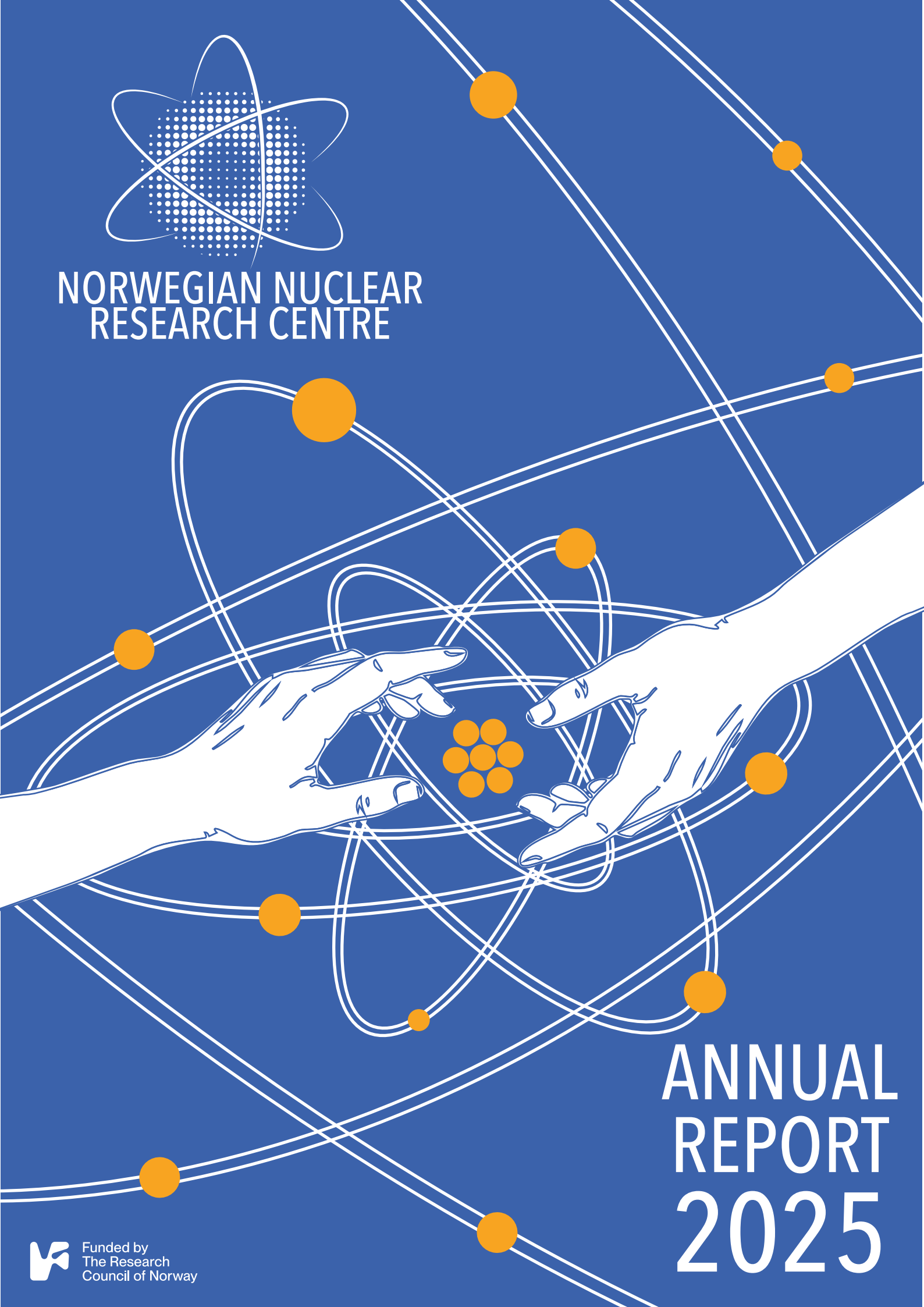
NORWEGIAN NUCLEAR RESEARCH CENTRE



ANNUAL REPORT 2025

Funded by
The Research
Council of Norway

Contact

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Physics building
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Photo: NASA, James Webb Telescope

Preface



Photo: Yngve Vogt

The Norwegian Nuclear Research Centre (NNRC) is now fully operational and the year 2025 has been very productive both in terms of research, education and outreach. With this report we aim to provide insight into the Centre activities in 2025, including scientific highlights from the different Research Themes, as well as the initiatives and work done on education and outreach.

The different research themes have, in addition to maintaining excellent research, further increased their collaboration across partners and research topics in 2025. This has led to more integrated projects, greater exchange of expertise, and a stronger shared identity across the Centre. The activity level in terms of conferences, workshops, and outreach has also remained high, ensuring strong visibility in both the academic communities and society at large. We have further strengthened the Centre's research capacity by recruiting highly qualified staff, both permanent and temporary. In addition we welcomed our new Centre coordinator Gøril Mellem, who has done an excellent job administrating the centre.

The nuclear science study programmes, at both the University of Oslo (UiO) and the Norwegian University of Life Sciences (NMBU), are very popular and have also in 2025 attracted highly motivated students from several disciplines. Both universities have invested significantly in developing new, specialized courses at bachelor, master, and PhD level. Several of these courses are developed and taught in close collaboration with NNRC partners from industry, both from radiopharmaceutical industry and nuclear energy related industry, ensuring that our students gain relevant competence and early exposure to industry challenges and career opportunities.

As a result of the feedback from the Advisory Board, the NNRC management team initiated the first in a series of strategy seminars. The goal is to have several meetings with all members of NNRC, and in addition topical meetings for the separate Research Themes. The overall goal of the Centre will remain: "To increase nuclear competence in Norway" meaning to increase the number of people with nuclear competence to meet Norway's long-term needs in the nuclear field. This strategic process will continue into 2026 and result in an updated long-term roadmap that will guide our priorities in research, education, innovation, and infrastructure needs.

On behalf of the NNRC management team, I would like to thank all the members of NNRC, including all the academic and industry partners, for helping create a good and collaborative work environment, and for your contribution to excellent research, education and outreach. I would also like to thank our NNRC Board, the Advisory Board and the Research Council of Norway, for their strong engagement and support.

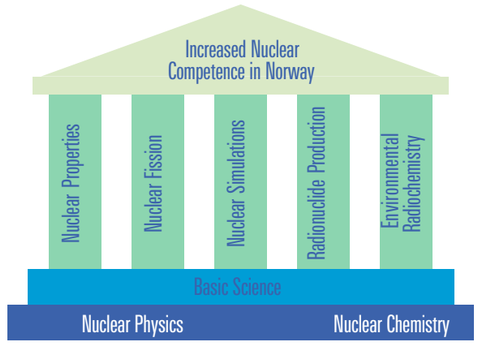
Sunniva Siem
Centre Director of The Norwegian Nuclear Research Centre

About the Centre

The goal of the Norwegian Nuclear Research Centre is to increase Norway's competence within the fields of nuclear physics and nuclear chemistry.

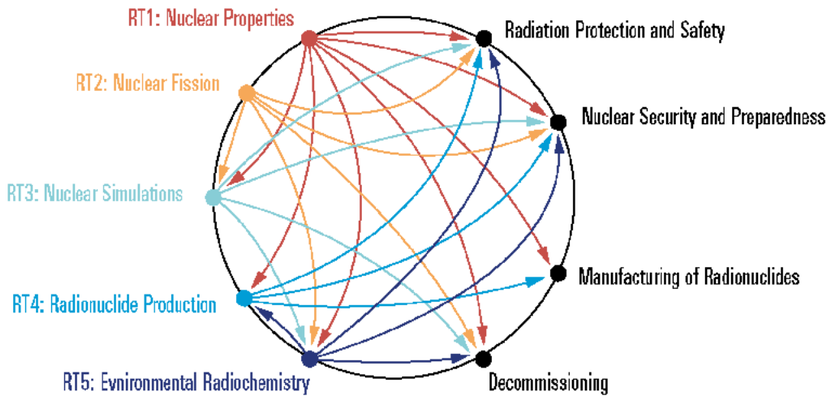
An important aspect of this Centre is the training of the next generation of scientists to fulfill our society's urgent need for competence in nuclear science. It is an important goal of the Centre to provide excellent candidates for both academia, industry, and public institutions.

The Centre is a cross-disciplinary collaboration between Norway's leading institutions within nuclear physics and nuclear chemistry research: University of Oslo (UiO), Norwegian University of Life Sciences (NMBU), and Institute for Energy Technology (IFE). We also have a range of collaborators, including universities abroad and the nuclear industry in Norway.



Research Themes

Nuclear Competence Needs



Our work includes research on properties of the atomic nucleus as well as applications within the fields of medicine, energy, and preparedness.

We address major research questions within the nuclear field ranging from fundamental nuclear physics and nuclear chemistry to medical isotope production, reactor simulations, and modelling the spread of radioactivity in the environment.



Organisation

The Centre is distributed over four different campuses, UiO, NMBU and IFE.

This centre brings together the three main nuclear research environments in Norway – UiO, NMBU, and IFE, – under a national umbrella, fostering collaboration across disciplines and enabling research at the highest international level.

At UiO, key contributions come from the disciplines of nuclear physics and -chemistry, and radiopharmacy. NMBU, are Norway's leading expertise in environmental nuclear chemistry. At IFE the focus areas are nuclear chemistry, and - technology, and decommissioning. Together, these complementary research environments provide an integrated and comprehensive national competence in nuclear science.

The NNRC Board

The board's main task is to oversee the Centre's activities and use of resources to ensure that the goals within its defined research themes are achieved. Three Board meetings were held in 2025.







Photo: UiO, NMBU, IFE, private

Susanne Viefers

Board member,
Head of the Department of Physics, University of Oslo

Martin Foss

Board member,
Vice President Energy, Institute for Energy Technology

Ågot Aakra

Board member,
Dean, Faculty of Environmental Sciences and Natural Resource Management, Norwegian University of Life Sciences





Bjørn Jamtveit

Chair of the board
(until 31 July 2025),
Pro-Rector,
University of Oslo

Øystein Prytz

Chair of the board,
(from 1 August 2025)
Vice Dean of Research, Faculty of Mathematics and Natural Sciences, University of Oslo

Alternate participants with the right to attend meetings

- Bjørn Axel Gran, Vice President, IFE Halden - substitute for Martin Foss
- Christian Dye, Research Director, IFE - substitute for Martin Foss
- Kathrin Bjerknes, Head of the Department of Pharmacy, UiO - substitute for Susanne Viefers
- Stian Svelle, Head of the Department of Chemistry, UiO, substitute for Susanne Viefers
- Jan Vermaat Research Dean, Faculty of Environmental Sciences and Natural Resource Management, NMBU - substitute for Ågot Aakra
- Trond Inge Westgaard, Senior Adviser, The Research Council of Norway (RCN), observer

Centre Management Team







Photo: UiO, Caroline Roka, IFE, private

Centre Director

Professor Sunniva Siem at UiO in the field of experimental nuclear physics

Deputy Director

Professor Deborah Oughton at NMBU in the field of environmental radiochemistry

Deputy Director

Dr. István Szőke, Department head of the Applied Physical Science group at IFE in Halden





Team member

Dr. Liv Stavsetra,
Senior scientist in Nuclear Chemistry at IFE Kjeller

Centre Coordinator

Gøril Mellem

The NNRC Management Team meets on a weekly basis.

Adjunct professors



Bent Wilhelm Schoultz
Norsk Medisinsk Syklotronsenter



Syed Nuruddin
Norsk Medisinsk Syklotronsenter



István Szőke
IFE



Tomas K. Eriksen
IFE



Håvar Gausemel
Bayer AS



Sunniva Johanne Rose
Norsk Kjernekraft AS



Liv Stavsetra
IFE



Ole Reistad
DNV

Eleven Adjunct Professors are currently affiliated with the Centre. They contribute 20% of their time to the academic environments at either UiO or NMBU, alongside their primary responsibilities outside the university. Five adjunct Professors are funded by the Centre: Dr. Tomas Eriksen, Associate professor Verena Pichler, Associate Professor Ali Al-Adili and Dr. Liv Stavsetra at UiO and Dr. Istvan Szöke at NMBU.



Ali Al-Adili
Uppsala University



Sindre Hassfjell
Thor Medical AS



Verena Pichler
University of Vienna

The remaining six Adjunct Professors are externally funded by their primary employers: Sunniva Rose (Norsk Kjernekraft), Bent Wilhelm Schoultz (Norsk Medisinsk Syklotronsenter), Syed Mohammad Nuruddin (Norsk Medisinsk Syklotronsenter), Ole Reistad (DNV), Sindre Hassfjell (Thor Medical) and Håvar Gausemel (Bayer). In addition, Advansia is funding the equivalent of a 20% position, but the time is shared between several of their employees. Both research and education in the Centre benefit significantly from having all these experts from industry spend their time at the University, contributing to research, supervision of master's and PhD students, and teaching courses.

Photo: Private, IFE, UiO, NMS, DNV, Mikael Wallerstedt

Principal Investigators



RT1: Nuclear Properties
Associate Professor **Eda Sahin** (UiO)in experimental Nuclear Physics



RT2: Nuclear Fission
Professor **Sunniva Siem** (UiO) in experimental Nuclear Physics



RT3: Nuclear Simulations
Dr. **István Szőke** (IFE) in Nuclear Physics



RT 4: Radionuclide Production and Speciation
Dr. **Liv Stavsetra** (IFE) in Nuclear Chemistry



RT 5: Environmental Radiochemistry and source Characterisation
Professor **Ole Christian Lind** (NMBU) in Environmental Radiochemistry



Education (UiO)
Professor **Andreas Görgen** in experimental Nuclear Physics



Education (NMBU)
Professor **Lindis Skipperud** in Environmental Radiochemistry

Photo: Private, IFE, UiO, Håkon Sparre – NMBU

Highlights of 2025

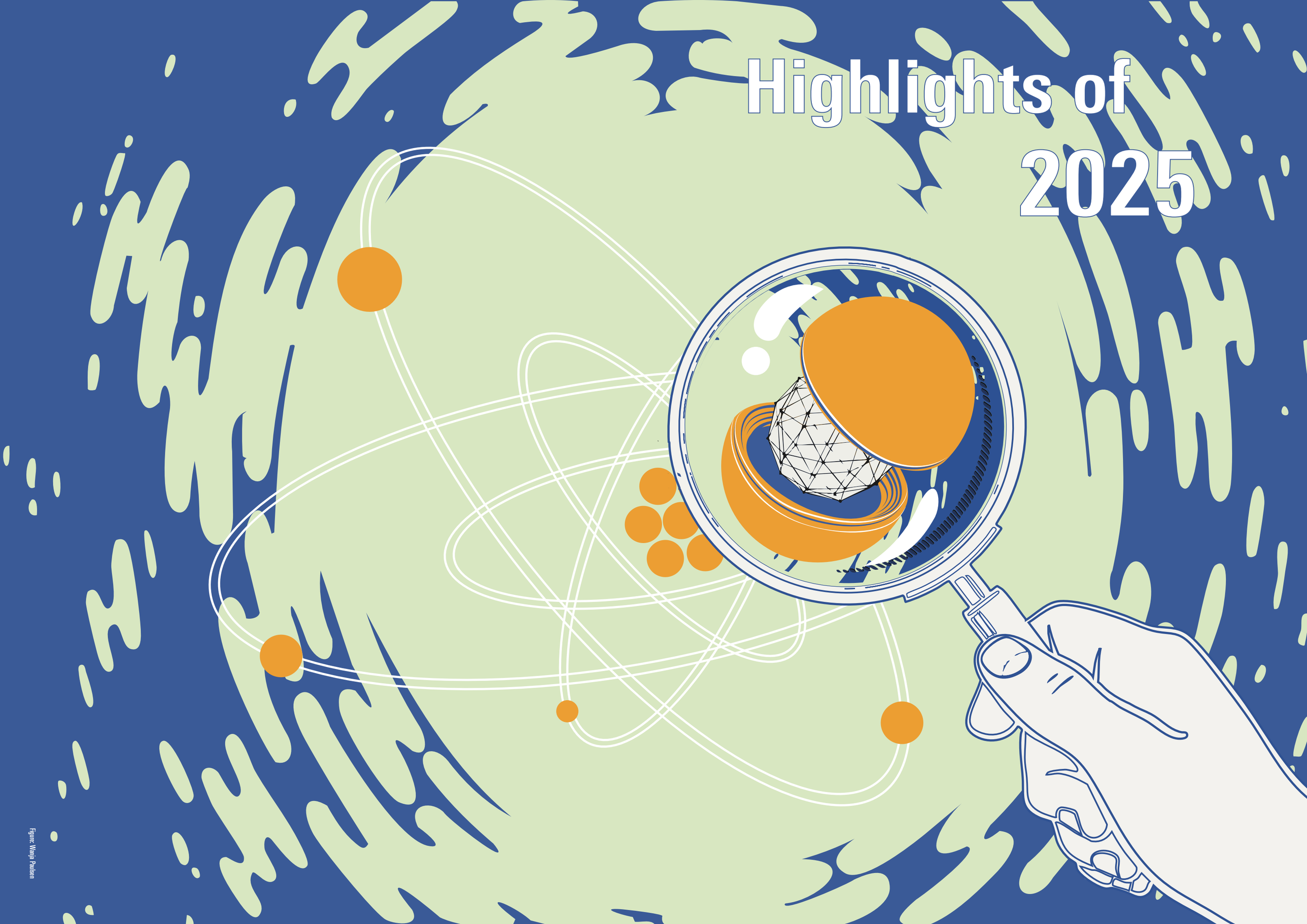


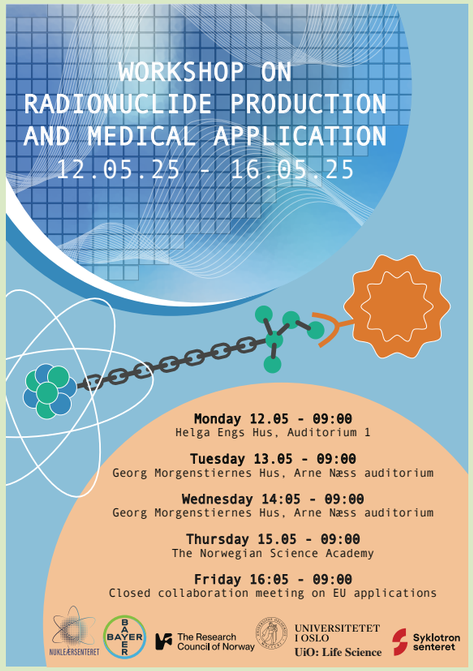
Figure: Wiebke Paulsen

Conferences, Meetings and Prizes

Workshop on radionuclide production and medical applications

The Norwegian Nuclear Research Centre (NNRC) arranged a workshop on radionuclide production and medical applications between 12-16 May 2025, to provide an alternative discussion forum to the canceled 13th International Symposium of Targeted Alpha Therapy (TAT) which was supposed to be held in Oslo this year. This new workshop was expanded to contain all types of radionuclides rather than to focus on only alpha emitters, opening the possibilities for knowledge exchange and discussions among participants from academia and industry. Researchers from academia, hospitals, and industry from Norway and all over the world gathered at the University of Oslo for a successful week focused on cancer treatments using radioactivity. The workshop was so successful that it will now be held as a biannual event at the University of Oslo.

Norway holds a strong position in targeted radionuclide therapy, with unique research expertise, production capabilities, and clinical experience. The key to Norway's ability to compete globally in this field is its strong collaboration between academia, hospitals, and industry. One of the main goals of NNRC and its partners is to further strengthen nuclear medicine competence and collaboration in Norway, not only through education, but also via workshops and dedicated collaboration meetings.



Poster for the Workshop on radionuclide production and medical application. Figure: Wanja Paulsen

Nuclear Norway: Should Thorium be part of the deal?

A workshop was arranged by NNRC and the Norwegian Academy of Science and Letters on 11 June 2025 as part of the debate on whether Norway should adopt nuclear energy. What would Norway's future look like if the country decided to embrace nuclear power? Given Norway's rich thorium resources, what role might thorium play? To address these questions, NNRC brought together a broad range of stakeholders, covering Norwegian academia, authorities and industry, and international experts to exchange views and participate in facilitated discussion.



Poster for the workshop "Nuclear Norway: Should Thorium be part of the deal?" Figure: Wanja Paulsen

Short presentations were held to address the role of thorium in nuclear industry, its asset as a Norwegian resource, and general perspectives on 'new nuclear' from other countries. In summary, the general conclusion was that, if Norway were to adopt nuclear power, thorium should certainly be part of the discussion. However, it would neither be the first nor the only technology to be developed. A smart, pragmatic, and distinctly Norwegian strategy would be to focus on uranium-based SMRs in the near term, while in parallel developing a long-term thorium programme: "Uranium Now + Thorium Next".. The near-term program could focus on fast deployment, and building regulatory competence and public trust. A long-term research program, with EU and Nordic collaboration, could position Norway internationally as a research leader providing exportable intellectual competence, not just electricity.

Fysikermøtet 2025 at NTNU in Trondheim

Fysikermøtet, the Norwegian Physical Society's biannual meeting welcomed physicists working in academia, research, secondary education and industry to Trondheim from 16-18 June 2025. The Norwegian Nuclear Research Centre had a strong presence in this year's meeting, with most of the master's students and Ph.D. students attending the conference, in addition to permanent staff.

The Norwegian Physical Society awards three prizes during these meetings: Martin Landrø's Prize for best MSc-thesis, the education prize and the outreach prize. Two of these prizes was awarded to students of NNRC this year. Ph.D. fellow Gulla Louise Serville Torvund was awarded Martin Landrø's Prize for best MsC-thesis for her MsC thesis "Multi-recycling of plutonium in PWRs with the MMOX strategy". Ph.D. fellow Elise Malmer Martinsen was awarded the outreach prize for her work in organizing public lectures in nuclear physics, as well as efforts and public lectures aiming at recruiting students to nuclear physics and physics in general.



Fysikermøtet 2025 was held at NTNU.

Photo: Wanja Paulsen

Martin Landrø's Prize for best Master's thesis

Gulla Louise Serville Torvund won the prize for best Master's thesis where she has conducted important simulations of reactors that provide insights into how to limit the amount of long-lived radioactive waste from reactors in France. She has demonstrated how multi-recycling of used fuel will reduce the growth of plutonium and decrease the need for new fuel. The thesis is relevant to several of the UN's Sustainable Development Goals. By reducing the need for newly produced reactor fuel, this contributes to making more resources available for energy production, thereby addressing the objective of clean energy for all. Additionally, the thesis is relevant for reducing the need for climate-impacting uranium mines for the extraction of reactor fuel. The results will help inform decision-makers when important decisions are made regarding future investments in recycling facilities for reactor fuel. The master's project has resulted in an article in the Annals of Nuclear Energy, with Torvund as the first author.



Gulla Louise Serville Torvund

Photo: Private

Norwegian Physical Society prize for outreach in science



Elise Malmer Martinsen

Photo: UiO

Elise Malmer Martinsen outreach efforts were recognized by the Norwegian Physical Society. The past year she has been the main organizer of a series of lectures and debates consisting of four evenings with various topics in nuclear physics and nuclear technology. The series was held at Scene Domus Bibliotheca in downtown Oslo from October 2024 to February 2025. The events included popular science presentations from both young researchers and established experts, followed by panel discussions where the audience had the opportunity to ask questions and engage in discussions with the experts. In addition to organizing the series, she also gave a lecture explaining how radionuclides can be used in cancer medicine. This lecture series reached a wide audience with several hundred participants from diverse backgrounds. Martinsen has also given several lectures for high school students who visited the University of Oslo. In January 2025, she shared experiences from her master's thesis and life as a student with around 400 students from various high schools over two days. Feedback from both students and teachers has been very positive, and students reported that they felt more motivated to study physics after attending her lecture.

Workshop on Radiolabeling Techniques for PET and SPECT

Radiolabeling is a routine and essential procedure in medical applications, particularly for producing radiopharmaceuticals used in Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT). These imaging techniques depend on the precise incorporation of radionuclides into biologically relevant molecules to enable in vivo visualization of physiological and pathological processes.

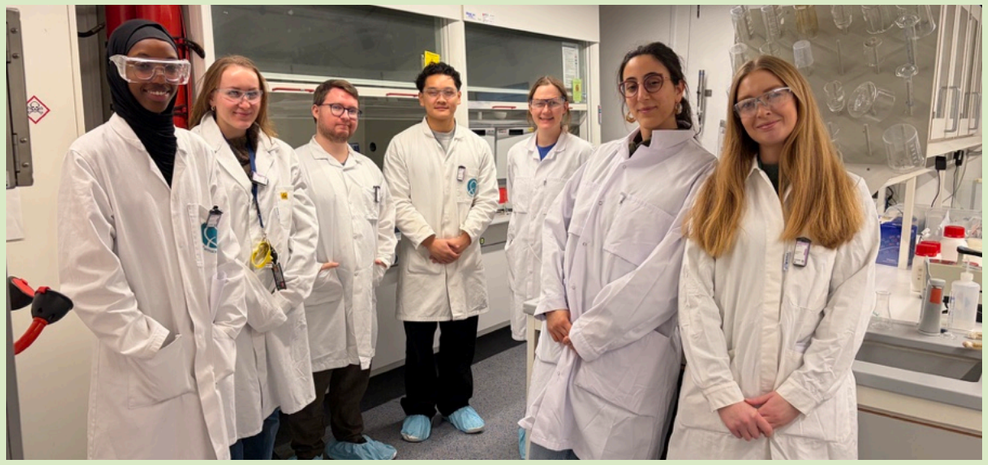
To illustrate this process, a two-day workshop was held at the Radiochemistry Labs (MU51 and MU54) at the Oslo Cyclotron Laboratory (OCL) on 17–18 December 2025. The sessions, which included demonstrations of the radiolabeling of [^{68}Ga]NOTA-CXCR4, [^{18}F]Al-NOTA-CXCR4, and new molecules developed at the Department of Pharmacy, University of Oslo, were led by Associate Professor Verena Pichler from the Section for Pharmaceutical Chemistry.

The primary goal of these experiments was educational: to demonstrate and compare different radiolabeling strategies commonly used in nuclear medicine, with a focus on both chelation-based radiometal labeling and direct fluorine-18 substitution approaches.



Associate Professor Verena Pichler is demonstrating for the students.

Photo: Marianna Canonaco



All the participants at the workshop on radiolabeling techniques for PET and SPECT.

Photo: Sunniva Siem

DigiDECOM – NuclearNEXT 2025

The 2025 DigiDECOM–NuclearNEXT event was organized by the members of Research Theme 3 of the NNRC from 17-21 of November 2025. Demonstrations showcased digital twin modules, radiological scenario tools and modelling concepts reflecting RT3's work across AI, robotics and advanced simulation. The event strengthened competence building and facilitated collaboration between research, industry and regulatory groups, providing a platform to disseminate the work performed within NNRC.

The 2025 NuclearNEXT edition of DigiDECOM in Halden was a major international meeting place for researchers, industry representatives and authorities working with digitalisation and emerging technologies in the nuclear sector. The event provided a structured arena for knowledge exchange, discussion and networking across organisational and disciplinary boundaries, with a strong emphasis on practical use cases and lessons learned from ongoing activities.

In addition to technical presentations, the programme included demonstrations and dialogue sessions that highlighted how digital tools, modelling approaches and advanced simulation methods can support nuclear decommissioning, safety and operational planning. NNRC used the event to present ongoing work, facilitate interaction between different stakeholder groups and strengthen connections between national and international initiatives. As such, NuclearNEXT 2025 played an important role in reinforcing the visibility of NNRC and its contribution to competence building and collaboration within the nuclear community.



The official poster of DigiDECOM - NuclearNEXT 2025.
Figure: István Szoke



Pictures from DigiDECOM - NuclearNEXT 2025.
Photos: István Szoke

Honorary Seminar celebrating Professor Emeritus Tor Bjørnstad

On 15 September 2025, NNRC hosted an honorary seminar to celebrate Professor Emeritus Tor Bjørnstad at the Norwegian Academy of Science and Letters in Oslo. The event gathered colleagues, former students and collaborators from academia, research institutes, industry and international organizations to recognize his remarkable scientific career and lasting influence on Norwegian nuclear research.



Professor Emeritus Tor Bjørnstad in his office.

Photo: Private

Bjørnstad is professor emeritus at the University of Oslo and former Research Leader and Department Head at the Institute for Energy Technology (IFE). Over several decades, he played a key role in advancing nuclear chemistry and physics in Norway, with particular emphasis on tracer technology. Through this work, he became a vital link between academic research and industrial application, contributing significantly to developments in the oil and gas sector, as well as to medical and environmental applications.

The seminar program reflected the wide range of his contributions. After welcome addresses, a full day of academic presentations covered topics as tracer technology, nuclear chemistry, medical radionuclides, alpha-emitters for therapy, PET development, thorium research and education in nuclear science. Several talks combined scientific perspectives with personal reflections, highlighting Professor Bjørnstad's role as an inspiring mentor, lecturer, and colleague. The event also marked his 80th jubilee and included video greetings from international collaborators.

The day concluded with an aperitif and dinner, providing an opportunity for informal discussions and shared memories. The seminar served as a worthy recognition of Professor Bjørnstad's scientific achievements, leadership and lasting influence within the nuclear research community.



The honorary seminar to celebrate Professor Emeritus Tor Bjørnstad at the Norwegian Academy of Science and Letters in Oslo.

Photo: Private

Annual meeting NNRC 2025

The NNRC annual meeting 2025 was held at the Norwegian Academy of Science and Letters on 16 December 2025 and gathered the Norwegian nuclear research community together with representatives from the NNRC's Board and Advisory Board members, for a full day of scientific presentations, strategic discussions, and networking. The programme combined overview talks on NNRC research tasks and infrastructure with focused contributions on nuclear physics, fission experiments, nuclear modelling and AI, environmental radiochemistry, radionuclide behaviour, nuclear security, and applications ranging from medical isotope production to nuclear power and industrial strategy, illustrating the breadth of NNRC's research portfolio and national collaborations.

Education, outreach, and competence-building were also key themes, with dedicated contributions on education and outreach activities at UiO/NMBU, plans for stakeholder workshops related to nuclear master programmes, and research on teaching and learning about stars and the chemical elements. The meeting concluded with a joint dinner at the Academy, providing an important arena for informal discussion and further strengthening of the NNRC network.



The annual meeting of NNRC in 2025 at the Norwegian Academy of Science and letters. Photo: Yngve Vogt

Kroll Zirconium Medal Award to the Halden Reactor Project

In 2025, the Halden Reactor Project (HRP) was awarded the prestigious Kroll Zirconium Medal for its internationally recognised contributions to zirconium alloy research for nuclear applications. This was the first time since the medal's establishment in 1975 that the award was presented to a team, highlighting the collective impact of HRP's work.



The Kroll Zirconium Medal

Photo: ASTM international

The award was presented at ASTM International's 21st Symposium on Zirconium in the Nuclear Power Industry on 16 April 2025 in Aix-en-Provence, France. The HRP team comprised Peter Bennett, Torill Karlsen, Réka Szőke, Terje Tverberg, Margaret McGrath, Erik Kolstad, and Wolfgang Wiesenack, with the acceptance speech delivered by Réka Szőke, who is also a member of NNRC under Research Theme 3.

The recognition underlines the international significance of HRP's materials research legacy, which represents a unique and highly valued historical knowledge base for Norwegian nuclear research. Preserving and building on this legacy is a key objective of NNRC, and the award reinforces the importance of these efforts for national competence building and continued international engagement.

Yevgeniya Tomkiv elected as president of the SHARE Platform

Yevgeniya Tomkiv was elected President of the European Platform for Social Sciences and Humanities in Ionising Radiation Research (SHARE) from January 2025. Previously a board member and head of communications, Tomkiv now leads SHARE's mission to stimulate the integration of social sciences and humanities into the research, practice, and policy sectors related to ionizing radiation. This prestigious appointment recognizes her as a leading researcher in risk communication and stakeholder engagement within the field of radiation protection and nuclear emergency preparedness. Her leadership enhances NMBU and the NNRC's global influence, fostering dialogue between academia and civil society to improve societal resilience and safety in the face of radiological risks.



Photo: Jon Petter Helgesen-Enestad

Researcher Yevgeniya Tomkiv

Poster prize at 16th Nuclear Data for Science and Technology Conference

At the 16th Nuclear Data for Science and Technology Conference (ND2025), held in Madrid, Spain, in June 2025, PhD student Lauren Tracy Bell (UiO) was awarded the Third Best Poster Prize for her poster entitled "Extracting the nuclear level density and γray strength function of ^{90}Zr". Her contribution was selected from a total of 115 posters presented at the conference. This prize is awarded to young researchers in recognition of outstanding scientific quality and excellence in presentation.



Among the 115 posters presented, 7 were chosen as having outstanding scientific quality. PhD student Lauren Tracy Bell is leftmost in the picture.

Photo: ND2025

Yara's Birkeland Prize 2025

The Yara's Birkeland Prize is an annual award established by Yara International to honor the legacy of Kristian Birkeland, one of Norway's most prominent scientists and a pioneer in both physics and chemistry. The prize recognizes outstanding young researchers in these fields who have made significant contributions to fundamental or applied science, often with a focus on innovation and the responsible use of natural resources. In 2026, Yara's Birkeland Prize was awarded to Dr. Maria Markova for her contributions in the fields of nuclear physics and astrophysics with her PhD thesis "Approaching the Pygmy Dipole Resonance in Sn isotopes with the Oslo method".



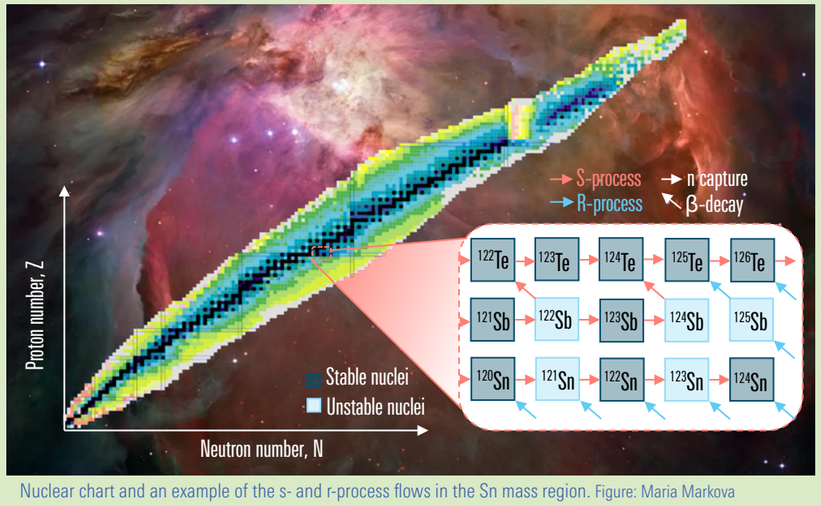
Dr. Maria Markova recieving the prize from Per Knudsen, Yara.

Photo: Maria Markova

The pygmy dipole resonance and the synthesis of heavy elements in the Universe

Collective resonance phenomena in atomic nuclei provide unique information on nuclear structure and properties of nuclear matter. One of them, the pygmy dipole resonance (PDR), is commonly recognised as a potential key to the description of dense neutron-rich matter, thus bridging the gap between heavy, neutron-rich nuclei and massive astrophysical objects, such as neutron stars. In this regard, systematic experimental studies of the PDR are highly desired to guide improvements in the theoretical description of its underlying mechanisms.

In her work, Markova shed new light on the evolution of the PDR in eleven isotopes of tin with increasing neutron-to-proton ratio. Her experimental results are based on a systematic analysis of data from the Oslo Cyclotron Laboratory using the so-called Oslo method. Her work shows that the macroscopic interpretation of the PDR as a neutron skin oscillation is too simple. Her thesis contributed not only to the theoretical understanding of the PDR, but also to better understanding its impact on the production of heavy elements in the astrophysical neutron-capture processes. More specifically, her experimental findings helped to reduce uncertainties for the production of tin isotopes in large-scale astrophysical simulations.



Nuclear chart and an example of the s- and r-process flows in the Sn mass region. Figure: Maria Markova

Report on nuclear power in Norway

This year Vala Maria Valsdottír, an industry PhD fellow at the University of Oslo and a data scientist at Crayon Consulting, published her expert report on nuclear power "Establishing nuclear power in Norway: Costs, challenges and possibilities (Etablering av kjernekraft i Norge: Kostnader, utfordringer og muligheter)". This report has been written to contribute knowledge, insights, and nuances to the debate about the role of nuclear power in Norway's future energy mix. In a time marked by climate challenges, electrification, and the need for supply security, it is crucial that the discussion about new technology is based on facts, experiences, and realistic assessments. The report addresses several topics and questions for the energy industry of Norway, including "Why is nuclear power expensive today – and what can we learn from previous projects?", "What are the main cost drivers in the construction of nuclear power plants?", and "What role can Norway play in future nuclear power initiatives?".

The report was written by Vala Maria Valsdottír under the support of the Norwegian Nuclear Research Centre, where both Vala and her employer, Crayon Consulting, are partners. In addition, NNRC leader Professor Sunniva Siem and Post. Doc. Martin Hjelmland from the Norwegian University of Science and Technology (NTNU) contributed to the report with expertise and supervision.

As part of the publication of this report, an event was held at Domus Bibliotheca on 20.05.2025, where Valsdottir presented the report and its main findings, alongside contributions from several prominent voices in nuclear research and energy. From Norwegian industry, the speakers included Peter Keyser from AFRY Norway, István Szöke from IFE, Sunniva Rose from Norsk Kjernekraft AS, and co-author Martin Hjelmland from NTNU. Offering a broader European perspective, Cécile Maisonneuve, nuclear power expert and former Vice President at AREVA, discussed international and European developments in the nuclear power sector.

The event concluded with an open Q&A session, where Valsdottir and the other speakers responded to a range of insightful questions from the audience, effectively serving as an expert panel.



Picture of the event at Domus Bibliotheca, from left to right: Istvan Szöke (IFE), Susanne Møgster Sperrevik (Norsk Kjernekraft AS), Martin Hjelmeland (NTNU), Vala Maria Valsdottir (UiO and Crayon COnsulting); Cécile Maisonneuve (DECYSIVE), Peter Keyser (AFRY), and Gulla Louise Serville Torvund (UiO). Photo: Private

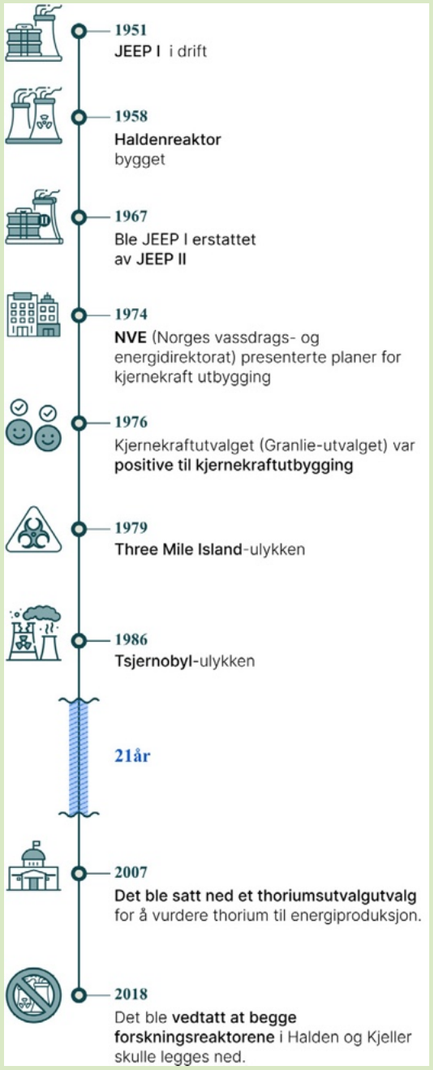


Figure from Vala's expert report, depicting the history of nuclear power in Norway. Figure: Vala Valsdottír, Crayon Consulting

From Rock to Targeted Cancer Therapy

In June 2025, Kristoffer Poulsen became the first student to graduate with a Master's Degree in Nuclear Technology with his master thesis on "Method of development for detection of ^{227}Ac in ^{225}Ac samples" in Nuclear Technology at the Department of Physics at the University of Oslo.

In autumn 2023, Kristoffer Poulsen started a master's degree in Nuclear Technology at the University of Oslo. He was given the opportunity to carry out an industrial master project in collaboration with the pharmaceutical company Bayer AS, an associate partner of NNRC. The project allowed him to work at the intersection of university research and real-world cancer treatment development. "My motivation was to work on something that could make a real difference," Kristoffer emphasizes.



Photo: Kristina Kantima Østvold

Kristoffer Poulsen, the first student to graduate the master's degree in Nuclear Technology at University of Oslo

His master project focused on improving how scientists can detect tiny traces of an unwanted radioactive substance, actinium-227, in samples that contain actinium-225. Actinium-225 is attracting strong interest in cancer treatment because it releases intense radiation that can be directed at tumor cells, while minimizing damage to surrounding healthy tissue. Another advantage is that it disappears quickly from the body: its radiation fades within ten days.
Actinium-227, however, behaves differently. It remains radioactive for nearly 22 years and could stay in the body for decades. "That's why even very small amounts of actinium-227 matter," Kristoffer explains. Making sure that medical isotopes are as pure as possible is therefore crucial for patient safety.

One of the main challenges was that the two forms of actinium are chemically indistinguishable, making them impossible to separate with standard laboratory techniques. Kristoffer instead took a clever detour. Actinium-227 slowly transforms into another radioactive element, thorium-227, a substance that does not come from actinium-225. By isolating and measuring this decay product, he could determine how much actinium-227 had originally been present. "Finding a way to work backwards from the decay product was the key," he says. The method developed in the master's project provides an important tool for quality control in the production of medical isotopes.

Working closely with industry gave Kristoffer hands-on experience with radioactive materials, radiation safety, and laboratory process development - skills he now uses daily in his position at Thor Medical AS. There, the focus is on producing thorium-228, which is used to create other radioactive substances for targeted cancer therapy. "I use the same core knowledge every day, and it's rewarding to know that my work can contribute to better cancer treatments in the future," Kristoffer concludes.

A saga on the Hoyle state in ^{12}C

Few nuclei capture the interest of nuclear physicists like Carbon-12 (^{12}C), a vital element for organic life, that plays a key role in understanding many important processes in nuclear physics. Central to the allure of ^{12}C is the Hoyle state, a resonance in its energy spectrum, which plays a pivotal role in nucleosynthesis during stellar evolution. In 2025 former PhD student, and currently a Post-Doc, Wanja Paulsen defended her PhD thesis on the subject of the Hoyle state. The unique structure and formation of the Hoyle state make it a convergence point for nuclear astrophysics and nuclear structure, making precise characterisation of the nature of this state essential for nuclear physicists.



Photo: UiO

Wanja Paulsen, post-doc at NNRC

Studying the Hoyle state

The Hoyle state is an excited, short-lived resonance in ^{12}C that enhances the rate of fusion of three alpha particles (helium nuclei) to into carbon inside stars. Ever since its prediction by Fred Hoyle in 1953 and its experimental discovery soon after, the Hoyle state has been subject of extensive experimental measurements and theoretical investigations to understand its structure and role for astrophysics.In the field of nuclear astrophysics, an important aspect is to understand how the Hoyle state acts as a bottleneck in the creation of elements. Studies of the electromagnetic decay paths from the Hoyle state are crucial for constraining the mechanisms of ^{12}C production in stars, as precise measurements of these decays have a direct impact on stellar evolution models.

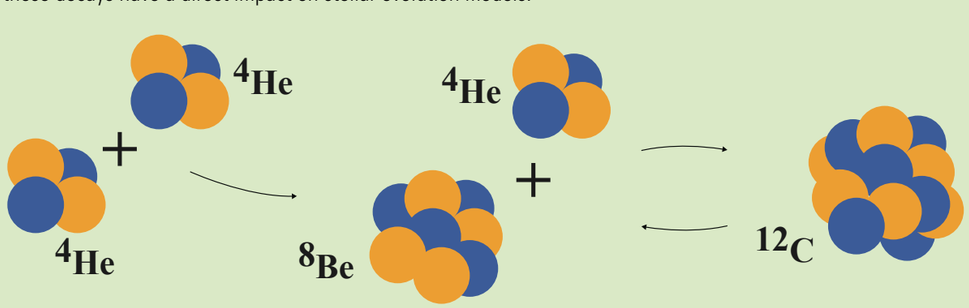
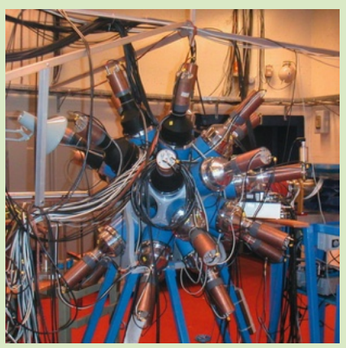


Illustration demonstrating the formation of ^{12}C through the triple-alpha process. Figure: Wanja Paulsen

A surprising result measured in Oslo

In 2020, a measurement of the gamma decay from the Hoyle state in ^{12}C, translated to the probability of creating ^{12}C, reignited an interest in studying this state within the nuclear physics community. This measurement was performed by researchers from the Australian National University at the Oslo Cyclotron Laboratory in 2014 using CACTUS, the previous gamma-ray detector at OCL. The collaborative measurement between Australian National University and University of Oslo yielded a highly discrepant and controversial result, which was approximately 50% larger than the previously accepted value in the research literature.

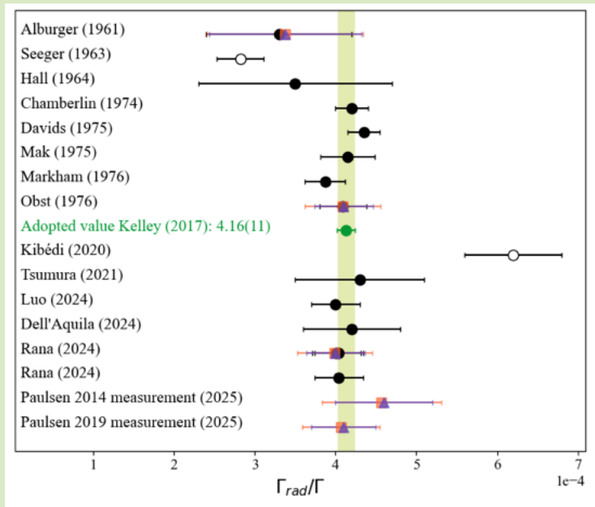


The old CACTUS array stationed at Oslo Cyclotron Laboratory. Photo: Ann-Cecilie Larsen

An investigation into the controversy and a new measurement in Oslo

Wanja's PhD started with a measurement intended to be an independent confirmation of this newly found controversial value using the then new OSCAR detectors at the Oslo Cyclotron Laboratory. However, this measurement was the beginning of an extensive and thorough research journey, characterised by multiple investigations, experimental undertakings and long scientific discussions. In 2025 her PhD work was finally published in a scientific journal with a new independent measurement and a complete reanalysis of the previous measurement. Her new results include analyses of eight different experiments performed with both CACTUS and OSCAR, which she uses to validate her methodology for reanalyzing the data previously collected at OCL that had yielded the highly discrepant value.

These new results were in agreement with the historical values and all the new measurements performed worldwide to investigate this controversial result from 2020. Her complete reanalysis of the data from these controversial results also showed step-by-step what had created such a discrepant value in the first place, presenting a complete picture with new and old measurements, solving this scientific dispute.





Upper photo: The new OSCAR array stationed at Oslo Cyclotron Laboratory.

Left figure: All measurements of the gamma decay from the Hoyle state, translating to the probability of creating ^{12}C through the triple-alpha process.

The open circle shows marked as "Kibédi" is the controversial result performed at OCL in 2014. Wanja Paulsen's reanalysis of this data from 2014 is shown in "Paulsen 2014 measurement", while the results from the new measurement is shown in "Wanja Paulsen 2019 measurement".

Figure and photo: Wanja Paulsen

The path forward - FRIPRO International Mobility Grant

After her PhD dissertation in September 2025, Wanja went on to be awarded the FRIPRO international mobility research grant from the Research Council of Norway, with her project "Advanced Measurements in Carbon-fusion REactions: Cross-section Measurements and Branching Ratios" (AMiCARE). Wanja will spend the next two years in Italy at University of Naples Federico II, performing carbon-fusion measurements at the CIRCE laboratory in Caserta, Italy. She will also be a part of the LUNANOVA collaboration, an ERC Synergy collaboration between Italy, Germany and Spain. After these two years in Italy, Wanja will return to University of Oslo to continue working on her research on nuclear astrophysics.



University of Naples Federico II in Naples, Italy.

Photo: University of Naples Federico II

Update on NuCapCure

Funded by the European Union

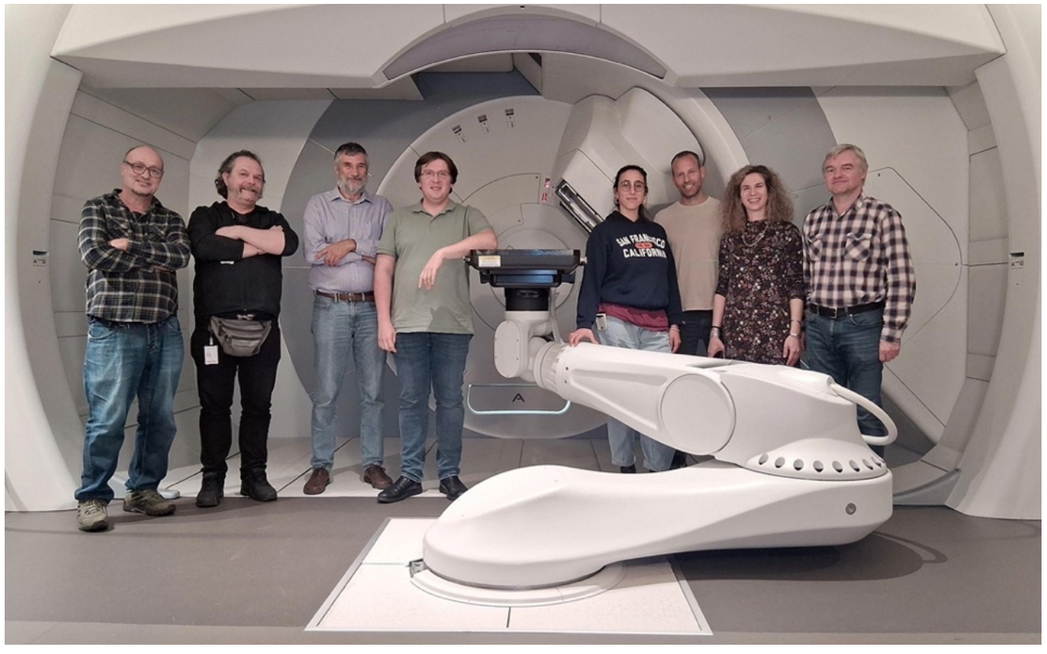
What is NuCapCure?

NuCapCure is an international research project that aims to make cancer treatment both more precise and more powerful by "hijacking" a process that already takes place inside our cells. Cancer cells have an altered metabolism and often produce certain molecules, such as those involved in haem (the red pigment in blood) biosynthesis, in abnormal ways. NuCapCure develops new chemical compounds that take advantage of this difference: they are designed to accumulate specifically in cancer cells and then become highly effective when exposed to proton or neutron radiation, leaving healthy tissue as unharmed as possible.

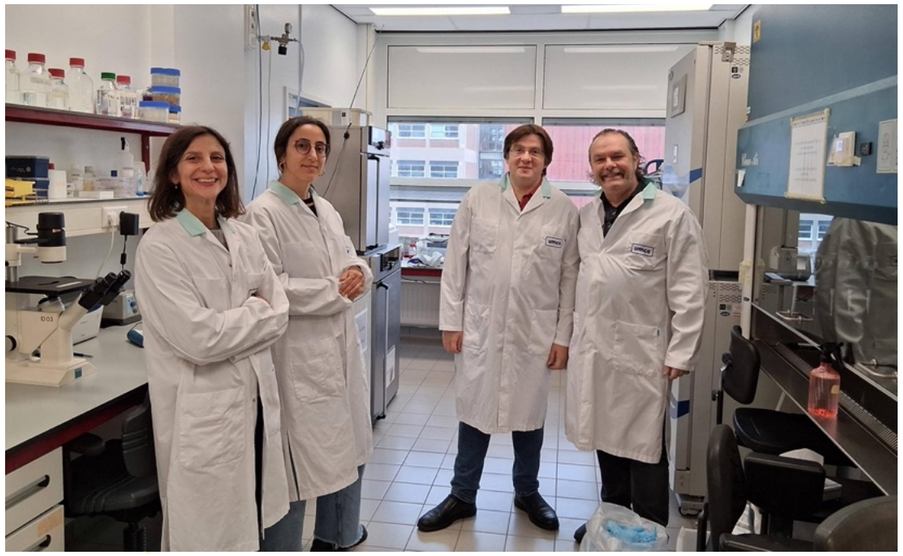
Backed by €6 million from the European Innovation Council, the project unites universities, hospitals and research centres across Europe.

Over the past year, the NuCapCure project has made substantial progress in synthesis, experimentation, and consortium integration. Several NuCapCure compounds have been successfully synthesised by project partners at Charles University in Prague and Galchimia, a chamical company in Spain,, providing the essential material base for the next phase of biological and physical evaluation. Experimental activities have intensified, with a team from the National Centre for Scientific Research Demokritos (NCSRD) in Athens visiting the Oslo Cyclotron Laboratory (OCL, UiO) and Oslo University Hospital Proton Centre (OUS) from 19–29 October 2025 to perform benchmark experiments to validate and refine their simulation models.

Shortly thereafter, the UiO/OUS team visited collaborators at the University Medical Centre Groningen (UMCG) from 2–8 November 2025 for joint experiments, further consolidating internal collaboration and knowledge transfer within the consortium. Since then, NuCapCure proton in vitro experiments have been ongoing in Oslo at both UiO and OUS, generating critical data on compound performance under clinically relevant irradiation conditions.



Visit of the NCSRD NuCapCure team to Oslo Proton Centre OUS. From left to right: K. Stefanopoulos (NCSRD), T. Theodossiou (UiO/OUS), I. Stamatelatos (NCSRD), A. Kleinauskas (UiO), M. Canonaco (UiO), T. Hompland (OUS), A. Kalamara (NCSRD) and P. Juzenas (OUS). Photo: Oslo Proton Centre OUS



Visit of UiO/OUS members to UMCG in Groningen. From left to right: Lara Barazzuol (UMCG), M. Canonaco (UiO/OUS), A. Kleinauskas (UiO) and T. Theodossiou (UiO/OUS). Photo: T. Theodossiou

In parallel, NuCapCure neutron experiments have commenced at the nuclear reactor in Řež (Czech Republic), conducted by partners at BIOCEV with the on-site participation of UiO and NCSRD representatives, and these studies are currently ongoing. Collectively, these experimental campaigns represent a major milestone in assessing the therapeutic potential and mechanistic performance of the newly developed NuCapCure compounds.

The project team has also strengthened its expertise through the inclusion of Dr. Athanasios (Thanos) Papakyriakou in the NCSRD group. He is contributing advanced molecular docking studies to support and guide the structure-based design and chemical synthesis efforts within NuCapCure, thereby enhancing the rational development of next-generation compounds.

Regarding coordination and dissemination, the second annual UiO/OUS NuCapCure meeting was successfully held on board the Oslo–Kiel ferry from 4–6 December 2025, providing a focused setting for scientific exchange, strategic planning, and team building.

Looking ahead, the third annual NuCapCure meeting is scheduled to take place in Athens, Greece, on 18–20 March 2026, where the consortium will present recent results and developments, align on scientific priorities, and define the next steps for advancing the project toward its overarching clinical and translational goals.



The second annual UiO/OUS NuCapCure annual meeting held on board of the Oslo-Kiel ferry from 4-6 December 2025. Photo: T. Theodossiou

New projects funded

EU PIANOFORTE: «MULTIPLEX» and «CIThARA»

PI of MULTIPLEX: Hans Christian Teien
PI of CIThARA: Erik Berge and Deborah Oughton



Photo: NMBU



Photo: Anniken Sanna/MET

RT5 has secured 5 million NOK for two new EU research projects under the Pianoforte EURATOM Programe: 1) MULTIPLEX (Metrics Used to Link sTressors for Integrated Protection of Living organisms EXposed to radiological and non-radioactive hazards), with Hans Christian Teien as NMBU PI; and 2) CIThARA (Citizen engagement, AI-supported decision and trust for radiological impact assessment and emergency response), with Erik Berge as MET PI and Deborah Oughton as NMBU PI. CIThARA adds to NMBUs growing research portfolio in emergency preparedness and management. MET contributes with the application of AI in atmospheric modelling, also including participation of NNRC PhD student Chayton Bouwmeester. NMBU will work on the use of AI in monitoring and citizen measurement, together with analysis of ethical challenges with the application of AI in emergency preparedness. MULTIPLEX is the first Pianoforte project addressing the environmental impact of radiological stressors, and NMBU will contribute across all WPs, including case studies from Niteelva, Norway and applications in decommissioning, both of which require a multiple hazards approach.

PIANOFORTE
EUROPEAN PARTNERSHIP FOR RADIATION PROTECTION RESEARCH

MULTIPLEX

CIThARA

Funded by
the European Union



Photo: NMBU

FRIPRO International mobility grant: «Advanced Measurements in CArbon-fusion REactions: Cross-section measurements and branching ratios (AMiCARE)»

PI: Wanja Paulsen



Photo: UiO

One of the Centre's former PhD students, Wanja Paulsen, has been awarded a FRIPRO International Mobility research grant from the Research Council of Norway with a timeline of four years and a budget of 7.2 MNOK. She received the good news on 21 November 2025, shortly after defending her PhD in September 2025. The four-year grant nicknamed AMiCARE will investigate low-energy cross-section measurements of carbon fusion. The first two years will be spent at the host institution, the University of Naples Federico II, where Wanja will also be immersed in the ERNA collaboration and the ERC synergy project LUNANOVA. The final two years will be based at the University of Oslo, where Wanja will carry out experiments at the Oslo Cyclotron Laboratory.

Funded by
The Research
Council of Norway

Infrastructure grant for new Germanium detectors

PI: Andreas Görgen



Photo: UiO

NNRC secured NOK 2.1 million in internal UiO funding for research infrastructure to procure two high-purity germanium (HPGe) detectors. Owing to their excellent energy resolution, HPGe detectors are essential and highly versatile instruments for gamma-ray spectroscopy in nuclear research.

The primary motivation for this acquisition is to strengthen laboratory-based teaching. Given the broad and societally relevant applications of HPGe detectors, it is crucial that students in nuclear technology gain hands-on experience with their use. Training in the operation, calibration, and data analysis associated with HPGe detectors provides students with critical competencies that are directly transferable to real-world challenges they are likely to encounter in their future careers.

Outside the teaching period of the nuclear instrumentation laboratory, the detectors will be available for research activities within NNRC, including Master's and PhD projects. Planned applications include cross-section measurements at OCL to optimize production routes for medical radionuclides using the stacked-target technique. The detectors are also envisaged for neutron activation studies with the HUNT neutron generator. In addition, selected experiments with the Oslo Scintillator Array (OSCAR) will benefit from the complementary use of HPGe detectors. Further uses are anticipated, including research projects in collaboration with industrial partners of NNRC and public stakeholders such as Norwegian Radiation and Nuclear Safety Authority (DSA).

Peter Saether grant

PI: Sunniva Siem and Lee Bernstein



Photo: UiO

Within the Norwegian Nuclear Research Centre (NNRC), a UC Berkeley (UCB)-University of Oslo (UiO) collaboration obtained a $25,000 Peder Sather grant to build a persistent competency in measuring the nuclear data needed to enable advancements in radiopharmaceutical isotope production.



Photo: UC Berkeley

Accurate nuclear data are critical to optimizing radioisotope production pathways for medical and industrial applications. At intermediate-to-high proton energies, the nuclear reaction cross section data necessary to evaluate production yields remain sparse, limiting the ability to predict the contaminant-free production of desirable radionuclides. To address this gap, we propose a collaborative measurement campaign between the UC Berkeley (UCB) and the University of Oslo (UiO) to acquire high-quality (p,x) reaction cross section. High-priority target isotopes have been identified based on nuclear structure characteristics and application relevance. Data products will directly support radionuclide production efforts at UCB and UiO and the resulting improvements to nuclear reaction models will enhance future predictive capabilities across the field.

The collaboration will leverage the established Berkeley codebase and analysis tools, and foster international training of graduate students from UCB, UiO and NMBU. The students will work together and exchange ideas during experimental campaigns, collaborative research visits and a dedicated school with a focus on radiopharmaceutical isotope production.

Industrial PhD project: «Development and Optimization of Immuno-PET Tracers for Targeted CAR T-Cell Therapy in Precision Cancer Treatment »

PI: Ingrid Norberg-Schulz

Together with the Norwegian Medical Cyclotron Centre, Ingrid Norberg-Schulz has received NFR funding for an Industrial PhD (2026–2029) in collaboration with the Department of Pharmacy at UiO and the Department of Cancer Immunology at OUS.

The project will develop novel antibody-based immuno-PET tracers for non-invasive imaging of solid tumors. Using advanced PET imaging, these tracers will visualize tumor location and monitor response to CAR T-cell and other therapies over time, helping clinicians better assess treatment effects, individualize therapy, and support the development of more precise cancer treatments.



Photo: Private

Ingrid Norberg-Schulz

Industrial PhD project: «Enhancing Nuclear Security in Norway»

PI: Henrik Horne

Henrik Horne started his PhD project with NMBU in 2024 while working at DSA, but started a new job with Viljr in 2025. We are delighted to report that Viljr will now be co-financing his PhD project . This recognises the importance of nuclear security across a range of research areas of relevance to NNRC, including, for example, decommissioning, novel nuclear reactors and radionuclide production. Henrik will be working on his PhD for 40% of his time at Viljr and is expected to submit his thesis in 2030.



Photo: Private

Henrik Horne

New associate professors in NNRC

New tenure track position at University of Oslo

PI: Amalie Føreid Reinertsen

Amalie Føreid Reinertsen started her tenure-track Postdoc position in 2025. Her research interests lie at the interface of medicinal chemistry, radiochemistry, and radiopharmacy, with a particular focus on positron emission tomography (PET). A. Reinertsen is especially interested in the total organic synthesis of specialized pro-resolving mediators (SPMs) and related bioactive molecules, aiming to advance therapeutic strategies for pain management, inflammation resolution, and antibacterial applications.



Photo: Private

Amalie Føreid Reinertsen

In parallel, she works on the design and development of PET radiotracers to enable non-invasive investigation of biological processes relevant to inflammation and disease progression. A key aspect of A. Reinertsen's research philosophy is the integration of green chemistry principles, striving to improve the sustainability and efficiency of synthetic and radiochemical methodologies.

Overall, her work seeks to bridge fundamental chemical synthesis and translational molecular imaging, contributing to both mechanistic understanding and the development of innovative diagnostic and therapeutic tools.

Juuso Sammaljärvi

Juuso Sammaljärvi was appointed Associate Professor of Radiochemistry in the Environmental Chemistry Section of the MINA faculty at NMBU in June 2025. Juuso has spent much of his career working in the field of nuclear waste management, with a particular focus on understanding how engineered and natural barriers retain and limit the migration of radionuclides in both spent nuclear fuel and low- and intermediate-level waste systems. Earlier in his career, he also contributed to the development of analytical tools for characterizing porosity in rocks and other porous materials. At NMBU, Juuso continues his work in nuclear waste management, with research focusing on the decommissioning of Norwegian research reactors and the associated disposal of the heterogeneous inventory of high-level nuclear waste. His work addresses key scientific and practical challenges related to long-term safety and environmental protection.



Photo: Jon Petter Helgesen-Ernestad

Associate Professor Juuso Sammaljärvi

In addition to research, teaching is an important part of Juuso's position. He contributes to several courses in the B-RAMI and M-RAMI study programmes at NMBU, holding lectures and participating in the supervision and assessment of laboratory coursework. Teaching laboratory skills is particularly important, drawing on more than ten years of experience from the University of Helsinki. He is actively involved in developing the study programmes to ensure that students acquire skills and expertise that are in demand.

Norway faces its unique set of challenges related to the decommissioning of ageing nuclear reactors and the potential development of new nuclear capacity to meet growing energy demands. At the same time, changing geopolitical conditions emphasize the importance of strong emergency preparedness to account for new and existing threats. Addressing these challenges requires a new generation of professionals with solid scientific and mathematical foundations. Through the Norwegian Nuclear Research Centre, Juuso sees strong opportunities for collaboration, knowledge building and the production of world-class research. He looks forward to fruitful cooperation with colleagues across NNRC and the wider scientific community in Norway.

Verena Pichler

Verena Pichler is an Associate Professor at the Department of Pharmaceutical Sciences at the University of Vienna. In 2025, she was appointed Adjunct Professor at the Department of Pharmacy at UiO, where she commits 20% of her time to teaching and supervising students and contributing to RT4 of NNRC. In 2013, she received her PhD in bioinorganic chemistry at the University of Vienna, followed by a PostDoc in biomedical engineering. Between 2016-2020, she was head of radiochemistry and biomarker development and head of radiopharmaceutical production at the Medical University of Vienna and built up a strong background in neurochemistry. Her research focuses on drug and radiotracer synthesis, radiopharmaceutical chemistry, and high-throughput analysis of physico-chemical parameters of blood-brain barrier-penetrating small molecules. Since 2020, she further applied (radio)labelling methods to investigate the impact of micro- and nanoplastics on human health.



Photo: Private

Associate Professor Verena Pichler

V. Pichler is currently elected board member of the Society of Radiopharmaceutical Sciences (SRS), delegate of the working group for radiopharmaceutical medicinal regulation of the International Atomic Energy Agency (IAEA), and committee member of the radiopharmaceutical science committee of the European Association of Nuclear Medicine (EANM). She has published more than 95 research articles, review articles, guidelines, book chapters, and patents (more than 2000 citations, H-factor 31, google scholar), secured a total of third-party funding of more than EUR 2,5 Mio, and has given more than 40 presentations of which over 20 were invited talks. Until now 11 PhD and 45 Master students work(ed) under her supervision or co-supervision.

Visiting scientists at NNRC

Every year, numerous scientists undertake short- and long-term visits to the partners of NNRC. These exchanges are a core part of the centre's mission, fostering collaboration across universities and research institutions, strengthening international networks, and advancing nuclear science through shared expertise, joint experiments, and coordinated research activities.

Peter von Neumann-Cosel

Peter von Neumann-Cosel, Professor at the Institute of Nuclear Physics, Technical University Darmstadt, Germany, spent a 3 months sabbatical at the NNRC in 2025. He gave a series of informal seminars for the nuclear physics group at UiO on topics of common interest. From the discussions two new projects emerged, namely a study of the magnetic dipole scissors mode in the quasicontinuum and the possible use of the population of spin isomers in the Oslo method to constrain the level density spin distribution. Furthermore, publications relevant to the goals of Research Theme 1 (RT1) were completed.



Photo: Private

Professor Peter von Neumann-Cosel

Sivahami (Sivi) Uthayakumaar

Sivi Uthayakumaar is a postdoctoral fellow at the Facility for Rare Isotope Beams (FRIB) at Michigan State University (USA). She summarizes her several-months long research stay at UiO as follows:

During my visiting fellowship at the University of Oslo, I was able to work with collaborators and experts on the Oslo method. As part of this visit, I was able to have in-depth discussions on my current analysis that was conducted at Argonne National Laboratory (USA), using the βOslo method, discuss the next steps to explore the causes of the features seen in the extracted γStrength Functions (γSF) resulting from the Oslo method analysis, and take part in reaction-based experiments at the Oslo Cyclotron Laboratory.

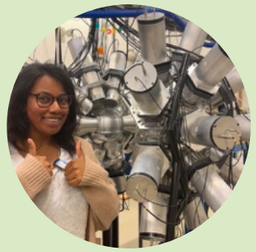


Photo: Private

Dr. Sivahami (Sivl) Uthayakumaar

While at the NNRC, I participated in an experiment to study the role of the neutron-capture reaction ^{92}Nb(n, γ)^{93}Nb. Because direct neutron-capture measurements are not feasible, we performed an inelastic scattering experiment using OSCAR+SiRi on the ^{93}Nb(p,p')^{93}Nb reaction. This reaction is important for understanding the production of ^{92}Nb in the p-process, where current astrophysical models struggle to reproduce observed abundances. The experiment gave me hands-on experience with experimental setup, online data analysis, and work at a stable-beam facility studying nuclei close to the valley of stability. Analysis of the dataset is ongoing, with results expected in 2026.

I also had detailed discussions with researchers at the University of Oslo on my current analysis using the βOslo method, which helped define the next steps of the project. We explored how to experimentally probe resonances observed in the extracted γSF, whose origins remain uncertain. These interactions led to proposals submitted to international laboratories and strengthened collaborations with the University of Oslo, allowing me to extend my expertise from short-lived radioactive nuclei to nuclei nearer stability and to gain first-hand experience with reaction-based experiments at the Oslo Cyclotron Laboratory.

Rahul Jain

Rahul Jain is a postdoctoral researcher at Lawrence Livermore National Laboratory (USA). His research interests concern neutron-capture reactions and their role for the synthesis of heavy elements in the Universe. More specifically, he is studying neutron-capture reactions play a key role in how the universe forges many of its heaviest elements. Yet, for many isotopes these reactions cannot be measured directly in the lab, often because the nuclei involved are too short-lived. To get around this, nuclear physicists use indirect methods. One of these is the Oslo method, which uses charged-particle reactions to reveal how densely packed the energy levels are inside a nucleus and how likely it is to emit gamma rays. Together, these properties allow researchers to estimate neutron-capture rates that would otherwise be out of reach.



Photo: Private

Dr. Rahul Jain

A particularly important case is the reaction ^{181}Hf(n, γ)^{182}Hf. The isotope ^{182}Hf can be used as a kind of cosmic clock, helping us understand the timescales of processes that shaped our solar system. However, ^{181}Hf has a half-life of only 42 days, making direct measurements impractical. Instead, one can study the 180Hf(d,pg)181Hf reaction as an indirect route to constrain the neutron capture rate on 181Hf. Rahul was leading an experimental study of this reaction carried out at Florida State University (FSU) in 2025.

During his visit at NNRC, Rahul analyzed this dataset using two versions of the Oslo method: the traditional FORTRAN-based software and a newer, Bayesian Python code (OMPy). The work showed how important it is to carefully remove signals from unwanted impurities—such as carbon and oxygen in the target material—to reliably extract the nuclear properties of interest. At the same time, the new CeBrA gamma-ray detector system at FSU was characterized using detailed Geant4 simulations. These simulations are essential for "unfolding" the measured data and form the first step in a full Oslo analysis. A publication on the target characterization and associated simulation tools is in preparation, and the full Oslo analysis of the ^{180}Hf(d,p γ)^{181}Hf reaction will follow.

The visit also sparked a new collaboration between the Oslo Cyclotron Laboratory (OCL) and Lawrence Livermore National Laboratory (LLNL). Together, they plan to study reactions on tungsten isotopes to better constrain neutron-capture rates on rhenium, which are important for understanding the slow neutron-capture process (s-process) and another long-lived cosmic clock, ^{187}Re.

Neshad Deva

Neshad is a Ph.D. candidate in experimental nuclear astrophysics at Michigan State University and a graduate research assistant at the Facility for Rare Isotope Beams (FRIB), USA. In summer 2025, he spent three months at the University of Oslo as a fully funded Visiting Scholar through the Norwegian Nuclear Research Center (NNRC). During this period, Neshad participated in nuclear-physics experiments and completed a substantial part of the data analysis for his Ph.D. thesis, with results now in preparation for publication. The visit also fostered valuable professional connections and benefited from the supportive and stimulating research environment at NNRC and the University of Oslo.



Photo: Private

Neshad Deva

Naomi Marks

Deputy Director of Glenn T. Seaborg Institute, Lawrence Livermore National Laboratory (LLNL), Dr. Naomi Marks visited NMBU July – August 2025 interacting with several colleagues there on nuclear security issues. She gave a seminar entitled "The Future Looks Bright: Using Taggants in Nuclear Forensics" on some of the nuclear forensics research ongoing at LLNL.



Photo: UC Berkeley

Deputy Director Dr. Naomi Marks

Lee Bernstein

Professor Lee Bernstein, Lawrence Berkeley National Lab/ University of California, Berkeley, visited NMBU June 4th in capacity as chair of the NNRC advisory board. He was given tours of the NMBU campus and nuclear related facilities, interviewed staff and students involved in NNRC as well as a gave a presentation of LBNL/University of California Berkely activities.



Photo: UC Berkeley

Professor Lee Bernstein

Takashi Nakamura

Professor Takashi Nakamura from the Institute of Science Tokyo visited the University of Oslo and NNRC in August 2025. As part of his visit, he held a seminar on "Exploring extremes of the nuclear landscape" on the 29th of August. The seminar discussed the recent efforts into research on extremely exotic nuclei, mainly extremely neutron rich nuclei such as ^{28}O and multi-neutron detection techniques. During the time he spent at NNRC Nakamura also worked closely with PhD student Hyeji Lee and visiting PhD student Osawa Yuma on a research project between UiO and Institute of Science Tokyo.



Photo: Private

Professor Takashi Nakamura

Luca Zago

Dr. Luca Zago from the University of Milano, Italy, visited the University of Oslo and the Norwegian Nuclear Research Centre (NNRC) in March 2025. Dr. Zago has extensive expertise in the study of neutron-rich nuclei using different reaction mechanisms, in particular multi-nucleon transfer reactions using the PRISMA magnetic spectrometer coupled to the AGATA gamma-tracking array. The main purpose of his visit was to collaborate with PhD candidate Ida Plahter Rosenqvist on the analysis of data related to her PhD thesis. The data were obtained from a multi-nucleon transfer reaction experiment performed at LNL-INFN in Padova, Italy, using the PRISMA–AGATA setup. As part of his visit, Dr. Zago delivered a seminar on "Mixing between single-particle and intruder states towards the N = 20 island of inversion: lifetimes in ^{37}S" on 19 March.

The seminar presented new studies of the neutron-rich nucleus ^{37}S near the N = 20 island of inversion, a region where the usual ordering of nuclear energy levels breaks down. Using high-resolution gamma-ray spectroscopy with the AGATA detector system, the work explores how different nuclear configurations mix and shape the structure of the nucleus.



Photo: Private

Dr. Luca Zago

Andreas Zilges

Professor Andreas Zilges spent three months at NNRC as a visiting scientist. During his stay, he led a nuclear-physics experiment at the Oslo Cyclotron Laboratory, where a beam of protons was accelerated onto a thin foil of the isotope nickel-64 in a vacuum chamber. When the proton beam hit the nickel nuclei, they were excited and then released their excess energy by emitting charged particles and gamma rays, which were recorded by the SiRi silicon detector system and the OSCAR gamma-ray detector array.

The experiment had two main goals. First, the team investigated how specific excited states in nickel-64 decay, in order to learn more about how the nucleus vibrates and changes shape at very small scales. Second, they used these gamma decays to test a new analysis technique (the Shape method) that complements the well-established Oslo method. Together, these measurements help to more precisely determine neutron-capture probabilities for the neighboring isotope nickel-63. Such data are important for understanding how heavier elements are built up in stars through the slow neutron-capture process, for example in Asymptotic Giant Branch (AGB) stars.



Photo: Private

Professor Andreas Zilges

Oceam Toujan

Oceam Toujan, a student from École Polytechnique at Université de Paris, joined the HADRON laboratory at IFE through the Erasmus scholarship programme. During the internship, his main task was to develop a prototype system for sorting radioactive waste using two robotic manipulators and conveyor belts. In this setup, the waste was represented by colored cubes placed on a conveyor belt, with each color corresponding to a specific radiation level.

Using cameras and radiation sensors, the robotic arms identified, picked, and sorted the objects into appropriate containers according to their simulated radiation level. The project was successfully completed, and the results are currently being used by students from University College Østfold in Halden, who are continuing the work this year by developing additional tasks and functionalities.



Photo: Private

Oceam Toujan

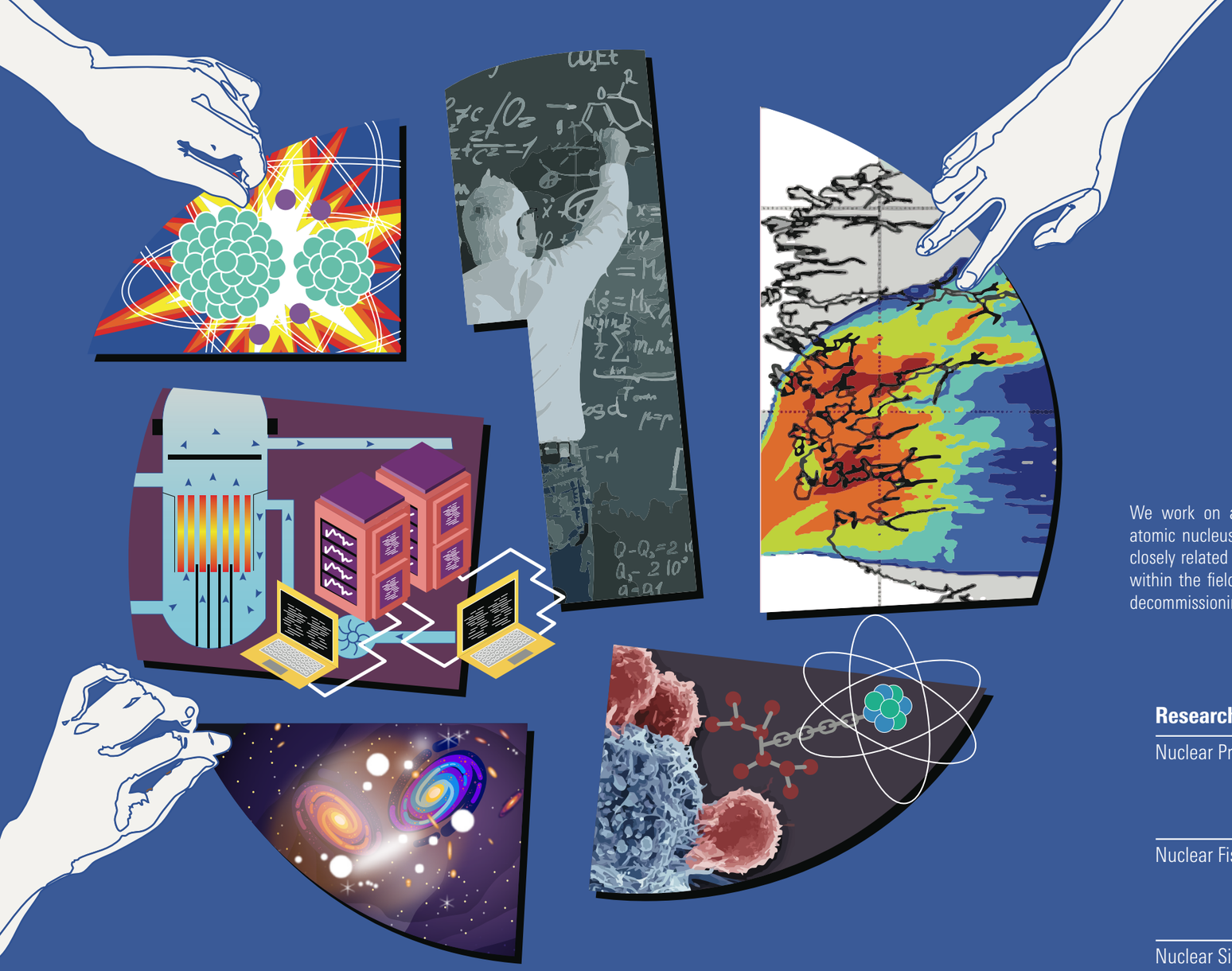
Osawa Yuma

Yuma Osawa is a Ph. D. Student in experimental nuclear physics at Institute of Science Tokyo, and also works closely at RIBF RIKEN, Japan. In 2025 summer, he spent one month at the University of Oslo, working with Ph.D. candidate Hyeji Lee on neutron-rich nuclear structure research. His research is mainly about ^{14}Be, the heaviest Be isotope with two-neutron halo structure. During the time in Oslo, he worked on data analysis from SAMURAI spectrometer at RIBF, RIKEN and presented on short seminar with Hyeji Lee.



Photo: Private

Osawa Yuma



Our Research

Nuclear physics and nuclear chemistry are the study of the basic properties of the atomic nucleus, and nuclear technology is how these properties can be exploited for different applications.

Figure: Wanja Paulsen

We work on a range of different topics relating to the atomic nucleus and nuclear technology. All the topics are closely related to Norway's need for increased competence within the fields of radiation protection, nuclear medicine, decommissioning and nuclear preparedness.

Our work is partitioned in to five research themes (RTs) with their own milestones. Every research theme has its own principal investigater (PI). Education is also an important factor within the Centre and has its own PIs. A summary of the main goals of each research theme is listed in the table below

Research Themes of the Nuclear centre

Nuclear Properties (RT1)	New experiments on nuclear properties aimed at improving theoretical models and predictions of reaction rates, important for simulations of nuclear reactors and nucleosynthesis in stars.
Nuclear Fission (RT2)	New experiments to conduct fundamental research on the fission process, benchmark and improve fission models, and provide experimental data for reactor and nuclear safety applications.
Nuclear Simulations (RT3)	Nuclear physics simulations, including reactor simulations and radiological (protection) simulations.
Radionuclide Production and Speciation (RT4)	Investigate production pathways of radionuclides to provide preclinical quantities and constrain modelling codes and develop chemical purification procedures for relevant radionuclides.
Environmental Radiochemistry and Source Characterisation (RT5)	Develop analytical methodologies and new and improved transport, impact and safety assessment models to address emerging nuclear threats and challenges associated with nuclear decommissioning.
Education	Attract and train the next generation of nuclear scientists, and provide opportunities for young researchers to become leaders in this field.

RT1: Nuclear Properties

Scope of RT1

One class of experiments that are performed within RT1 aim at providing data to constrain **cross sections for neutron-capture reactions**. Neutron capture is the reaction mechanism that is responsible for producing minor actinides in nuclear reactors, and for producing all elements heavier than iron in stars and explosive stellar environments. Reliable neutron-capture reaction rates can be extracted for short-lived unstable nuclei by measuring the properties of the compound system using charged-particle induced reactions.

Two of the main ingredients to calculate radiative neutron-capture cross sections are the **nuclear level density** (NLD, number of quantum levels per excitation-energy interval) and the **gamma-ray strength function** (GSF, average decay probability) and can be measured using the so-called Oslo method. The experimentally deduced neutron- capture rates provide improved input to large-scale nuclear reaction network calculations to model **nucleosynthesis in reactors or stellar environments**, connecting RT1 with RT3.

Because it is impossible to constrain all reaction cross sections experimentally, such network calculations must rely partially on theoretical predictions of nuclear properties, especially for exotic nuclei far from stability. It is therefore important to test theoretical model predictions and determine their reliability. This can be done by measuring **fundamental properties of exotic nuclei** such as masses, ground-state spins and parities, the spectrum of low-lying excited states, transition probabilities between them, and electromagnetic moments for both ground and excited states. We are planning to expand our successful experimental program towards exotic nuclei that have not been studied in sufficient detail in the past.

New accelerator facilities for radioactive ion beams and new instrument developments will enable us to push the frontier of nuclei that can be studied experimentally. The neutron-rich nuclei of interest are primarily produced in fission reactions. Studying the properties of these fission fragments provides furthermore valuable information on the fission process itself, the decay heat produced in reactors, and the probability βdelayed neutron emission. These aspects connect RT1 to RT2.

Progress 2025

Between April and November 2025, eight experiments were carried out at the Oslo Cyclotron Laboratory. A central question addressed by these studies is how heavy elements are produced in extreme stellar environments. One suspected production route is the intermediate neutron-capture process, or i-process, which has attracted growing interest in recent years. Understanding this process requires precise knowledge of how nuclei absorb neutrons and emit energy in the form of gamma rays.



Celebration at the Oslo Cyclotron Laboratory after Experiments performed in September 2025. Photo: Ann-Cecilie Larsen

In parallel, the experiments investigate the structure of exotic nuclei by studying nuclear level densities and gamma-ray emission properties, providing insight into collective nuclear behaviour and subtle excitation modes such as the pygmy dipole resonance.

The experiments were primarily led by UiO and provide data for both master's and PhD theses. Some experiments were carried out in collaboration with researchers from Michigan State University and Lawrence Livermore National Laboratory.

Experiments at Oslo Cyclotron Laboratory in 2025

April 2025: ^{93}Nb using 16-MeV proton beam

June 2025: ^{106}Pd, ^{59}Co, and ^{27}Al using 16-MeV proton beam

August 2025: ^{154}Sm using 30-MeV alpha-particle beam

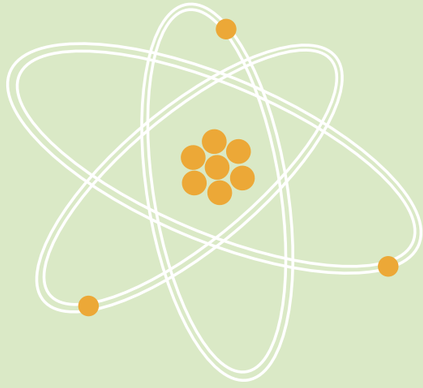
September 2025: ^{130}Te using 30-MeV alpha-particle beam

September 2025: ^{130}Te using 24-MeV alpha-particle beam

October 2025: ^{116}Cd using 30-MeV alpha-particle beam

November 2025: ^{107}Ag and ^{109}Ag using 16-MeV proton beam

November 2025: ^{186}W using 30-MeV alpha-particle beam



Experiment in iThemba LABS, South Africa

How stars evolve and how the chemical elements in the universe are created depend on a small number of key nuclear reactions. One of the most important of these is the ^{12}C(α ɣ)^{16}O reaction, which determines how much carbon and oxygen a star produces after it has finished burning helium. This balance strongly influences whether a star later becomes a white dwarf, neutron star, or black hole, and how it ultimately explodes or collapses.

As part of a broader campaign to tackle these critical reactions, an experiment was performed at iThemba LABS in August 2025 to measure the ^{12}C(α ɣ)^{16}O reaction at high energies. This experiment was UiO led with critical collaboration from iThemba LABS researchers. The resulting data form a central part of a PhD project at UiO, and the analysis is currently in progress.



Photo of the International research team taken during the experiment. Photo: OCL-iThemba collaboration

PANDORA experiment at RCNP, Osaka University, Japan

Students and staff from NNRC traveled to the Research Center for Nuclear Physics (RCNP) at Osaka University to join the PANDORA (Photo-Absorption of Nuclei and Decay Observation for Reactions in Astrophysics) experiment. During two intensive weeks in October 2025 the teams from Oslo and Osaka prepared the Grand Raiden magnetic spectrometer and installed a new array of 16 large-volume LaBr3(Ce) detectors together with accompanying silicon-strip detectors. The experiment used relativistic, zero-degree inelastic proton scattering to study photo-absorption in ^{16}O, ^{26}Mg and ^{56}Fe. This experiment is part of the worldwide PANDORA effort to improve our knowledge of giant resonances in light nuclei and their decay, and to refine models of how ultra-high-energy cosmic rays interact with photons from the cosmic microwave background as they travel between galaxies. The campaign also gave students first-hand experience with sophisticated, large-scale instrumentation and the opportunity to contribute their skills to an international research team.



The teams from Oslo and Osaka posing for a group photo after finishing the assembly of the LaBr3(Ce) detector array that is surrounding the target chamber. The beam from the K400 Ring Cyclotron is arriving from the right; part of the first dipole magnet of Grand Raiden is seen on the left. Photo: Andreas Görgen

Published article: Remeasuring the γ-decay branching ratio of the Hoyle state

Paulsen, W., K. C. W. Li, S. Siem, V. W. Ingeberg, A. C. Larsen et al., Remeasuring the γdecay branching ratio of the Hoyle state, Phys. Rev. C 112, 015803 (2025).

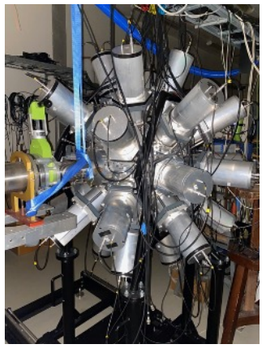
Carbon, an essential element for life, is created inside stars through a process known as the triple-alpha reaction. A key role in this process is played by the Hoyle state, a short-lived excited state of the carbon-12 nucleus. How this state decays determines how efficiently carbon is formed in stellar environments. In this work, a new high-precision measurement of a rare gamma-ray decay of the Hoyle state was performed at the Oslo Cyclotron Laboratory. Although infrequent, this decay channel is crucial for accurately estimating carbon production in stars. The results are found to be be consistent with established values and recent studies.

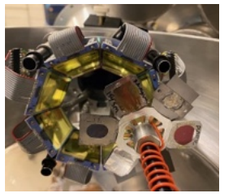
A reanalysis of earlier experimental data shows that previously reported discrepancies disappear once methodological issues are corrected. These findings reinforce confidence in current models describing how carbon—and ultimately the building blocks of life—are produced in the universe.

Published article: Systematics of the low-energy electric dipole strength in the Sn isotopic chain

Markova, M. et al., Systematics of the low-energy electric dipole strength in the Sn isotopic chain, Phys. Lett. B 860, 139216 (2025)**.**

The response of atomic nuclei to electromagnetic radiation reveals important aspects of their internal structure. In this work, the low-energy electric dipole strength of several tin isotopes was investigated as a function of nuclear mass. By combining complementary experimental techniques, the dipole strength was mapped over a broad energy range, allowing the dominant giant dipole contribution to be separated from additional low-energy structures. In all isotopes, a pronounced resonance was observed near 8.3 MeV, carrying a nearly constant fraction of the total expected strength. For the heavier tin isotopes, a second, weaker resonance appears at lower energy and grows with mass number. This behaviour is consistent with the emergence of the pygmy dipole resonance. Comparisons with theoretical calculations indicate that coupling between single-particle motion and collective vibrations is essential for describing these features.





OSCAR LaBr3(Ce) array (left) and 154Sm target surrounded by the SiRi silicon array (top),

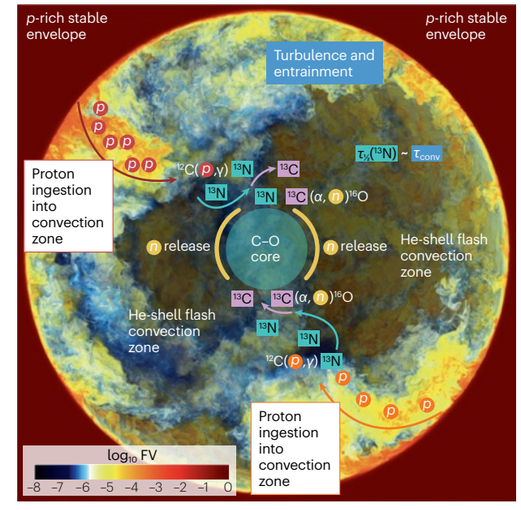
Photo: Ann-Cecilie Larsen

Published article: Unlocking i-process nucleosynthesis by bridging stellar and nuclear physics

Wideking, M. et al. (M. Guttormsen, A.C. Larsen, S. Siem), Unlocking i-process nucleosynthesis by bridging stellar and nuclear physics, Nature Reviews Physics 7, 696 (2025).

The origin of chemical elements and their abundances across the cosmos remain one of the central questions in physics. The formation of elements heavier than iron is traditionally attributed to three main mechanisms: the slow and rapid neutron-capture processes (s and r processes) and the p process (mostly driven by photodisintegration reactions).

However, certain astronomical observations reveal elemental abundance patterns inconsistent with these processes. These discrepancies prompted the introduction of the intermediate neutron-capture process (i process), which operates at neutron densities between the s and r processes, and which has emerged as a key area of research. Observations of elemental abundances of stars confirm that the i process does indeed take place. Identifying the required astrophysical conditions and contributions of the i process sensitively depend on neutron-capture reaction rates involving unstable atomic nuclei. Important advancements have been achieved through these new astronomical observations and cutting-edge experimental and analytical techniques in nuclear physics, in addition to models of nuclear physics and nucleosynthesis. in addition to models of nuclear physics and nucleosynthesis. State-of-the-art facilities and theoretical models are revolutionizing our ability to explore the i process and offer fresh perspectives on the nuclear behaviour under extreme stellar conditions. This Review underscores the synergy between groundbreaking astronomical and nuclear physics research, bridging nuclear physics and observational astrophysics, and advancing our understanding of i-process nucleosynthesis.



The convective-reactive i-process engine. Figure: Wideking, M. et al. (M. Guttormsen, A.C. Larsen, S. Siem), Nature Reviews Physics

Published article: Nuclear level density and γray strength function of ^{67}Ni and the impact on the γprocess

Ingeberg, V.W. et al. (S. Siem, F.L. Bello Garrote, T.L. Christoffersen, A. Görgen, B.V. Kheswa, G.M. Tveten, F. Zeiser), Nuclear level density and γray strength function of 67Ni and the impact on the i process, Phys. Rev. C 111, 015803 (2025).

The way atomic nuclei capture neutrons plays an important role in how heavy elements are formed inside stars. In this work, nuclear properties of ^{67}Ni were investigated using neutron pickup reactions induced by a beam of ^{66}Ni, at the HIE-ISOLDE facility at CERN. The study made it possible to determine the nuclear level density and gamma-ray strength function, key quantities to determine reaction rates. These experimentally determined properties were then used to calculate the neutron-capture reaction rate of ^{66}Ni, a reaction thought to influence the flow of element production in certain stellar environments. The results confirm that this reaction can slow down nucleosynthesis in simplified stellar models. However, when more realistic models of low-metallicity asymptotic giant branch stars are considered, the influence of this reaction is found to be significantly reduced. This shows that detailed nuclear measurements, combined with realistic stellar modelling, are essential for understanding how the elements are formed in the universe.

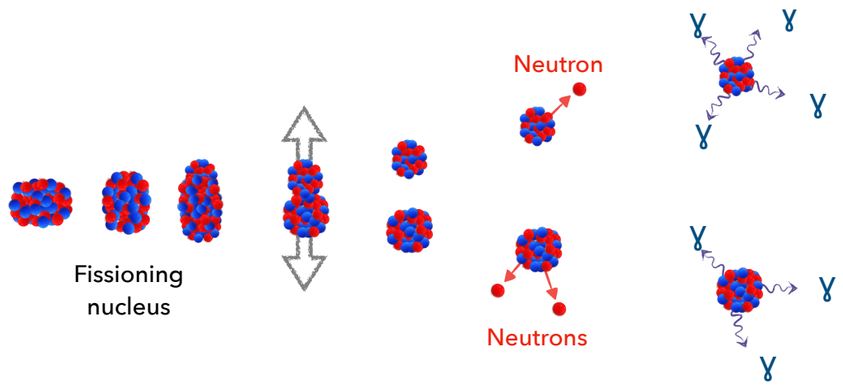
Collaborative participation at ISOLDE, CERN, in experiment IS747: Laser and Nuclear Decay Spectroscopy Study

Understanding how protons and neutrons are arranged inside atomic nuclei is essential for explaining the structure of matter and the forces that bind nuclei together. In an experiment led by our collaborators from the University of York (UK) and KU Leuven (Belgium), neutron-rich isotopes of bismuth, ^{212}Bi and ^{213}Bi, were investigated at the ISOLDE facility at CERN using a combination of laser spectroscopy and nuclear decay spectroscopy techniques. The experiment focused on long-lived high-spin isomeric states — excited nuclear states in which nucleons are aligned to produce large total angular momentum. These rare configurations provide a sensitive probe of the underlying single-particle structure of the nucleus, particularly near the magic neutron number N = 126.

Special attention was given to measuring magnetic moments and changes in mean-square charge radii through hyperfine structure and isotope-shift studies. This work demonstrates how advanced laser spectroscopy techniques, coupled with high-efficiency decay detection, allow detailed investigations of exotic nuclei far from stability.



RT2: Nuclear Fission



In the fission process, a heavy nucleus splits into highly excited fission fragments that carry both linear and angular momenta. These neutron-rich residual products emit particles, including prompt neutrons, gamma rays, and beta particles, as they try to reach nuclear stability.
Figure: Ali Al-Adili

What is nuclear fission?

When a heavy atomic nucleus undergoes fission, the fundamental forces of nature come into competition. The strong nuclear force acts to keep the nucleus bound together, while the electromagnetic force drives the positively charged protons apart. After absorbing a neutron, for example, the nucleus begins to deform like a liquid drop until it ultimately ruptures, splitting into two and occasionally three smaller nuclei. The combined mass of these fission products is slightly lower than that of the original nucleus, since the daughter nuclei are more tightly bound. The missing mass is converted into energy, which is exploited in applications such as nuclear reactors.

During the fission process, hundreds of different nuclices can be produced. Immediately after scission, the newly formed fission fragments carry large amounts of internal excitation energy as well as linear and angular momentum. Put simply, they are very hot, move at high velocities, and rotate rapidly. After the ions are stopped in the fuel, their kinetic energy is deposited, subsequently heating up the surrounding water. This thermal energy is then used to generate steam, drive turbines, and ultimately produce electricity.
The internal excitation energy is also released as the fission fragments seek a more stable configuration. This occurs initially through the emission of prompt neutrons, followed by the emission of high energy gamma radiation, as illustrated in the figure above. To further approach stability, the fission products subsequently undergo beta decay.

Of these neutrons, at least one must trigger fission in another uranium nucleus to maintain the chain reaction. When this condition is fulfilled, the reactor is said to be critical, and the neutron population, and thus the reactor power, remains constant. The emitted gamma rays, meanwhile, also contribute to the overall heat production in the reactor core.

Despite more than 80 years of research on nuclear fission, many aspects of the process remain insufficiently understood. What determines the amount of excitation energy carried by the fission fragments, and how rapidly they rotate? How do the properties of emitted particles vary when different nuclei undergo fission?

And how can improved theoretical descriptions of fission contribute to safer and more efficient future nuclear power plants? These open questions motivate Research Theme 2, which focuses on fundamental investigations aimed at deepening our understanding of the underlying mechanisms governing the fission process.

Scope of RT2

In Research Theme 2 we focus on two key areas that are central to nuclear fission. The first concerns fission yields, which describe the probabilities of producing specific nuclei when a heavy nucleus splits. By studying these hundreds of possible yields, we contribute to a deeper understanding of the quantum mechanical fluctuations that ultimately decide how fission unfolds. This work also provides insight into how rare and exotic nuclei are created through the fission process and in astro-physical processes in neutron-star mergers and the rapid-neutron capture.

The second focus area is the measurement of gamma rays emitted by the fission fragments. Together with neutrons, these gamma rays carry signature information on how excitation energy and angular momentum are shared between the daughter nuclei. By measuring them, we gain valuable information about the initial state of the fragments immediately after fission.

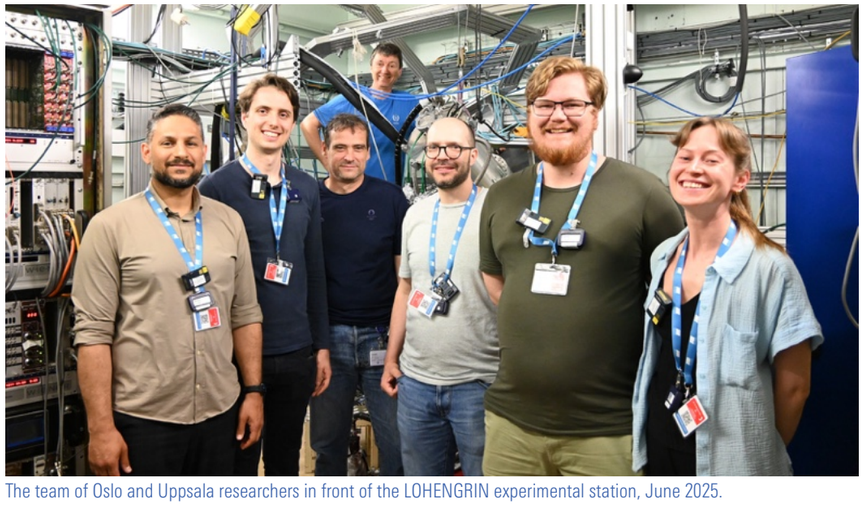
Our approach is twofold. We measure average gamma ray properties, such as their energy and how many are emitted per fission event, as well as discrete gamma rays from specific fragment nuclei. These measurements provide important benchmarks for fission simulation codes and help assess whether the underlying physics is correctly implemented. To support this effort, we develop and test state of the art models of nuclear de-excitation, improving predictions in regions where experimental data are scarce.

Because our work focuses on the properties of the fission fragments, Research Theme 2 is closely connected to Research Theme 1 on nuclear properties. In addition, since the energy released in fission is exploited in nuclear reactors and gamma ray heating is an important aspect of reactor physics, our results are also directly relevant to Research Theme 3 on nuclear simulations.

Progress 2025

Fission yields at the The Institut Laue-Langevin (ILL) facility

A new experimental program has been launched at the NNRC with the aim of exploring some of the rarest products of nuclear fission. This program focuses on exotic fission fragments that are produced roughly one million times less frequently than the most common fragments, such as cesium and iodine. We have chosen to investigate the fission of uranium-233, a reaction that has never been measured in this mass region. In addition, this system is of particular interest for the thorium uranium fuel cycle, since uranium 233 is the key fissile isotope bred from thorium and plays a role in some of the proposed upcoming generation nuclear energy concepts.



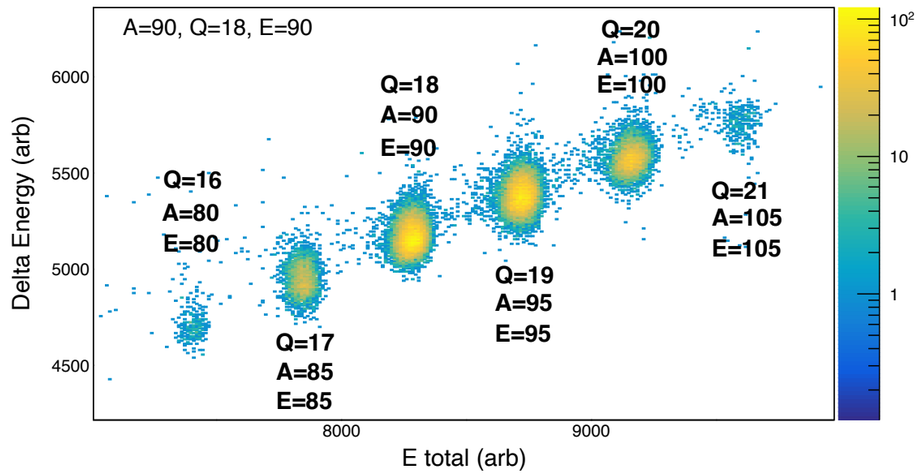
The team of Oslo and Uppsala researchers in front of the LOHENGRIN experimental station, June 2025.
Photo: Institut Laue-Langvin (ILL)

The first experiment has already been carried out at the LOHENGRIN mass separator at The Institut Laue-Langevin (ILL) facility in Grenoble, France. The ILL reactor is among the most intense research reactors in the world in terms of neutron flux (10^{15} n/cm^{2}s), making it uniquely suited for producing beams of exotic fission fragments. At LOHENGRIN, these fragments can be filtered with high precision according to their mass to ionic charge ratio.

By combining the LOHENGRIN separator with an ionisation chamber, we can obtain clean beam separation in energy and uniquely identified by mass. The ionisation chamber consists of two sections.

The first measures the energy loss of the fragments, which depends on their atomic number. This allows us to identify the proton number in addition to the nuclear mass. In this way, we can reveal stable configurations (magic shells) in both neutron number and proton number. The second part measures the residual energy, which then gives the total particle energy when summed with section 1.

A team of four UiO students, working closely with colleagues from Uppsala University in Sweden, carried out an experiment on uranium-233 induced fission, with a particular focus on very light fragments in the mass range from 68 to 72.



Experimental data showing well-separated fission products with masses from 80 to 105, based on their energies E and ionic charges Q. Figure: Ali Al-Adili

This region is expected to have unexpectedly high production probabilities, pointing to enhanced nuclear stability and providing new insight into the internal nuclear structure. The team successfully measured fission yields spanning masses from A=98 down to A=68. Preliminary results are highly encouraging and suggest the presence of previously unexplored features of the fission process. A new beam time is scheduled for 2026, during which we will further investigate this mass region to collect higher statistics and strengthen the confidence in our results.

Angular momentum studies

One of the main goals of this research theme is to understand how angular momentum is generated during the nuclear fission process. As mentioned before, the nuclei are not only excited but also spinning, and this rotation carries important clues about fission. Several measurable quantities are sensitive to this initial angular momentum, including isomeric yield ratios and the number of gamma rays emitted as the fragments de-excite.

Photo: Argonne National Laboratory, Idaho National Laboratory

Within Research Theme 2 we examined how different properties of a fissioning system influence the isomeric yield ratios of the fission fragments. These ratios describe how often fragments are produced in long lived excited states, known as isomers, compared to their ground states. Since populating such states depends strongly on angular momentum, isomeric yield ratios are particularly sensitive probes of how much spin the fragments acquire during fission. By understanding these ratios, we gain new insight into both the fission dynamics and the origin of fragment angular momentum.

The study builds on a novel experimental technique developed previously at UiO, based on precise measurements of the arrival times of selected gamma rays emitted during the decay of fission fragments. This approach enabled the extraction of isomeric yield ratios for Rb-94, Sn-130, Sb-135, Te-135, and Xe-137 from neutron induced fission of uranium-238 at an incident neutron energy of 1.9 MeV. For two of these nuclei, Sn-130 and Te-135, additional data were obtained at a higher incident neutron energy of 3.5 MeV. In the case of Te-135, complementary measurements were also performed for a different reaction, thorium-232 neutron induced fission at an incident neutron energy of 2.0 MeV. All measurements were carried out as part of the nu ball campaign at IJCLab in Orsay, France [1].

The theoretical extraction of angular momentum from experimental observables is highly model dependent and subject to different sources of systematic uncertainty. It is therefore essential to validate and benchmark the models that are widely used in the field. To this end, we have initiated a systematic comparative study of the Uppsala Spin Method [2] and the Manchester Spin Method, using the experimental cases presented in Ref. [1]. The results obtained so far show a very good agreement between the two approaches. At the same time, the comparison has revealed some small systematic effects that point to underlying biases in the models, highlighting areas where further refinement is needed.

References

1. A. Al-Adili, et al. Extraction of angular momenta from isomeric yield ratios Eur. Phys. J A 55:61 (2019)

2. J. N. Wilson et al. Angular momentum generation in nuclear fission, Nature 590, pages 566–570 (2021)

3. M. Hunyadi et al., Adv. Photonics Res. 2025, 2400217; Adv. Funct. Mater. 2022, 32, 2206645

Theory-6 Scientific Workshop on "Nuclear Fission Dynamics and the Emission of Prompt Neutrons and Gamma Rays"

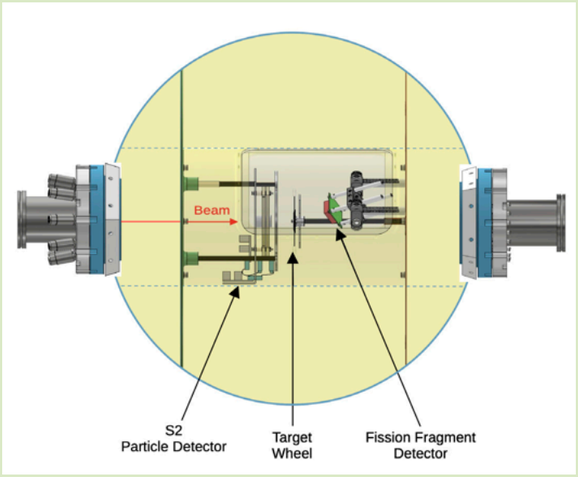
The members of RT2 attended the specialized fission theory conference organized by the Joint Research Centre in Catania, Sicily. Five scientific talks were delivered on various aspects of fission research within the NNRC.



The RT2 team at the Theory-6 Scientific Workshop on "Nuclear Fission Dynamics and the Emission of Prompt Neutrons and Gamma Rays", Photo: Ali Al-Adili

Oslo Cyclotron Laboratory - Fission Chamber

A major focus during 2025 has been the preparation of fission experiments at the Oslo Cyclotron Laboratory. The experimental fission research program at the Oslo Cyclotron Laboratory will begin with the construction of a spherical fission chamber, designed to be installed inside the existing OSCAR LaBr3 gamma ray detector array. The chamber will be equipped with newly developed scintillation based ternary copper halide fission fragment detectors. Each detector has an active area of 25 mm by 25 mm with 4 by 4 segmentation and is read out using silicon photomultipliers. The detection of gamma rays in coincidence with fission fragments using OSCAR will form a central element of the program.



The sherical fission chamber designed for the Oslo Cyclotron Laboratory.
Figure: Neeraj Kumar

The availability of proton, deuteron, and alpha particle beams at the Oslo Cyclotron Laboratory enables systematic investigations of particle induced fission over a wide range of excitation energies. Earlier studies using conventional gaseous fission detectors demonstrated the ability to probe structural features in the pre fission gamma ray spectrum and to study their evolution with excitation energy. These measurements were performed using the charged particle detector system SiRi, a conical double sided silicon detector setup with thicknesses of 130 micrometers and 1550 micrometers.

Building on this experience, the new experimental setup will employ highly segmented, circular, double sided silicon detectors of the S2 type for charged particle detection. With optimized thicknesses of 130 micrometers and 1500 micrometers for different experimental requirements, these detectors will provide significantly improved position and energy resolution. This improvement will lead to a substantial increase in the precision of the reconstructed excitation energy of the fissioning system. By integrating these detector arrays with advanced data acquisition and analysis frameworks, the program aims to place stringent constraints on theoretical fission models and to improve their predictive power. The results are expected to have broad impact, spanning both fundamental nuclear science and applied research areas.

Changes in RT2 in 2025

Research Theme 2 has strengthened its team with several new appointments. We are happy to welcome Associate Professor Ali Al-Adili from Uppsala University as Professor II at the University of Oslo, he will also serve as the principal investigator of RT2 from 2026.

In addition, a new PhD student has been admitted with a research focus on fission yield measurements at the ILL facility. Furthermore, a new postdoctoral researcher, Neeraj Kumar, has been recruited with the primary task of developing the reaction chamber for the Oslo Cyclotron.



Associate Professor Ali Al-Adili from Uppsala University, PI of RT2 from 2026 and Professor II in NNRC.
Photo: Mikael Wallerstedt

RT3: Nuclear Simulations

Scope of RT3

Nuclear simulations are computational, mathematical, and physics-based models that replicate the behaviour of nuclear systems. These models analyse and predict the performance and safety of different types of nuclear systems without physical testing. By performing nuclear simulations, it is possible to deepen understanding of nuclear and technological system behaviour, enhance safety analysis, and predict the operational limits and boundary conditions of advanced reactor concepts. These simulations also support informed decision-making, optimize reactor design and performance, and assist with the planning, risk assessment, and safe execution of reactor operations and related activities.

In RT3, the research theme focuses on reactor-physics modelling, radiological scenario development and digital twin workflows that support nuclear system decommissioning, training and education, and operational planning. The growing global interest in and investment toward advanced nuclear technologies and next-generation reactors calls for expanded efforts in high-fidelity nuclear simulation and modelling. Strengthening this area of research enhances the technical foundation required to evaluate innovative designs, validate safety margins, and assess performance under a wide range of operating and accident scenarios. Such work increases stakeholder confidence to implement new nuclear systems, supports evidence-based regulatory and engineering decisions, and contributes to the development of robust infrastructure, supply chains, and operational frameworks around emerging nuclear technologies.

Progress 2025

To address the increasing demand for nuclear simulation research and to support the expanding team of researchers and students in RT3, the research activities were reorganized into two distinct work packages in 2025.

WP1: Reactor Physics Modelling and SMR Related Studies

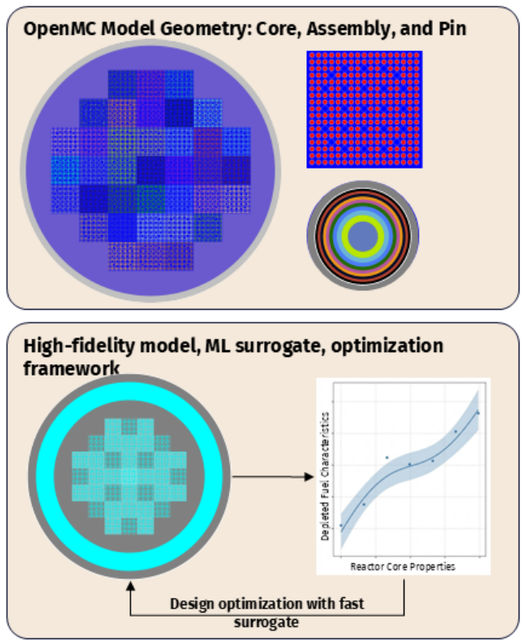
Work Package 1 (WP1) is led by the newly established Nuclear Reactor Applications research group at the University of Oslo. The group focuses on advanced reactor concepts, including Generation IV systems and microreactors, where advanced neutronics, novel fuel types, compact core designs, and mobile applications require new modelling frameworks and experimental methodologies distinct from those of large, stationary nuclear power plants.

Research on microreactors strengthens UiO's contributions to non-proliferation, safety analysis, and regulatory science by generating the data, methodologies, and simulation tools required to assess, license, and safely deploy novel reactor classes. Microreactors require high-fidelity experimental validation and integrated multi-physics modelling—such as coupled neutronics, materials performance, and shielding interactions—tailored to emerging energy applications including remote and off-grid energy systems.

A defining aspect of WP1 is the evaluation of microreactors for maritime and mobile nuclear propulsion for commercial marine vessels. New research on reactor and radiological behaviour in maritime applications was supported by student projects on propulsion concepts, safety characteristics, accident considerations, and molten-salt-based and other advanced maritime reactor designs. These activities strengthened modelling approaches for compact cores, microreactors, and mobile reactor applications, particularly in maritime contexts.

Beyond maritime-specific studies, WP1 carried out general reactor physics modelling for small modular reactors (SMRs), advanced reactors, and microreactors with particular relevance to Generation IV systems. The work covered core-level neutronics, fuel utilisation and depletion, as well as activation, shielding, and source-term assessments relevant to lifecycle, non-proliferation, and backend considerations. Research on microreactors contributed to safety analysis and regulatory science by developing data, methodologies, and simulation tools to assess and license novel reactor classes, including for remote, off-grid, and maritime energy systems.

Many activities were conducted in connection with MSc and PhD projects, supporting methodological development and competence building in reactor physics and nuclear simulation. The Nuclear Reactor Applications group has strengthened UiO's computational and analytical capabilities, particularly in Monte Carlo methods, multi-physics coupling, and shielding and source-term simulations. Additional expertise in nuclear fuel cycle analysis, passive safety characteristics, reactor core optimisation, and shielding design supports an integrated approach to advanced reactor research and development. Student research in 2025 also contributed to neutron activation modelling of reactor-adjacent structures, informing decommissioning assessments and backend-oriented analyses.



Reactor core simulation and optimisation workflow. The figure illustrates reactor core modelling work carried out in student projects within RT3 focusing on advanced reactor simulations relevant to both land-based and maritime nuclear applications. The upper panel shows the geometry representation used in OpenMC Monte-Carlo neutron transport simulations, including core, fuel assembly and fuel-pin level structures used to calculate neutron behaviour and core performance.

The lower panel illustrates how results from these high-fidelity simulations are used to train a machine-learning surrogate model, enabling rapid evaluation of reactor design parameters and supporting design optimisation studies. This combined physics-based and data-driven approach allows exploration of reactor performance and fuel utilisation across different reactor configurations.

Figure: István Szoke

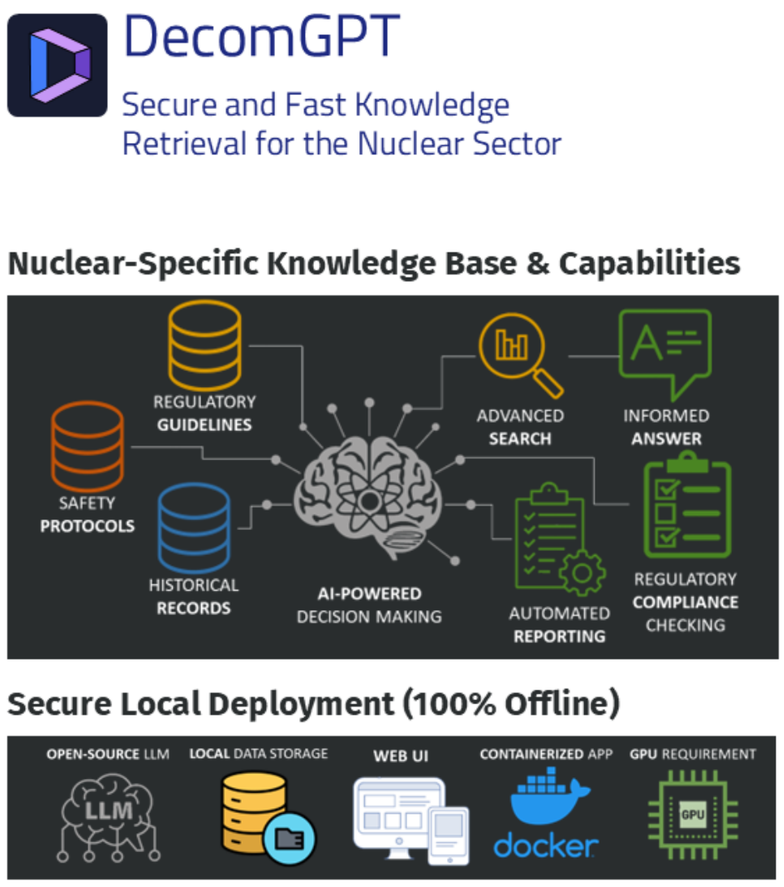
Research within RT3 and WP1 fed into conference presentations on regulatory and system-identification aspects of SMRs, advanced reactors, and microreactors, including nuclear propulsion for shipping. A cross-disciplinary UiO summer research project, involving students from reactor physics, radiation protection, systems engineering, and safety analysis, provided a basis for outreach at conferences and stakeholder meetings and supported early technical dialogue on commercial nuclear-powered ships.

Overall, WP1 strengthened reactor physics capabilities through SMR, microreactor, and advanced reactor modelling, while establishing a coherent maritime reactor research line as an application-specific extension.

The strong involvement of students, together with depletion, activation, and shielding studies, reinforced the physics basis for advanced reactor analysis, safety assessment, and backend-related evaluations.

AI-Supported Knowledge Retrieval for Nuclear Applications

RT3 continued development of DecomGPT in 2025, building on work initiated in earlier years. The activity focused on refining AI supported knowledge retrieval for nuclear specific documentation, including regulatory material, technical reports and historical records. In 2025, this work contributed to defining use cases and workflows that supported subsequent qualification project preparation.



Conceptual overview of the DecomGPT system developed within RT3 to enable secure AI-assisted retrieval and analysis of nuclear-specific documentation, including regulatory guidelines, safety procedures and historical technical records, with the capability for fully local and offline deployment. Figure: István Szoke

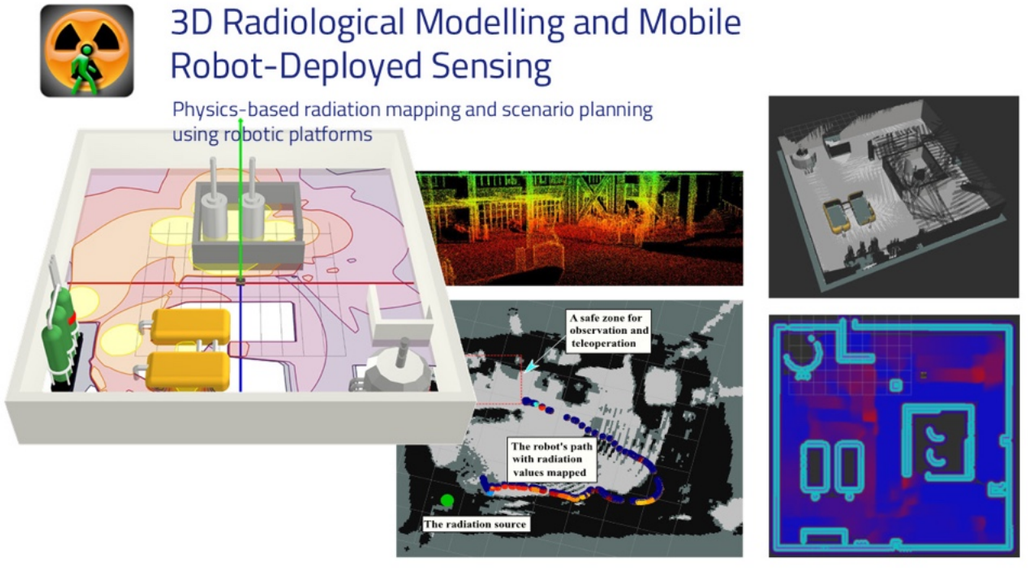
WP2: Radiological Modelling, Mapping and Scenario Based Training

The second work package is led by IFE Halden and focuses on advanced radiological modelling and digital twin development for environments outside of nuclear reactor cores. The tools developed by WP2 support nuclear decommissioning planning, radiation protection training for professionals in the global nuclear industry, and stakeholder communication. By combining physics-based modelling with immersive and scenario-driven interfaces, the work package strengthens capabilities for analysing and communicating radiological risk across the nuclear lifecycle.

WP2 advances digital twin methods through the integration of virtual reality (VR) environments, simplified dose calculation approaches, and pathways toward high-fidelity Monte Carlo validation. A prototype export chain from VR-based geometry construction to the OpenMC radiation transport code was initiated in 2025, representing the first step toward tighter coupling between interactive scenario development and physics-accurate simulation workflows. This development lays the groundwork for future validation and benchmarking of training and communication scenarios against state-of-the-art transport calculations.

A central activity in 2025 was the development of new radiological scenario material, including a worst-case radioactive material transport scenario used in municipal outreach, educational settings, and stakeholder dialogue. The scenario demonstrated how VR-based point-kernel dose calculations can support rapid situational assessment, risk communication, and decision-making discussions. These tools have been applied in university teaching and public demonstrations, strengthening the educational dimension of radiological modelling and preparedness.

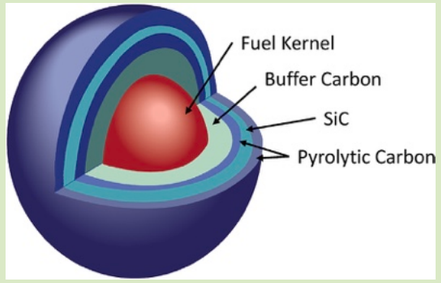
WP2 also established the foundations for robotics–digital twin integration. Student-led projects defined conceptual pathways for integrating mobile robotics workflows with VR-based radiological scenarios, including navigation strategies, sensor integration approaches, and 3D mapping concepts. This preparatory work supports future development of robotics-assisted radiological characterisation and mapping in complex or constrained environments.



Example of radiological scenario modelling combining physics-based dose calculations with mobile robotics sensing and 3D environment reconstruction. The approach enables radiation field visualisation, mapping and scenario planning using robotic platforms and digital twin representations of facilities, supporting applications such as characterisation, remote inspection and radiological preparedness activities developed within RT3.
Figure: István Szoke

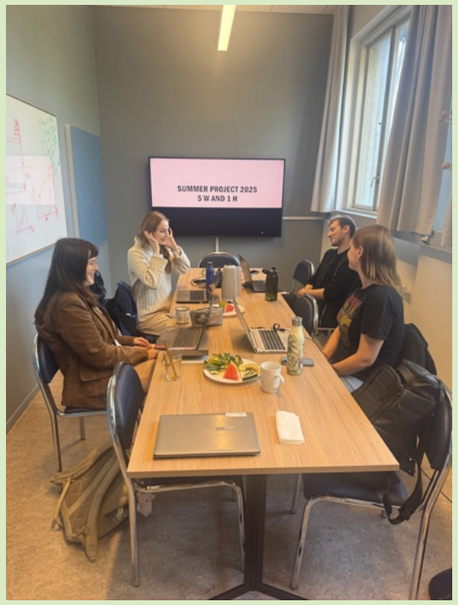
The 2025 'Nuclear Propulsion' summer project

The 2025 'Nuclear Propulsion' summer project was a continuation of the 2024 project of the same name. The previous project compared a series of reactor technologies using selection criteria centred around technical aspects such as fuel enrichment, refuelling frequency, and total power. Using these criteria and the design specification of a Deep Sea Container ship the project selected a helium-cooled TRISO-particle fuelled reactor as the most appropriate technology. The 2025 project investigated a similar reactor design, but instead focused on the safety and radiological impact of a ship powered by such a reactor.

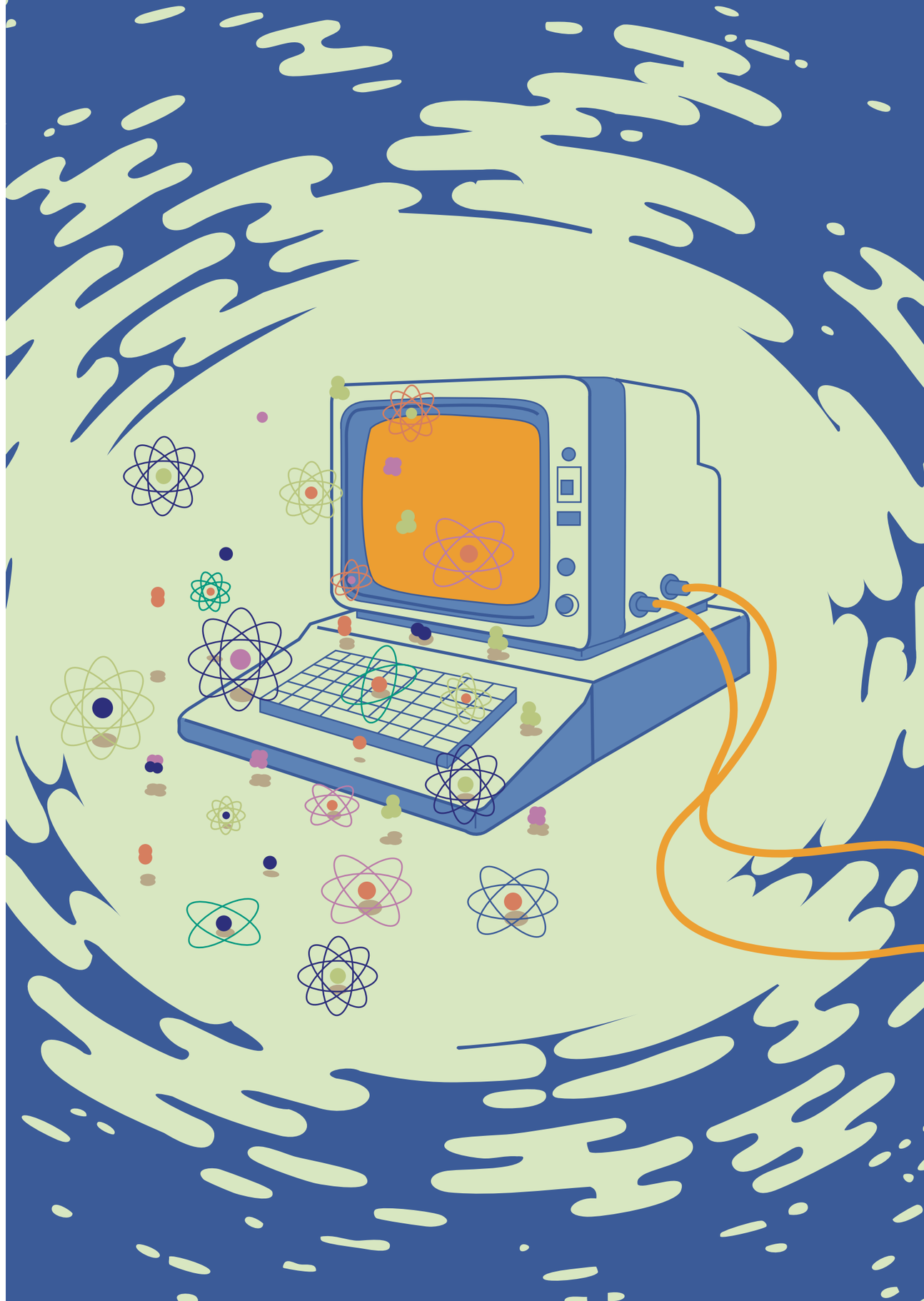


TRISO particles are particles of encapsulated fuel with a diameter of approximately 0.9 mm including the encapsulating layers (from innermost layer outward) of buffer carbon, pyrolytic carbon, silicon carbide, and an outer coating of pyrolytic carbon. Figure: Condon, C.A. et al. (2021). Fate and transport of unruptured tri-structural isotropic (TRISO) fuel particles in the event of environmental release for advanced and micro reactor applications J. Environ. Radioact., 234, 106630.

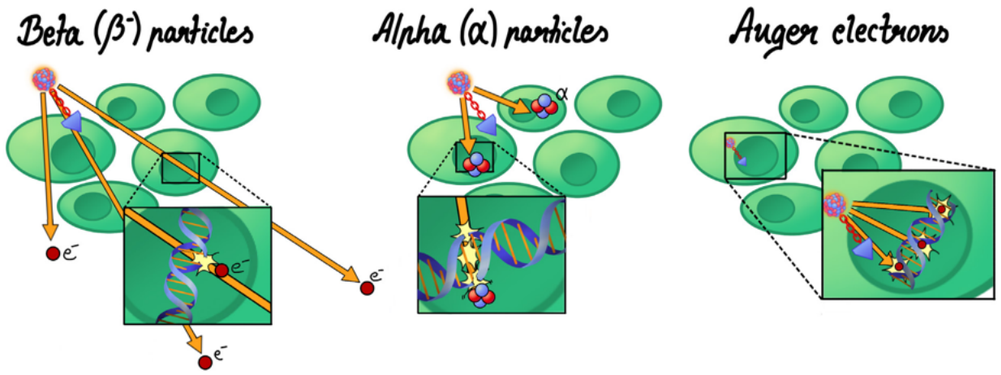
This involved determining the total inventory of radioactive material when the ship entered a Norwegian harbour, determining release fractions for two accident scenarios, and modelling the environmental dispersion of this material. Design features of the reactor such as the fuel reduced the radiological impact at ground level significantly when compared to more traditional water-cooled designs, and ensured that accumulated doses remained below the Norwegian limit of 1 mSv per annum for non radiation workers. Despite these strengths, flooding of the reactor remains a potential risk and highlighted the need for revamped safety systems should such a design be employed in a maritime environment. Part of the results of this work will be presented as a poster at the 12th NERIS workshop in Paris in 2026.



Picture of the students Baltasar Johannes Hemmerle, Elise Harila Christensena, Ella Hedegart Flaata and Hannah Westgaard working on the summer project together.
Photo: Baltasar Johannes Hemmerle



RT4: Radionuclide Production and Speciation



Different types of radiation not only traverse distinct distances within the body but also damage DNA in different ways, ranging from small, repairable lesions to dense clusters of breaks that are more difficult for the cell to repair. Figure: Trine Kvam Olafsen

Scope of RT4

Several disciplines are engaged in this research theme, to identify and study emerging radionuclides and subsequent coupling to compounds which are interesting for medical and industrial applications. This comprises, but is not limited to, fundamental nuclear reactions studies, development of radiolabelled compounds for potential diagnostic and therapeutic uses, and synthesis of potential industrial radiotracers.

Progress 2025

The Department of Pharmacy has strengthened its focus on radiopharmacy as part of NNRC WP4. In 2025, two tenure-track positions were successfully filled: Dr. Amalie F. Reinertsen in Medicinal Chemistry and Dr. Bjarke Strøm Larsen in Pharmaceutical Technology. One Ph.D. candidate is linked to WP4. Three master's students in pharmacy are currently specializing in radiopharmacy within Medicinal Chemistry.

A strategic joint initiative was launched in 2025 to build institutional competence in radiopharmaceutical sciences across education and research.

In December 2025, the first hands-on practical training was successfully delivered within the department for the new tenure tracks and students. Participants gained direct experience with [^{68}Ga] and [^{18}F] radiolabeling, including radionuclide handling, synthesis workflows, and quality control procedures in a clinical-relevant setting. In parallel with the establishment of robust theoretical and practical training, the initiative focuses on systematic knowledge building and interdisciplinary integration.

This effort is designed to culminate in joint research activities and collaborative projects, creating a sustainable educational and research pipeline that supports ongoing research interests while also fostering innovation in emerging areas such as green radiopharmaceutical sciences and more sustainable production methodologies.

Based on this initiative, a new interdisciplinary 10-credit course, entitled FARM5230: Radiopharmacy: Making Drugs for Diagnosis and Treatment has been developed at the department of Pharmacy. The course provides in-depth training in the radiochemical principles and methodologies that underpin the design, synthesis, formulation, and quality control of radiopharmaceuticals for both diagnostic and therapeutic applications. The course will be offered for the first time in spring 2026.

Emerging radionuclides – studies of the production of ^{119}Sb and ^{177}W

A radiopharmaceutical suitable for therapeutic purposes will bind selectively with a tumor to deliver a targeted dose of radiation to the tumor and its metastasis, sparing the dose to surrounding healthy tissue. Different radionuclides can be used to deliver this targeted dose: alpha-particle emitters deposit their energy in cellular ranges (50 – 100 µm) due to the very high linear energy transfer (LET) of the particle, while beta-particles have lower LET values which result in the energy being deposited in multicellular ranges (0.1 – 10 mm). Meitner-Auger electron emitters take advantage of the high LET value combined with the very short range of the Meitner-Auger electrons to provide high cytotoxicity subcellularly (< 10 um).

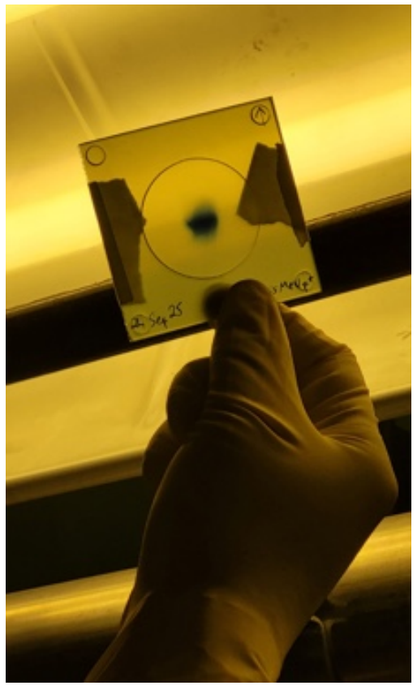
One objective of RT4 is the study of radionuclides that have potential for future radiopharmaceutical applications. It is not only the nuclear properties of these potential radionuclides that determine if a given radionuclide has potential - can we easily produce it and purify it from unwanted byproducts?



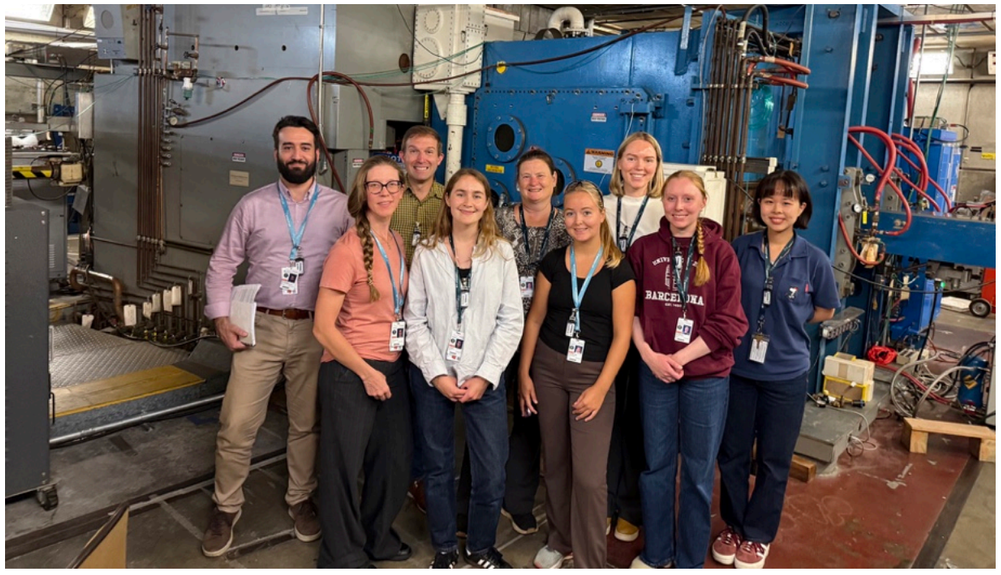
Photo of double-panel of stacked-targets holder during an experiment at the 88-inch cyclotron at Lawrence Berkeley National Laboratory. Photo: Liv Stavsetra

A study of two potential Meitner-Auger electron emitters, ^{119}Sb and ^{177}W, was conducted at the 88-inch Cyclotron in Berkeley, California in September. The objective of the experiments was to measure the production rate of these two nuclides and to establish what other by-products were made concurrently. An accelerated beam of protons irradiated target foils of tantalum and tin to produce the nuclides of interest.

A setup referred to as a stacked-target configuration enables us to simultaneously study the reactions that occur between the protons at different energies and the tantalum and tin. As the beam of protons travels through the stack of foils, its energy is reduced and every foil in the stack is bombarded with protons of different energy. This allows us to establish which proton energy is optimal for the highest production rate of ^{119}Sn and ^{177}W. However, the optimal production conditions must also minimize the formation of unwanted by-products to ensure high purity of the desired radionuclide.



Verification of the beam profile using photographic film.
Photo: Liv Stavsetra



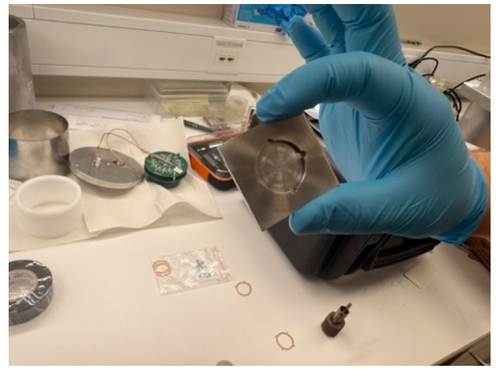
Participants at the experiment in the 88-inch Cyclotron in Berkeley, from left to right back: Georgios Kalantzopoulos (IFE), Andrew Voyles (UC Berkeley/LBNL), Sunniva Siem (UIO), Camilla Almli Tokstad (UIO), front left to right: Liv Stavsetra (IFE/UIO), Hannah L. Ekeberg (UIO/IFE), Elise Martinsen (UIO), Elisabeth Brynildsen (UIO), Abby (Yun-Hsuan) Lee (UC Berkeley)
Photo: Hannah Ekeberg

Norwegian production of the ^{95m}Tc radiotracer for nuclear preparedness

A new collaborative project was initiated between UiO and NMBU to produce technetium-95 in a metastable state, ^{95m}Tc, with a half-life of 62 days. 95mTc has the same chemical properties as other, longer-lived isotopes of technetium which occur as fission products. 95mTc is therefore ideally suited as an environmental radiotracer to investigate environmental transport of technetium, critical for nuclear preparedness.

Worldwide, supplies of this radiotracer are sporadic, with few production facilities. The cyclotron at the OCL is an ideal setup for production through the ^{93}Nb(α 2n)^{95m}Tc reaction, which produces ^{95m}Tc completely without any ^{99m}Tc contamination, which is undesirable for this case.

Prior to the first full production run planned for 2026, a test irradiation was performed on the 10th of November 2025 using an alpha-particle beam for one hour (5–6 enA), after which the irradiated target (see figure) was analysed to confirm successful production.



The water-cooled target assembly used for irradiating the niobium.
Photo: Kevin Ching Wei Li

Update on the Neutron Generator at the Section for Nuclear Chemistry

Early in 2025, the necessary radiation dose measurements were carried out to support the application to the DSA for permission to operate the new HUNT-funded Genie-16 neutron generator. Before submitting the application, improvements to the existing shielding were implemented. In particular, the back-wall shielding was upgraded so that the hallway behind the generator room can now be used, albeit with some restrictions. The measurements were informed by neutron-field modelling completed in 2024. The application for an operating licence was submitted in June 2025; approval is expected in early 2026, making 2026 the first year the generator will be available for general use.

As part of the commissioning process in autumn 2025, the radiation field around the generator—information essential for safe and efficient operation—was carefully mapped. This work was carried out by a MSc student under the supervision of the radiation-protection group at the Section for Nuclear Chemistry. Detailed measurements were obtained by irradiating Cu and Al targets placed at well-defined positions and using carefully calibrated procedures.

The target "coins" were mounted on a web of threads arranged around the generator. The mapping was performed as a function of vertical and horizontal distance, as well as azimuthal angle in the horizontal plane.



Master student Julia Höst mapping out the neutron irradiation field around the generator. Targets of copper and aluminium were mounted on a web of threads in different distances and angles from the generator.
Photo: Jon Petter Omtvedt

PhD student at Lawrence Berkeley National Laboratory

Elise Malmer Martinsen is a PhD student in experimental nuclear physics for medical applications at the University of Oslo. Her main research topic is the production of medically relevant radioactive atoms. Radioactive atoms, or radionuclides, can be used for both diagnostics and treatment of diseases such as cancer. Because these radionuclides decay, new batches must be produced continuously to supply hospitals with the required quantities. An important research topic is therefore to investigate different production pathways for medically relevant radionuclides.

During her four-month stay at LBNL from August to December 2025, Elise was warmly welcomed by both the team at the 88-inch Cyclotron and the Abergel Group. She participated in several experiments during the visit. Experimental work began at the 88-inch Cyclotron, where two stacked-target experiments were performed to measure the cross section for the production of several medically relevant radionuclides as a function of beam energy. These two data sets will be analyzed by Camilla Tokstad and Elisabeth Brynildsen, two master's students from the University of Oslo.

In addition, a thick RbCl target was irradiated at the 88-inch Cyclotron to produce strontium-82. This radionuclide decays to rubidium-82, a positron-emitting nuclide used in PET scans. The strontium was chemically separated from other coproducts, mainly rubidium, and injected into both male and female mice. The biodistribution of the strontium was then studied using PET scans at several time points after injection and by dissection after euthanasia. This experimental work will be published in collaboration between the University of Oslo and LBNL, and will be part of Elise's PhD thesis.

Elise also participated in three other experiments: a third stacked-target experiment at the 88-inch Cyclotron to study the cross section of polonium-209, the production of polonium-208



A team from NNRC inside the control room of the 88-inch Cyclotron at LBNL during stacked target experiments. From the left: Camilla Tokstad, Elisabeth Brynildsen, Elise Malmer Martinsen, Hannah Ekeberg and Liv Stavsetra.
Photo: Sunniva Siem

at the 88-inch Cyclotron which will be used in further experiments in the Abergel Group, and measurements of the biodistribution of strontium-90 in mice. The study on strontium-90 was performed by the Abergel Group and will be connected to the experimental work with strontium-82 described above.

The research stay has been of great value. Elise gained important insight and hands-on experience, and the experiments have provided data for several students at the centre. We will continue the strong collaboration with LBNL, and are pleased that Andrew Voyles from LBNL serves as co-supervisor for Elise and several other students at the centre.

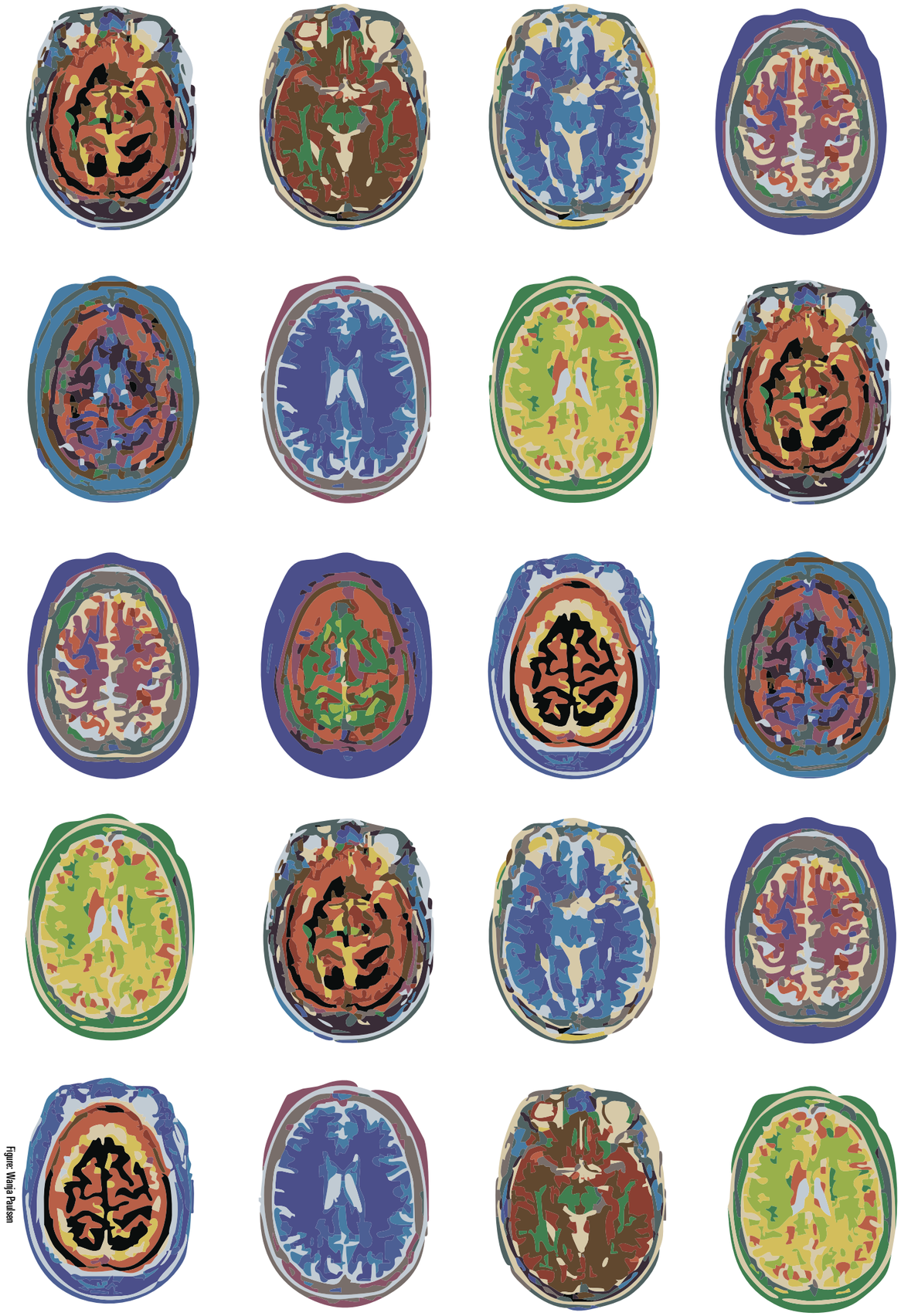


Figure: Wanja Paulsen

RT5: Environmental Radiochemistry and Source Characterisation

What is environmental radiochemistry?

Environmental Radiochemistry, or the Environmental Chemistry of Radionuclides, involves the study of the transport and fate of radioactive isotopes in the environment and supports decision makers with a scientific basis for environmental risk assessment and management. Applications include topics such as radon exposures to the public, nuclear decommissioning and waste disposal, nuclear preparedness, and nuclear security, and cover a multitude of potential sources, including nuclear power reactors, research reactors, medical and industrial sources, fuel cycle facilities, as well as nuclear weapon stockpiles. All these sources can be subject to nuclear accidents, nuclear terrorism and other nuclear security threats including the use of nuclear weapons against Norway or close to Norway.

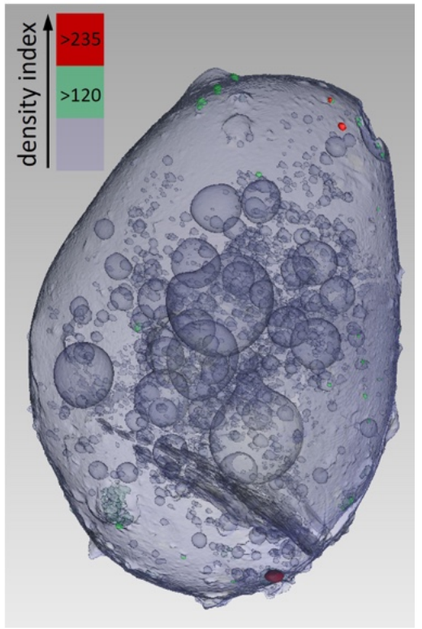
Knowledge on the behaviour of radionuclides in the environment is fundamental to under- standing the impacts on humans and the environment of any potential release. This requires information on source term (inventory as well as the amount, composition and speciation of the released radionuclides), as well as factors influencing transfer and exposure, all of which are linked to key research areas within environ- mental radiochemistry.

Scope of RT5

The key research objectives in RT5 can be split into two main areas, namely questions about the potential source term (e.g., what might be released and how) and questions about the be- haviour and impact of radionuclides following release. Both research areas are supported by state-of-the-art radioanalytical facilities, laboratory and field studies and a suite of transport, transfer and impact models.

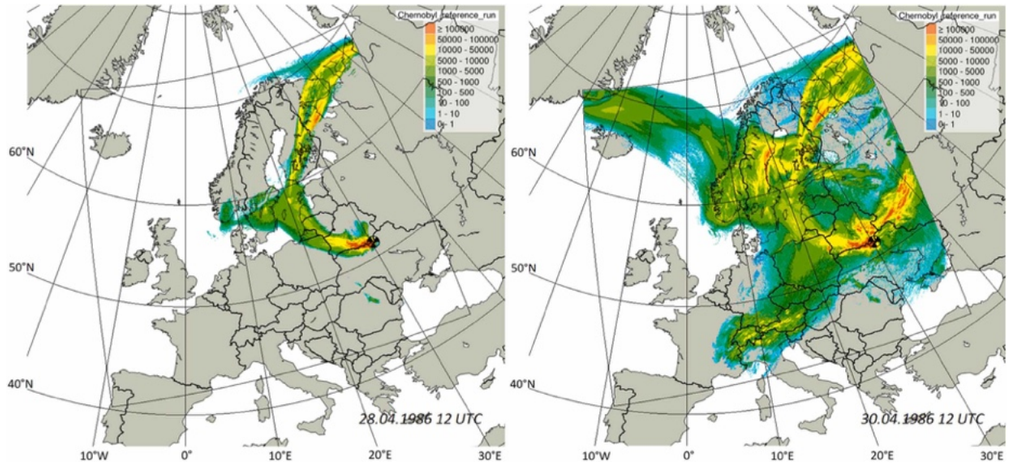
RT5.1: Sources Security and Safety

Sources security and safety spans several scientific fields and employs a broad range of destructive and non-destructive analytical techniques to obtain detailed elemental, isotopic, chemical, and physical signatures. These signatures are used to determine the origin (source) and history (age, release scenario, and environmental conditions) of radioactive materials in environmental samples and nuclear forensic evidentiary specimens, and to strengthen source-term characterisation for emergency preparedness and risk assessment.



Radioactive particle from the UK OneTree Round 1 nuclear test (15 kt tower shot) of the Buffalo nuclear test series at Maralinga, Australia, 27 September 1956. The image is a transparent 3D rendering based on computerized nanotomography showing high density inclusions (red) expected to contain Pu and U as well as interior voids surrounded by glassy material. Such particle characterisation data serve as important input in ongoing work to adapt existing nuclear preparedness systems to nuclear detonations.

Figure: Salbu et al., Challenges associated with the behaviour of radioactive particles in the environment, Journal of Environmental Radioactivity, 186, 2018.



Fallout map of accumulated total deposition (wet + dry deposition) of ^{137}Cs (Bq/m^2) at 28.04.1986 12 UTC (left panel) and 30.04.1986 12 UTC (right panel) after the Chernobyl accident. The dispersion is calculated by use of the SNAP model of the Norwegian Meteorological Institute and the original dry deposition scheme. Figure: Berge et al., A study of particle dry deposition parameterizations in an atmospheric radioactive preparedness model: Application to the Chernobyl case, Journal of Hazardous Materials, 474, 2024.

RT5.2: Environmental Transfer and Impact

Assessment focuses on the transfer and impacts of radionuclides in the environment, including the way physical-chemical properties influence their behaviour. While studies of the impacts of the Fukushima accident has provided valuable knowledge for nuclear preparedness, the majority of data is related to a few radionuclides and there is an urgent need to address other nuclear threats such as nuclear weapons, new generation reactors (including SMRs), materials out of regulatory control (MORC) and challenges associated with decommissioning of Norway's research reactors.

Progress 2025

Work in RT5 has largely built on research initiated under the Centre of Environmental Radioactivity (CERAD). Eight PhD students and a postdoc are working on projects of direct relevance to the research objectives of NNRC RT5. A new associate professor within radiochemistry has also contributed since commencing in his new position June 2025. The PhD projects cover studies on atmospheric transport and emergency preparedness modelling in RT5.1 as well as ecosystem transfer of natural and anthropogenic radionuclides in RT5.2. Naomi Marks from the Seaborg Institute at Lawrence Livermore National Laboratory visited NMBU in the summer of 2025 as part of her sabbatical. Exchange of knowledge, planning of further collaboration including on participation of Naomi in teaching at NMBU related to the new specialization of the environmental physics civil engineering programme in nuclear power, security and safety.

Specific progress projects include analysis of natural radionuclides in drinking water which have contributed to improving risk assessment of naturally occurring radionuclides. Furthermore, several studies on radiocaesium and radiostrontium have highlighted the importance of insects in the ecological transfer of radionuclides. In support of nuclear decommissioning and nuclear waste management, projects in RT5.1 develop analytical methods for difficult-to-measure (DTM) radionuclides and in RT5.2 the toxicokinetics of Th in D. magna and C.elegans is explored.

Excellent inter-Research Theme collaboration was initiated in 2025 between RT4 who produces radionuclides (see RT4 report) and RT5 that will use these as tracers in upcoming experiments and for analytical purposes.

NMBU and MET participate in several EU PIANOFORTE funded projects (EU PREDICT, EU RRADEW, EU GIROSCOPE, EU CITHARA) on nuclear preparedness related topics. The GIROSCOPE project (emergency preparedness linked to SMR and Gen VI reactors) also includes UiO and is a good example of collaboration between RT3 (reactor source term simulations) and RT5 (transport and environmental impact assessments). In 2025, NMBU participated in several international arenas including IAEA CRPs "Transfer of Radionuclides in Arid and Semi-Arid Environments for Radiological Environmental Impact Assessment" (K41022) and "Improving External Dosimetry for Terrestrial Animals and Plants" (K41023) as well as IAEA Workshop on Methods for Radiological and Environmental Impact Assessment (MEREIA; EVT2404077).

The RT5 PI is involved in the planning of a new synchrotron beamline related to the MAX4U upgrade at MAX IV, Lund, Sweden. The new multimodal chemical microscopy and micro-spectroscopy beamline may prove to be very useful for future RT5 research.

NNRC/NMBU visit at University of California Berkeley and Lawrence Livermore National Laboratory

Professor Ole Christian Lind, NMBU, visited UC Berkeley, Lawrence Berkeley National Laboratory and the Glenn T. Seaborg Institute, Lawrence Livermore National Laboratory (LLNL) in March and gave an invited lecture at LLNL. The visit also included very interesting meetings with discussions on both research and student training, which should contribute to strengthening US-Norwegian collaborations within environmental radiochemistry.



Professor Lee Bernstein and assistant research engineer Andrew Voyles, Lawrence Berkeley National Laboratory (LBNL), hosted Professor Ole Christian Lind, NMBU for a tour of the LBNL facilities including the fabulous San Francisco Bay views. Photo: Ole Christian Lind



Figure caption: Aerial view of the MAX IV synchrotron facility, Lund, Sweden.
Photo: Perry Nordeng, courtesy of MAX IV.

NNRC visit at IJCLab

Professor Ole Christian Lind, NMBU, visited Laboratoire De Physique Des 2 Infinis Irène Joliot-Curie (IJCLab) in June 2025 and gave an invited lecture as part of the IJColloquium seminar series. The visit also included several very interesting meetings and lab visits on the campus in Orsay, which should contribute to strengthening French-Norwegian collaborations, also within environmental radiochemistry.

There are many past, present, and potential future sources of radioactivity that can contaminate the environment. To protect humans and ecosystems, impact and risk assessments are essential. Radioecological models used to predict radionuclide distribution, fluxes, and exposure must be robust and fit for purpose, with uncertainties reduced as far as reasonably possible. Many factors contribute to overall model uncertainty. This seminar presented research aimed at quantifying and reducing these uncertainties, with emphasis on radionuclide speciation and the use of state-of-the-art analytical techniques.



Poster for the seminar of Professor Ole Christian Lind. Figure: IJC-Lab

Education

2025 was the third year in which students could apply to the new nuclear science programmes at UiO, and demand for education in this field remains strong. The Bachelor's programme in Nuclear Physics and Technology received over 500 qualified applicants, 82 of whom listed the programme as their first choice. Applicant numbers have remained consistently high for three consecutive years. Thirty-two students were admitted, bringing the total number of active bachelor students at UiO across all three years to about 75.

Significant effort has been invested in adapting three core nuclear-technology courses to the bachelor level and scaling them up to accommodate roughly 25–30 students each: Medical Applications of Nuclear Physics, Introduction to Reactor Physics, and the laboratory course Nuclear Methods and Instrumentation (the latter taught jointly by the Departments of Physics and Chemistry). Excellent learning outcomes indicate that these courses can be successfully offered in the fourth and fifth semesters of the bachelor programme, respectively.

New advanced courses at the master and PhD levels were developed and taught for the first time in 2025. Notable examples include Project Management in the Nuclear Context (in collaboration with Advansia), Targeted Alpha Therapy (in collaboration with Bayer), and Advanced Reactor Physics (in collaboration with IFE and DNV). Contributions from adjunct professors from NNRC partners are essential for these advanced courses.

Ten master students graduated in 2025 from UiO with degrees in nuclear-related subjects. This group includes the first graduate of the new master's programme in Nuclear Science, who completed an external research project on targeted alpha therapy at Bayer, as well as master's graduates in nuclear physics, nuclear chemistry, and science education—the latter having developed new nuclear-physics learning resources for high-school students. Many of the master's projects had adjunct professors as main or co-supervisors, providing students with experience and insight into highly relevant research activities among NNRC's partners and stakeholders.

NMBU is in the second year of its new Bachelor programme in Environmental Radioactivity, and while it did not attract as high numbers as UiO, there are now 30 students enrolled on the programme. A new bachelor level course: Nuclear Industries, Facilities and Activities was held for the first time in 2025, and attracted a large number of students, the majority being from study programmes other than



Students from RAD200 Nuclear Facilities at a site visit to IFE Kjeller.

Photo: IFE

Environmental Radioactivity (e.g., Environmental Physics, Renewable Energy, Environmental Sciences). This emphasizes the interest in nuclear-related subjects for students across different disciplines. In order to meet this interest, NMBU has instigated a new civil engineering study programme Nuclear Power and Emergency Preparedness.

The MSc Programme at NMBU - Nuclear and Environmental Science, continues to attract students, with 4 students enrolling in 2025. A new advanced course Experimental Radioecology was run for the first time, while the MSc level course Introduction to Decommissioning and Environmental Remediation was held for the second year, again with a number of students from other study programmes, as well as professional participants - credits were offered as an a continuing and further education (etter- og videreutdanning, EVU) course.. NMBU/NNRC adjunct professors were involved in teaching on all courses. Six master students graduated from NMBU in 2025 with degrees in nuclear-related subjects.

Accreditation has been awarded to the ERASMUS+ programme "Master in Nuclear Decommissioning and Environmental Remediation (MINDER)" which is a collaboration between University of Porto, Portugal (lead), NMBU/MINA, Czech Technical University, and University of Hasselt, Belgium. The official start up has been postponed to 2027, but courses are already available for students, and a bilateral ERASMUS agreement has been signed by UHasselt and NMBU.

NNRC continued to provide regular arenas where stakeholders can present their activities to students and mingle with them afterwards. These events give students an overview of the nuclear sector in Norway, inspire ideas for possible master's projects and connections to future employers, and help them develop a better understanding of the relevance and value of their education for future careers.

Nuclear Technology Seminar Series

Since the beginning NNRC has organized regular company presentations at UiO where stakeholders of the centre present their activities and employment opportunities to students, followed by social mingling. A total of 15 seminars was held in 2025. These seminars were very popular among the students in the new Bachelor program: nuclear technology, and the wider physics department.

21/01-2025: **John Koblanski, University of Hawaii**
«Seminar on genetic algorithms»

05/03-2025: **Thor-Audun Saga (Norsk medisinsk syklotronsenter)**
«Virksomheten ved Norsk medisinsk syklontronsenter AS og behov for nukleær kompetanse»

23/04-2025: **Per Peterson, University of California Berkeley and Kairos Power**
«Kairos Power: From University Conception to Mission-Driven Start-Up»

30/04-2025: **Ole Christen Reistad (Den norske veritas)**
«What is the future of sea-based nuclear propulsion – what do we need to solve?"»

08/05-2025: **Fredrik Parnefjord Gustafsson (CERN)**
«Antimatter-Matter Atoms: A Powerful Tool for Fundamental Physics and Nuclear Research»

20/05-2025: **Cécile Maisonneuve (DECYSIVE and former vice president of AREVA)**
«The role of nuclear energy in the new paradigm of energy security»

29/08-2025: **Professor Takashi Nakamura (Institute of Science Tokyo, Japan)**
«Exploring extremes of the nuclear landscape»

03/09-2025: **Sunniva Rose (Norsk kjernekraft AS)**
«Er kjernekraft løsningen for en fossilfri framtid?»

10/09-2025: **Erik Berge (Meteorologisk institutt)**
«Meterology, Air Pollution and Applications to Dispersion of Radionuclides in the Atmosphere»

17/09-2025: **Hannah Westgaard, Elise Harlia Christensen, Ella Hedegart Flaata and Baltasar Johannes Hemmerle**
«Summer Project on Gas-cooled Reactors on Ships: Reference Accident and Regulatory Considerations»

01/10-2025: **Tellef Storebakken, Julian Ersland Vevik and Noémie Fritz (Advansia)**
«Nukleærteknisk prosjektledelse hos Advansia»

15/10-2025: **Knut Dæhli (Nei til Atomvåpen)**
«Intro til kjernevåpen - Risiko, konvekvenser og status 2025»

22/10-2025:: **Forsvarets Forskningsinstitutt**
«Defence-Related Nuclear Issues»

29/10-2025:: **István Szöke (IFE Halden)**
«Reimagining nuclear with AI, physics & robotics powered digital twins»

05/11-2025:: **Håvar Gausemel (Bayer)**
«Targeted Alpha Therapy (TAT) and Bayer: An opportunity for you?"»

UTFORSK school: Advanced Nuclear Reactions and Applications in Astrophysics 2025

The University of Oslo (UiO) organized an intensive two-week summer school on "Advanced Nuclear Reactions and Applications in Astrophysics" in November 2025. The event was held in South Africa at the WITS Rural Facility of the University of the Witwatersrand in Limpopo Province. The school brought together 24 early-career researchers (master's and PhD students) from Norway, South Africa, the United States of America, and Japan. Lecturers from UiO, WITS, Université Libre de Bruxelles (Belgium), CEA DAM (France), and the IAEA gave lectures on nuclear reactions and practical exercises with the TALYS reaction code. The school content was relevant not only for students working on nuclear astrophysics, but also for those engaged in applied research topics related to nuclear energy and medical applications of nuclear science. This school is made possible through the support of the UTFORSK grant from the Norwegian Directorate for Higher Education and Skills (HK-dir).

By prioritizing discussion and interaction over formal lectures, the school created a collaborative learning environment where students could learn from each other, and in addition, identify opportunities for collaboration, either with the other students or the lecturers. Many participants left with a network of collaborators that they have continued to stay in touch with. Each participant delivered a brief presentation of their current research to an international audience.



Group photo with almost all of the attendees of the UTFORSK school in November 2025.
Photo: Luna Pellegri

Summer School on Implementation of Emerging Technologies

NNRC co-organized this summer school together with the Halden Human Technology Organization (HTO) Project from August 31st to September 4th, 2025. This summer school supported competence development by providing participants with practical exposure to emerging analytical technologies relevant to nuclear operations. The programme addressed the use of digital twins, AI enabled modelling tools and robotics related methods in emerging nuclear technology contexts. The members of RT3 in NNRC contributed lectures and demonstrations in line with its modelling and simulation activities.

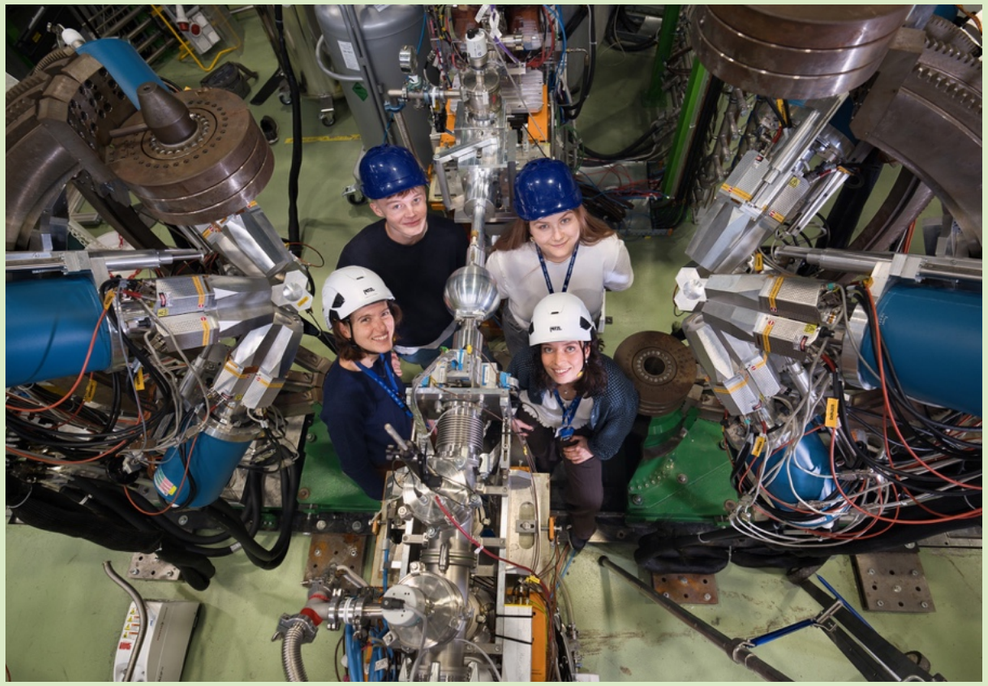
The event brought together participants from NNRC and Halden HTO member organisations as well as students and early career professionals from all organisations, creating a shared learning arena that combined operational experience with academic and research oriented perspectives. NNRC contributed input related to physics based modelling, simulation tools, digital twins and AI supported research and development. These contributions complemented the broader focus of the Halden HTO Project, which extends beyond technology development to include additional aspects of operational safety such as human factors, organisational issues, cyber security, control room design and other socio technical considerations. Together, the contributions illustrated how advanced technical methods developed within RT3 can be applied alongside HTO's long standing expertise in human technology organisation interactions.

Beyond the technical content, the Summer School functioned as an important platform for knowledge exchange and networking across roles, disciplines and organisations. The collaboration between NNRC and the Halden HTO Project highlighted the complementary nature of their activities and supported a more holistic understanding of safety, reliability and performance in nuclear operations.



A collection of photos of the summer school on implementation of emerging technologies.
Photo: István Szoke

PhD student at ISOLDE, CERN



The local Miniball team inside the opened Miniball gamma detector array and around the target chamber. From top left clockwise: Josh Curry, Faye Rowntree, Gulla Torvund and Carlotta Porzio.
Photo: CERN

PhD student Gulla Torvund studies nuclear structure. Her first PhD project involves analysis of experimental data from a 2017 ISOLDE Coulomb-excitation experiment that used the Miniball HPGe array for gamma detection together with a DSSSD particle detector. To deepen her knowledge of the experimental setup and gain broader hands-on experience in experimental nuclear physics, she spent an extended stay at ISOLDE as part of the local Miniball team. She was warmly welcomed and hosted by the ISOLDE collaboration from 1 September to 6 December.

During her stay three Miniball experiments took place. Gulla contributed to experiment preparation (testing detectors, running calibration runs, mounting targets, pumping beamlines, etc.), took shifts and performed online analysis during the runs, and carried out general detector maintenance (cryogenics, troubleshooting detector noise, determining operating bias voltages, etc.). In addition to practical work, she advanced her PhD analysis with highly valuable advice and support from Miniball experts at ISOLDE.

Gulla enjoyed her work at ISOLDE so much that she identified a second PhD project, also based on Miniball data but focusing on lifetime measurements. She will return to CERN in June 2026 for a stay of about seven months and will be partly supervised by the local Miniball lead, Carlotta Porzio. This return is excellent for the continued partnership between the Oslo nuclear group and ISOLDE.

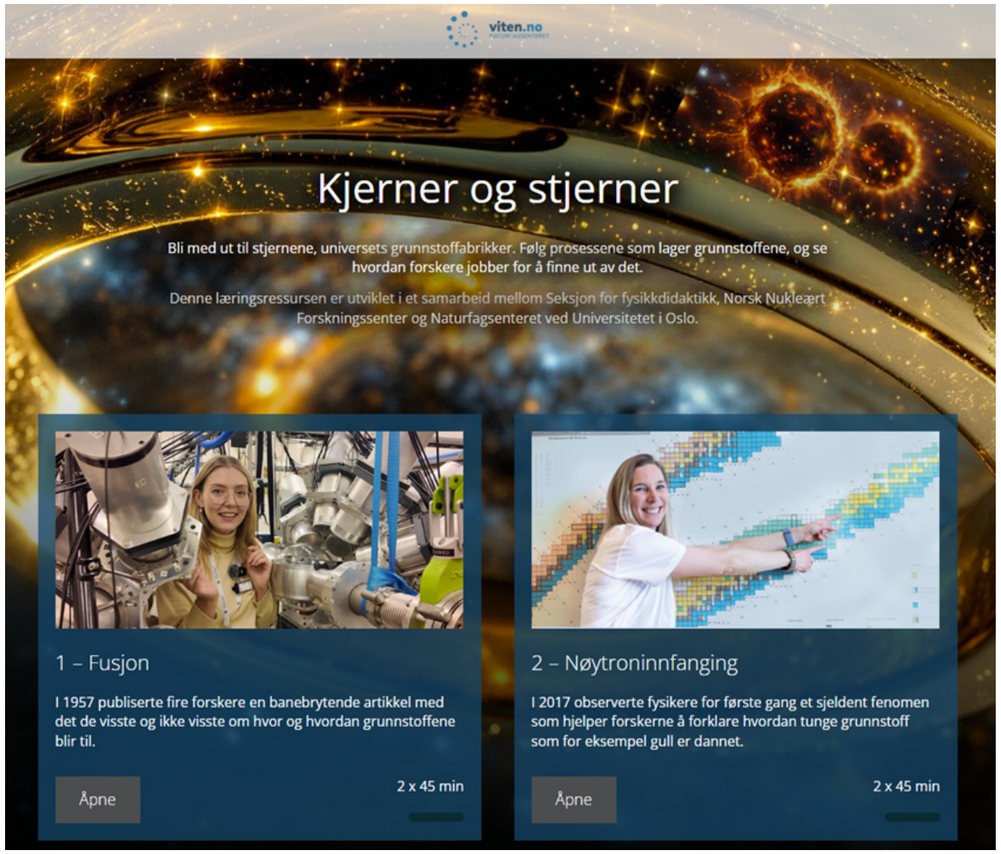
Update on STELLER

NNRCs educational project «STELLER – Stars and elements educational research» develops a digital learning resource for upper secondary physics about how elements are created in stars and neutron star mergers. Below we describe activities in the project in 2025.

Learning resource development and testing

The first version of the learning resource «Stars and elements» was ready in February, and concerned heavy element nucleosynthesis and how the 2017 neutron star merger changed our knowledge about it.

In March, six teachers and 120 secondary physics students tested the learning resource and provided data to inform further development and research on student learning. Both teachers and students reported positive impact on student learning and motivation. Still, data from the classroom tests pointed to several possible improvements. Consequently, a new version of "Stars and elements" (thus far only in Norwegian) has been developed, twice as large as the first version, due to a new module on the creation of elements in fusion processes. The new version will be tested among around 150 students in March 2026.



Screenshot of the latest version of Stars and elements with modules on fusion and neutron capture processes.

Photo: Maria Vetleseter Bøe

What is STELLER?

The education project "STELLER – Stars and Elements educational research" develops digital learning resources about nuclear physics and nucleosynthesis for upper secondary physics and researches student learning in these topics. STELLER is a collaboration between the Norwegian Nuclear Research Centre, the Physics Education research section, and Norwegian Centre for Science Education at UiO, and physics teachers and students in Norwegian upper secondary school.

STELLER development and research team consists of physics education researchers M. V. Bøe and E. K. Henriksen, science educator and developer Ø. Sørborg, and nuclear astrophysicists A. C. Larsen and W. Paulsen. Master student Helene Aune from the University of Oslo's teacher education program completed her thesis in the project in 2025.



Presentation for physics teachers at Teacher Day at UiO.

Photo: Øystein Sørborg.

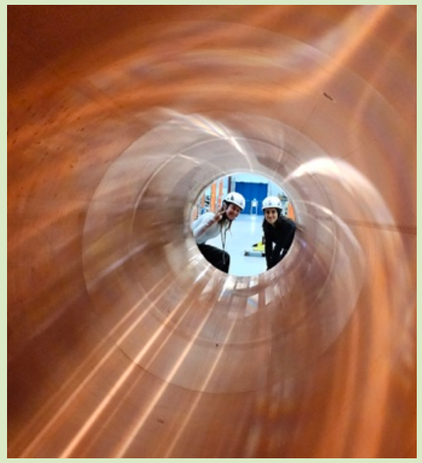
STELLER outreach activities

The STELLER project and the «Stars and elements» learning resource were presented to roughly 70 Norwegian physics teachers in a webinar with the Norwegian Association of Physics Teachers in October and at the University of Oslo's Teacher Day in November. The project was also presented at a research seminar hosted by NAFA, a Danish Academy of Science Education, in October.

STELLER has arranged two seminars where nine participating physics teachers have been introduced to and discussed the learning resource and classroom testing results and received talks on nuclear astrophysics by NNRC experts. STELLER has also established links with the Danish project AKTUALISER, which employs similar research and development methods and wishes to learn from STELLER.

Student visit to see nuclear facilities in Sweden

In November 2025, four students from UiO undertook a study visit to Sweden. As part of the program, they visited Uppsala University, the Tandem Laboratory, and the NESSA neutron generator facility. The visit also included a trip to Clab, the central interim storage facility for spent nuclear fuel in Oskarshamn and the Äspö hard rock laboratory.





Group photo with the four students from University of Oslo on their trip to see some of Sweden's nuclear facilities.
Photo: Ali Al-Adili

Building a nuclear chart made of LEGO®

As part of the creation of an exhibition about the Oslo Cyclotron Laboratory by the Museum of University History, construction began of a model of the nuclear chart made up of LEGO® bricks. The building process has served as both an educational tool and a team building exercise, and the model – once completed – will be displayed as a physical representation of nuclear properties.





Photos of students and staff building the nuclear chart made of LEGO.

Photo: Ida Margrethe Klingvall

Introduction to project management in nuclear context

NNRC has in collaboration with the centre partner Advansia developed a new course titled "Introduksjon til prosjektledelse i nukleær kontekst" (5 ECTS) in collaboration with Advansia. This course ran for the first time in the first few months of 2025 and was received very well by the students. Advansia has its own dedicated professional group specializing in nuclear activities, through which it collaborates with the Norwegian Nuclear Research Centre (NNRC). Since expertise in project management is in high demand among employers in the nuclear sector, this course was established to help meet that need.

As part of the course, students worked on a fictional case involving the construction of a small modular reactor (SMR). Their task was to develop a project management plan for the project. This plan was presented as part of a final oral examination, which was graded on a pass/fail basis.

The course was organized over six weeks. Each week, professionals from Advansia delivered guest lectures focusing on different aspects of project management. Among other topics, students learned about project management models, different ways of viewing and structuring projects, risk and safety management in a nuclear context, and international guidelines from organizations such as the IAEA. At the end of each lecture, students were given a set of tasks that contributed to the development of their project management plan, which they continued to work on throughout each week.



Group photo with students taking the new course on project management in nuclear context, together with one of the lecturerers from Advansia, Mathias Johnsen.

Photo: Advansia/NNRC

World Nuclear Exhibition (WNE), 4-6 November, Paris, France

Staff and students in NNRC participated actively at the World Nuclear Exhibition 2025, with representation in panel discussions and strategic meetings. Leader of RT3, István Szőke, took part in a Nordic panel addressing nuclear collaboration and ecosystem development, and contributed to activities leading to the signing of cooperation agreements with partners from Finland, Sweden and Canada. The event supported NNRC's international engagement and strengthened Nordic and transatlantic collaboration in nuclear research, competence building and technology development.



Photo from the World Nuclear Exhibition in Paris, France. Photo: István Szőke

PhD Defences 2025

Deniz Avsar

In March 2025 Deniz Avsar defended her thesis **"Speciation and Extraction of Cr(VI) Compounds from Acidic Nitro-phosphate Solutions Using Conventional and Radiochemical Methods"** for the degree of Philosophiae Doctor at the University of Oslo, Faculty of Mathematics and Natural Sciences.



Photo: Private

Main research findings

Phosphorus is essential for life and a key ingredient in the fertilizers that support global food production. However, as high-quality phosphorus sources become scarce, industries are turning to alternative materials that often contain unwanted impurities. This research investigates the removal and recovery of such impurities—especially the harmful form of chromium known as Cr(VI)—from acidic nitro-phosphate solutions.

Under these harsh conditions, we found that Cr(VI) is unstable and converts to Cr(III), a much less toxic form that can even act as a nutrient. To better understand this process, we investigated the key factors influencing its reduction.

In addition, we explored various extraction methods and discovered that the extraction agent Cyanex 923 works particularly well for ing and removing and recovering Cr(VI). We also produced radioactive tracers of lead (Pb) and arsenic (As) to further refine our process. Overall, this research contributes to a cleaner and more sustainable fertilizer production by turning a toxic challenge into an opportunity for resource recovery.

Wanja Paulsen

In September 2025 Wanja Paulsen defended her thesis **"A saga on the Hoyle state γdecay branching ratio of the Hoyle state"** for the degree of Philosophiae Doctor at the University of Oslo, Faculty of Mathematics and Natural Sciences.



Photo: UiO

Main research findings

The triple-alpha process is a key reaction in stars that produces carbon-12, an essential element for life. At temperatures between 0.1 and 2.0 billion kelvin, this reaction proceeds through an excited state of carbon-12 called the Hoyle state, so understanding this state is crucial for accurately modelling how stars make carbon. The probability that the Hoyle state produces carbon-12 via gamma decay is described by its radiative branching ratio. This quantity has been measured many times and was thought to be well known. However, a 2020 study by Kibédi et al. reported a value almost 50% higher than the previously accepted one, creating a serious discrepancy with important astrophysical implications.

Because that experiment was performed at the Oslo Cyclotron Laboratory (OCL) with involvement from several NNRC researchers, the centre initiated a new study using the OSCAR detector array at OCL. This project combined a new measurement of the gamma-decay branching ratio of the Hoyle state with a full reanalysis of the Kibédi et al. data. The results, recently published in a leading scientific journal, resolved the discrepancy through both the new experiment and the comprehensive reanalysis.

Magnus Ulimoen

In September 2025, Magnus Ulimoen defended his thesis **"Atmospheric transport modelling in nuclear preparedness, focusing on quantification and reduction of uncertainties"** for the degree Philosophiae Doctor at the Norwegian University of Life Sciences (NMBU), The Faculty of Environmental Sciences and Natural Resource Management (MINA).



Photo: NMBU

Main research findings

Ulimoen's PhD research contributes to the improvement of atmospheric transport models (ATMs) that are used to calculate the transport and dispersion of radionuclides following a nuclear event such as nuclear power plant accidents.

As part of a decision support system following nuclear incidents, ATMs simulate the transport and deposition from a given estimate of the source term and provide outputs of air concentrations and ground contamination. These model outputs underpin assessments of radiation dose, the effectiveness of countermeasures such as evacuation orders, and impacts on the terrestrial and marine environment. The reliability of decisions depends not only on the forecast but also on how much confidence can be attributed to the results. Therefore, a good understanding of the uncertainties of the model results are also critical for the decision-makers.

The work by Ulimoen has enhanced the capabilities of the decision support system used by Norwegian authorities by quantifying and reducing uncertainty of the output from the Severe Nuclear Accident Programme (SNAP) atmospheric transport model.

He addressed three key questions:

- How well do models describe wet deposition, which control where radioactivity ends up on the ground?
- How do different assumptions about the release and the weather change the results?
- How can we locate an unknown source using measurements and models run backwards in time?

Using the Chernobyl and Fukushima accidents as cases, he showed how improved physics and ensemble simulations (multiple model runs with slightly different initial conditions) provide more realistic fallout maps and a better grasp of uncertainty. For the 2017 episode with releases of radioactive ruthenium from an unknown source, his methods narrow down a likely release area in Russia. Taken together, this work leads to more reliable, transparent decision support in future nuclear emergencies.

Master students graduated in 2025

Master students at UiO during 2025

Master in Nuclear Science

Kristoffer August Poulsen
"Method of development for detection of 227Ac in 225Ac samples", 04.06.2025, UiO/Bayer AS (RT4)

Master in Physics (Nuclear and particle physics)

Sondre Nese Waldron
"Using Reactor Simulations to estimate neutron activation in the JEEP II reactor", 18.06.2025, UiO/IFE (RT3)

Maia Oline Grund Wirgenes

"Exploring Fuel Properties in the BANDI-60 Small Modular Reactor for Maritime Applications",11.08.2025, UiO/DNV/DSA (RT3)

Marius Torsvoll
"Investigating the use of open-source methodology for assessments of Russian PWR naval reactors: The case of the sunken submarine K-278 'Komsomolets'", 13.08. 2025, UiO/DNV/DSA (RT3)

Lise Anette Granheim
"Level Density and γray Strength Function of ^{28}Si", 21.10. 2025, UiO (RT1)

Master in Chemistry (Nuclear chemistry)

Ragne Lundeby Grønvold
"Separasjon av Scandium og Thorium fra Fen-mineraler", 09.01.2025, UiO/IFE (RT4)

Silje Kristine Aas
"Determination of ^{225}Ac in urine for assessment of accidental intake among occupational workers, using gamma spectrometry and liquid scintillation counting", 14.02.2025, UiO/IFE (RT4)

Leonard Rahn
"Utvinning av kritiske mineraler fra Bordvedåga - En studie av HCl-utlaking og væske-væske ekstraksjon av beryllium, platinagruppemetaller, sjeldne jordarter, thorium og uran", 25.04.2025, UiO (RT4)

Gennaro Nesso
"Design and development of a new RoboLab software for Neutron Activation Analysis – A tool for training and analysis in Nuclear Chemistry", 12.12.2025, UiO (RT4)

Master in Education

Helene Aleksandra Sæthre Aune
"Grunnstoffproduksjon i stjerner - Utvikling og utprøving av læringsressurs i kjernefysikk", 10.11.2025, UiO (Education)

Master students at NMBU during 2025

The Faculty of Environmental Sciences and Natural Resource Management (MINA)

Camille Jane Esmero Fredriksen
"Mineral extraction at the Fen Complex. A qualitative study of local community involvement in Nome in relation to potential mineral development", NMBU (RT5)

Nurtene Dernjani
"Optimization of a Fibroblast-Associated 3D Tumor Spheroid Model for Radionuclide Therapy", NMBU/Norwegian radium hospital (RT4)

Martin Hansebråten
"Transfer of radionuclides and stable analogues to edible plants in the semi-arid Tabernas desert, Spain", NMBU (RT5)

Hedda Eidsmo Sandholt
"Adverse effects from depleted uranium exposure in the nematode Caenorhabditis elegans: a focused investigation into uptake and biodistribution", NMBU (RT5)

Sjur Sletner
"Mobilitet av uran i sedimenter påvirket av sur avrenning fra alunskifer", NMBU (RT5)

The Faculty of Science and Technology (REALTEK)

Enya Frebrich
"Små modulære reaktorer i Norge: Utfordringer og muligheter innen økonomi, sikkerhet og avfallshåndtering", NMBU (RT3/RT5)



Photo: Daniele La Rosa Messina, www.unsplash.com

Outreach

Outreach is crucial for the Norwegian Nuclear Research Centre to enable informed public and political decisions about nuclear technologies, and secure future expertise by engaging and inspiring new generations.

Conservative Party's parliamentary group visit to the Oslo Cyclotron Laboratory (OCL)

On 24 March 2025, NNRC had the pleasure of welcoming representatives from the Conservative Party's parliamentary group to the Oslo Cyclotron Laboratory (OCL). The delegation consisted of Members of Parliament Kari-Anne Jønnes and Live Kroknes. During the visit, we presented both basic and applied research conducted at OCL and NNRC, as well as our new NucTech bachelor's and master's programmes, which are attracting strong interest.

The visit provided a valuable arena for discussion about the importance of knowledge, research, and science communication in today's society. The group also met several of our bachelor's, master's, and PhD students before being given a guided tour of OCL. Among other facilities, we visited the Cyclotron Hall to see the Scanditronix accelerator, and the Experimental Hall where the detector systems OSCAR and SiRi are installed.



The Conservative Party's parliamentary group together with Ann-Cecilie Larsen (NNRC), Susanne Viefers (Head of Department), Solveig Kristensen (Dean of the Faculty of Mathematics and Natural Sciences) and Carina Hundhammer (Director of the Faculty of Mathematics and Natural Sciences).
Photo: UiO

Podcast episode with DSA, "Sikre kilder"

Is mobile phone radiation dangerous? What do UV rays actually do? How much radioactivity is there in Norwegian nature? And what do we do if a nuclear accident happens? You'll find answers to these and many other questions on the podcast 'Sikre kilder' from the Norwegian Directorate for Radiation Protection and Nuclear Safety (DSA).

Former master student and currently PhD student Marius Torsvoll, bachelor students Cathrine Haagensli Bruun, Nicolay Lyngvær-Heyn, Helene Kind Wensink and Hannah Westgaard from the nuclear study programs at NMBU and UiO participated in an episode of a podcast created by the DSA this year. In the podcast they were interviewed about their choice of studying nuclear science, what nuclear competence is and how Norway has a very high demand for this competence in the coming decades. The four bachelor students were interviewed about their study programme in Nuclear Technology and the motivation behind their choice.



PhD student Marius Torsvoll posing in the Oslo Cyclotron Lab for the DSA podcast "Sikre kilder"
Photo: Directorate for Radiation Protection and Nuclear Safety (DSA)

In another episode Professor Deborah Oughton from NMBU and Professor Andreas Görgen from UiO were interviewed about why Norway needs more people with a background in nuclear subjects, and the oppurtunities for students after they have finished their studies.

"Inntil Kjernen – Er kjernekraft løsningen på en fossilfri framtid? (Close to the nuclear core – Is nuclear power the solution for a carbon free future?)", new book from Dr. Sunniva Rose

Doctor Sunniva Rose, author and Professor II at the University of Oslo and communication director in Norsk Kjernekraft AS, has published a new book called "Inntil Kjernen – Er kjernekraft løsningen på en fossilfri framtid? (Close to the nuclear core – Is nuclear power the solution for a carbon free future?)" in July of 2025.

Doctor Rose's work is grounded in the ongoing international research and presents our current knowledge basis of the subject of nuclear energy in the context of the energy crisis, aimed at enhancing understanding of the complex relationships between energy, technology, and climate.

The book is structured into clear, accessible sections that outline how advancements in physics and technology can help tackle the energy and climate challenges we face today. Doctor Rose has also included sections where she thoughtfully addresses public concerns regarding nuclear waste and the risks of potential accidents. The book highlights significant impacts that current energy sources have on our environment and highlights the importance of transitioning towards more sustainable practices, with, or without nuclear power in the energy mix.

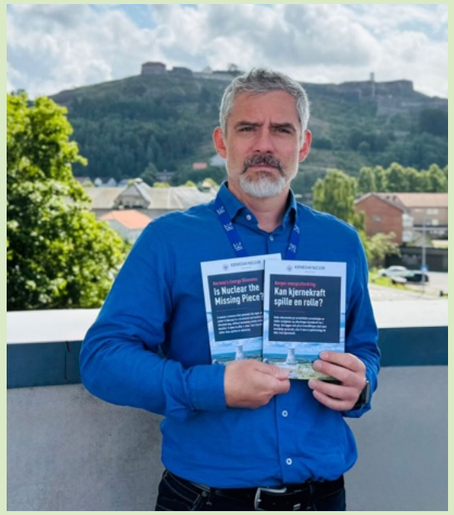


Front cover of Doctor Sunniva Rose's new book "Inntil Kjernen – Er kjernekraft løsningen på en fossilfri framtid?".
Photo: Megafon forlag, Sunniva Rose

"Norway's Energy Dilemma: Is Nuclear the Missing Piece?", new book from Dr. Istvan Szöke

Dr. István Szőke works with nuclear research and energy policy in Norway as Deputy Director of the Norwegian Nuclear Research Centre (NNRC), Research Manager at the Institute for Energy Technology (IFE), Professor II at the Norwegian University of Life Sciences (NMBU), and Acting Director of the Norwegian Nuclear Association (NNA). He has published a new book titled "Norway's Energy Dilemma: Is Nuclear the Missing Piece?", released as a report of the Norwegian Nuclear Association. The book provides a concise, technically informed overview of nuclear power and its potential role in Norway's future energy system, addressing technology options, safety, waste management, economics and societal considerations.

Dr. Szőke's work draws on international research and practical experience from the nuclear sector and places the discussion in the context of Norway's evolving energy landscape, including rising electricity demand, industrial electrification, climate commitments, and increasing debate about future energy infrastructure.



Dr. István Szöke with the book "Norway's Energy Dilemma: Is Nuclear the Missing Piece?" Photo: Private

The book aims to support a fact based discussion about how different energy technologies may contribute to secure, reliable and low carbon energy systems. The book is structured into clear, accessible sections that explain the fundamentals of nuclear technology and its role within modern energy systems. It also discusses key questions frequently raised in public debates, including reactor safety, management of radioactive waste, and the economic and regulatory frameworks that shape nuclear projects. Through this approach, the book seeks to provide readers with a balanced and technically grounded introduction to the opportunities and challenges associated with nuclear power in the Norwegian context.

Radioaktive kjerner redder liv (radioactive nuclei saves lives)

This public seminar consisted of three talks from experts within UiO, Bayer and IFE about how radioactive nuclei are used in medicine. The talks discussed the entire process of how the promising technology of radioactive medicine is researched, developed and finally in use at hospitals to save lives. The expert panel answered questions from the audience after the presentations.



Protonterapi – Norges mest moderne strålebehandling (Proton therapy – Norways most modern radioactive treatment)

This public seminar consisted of talks from experts working with the research, development and implementation of the new proton therapy centres that have opened in Oslo and Bergen this year. These talks discussed how radiation affects biological tissue, how the new proton therapy centres provide better precision and improved effectiveness in treating cancerous tumors and who can benefit from this new treatment option in Norway. The expert panel answered questions from the audience after the presentations.presentations.



Breakfast Meeting at Domus Bibliotheca: New Hope for Cancer Patients with Radiopharmaceuticals: Radiopharmaceuticals Will Be Extremely Important in the Cancer Treatments of the Future. Meet Norwegian Experts at the Global Frontier!

Domus Bibliotheca hosted a breakfast meeting on 19 November 2025 to bring together some of Norway's leading researchers in radionuclides – and to hear how this technology can change the future treatment of cancer and other serious diseases. The breakfast meeting was organized as a collaboration between Oslo Science City and the University of Oslo. The program addressed the following topics:

- **How can Norway strengthen its international position?**
- **What does it take to become an attractive host country for industry and investment?**
- **How can research, business, and capital be more closely and effectively connected?**



All the experts who were involved in the breaktfast meeting at Domus Bibliotheca. Photo: Carl Henrik Gørbitz

Targeted radiopharmaceuticals can precisely destroy diseased cells while sparing healthy tissue, and the first of these medicines have already been introduced in the global market. A Norwegian breakthrough in the field is the drug Xofigo, developed in Norway and forming the basis for the company Algeta, which was later acquired by Bayer – one of the country's greatest commercial successes in the pharmaceutical sector.

Extensive research is now underway, both nationally and internationally, to explore how radionuclides can be used to combat serious diseases. Today, Norway is among the world's leading countries in targeted radiotherapy, and radiopharmacy has been highlighted as one of the country's six national priority areas. This is work that NNRC is involved in through many of our partners, and two representatives from NNRC took part in the breakfast meeting. Håvar Gausemel from Bayer and Adjunct Professor at the University of Oslo gave a presentation, and the head of RT4, Liv Stavsetra, was part of the expert panel.

Apollon's special edition on nuclear medicine

The independent research magazine Apollon dedicated 20 pages to nuclear medicine in its fourth edition of 2025, where many of the members of NNRC were interviewed and involved in the process of creating this edition. In these 20 pages you can find all you need to learn about the field of nuclear medicine, about the current status of the field as well as the future of nuclear medicine, and how Norway is a leading country in the development of such medicine. In all the articles several master students, PhD students, staff and partners of NNRC were interviewed, covering almost all the expetise on nuclear medicine in the centre. Here we highlight some of the articles you can find in this special edition of Apollon.

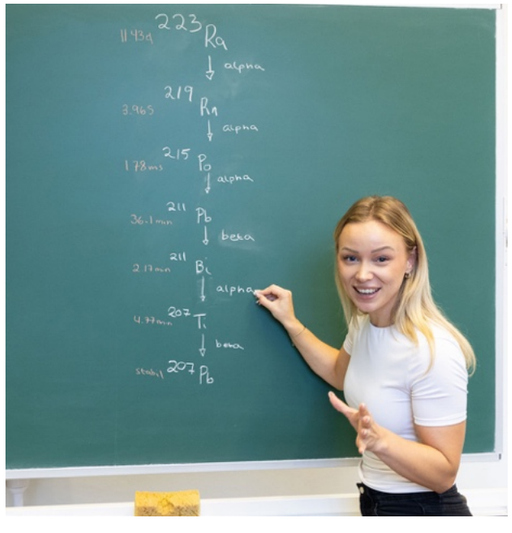
"Almost 40,000 people got cancer last year. 10,000 died from cancer. Nearly 8,000 of them had metastases, meaning cancer that has spread. Today, the most common forms of treatment are surgery, chemotherapy, and conventional radiotherapy. The extremely tough treatment takes its toll. Many suffer long-term side effects. Now, yet another form of treatment has arrived. It is called nuclear medicine and is radioactive. Unlike conventional radiotherapy, where tumors are damaged by sending radiation through healthy tissue and into the body, nuclear medical treatment is about locating, irradiating, and killing the cancer cells from the inside, while the healthy cells are damaged as little as possible. This precision medicine will be particularly well suited to destroying cancer that has spread."

Citation from the introduction of the special edition on nuclear medicine, written by Yngve Vogt for Apollon.



Radionuclides in 1-2-3

This article gives the reader all they need to understand how the tiniest building blocks of matter can be turned into powerful tools against cancer. By linking nuclear physics concepts like isotopes, half-life and radiation types directly to real medical challenges, it shows how targeted radioactive treatments are developed, what makes them so promising, and why they are difficult to design and use safely.



A common substance in today's radioactive medicines is Radium-223. Master's student Thale Øyen in medical physics shows all seven steps of Radium-223 before the substance is converted into a stable substance.
Photo and figure text: Yngve Vogt, Apollon

Discovering diseases with antiparticles

How does PET and SPECT scans use tiny amounts of radioactivity to reveal where disease is hiding in the body? By following the journey of positrons, from a 1930s physics breakthrough to today's hospital scanners, this article shows how antiparticles, annihilation and high-tech detectors are combined to create detailed images of cancer and heart and brain function. The text also explains why PET images are sharper than SPECT, why PET is not simply replacing SPECT, and why the same clever trick that lets us see cancer cells cannot be used as easily to kill them, highlighting some of the fundamental questions for the future of nuclear medicine.



SPECT and PET: –SPECT uses radioactive substances that only emit photons in one direction. PET emits photon pairs that go diametrically opposite directions, says Associate Professor Caroline Stokke in the SPECT machine at Radiumhospitalet. Photo and figure text: Yngve Vogt, Apollon

Better personalized treatment with radioactive atom pairs

The article introduces theranostics, a rapidly emerging approach in nuclear medicine that couples imaging and therapy using matched radionuclide pairs. It describes how the same targeting agent can first identify and quantify cancer lesions and then deliver highly precise, personalized radiation treatment, with potential for better outcomes and fewer side effects. Examples from Norwegian industry, such as the development of yttrium-86/yttrium-90 pairs and the need for advanced PET/SPECT infrastructure, it highlights both the scientific opportunities and the strategic choices facing the healthcare system of the country. The article gives the reader an understanding of where the research front is moving, what is required to keep Norway at the forefront, and why this field merits targeted investment.

Discovering infections with radioactivity

The article portrays an ambitious research programme led by Professor Trond Vidar Hansen, who aims to target the very origins of disease by resolving harmful inflammation rather than merely suppressing it. Combining advanced PET imaging with tailor-made, receptor-seeking molecules, his group works to identify and activate so-called "resolution receptors" that can switch off pathological inflammation early and allow the body to restore normal immune function. Using AI-driven screening of millions of molecules, preclinical models of lethal infection and neuroinflammation, and close collaboration with nuclear physicists and chemists, the project explores new strategies for treating everything from inflammatory brain disease and pain to antibiotic-resistant infections and opioid dependence. The article gives a rare insight into a potential paradigm shift in how we diagnose and treat inflammation-driven disease, and into the interdisciplinary and technological effort required to translate this concept from mice to humans.

Extracting medical radionuclides from mining waste

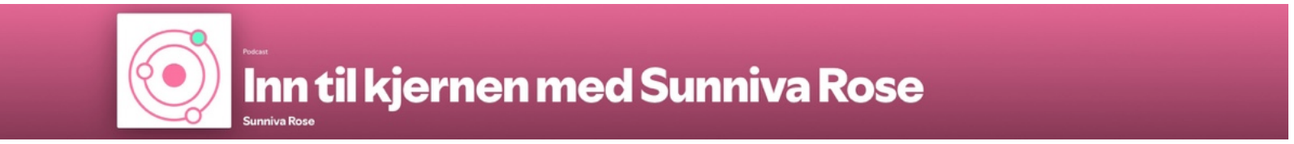
The article explains how technically demanding and strategically important the production of medical radionuclides really is, from the early challenges of sourcing actinium-227 for the Norwegian-produced medicine Xofigo to today's efforts to build robust, industrial-scale supply chains in Norway. It shows how cyclotron and generator technologies, stringent cleanroom requirements, and short half-lives turn radionuclide production into a high-tech, capital-intensive business with clear bottlenecks—and major commercial potential far beyond medicine, including electronics, solar cells and quantum computing. Through the case of Thor Medical's extraction of lead-212 from thorium, it highlights how Norwegian resources and expertise could transform what was once nuclear "waste" into a critical input for cutting-edge cancer therapies and a new billion-kroner export industry.



New industry in Porsgrunn: The Norwegian company Thor Medical extracts one of the most important nuclides in radioactive medicine, lead-212, from natural thorium, says Sindre Petter Hassfjell.
Photo and figure text: Yngve Vogt, Apollon

Podcast series “Inn til kjernen med Sunniva Rose”

“Inn til kjernen med Sunniva Rose” is a podcast where nuclear physicist and host Sunniva Rose explores topics related to energy, nuclear power, technology, and society together with various guests. All podcast episodes are available on various podcast platforms. Here we present a few selected episodes produced in 2025.



The header for Sunniva Rose’s new podcast series “Inn til kjernen med Sunniva Rose” as found on various streaming platforms.
Photo: Inn til kjernen med Sunniva Rose as seen on the streaming platform Spotify.

Persistent myths about building nuclear power – what does research actually say?

“Inn til Kjernen” Episode #6 - 12.05.2025, 01:02:52

This podcast episode features Vala Maria Valsdottir, a researcher and PhD candidate at UiO, discussing whether nuclear power can serve as a sustainable and profitable energy source for Norway. The conversation highlights findings from her report «Nuclear Power Norway – costs, challenges and og opportunities» and specifically addresses economic barriers and myths like “negative learning”. Additionally, the host and guest evaluate the technology’s feasibility by debating three hard facts for and three against the implementation of nuclear power in the Norwegian context.



NNRC PhD candidate Vala Maria Valsdottír appearing on the podcast series.
Photo: Inn til kjernen med Sunniva Rose

Chernobyl, Aircraft Carriers, and Polonium Killings

“Inn til Kjernen” Episode #24 - 29.09.2025, 01:02:00

In this episode Andreas Edenberg, lieutenant colonel, chief physician and PhD student, explores the medical and technical aspects of radiation doses and CBRN threats. The discussion ranges from historical nuclear events like Chernobyl and Three Mile Island to the unique case of the polonium poisoning of Alexander Litvinenko. Key scientific topics include the mechanics of acute radiation syndrome (ARS), the vulnerability of different organs to radiation, and the actual long-term health impacts of nuclear disasters.



Andreas Edenberg, lieutenant colonel, chief physician and PhD student appearing on the podcast series.
Photo: Inn til kjernen med Sunniva Rose

Understanding Nuclear Energy: A Comprehensive Summer Series

“Inn til Kjernen” Episodes #12-#19 – July-August 2025, approximately 10 min each

These eight postcast episodes feature summer specials, where Sunniva Rose offers an educational look at nuclear physics and power. She explains nuclear fission, power plant operations, and the technical role of enriched uranium. Safety and environmental impact are primary themes, including a comparison of nuclear safety relative to hydropower. The series also details how radioactive waste is produced and managed. Furthermore, the podcast explores the risks of plutonium and global variations in background radiation. Overall, the series provides a foundation for understanding the complexities of nuclear energy.

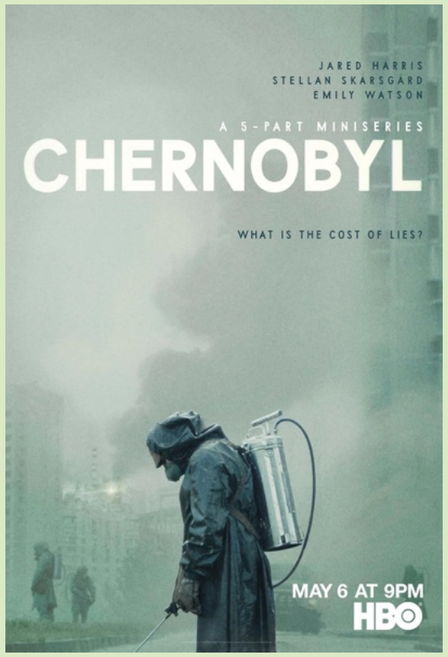


Snapshot of Sunniva Rose during her podcast series “inn til kjernen med Sunniva Rose”
Photo: Inn til kjernen med Sunniva Rose

A Scientific Evaluation of HBO’s Chernobyl – 5 Episodes

“Inn til Kjernen” Episodes #35-#39 – December 2025, approximately 60 min each

The “Chernobyl Special” is a five-part podcast series within “Inn til kjernen”, where nuclear physicists Gry Tveten and Sunniva Rose critically analyze the 2019 HBO series Chernobyl. The series aims to evaluate the scientific accuracy of the show, distinguishing between historical facts and dramatized myths while maintaining an appreciation for the production. The first episode explores the immediate aftermath of the reactor explosion, discussing the ionizing blue light, the biological effects of extreme radiation doses, and the historical reality of the “bridge of death”. In the second part, the hosts clarify radiation units, specifically correcting the conversion from Röntgen to Sievert and assessing the realism of hospital scenes and the “suicide mission” of the three divers. The remaining episodes, titled “Open Wide, O Earth,” “Happiness of all mankind,” and “Vichnaya Pamyat,” continue this evaluation of the HBO episodes. Through this review, the physicists provide a scientific perspective by contrasting cinematic storytelling with nuclear science.



Poster for the HBO series about the Chernobyl accident.
Photo: HBO



Physicist Gry Tveten during one of the five-part podcast series within “Inn til kjernen med Sunniva Rose”.
Photo: Inn til kjernen med Sunniva Rose

Facilities





The Oslo Cyclotron Laboratory

The Oslo Cyclotron Laboratory at UiO features the most powerful particle accelerator infrastructure in Norway and is the only accelerator dedicated to fundamental research. The laboratory has facilities for research in basic physics, chemistry, radionuclide production, and radiation biology. It features state-of-the-art instrumentation such as the Oslo Scintillator Array (OSCAR), the largest LaBr3:Ce detector array in the world with excellent high-energy detection efficiency. The unique instrumentation at OCL enables studies that cannot be performed elsewhere.

The radiochemistry laboratory at OCL is used for R&D on medical radionuclides as part of RT4.

The HUNT

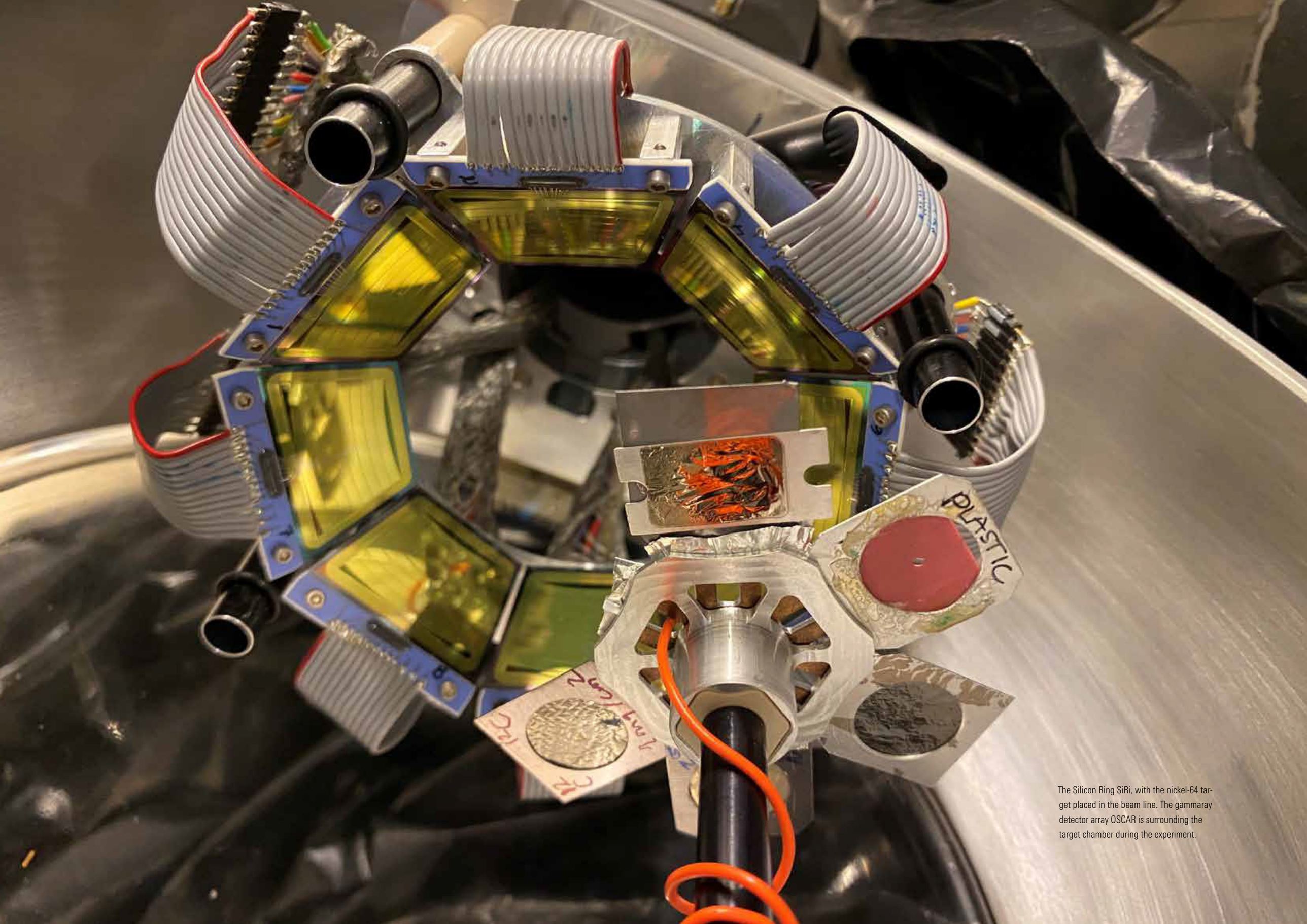
The Competence Hub for Neutron Technology (HUNT) is a national neutron irradiation facility jointly operated by IFE and UiO. The facility, which is funded under RCN's 2020 FORINFRA program, is in the process of being established and will consist of two small compact neutron generators. The first generator is in operation from the beginning of 2026, and the second generator will be acquired during 2026/27.



NMBU

NMBU is supported by access to some of the most sophisticated instruments, experimental programmes and numerical models within environmental radiochemistry. The laboratories are well equipped with tools for speciation, material- and exposure characterisation as well as radiometry and mass spectrometry, and the FIGARO gamma irradiation facility. NMBU has access to accelerator mass spectrometry (CTU, University of Seville, Australian National University) and are frequent users of synchrotron facilities (e.g., MAX IV; ESRF, Petra III).

Infrastructure/Resources	Location	Capabilities
Oslo Cyclotron Laboratory (OCL)	UiO Department of Physics, Oslo	K-35 light-ion cyclotron with experimental hall and adjacent class-B radiochemistry lab, detector lab, and electronics lab
UiO's Nuclear Chemistry Laboratories	UiO Department of Chemistry, Oslo	Class B and C labs, low-level lab, instrumentation lab
NMBU's Environmental and Nuclear Laboratories	NMBU Faculty of Environmental and Natural Resource Management, Ås	Class B and C labs, low-level lab, instrumentation lab, FIGARO gamma irradiation facility
IFE's Nuclear Chemistry Laboratories	IFE Kjeller	Class B and C labs, low-level lab, instrumentation lab
IFE's HADRON Lab	IFE Halden	Training laboratory
IFE's Sensor Lab	IFE Halden	Instrumentation laboratory
HUNT National Infrastructure	IFE Kjeller/UiO Department of Chemistry, Oslo	Neutron irradiation facility



The Silicon Ring SiRi, with the nickel-64 target placed in the beam line. The gammaray detector array OSCAR is surrounding the target chamber during the experiment.

People

Key researchers and technical staff

NAME	INSTITUTION	MAIN RESEARCH AREA
Alexander Krivokapic	IFE	Organic chemistry
Ali Al-Adili	Uppsala University, Sweden /UiO	Fission
Amalie F. Reinertsen	UiO	Radiopharmacy
Andreas Görgen	UiO	Experimental nuclear physics
Andreas Zilges	University of Cologne, Germany	Experimental nuclear physics
Andrew Voyles	UC Berkeley	Medical isotope production
Ann-Cecilie Larsen	UiO	Experimental nuclear physics
Azusa Inoue	UiO	Experimental nuclear physics
Bent W. Schoultz	NMS, UiO	Radiopharmaceutical chemistry
Brit Salbu (emerita)	NMBU	Environmental Radiochemistry
Dag Anders Brede	NMBU	Radiobiology/radioecology
Darren Bleuel	Lawrence Livermore National Laboratory	Experimental nuclear physics
Deborah Oughton	NMBU	Environmental radiochemistry
Deniz Avsar	IFE	Nuclear chemistry
Eda Sahin	UiO	Experimental nuclear physics
Ellen Henriksen	UiO	Physics education research
Erica Maremonti	NMBU	Environmental Radiochemistry
Erik Berge	MET	Atmospheric modeling
Estela Reinoso-Maset	NMBU	Environmental radiochemistry, nuclear safety and security
Gøril Mellem	UiO	Centre coordinator
Han Christian Teien	NMBU	Environmental chemistry ecotoxicology
Håvar Gausemel	Bayer, UiO	Nuclear chemistry

NAME	INSTITUTION	MAIN RESEARCH AREA
Heiko Kein	MET	Atmospheric modeling
Hengyi Zhu	NMBU	Environmental radiochemistry, nuclear safety and security
Ingeborg Lie Sollund	IFE/UiO	Radiation Protection Coordinator, nuclear chemistry
István Szőke	IFE/NMBU	Radiation modeling
Jan John	Czech Technical University in Prague, Czech Republic	Environmental radiochemistry
Jon Petter Omtvedt	UiO	Nuclear chemistry
Jonathan Wilson	IJC-Labs	Fission
Juuso Sammaljärvi	NMBU	Environmental radiochemistry, nuclear waste management
Jørgen Randrup	LBNL	Fission
Karl Andreas Jensen	NMBU	Technical staff/analytical radiochemistry
Kevin Ching Wei Li	UiO	Experimental nuclear physics
Koen Janssens	University of Antwerp, Belgium	Environmental radiochemistry
Lee Bernstein	UC Berkeley	Medical isotope production, nuclear physics
Lindis Skipperud	NMBU	Environmental radiochemistry
Liv Stavsetra	IFE, UiO	Nuclear chemistry
Luna Pellegri	University of the Witwatersrand, South Africa	Experimental nuclear physics
Maria Markova	UiO	Experimental nuclear physics
Maria Vetleseter Bøe	UiO	Physics education and research
Mariana Filipa Foseca Rodrigues	NMBU	Environmental radiochemistry, nuclear safety and security
Marianne Hiorth	UiO	Pharmasceutical and Social Pharmacy
Marit Nandrup Pedersen	NMBU	Senior technician
Martin Hjelmeland	Institutt for elektrisk energi, NTNU	Postdoctor
Mathis Wiedeking	LBNL, USA	Experimental nuclear physics
Mavrik Zavarin	Glenn T. Seaborg Institute, LLNL, USA	Environmental radiochemistry
Mojmir Němec	Czech Technical University in Prague, Czech Republic	Environmental radiochemistry
Mustafa A. H. Jarallah	IFE	Radiation modeling
Naomi Marks	Glenn T. Seaborg Institute, LLNL, USA	Environmental radiochemistry, nuclear safety and security
Neshad Deva Pathirana	Michigan State University, USA	Nuclear astrophysics
Nils-Henrik Mørch von der Fehr	UiO	Economics
Neeraj Kumar	UiO	Experimental nuclear physics

NAME	INSTITUTION	MAIN RESEARCH AREA
Noritaka Shimizu	University of Tsukuba, Japan	Nuclear theory
Ole C. Reistad	DNV, UiO	Reactor simulations
Ole Christian Lind	NMBU	Environmental radiochemistry
Pawel Andrzej Sobas	UiO	Senior engineer
Peter von Neuman-Cosel	Technical University Darmstadt, Germany	Nuclear astrophysics/Experimental nuclear physics
Ramona Vogt	Lawrence Livemore National Laboratory (LLNL) & UC Davis	Fission
Rahul Jain	Lawrence Livermore National Laboratory	Nuclear astrophysics
Rebecca Julie Abergail	UC Berkeley, USA	Medical applications, nuclear physics
Réka Szőke	IFE	Radiation modeling
Simone Jerome	NMBU	Analytical radiochemistry
Sindre Hassfjell	Thor Medical, UiO	Nuclear chemistry
Sivahami (Sivi) Uthayakumaar	Michigan State University, USA	Nuclear astrophysics
Steinar Høibråten	FFI	
Stephane Goriely	Université libre de Bruxcelles, Belgium	Nuclear astrophysics
Sunniva Rose	Norsk kjernekraft, UiO	Fission, reactor simulations
Sunniva Siem	UiO	Experimental nuclear physics
Syed M. Nuruddin	NMS, UiO	Pharmaceutical chemistry
Takaharu Otsuka	University of Tokyo, Japan	Nuclear physics
Tamas Tornyi	Institute for Nuclear Research, Hungary	Fission
Tellef Storebakken	Advansia	Reactor simulations
Tomas Eriksen	IFE, UiO	Reactor simulations
Tor Bjørnstad (emeritus)	UiO	Nuclear chemistry
Trine Wiborg Hagen	FFI	Nuclear security
Trond V. Hansen	UiO	Pharmaceutical chemistry
Valeriia Morozova	NMBU	Environmental radiochemistry, nuclear safety and security
Verena Pichler	University of Vienna, Austria/UiO	Radiopharmacy
Vetle Wenger Ingeberg	UiO	Experimental nuclear physics
Victor Modamio	UiO	Senior engineer
Yetnerbeke Kassaye	NMBU	Technical staff/radiobiology
Yevgeniya Tomkiv	NMBU	Communication/emergency preparedness
Åshild M. Sørskår	UiO	Organic Chemistry

Phd Research Fellows

NAME	INSTITUTION	RESEARCH GROUP
Aleksander Sverdrup Aarsand	NMBU	RT5 - Environmental radiochemistry, nuclear safety and security
Andreas Halkjelsvik Mjøs	UiO	RT1 - Experimental nuclear physics
Chayton Bouwmeester	NMBU/MET	RT5 - Environmental radiochemistry, nuclear safety and security
Elise Malmer Martinsen	UiO	RT4 - Medical applications, nuclear physics
Erlend Lima	UiO	RT1 - Experimental nuclear physics
Gulla Louise Serville Torvund	UiO	RT1 - Experimental nuclear physics
Hanae Hassani	NMBU	RT5 - Environmental radiochemistry, nuclear safety and security
Hannah Lovise Okstad Ekeberg	UiO/IFE	RT4 - Medical applications, nuclear physics
Hengyi Zhu	NMBU	RT5 - Environmental radiochemistry, nuclear safety and security
Henrik Andrews	UiO	RT1 - Experimental nuclear physics
Henrik Horne	NMBU/Viljr	RT5 - Environmental radiochemistry, nuclear safety and security
Henrik Sørlie Haug	UiO	RT2 - Nuclear fission
Heyji Lee	UiO	RT1 - Experimental nuclear physics
Ida Plahter Rosenqvist	UiO	RT1 - Experimental nuclear physics
Ingrid Norgberg Schulz	UiO	RT4 - Pharmaceutial chemistry
Jeppe Thingholm	UiO	RT1 - Experimental nuclear physics
Jessica Sabrina Chow	NTNU	RT3 - Reactor simulations, nuclear physics
Johannes Heines Sørby	UiO	RT1 - Experimental nuclear physics
Jon Kristian Dahl	UiO	RT1 - Experimental nuclear physics
Jonas Lystrup Andresen	NMBU	RT5 - Environmental radiochemistry, nuclear safety and security
Lauren Tracy Bell	UiO	RT1 - Experimental nuclear physics
Magnus Ulimoen	NMBU/MET	RT5 - Environmental radiochemistry, nuclear safety and security
Maia Oline Grund Wirgenes	UiO/IFE	RT3 - Reactor simulations, nuclear physics
Marianna Canonaco	UiO	RT4 - Medical applications, nuclear physics
Marius Torsvoll	UiO	RT3 - Reactor simulations, nuclear physics
Mila Pelkonen	NMBU/IFE	RT5 - Environmental radiochemistry, nuclear safety and security
Trine Kvam Olafsen	UiO	RT1 - Experimental nuclear physics
Vala Maria Valsdottir	UiO/Crayon	RT3 - Reactor simulations, nuclear physics
Wanja Paulsen	UiO	RT1 - Experimental nuclear physics
William Eivik Olsen	UiO/IFE	RT3 - Reactor simulations, nuclear physics

Master Students

NAME	INSTITUTION	MAIN RESEARCH AREA
Ann-Kristin Furu	UiO	RT1 - Experimental nuclear physics
Baltasar Johannes Hemmerle	UiO	RT3 - Reactor simulations, nuclear physics
Camilla Almli Tokstad	UiO	RT4 - Medical applications, nuclear physics
Camille Jane Esmero Fredriksen	NMBU	RT5 - Environmental radiochemistry, nuclear safety and security
Cathrine Haagensli Bruun	NMBU	RT5 - Environmental radiochemistry, nuclear safety and security
Claudia Emilia Grieg	UiO	RT1 - Experimental nuclear physics
Elisabeth Brynildsen	UiO	RT4 - Medical applications, nuclear physics
Ella Hedegart Flaata	UiO	RT3 - Reactor simulations, nuclear physics
Enya Frebrich	NMBU	RT5 - Environmental radiochemistry, nuclear safety and security
Hedda Eidsmo Sandholt	NMBU	RT5 - Environmental radiochemistry, nuclear safety and security
Jonas Strand Gjersvik	UiO	RT3 - Reactor simulations, nuclear physics
Josef Ali Hasan Hisanawi	UiO	RT3 - Reactor simulations, nuclear physics
Lars E. Thomas	UiO	RT1 - Experimental nuclear physics
Magnus Hellstrøm-Finnsen	UiO	
Martin Hansebråten	NMBU	RT5 - Environmental radiochemistry, nuclear safety and security
Mathias Signebøen	UiO	RT3 - Reactor simulations, nuclear physics
Nurtene Dernjani	NMBU	RT5 - Environmental radiochemistry, nuclear safety and security
Oda Gundersen	NMBU	RT5 - Environmental radiochemistry, nuclear safety and security
Oskar Idland	UiO	RT4 - Medical applications, nuclear physics
Sjur Sletner	NMBU	RT5 - Environmental radiochemistry, nuclear safety and security
Thale Øien	UiO	RT4 - Medical applications, nuclear physics
Tina Moen	NMBU	RT5 - Environmental radiochemistry, nuclear safety and security
Therese Einskau Mørk	UiO	RT1 - Experimental nuclear physics
William Bjørge Banelind	UiO	RT1 - Experimental nuclear physics

Presentations and Publications

Presentations 2025

Bell, Lauren T., Extracting the nuclear level density and gamma strength function of 90Zr, 16th Nuclear Data For Science and Technology Conference, June 2025

Benkrid, Abdenour, AI methods relevant to nuclear safety and robotics, NAIS 2025 – Norwegian Artificial Intelligence Society Symposium, Tromsø, Norway, 18–19 Jun 2025

Benkrid, Abdenour, HADRON related AI and robotics for nuclear applications, European Robotics Forum 2025, Stuttgart, Germany, 25–27 Mar 2025.

Brede, Dag Anders, Bhattacharjee, Payel, Olsen, Jorunn Elisabeth, Lind, Ole Christian, Deciphering molecular mechanisms of plant radiosensitivity, Low Dose Radiation Risks: Present Research & Future Perspectives - NATO Science for Peace and Security Programme workshop, Yerevan, Armenia 30.03 – 02.04.2025

Görgen, Andreas, Triaxiality of neutron-rich ruthenium nuclei studied by lifetime measurements, African Nuclear Physics Conference, iThemba LABS, Sommerset West, Cape Town, South Africa, 25.11.2025

Görgen, Andreas, Concluding Remarks, Fysikermøte, NTNU, 18.6.2025

Görgen, Andreas, Triaxiality of neutron-rich ruthenium nuclei studied by lifetime measurements, International Nuclear Physics Conference, Daejeon, Republic of Korea, 25.-30.5.2025

Halkjelsvik Mjøs, Andreas, Hierarchical Bayesian Unfolding in the Oslo Method, ISNET-11: Information and Statistics in Nuclear Experiment and Theory, 18.11.2025

Haug, Henrik, Extracting isomeric yield ratios in fission fragments,16th Nuclear data for science and technology conference, Madrid, Spain, 22-27 June 2025

Haug, Henrik, Extracting the isomeric yield ratios of fission products from the nu-ball data and calculating the fragment angular momenta, Theory-6: Scientific Workshop on Nuclear Fission Dynamics and the Emission of Prompt Neutrons and Gamma Rays, Aci Castello, Italy, 7 – 10 October 2025

Ingeberg, Vetle W. , The Oslo Method. HYPATIA workshop, Institute of Physics, London, UK 20-21.03.2025

Inoue, Azusa, M. Asai, S. Hayakawa, N. Kobayashi, Y. Maeda, H. Makii, T. Shima, H. Shimizu, A. Tamii, D.T. Tran, X. Wang, H. Yamaguchi, L. Yang, Z. Yang, Study of the 7Be(d, p)8Be Reaction and its Impact on the Cosmological Lithium Problem, XVIII International Symposium on Nuclei n the Cosmos, Girona, Spain, 15-20.06.2025

Inoue, Azusa, Meta-analysis and Computational Understanding in the Nucleosynthesis, DSTrain Workshop - UiO, 17-18.03.2025

Inoue, Azusa, Research Progress, Meta-analysis and Computational Understanding in the Nucleosynthesis, DSTrain Kick-Off Seminar, UiO, 09.11.2024
Kjelsberg Ronny, Erik Wahlström, Andreas Görgen, Vegard Gjerde, Physics of the future (panel debate), Fysikermøte, NTNU, 17.6.2025

Kumar, Neeraj, Study of the evolution of fission modes with VAMOS++ and a Novel Gas-Target Setup, Theory-6: Scientific Workshop on Nuclear Fission Dynamics and the Emission of Prompt Neutrons and Gamma Rays, Aci Castello, Italy, 7 – 10 October 2025

Larsen, Ann-Cecilie, Indirect measurements of neutron-capture rates for exotic, neutron-rich nuclei relevant to the intermediate and rapid neutron-capture processes, CEA de Bruyères-le-Châtel, France, 26.11.2024

Larsen, Ann-Cecilie, The Beta-Oslo Method and Neutron-Capture Reactions, International Symposium on Nuclei in the Cosmos XVIII (NIC XVIII), Girona, Spain, 16.06.2025

Li, Kevin Ching Wei, Clarifying key components within helium burning, Invited speaker to Key Reactions in Nuclear Astrophysics ECT* 2025, Trento, Italy, 17.02.2025

Li, Kevin Ching Wei, Helium burning and nuclear clustering: recent studies and constraints from direct reactions, Trento, Italy, 25.09.2025

Li, Kevin Ching Wei, Helium burning: Addressing discrepancies and future approaches, Invited speaker to VIIth Topical Workshop on Modern Aspects in Nuclear Structure, Bormio, Italy, 05.02.2025

Lind, Ole Christian, Atmospheric Transport and Environmental Behaviour of Radioactive Particles, Invited lecture at V E R A - S E M I N A R, University of Vienna, 23.10.2025

Lind, Ole Christian, Berge, Erik, Brown, Justin E., Hosseini, Ali, Klein, Heiko, Oughton, Deborah H. Fallout from tactical nuclear weapon detonations: improving modelling capabilities and decision-making processes in Norway, International Conference on Methods and Applications of Radioanalytical Chemistry (MARC XIII), Kailua-kona, 23.03. - 28.03.2025

Lind, Ole Christian, Environmental behavior of radioactive particles originating from nuclear detonations, NKS-B REMSEM: the 1st Nordic seminar regarding modelling of radionuclide transfer from fallout after a nuclear explosion, Sigtuna, 09.09. - 10.09.2025

Lind, Ole Christian, Environmental Radiochemistry in the Norwegian Nuclear Research Center - from a historical perspective to future plans, Invited presentation, Lawrence Livermore National Laboratory, 20.03.2025

Lind, Ole Christian, Focused research to reduce the overall uncertainties in radioecological models, Invited lecture at IJColloquium, Laboratoire de Physique des 2 Infinis Irène Joliot-Curie, Orsay, 13.06.2025

Mark, Niels Kristian, 3D radiological simulation and safety analysis, NSFS XX Conference – Nordic Society for Radiation Protection, Lillehammer, Norway, 27–29 Aug 2025

Oughton, Deborah H., Kjernekraft: Konsekvenser for miljø, mennesker og beredskap? Invited presentation, Ås Rotary, 04.03.2025

Oughton, Deborah H., Strålingsrisiko: Etiske og sosiale aspekter, Invited presentation, Kjernekraft Utvalget, 20.05.2025

Oughton, Deborah H., When is change bad? Low dose radiation research from an ethical and social science perspective, Low Dose Radiation Risks: Present Research & Future Perspectives - NATO Science for Peace and Security Programme workshop, Yerevan, Armenia 30.03 – 02.04.2025

Paulsen, Wanja, A saga on the gamma-decay branching ratio of the Hoyle state at the Oslo Cyclotron Laboratory, Invited speaker to HELIUM25 conference, Dresden, Germany, 22.07.2025

Paulsen, Wanja, A saga on the gamma-decay branching ratio of the Hoyle state at the Oslo Cyclotron Laboratory, Laboratorio Nazionale di Gran Sasso, 05.06.2025

Paulsen, Wanja, Hvordan stjerner skaper kjerner: Lette kjerner, Fysikk i origo at UiO, 24.09.2025

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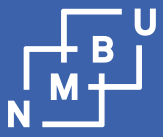
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