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GammaAI 2025 proceedings: seminar for users of gamma-ray spectrometry

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Abstract

The NKS GammaAI 2025 seminar took place on 8–9 October 2025 at the Technical University of Denmark, Lyngby Campus. Eighty-five participants from 14 countries attended, representing universities, research institutes, authorities, and industry. The focus was on introducing artificial intelligence (AI) in gamma-ray spectrometry. Two invited presentations provided both an overview of AI principles and examples of practical applications for spectral analysis and automation. In total, 24 presentations were given, addressing topics such as data evaluation, instrumentation, software development, and applied measurements. Two practical exercises were organised: a data analysis intercomparison and a background survey. These activities supported exchange of experience and comparison of analytical methods. Feedback from participants was very positive and confirmed the value of continuing such meetings. The seminar strengthened cooperation within the Nordic gamma-ray spectrometry community and demonstrated the potential of AI tools to improve data interpretation and analytical efficiency.

Key words

Gamma-ray spectrometry, seminar, artificial intelligence

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**Final Report from the NKS-B GammaAI 2025 activity
(Contract: AFT/B(25)2)**

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1. Introduction

The GammaAI 2025 activity brings together Nordic professionals in gamma-ray spectrometry for a collaborative two-day event focused on knowledge sharing and skill development. This event tried to introduce key artificial intelligence (AI) concepts. GammaAI 2025 also covered a broad range of topics related to gamma-ray spectrometry. The seminar's scope was intentionally wide, allowing discussions on various relevant areas. It also included a data analysis exercise and a background survey.

2. GammaAI 2025

The NKS GammaAI 2025 Seminar was held on 8–9 October 2025 at DTU Lyngby Campus. In total, 85 participants from 14 countries joined either on site or remotely via MS Teams. The participants represented universities, research institutes, industry, and authorities. Twenty-four presentations were given (see Appendix 1), and all presentations are available on the GammaWiki website.

The seminar opened with news from NKS and continued with a focus on introducing artificial intelligence in gamma-ray spectrometry. Two invited speakers gave an introduction to the topic. The first presented the basic concepts of AI and showed how including physical knowledge in models can make data analysis more transparent and reliable. The second speaker demonstrated practical AI tools and workflows for gamma-ray spectroscopy, showing how machine learning can support spectral analysis and automation. Several participants also shared how they use or plan to use AI in their work.

Two exercises were organised during the meeting. Twelve participants joined the data analysis of a soil sample, and seven contributed to the background survey.

The data analysis exercise showed a large spread of results for nuclides with low activities, spectral interferences, or complex decay chains. In particular, Ra-226 activities differed considerably depending on how participants handled the U-235 interference at ~186 keV. The Th-232 and U-235 decay chains showed the largest discrepancies, mostly due to different assumptions on secular equilibrium. The main outcome was that, even with identical input data, differences in analysis procedures and software have a strong impact on the results and are a major source of uncertainty.

The background survey compared seven high-purity germanium detector setups operated in “standard laboratories.” Background levels and spectral shapes varied significantly between the laboratories, reflecting the specific design and shielding configuration of each setup. The comparison concluded with a short guide on background reduction presented by one of the participants.

Other sessions covered data analysis and evaluation, including background reduction, intercomparison results, nuclide identification, and analytical reliability. Further presentations discussed instrumentation, new software tools and modelling methods, and recent activities in participants’ laboratories. The final session presented applied examples ranging from environmental and waste characterisation to nuclear physics and field measurements. The seminar offered an efficient platform for sharing experience, strengthening collaboration, and identifying future work within the Nordic gamma-ray spectrometry community, with particular attention to the growing use of AI in the field.

3. Feedback

An anonymous questionnaire was sent to all the participants to identify ways to improve future seminars. The result of the questionnaire is given in Appendix 2. Feedback from 32 seminar participants was overwhelmingly positive, indicating a successful event. Attendees reported strong satisfaction with the seminar's organization, content, and networking opportunities.

4. Conclusions

The GammaAI 2025 seminar continued the long-standing cooperation between Nordic laboratories, authorities, and research organisations in the field of gamma-ray spectrometry. The introduction of artificial intelligence as a main theme brought new perspectives and ideas for future work. The seminar offered an opportunity to exchange experience, compare results, and discuss practical challenges and developments in the field. It was also noted that finding experts with combined competence in gamma-ray spectrometry and artificial intelligence remains challenging.

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Disclaimer

The views expressed in this document remain the responsibility of the author(s) and do not necessarily reflect those of NKS. In particular, neither NKS nor any other organisation or body supporting NKS activities can be held responsible for the material presented in this report.

Appendix 1 – Programme of the GammaAI 2025 seminar



Nordic nuclear safety research

NKS GammaAI 2025 Seminar

Day 1: Wednesday, October 8, 2025

08:30-09:00	Registration
09:00-09:10	Opening and practical information <i>Guillaume Lutter, DTU Sustain</i>
09:10-09:15	Welcome <i>Claus Hélix-Nielsen, Head of Department, DTU Sustain</i>
09:15-09:25	News from NKS <i>Kasper Andersson, DTU Sustain & NKS</i>
Session 1:	<i>AI in Nuclear Analysis/Gamma-ray spectrometry</i>
09:25-10:15	From Machine Learning to Physics-Informed, Cognitive AI in Nuclear Analysis <i>Marcus Neuer, innoRIID / Ametek Department for R&D, Invited speaker</i>
10:15-10:45	<i>Coffee/Tea break</i>
10:45-11:30	A Practical Guide to AI Tools for Gamma-Ray Spectroscopy <i>Alexandr Malusek, Linköping University, Invited speaker</i>
11:30-12:05	AI used in Germanium detector health prediction <i>Tommy Tallqvist, Mirion Technologies</i>
12:05-13:00	<i>Lunch break</i>
Session 2:	<i>Data Analysis & Evaluation</i>
13:00-13:15	Background survey, part 1 <i>Guillaume Lutter, DTU Sustain</i>
13:15-13:30	Background survey, part 2 <i>András Kocsonya, Centre for Energy Research</i>
13:30-13:50	Data analysis intercomparison <i>Guillaume Lutter, DTU Sustain</i>

13:50-14:10	Problem in U-238 (Pa-234m) determination <i>Roy Pöllänen, STUK, Online</i>
14:10-14:25	Failed peak identifications caused by peak overlaps in gamma-spectrometry and how to resolve them? <i>András Kocsonya, Centre for Energy Research</i>
14:25-14:50	Improvement of reliability of evaluation of environmental spectra by simultaneously applied computer codes <i>András Kocsonya, Centre for Energy Research</i>
14:50-15:15	<i>Tea/Coffee break</i>
15:15-15:25	Reducing true coincidence summing effects by using an absorber - practical experiences <i>Alexander Muring, Institute for Energy Technology (IFE)</i>
Session 3:	<i>Instrumentation</i>
15:25-16:10	BrightSpec <i>Vicente Osorio, BrightSpec NV</i>
Session 4:	<i>Discussion & Networking</i>
16:10-16:30	Free
16:30-21:30	<i>Social activities: Classic Car House visit + Dinner</i>

08:30-09:00 Morning Warm-Up

Session 5: Laboratory News

09:00-09:15 Recent activities/development in STUK's gamma ray laboratory
Jani Turunen, STUK

09:15-09:30 Gamma Spectroscopy activities at the Nuclear Security Department of the Center for Energy Research, Hungary
Judith Dembo, HUN-REN Centre for Energy Research

09:30-09:45 Challenges with gamma spectrometry at ESS and how could AI help
Nikola Markovic, European Spallation Source

09:45-10:05 Risø gamma spectrometry laboratory
Guillaume Lutter, DTU Sustain

Session 6: Software & Methods

10:05-10:30 LVis & tRAYcy - the basis for a new approach to gamma spectrometry
Marc Breidenbach, AMETEK GmbH ORTEC

10:30-10:40 Ba-133 transmission measurement for geometry validation
Asser Nyander Poulsen, Danish Health Authority, Radiation Protection

10:40-11:05 *Coffee/Tea break*

11:05-11:30 Practical applications of ISOCS Multi-Efficiency modelling for complex pipe geometries at a nuclear power plant – an in-house development
Ylva Ranebo, RadPhys Consulting AB

11:30-11:45 How to extend efficiency calibration curves to low and high energy ranges?
András Kocsonya, Centre for Energy Research

Session 7: **Applications**

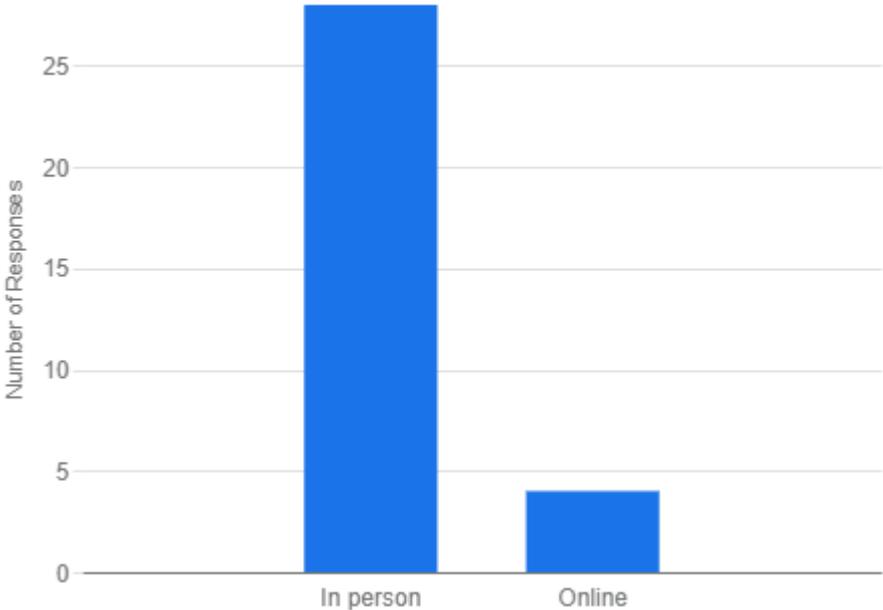
- 11:45-12:10 List Mode: 2D scanning for nuclides in raw waste
Bas Janssen, NRG PALLAS, Online
- 12:10-12:20 Application of ^{137}Cs and plutonium isotopes for sediment dating in
Nebkha sediments in northwest China
Yihong Xu, Anhui Normal University
- 12:20-13:20 *Lunch break*
- 13:20-13:40 Test of symmetries of fundamental forces in nuclear reactions using
HPGe detectors
Luca Zanini, DTU Sustain
- 13:40-14:10 Field gamma spectrometry measurements near a nuclear power
plant and on Roskilde Fjord
Sven Nielsen, DTU Sustain

Session 8: **Ending**

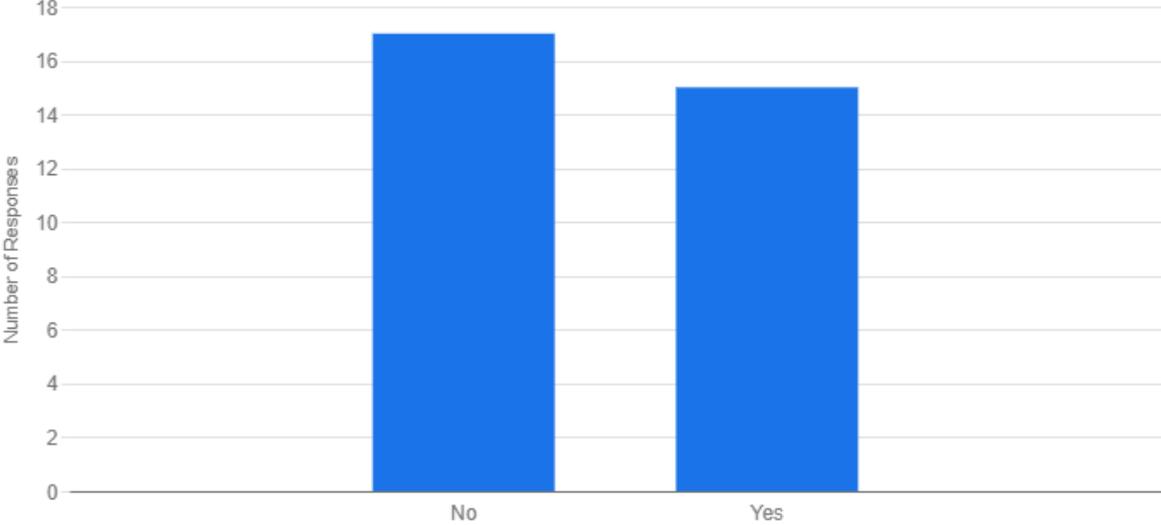
- 14:10-14:20 Closing
Guillaume Lutter, DTU Sustain
- 14:20-15:00 Open Discussion & Networking

Appendix 2 – Participant’s feedback

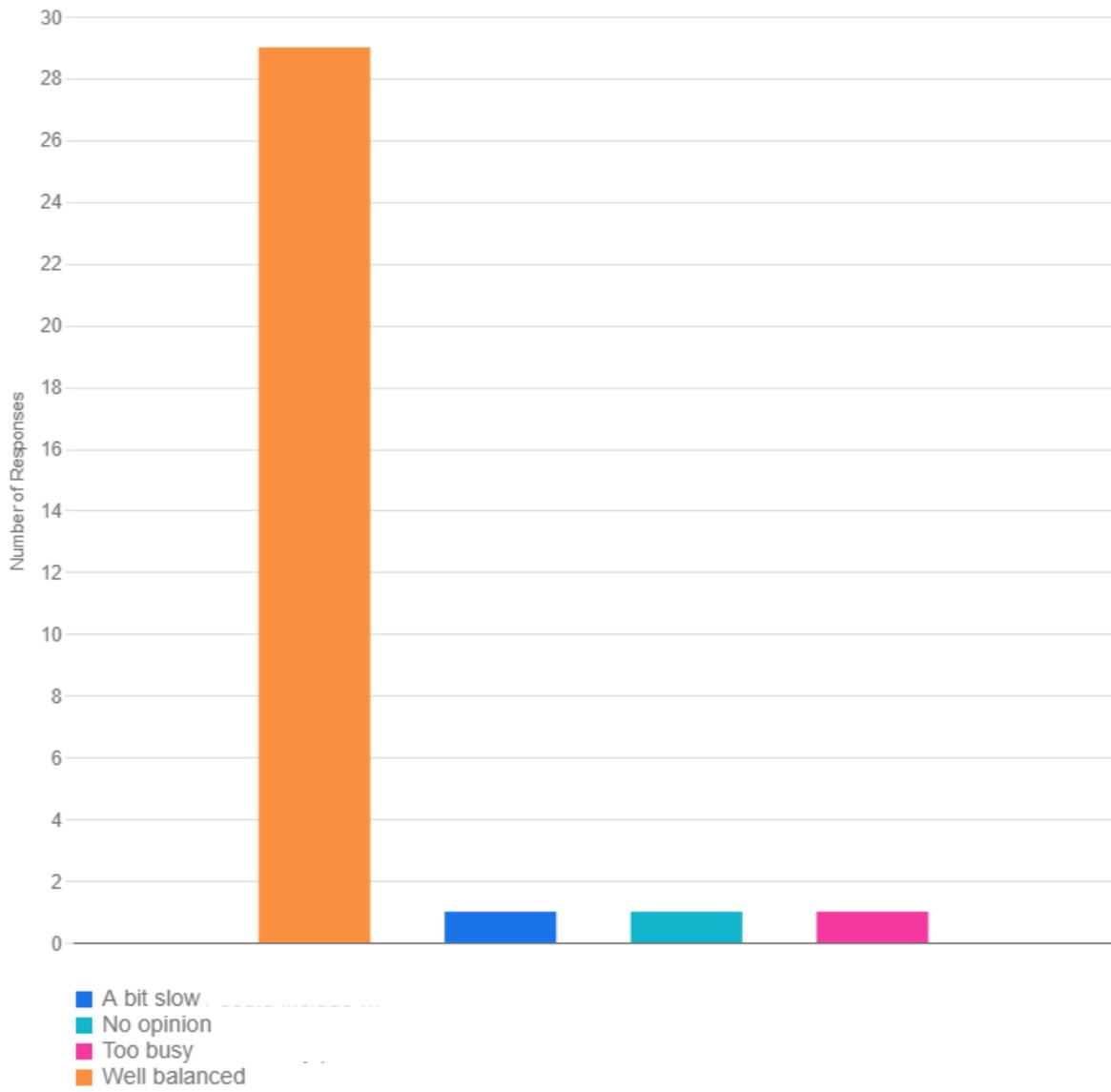
How did you attend the seminar?



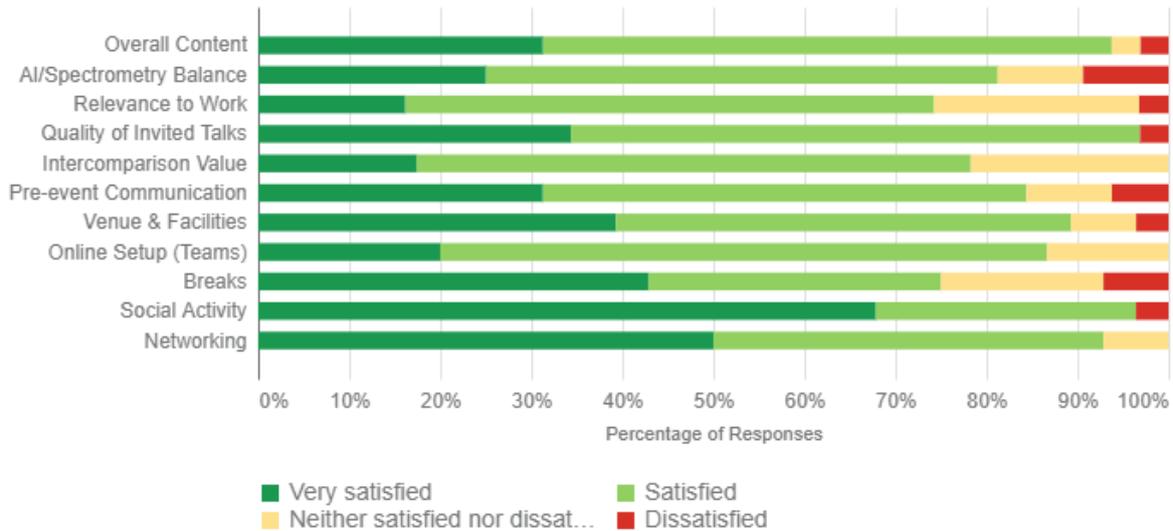
Attended Previous NKS Events?



Overall Pace and Structure



Summary of Satisfaction Ratings



Do you have any suggestions for future topics or themes you would like to see covered in upcoming seminars?

Geological applications of gamma spectrometry

Underwater, field, and aerial measurements.

MCA settings across different brands and different setups

User and Expert collaboration workflow with common compare options to evaluate settings and spectra

New features of hardware and software including AI, and more sharing of experience across users

Session with Gamma-ray spectrometry exercises.

How to setup and adjust gamma-spectrometers.

Several users do not know exactly the adjustment possibilities of gamma-spectrometry systems (detectors and data acquisition electronics) and the effect of the adjustable parameters. An introduction even from a manufacturer or experienced user would be useful.

I really enjoyed it

continue with use of AI in gamma spectrometry

not at the moment

Any additional comments or suggestions?

Iceland would be a nice location to host the next NKS meeting :)

Timing of the event can interfere with other gamma related events like IAEA LABONET

A guided visit at the laboratories of the Lyngby campus would have been informative.

Thanks for a very nice meeting! Look forward to next one. :)

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