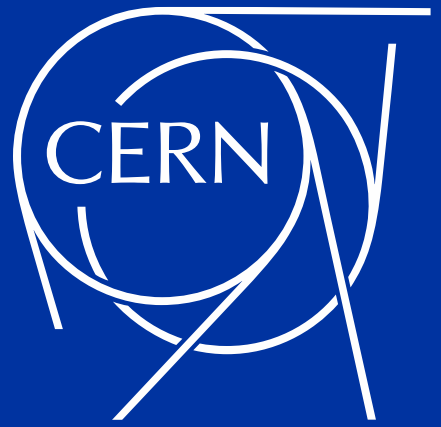


Status of the n_TOF facility
Collaboration Meeting 22-24 Nov 2023

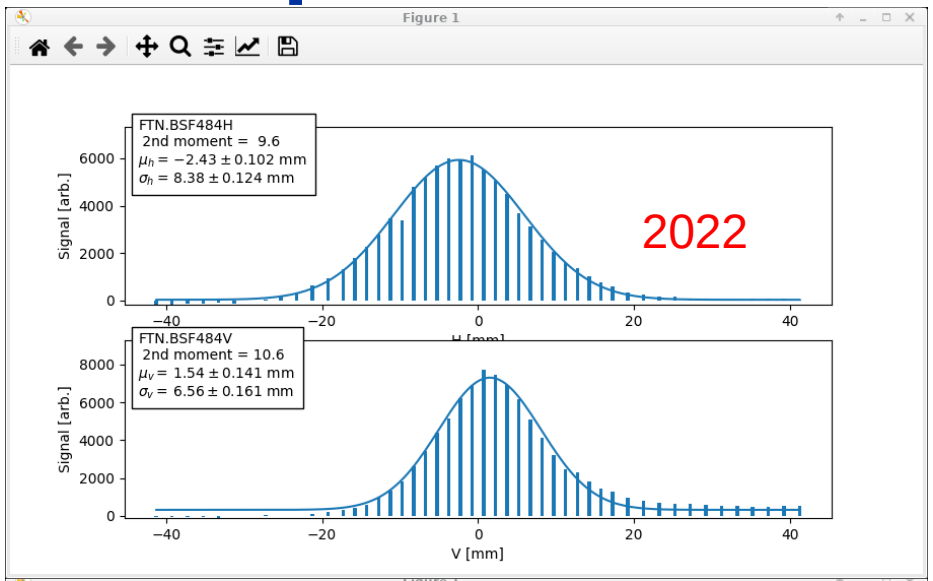
Oliver Aberle, Ana-Paula Bernardes & Marco (SY-STI-TCD)

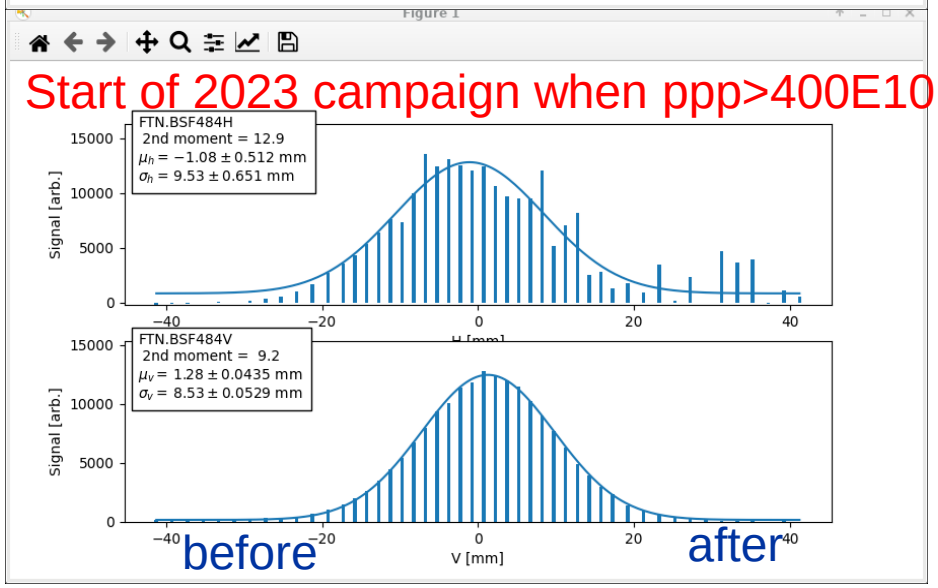
22-24 November 2023

Content

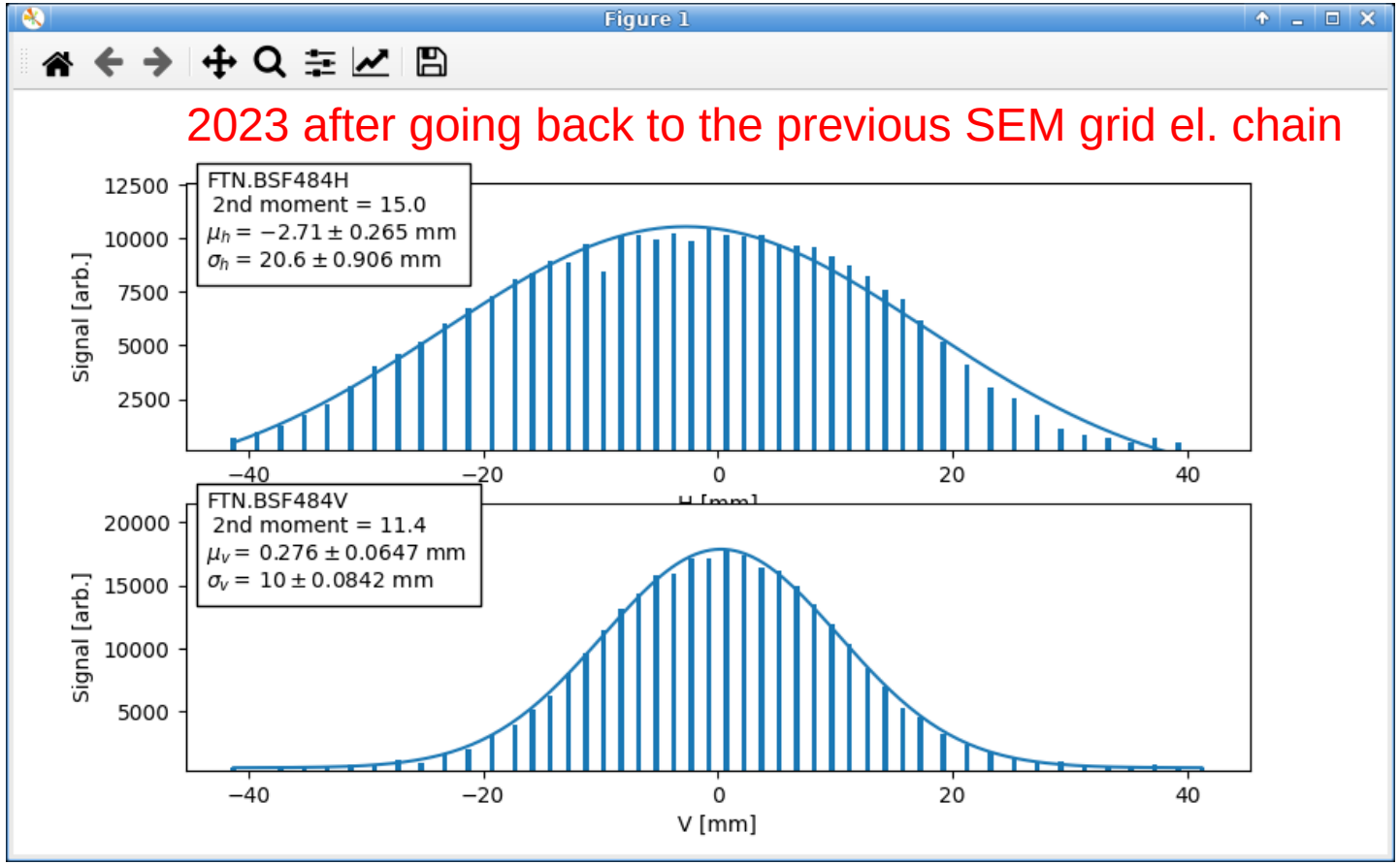
- Proton beam line FTN
  - SEM grid
- Target(s) and facility
  - Homologation
  - Autopsy and waste packaging of target #2
- Work done during 2023 in type A areas and NEAR
- Work for YETS 23/24

Some problems with SEM grid at the start of 2023 run





Beam start at 03.04.2023 - FTN line commissioning



FTN line – SEM grid

Figure 7 **Left:** old design (SPSBSAPB0030). **Centre**: new design SPSBSAPB0064. **Right**: schematic overlap of the old (red) and new (grey) aperture, illustrating the increased clearance for the beam passage.

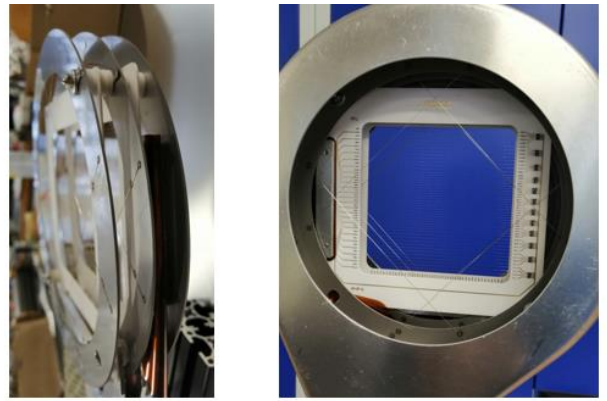


Figure 1: Pictures of the present system taken before installation. **Left**: the 3 stainless steel rings and 2 ceramic PCBs without the aluminium cover. **Right**: the assembly with the aluminium cover.

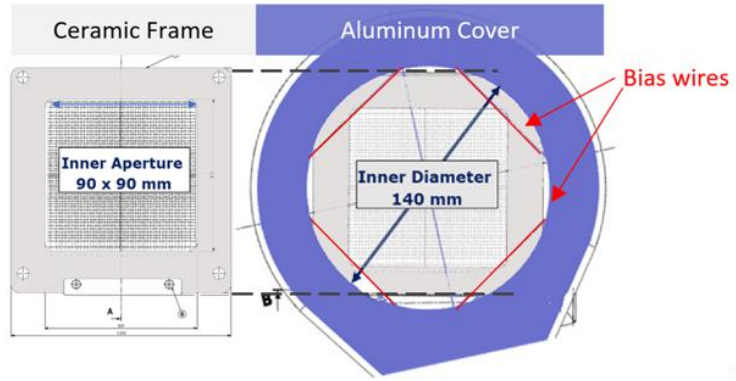


Figure 2: Illustration of the present system aperture. **Left**: the ceramic frames (CDD Drawing EDMS SPSBSAPB0031) on which the wires are fixed. **Right**: the aluminium cover and (not visible because in the shadow) the stainless-steel circular supports holding the frames and the bias wires (CDD SPSBSAPB0030).

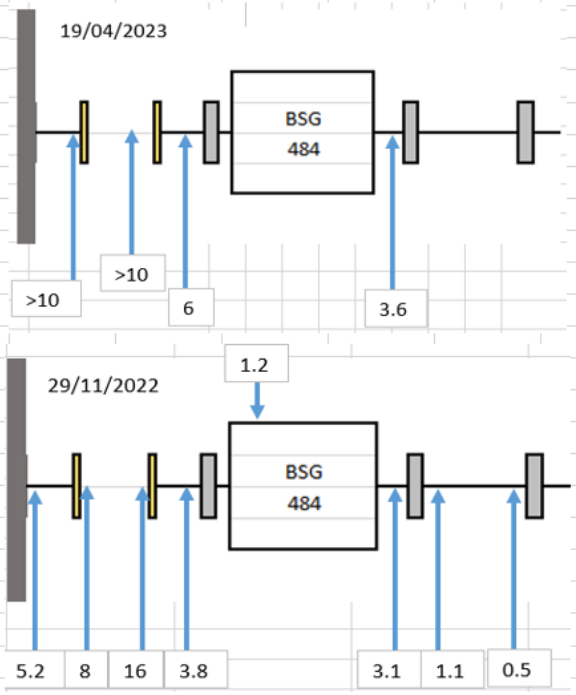
- Issues with the read out of channels
- Reversed back to the 2022 cabling and patch panel
- In February 2024 implementation of the final configuration (increase from 48 to 64 wires)
- Horizontal and vertical beam profile measurements completely decoupled
- Fully funded by STI/TCD operational budget

FTN line – SEM grid

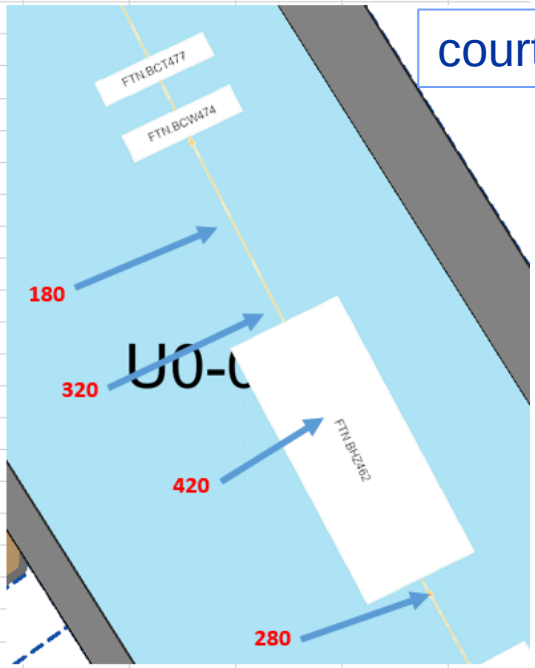
Mesure 1m (uSv/h)

ID	Reference	Position	Dose rate [µSv/h] Date: 29-11-22 (13:10) Cool down time: 31 h	Dose rate [µSv/h] Date: 19-04-23 (10:30) Cool down time: 2h
1	-	Start of FTN	1	2.5
2	QFO.435	UPSTREAM	5	6
3	QFO.435	DOWNSTREAM	5	9
4	DHZ.436	DOWNSTREAM	4	7
5	QDE.450	UPSTREAM	20	50
6	QDE.450	DOWNSTREAM	20	67
7	DVT.451	DOWNSTREAM	12	45
9	Vacuum pump	Between DVT.451 and FTN.BTV454	9	45
10	FTN.BTV454	UPSTREAM	12	35
11	FTN.BTV454	DOWNSTREAM	15	55
13	BHZ 456	DOWNSTREAM	19	55
14	BHZ 459	DOWNSTREAM	44	130
15	BHZ 462	DOWNSTREAM	88	230
17	UWB.474	UPSTREAM	71	186
18	UWB.474	DOWNSTREAM	77	246
21	BSG.484	UPSTREAM	157	410
22	BSG.484	DOWNSTREAM	170	500

Mesure CONTACT (mSv/h)



Mesure 40cm (uSv/h)



courtesy F. Pozzi

- FTN (n_TOF side): the beam loss pattern looks similar to the one we had at the beginning of the YETS, being the area around the SEMGRID the hottest one;
- F16: the hot spot identified at the beginning of the YETS after the dipole BHZ.0378 (where the vacuum chamber splits) is still there with a clear asymmetry (already identified during the last radiation survey): on top of the vacuum chamber we measured 15.2 mSv/h in contact and below the vacuum chamber 3.4 mSv/h in contact (FYI, during the last two YETS, colleagues from TE-VSC performed works on this vacuum chamber);
- FTN (TT2 side): hot-spot (~80 uSv/h at 1 m distance) between the BTV.0414 and QFO.0415

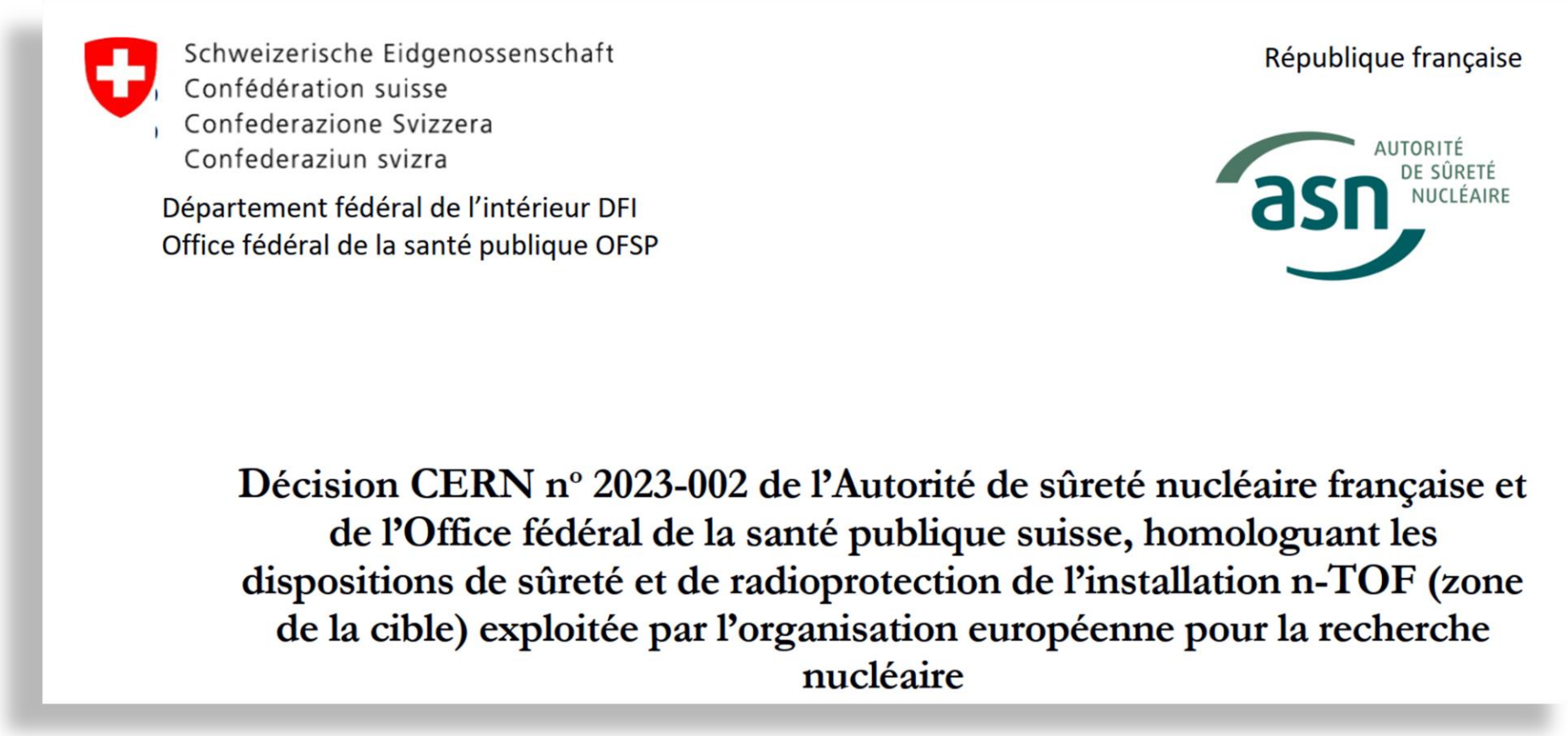
Target #3 performance and power margins increase

- Thanks to the excellent work done by ABT, OP, BI and RP (coordinated by STI/TCD), **large beam spot on target** (and its continuous monitoring via SEM grid) **is now available**
- This optimisation, coupled with efficient (gas) cooling systems of Target #3 and supervision allowed by target thermocouples, **allows for target average power increase** (166*10^{10} p/s to **220*10^{10} p/s**)
- Facility “homologation” with Tripartite Authority (ASN/OFSP) is approved (TOF-L-SF-0005 and 0006)

Homologation of n_TOF facility

- Facility “homologation” with Tripartite Authority (ASN/OFSP) completed on 13/09/2023 (TOF-L-SF-0005)

Technical visit to EAR1 planned end of Feb 2024



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l’intérieur DFI
Office fédéral de la santé publique OFSP

République française

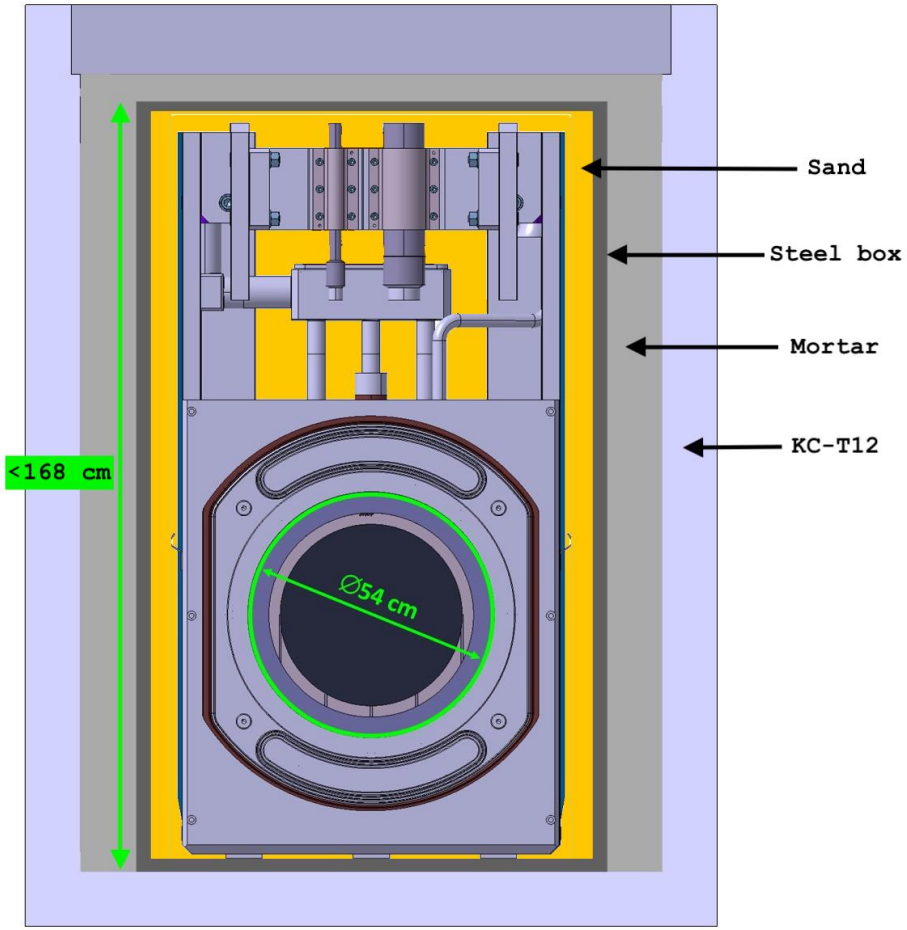
AUTORITÉ DE SÛRETÉ NUCLÉAIRE

Décision CERN n° 2023-002 de l’Autorité de sûreté nucléaire française et de l’Office fédéral de la santé publique suisse, homologuant les dispositions de sûreté et de radioprotection de l’installation n-TOF (zone de la cible) exploitée par l’organisation européenne pour la recherche nucléaire

n_TOF spallation Target #2 Autopsy and Waste Packaging Review (T2AWPR) on 03/10/2023

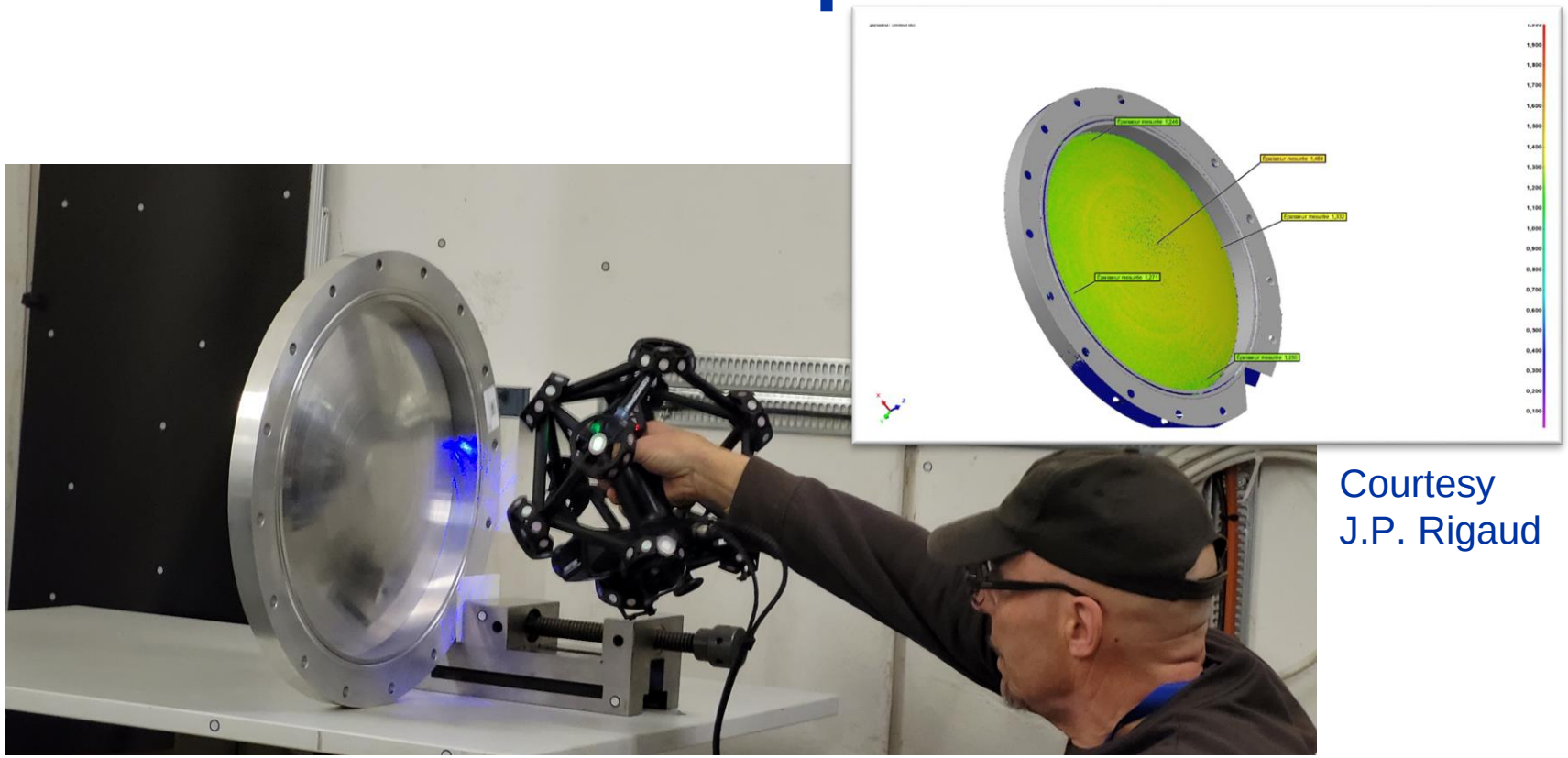
https://indico.cern.ch/event/1293320/

- In Switzerland, bulky radioactive waste items are **generally cemented with mortar** inside concrete containers. The so-called KC-T12 container is to be used for n_TOF Target #2 (e.g. same as n_TOF Target #1).
- n_TOF #2 is made of a cylindrical monolithic **lead** block enclosed in a vessel (water cooling and moderator) made of **aluminium ← chemical incompatibility with mortar**
- **Target dimensions**:
  - Footprint 830 x 628 mm
  - Height 1990 mm ← **not compatible with KC-T12**
- A **specific conditioning solution** developed for Target #2.
- Review result (report in work):
  No showstopper identified. Proposed timeline supported, green light to proceed after the final dry run in ISR8 (early 2024).



Courtesy P. G. Pisano, L. Bruno
On the behalf of HSE-RP-RWM

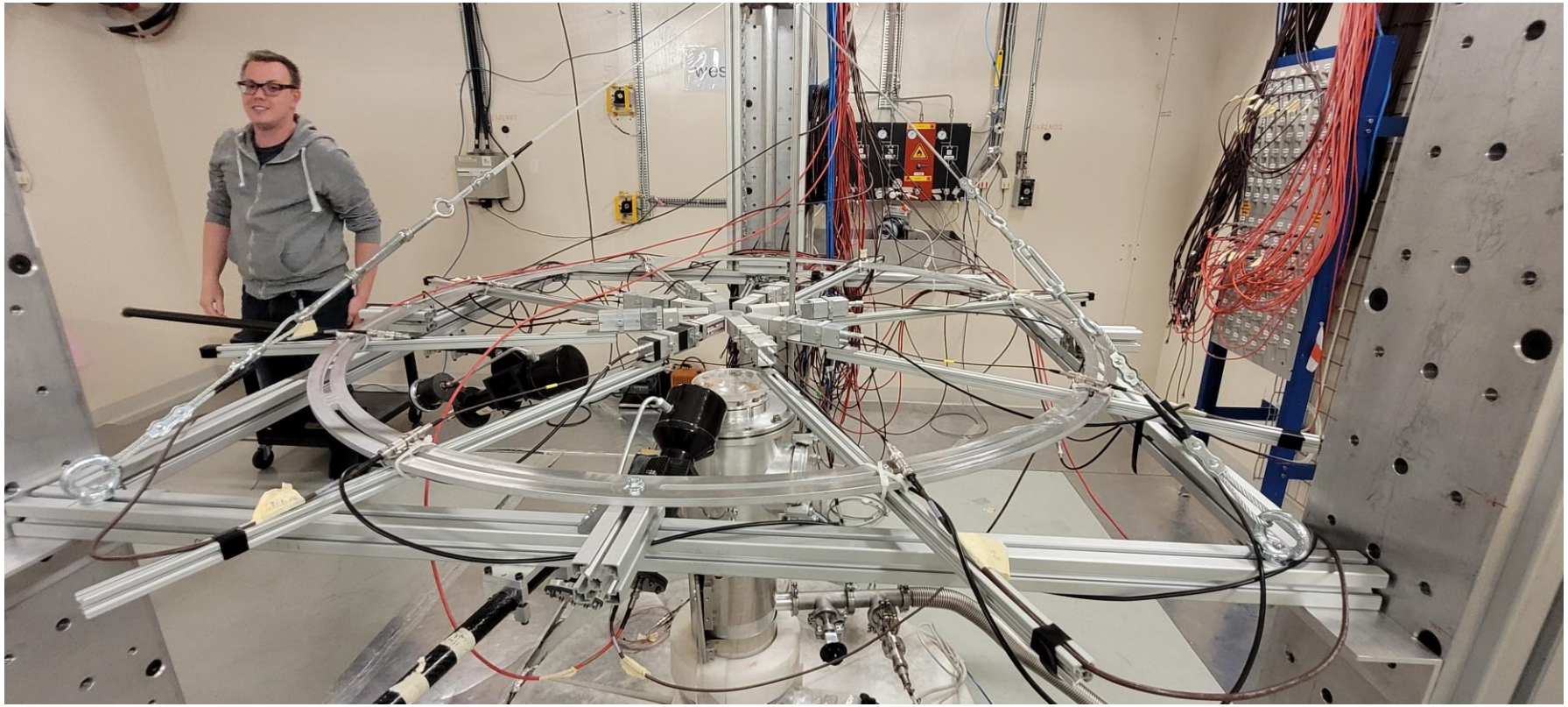
Modification of escape lane



Courtesy
J.P. Rigaud

- Beam window characterisation and shift of 2m
- Additional space for parasitic measurements
- New (thinner) window planned + roof laser installation

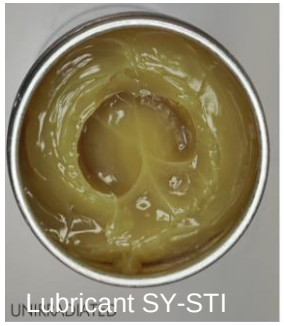
Type A areas

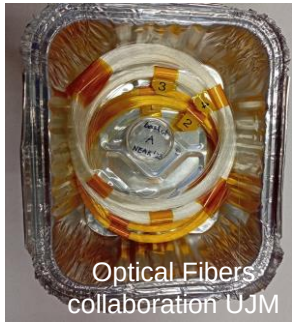


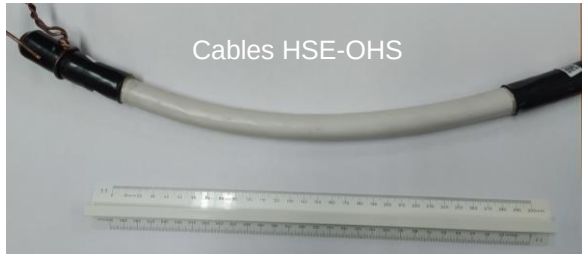
- New lightweight support frame with lift function useable for more applications
- Further improvements identified
- “Ringing” investigation with combined with immediate improvement measures, more potential identified for YETS – first beam in 2024

i-NEAR – n_TOF and R2M activities

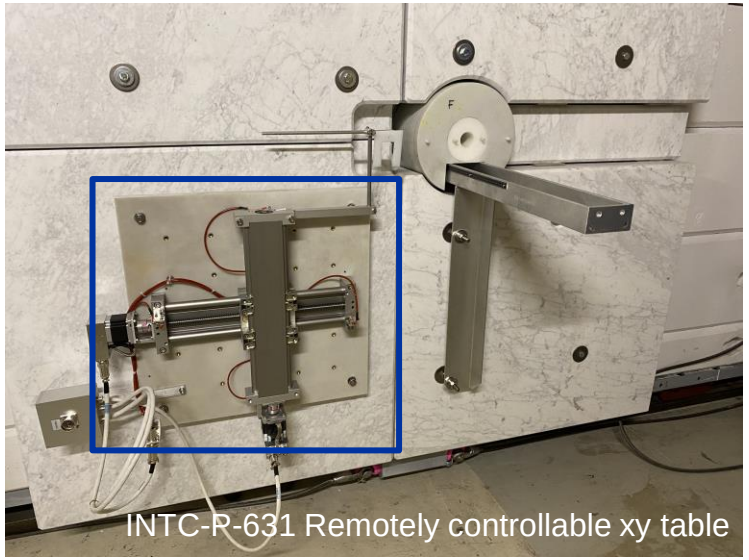
Large variety of samples installed at i-NEAR on Shelve or Rabbit positions

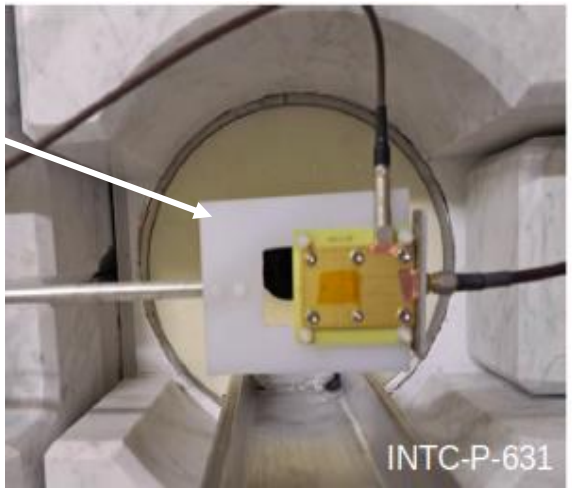


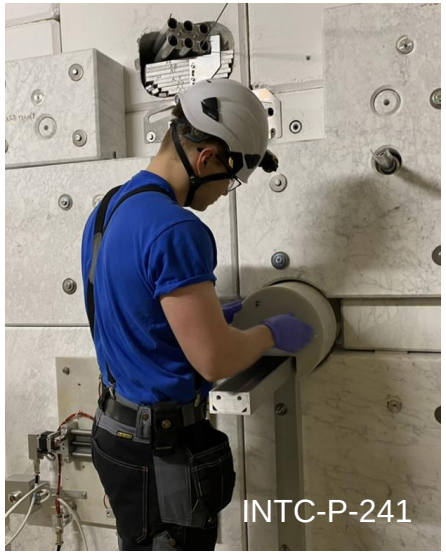


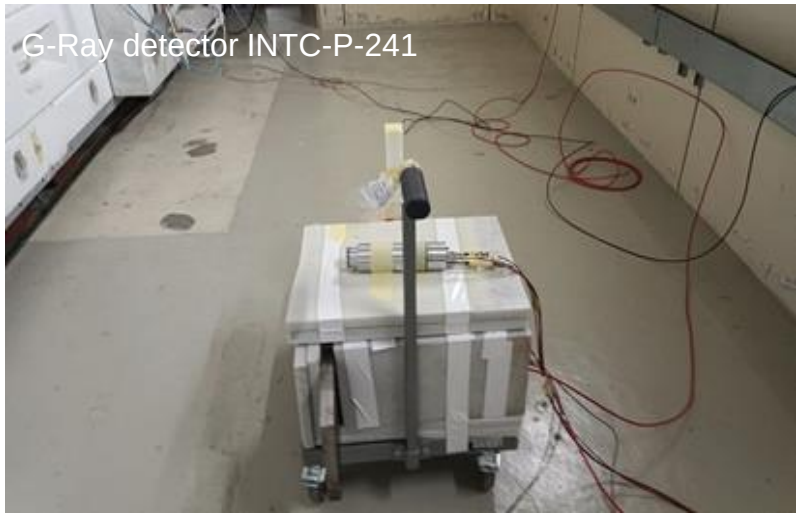


a-NEAR – n_TOF activities



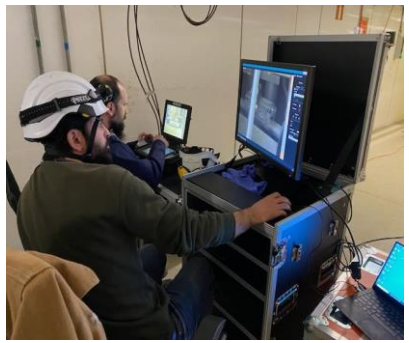






Thermal neutron background
INTC–P-241

i-NEAR – n_TOF activities



- Long irradiation of samples (April - October 2023)
- Versatile containers for irradiation of different kind of materials/samples
- Removal of irradiated samples on December 2023

Many thanks to Ana-Paula Bernardes!

Issues during the 2023 campaign

n_TOF target borated water filter leak on 16/6/2023: for this reason we have backup filters available!
Many thanks to: Ch. Saury, N. Roget, Cl. Pruneau for the successful intervention!

16.Jun.23 AFTERNOON PS

1 2 3

21:29:00 3787102

END OF SHIFT SUMMARY:

- Several trips of PSB BSW early in the afternoon.

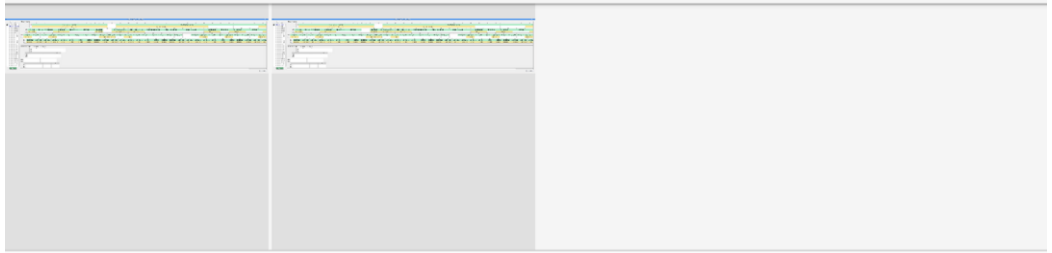
- Three radiation alarms late in the afternoon:
  - We saw that when the SPS tried to take the 72b beam two C10 were tripping. We called the Piquets, but after trying again everything was working fine.

  - We also had a radiation alarm because the SPS took the wrong beam in the PSB.

  - 2 modules of KFA71 tripped and that caused a radiation alarm too.

- nTOF is not receiving beam: there is a leakage in the cooling system. TI called the Piquet and they are organizing an access to fix it.

16.Jun.23 NIGHT PS



16-06-2023 22:38:55 3787422

nTOF water leak, team:
Ch.Saury (HSE-RP);
N.Roget(EN-Cv);
Cl.Pruneau (BE-OP-TI);
grants acces in Tof-Target S4 to check the water plant.
EIS set in safe mode and TFT in access restricted.

16.Jun.23 NIGHT PS

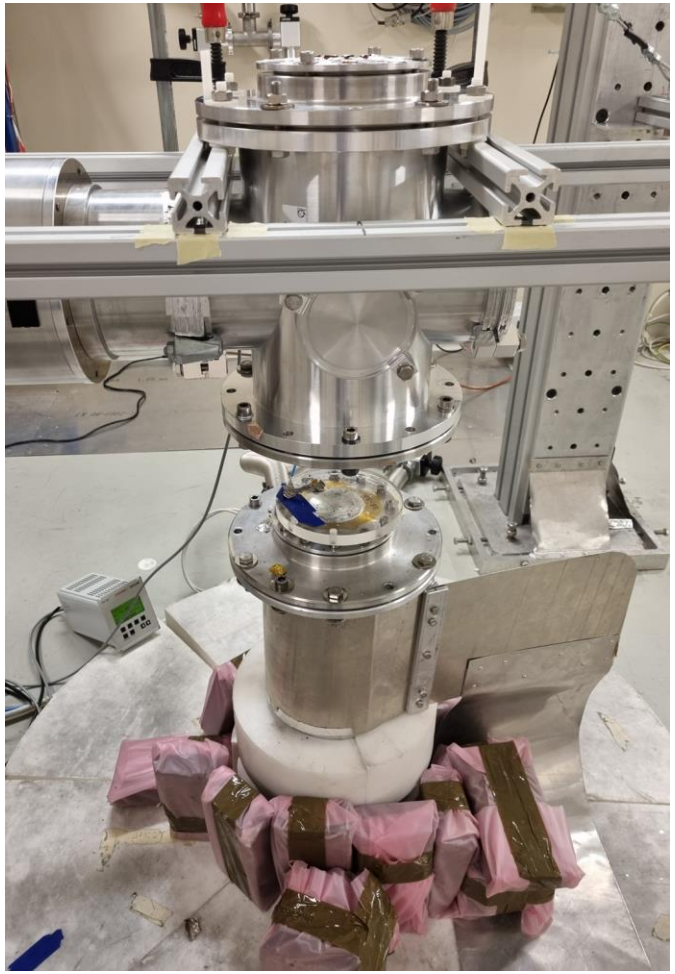
1 2

17-06-2023 05:29:00 3787551

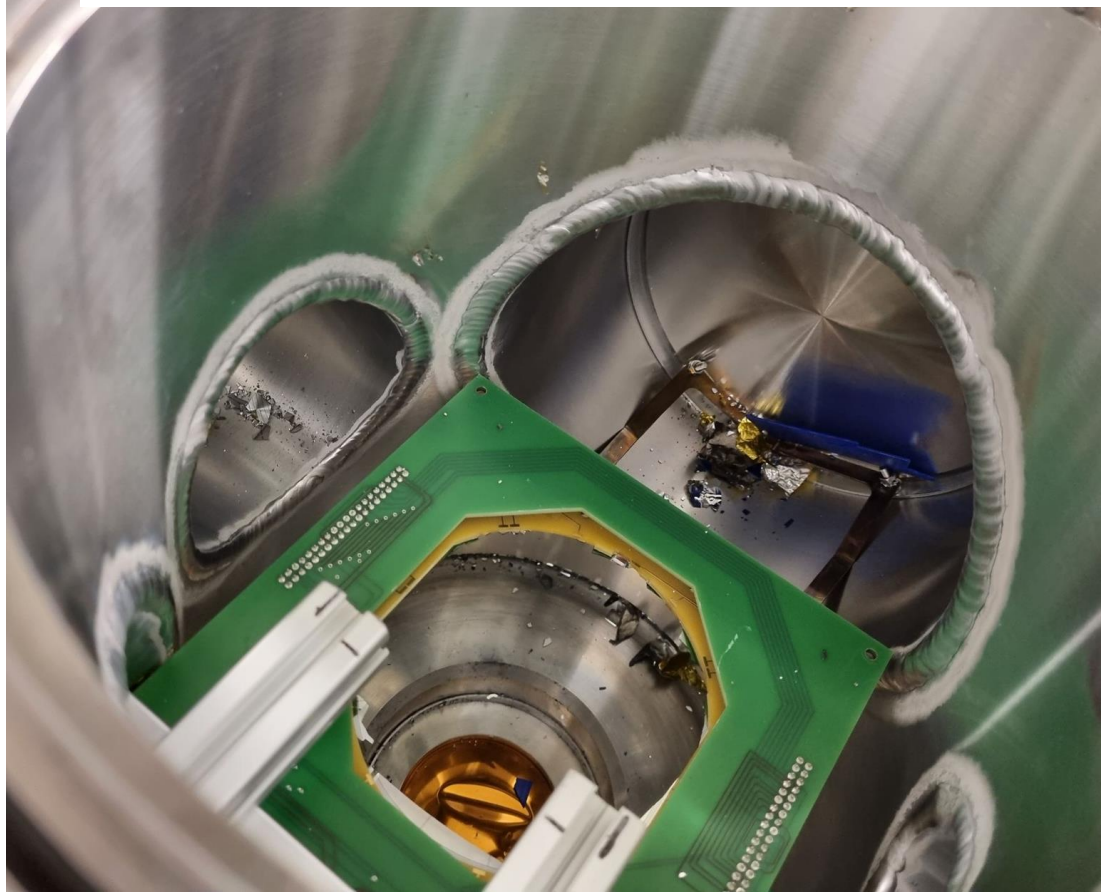
END OF SHIFT SUMMARY:

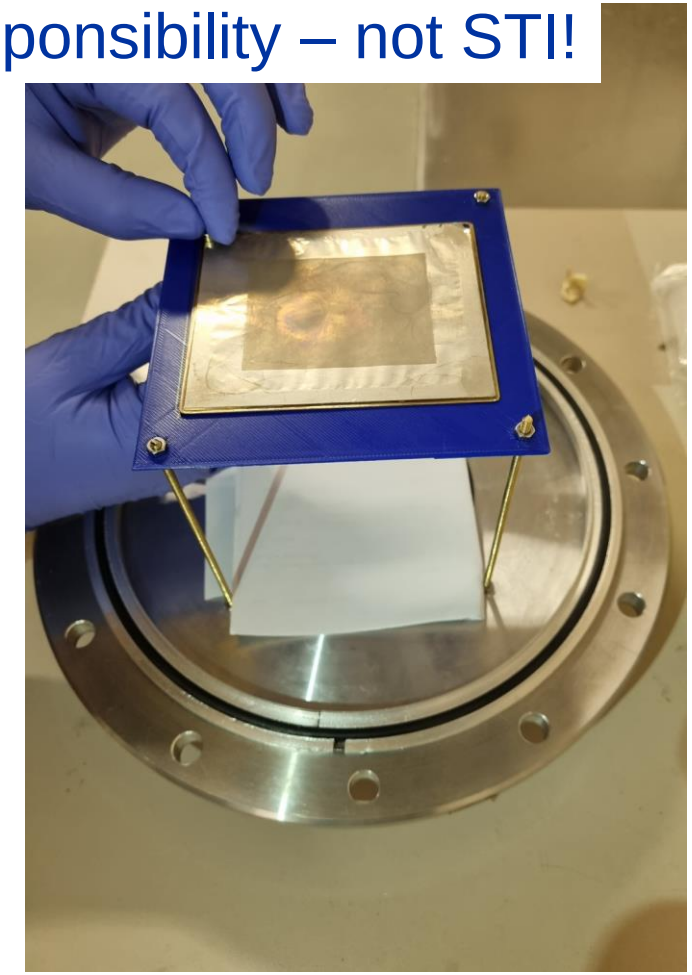
- **NTOF Water leak:** N. Rogent and Ch. Saury were able to switch to the back-up water filter. We are now without a backup. A new back-up will be ordered and likely installed in the YETS.

Issues during the 2023 campaign



NB: this is n_TOF Collaboration responsibility – not STI!





https://edh.cern.ch/Document/General/IncidentDeclaration/9967462

Main works during YETS 23/24

- ***TT2A***
  - General Maintenance
  - Endoscopic magnet checks
  - Installation of new SEM grid detector head (larger aperture, more channels)
- ***Target***
  - Cooling station upgrade (extend confinement to the entire station + additional retention vessels for the moderator skids, as requested by the tripartite)
  - Target #2 autopsy in the ISR8
  - Near activities with opening target shielding (R2M)

STI/TCD responsibility

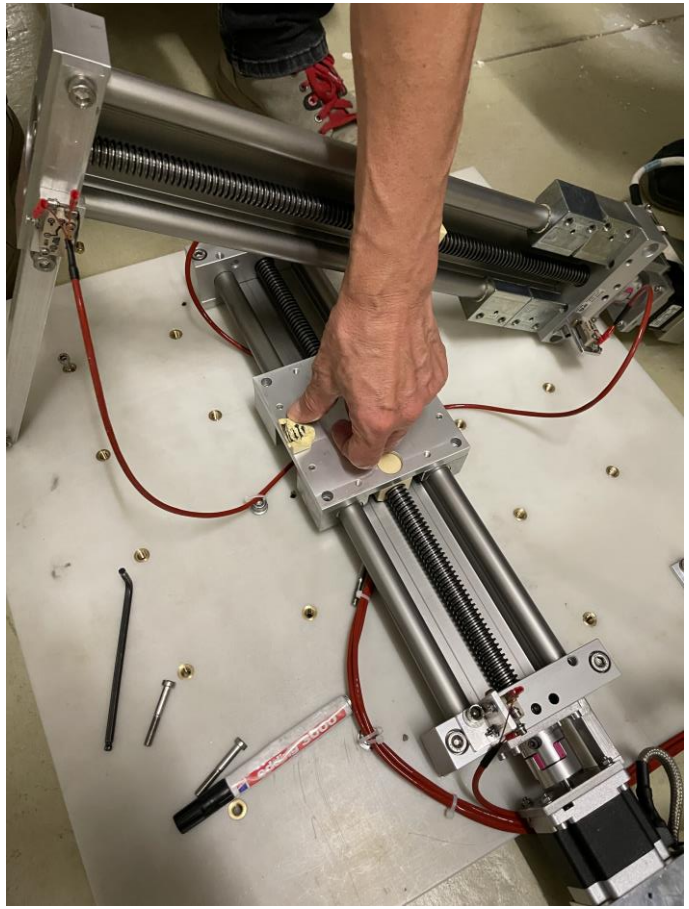
Critical Path:

- EN-CV works period :
  14th of November-21st February (n_TOF water circuit stopped)

- ***EARs***
  - RF - antenna analysis has to be organized for early next year (during hardware commissioning).
  - Vacuum improvements (EAR1)
  - Li-PE floor EAR2
  - Optimize NEL exit window
  - …

n_TOF Collaboration responsibility

- Support to the collaboration on detectors and experiments (e.g. x/y table, sample exchanger EAR1, s-TED array, MArEx etc.)



Last “test measurement” for MArEx as an example:

- When, where, how and if?
- Experiment in the bunker -> DSO from EP
- Part of the set up in the beam line -> BE/SY
- Timeline got very squeezed at the end of the run
- Procedure on “the fly”, not written and approved
- *This shall not be repeated as such...*

Proposal for discussion before Christmas

Work during YETS 23/24 in target cool/mod station

- Mitigation on local contamination/risk of leakage on the moderator skids

→ De-contamination and installation of In situ steel retention vessels

- Comments from the visit of the French and Suisse authorities **(global confinement)!**

→ Study with external company by CV → work scheduled during YEST 23/24

Conclusions

- Target performance as expected, FTN beam line modifications successful (SEM upgrade planned for Feb. 2024)
- Thanks to the excellent work done by ABT, OP, BI and RP (+STI), large beam spot on target (and its continuous monitoring via SEM grid with update) is available
- This optimisation, coupled with efficient (gas) cooling systems and target thermocouples, allows for target average power increase ($220*10^{10}$ p/s)
- Facility “homologation” with Tripartite Authority (ASN/OFSP) is approved (Technical meeting 03rd May, Safety files TOF-L-SF-0005 and TOF-L-SF-0006 under approval).

Additional comments and points for discussions

- Resources from STI to run the facility
  - STI resources are supporting the running of the experimental areas (detectors, supports, etc.) - n_TOF Collaboration should strive to increase their efforts
  - Help to the collaboration on detectors and experiments
- Feedback on 2023 operation?
  - Reviewing NEAR activities
  - Reviewing EAR1 and EAR2
- What about the NEAR moderator – needed for LS3 or not?
- Mandates for n_TOF local team – including EXSO, Area responsible, Run coordinators are **requested** by the STI/TCD team

Outlook

Meeting(s) with HSE, STI and n_TOF to agree on and improve next years run

NEAR :

- Mesures actives = risque d'intervention plus élevé (nombre de période de décroissance et estimation de doses pour intervenants)
- Taille des intervenants pour accès aux Rabbit
- Faible utilisation de l'egroup pour annoncer les accès
- Nouvelles expériences en cours d'année
- Besoin de mieux optimiser les interventions (nécessité de déclarer les interventions en avance et d'organiser des réunions de préparation)
- Stockage des échantillons irradiés… (zone autour de l'aimant permanent pas optimisé)

EAR1 collimateur

- Nombre de demandes d'accès important
- Faible dose pour intervenants

EAR1 et 2

- Besoin d'approbation de toutes les demandes d'expérience afin de réaliser les analyses de risque
- Prendre en compte les incidents
  - Upgrade Safety [illegible]
    - Confirmation de test des installations
      - Port d'EPI
      - Capacité ?
      - Risque mise sous vide
- Amélioration des EPI
  - Fit tests
  - Cagoule ventilée
- Nettoyage fréquent ?

Cooling station

- Amelioration des EPI
  - Protection contre liquide
    - Fuite pendant accès ?
- Nettoyage annuel ?

Main message:
More communication and preparation