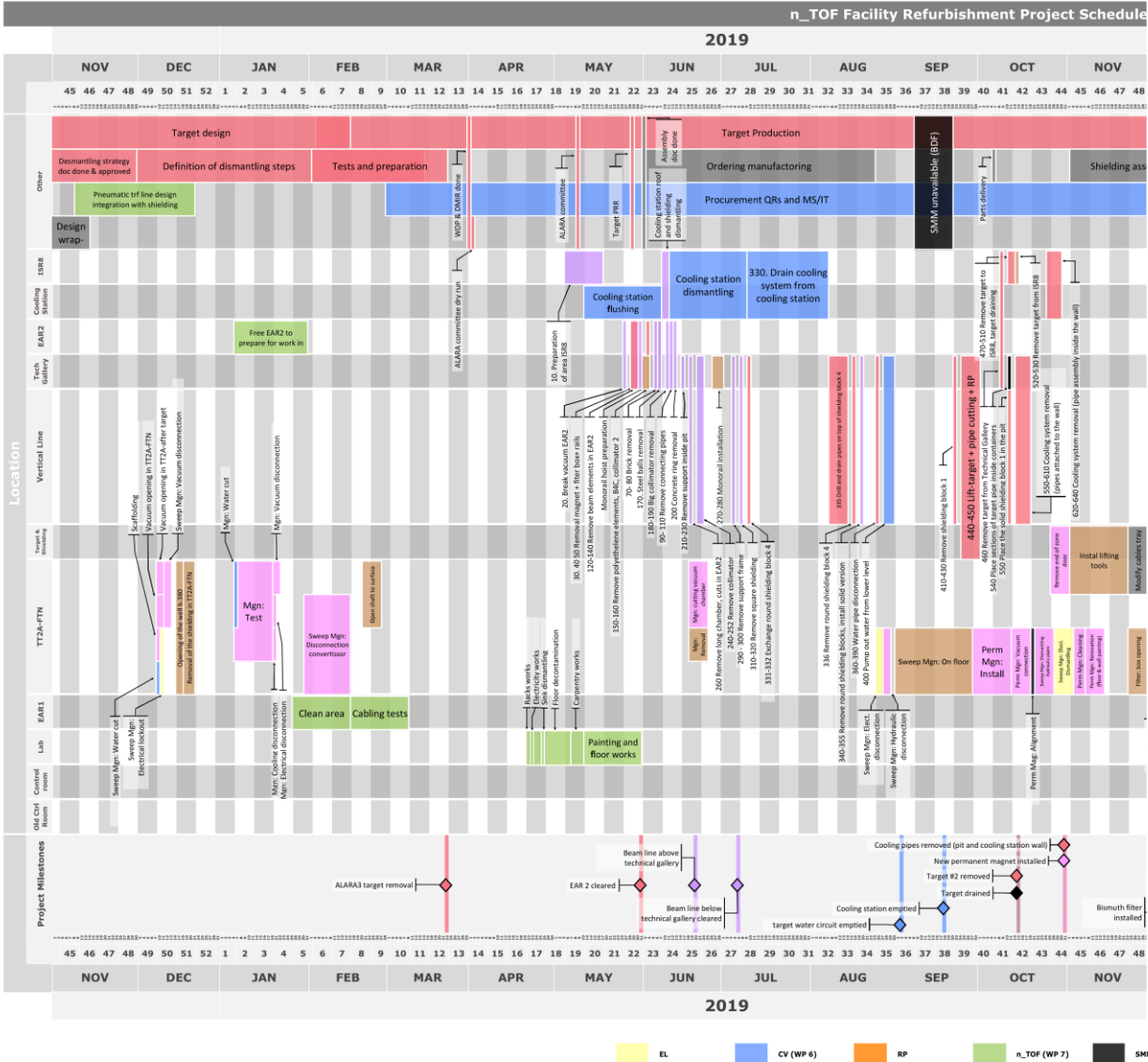
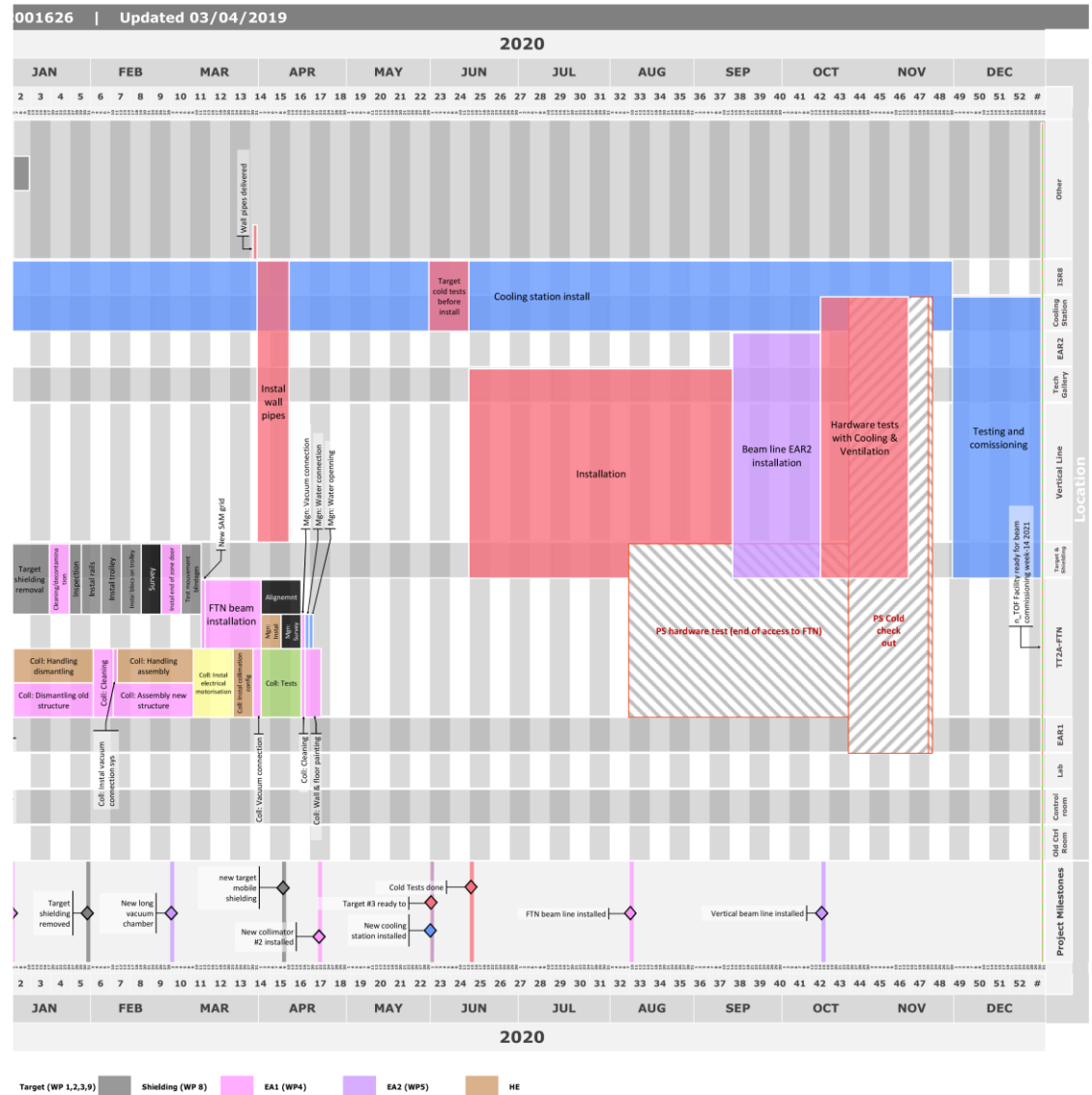


Report dal CERN

M. Barbagallo, L. Damone

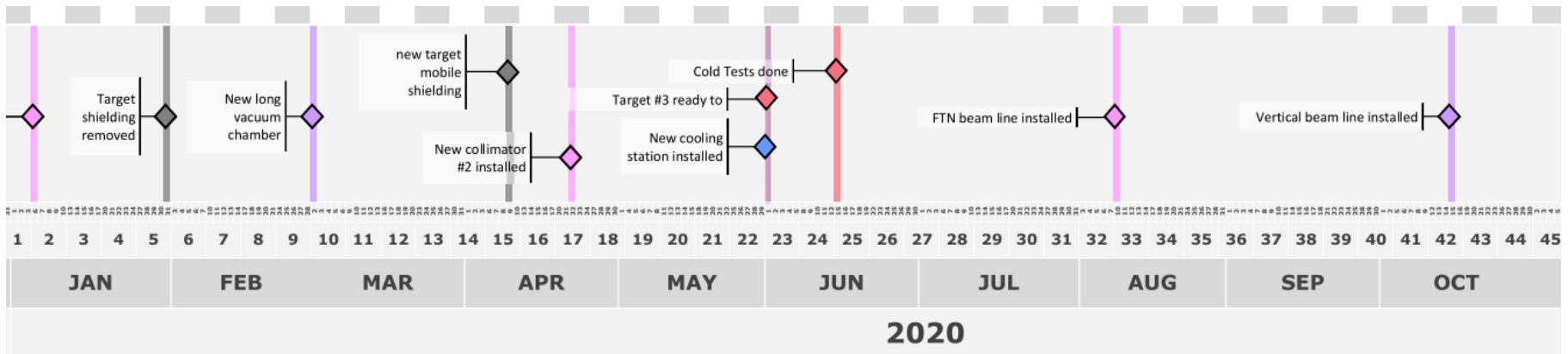
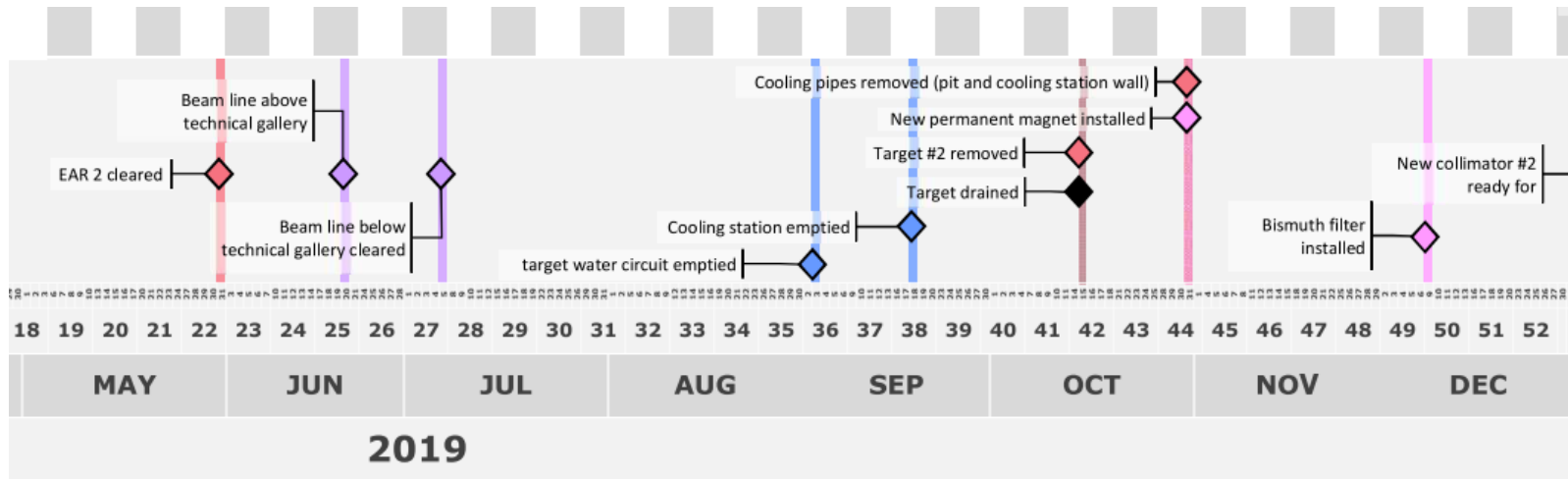


Upgrade Planning



Upgrade

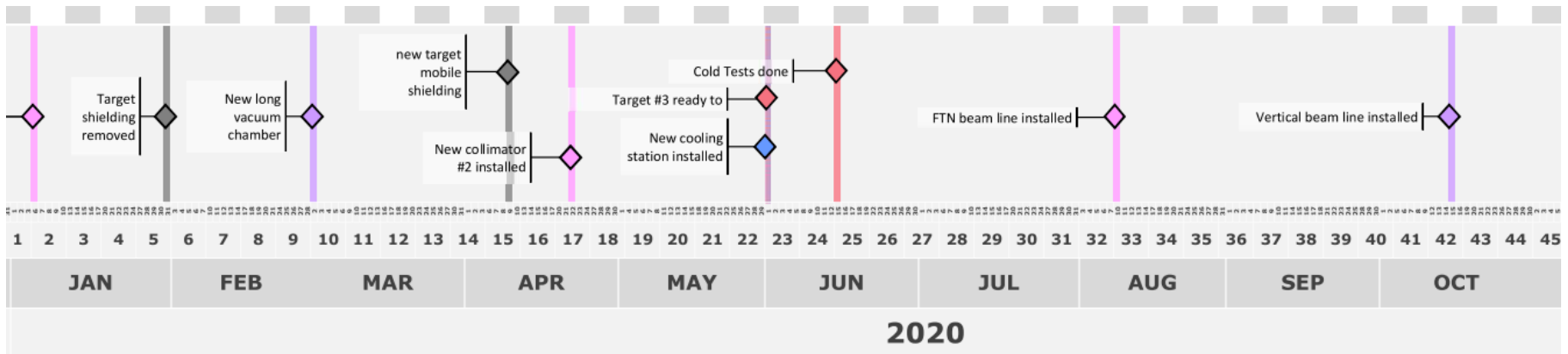
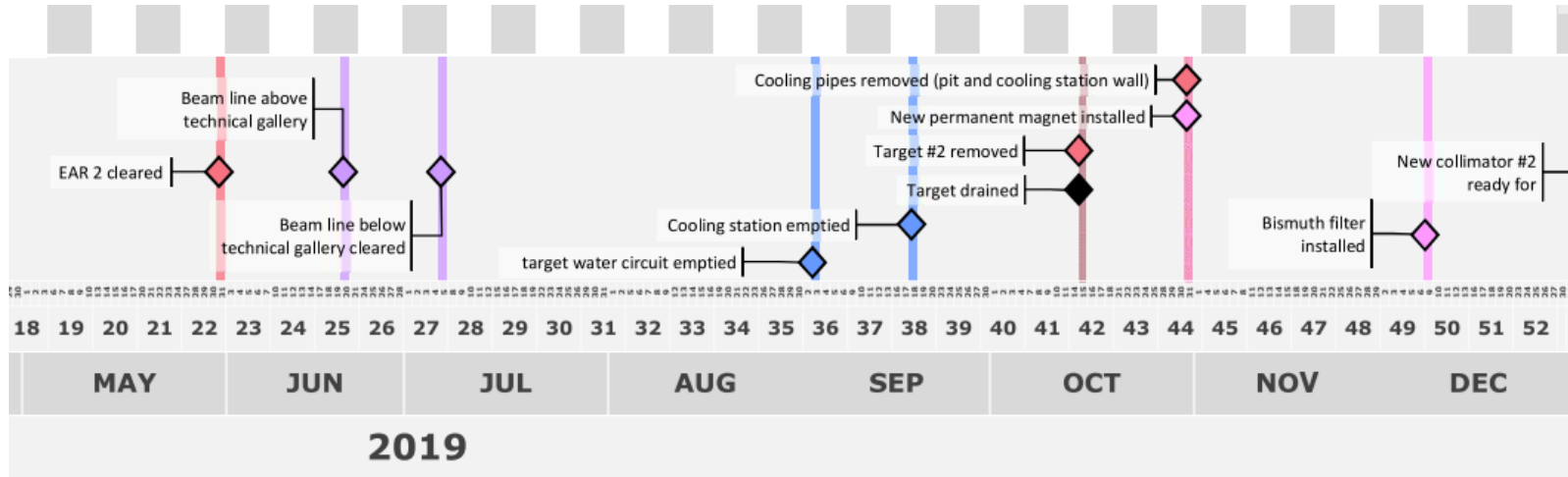
Intense period for facility upgrade:



Upgrade

First beam Spring 2021 (TBC)

Intense period for facility upgrade:

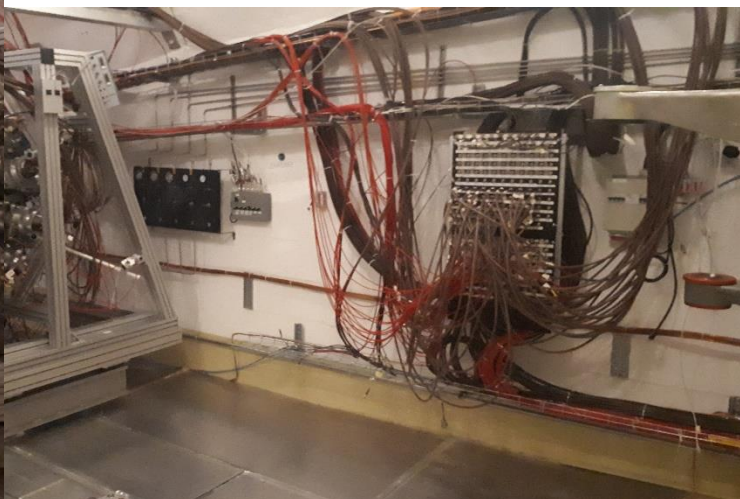


Intense period for facility upgrade:

- EAR1
- EAR2
- EAR3
- 547 (electronic lab)
- Control room
- Near station

Intense period for facility upgrade:

- EAR1



Intense period for facility upgrade:

- EAR1 and beam line
 - Extended ventilation system
 - New collimator (remotely moveable)
 - Re-cabling from the Rack area to the Bunker and from the bunker to the old control room
 - Removal of asbestos
 - Grounding improvement (from Rack area to bunker)
 - Removal of the sweeping magnet – installation of the new one
 - Consolidation of the alignment system
 - New long pipes in carbon fiber

Intense period for facility upgrade:

- EAR2 and beam line
 - Consolidation gas point
 - Consolidation alignment system (4 lasers at 90 degrees rather than 3 at 120 degrees)
 - New material room

Intense period for facility upgrade:

- EAR3 (Dump EAR1, so far for detector tests)
 - FIC chamber, 1 m available between dump and endcap of EAR1 beam line
 - Dedicated trigger (e.g. bunch-type)
 - Dedicated crate and electronic
 - New material room

Intense period for facility upgrade:

- 547 (Electronic Lab)
 - Laboratory completely dismantled and renewed

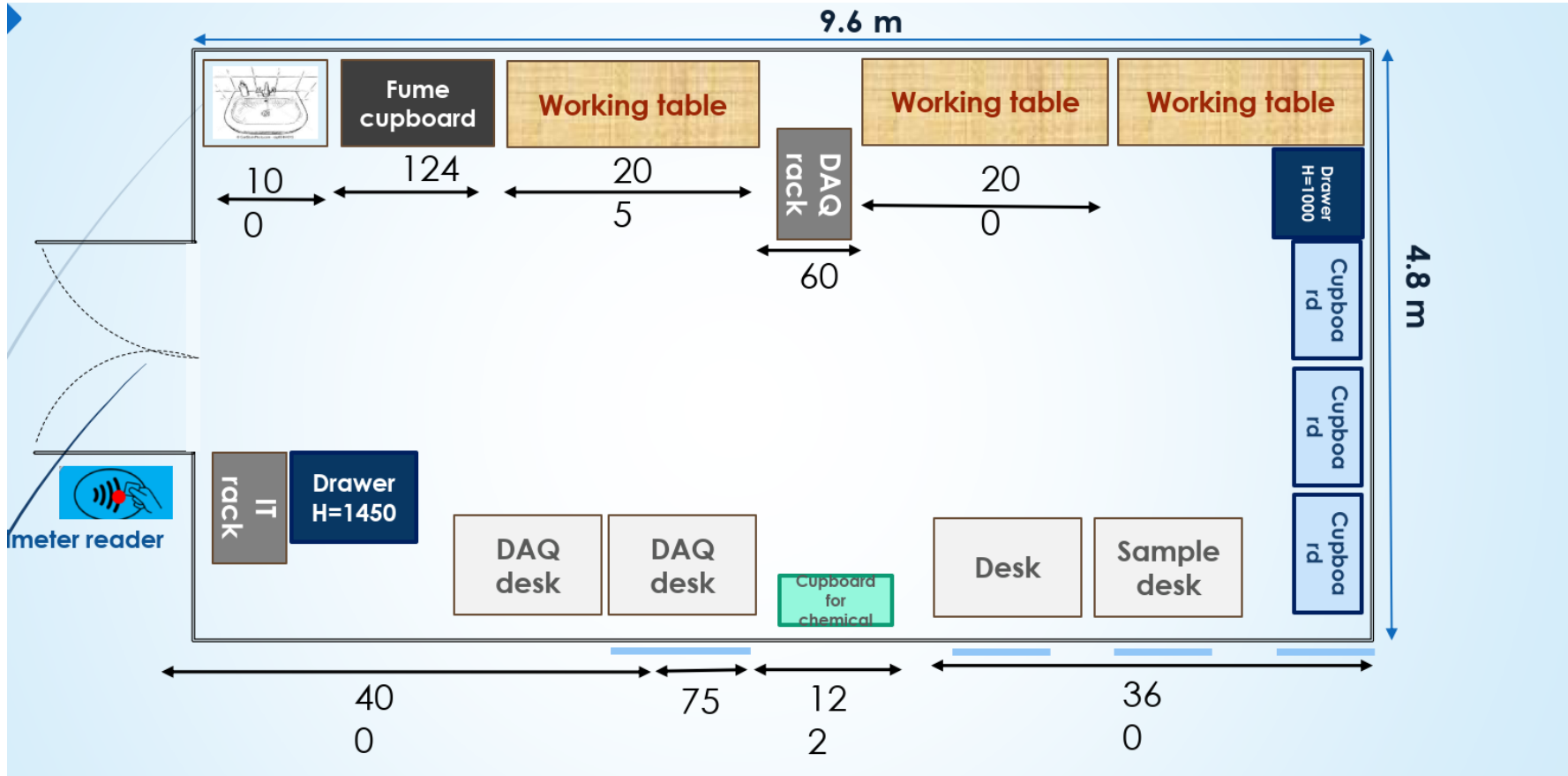


Upgrade

Intense period for facility upgrade:

Laboratory usable by mid Summer

- 547 (Electronic Lab)
 - Laboratory completed dismantled and renewed

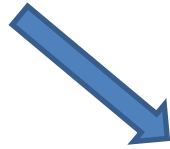


Intense period for facility upgrade:

- Control Room (603)

Intense period for facility upgrade:

- Control Room (603)



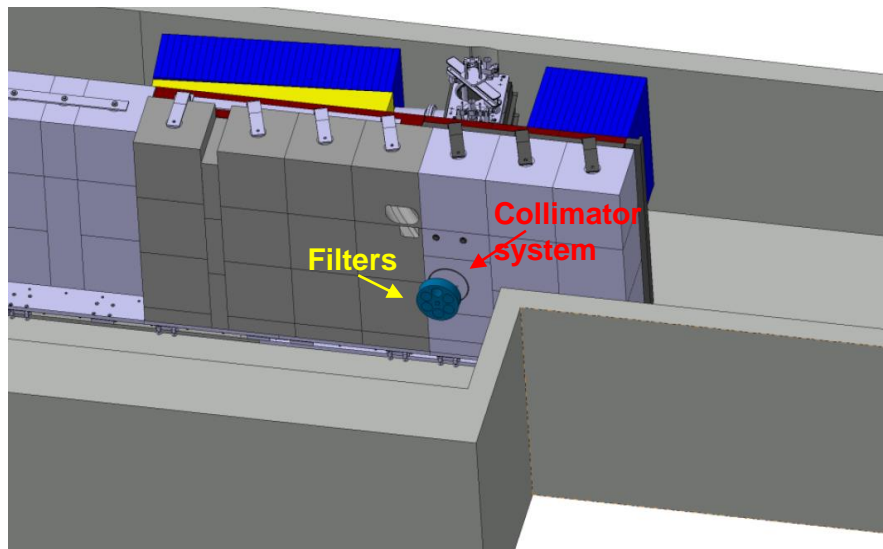
506

Intense period for facility upgrade:

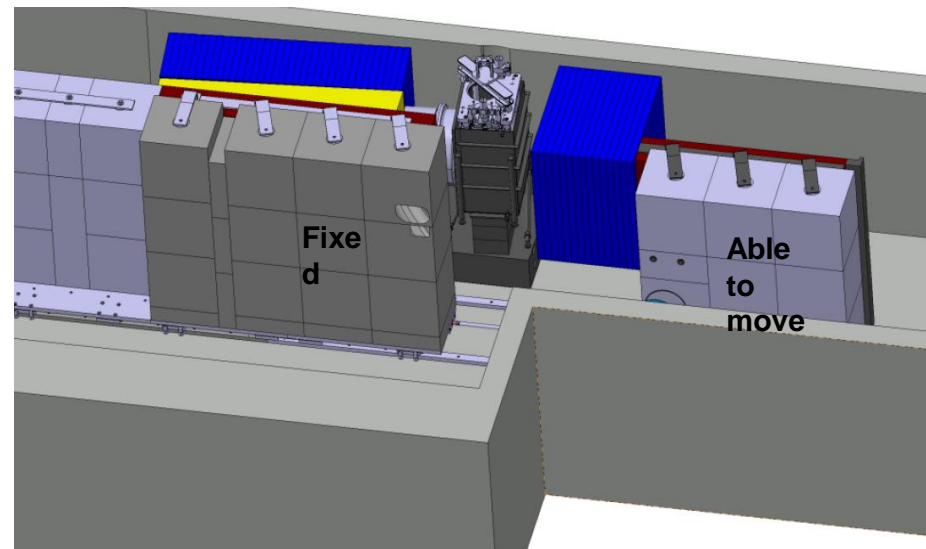
- NEAR

IMPLEMENTATION PROPOSAL

PHASE 1 (during LS2): modification of the current fixed target shielding around the spallation target in order to fit a mobile version allowing to access the target pit.



Shielding closed (beam on)



Shielding opened (beam off) for access operation

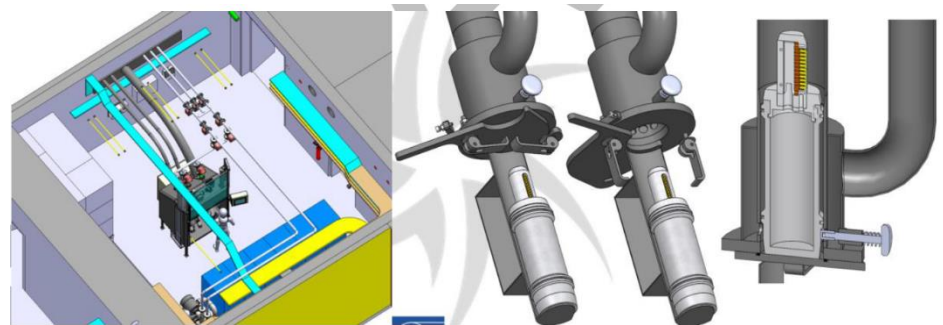
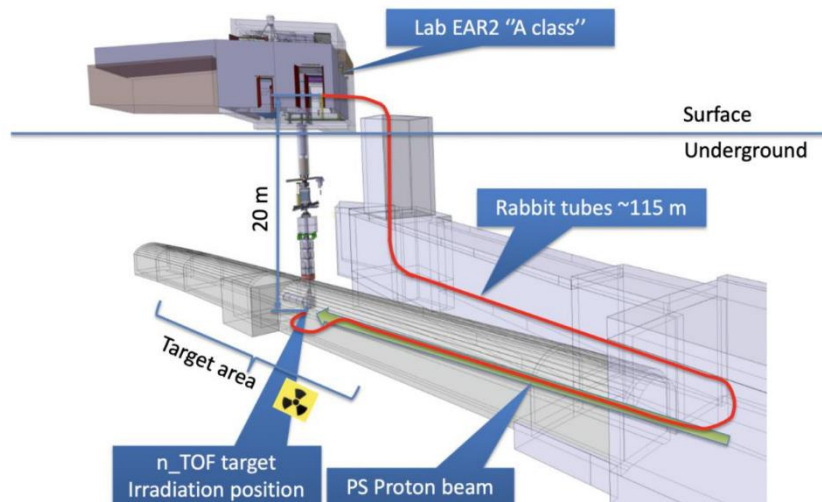
2019-06-20

LUCIA ANNA DAMONE

IMPLEMENTATION PROPOSAL

PHASE 2 (during Technical Stop between 2021-2022): Opening of the collimator hole and insertion of a dedicated collimation system; A moderator assembly will be installed to shape the emerging neutron beam in order to match the most appropriate requirements; An appropriate «dump» will be put on the wall opposite side in order to avoid significant activation of the tunnel walls.

PHASE 3 (during Technical Stop between 2022-2023): A pneumatic rabbit system will be implemented for the irradiation of samples from the n_TOF target pit to a received station. Full decoupling of the irradiation scenarios from the operation of the Facility.

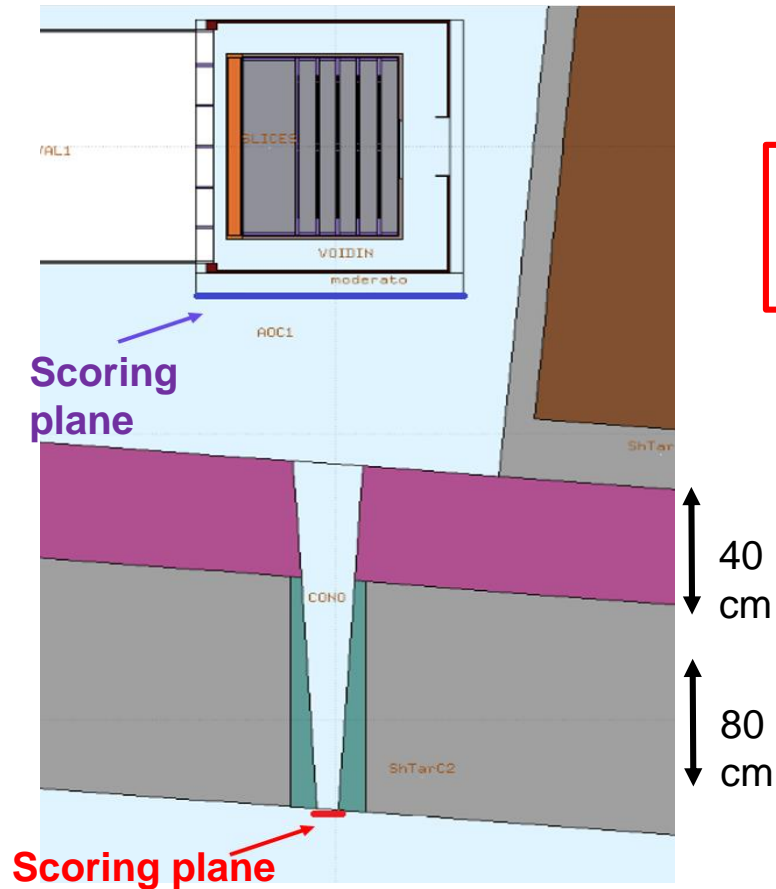


Sketch of the **receiving** and **sending** station to be located in the n_TOF Experimental Area 2.

2019-06-20

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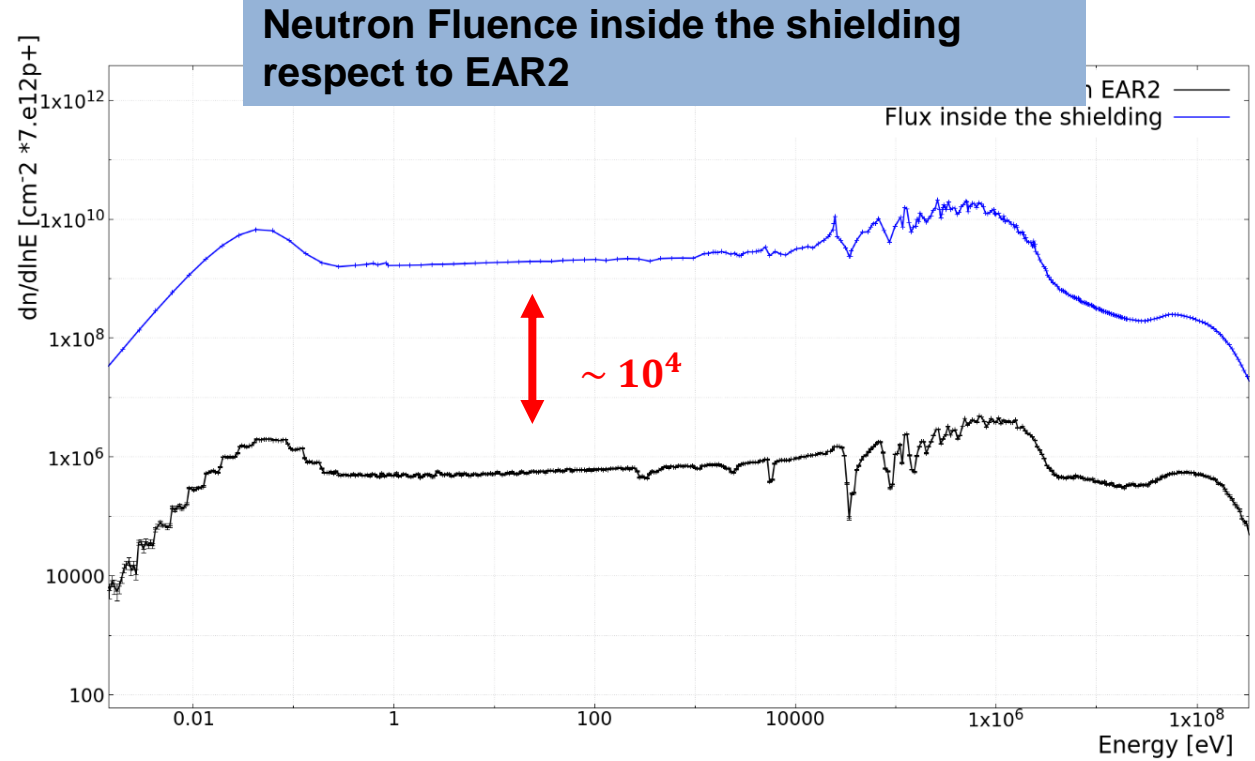
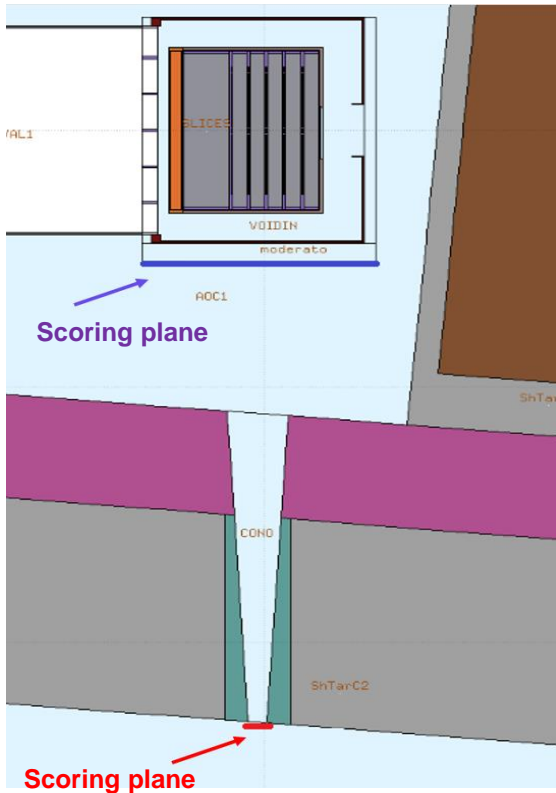
PRELIMINARY GEOMETRY



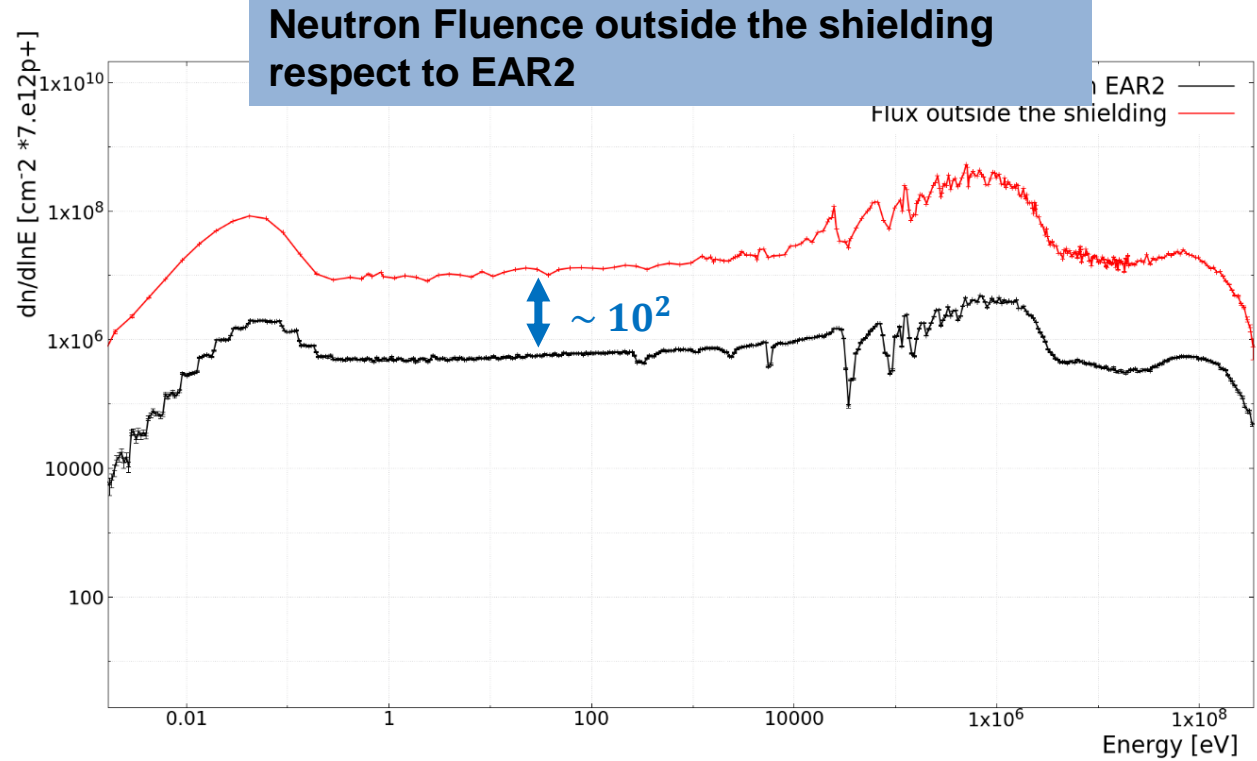
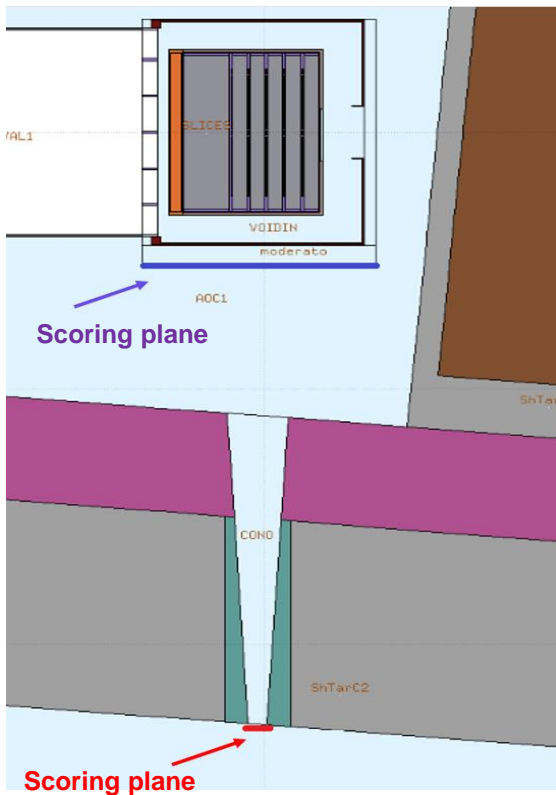
This is a tentative and preliminary geometry that could be modified according to needs!

Cone:
base radius: 10.5 cm
apex radius: 3 cm

RESULTS FROM SIMULATIONS

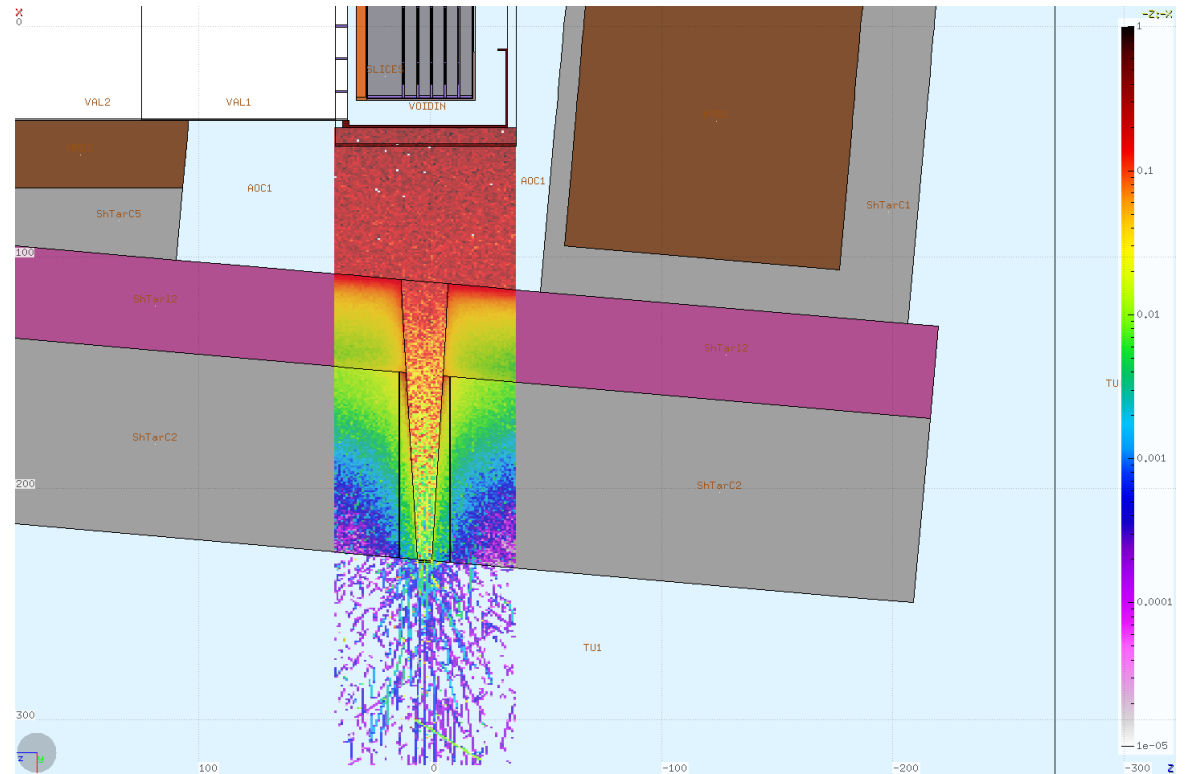
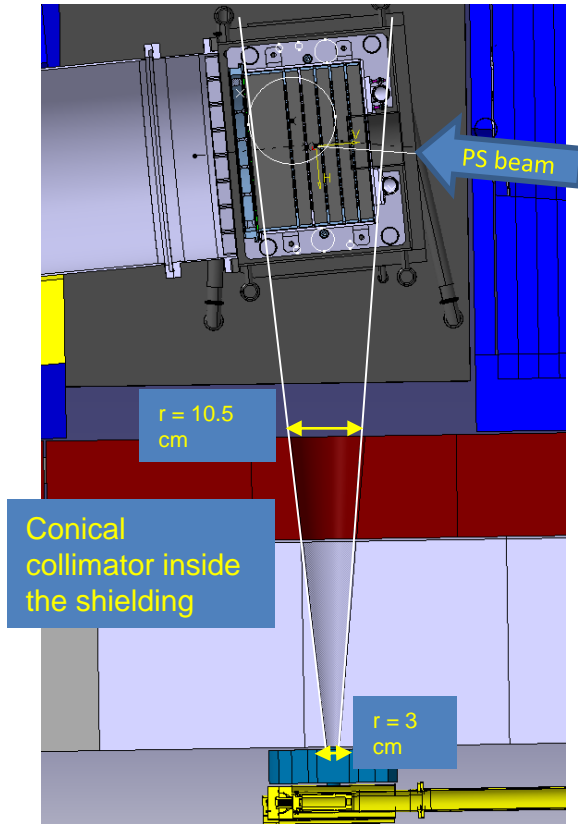


RESULTS FROM SIMULATIONS

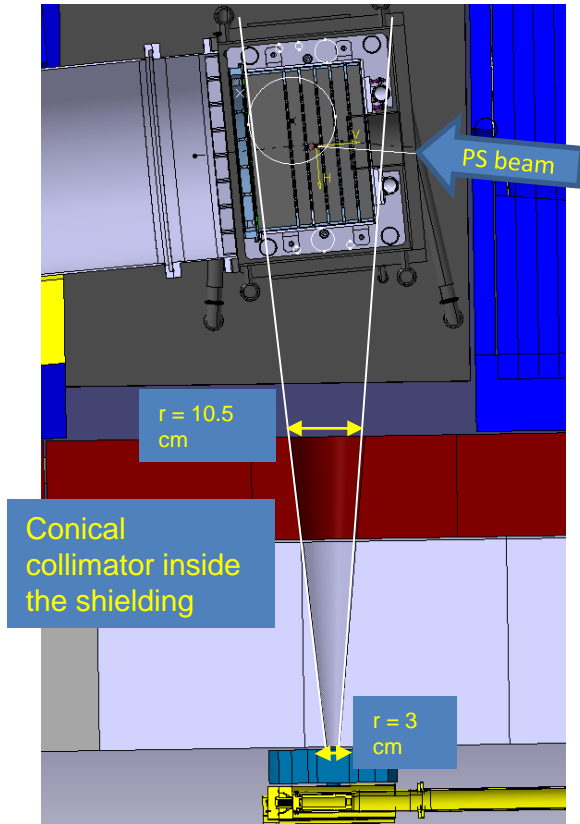


RESULTS FROM SIMULATIONS

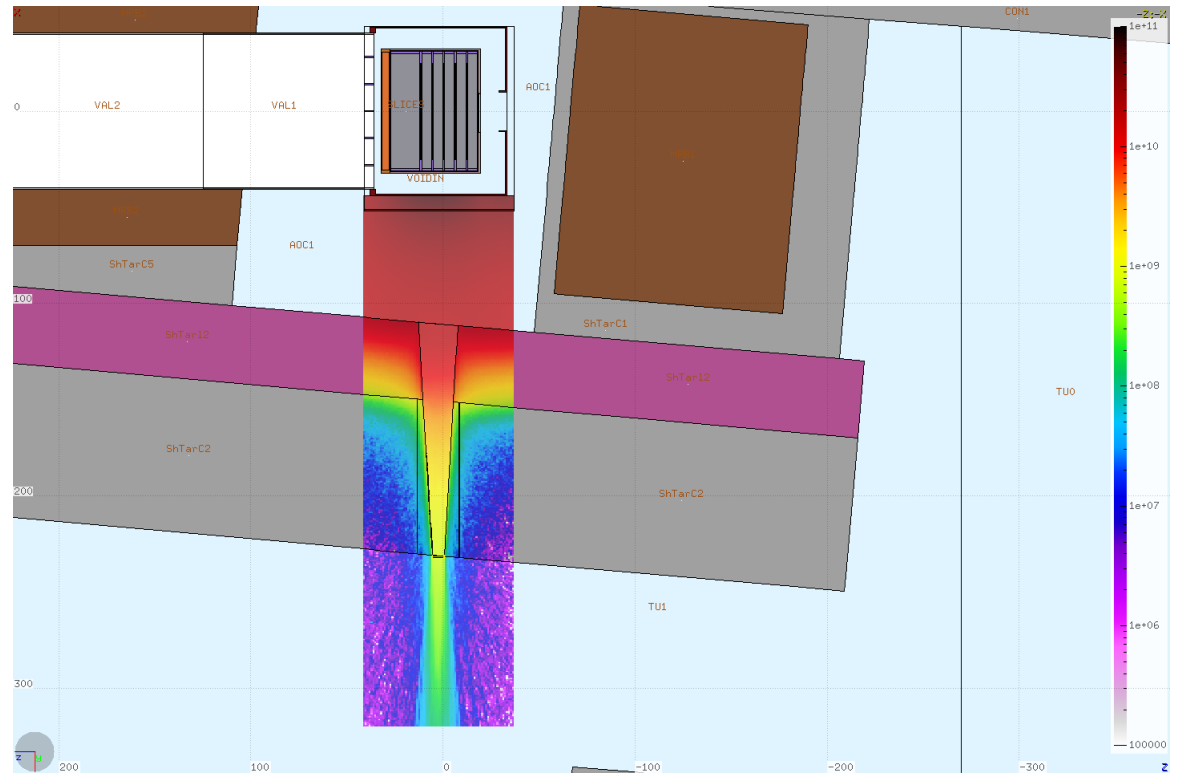
Simulated **dose (Gy per pulse)** from the exit of the target up to 100 cm from the conical collimator



RESULTS FROM SIMULATIONS

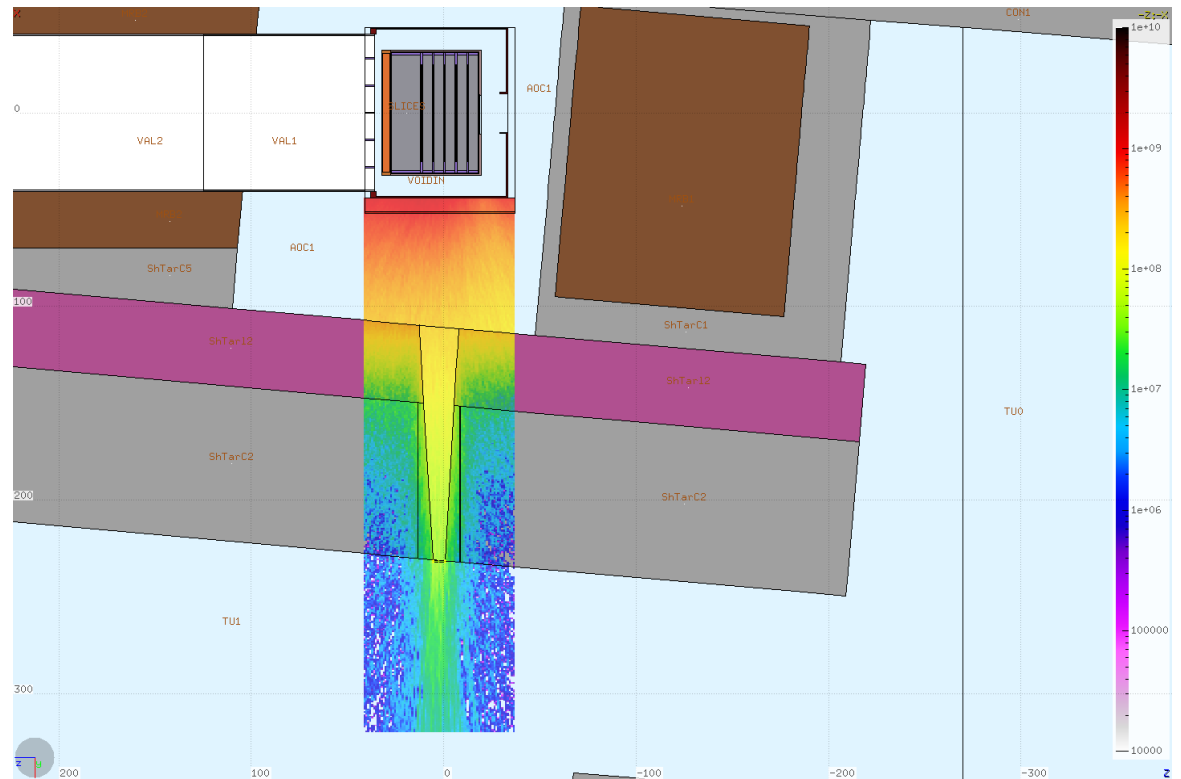
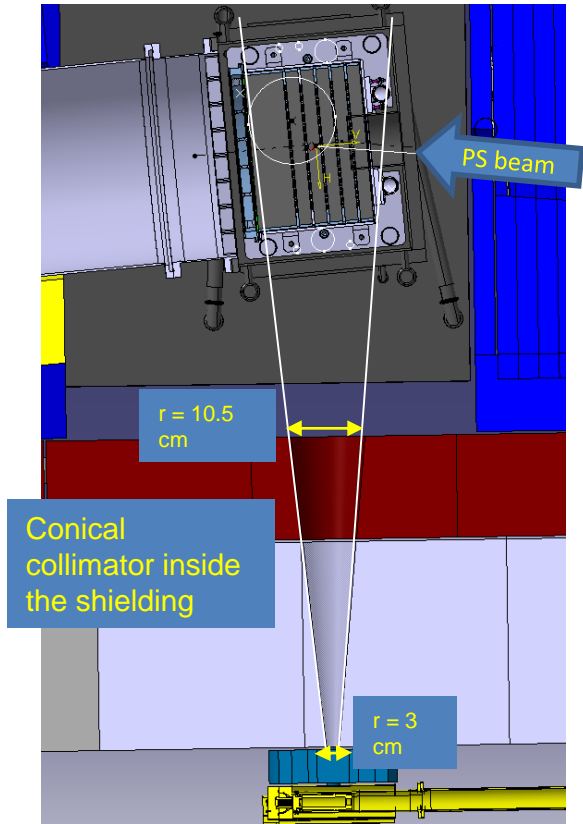


Si1MeVneq (per pulse) from the exit of th target up to 100 cm from the conical collimator



RESULTS FROM SIMULATIONS

High energy neutron fluence (per pulse) from the exit of the target up to 100 cm from the conical collimator



PRELIMINARY RESULTS FROM SIMULATIONS

Pulses per day at n_TOF ~ **15000**

General R2E limits

- Typical values above which equipment based on commercial-of-the-shelf (COTS) components needs to be qualified against radiation effects

Quantity	General R2E limit
TID	10 Gy (lifetime)
DD	10^{12} n _{eq} /cm ² (lifetime)
HEH fluence	10^7 HEH/cm ² /yr (annual)

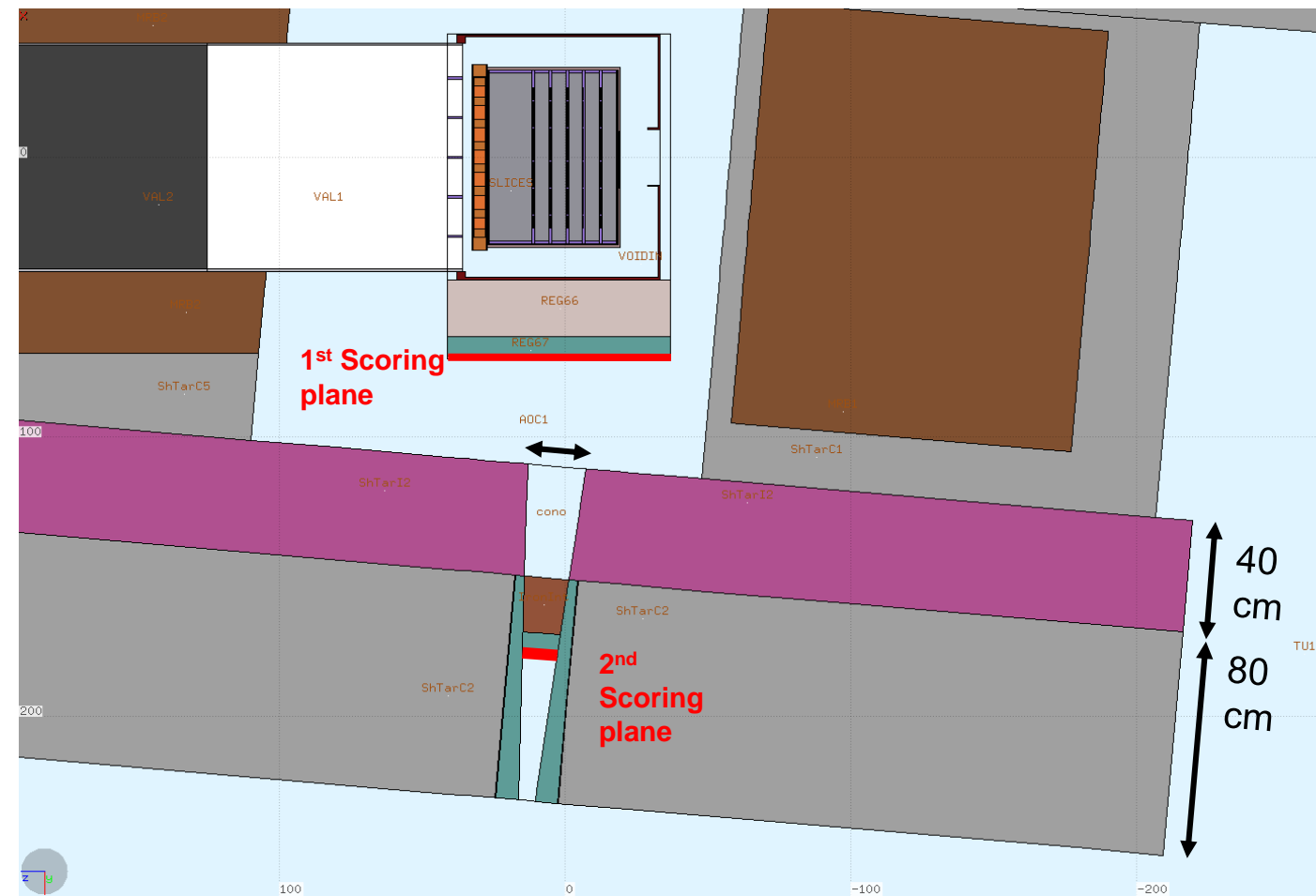
To be applied with caution, as actual values will depend on e.g. technology type, number of systems, failure criticality, etc.



1

	Inside the shielding	Outside the shielding
Dose	0.5 Gy/pulse	8×10^{-3} Gy/pulse
Si1MeVneq	4.58×10^{10} n _{eq} /cm ² /pulse	7.44×10^8 n _{eq} /cm ² /pulse
HEH	8×10^8 HEH/cm ² /pulse	4.6×10^7 HEH/cm ² /pulse

MODERATORS AND SCORING POSITION TESTED



Moderators

Fe 5, 10, 20
cm

or

Be 5, 10, 20
cm

*To reduce the fast
neutrons*

+

Pol 7 cm

*To increase the
thermal neutrons*

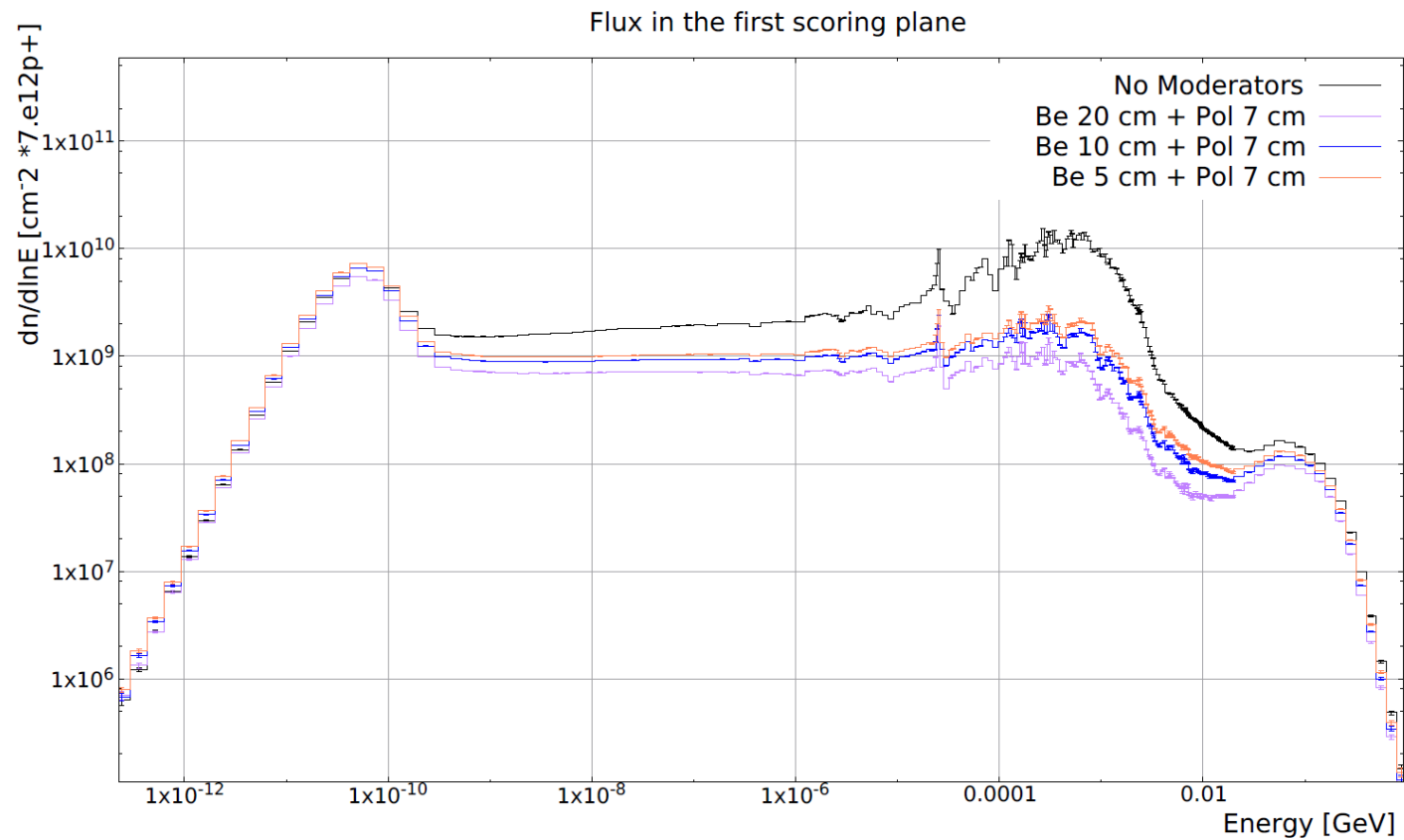
Position

1st Scoring plane

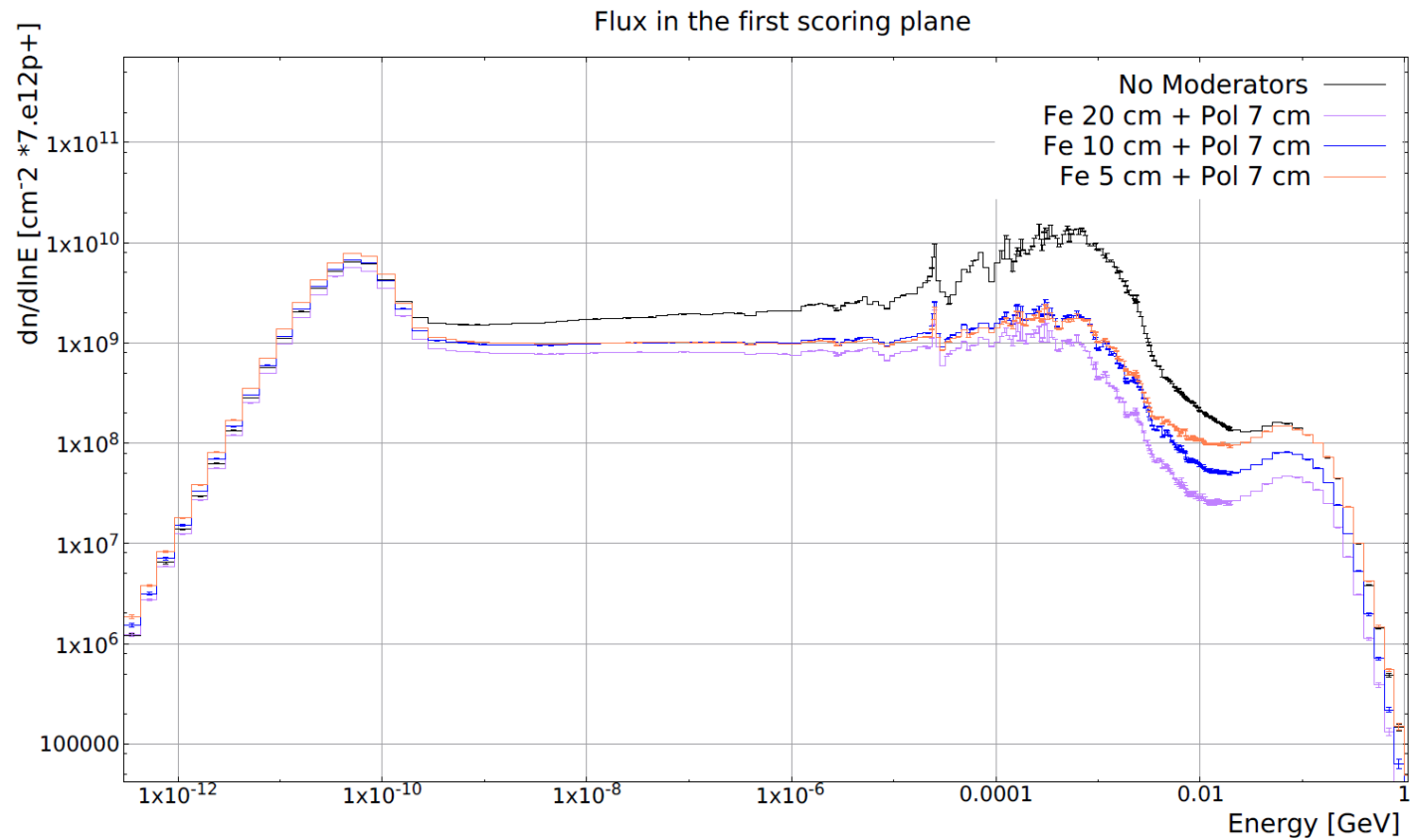
and

**2nd Scoring
plane**

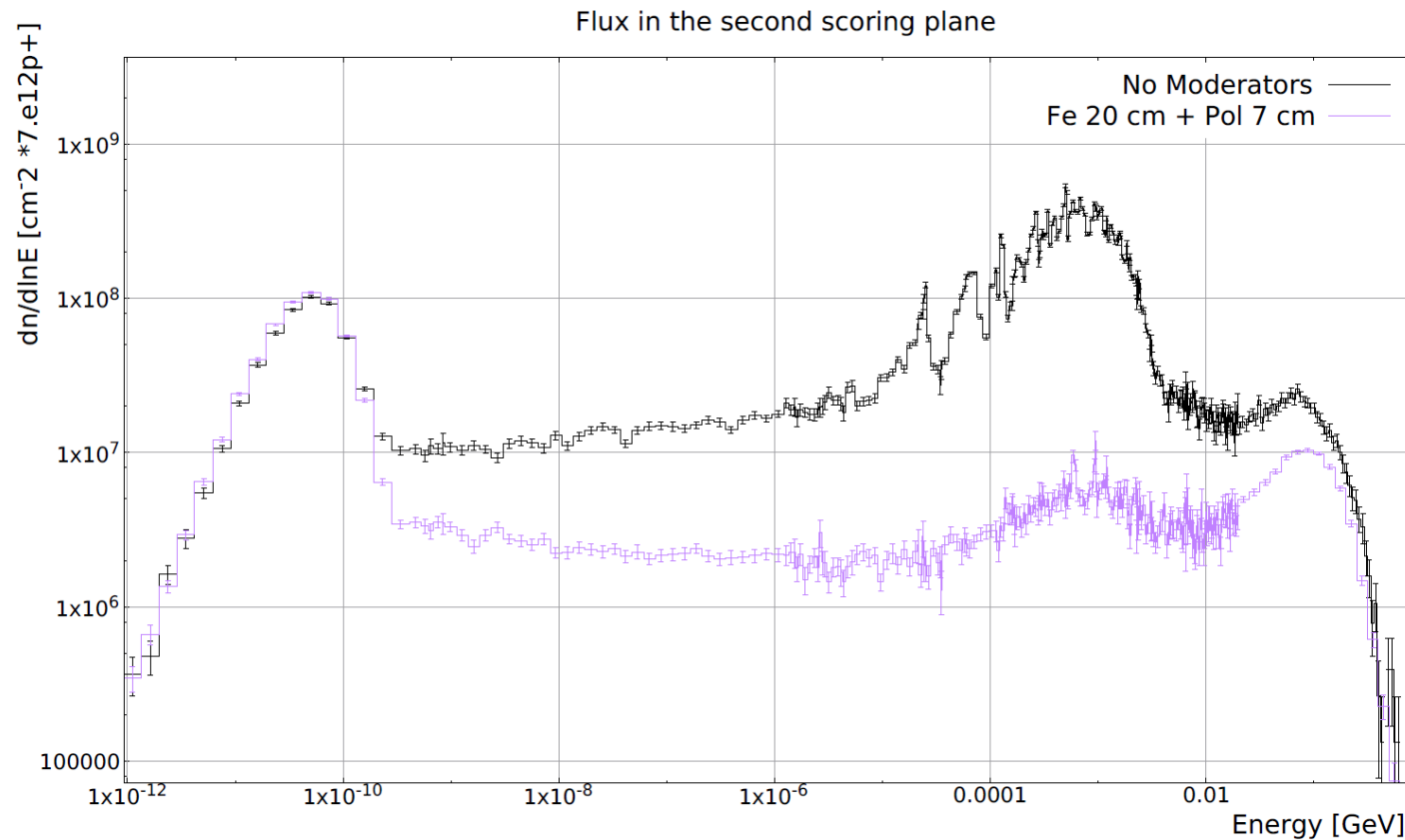
MODERATORS AND SCORING POSITION TESTED



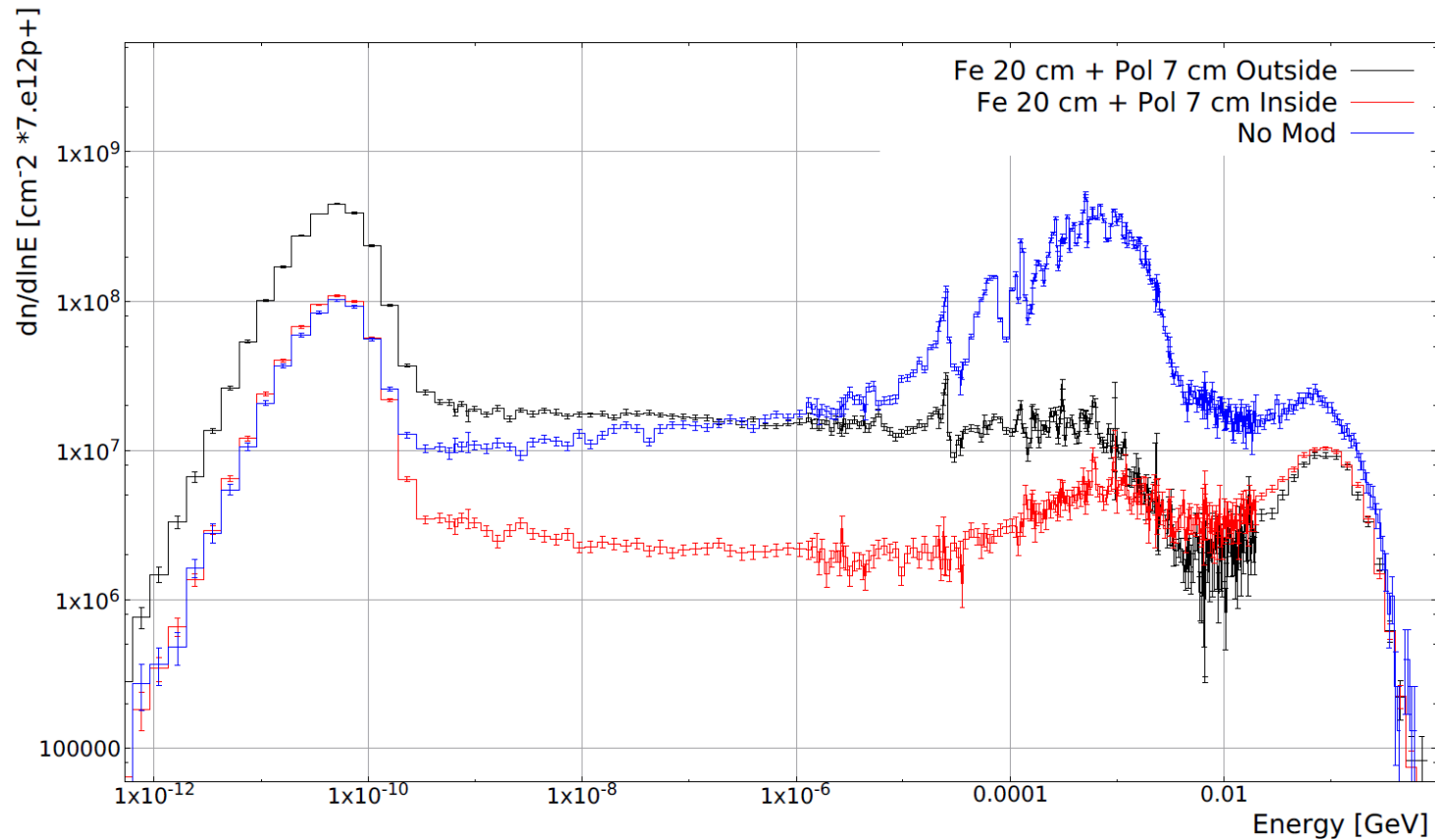
MODERATORS AND SCORING POSITION TESTED



MODERATORS AND SCORING POSITION TESTED



MODERATORS AND SCORING POSITION TESTED



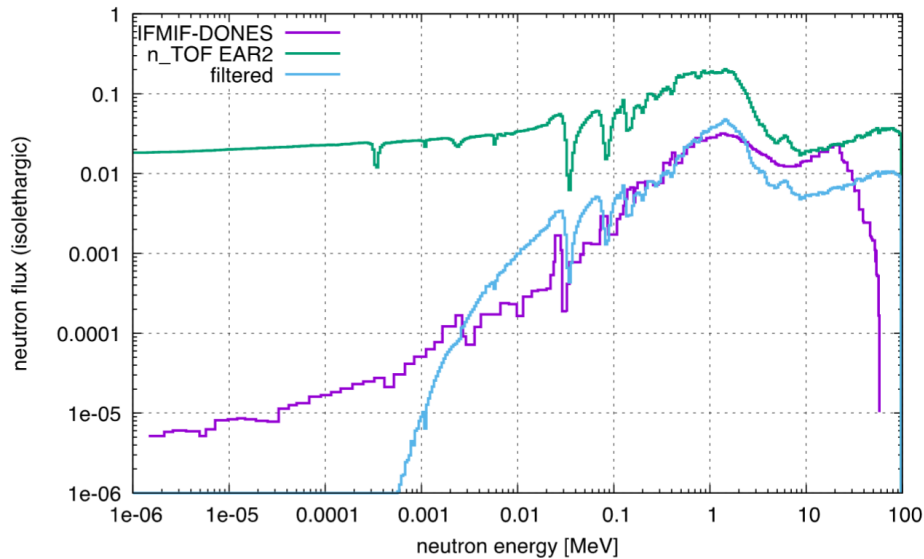
SUMMARY

1st Scoring plane	Thermal Energy	~ 1 MeV	~ 100 MeV
5 cm Fe + 7 cm Pol	Factor 1.2	Factor 6.2	Factor /
10 cm Fe + 7 cm Pol	Factor /	Factor 7	Factor 2
20 cm Fe + 7 cm Pol	Factor -1.2	Factor 12	Factor 4
5 cm Be + 7 cm Pol	Factor 1.12	Factor 6	Factor 1.3
10 cm Be + 7 cm Pol	Factor /	Factor 8	Factor 1.4
2st Scoring plane	Thermal Energy	~ 1 keV	~ 100 keV
20 cm Fe + 7 cm Pol	Factor 1.2	Factor 58	Factor 2

FURTHER POSSIBLE APPLICATIONS

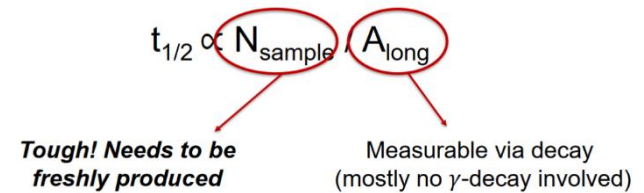
Testing, validation and qualification of the materials to be used in a fusion reactor

Filters: 0.5 cm Cd + 2.5cm B-10

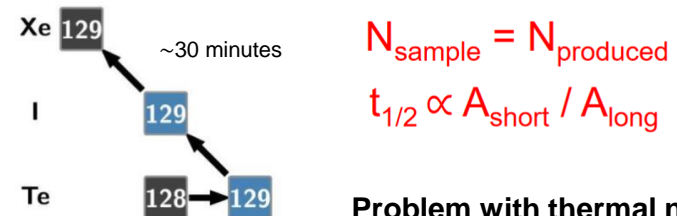


Determination of long half lives using high-energy neutrons at NEAR

Problem: slow decay → only activity can be measured

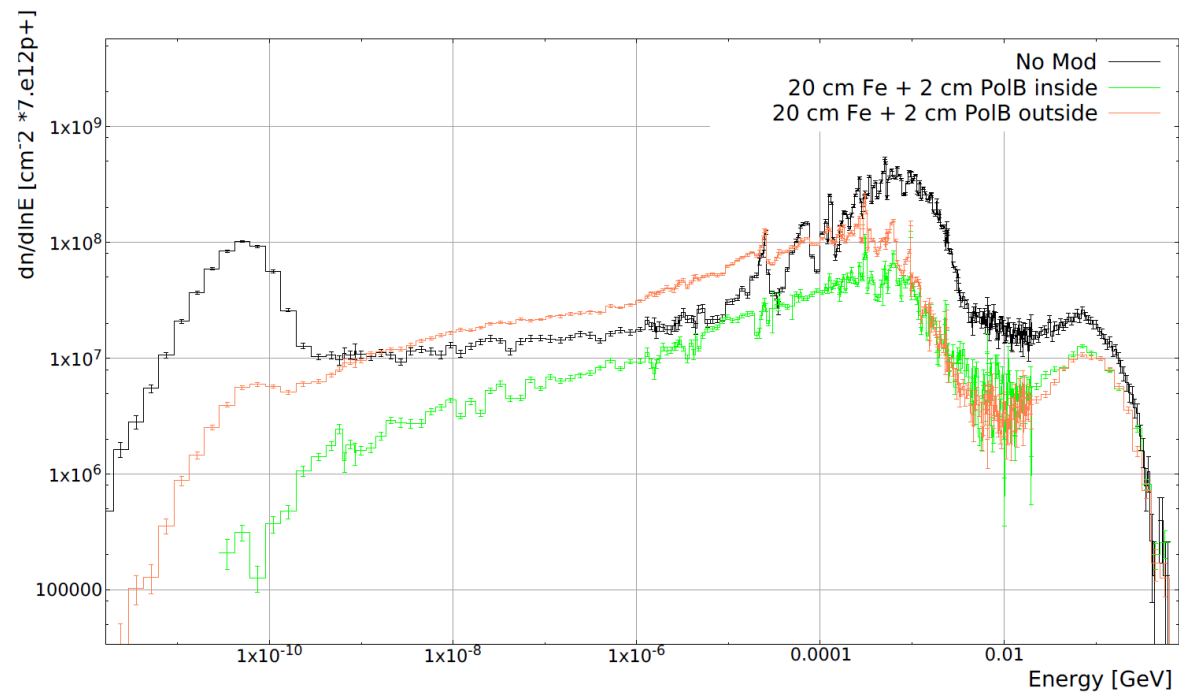
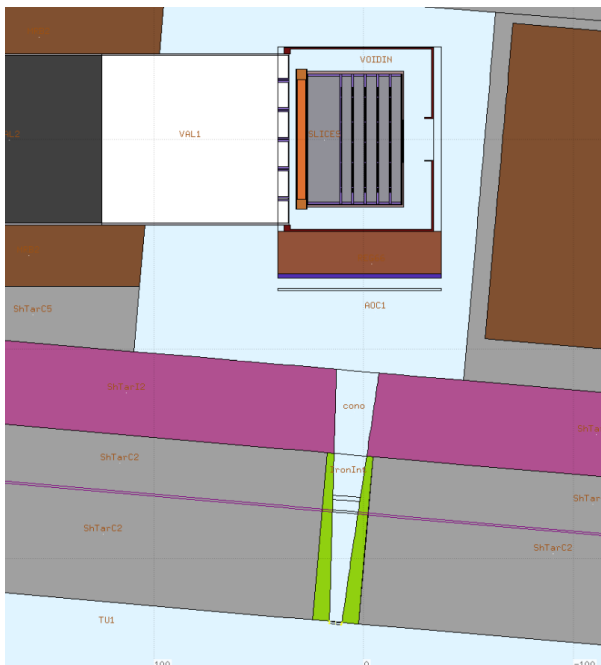


Way out: N_{sample} determined via short decay



Problem with thermal neutrons:
Contaminations!

MODERATORS AND SCORING POSITION TESTED



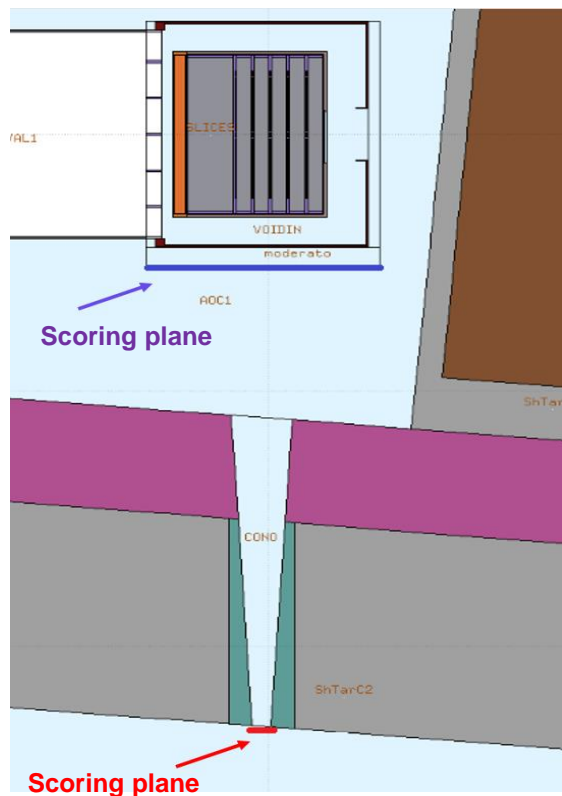
2019-06-20

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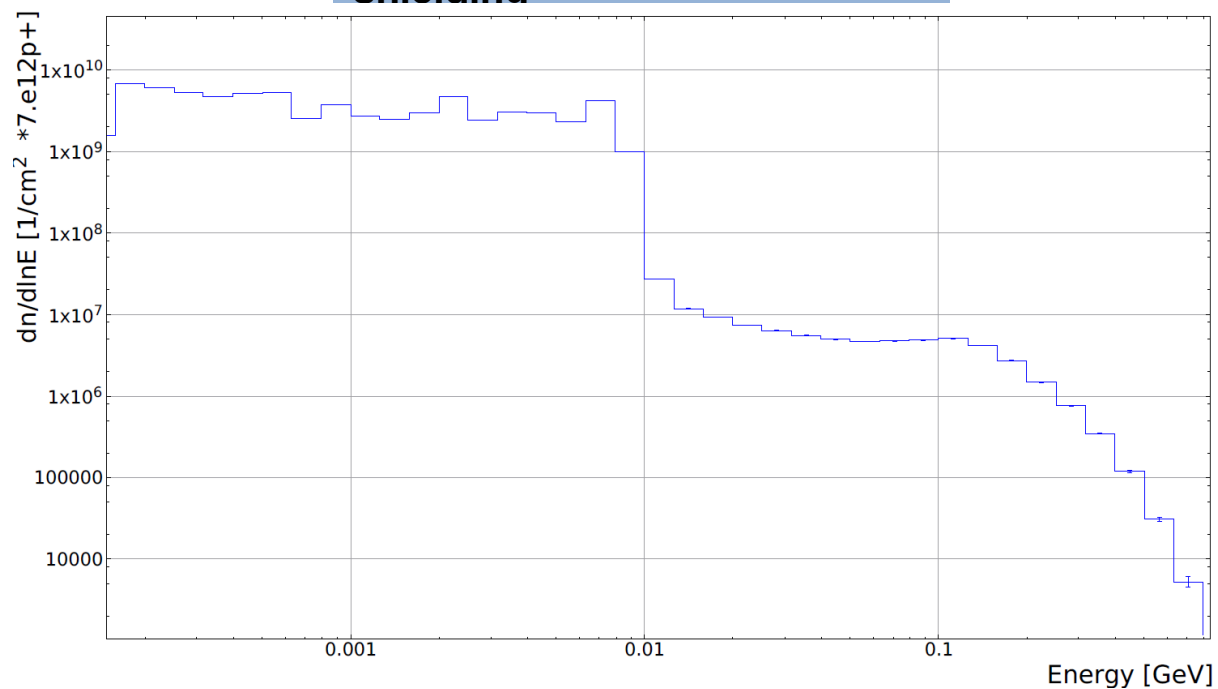
THANK YOU

BACK UP SLIDES

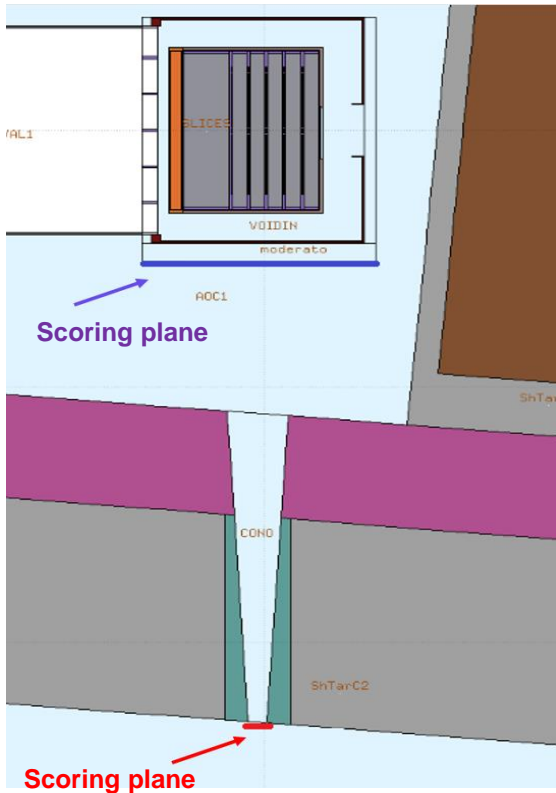
RESULTS FROM SIMULATIONS



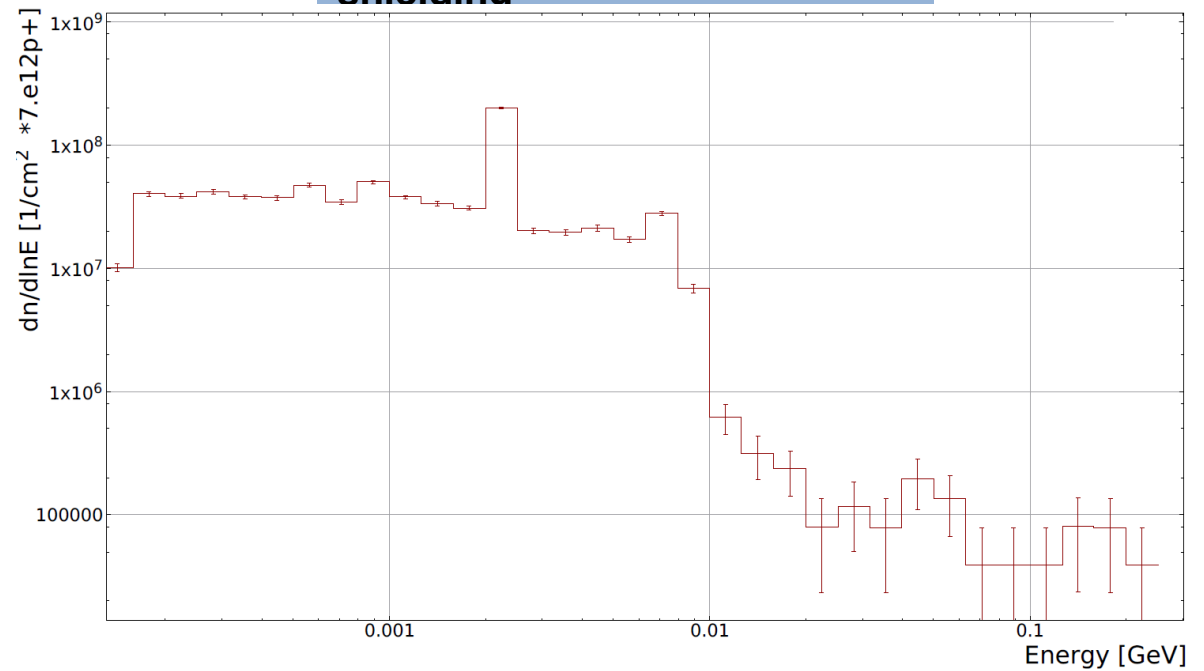
Photon Fluence inside the shielding



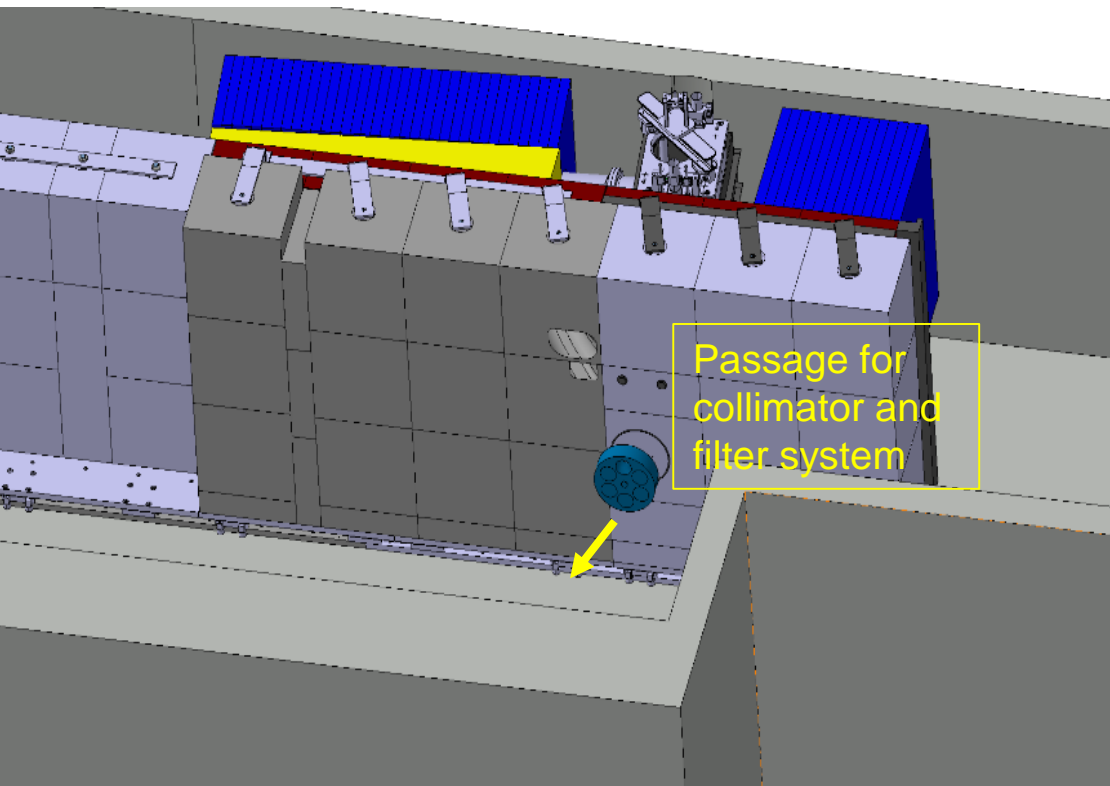
RESULTS FROM SIMULATIONS



Photon Fluence outside the shielding



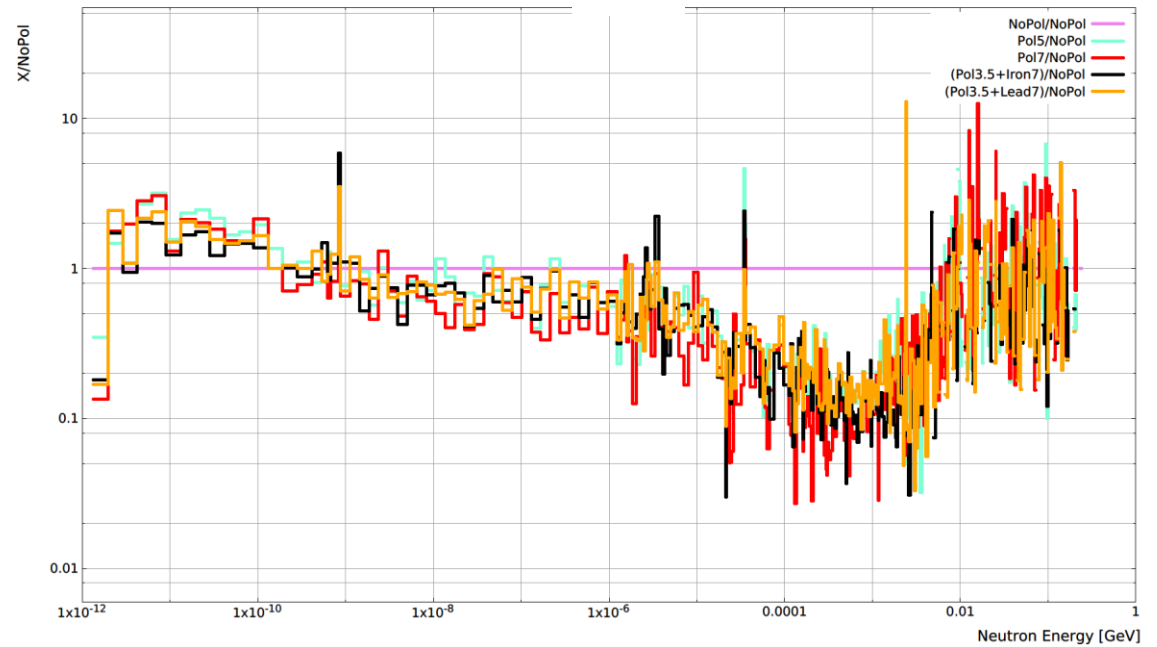
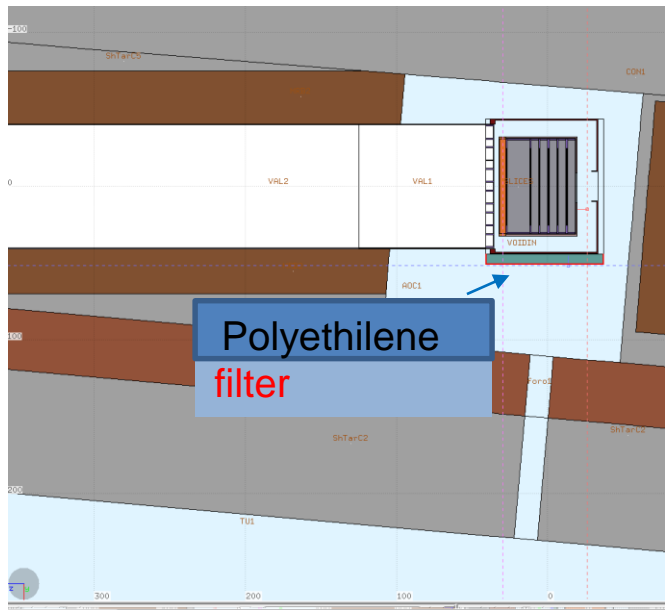
COMBINATION OF FILTERS



List of filters that could be used

Rh	1.3 eV
Au	4.9 eV
Ag	5.2 eV
W	18.8 eV
Ge	102 eV
Co	132 eV
Bi	800 eV
Na	2.850 eV
S	102.7 eV

TEST OF MODERATORS FOR IMAGING



COMBINATION OF MODERATORS FOR IMAGING

