DE LA RECHERCHE À L'INDUSTRIE

S3-LEB@SPIRAL2 physics and status

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IJCLab (Orsay)
GANIL (Caen)

SEASON@S^3-LEB

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

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CEA IRFU (Saclay)

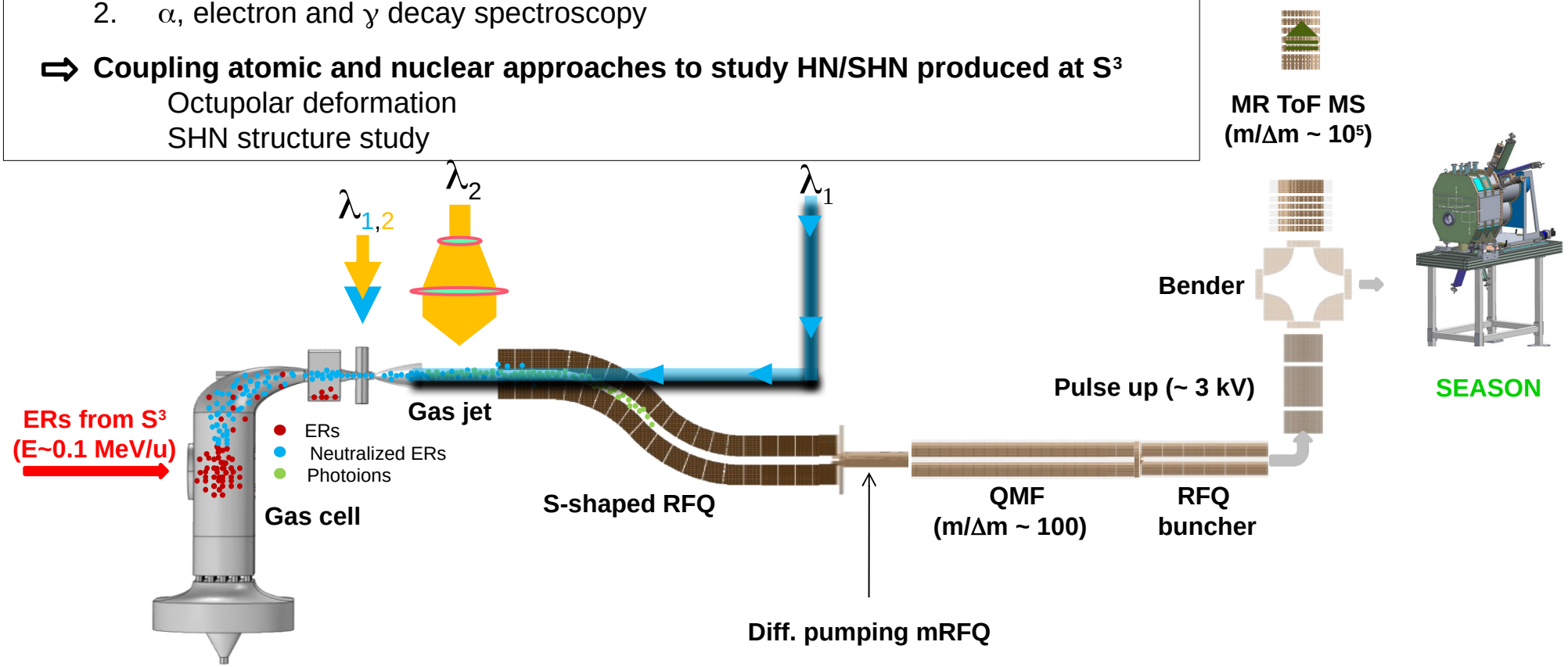
Journées du LabEx P2IO
01-12-2022

SEASON at S³-LEB

- **SEASON** will be mounted at the end of the S³-LEB for the study of HN/SHN

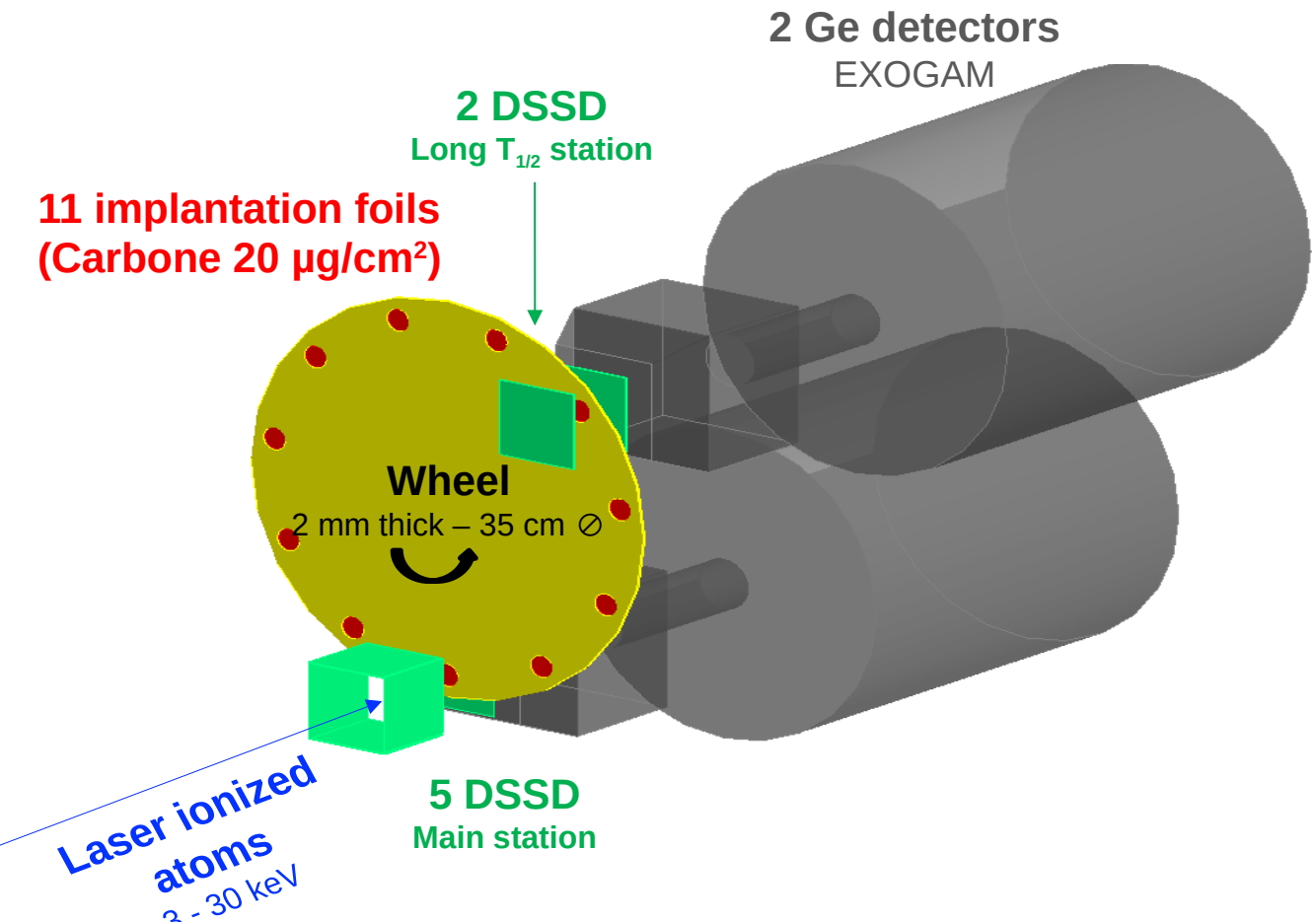
- It will be dedicated to :
  1. Counting laser ionized atoms (laser ionization spectroscopy)
  2. α, electron and γ decay spectroscopy

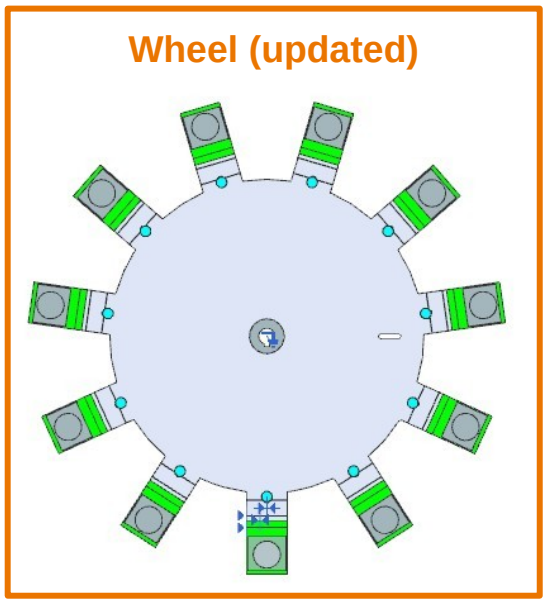
⇨ **Coupling atomic and nuclear approaches to study HN/SHN produced at S³**
Octupolar deformation
SHN structure study

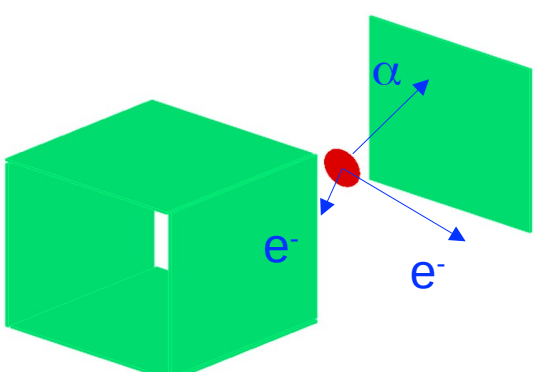


What is SEASON?

View of SEASON in GEANT4







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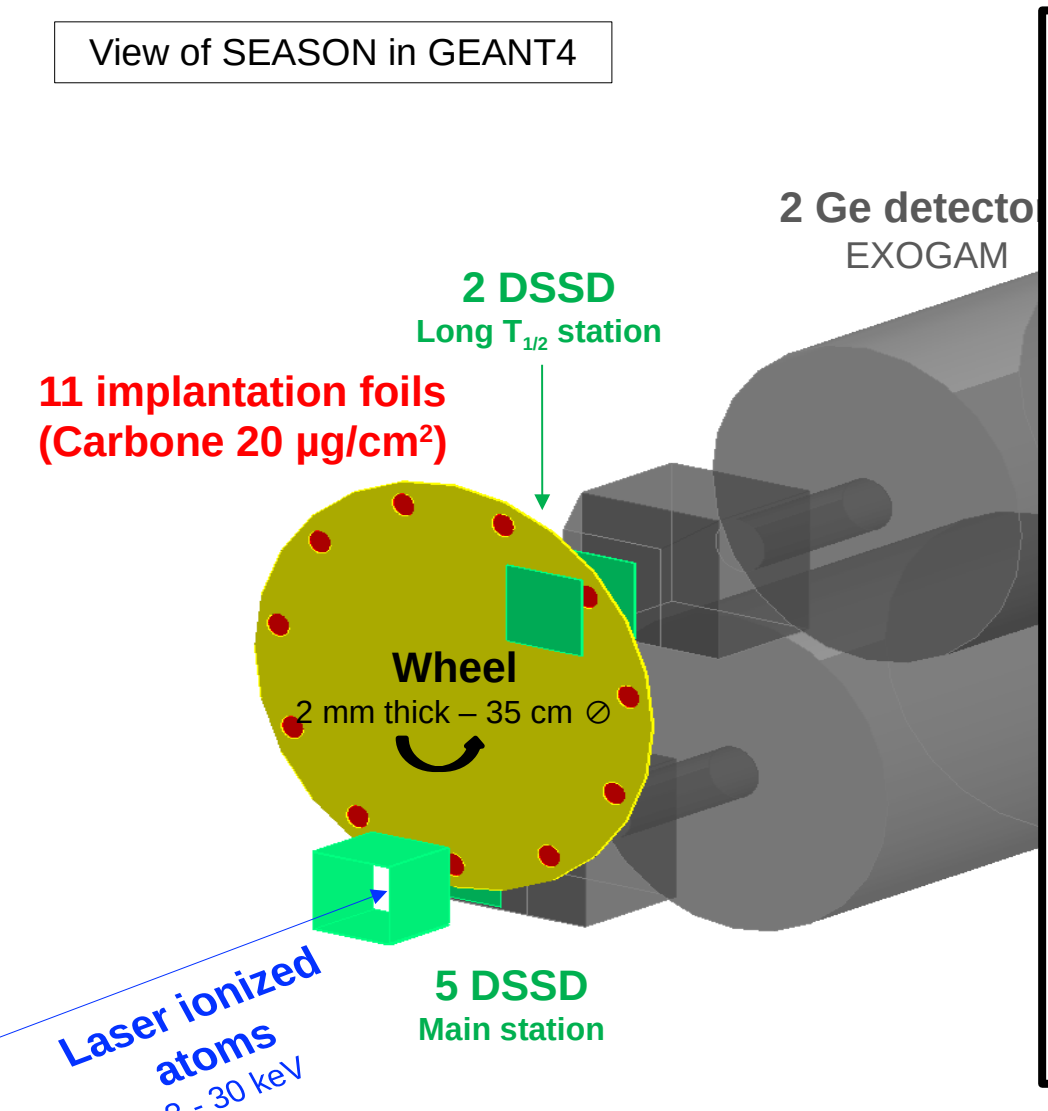
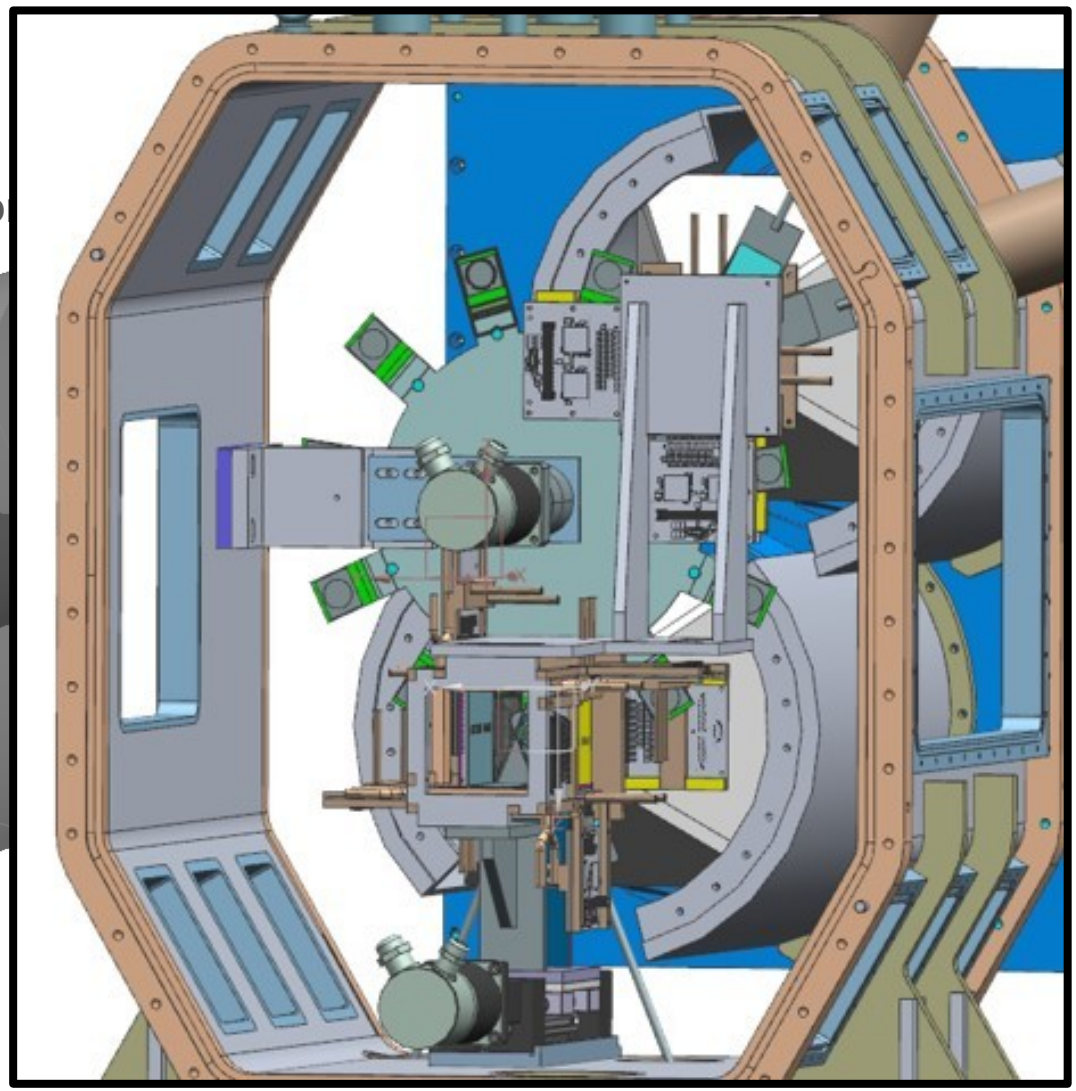
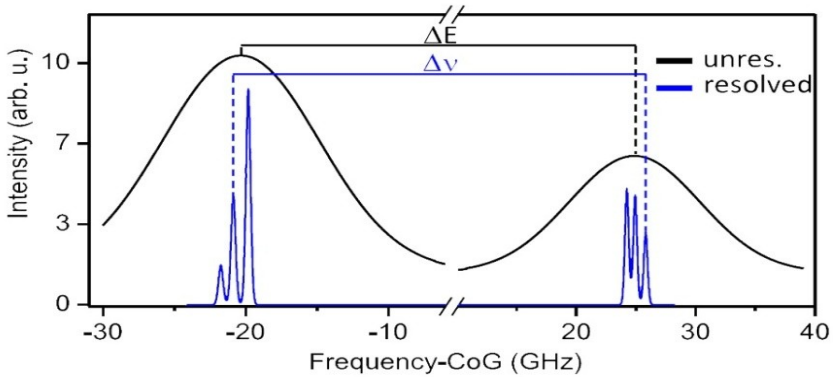




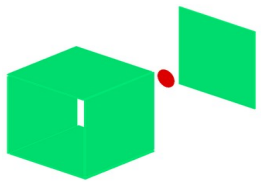
SEASON objectives

Goal 1: counting the laser ionized atoms to perform laser ionization spectroscopy



R. Ferrer *et al.*, PLB 728(2014)

- Need good detection efficiency for α (5 – 12 MeV) and electrons (20 – 600 keV)



Tunnel configuration
Si detectors (BB7 from Micron)
- ✓ Thickness 1 mm
- ✓ Active area 64 x 64 mm²

α detection efficiency **81%**
electron detection efficiency **51%**

} From Geant4 simulation

Goal 2: perform α, electron, γ decay spectroscopy

- Need good energy resolution and avoid summing effects

Energy resolution (FWHM)	15 keV (α from 5 MeV to 12 MeV) 7 keV (electron from 20 keV to 600 keV)
Energy threshold	20 keV
Time resolution (FWHM)	20 ns

Si detectors (BB7 from Micron)
- ✓ Thickness: 1 mm
- ✓ Active area: 64 x 64 mm²
- ✓ Number of strips: 32 x 32
- ✓ Strip pitch: 2 mm
- ✓ Dead layer: 50 nm

Development of a front-end electronics

In order to measure both alpha and electrons with the best energy resolution

Si detector
(BB7 from Micron)

FRONT-END

FEANICS

Front-End Adaptive gaiN Integrated CircuitS
is a novel multi-channel ASIC in development at CEA/IRFU

Key feature:
Automatic **gain switch** depending of the signal amplitude

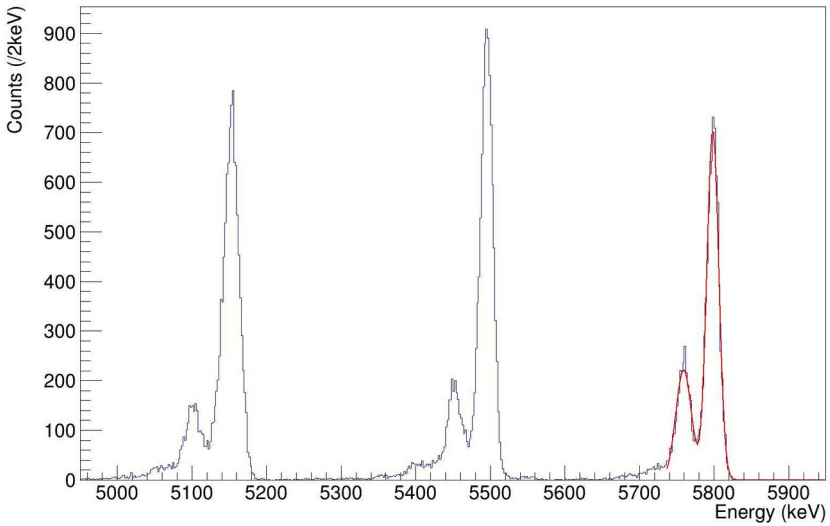
High gain (~50 fF)	⟷	electron
Low gain (~550 fF)	⟷	alpha

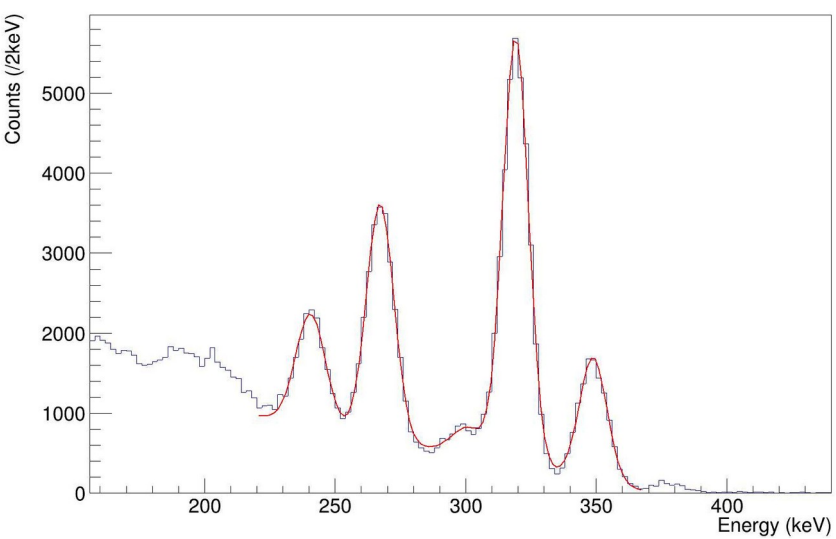
BACK-END

NUMEXO2

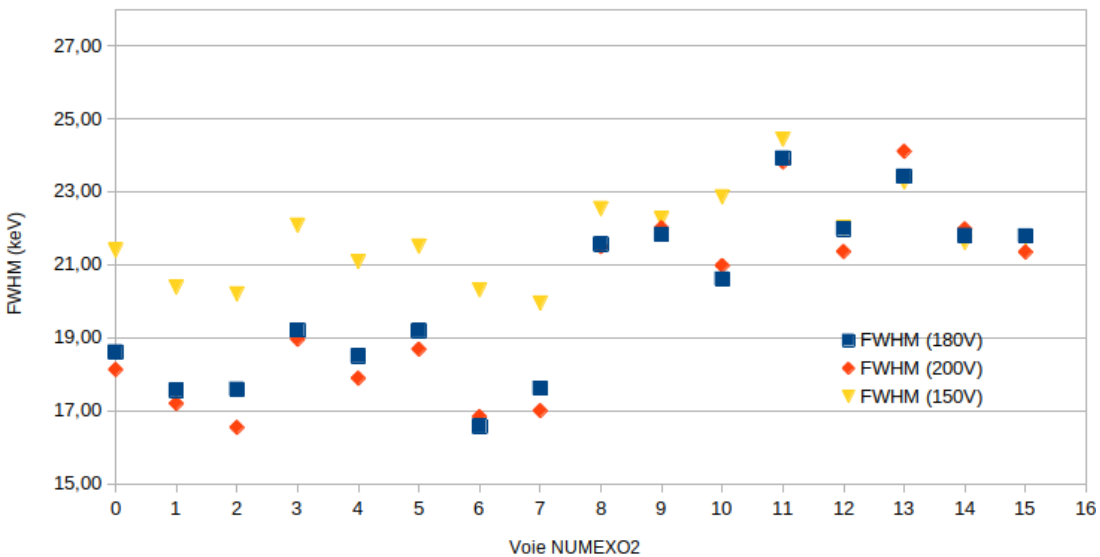
Tracks recording for offline processing

First tests at CEA of the full coupling





3-α calibration source (^{239}Pu, ^{241}Am, ^{244}Cm)
FWHM @ 5804.77keV : **18.7 keV**



Electron source (^{133}Ba)
FWHM @ 320.3 keV : **11.6 keV**

Obtained with a test detector (slightly different from the final ones)

Conclusion and planning

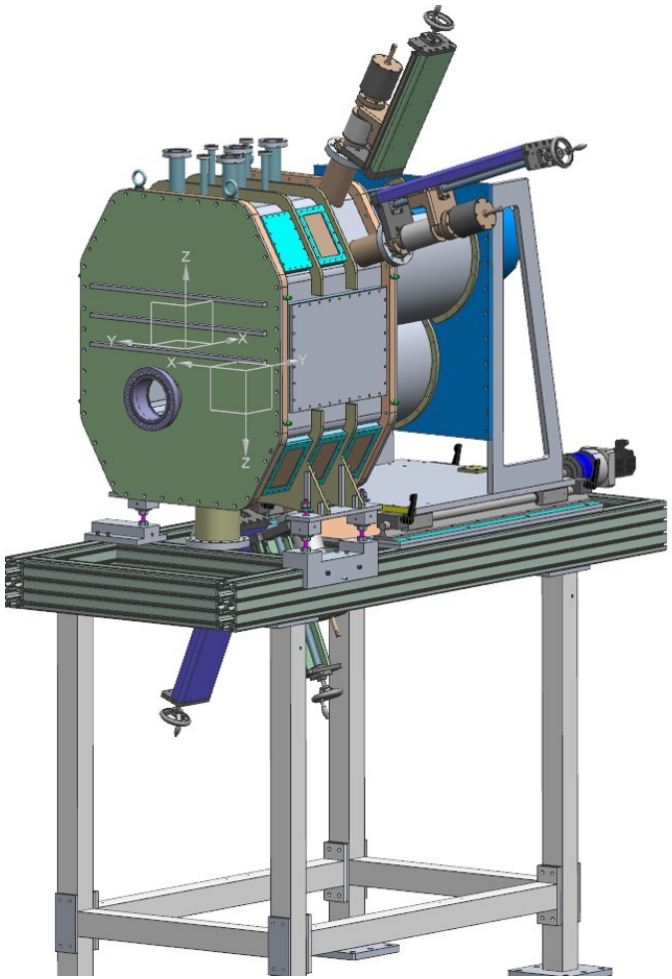
Design of SEASON is validated and the manufacturing is in progress

Electronics has been validated and the first SEASON's DSSD will arrive soon to be tested

An offline commissioning is scheduled for the summer 2023 at CEA-Saclay

An online commissioning is scheduled end of 2023 – beginning of 2024 at Jyväskylä

Then it will be set at GANIL on S3-LEB



DE LA RECHERCHE À L'INDUSTRIE

cea

P2IO

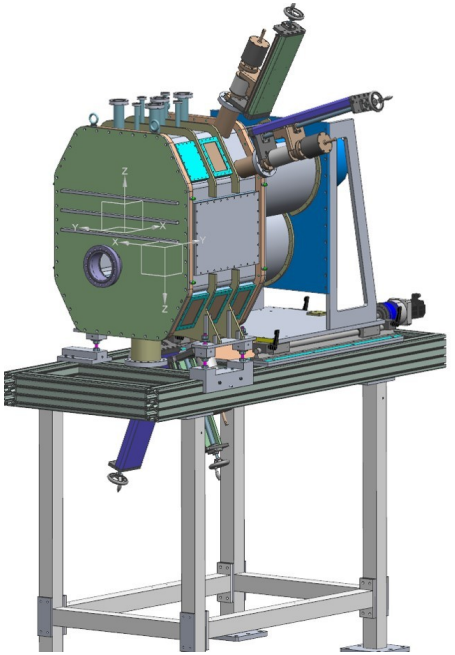
Physique des 2 Infinis et des Origines

ANR AGENCE NATIONALE DE LA RECHERCHE

Irfu

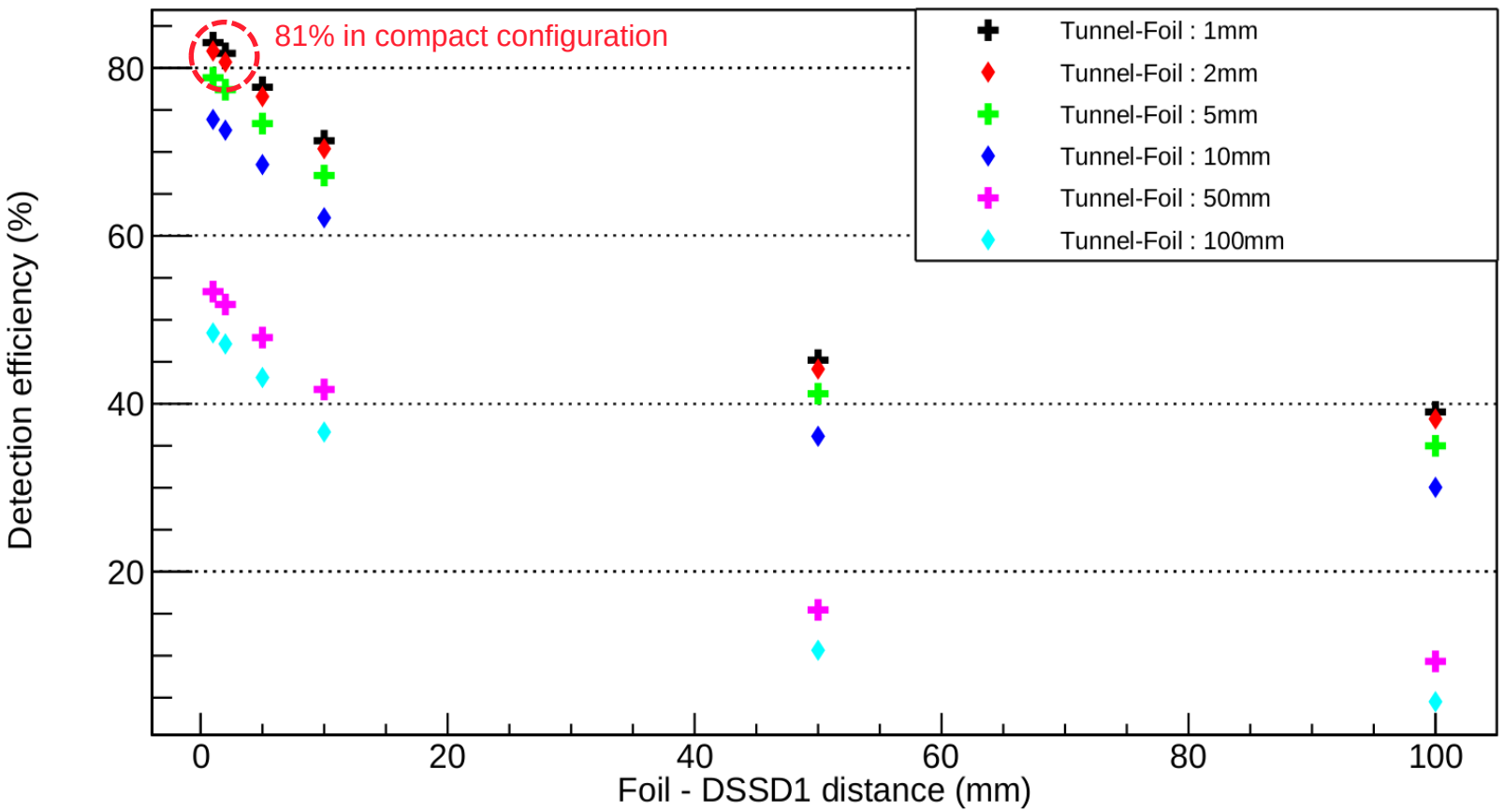
Thank you for your attention

Florent Bouyjou, Sandrine Cazaux, Thomas Chaminade, Olivier Cloué, Philippe Daniel-Thomas, Antoine Drouart, Alexis Gaget, Olivier Gevin, Thomas Goigoux, Jean-Christophe Guillard, Hervé Le Provost, Jorge Mendes-Ribeiro, Gilles Minier, Julien Noury, Yann Reinert, Johan Relland, Emmanuel Rey-Herme, Arnaud Roger, Barbara Sulignano, Christophe Theisen, Damien Thisse, Marine Vandebrouck



Efficiency as a function of the distance

Work of **T. Goigoux**
+ E. Rey-herme



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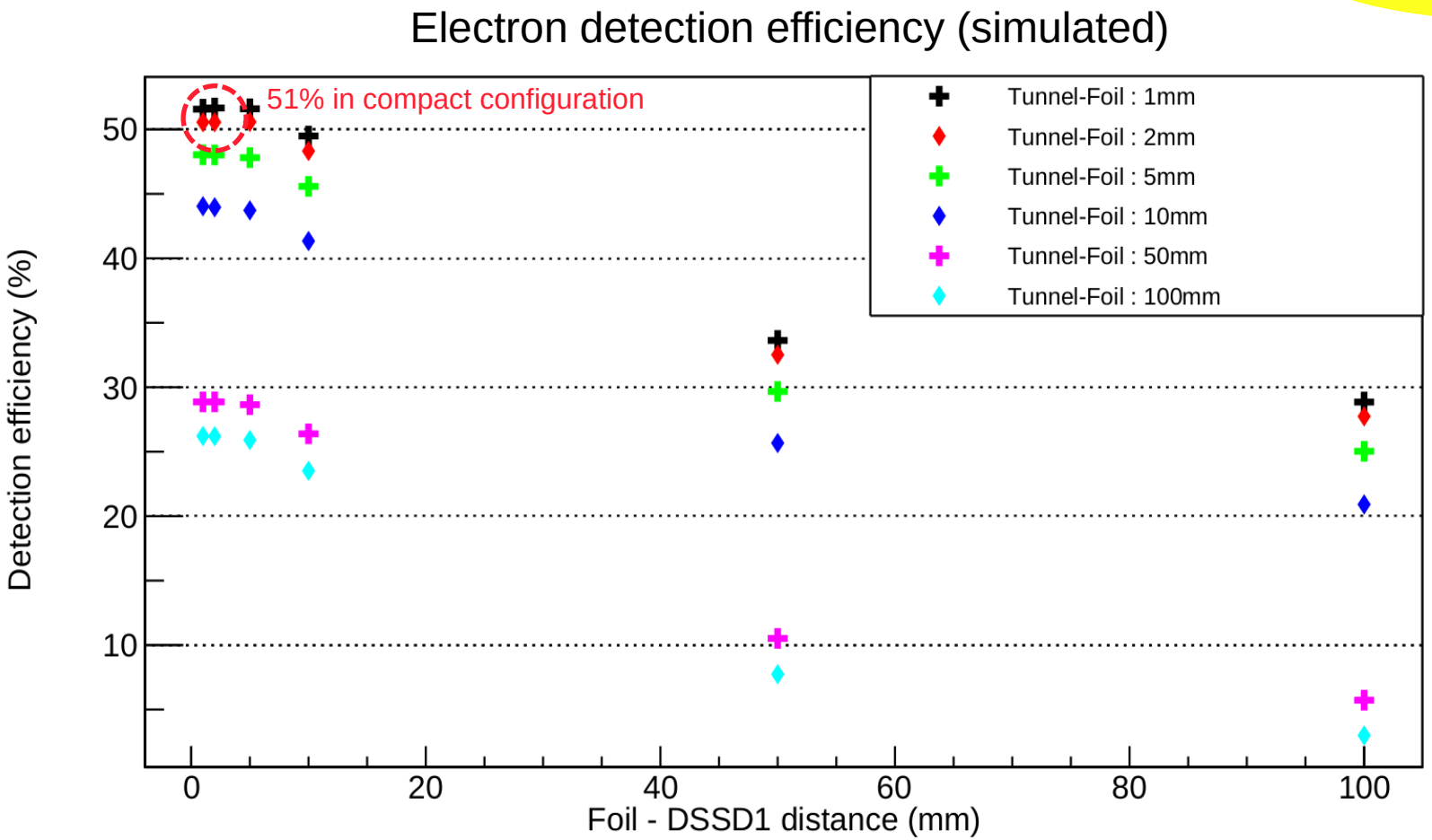
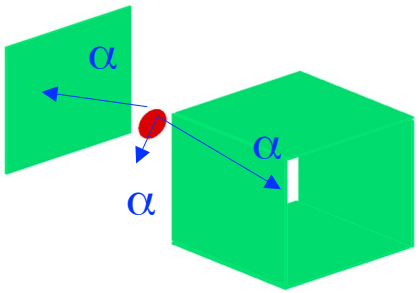


Hit pattern of tunnel and front detectors



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