

# n\_TOF Physics Report

67<sup>th</sup> INTC Meeting

**Javier Praena**

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CERN Scientific Associate (EP/SME)  
n\_TOF Physics Coordinator

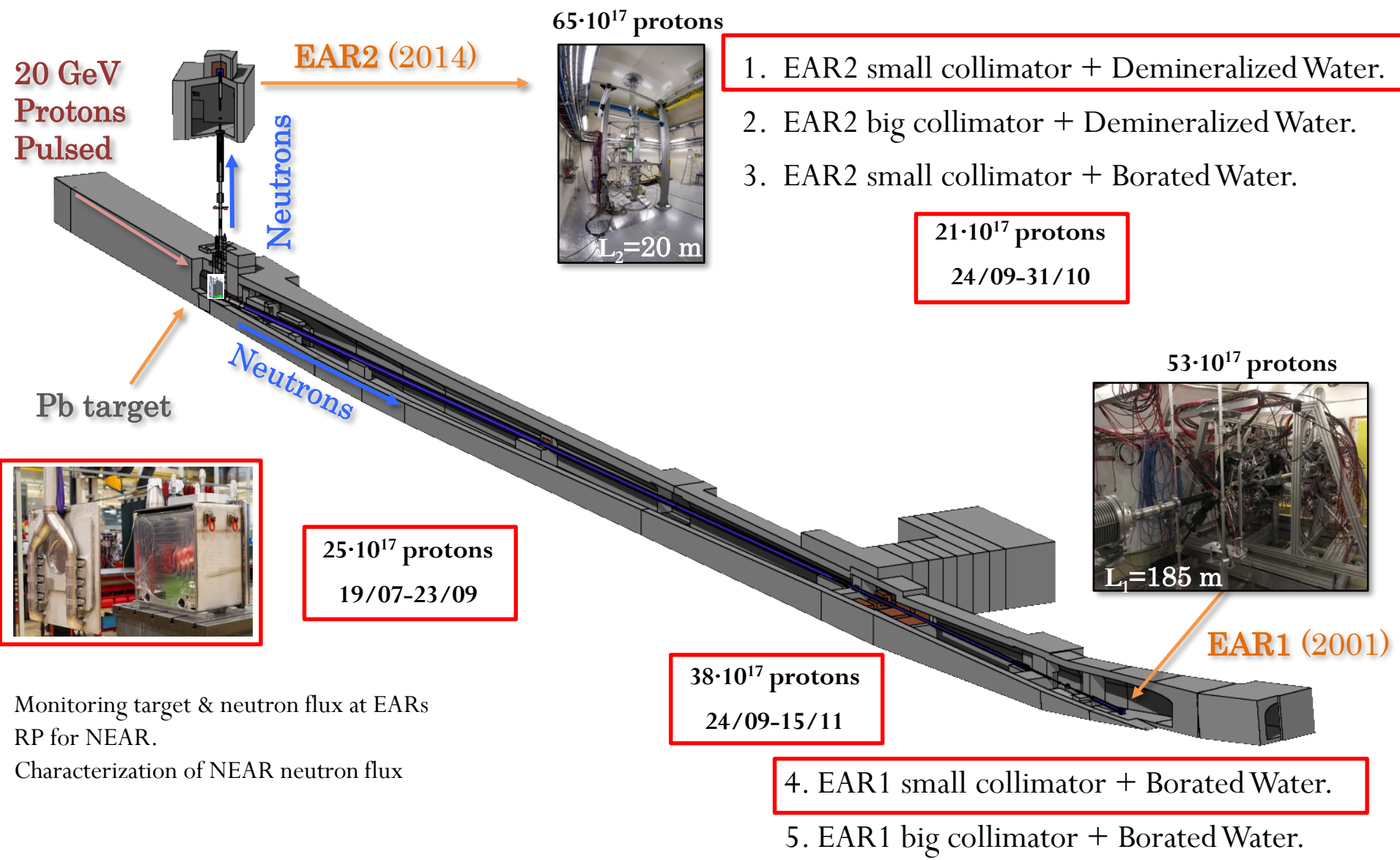


# INTC recommendation Nov 2020

In the committee's view, the commissioning part is unavoidable for reliable and safe operation of the facility. In addition, experience by the collaboration with the planning and interpretation of experiments has shown that the characterisation of flux, spatial profile, resolution function and background are essential for any physics campaign. Therefore, the requested protons should be allocated. Optimization of beam time in 2021 will be called upon by those with approved experiments. It is however, strongly recommended that these optimizations are not allowed to compromise **good commissioning and a high quality characterisation of the experimental conditions.**

*The INTC recommends  $1.78e19$  protons for approval by the Research Board.*

# Commissioning. In red what is planned in 2021 (YETS on 15<sup>th</sup> Nov)



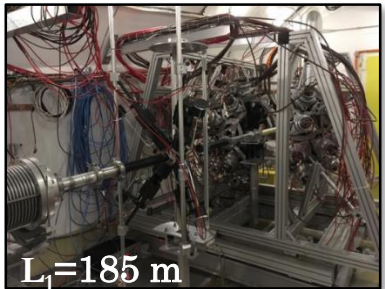
1. EAR2 small collimator + Demineralized Water.
2. EAR2 big collimator + Demineralized Water.
3. EAR2 small collimator + Borated Water.

**25 · 10<sup>17</sup> protons**  
**19/07-23/09**

**21 · 10<sup>17</sup> protons**  
**24/09-31/10**

**38 · 10<sup>17</sup> protons**  
**24/09-15/11**

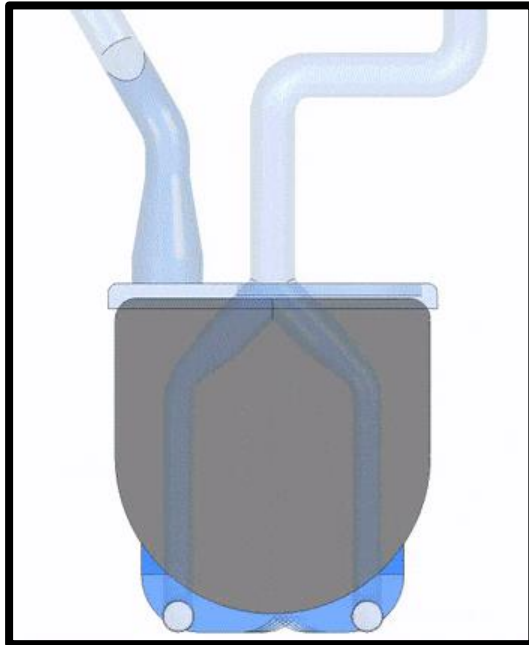
4. EAR1 small collimator + Borated Water.
5. EAR1 big collimator + Borated Water.



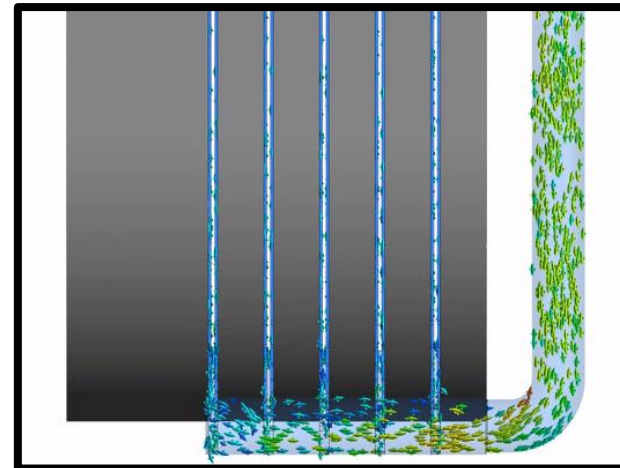
Monitoring target & neutron flux at EARs  
RP for NEAR.  
Characterization of NEAR neutron flux

# Target Commissioning

19<sup>th</sup> July – 23<sup>rd</sup> September 2021



Al-6082-T6 supporting structure  
(anti-creep and N<sub>2</sub> cooling channels)

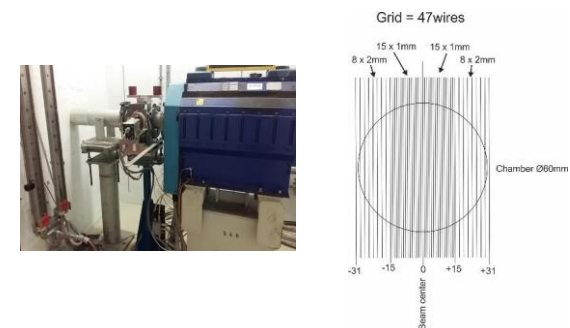


N<sub>2</sub>-cooled Pb neutron spallation target for the CERN's n\_TOF facility  
*R. Esposito, M. Calviani*  
ICANS XXIII – International Collaboration on Advanced Neutron Sources – October 2019

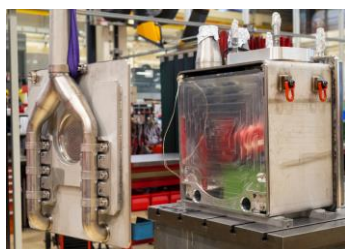
# Proton beam size and position & neutron flux

**Secondary Electron Monitor (SEM)** will act as monitoring for the positioning and size of the proton beam. SEM was installed on the Week 5 2021 in the proton transfer line to the target (FTN).

Correlated to neutron detectors at EARs.



## Temperature & proton intensity



**K-thermocouples** located between the Pb slices for monitoring the temperature versus proton intensity.

## Neutron fluence with SPND

**Self Powered Neutron Detectors (SPND)** will be used for determining the neutron fluence in a position close to the target.

Cross-check with FLUKA and EARs data.

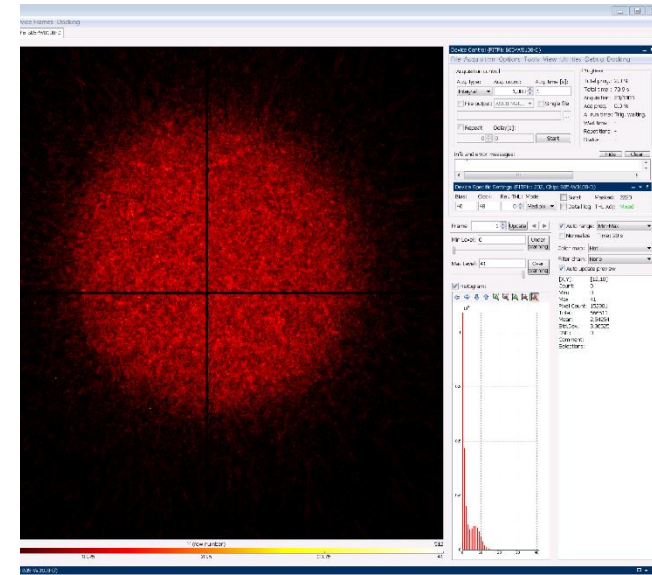
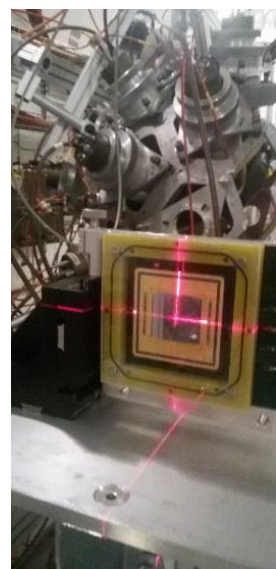
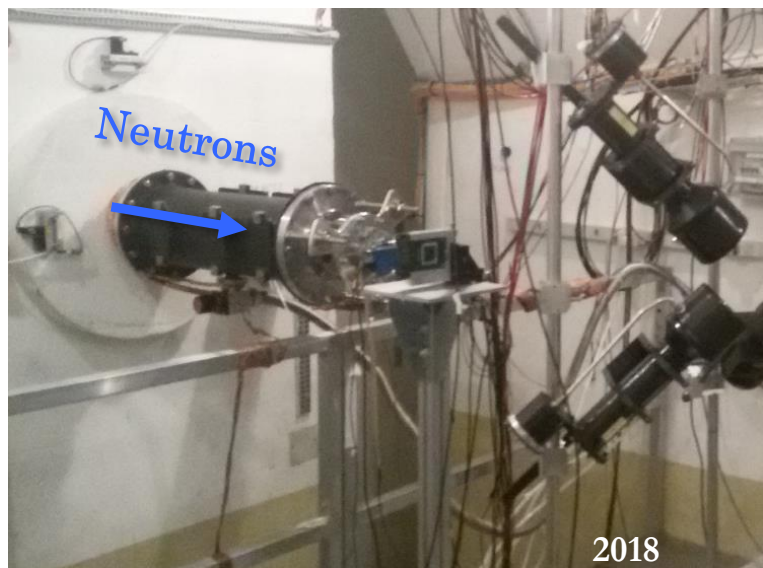
IFMIF-DONES (collaboration with fusion material irradiation facility).

SPND are already at CERN (2nd Installation coordination meeting).



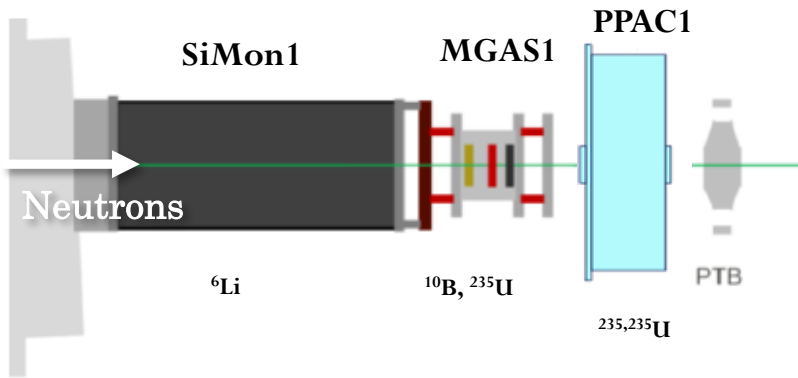
# 19<sup>th</sup> July - 22<sup>nd</sup> July: timepix for alignment

- Two Timepixes (4 sensors 15x15 mm<sup>2</sup>, as used in 2018 for beam alignment)
- EAR1 and EAR2. For EAR2 the support are on construction.
- More detectors will be already installed downstream Timepix.

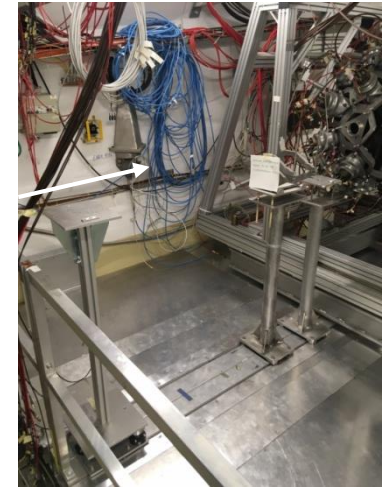


Fabrizio Murtas, Michael Bacak

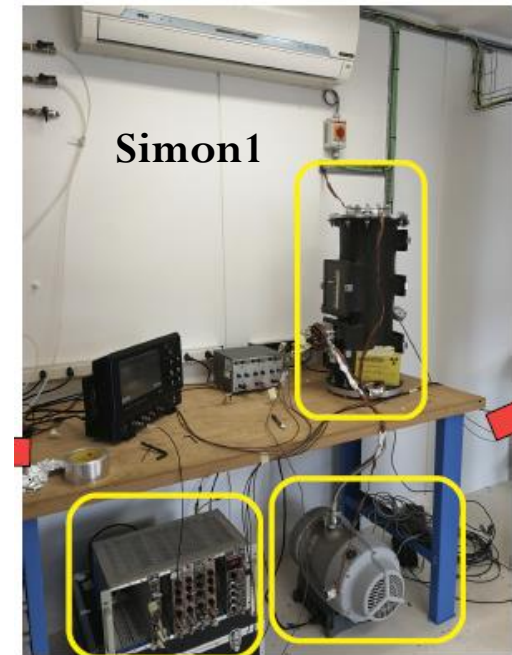
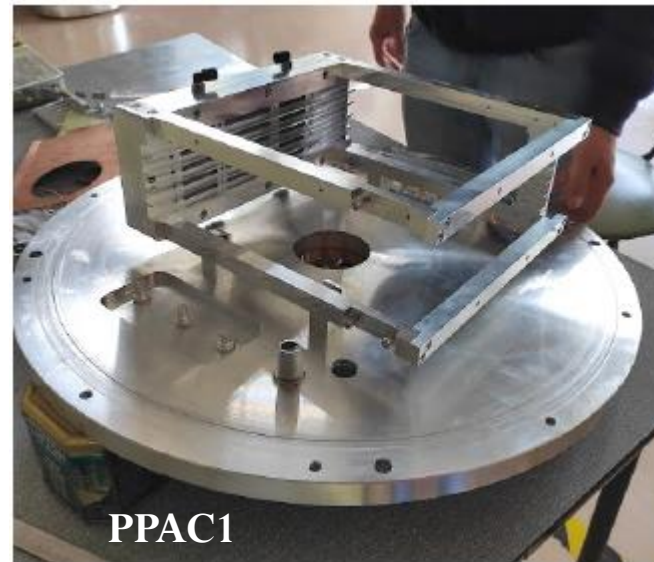
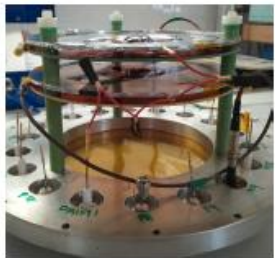
# EAR1 during Target Commissioning: $25 \cdot 10^{17}$ protons



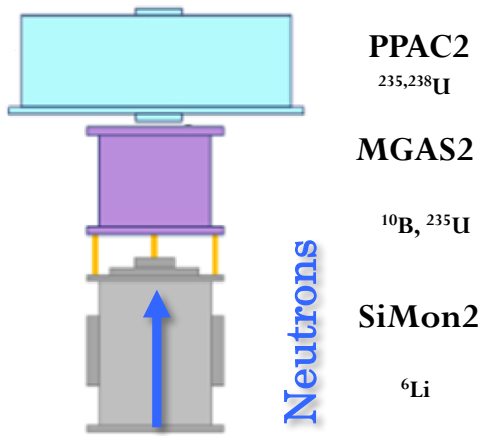
All the chambers and samples are already at CERN except PPAC1 (at CERN on 7th July).



Works and several tests have been done at CERN and other laboratories



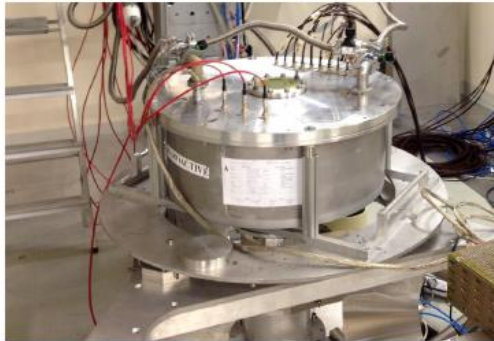
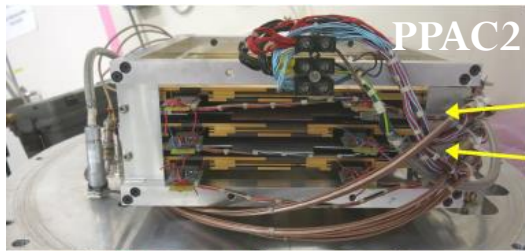
# EAR2 during Target Commissioning: $25 \cdot 10^{17}$ protons



All the chambers and samples are already at CERN.



Works and several tests have been done at CERN and other laboratories



Alice Manna, Diego Tarrío, Laurent Tassan-Got



# Summary of Planning for Target Commissioning 2021

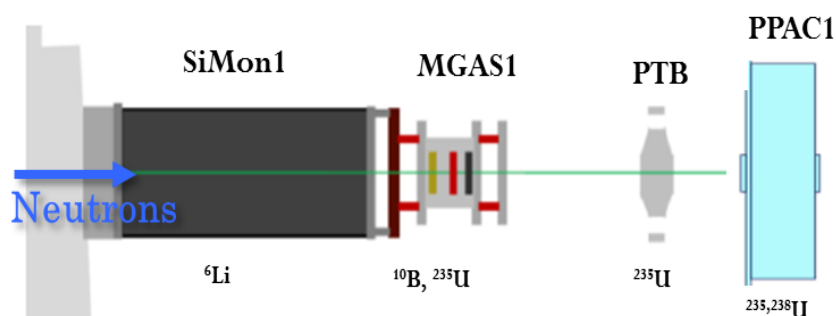
Dates (Protons)	Task	Thermocouples	SPND	SEM	EAR1 EAR2
19/07 ( $3 \cdot 10^{16}$ )	First Proton Beam on target (max 1E12 ppp)	Yes	Yes	Yes	Timepix
20/07- 04/08 ( $10^{17} + 2 \cdot 10^{17}$ )	FTN optics cross-check (max 1E12 ppp)			Yes	Timepix
28/07 - 04/08	Low intensity (max 2E12 ppp), stable operation	Yes	Yes	Yes	PPACs PTB SiMoNs MGASs
12/08 - 17/08 ( $10^{17}$ )	FTN optics cross-check (max 1E12 ppp).			Yes	
12/08 - 27/08 ( $8 \cdot 10^{17}$ )	Medium intensity (3.5E12 ppp)	Yes	Yes	Yes	PPACs PTB SiMoNs MGASs
23/08 - 30/08 ( $10^{17}$ )	Moving beam on target			Yes	PPACs PTB SiMoNs MGASs
07/09 - 10/09 ( $10^{17}$ )	FTN optics cross-check			Yes	
07/09 - 23/09 ( $12 \cdot 10^{17}$ )	High intensity (8.5E12 ppp)	Yes	Yes	Yes	PPACs PTB SiMoNs MGASs
<b>23/09/2021</b> <b><math>25 \cdot 10^{17}</math></b>					

# Neutron Beam Commissioning

24<sup>th</sup> September – 15<sup>th</sup> November (EAR1)

24<sup>th</sup> September – 31<sup>st</sup> October (EAR2)

# Neutron Flux and Beam Profile at EAR1: $12 \cdot 10^{17}$ protons (24/09-06/10)



Michael Bacak

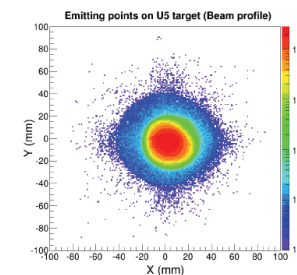
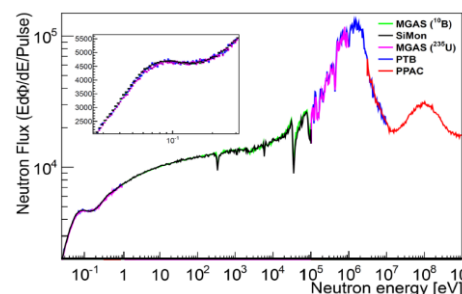
Simon1: Simone Amaducci, José Antonio Pavón.

MGAS1: Nikola Patronis, Elisso Stamati, Veatriki Michalopoulou

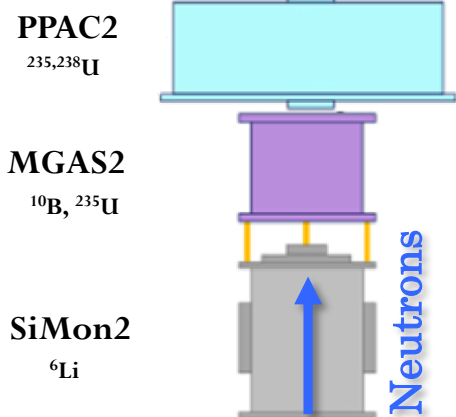
PPAC1: Alice Manna, Diego Tarrío.

PTB: Elisa Pirovano, Mirko Dietz

All the chambers and samples are already at CERN except PPAC1 (to be delivered at beginning of July 7th).



# Neutron Flux and Beam Profile at EAR2: $7 \cdot 10^{17}$ protons (24/09-03/10)



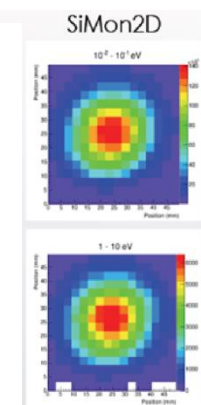
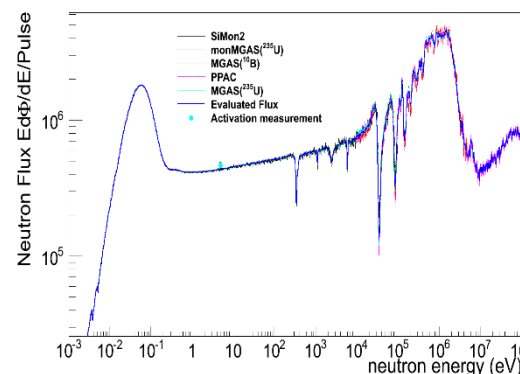
All the chambers and samples are already at CERN.

Michael Bacak

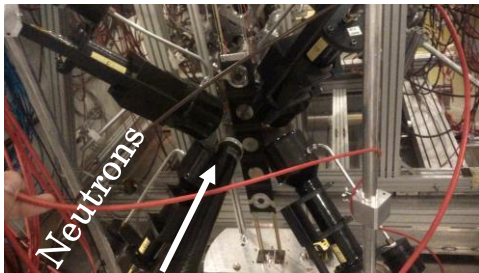
Simon2: Simone Amaducci, José Antonio Pavón.

MGAS2: Marta Sabaté, José Antonio Pavón

PPAC2: Alice Manna, Diego Tarrío.



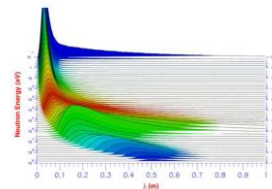
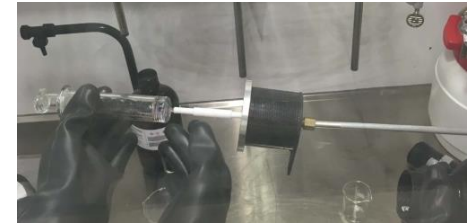
# Time-to-Energy at EAR1: $14 \cdot 10^{17}$ protons (07/10 – 31/10)



C6D6 were already filled with benzene at ISOLDE vented cup.

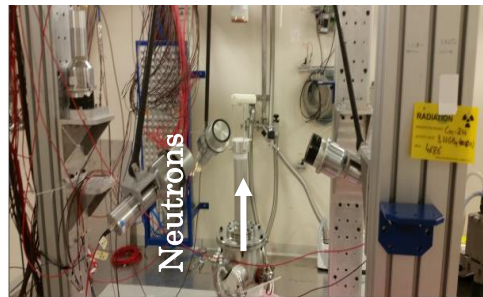
Laboratory test have been already performed.

Adriá Casanovas, Francisco García Infantes, Jose Antonio Pavón.



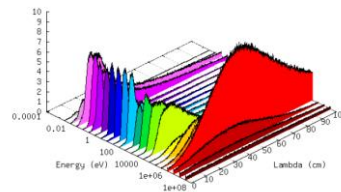
Combination of measurements of neutron capture reactions and FLUKA simulations. Vasilis Vlachoulis, Marta Sabaté, Francisco García Infantes and José Antonio Pavón.

# Time-to-Energy at EAR2: $7 \cdot 10^{17}$ protons (05/10 – 15/10)



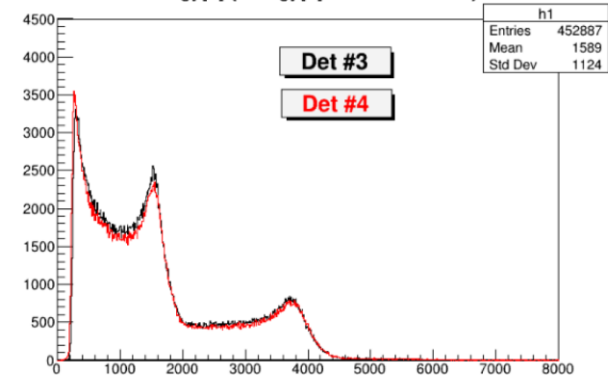
C6D6 Bicron were already tested at CIEMAT.

Víctor Alcayne, Jorge Lerendegui



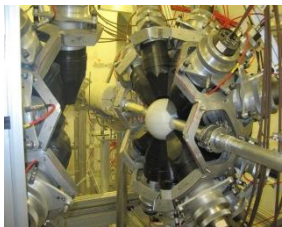
Combination of measurements of neutron capture reactions and FLUKA simulations. Vasilis Vlachoulis, Marta Sabaté, Francisco García Infantes and José Antonio Pavón.

Pulse height spectra measured with an  $^{88}\text{Y}$  source  
energy[1] {energy[0]>10 && time<20}

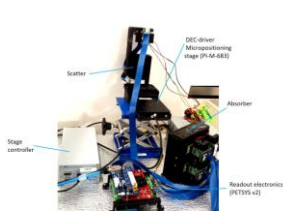


# Background and Tests at EAR1: $12 \cdot 10^{17}$ protons (01/11 - 15/11)

TAC



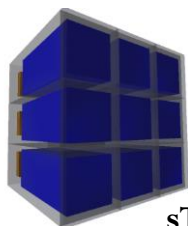
iTED



He3



Adriá Casanovas, César Domingo, Emilio Mendoza, Víctor Alcayne, Adriá Sánchez Caballero, Jorge Lerendegui, Ariel Tarifeño, Cristian Massimi, Nikolas Patronis, Agatino Musumarra, P. Mastinu.



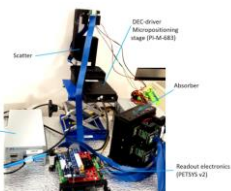
sTED



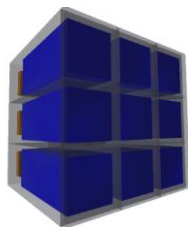
HPGe

# Background and Tests at EAR2: $7 \cdot 10^{17}$ protons (16/10 - 31/10)

iTED



sTED



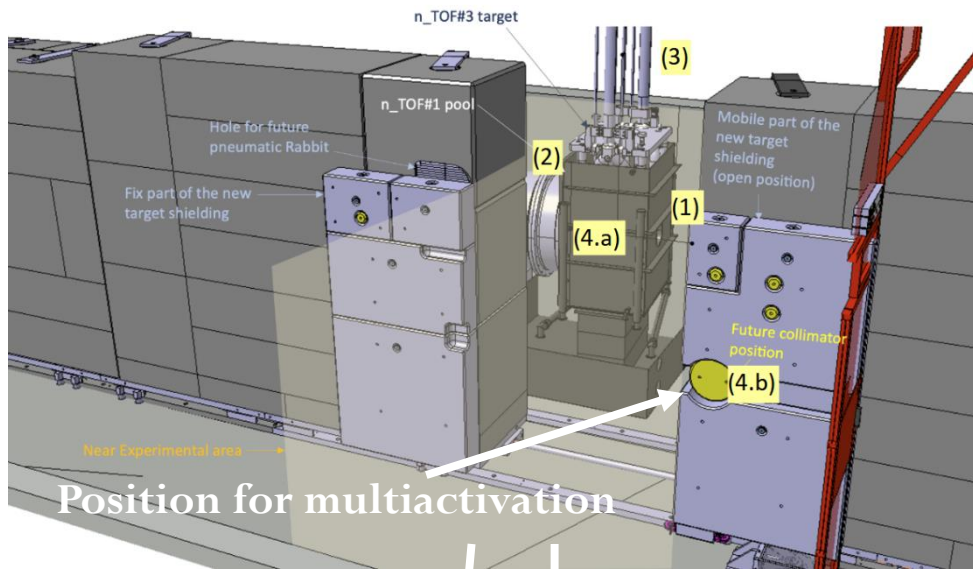
He3



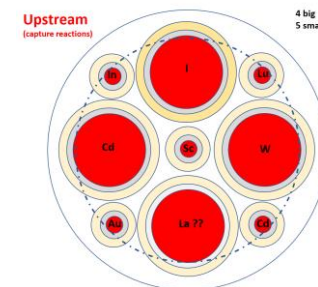
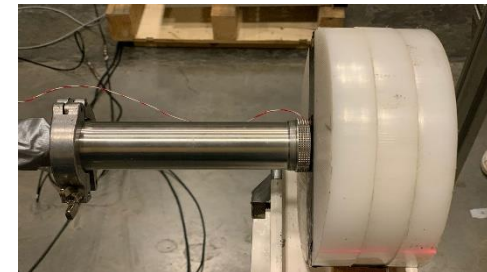
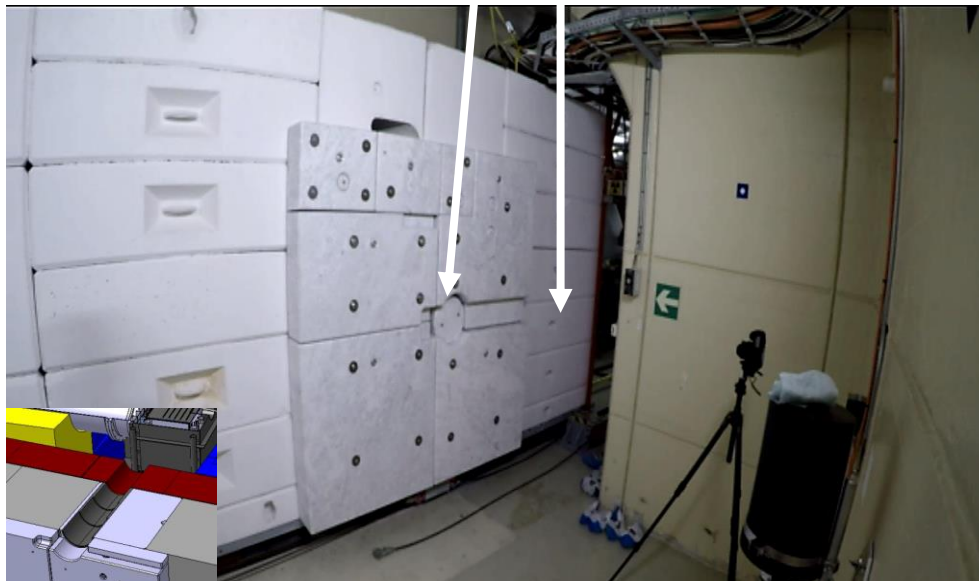
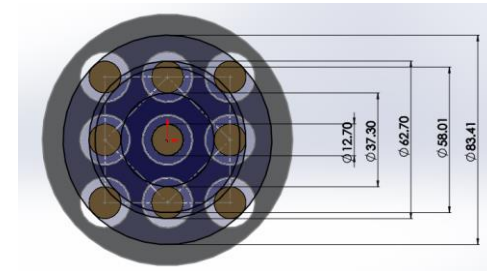
Adriá Casanovas, César Domingo, Emilio Mendoza, Víctor Alcayne, Adriá Sánchez Caballero, Jorge Lerendegui, Ariel Tarifeño  
Cristian Massimi, Nikolas Patronis, P. Mastinu.

# NEAR (new experimental area)

# NEAR: multiactivation characterizations of the neutron flux.



Few slots are already planned for accessing NEAR for the characterization of the neutron flux and the RP conditions.



Ana-Paula Bernardes

# COVID measures







COVID measures in control room are organized.

At present in the offices we have only two free tables.

We are already quite full!!!

COVID measures in experimental areas are ongoing.

- **Target Commissioning** will run from 19<sup>th</sup> July to 23<sup>rd</sup> of September.  
New elements across the lines, new elements for monitoring the target, proton beam optics, possible variations of the neutron flux at the Experimental Areas will be checked and carefully studied. Data for the neutron flux will be acquired in the last two weeks.
- **Commissioning of the Neutron Beam at the EARs** will run from 23<sup>rd</sup> of September to the YETS (15<sup>th</sup> of November).  
It should be possible to have two weeks for Physics Measurements at EAR2.
- **Several actions and tests have been carried out for each detector setup.**  
**Everything on schedule.**
- We have already at CERN an expertise team for setting up the detectors and to analyze the data. DAQ upgrade and commissioning ongoing.

# *Thank you on behalf n\_TOF Collaboration*

**Javier Praena**

Universidad de Granada (Spain)  
CERN Scientific Associate (EP/SME)  
n\_TOF Physics Coordinator



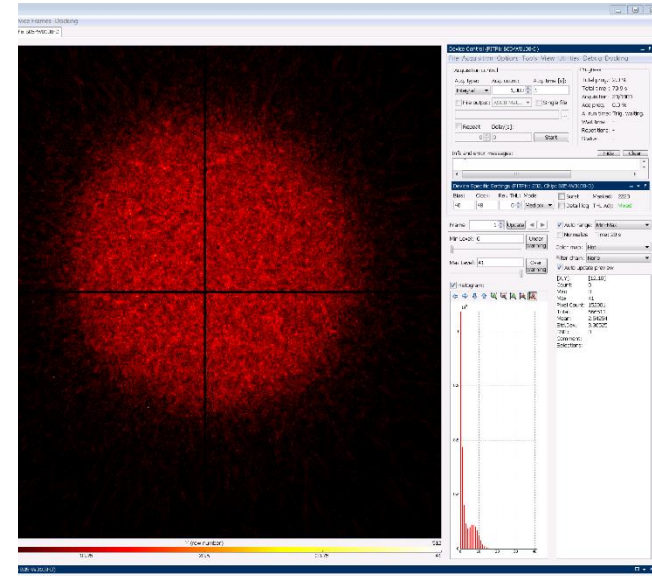
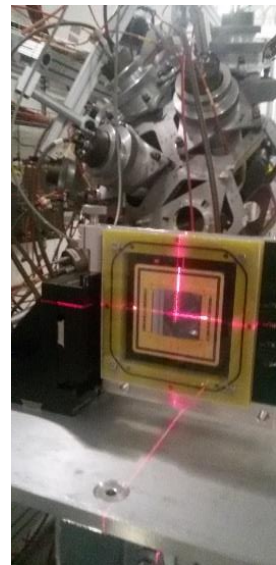
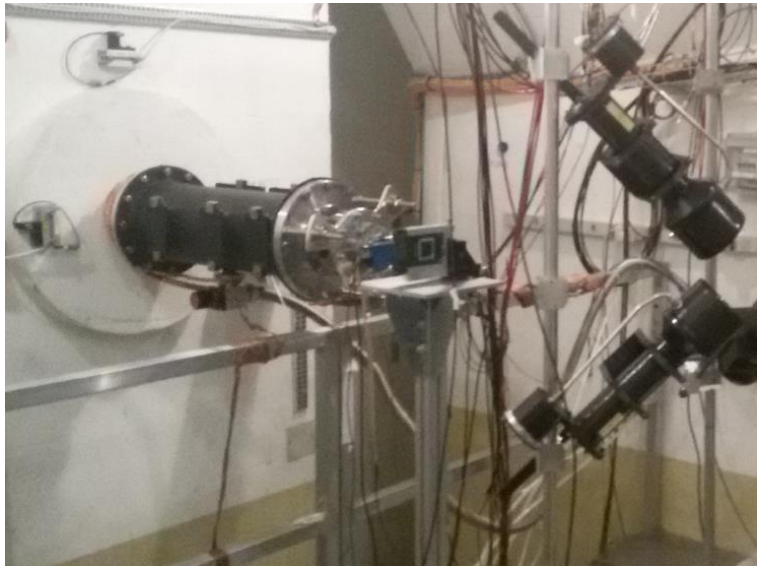


# Outlook of the proton request

PROTON REQUEST n_TOF facility		
	EAR1 ( $\cdot 10^{17}$ )	EAR2 ( $\cdot 10^{17}$ )
<b>Target Commissioning</b>	<b>25</b>	<b>25</b>
Neutron Flux	15	21
Beam Profile	7	13
Resolution Function	14	14
Background	17	17
<b>Total Neutron Beam Characterization</b>	<b>53</b>	<b>65</b>
<b>Contingency</b>	<b>5</b>	<b>5</b>
<b>TOTAL</b>	<b>83</b>	<b>95</b>

Table 3. Summary of the proton request for commissioning the n\_TOF facility.

- Two Quad Timepixes (4 sensors 15x15 mm<sup>2</sup> each) fully operational already at CERN (as used in 2018 for beam alignment)
- In order to perform alignment in EAR2 as well, funds for two more requested by INFN-LNF
- Integration mechanic for EAR2 beam line needed



- **Neutron Flux:** several detectors at EARs (neutrons/(cm<sup>2</sup>proton))
- **Neutron Beam Profile:** PPACs (transversal distribution of the fluence as a function of the energy) .
- **Background:** possible several detectors at EARs compatible with the CM Planning.
- **Temperature & proton intensity:** K-type thermocouples.
- **Neutron fluence close to the target:** SPND.
- **Neutron Flux & proton beam size and position:** SEM.
- **Radioprotection conditions in the area around the target.**
- **Multiactivation technique for characterizing the NEAR spectrum.**



- Document of the Commissioning presented at the INTC (November 2020):
  - [CERN-INTC-2020-072 ; INTC-P-587.](#)
  - [https://cds.cern.ch/record/2737307.](https://cds.cern.ch/record/2737307)
- Facility Operation Meetings (weekly). R. Steerenberg, K. Hanke.
- n\_TOF Facility Commissioning Working Group (2-3 weeks). M. Calviani, J. Praena.
- n\_TOF NEAR Technical Meetings (2 weeks). A. Bernardes
- n\_TOF Target Installation Coordination (weekly). R. Franqueira Ximenes.
- NEAR Working Group (monthly). N. Colonna, A. Mengoni.
- Local Team Meetings (two weeks). A. Mengoni, J. Praena.

- **Target Commissioning** requires of a cross-check with monitoring in EAR1 and EAR2 (Simon, MGAS, PPAC)  
During the Target Commissioning several postdoc with expertise and PhD students will be involved in the analysis for a “prompt” response. See talk of Alberto.
- **Commissioning of the Neutron Beam at the EARs**  
The 3 PhD at CERN will be involved in the CM. Several postdocs and more students will join the Local Team.
- **Work on going**
  - Simon1 and Simon2 on schedule. Test at Lab in April. Both ready at the middle of May.
  - MGAS1 and MGAS2 on schedule. Test at Lab finished. Test at EARs during April-May. Part DAQ Commissioning.
  - PPAC1 and PPAC2. On schedule. Test and mounting at CEA. Shipping to CERN at the end of May. Laurent Tassan Got and Diego Tarrío can provide more details if needed.
  - PTB. On schedule. Ralf Nolte can provide more details.
  - L6D6. Filling with no bubbles. Test at EAR1 with source end of March. Part DAQ Commissioning.
  - Bicron. A test in Spain was planned (April). Shipping to CERN schedule at beginning of May/end April.
  - Local Team from April: S. Amaducci, A. Casanovas, F. García Infantes, J. A. Pavón, E. Stamati, M. Barbagallo.

# Commissioning Gantt-Chart in JIRA

its.cern.ch/jira/secure/WBSGanttMain.jspa?filter=BOARD\_617

Apps MMM Services Cerrar sesión Importados

JIRA Dashboards Projects Issues Boards WBS Gantt-Chart CERNforge Create

Gantt: Facility Commissioning

+ Add Delete Edit View Data

#		Project/Version/Issue	Assignee	Units	Priority	Start date ↑	Finish date	Durati...	Perce...
1		▼ n_TOF_Commissioning_Work...							4%
1-15	!	▶ <input checked="" type="checkbox"/> NEAR Experimental area r...	⊙ Ana-Paula Bernar...	100%	Minor	11/Jan/21	30/Jun/21	123 days	0%
1-1		<input checked="" type="checkbox"/> Preparatory activities befo...	⊙ Oliver Aberle	100%	Blocker	25/Jun/21	19/Jul/21	17 days	0%
1-2		<input checked="" type="checkbox"/> First proton beam on target	⊙ Marco Calviani	100%	Critical	19/Jul/21	19/Jul/21	0 days	0%
1-4		<input checked="" type="checkbox"/> SEM Commissioning	⊙ Federico Roncarolo	100%	Major	20/Jul/21	22/Jul/21	3 days	0%
1-3		<input checked="" type="checkbox"/> FTN optics cross-check	⊙ Francesco Maria ...	100%	Major	20/Jul/21	4/Aug/21	12 days	0%
1-5		<input checked="" type="checkbox"/> Target - low+ intensity	⊙ Marco Calviani	100%	Critical	28/Jul/21	10/Aug/21	10 days	0%
1-6		<input checked="" type="checkbox"/> RP survey in target area a...	⊙ Fabio Pozzi	100%	Major	12/Aug/21	12/Aug/21	1 day	0%
1-7		<input checked="" type="checkbox"/> FTN optics cross-check	⊙ Francesco Maria ...	100%	Major	12/Aug/21	17/Aug/21	4 days	0%
1-8		<input checked="" type="checkbox"/> Target - medium intensity	⊙ Marco Calviani	100%	Critical	12/Aug/21	27/Aug/21	12 days	0%
1-9		<input checked="" type="checkbox"/> Fluence vs. beam position ...	⊙ Antonio Javier Pr...	100%	Major	23/Aug/21	30/Aug/21	6 days	0%
1-10		<input checked="" type="checkbox"/> RP survey in target area a...	⊙ Fabio Pozzi	100%	Major	6/Sep/21	6/Sep/21	1 day	0%
1-11		<input checked="" type="checkbox"/> FTN optics cross-check	⊙ Francesco Maria ...	100%	Major	7/Sep/21	10/Sep/21	4 days	0%
1-12		<input checked="" type="checkbox"/> Target - high intensity	⊙ Marco Calviani	100%	Critical	7/Sep/21	24/Sep/21	14 days	0%
1-13		<input checked="" type="checkbox"/> n_TOF first physics commi...	⊙ Antonio Javier Pr...	100%	Blocker	27/Sep/21	27/Sep/21	0 days	0%
1-14		<input checked="" type="checkbox"/> Physics measurement eval...	⊙ Antonio Javier Pr...	100%	Needs ...	20/Oct/21	20/Oct/21	1 day	0%

# Commissioning Gantt-Chart in JIRA

