

# New NEAR Irradiation Station at n\_TOF: design implementation and first results

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J.Praena [EP-SME] , J.-F.Gruber, F.Pozzi, A.Makovec [HSE-RP], A.Mengoni  
[EP-UNT], the NEAR Working Group and many others...

R2E Annual Meeting – 1-2 March, 2022

<https://indico.cern.ch/event/1116677/>



# REFERENCE

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## Design development and implementation of the NEAR area and its neutron irradiation station at the n\_TOF facility at CERN

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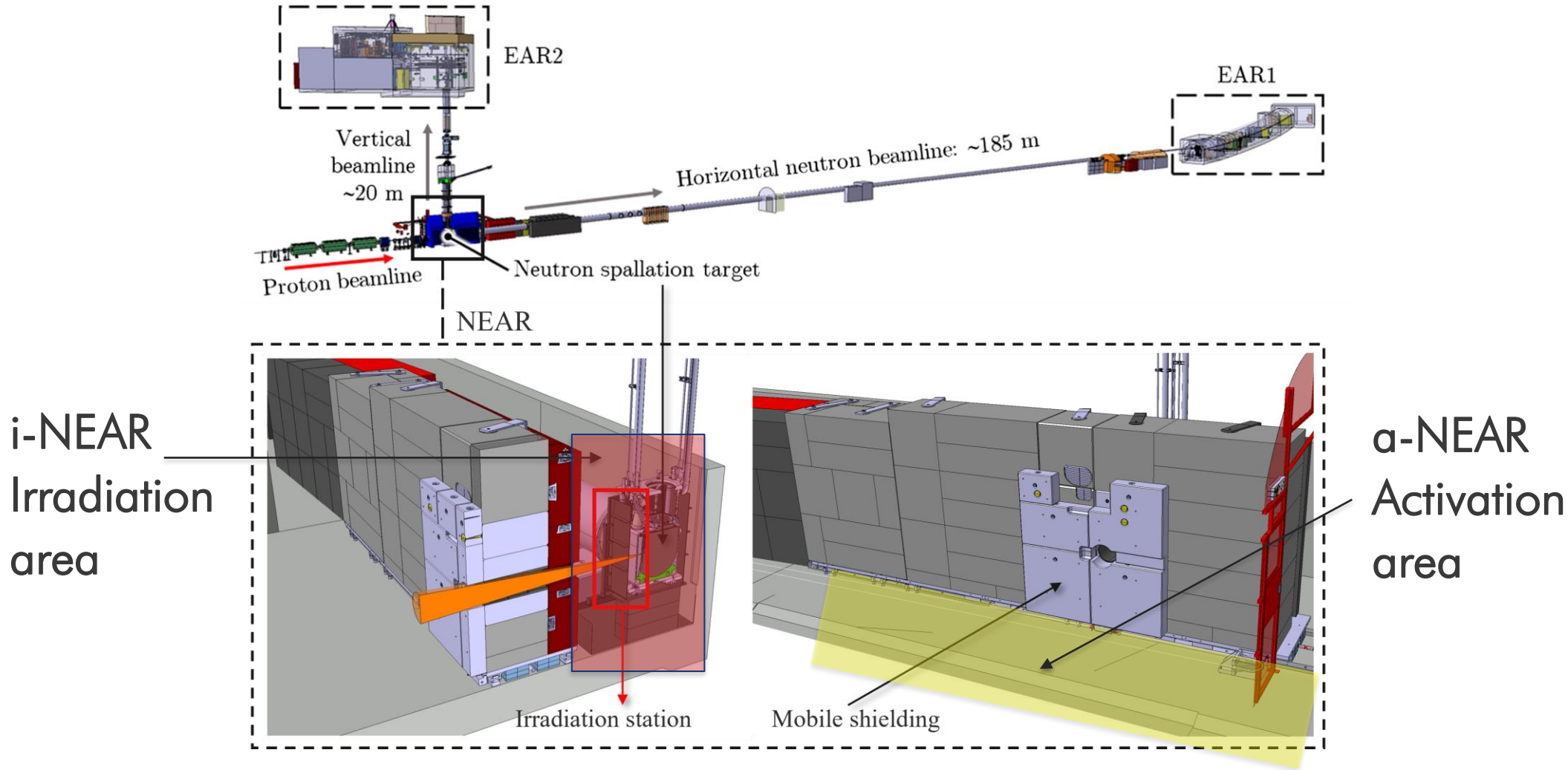
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<sup>c</sup>*ENEA Italian National Agency for New Technologies Energy and Sustainable Economic Development Italy*

<sup>d</sup>*Jaume I University of Castellon 12006 Castellon de la Plana Spain*

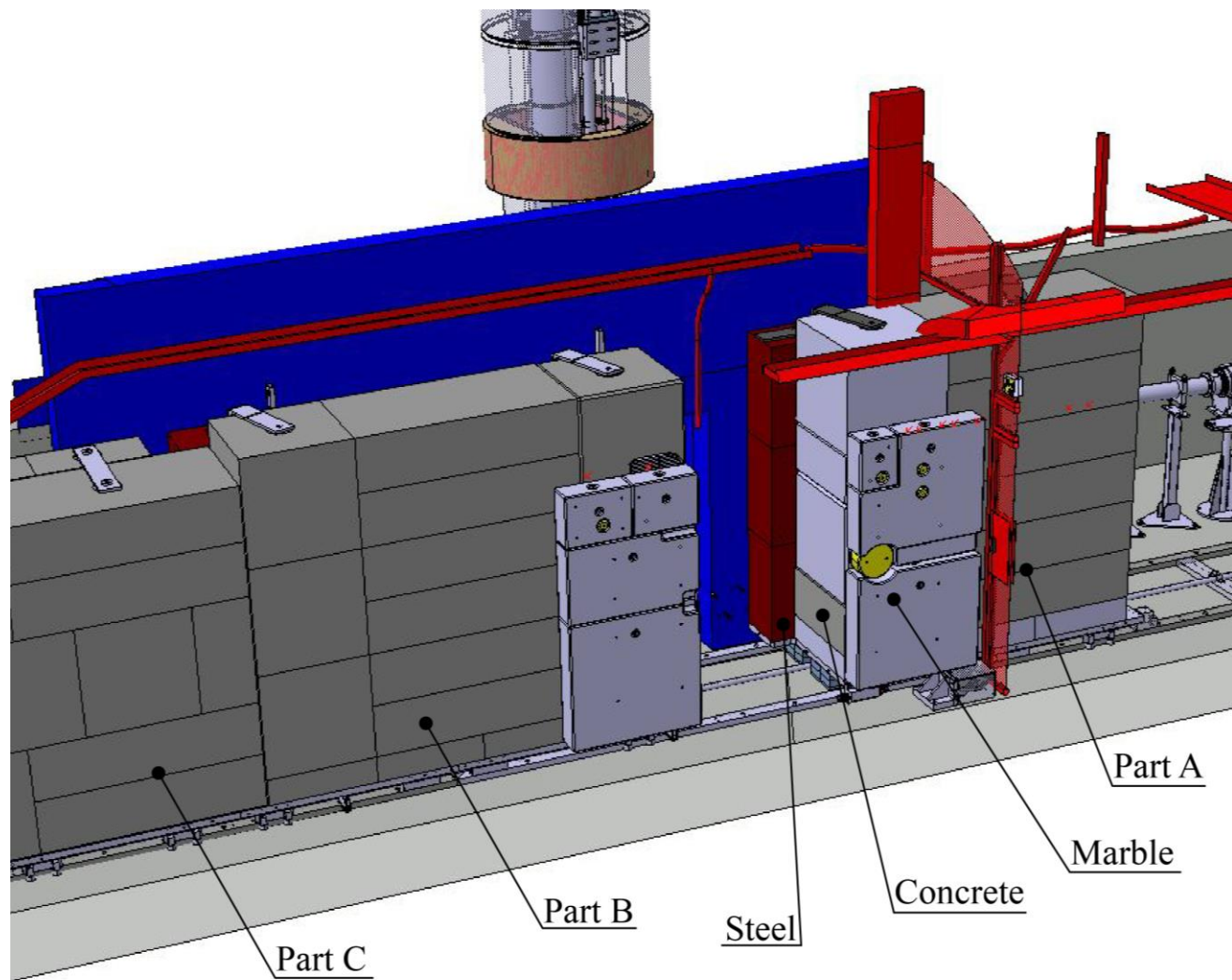
- arXiv:2202.12809 (2022) <http://arxiv.org/abs/2202.12809>
- To be submitted to *Journal of Nuclear Materials and Energy*

# THE NEAR TARGET AREA AT THE n\_TOF FACILITY

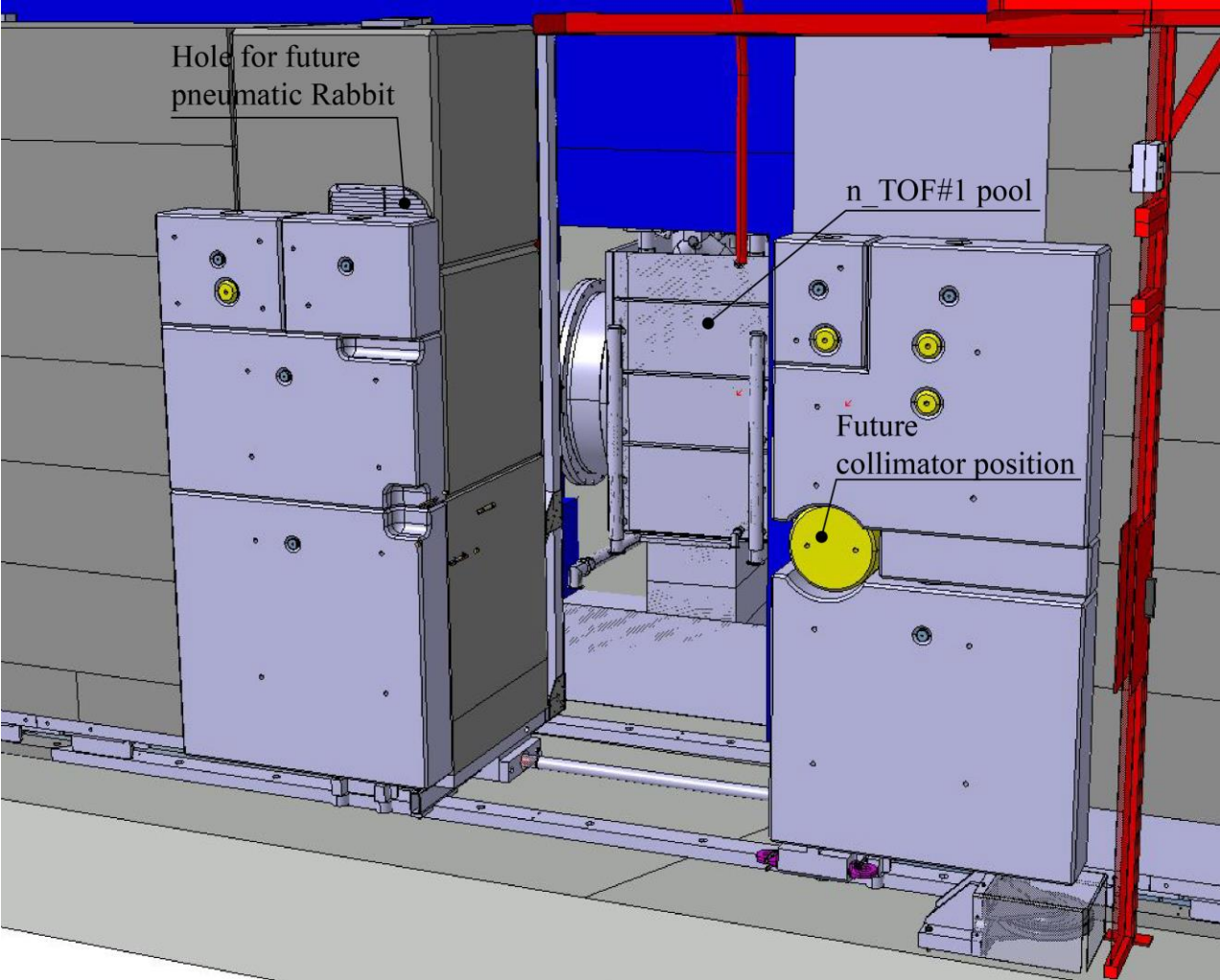




# THE NEW MOBILE SHIELDING

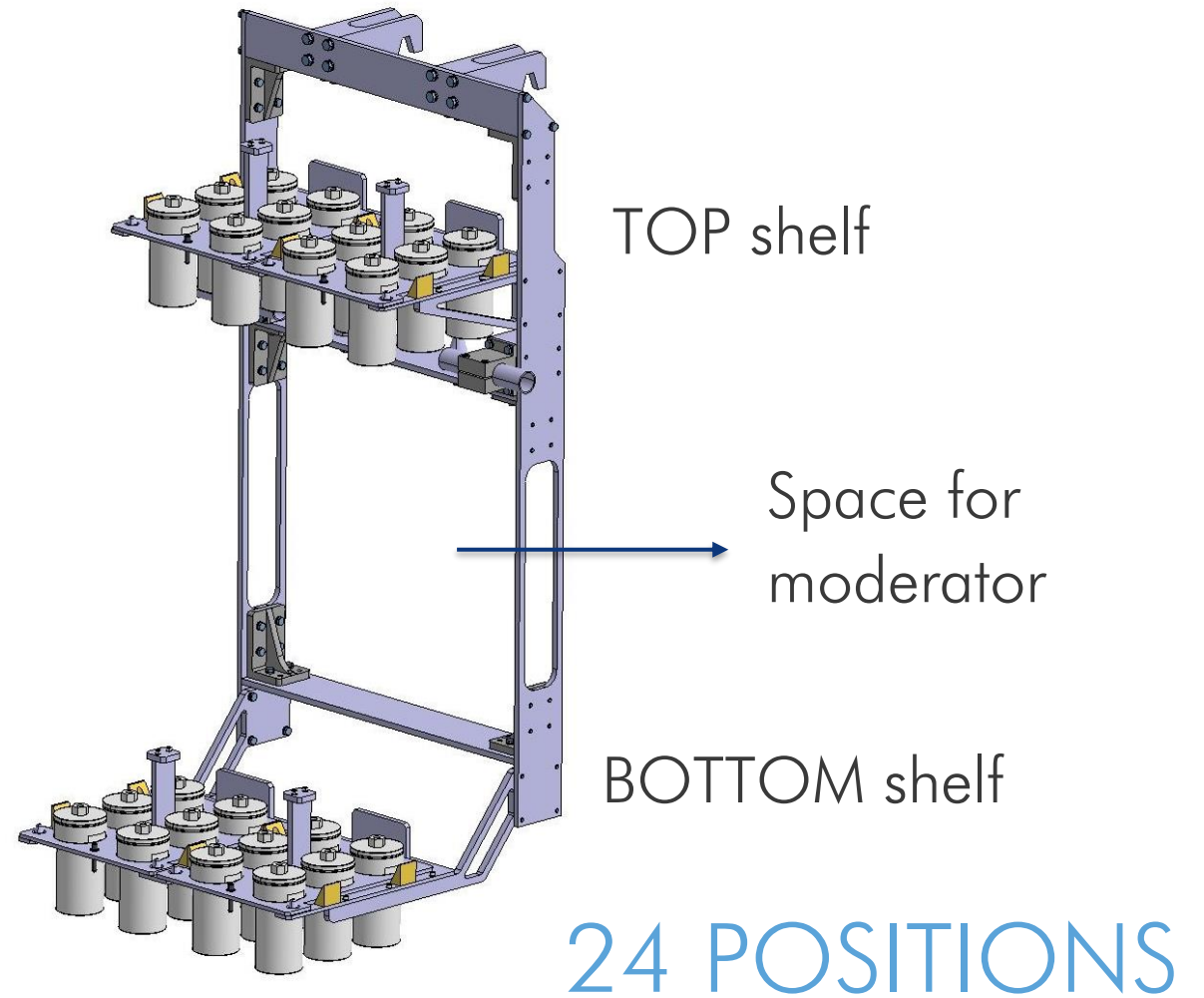


# OPPORTUNITIES OFFERED BY NEAR





# A NEW NEUTRON IRRADIATION STATION



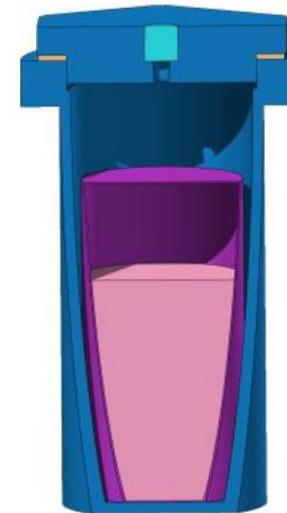
# SAMPLE CONTAINERS: REQUIREMENTS

RESEARCH {  
1. Sufficient sample amount  
2. No chemical interaction

SAFETY {  
3. Radiation resistant  
4. No pressure accumulation

RP {  
5. No contamination  
6. Compatible with robots  
7. Limited activation  
8. Limited waste

Valve  
(3,4,5,7)



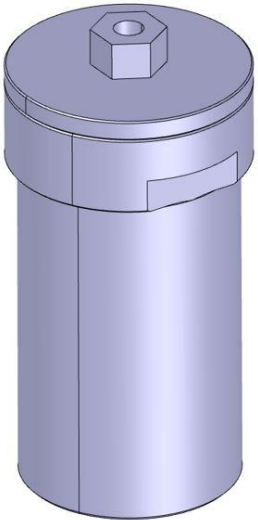
Seal  
(3,5,7)

Sample  
(1,8)

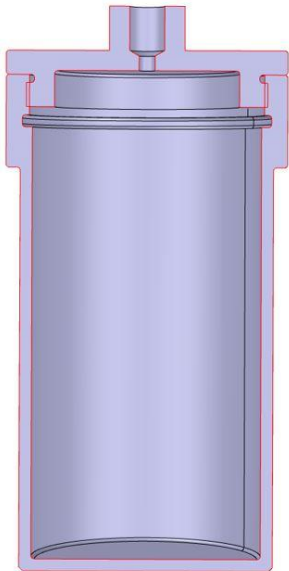
Outer container  
(1,3,4,7,8)

Inner container  
(1,2,3,7,8)

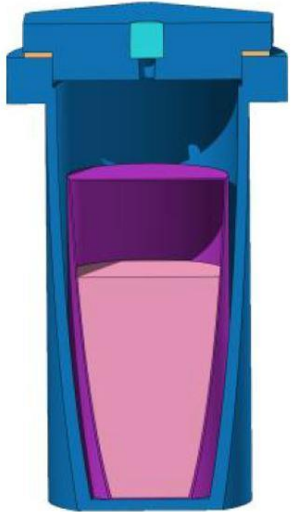
# SAMPLE CONTAINERS: DESIGN



Outer container  
Al 180 g



Micro-valve  
SS 3.6g



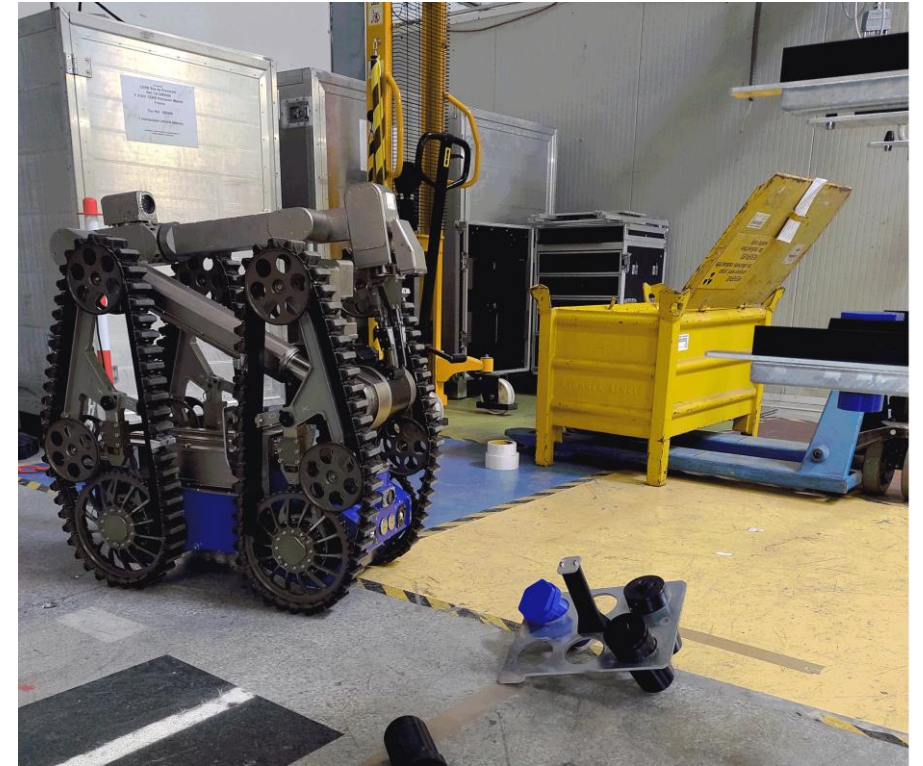
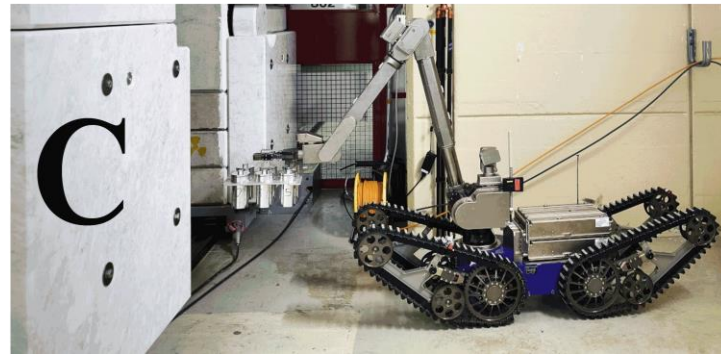
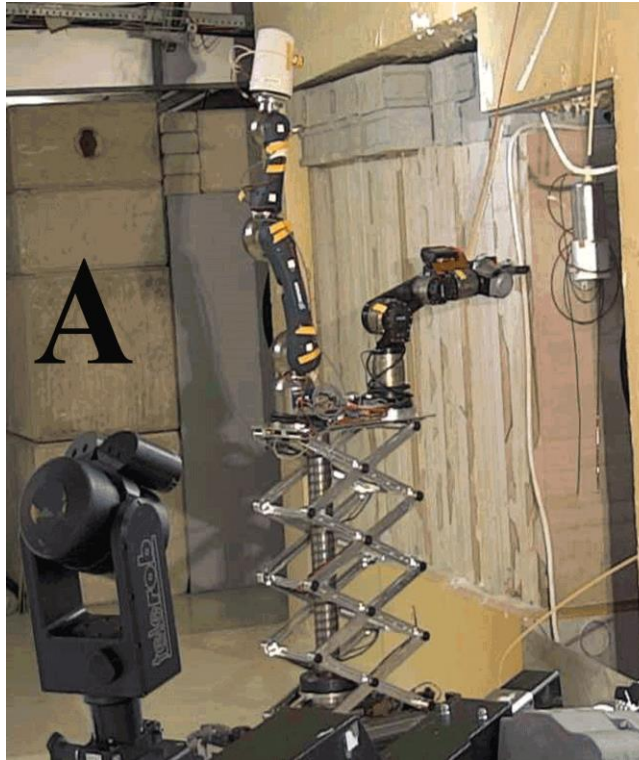
Seal  
graphite 3.4 g

Sample  
100 g

Inner container  
Al 19 g



# TELEMANIPULATION SYSTEM

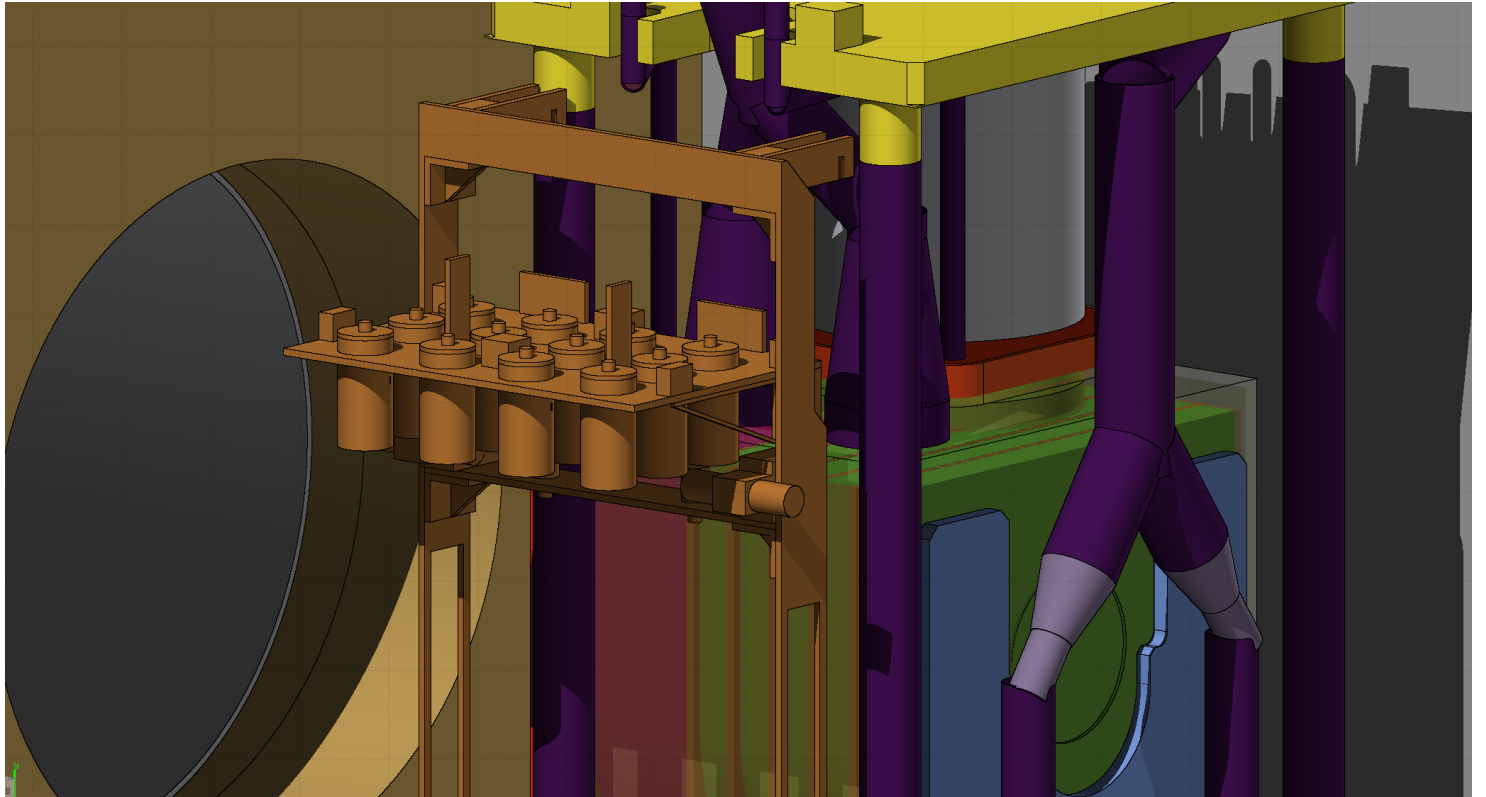
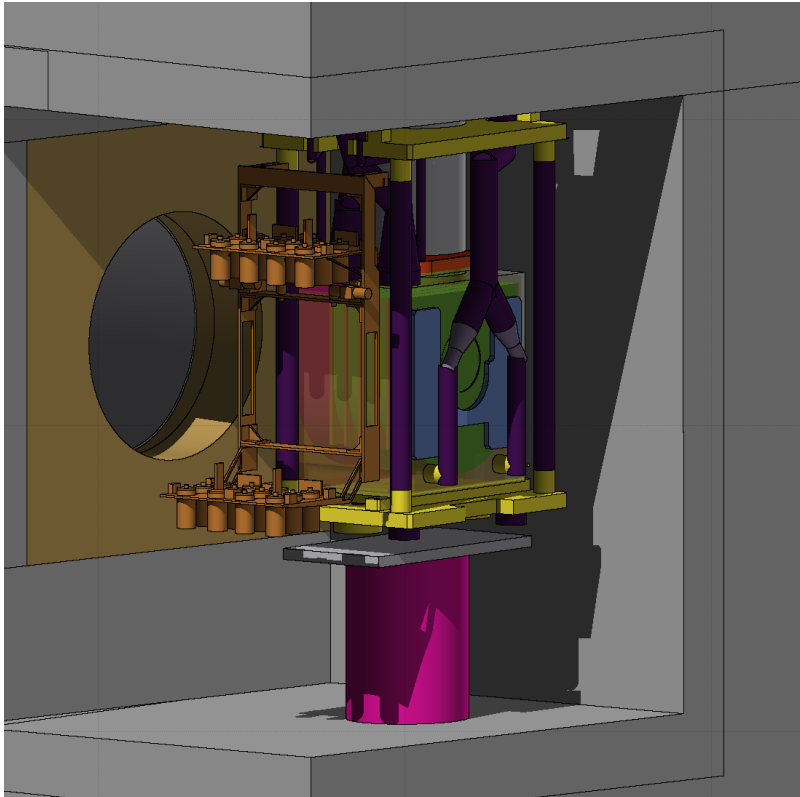


EXTENSIVE USE OF ROBOTS  
DEFINITION OF EFFICIENT AND SAFE PROCEDURE





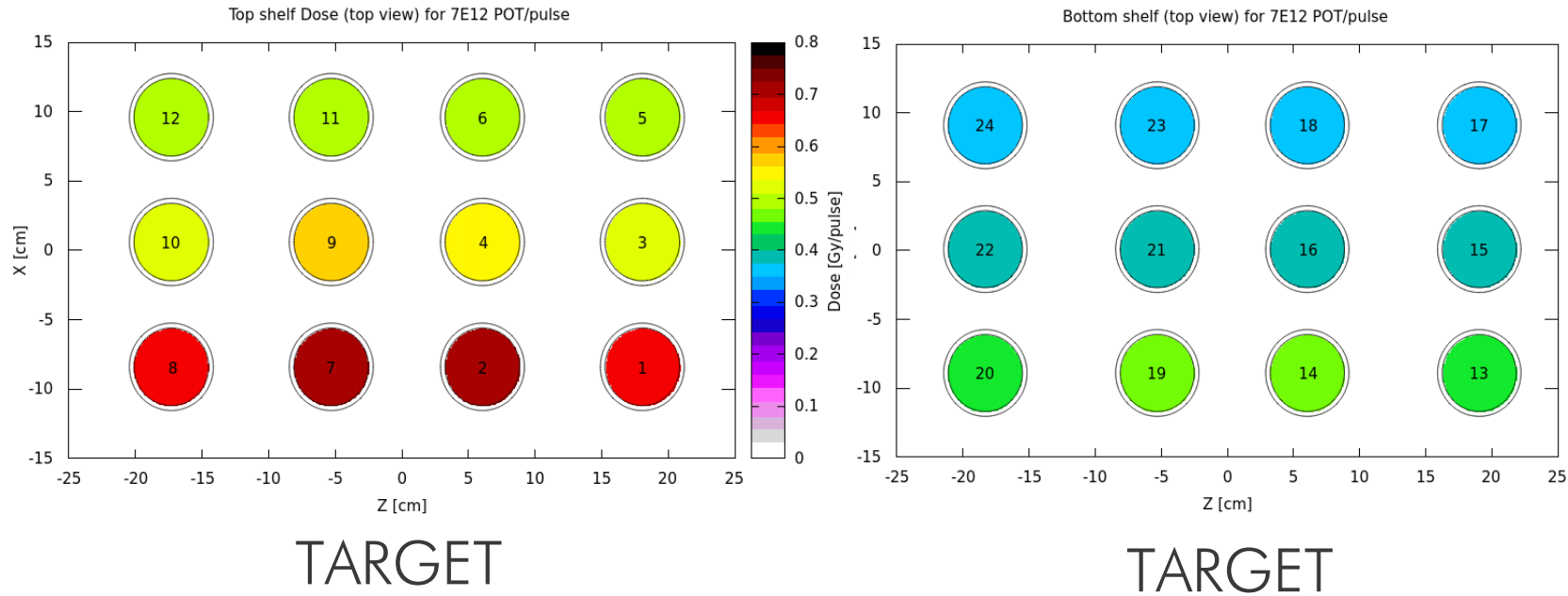
# DOSE CALCULATIONS - FLUKA



## GEOMETRY USED



# DOSE CALCULATIONS - FLUKA

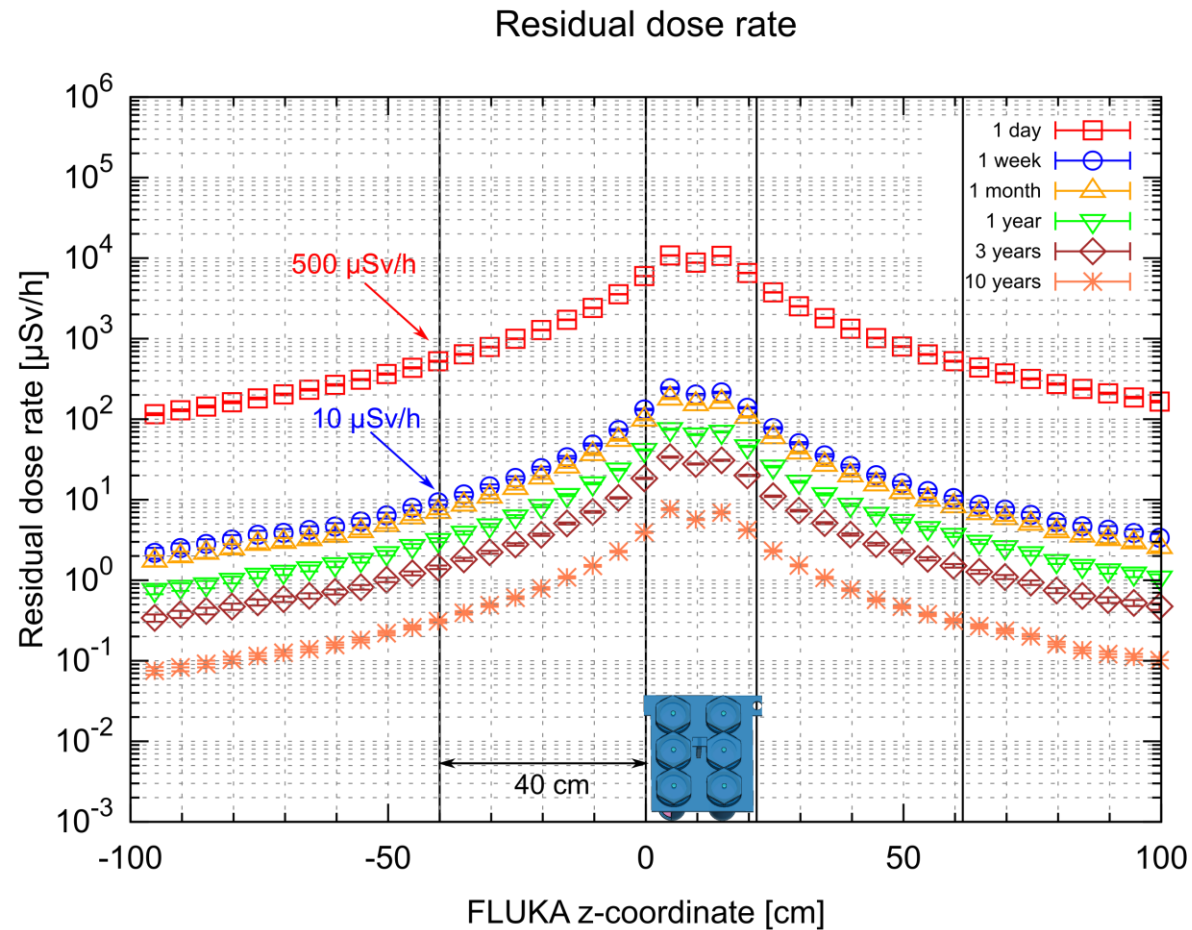


## PARAMETERS:

- 20 GeV/c protons
- 7e12 protons/pulse
- 2.5e19 POT / year (200 days)
- 1.2-2.5 MGy/year
- 70-80% neutron
- 20-30% gamma

UNEXPLORED IRRADIATION  
CONDITIONS FOR MATERIALS,  
MUCH CLOSER TO OPERATION

# RADIATION PROTECTION ASPECTS



## PARAMETERS:

- 1 week cooling minimum
- Activation compatible with handling by operators
- Measured values after first irradiation validate FLUKA

## NEUTRON IRRADIATION: RESIDUAL ACTIVATION

# FIRST IRRADIATION IN 2021



- Irradiation permit approved by RP
- 22 samples (lubricants and elastomers)
- 8 RPL dosimeters (thanks to HLD, R2E) satisfactory agreement with simulations!
- July-Nov 2021
- POT: 7.6 E18
- Dose: 0.4-0.8 MGy

**NEAR Irradiation station**

First samples installed

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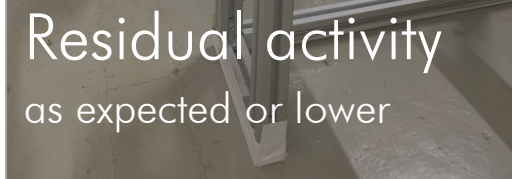
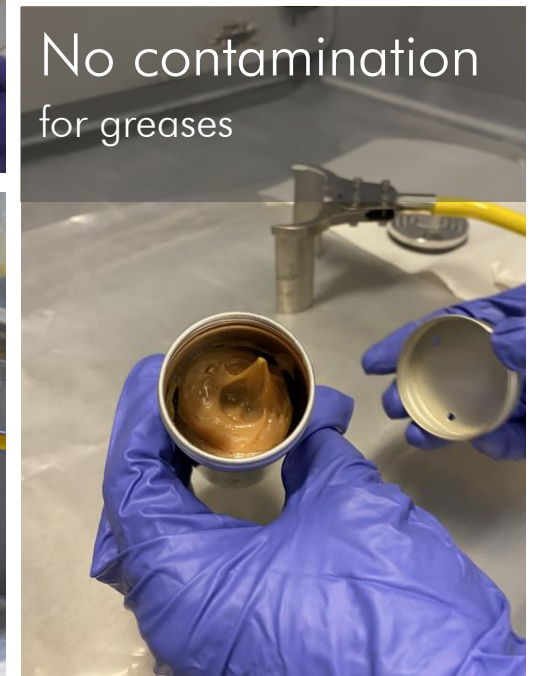
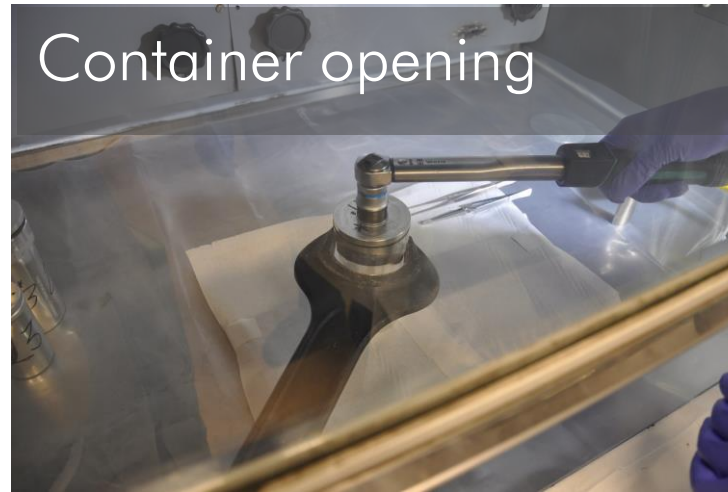


TEPM01.TFP  
= 802





# PROCEDURE VERIFICATION



# FIRST IRRADIATED SAMPLES

## SELECTED MATERIALS

- Wide range of commercial products
- Generic vs declared as rad hard
- Lubricants and EPDMs used at CERN in high-rad areas (LHC TDE dump, SPS dump TIDVG#5...)



## ANALYSES

- Collaborations:
- Academic collaborations:



Imperial College  
London



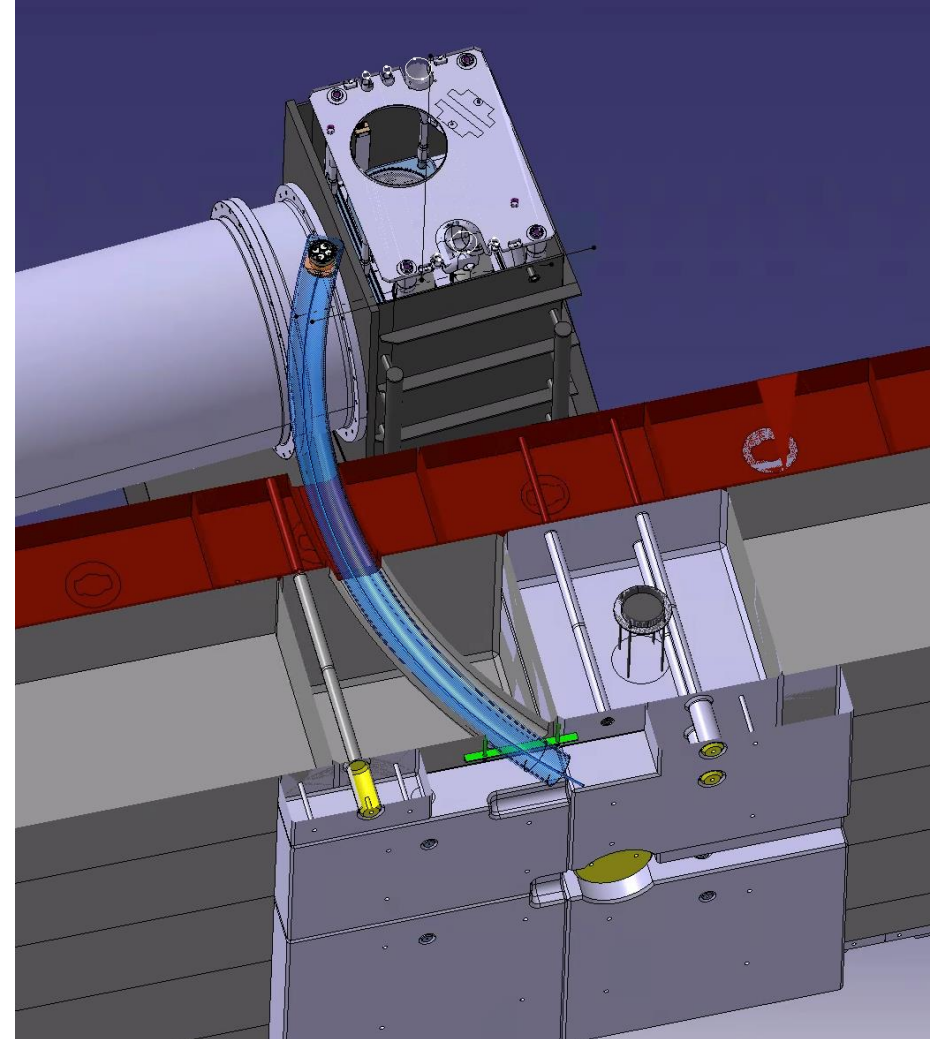
### Previous talks

- Radiation damage studies on lubricants
- Radiation tolerance of EPDM O-rings used at CERN: recent results



# ONGOING DEVELOPMENTS

- Second irradiation campaign (2022)
- Comparison between neutron and gamma radiation effects
- Characterisation of the irradiation station
- Additional irradiation positions ('rabbit')



# TAKE-HOME MESSAGE

- Irradiations of materials: continuously needed at CERN
- New in-house irradiation station
- Multi-disciplinary activity: robotics, dosimetry, radiation protection...



CERN-PHOTO-202107-085-1

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