SPIRAL 2 production station

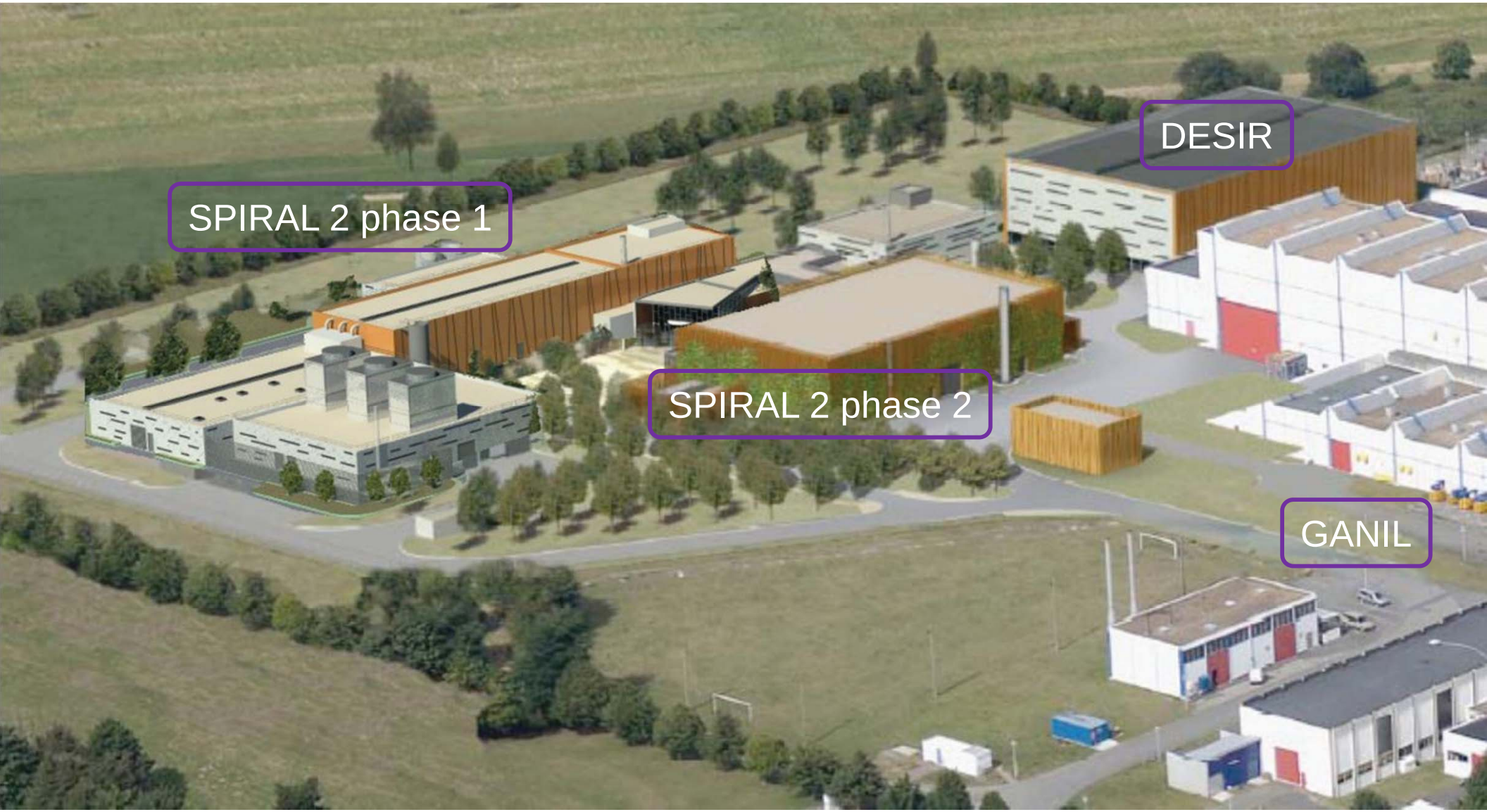
Hanna Frånberg Delahaye
Radioactive beam production
GANIL-SPIRAL 2, Caen, France

May 3, 2011

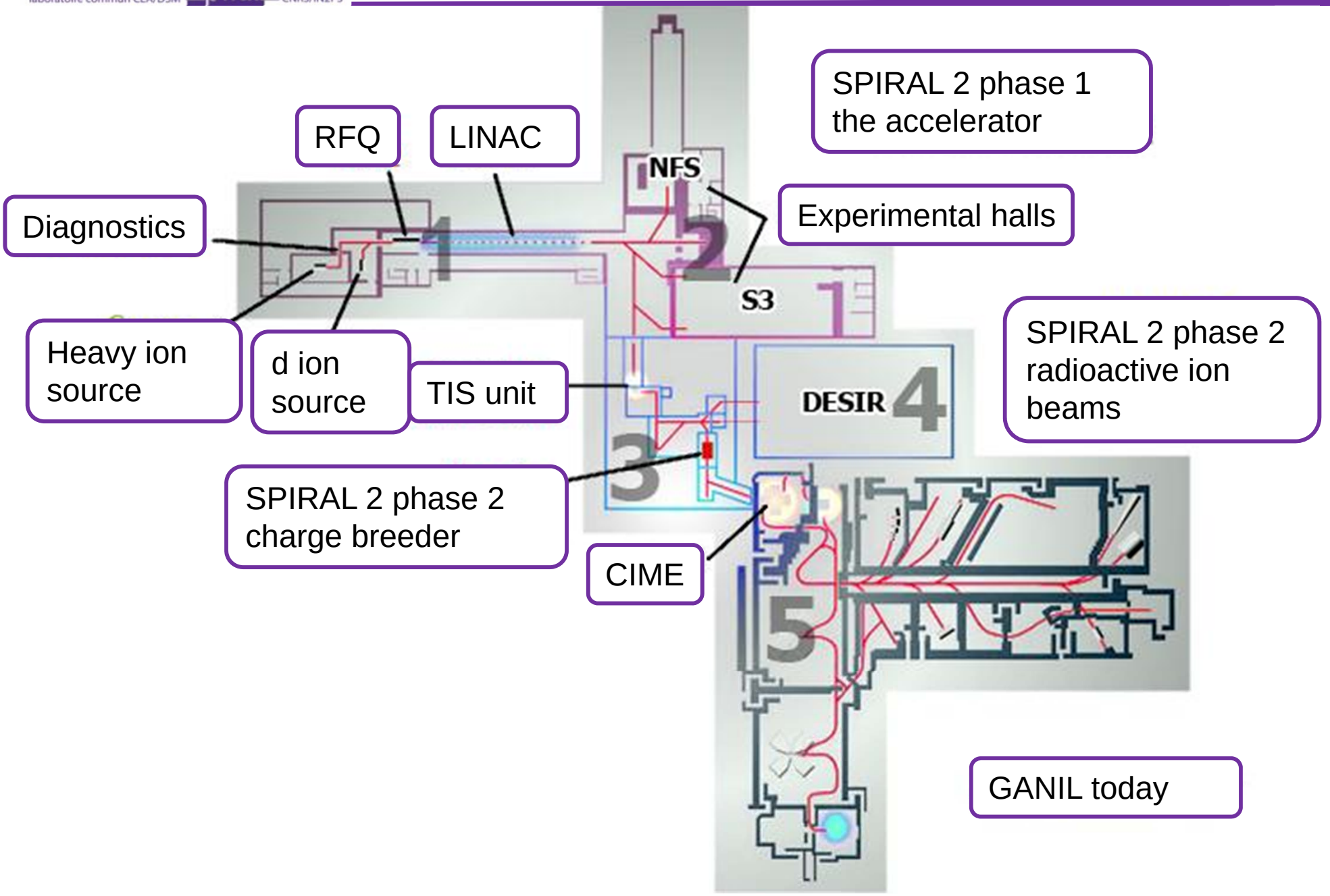
Lay out of the presentation

- SPIRAL 2 phase 2
- RNB production
- Front end – production module
- Neutron converter
- Target and ion sources
- Radiation levels in the production building

The SPIRAL 2 construction



Accelerator and beam line layouts

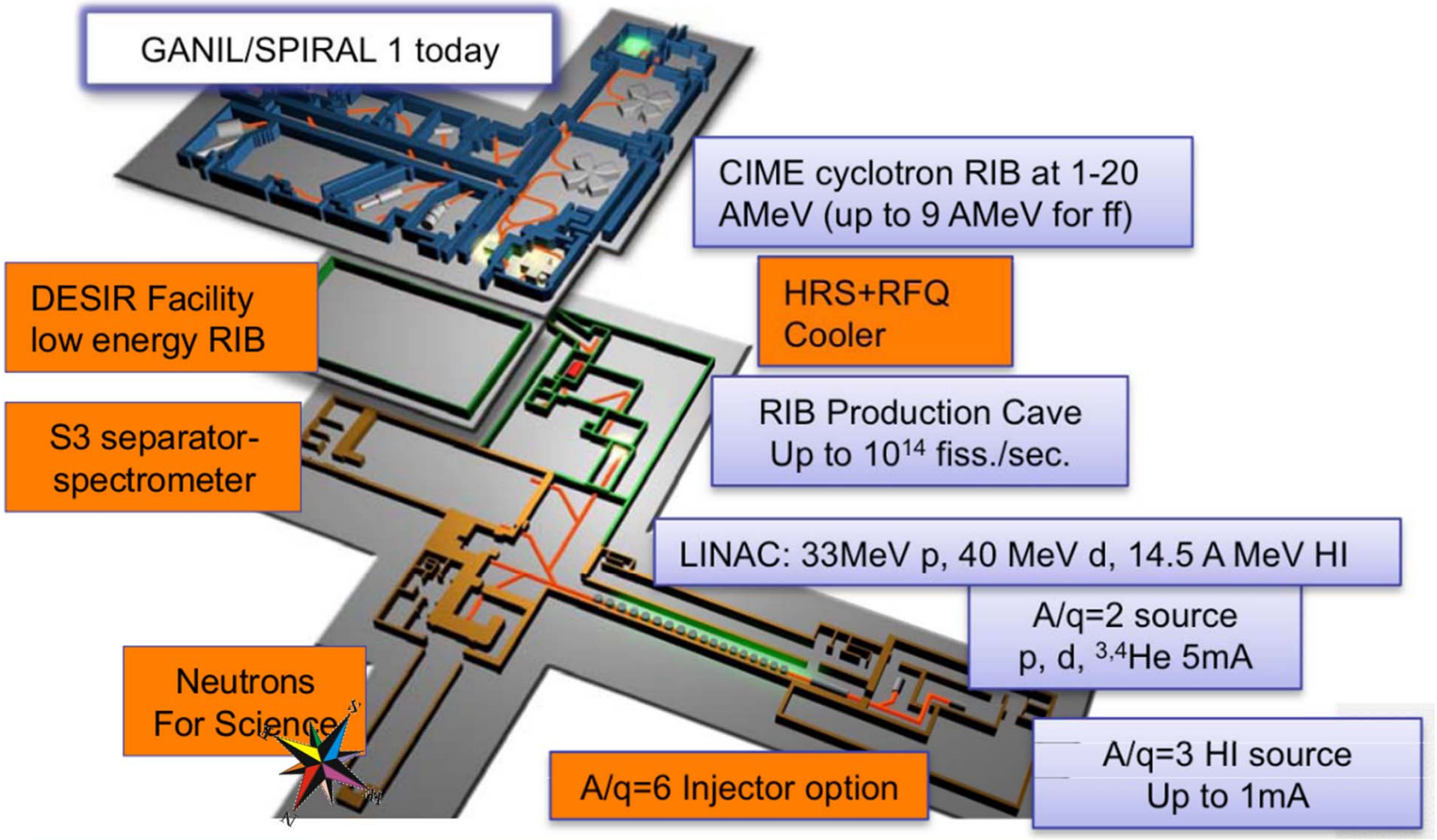


SPIRAL2 goals

RI produced by fission process, fusion evaporation residues or transfer products

High intensity stable primary beams : P, D, ^{3,4}He, heavy ions with A/Q=3 (1mA-5mA)

Energy range : from 2MeV/u up to 20MeV/u (D), 14.5MeV/u (HI), 33MeV (P)



The construction has started

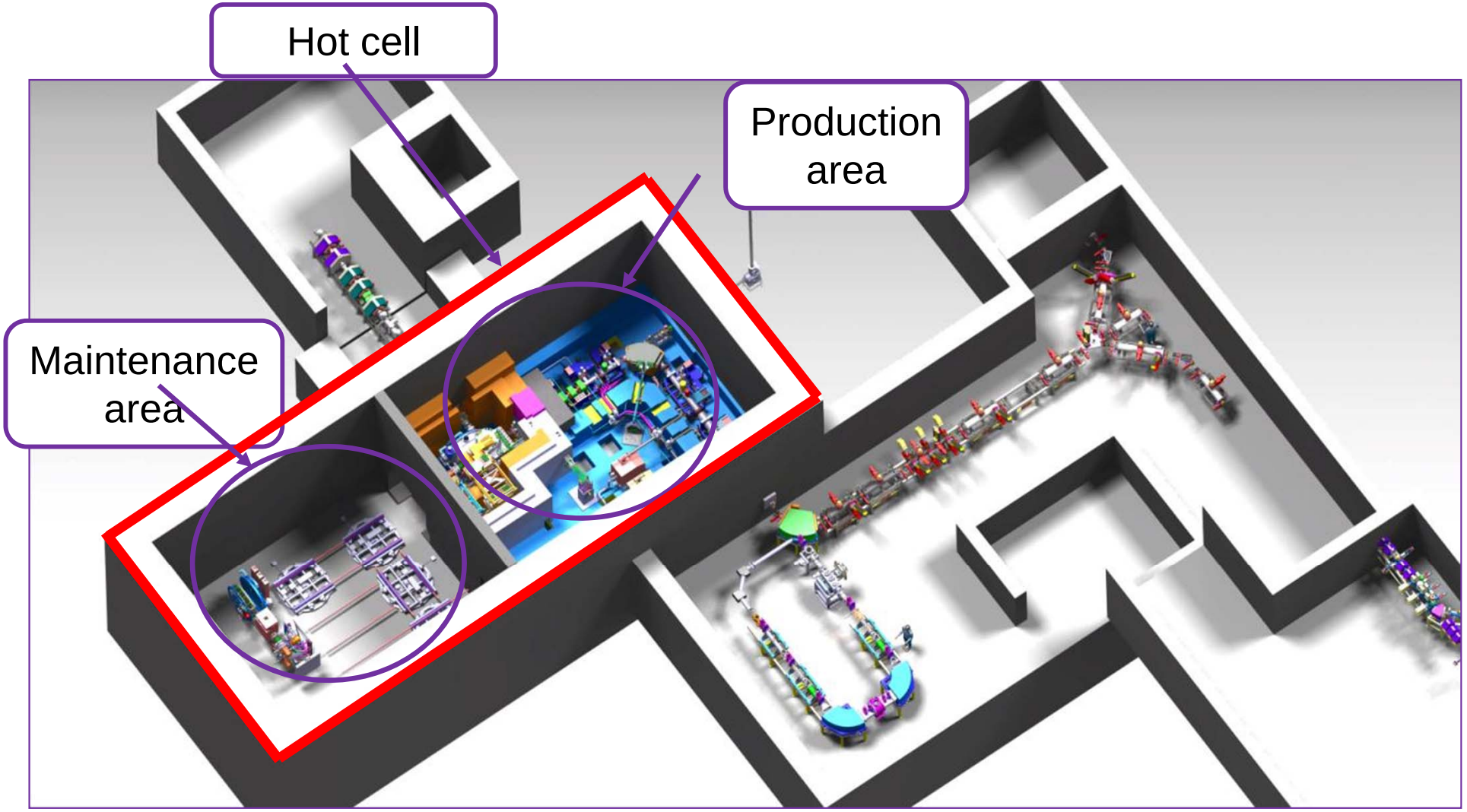
The construction has started

Equarrissage des talus

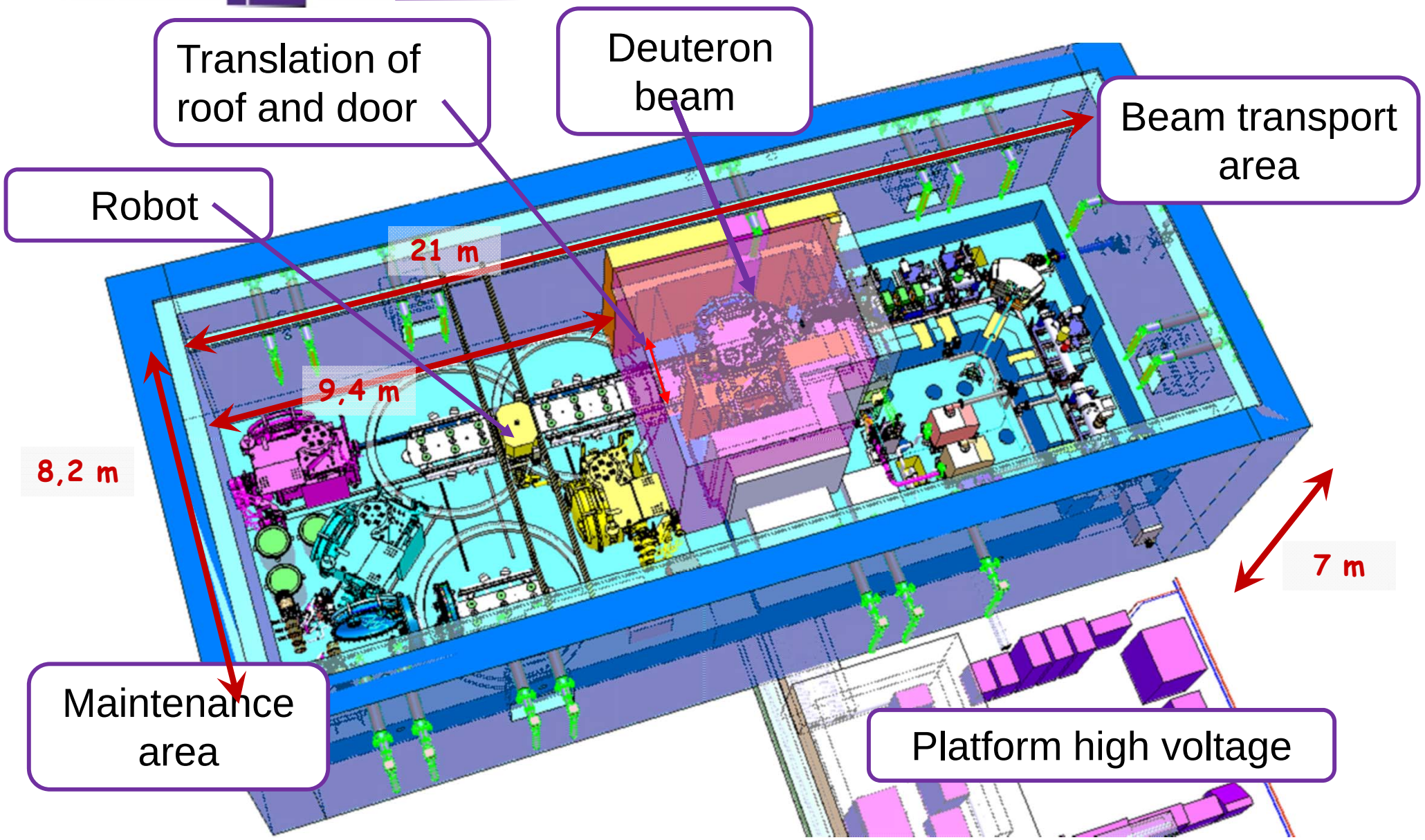
Analyse des talus par les géotechniciens

Chantier SPIRAL2 au 22 avril 2011

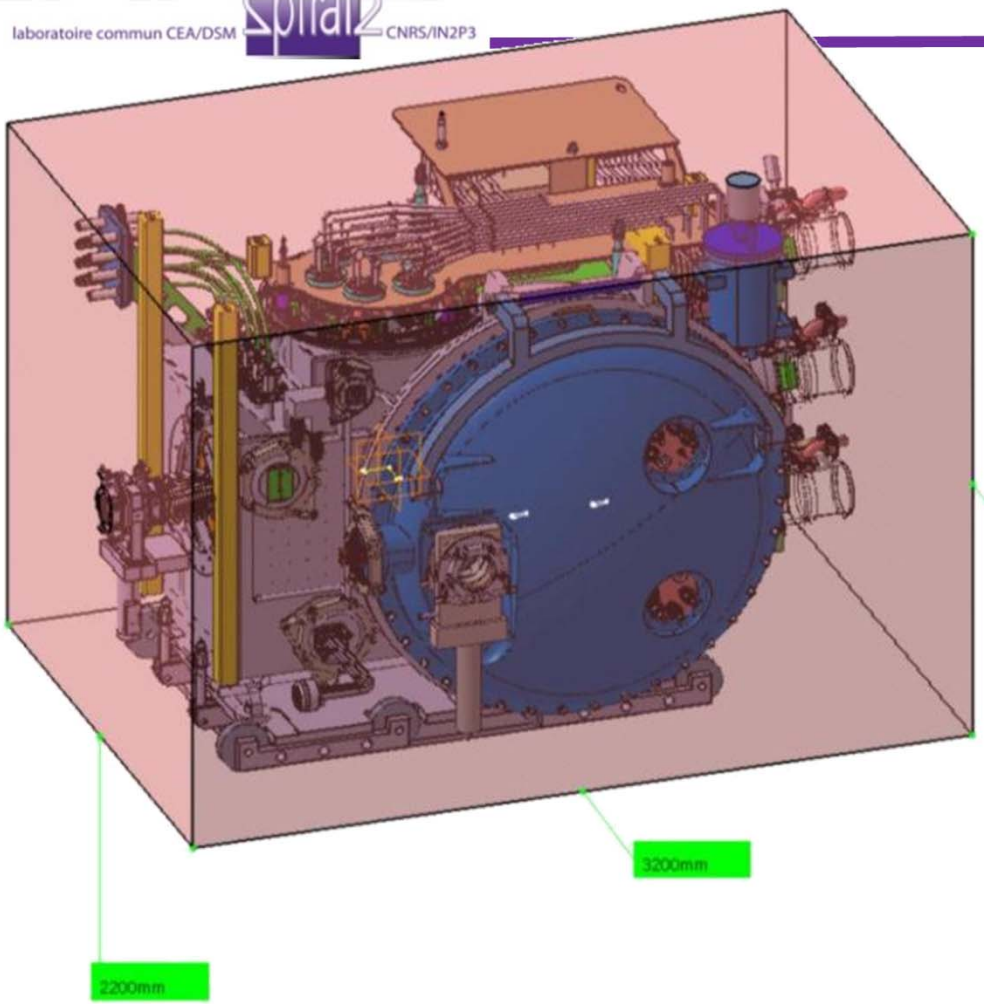
Production zones and 1+ beam lines

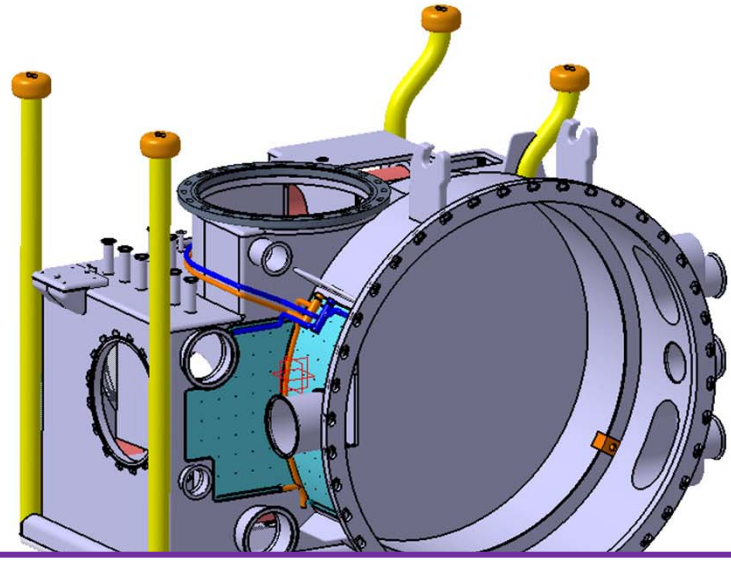


The hot cell

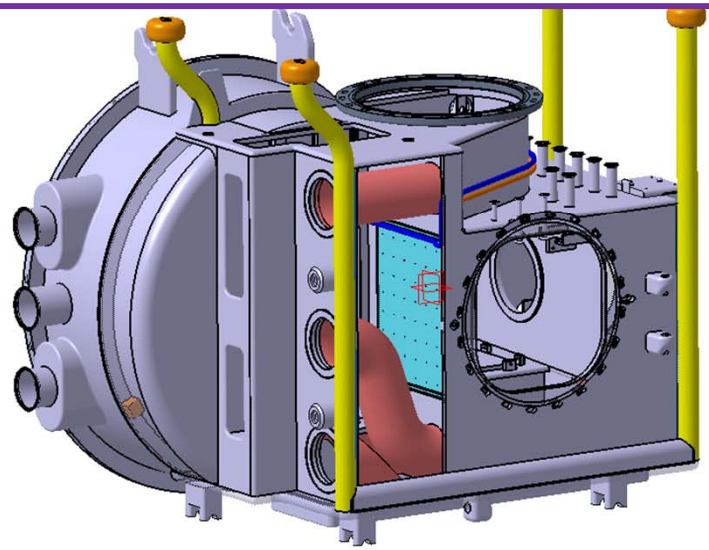

Translation of roof and door
Deuteron beam
Beam transport area
Robot
21 m
9,4 m
8,2 m
7 m
Maintenance area
Platform high voltage

Size of the production module



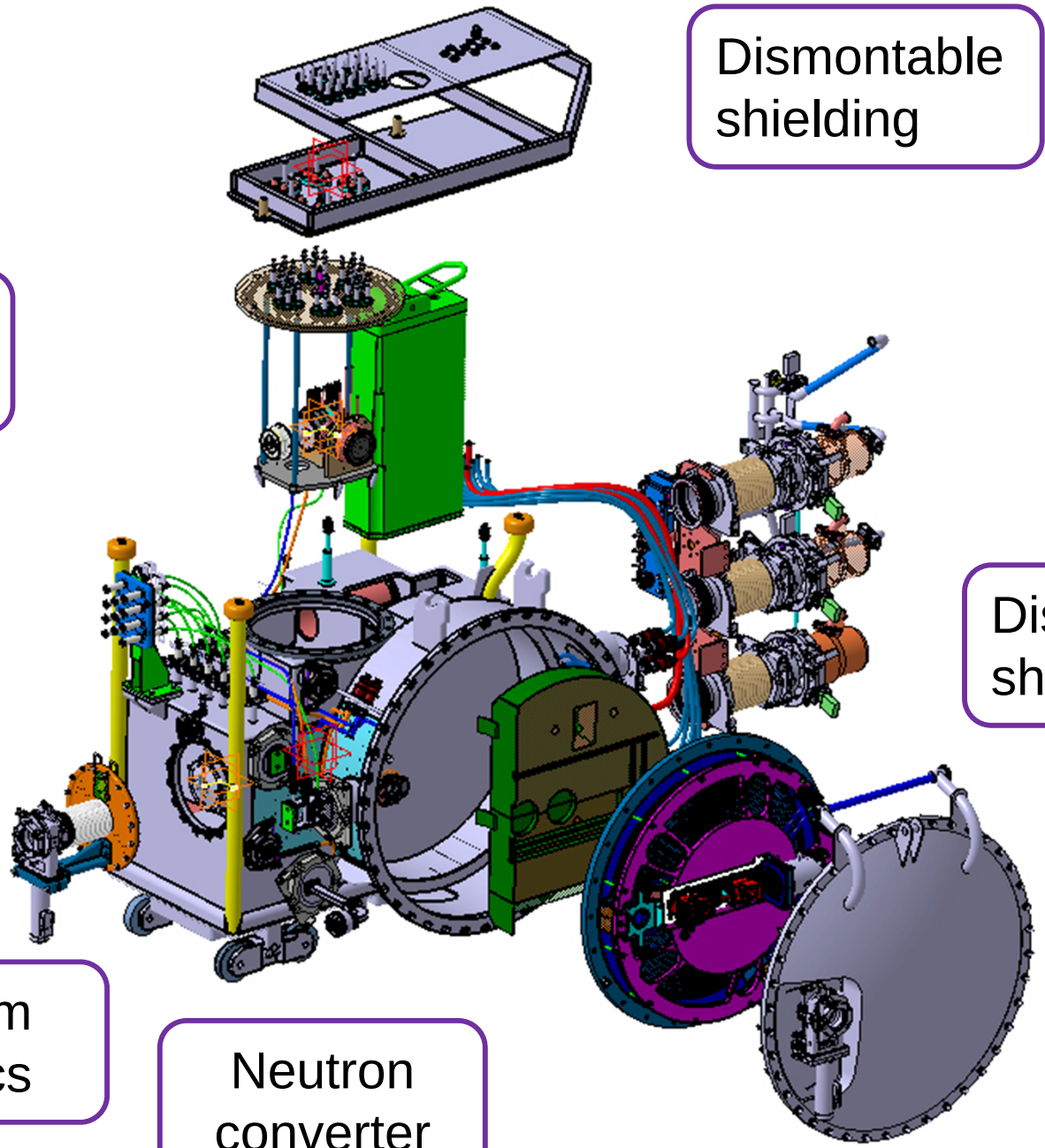


Material: stainless steel 316L,
Weight: 2,1t



Height: 2.15 m
Length: 3.20 m
Width: 2.20 m
Weigth: 8 t

Components of the production module



Connectors easements

Dismontable shielding

Y. Huguet

Target and ion source

Pump module

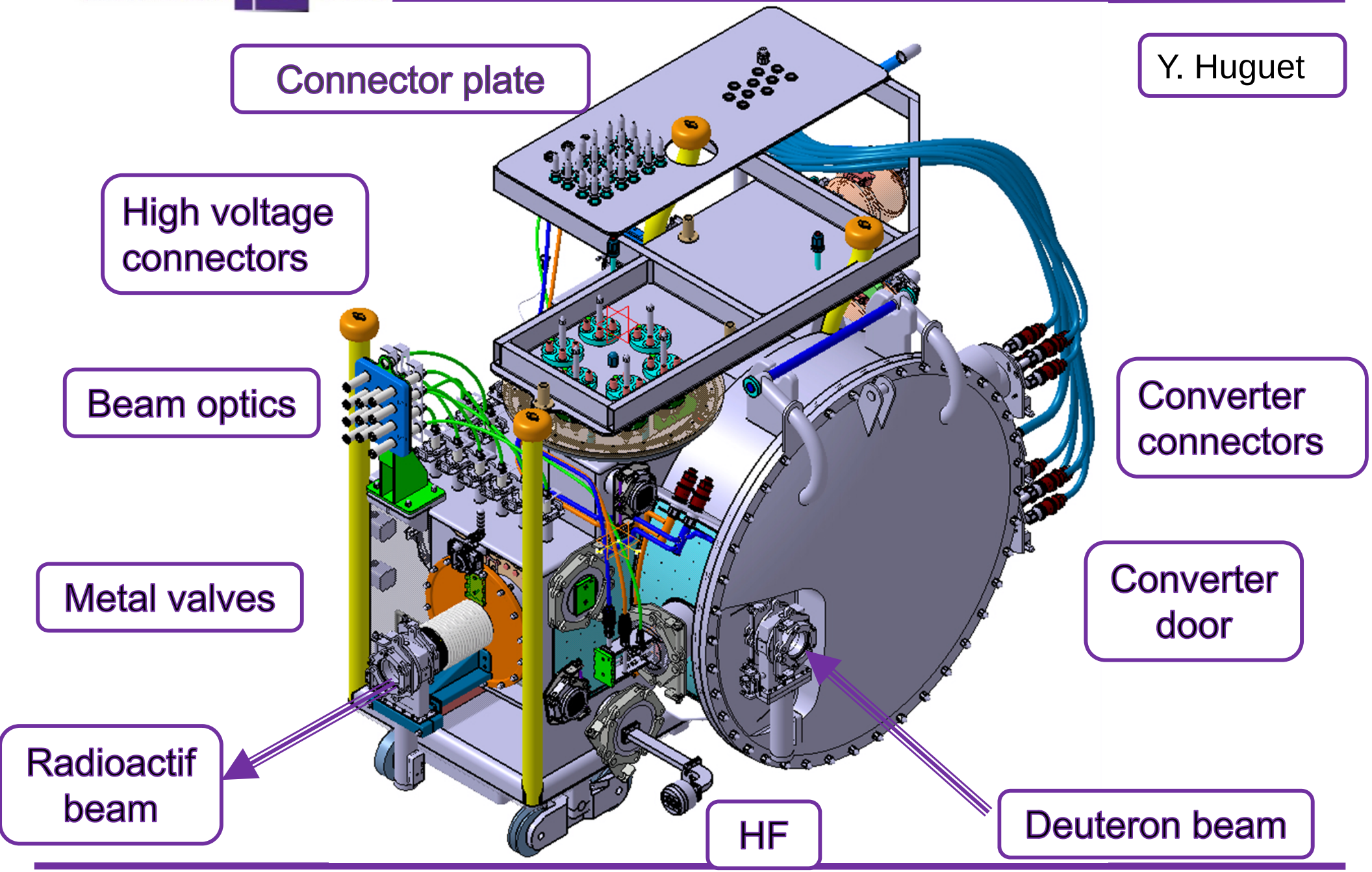
High voltage connectors

Dismontable shielding

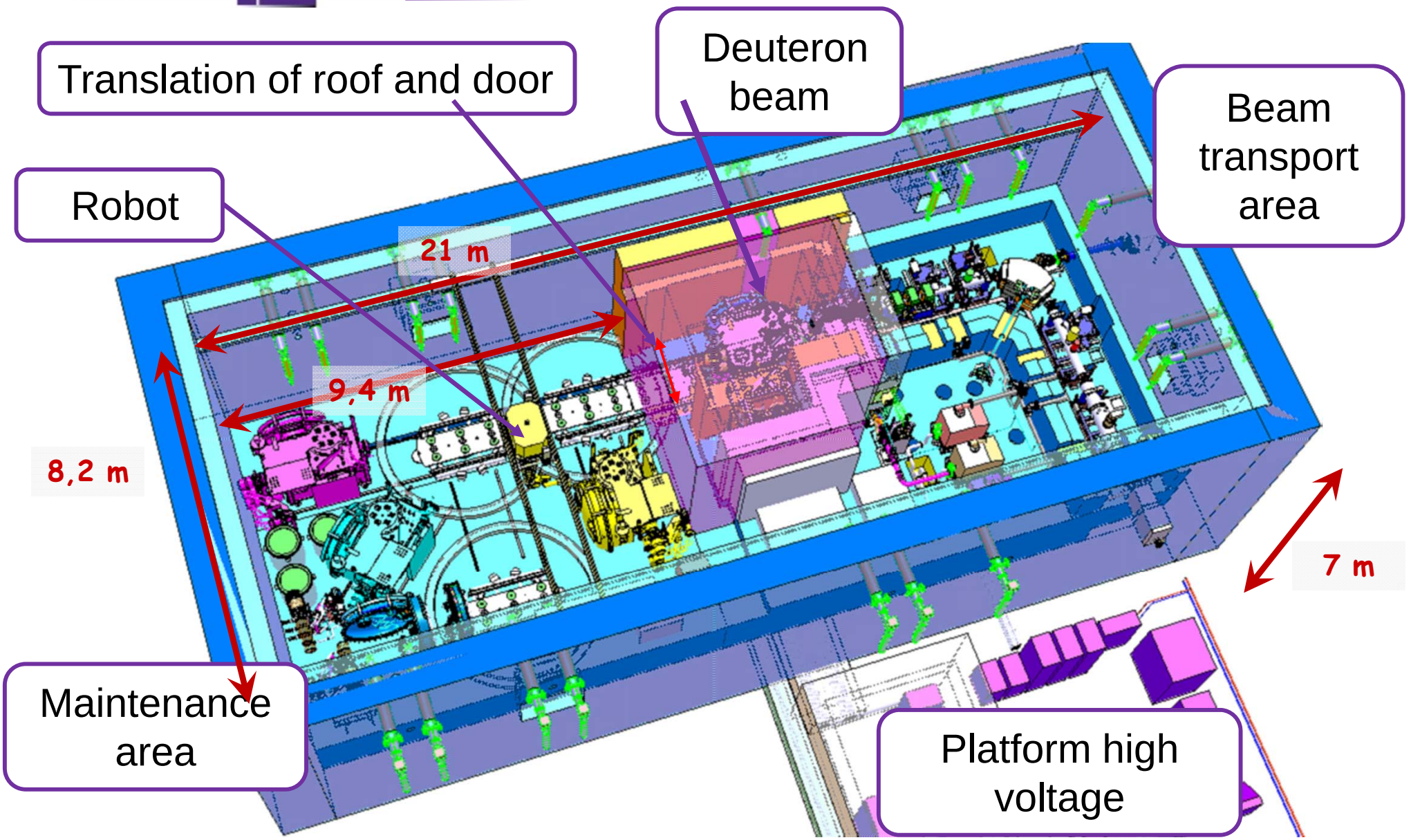
Beam optics

Neutron converter

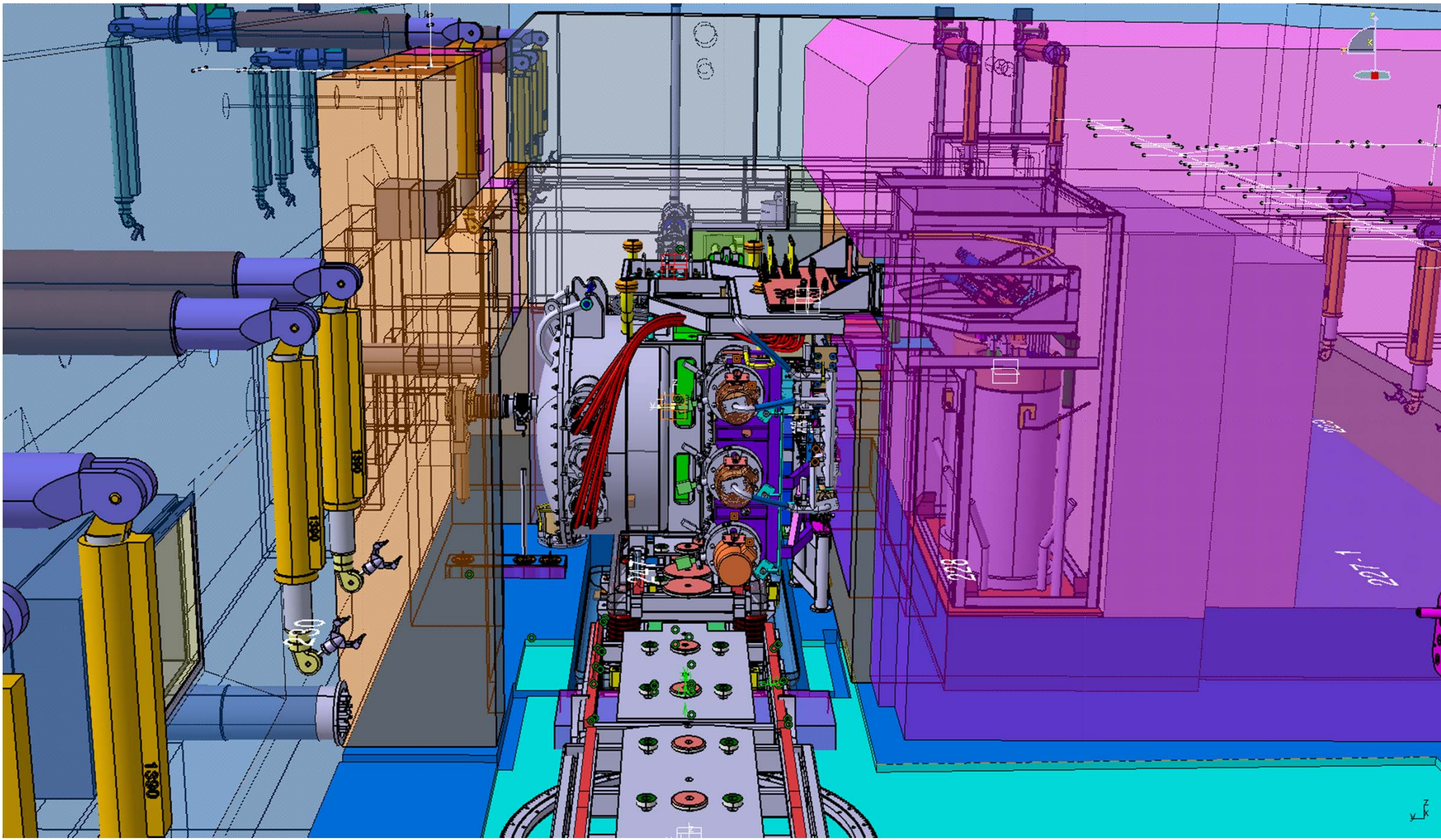
Overview of the production module



The hot cell


Translation of roof and door
Deuteron beam
Beam transport area
Robot
21 m
9,4 m
8,2 m
7 m
Maintenance area
Platform high voltage

The front end

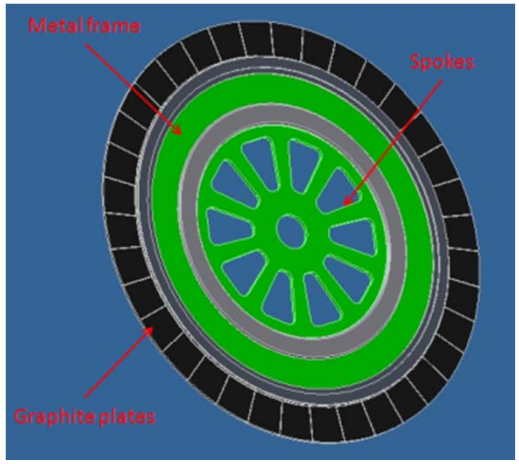


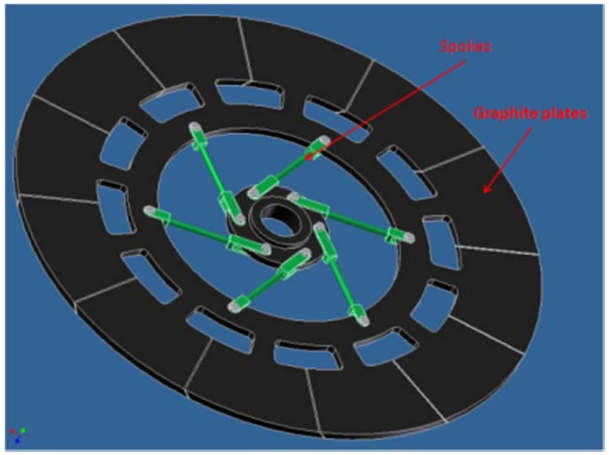
Converter design

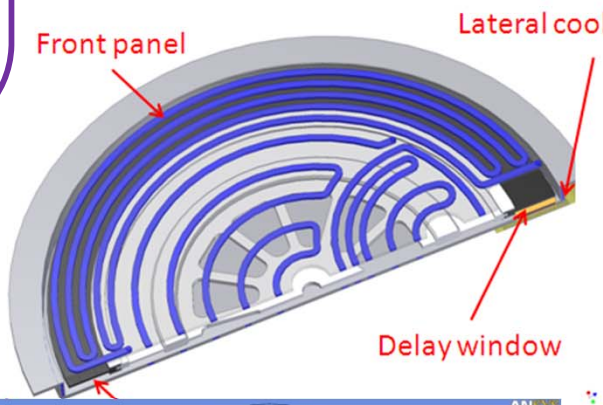
The 200 kW and 50 kW converter design
•120 and 52 cm in diameter
• rotation of 6-15 Hz (temperature difference 10-20°C/turn)
AXF-5Q from POCO Graphite inc

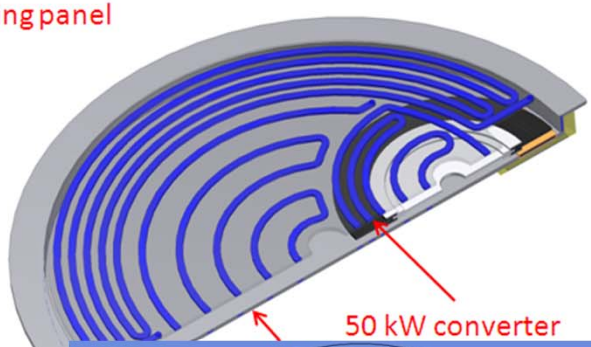
The d beam is stopped in the 7 mm graphite disk

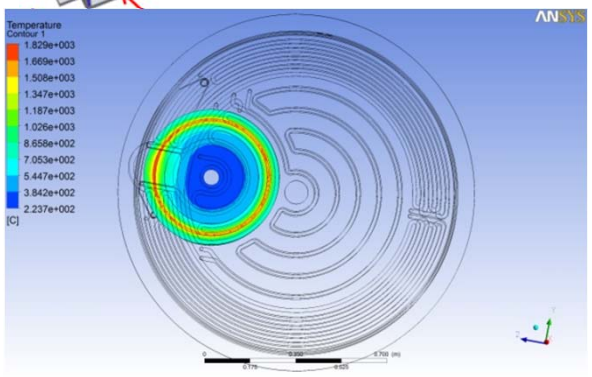
The working temperature of the graphite is1850°C

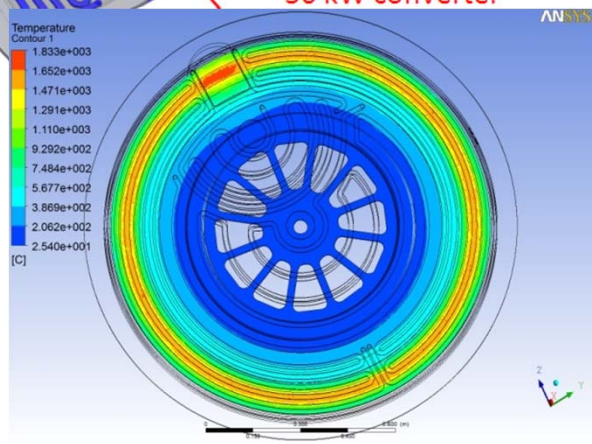




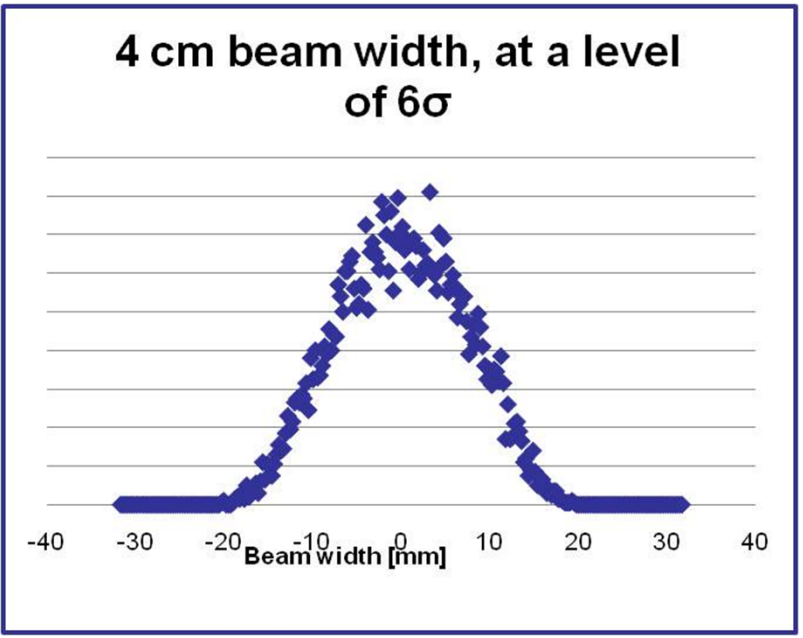








- Beam profile used for the thermo mechanical calculations



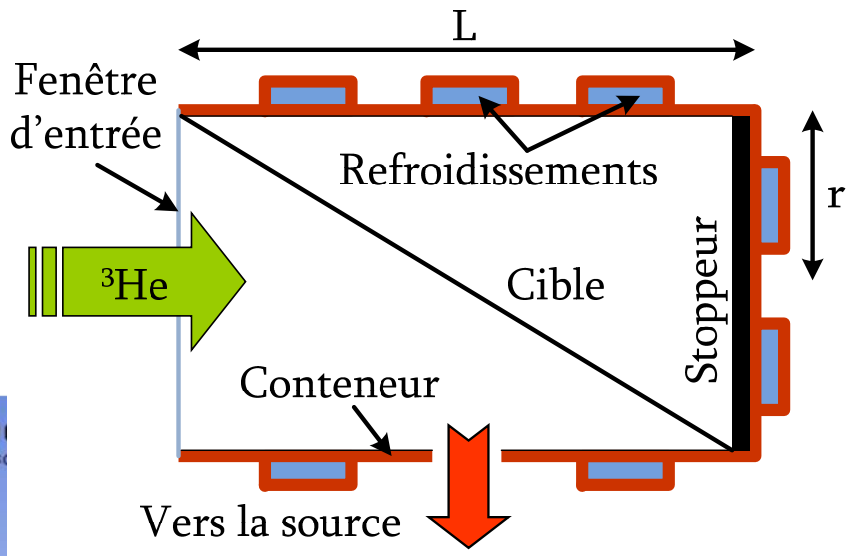
Material	Radiation damage [dpa]	Radiation source
Graphite	50	Deuteron beam
Wheel body (stainless steel)	10^{-3}	Neutrons
Cooling panels (stainless steel)	10^{-2}	Neutrons

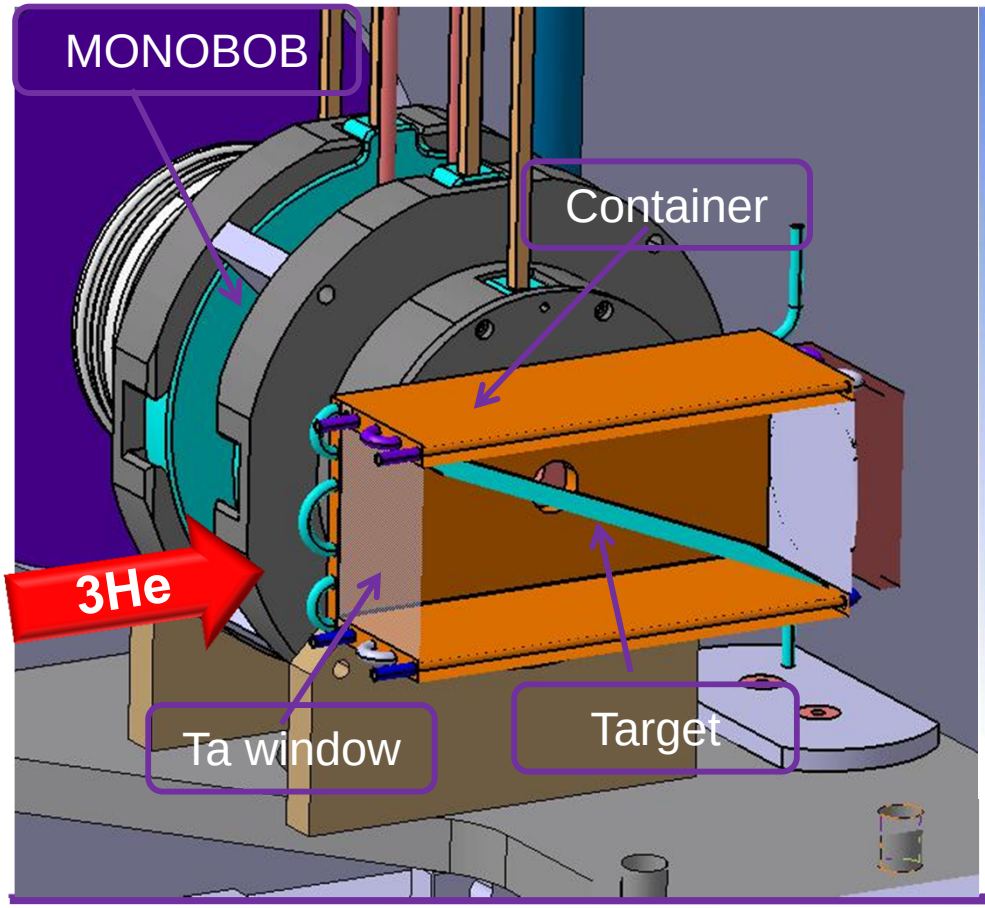
	50 kW converter	200 kW converter
Maximum converter temperature, ^{0}C	1843	1923
Maximum stress (von Mises, Pa)	$2.59 \cdot 10^7$	$3.22 \cdot 10^8$

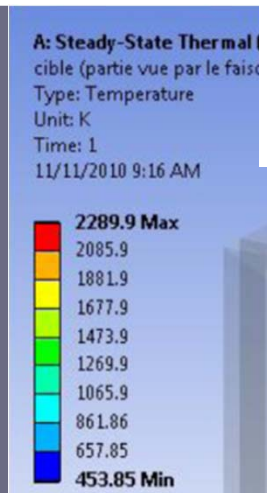
J. Bermudez, L. B. Tecchio, E. Udup

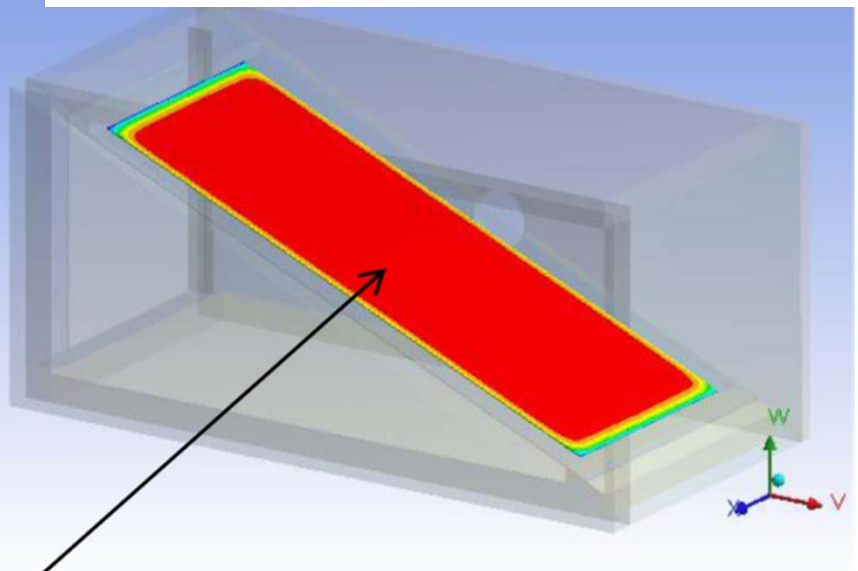
Prototype for the production of 14O at SP2

- A tilted carbon target
- chamber with black coating for thermal issues,
- Cooling around the chamber
- Beam stopper …







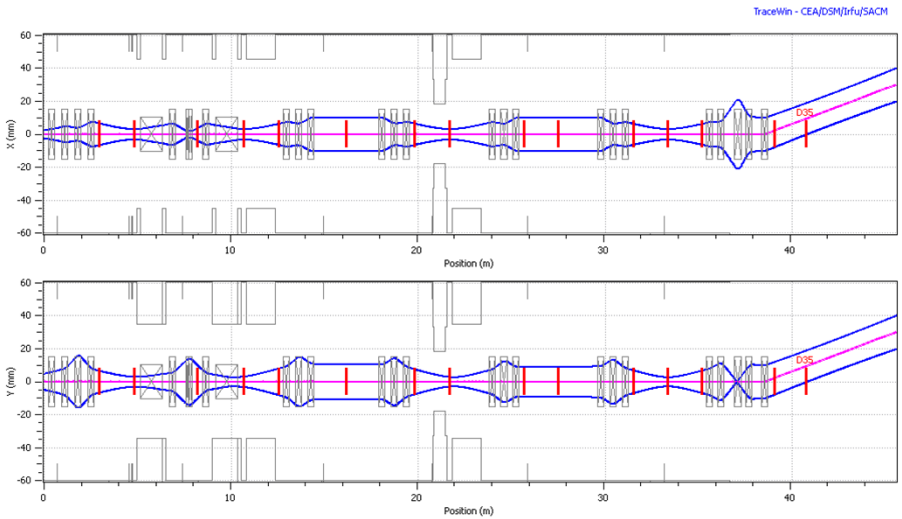


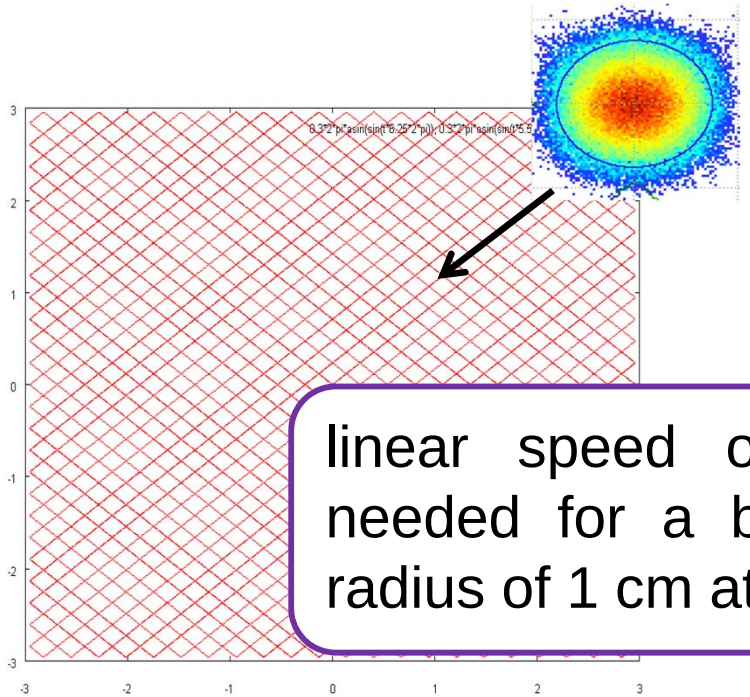
M G Saint Laurent et A. Pichard

2300 K

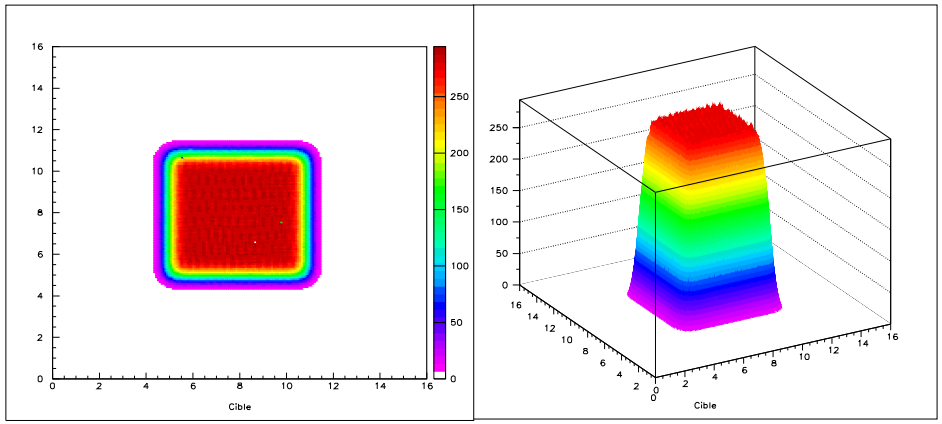
P. Jardin, A. Pichard

Beam scanning system



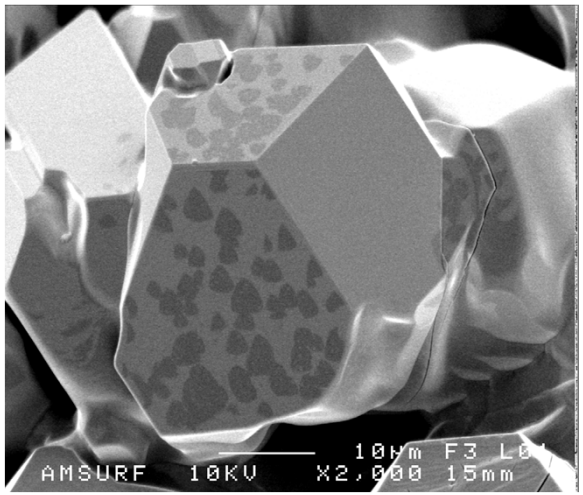


linear speed of 44 m/s is needed for a beam with a radius of 1 cm at 3 rms.

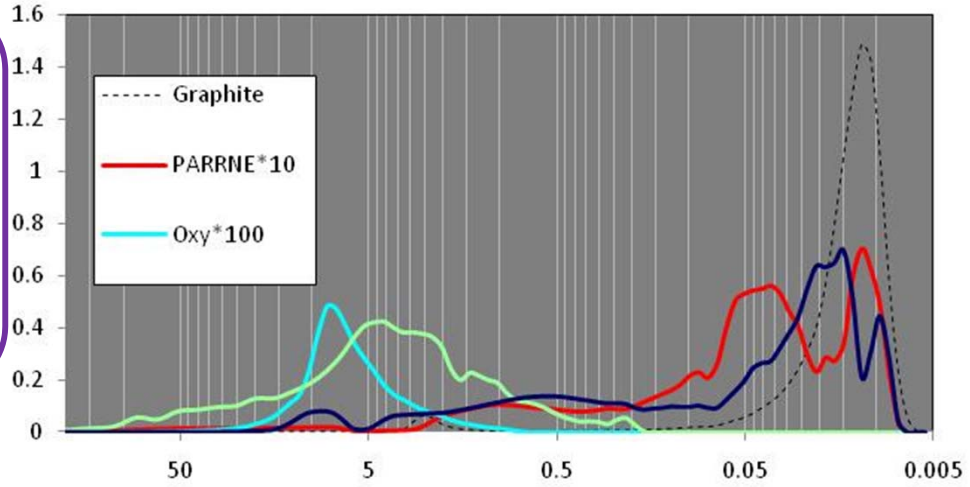


Centroïd of ± 3 cm give less than 150 W losses for a 35 kW beam
It implies a field of 350 G (due to 1/6 ions)
The preliminary frequencies are : 68.75 Hz for X and 60.5 Hz for Y.

R&D on UC_x targets

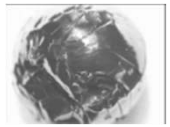


Synthesis of UC_X pellets
Charactherisation
Release tests

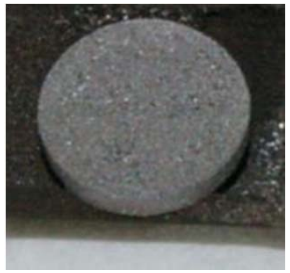


- Study of physicochemical properties (by XRD, SEM, porosimeter etc.)
  - Collaboration with the radiochemistry group
- Study of release properties by irradiation tests
  - Collaboration with the radiochemistry group and the nuclear physics group NESTER
- Development of UCX targets throughout European collaborations:
  - ActILab (ENSAR)

UNIVERSITÉ DE RENNES 1

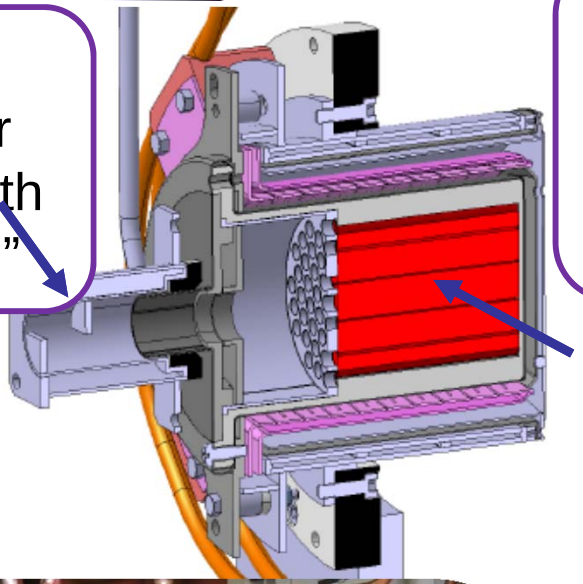


C. Lau



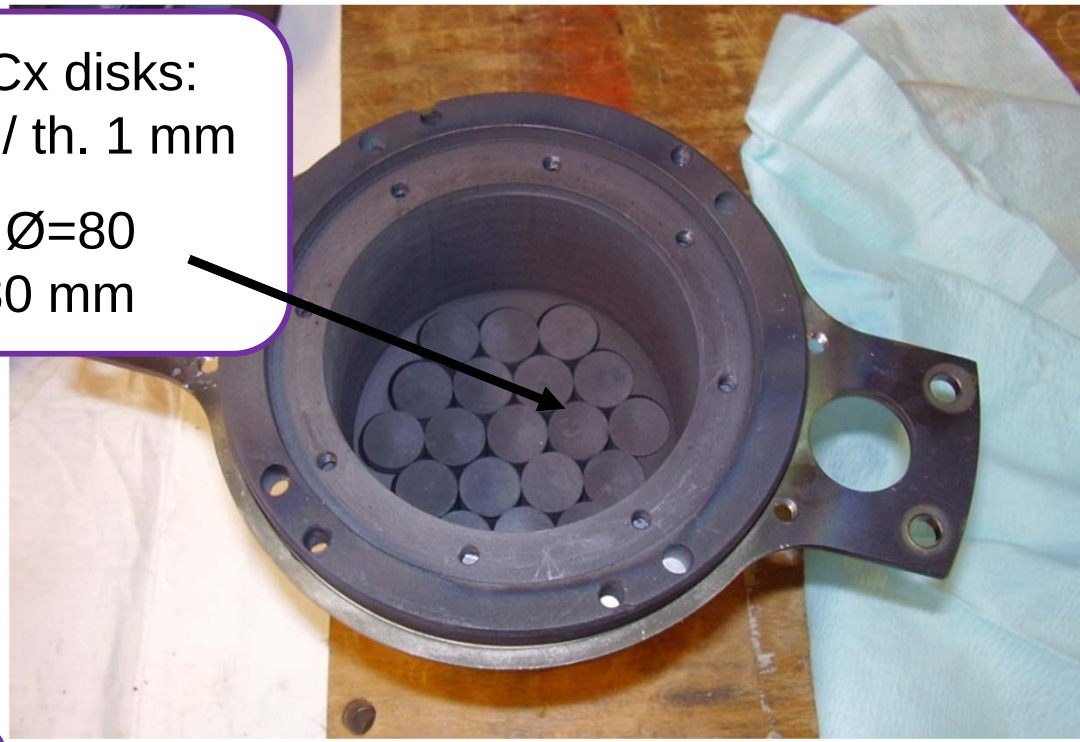
UC_x target

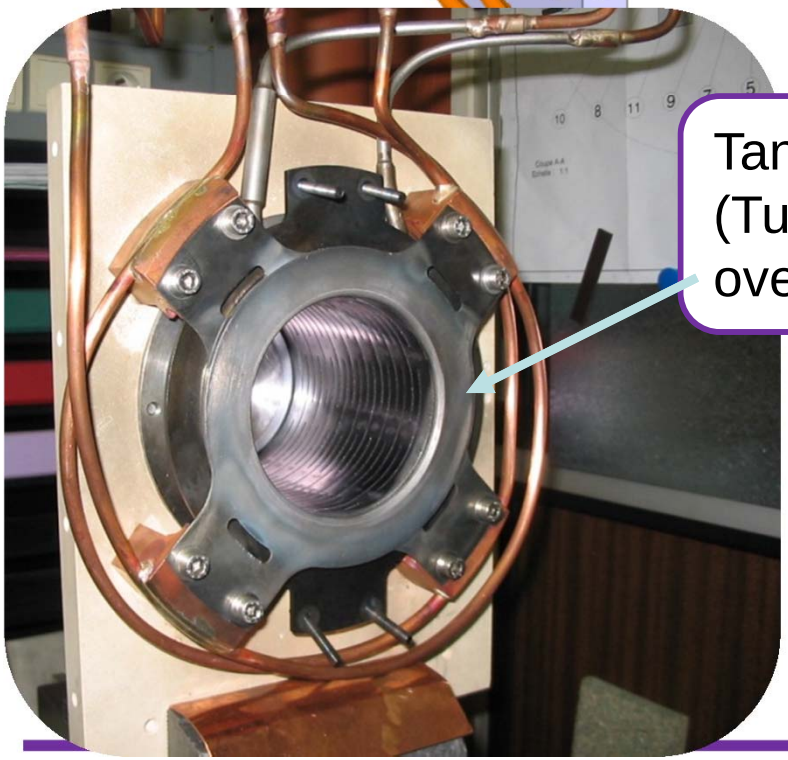
Cooled transfer tube with "zigzag"



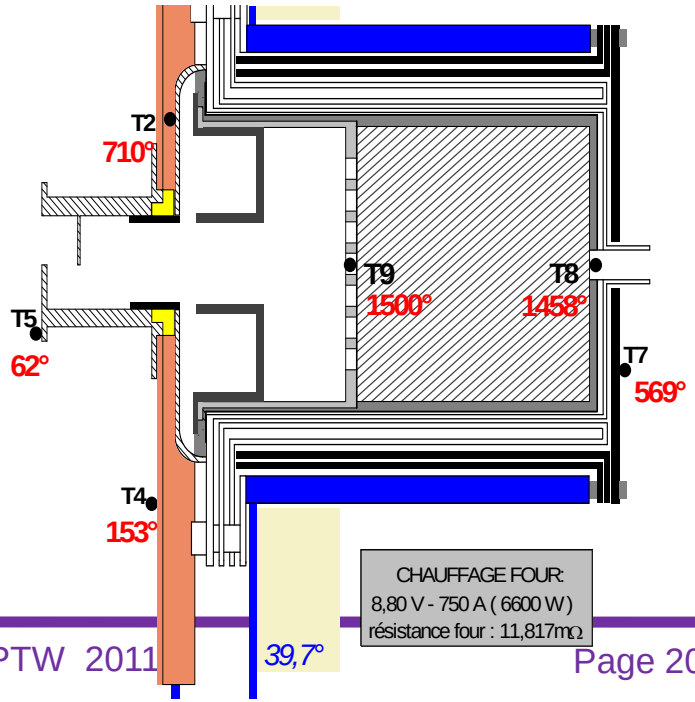
1300 UCx disks: Ø15mm/ th. 1 mm

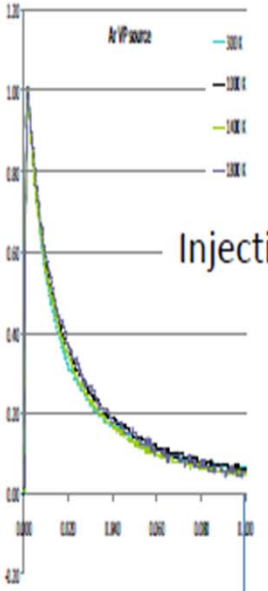
Target : Ø=80 mm, l=80 mm



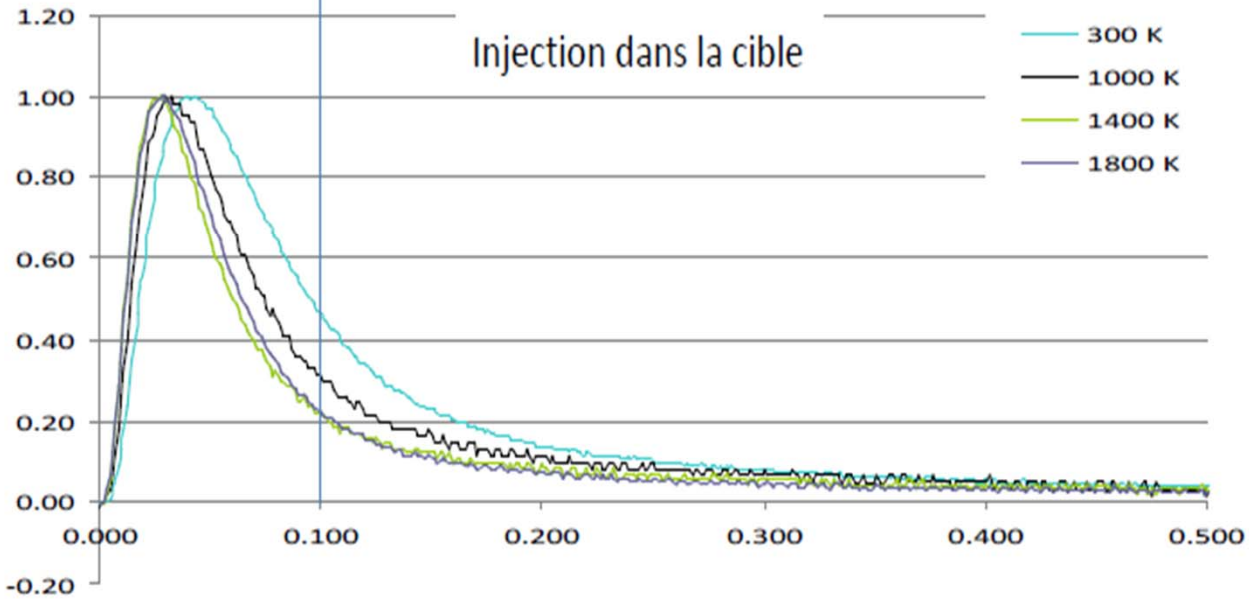


Tantalum (Tungsten) oven





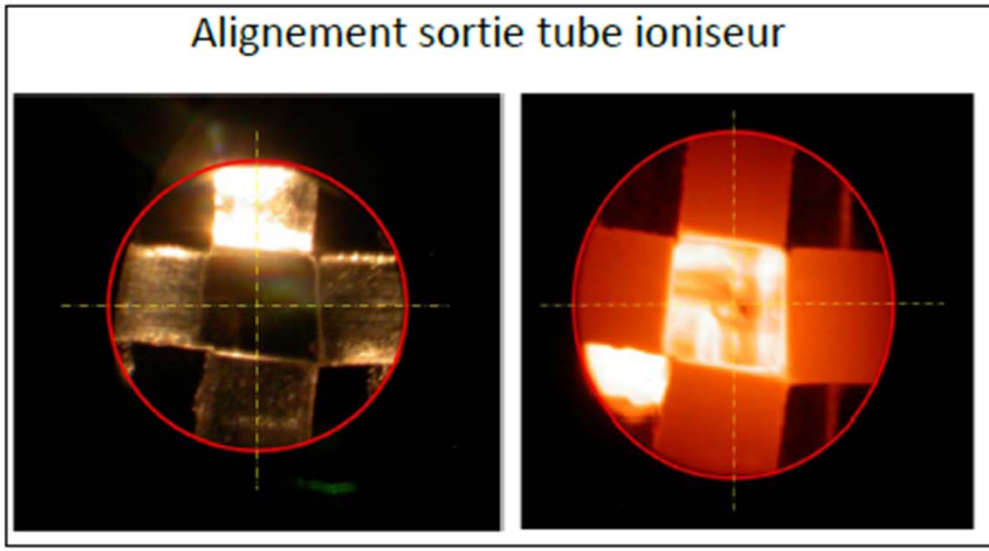
- Studies on the waveguide for the injection of the RF
- Release times measurements connected to an oven.
- Adaptation tests to a long extraction.

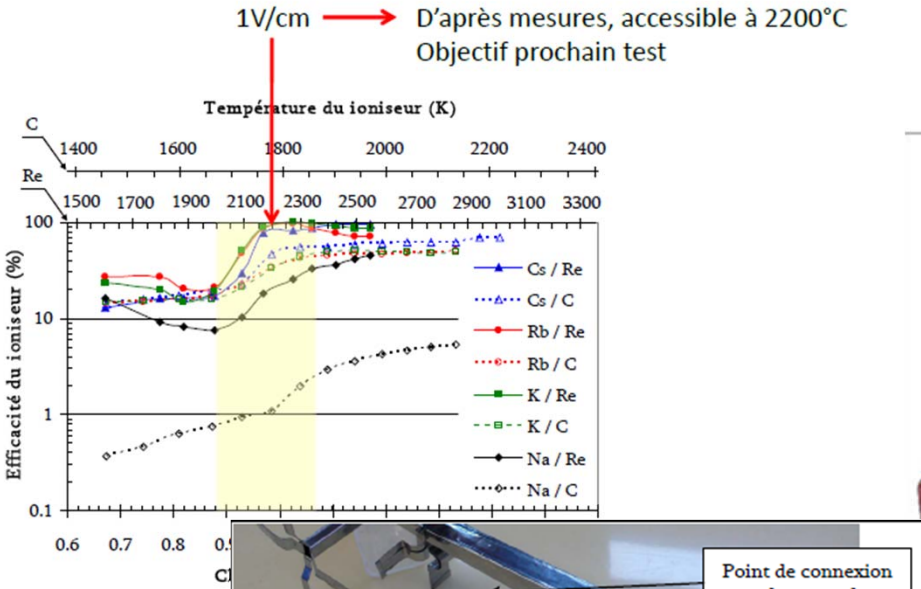


P. Jardin, A. Pichard

Source Ionisation surface

- **One source** for laser and surface ionisation
- No mouvement of the point of extraction





Graphique présentant l'efficac et de la température dans le tu

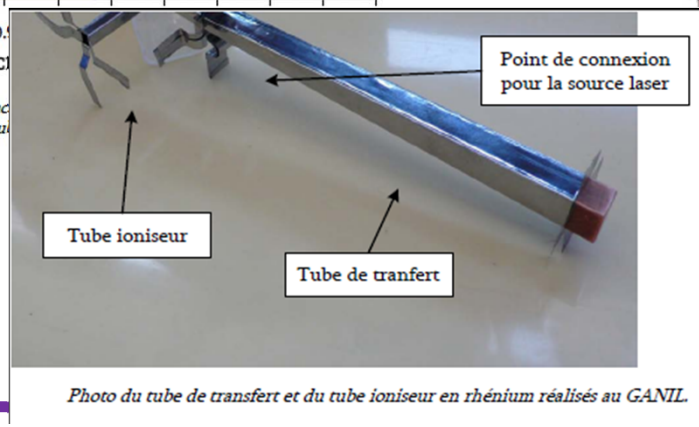
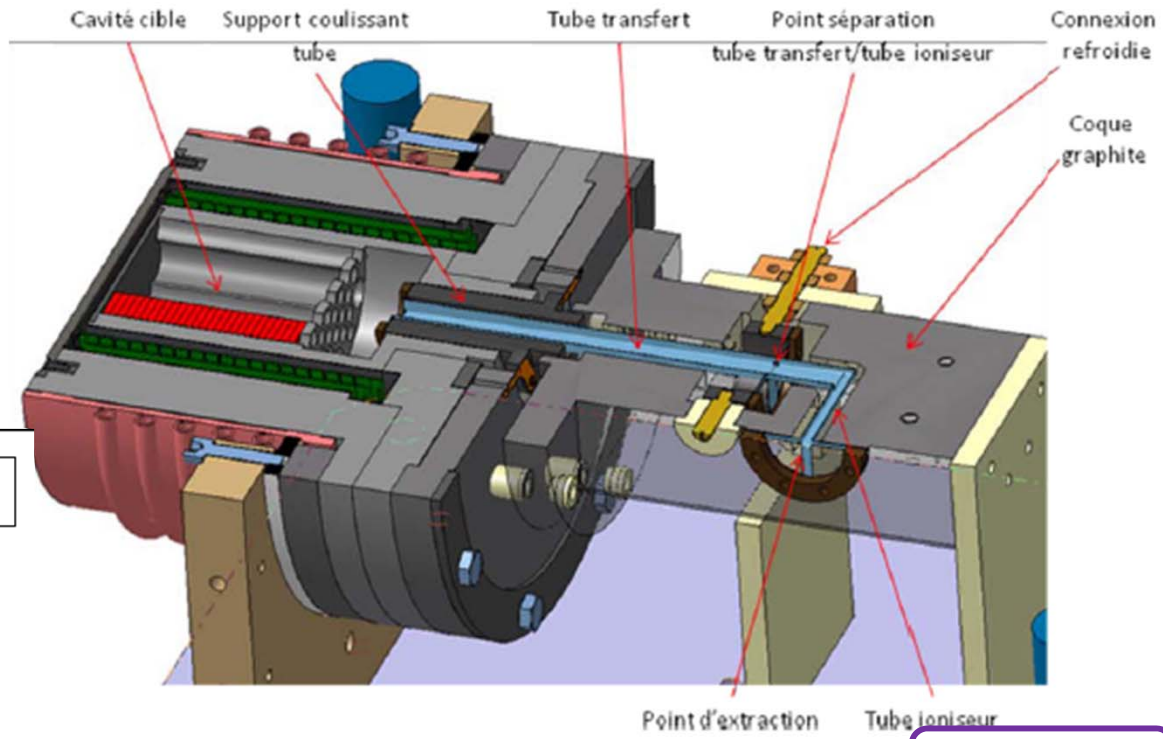
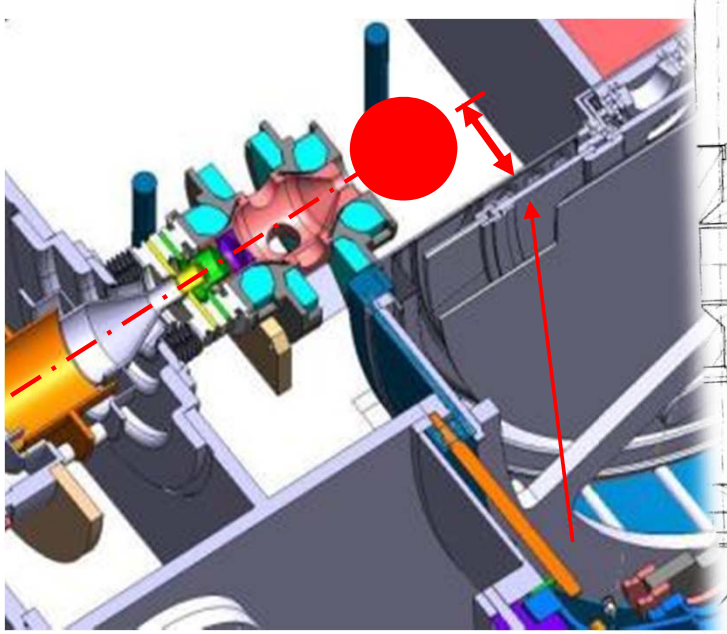


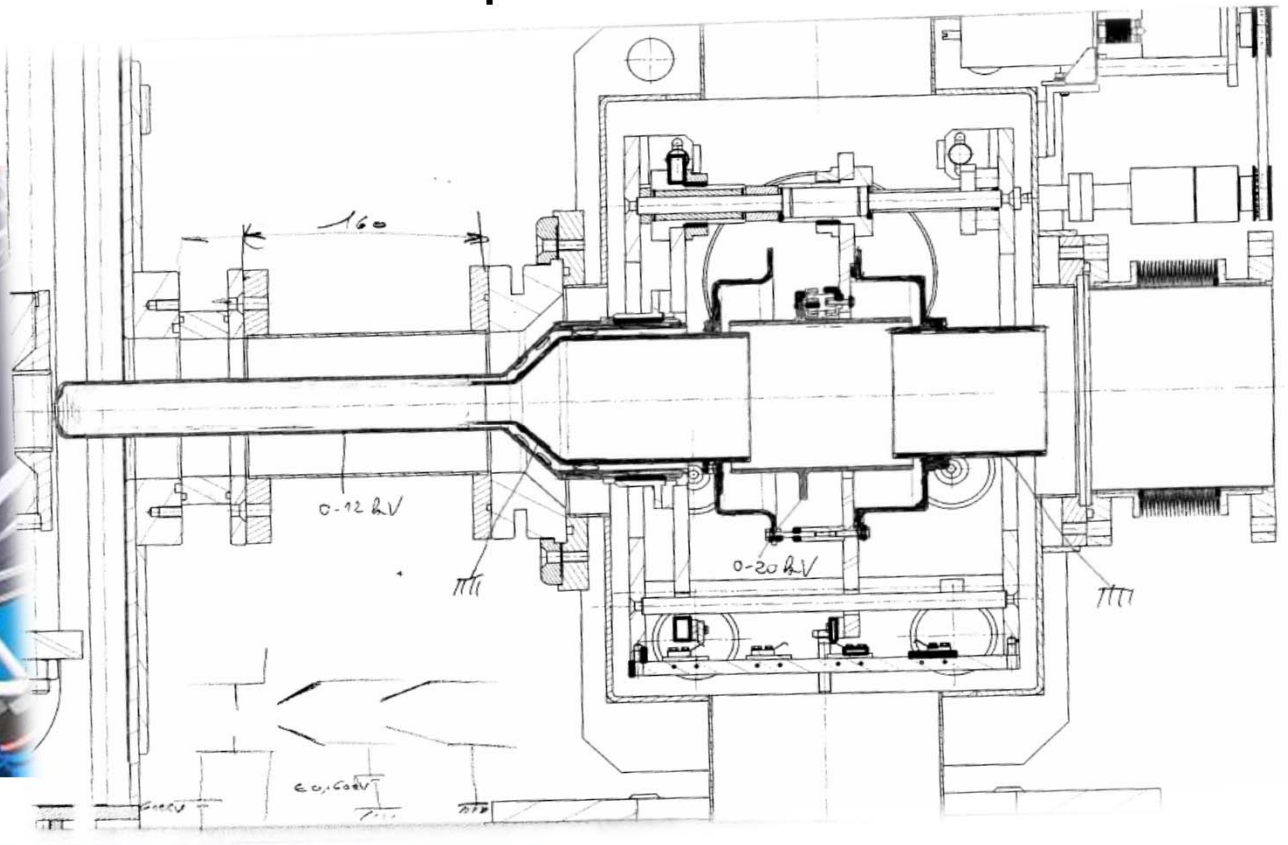
Photo du tube de transfert et du tube ioniseur en rhénium réalisés au GANIL.



P. Jardin

- Optimisation of the extractions of the production module and tests bench



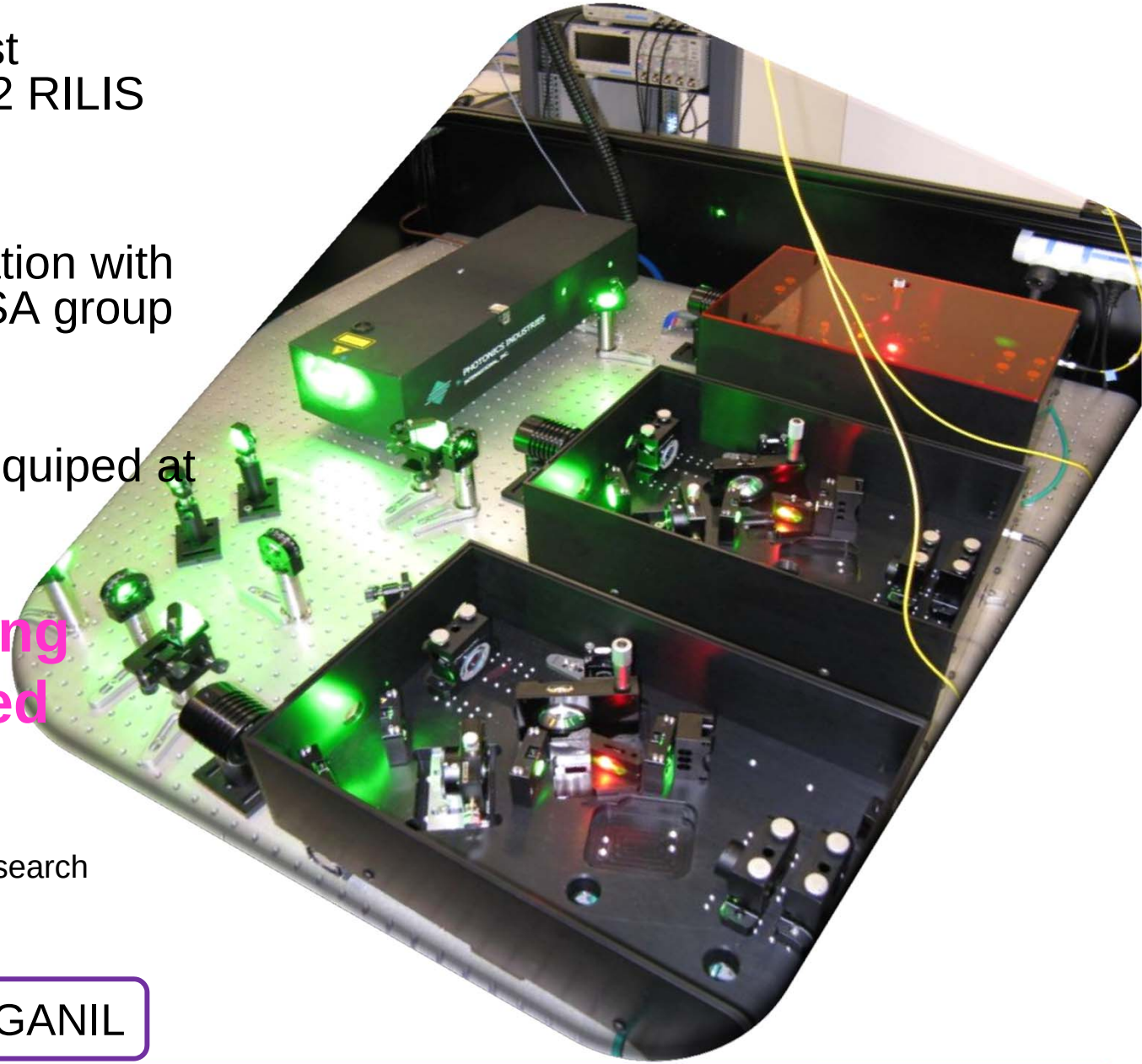


228 µA with 99 % transmission
Feasible

O. Bajeat

Resonant Ionization Laser Ion Source

- GISELE ANR project: first prototype of the SPIRAL2 RILIS (GANIL, IPNO)
- TiSa System in collaboration with TRIUMF and the LARISSA group from Mainz University
- Off line laser room fully equiped at GANIL

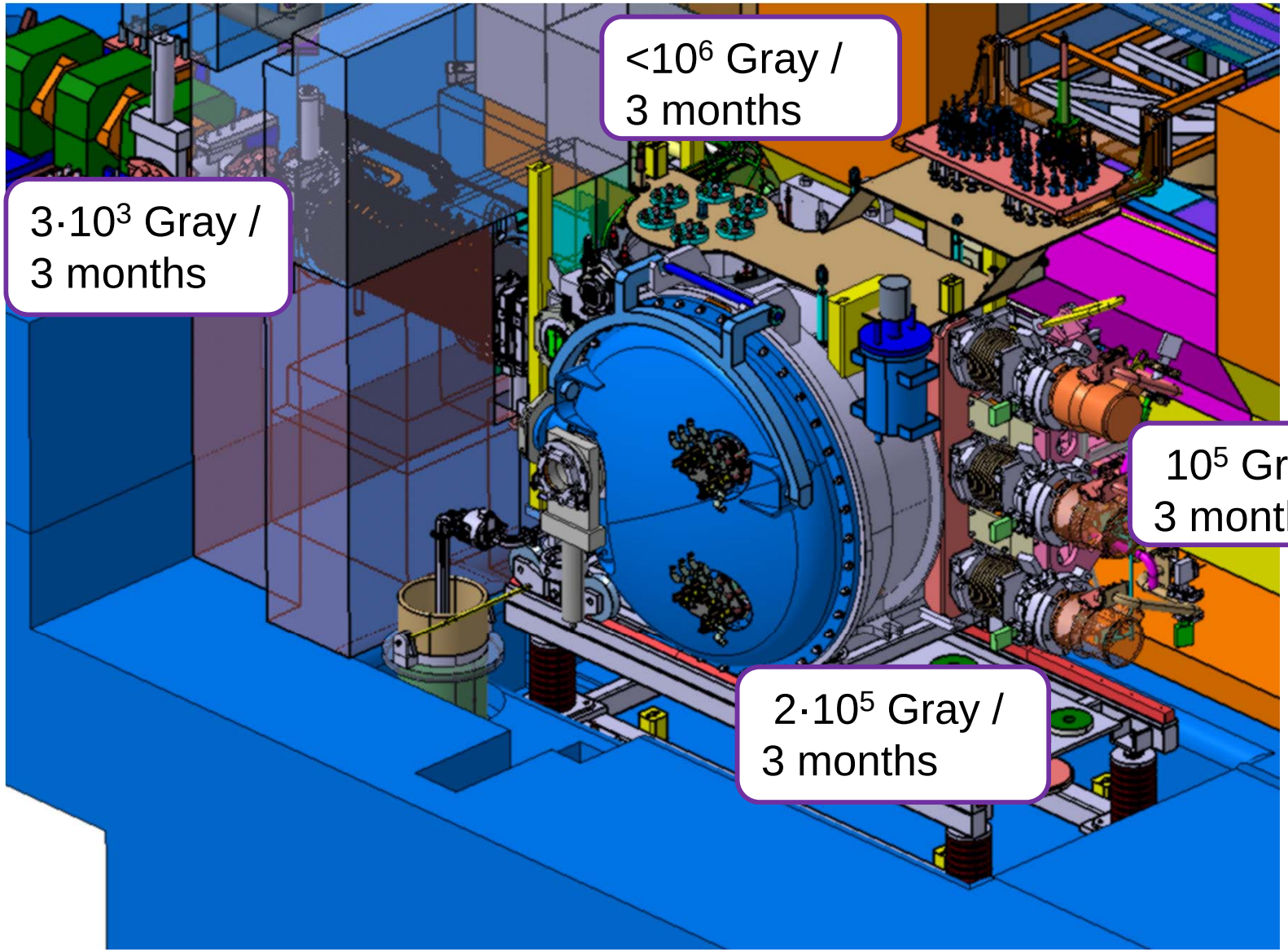


3 TiSa Cavities running
Up to 3.5W of InfraRed beams produced

This work is supported by the French Research National Agency (ANR) under contract n° ANR-08-BLAN-0116-01

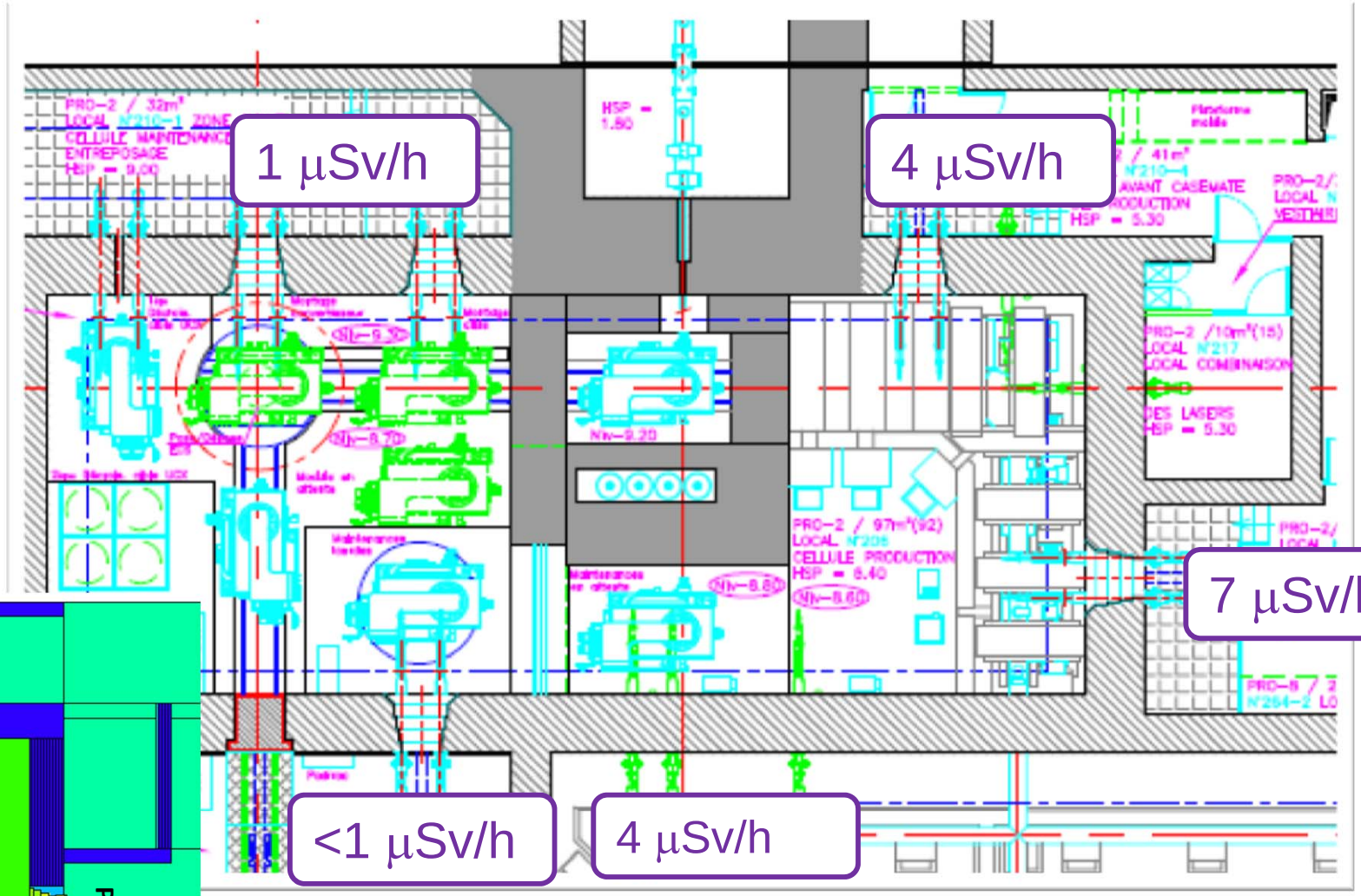
N. Lecesne GANIL

Integrated doses from the n



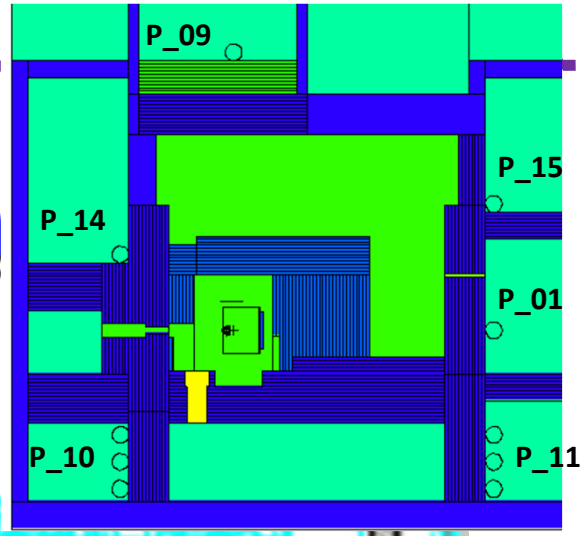
A. Savalle

Primary calculations of the Equivalent dose rates (EDR)

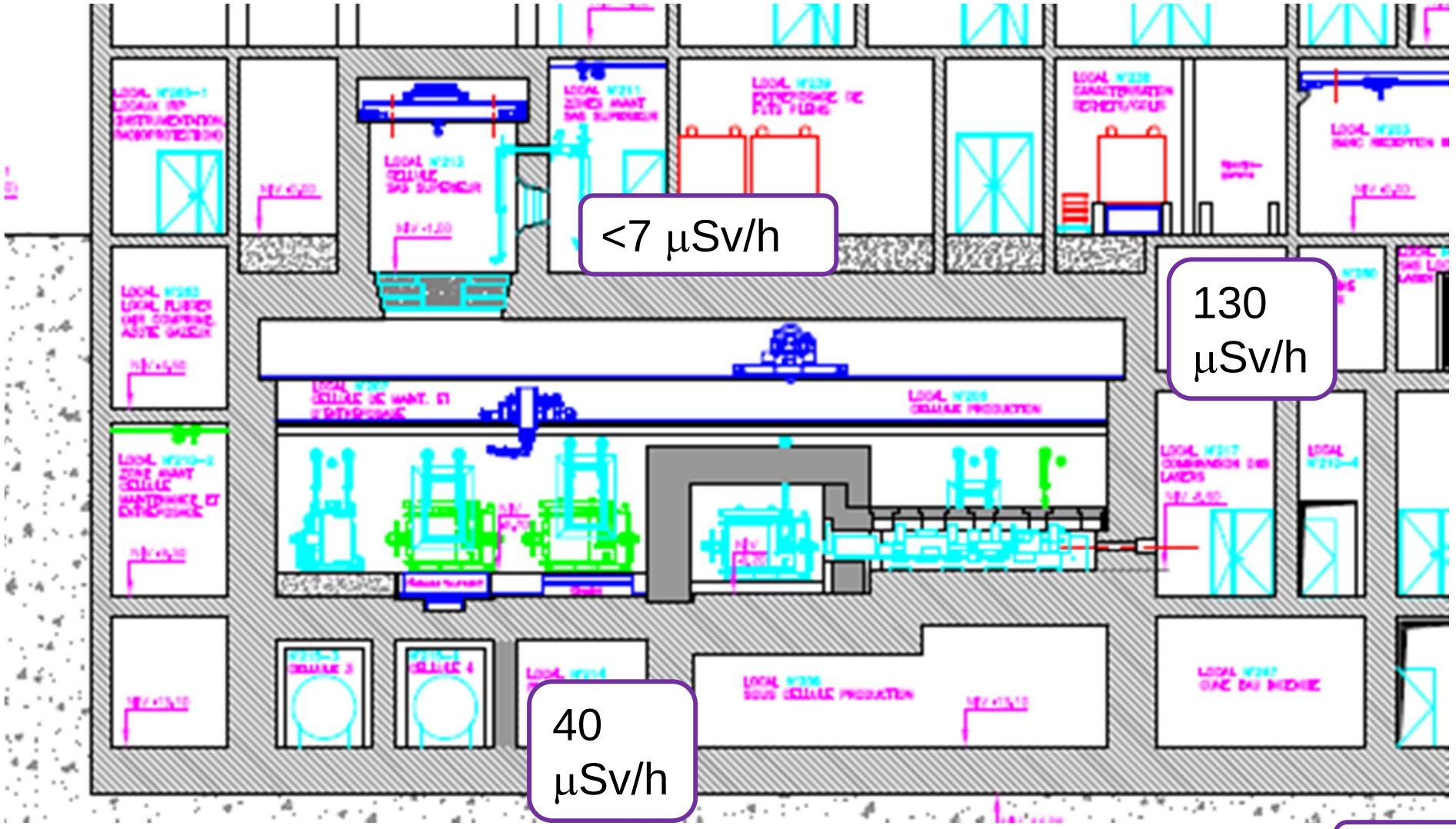


A. Savalle

Primary calculations of the Equivalent dose rates (EDR) -2



Primary calculations of the Equivalent dose rates (EDR) -3



A. Savalle

Acknowledgements

O. Bajeat, J. Bermudez, C. Lau, Y. Huguet, P. Jardin, N. Lecesne,G. Normand, F. de Oliviera A. Pichard, M. G. Saint Laurent, A. Savalle, L. Serani, L. Tecchio, …

SPIRAL 2 production module

Deutons

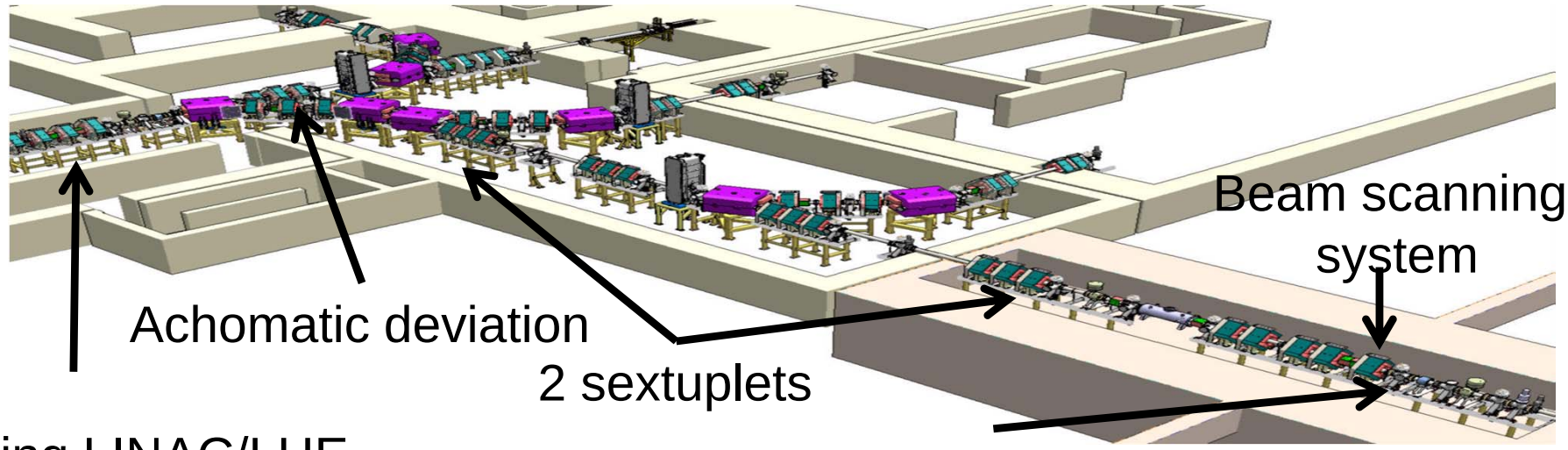
Deutons 50 kW	R min (1rms)	Nominal radius (1rms)	R max (1rms)
x	2.8	3.4	4
y	3.1	3.4	

Deutons 200 kW	R min (1rms)	Nominal radius (1rms)	R max (1rms)
x	6	7.1	8
y	6.5	7.1	8.5

1/3 and 1/6 ion beams

1/3 5 MeV/A	R min (1rms)	Nominal radius (1rms)	R max (1rms)
x	**1.9**	**2.2**	**2.7**
y	**1.9**	**2.2**	**2.9**

1/6 5 MeV/A	R min (1rms)	Nominal radius (1rms)	R max (1rms)
x	**1.9**	**2.2**	**2.8**
y	**1.7**	**2.1**	**2.7**



Ball bearings for the converter

Bearing Characteristic	WSP15312 RT4K4297	W6001 RT4K4298	W6002 RT4K4296
Material codification	W	W	W
Rings material	Stainless steel AFNOR X40CrMoVN16.2/ XD15NW		
Hardness	675 HV mini		
Temperature of use	Max <500		
Balls material	Ceramic AFNOR Si3N4		
Hardness	1050HV 10 mini		
Cage Material	Stainless steel X105CrMo17/ AISI:440C		
Lubricant	MoS2 Coating < 1 m		
Holes	40 mm	12 mm	15 mm
External Diameter	68 mm	28 mm	32 mm
Number of balls	20 (2x10)	8	9
Nominal contact angle	25°	15°	15°