SEASON at S³-LEB

GANIL Scientific Council

February 4th 2025

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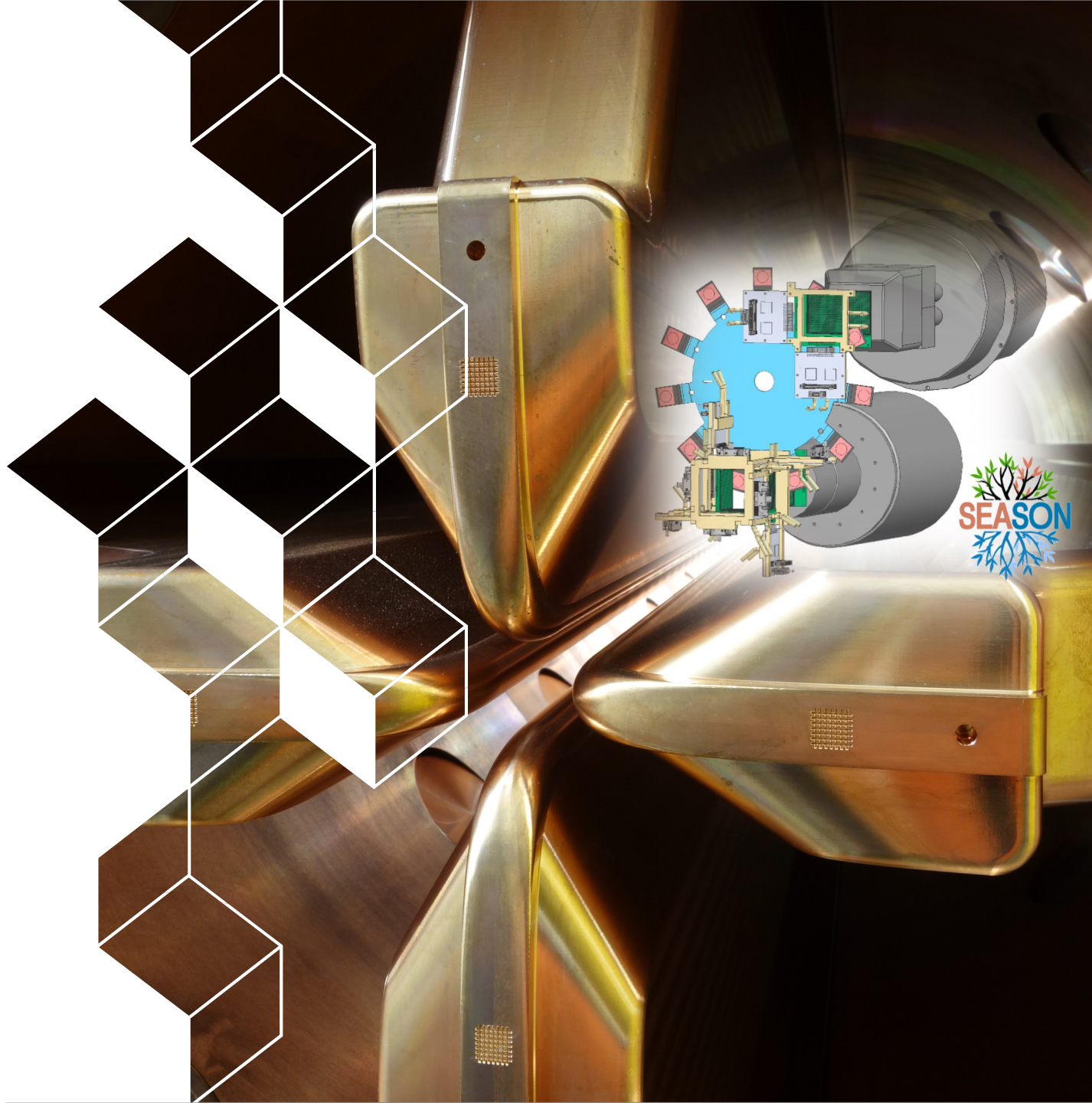


Introduction

- Detailed spectroscopy of heavy nuclei (HN, Z ≥ 89) et superheavy nuclei (SHN, Z ≥ 104) is one of the major research area in modern nuclear physics

→ Paramount importance to provide information on the nuclear landscape at the upper limit of the nuclear chart. What are the limits of the nucleus cohesion?

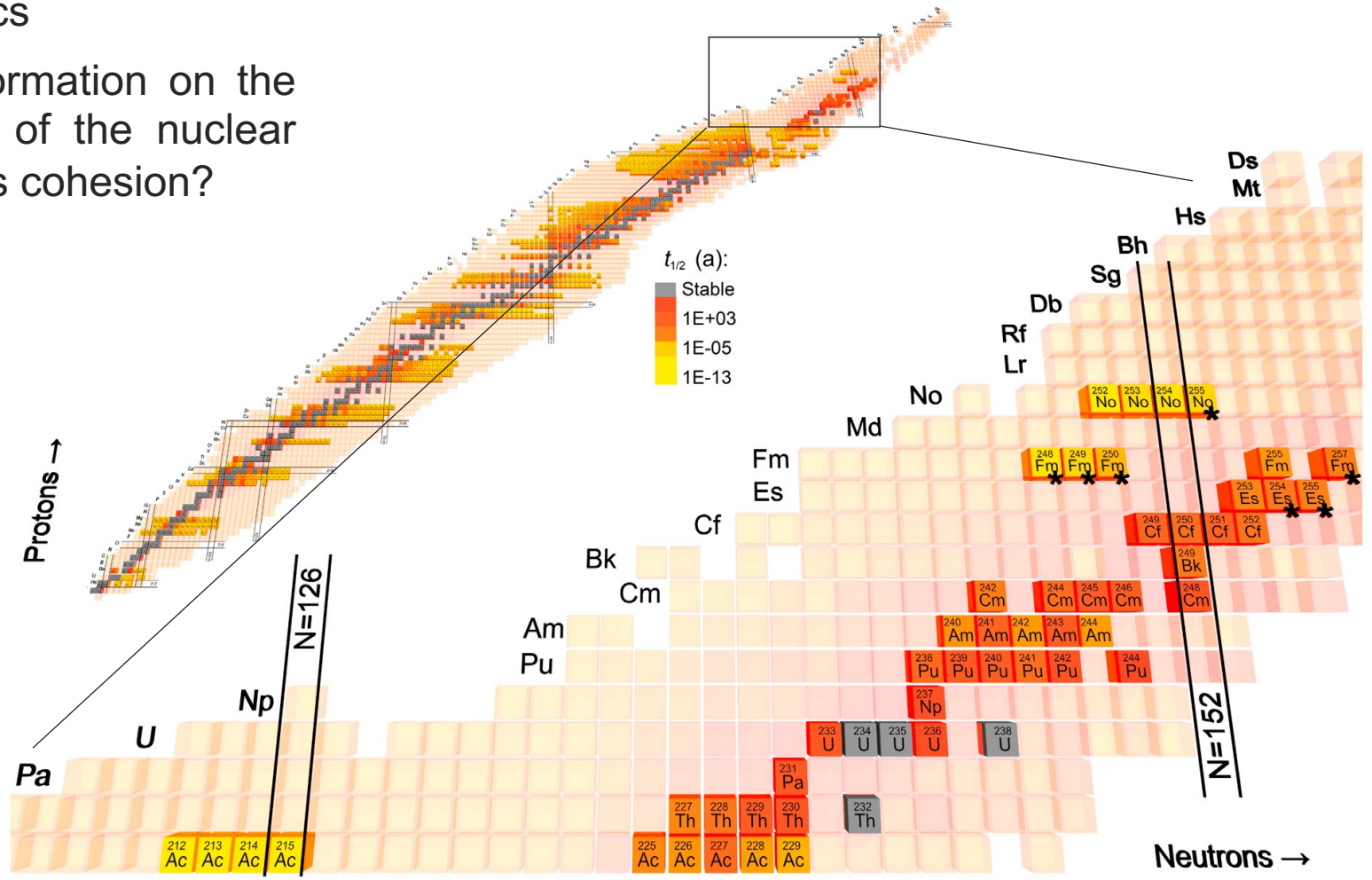
- Difficulty: low production cross-sections

→ Opportunity at **GANIL-SPIRAL2/S³**

- Experimental methods at S³ :

→ Decay spectroscopy (SIRIUS)

→ Laser spectroscopy (S³-LEB)



M. Block, M. Laatiaoui & S. Raeder, Prog. Part. Nucl. Phys. 116 (2021)

SEASON detector

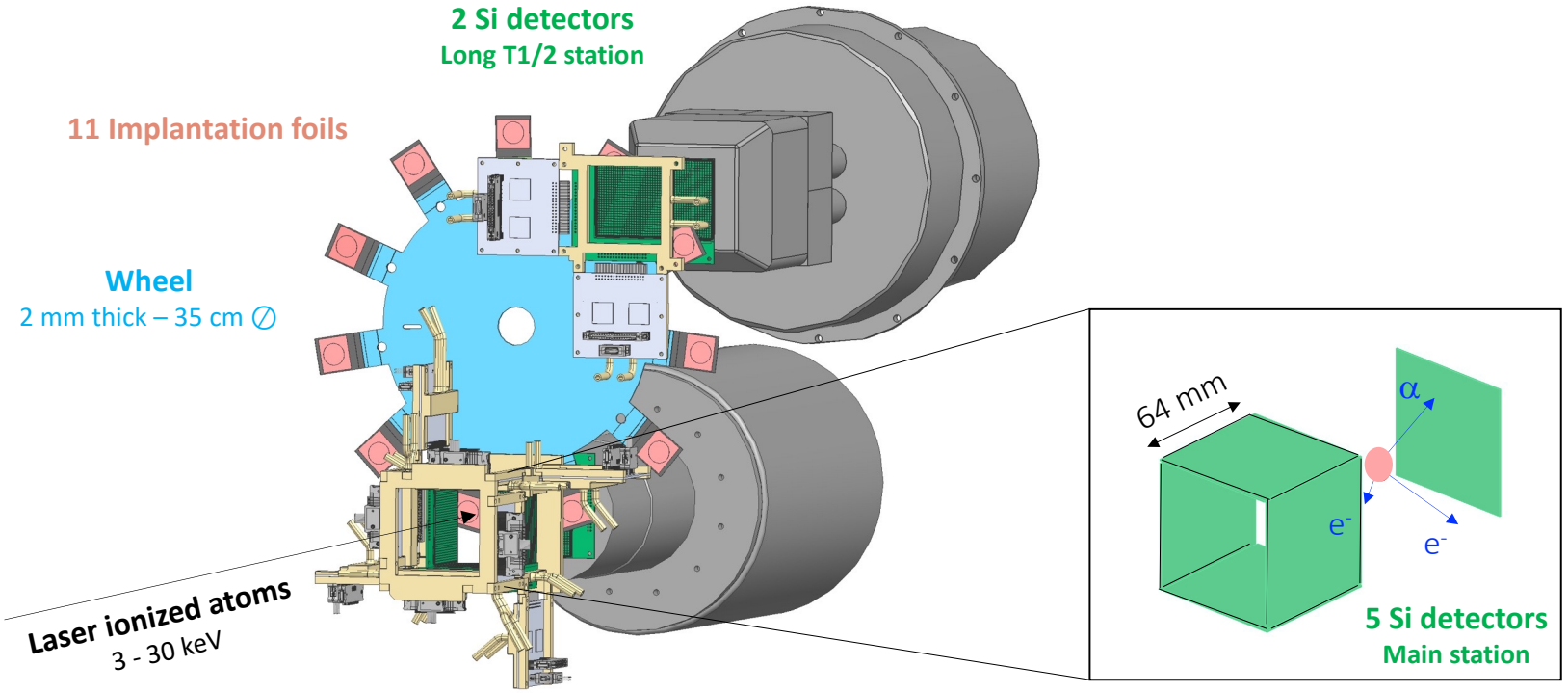
- **S**pectroscopy **E**lectron **A**lpha in **S**ilicon b**O**x cou**N**ter

Designed to complete S^3-LEB device for HN/SHN physics cases. It will:

1. Count the ions coming from laser ionisation during laser spectroscopy
2. Perform high energy-resolution α, electron and γ-ray decay spectroscopy

Requirement: high efficiency for α up to 12 MeV and e^- from 20 keV to 600 keV

Requirement: granularity, thin dead layer, ultra high resistivity, low noise front-end electronics



2021 - 2025

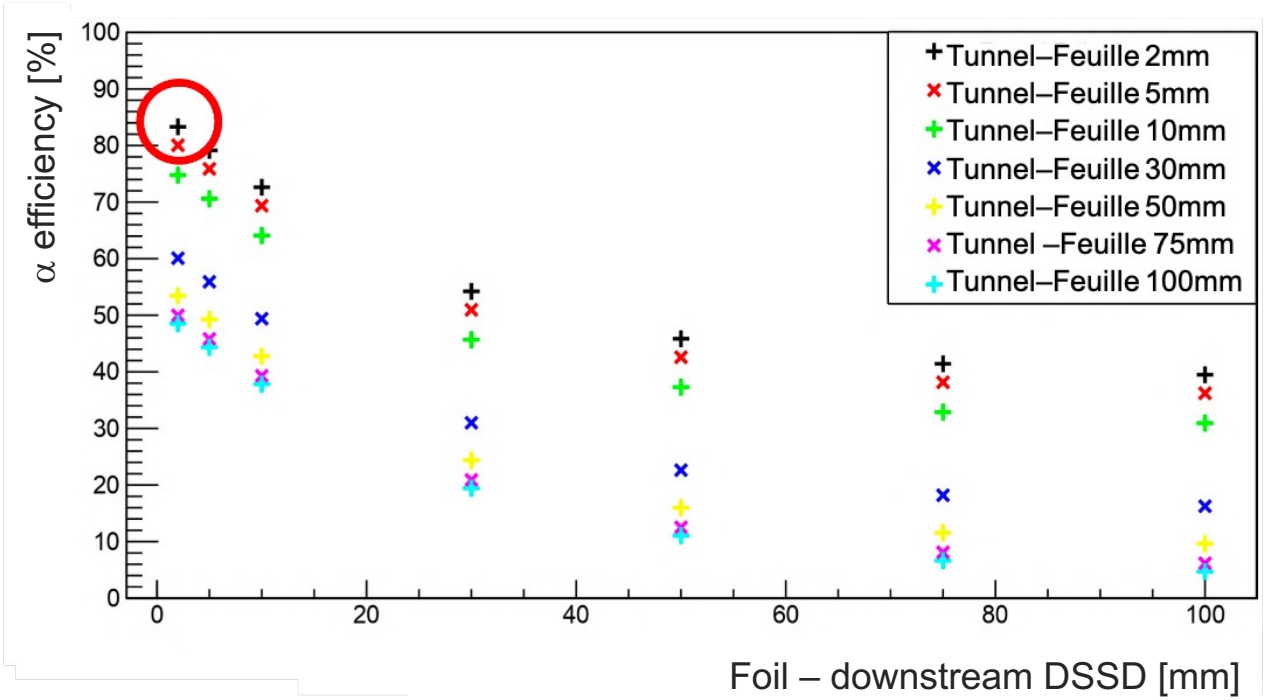
Characteristics of 7 Si detectors (DSSD)	
Thickness	1 mm
Active area	64 x 64 mm²
Nb of strips	32 x 32
Strip pitch	2 mm
Dead layer thickness	50 nm

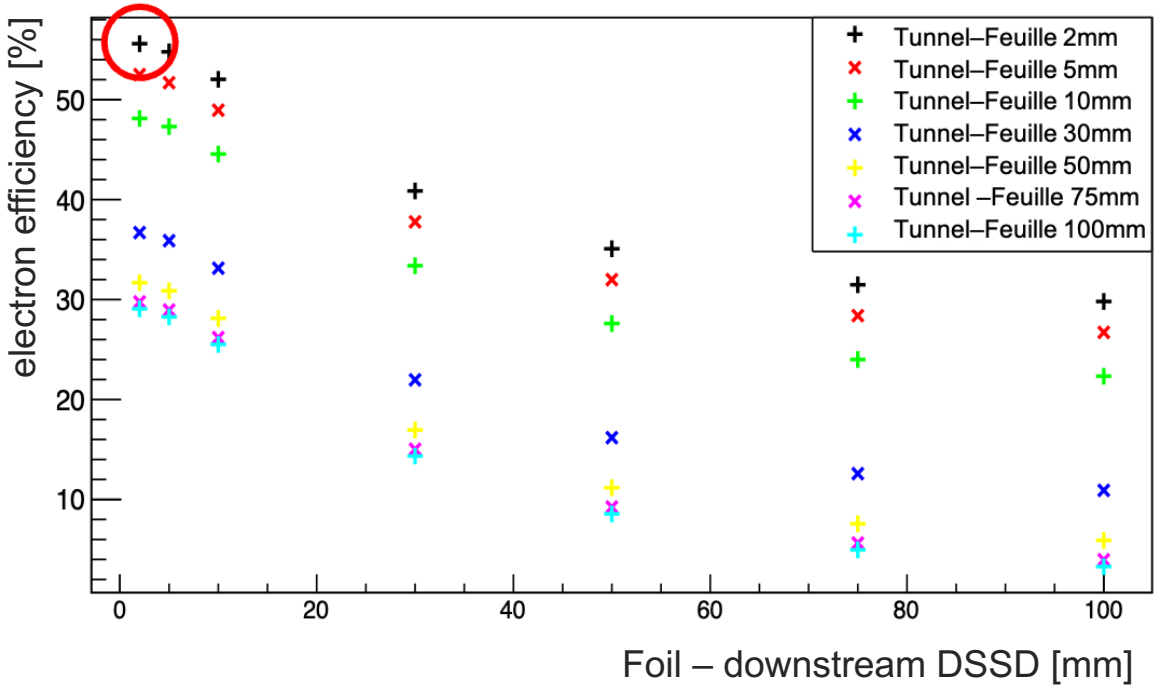
SEASON GEANT4 simulations

- GEANT4 simulations performed using NPTool

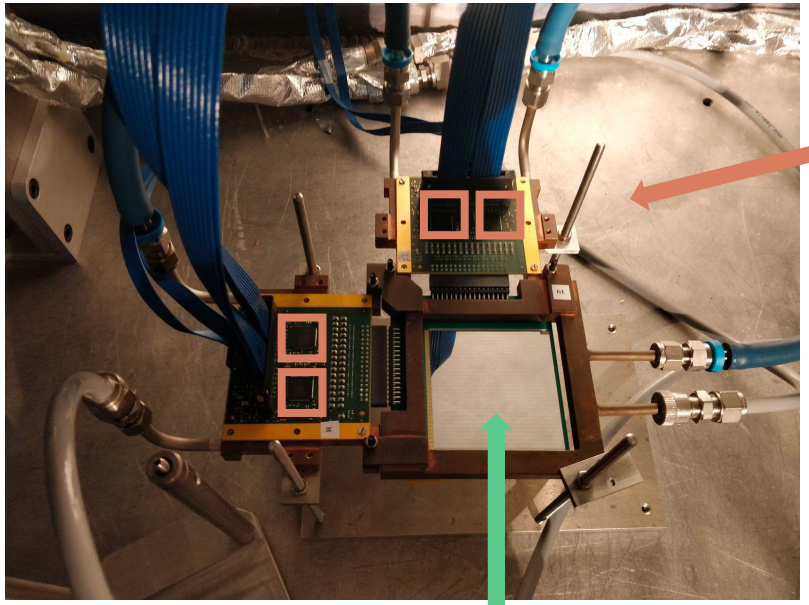
→ α detection efficiency: 83% in compact configuration

→ Electron detection efficiency: 56% in compact configuration





SEASON electronics



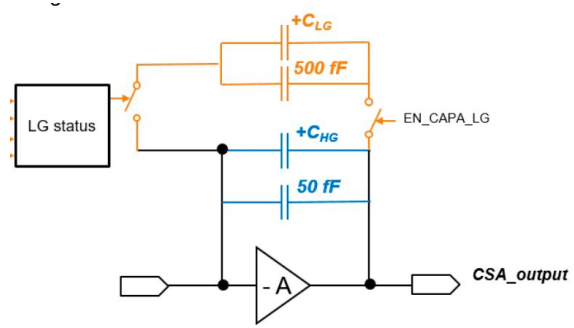
1. SEASON DSSD

2. Front-end electronics FEANICS

Front-End Adaptative gaiN Intergrated CircuitS

FEANICS

- Charge sensitive preamplifier (CSA) developed @Irfu
- ASIC 16 channels
- Automatic gain switch as a function of the amplitude signal



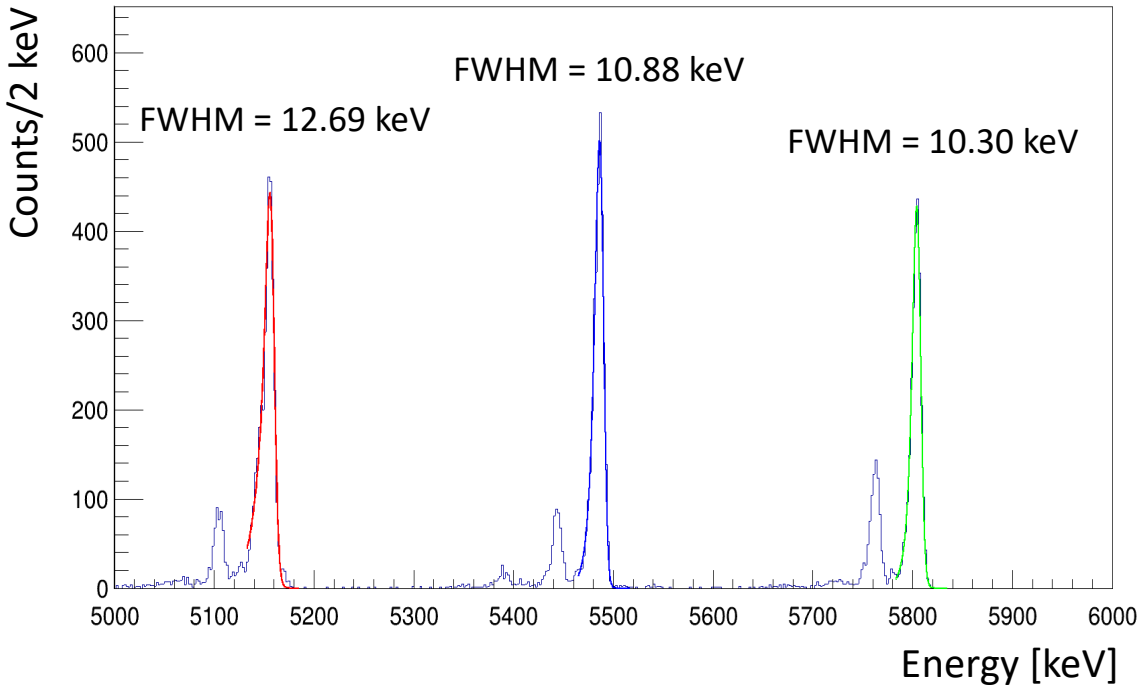
- CSA floor noise (no detector) ~ 2.3 keV

3. Back-end electronics

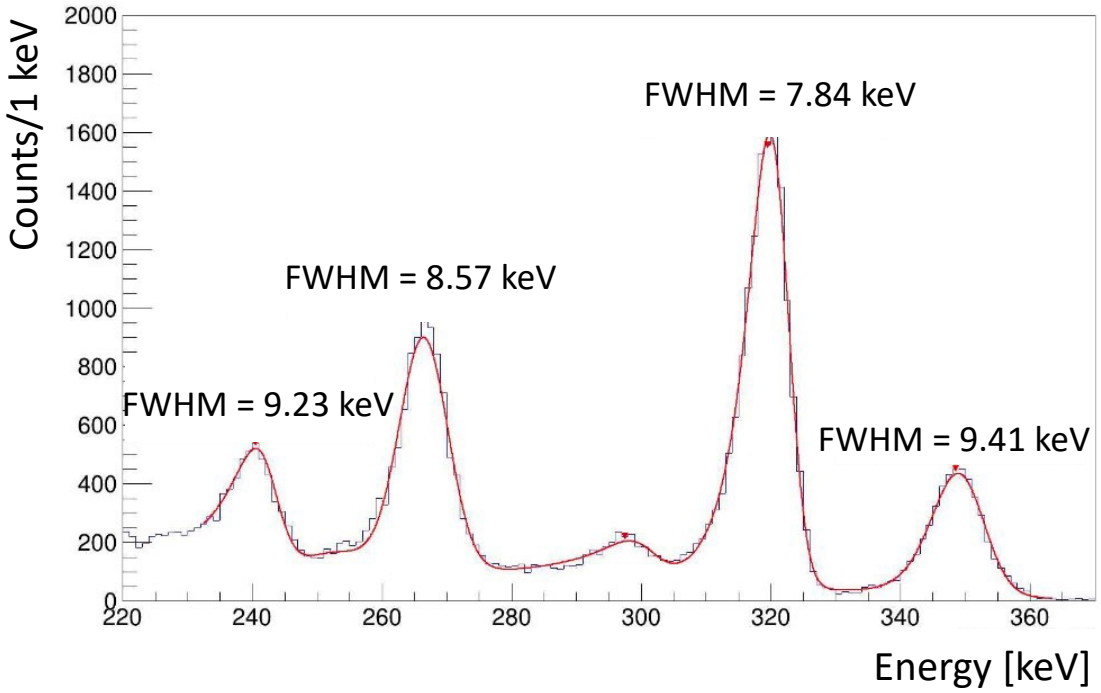
- At S^3-LEB: (SIRIUS) NUMEXO2 to digitize, process and timestamp the signal

SEASON performances

3-α source (^{239}Pu, ^{241}Am, ^{244}Cm)



Electron source (^{133}Ba)



Planning

Starting tomorrow !!

Source commissioning at GANIL

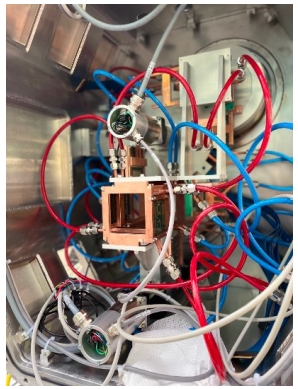
Experimental campaign at Jyväskylä and then to S^3-LEB

2024 | 2025 | 2026

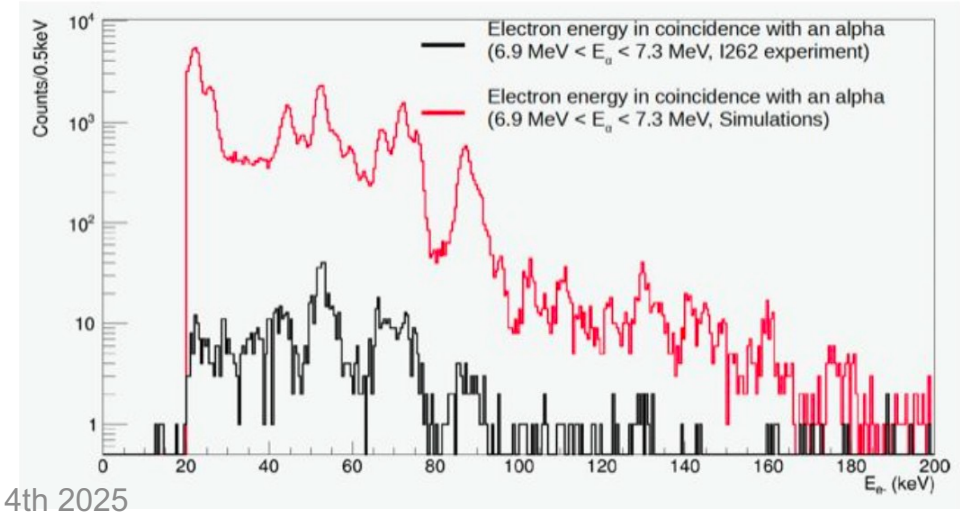
T1 T2 T3 T4 | T1 T2 T3 T4 | T1 T2 T3 T4

Mechanical mounting at CEA Saclay

Online commissioning at Jyväskylä



« Commissioning of the SEASON detector: decay properties of neutron-deficient actinides produced by proton-induced fusion-evaporation on ^{232}Th » (D. Thisse *et al.*) accepted



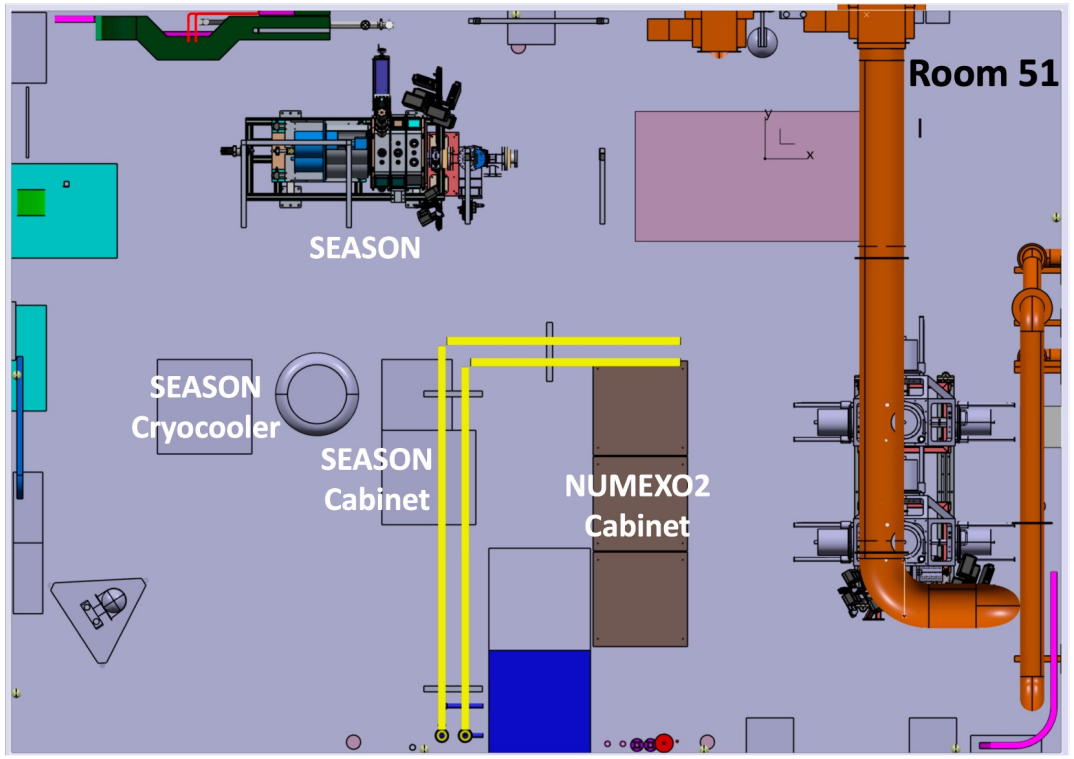
SEASON Collaboration

Thomas Bey, Florent Bouyjou, Sandrine Cazaux, Thomas Chaminade, Olivier Cloué (technical project manager), Olivier Corpace, Philippe Daniel-Thomas, Jules Dartois, Antoine Drouart, Alexis Gaget, Olivier Gevin, Thomas Goigoux (postdoc), Jean-Christophe Guillard, Mariam Kebbiri, Fabien Prunes, Jorge Mendes-Ribeiro, Julien Noury, Mathilde Ragot (PhD student), Yann Reinert, Johan Relland, Emmanuel Rey-Herme (PhD student), Arnaud Roger, Barbara Sulignano, Christophe Theisen†, Damien Thisse, Marine Vandebrouck (scientific project manager)

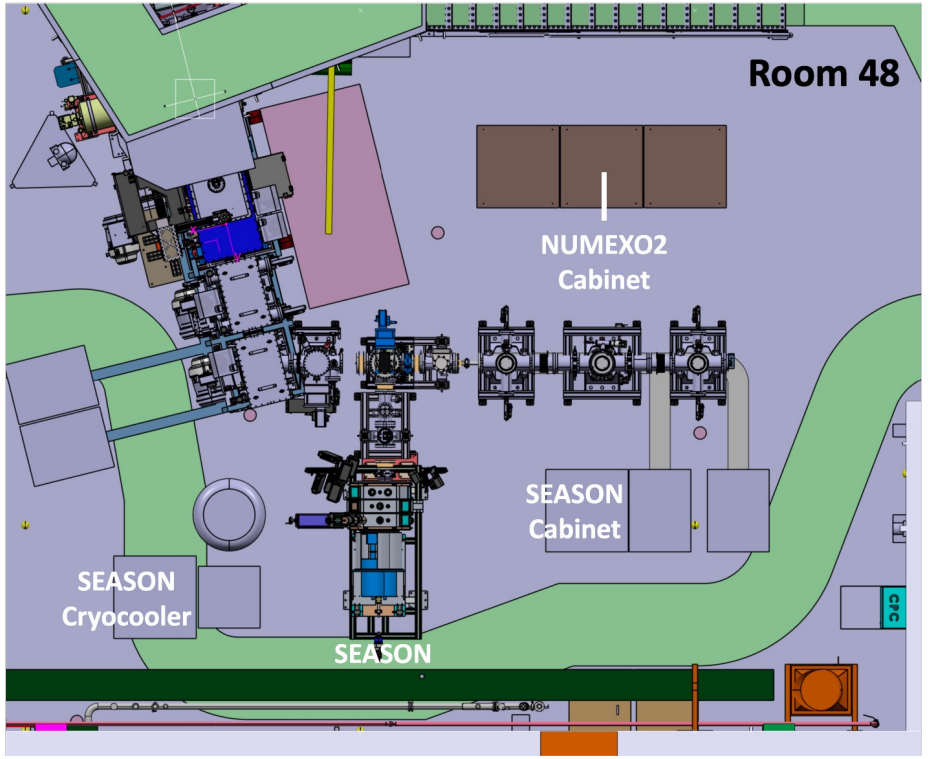
Close collaboration with S^3-LEB Collaboration during all stages of development to best meet the needs at S^3-LEB and with IGISOL team (University of Jyväskylä) for the online commissioning part

SEASON implantation at S³-LEB

1. During in-source commissioning



2. During day-on experiments, before DESIR operation



3. After the starting of DESIR, SEASON will be back to room 51

SEASON operation at S^3-LEB
Focus on human resources from GANIL

➢ Each SEASON mounting
- Carried out by SEASON Collaboration
- Support from GANIL:
  1. help during the installation process,
  2. help in setting up the communication interface between S^3-LEB and SEASON,
  3. help with NUMEXO2 digitizers

➢ In-source commissioning
- Carried out by Irfu/DPhN physicists with support from other members of the SEASON Collaboration
- Support from GANIL: help in using NUMEXO2 digitizers if necessary

➢ Operating SEASON during experiments
⚠ It depends on the number of experiments using SEASON. Assuming 3-4 experiments per year:
- Ensured by the SEASON Collaboration with the help of S^3-LEB experiment participants

➢ Detector maintenance
- Carried out by SEASON Collaboration (Irfu)

⚠ Physicists in charge of SEASON will have to be contacted in advance of the proposal submission ⚠

Conclusion

- Detector conceived and built at CEA Irfu

- Developed to complete the S^3-LEB device for HN/SHN physics cases, acts as:
  - counter for laser spectroscopy
  - high energy-resolution decay station

- Mechanical assembly is finished, in-source commissioning starts tomorrow

- Traveling detector, can be used in other facilities when not needed at S^3-LEB

- Operation at S^3-LEB like other traveling detectors operated at GANIL

Thank you for your attention