



UPPSALA UNIVERSITET



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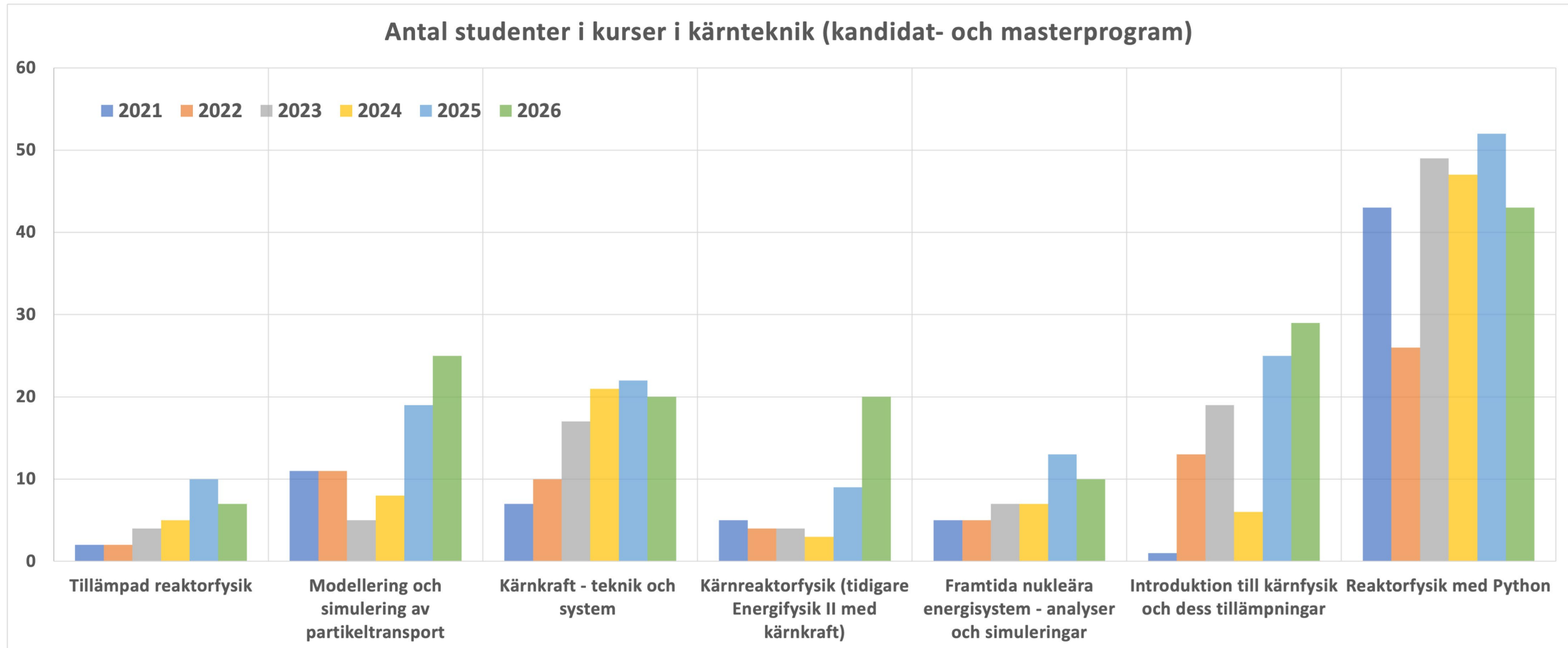
SKC and ANItA-supported activities at UU

Education and Research

Henrik Sjöstrand
Applied nuclear physics
Department of physics and astronomy

Education

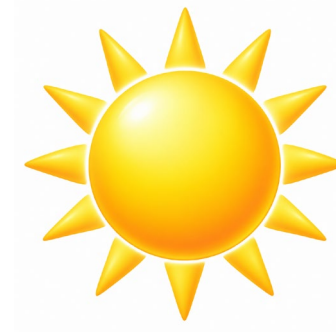
- Support teaching activities in first and second cycle.
- Increasing number of students in nuclear-technology courses.



Examples of Diploma thesis (2026)

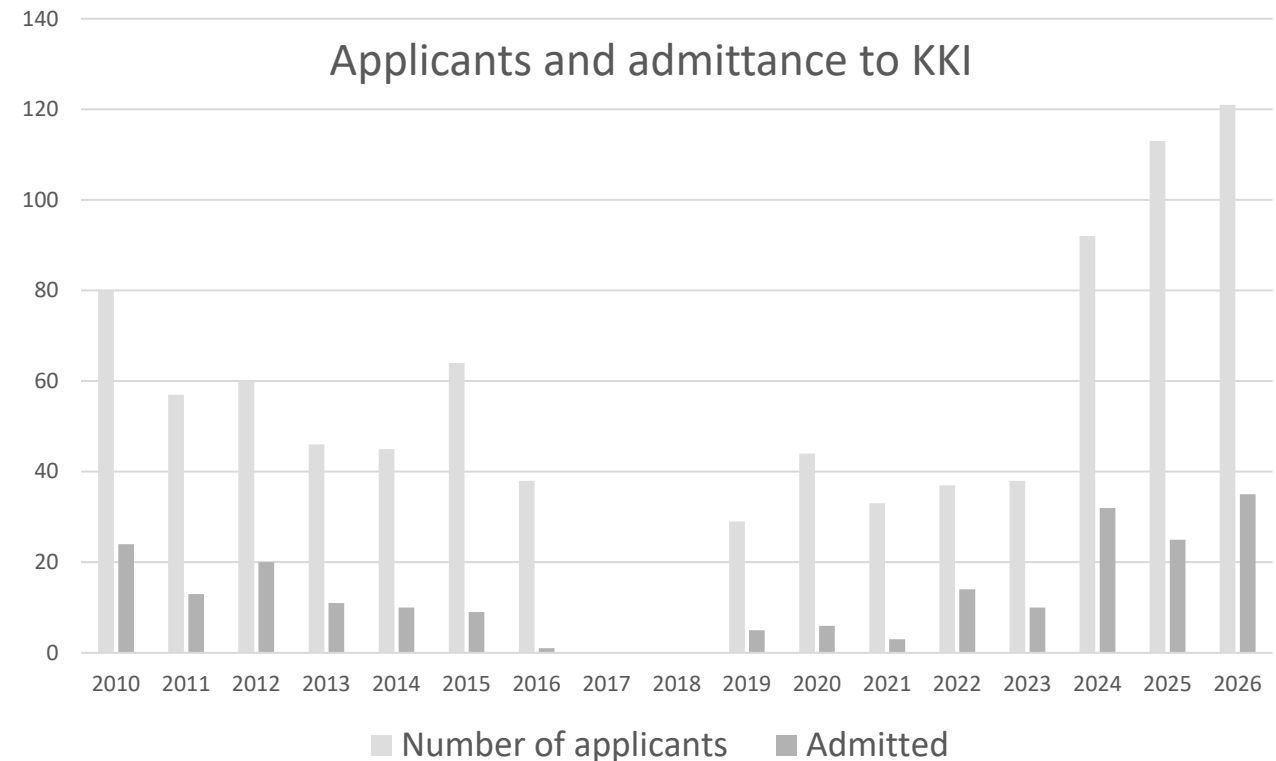
- **Empirical frazil ice identification and optimized winter warm-water recirculation at Forsmark nuclear power plant**
- **A Study on the Application of Burnup Credit Methodology on Fuels with Burnable Absorbers**
- Future Domestic Uranium Demand in Sweden : A scenario analysis of reactor technology and fuel cycle strategies
- Dispersion modelling of radionuclide releases to marine environments : A marine dispersion and dose assessment study of a floating SMR in the Baltic Sea
- **Investigating BWR Lattice Physics Modeling choices for PHOENIX5 Production Work : A Study in Reactor Core Simulations**
- Anpassning av beredskapszoner för små modulära reaktorer (SMR) : En komparativ studie av Sverige, Kanada och Storbritannien
- Mätning av radon i olika miljöer med Airthings och HPGe- gammaspektrometri : En studie av radonvariation och radonrelaterad bakgrund vid tillämpad kärnfysik
- Kommunikationsstrategi för samhällsacceptans vid etablering av SMR : En fallstudie av Valdemarsvik
- Hur påverkar transporter av radioaktiva ämnen människor och omgivning
- Weather dependence of airborne nuclides: Measurements of radioactivity compared to weather data
- Pore induction of micro-scale, free-standing Germanium membranes by implantation of 4 MeV Bromine ions





Bachelor's Programme in Nuclear Engineering

Course name
• Introduction to nuclear power technology
• Reactor physics
• Nuclear thermohydraulics and steam turbine technology
• Power Engineering and three-phase systems
• Chemistry, material and fuel for reactor applications
• Nuclear power safety
• Nuclear waste and decommissioning
• Nuclear power operation
• Future nuclear energy systems
• Bachelor thesis



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Director: Senior Lecturer Cecilia Gustavsson



Bachelor's Programme in Nuclear Engineering

- The programme has been offered since 2010 when it was started in collaboration with the nuclear power plants.
- After many years of weak student interest, we now have a steady student number of 20+ students per year.
- Despite this positive development, the program remains financially vulnerable without external support.
- A recent working-group report at UU, recommends that the **Bachelor's Program in Nuclear Engineering be considered for closure.**
- SKC's base funding is not directly tied to the program. However, it supports the teaching competence, and it demonstrates long-term industry commitment.
- SKC's continued support is an important internal argument for the program's continued existence.



More nuclear engineering @ UU

- Nuclear engineering track at the Master of Energy Systems Engineering program.
- Planned new nuclear engineering track at Master of Engineering Physics.
- Elective course in several master's programs:
 - Engineering physics, Electrical engineering, Systems in technology and Society .
- Introductory courses offered to “everyone”.
- Commissioned education.
- Short courses.



Short courses for working professionals from Uppsala University

Courses to be offered soon



Framtida Nukleära System (fission)



Framtida Nukleära System (fusion)



Safeguards, Security, and Safety



Introduktion till reaktorfysik



Multiphysics of a reactor I



Multiphysics of a reactor II



Kärnkraft för samhällsvetare och beslutsfattare

Planned courses

1

Neutroninstrumentering

2

Reaktorfysik i Python II

3

Reaktorfysik med Python 1

4

Introduktion till kärndata

New task 2026 from the government to UU, KTH and CHT to launch short courses for working professionals. Coordinated by UU, Erik Andersson Sunden.



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THIRD TASK ACTIVITIES

- Undervisning av Högstadielärover - M. Weiszflog
- Samtal och frågor från utrikesutskottet i Sveriges riskdag, P. Andersson
- Interview om ANiTA på UUs hemsida.
- Podavsnitt i Nobelprismuseets pod "Idéer som förändrar världen 2024. Podcast number 81: Srålande sönderfall, C. Gustavsson
- Samtal med reporter från Utbildningsradion (UR) om fusionsforskning, J. Eriksson
- 13x13 Föreläsningar "Isotoper, isomerer och insikter – vad massmätningar lär oss om atomkärnan", S. Pomp
- Interview with FMV on SMRs and nuclear power, S. Grape and M. Lantz
- SciFest – 2025 and 2026
- Interview to the article "Ny satsning möter kärnkraftsbranschens växande kompetensbehov", UU website, E.A. Sudén



Arjan Koning

Honorary Doctor, Faculty of Science and Technology

Uppsala University · 2026

SCIENTIFIC & INTERNATIONAL IMPACT

IAEA

Head of the Nuclear Data Section

TALYS

Lead developer of TALYS; creator of the Koning–Delaroche optical model

JEFF

Chaired the OECD/NEA JEFF project (2003–2010)

UPPSALA COLLABORATION

Since the late 1990s

Research collaboration and PhD supervision

2006–2013

Nuclear-physics courses across Europe

2013–2019

Adjunct professor at Uppsala University



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NEXUS

National nuclear research and innovation initiative

KTH-led excellence-cluster proposal · 2025–2026

NATIONAL COLLABORATION

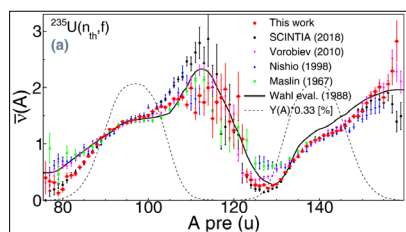
KTH	Lead university and coordinator
UU + CHALMERS	Key academic partners
SKC NETWORK	Broader university and industry participation

RESEARCH & INNOVATION VISION

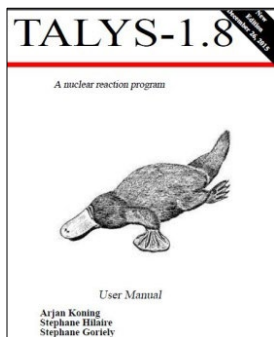
SCOPE	Existing reactors, Generation IV, and fusion
FOCUS	Materials, fuel cycles, AI, and regulation
IMPACT	Education, innovation, and industrial uptake

PLANNING GRANT · 2025 SEK 1.5 million awarded	FULL PROPOSAL · 2026 Large-scale application submitted	OUTCOME Main grant not secured
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Research - "Putting nuclear physics to work"

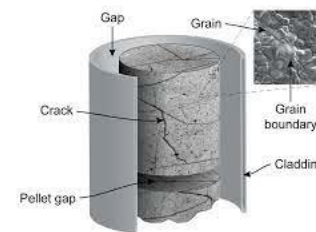
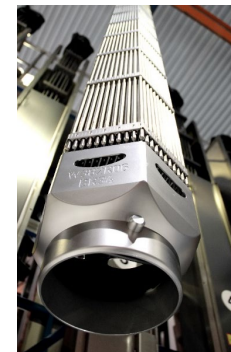
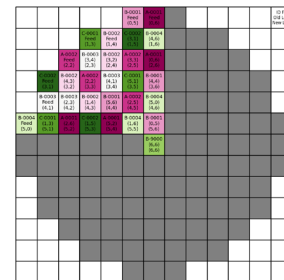


Nuclear physics
experiments



Nuclear physics
model codes

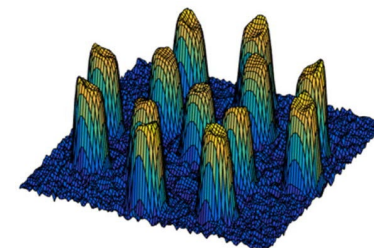
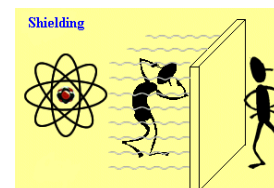
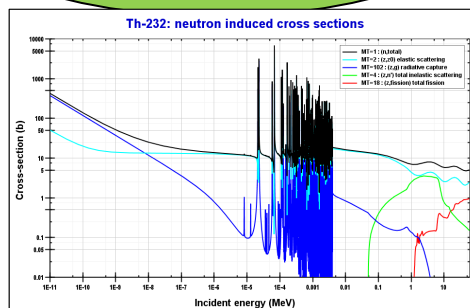
Nuclear data
evaluation



Applications

ENDF

Serpent
MCNP
...



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Nuclear data measurements

New collaboration with University of Oslo. Supervising 2.5 PhD students.

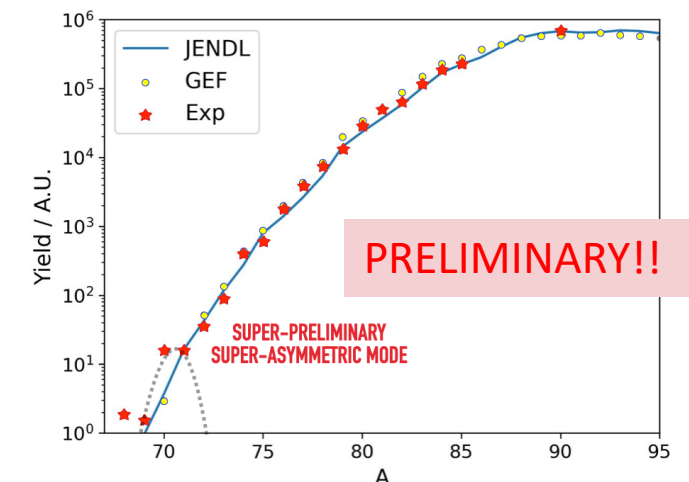
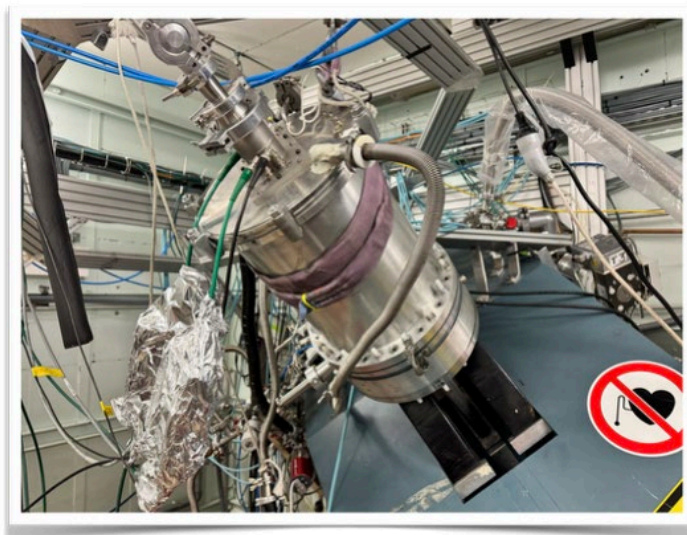
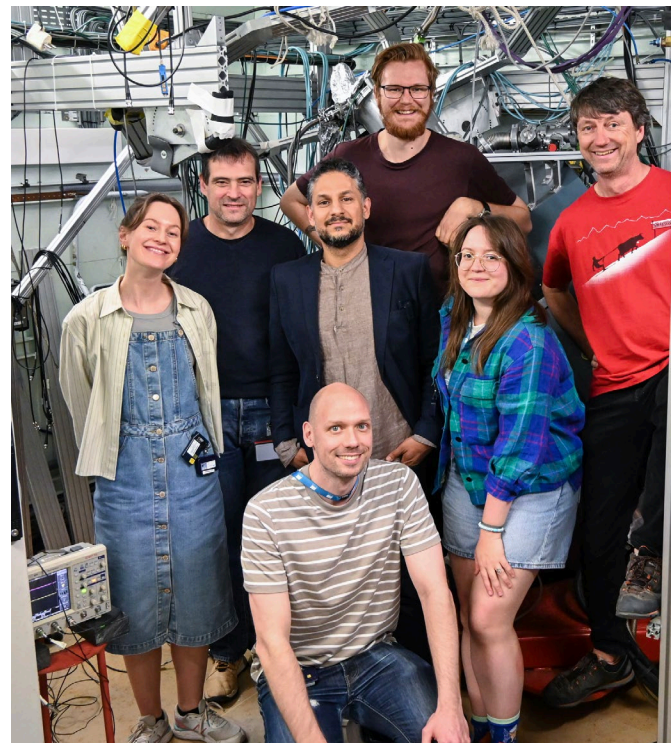
Experiment at ILL – Grenoble measuring fission observables.

PI: Ali Al-aladili

Nuclear
physics
experiments



Measurements performed at one of the most intense neutron beams in the world (1.5×10^{15} n/s cm²)



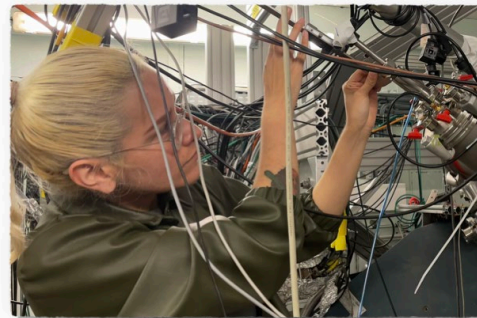
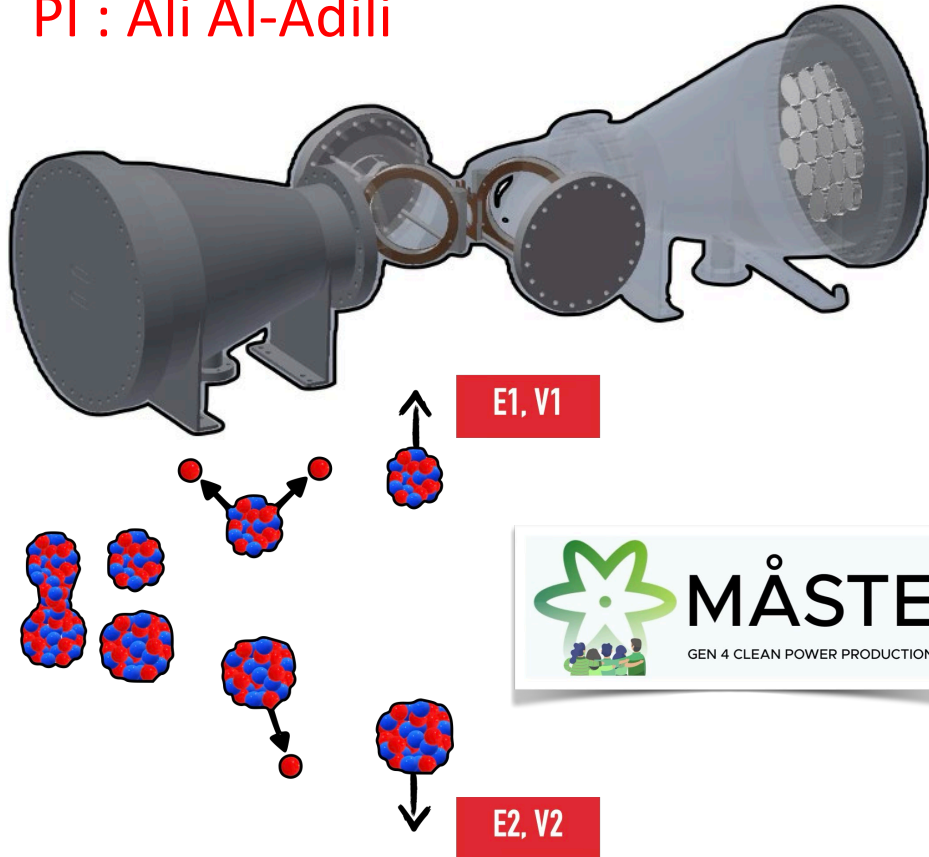
Nuclear data measurements

Fission Observables measured at Joint Research Centre (JRC) in Geel, Belgium.

VERDI (Velocity for Direct Particle Identification) 2E-2v spectrometer

Ana M. Gomez Ph.D. thesis defence at 24 November

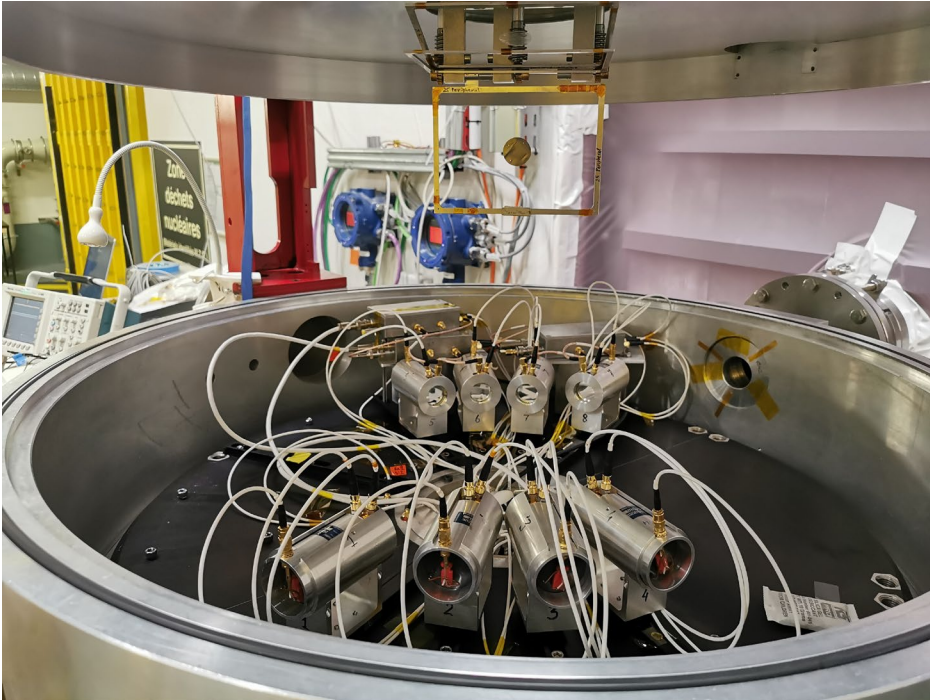
PI : Ali Al-Adili



Ana María Gómez Londoño

Developing and Validating VERDI
for Fission-Fragment
Measurements

Nuclear reaction measurements @ NFS-GANIL

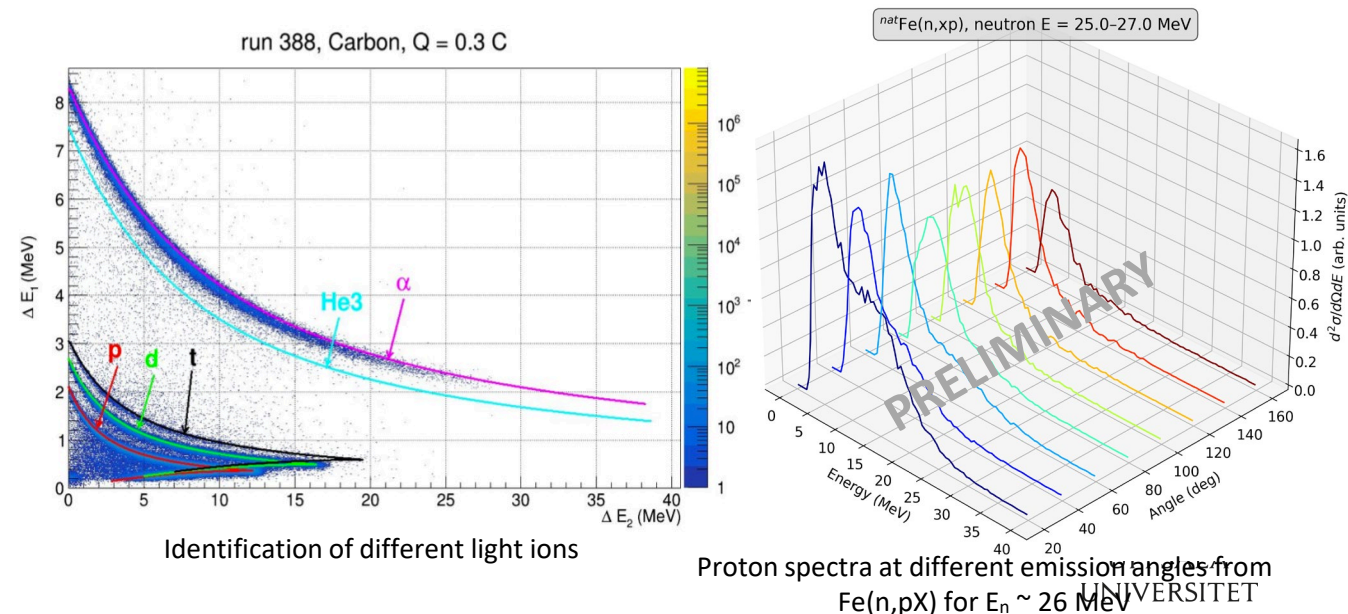


Recent publications:

- L. De Arruda. Studies on neutron-induced reactions with Medley at GANIL-NFS. PhD thesis, Uppsala Univ (to be defended in Dec. 2026)
- L. De Arruda et al., Double-differential neutron-induced cross sections on Fe-nat at GANIL-NFS, submitted to EPJ Web of Conf (2026)
- D. Tarrío et al., Timing Challenges in Transmission Silicon Detectors for Light Ions, submitted to EPJ Web of Conf (2026).
<https://doi.org/10.48550/arXiv.2610.10127>

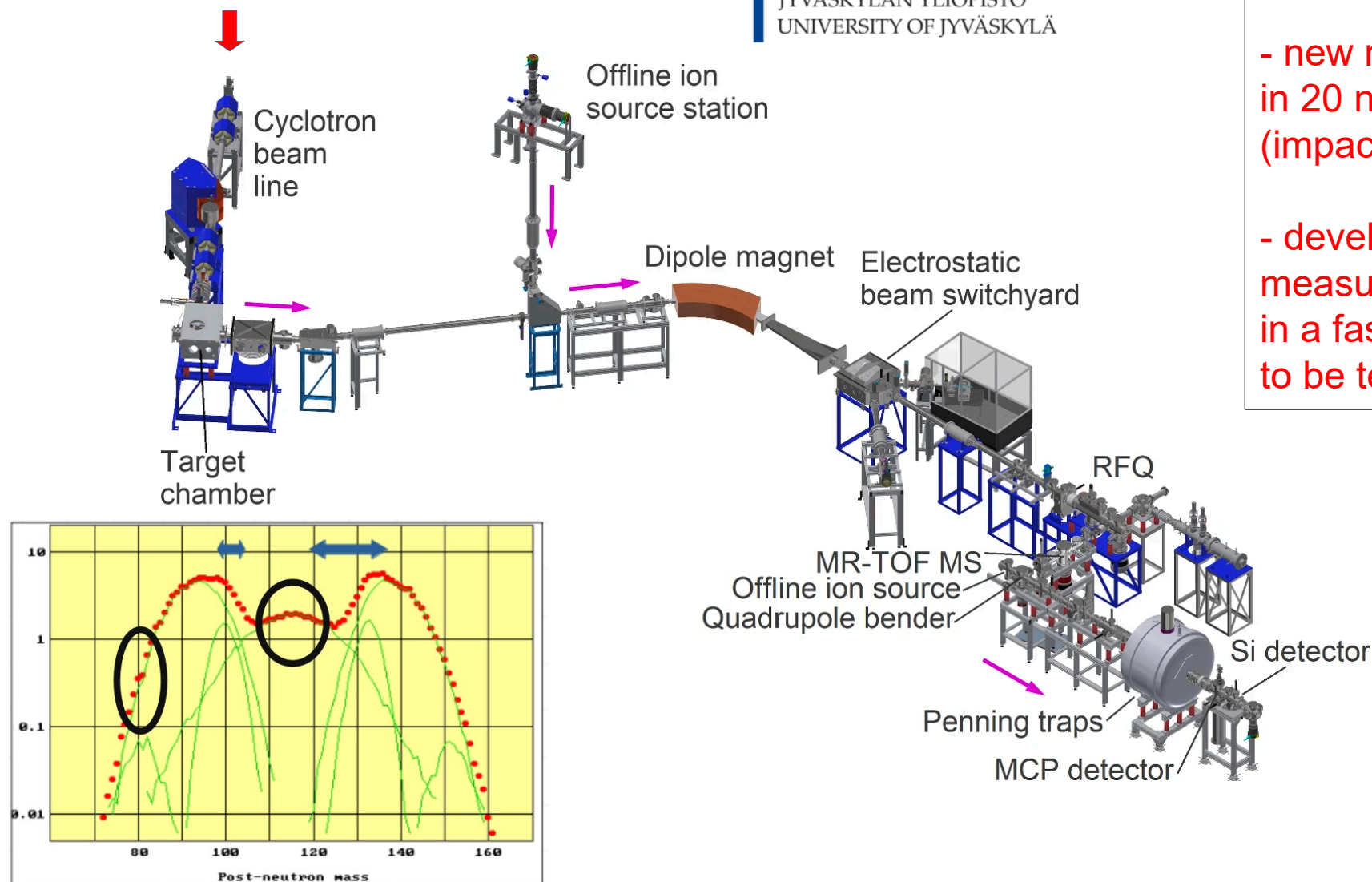
Goal: Measure light-ion production cross sections in structural materials to improve nuclear data evaluations and reaction models.

Upcoming: PhD defence december 3 Lucas de Aruda



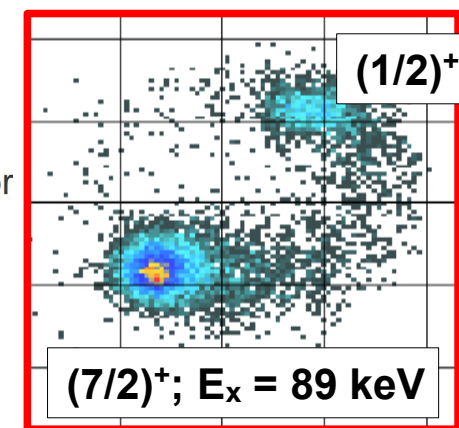
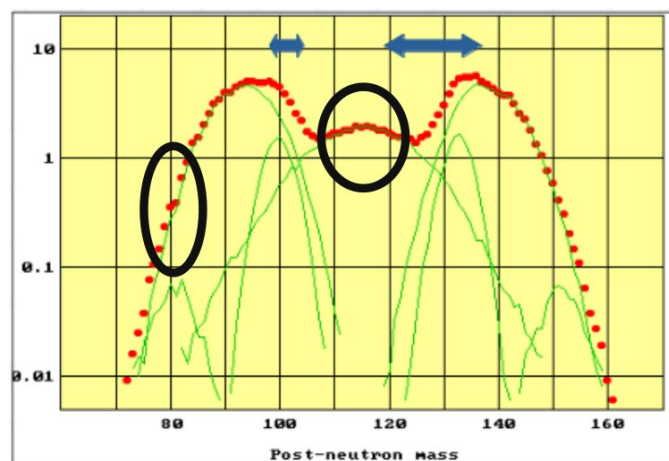
IGISOL and JYFLTRAP in Jyväskylä, Finland

Beam from K-130 cyclotron



Key achievements:

- new measurement campaign resulting in 20 new measured isomeric yield ratios (impacts e.g. beta decay in spent fuel)
- development of new ion guide for measuring neutron induced fission yields in a fast fission spectrum; to be tested in spring 2027



^{115}Pd



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NESSA – Neutron Source in uppSala

A 14 MeV DT neutron facility at Ångström Laboratory – **installed in Nov 2025**

Highlights since last meeting:

- **Installed Nov 2025**
- **First neutrons Nov 2025** with the loan DT generator from SKB; yield $(4.3 \pm 0.4) \times 10^8$ n/s via ^{93}Nb activation
- **Purchase order placed for high yield generator**

Other activities 2025–26:

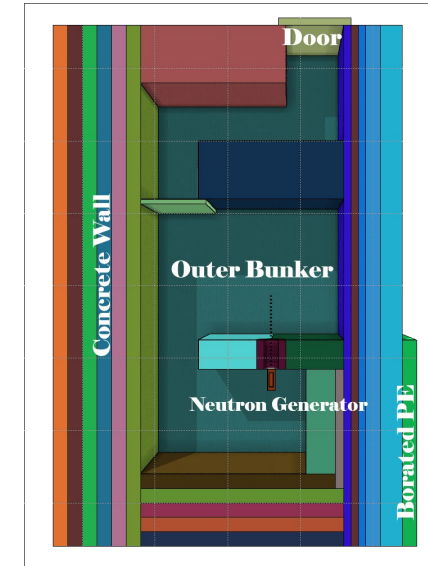
- **Neutron field characterised:** $^{235}\text{U}/^{238}\text{U}$ fission chambers, HPGe, liquid scintillator vs PHITS/FLUKA/MCNP
- **First data:** Neutron Moderation study, dosimetry-foil cross sections, neutron-induced errors in FPGAs
- Presented at the 15th Nordic Meeting on Nuclear Physics (May 2026)

Next (2026–27):

- Procure and commission the 1×10^{10} n/s generator; open to users from 2027
- Together with Tandem Lab p/d+Be fields (0.1–10 MeV): **neutrons from thermal to 14 MeV on one campus**

NESSA team: Stephan Pomp, Göran Ericsson, Mattias Lanz, Sandipan Dawn ... and colleagues

More detail about the facility: <https://arxiv.org/abs/2605.18929>



☀ **Good News: NESSA is funded and Purchase order placed for high yield generator**
Swedish Energy Agency: 6.5 MSEK (2025–27) for a 1×10^{10} n/s generator — $\sim 20\times$ today's yield.
With SKC (postdoc) and UU.

Talk in Session B2



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Method development for radionuclide measurements (UGGLA & nUGGLA)

Key goals

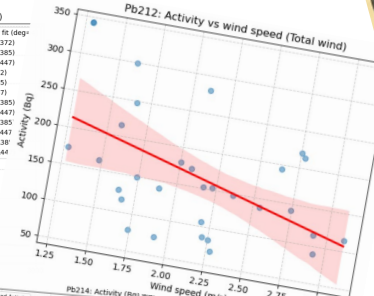
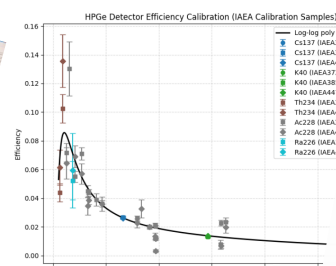
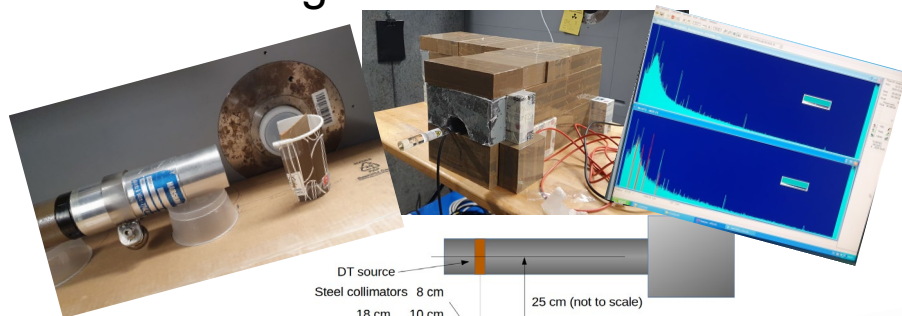
- General gamma spectroscopy facility: "You've got gamma? – We can measure it!"
- Be a friendly **neutron activation** partner to the **NESSA** neutron facility
- **Radioecology** studies for societal concerns and environmental studies

Recent/present activities

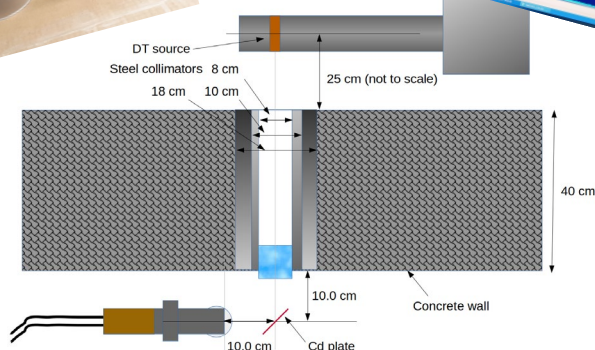
- **nUGGLA**: A new HPGe detector setup near the NESSA facility is being characterized.
- **Neutron prompt gamma activation** with NESSA (DT) and PuC neutron source for legacy waste studies.
- **Radioecology**: Studies of environmental samples 40 years after Chernobyl (plants, soil, and wild boar).
- **Air sampling**: Basic studies for radiation monitoring in air.
- Studies of radon background at the UGGLA detector.



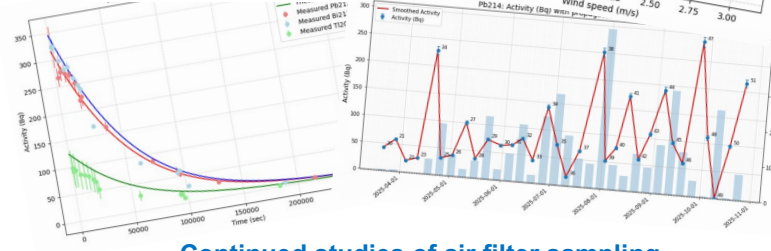
Installation of nUGGLA
Image: Sandipan Dawn



Plant and boar samples being prepared
Images: Mattias Lantz, Karl Lundén

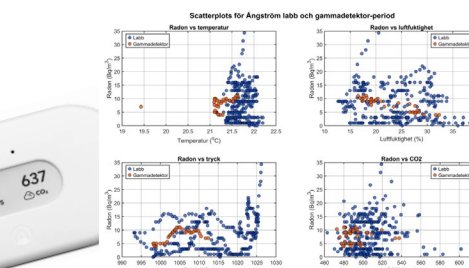


NESSA & PuC setups for neutron irradiation of Cd
Images: Daniel Okolie, Jonathan Herlitz



Continued studies of air filter sampling

Images: Kristin Herberthson, Adéla Holmén, Ebba Lorin, Erik Malmqvist, Elsa Rohlin



Radon studies at UGGLA
Images: Nimat Lali, Airthings

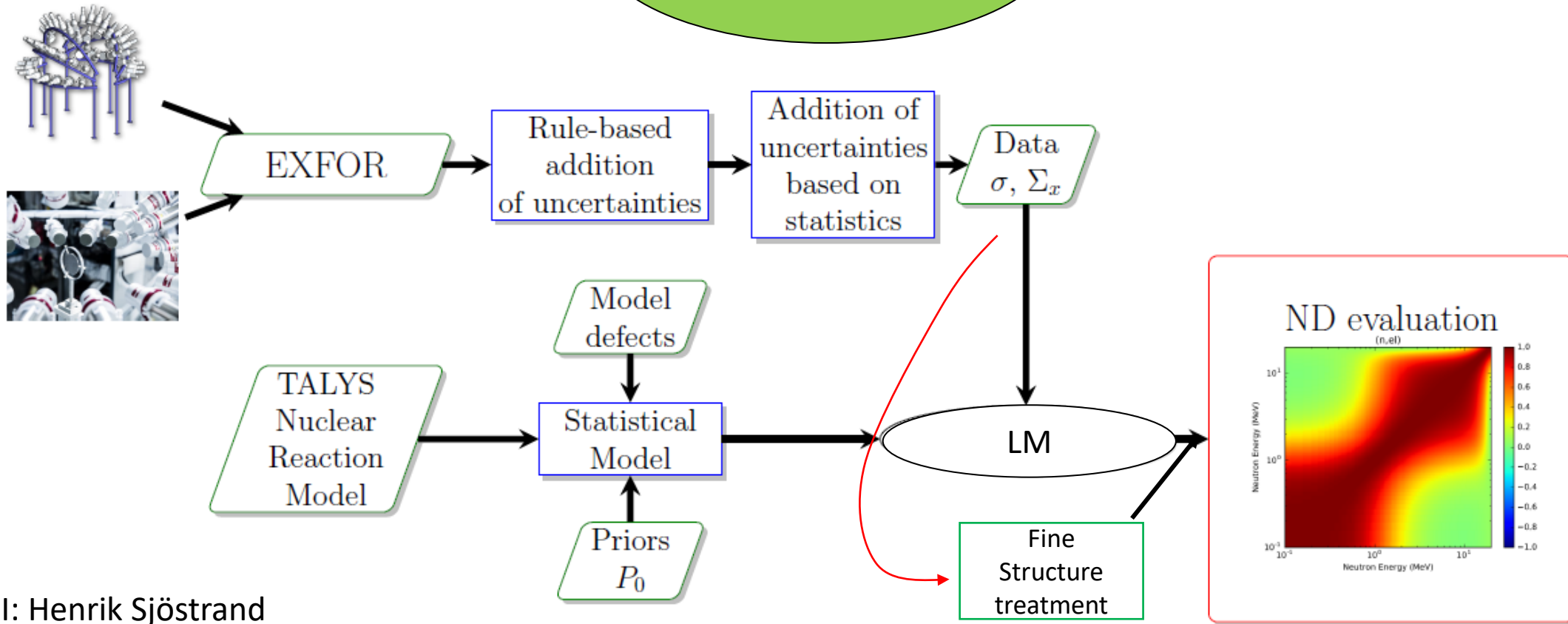
PI: Mattias Lantz



Sandipan Dawn
Cecilia Gustavsson
Erik Andersson Sundén

The Nuclear data Evaluation Pipeline of Uppsala University (NEPU)

Nuclear data
evaluation

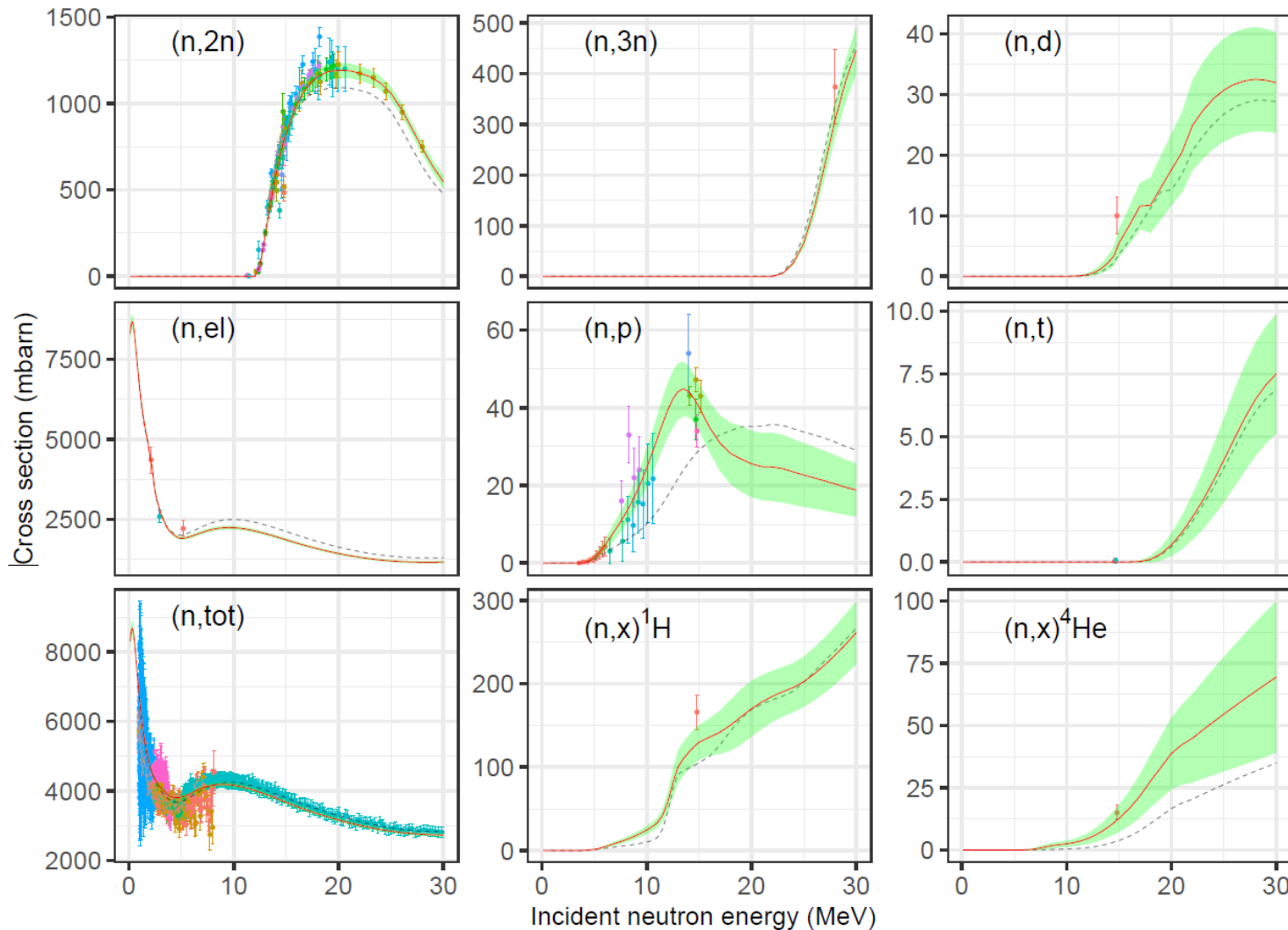


PI: Henrik Sjöstrand



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The Nuclear data Evaluation Pipeline of Uppsala University (NEPU)



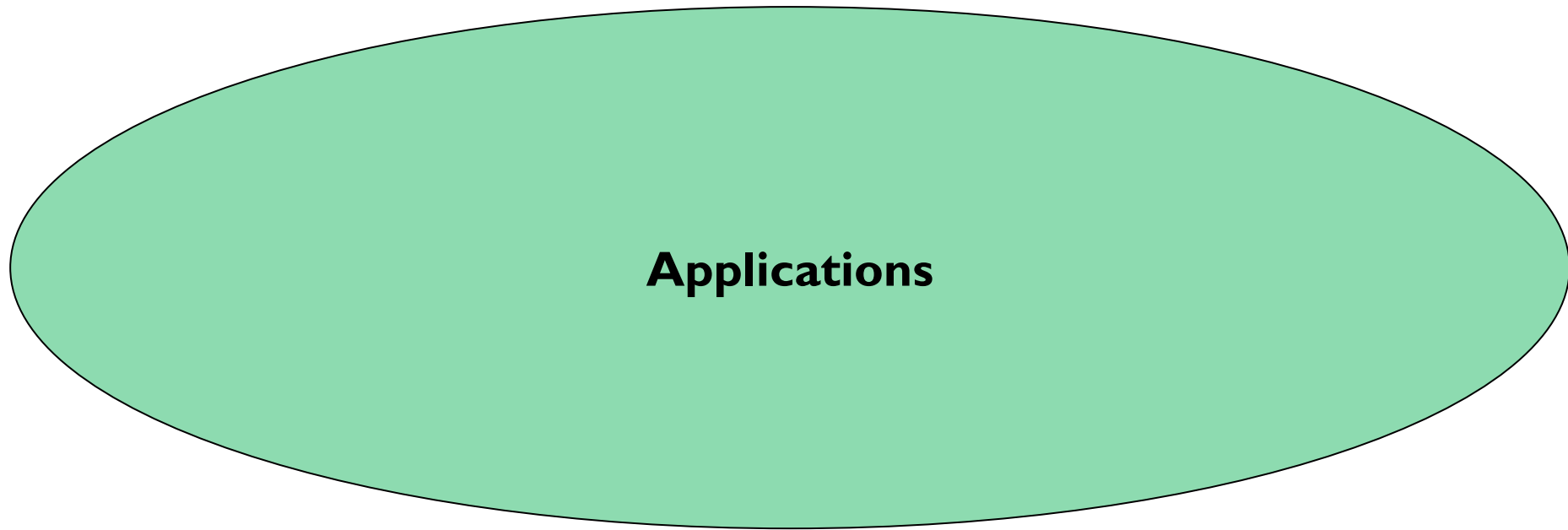
- **A Zr-90 evaluation using NEPU**
- **Investigated the χ^2 paradox**
 - Correlated systematics favor shape over magnitude
- **Peelle's Pertinent Puzzle**
renormalization introduces potential problems
 - Particularly when models misrepresent data
- **Main contributor: Jinti Barman**

PI: Henrik Sjöstrand



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Some application examples



Application of state-of-the-art machine learning techniques in support to core design activities

Main Goal

- ❑ Methods for optimization of lattice design and equilibrium cycles design

Techniques

- ❑ Artificial Neural Network for surrogate modelling
- ❑ Economic modelling based on Linear Reactivity Model and Levelized Cost of Electricity
- ❑ Population-based optimization algorithms

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		A-0002 Feed (2,2)	B-0003 (3,4) (2,3)	B-0002 (3,2) (2,4)	A-0002 (3,3) (2,5)	A-0001 (0,6) (2,6)						
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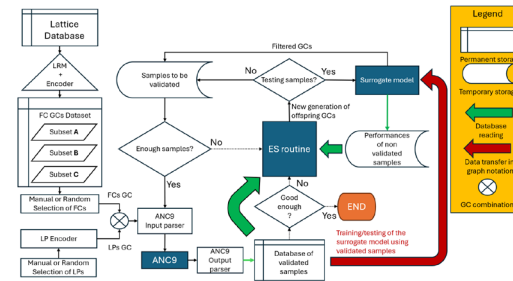
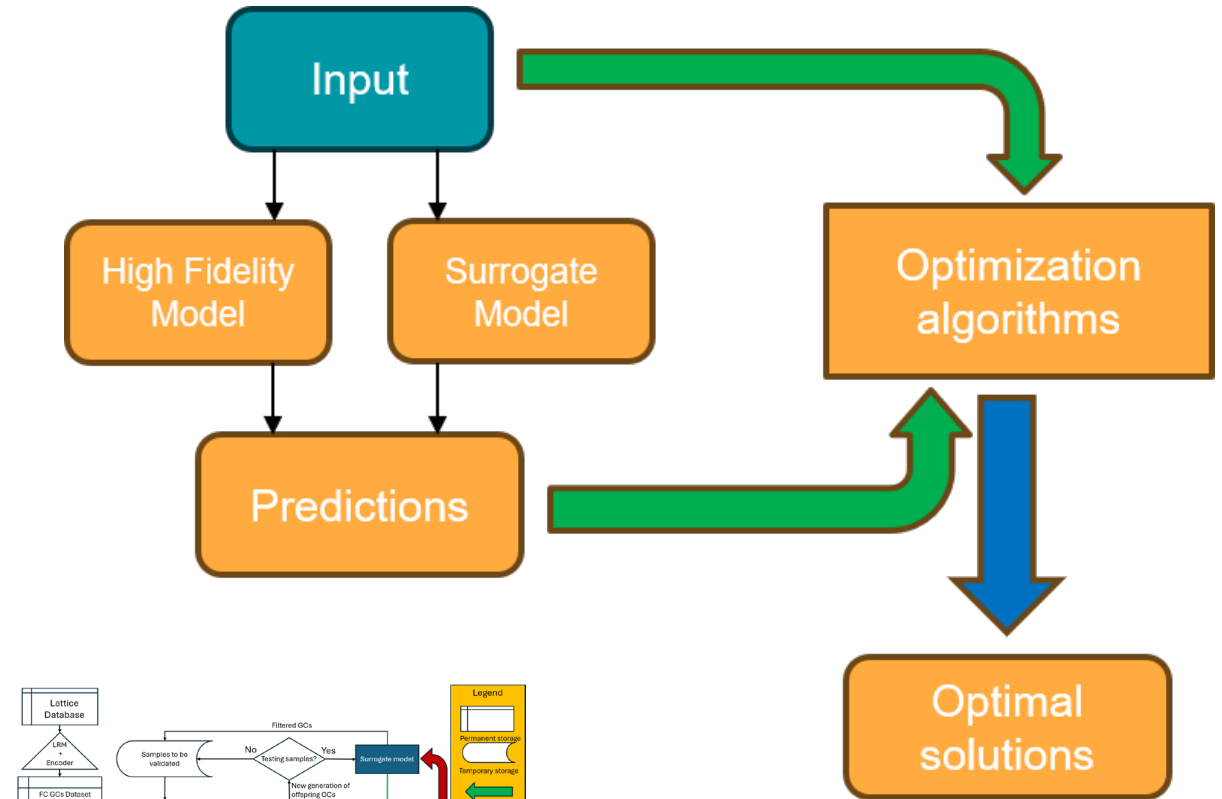
Project description

B1. Fuel assembly and core design optimization for SMRs

Project status, deliverables and future work:

- Licentiate Thesis successfully defended in April 2026
- PHYSOR 2026 presentation on Graph Neural Network for equilibrium cycle surrogate modeling
- ❑ Methodology and results have been further expanded with a dedicated paper to be published in the NSE's special issue PHYSOR 2026
- ❑ Ongoing activities on surrogate-assisted lattice optimization with VNF

A new PhD position has been announced within ANItA 2, building on the ongoing project > 200 applicants!



PhD student: Flavio Ferella
PI: Jesper Kirkengard
(Westinghouse)
Main supervisor: Andreas Solders

Presents in Track B

D2: Non-proliferation and nuclear safeguards in ANiTA



Objective:

- Perform proliferation resistance assessment to analyse safeguards consequences of introducing light-water SMRs in the Swedish nuclear energy system.

Highlight:

- Licentiate thesis presented on Oct 2, 2026
- INPRO paper accepted for publication
- Safeguarability conference paper accepted to IAEA Safeguards symposium
- Load following paper in manuscript form

Methodology:

- Apply IAEA:s self-assessment methodology INPRO on selected deployment scenarios
- Perform safeguardability study of hypothetical SMR facilities (reactor + dry storage)
- Study implications of load following operation for nuclear safeguards

Talk in Session A3

PI: **Sophie Grape**
Main supervisor: **Sophie Grape**
PhD student: **Claudia Olaru**



Figure: User Requirements (URs) to be evaluated in the INPRO methodology



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Research on maritime applications of nuclear technology



- Interdisciplinary research project on maritime applications of nuclear energy with focus on “3S” (Safety, Security and Safeguards).
- Project associated with ANItA.

Research projects cover:

- Assessments of regulatory frameworks (UU Department of Law)
- Safeguards assessments barges with HALEU-fueled LWRs
- Proliferation resistance and physical protection assessments of lead-cooled reactors deployed on floating platforms
- Studies of TRISO fuels in Generation IV systems

Collaboration:

- Marine Technology, Mechanics and Maritime Sciences at Chalmers (POWERSHIP project)
- Norwegian NuProShip project on nuclear propulsion.
- Approved project on “Center for Sustainable And Industrialized Nuclear Technology” (SAINT), aiming to study nuclear propulsion.



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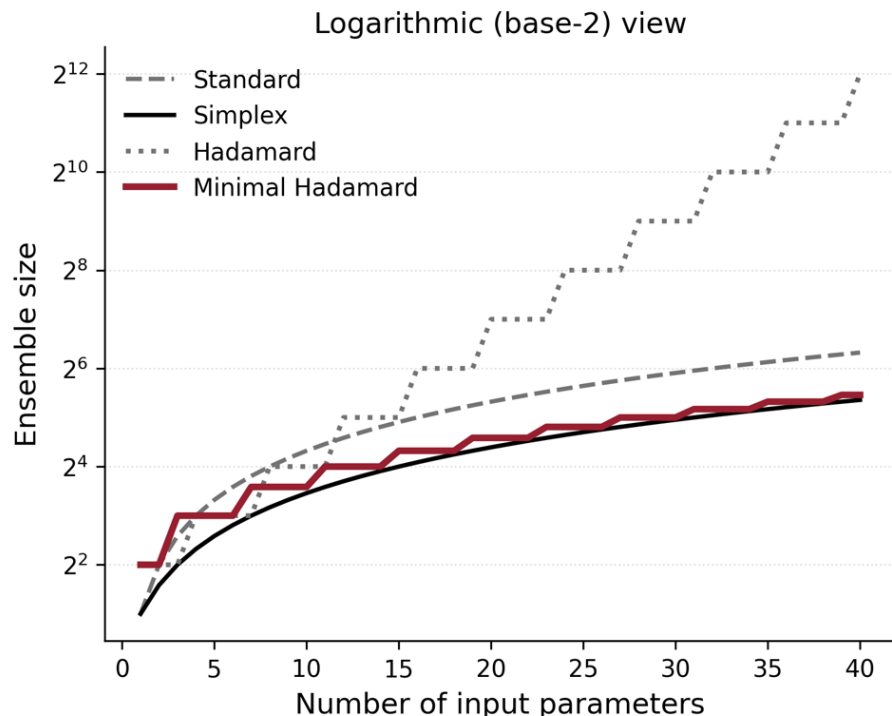
Talk in Session C3

PI: Sophie Grape

LAICA

Linking Academia and Industry in Criticality safety Analysis

Number of needed random files
(ensemble sizes) for different
deterministic sampling ensembles



- **Uncertainty quantification in criticality safety**
 - **New method for deterministic sampling**
 - minimum Hadamard ensemble
 - **Avoids curses of dimensionality while retaining precision in all moments.**
- **New sampling tool**
 - Supports geometric/material parameter distributions
 - Random and deterministic sampling
- **Applied to LCT077 integral experiment**
- **Manuscript in preparation**

PhD student: **Aura Jahan**
PI: **Erik Andersson Sundén**

Talk in Session A3



Field Theory for Neutronics

Objective:

Improve the modeling of neutron transport by including noise and feedback in the diffusion equation.

Method :

Use statistical field theory to calculate correlation functions, such as the response propagator, allowing us to rewrite the diffusion equation in a simple form that takes the interaction between noise and feedback into account.

People involved:

Industrial PhD student: Jacob Persson

Supervisors @ UU:

Stefano Moretti, Andreas Solders, Eliel Camargo-Molina

Supervisor at Ringhals:

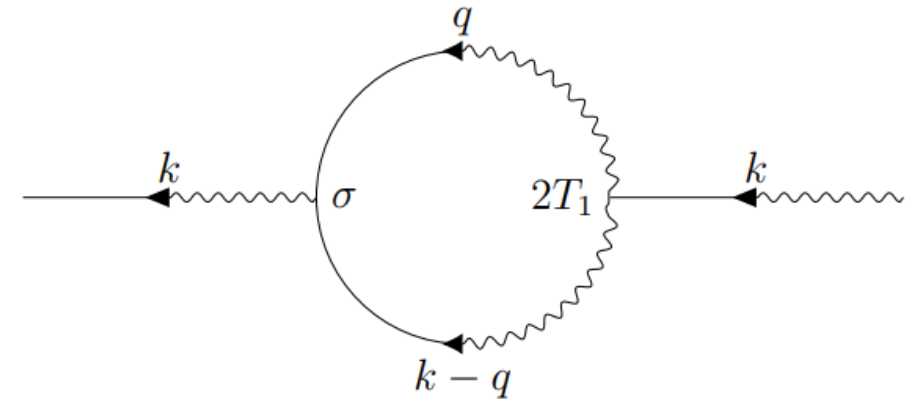
Anders Jonsson (Härdanalys, bränsle och safeguards)



**Talk by Jacob Persson
in Session B3**



$$\frac{\partial}{\partial t} N(\vec{x}, t) = (D \nabla^2 + \rho) N(\vec{x}, t) + \overset{\text{Noise term}}{\eta(\vec{x}, t)} + \overset{\text{Feedback}}{\sigma N^2(\vec{x}, t)}$$



Nuclear Fuel Performance - B3

- Impact of SMR operation on fuel performance
- Methods
 - Fuel performance modelling (e.g. Transuranus)
 - Analysis of In-pile experiments and post-irradiation examination
 - Non-destructive gamma emission tomography for spent nuclear fuel

Talk in Session B1
Peter Andersson PI



Activities by members of E1 and E2



E1: Implementation of SMRs – serial production and project management

PI: Åse Linné
Postdoc: Emil Ahlström
PhD student: Vidar Ekström

- **PhD student Vidar Ekström**

- Presented research at two conferences (EASST in Krakow and NFF in Aarhus where drafts of his second article were presented)
- Completed halftime seminar
- First article in review since May in the journal Futures
- Vidar is planned to finish his dissertation in the first quarter of 2029

Presents in Session C2

- **Postdoc Emil Ahlström**

- Conducted site visits, both together with SKC in Nyköping but also to decommissioning sites at Ringhals
- One article currently in review on the topic of nuclear cultures and waste
- Second article on project management in decommissioning projects currently being drafted

E2: Licensing issues and perspectives on regulatory frameworks

- Draft of a report on changes in licensing processes based on consultation response on SOU (2025:07) has been written with response received from partner organisations, revised draft will be sent for review before the end of the year



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Conclusions from Uppsala

- Historical high student interest and a broad spectrum of both recurrent and new courses
 - A current threat of closing down the nuclear bachelor engineering program
- A record broad research portfolio.
- More application-oriented than before.
- Stronger industrial collaboration than previously.

Thank you!



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