



EURO-LABS SAM : HiRadMat facility – TA progress

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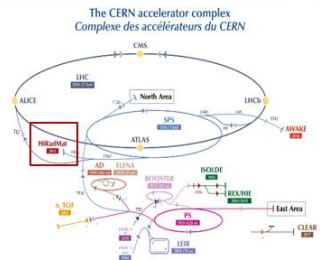
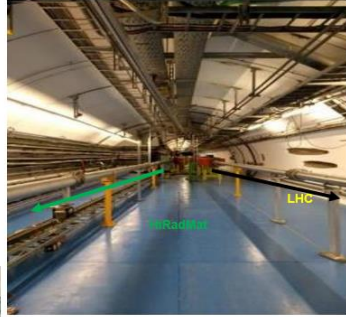

October 2023

Reminder : HiRadMat @ CERN/SPS

EURO-LABS

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


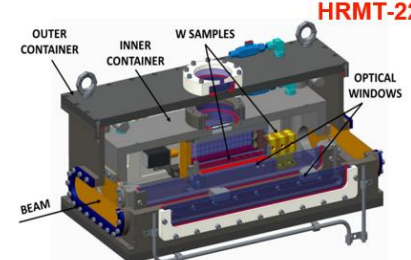


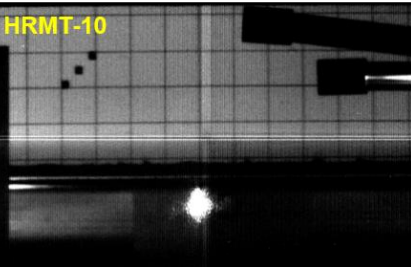
HiRadMat - High Radiation to Materials

N. Charitonidis – HiRadMat Facility – EUROLABS KOM

A CERN facility, with ~5 very complicated experiments per year, with lots of preparations and navigating (usually) via a “minefield” of issues

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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

N. Charitonidis – HiRadMat Facility – EUROLABS KOM

EURO-LABS KOM, Bologna 2022

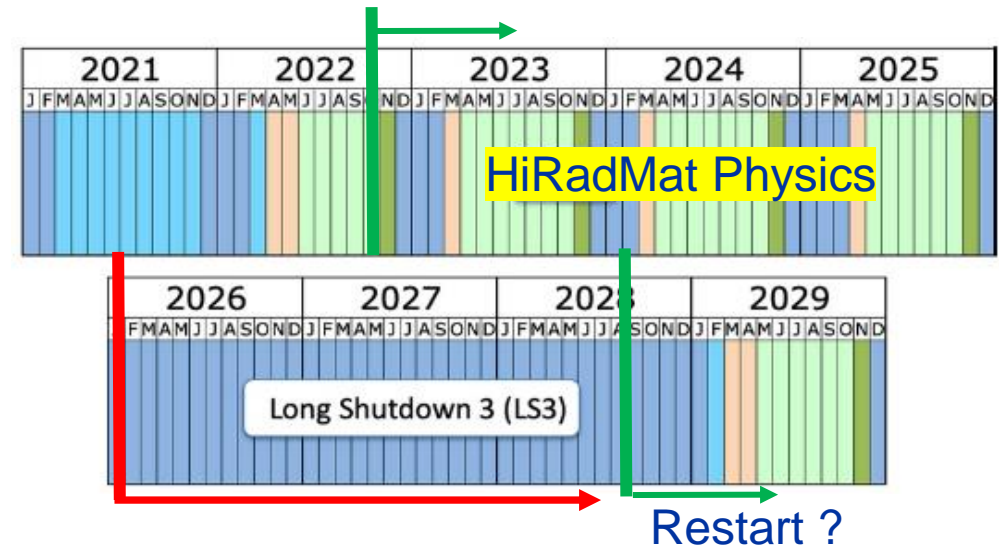
EURO-LABS has been essential in supporting the facility and most importantly these users that – without this TA budget – would be impossible to do their experiment.

Introduction – AU Budget

- **Granted 4800 Access Units (AUs) - Project duration: 4 years**
- **However:**
 - **LS3:** no beamtime at all during the last year of the project (2026)
 - **Many CERN internal experiments critical for HL-LHC operation upcoming**
 - **A “fallout” from COVID-19 :** People seem ‘reluctant’ to travel if something can be done on zoom....

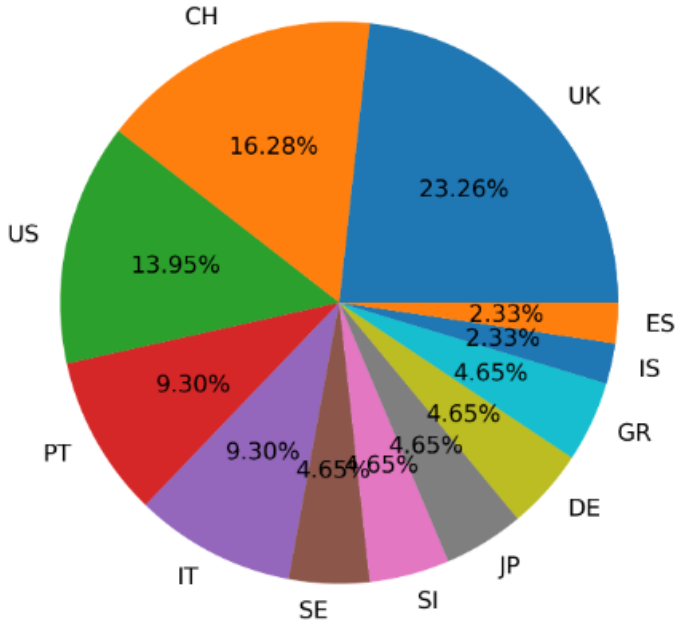
➤ So, by the end of 2023 run:

- **Delivered 1528 AUs (65.41 %) out of 2336 requested AUs**
- **Delivered 1528 AUs (31.83 %) out of total 4800 available AUs**
- **3272 AUs for 2 more experimental seasons (2024 and 2025)**

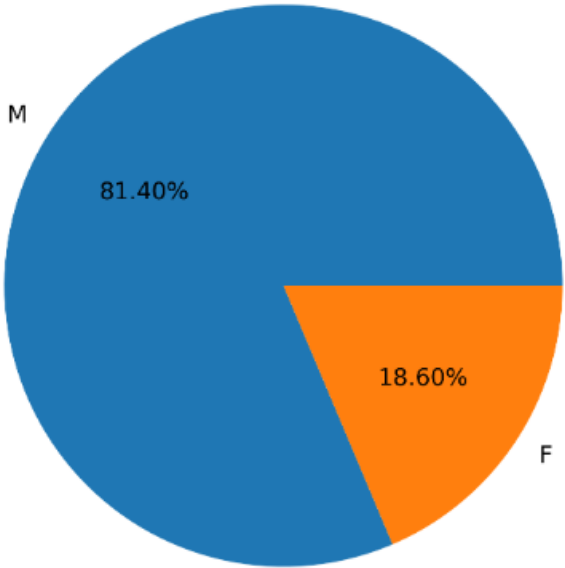


Up to now – Declared Users and Collaborators

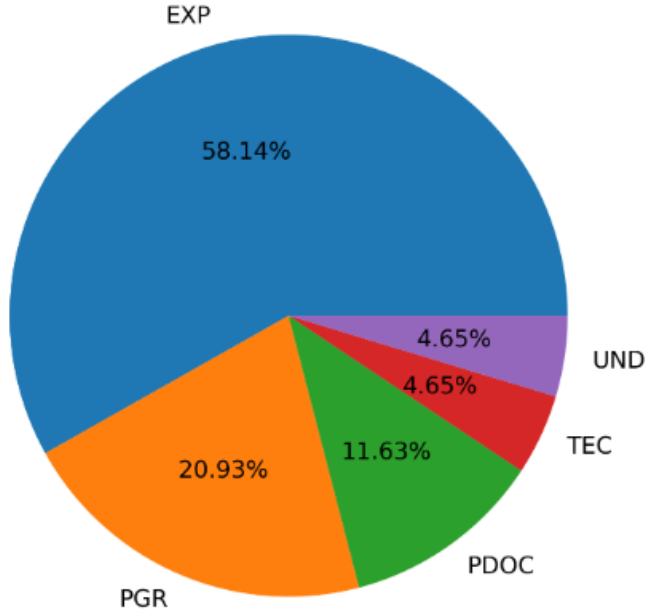
All users - Country distribution in all projects



All users - Gender distribution in all projects



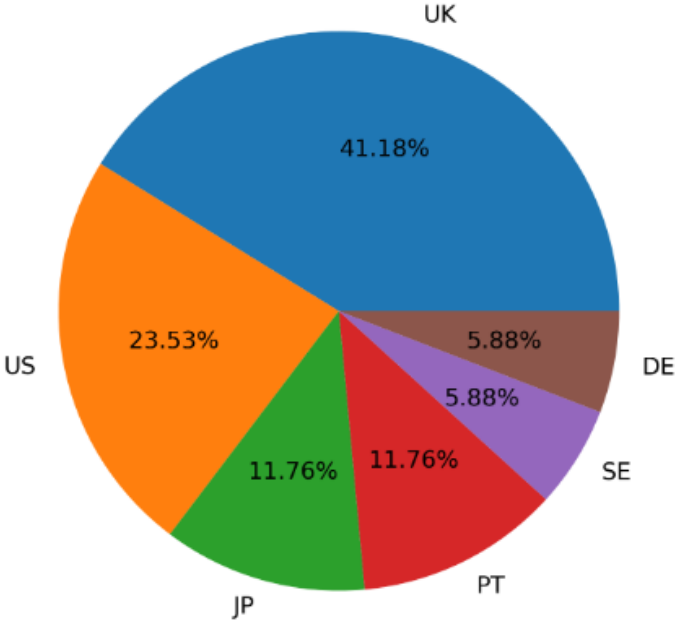
All users - Research status distribution in all projects



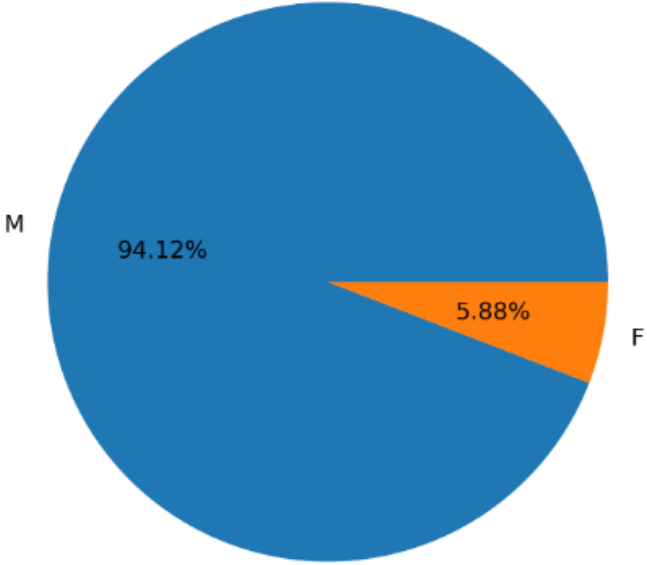
A nice breakdown of TNA users (funded & not-funded), with a slight inclination towards experienced researchers and males

Up to now – Funded Users

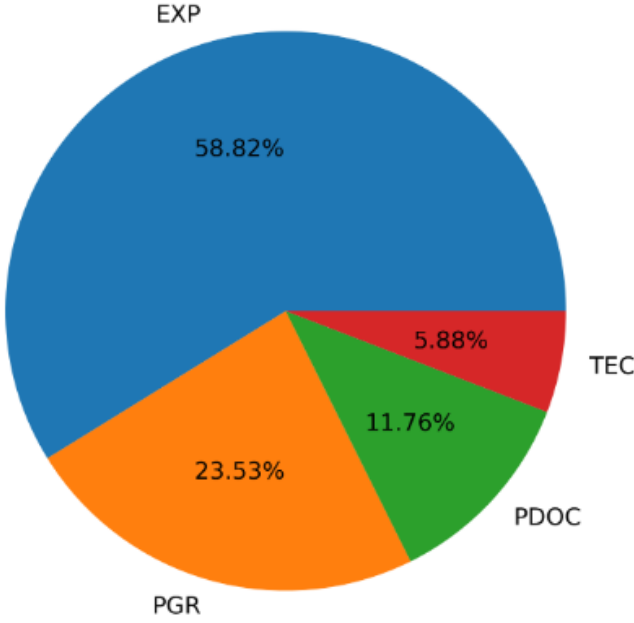
Funded users - Country distribution in all projects



Funded users - Gender distribution in all projects

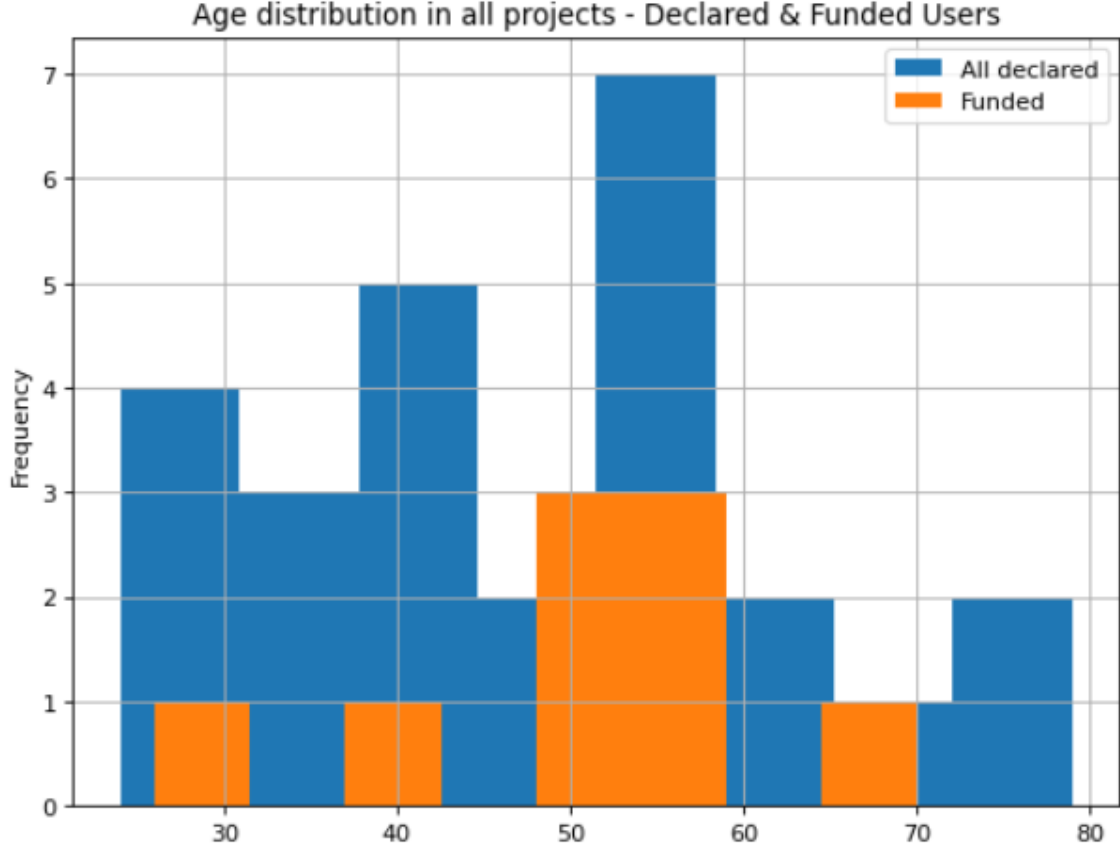


Funded users - Research status distribution in all projects

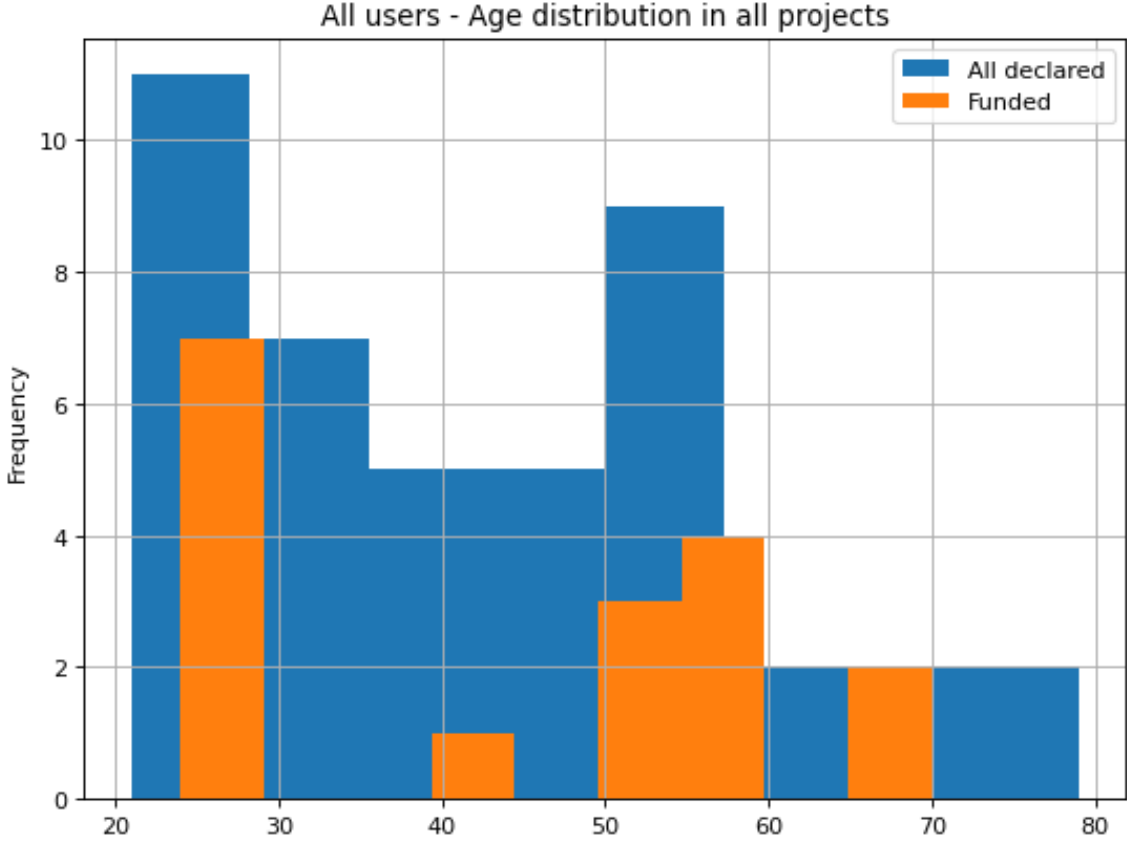


- Due to unforeseen conditions, some visits were cancelled and access units were not used (e.g. HRMT55, HRMT58)
- Some collaborators could access other sources of funding (i.e their institutes covered)

Up to now – Age distribution



User data until 15/02/2023

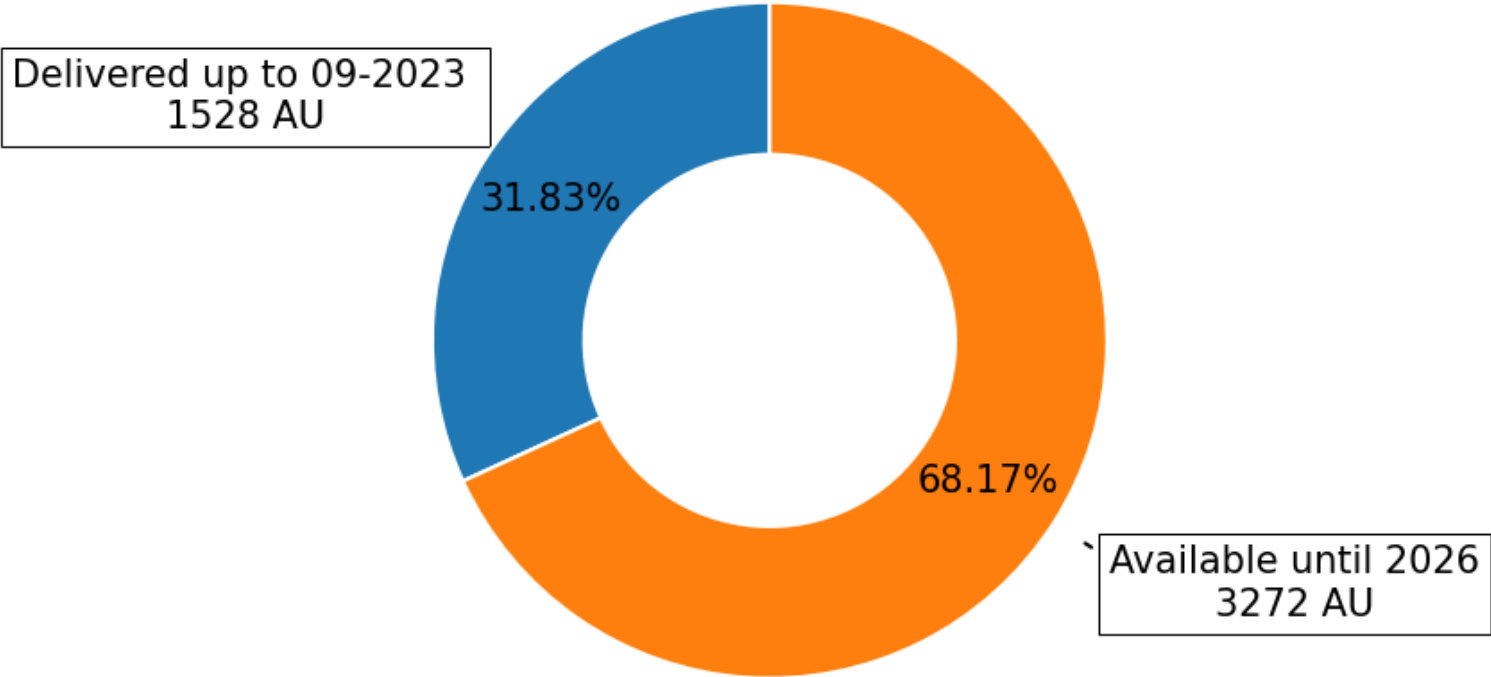


User data until 19/09/2023

We actively instructed the USPs and the proponents / applicants to motivate younger people, undergrads postdocs & females to apply.

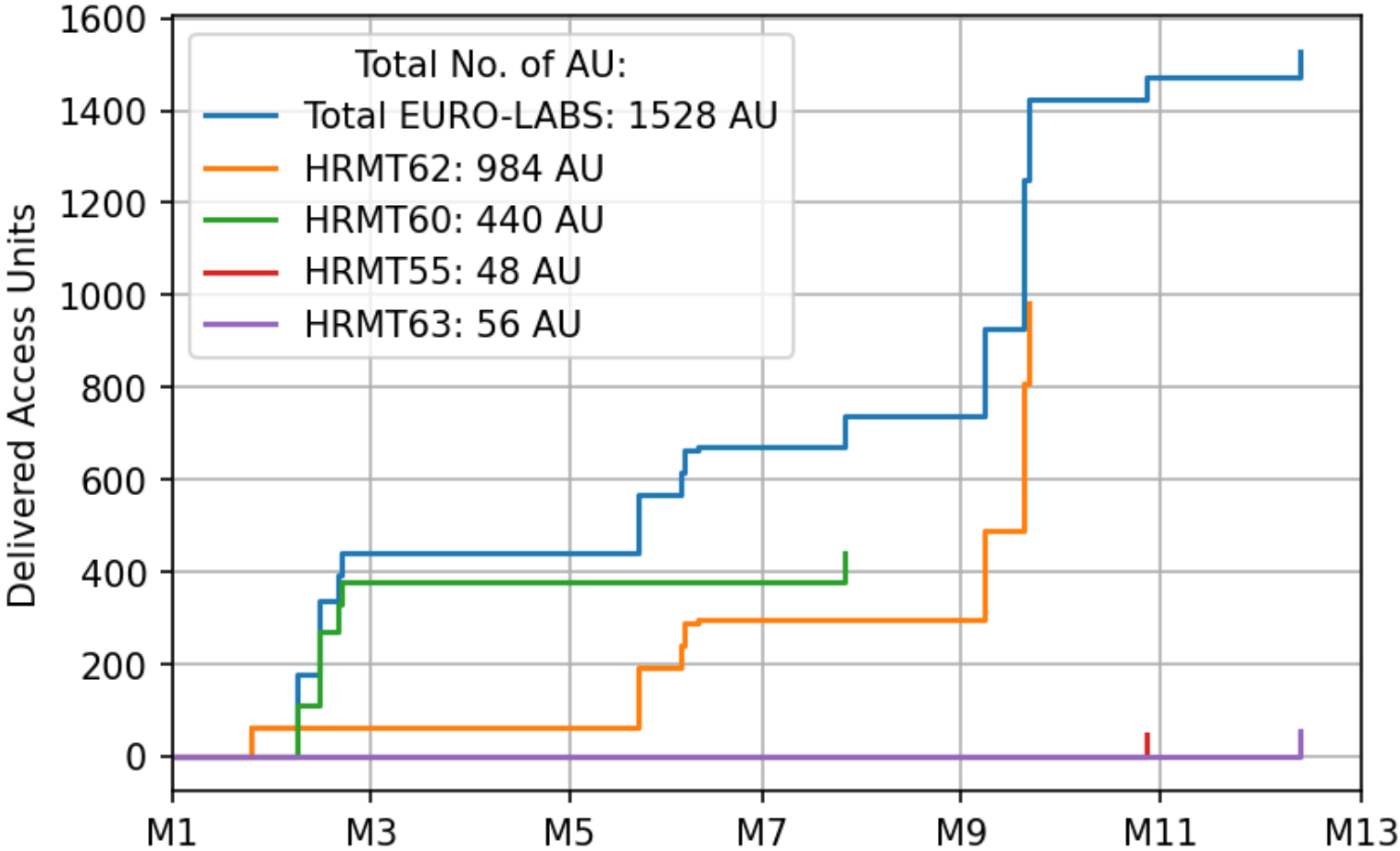
Up to now – Access Units delivered

HiRadMat EURO-LABS AU Status



Up to now – Access Units delivered

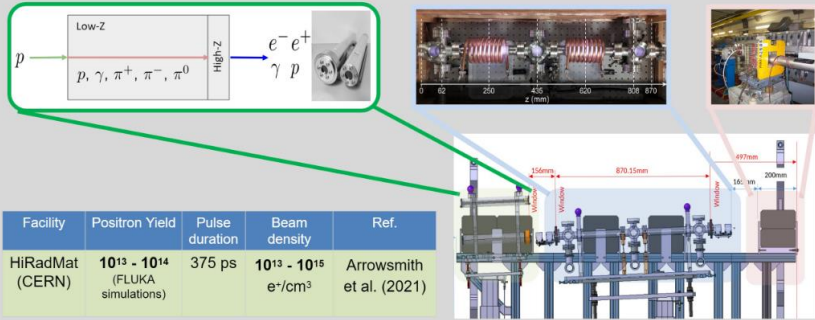
Delivered AU in HiRadMat between M1 and M13
Extracted 11-09-2023



Highlights – HRMT-62



We have adopted a completely new approach using CERN SPS



- We have developed a new platform to study the propagation of quasi-neutral beam through an ambient plasma.
- 440 GeV/c protons irradiate a low-Z target, initiating a hadron cascade. Decay of neutral pions generate GeV photons that produce pairs in the high-Z target.

A unique experiment for laboratory astrophysics, for first time at HiRadMat

EURO-LABS is acknowledged in all publications and talks in APS physics conferences !

<https://meetings.aps.org/Meeting/DPP23/Session/PP11.95> and more publications to follow.

Courtesy: G. Gregori (Univ. Oxford)



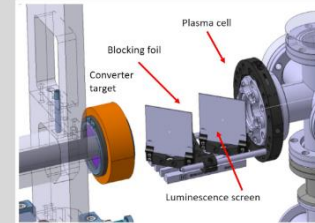
Installation completed



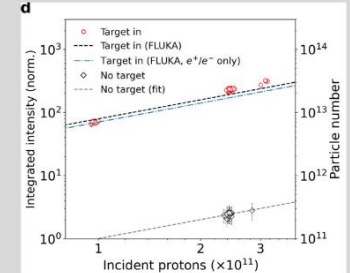
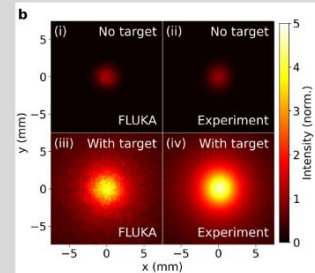
Remote operations from CERN Control Center (CCC)



Preliminary results: evidence of high-yield pair plasma (as predicted from simulations)



- Luminescence screens show significant increase in electron/positron signal compared to proton beam only.
- Energy deposition for different species is accounted for.
- **Estimated pair number is $>10^{13}$** (in agreement with FLUKA simulations).



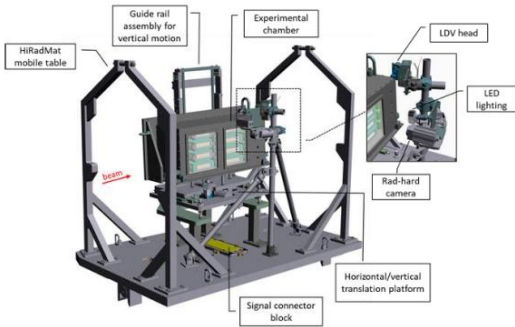
10/10/23

N. Charitonidis | EURO-LABS Annual Meeting, October 2023

Highlights – HRMT-60

Courtesy: K. Ammigan (Fermilab)

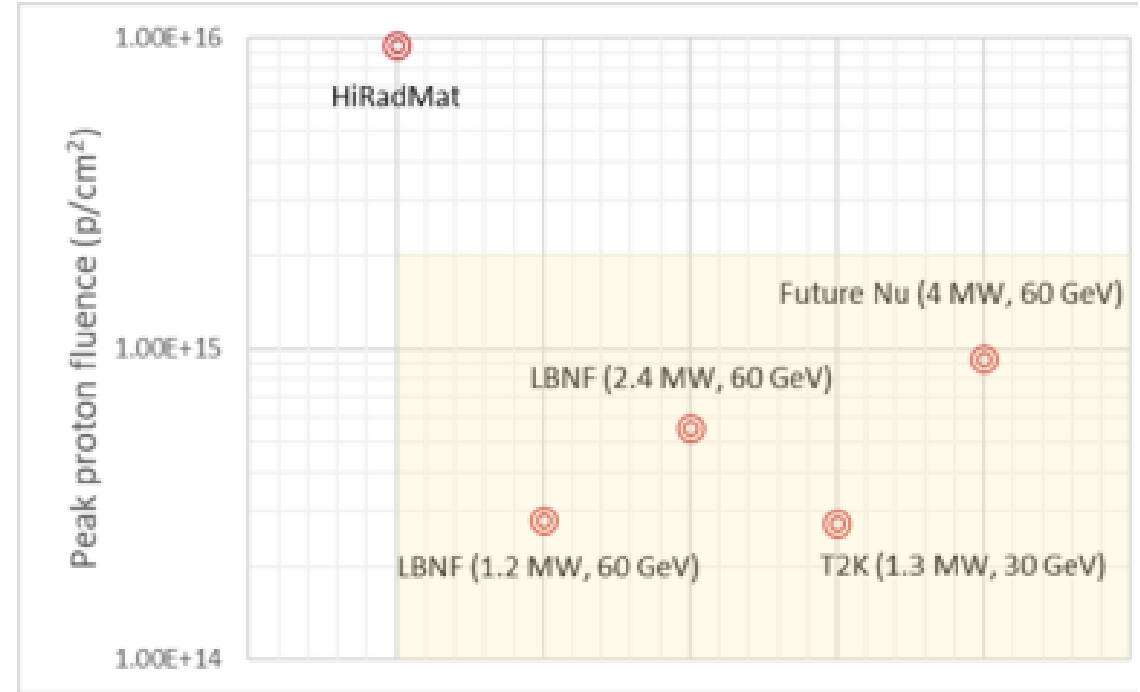
HRMT-60 Experimental Set-Up



- Double containment design with outer chamber as a dynamic secondary containment
- Outer chamber maintained at slightly negative pressure
 - Aspiration system, HEPA filter, flow switch
- Test chamber assembled on motorized 2-axis translation stage (BBA & array alignment)
 - LED lighting array and rad-hard camera for visual monitoring



4 9/18/2023 Kavin Ammigan | HRMT-60 RaDIATE HiRadMat Experiment



- A critical experiment for understanding thermal shock behaviour of beam intercepting devices
- Challenge: compare behavior of non-irradiated to pre-irradiated materials
- **EURO-LABS acknowledged to every talk / presentation given and was very important for the experiment's success.**

- Follow-on to HRMT-24 (2015) and HRMT-43 (2018)



<https://radiate.fnal.gov>



Highlights – HRMT-55

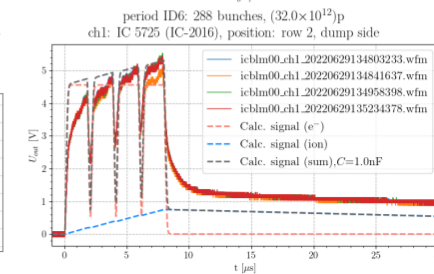
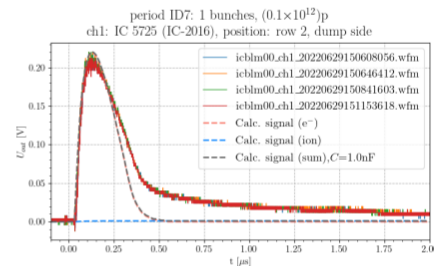
Courtesy: S. Grishin (ESS)

- Development of novel BLMs, for LHC (CERN) and ESS. Project to continue expanding its scope in 2024

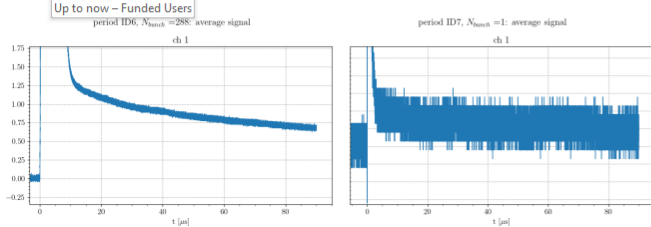
IC results 2022: signal

- Signal shape rather different than what is expected for a parallel plate geometry, assuming $+N_2$ and e^- drift:
 - Less linear for ion drift part
 - Increased contribution from ions

Measured and calculated (dashed lines) signal for 1 (top) and 288 (bottom) bunches assuming e^- and $+N_2$ drift times from literature:

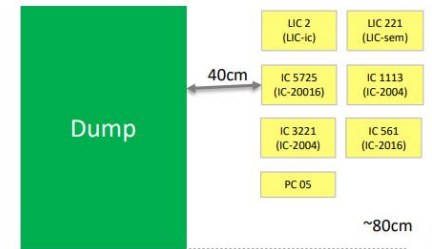


Measured average signal for 1 (right) and 288 (left) bunches – ion drift zoomed in:



Experimental setup at HiRadMat

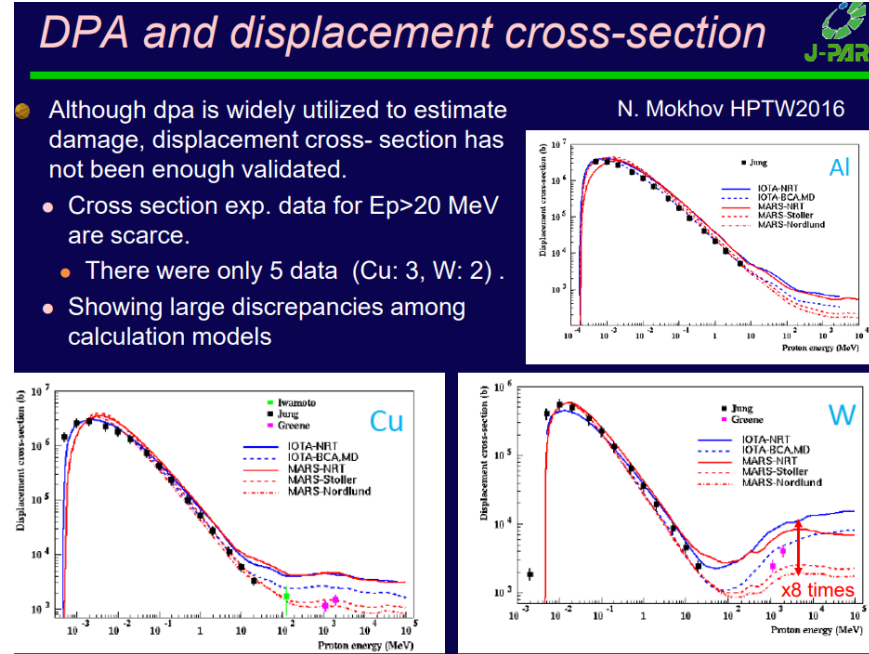
- Detectors connected from the area of HiRadMat side of dump to the HiRadMat Control Room in BA7.
- Due to low detector current
 - Detector signal cables connected through only one patch panel
 - Signal connection not grounded.
- DAQ:
 - Signal waveforms acquired with a scope (Tektronix, MSO 5), ~3-6 waveforms per pulse/bunch
- Detector locations:



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Highlights – HRMT-63

- Preparatory meetings for a JPARC related experiment to measure DPAs on superconducting wires.
- Quite complicated experiment, preparations have started and a broader collaboration between CERN-JPARC has “sprung-out”
- Partial support from EURO-LABS very helpful



Visit HiRadMat on Aug 2023

- Training was completed to enter TNC
- Fitting test of baseplate was made and some revisions were found.

HiRadMat Service Improvements

- **Doctoral student: optimization machine learning algorithms to improve beam delivery at HiRadMat**
 - **Machine learning based calibration procedures and data processing for the SPS BPMs (ALPS system), that will improve beam stability for HiRadMat and LHC-type beams in the SPS.**
 - **Better understanding of the beam conditions for the HiRadMat beam**
- **Beginning of DOCT contract: April 2024 (estimated)**
- **Preliminary results estimated by the end of 2024**

Plans for 2024

	Jan				Feb				Mar							
Wk	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mo	1	8	15	22	29	5	12	19	26	4	11	18	25			
Tu																
We	Annual closure															
Th																
Fr																G. Friday
Sa																
Su																
	Apr				May				Jun							
Wk	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
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	Jul				Aug				Sep							
Wk	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
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	Oct				Nov				Dec							
Wk	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
Mo	30	7	14													
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Sa																
Su																

- 2024: A tight year for HiRadMat with CERN critical experiments & external users
- FIREBALL-II, SMAUG-2 & BLM and ATLAS-DPA expected to request TNA support
- Schedule for the moment not frozen.

Events, User Selection Panels, User Days

EURO-LABS User Selection Panel Meetings

Enter your search term

September 2023

20 Sept HiRadMat EURO-LABS User Selection Panel #3 **In-person**

February 2023

15 Feb HiRadMat EURO-LABS User Selection Panel #2 **Zoom**

September 2022

06 Sept HiRadMat EURO-LABS User Selection Panel #1 **Zoom**

There are 2 events in the past. [Hide](#)

<https://indico.cern.ch/category/15888/>
(access restricted to the WP leader & USP members)

Next USP being planned for ~15.02.2024

HiRadMat EURO-LABS User Selection Panel #2

Wednesday 15 Feb 2023, 15:00 → 15:45 Europe/Zurich

Online Conference via ZOOM

Description The EUROLABS User Selection Panel Members for HiRadMat are:

Dr. David Sprouster (StonyBrook Univ. and Brookhaven NL, External Reviewer)

Dr. Bernie Riemer (ORNL, HiRadMat scientific board chairperson)

Dr. Pascal Simon (CERN, HiRadMat facility operations responsible)

Dr. Nikolaos Charitonidis (CERN, HiRadMat facility and WP3, Task 3.1 leader)

Dr. Ilias Efthymiopoulos (CERN, EURO-LABS WP3 Coordinator)

15:00 → 15:20 **Selection and discussion on the 2023-2024 proposals**

20m

Minutes

Speakers: Bernard Riemer, David Sprouster (Stony Brook University), Nikolaos Charitonidis (CERN), Pascal Simon (CERN), Vasiliki Stergiou (National Technical Univ. of Athens (GR))

HRMT55-1.xlsx HRMT55-2.xlsx HRMT58-1.xlsx HRMT-USP-2.pdf HRMT-USP-2.pptx

Phases of the following two experiments were reviewed :

- HRMT-55 BLM
- HRMT-58 ATLAS ITk

Both experiments are continuations of previous projects conducted in HiRadMat and are expected to receive beam time in 2023. The requests were fully granted. The current statistics and future prospects and budget projections were discussed, in the light of the upcoming LS3.

The presentation showing the statistics charts, as well as the application forms with the requested and the granted TA units, are attached to the agenda.

In addition, a joint, in-person User Selection Panel and Scientific Board was approved to take place at CERN, in September 16th-21st of 2023.

Events, User Selection Panels, User Days

HiRadMat User Day 2023
 Monday 18 Sept 2023, 09:00 → 16:20 Europe/Zurich
 13/3-005 (CERN)
 Alice Marie Goillot, Nikolaos Charitonidis (CERN), Vasiliki Stergiou (National Technical Univ. of Athens (GR))

Videoconference: HiRadMat User Day 2023

09:00 → 09:15 **Welcome Speech - History and Significance of HiRadMat for CERN**
 Speakers: Markus Brugger (CERN), Dr Simone Gilardoni (CERN)
 hiradmat-gilardoni.p... hiradmat-gilardoni.p...

09:20 → 09:40 **On the Scientific Merit and Importance of HiRadMat Experiments**
 Speaker: Bernard Riemer
 Riemer HRM Scienc...

09:40 → 10:00 **Review of the latest HRMT Experiments: HRMT-55 BLM**
 Speakers: Christos Zamantzas (CERN), Slava Grishin (ESS - European Spallation Source (SE))
 HRM55-BLM_HRM-... HRM55-BLM_HRM-...

10:00 → 10:20 **Review of the latest HRMT Experiments: HRMT-60 RaDIATE**
 Speakers: Kavin Ammigan, Kavin Ammigan (FNAL), Kavin Ammigan
 HRMT-60 HRMT Us... HRMT-60 HRMT Us...

10:20 → 10:50 **Coffee & Tea Break**
 30m 13/3-005

10:50 → 11:10 **Review of the latest HRMT experiments: HRMT-57 Multimat2**
 Speakers: Federico Carra (CERN), Jorge Guardia Valenzuela (CERN)
 2023-09-18_Multim... 2023-09-18_Multim...

11:10 → 11:30 **Review of the latest HRMT experiments: HRMT-56 HED**
 Speakers: Nicola Solieri (CERN), Thomas Gabriel Banks (CERN)

<https://indico.cern.ch/event/1302657/>

Many thanks to the EURO-LABS TNA support, HiRadMat team, RP team, radioactive shipping/receiving group, transport and support personnel at CERN

This project has received funding from the European Union's Horizon Europe Research and Innovation programme under Grant Agreement No 101057511 (EURO-LABS)

17 10/4/2023 Kavin Ammigan | HRMT-60 RaDIATE HiRadMat Experiment



Acknowledgements

- We thank T.Shea, C.Derrez, who provided support at ESS.
- We especially thank to HiRadMat team, P. Simon, N.Charitonidis, A.Goillot.
- We thanks to J.Hunt and L.Esposito from CERN for calculations.
- We thank to A.Larionov, A.Koshelev, M. Slepsov from IHEP for their collaboration.

• *This project has receiving funding from the European Union's Horizon 2020 Research and Innovation programme under Grand Agreement No. 730871 with TA Project Identifie : ARIES-CERN-HiTadMat-2020-01*

• *In 2023 this project has receiving funding from the Horizon Europe EC funded EURO-LABS project under Grant Agreement No. 101057511 with Project Identifier EURO-LABS-2023-HRMT55-1/2.*

• *IBIC23 TUP004 presentation (poster)*

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A big thank you to EURO-LABS for greatly supporting the operation of HiRadMat !



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