

n_TOF Physics Report



76th INTC meeting
May 2024

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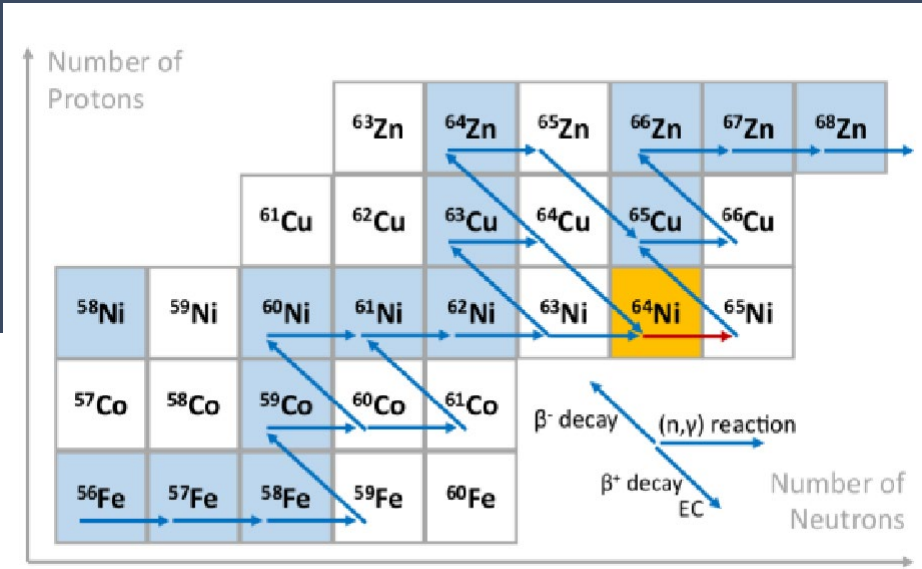
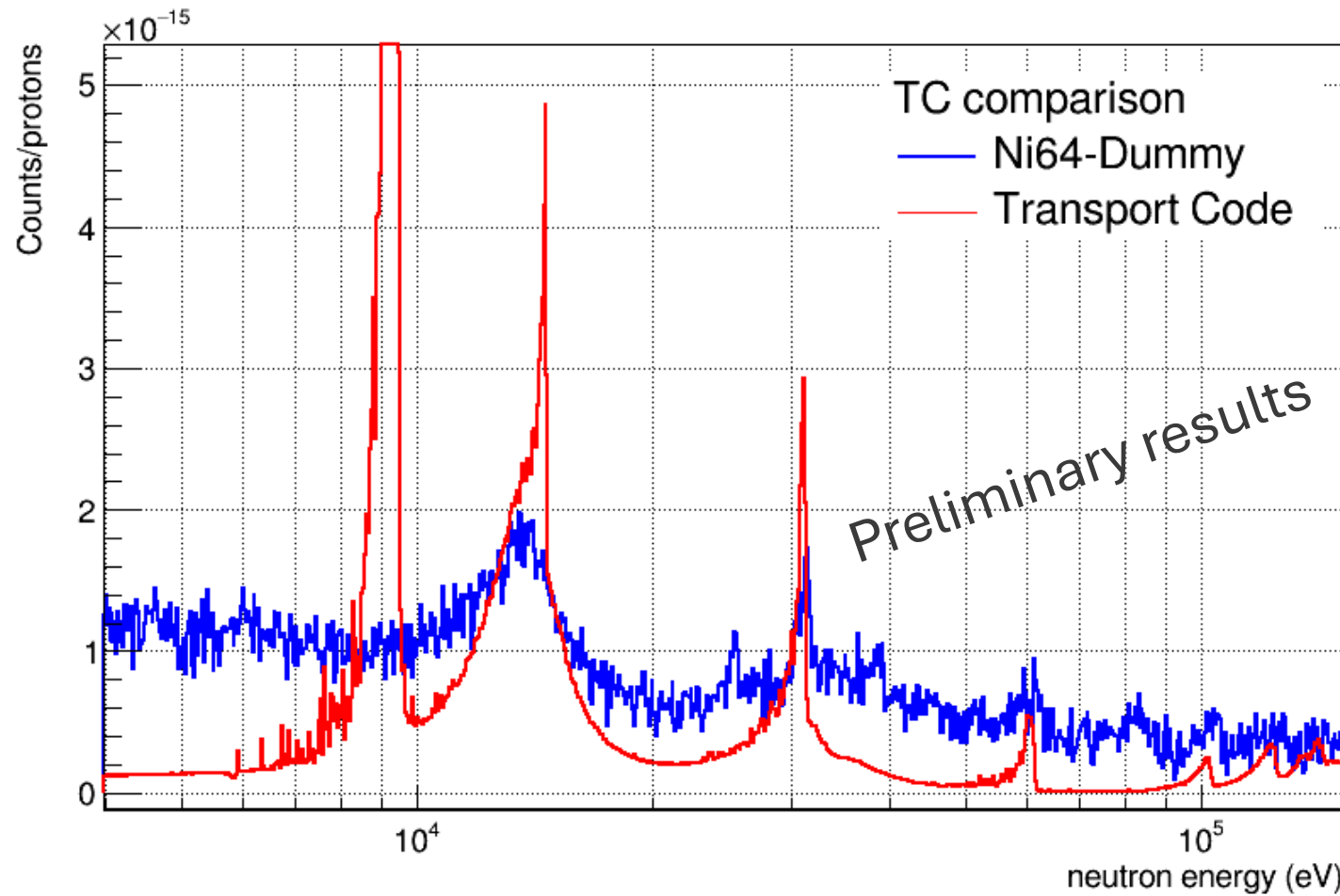
Alberto MENGONI

Riccardo MUCCIOLA

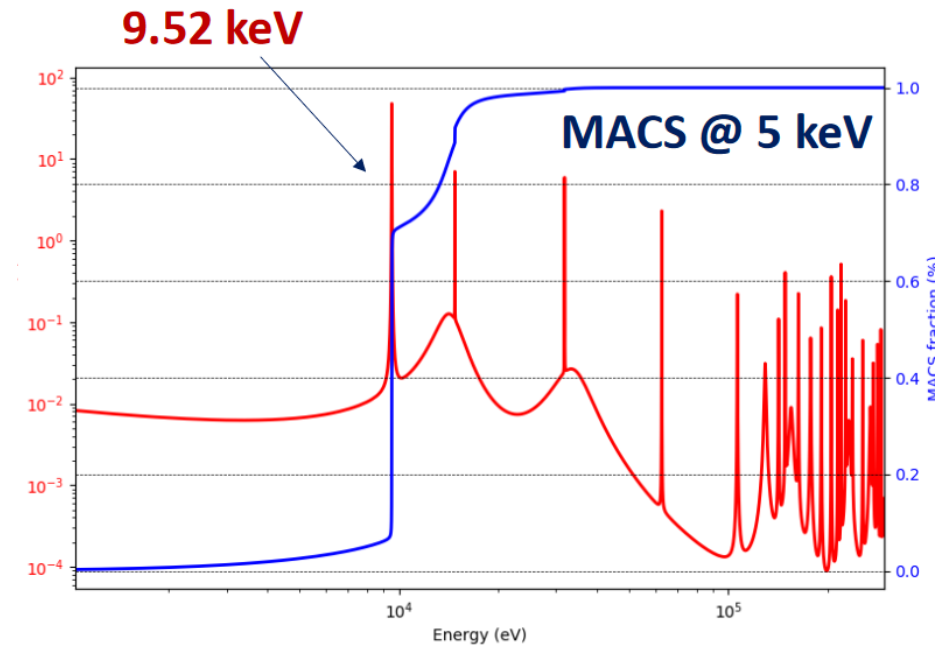
Michele SPELTA

CERN-INTC-2022-033 ; INTC-P-208-ADD-1

$^{64}\text{Ni}(n, \gamma)$



Hockenbury et al., Phys. Rev. 178 (1969) 4

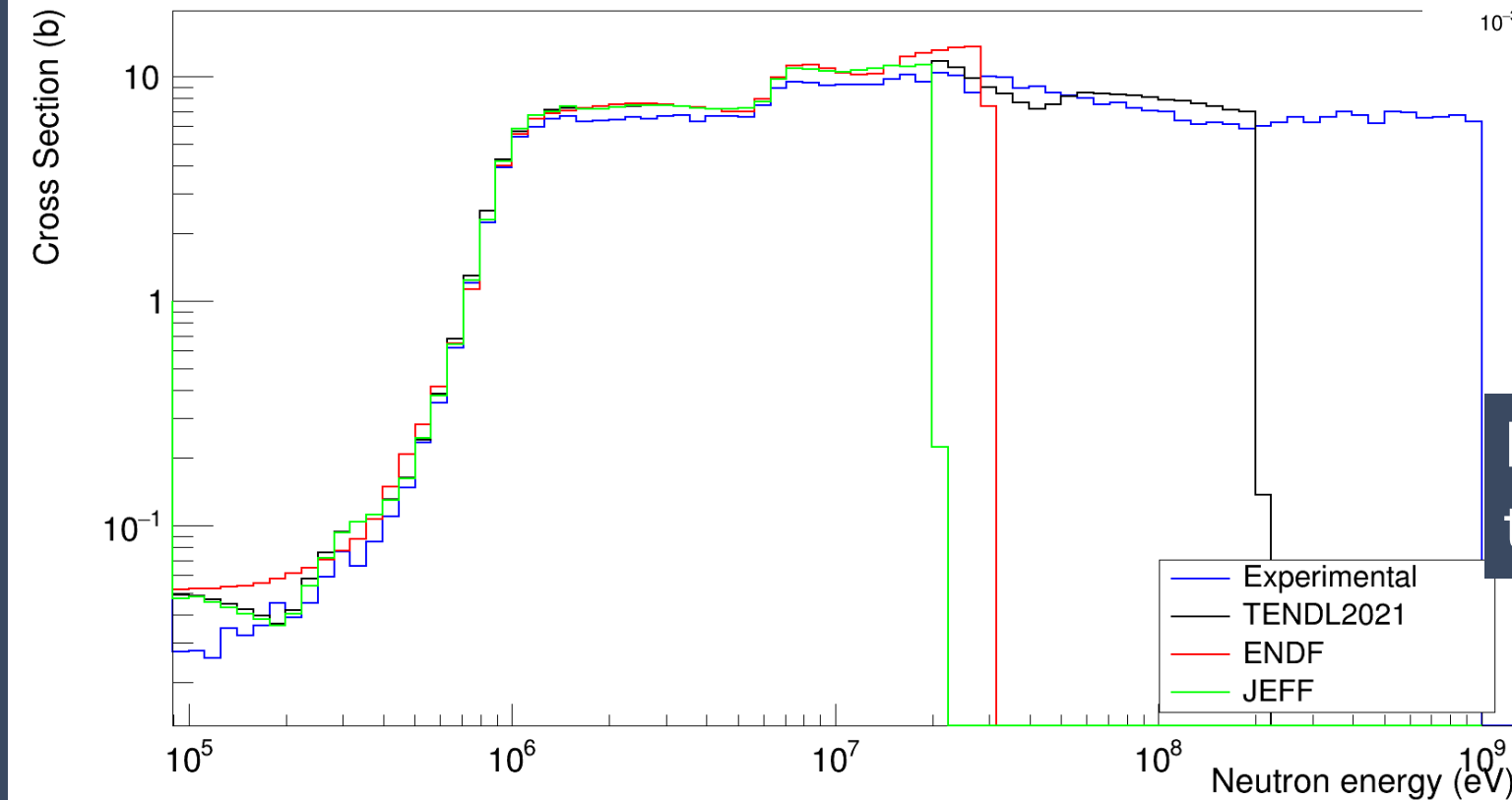


Royalties to Michele Spelta

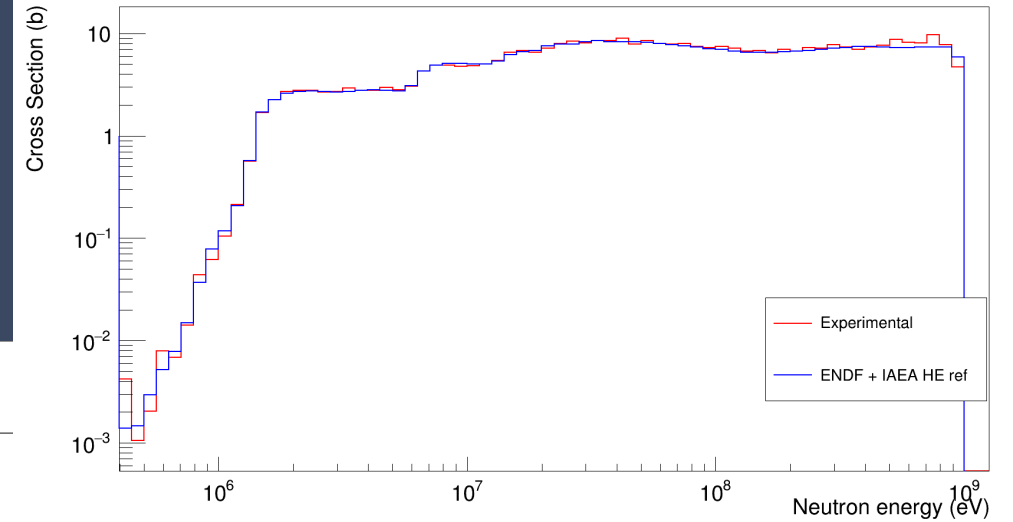
CERN-INTC-2020-048 ; INTC-P-566

$^{243}\text{Am}(n, f)$

Experimental Cross section of ^{243}Am from ^{235}U



Experimental Cross section of ^{238}U from ^{235}U



Extension of experimental data
to 1 GeV

RESEARCH NEWS

PDF Version



Heavy Element Quandary in Stars Worsened by New Nuclear Data

March 21, 2024 • *Physics* 17, 47

A widening gap between the cerium-140 abundance predicted by theories and that measured in observations of certain stars indicates a potential need for updated models of element formation.

Measurement of the $^{140}\text{Ce}(n, \gamma)$ Cross Section at n_TOF and Its Astrophysical Implications for the Chemical Evolution of the Universe

S. Amaducci *et al.* (n_TOF Collaboration)*Phys. Rev. Lett.* **132**, 122701 (2024)

Published March 21, 2024



Tomasz Zajda/stock.adobe.com

New experiments indicate that cerium-140 is significantly more likely to capture an incoming neutron than previously thought.

CERN Accelerating science

[News](#) • [News](#) • [Topic: Physics](#)

Scientists use n_TOF to investigate how cerium is produced in the Universe

The CERN facility allowed scientists to see how this rare Earth metal is synthesised in stars. The results open up new questions about stellar nucleosynthesis and the chemical evolution of galaxies

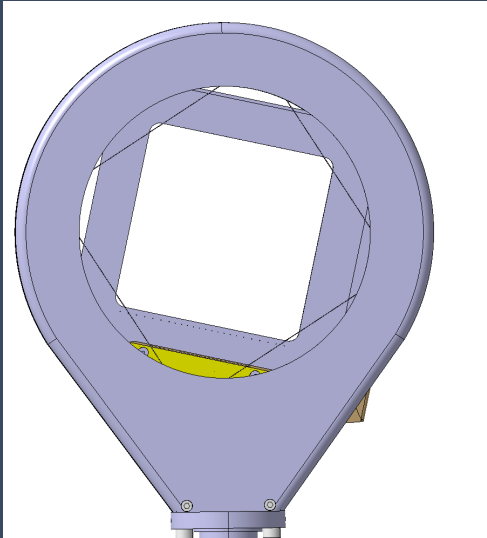
21 MARCH, 2024

<https://home.cern/news/news/physics/scientists-use-ntof-investigate-how-cerium-produced-universe>

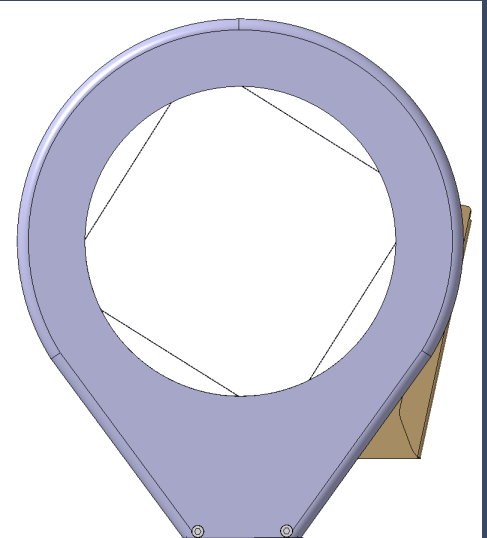


n_TOF Technical Report at the 76th INTC Meeting

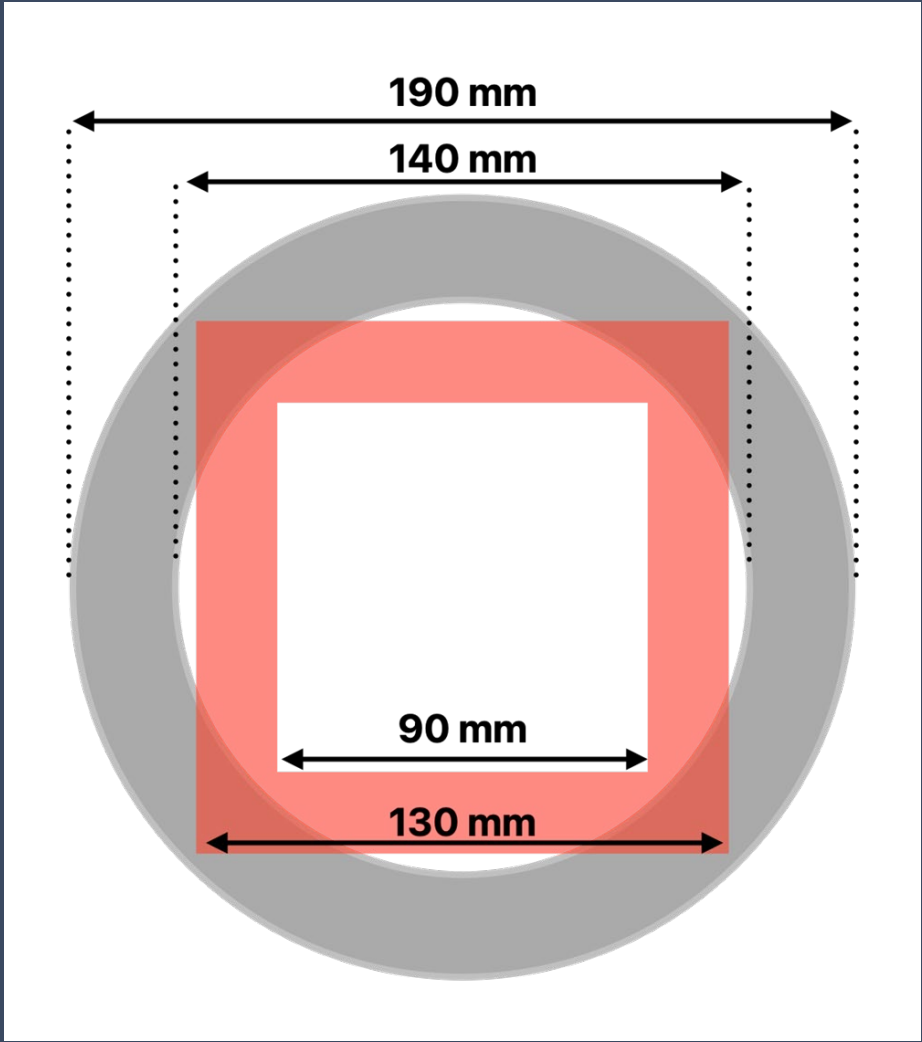
Upgrade of the Wire Grid System in FTN.BSGF484 to an Enlarged Aperture Version



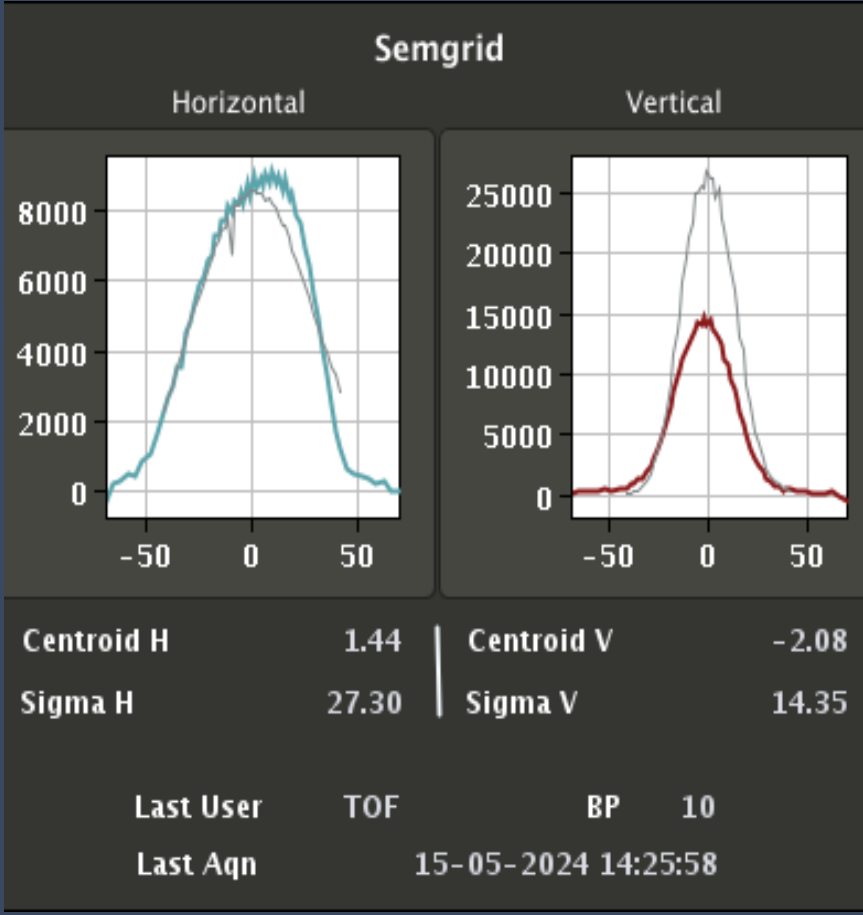
Old design (SPSBSAPB0030)



New design SPSBSAPB0064



Schematic overlap of the old (red) and new (grey) aperture, illustrating the increased clearance for the beam passage.

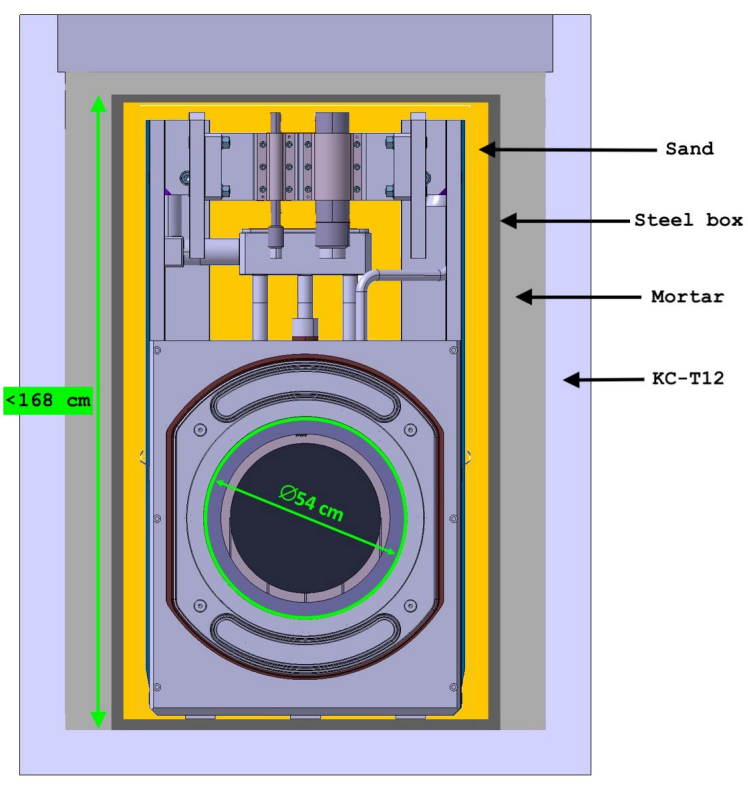


n_TOF target cooling station

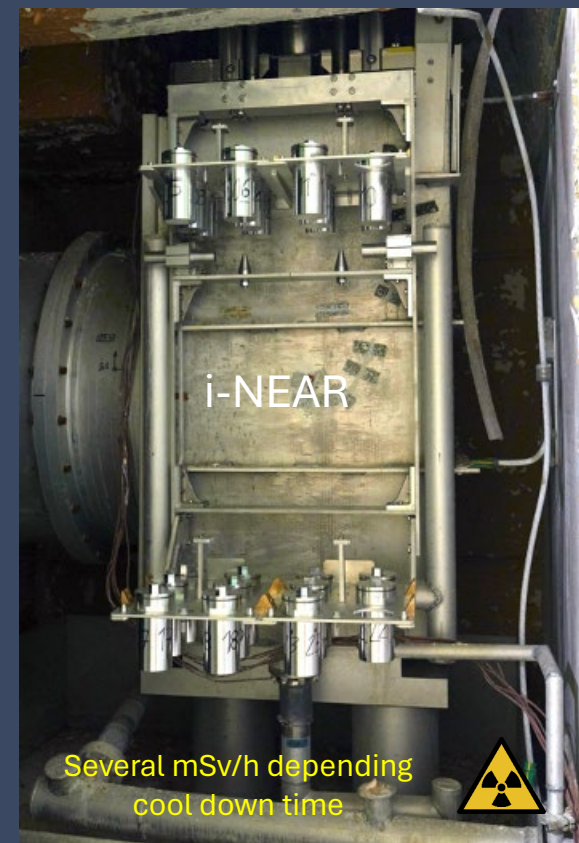
Global confinement of entire cooling station implemented during the YETS.

Safety improvement (extend under pressure confinement to the entire station + additional retention vessels for the moderator skids)





(Some of) Radioprotection issues Implemented during YETS

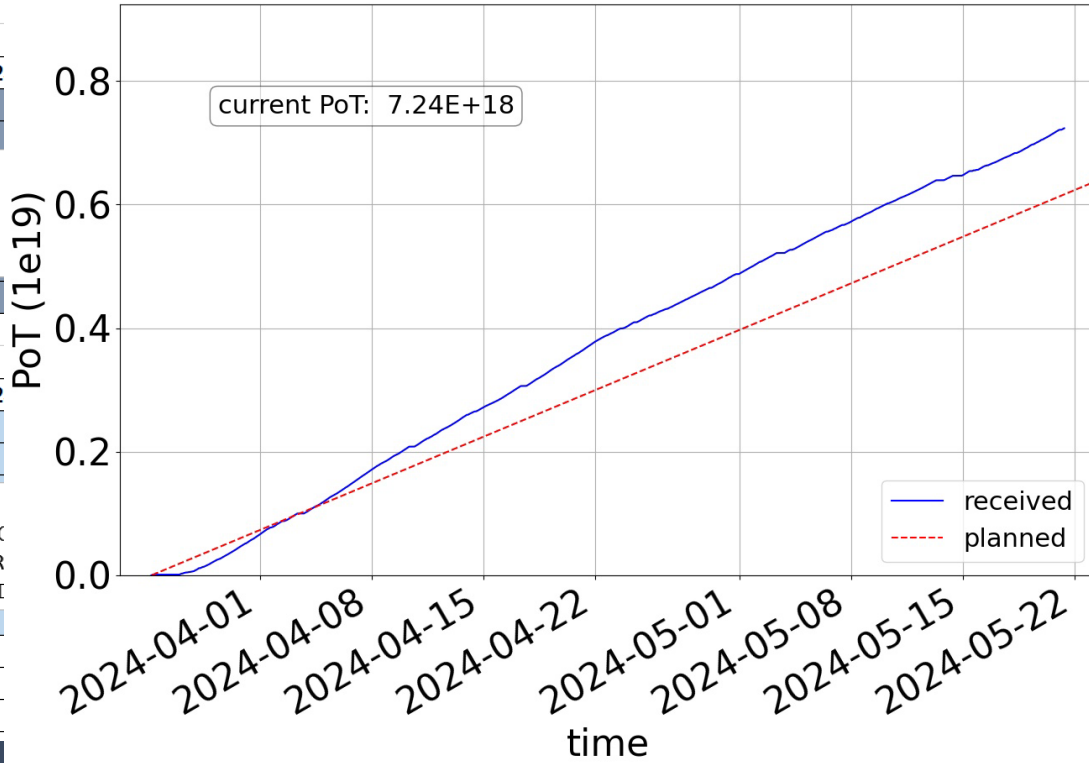
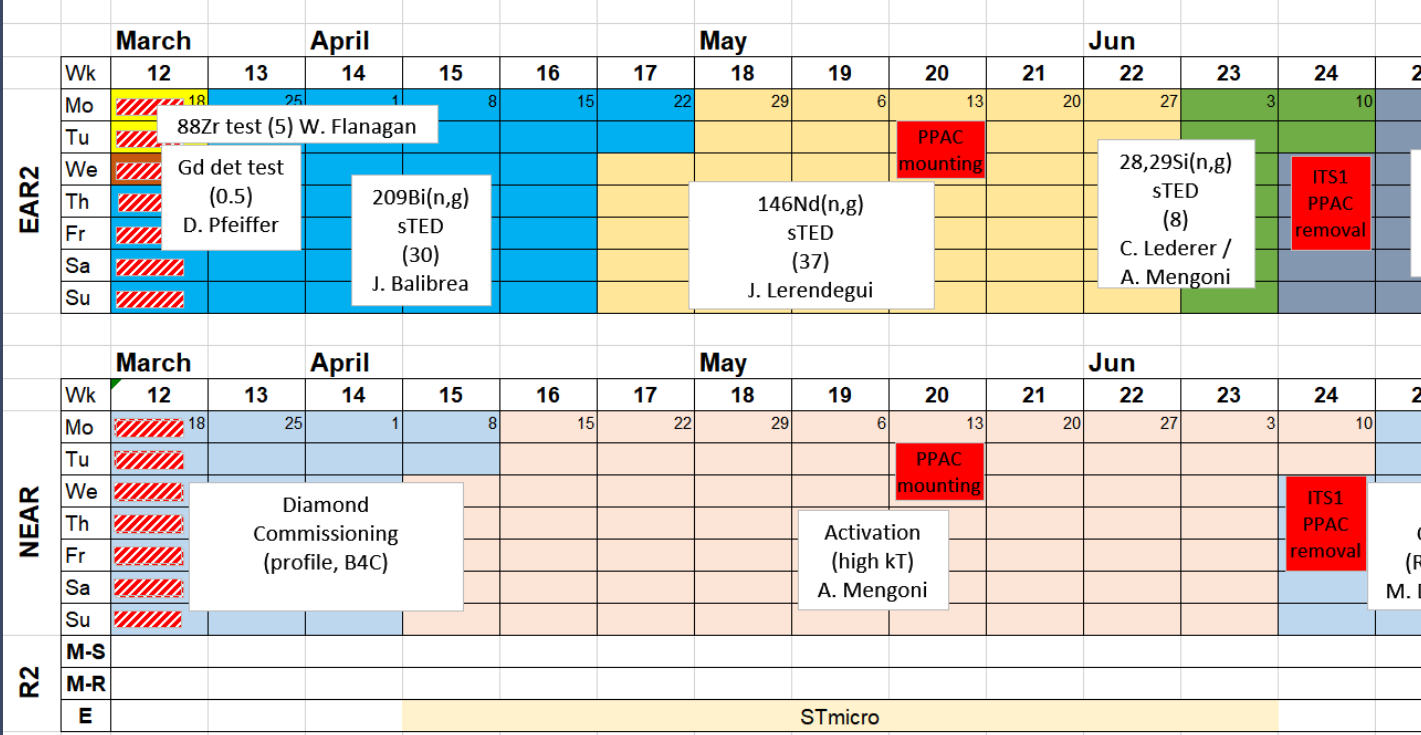
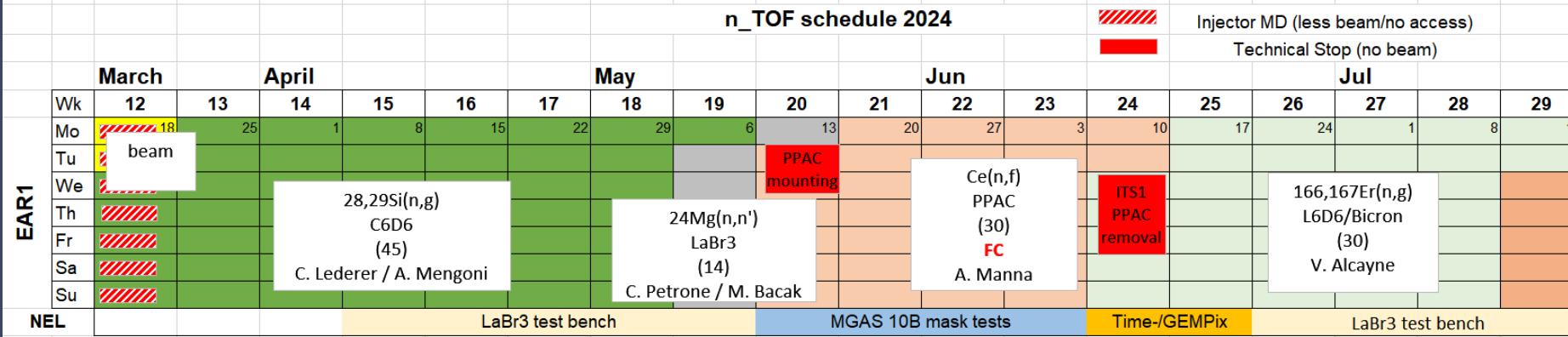


- Target #2 autopsy and waste packaging in the ISR8
- NEAR activities with open target shielding (R2M)
- Implementation of the ASN-OFSP safety recommendations
- n_TOF facility homologated and safety files up to date

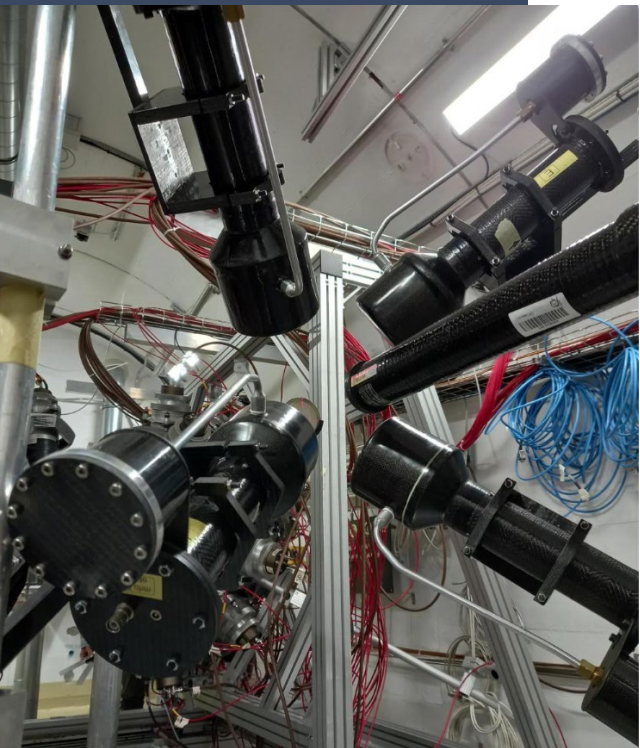
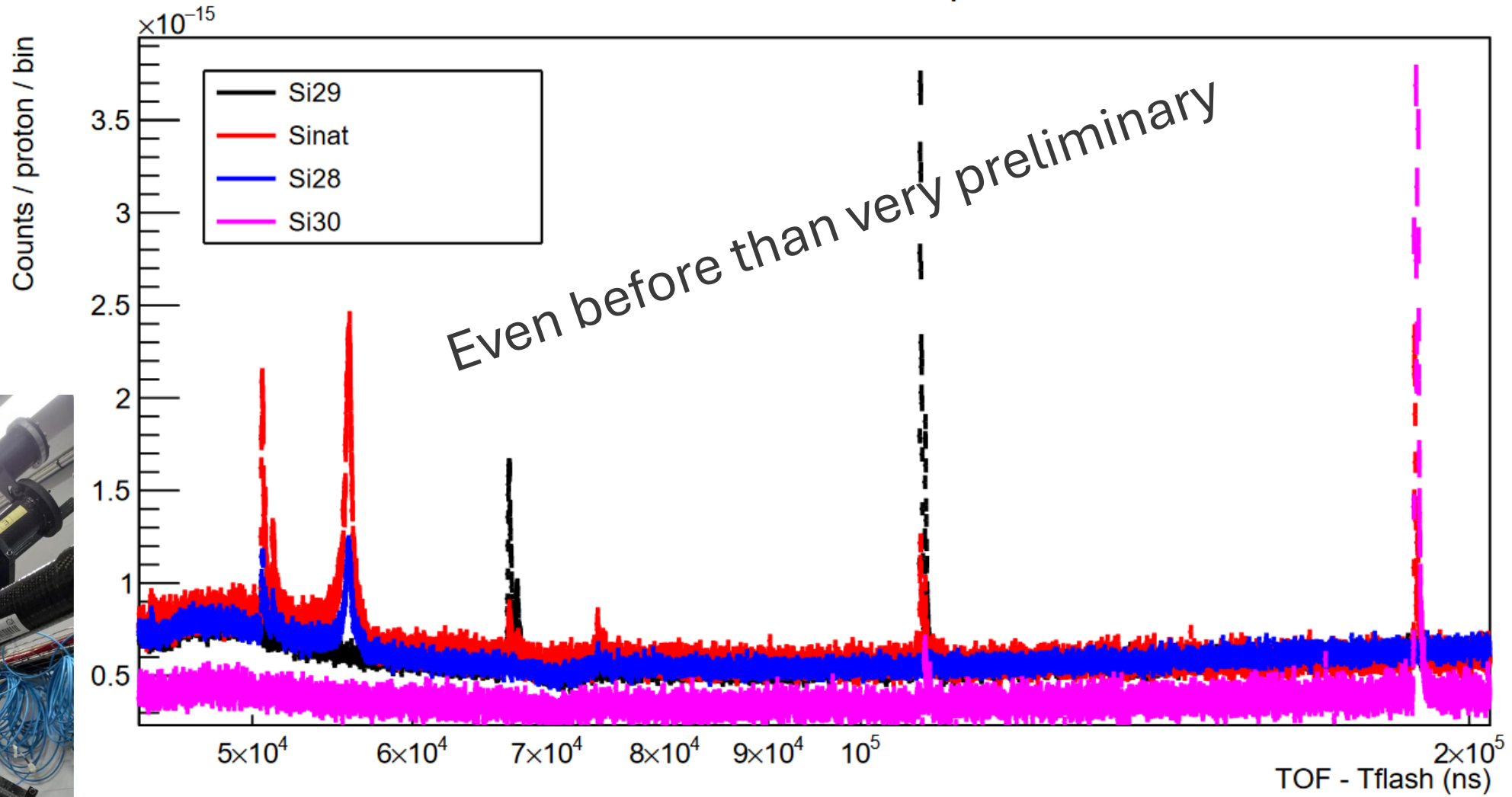
Start of **2024** campaign on March 25th.

58 days of measurement up today

7.24E18 poT (+30% than expected)

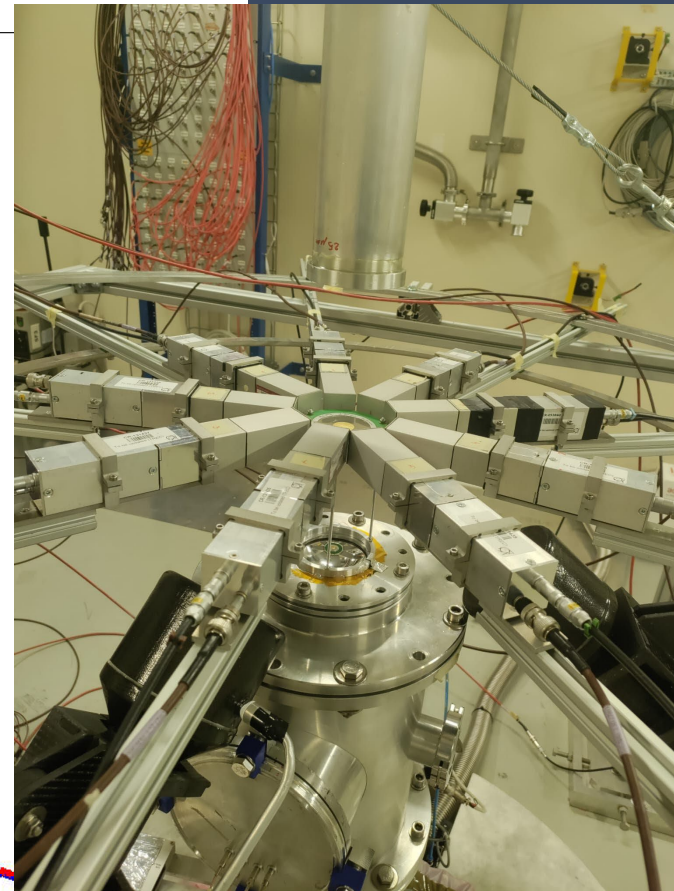
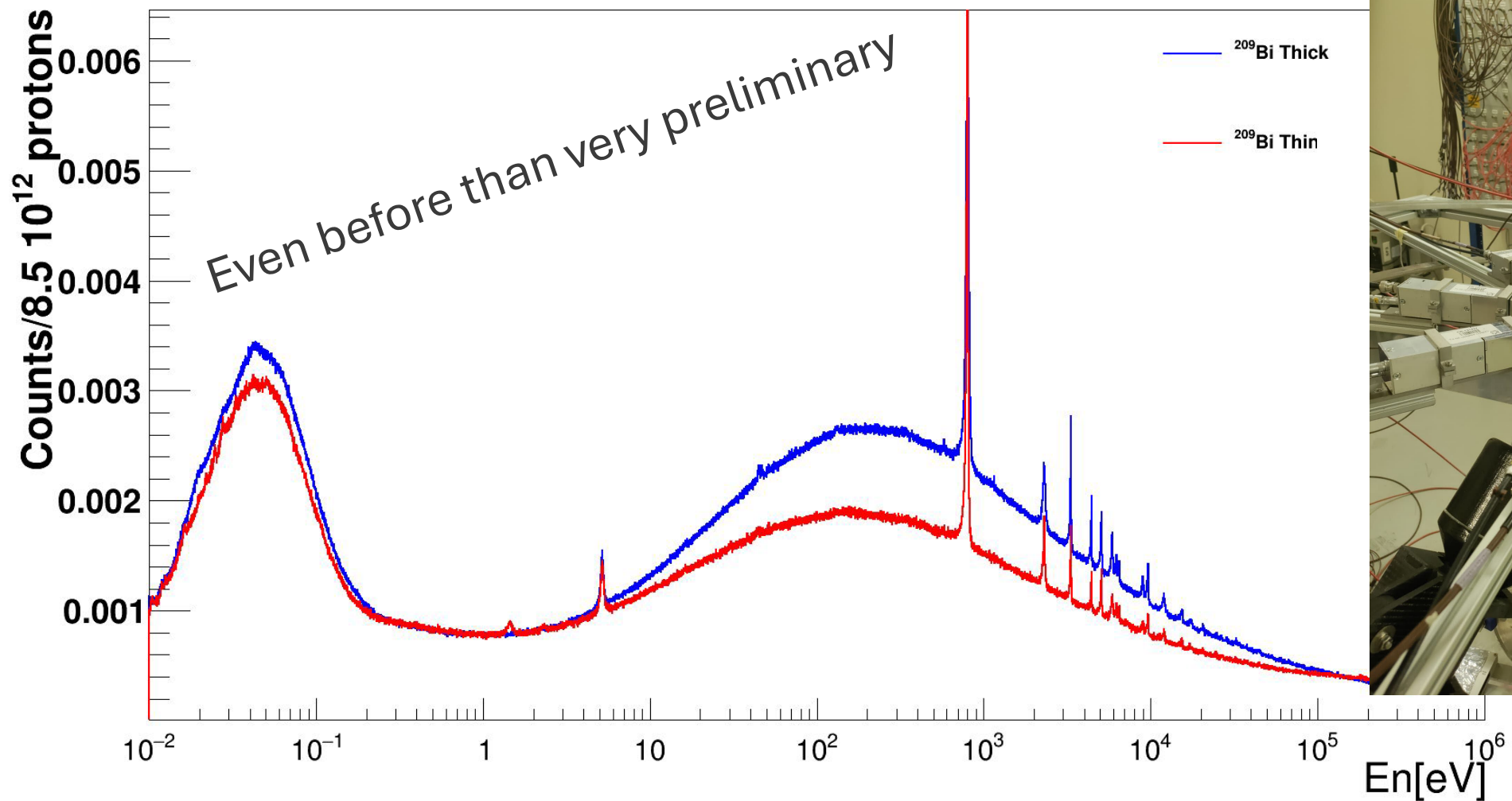


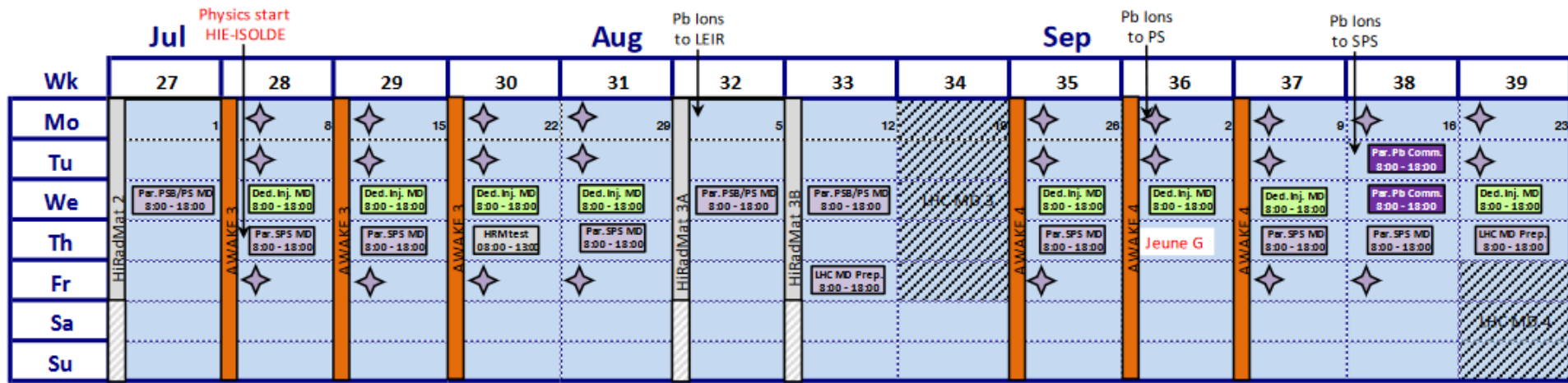
EAR-1 28,29,30Si(n, γ)



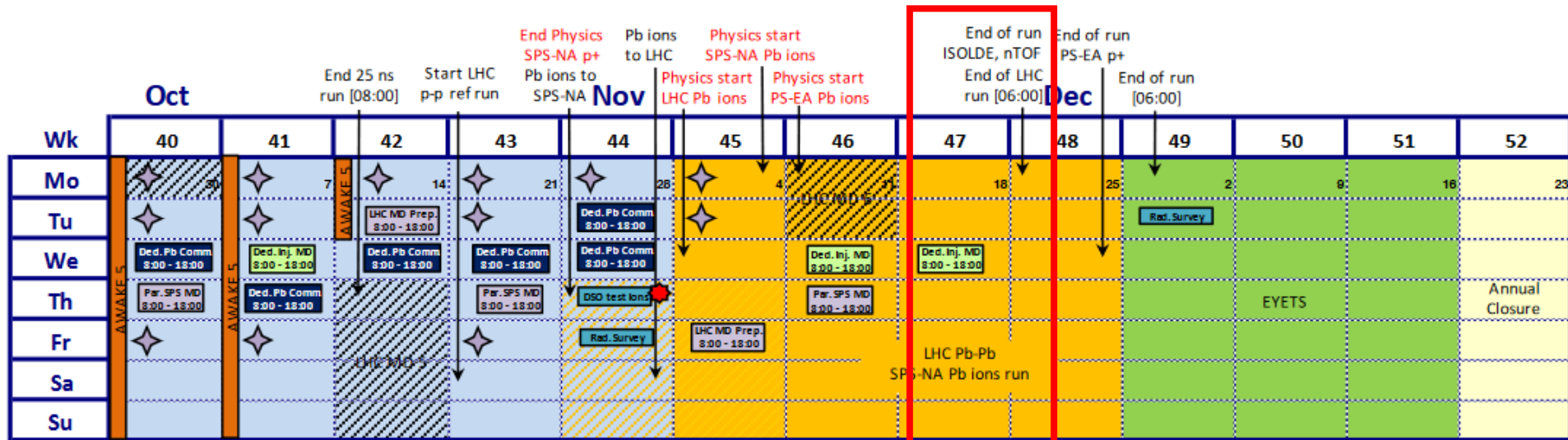
EAR-2 $^{209}\text{Bi}(n, \gamma)$

En_Projection_sTED





4 weeks Extension!



- Proton & Antiproton physics
- Pb ions physics
- Parallel SPS ions beam commissioning
- Parallel Injectors MD block (08:00 - 18:00)
- Dedicated Injectors MD Block (08:00 - 18:00)
- Dedicated SPS ions beam commissioning
- YETS & Injector chain Technical Stop
- SPS ions Hardware commissioning
- EYETS & Injector chain Technical Stop
- Annual closure
- Hardware commissioning / Sys. admin days
- Beam commissioning
- Dedicated SPS ions beam commissioning
- AWAKE Run (08:00 - 24:00)
- HiRadMat Run & reserve (08:00 - 24:00)
- LHC MD block proton period
- LHC MD blocks ion period
- Special interventions/stops
- CERN Official Holidays
- Linac 3 source refill

2024 Tentative (August-November)



Injector MD (less beam/no access)

Technical Stop (no beam)

		Nov																		
Wk		30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	
EAR1	Mo	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	
	Tu	Cu(n,g) L6D6/Bicron (25) C. Massimi		238U(n,g) L6D6/Bicron (32) E. Mendoza			24Mg(n,n') + water(n,n') LaBr3 (14 +3) C. Petrone / M. Bacak			12C(n,lcp) DDX (30) E. Pirovano			Re-TOF spectrometer (parasitic 7) A. Manna			12C(n,nn') p-stilbene (6) M.G. Pellegriti			Cu(n,g) L6D6/Bicron (25) C. Massimi	
	We																			
	Th																			
	Fr																			
	Sa																			
	Su																			
NEL	LaBr3 test bench																			

		Aug					Sep					Oct					Nov				
Wk		30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47		
EAR2	Mo	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18		
	Tu				88Zr(n,g) sTED (50) W. Flanagan			Sili Annular det test (5) S. Amaducci			X17 test C. Gustavino			40K(n,a/p) EDI silitele (50) C. Lederer							
	We																				
	Th																				
	Fr																				
	Sa																				
	Su																				

		Aug					Sep					Oct					Nov				
Wk		30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47		
NEAR	Mo	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18		
	Tu																				
	We																				
	Th																				
	Fr																				
	Sa																				
	Su																				
R2	M-S																				
	M-R																				
	E																				

Draft 2025 Injectors Schedule ver. 0.1 in numbers

Experimental facility	Beam to	Start physics	End physics	Duration 2025 Physics DRAFT Version 0.1 [days]*	
ISOLDE	17.03.2025	25.03.2025	17.11.2025	237	
nTOF	24.03.2025	31.03.2025	17.11.2025	231	
PS East Area p ⁺	24.03.2025	31.03.2025	17.11.2025	231	
PS East Area Pb ions	-	27.10.2025	17.11.2025	21	
SPS North Area p ⁺	03.04.2025	17.04.2025	07.07.2025	51	148
	-	11.07.2025	16.10.2025	97	
SPS North Area O ions	07.07.2025	09.07.2025	11.07.2025	2	
SPS North area Pb ions	16.10.2025	20.10.2025	17.11.2025	28	
AD-ELENA	26.03.2025	05.05.2025	17.11.2025	196	
HiRadMat	-	28.04.2025	21.09.2025	20 (+8)	

*TS and MD time etc. not deducted

2024 + Draft 2025 Injectors Schedules in numbers

Backlog of
4.4E19 EAR-1
3.0E19 EAR-2

Experimental facility	Duration 2024 v. 2.0 [days]	Duration 2025 v 0.1 [days]	Totals
ISOLDE	231	237	468
nTOF	245	231	476
PS East Area p ⁺	251	231	482
PS East Area Pb ions	21	21	42
SPS North Area p ⁺	204	148	352
SPS North Area O ions	0	2	2
SPS North area Pb ions	28	28	56
AD-ELENA	224	196	420
AWAKE	86	0	86
HiRadMat	20 (+8)	20 (+8)	40 (+16)

*TS and MD time etc. not deducted



New proposals

Measurement of $^{92,97,98,100}\text{Mo}(n, \gamma)$ relevant to Astrophysics and Nuclear Technology

Speaker: Riccardo Mucciola (Università e INFN, Bari (IT))

Measurement of the neutron-induced fission cross section of ^{236}U at n_TOF

Speakers: Andrea Tsinganis (Joint Research Center (JRC) (BE)), Zinovia Eleme (University of Ioannina (GR))

Measurement of the neutron-induced fission cross section of ^{239}Pu at n_TOF

Speakers: Alice Manna (Università e INFN, Bologna (IT)), Laurent Audouin (Université Paris-Saclay, CNRS, IJCLab, (FR))

ABOUT US

NUPECC

https://indico.ph.tum.de/event/7629/contributions/8953/attachments/6020/8072/Full_LRP2024_Report_03042024_clean.pdf

Recommendations for Nuclear Physics Infrastructures

Neutron facilities that are producing unique experimental results in nuclear fundamental research and applications, like ILL, and **n_TOF at CERN**, should be kept in operation.

Recommendations of the Nuclear Astrophysics

The neutron beam facility **n_TOF at CERN** provides essential nuclear data to unveil the origin of the chemical elements. We strongly recommend full exploitation of the facility in the future and support further upgrades.

Metrology standards

...there is an increasing interest in the measurement of (n,f) and (p,f) reactions at high energy up to 1 GeV, in which the main challenge is to produce absolute results with accuracy suitable for a standard. In Europe, the n_TOF facility at CERN is the only one with such capacity and its uniqueness should be fully exploited.

The n_TOF facility

Detector developments

Radiative capture reactions (n, γ)

Fission reactions (n, f)

Light particle emission reactions (n, cp)



PUBLICATIONS

<https://twiki.cern.ch/NTOFPublic/ListOfPublications>

DATA DISSEMINATION

<https://twiki.cern.ch/twiki/bin/view/NTOFPublic/DataDissemination>