DE LA RECHERCHE À L'INDUSTRIE

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SPALAX-New Generation: Deployment, Operation and Performances

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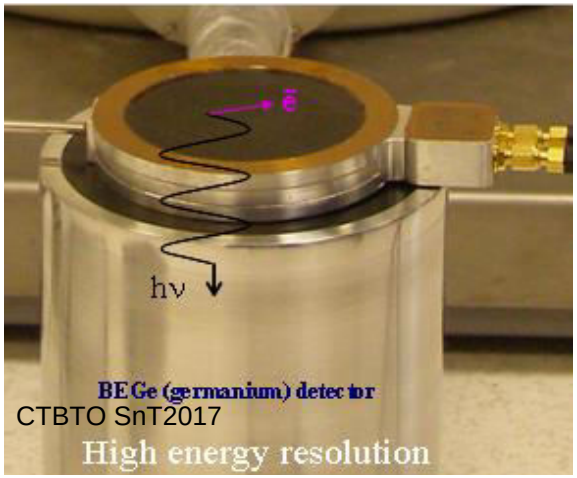


Summary

Context & Challenges

2012 – 2017: From the SPALAX to the SPALAX-New Generation

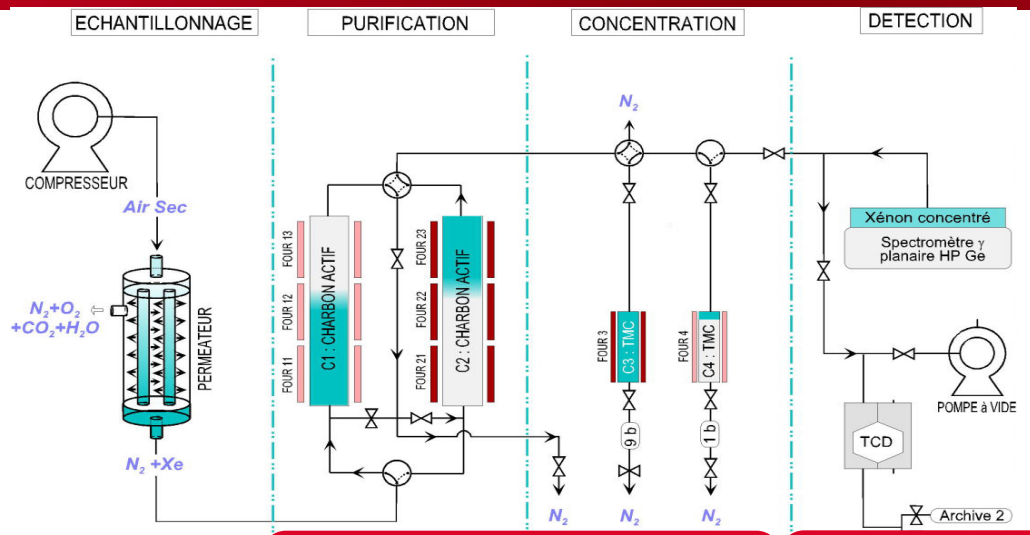
Deployment & Operation

Sequence of operations & Performances

Roadmap

Context

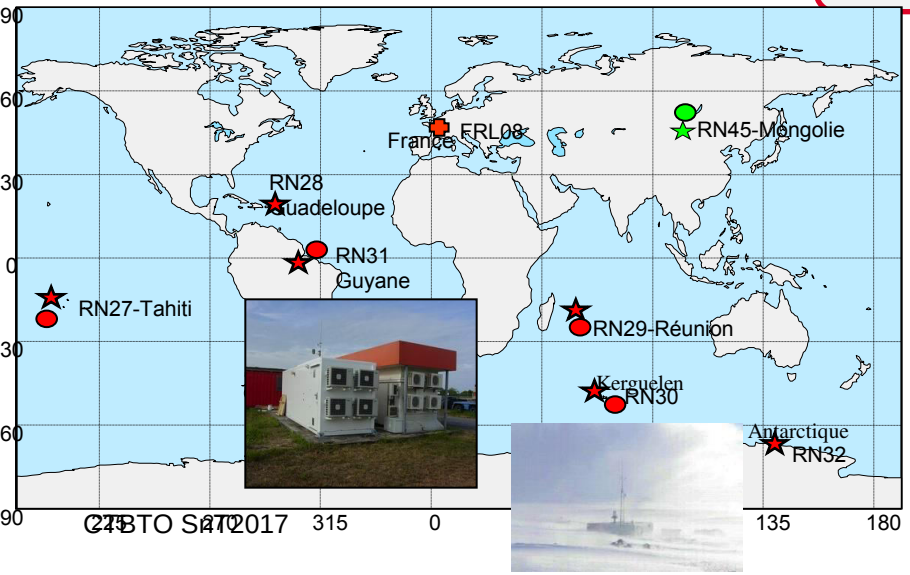
*SPALAX, Système de Prélèvement en Ligne avec Analyse du Xénon (**CEA/DAM/DIF/DASE, 2004**)*



Air sampling and purification across membranes

Xe separation and concentration across adsorbant materials

Détection ^{131m}Xe, ^{133m}Xe, ^{133}Xe, ^{135}Xe



- **SPALAX key dates:**

CEA/DASE patent: 1999

First industrial version: 2001-2002

SPALAX-DR (Rapid Deployment): 2009

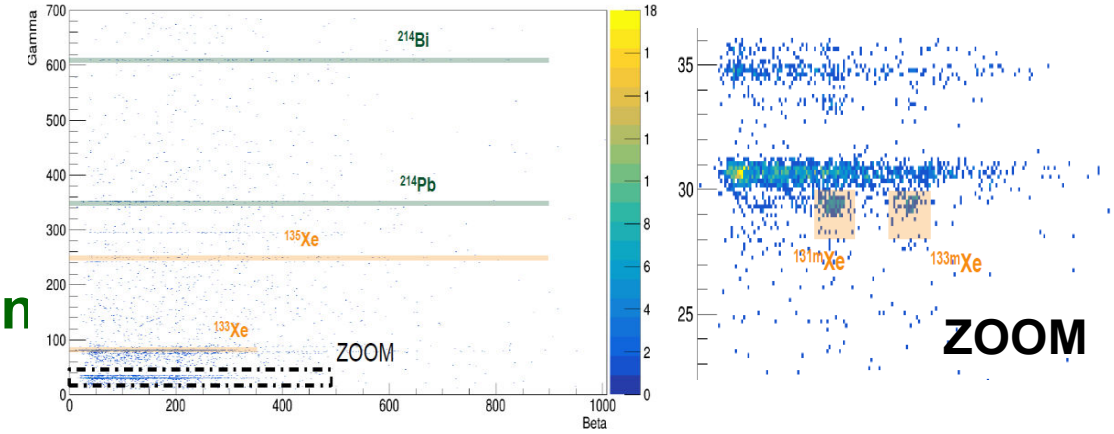
- **SPALAX inside the IMS:**

40 noble gas stations to be installed on the IMS

13 SPALAX already installed or to be installed soon (including 10 certified station) + non-IMS systems (Canada, France, CTBTO…)

Challenges for a new system

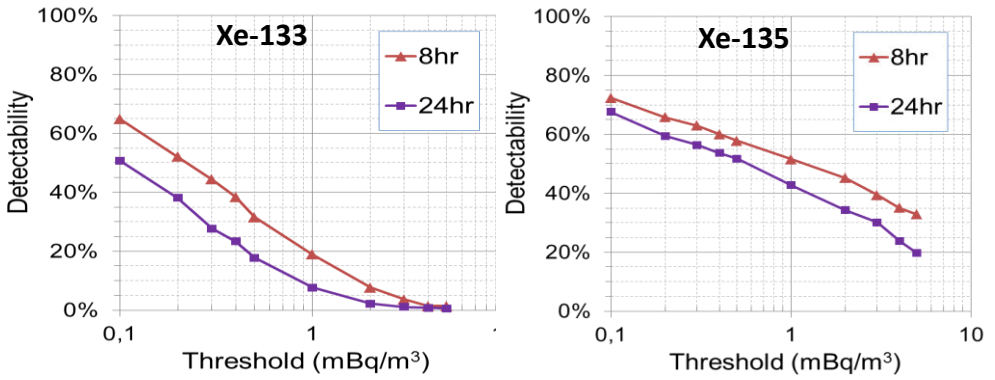
- ✓ High sensitivity for ^{133m}Xe and ^{131m}Xe detection (**key role in event discrimination)**



- ✓ High resolution spectra: **simple analysis, low interference, low correction**

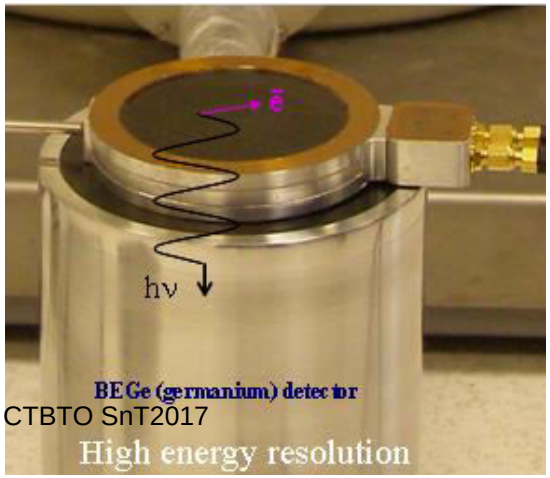
- ✓ Good source localisation and high detectability: **high sampling frequency**

*P. Achim, G. Le Petit, S. Generoso, M. Morin, P. Gross (**2015**). Sample integration time influence on the detection of a ^{133}Xe and ^{135}Xe prompt release. International Noble Gas Experiment Workshop, Austin, USA*



- ✓ High reliability / Easy Operation & Maintenance: **harsh environmental conditions taken into account (feedback from 15 years experience)**

SPALAX-DR during operation in Kuweit



2012 – 2017: From the SPALAX to the SPALAX-NG

Sampling stage

Purification & Concentration stage

Detection stage

Sampling stage development

Sampling flow rate X2

Old sampling design

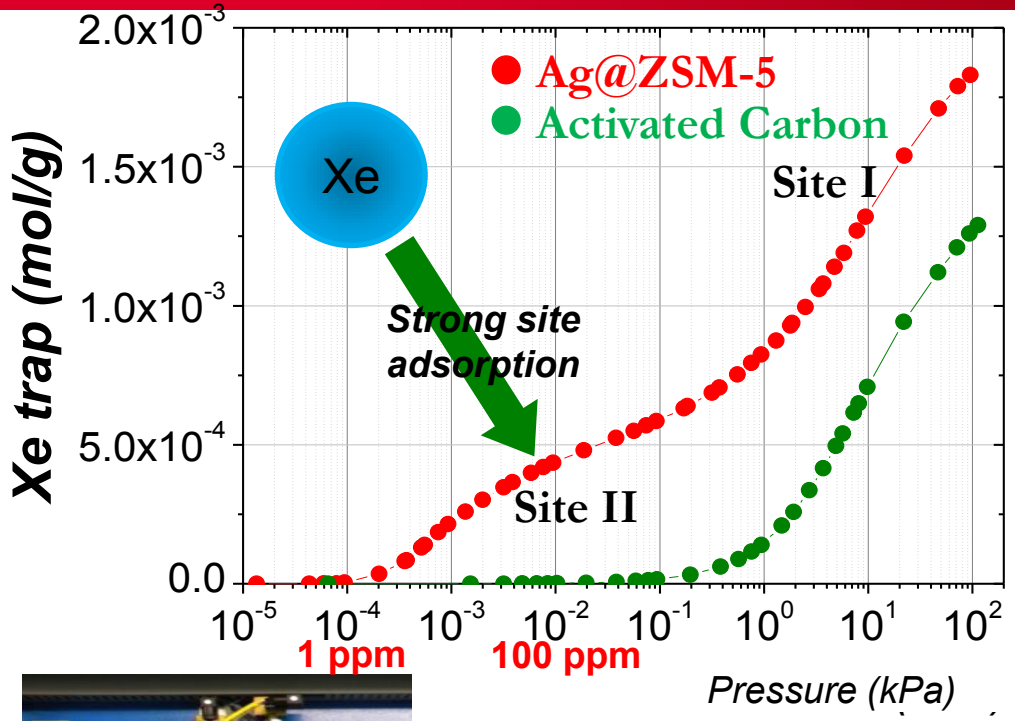
New sampling design

Xe enrichment X2

- Larger Xe volume sampled: 0.2 cm^3/h → 0.8 cm^3/h
- Improved MTBF : > + 30 %
- Redundancy : 2 compressors operating in parallel

Topin, S., et al, 2015. SPALAX new generation. J. Env. Rad. 149, 43-50.

Purification & Concentration development

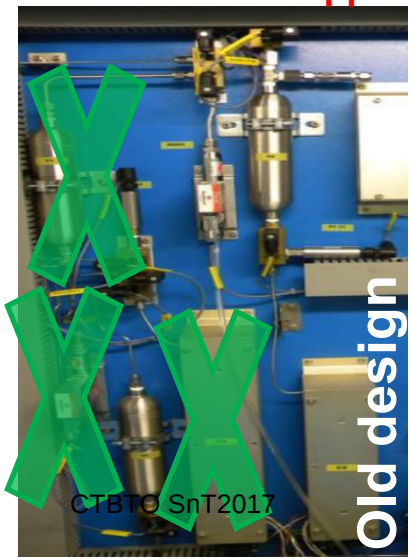


Activated Carbon

New adsorbant: Ag@Zeolite

Zeolite

In collaboration with IRCE-Lyon



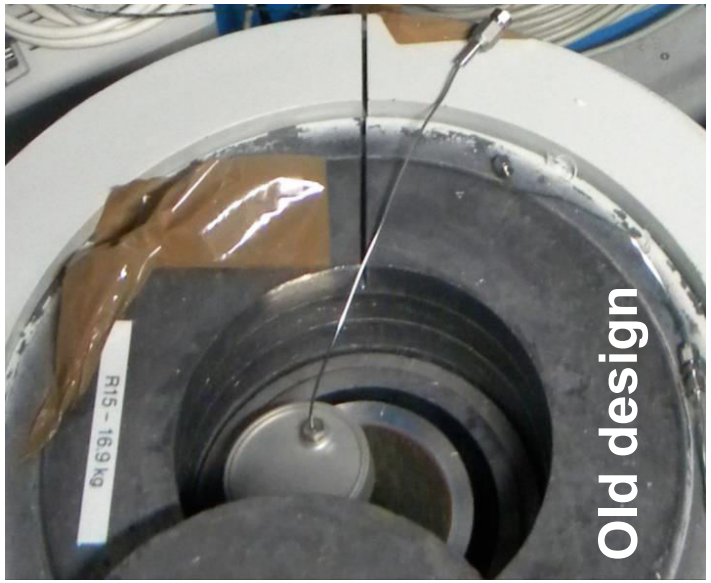
- 15 x larger retention capacity
- Size and Cost reduction

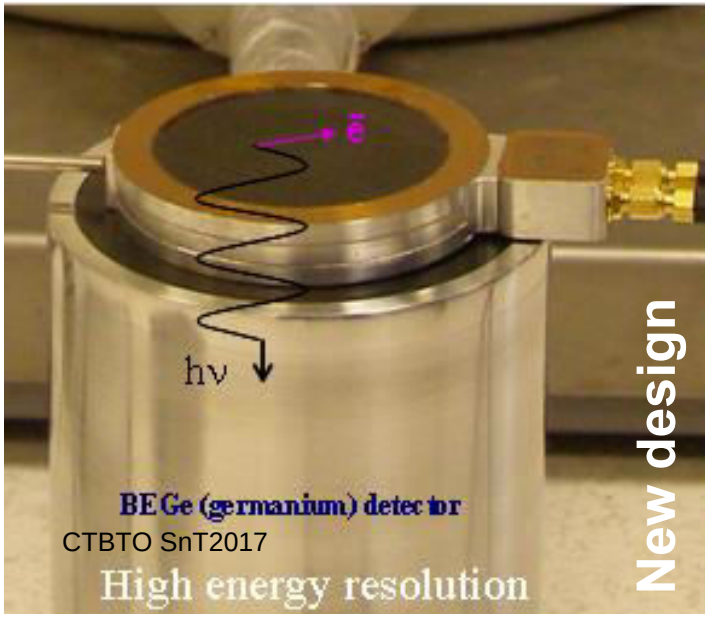
Deliere, L., et al, 2014. Role of silver nanoparticles in enhanced xenon adsorption using silver exchanged zeolites. J. Phys. Chem. C 118, 25032-25040

Deliere, L., et al, 2016. Adsorption in heterogeneous porous media: Hierarchical and composite solids. Microp. Mesop. Mat. 229, 145 – 154

Deliere, L., et al, 2016. Breakthrough in Xenon Capture and Purification Using Adsorbent-Supported Silver Nanoparticles. Chem. Eur. J. 22, 1-8

Detection development



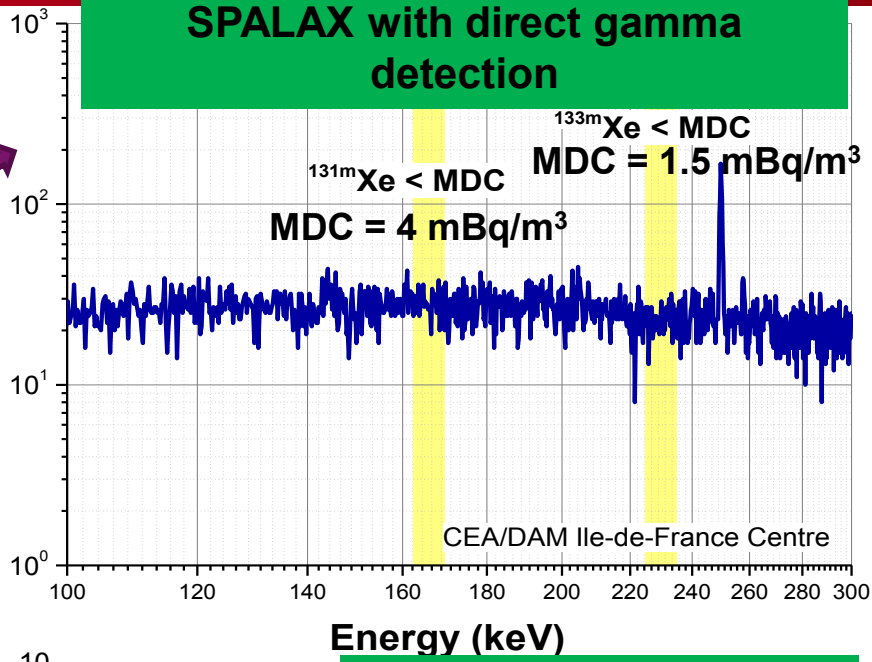


CTBTO SnT2017

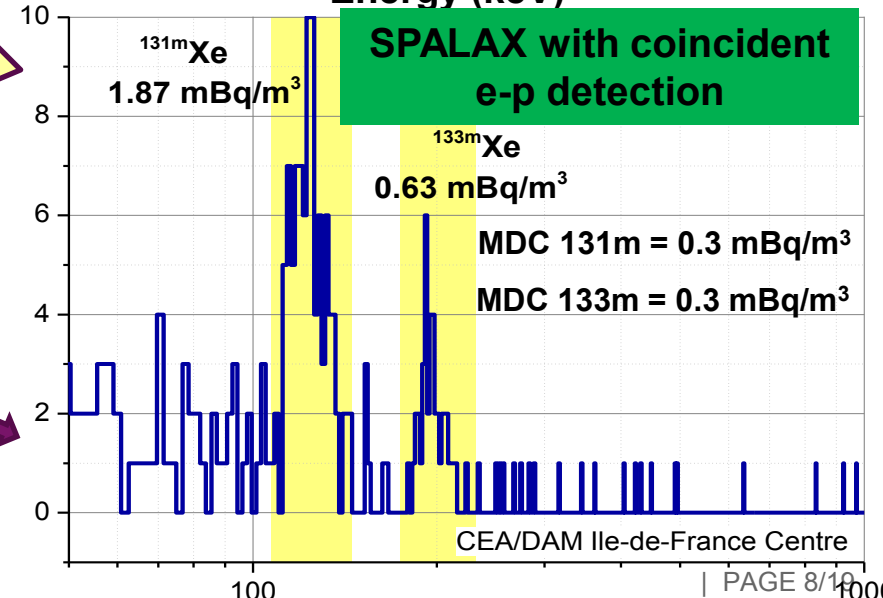
High energy resolution

HR electron/photon spectrometer

SPALAX with direct gamma detection



SPALAX with coincident e-p detection



SPALAX-NG deployment & operation

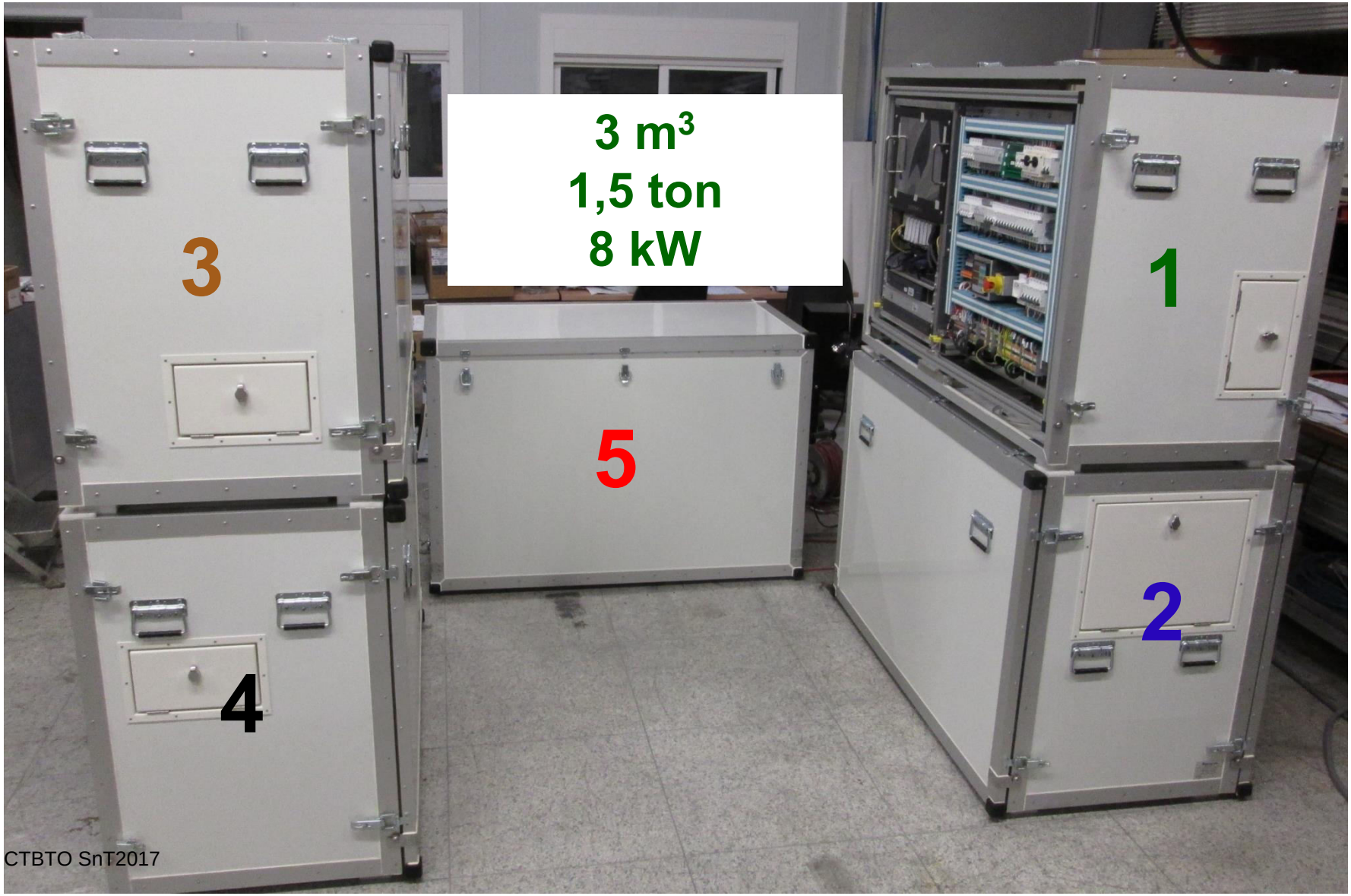
Designed with our industrial partner

Cegelec Défense

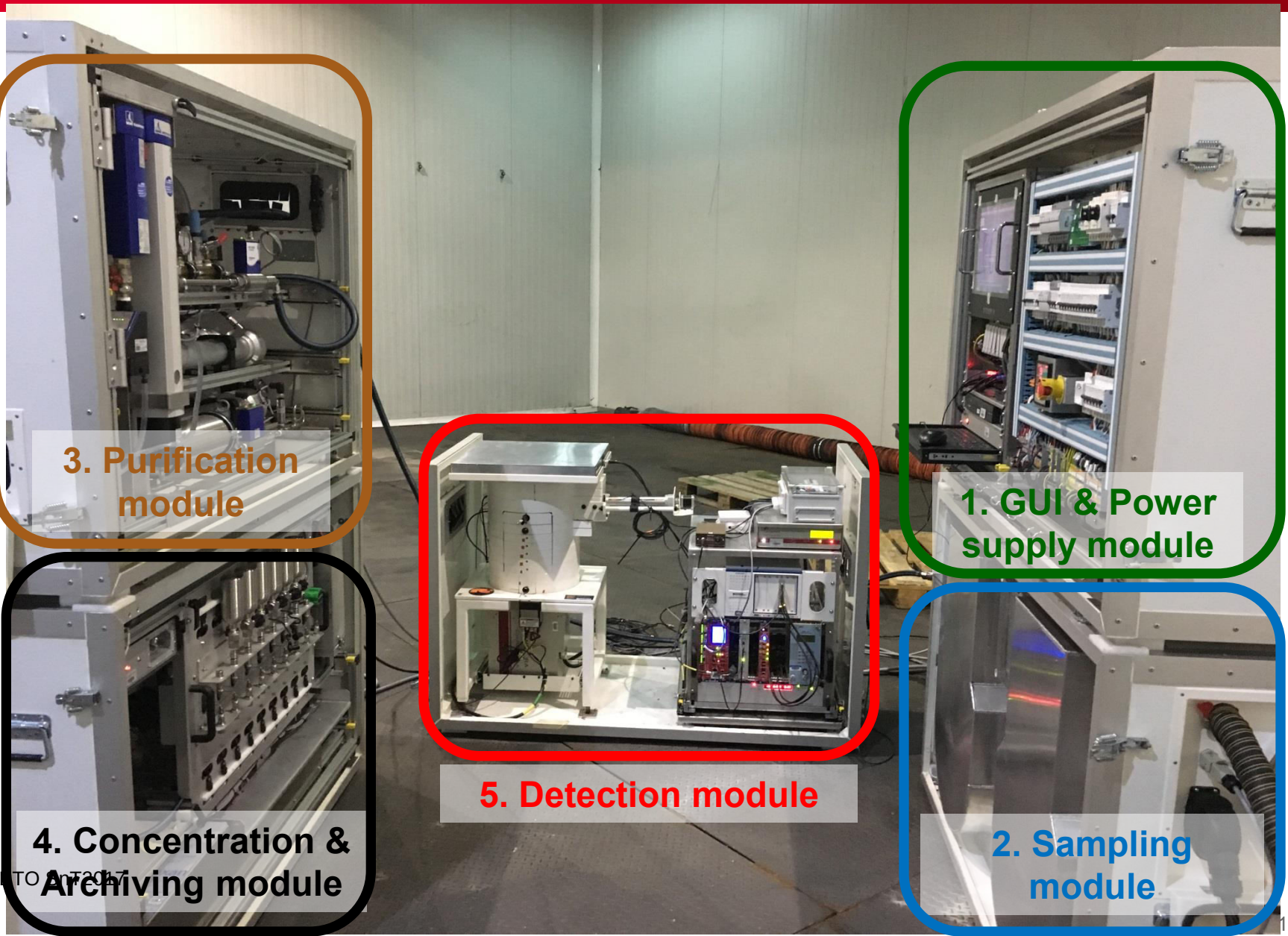
Installation

Operation & Maintenance

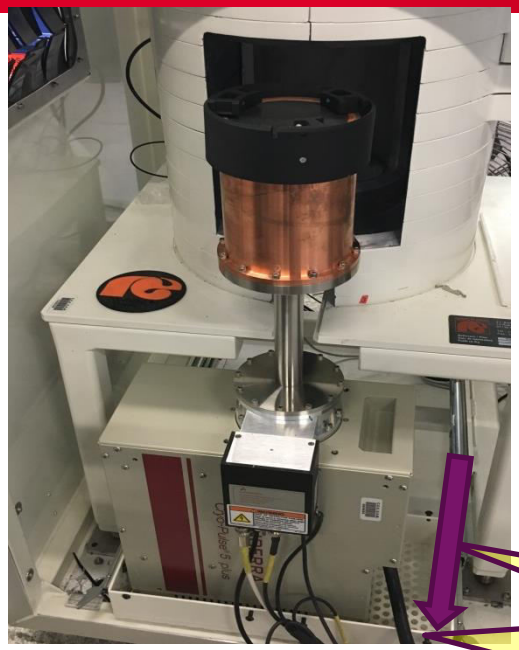
SPALAX-NG Deployment

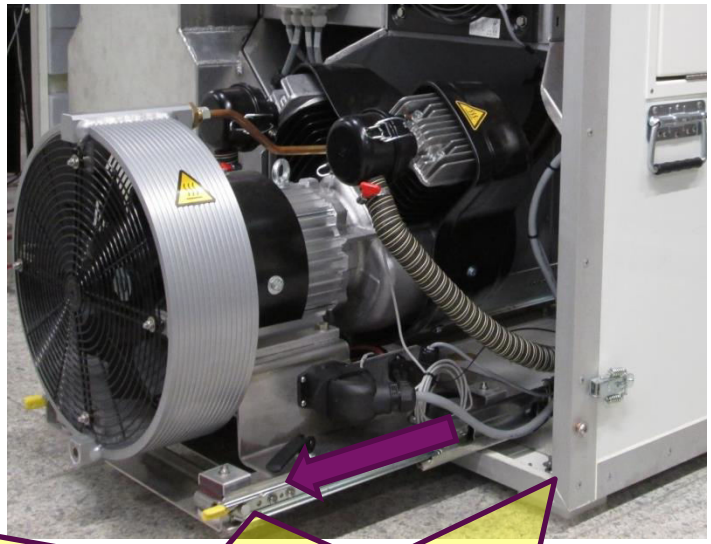


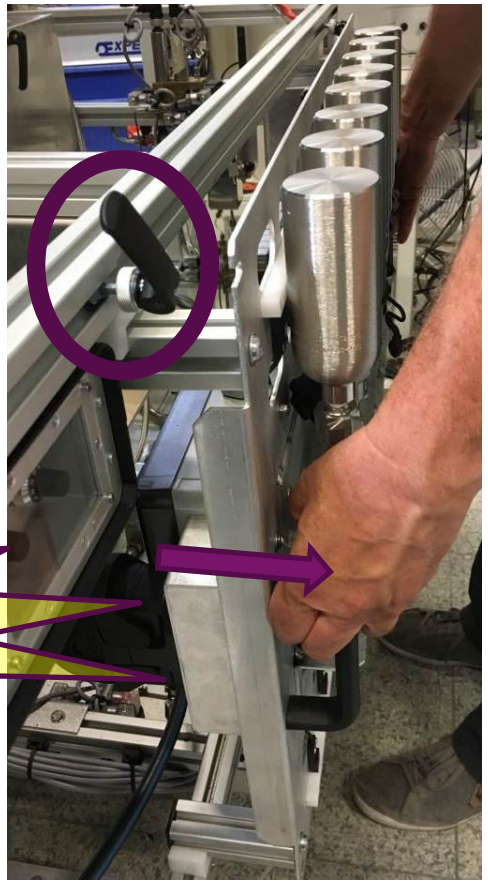
SPALAX-NG Deployment



SPALAX-NG Operation







Removable sub-units on rail

Few “quick” gas and electric connections

Easy installation – modular / plug&play: no heavy material required
Fast installation → < 2 hours

SPALAX-NG Operation - GUI

Spectro App access

Local or remote control

Operator or expert level

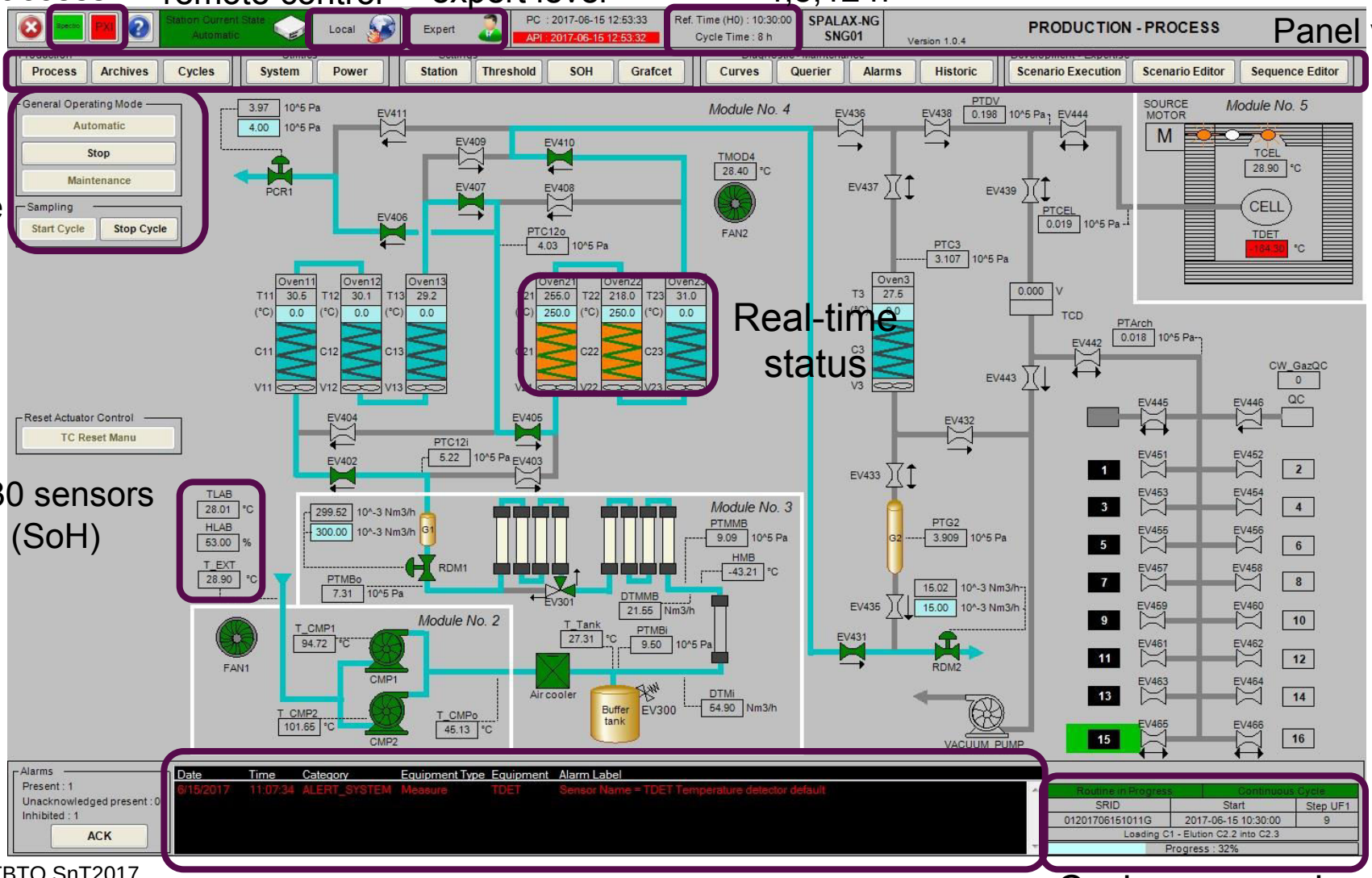
Cycle duration 4,8,12 h

Panel views

Gen. op. Mode

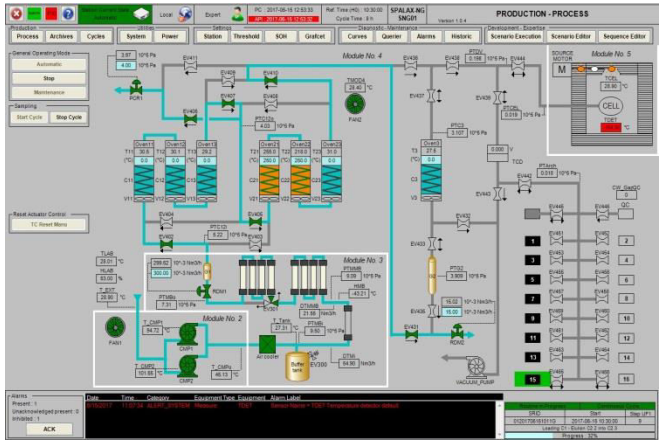
> 30 sensors (SoH)

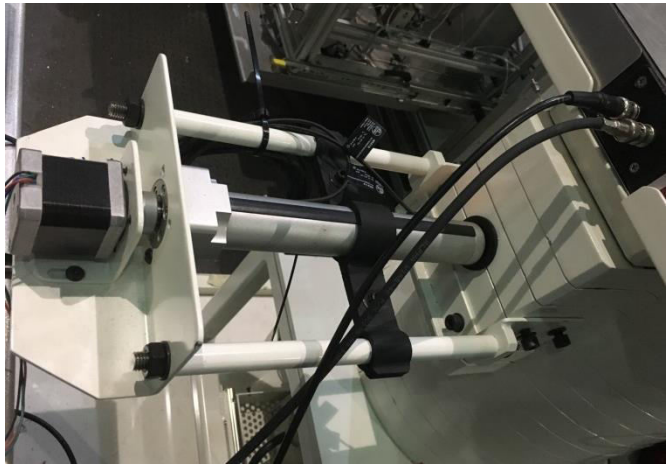
Real-time status

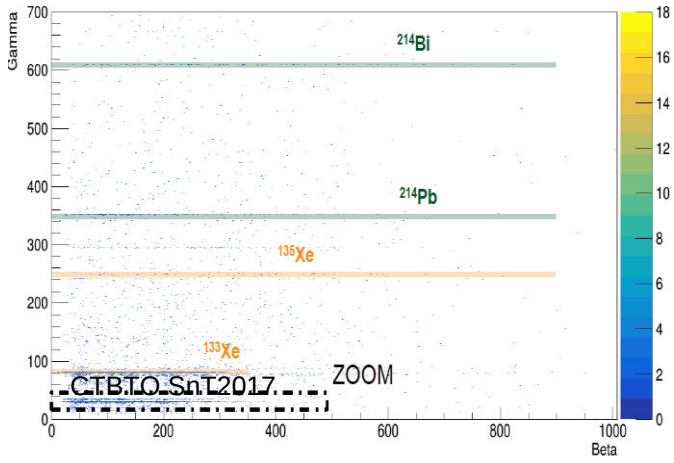


Alarm display

Cycle progression





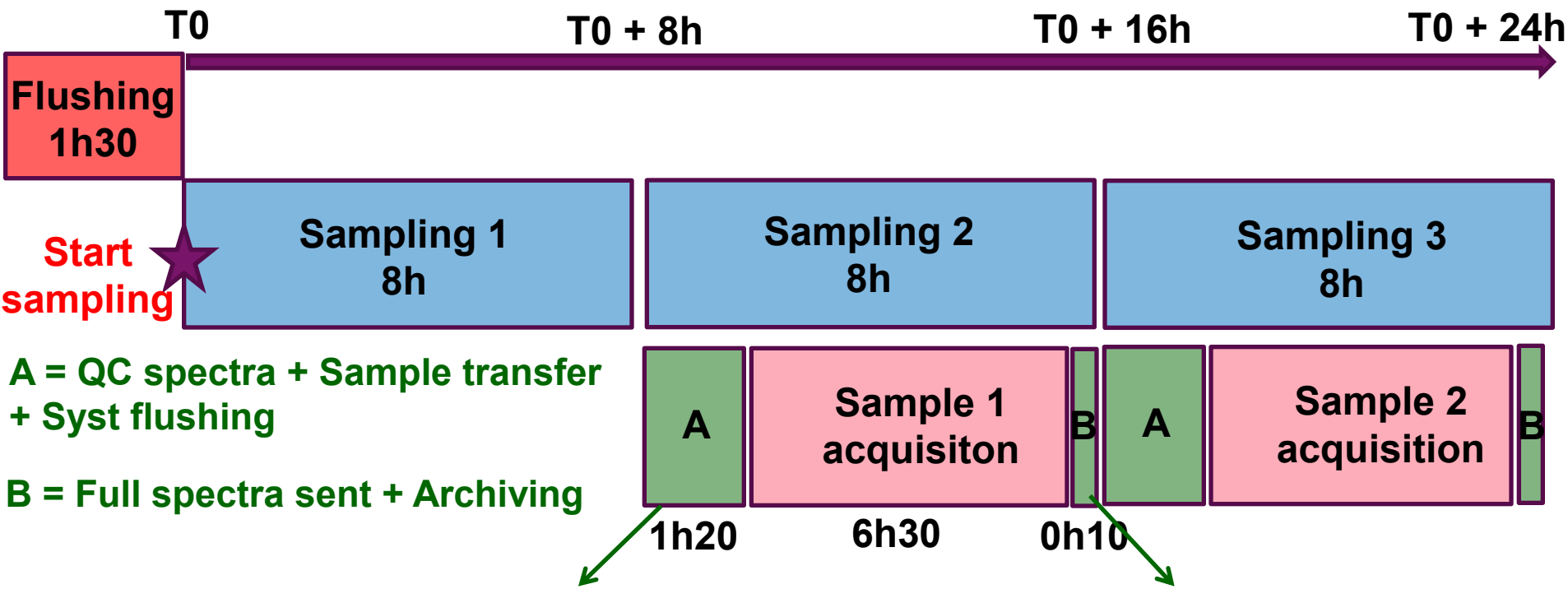


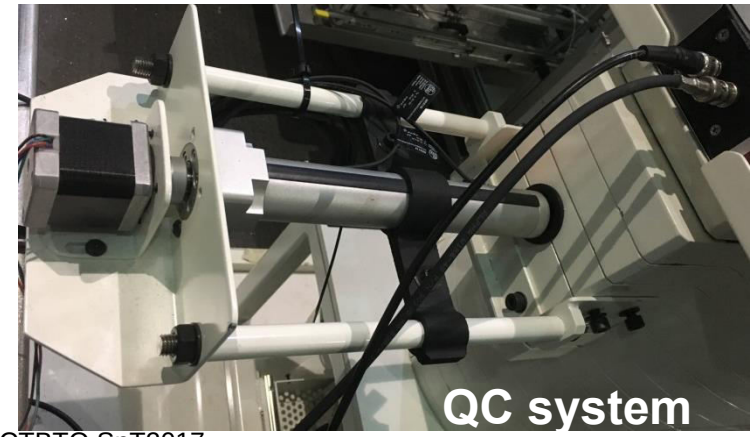
SPALAX-NG chronogram & performances

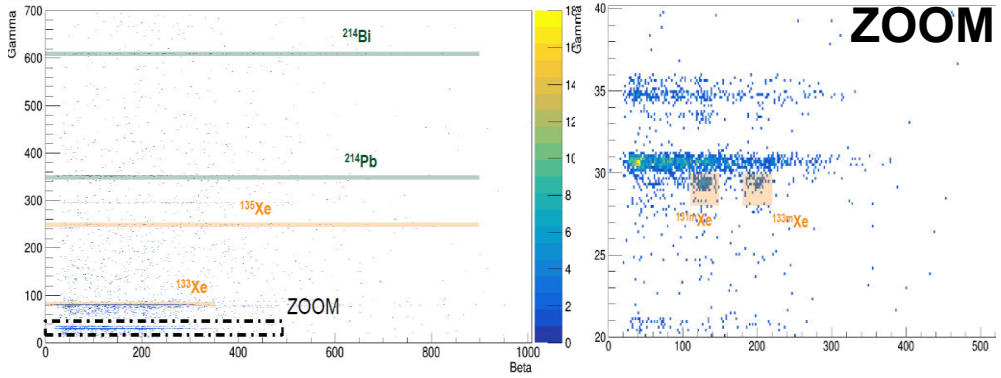
Sequence of operations

Performances

Sequence of operation





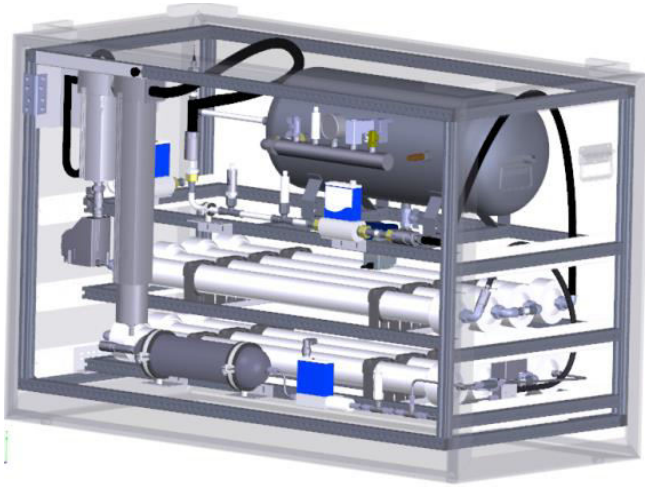


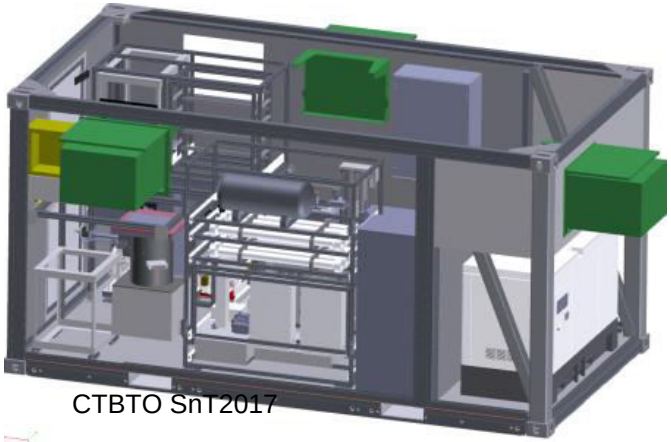
Performances






		SPALAX	SPALAX-NG
Power		6 kW	8 kW
Sampling Frequency		24 h	8 h
Xe volume		3.5 cm^3	5 cm^3
Spectrometer		High Res. γ/X	HR e-γ coincidences
MDC ($mBq\ m^{-3}$)	^{133}Xe	~0.3	~0.3
	^{131m}Xe	~4.0	~0.3
	^{133m}Xe	~1.5	~0.3
	^{135}Xe	~0.3	~0.3





Roadmap

Roadmap of SPALAX NG

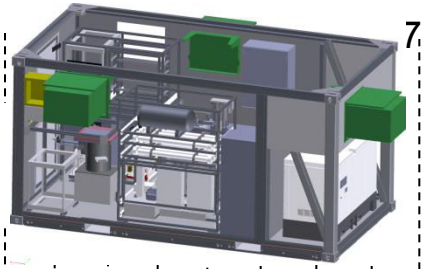
2016 2017 2018 2019 7 28

R&D at CEA/DAM since 2012

Start of SPALAX-NG design and construction

Integration and test of the shelter version

SPALAX-NG Shelter release



Design & Construction of the indus. Proto.

Delivery at CEA

Start of commercialization Cegelec Defense

Test at CEA

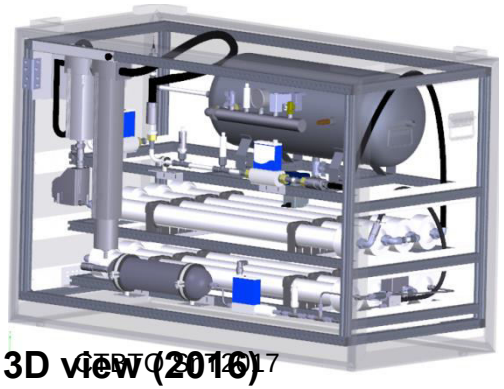
On-site Test

Available for Implementation on IMS network

Start to send data to PTS

Validation after 1 y DA (> 95%)

2015 2016 2017 2018 2019 20 21 22 23 24 25 26 27 28



3D view (2016)

START (2016-2017

1st SPALAX-NG, Cegelec Toulouse, France (April 2017)

Implementation on IMS network from 2018-2019

Thank you

CEA team: Thomas Philippe, Gilbert Le Petit, Antoine Cagniant, Olivier Delaune, Philippe Gross, Guilhem Douysset, Christophe Moulin

Health Canada team

PTS / Engineering & development section
PTS / IDC

Industrial partner Cegelec Defense