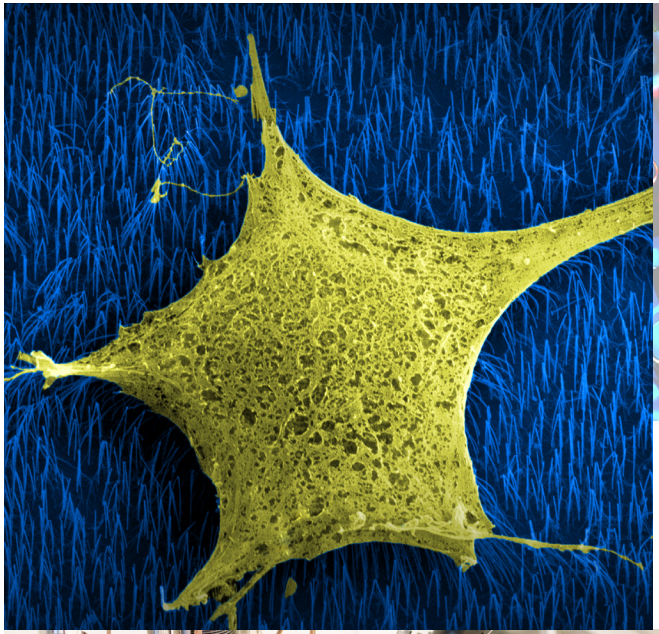
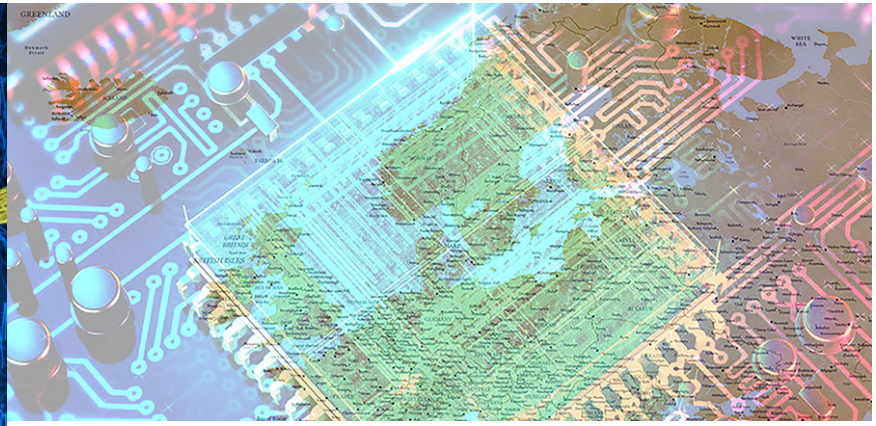




LUND UNIVERSITY

NanoLund

CENTER FOR NANOSCIENCE

At the Forefront of Nanoscience

NanoLund is the center for research, education and innovation within nanoscience at Lund University.

NanoLund engages more than 400 persons including researchers, students and staff, within the faculties of engineering, science and medicine. It is a strategic research area funded by the Swedish Government, and Sweden's largest research environment for nanoscience and nanotechnology.

Our ambition is to be a Great Place to do Nanoscience: an international, highly visible center that offers exceptional scientific opportunities, training, and career development. We do this through a strong culture of openness and by offering access to a wide range of state-of-the-art capabilities within characterization, nanofabrication and modelling.

NanoLund research topics range from materials science and quantum physics to applications in energy, electronics and semiconductors, photonics, life science and nanosafety.

Nanotechnology for the Future

Nanotechnology offers ground-breaking methods for addressing many of humankind's greatest challenges in a sustainable way.

We contribute to societal and sustainability challenges, for example in health and clean energy, using the tools of nanoscience and nanotechnology. We have identified four areas that we can help address:

ENABLING A SUSTAINABLE FUTURE

Paradigms and technologies for efficient harvesting and use of energy, and for nanomaterial-based products that are sustainable and safe from a life-cycle perspective.

A PATHWAY TO THE FUTURE INFORMATION ERA

New physical concepts, smart materials, nanoscale devices, sensors and their heterogeneous integration to enable next-generation information technology.

PRECISION MEDICINE

Nano- and microstructures for bio-medical research at the single-cell level and for fast point-of-care diagnostics, enabling targeted, individualized therapy.

INTERACTION WITH BUSINESS AND COMMUNITY

Collaboration with the private and public sectors both locally and internationally. Jointly we can address sustainable development goals, help solve societal challenges, and create new industry.

Materials & Manufacturing

Controlled synthesis and assembly of nanostructured materials are key in future sustainability applications.

Our area provides the physical basis for fundamental nanomaterials research and future nanotechnology and industrial production. We aim to relate atomic structure and properties of materials and understand when and how nanostructures form.

Our areas of expertise include:

COMPOUND MATERIAL SYNTHESIS AND INTEGRATION

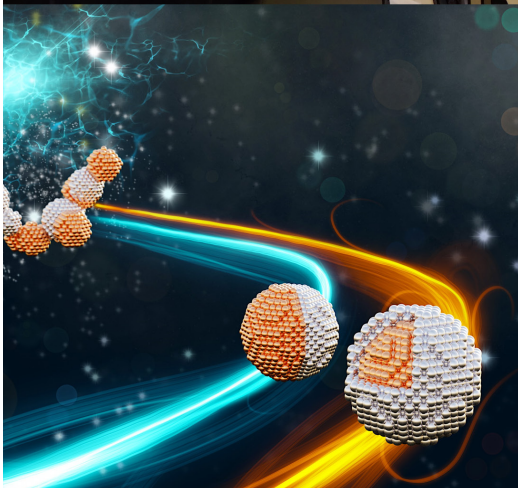
With a strong foundation in group III-V semiconductor vapour-phase synthesis and heterointegration, we explore earth-abundant semiconductors and ferroics for digital and energy applications. In situ investigations using e.g. ETEM and synchrotron X-rays provide atomic-scale understanding of the crystal growth process.

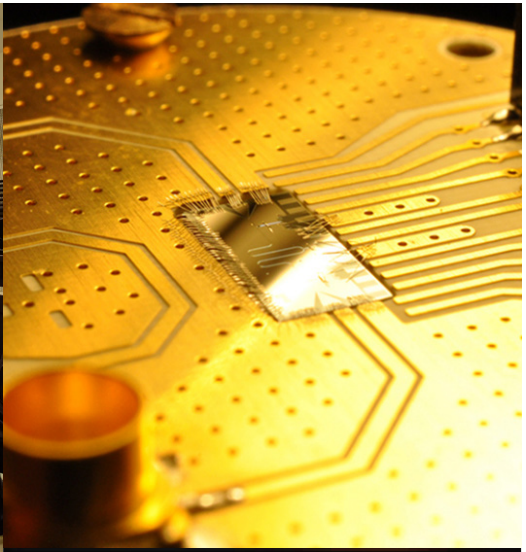
NANOPARTICLE SYNTHESIS AND ASSEMBLY

Multifunctional nanoparticles are synthesized via aerosol and solution-based methods, with tuning of e.g. semiconducting, magnetic and catalytic properties. Self-assembly into 1D, 2D, 3D and superlattice structures are explored for utilizing collective phenomena.

NANOFABRICATION AND INDUSTRIAL PRODUCTION

We explore novel nanofabrication methods such as directed self-assembly and template-assisted crystal growth. Metal products and production methods have multiple synergies with nanostructured materials e.g. through integration of nanosensors. Processes such as oxidation, melting and deformation are studied at the nano and atomic scales.





Quantum Physics

From fundamental physics to applications by describing and observing quantum phenomena.

In nanostructured systems pronounced quantum behaviour can be observed. We develop the theoretical tools to better describe few and many-body quantum systems in the presence of correlations and coherence, and we use advanced nanodevices to experimentally observe these effects. The goals are the discovery of new quantum physics and its potential future use in advanced quantum devices.

QUANTIZED STATES - ENTANGLED PARTICLES

Using quantum properties, like the superposition of states and entanglement, for fundamental physics studies and new technology development.

NANOTHERMODYNAMICS & TRANSPORT PHYSICS

Developing new paradigms for energy conversion and quantum devices at the nanoscale where thermal and quantum fluctuations profoundly alter the properties.

QUANTUM OPTICS

Studies of light interacting with nanoscale systems, in both experiment and theory to create and study hybridized quantum states between electrons and photons and to build electro-optical systems, devices and sensors.

Photons

We aspire to be a hub for scientists interested in light-matter interactions in nanoscale materials.

Our area assembles research on light-matter interactions using photons, from microwaves to X-rays, with the aim to understand light-triggered and light-emitting processes in nanoscale materials. We also use scattering of photons from various sources to characterize the diverse properties of these materials.

PROBING EXCITATIONS AND CHARGES IN NANOMATERIALS USING PHOTONS

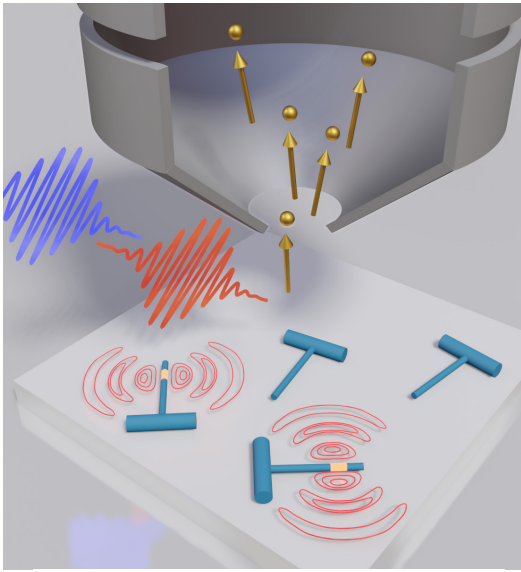
This includes spectroscopic investigation of III-V semiconductor, metal and hybrid nanostructures as well as microscopy of morphology and distribution of properties in these materials.

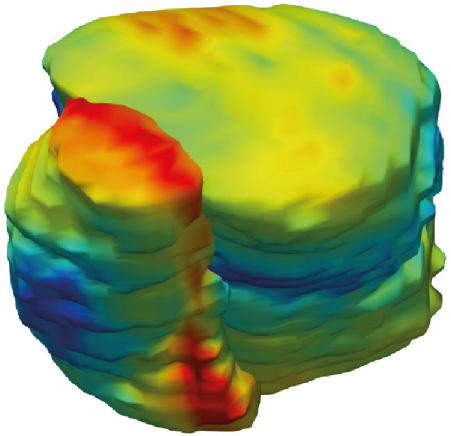
PHOTON EMITTERS, DETECTORS AND CONVERTERS

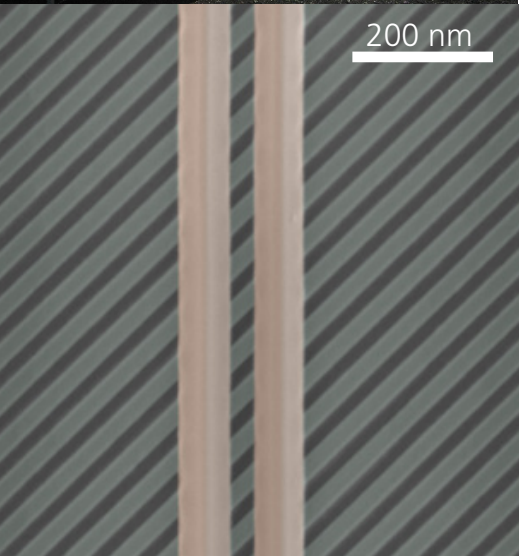
We work with semiconductor-based light sources and detectors, as well as microwave photonics and study photovoltaic and photocatalytic materials/devices.

X-RAY CHARACTERIZATION OF NANOSTRUCTURES

Characterization of nanostructured devices using high-resolution X-ray methods and spectroscopy and investigation of materials in situ and in operando, including their composition and strain.







Semiconductor Technology

Semiconductors are vital for information technology, which is why we emphasize this field's research for high-performance electric and optical devices.

Devices and applications based on semiconductors are at the heart of modern society. Within our research area, we aim to develop and understand new materials, structures, and concepts for applications in high-performance electronic, optical, and energy-harvesting devices and applications.

ELECTRONIC DEVICES

Research on novel high-performance devices to meet the ongoing digitalization and electrification, ranging from wide bandgap devices for power electronics to efficient memory and devices ideally suited for the implementation of artificial intelligence to quantum-enabled cryogenic electronics.

ENERGY HARVESTING

Developing semiconductor nanowires for a future generation of solar cells to harvest from the most plentiful renewable energy source on our planet, the sun.

ELECTRO OPTICAL DEVICES

To study controlled emission and enable detection of photons we design and fabricate semiconductor devices.

Life Science & Nano

Unravelling fundamental cellular mechanisms for use in biomedical applications.

We open new possibilities for fundamental studies in life science by designing nanostructures of relevance for cells and biomolecules. The structures can also be used to create new tools for devices and diagnostics. Our research results are translated into applications within biophysics, brain science, and personalized therapy.

UNDERSTANDING NANOBIO INTERACTIONS

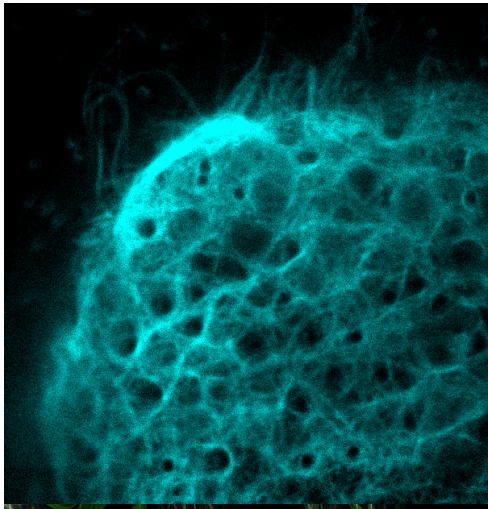
We use clever model-systems, designed nanostructures and advanced optics to understand biological interactions on the nanoscale. We study mechanistic properties and measure live bioprocesses. We also make use of biological phenomena to develop unconventional computation of combinatorial problems.

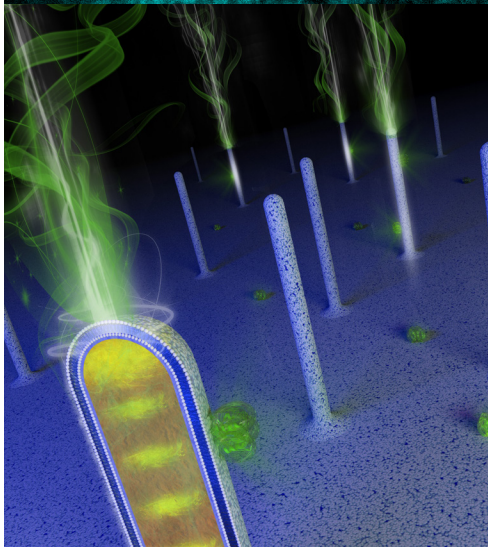
SINGLE-CELL AND SINGLE-MOLECULE BIOLOGY AND ENGINEERING

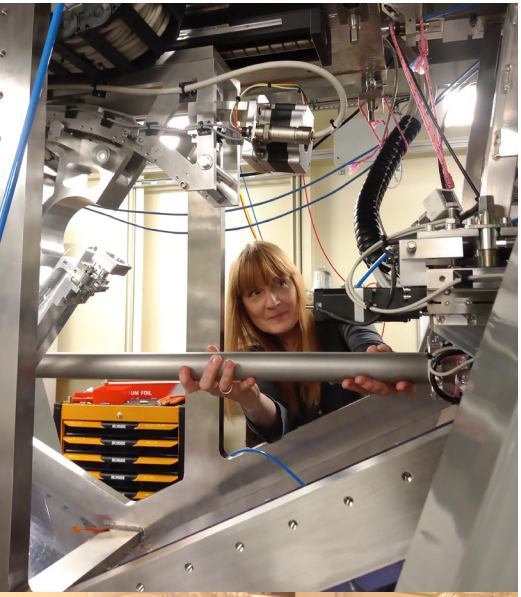
We develop and use advanced nano- and microstructured surfaces, particles and devices to study single-cells and single-molecules in parallel. This can be used for high-throughput devices with high accuracy and sensitivity.

NANOPROBES AND SENSORS

Miniaturization and careful choice of materials allow us to develop ultra-sensitive probes for discovery of low concentrations of analytes as well as monitoring electrical signals in biological tissue. Our applications range from minimally invasive neuro-electrodes to biosensors with single-molecule sensitivity.







Nanosafety

In a rapidly evolving research field, it is crucial to understand the impact of nanomaterials on human health and the environment.

Our overall objective is to increase our understanding of the fundamental connections between particle properties and human- and environmental toxicology, as well as of emissions and exposure in all stages of the lifecycle of a nanomaterial. The research aims at providing the tools needed to implement the concept of Safe(r)-and-sustainable-by-design in the development and production of novel materials.

We are involved in several EU collaborations, e.g. developing Safe-by-design strategies for advanced high aspect ratio and multicomponent materials, developing a platform for comprehensive analysis methods at the nanomaterial-cell interface, and working to bridge the gaps in nanosafety for animal-free prediction of adverse outcomes.

EMISSION AND EXPOSURE ASSESSMENT

We assess "real world" emissions and exposure in all stages of the life cycle of a nanomaterial.

BIOLOGICAL EFFECTS

We study eco-toxicological effects on all levels, from single-celled organisms to ecosystems.

RISK ASSESSMENT AND RISK MANAGEMENT

We combine nano-related exposure and toxicity knowledge with state-of-the-art procedures for risk management.

Lund Nano Lab

Lund Nano Lab (LNL) is an open-access cleanroom nanofabrication facility, which provides state-of-the-art equipment and expertise in the fabrication and characterization of nanostructures and semiconductor material devices used in basic and applied research.

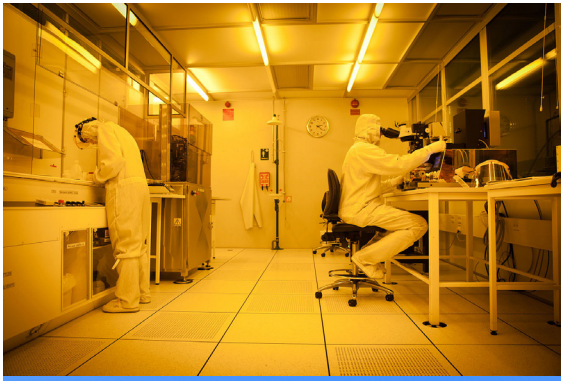
LNL provides academic researchers, entrepreneurs and industrial users with access to a cutting-edge cleanroom facility. We are staffed with process experts who are available to train and guide you. We educate students enrolled at Lund University and participate in outreach activities for the local community and society.

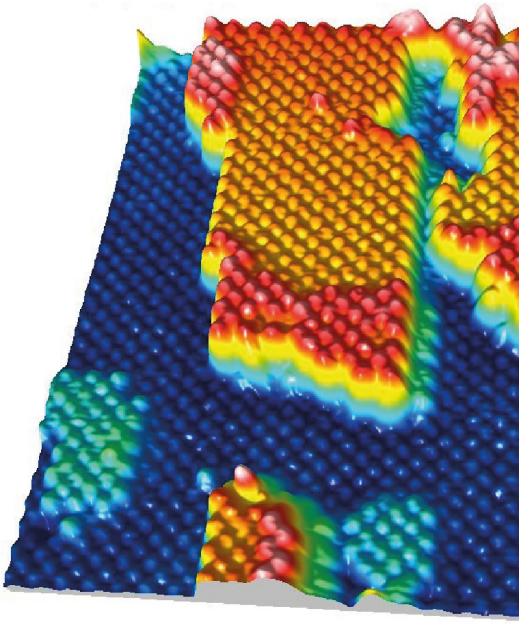
We continuously invest in new semiconductor processing and metrology equipment to enable our user base to stay at the forefront of research activities.

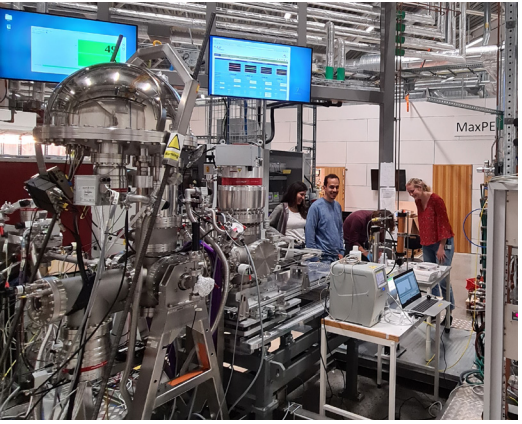
LNL is part of Myfab, the Swedish national research infrastructure for micro- and nanofabrication and we cooperate closely with other major Scandinavian cleanrooms.

NANOLAB SCIENCE VILLAGE

Lund University will build Nanolab Science Village, a new cleanroom facility that will provide unique opportunities for research and collaboration with industry aiming to improve conditions for human life and climate through nanotechnology. Nanolab Science Village will be the first step towards establishing the University's presence in the burgeoning Science Village, located between the research infrastructures MAX IV and ESS. Nanolab Science Village will be the third large, advanced research infrastructure for materials science in the area.







Lund Nano Characterization Labs

Exploring nanostructures with a variety of complementary tools.

Lund Nano Characterization Labs, LNCL, include an extensive range of cutting-edge characterization instruments and techniques distributed across Lund University. We have access to virtually all standard characterization tools in nanoscience, all at a high-quality level. We further have access to several worldwide unique tools and facilities located in Lund.

Our researchers are heavily involved in designing, developing, and refining cutting-edge nanocharacterization tools, not only in Lund but also at an international level. At LNCL, we integrate these activities to give NanoLund's researchers access to all these tools as well as to train them in their usage.

STRUCTURAL CHARACTERIZATION
down to the atomic scale, using a variety of techniques including scanning probe and electron microscopy as well as preparing for experiments at ESS.

OPTO-ELECTRONIC STUDIES
using spectroscopy over a wide wavelength range and down to ultrashort timescales.

IN SITU AND IN OPERANDO EXPERIMENTS AT MAX IV
for exploring synthesis, properties, and performance of nanostructures and aerosol nanoparticles.

Education & Outreach

Our research findings are important corner stones when we communicate the potential of nanoscience.

We work to share our knowledge in order to help address important needs in society and to inspire young people to engage in the development of nanoscience. NanoLund has a variety of initiatives that aim at educating and informing our society and coming generations of scientists.

UNDERGRADUATE STUDENTS

We contribute to the intertwining of undergraduate education and research by giving specialised courses and by providing thesis projects. Students on all levels and in all study programs at Lund University are welcome to join as a NanoLund student member to participate in student seminars and retreats.

PHD STUDENTS

PhD students constitute roughly a third of the staff engaged in NanoLund and are an important and integrated part of the research conducted. NanoLund PhD students are eligible for funding for international research visits and are offered a mentor program for career development. Dedicated PhD students can be awarded NanoLund distinction.

OUTREACH

All our members are encouraged to join our dedicated outreach program where we inform society about the possibilities of nanoscience and -technology. Activities include visits to schools, popular science articles, teacher training, and public talks.

Collaboration & Innovation

By supporting collaboration and innovation, we help address societal challenges.

Nanoscience and nanotechnology hold great potential to contribute to new solutions needed to address pressing global challenges. By introducing cutting-edge technology and combining the fields of science and engineering within the physical, biological, and digital arenas it is possible to come up with radically new ideas and innovations.

Researchers and students within NanoLund are encouraged to validate how knowledge and results can be developed to benefit society. By engaging with companies and partners we aim to develop a good understanding of their needs and create common grounds to address the challenges in collaboration. We strive to develop long-term research partnerships built on mutual trust, world-leading research and education of generations to come.

We work in close collaboration with LU Innovation to help support and fund researchers and students to develop their ideas into new methods, products and services. We are very proud of all the companies spun out of NanoLund – as many as 30 companies since the start of the research center in 1988.

We are looking for partners. Do you want to get involved?

NanoLund in numbers

NanoLund is Sweden's largest research environment for nanoscience and nanotechnology. NanoLund is founded on the basis of the Nanometer Structure Consortium (nmC) that was initiated in Lund in 1988. Since 2009 NanoLund has the status of a Strategic Research Area and as such we are provided long-term financial support from the Swedish Government.

441 persons
engaged in 2022

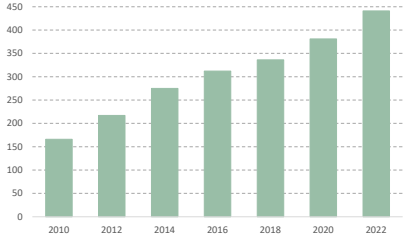
239 MSEK
in funding in 2022

428 publications
in 2022

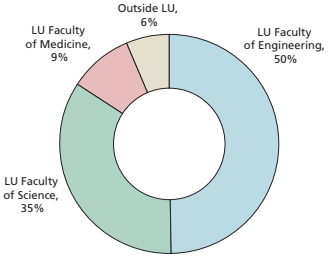
20 ERC awards
since 2009

30 spin-off companies
since the start in 1988

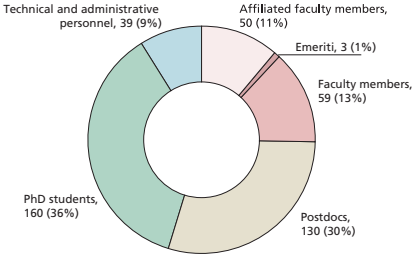
Development of the number of persons engaged in NanoLund 2010 – 2022



NanoLund persons' faculty affiliation in 2022



NanoLund per personnel categories in 2022



A Great Place to do Nanoscience

NanoLund is part of Lund University, one of the largest universities in Sweden and ranked among the top 100 universities in the world. Lund is situated in the southernmost part of Sweden, very close to Copenhagen, Denmark. The international airport of Copenhagen is only 40 minutes away by train.

In Science Village in the north-east of Lund, a unique international, innovative research and entrepreneurial environment is emerging with NanoLund and Nanolab Science Village being pioneers in the establishment of a new campus for Lund University. Here we will form a center for multidisciplinary materials research together with the world-leading research facilities ESS, the European Spallation Source, and the synchrotron radiation facility MAX IV, endowing researchers with unparalleled opportunities to provide humanity with new knowledge.

For more information

Website: www.nano.lu.se
E-mail: info@nano.lu.se
LinkedIn: https://www.linkedin.com/company/nanolund/

ARE YOU INTERESTED IN LUND NANO LAB?
Website: www.nano.lu.se/facilities/lund-nano-lab

LUND UNIVERSITY

NanoLund
CENTER FOR NANOSCIENCE

Images: Page 1: Henrik Persson, Jesper Löfman. Page 2:Charlotte Carlberg Bärg. 4: Mikelis Marnauza, Namsoon Eom. Page 5: Waqar Khan, Tönu Pullerits. Page 6: Lukas Wittenbecher, Dimitry Dzhigaev adapted from New J. Phys. (2021) 23 063035. Page 7: Erik Lind. Page 8: Elke Hebisch, Phillip Krantz. Page 9: Fanny Bergman, Mikael Ekvall. Page 10: Nils Bergendal, Ivan Maximov. Page 11: Johan Knutsson, Calle Preger. Page 12: Evelina Lindén, Ivan Maximov. Page 13: By courtesy of Cellevate AB. Page 15: Cobe. Page 16: Charlotte Carlberg Bärg. **Printed by:** Media-Tryck, Lund University, 2023

LUND UNIVERSITY

NANOLUND
Box 118
221 00 Lund
Tel 046-222 00 00
www.nano.lu.se