
 Inria / CNRS, France
 Institut de Biologie Structurale – Grenoble, France
 Institut Laue Langevin (ILL), France
 ISIS Facility, STFC, United Kingdom
 Johnson Matthey Formox AB, Sweden
 Karolinska Institutet, Sweden
 KTH Royal Institute of Technology, Sweden
 La Trobe University, Australia
 Linköping University, Sweden
 Linnaeus University, Sweden
 Lund University, Sweden
 Malmö University, Sweden
 MAX IV, Sweden
 Northwestern University, USA
 Norwegian University of Science and Technology, Norway
 Novozymes, Lyngby, Denmark
 Oatley, Sweden
 Rensselaer Polytechnic University, USA
 Research institutes of Sweden (RISE), Sweden
 Sense Unlimited, Denmark
 Stockholm University, Sweden
 Swedish University of Agricultural Sciences (SLU), Sweden
 Tampere University, Finland
 Technical University Munich (TUM), Germany
 Technical University of Denmark (DTU), Denmark
 The “Abdus Salam” Int. Centre for Theoretical Physics, Italy
 Tetra Pak, Sweden
 University Düsseldorf, Germany
 Universität Regensburg, Germany
 University of Copenhagen, Denmark
 University of Florida, USA
 University of Gothenburg, Sweden
 University of Luxemburg
 University of Pavia/University College London, United Kingdom
 Uppsala University, Sweden

Northern Lights on Food theme

The Northern Lights on Food (NLF) theme was started with the aim to bring together expertise in food science and technology together with experts in characterization methods using neutrons and X-rays to generate new knowledge and cutting-edge technology within food science. The potential to advance food science by taking full advantage of the research tools provided by ESS and MAX IV is explored and promoted.

Before the NLF theme was established, a WG was established within the Imaging theme and a second Northern Lights on Food Workshop was arranged June 9–11 2021 as a fully digital event with financial support from FORMAS. The workshop was opened by the Vice Chancellor of Lund University, Professor Erik Renström and attracted 125 participants.

Apart from the scientific talks, funding opportunities for advanced food research were presented by Sisse Marquina-Jonberg – Novo Nordisk Foundation, Denmark and Maria Öhman – Vinnova, Sweden. The workshop also featured a panel debate on the future of food research and how to utilize the infrastructures Max IV and ESS. The panel consisted of Elisabet Nielsen (Vinnova), Johanna van Schaik Dernfalk (Formas), Carina Knorpp (Näringsdepartementet), Rickard Öste (Aventure/Oatly), and Tommy Nylander (LU-LINXS) and was moderated by Pia Kinhult, ESS, Sweden.

The activities within the NLF LINXS theme were kicked off with an inspirational symposium for new theme Northern Lights on Food on October 22, 2021. Presentations was given by Prof. Brent S. Murray, The University of Leeds, UK, Dr. Camille Loupiac, University of Burgundy, UB- AgroSup Dijon, France and Dr. Fabrice Cousin, Laboratoire Léon Brillouin, Université Paris-Saclay, France. The symposium attracted about 50 participants.

A 2nd Northern Lights on Food Masterclass was held 15–19 Nov 2021 and was arranged as a hybrid event. The Masterclass was funded by a FORMAS grant and attracted 15 attendees. The theme of the course was imaging and included hands-on experience at Stephen Hall's tomography lab at Lund University.

The 5 Working Groups started the activities during the autumn 2021:

WG 1 – Structure of Food Raw Materials: Focus on the relationship between the structures of raw materials and process conditions. (Nick Sirijovski, Oatly; Maud Langton, SLU; Francesco Vilaplana, KTH)

WG 2 – Food Colloids: Focus on the colloidal and interfacial phenomena to build up the complex food matrix. (Ben Boyd, Copenhagen Uni; Jacob Kirkensgaard, Copenhagen Uni)

WG 3 – Structure of Food during Processing: (Stephen Hall, LU; Niklas Lorén, RISE)

WG 4 – Food Interactions on Surfaces: Focus on the interface between food and processing surfaces, attachments of microorganisms, as well as food and packaging materials. (Tommy Nylander, LU; Jenny Schelin, LU; Martin Adell, Tetra Pak)

WG 5 – Food and health: (Peter Spéjel, LU; Greg Smith, ISIS; Anna Ström, Chalmers)

Funding obtained for Northern Lights on Food Activities in 2021:

- Northern Lights on Food – knowledge and innovation for a green transition in the food sector. (Grant ID: 20307448, Swedish Agency for Economic and Regional Growth, EU European Regional Development Fund and Skåne Region)
- European Food Laboratory (EuFL) – Case study. (The research and innovation council of Skåne (FIRS))
- Strengthen food sector research and innovation by enabling use of neutron and synchrotron techniques. (2021-04909, Vinnova)





The Northern Lights on Food Conference II highlights the need for a food network for scientists

The conference, held in June 2021, brought together researchers from academia and industry with the aim to establish a food network that will enable researchers to take full advantage of the new tools provided by large scale research infrastructures such as the ESS and MAX IV in Lund, Sweden. It was organised by the Food Science and Technology working group at LINXS.

A close to 140 participants, as well as keynote speakers and panelists, gathered for the online event, which took place over three days. It was opened by introductory remarks from the Lund University vice-chancellor, Prof. Erik Renström. In this interview, some of the keynote speakers and participants, share their reflections on the conference – which is a follow up activity on the successful Northern Lights on Food workshop in 2019.

– The great science, collegial nature of the participants, and the many future potential intersections really highlighted the timeliness and need for a food network for researchers. This was not so much a surprise but a great validation of the concept we are trying to establish, says keynote speaker, Benjamin Boyd, professor at Monash University, Australia, and recently commenced a Novo Nordisk Laureate Research Fellowship at the University of Copenhagen. He is also core member of the new Northern Lights on Food theme at LINXS.

– Especially bringing together such a great array of scientists across the food and scattering communities was brilliant: the speakers and also the attendance list was really a who's who from the Oresund region and beyond, so I was very impressed.

Mario Martinez-Martinez, tenure-track assistant professor at Aarhus University (Denmark) with a focus on carbohydrates, participated in the conference:

– The scientific rigor of the talks was at the highest level, covering the entire spectrum of structuring food macromolecules. I really enjoyed the talks. One interesting observation

is that many of the researchers work on systems that might be too pure to resemble reality. This can represent a limitation that we need to be aware of going forward.

Research frontiers in food

When asked what Benjamin Boyd sees as research frontiers in food science, he responds:

– I think it is fair to say, that in the past, a large part of the food science spectrum has been too empirical. As approaches to study the structure in food systems are developed and matured, these new levels of understanding of how structure dictates performance will enable true engineering of foods that are not only optimal from a composition perspective, but where structure is a much more important design feature.

– I also believe that understanding the interplay between structure and interactions with gut biology will be crucial for understanding the positive and negative impact of food, and X-ray and neutron scattering techniques are at the appropriate length scales to make a huge impact in this regard.

Mario Martinez-Martinez adds that, as a society and food scientists, we are now in an exciting time for science, since finding the crossover between nutrition and sustainability will dictate the most important aspects of food production and consumption.

– As an example, having livestock as the primary source of protein globally, considering the growing population, could be argued to potentially result in serious consequences for global protein security in the near future. But it is difficult to engineer those palatable and indulgent structures with the complex and diverse biopolymeric plant tissues.

He continues:

– Likewise, fighting chronic diseases, such as type-2 diabetes, obesity and cancer, through strategies empha-

sising individual willpower and personal responsibility is not enough unfortunately. Developing structured carbohydrate foods with the right dietary fibre and associated metabolites will become paramount, whose engineering principles would have to be built on clear structure-function relationships.

Mario Martinez-Martinez believes that the successful re-integration of fruit and vegetable waste is a good example of a strategy to move forward, yet the structuring and colloidal properties of such by-products needs to be understood at different length and processing scales.

– Because maintaining health is not only about reaching for that apple in the basket. We need indulgent foods that are more nutritious, healthy and sustainable.

Next steps

Going forward, Benjamin Boyd would like to see the development of a joint roadmap produced by both industry and academics.

– It would be great if we could get industry and academics together to develop a roadmap of what problems are unsolved, what areas are underdeveloped, and where the intersections are to develop new techniques/experimental formats to answer those questions. For me, this is clearly the next step, and the working groups within the coming theme Northern Lights on Food are in a good position to focus on these objectives.

It will also be key to start meeting in person, and not only online, he emphasises.

– Getting people together in person and not virtually is crucial. It is also very important to provide industry with a very clear picture of how scattering science can help them to solve problems – in a language understood by industrial scientists.

Mario Martinez-Martinez agrees that all the sectors that have an interest in food should be brought together with a clear understanding of their strengths and weaknesses.

– On the one hand, we have the small companies that are agile enough to materialise new ideas. Then we have the large companies, that have money and a scientific workforce, but whose size-derived inertia could halt new ideas to see the light.

– Above all, big and small companies, together with academics and policy makers, should jointly prioritise human and environmental health moving forward, he concludes.

The working group Food Science and Technology was formed under the Imaging theme but has now progressed

and formed a new theme at LINXS, Northern Lights on Food. The theme will start in August 2021 and run for three years. One long-term goal is, thanks to the collaboration established through LINXS activities, to establish an interdisciplinary European Food Laboratory next to Max IV, ESS and the future location of LINXS at Brunnshög. These aspects were discussed in a panel debate at the conference, moderated by Pia Kinhult.

– To meet the need to transform the food systems we have to establish inclusive, efficient, sustainable, nutritious and healthy food systems capable of achieving the SDGs. The Northern Light on Food initiative is making one vital effort to make this happen by increasing the awareness in the research community of new and advanced techniques and also building bridges between academia and industry. Innovation in technologies, policies and new institutions will be critical. I am looking forward to the European Food Laboratory taking on this role in the future.



Benjamin Boyd, professor at Monash University, Australia, and the University of Copenhagen.



Mario Martinez-Martinez, Tenure-track assistant professor at Aarhus University.

New Materials theme

The New Materials for Energy and Sustainability theme aims to push forward the development and characterization of new materials with potential future applications in the fields of energy and sustainability, bringing together X-ray and neutron experts with material development experts.

Five working groups were defined at the start of the theme, focusing on different types of material. Each group has now more clearly defined the spheres they are interested in, and some groups have focused on using LINXS to tackle community problems, whereas others have focused on education activities, or building networks. Although the year has presented challenges, primarily due to the pandemic, the different groups have trialled different approaches and have met many of their goals. Two grant applications to the Röntgen-Ångström Cluster programme were submitted, growing from partnerships developed within the working groups. Unfortunately, both proposals were rejected, but the collaborations are still growing.

A variety of different activities have been held throughout 2021 within the theme, along with several jointly organized activities. Each of the working groups has adopted a different approach, targeting different areas and audiences. A brief description of each working group's approach and progress will now be given.

Functional Magnetic Materials

Throughout 2021, the working group met regularly. The initial focus was on combining micromagnetic simulations with scattering data (specifically neutron scattering data). This resulted in a clear statement of the importance of being able to link well-tested simulations to neutron scattering results, and that the end-goal should be that this becomes a normal, easy-to-use method of analysing relevant neu-

tron data. Next steps were outlined, and work is moving forward by those interested to achieve this.

The working group has subsequently been exploring other areas, for example the issue of considering inelastic scattering specifically in the small momentum transfer regime, as well as examining the situation with relation to studies of magnetic materials at MAX IV. As a part of this, the working group organized a session at the MAX IV User Meeting looking at the broader field of quantum materials.

Charge Transfer Materials and Light Harvesting Processes

Over the course of 2021, it became clear that these two working groups were very closely linked, and this has been formalized by merging the two groups. This working group pioneered innovative ways of building collaborations, by means of a weekly open LINXS meeting run through Microsoft Teams, that has led to several joint beamtime proposals, grant applications, and an LCLS campaign proposal.

An in-person school for 24 people specializing on X-ray absorption spectroscopy (including EXAFS and XANES) was organized by the working group, including experimental time provided by Balder at MAX IV, and proved to be very popular with the students. The group plans to continue running this school annually, and also to introduce a more advanced workshop for practitioners in the field.

Catalysis

The catalysis working group ran a series of webinars in the first half of the year, culminating in an in-person meeting in October, bringing together speakers from all over Europe. The group has also worked with the Charge Transfer

Materials working group to discuss sample environment requirements where they overlap, together with representatives from MAX IV and ESS. A prototype flow cell has been constructed and will be tested in the coming year. One area in which the group is planning to develop in 2022 is in trying to establish greater contact between the current group and researchers using neutron scattering to address catalytic questions.

Nanostructures and Interfaces

This working group has been building up a network of collaborations and is developing some joint projects with other working groups, particularly with Catalysis. A LINXS workshop on X-ray phase imaging was held in December 2021. Looking forward, the group plans to liaise more closely with the other working groups and outside partners at ESS.

XAS School provides practical and useful skills – will be repeated annually

In the first week of November 2021, an intensive hands-on crash course in the planning, performance and evaluation of X-ray absorption spectroscopy was conducted. Inspired by the success of a long running course, the course team, headed by Jens Uhlig, Lector at Lund University at Chemical Physics, modernised the approach and in close collaboration with MAX IV, developed a new concept.

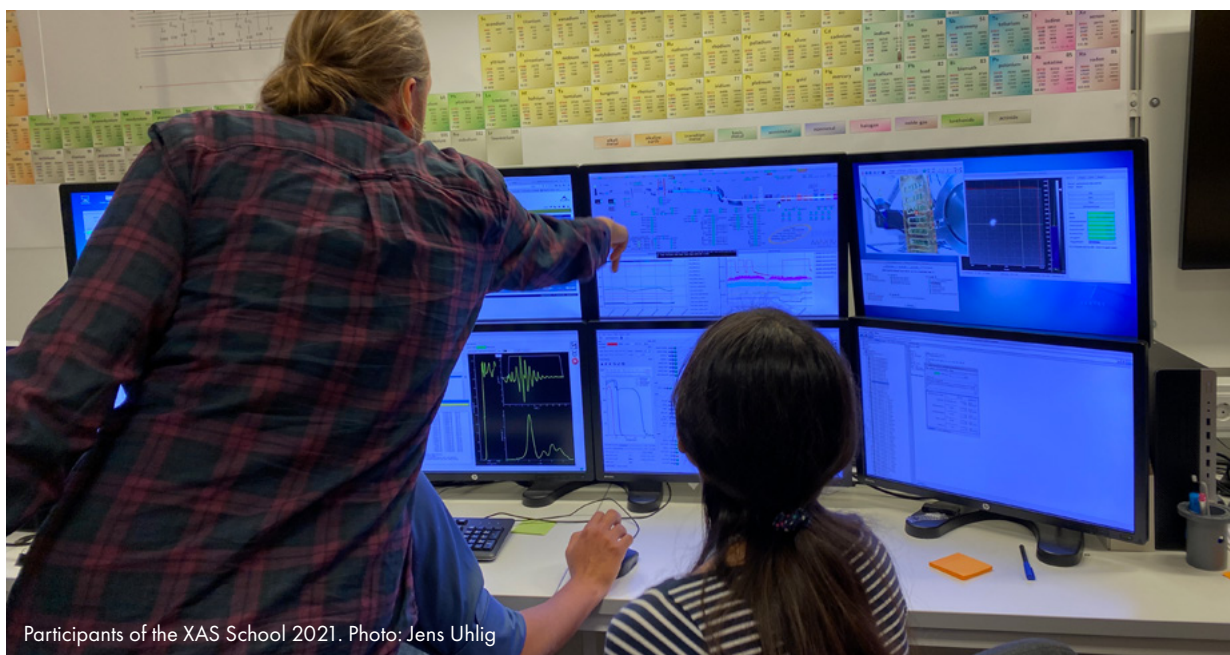
The design consisted of one third part lectures, another third on data analysis and the last third part on practical work, including sample preparation and a mini beamtime. The course was given by teachers from Lund university, Malmö university and MAX IV, and received great interest from the very beginning.

Limited by practical aspects, much less than 50 percent of the applications could be accepted to this first round. 20 participants could join and based on an anonymous course evaluation the participants were very happy with both the concept and this year's course and are looking forward to using their newfound skills in future work.

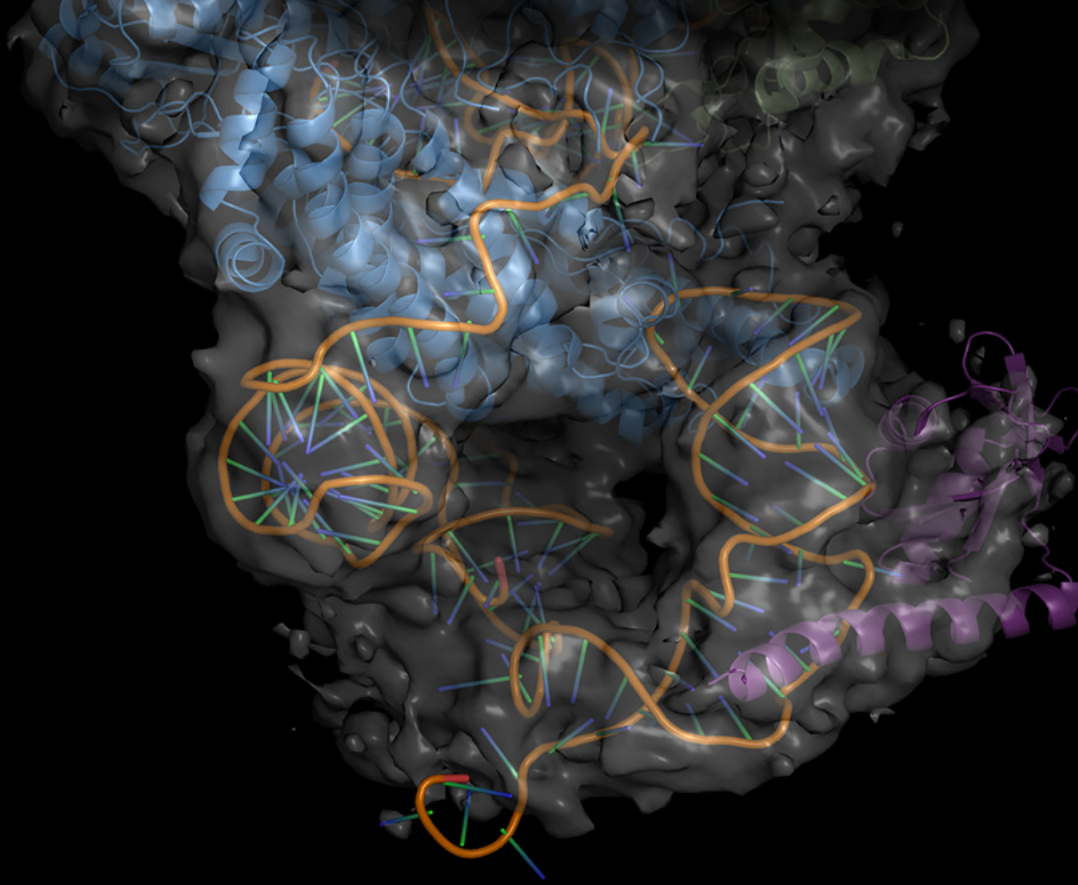
Jens Uhlig,
New Materials Core Group
Member, LINXS Fellow
Associate professor
Chemical Physics, Lund
University.



"Through such intensive and practical training session we are forming a new generation of scientists that can propose and perform better experiments at our facilities. This course will be repeated annually and will form the first of multiple training opportunities provided to national and international researchers by scientists under the egis of LINXS", says Jens Uhlig.



Participants of the XAS School 2021. Photo: Jens Uhlig



Integrative Structural Biology (ISB) theme

2021 was a year of many positive developments for the Integrative Structural Biology theme, and also the last year for the theme at LINXS. Unfortunately, the big show-stopper – the COVID-19 pandemic, was still affecting the activities. After two very successful ISB symposia in 2018 and 2019, the ISB core group had already before the pandemic decided to not have a symposium in 2021. Instead, the final symposium will take place the 4–6th of May in 2022. Despite the pandemic, ISB has managed several successful events.

During 2021, the Membrane Protein working group has had two successful workshops, the first one was focusing on protein expression and sample quality control, and the second focused on sample preparation for structural biology and structure determination by different methods such as X-ray crystallography, neutron crystallography and single-particle cryo-EM. Both workshops were held online with roughly 100 participants from all over the world.

Like the rest of the ISB theme activities, the activities of the amyloid working group have suffered badly from the pandemic. Thus, a meeting aiming to highlight and promote the application of SAXS (MAX IV) and SANS (ESS) for the characterization of amyloid systems was cancelled due to travel restrictions. However, a workshop focused on “User-friendly analysis of spectroscopy data with Quasar – multivariate statistics and machine learning” which occurred in May 2020 resulted in a follow up workshop on the 13–15 January 2021.

This activity was based on a collaboration between the French Soleil light source, MAX IV and Lund University Faculty of Medicine. A meeting entitled “Heart and Mind”, focusing on the cardiomyopathy and neuropathy in relation to amyloidogenesis will be held on 5 March 2022. In addition, as a follow up event, a further meeting of the “Heart and Mind” workshop will be held 16–17 June, 2022.

Members of the amyloid group have also been involved in outreach activities, delivering seminars and teaching. For example, Dr Oxana Klementieva, a senior lecturer at LU medical faculty and LINXS Co-Director, delivered a lecture at SciLifeLab entitled “How to become a Life Science researcher that uses synchrotron light and neutron applications” in September, and has also been involved in a PhD course on “MAX IV/ESS-based imaging for medical and biomedical research”.

The time-resolved working group has had working group meetings during 2021 focusing on a follow-up to the successful online workshop organized in November 2020. It was decided to aim on a physical meeting this time hoping the pandemic restrictions would ease but with the constantly changing restrictions it has not been possible to organize the workshop.

The aim of the working group ISBC, Lund Integrative Structural Biology Centre Initiative, was to investigate if there is an interest, in the Lund area, of a future integrative structural biology centre placed at Brunshög, and to help catalysing

the discussion and development of these ideas. The first workshop was held in February 2021, with four invited speakers from integrative structural biology centers in Europe.

For this meeting, PIs directly working with structural biology in the Lund area were invited and asked to fill in a survey. It showed that 93% of the participants were positive towards the establishment of ISBC. As the working group received such a positive response, the working group decided to go further with their plans and submitted a letter to Lund

University management. The letter was also received very well from the management and currently there are ongoing discussions on how this will be funded.

During 2021 the working group had additional meetings and initiated a seminar series to strengthen the structural biology community in Lund. This has led to the submission of a "letter of interest" to the University management to become one of the five scientific profile areas that LU will have in the future.

Great response to the second workshop on Membrane Proteins

In December 2021, the Membrane Proteins Working group held their second workshop, following up on the very successful one in May with more than 200 participants from a range of disciplines. The topics for the winter workshop was related to "Structural Resolution of Membrane Proteins: From Sample Preparation to Structural Resolution".

In the first online workshop in May 2021, several aspects of expression systems, protein purification, membrane solubilization and other preparation methods were discussed. In December more topics were covered such as multi-protein complexes, detergent trials and crystallization strategies such as LCP and Hi-LIDE.

"In addition, we had also invited scientists to introduce their best practices on Cryo-EM and neutron structures, scattering techniques, and data collection and processing", says Erika Tóth, postdoc at Lund University and co-ordinator of the workshops. The production of high-quality membrane protein crystals is always very challenging. We were able to cover many steps of the processes and get good advice on how to figure out the best way to prepare samples, which methods to use, learn more about data models and new software as well as how to conduct experiments at MAX IV.

New techniques and hot topics

The range of participants, from PhD students to senior researchers, was valuable. The younger researchers could talk in more detail about technical aspects from their lab work which many found very useful. The senior researchers contributed with perspectives on what they see ahead from decades of experience in the field.

"We had good discussions and got a broad overview of new techniques and hot topics. In this field negative results do not get published and that may lead to people trying to do the same things. With this kind of open sharing, we can also learn what does not work so well. Everyone gets stuck somewhere in this pipeline", explains Erika Tóth.



The workshop offered both longer keynote presentations and smaller talks, promoting interaction and Q&A sessions. Speakers included Maria Marta Garcia Alai and Christian Löw from EMBL, Hamburg, Petra Fromme, Arizona State University, Gisela Bränden, University of Gothenburg, Alessandra Luchini, PSI and Erik Lindahl, Stockholm University.

Valuable knowledge exchange

An important part was to connect people and although the ambition was to hold a hybrid meeting, it had to be an online event in the end as the omicron version of the corona virus was spreading everywhere. On the positive side it made it easy for a broad international participation and speakers from the US to join over the two-day schedule.

"People really wanted to reach out, to be able to share data and find potential collaborations. Many have overlapping study subjects and can benefit from different approaches and methods to try. For those who are new to the field this kind of opportunity is very useful. We hosted a friendly environment where you could ask any questions you wanted. It was two days of really good networking opportunities, concludes Erika Tóth.

Except from the article “The ISB theme has progressed protein science and made it easier for disciplines to meet”

As the ISB theme activities come to an end in the first part of 2022, the first theme leader, Jens Lagerstedt, and the ending theme leader, Karin Lindkvist, reflected that protein science have become much broader than what it was before the Integrative Structural Biology theme started in 2018. The methods available within the field have also become more known to a larger group of researchers.

– One of the greatest strengths of the theme is how the different working groups have taken on different shape and direction. It has allowed for a more in-depth exploration of integrative structural biology issues since both advanced researchers and newcomers to the field have been able to join, says Jens Lagerstedt, now head of Rare Endocrine Disorders at Global Biopharm at Novo Nordisk.

Jens and Karin note that a lot has happened in the field overall, which has made it easier for more people to use different methods, for example macromolecular crystallography, Cryo-EM, that although it is not a neutron or X-ray method, has helped open up the field to clinical people, not just experts in structural biology.

Apart from broadening the science and introducing the use of methods to more people, another important milestone for the theme is that it has brought different questions to meet the right expertise and technology. Medical and biological questions have come together and have benefitted from a transdisciplinary perspective. Examples are new ideas on what can be done in terms of addressing key questions in life sciences, and deeper discussion on what is important to investigate to progress structural biology.

The impact on the broader scientific landscape has also been notable. The theme has placed LINXS and Lund on the map as a strong research hub for integrative structural biology research. This impact will be even more keenly felt if the ISBC working group manages to establish a special centre for national and international structural biology researchers. Such a centre can progress the science even more, and work towards getting bigger grants and funding, believe Karin and Jens.

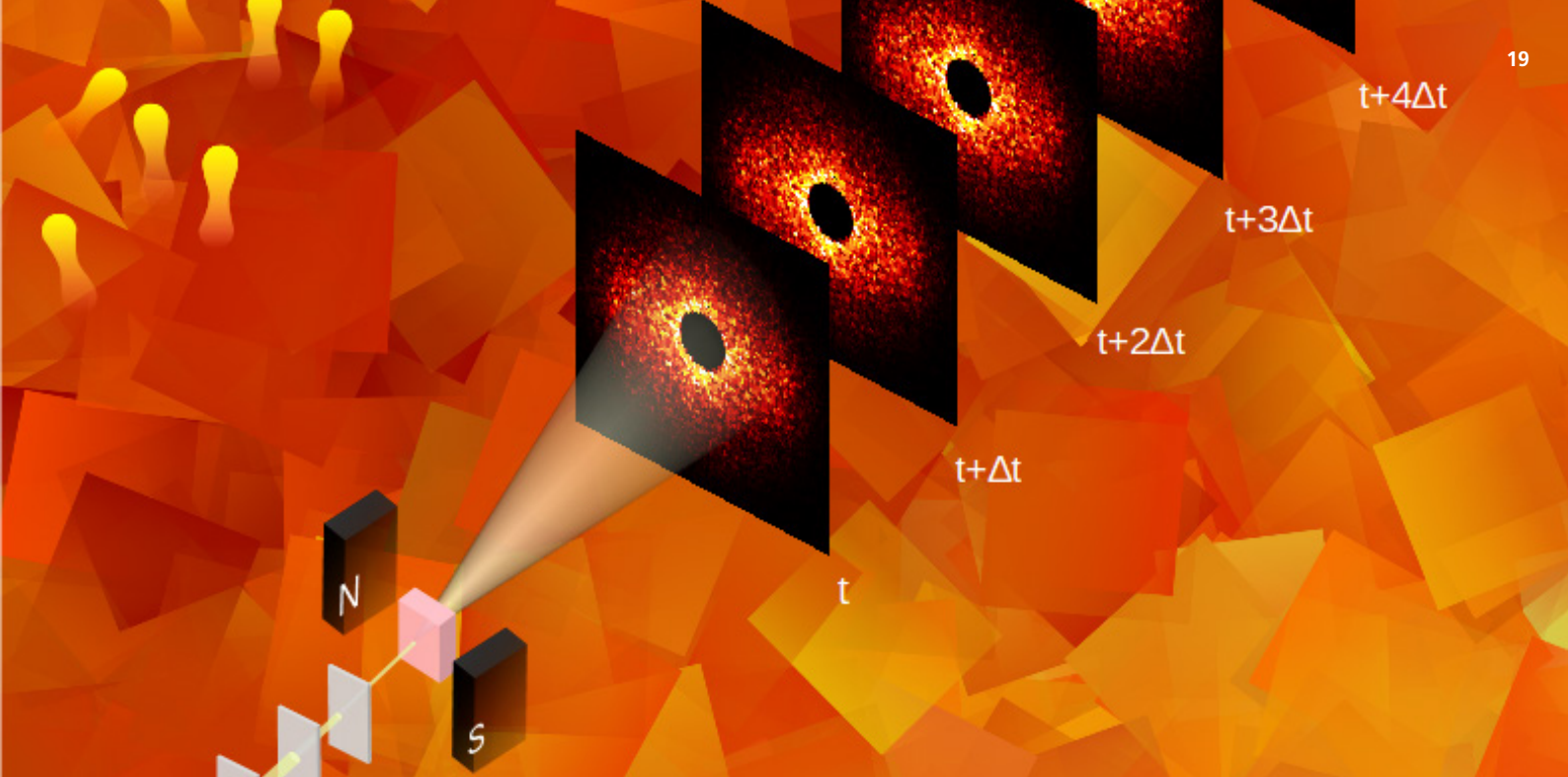
– LINXS is absolutely the right place to facilitate new ideas and spark initiatives. And with Trevor Forsyth as new Director, with his experience of building up a similar centre, Partnership for Structural Biology at the ILL in France, we have access to great experience in terms of how to go forward, says Karin Lindkvist.



Jens Lagerstedt
First theme leader, ISB

What do Jens and Karin think is key for a theme to succeed? Curiosity and commitment, they respond! Without a genuine interest, and passionate people, a theme will simply not work. Another important factor is to have researchers from other universities and from other countries be part of the core group of a theme. A regional and international collaboration around activities allow for more networks to be formed, and for new science to develop.

The results and outcomes from the Integrative Structural Biology (ISB) theme will be available when final reporting is finalised in a theme legacy section of LINXS website, www.linxs.se/integrative-structural-biology.



Dynamics theme

Dynamics and structure of biological macromolecules: 'Antibodies in Solution'

The establishment of a close collaboration with the American National Institute of Standards and Technology (NIST) agreeing to act as a source for mAb material and as a partner in the programme followed by the 'Antibodies in Solution' online Kick-off Meeting at the end of 2020 paved the way for the 2021 activities: A detailed research Road Map describing the underlying research strategy, the four different research Work Packages as well as the research goals and timeline of this LINXS initiative has been established during the first quarter of 2021. This was accomplished by numerous zoom meetings of the entire Consortium, the individual Work Package members and the LINXS mAb Steering Group.

After the next hurdle – the establishment of a Material Transfer Agreement (MTA) and the respective negotiations between the legal departments of NIST and the different Consortium partners – a first load of the NIST antibody (NISTmAb) material was sent out to those partners whose submitted Materials Request Forms (MRF) had been evaluated positively by the Steering Group and subsequently by NIST. This happened at the end of May / beginning of June. First experiments on the NISTmAb then started in early summer 2021, both at neutron and X-ray large scale facilities as well as in-house. The experimental and simulation results were presented at the first Progress Report Meeting in November 2021. Two of the most important achievements on the NISTmAb in 2021 were: i.) the identification and fixation of specific solvent conditions based on a systematic screening study and ii.) the establishment of a detailed sample preparation protocol.

Throughout the entire year of 2021, the individual Work Packages have had regular Zoom meetings, always in close collaboration and vivid exchange with interested NIST scientists. Moreover, intense discussions with a second potential partner and mAb provider (Novartis, Switzerland) have been and are still ongoing.

Dynamics and Structure of Membranes and their Constituents

In the last year of the dynamics theme the WG 3 initiated work started to make an impact in several ways. The publications as a product of the visiting fellows program 2020 started to appear and resulted in 7 publications. The WG 3 organized Neutrons in Life Science and Biomaterials, 14 – 18 June 2021 as a web-based graduate course with 20 participants within the SWEDNESS program. SwedNess is a graduate school providing research training in neutron scattering funded by The Swedish Foundation for Strategic Research (SSF). An important part of the curriculum was dynamics and structure of membranes and their constituents. A conclusive workshop focusing on biomembranes was planned for 2021 but was postponed to 2022. It is now planned as a hybrid LINXS Partner event – Lipid Bilayers at ESS- BESS in Lund, 13–15 June 2022. WG 3 leader Tommy Nylander was elected vice president and president elect of European Colloid Interface Society ECIS in September 2021. He was also appointed Specialty Chief Editor of Frontiers in Soft Matter, Self-Assembly and Self-Organisation.

Structure and dynamics utilizing the GISANS technique

Swedish universities, institutes and companies collaborate on planning new instruments for installation at ESS, the world's most powerful research facility for neutron radiation, outside Lund. A dedicated Grazing-Incidence Small-Angle Neutron Scattering (GISANS) instrument will enable researchers to analyse in detail how a neutron beam spreads when reflected from a surface. Here LINXS has served as a meeting point and a hub to solidify the collaboration. In November 2021, the Swedish Research Council granted funding (2021-06230) for an interdisciplinary project "Preparing for a GISANS instrument at ESS – A Swedish Initiative" with Tommy Nylander as project leader. This project, SAGA, is jointly conducted by Lund University, Uppsala University, Malmö University, Linköping University and KTH Royal Institute of Technology. During 2022 a 3-year PostDoc will be appointed, placed at LINXS. During 2021 a SAGA GISANS workshop was held on 12 May in connection with the Swedish Neutron week 10–12 May.

Sample environment and data evaluation of biological membranes

Quite some effort was made to secure how to provide sample environment to increase the activities in this area. Here should be mentioned the successful proposal for renewed funding (2021-00159) from the Swedish Research Council for the only Swedish operated and own neutron instrument, Super ADAM, placed at ILL in Grenoble France, and operated jointly by the universities in Uppsala, Lund and Linköping. Another successful grant application (2021-06151) for the Swedish Research Council were dealing with growth and characterization of magnetic layers to develop new methodology for exploring soft matter and life sciences using neutron scattering. The project involved partners from universities in Linköping, Lund and Uppsala as well as ESS an STFC – ISIS neutron and muon source, UK. An important part of this project is to get new methodology to study biological membranes based on magnetic reference layers.

Tackling research questions at the absolute forefront – the impact of the Dynamics theme

The Dynamics theme was one of the two first themes to form at LINXS back in 2017. As its activities came to an end in 2021, Peter Schurtenberger, and Marie Skepö reflected on some of the main achievements, and the importance of LINXS as a strong incubator for neutron and X-ray science.

"The Dynamics theme made it possible for research groups to focus on research questions that are much bigger than one researcher can tackle alone", say theme leader, Professor Marie Skepö, and founding LINXS Director, Professor Peter Schurtenberger.

Antibodies, XPCS, Simulation, theory and software development

The creation of the Antibodies in solution research programme within the working group "Dynamics and Structure of Biological Macromolecules" was a major milestone for the Dynamics theme. The idea for the programme grew out of an early workshop on dynamics of biological macromolecules. A need to secure sufficient amounts of well-defined antibodies was identified – in order to perform research that covers relevant length and time scales to understand the physical properties of individual antibodies as well as those of concentrated solutions. Today, the research programme gathers 14 international research groups, with four groups from Lund University, as well as a pharmaceutical company and the American National Institute of Standards and Technology (NIST).



Marie Skepö, professor in Theoretical Chemistry at Lund University



Peter Schurtenberger, professor in Physical Chemistry at Lund University

“Without LINXS as an incubator, the programme would not have been successful. We needed an independent broker that could gather us researchers under common goals, and to help us sustain the effort. For me, this is a prime example of what can be achieved if you have genuine support for a bottom-up approach”, says Peter Schurtenberger, professor in Physical Chemistry at Lund University.

Marie Skepö, professor in Theoretical Chemistry at Lund University, highlights other significant achievements such as the take-off of the research programme on Simulation, theory, and software development for anisotropic systems, where researchers came together to share ideas and advance the methodological toolbox for analysing, understanding, and predicting experiments with X-rays and neutrons. This programme has now merged into the Antibodies programme’s efforts. Researchers from the Dynamics theme have also been involved in other LINXS initiatives such as the Northern Lights on Food theme.

Another example is the outcomes from the working group on Characterizing soft matter with X-ray Photon Correlation Spectroscopy (XPCS). Based on the group’s work, in 2020, funding was granted for a large-scale international research project, Dynamics of proteins in crowded environments on multiple length and time scales, in the frame of a so-called Röntgen-Ångström Cluster, led by Professor Christian Gutt from the University of Siegen in Germany and Peter Schurtenberger. Another side-effect is that it has helped to boost the corresponding interests and activities at MAX IV, which has now also led to a successful application to the Swedish Research Council for a new detector, more suitable for using the technique.

“The knock-on effects of our initial work are great, because XPCS is different to other comparable techniques since you can measure motion of nanoparticles on small length scales. In the case of proteins, the distances you can measure actually correspond to the size of the protein, and how it moves until it encounters a neighboring protein. XPCS is therefore the only technique that can currently reveal slow motion of proteins in highly concentrated solutions on these length scales”, says Peter Schurtenberger.

Impacts that will last long beyond the theme

The research programme on utilizing the Grazing-Incidence Small-Angle Neutron Scattering (GISANS) technique that started within the “Dynamics and Structure of Membranes and their Constituents” working group is another example of long-term impact. It has been instrumental in creating a concerted national effort for the design and construction of a GISANS instrument that could provide unique knowledge of surface layers for potential use in a large variety of areas such as developing new medicines, packaging, batteries and other applications. The Swedish Research Council has now granted funding for a feasibility study for such an instrument at ESS.

At its core, the Dynamics theme – and its legacy- is about the people. Both the many researchers involved, as well as the inspiring guest researchers who have been connected to the theme over the years, say Marie and Peter.

“Our theme has paved the ground for setting up new constellations of people and focused on research questions that are much bigger than one researcher can tackle alone. By combining different experimental and theoretical techniques and backgrounds of the people involved, we become stronger. Now, theoreticians and experimentalists work together with research questions at the absolute forefront, both regarding scientific questions as such, as well as method development”, says Marie Skepö.

Peter Schurtenberger adds that the combination of people with different backgrounds has served the antibodies programme well. It was essential in creating a strong research consortium and plan that finally convinced NIST to provide the programme with their well-defined antibody, successfully ending an effort of more than two years to secure the required large quantities of material that was initially identified as the most important obstacle by the community. Since the programme will continue its work under the newly accepted LINXS theme: Integrative Pharmacology and Drug Discovery (IPDD) which will start in 2022, the expertise built up during the Dynamics theme will continue to feed into new LINXS initiatives, and by extension help to further develop X-ray and neutron science.

“The legacy of our theme, which can be seen on a local, national, and international level, in terms of the many important collaborations we have managed to establish, will only continue to grow as the years pass”, says Peter Schurtenberger.

The results and outcomes from the Dynamics theme will be available when final reporting is finalised in a theme legacy section of LINXS website, www.linxs.se/dynamics

Using the instrument SAGA, researchers can gain unique knowledge about cell wall surfaces leading to innovation opportunities for industry

Swedish universities, institutes and companies collaborate on planning new instruments for installation at ESS, the world's most powerful research facility for neutron radiation, outside Lund. In 2021, the Swedish Research Council granted funding for two interdisciplinary projects as feasibility studies for future instruments at ESS: SAGA and HIBEAM.

A dedicated Grazing-Incidence Small-Angle Neutron Scattering (GISANS) instrument will enable researchers to analyse in detail how a neutron beam spreads when reflected from a surface. The SAGA instrument (Surface Analysis using Grazing Angle neutron scattering) will provide unique knowledge of surface layers for potential use in developing new medicines, packaging, batteries and other applications.

"SAGA will give us a faster and more detailed understanding of the appearance and functioning of cell walls, for example. This will help us develop better medicines, food and packaging, as well as batteries and electronics for a sustainable society," says Tommy Nylander, Professor of Physical Chemistry at Lund University and active at LINXS.

Funding for the planning phase of Swedish instruments at ESS strengthens Swedish participation

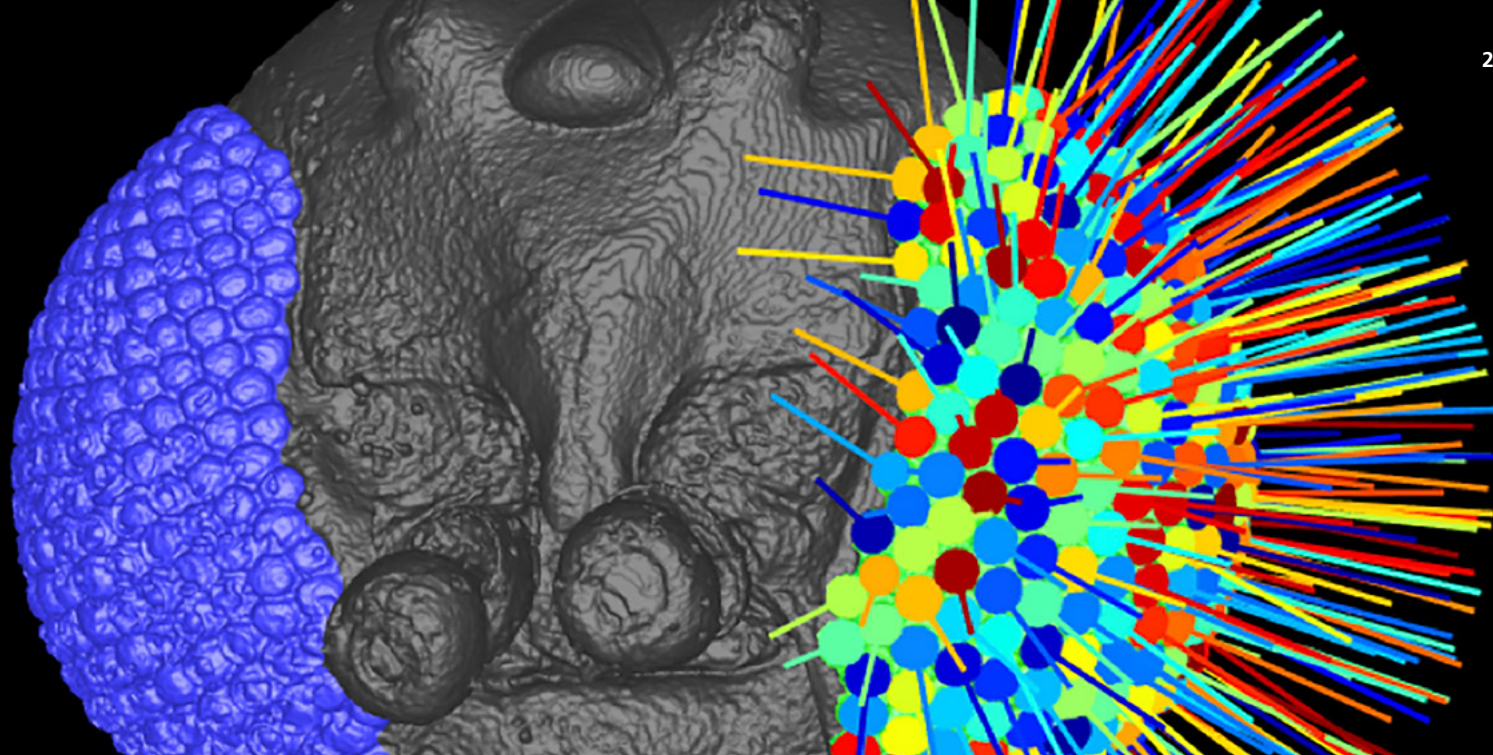
Research related to SAGA concerns the interface between physics, chemistry, and biology, while HIBEAM creates an environment for collaboration between specialists in particle and nuclear physics. The two projects are based on internationally prominent research and are being carried out in collaboration with international and industry partners.

"Swedish research already holds a leading position in surface physics and chemistry and the SAGA project is expected to further strengthen technological developments in the field. Applications exist for all major manufacturing industries, and it is therefore very positive that we are now able to take the next step," says Max Wolff, Professor of Neutron Scattering, Uppsala University.

The initiators of the SAGA project are Lund University, Uppsala University, Malmö University, Linköping University and KTH Royal Institute of Technology. This first phase of planning for an instrument proposal to be submitted to ESS will take approximately three years to prepare.



Aerial overview of ESS, European Spallation source. Photo: Perry Nordeng/ESS



Imaging theme

The Imaging theme concluded its activities in 2021. However, the very successful Co-Work webinar series continued to provide a much-needed international forum for coherent imaging with X-rays.

The theme also invited one of the few guest researchers who were able to come in the year: Prof. Adam Hitchcock from McMaster University in Canada, who spent two months in Lund supporting the SofriMAX beamline at MAX IV in its start-up phase. We are looking forward to his planned return in 2022. The invitation was supported by the Working Group on Soil Science.

Imaging also hosted a collaborative project between LTH and ESS, a demonstration model initially being used as a

prototype for the ODIN experimental station. This project was reported on in the LINXS news and laid the foundation for a larger initiative.

Within the framework of the GeoARCH working group, collaborations continued, including imaging of artefacts from the marine excavation of the Danish 15th century flagship “Gribshunden”. The excavation is widely known from both American and Swedish documentary television. Collaborations were also initiated with the Lund University Historical Museum.

A very few activities will be carried over into 2022, but the theme is now considered closed and has entered “Legacy” status.

Creating new communities – the legacy of the Imaging theme

“The Imaging theme was first and foremost about opening up the potential of using X-ray and neutron imaging techniques to new communities”, says theme leader, and outgoing LINXS director, Stephen Hall.

He led the theme from 2017–2021. Officially the theme should have concluded at the end of 2020, but various activities, that were delayed by the pandemic, continued through 2021.

As he reflects on the achievements of the theme’s core and working groups, one thing is clear: the greatest legacy of the theme overall is how it has sparked interest and curiosity to use X-ray and neutron imaging techniques to advance

science over a broad spectrum of research areas and involving many researchers who are completely new to the subject.

Reaching large research communities

Stephen Hall gives some key examples of how the theme engaged a large group of researchers from different fields during its time at LINXS.

“One such example was the very first workshop the theme organised back in 2017 on X-ray fluorescence imaging, which paved way for a new user group at NanoMAX at MAX IV and the building of a new working group, New opportunities in Imaging with X-rays and Neutrons”.

The GeoArcheology and Cultural Heritage (GeoArCH) working group attracted new users and sparked interest in imaging techniques among, for example, archeologists and paleontologists, whereas the Soil Science working group connected biologist and soil experts to explore new methods and applications.

The hackathons, organised by the QuantIm working group, brought data analysts from around Europe, in particular from the Center for Quantification of Imaging Data (qim.dk), together with researchers from many different research fields to discuss options and alternatives for improved data analysis and image quantification. This led to many new collaborations, as well as a template for a new way of collaborative working (hackathons) at LINXS.

The working group on Food Science and Technology, reached out to food researchers in the region, including from industry and food companies, a group not connected to LINXS previously and not common users of X-rays and neutrons. Late in the theme, an activity within the “New opportunities in Imaging with X-rays and Neutrons” working group developed (due to corona restrictions) into the webinar series, Co-Work, which focused on coherent diffraction imaging and Ptychography and Holography. This webinar series brought together experts from all over the world for focused discussions on how to plan, conduct and analyse experiments exploiting the coherence properties of X-rays for advanced material characterization. This took place during the corona pandemic and was a great success due to responding to a real need to meet and discuss, even if it was on-line.

A strong ambition to introduce imaging techniques

“It has been great to see how new people and scientific fields have become interested in imaging with X-rays and neutrons during this time. I think it has to do both with working practices, and with the actual scientific direction of the working groups. We have also had a clear ambition to reach out to large communities who are less familiar with X-rays and neutrons, which has led to many new researchers coming into the field. Imaging is a very visual technique, which of course helps in attracting new users!

The overall effect of the theme is actual quite significant, says Stephen Hall. Both locally and on an international level one can start to see lasting impacts, way beyond the duration of the theme.”

Consolidated communities around MAX IV and ESS

For example, locally, the theme has helped create a strong user group for fluorescence imaging in Lund, Sweden and in Denmark. Based on the very first workshop on X-ray fluorescence imaging, MAX IV saw a great increase in applications to use fluorescence in experiments.

The hackathon concept, as a method to capture interest and initiate focused discussions, has also taken off and inspired other themes and working groups. The food working group, meanwhile, has not only gone on to form its very own theme at LINXS, Northern Lights on Food, but has also secured independent funding and is progressing with plans to establish a European Food Laboratory, to be located in Science Village in Lund.

The theme has also helped to consolidate communities around MAX IV and ESS. Especially when it comes to pushing tomography as technique. For example, the theme helped in forming the communities around proposals for new imaging beamlines MAX IV. Furthermore, connections made within the GeoArCH working groups led to a pan-European proposal towards supporting multi-model imaging at the future ODIN beamline at ESS. The theme, and LINXS, have also been instrumental in increasing the capacity and knowledge of early career researchers, e.g., with the organisation of doctoral schools on neutron imaging in collaboration with SwedNess and the first Northern Lights on Food master class.

People and their engagement at the core of LINXS

A final question is how one keeps the momentum of the themes going – especially when the activities within the working groups are very much based on interest, passion and ideas, as opposed to financial recompense.

“One has to remember, that there are very few arenas that support X-ray and neutron science in the way LINXS does, in terms of organising and funding collaborative events and activities and providing a platform to meet. This is at the core of LINXS, and is a great precursor for successful themes, as long as we continue to get enthusiastic people; with a vision and passion to push forward scientific ideas”, Stephen Hall concludes.

The results and outcomes from the Imaging theme will be available when final reporting is finalised in a theme legacy section of LINXS website, www.linxs.se/imaging

LINXS visiting researcher programme

A rewarding visit as a guest researcher



Adam Hitchcock, Professor,
McMaster University,
Canada

Professor Adam Hitchcock, McMaster University, Canada is one of the most renowned and experienced researchers in X-ray adsorption microscopy and especially soft X-ray transmission microscopy (STXM). For two months in 2021 he visited Lund to support the Softimax beamline in its startup phase, educate advanced and potential synchrotron users in STXM and ptychography and to help developing methodologies, instrumentation, data and data treatment approaches.

– My visit was a real pleasure. I thank LINXS and BECC at Lund University for the support of my visit. I also thank Karina Thånell and all the SoftiMax team for their friendship and great teamwork, says Adam Hitchcock.

LINXS seminar on STXM

For the LINXS community, Professor Hitchcock held a seminar in October on the subject of “Chemically sensitive imaging with synchrotron based soft X-ray STXM and ptychography”.

The principles of STXM and ptychography were presented, with an emphasis on spectromicroscopy. STXM, Soft X-ray scanning transmission microscopy is a powerful synchrotron-based tool for nanoscale materials analysis. Ptychography is a computational method of microscopic imaging. Quantitative 3D imaging (tomography) at multiple photon energies can be performed with STXM and ptychography. Application areas are for example in biosciences (magnetotactic bacteria), energy materials (fuel cells, CO₂ reduction catalysts) and in situ electrochemical studies.

Excellent performance

The goal of his visit was an expert commissioning of a microscope at MAX IV and also to connect with communities in Sweden and the Nordics.

– The progress in the expert commissioning of the STXM was steady and rewarding. In the last weeks in November, the stability and outstanding performance of the ring, beamline and microscopy were abundantly demonstrated.

The SoftiMax STXM is already one of the best in the world. With further development of the capabilities, there is every reason to believe it will be the best in the world and maintain that position for quite some time.

LINXS webinar series and educational resources

Science at large scale research facilities

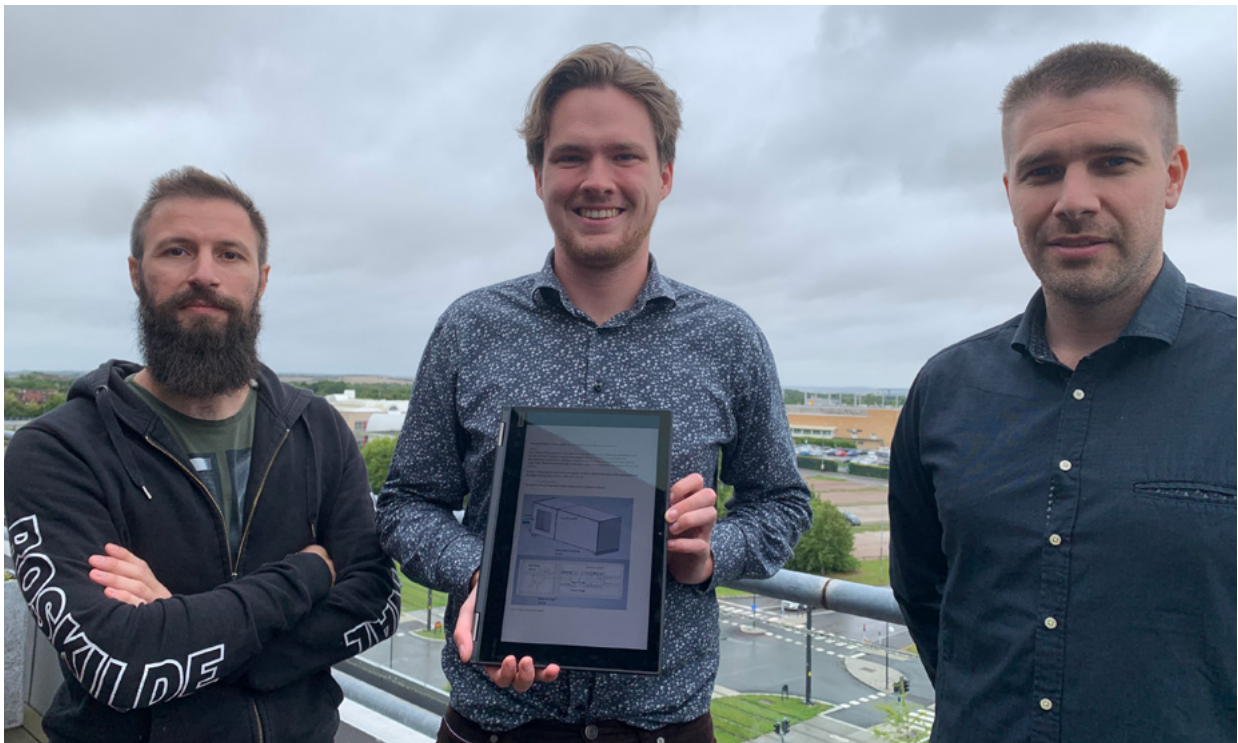
In 2021, Anurag Kawde, the LINXS Postdoc, worked on successfully moderating the webinar series that was focused on the sciences at large-scale facilities around the world. The scientific directors of various synchrotron and neutrons sources talked about different techniques used in their respective facilities and also shed light on how to explore different materials such as biological, battery related, green materials, fossils, and so on.

Educational resources

A remarkable achievement has been an accumulation of educational material, as LINXS undertakes to preserve talks and presentations and to act as a structured repository for such information. This repository grew significantly during the year to 120+ recorded talks and instructional videos that are now available in the LINXS website.

CoWork Series

As the statistics show, the activities of LINXS were predominantly hybrid and online because of the continuing pandemic, and due to the shift in LINXS’s strategy for achieving impact in the face of it. We were very pleased to host the continuation of the very successful Webinar series “Co-Work” dedicated to the exploitation of the coherence properties of X-rays, led by Gerardina Carbone, MAX IV Laboratory.



Stefanos Athanasopoulos, Samuel Staines and Emanuel Larsson have collaborated on the project which aims to help prepare for future neutron beamlines at ESS, hosted at LINXS this summer. Photo: Noomi Egan.

LINXS Collaboration – from kitchen tomography to a cutting-edge neutron imaging beamline

Today, his model is used as a prototype to help prepare for future neutron beamlines at ESS – as part of a collaborative project between LTH and ESS, hosted by LINXS in summer 2021.

– I had noticed that it was quite hard for people to grasp the basic principle of tomographic imaging. That made me want to build a model where you can actually show what is going on. I used stuff I found in the house, and I realised that they worked well to illustrate how one can scan, reconstruct, and render a sample in 3D, says Emanuel Larsson.

Neutron tomography is an imaging technique that allows visualisation of samples in three dimensions. The sample rotates in the beam and multiple 2D radiography images are recorded with high-speed digital cameras.

A 3D representation of the volume of the object can be reconstructed using a mathematical algorithm. The technique also enables the visualisation of fluids, such as water or oil in large metal objects.

Neutron tomography is pivotal to many future breakthroughs since it is non-destructive and can thus be used to investigate the temporal and spatial resolution down to the micrometre scale in samples of both soft and hard matter for example energy- and engineering materials, biological and geological samples and cultural heritage artefacts.

The model has evolved over time

Emanuel Larsson's first model was very basic. He used a paper screen, a light, a camera, and a sample. He took a photo of the sample, for example a water bottle, then he rotated it and took a new image, until he had captured the sample over 360 degrees. Three years later, that very first model has evolved – and now Emanuel is on version 25.

The new model is refined but is still using the same flashlight and is now connected to a single board Raspberry Pi 4 computer. The sample can rotate 200 steps over 360 degrees, which should be compared to tomography setups at large scale research facilities were often thousands of radiographic images are captured of a sample over 360 degrees. In addition, Emanuel has also set up user-friendly image reconstruction and analysis pipeline which can be applied both on the acquired and reconstructed data sets.

– Even though the model is quite basic it does the job. We did a comparison where we scanned a Lego figure with my model, and with real X-rays with the lab tomograph in the 4D Imaging Lab at the Division of Solid Mechanics at Lund University. And the results were not that different! The regular light could of course not penetrate through the plastic, as with the X-rays, but in both experiments you can see the outline of the figure in 3D.

The model is used as a prototype for ODIN at ESS

Today, Emanuel's model is not only used in the teaching he does in his new positions as a Method Expert in X-ray and Neutron Imaging at the Division of Solid Mechanics and as an Application Expert in Tomographic Imaging and Image Analysis at LUNARC, the Center for Scientific and Technical Computing at Lund University, it is also used as a prototype for the test beamline YMIR for the future imaging beamline ODIN, which will be built at ESS. This is because the techniques employed in the model can be used to test both hardware and software pipelines, both with light tomography and neutron tomography – even though Emanuel's model fits on two tables, and a neutron beamline fits in a very large room!

The very first version of the KBLT scanner was very basic and built of objects such as a paper screen, a light, a camera and a sample such as a water bottle.

Samuel Staines, a master student at the Division of Solid Mechanics, is responsible for designing a replica of the model which can be compatible with what is needed for the new YMIR test beamline and the future ODIN beamline at ESS. He explains that it works just as well to use normal light as it would to use neutrons to test how the beamline might behave. Before the ODIN beamline is built, the techniques will be tested in the test beamline, YMIR.

– There is a huge amount of work you need to do to develop a new beamline. That is why you need to test the platform, including hardware and software pipelines in multiple ways. One way is to refine and test in a smaller scale to get ideas on where the challenges and pitfalls will lie with the new instrument, says Samuel Staines, master student, Lund University.

Improving data collection strategies

Mechanics is also involved in the project with ESS. His work is focused on improving the data collection strategies for future experiments at large scale research facilities.

– A big part of developing a new beamline is also about testing optimal ways for data collection. How will it actually work when a user comes in and runs an experiment? Now a lot of data is acquired from the experiments, says Stefanos Athanapoulos, doctoral student, Solid Mechanics, Lund University.

– The ideal solution would be to build a single log file with all the data and information about the experimental setup so that you get everything in one place. That file can then be used by different researchers, not just the person conducting the actual experiments.

The model makes techniques available to more students

Emanuel Larsson is also planning to make the code of his model freely available to students across the world – with



Emanuel Larsson illustrates how the latest version of his kitchen-based light tomography (KBLT) scanner works.

the help of LINXS and Stephen Hall, outgoing Director of LINXS, and Senior Lecturer at the Division of Solid Mechanics at LTH. The idea is to publish an article on the kitchen tomography lab scanner, along with making the code available to download from the platform GitHub. If this plan succeeds, the cost of teaching students tomography techniques can be reduced drastically. Today, X-ray tomography scanners in laboratories can cost between 40 k€ to 1 M€. In comparison, the kitchen tomography scanner model can be built with readily available materials for between 100€ to 1000€, depending on which version of the KBLT scanner the students would like to build.

– Hopefully, the model can help inspire more students to start using imaging techniques in their research early on. It allows them to play around with samples and sample environments – for example what will happen if you point a heat gun onto a rotating sample, and image the change in 3D over time, thus meaning 4D?

While using the model, students will also learn important skills in engineering, image reconstruction, analysis and 3D-rendering. Skills that will come in handy for future imaging experiments both at ESS and MAX IV.

– In a few years models like the kitchen tomography scanner could have huge impact in terms of increasing the user base of people using the techniques offered at large scale research facilities. It is all about inspiring people and making it easy to learn, test things and have fun at the same time, Emanuel Larsson concludes.

Researchers from ESS who are involved in the project:
Kenan Murić, Data Acquisition Scientist, ESS.
Robin Woracek, Instrument Scientist, ESS.
Søren Schmidt, Senior Scientist, ESS.
Tobias Richter, Group Leader for Experiment Control and Data Curation, ESS.

LINXS activities in 2021

LINXS events and events organised in partnership

1. LINXS event – WEBINAR: CoWork series – Coherent X-ray imaging of 3D magnetic systems with Claire Donnelly, January 12, 2021 (Imaging)
2. LINXS event – Amyloid Workshop: User-friendly analysis of spectroscopy data with Quasar – multivariate statistics and machine learning, January 13–15, 2021 (ISB)
3. LINXS event – WEBINAR: CoWork series – The Atomic beamline at the Upgraded Advanced Photon Source with Ross Harder, January 28, 2021 (Imaging)
4. LINXS event – WEBINAR: CoWork series – ID01 in light of the ESRF – EBS with Steven Leake, February 12, 2021 (Imaging)
5. LINXS event – Workshop “Integrative Structural Biology Centre Initiative”, Feb 18, 2021 (ISB)
6. LINXS event – WEBINAR: CoWork series – Effectiveness of Phasing Algorithms in Bragg Coherent Diffractive Imaging with Ian Robinson, February 25, 2021 (Imaging)
7. LINXS event – Catalysis Working group Webinar – “Research in Catalysis at MAX IV” by Andrey Shavorskiy, March 2, 2021 (New Materials)
8. LINXS Event – Amyloid Workshop – Heart and Mind: linking in vitro science to the clinical context, March 5, 2021 (ISB)
9. LINXS Event – Workshop – Magnetic materials: linking scattering data to magnetic simulations, Part I, March 25–26, 2021 (New Materials)
10. LINXS event – WEBINAR: CoWork series – The new Carnaúba beamline at the new Brazilian synchrotron source with Carlos Sato Baraldi Dias, March 25, 2021 (Imaging)
11. LINXS Event – Workshop Magnetic materials: linking scattering data to magnetic simulations, Part II, April 8–9, 2021 (New Materials)
12. LINXS event – WEBINAR: CoWork series – Characterization and mapping of nanostructure using ptychographic 3D nanoscale imaging and small angle X-ray scattering at the cSAXS beamline, with Manuel Guizar Sicaïros, April 8, 2021 (Imaging)
13. LINXS event – WEBINAR: Science at Large Scale Research Facilities – The European XFEL: new science opportunities, start of user operation and first results, April 14, 2021
14. LINXS event – WEBINAR: Science at Large Scale Research Facilities – Science with the ESRF EBS, April 21, 2021
15. LINXS event – WEBINAR: CoWork series – Playing with coherence in soft X-ray scattering, with Claudio Mazzoli, April 22, 2021 (Imaging)
16. LINXS partner event – Webinar – How can researchers at MAX IV benefit from LINXS? April 23, 2021
17. LINXS event – WEBINAR: CoWork DUO webinar: Holographic tomography as a new tool for bioimaging and 3d Virtual Patho-Histology of Lung Tissue from Covid-19 Patients based on Phase-Contrast X-ray Tomography, April 29, 2021 (Imaging)
18. LINXS event – WEBINAR: Science at Large Scale Research Facilities – Neutron Sciences at the Oak Ridge National Laboratory, May 5, 2021
19. LINXS event – WEBINAR: CoWork series – Investigating the early life on Earth with nanoscale X-ray coherent imaging, with Lara Maldanis, May 6, 2021 (Imaging)
20. LINXS Event – Everything you want to know about applying for and managing a Theme at LINXS! May 6, 2021
21. LINXS Partner event – Swedish Neutron Week 2021, May 10–12, 2021
22. LINXS Partner event – Early Stage Researcher (ESR) Career Day, May 11, 2021
23. LINXS Partner Event – SWEDNESS/LINXS Doctoral-level course on neutron imaging, May 17–20, 2021 (Imaging)
24. LINXS event – Catalysis Working group webinar – Oxide formation at Pt-Sn model catalyst surfaces, with Lindsay Merte, May 18, 2021 (New Materials)
25. LINXS event – WEBINAR: Science at Large Scale Research Facilities – Neutron scattering and imaging at the Swiss Spallation Source SINQ, May 19, 2021
26. LINXS event – WEBINAR: CoWork DUO webinar: X-ray ptychographic topography, a new tool for strain imaging – Diffraction of X-ray by thin perfect crystals, May 20, 2021 (Imaging)
27. LINXS Event – Membrane Protein workshop: Structural Resolution of Membrane Proteins: From Expression to Sample Preparation, May 25–26, 2021 (ISB)
28. LINXS event – WEBINAR: Science at Large Scale Research Facilities – Revealing the hidden structure and dynamics of matter: opportunities for research at the ISIS Neutron and Muon source, May 26, 2021
29. LINXS Partner Event – SwedNESS PhD school: Small Angle Neutron Scattering (SANS), May 31 – June 4, 2021

30. LINXS event – WEBINAR: Science at Large Scale Research Facilities – Scientific opportunities at Sirius, the new Brazilian synchrotron light source, June 2, 2021
31. LINXS event – WEBINAR: CoWork series – Probing dynamics with X-ray Photon Correlation Spectroscopy: achievements & outlook, with Dina Sheyfer, June 4, 2021 (Imaging)
32. LINXS event – Northern Lights on Food (NLF) II, June 9–11, 2021 (Imaging)
33. LINXS Partner Event – SwedNESS PhD school: Neutrons in Life Science and Biomaterials, June 14–18, 2021
34. LINXS event – WEBINAR: CoWork series – XPCS: A powerful technique to study the dynamics on colloidal length scale, with Antara Pal, June 17, 2021 (Imaging)
35. LINXS Town Hall meeting, June 21, 2021
36. LINXS event – WEBINAR: CoWork DUO webinar: Upscaling X-ray nanoimaging to macroscopic objects – Ptychographic image reconstruction using automatic differentiation: first and second order methods, June 24, 2021 (Imaging)
37. LINXS Partner Event – Workshop on a Future μ -Spectromicroscopy Beamline, August 26, 2021
38. LINXS Partner event – Strategy workshop for IR spectromicroscopy beamline MIRARI at MAX IV, September 3, 2021
39. LINXS event – WEBINAR: Science at Large Scale Research Facilities – The SLS 2.0 Upgrade, September 22, 2021
40. LINXS event – WEBINAR: Science at Large Scale Research Facilities – The Institut Laue Langevin – 50 years of neutrons, science and innovation, September 29, 2021
41. LINXS Partner event – HELIOS International Graduate School, Lund Retreat, October 4–8, 2021
42. LINXS event – WEBINAR: Science at Large Scale Research Facilities – Science at the Diamond Light Source and future plans for a major upgrade of the facility with the Diamond-II programme, October 13, 2021
43. LINXS event – Seminar with LINXS Guest fellow Prof. Adam Hitchcock, McMaster University, Canada, October 14, 2021 (Imaging)
44. LINXS Partner Event – Workshop on synchrotron tomography for future MAX IV experiments, October 20, 2021
45. LINXS Partner event – MAX IV and ESS as engines for breakthrough science, October 20, 2021
46. LINXS event – WEBINAR: Science at Large Scale Research Facilities – Science at the research neutron source Heinz Maier-Leibnitz (FRM II), October 20, 2021
47. LINXS event – Lund Integrative Structural Biology Seminar Series, October 21, 2021 (ISB)
48. LINXS event – Inspirational symposium for new theme Northern Lights on Food, October 22, 2021 (Food)
49. LINXS Partner event – Quantum and advanced materials (MAX IV User meeting), October 26, 2021 (New Materials)
50. LINXS event – Catalysis workshop, October 28, 2021 (New Materials)
51. LINXS Event – XAS-School 2021, November 1–5, 2021 (New Materials)
52. LINXS Partner event – BECC – LINXS mini-symposium: Chemical imaging of soil and other environmental samples with synchrotron based soft X-ray STXM and ptychography, November 1, 2021 (Imaging)
53. LINXS event – 2nd Northern Lights on Food Masterclass, November 15–19, 2021 (Food)
54. LINXS Town Hall meeting, December 3, 2021
55. LINXS event – 2nd Membrane Protein Working Group Workshop, December 7–8, 2021 (ISB)
56. LINXS event – Workshop: Introduction to PyPhase – a Python package for X-ray phase imaging, December 9–10, 2021 (New Materials)

Timeline

2021 Regular Call for themes
New Theme Starting
Conclusion of two LINXS themes
Instalment of new Director

2022 Regular Call for themes
New Theme Starting
Conclusion of LINXS themes

2023 Long term funding secured
Regular Call for themes
New Theme Starting
Conclusion of LINXS themes
LINXS partnership offering updated

2024 Permanent location to SV
Regular Call for themes
New Theme Starting
Conclusion of LINXS themes

2025 Steady state operations achieved
at 16M/24M a year.

“LINXS is currently located in the IDEON science park but will be moving into purpose-designed premises at the Science Village (SV) as soon as possible, adjacent to the MAX-IV and ESS, as plans for local, national and international engagement develop.”

Trevor Forsyth, LINXS Director

Location 2024 +

Science Village

MAX IV

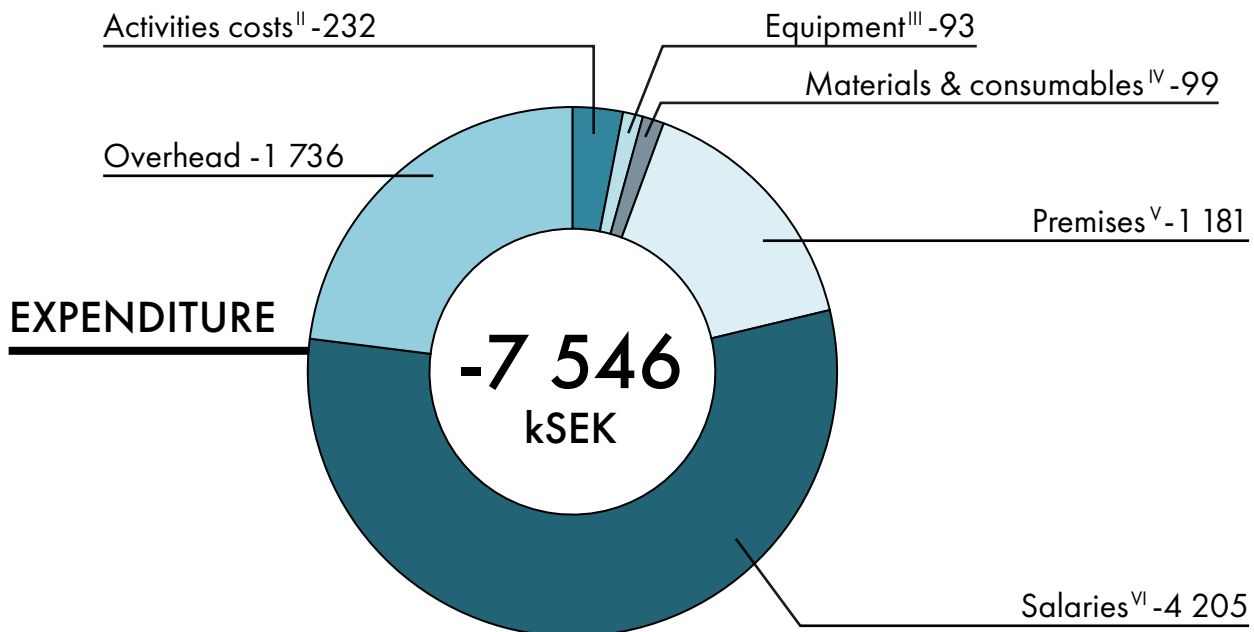
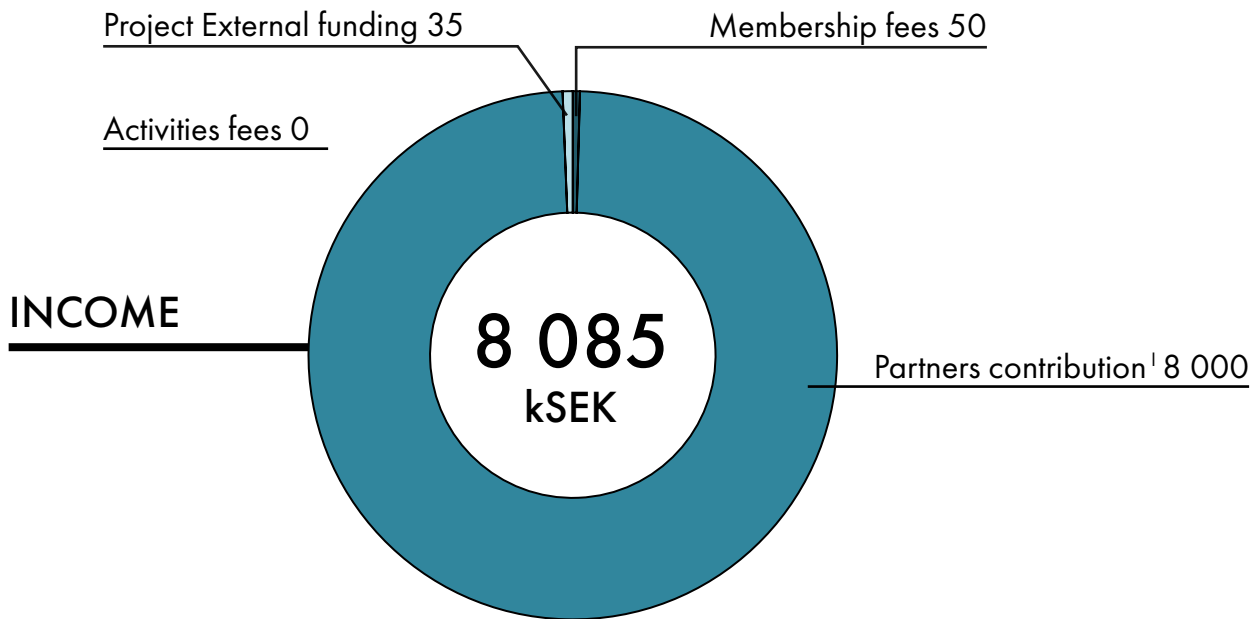


Location 2018 – 2024

Tramline



Finances 2021

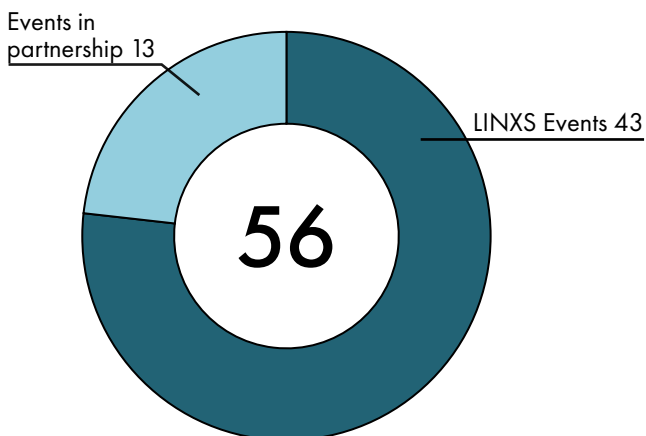


- I. Current partner is Lund University and contributions are from the Central administration, the Faculty of Science, Faculty of Engineering and Faculty of Medicine.
- II. Activities mainly include costs for the organisation of LINXS events, accommodation, travelling and outreach.
- III. Equipment mainly includes costs and depreciation for computers, equipment for the operation of scientific activities and furniture.

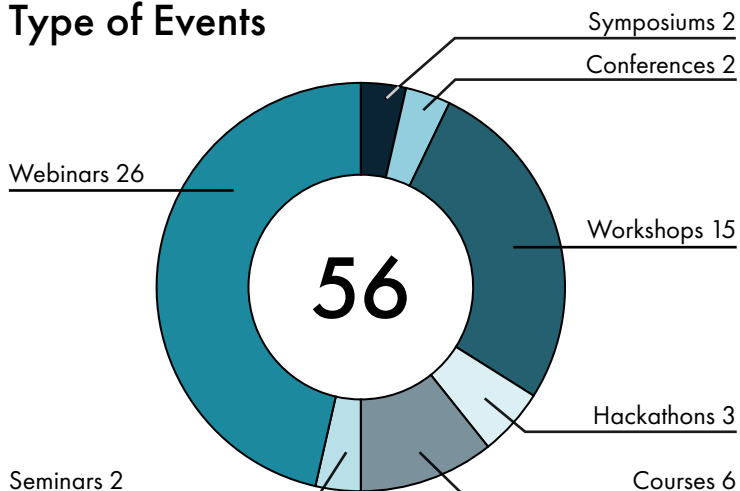
- IV. Materials and consumables mainly include office supplies and printing equipment.
- V. Premises include costs for rental, internet connection and cleaning services.
- VI. Salaries include staff, management and emoluments.

Statistics 2021

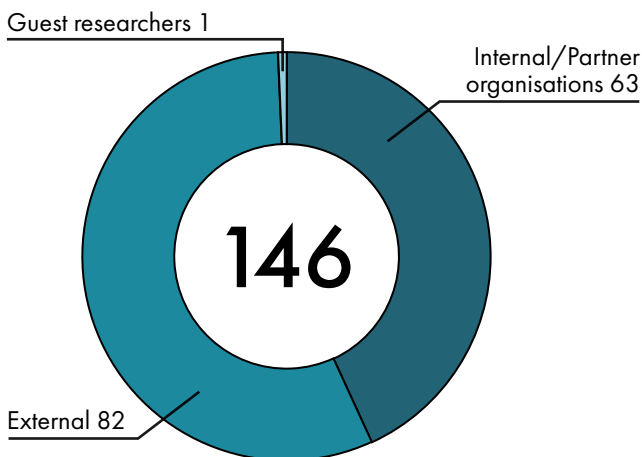
LINXS Events



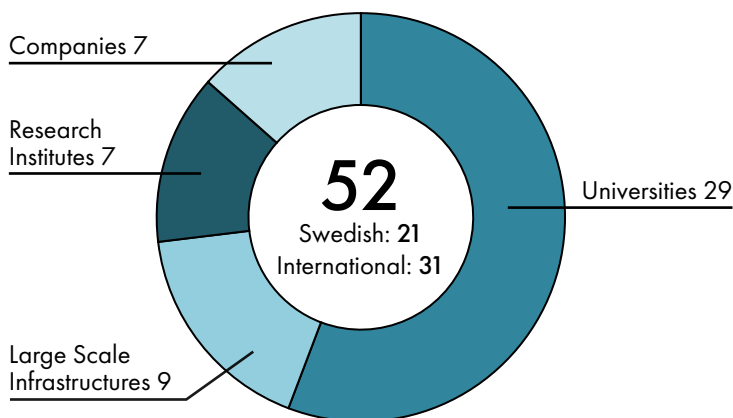
Type of Events



LINXS Fellows



Organisations involved in LINXS core and working groups and visiting researcher programme



Communication & outreach

2179 Subscribers to the LINXS newsletter

6 Newsletters

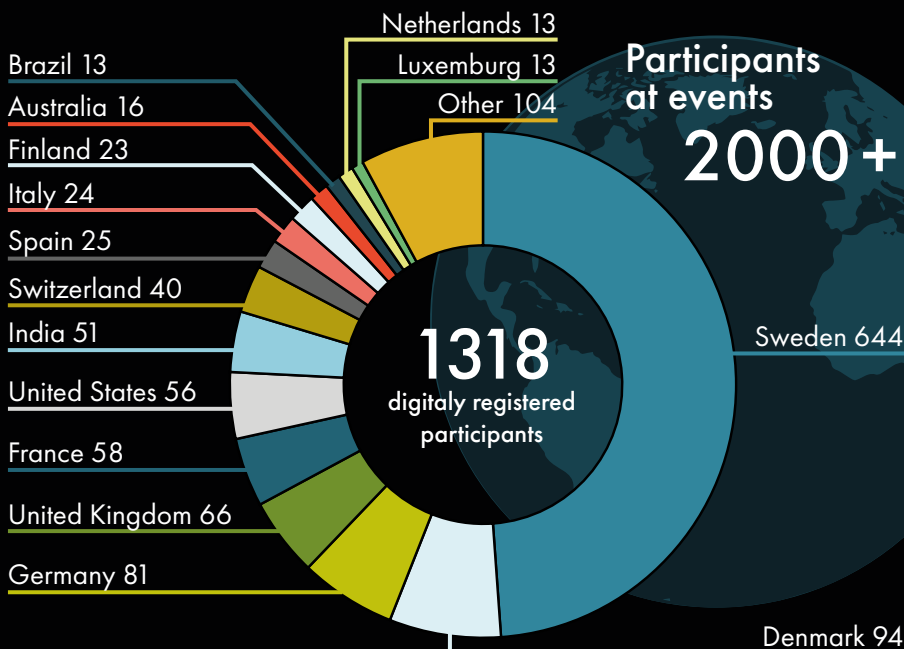
811 LinkedIn followers

224 Twitter followers

Keynote speakers

73 total

36% Female 64% Male



Organisation

Scientific Advisory Board



Prof. Stefan U. Egelhaaf

SAB Chair – Area Soft Matter
Stefan is a full professor (Soft Condensed Matter Physics) at the Heinrich-Heine University Düsseldorf. Interested in the physics of soft condensed matter, in particular its non-equilibrium behaviour. His research focuses on the behaviour of colloidal systems under external fields, their relaxation to equilibrium, and metastable states.

fields, their relaxation to equilibrium, and metastable states.



Prof. Lise Arleth

SAB Member – Area Life Sciences
Lise is a Professor and Head of the The Structural Biophysics Group at the Niels Bohr Institute, Faculty of Science, Denmark. Her main research topics include biophysics and physical chemistry with the main focus on structural investigations of macromolecules and their aggregates in solution.

aggregates in solution.



Prof. Marco Stampanoni

SAB Member – Area Life Sciences
Marco is the Head of the SLS Tomography group and Professor for X-ray imaging at the ETH Zürich. With his team, he is working on novel X-ray based instruments and methods for non-invasive investigations of samples at various length scales, ranging from single cells up to humans. Research areas encompass a host of X-ray based imaging techniques for biosystems and clinical applications.

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Prof. Christiane Alba-Simionesco

SAB Member – Area Hard Matter
Christiane is the Head of the Laboratoire Léon Brillouin (LLB). Her research focuses on the thermodynamics, structure and dynamics of molecular condensed phases, liquid, solid and amorphous. She is a leading expert in several experimental techniques and methods bridging the gap between time and space scales, improving theoretical concepts and analytical modelling.

bridging the gap between time and space scales, improving theoretical concepts and analytical modelling.



Prof. Andrew Boothroyd

SAB Member – Area Hard Matter
Andrew is a Professor of Physics at the University of Oxford, a Tutorial Fellow of Oriel College, and Associate Head of the Department of Physics. He is an experimentalist with broad interests in the fundamental properties of quantum materials, especially superconductors, magnetic materials, and topological semimetals. His group uses neutron and synchrotron X-ray scattering techniques to investigate novel electronic ground states and associated physical phenomena.

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Prof. Daan Frenkel

ex-SAB Member – Area Soft Matter
Daan is a former Head of the Department of Chemistry at Cambridge University and the current Director of Research. The Frenkel group focuses on the numerical exploration of routes to design novel, self-assembling structures and materials. In particular, the group is interested in the possibilities that bio-molecular recognition and motor action offer to create complex, nano-structured materials.

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Prof. Christian Rüegg

ex-SAB Member – Area Hard Matter
Christian is the Director of the Paul Scherrer Institute and Professor of physics at the University of Geneva, ETH Zurich and EPF Lausanne. His research projects focus on systematic studies of strongly correlated quantum phenomena in low-dimensional spin systems, single-molecule and frustrated magnets, and novel emergent materials.

and frustrated magnets, and novel emergent materials.

The LINXS Scientific Advisory Board (SAB) is made up of high-level international researchers in science involving neutrons and X-rays. The SAB provides advice on the scientific direction and strategy for LINXS, based on ensuring a high standard in the academic quality.

Reflections from the Scientific Advisory Board 2021

“The SAB thanks the outgoing director Stephen Hall (as well as the LINXS staff and others involved in LINXS) for all the effort during these taxing times. Despite the restrictions due to the COVID-19 pandemic, the LINXS activities remained on a qualitatively and quantitatively very high level and were successfully extended to new (previously not planned) directions, and in particular: different online formats, which we expect to be very valuable also after the pandemic. The SAB extends a warm welcome to the new director Trevor Forsyth and wishes him success with the further development of LINXS. In general, the SAB is impressed by the current activities. The themes render LINXS a very active, dynamic, multifaceted, nationally and internationally well-connected and inspiring ‘place’.”

LINXS Management

Trevor Forsyth

LINXS Director. Professor of Molecular Biophysics at the Faculty of Medicine, Lund University. Head of the Life Sciences group at Institut Laue-Langevin in Grenoble 2000–2021 and a Senior fellow in Biology. He is also a Professor of Biophysics at Keele University in the United Kingdom.

Marie Skepö

LINXS Vice-Director, responsible for the focus area of Soft Matter. Professor, Docent and Head of Division of Theoretical Chemistry at the Faculty of Science, Lund University.

Stephen Hall

LINXS Co-Director responsible for the focus area of Hard Matter. Associate professor at the Dept. of Solid Mechanics at the Faculty of Engineering (LTH), where he is also in charge of the 4D-Imaging Lab X-ray tomography facility. Came to Sweden in 2011 after moving from Laboratoire 3R in Grenoble, France.

Oxana Klementieva

LINXS Co-Director, responsible for the focus area of Life Science. Associate senior lecturer and Head of the research group of Medical Microscopy, Faculty of Medicine, Lund University.

Anna Ntinidou

Anna Ntinidou is the head of administration responsible for operations and supporting future development. She is a senior project manager with long experience in implementing EU and nationally funded transdisciplinary projects.

LINXS Board

Anders Tunlid, Board Chair

Pro-Dean at the Faculty of Science, Prof. Microbial Ecology, Lund University.

Olof (Charlie) Karis

Head of the Dept of Physics & Astronomy, Prof. Experimental Physics, Uppsala University.

Heiner Linke

Deputy Dean LTH, Prof. Nanophysics, Lund University. Representing Faculty of Engineering LTH, Lund University.

Kajsa M. Paulsson

Group Leader, Experimental Medical Science. Representing Faculty of Medicine, Lund University.

Ulf Olsson

Prof. Physical Chemistry, Lund University. Representing Faculty of Science, Lund University.

Sindra Petersson Årsköld

Senior Advisor at the European Spallation Source ERIC.

Marjolein Thunnissen

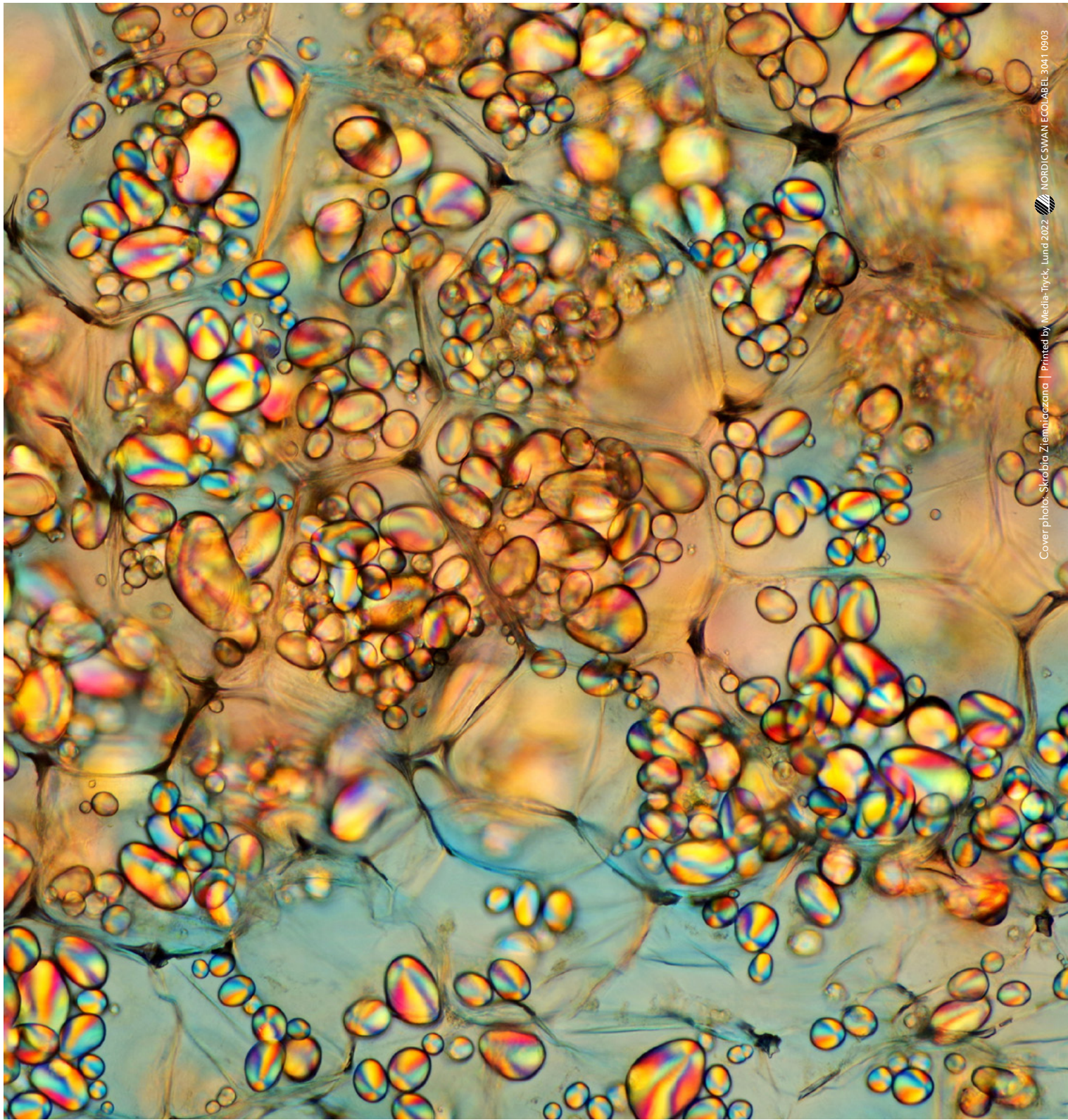
Life Science Director at MAX IV.

Hanna Sjö

Student representative, Lund University. President of the Science Student Union (LUNA).

Sandra Benter

Representative of the Science Doctoral Student Council (NDR), Lund University.



Cover photo: Skrabia Ziemniaczana | Printed by Media-Tryck, Lund 2022 | NORDIC SWAN ECO LABEL 3041 0903

A big THANK YOU to all those who have been active in LINXS and in particular to those who have contributed to our funding so far:



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Swedish Research Council

www.linxs.se

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