

Material testing @ the HiRadMat Facility of CERN/SPS

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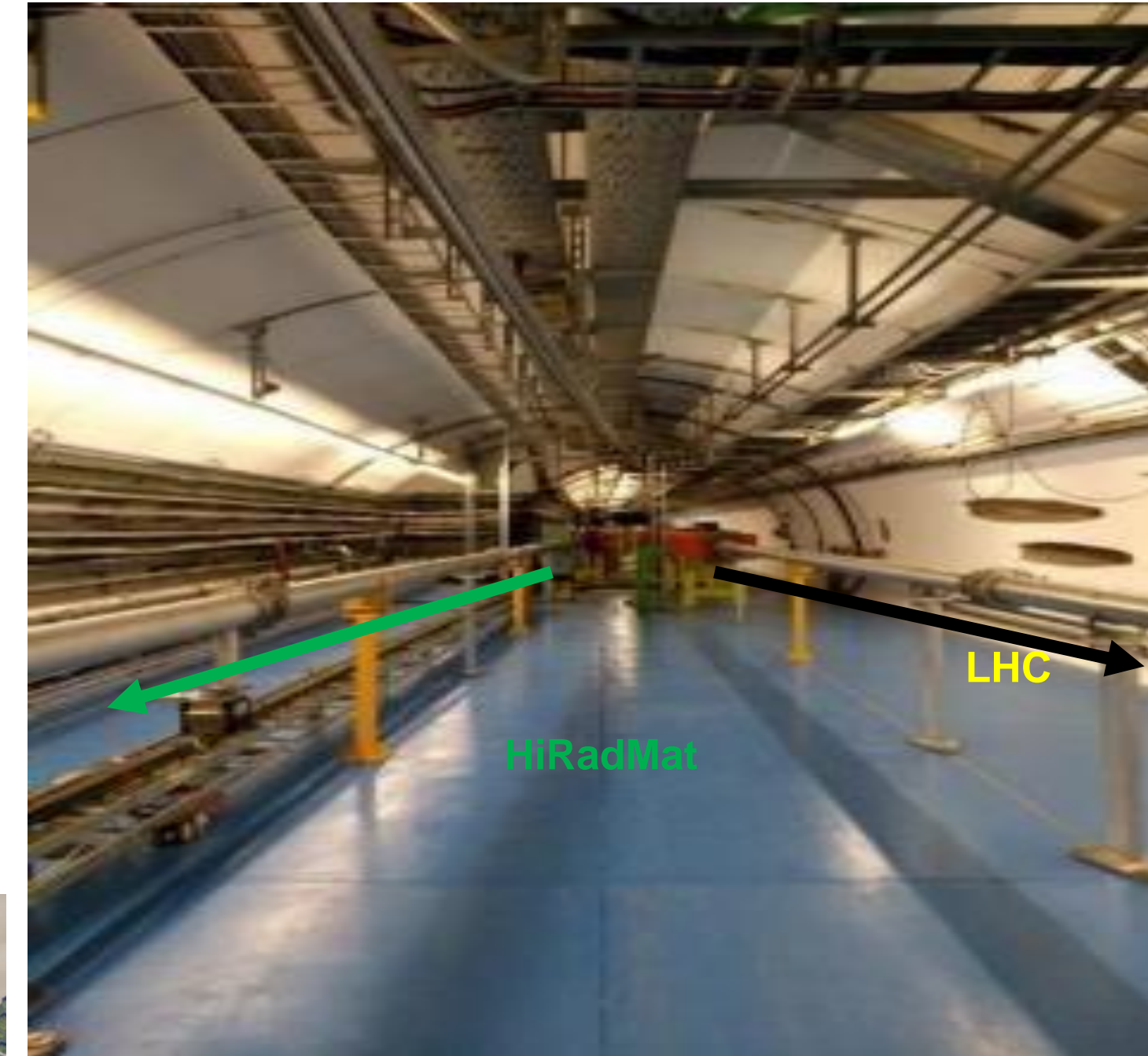
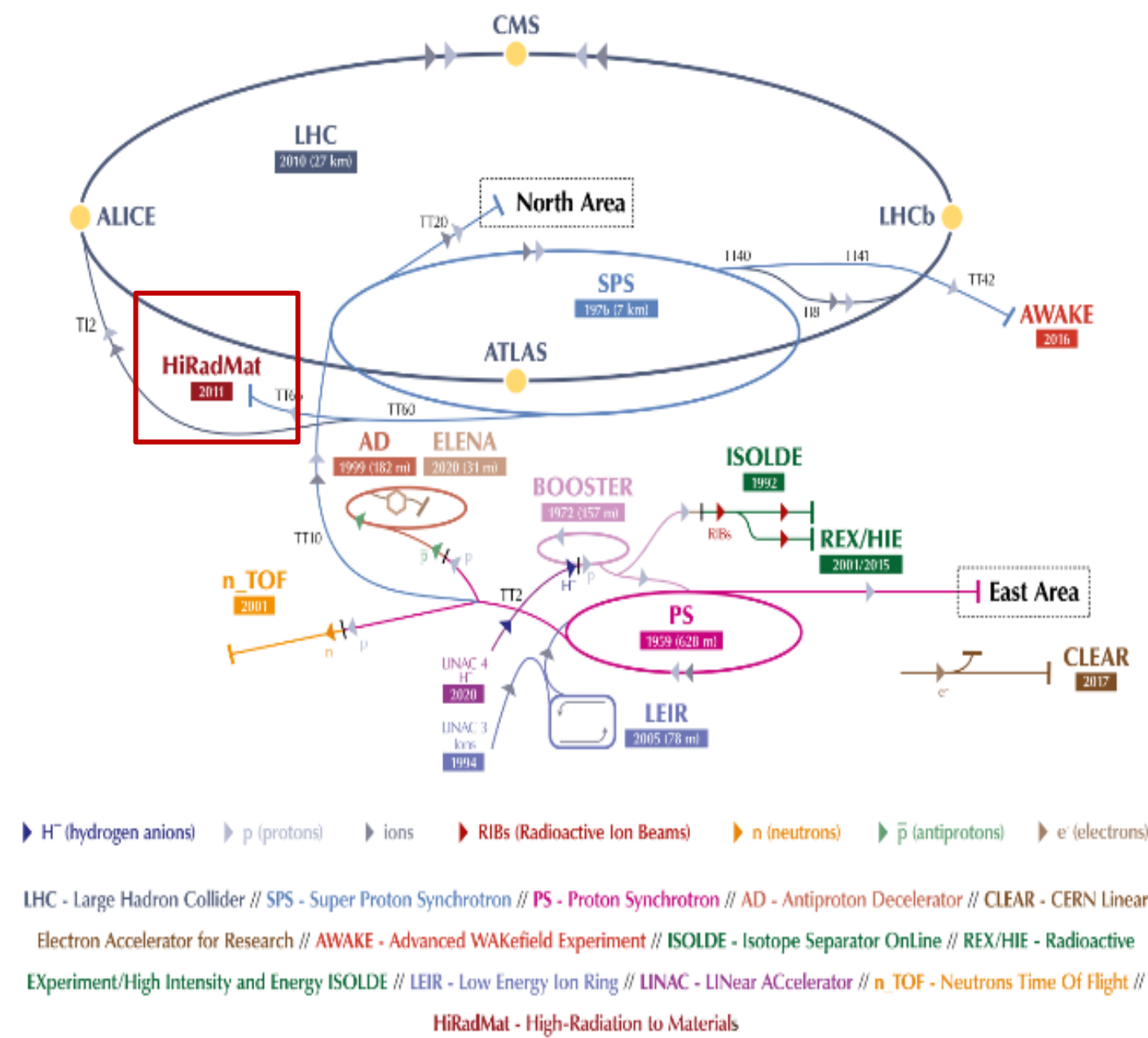


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A “flash” overview of HiRadMat

- HiRadMat (High-Radiation to Materials) is a user facility providing high-energy, high-intensity pulsed beams to a broad international scientific community.
- <https://hiradmat.web.cern.ch/>
- The facility was commissioned in 2011 (11y ago!) and is located in SPS Point 7.
- Since 2011: **40 successful experiments**

The CERN accelerator complex
Complexe des accélérateurs du CERN

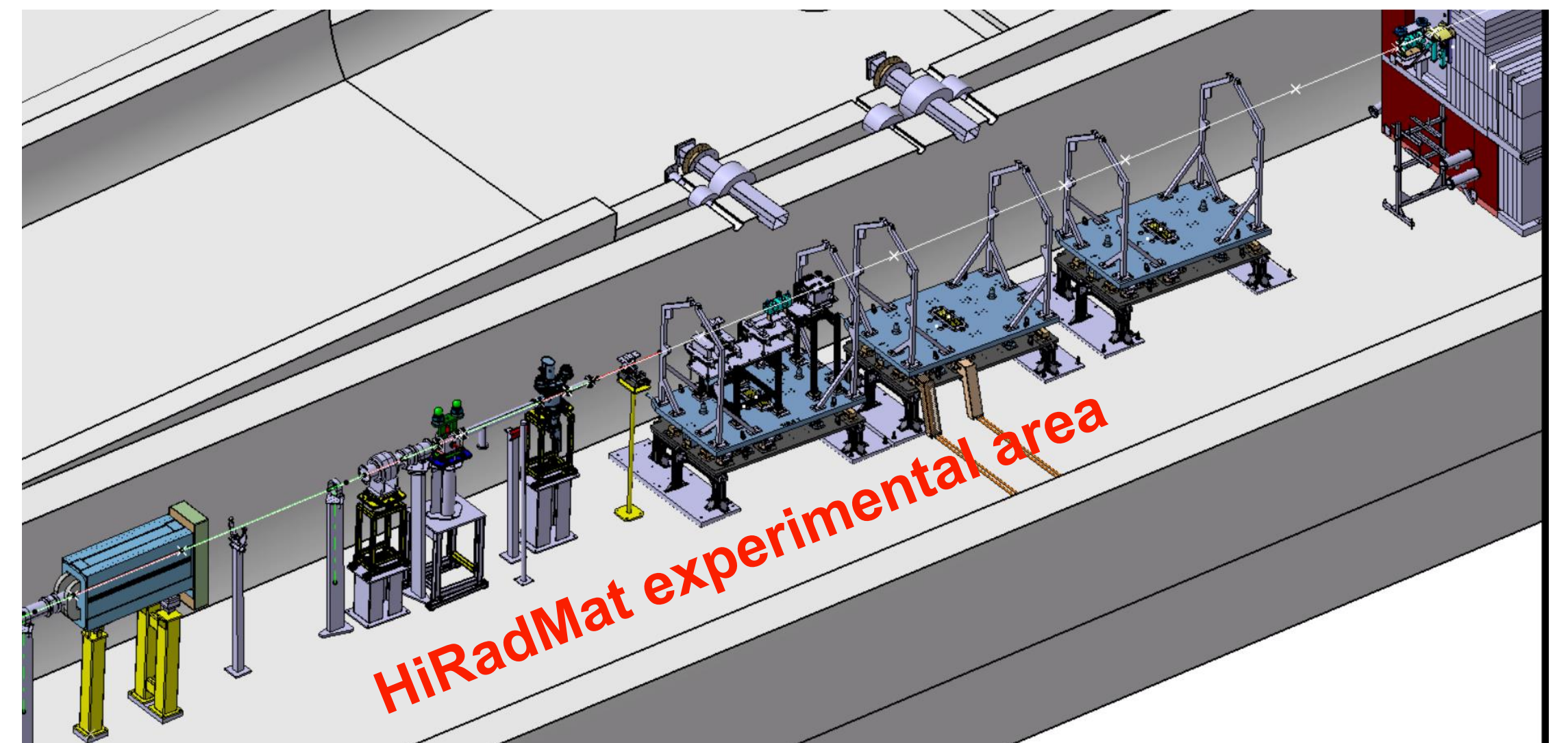


Performing Experiments in HiRadMat

- 1 HiRadmat pulse @ 440 GeV/c protons with the maximum intensity (288 bunches, 1.2×10^{13} p/bunch) has an instantaneous energy of **2.46 MJ/pulse**
 - *Equivalent with ~330 GW / pulse*
- It is this power density that allows study of :
 - *High Power Targets*
 - *Accelerator components*
 - *Novel radiation-hard materials*
 - *Beam instrumentation*
 - *Even galactic astrophysics phenomena*
 -
- In a **controlled experimental area** equipped with all necessary equipment and core-team expertise



MERIT experiment (2007)
installation in TT2A primary PS
transfer line

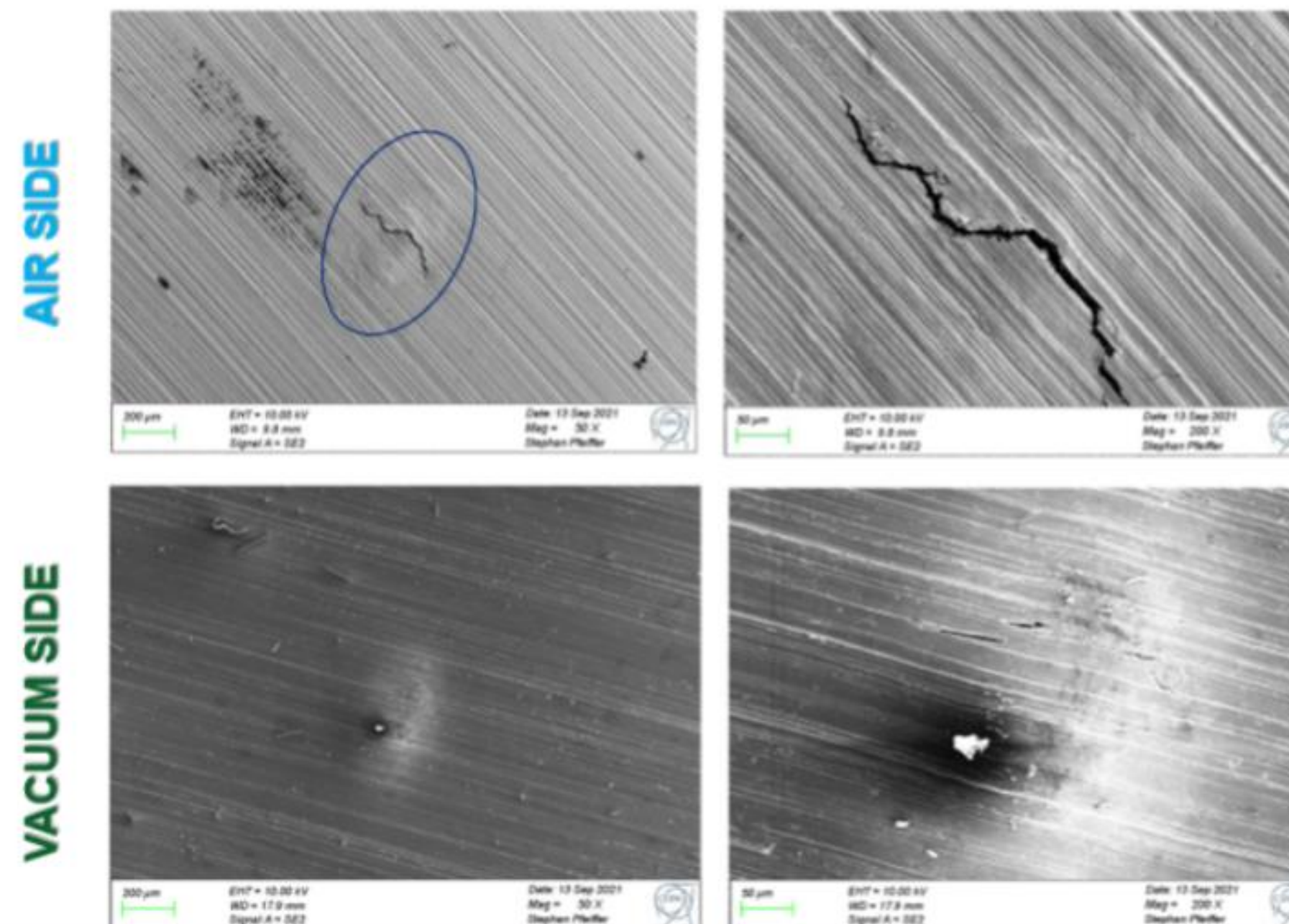


What actually this power means ?



Ta rod after irradiation with $6E18$ protons in 2.4us pulses @ 1.4 GeV/c (ISOLDE)

HiRadMat, 288 bunches @ $1.2E11$ ppb @ 440 GeV/c (7.2 us pulse)
Aug – Oct 2021 Two operational failures on the upstream

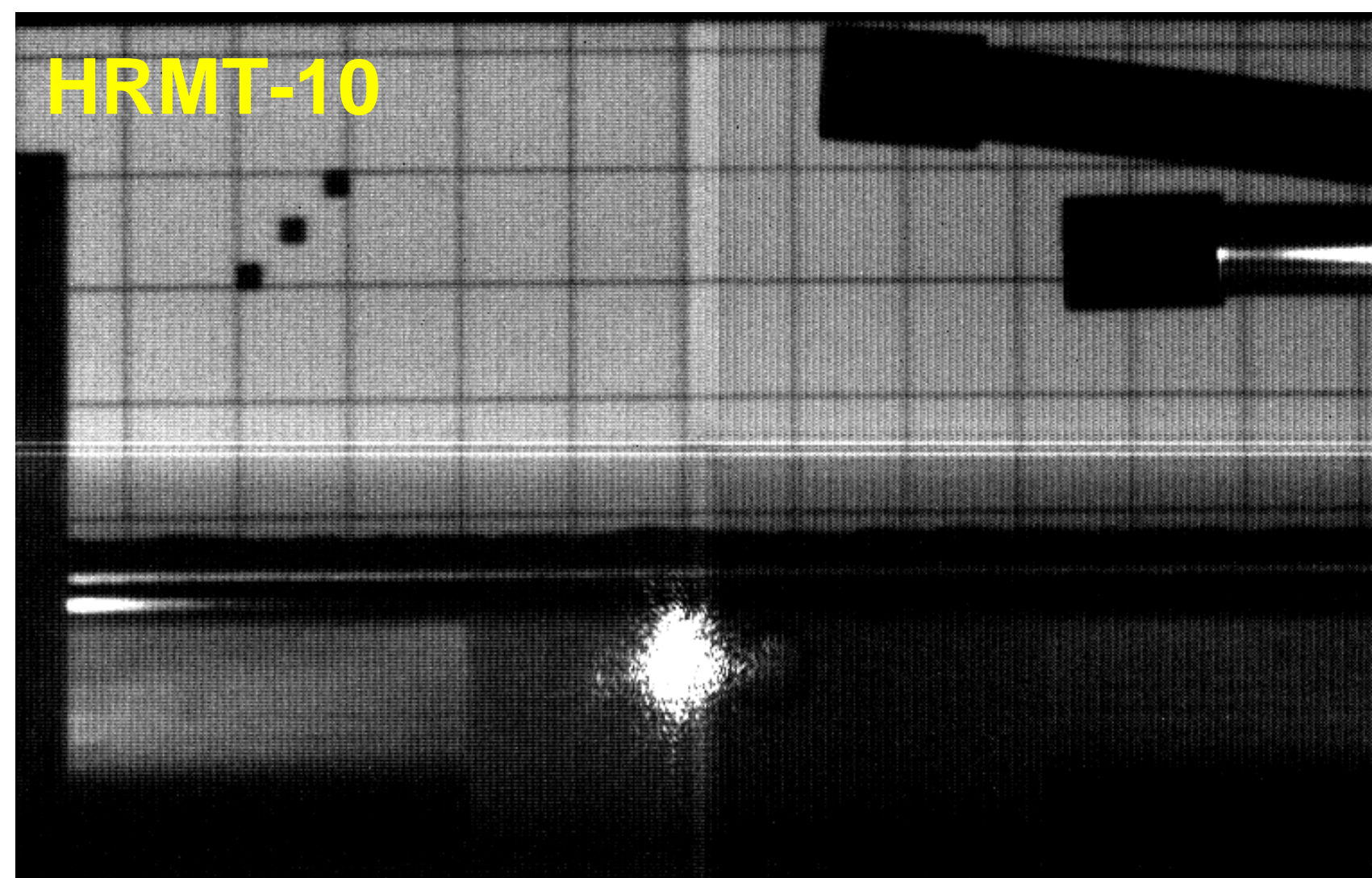
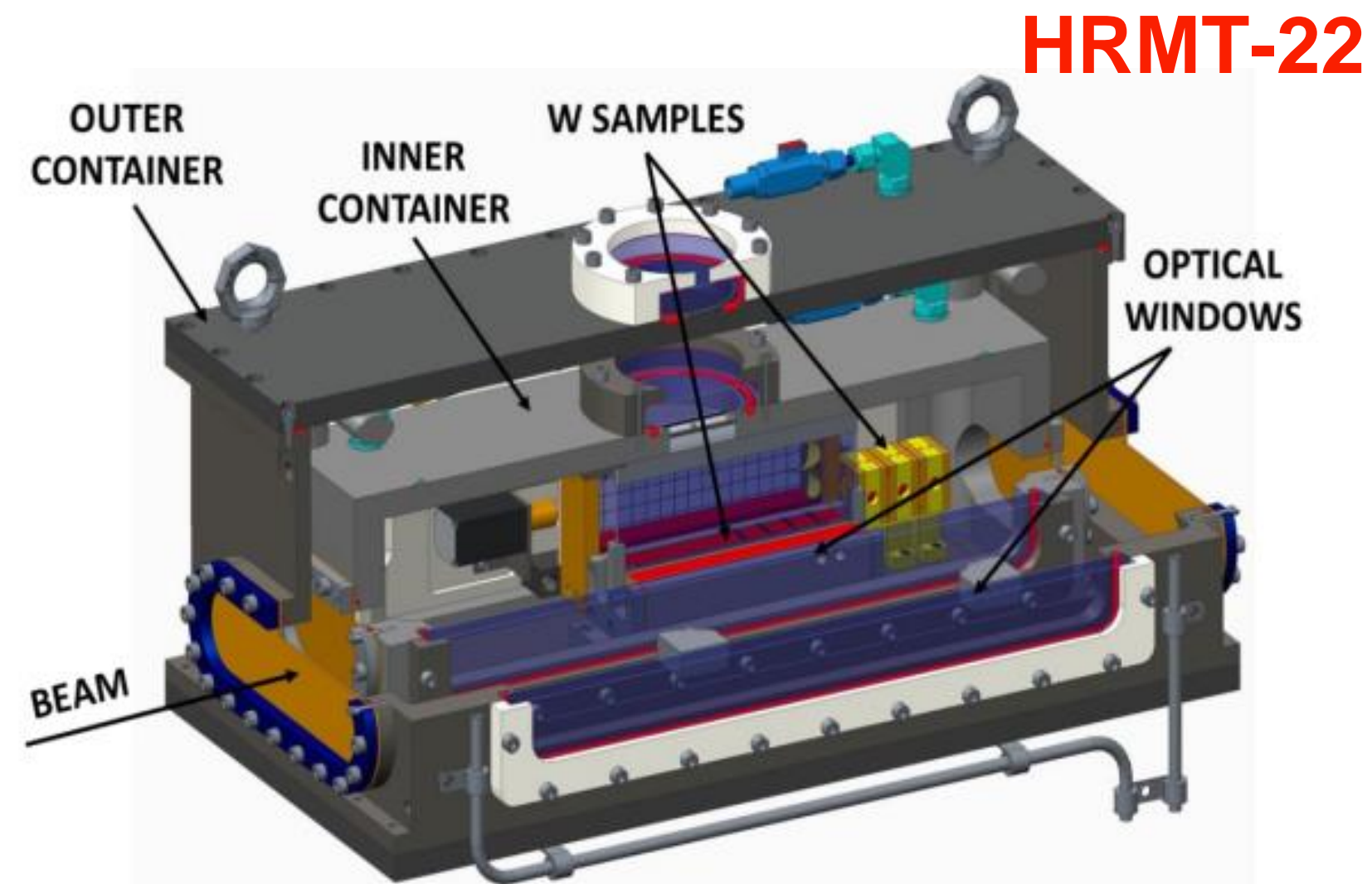
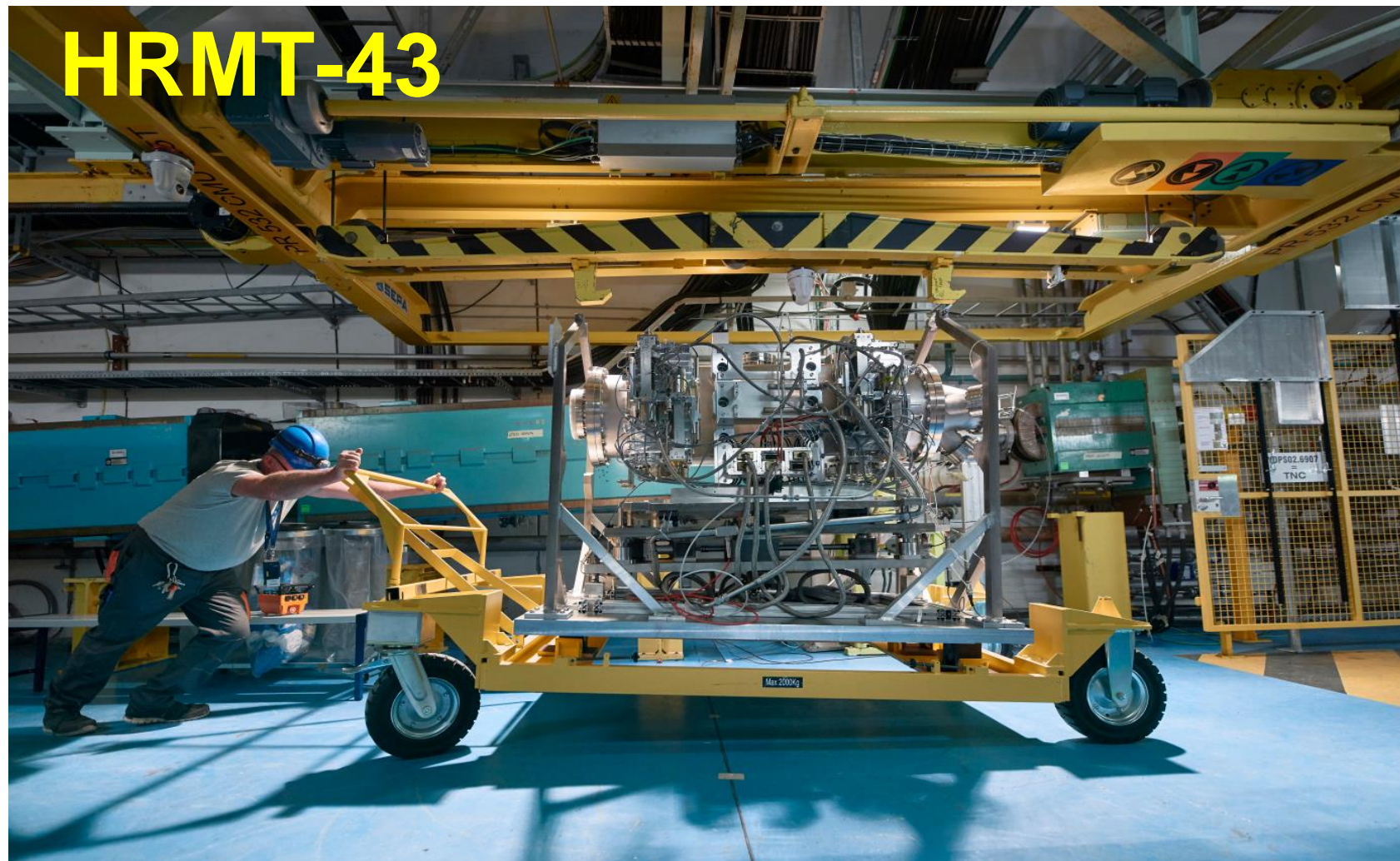


- Plastically-deformed beam imprint
- Fracture surface:
 - Ductile on beam spot
 - Fragile further away

- Beam imprint visible on opposite surface
- Fracture propagates to opposite surface

Courtesy: C. Pasquino

Impressions of HiRadMat Experiments

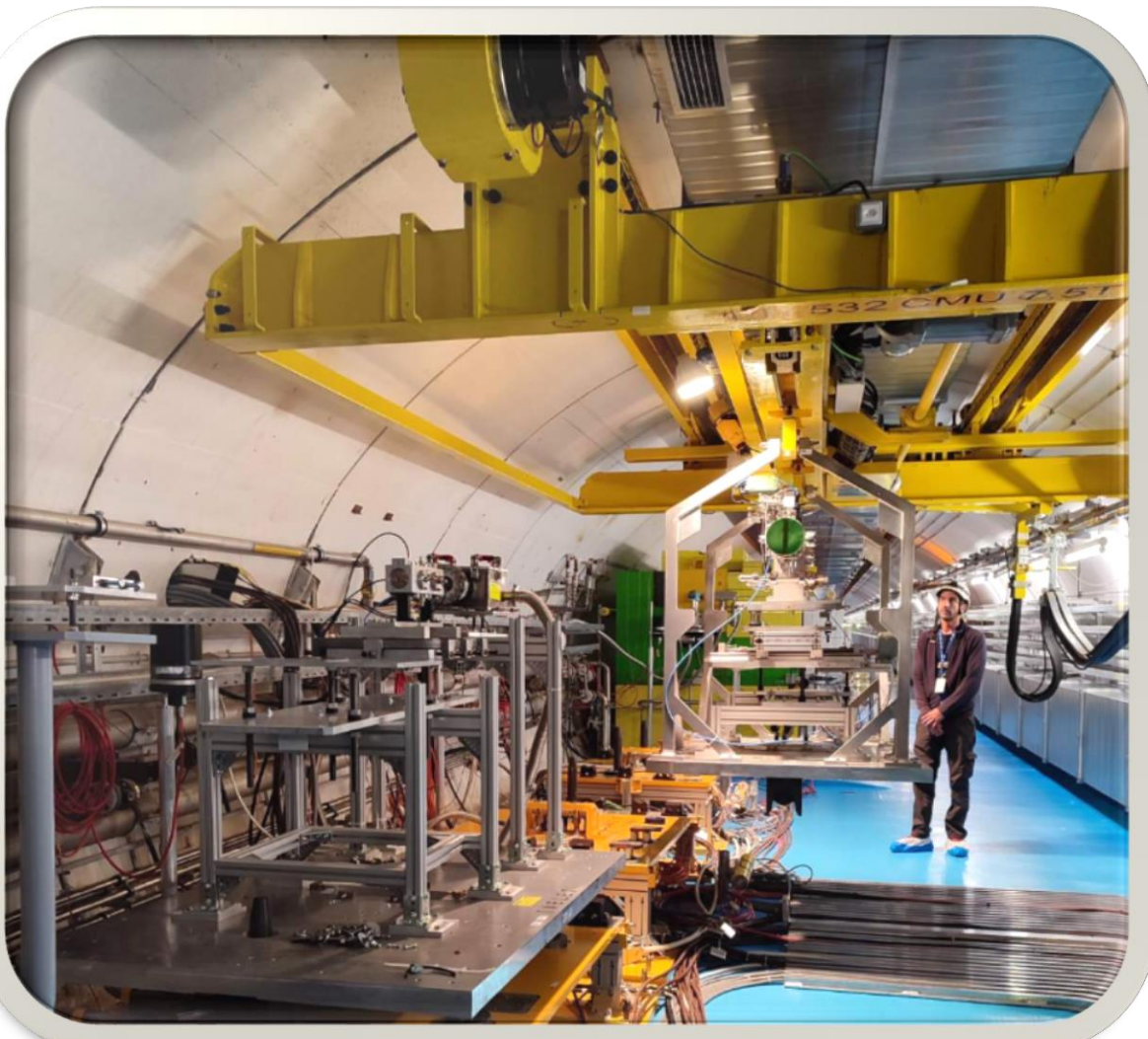


Experiments take long time and hard effort to prepare.

The results are unique additions to the knowledge of the beam-to-material impact

> 35 publications in peer reviewed articles and conference proceedings

Installation & Beam Time Highlights



Initial Phase
"First touch"

- A first idea for an experiment arises somewhere in the world
- Initial discussion with HiRadMat team to judge feasibility & time-line
- First discussions / meetings between various experts @ CERN or remote

Preparatory
Phase

- Experiment maturing : **Scientific Board** (scientific merit)
- (if OK) : **1st Technical Board** (technical feasibility & safety)
- (if OK) : experiment gets in the draft schedule of next year

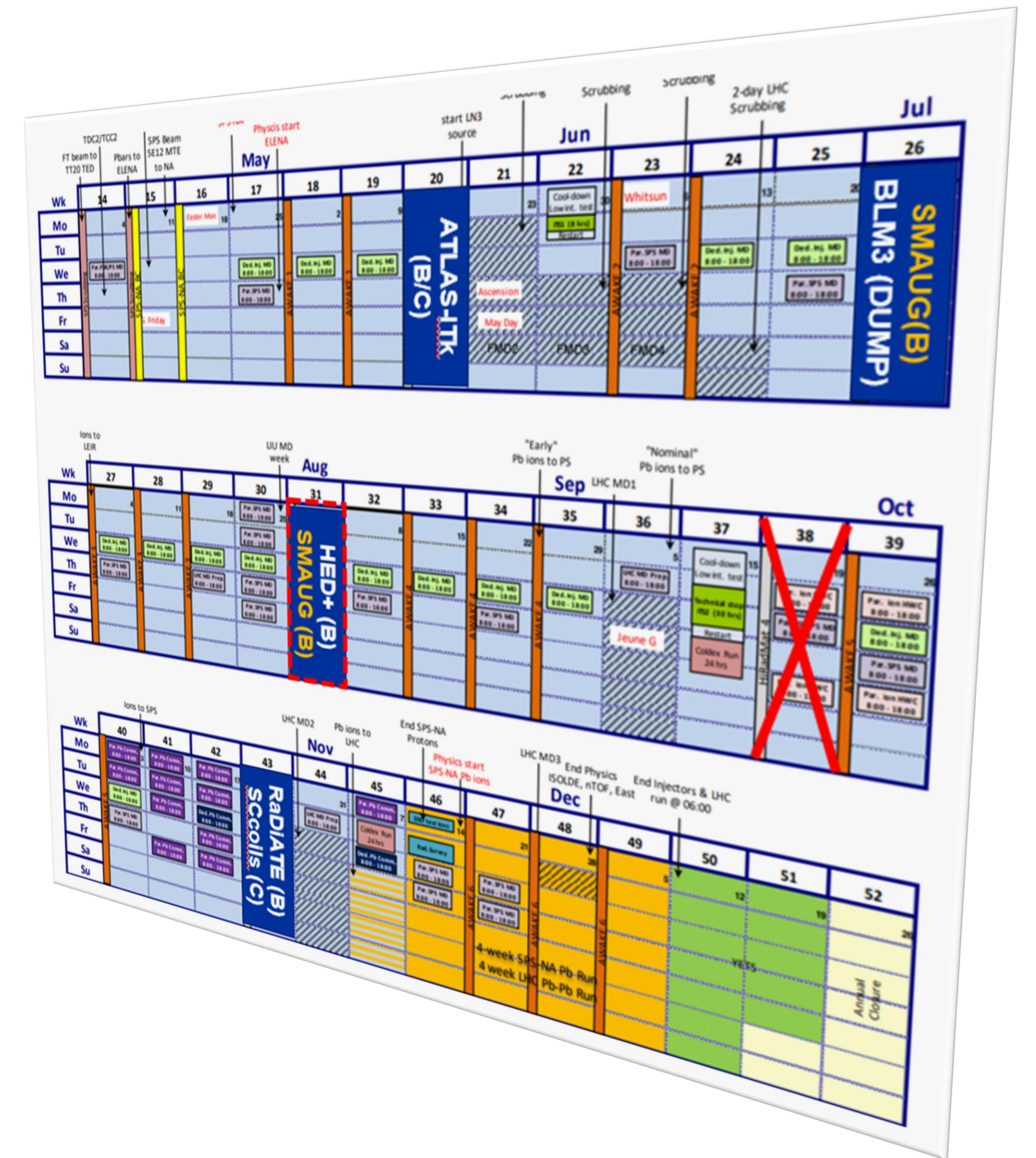
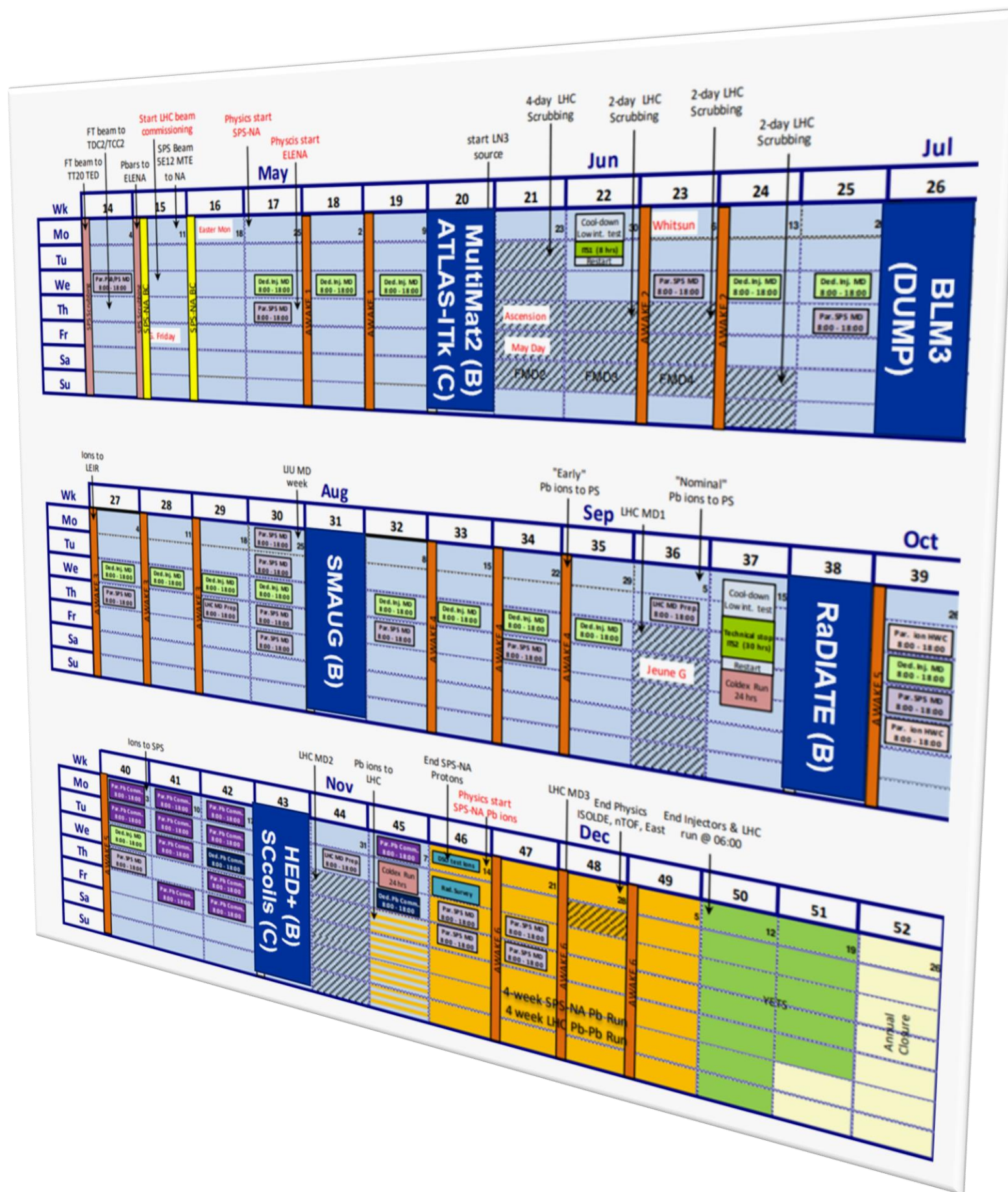
Experimental
Phase

- Beam time (protons) is ultimately approved by the **CERN ATS sector executive committee (IEFC)**
- **2nd Technical Board (optional)** : Gives the final OK for beam time, after thorough examination of all aspects or open points raised by any of the above.
- **Beam time allocated and experiment performed !**

Post
Irradiation
phase

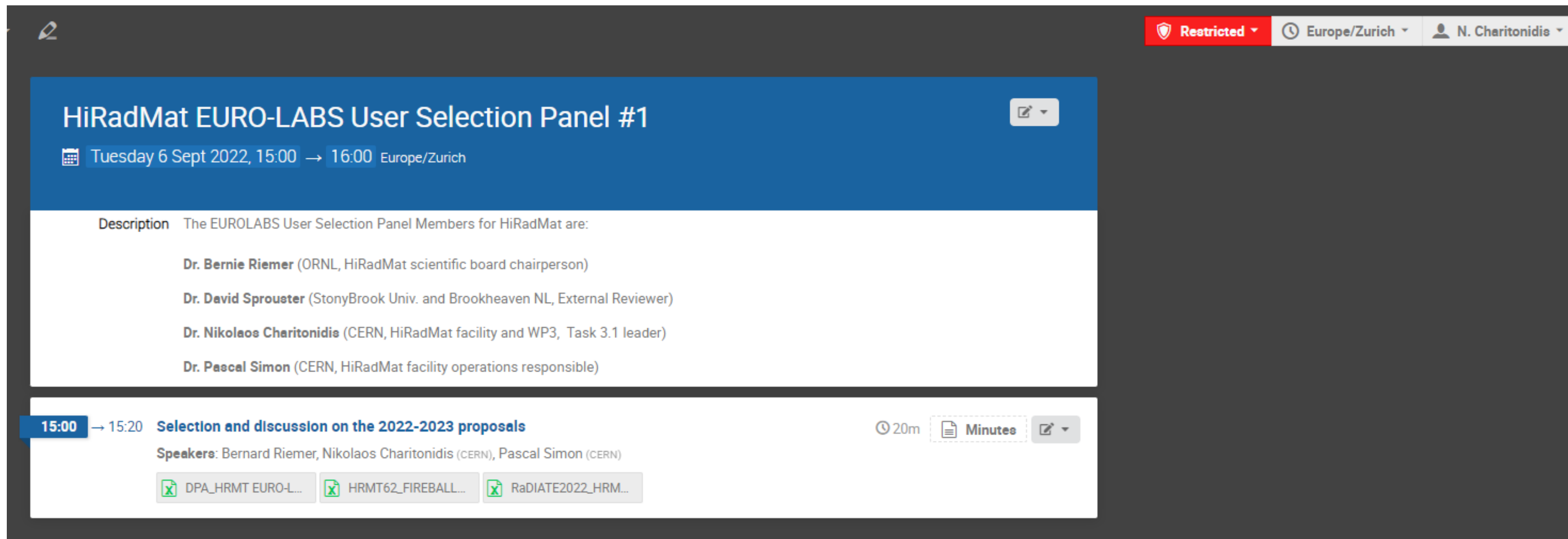
- Post irradiation analysis
- Meetings in person, or small workshops

Experimental Schedule & Proposals



A quite challenging exercise with many uncertainties !

- HiRadMat experiments need the TA support in *all four phases* of their lifecycle. For some of the experiments it is the **only way forward**.
- A user selection panel judges and approves the requests for access units, in dedicated meetings ~twice per year
- Dedicated restricted indico space with minutes written.



Restricted Europe/Zurich N. Charitonidis

HiRadMat EURO-LABS User Selection Panel #1

Tuesday 6 Sept 2022, 15:00 → 16:00 Europe/Zurich

Description The EUROLABS User Selection Panel Members for HiRadMat are:

- Dr. **Bernie Riemer** (ORNL, HiRadMat scientific board chairperson)
- Dr. **David Sprouster** (StonyBrook Univ. and Brookhaven NL, External Reviewer)
- Dr. **Nikolaos Charitonidis** (CERN, HiRadMat facility and WP3, Task 3.1 leader)
- Dr. **Pascal Simon** (CERN, HiRadMat facility operations responsible)

15:00 → 15:20 **Selection and discussion on the 2022-2023 proposals** 20m Minutes

Speakers: Bernard Riemer, Nikolaos Charitonidis (CERN), Pascal Simon (CERN)

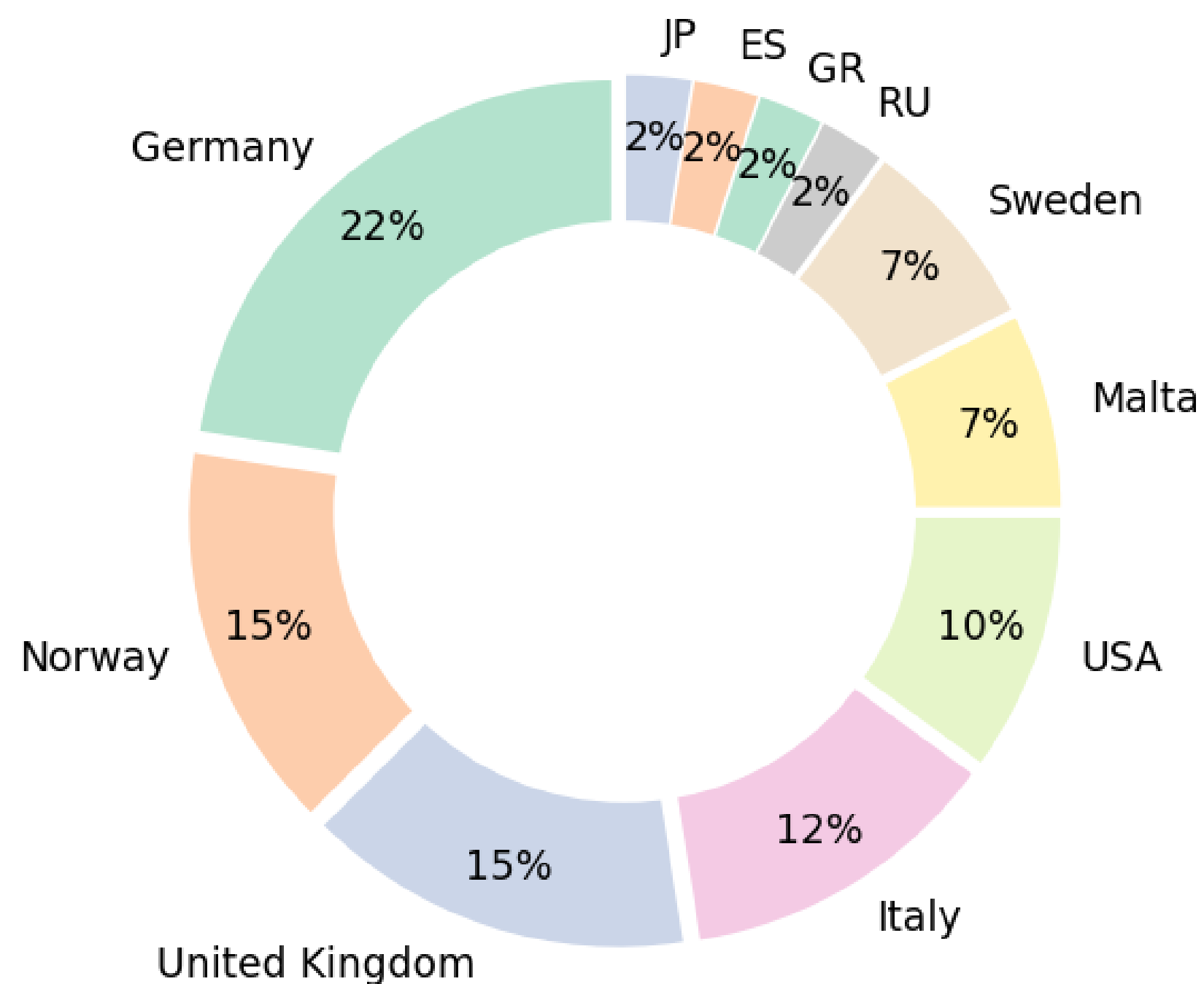
DPA_HRMT EURO-L... HRMT62_FIREBALL... RaDIATE2022_HRM...

- **Dr. Bernie Riemer (ORNL)**
- **Prof. D. Sprouster (StonyBrook)**
- **Dr. N. Charitonidis (CERN, HiRadMat)**
- **Dr. P. Simon (CERN, HiRadMat)**

Example of USP decision sheet

First name	Name	Gender	Home Institute	Country (Institute)	Legal Status (Institute)	Researcher Status*	Tunnel Access to HiRadMat?	Total no. of REQ. days	Total no. of GRANTED days	Total no. of REQ. visits	Total no. of GRANTED visits
				United Kingdom		EXP	Y	14	14	2	2
USER TEAM											
First name	Name	Gender	Home Institute	Country (Institute)	Legal Status (Institute)	Researcher Status*	Tunnel Access to HiRadMat?	Total no. of REQ. days	Total no. of GRANTED days	Total no. of REQ. visits	Total no. of GRANTED visits
				United Kingdom		PGR	Y	35	28	4	4
				United Kingdom		EXP	N	7	7	2	2
				United Kingdom		EXP	N	7	7	2	2
				United Kingdom		EXP	N	2	2	1	1
				United Kingdom		EXP	Y	28	20	3	3
				USA		PDOC	Y	7	7	2	2
				USA		PDOC	Y	5	5	1	1
				Iceland		EXP	Y	10	10	3	3
				USA		PDOC	N	5	5	1	1
				USA		EXP	N	5	5	1	1
				USA		EXP	N	5	5	1	1
				USA		EXP	N	5	5	1	1
				Germany		EXP	N	2	2	1	1
				United Kingdom		EXP	N	2	2	1	1
*UND=Undergraduate; PGR=Post graduate researcher; PDOC=Post-doc researcher; TEC=Technician; EXP=Experienced researcher.											
CERN COLLABORATORS											

Distribution of ARIES TA Users with respect to their home institutes



Overall statistics from ARIES

HiRadMat statistics show that on average we provide to our users ~1200 AU (hours) / y

5 persons, 3 exp/y, 10 days presence

Plus :

- **Service improvements (Machine Learning Studies for better beam control)**
- **Meetings of the Scientific Board**
- **Preparation & Post irradiation analysis meetings**



Credit: (Photo: LoveTheWind/iStock by Getty Images)

Thank you!

Questions ?