# Feedback from n\_TOF on 2023 Operation and Outlook

#### Joint Accelerator Performance Workshop, Montreux, 5-7/12/2023

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# The n\_TOF facility: EAR1 + EAR2 + NEAR



# n\_TOF: a unique neutron TOF facility

#### • Excellent time/energy resolution:

- total pulse width  $4\sigma = 28$  ns
- EAR1 0.03%@1 eV, 0.5%@1MeV
- EAR2: 0.4%@1 eV, 4%@1MeV
- Extended energy range (experimental XS data for neutron energies covering 11 orders of magnitude): meV to GeV
- High instantaneous flux along with low background exp. areas
  - EAR1 ~ 0.5E6 n/puse (18 mm aperture)
  - EAR2: ~1E7 n/pulse (23 mm aperture)
  - Excellent signal to background conditions
  - Measurements with samples of extreme specific radioactivity are feasible
- Excellent (and stable) neutron production conditions thanks to our NEW G3 spallation target









# Highlights of the 2023 n\_TOF campaign

EAR1	EAR2	NEAR		
<ul> <li>HPGe test</li> <li><sup>181</sup>Ta(n,γ)</li> <li><sup>nat</sup>Er(n,γ)</li> <li><sup>30</sup>Si(n,γ)</li> <li><sup>243</sup>Am(n,f)</li> <li><sup>12</sup>C(n,p/d/a) SADR</li> <li><sup>12</sup>C(n,p/d/a) DDX</li> <li>Ar-transmission</li> </ul>	<ul> <li>(n,γ) optimization study</li> <li>d-stilbene test</li> <li><sup>197</sup>Au(n,γ) with 1cm &amp; 2cm B4C</li> <li><sup>76</sup>Ce(n,γ) with 1cm &amp; 2cm B4C</li> <li><sup>243</sup>Am(n,f)</li> <li><sup>30</sup>Si(n,γ)</li> <li><sup>64</sup>Ni(n,γ)</li> <li><sup>26</sup>Al(n,p/a)</li> <li>(n,p/d/a) SADR</li> <li>Si det. test for (n,cp)</li> <li>X17 2nd part of in-beam test</li> </ul>	<ul> <li><sup>197</sup>Au(n,γ)</li> <li><sup>140</sup>Ce(n,γ)</li> <li><sup>94</sup>Zr(n,γ)</li> <li>Diamond det. test</li> <li>SiC</li> <li>Background</li> </ul>		

- 4 neutron capture reactions
- 2 (n,cp) reactions
- <sup>243</sup>Am fission study covering 11 orders of magnitude of neutron energies
- 2 neutron capture reactions have been (further) studied at NEAR and EAR2 with different B4C filter configurations; Activation technique; MACS for different stellar temperatures;
- NEAR beam profile, flux and background measurements
- 9 detector development projects have been accomplished successfully
- First transmission measurement at n\_TOF was realized





## **PoT status**

- We received (=2.3E19) more protons than expected (=2.
   2.03E19) = 1.14E17 p/day
- All experimental campaigns received the approved number of protons
- Flexibility on the pulse intensity
- Many thanks to the PS teams!



#### **PoT status**





Average proton beam intensity upper limit: 167E10pps -> 220E10pps; 09.06.2023



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5 5	TAGISOGPS 2023	22			805	840	ISOGPS
6	TOF 2023	23	0000	0000	840	839	TOF 4BSW16
7	TOF 2023	23	0000	0000	833	825	TOF 4BSW16
8	TOF_2023	23	0000	0000	847	842	TOF_4BSW16
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# **Issues during the 2023 campaign**



#### Beam start at 03.04.2023 - FTN line commissioning

#### 2023 after going back to the previous SEM grid el. chain



YETS 2023-24: Installation of new SEM grid detector head (larger aperture, more channels)

### **Issues during the 2023 campaign**

n\_TOF target borated water filter leak on 16/6/2023: Thankfully a backup filter was available! Many thanks to: Ch. Saury, N. Roget, Cl. Pruneau for the successful intervention!



- 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.

YETS 2023-24: Cooling station upgrade (extend confinement to the entire station + additional retention vessels for the moderator skids, as requested by the tripartite)

## **Issues during the 2023 campaign**

#### The ringing problem is still there!

- This is a beam related problem appeared in EAR1 during 2022 onwards
- For some detectors the problems is solved for others the mitigation is not possible
- **Detailed investigation is needed** (antenna scanning, cabling improvement, ...)



#### **Issues during the 2023 campaign** (on the Experiment side)





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



# n\_TOF desiderata for the 2024 operation

#### • 2024 Beam for n\_TOF (our request: 217E17 or 1E17\* protons/day)

- 18.03.2024 for hardware commissioning (7days)
- 25.03.2024 Physics Start
- 28.10.2024 beam off (217 days of physics)
- Pulses of different intensities
  - High intensity (dedicated): 8.5E12 ppp
  - Low intensity (parasitic): 4.5E12 ppp
- "Fixed" impact point on the lead target for both pulses
  - ± 5 mm horizontal (centroid)
  - ± 3 mm vertical (centroid)
- Same (as 2022) spatial profile dimensions of the beam
- Proton beam intensity: 200-220e10 p/s
- Pulse time length: 28 ns ( $\sigma \sim 7$ ns) without "tails" and pre- pulses
- For 2024 proton budget will be fully optimized, as every year, by running INTC approved experiments in parallel in three EARs

\* This is a "reasonable" request that takes into account the foressen 2024 demands.



## n\_TOF future (LS4: High Power target #4)



# n\_TOF future (LS4: High Power target #4)

With a target able to accept higher proton beam intensity (x10) we can:

- Extend significantly the abilities of both TOF experimental areas. Measurements ~<u>10 times</u> lower sample masses become feasible
  - Detection efficiency:
    - x2 or x3 in gamma detection
    - **x6** in particle detection
  - Average neutron flux for TOF measurements: x2 (or more) (Maintaining the nice single bunch parameters for TOF measurement)
  - **Potential increase single bunch intensity x2 or x3** -> important improvement in S/N ratio!
- Extend significantly the abilities of both NEAR: SACS measurements with ~<u>100 times lower</u> sample mass become feasible
  - Detection efficiency: **x10** thanks (!) to Spanish HPGe Clover funding
  - Average neutron flux: **x10** (or more) by reducing single bunch properties and increase the average power on target (e.g. by directing to FTN all 4 PSB pulses)

Thank you!

A	В	C	D	E	F	G	К
n_TOF	2024-run expected number of protons [1e17]: 217 (for 217 days)						
				NoP approved (1e17)			
		INTC meeting	experiment	EAR1	EAR2	NEAR	Spokesperson(s)
	INTC-P-406-ADD-1	71	40K(n,p/a)		50		C. Lederer-Woods, M. Friedman
	INTC-P-631	70	Diamond			7	M. Diakaki, M. Bacak
	INTC-P-651	72	DDX 12C	30			E. Pirovano, R. Beyer
approved and planned for 2024	INTC-P-653	72	28,29Si (70/11)	45	8		C. Lederer-Woods, A. Mengoni
	INTC-P-656	72	Er (60-20, 10 spare for TAC)	30			V. Alcayne, A. Guglielmelli
	INTC-P-665	73	natCe(n,f)	30			M. Caamano, D. Tarrio
	INTC-I-256	73	MArEX		7		A. Mengoni, R. Svoboda
			TOTAL	135	65	7	
	INTC-I-261	74	LaBr3(Ce) Lol	14			C. Petrone, M. Bacak
	INTC-P-671	74	146Nd(n.g) sTED		37		J. Lerendequi-Marco
approved and planned for 2024	INTC-P-672	74	238U(n.g) C6D6	32			E. Mendoza
	INTC-P-675	74	209Bi(n.g) sTED		30	t t	J. Balibrea-Correa
approved and planned for 2025	INTC-P-677	74	241Pu(n,g) TAC (2025)	53			E. Dupont, J. Heyse
			TOTAL	99	67		
wating approval			Dallas NiSoC		5		W. Flanagan
in the pipeline (to be submitted)				137	157	40	
			TOTAL	137	162	40	
			GRAND TOTAL	371	294	47	
				371	234		

### n\_TOF so far...



# Target #1

- The first n\_TOF spallation target served the facility up to 2008.
- On 28/11/2023 the n\_TOF target #1 at PSI (final storage)

Many thanks to SY-STI for the good care of all stages of this demanding task!



