



CERN PS-IRRAD Facility Operation Overview

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Nicola MINAFRA (KU and CERN) for the BPM project

Acknowledgements: colleagues from CHARM team (BE-CEM), R2E project (SY-STY), Beam Operation and Physics (BE-OP, SY-ATB), Beam Instrumentation (SY-BI) and Radiation Protection group (HSE-RP)

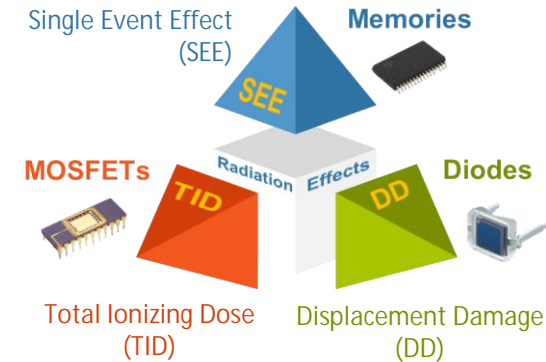
Outline

- **Irradiation Facilities at CERN**
- **PS East Area Proton Irradiation Facility (IRRAD)**
 - Characteristics, Dosimetry and Beam Instrumentation
- **User Operation**
 - Safety, Experiment Workflow, Data Management Tool (IDM) and User Infrastructure
- **Future Upgrades**
- **User Support**
- **Summary**

Irradiation Facilities Needs in HEP

- **Radiation damage studies on:**
 - **semiconductor** devices (silicon,...), other **sensitive media** (crystals,...)
 - **materials** used around accelerators & experiments (cables, glues,...)
 - **electronics components** COTS (transistors, memories,...) or ASICs
 - accelerator **parts exposed to high-intensity pulsed beams** (collimators,...)
- **Qualification of components, prototypes, full systems:**
 - **performance degradation** after long exposure / ageing (TID, NIEL,...)
 - **functional degradation** during operation (SEE, latch-up,...)
 - **performance evaluation under background** (“noise”) conditions
- **Radiation testing for:**
 - **components calibration** (sensors, dosimeters, measurement devices,...)
 - **providing benchmark data for Monte Carlo** transport codes

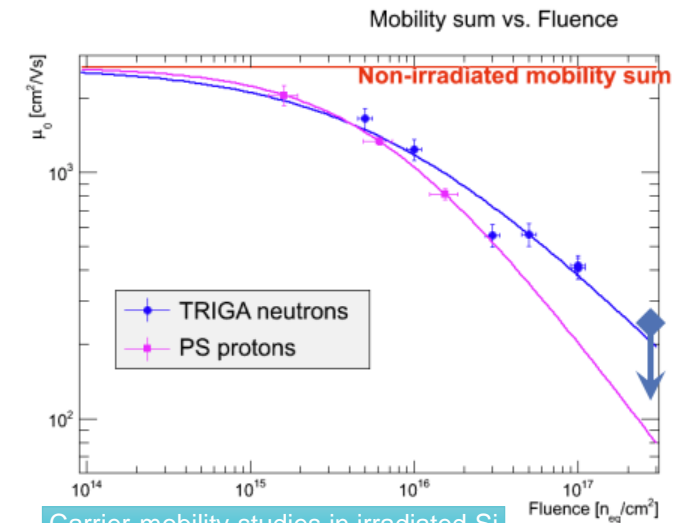
Radiation Effects in Electronics



ASTM Shear Strength Test



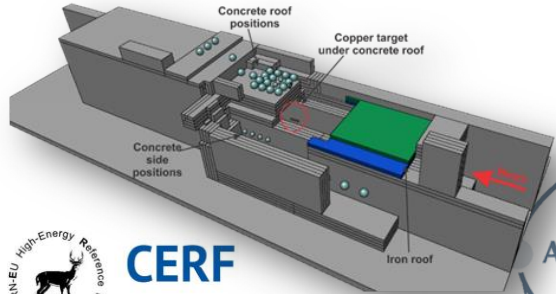
© N. Pacifico (CERN)



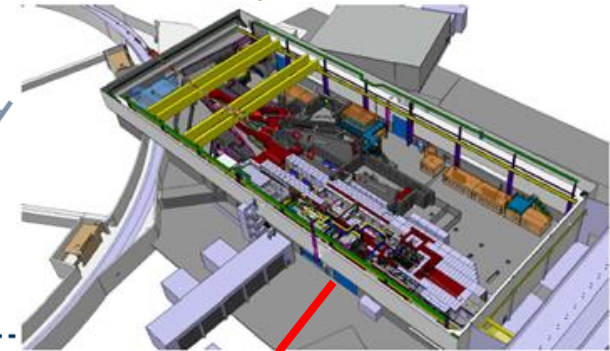
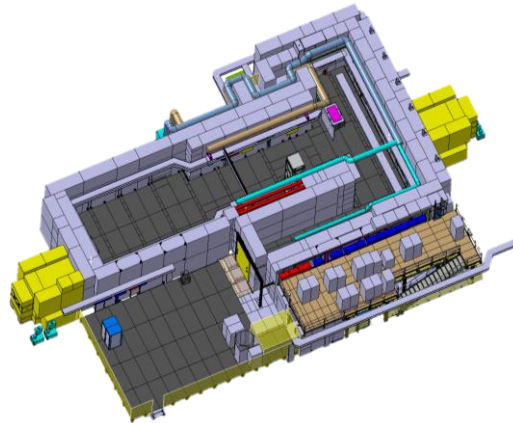
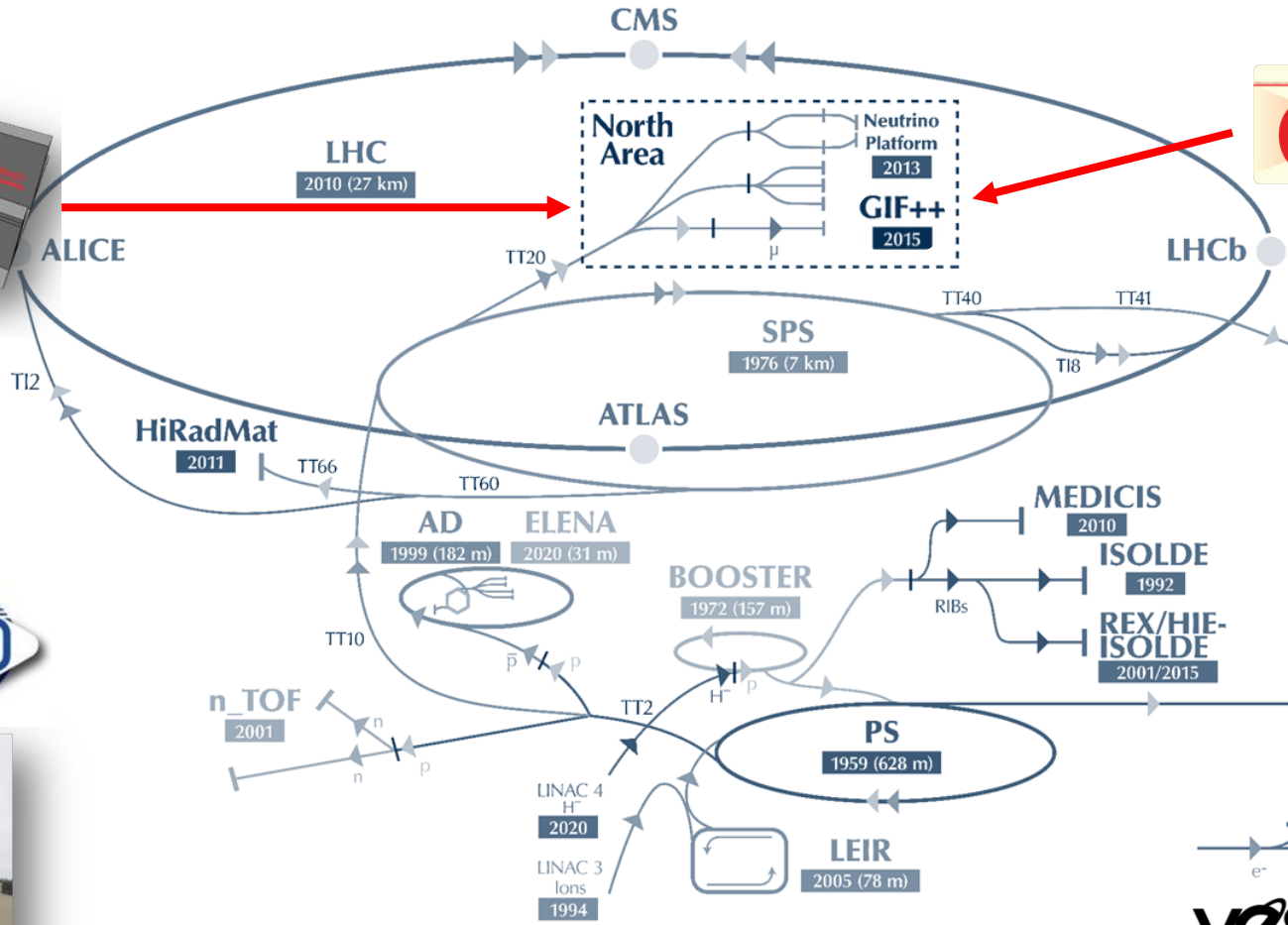
Carrier-mobility studies in irradiated Si

© M. Mikuz (JSI)

CERN Irradiation Facilities



CERF
The CERN-EU high energy Reference Field facility



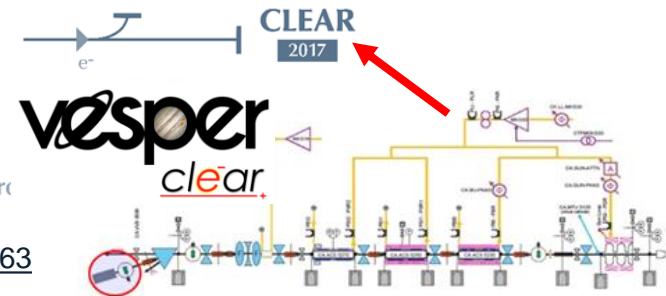
IRRAD
Proton Facility

CALLAB & CC60



anions) ▶ p (protons) ▶ ions ▶ RIBs (Radioactive Ion Beams) ▶ n (neutrons) ▶ \bar{p} (antiprotons)

see B. Gkotse, et al. (RADECS 2017): <https://doi.org/10.1109/RADECS.2017.8696163>

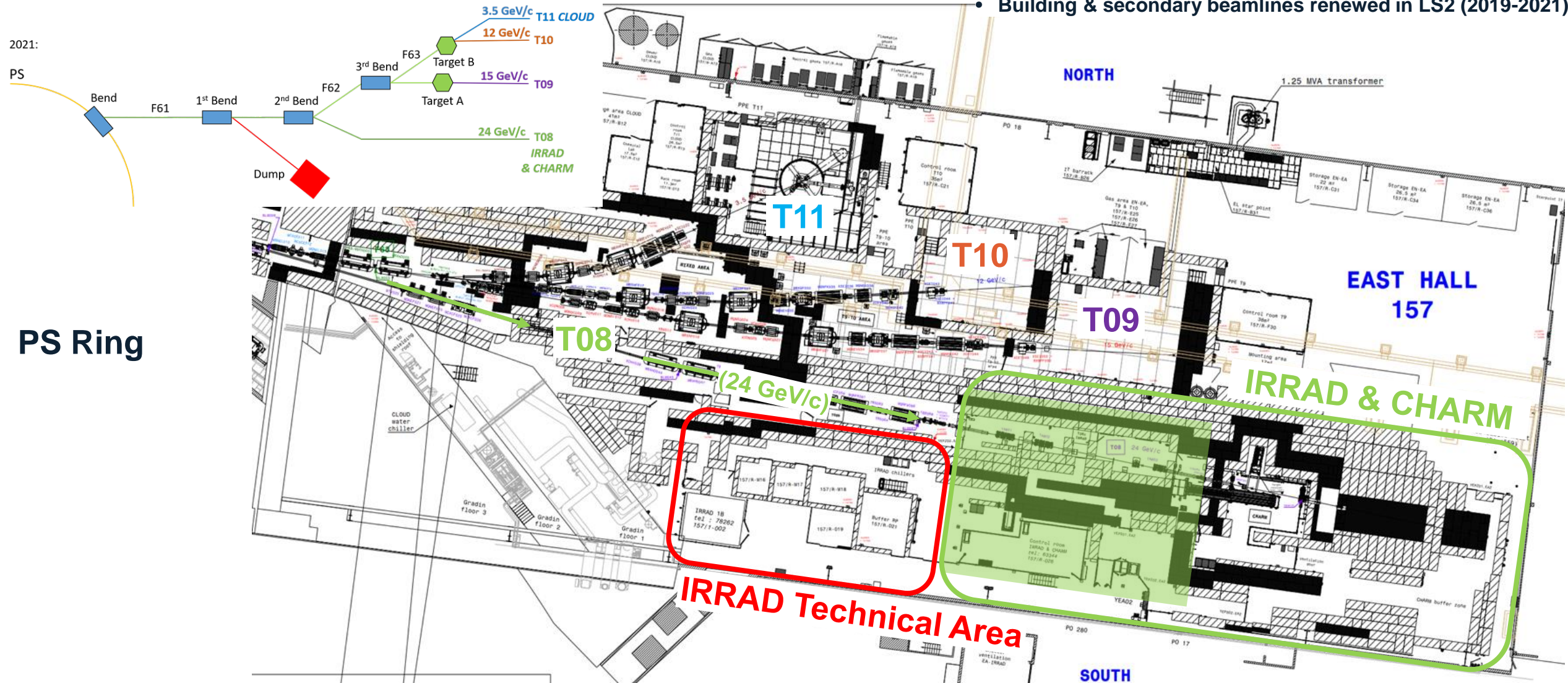


Outline

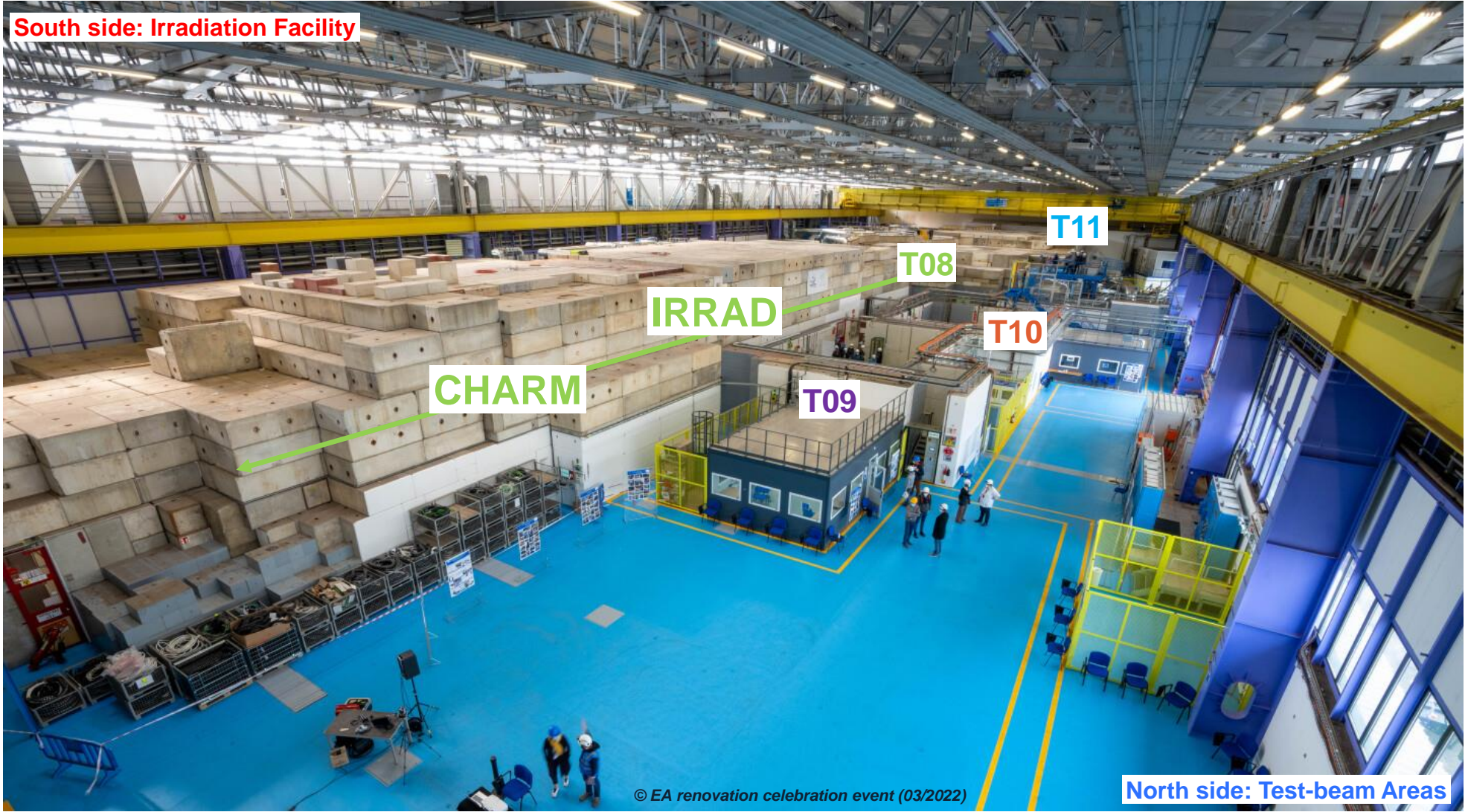
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PS East Area bld. 157

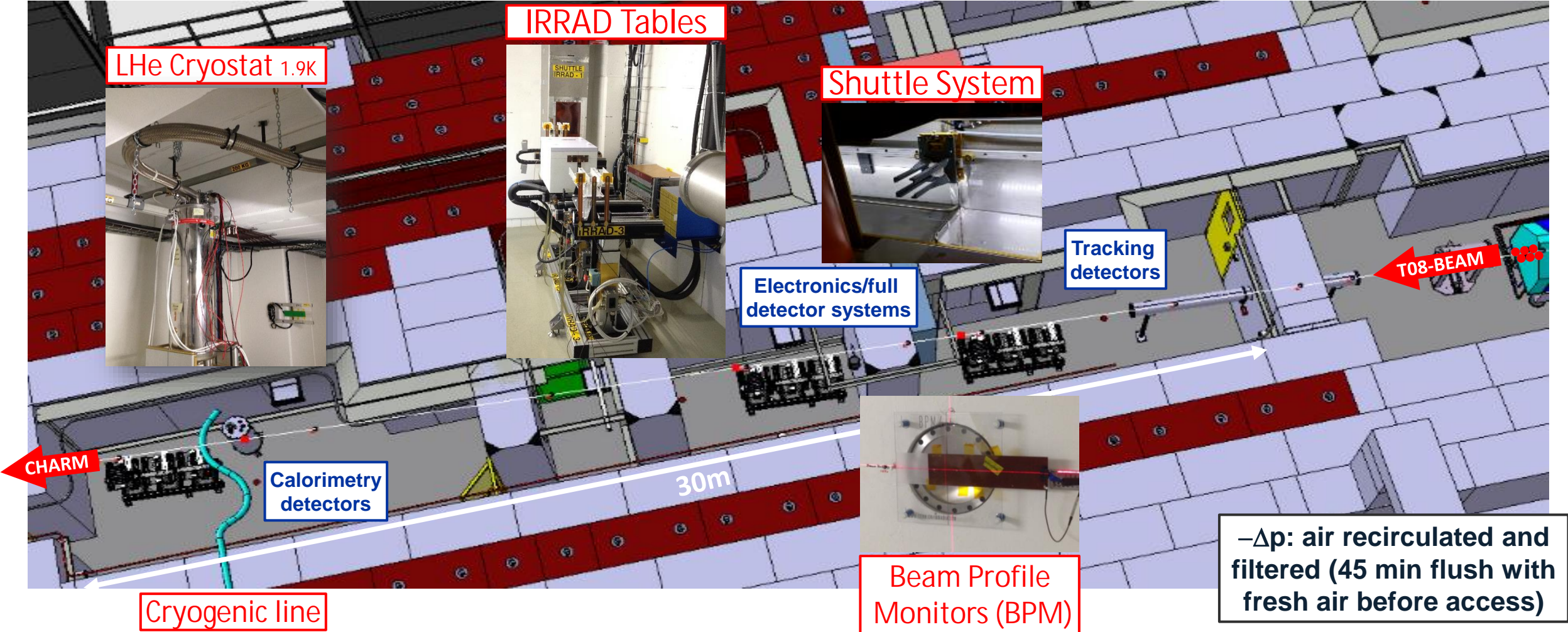
- Irradiation Facility built during LS1 (2013-2014)
- Building & secondary beamlines renewed in LS2 (2019-2021)



PS East Area b.157 (renewed during LS2)

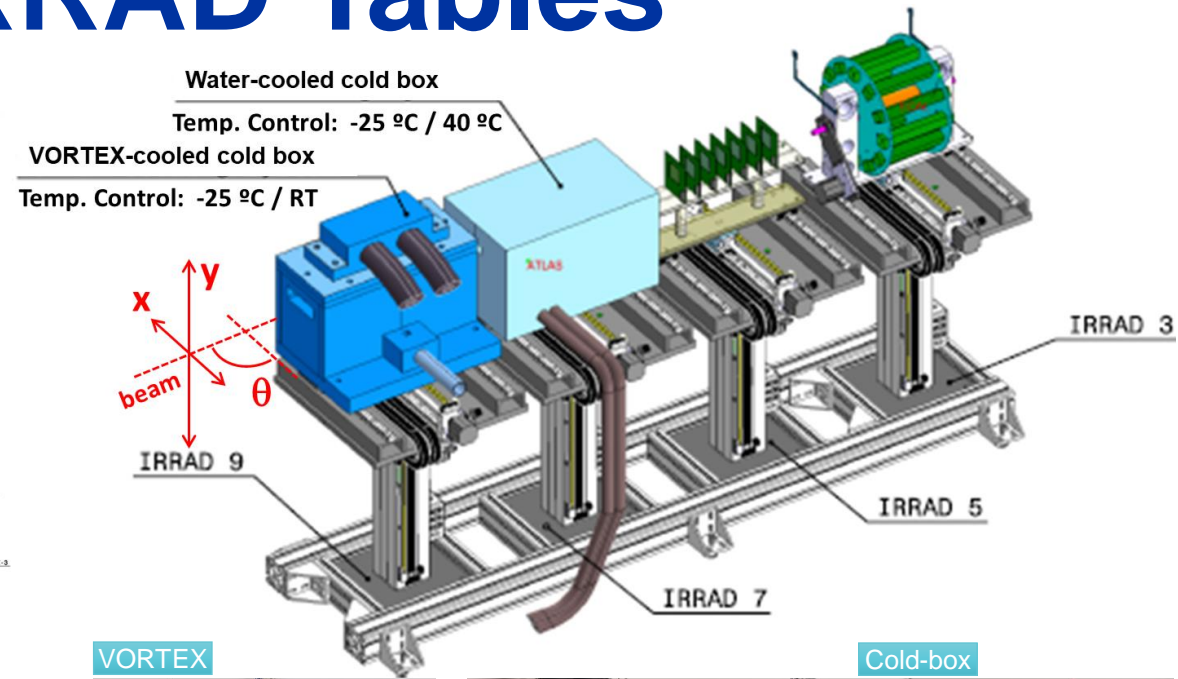
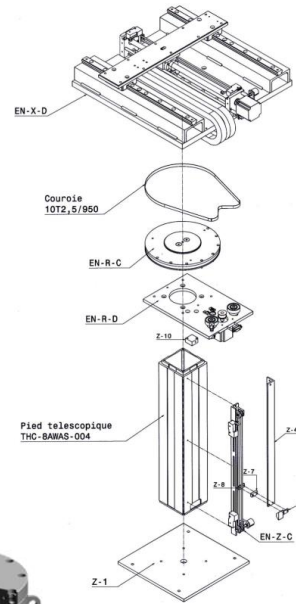


CERN Proton Irradiation Facility (IRRAD)



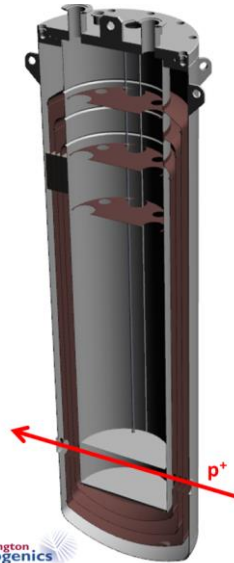
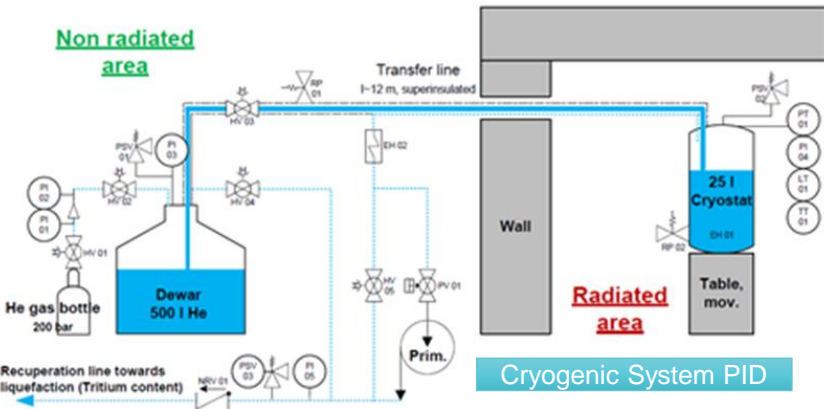
Irradiation Systems: IRRAD Tables

- 9 irradiation tables
 - 6x at room temperature
 - $V_{\max} = 20 \times 20 \times 50 \text{ cm}^3$
 - Scan over 10-20 cm (X-axis)
 - 2x with cold boxes (-25°C)
 - $V_{\max} = 12 \times 4 \times 38 \text{ cm}^3$
 - 1x cryogenic setup (1.9K)
 - $V_{\max} = 5 \times 5 \times 20 \text{ cm}^3$



VORTEX

Cold-box



wessington cryogenics

IRRAD Systems: Controls & Infrastructure

- IRRAD Motor Control Application (LS2 Upgrade)
 - based on pyQT (python)
 - open source
- Hardware Control Unit
- Database in the back-end

Motor Control Unit



- Cabling infrastructure
 - 4 Patch Panels with variety of connections (BNC, SHV, HF, D-SUB, Burndy, Ethernet, micro-coax, etc.)
- Piping network:
 - Neutral gases (N₂, user bottles or compressed-air)

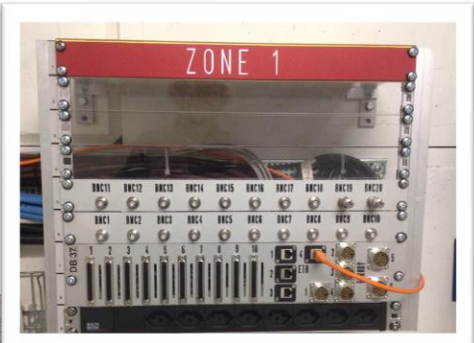
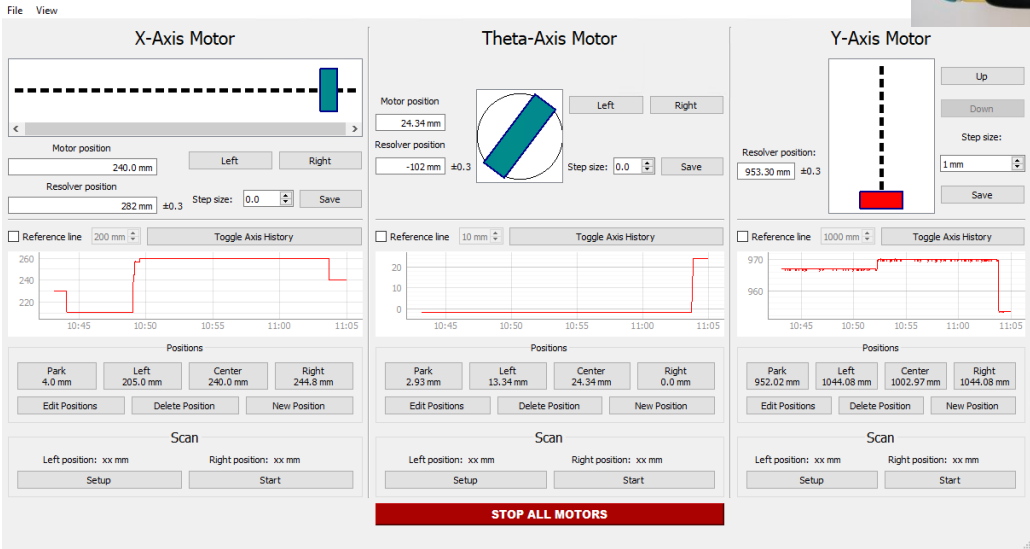


Table Control GUIs



The screenshot displays three motor control panels: X-Axis Motor, Theta-Axis Motor, and Y-Axis Motor. Each panel includes a position readout, a resolver position readout, and a step size control. The X-Axis Motor shows a position of 240.0 mm and a resolver position of 282 mm. The Theta-Axis Motor shows a position of 24.34 mm and a resolver position of -102 mm. The Y-Axis Motor shows a position of 953.30 mm and a resolver position of 953.30 mm. Each panel also features a 'Toggle Axis History' graph and a 'Scan' section with 'Setup' and 'Start' buttons. A red 'STOP ALL MOTORS' button is located at the bottom center.

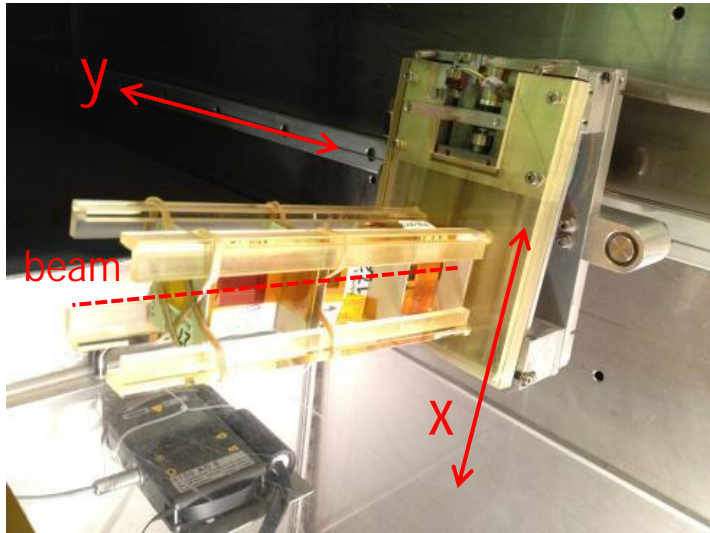


IRRAD Control Room

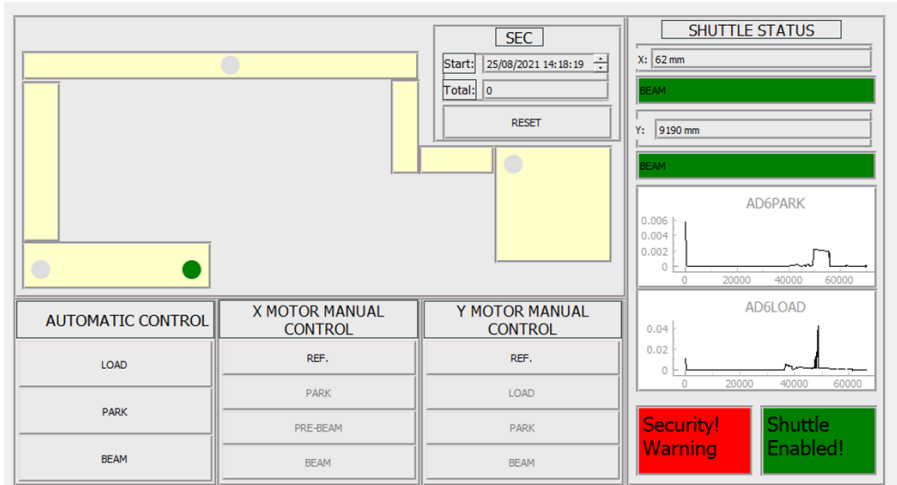
Irradiation Systems: IRRAD Shuttle

- 1 irradiation shuttle
 - room temperature
 - $V_{\max} = 5 \times 5 \times 15 \text{ cm}^3$
 - mainly passive samples (with bias)
- Beam-independent operation
- Python-based (pyQT), open source, motor control application (LS2 upgrade)

Shuttle Conveyor and Sample Holder



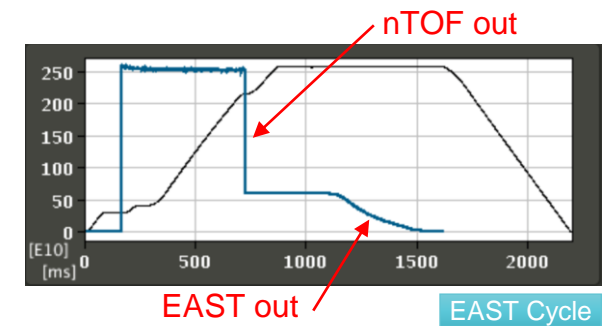
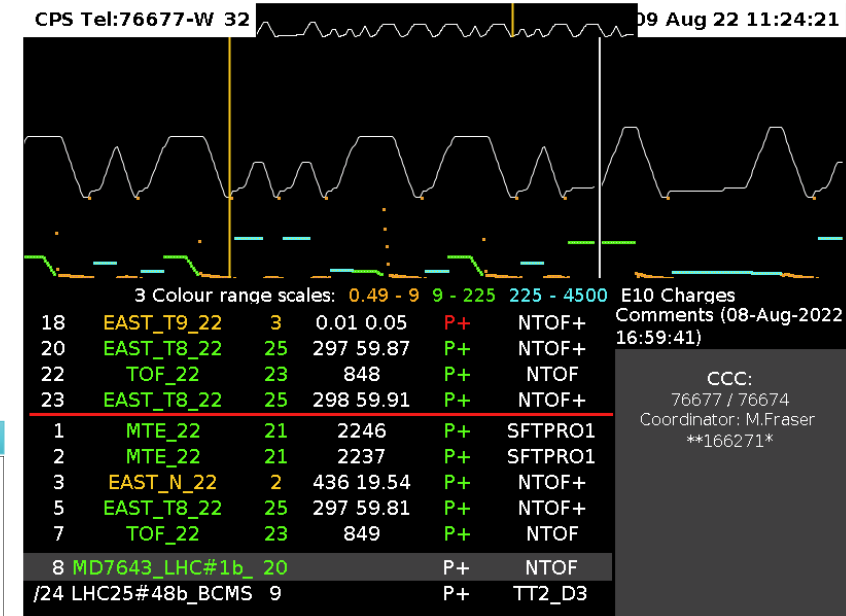
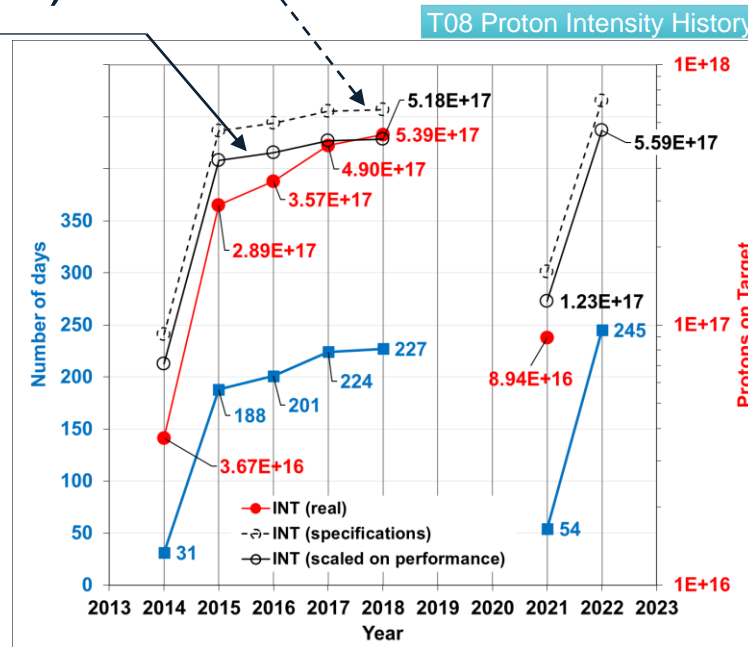
IRRAD1 Shuttle Loading Station



Motor Control Application GUI

24 GeV/c Proton Beam Delivery

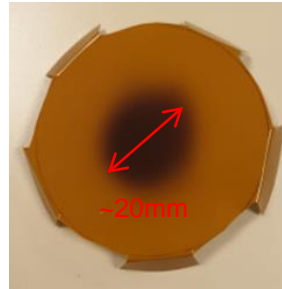
- Slow-extracted beam shared (EAST and n-TOF)
 - $EAST_T8 \sim 6.0 \times 10^{11}$ p/spill
- Specifications (2014):
 - 3 spills/CPS of ~ 30 s. duration during >220 days [max.: 6 spills]
 - $>2.0 \times 10^{16}$ p/week
- Performance in 1st run (2018):
 - $\sim 1.6 \times 10^{16}$ p/week
 - $\sim 1.0 \times 10^{16}$ p/cm²/2w^(*) [10mmx10mm] (~30% higher on smaller area)
 - MIPs, TID in MGy range
- After the LS2 (2021):
 - Priority to re-commissioning
 - Introduced new KPIs
 - Getting first “new” requests:
 - $>10^{17}$ p/cm²(*) 🤖!



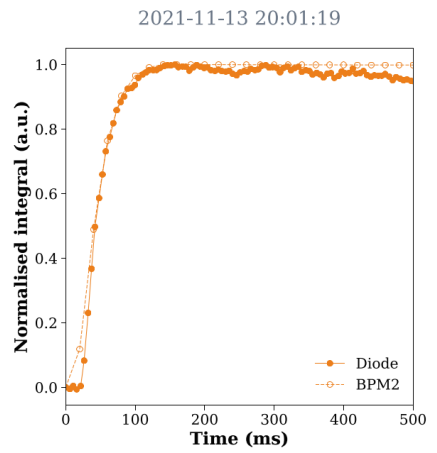
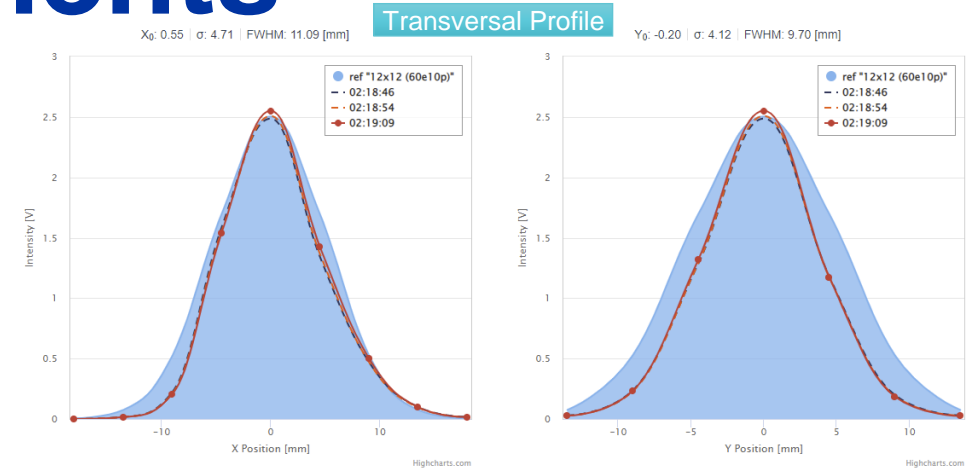
(*) NIEL Factor $k \sim 0.62$ for 24GeV/c protons to 1MeV-n_{eq}

Irradiation Beam Requirements

- **Intensity:**
 - **5×10^{11} p/spill** at facility location
 - Stable spill-by-spill, max. extraction & transmission efficiency
- **Transversal profile:**
 - Gaussian, **$12\text{mm} \times 12\text{mm}$ (FWHM)**
 - Shape constant along IRRAD
- **Longitudinal profile:**
 - Slow-extracted, **400ms**
 - Homogeneous (user-dependent)
- Special conditions on demand:
 - Fast Extraction $\sim O(10\text{ns})$
 - Very low intensity $\sim 10^9$ p/spill
- Information available on-line to users, operation and logging

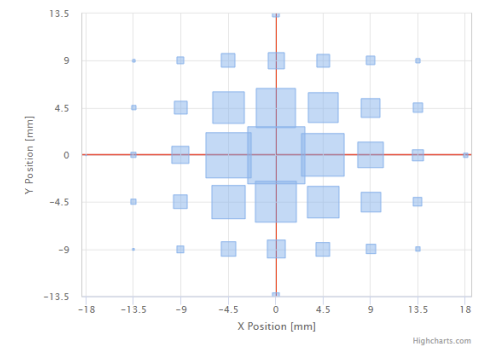


Beam Spot at CHARM

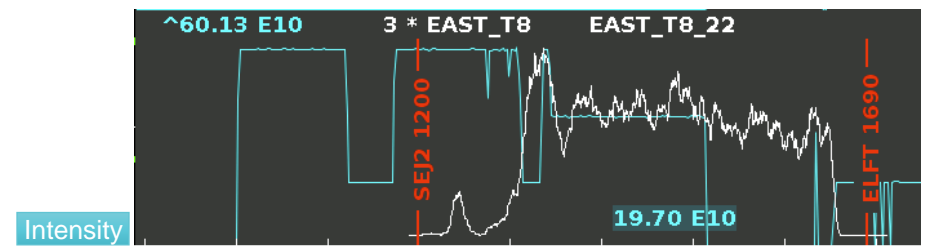
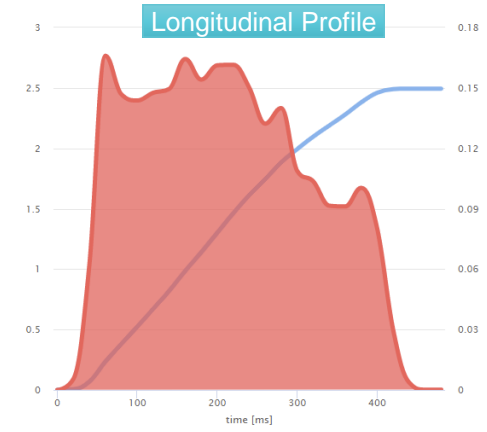


Fast-extracted beam response

© N. Emrskova (CERN)



Beam Spot at IRRAD



Intensity

Beam size vs. Samples size

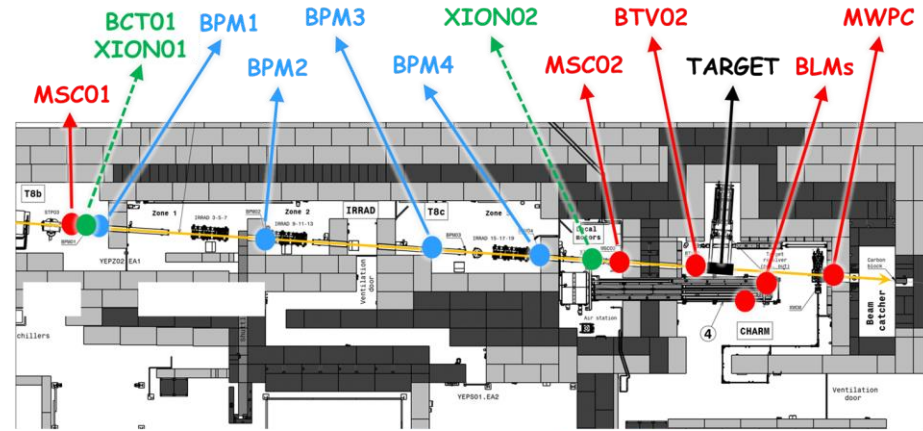
LHCb SciFi prototype

- These represent the majority of our samples ...
- ... but not only!
 - Machine Development periods being organized to consolidate the optics model for the T08 beamline



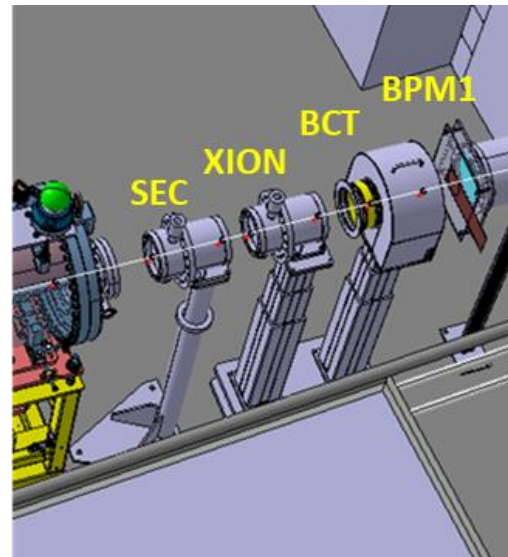
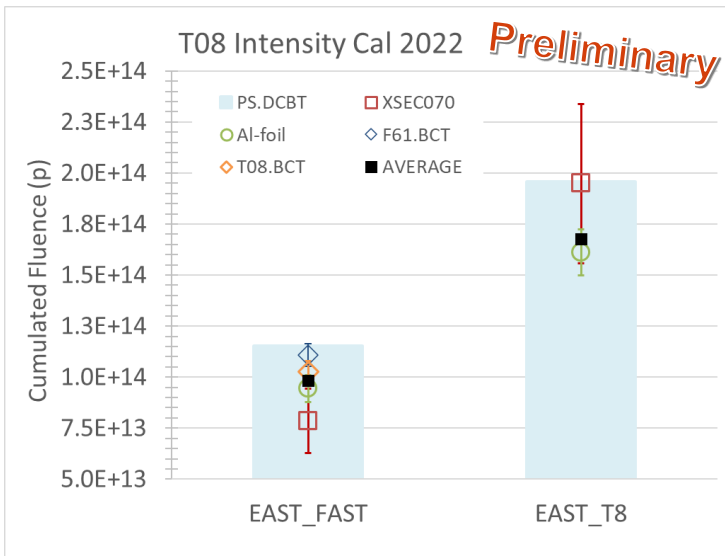
Beam Instrumentation (upgraded in LS2)

- Improving the T08 BI:
 - Better monitor the delivered proton intensity (extend range)
 - Future use of the beamline (HI beams)
 - Better inter-calibrate all instruments
- New measurement location for cross-calibration:
 - Slow- and fast-extracted beams



in red: responsibility SY/BI
 (upstream BTV/BCTs in F61 not shown)
 in blue: responsibility EP/DT
 in green: new/reinstalled devices in LS2 (SY/BI)
 XION01 and BCT01

XION02



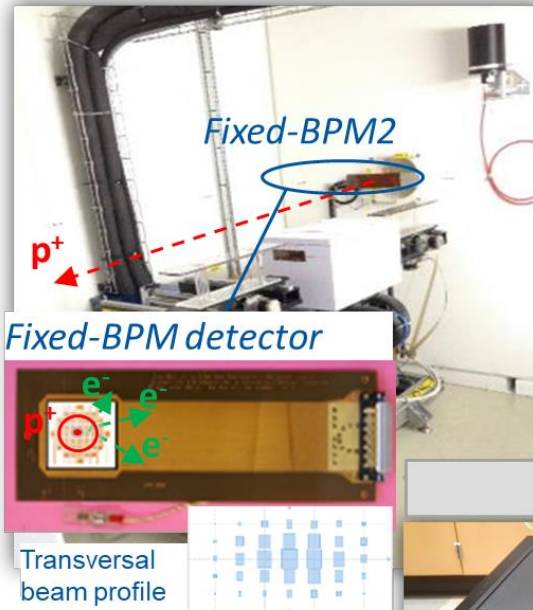
IRRAD Beam Profile Monitor

BPM Display at CCC



Fixed BPM

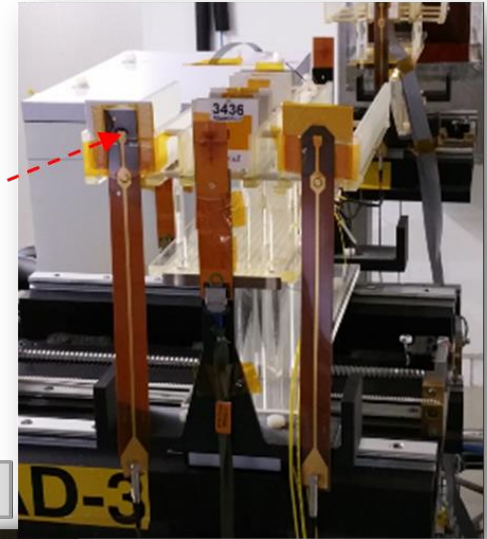
For beam steering (~40mmx30mm)



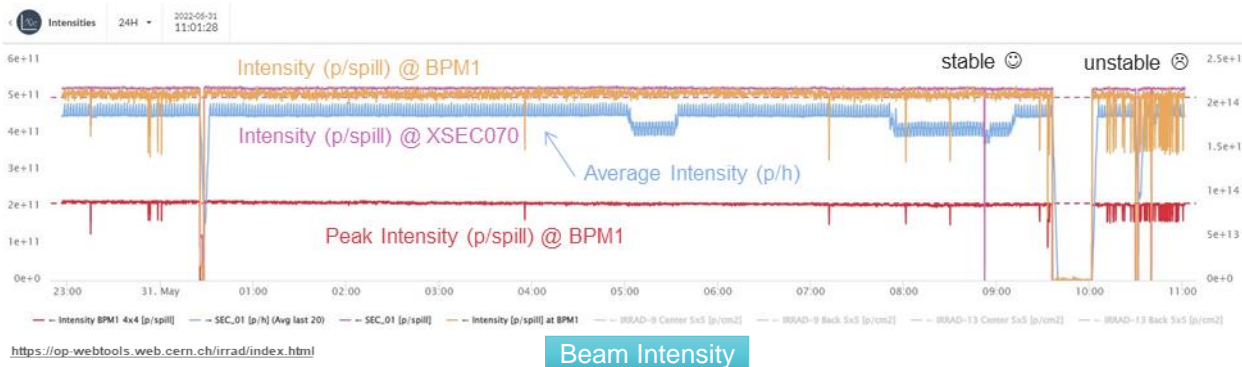
Mini and single-pad BPMs

IRRAD tables alignment purpose and "in-beam" detection

(~20mmx20mm)



BPM DAQ unit 25-35m away from fixed-BPM device



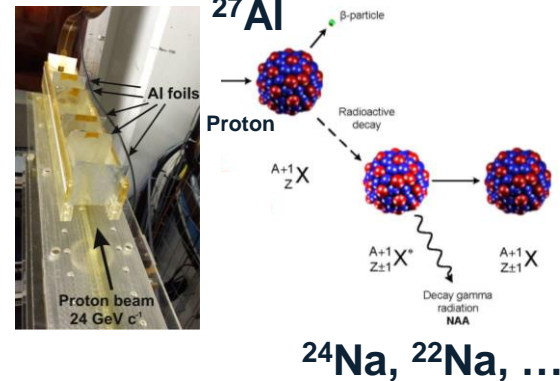
- Pixelized devices based on SEE in metal
- Data Integrated in accelerator logging (LS2 upgrade)

Proton Beam Dosimetry

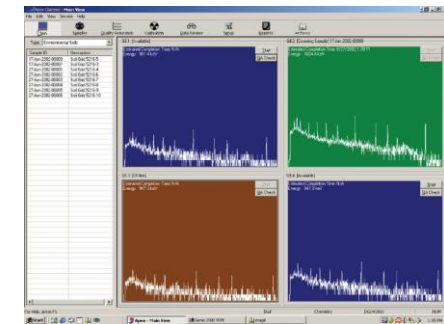
- Activation of thin Al-foils:
 - Calibrate beam instrumentation
 - Evaluate cumulated fluence on samples:
 - Typical dosimeters sizes: 5x5 or 10x10 mm²
- Reactions: $^{27}\text{Al}(p,3pn)^{24}\text{Na}$, $^{27}\text{Al}(p,3p3n)^{22}\text{Na}$
- Pure Aluminum:
 - High availability
 - Easy to handle
 - Relatively cheap
 - Good knowledge of σ
- Technique Error: +/- 7%
 - Activity statistical $\varepsilon < \text{few } \%$
- MIRION APEX-gamma
 - 1x VM server on *OpenStack*
 - 2 clients (**4 detectors**)
 in different locations at CERN
(LS2 upgrade)



(1) Foil preparation



(2) Exposure / activation



(3) Gamma Spectrometry



(4) Fluence Calculation

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Material Samples

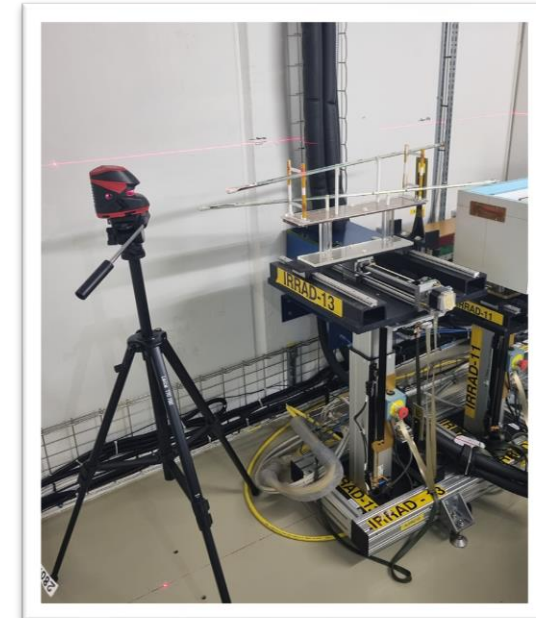
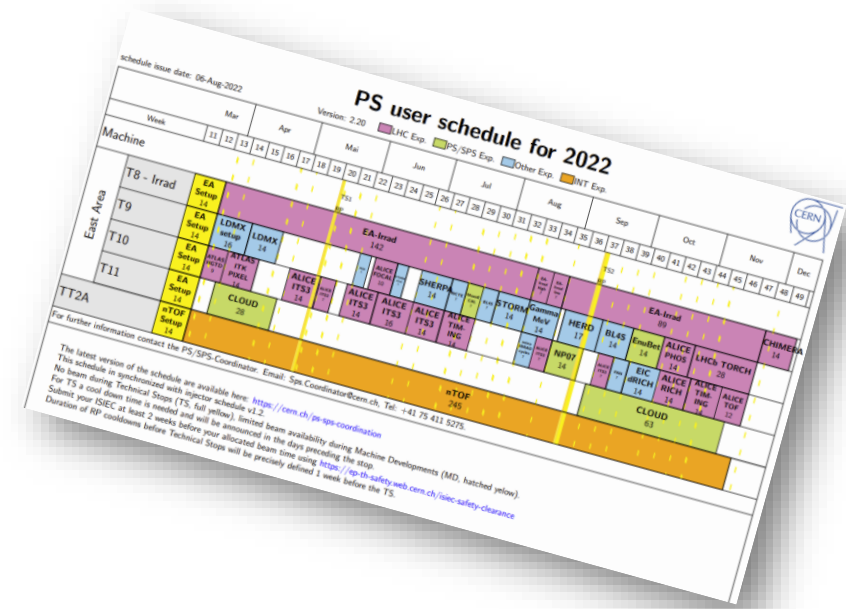
© IRRAD user community



Small material samples are usually processed by the IRRAD team staff (no need for the user to come on site at CERN)

Operational insights

- User Planning:
 - Experiments are discussed separately with IRRAD/CHARM users and scheduled in a common “masterplan”
 - **Evolving during the year** according to the requests
- Facility Commissioning (2 weeks):
 - Beam is **characterized**
 - Beam Instrumentation is **calibrated** (Al-foils & GaF films)
 - Irradiation systems are **aligned**
- Weekly Operation:
 - Dedicated e-group for coordination:
 - Usually, **area in access on Wednesday morning**
 - Intervention **prepared & supervised by the IRRAD staff**
 - Installation/removal, connection/disconnection, local checks of the setup's alignment



User Operation: Safety

- Risks during facility operation:



- Dedicated access rights, wear Personal Protective Equipment, mandatory safety courses, etc.
 - <https://ps-irrad.web.cern.ch/ps-irrad/safety.php>
-
- Safety is integral part of the irradiation workflow:
 - **Safety documentation (irradiation permit), if applicable**
 - PRP17 to implement ALARA process
 - Formally approved before the experiment takes place
 - **Manufacturing of sample holders:**
 - Optimize layout & materials respecting guidelines (IS41, etc.)
 - **Samples handling:**
 - Work organization, tools, personal and operational dosimetry, cool-down time, post-irradiation meas., logistics, etc.

Before

During

After

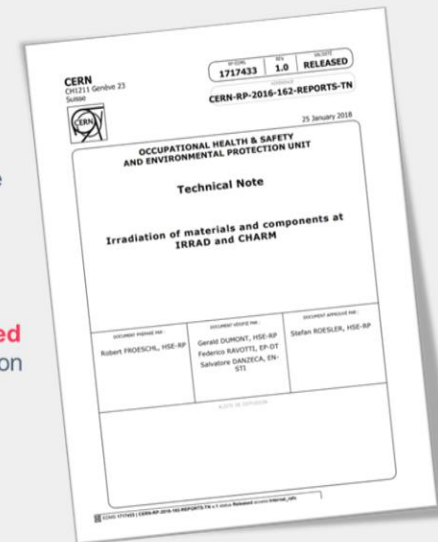
Contact the IRRAD Facility team to:

1. Discuss the details of your experiment and the **potential radiation safety implications**
2. Discuss the **preparation of the safety documentation** (if applicable to your case)

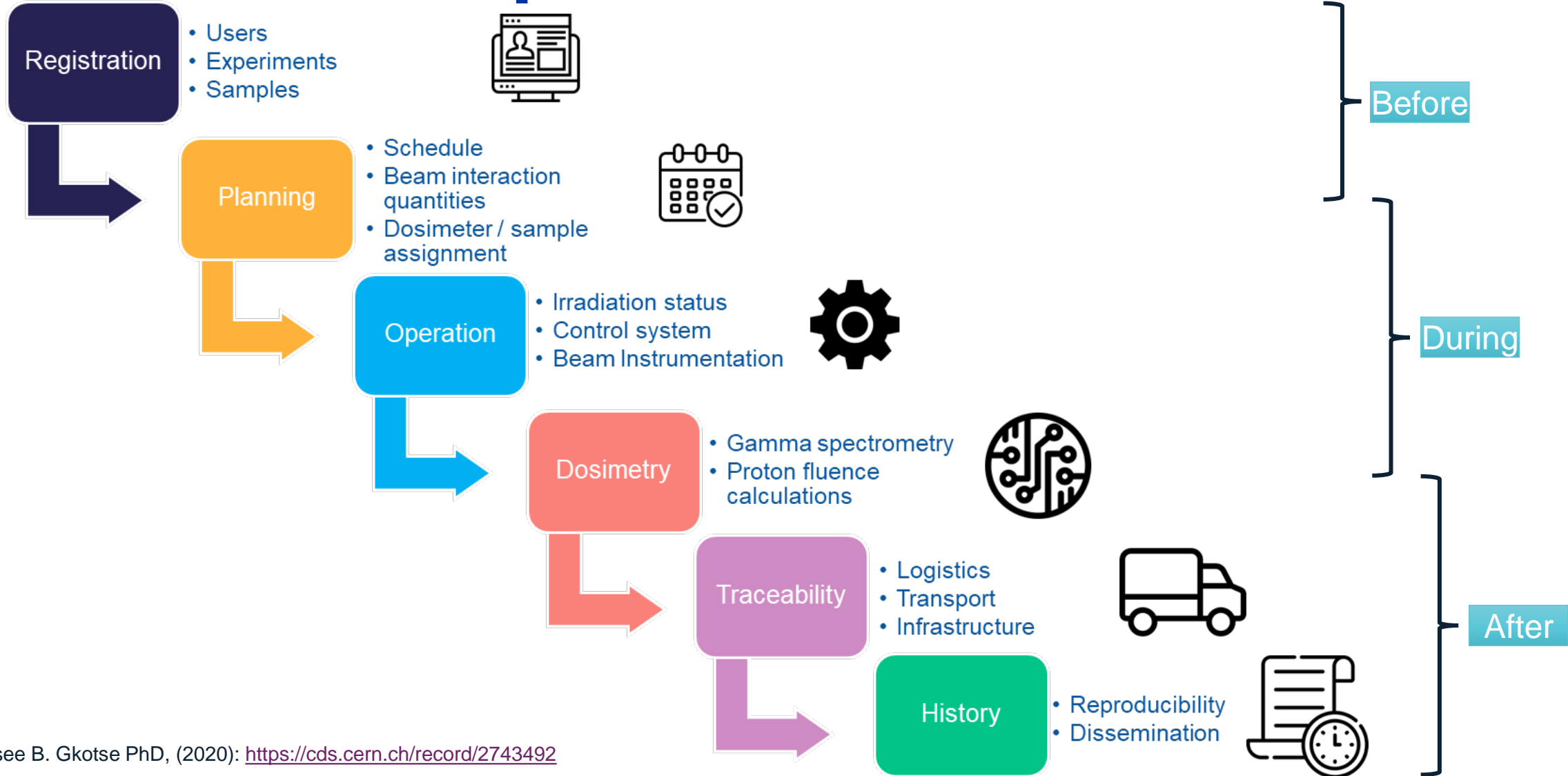
To fulfill the optimization principle (ALARA) **a formal approval of your irradiation experiment may be required** following a dedicated Radiation Protection Procedure (PRP17), [EDMS 1717433](#)



Contact the IRRAD team as early as possible while planning your irradiation experiment

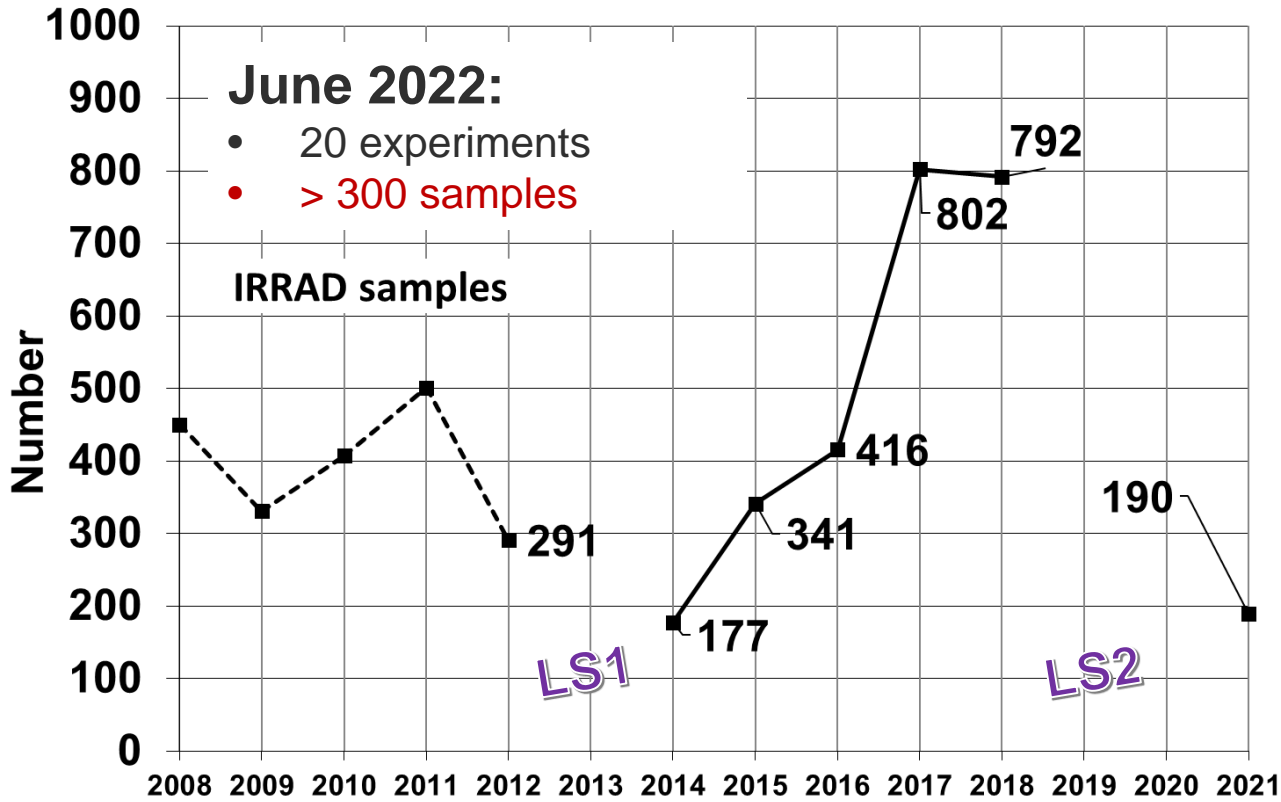
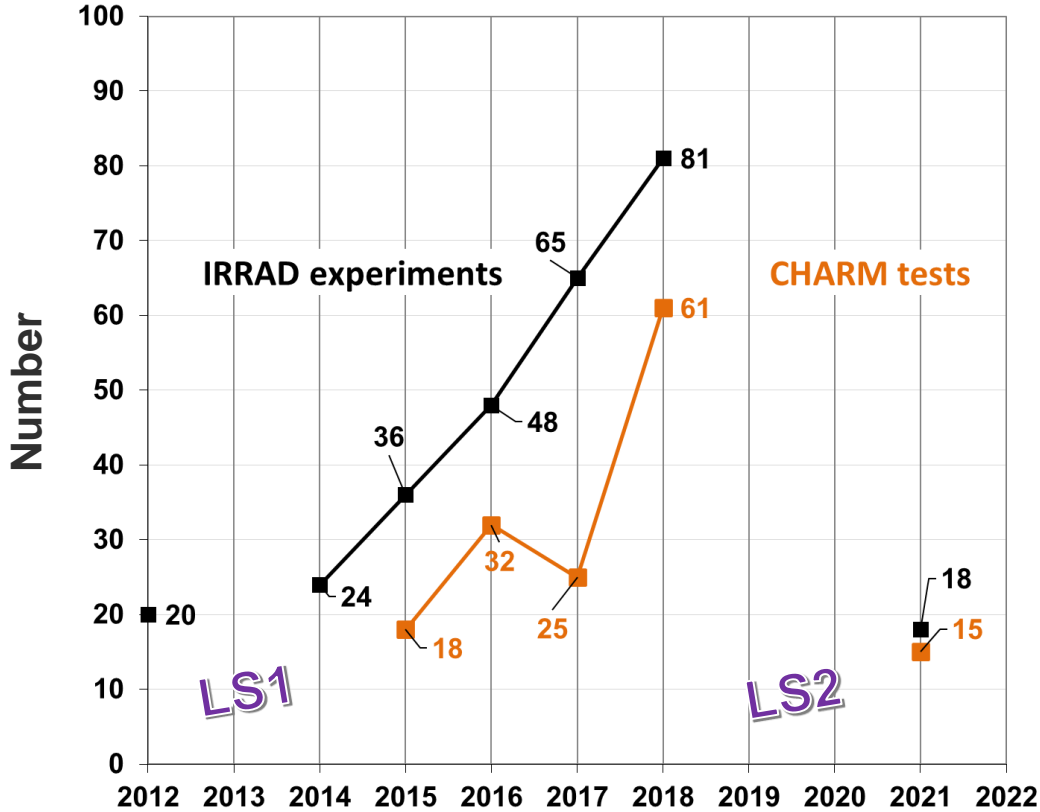


Irradiation Experiments Workflow



see B. Gkotse PhD, (2020): <https://cds.cern.ch/record/2743492>

IRRAD Annual Facility Statistics



- + $O(1000)$ activation foils measurements each year!

IRRAD Data Manager (IDM)

A unified data management tool for Irradiation Experiments follow-up

IRRAD Data Manager - Irradiation Experiments

| ID | Irradiation title | Availability | No. registered/declared samples | Radiation/NaCl/CaK Length Occupancy (%) | No. Users | Responsible person | Status | Actions |
|------|---|--------------|---------------------------------|---|-----------|----------------------|-----------|---------------------|
| 81 | FDC RADMON (M) | 02/04/2018 | 4/6 | 4.139/1.895 | 0 | Georgi Corine | Completed | Visible Edit Delete |
| 842 | Photo diode Irradiation (M) | 28/06/2018 | 7/7 | 9.111/4.212 | 0 | Luigi Aghari Chahera | Completed | Visible Edit Delete |
| 1483 | Heavy Ion Irradiation for silicon defect spectroscopy (M) | 16/11/2018 | 4/4 | 0.212/0.060 | 0 | Witka Matej | Validated | Visible Edit Delete |
| 1482 | NIEL calibration - Heavy ION 2018 - RADMON (M) | 14/11/2018 | 1/1 | 0.085/0.043 | 0 | Giuseppe Piccolo | Validated | Visible Edit Delete |
| 1481 | NIEL calibration - Heavy ION 2018 (M) | 14/11/2018 | 5/5 | 3.205/0.995 | 0 | Giuseppe Piccolo | Validated | Visible Edit Delete |

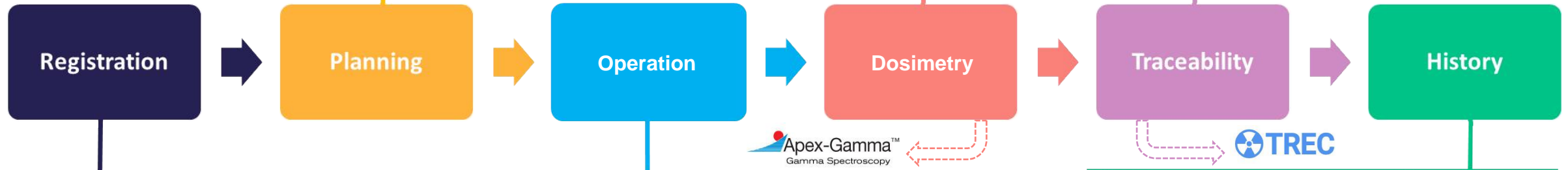
IRRAD Data Manager - Dosimetry results for SET-003252 (ULTEM1000)

| Dosimeter | Dimensions (mm ²) | Date In | Date Out | SEC | Accumulated fluence | Error (%) | Comments |
|------------|-------------------------------|------------------|------------------|----------|---------------------|-----------|----------|
| DOS-004033 | 10x10 | 18/04/2018 20:02 | 05/09/2018 03:00 | 1.45e+30 | 9.79e+16 | 7 | |
| DOS-004151 | 10x10 | 12/09/2018 13:25 | | 0.00e+00 | | None | |

Dosimeter dimensions (mm²): 10x10 mm² Total accumulated fluence: 9.790e+16 Protons/cm²

IRRAD Data Manager - TREC Data of Sample SET-003122

| Modification | Characteristics |
|---|---|
| <ul style="list-style-type: none"> Code: F001SET001-0003122 Serial Number: SET-003122 Description: Sample Sets Current location: 25.2-019 Value: 1 CHF | <ul style="list-style-type: none"> Length: 1 cm Width: 0.5 cm Height: 0.002 cm Weight: 0.1 kg Family: Material: |



Sample dimensions configuration interface showing a 3D model of a sample and input fields for length, width, height, and board diameter.

IRRAD Data Manager - Irradiation Status

| Updated at | Sample | Dosimeter | Date IN - Date OUT | IRRAD table | Table position | Accumulated fluence | SEC | Updated by | Status | In Beam | Actions |
|------------|------------|------------|--------------------|-------------|----------------|---------------------|--------|--------------------------------|------------|--------------------------|---------------------|
| 15/11/2018 | SET-003899 | DOS-004211 | 15/11/2018 16:11 - | IRRAD19 | Center | | 272851 | irradiation.facilities@cern.ch | Registered | <input type="checkbox"/> | Visible Edit Delete |
| 15/11/2018 | SET-003900 | DOS-004211 | 15/11/2018 16:11 - | IRRAD19 | Center | | 272851 | irradiation.facilities@cern.ch | Registered | <input type="checkbox"/> | Visible Edit Delete |
| 15/11/2018 | SET-003901 | DOS-004211 | 15/11/2018 16:11 - | IRRAD19 | Center | | 272851 | irradiation.facilities@cern.ch | Registered | <input type="checkbox"/> | Visible Edit Delete |
| 15/11/2018 | SET-003902 | DOS-004211 | 15/11/2018 16:11 - | IRRAD19 | Center | | 272851 | irradiation.facilities@cern.ch | Registered | <input type="checkbox"/> | Visible Edit Delete |
| 15/11/2018 | SET-003903 | DOS-004211 | 15/11/2018 16:11 - | IRRAD19 | Center | | 272851 | irradiation.facilities@cern.ch | Registered | <input type="checkbox"/> | Visible Edit Delete |

IRRAD Data Manager - 3D pixel for ATLAS ITk

Experiment Details: Title: 3D pixel for ATLAS ITk. Description: Study of radiation hardness of 3D silicon pixel sensors for the innermost pixel layer of ATLAS ITk with fluences up to 2e16 protons/cm2. Both FE4 prototypes and modules with the new RD53A readout chip are going to be tested.

Sample Details: Category: Passive Custom. Type: Silicon sensor. Irradiation area: 25x25mm2. Modals opened: Pixel modules on the ATLAS 3D silicon pixel sensors for the last year. Usually wide beam (25x25mm2) at end of beamline. Fluence: 1e16 Protons/cm2 to 1e18 Protons/cm2. Type of samples: Silicon sensor + readout chip/bump bonded.

Dosimetry results: SET-003899 with dosimeter DOS-004211: 1.200e+16 Protons/cm2. SET-003900 with dosimeter DOS-004211: 1.234e+16 Protons/cm2. SET-003901 with dosimeter DOS-004211: 1.200e+16 Protons/cm2.

Registration in IDM (Example)

The image shows a composite screenshot of the IDM (Integrated Data Management) system interface. The main window displays the 'Sample details' page, which includes a 3D diagram of a sample stack and input fields for dimensions and layer details.

Sample dimensions diagram: A 3D stack of three layers labeled M1, M2, and M3. The top layer is labeled 'material 1 (M1)'. Red arrows representing a proton beam (p^+ 24 GeV/c) are shown incident on the stack. Dimensions are labeled: Height (H), Width (W), and Length 1 (L1). The layers are labeled L1, L2, and L3.

Form fields:

- Total height (mm) *: 25
- Total width (mm) *: 25
- + Add new compound

Layer details table:

| Name * | Length (mm) * | Element/Compound | Delete |
|---------|---------------|------------------|--------|
| L1 | 0.13 | kapton | x |
| L2 | 0.0006 | Al(13) | x |
| L3 | 0.0006 | SiO2 | x |
| e.g. L1 | | ----- | x |

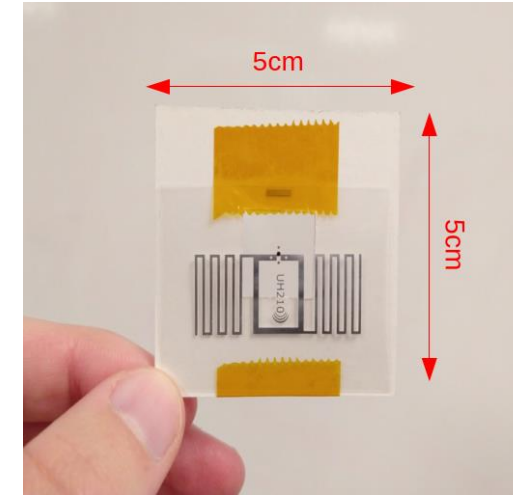
Buttons: Add Layer, Previous, Next.

The background shows a list of samples with columns for Last update, ID, and Name. The right sidebar contains navigation options like '+ New Sample' and '+ New Experiment' (highlighted with a red box). The bottom right shows an 'Actions' section with 'Samples' buttons (highlighted with a red box) and 'More' options.

Traceability in IDM (Radiation Protection)

- IDM assign unique ID during registration:

- Samples and Dosimeters
- New Labels format & QR code (upgraded in LS2)
- Study the usage of RFIDs:
 - <https://doi.org/10.5281/zenodo.5846411>



RFID tag (© CAEN, IT)

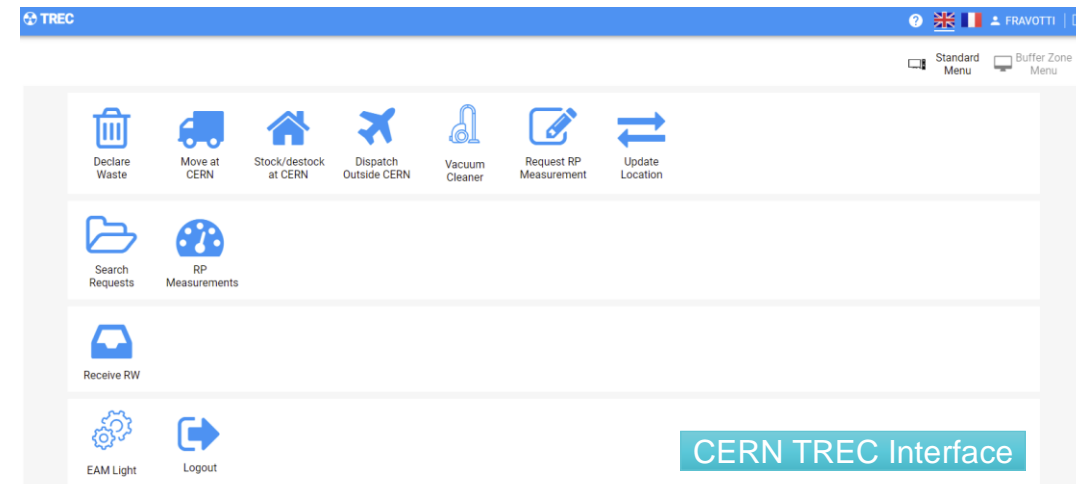


1cmx2cm

IDM Traceability ID

- Material Logistics (Transport / Shipping):

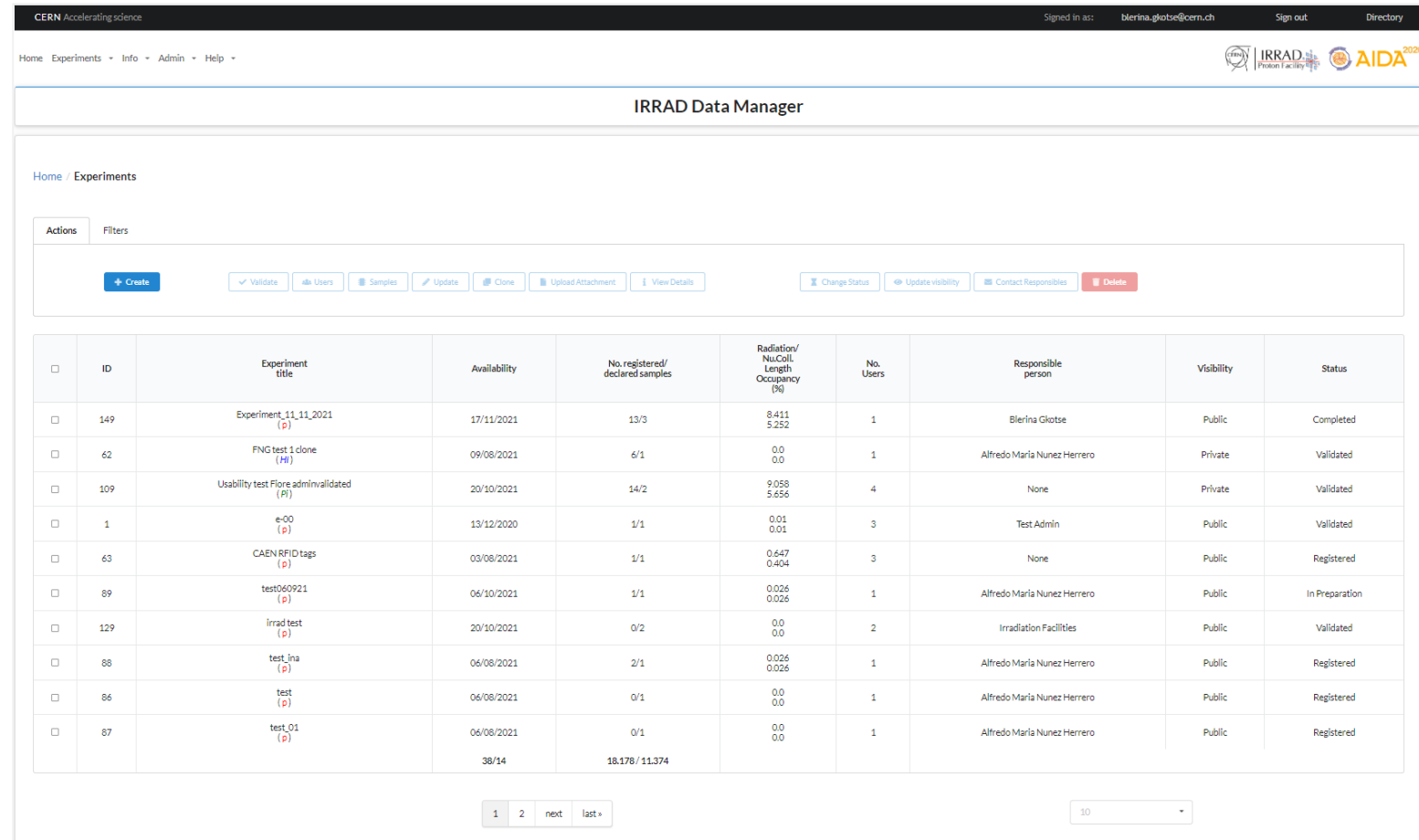
- Generally, 2/3 weeks cooldown before proceeding
- Follow the general CERN procedure:
 - Hand-over (material, responsibility and sample data to TREC) done in the “buffer-zone”
 - RP job is requested: classification done according to destination and foreseen manipulation (dose-rate, smear-tests, etc.)



CERN TREC Interface

IRRAD Data Manager Upgrades

- The IRRAD tool to register irradiation experiments and samples:
 - Under development since 2017
- Upgrades in LS2:
 - Several improvements and bug fixing
 - New User Interface style
 - Documentation finalized:
<https://edms.cern.ch/document/2664569/>
 - GitLab repository:
<https://gitlab.cern.ch/irrad1/irrad-data-manager>
- Next step:
 - Full integration with APEX-gamma (ARAMIS project)

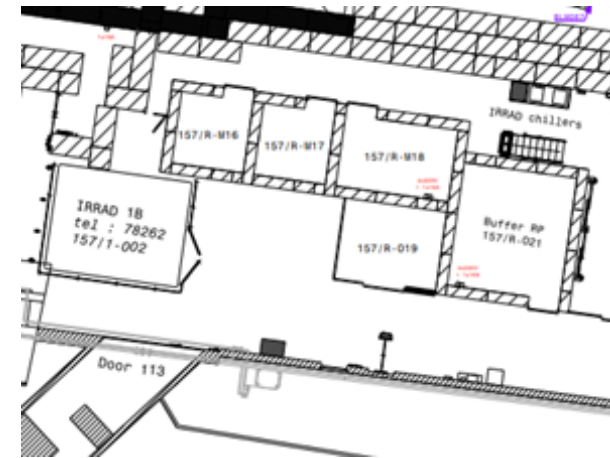


The screenshot shows the IRRAD Data Manager web interface. At the top, there is a navigation bar with 'CERN Accelerating science' and user information. Below that, there are navigation links for 'Home', 'Experiments', 'Info', 'Admin', and 'Help'. The main header is 'IRRAD Data Manager'. The content area shows a list of experiments with a table of columns: ID, Experiment title, Availability, No. registered/declared samples, Radiation/ Nu.Coll. Length Occupancy (%), No. Users, Responsible person, Visibility, and Status. The table contains 12 rows of data. At the bottom, there is a pagination control showing '1 2 next last' and a dropdown menu set to '10'.

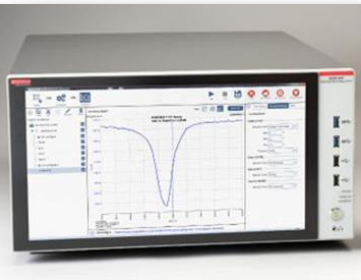
| ID | Experiment title | Availability | No. registered/declared samples | Radiation/ Nu.Coll. Length Occupancy (%) | No. Users | Responsible person | Visibility | Status |
|-----|---|--------------|---------------------------------|--|-----------|-----------------------------|------------|----------------|
| 149 | Experiment_11_11_2021 (p) | 17/11/2021 | 13/3 | 8.411 5.252 | 1 | Blerina Gkotse | Public | Completed |
| 62 | FNG test 1 clone (H) | 09/08/2021 | 6/1 | 0.0 0.0 | 1 | Alfredo María Nunez Herrero | Private | Validated |
| 109 | Usability test Flore adminvalidated (P) | 20/10/2021 | 14/2 | 9.058 5.656 | 4 | None | Private | Validated |
| 1 | e-00 (p) | 13/12/2020 | 1/1 | 0.01 0.01 | 3 | Test Admin | Public | Validated |
| 63 | CAEN RFID tags (p) | 03/08/2021 | 1/1 | 0.647 0.404 | 3 | None | Public | Registered |
| 89 | test060921 (p) | 06/10/2021 | 1/1 | 0.026 0.026 | 1 | Alfredo María Nunez Herrero | Public | In Preparation |
| 129 | irrad test (p) | 20/10/2021 | 0/2 | 0.0 0.0 | 2 | Irradiation Facilities | Public | Validated |
| 88 | test_ina (p) | 06/08/2021 | 2/1 | 0.026 0.026 | 1 | Alfredo María Nunez Herrero | Public | Registered |
| 86 | test (p) | 06/08/2021 | 0/1 | 0.0 0.0 | 1 | Alfredo María Nunez Herrero | Public | Registered |
| 87 | test_01 (p) | 06/08/2021 | 0/1 | 0.0 0.0 | 1 | Alfredo María Nunez Herrero | Public | Registered |
| | | 38/14 | 18.178 / 11.374 | | | | | |

User Infrastructure (upgraded in LS2)

- reduce transport of irradiated material
- increase **samples storage** (room and -25°C) / **handling capabilities** (work supervised by HSE-RP)
- provide users with a **laboratory**, required **manipulation tools** & advanced **characterization tools**

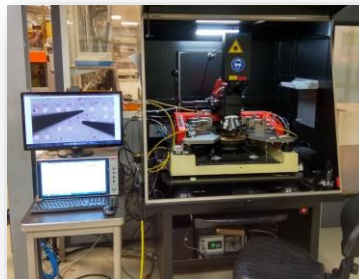


IRRAD Technical Area



Keithley 4200A SPA

Keithley 2657A Extension
HV SMU up to 3kV



Suss PM8
Probe
Station



TH100
Climatic
Chamber



HpGe
Gamma
Spectrometer
station

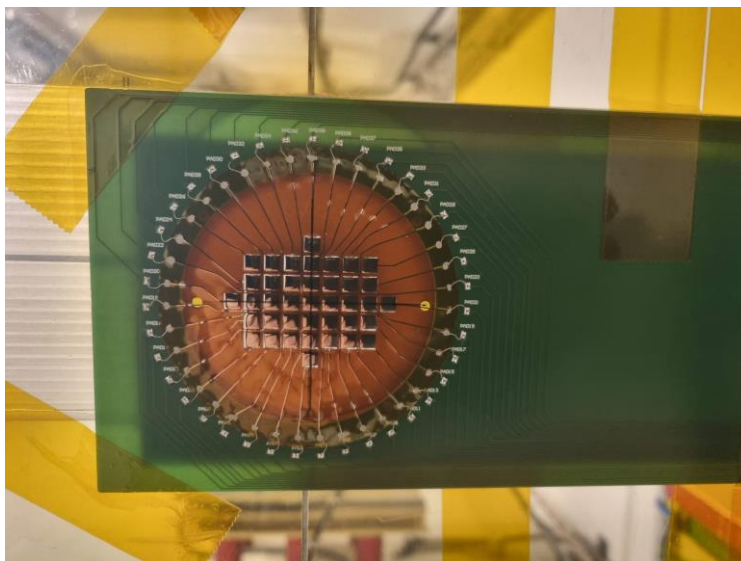


Outline

- Irradiation Facilities at CERN
- PS East Area Proton Irradiation Facility (IRRAD)
 - Characteristics, Dosimetry and Beam Instrumentation
- User Operation
 - Safety, Experiment Workflow, Data Management Tool (IDM) and User Infrastructure
- **Future Upgrades**
- User Support
- Summary

IRRAD Beam Profile Monitors Upgrade

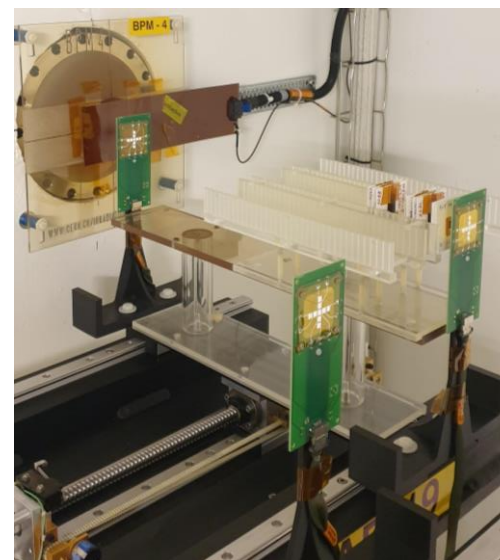
- Innovative Beam Profile Monitor Devices:
 - Traditional **BPMs Cu/FR4 (140/600 μm)** had several drawbacks:
 - Limited sensitivity, low radiation hardness, high material activation, etc.
 - New **mini-BPM Al/Kapton (0.3/25 μm)** produced, tested in IRRAD, now operational
 - >30x reduced material budget, $X_0 < 1\%$
 - Large pattern (40ch.) **micro-BPM Al/Kapton (0.2/25 μm)**: first prototype tested, new production ongoing



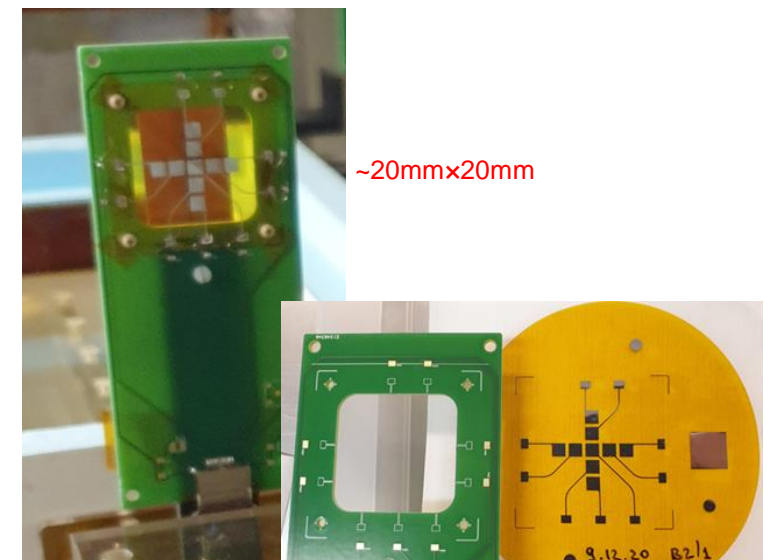
~40mmx30mm



40ch. micro-BPM device



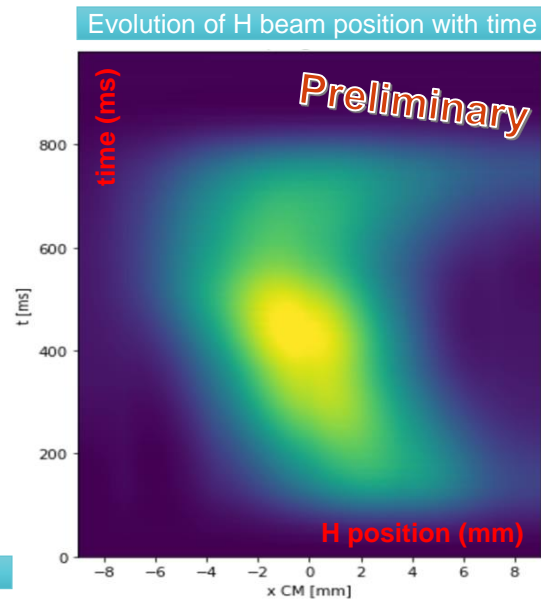
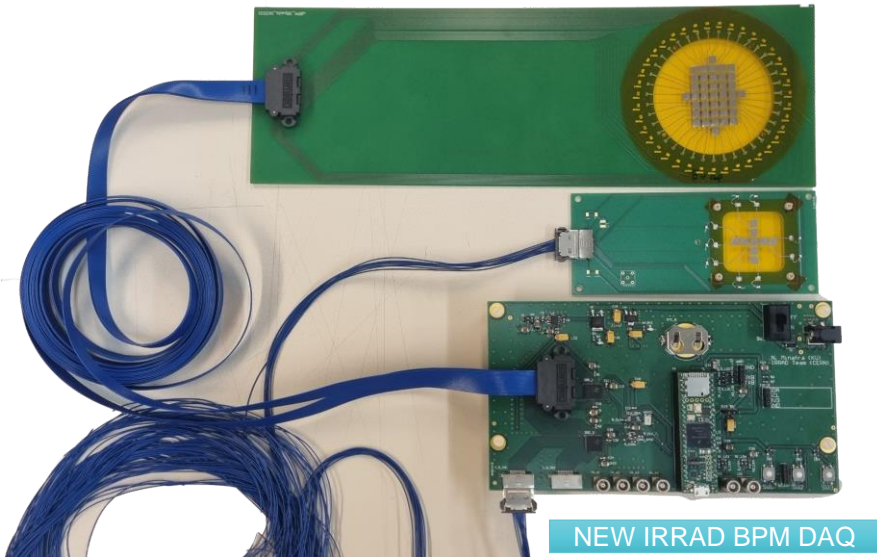
New mini-BPMs



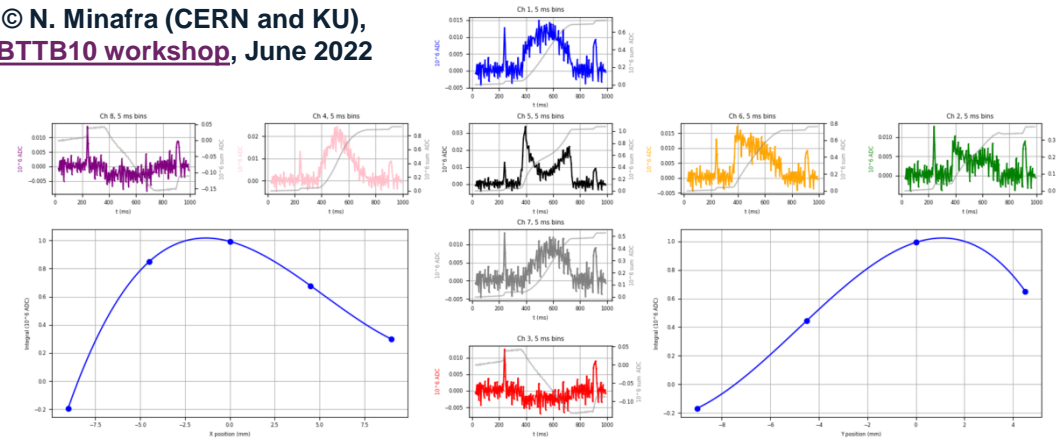
~20mmx20mm

BPM DAQ Electronics Upgrade

- New DAQ Electronics being designed:
 - Previous DAQ electronics (~ 10 years old) had several limitations:
 - 20ms **sampling time**, limited **number of channels** and **dynamic range** (matching with new detector technology), **longitudinal profile availability** (one channel only), etc.
 - Need to cope with new operational requirements:
 - slow- and **fast-extracted beams**, **heavy ion** beams, **new sensor technology**, increase information available for MD studies, etc.
 - **Scalable system** (data bus), **sampling time down to 100's μ s**, first prototype being tested



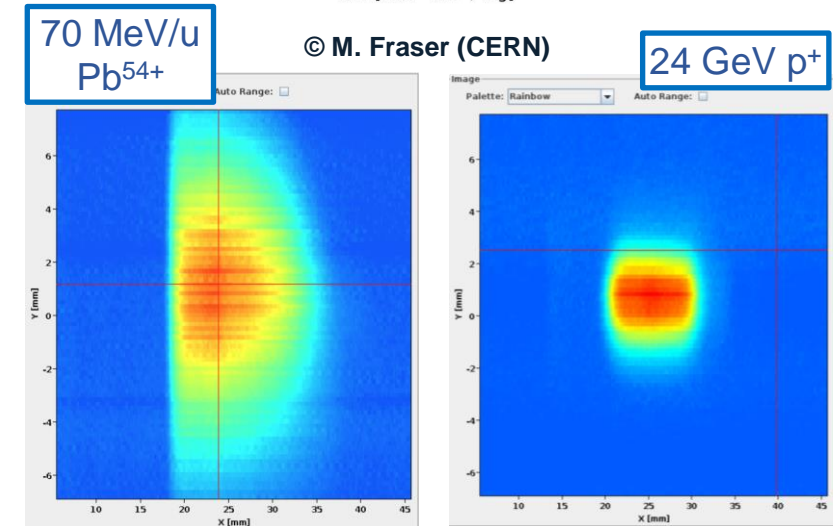
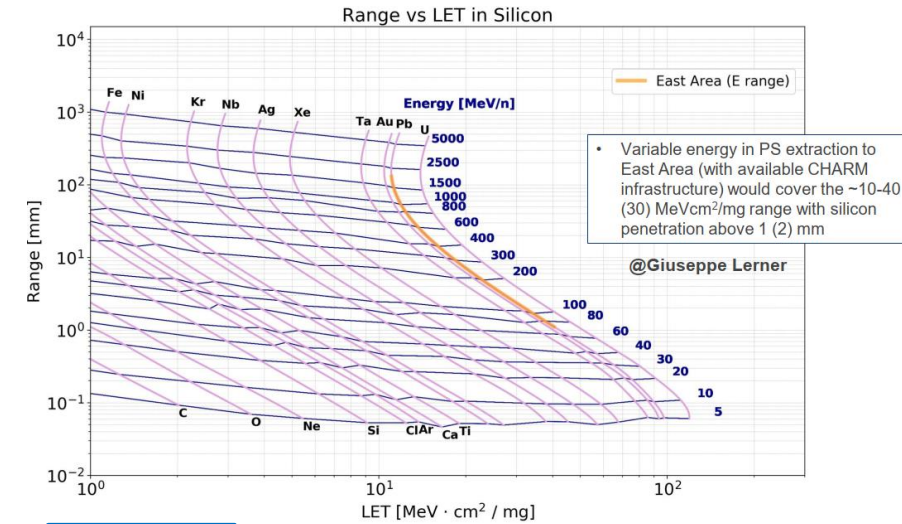
© N. Minafra (CERN and KU),
BTTB10 workshop, June 2022



H and V beam profiles from a mini-BPM in IRRAD

CHIMERA (Charm High-energy Ions for Micro Electronics Reliability Assurance)

- Electronics testing with high-energy heavy-ions:
 - Interest for testing state-of-the-art / complex packaged microelectronics structures:
 - High-LET ($> 20 \text{ MeVcm}^2/\text{g}$) cyclotron ions ($E \sim 10\text{-}20 \text{ MeV/n}$) have range (Si) $< 200 \mu\text{m}$: vacuum test with de-lidded parts
 - High-energy ions $70 \text{ MeV/n} - 2 \text{ GeV/n}$ have range (Si) $\sim \text{mm}$
 - Scarce availability worldwide and very expensive (only at NSRL, USA and GSI, DE)
 - Collaboration agreement CERN-ESA on this topic (2019)
 - Use downstream position in T08 (CHARM) to achieve:
 - Large beam spot ($20 \times 20 \text{ cm}^2$)
 - Low ion fluxes ($10^2\text{-}10^5 \text{ ion/cm}^2/\text{s}$)
 - In 2021:
 - 70 MeV/u ion beam (Pb^{54+}) extracted into F61
 - Slow-extracted ion beam at 6 GeV/u propagated into T08 (2 days)
 - In 2022: 2 weeks ion run in the schedule



BTV at SMH57

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Irradiation Facilities Database

CERN Accelerating science

Directory

AIDA²⁰²⁰

HOME DATABASE USER GUIDE COLLABORATIONS TERMS OF USE CONTACT

IRRADIATION FACILITIES DATABASE

Welcome to the Irradiation Facilities Database.
This website hosts information about facilities for radiation testing at CERN, in EU, and worldwide.

This website is of public access and its content has been compiled from a variety of sources. Data accuracy and completeness relies on the information submitted by the facility coordinators.

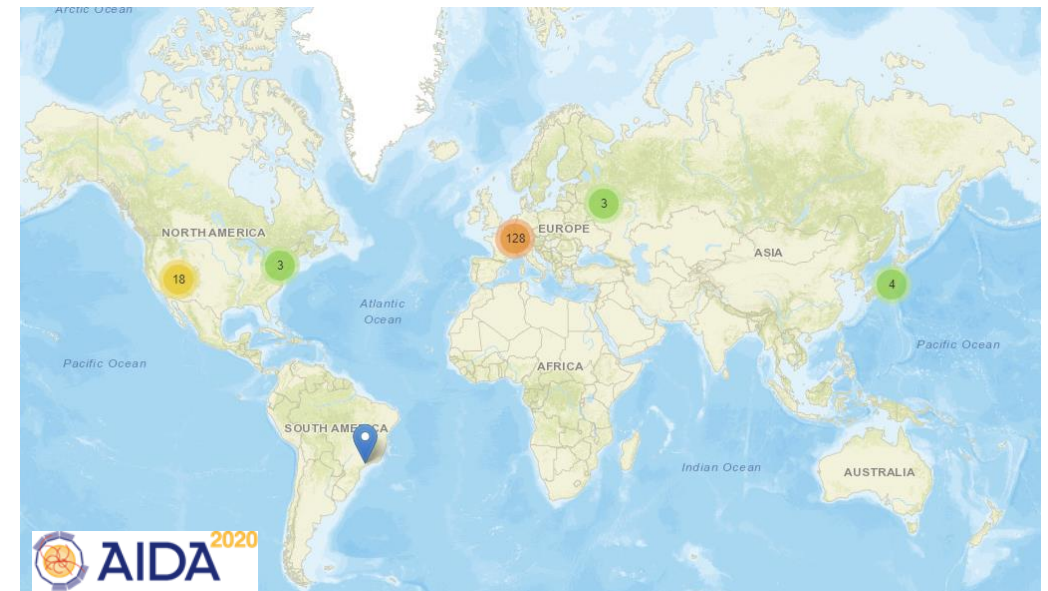
CERN FACILITIES IRRADIATION FACILITIES DATABASE FACILITIES MAP

A unified entry point for **CERN and worldwide irradiation facilities** with an essential collection of information
<https://www.cern.ch/irradiation-facilities/>

Irradiation Facilities Database

- A database platform for listing essential information about irradiation facilities at CERN and worldwide:
 - **open source** developed at CERN (EP dept.) within the EU-funded project AIDA-2020
 - list infrastructures **across application domains**
 - information under the **responsibility of the facility coordinators**:
 - automatic **annual reminders for updates**
 - information **validated by database admin**
 - >210 entries initially listed (2017) from “paper” data collections, webpages, etc. (often outdated)
 - **Today:**
 - **228 valid facility entries** (160 with full location info)
 - **~8100 visits** since launch

Piwik web statistics (CERN)

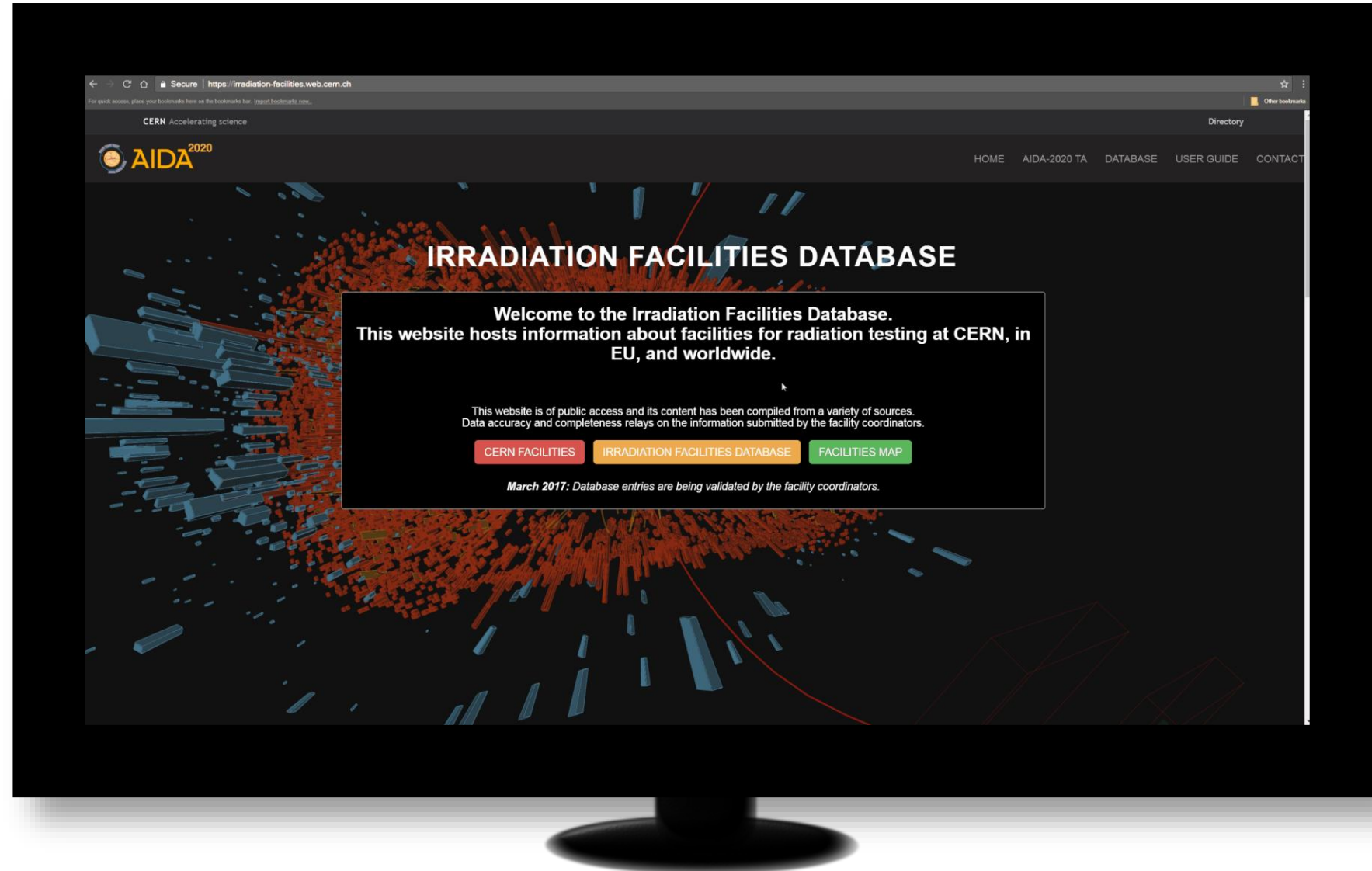


Location of the facilities in the database

Irradiation Facilities Database

- **Features:**

- **CERN facilities portal**
 - including CERN partner facilities (not shown here)
- **worldwide map view**
- **a form for each facility entry:**
 - [contact information](#)
 - facility data
 - irradiation conditions
 - safety
 - accessibility
 - comments
- **search functionalities**
- **editing functionalities** (protected by CERN SSO, support external “lightweight” accounts)
- **user manual:**
 - [AIDA-2020-NOTE-2017-002](#)



Informative Resources & Tools

- Availability of Irradiation Test Results

- **RADWG online database:**

- results of **electronics components** radiation tests
 - [URL](#) (access CERN RADWG members)

- **MaxRAD online database:**

- results of **structural materials** radiation tests
 - [URL](#) (access upon request)

- **CERN-IRRAD Data Manager:**

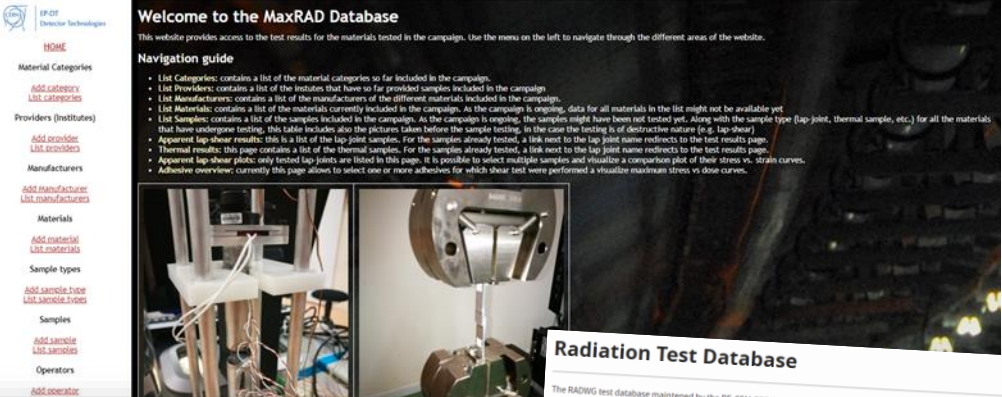
- results of **detector component** radiation tests (mainly)
 - [URL](#) (access upon request)

- **IMHOTEP online database:**

- results of **components for LHC detector upgrades** tests
 - [URL](#) (free access)

- **CERN Yellow Reports on Radiation Damage:**

- historic “catalogues” collection (free): [URL](#) with list



IRRAD Data Manager

Home / Experiments

Actions Filters

[+ Create](#)
[+ Update](#)
[+ Add](#)
[+ Edit](#)
[+ Delete](#)
[+ Change status](#)
[+ Update visibility](#)
[+ Add](#)

| ID | Irradiation title | Availability | No. registered/declared samples | Radiation/ Nu.Coll. Length Occupancy (%) | No. Users | Responsible person | Visibility | Status |
|------|--|--------------|---------------------------------|--|-----------|------------------------------|------------|----------------|
| 2561 | Silicon sensor mortality study (a) | 01/09/2021 | 0/40 | 0.0/0.0 | 1 | Evangelos Leonidas Chingirov | Private | Registered |
| 3081 | Defect Modeling on High-Fuence Planar Sensors (a) | 01/03/2022 | 0/64 | 0.0/0.0 | 1 | Jakob Hainberger | Public | Registered |
| 2641 | Irradiation of WLS and scintillating fibers (a) | 15/08/2021 | 2/1 | 95.65/73.244 | 1 | Iouri Guz | Public | In Preparation |
| 3061 | (EP) SET Optocoupler sensor (a) | 10/11/2021 | 1/1 | 0.916/0.391 | 2 | Rudy Ferraro | Private | In Preparation |
| 3041 | UltraTron-BPM v1 (a) | 03/11/2021 | 1/1 | 0.001/0.0 | 1 | Nicola Mirafra | Private | Validated |
| 3021 | Diode beam characterization (a) | 02/11/2021 | 1/1 | 04.024/9.621 | 1 | Giuseppe Pezzullo | Public | In Preparation |
| 2961 | CAEN-BFID-Characterization (a) | 15/10/2021 | 2/1 | 0.026/0.01 | 2 | Alfredo Maria Nunez Herrero | Public | In Preparation |
| 2721 | monopile chip (a) | 01/10/2021 | 0/2 | 0.0/0.0 | 2 | Patrick Bragnon | Private | Paused |
| 3001 | SEU tests of the BPS3-B-chips (a) | 10/10/2021 | 0/2 | 0.0/0.0 | 1 | Alexandre Rozovan | Public | Paused |
| 2461 | Effect of proton irradiation on the mechanical properties of epoxy resin for superconducting magnets (a) | 05/07/2021 | 14/9 | 20.351/10.448 | 1 | Christian Schwaerlin | Private | Ongoing |

Radiation Test Database

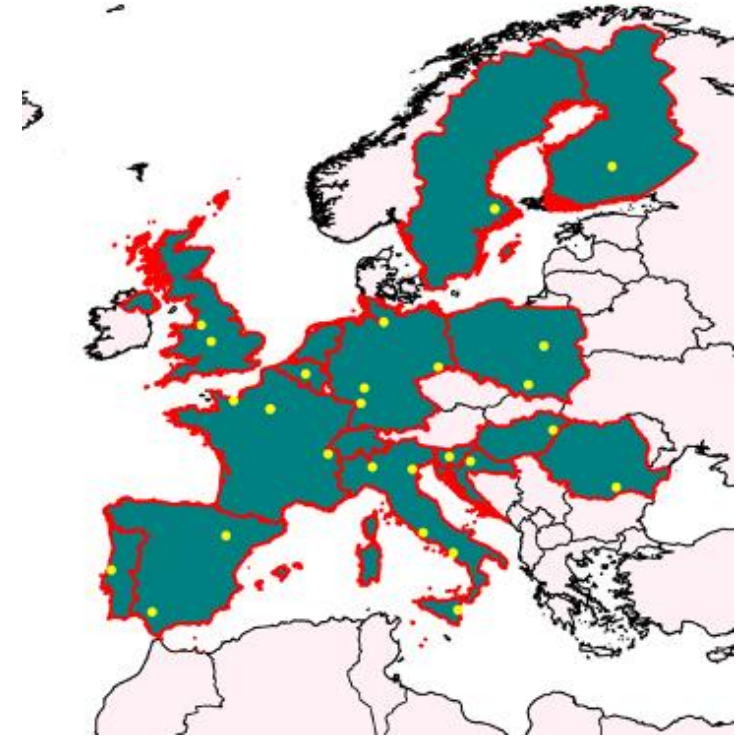
The RADWG test database maintained by the BE-CERN-EPR Section is currently only accessible for CERN users.

List (476) Add Filter

| Reference | Type | Device Function | Test Date | Test Characteristics | Edms Report Number |
|------------|-----------------------|--------------------------------------|------------|----------------------|--------------------|
| MAX5241CSA | Voltage Reference | Voltage Reference | 2011-02-05 | SET, ΔVout | 1171336 |
| ADA4899 | Operational Amplifier | High Speed Operational Amplifier | 2011-02-05 | SET, SEL, ΔVout | 1171336 |
| LMH5511MA | Operational Amplifier | High Speed Operational Amplifier | 2011-02-05 | SET, SEL, ΔVout | 1171336 |
| MAX410ESA | Operational Amplifier | Precision Operational Amplifier | 2011-02-05 | SET, SEL, ΔVout | 1171336 |
| TL431 | Voltage Reference | Programmable Voltage Reference | 2011-03-18 | SET, ΔVout | 1171336 |
| TL432 | Voltage Reference | Voltage Reference | 2011-03-18 | SET, ΔVout | 1171336 |
| LM4041 | Voltage Reference | Precision Voltage Reference | 2011-03-18 | SET, ΔVout | 1171336 |
| OFA2227 | Operational Amplifier | High Precision Operational Amplifier | 2011-03-18 | SET, SEL, ΔVout | 1171336 |
| INA141 | Operational Amplifier | Low Power Operational Amplifier | 2011-03-18 | SET, SEL, ΔVout | 1171336 |
| TL072C | Operational Amplifier | Low Noise Dual Operational Amplifier | 2011-03-18 | SET, SEL, ΔVout | 1171336 |
| BCP53 | Transistor | Power BJT | 2011-04-15 | SET, SEL, Gain | 1171985 |
| BCP56 | Transistor | Power BJT | 2011-04-15 | SET, SEL, Gain | 1171985 |
| BSR18A | Transistor | Switching BJT | 2011-04-15 | SET, Gain | 1171985 |
| BSR17A | Transistor | Switching BJT | 2011-04-15 | SET, Gain | 1171985 |
| MAX1046 | Converter | 16 Bit ADC | 2011-06-03 | SET, SEL, Vref, ICC | 1171984 |

EURO-LABS Project






- A consortium of thirty-nine Research Infrastructures (RIs) from twelve countries in Europe
- First joint EU proposal between Nuclear Physics, HEP accelerators and HEP detectors
- Mostly Transnational Access (TA) and service improvements:
 - **TA to CERN IRRAD and GIF++**
- Foreseen to start 1st September 2022^(*)
 - Kick-off meeting in Bologna, Italy beginning of October

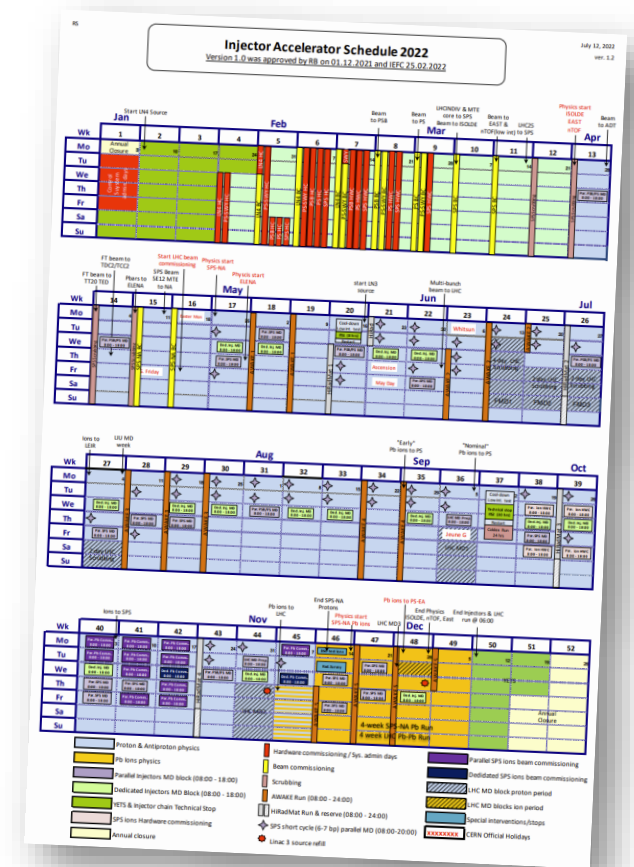


(*) see Paolo Giacomelli's presentation: <https://indico.cern.ch/event/1104064/contributions/4797462/>

Summary



- The Proton Irradiation Facility (IRRAD) at CERN provide:
 - A **variety of irradiation systems** and a **dedicated infrastructure** meeting the evolving radiation testing needs of the CERN/HEP community for the HL-LHC
 - The **availability of a versatile 24 GeV/c proton beam** during about 35 w/year
- Continuous improvements are made for its operation & users:
 - **Beam instrumentation** (ATTRACT ) , safety procedures, **data management**, post-irradiation **laboratory infrastructure** and tools (AIDAinnova ) ,etc.
 - ... as well as for supporting the user community at large:
 - **Irradiation facilities database** (AIDA-2020 ) , informative resources, **access funds through EU-projects** (EUROLABS ) ,etc.
- Challenging future requirements:
 - Beam quality always improving, but **hitting the limitations for the post HL-LHC!**
 - It is time soon to look for alternatives ! → first study starting end 2022 (RADNEXT )
 - Qualify the facility for **testing with high-energy heavy-ions** (CHIMERA)





This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under GA no 101004761.

home.cern