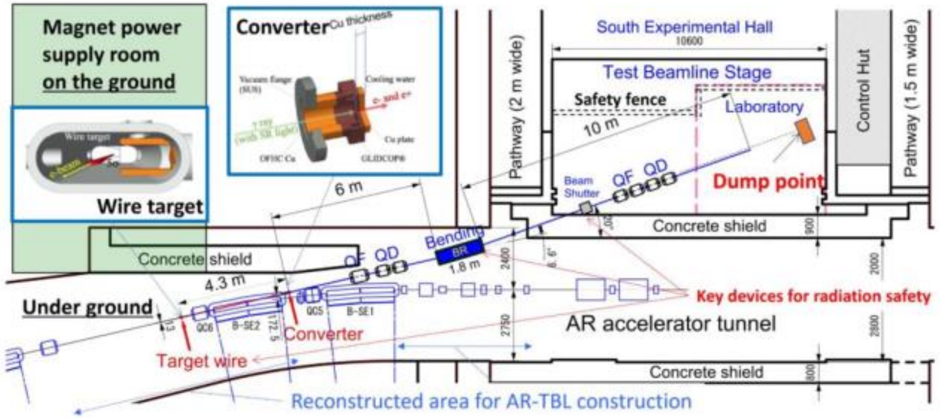
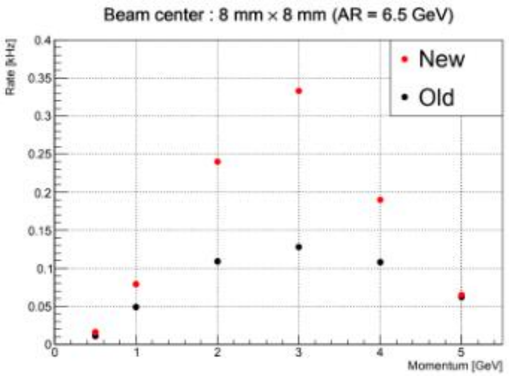
Overview of facilities within DRD3

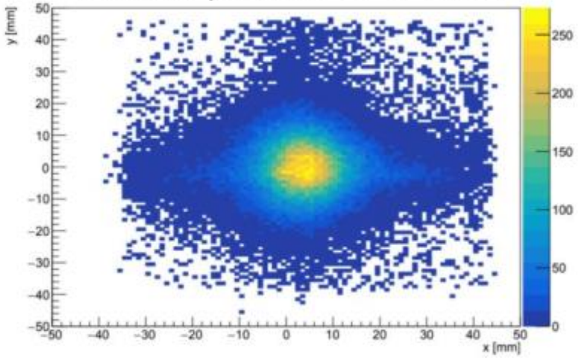
Testbeam

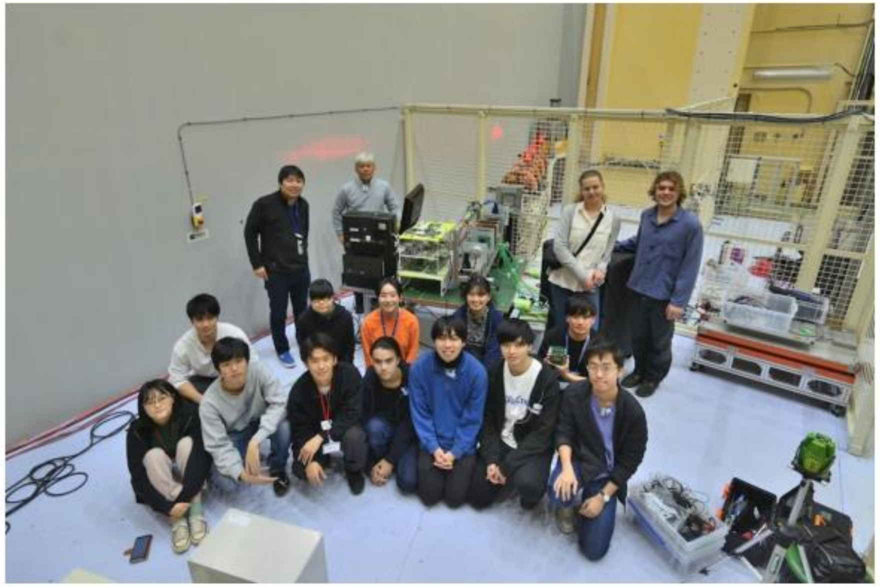
KEK PF-AR Electron test-beam line





Beam profile @ 3 GeV





Test-beam setup for K.Nakamura's team

- Electron beam
  - Momentum up to 5 GeV
  - Rate: ~ 3 kHz @ 3 GeV
  - 24 hours stable beam with top-up injection
- Availability: May-Jun, Oct-Dec, Mar
- 1 user beam time: typically, 7 days
  - Wednesday is machine study day.
- No fee to obtain a beam time.
  - Shipping, special cooling, gas needs to be covered by user.

Microbeam

Microbeam
CNA Sevilla

CENTRO NACIONAL DE ACELERADORES

Centro Nacional de Aceleradores · Universidad de Sevilla · CSIC Consejo Superior de Investigaciones Científicas · Junta de Andalucía · Infraestructuras Científicas y Técnicas Singulares

User's Facility

Unique Science and Technology Infrastructures (ICTS)

ICTS have three key characteristics: they are publicly owned, unique and open to competitive access.

How can I access CNA?

You need to fill a beam time application: request

Usage fees: price list

Centro Nacional de Aceleradores
Phone: (+34) 954460553
Fax: (+34) 954460145
solicitudescna@us.es
CNA Access application

Access to stable-ion and neutron beams in the framework of the EURO-LABS project:

Cluster of Low Energy Accelerators for Research
CLEAR
Sevilla – Lisboa - Debrecen

EURO-LABS
EUROPEAN LABORATORIES FOR ACCELERATOR BASED SCIENCES

Transnational Access	https://institucional.us.es/clear/

Please contact us for more details (mcyjr@us.es)

3 MV TANDEM & 18/9 CYCLOTRON

3 MV Tandem
Ions: H-Au
600 keV-few MeV

Cyclotron
18 MeV H^+/ 9 MeV D^+

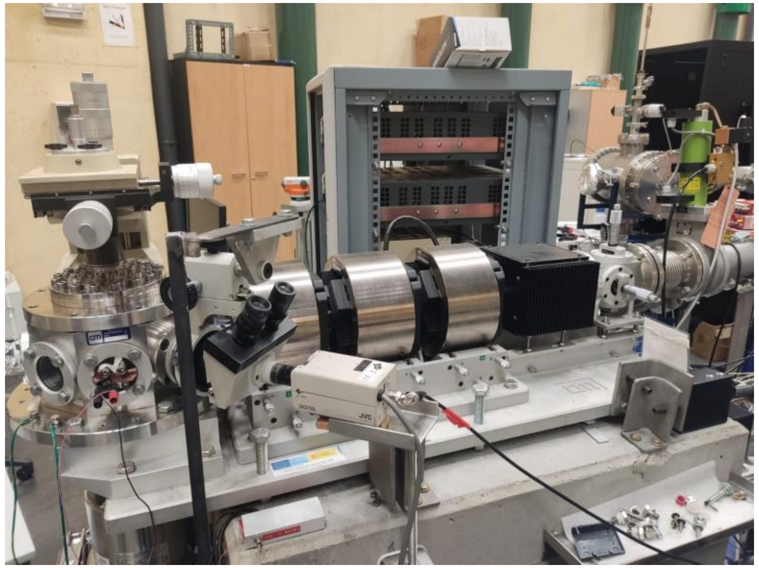
- ✓ **Beam currents:** μA –pA
- ✓ **Continuous and pulsed beams**
- ✓ **High temperature measurements up 500ºC**

- ➢ **IBA Techniques (RBS, PIXE..)**
- ➢ **Materials Modification**
- ➢ **Irradiation Damage:** areas ~up to 20x20 cm^2 and fluences up to10^{17} p/cm^2 (beam ~mm-cm)
- ➢ **Neutron Physics**
- ➢ **Advanced Characterization of Detectors**

- ✓ **Pulsed beam** (2.4 ns pulse every 24 ns)
- ✓ **FWHM:** 200 KeV (1.1%)
- ✓ **Maximum currents ~** tens of μA
- ✓ **Remote control variable collimator & FC**
- ✓ **Room Temperature**

- ➢ **Radioisotope production for PET**
- ➢ **Irradiation of materials:** areas ~1cm^2 fluences 10^{17} p/cm^2 (or lower fluence for larger areas)
- ➢ **Calibration of Nuclear Instrumentation & Detectors**

IBIC/TRIBIC powerful tool for semiconductors characterization

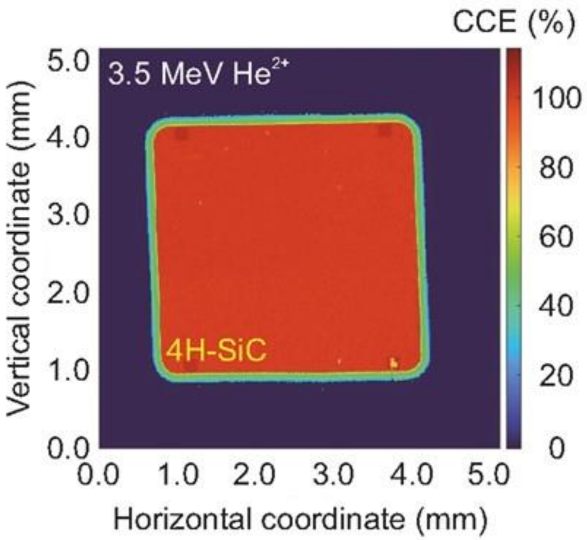


Nuclear microprobe at CNA

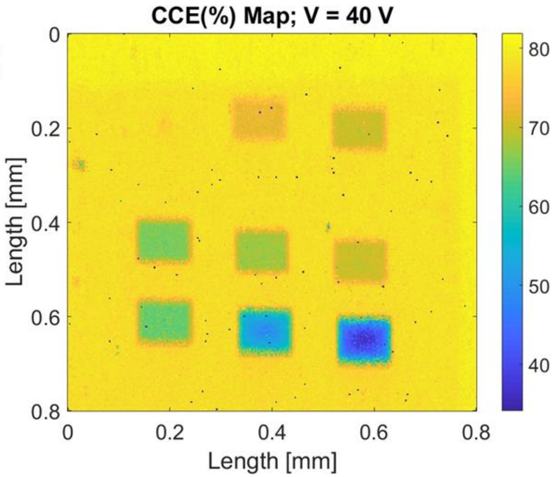
- Focused beams to μm dimension.
- Continuous/pulsed beams.
- Low/high current mode: nA to few pps (micrometric slits).
- Scanning system: few mm^2.
- Synchronous acquisition system with scanning: mappings.
- Rotating sample holder with a precision of 1º.

- Charge Collection Efficiency
- Gain (Avalanche detectors)
- Energy resolution
- Transport properties
- Polarization effects (Diamond detectors)

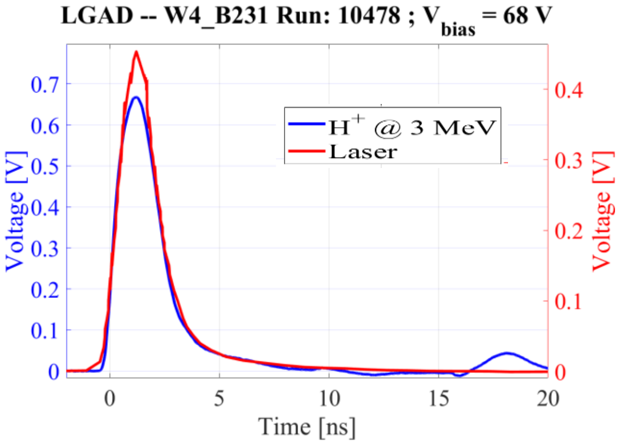
CCE homogeneity



Micrometric irradiations for damage study



Time-Resolved signals

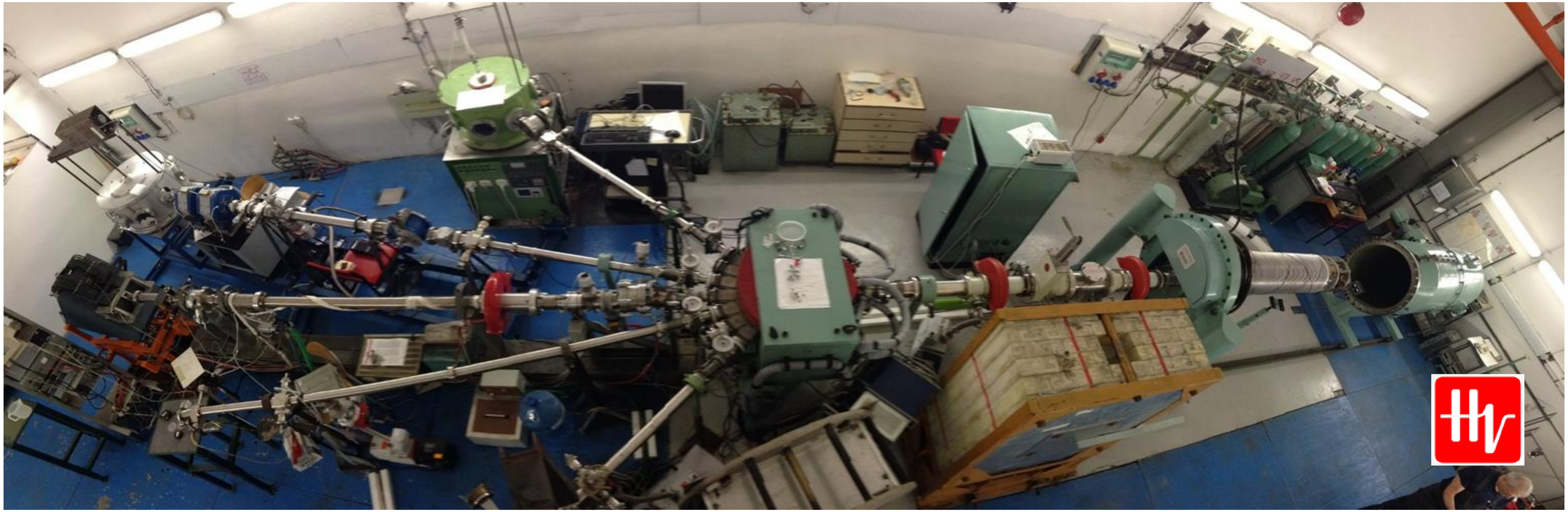


Please contact us for more details (mcyjr@us.es)

Microbeam
IEAP Prague

Van de Graaff (VdG) accelerator

IEAP CTU
VdG Accelerator



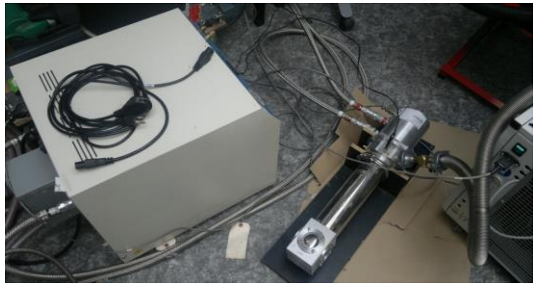
- HV engineering Europa B.V., 1980
- Accelerates (ions of) $^{1}H_{(2)}$, $^{2}H_{(2)}$, ^{4}He, $^{14}N_{(2)}$
- Energy 0.2 – 2.5 MeV/charge
- Beam currents: 0.1-10 μA

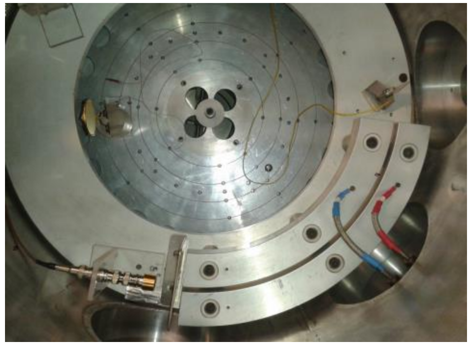
More info at: https://aladdin.utef.cvut.cz/projekty/vdg/

- For beam time request please email to
  - Rudolf.sykora@cvut.cz (head of laboratory)
  - tomas.slavicek@utef.cvut.cz (deputy)
  - Benedikt.bergmann@utef.cvut.cz (as DRD3 representative)
- Beam times are free of charge on a first come first serve base

Not just the accelerator…

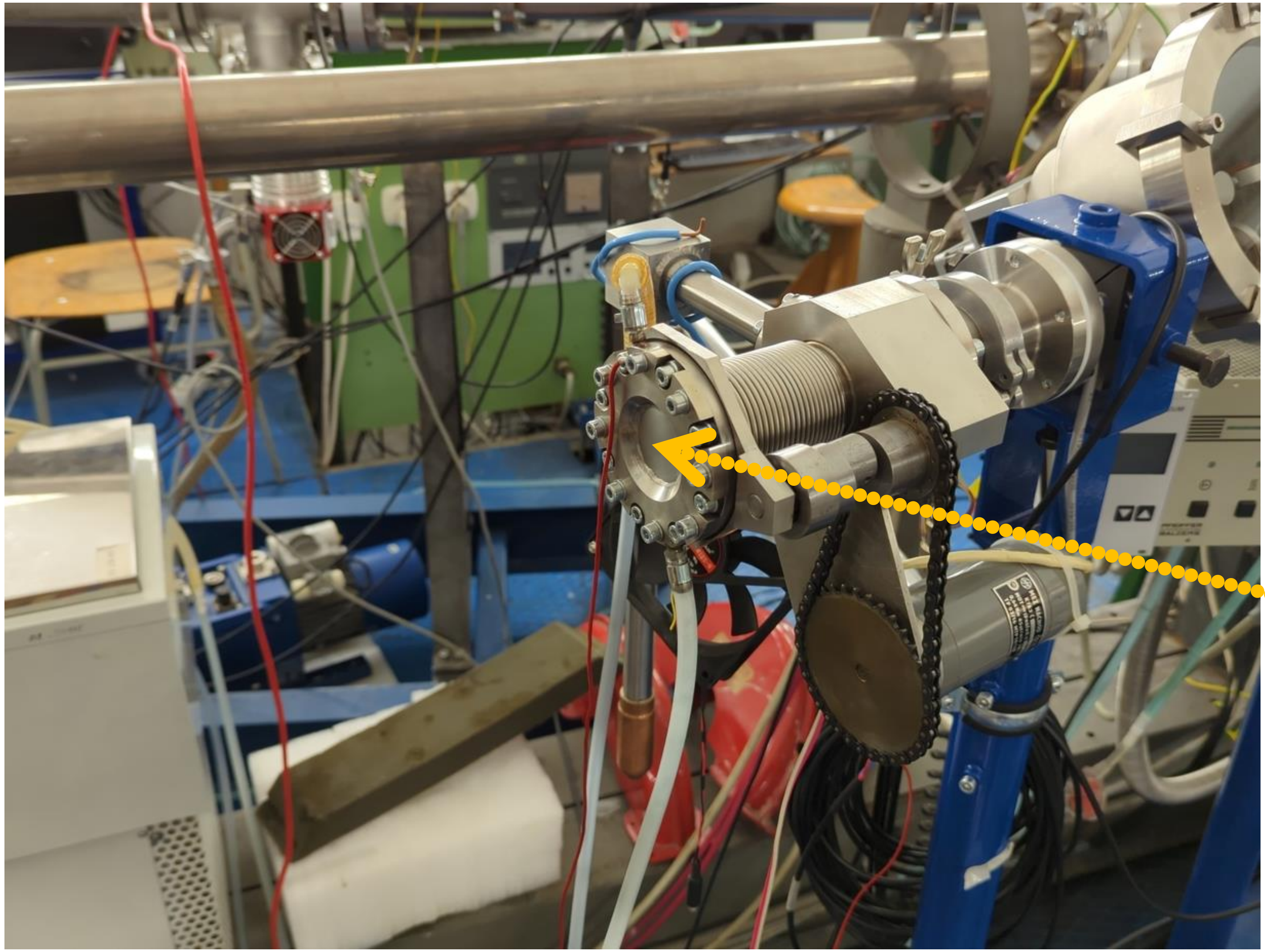
… but a **multipurpose research laboratory**





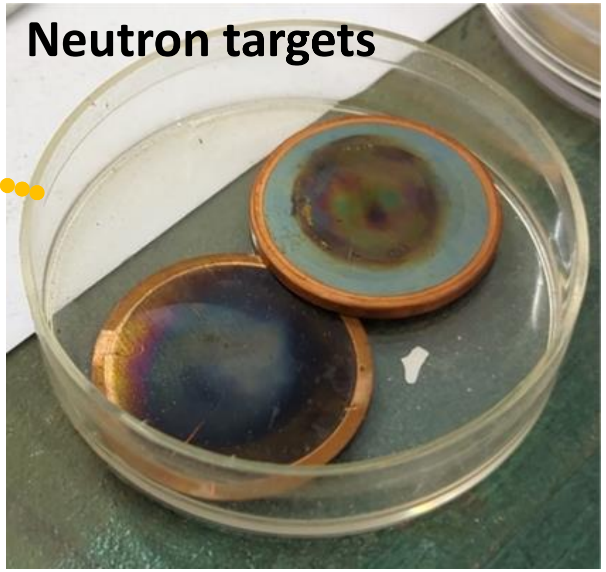
- monoenergetic neutrons (p-T, d-D, d-T reactions); + neutrons from AmBe
- source of low-energetic (30 keV and upwards) charged particles (electrostatic separator)
- radionuclide emitters like ^{22}Na, ^{55}Fe, ^{60}Co, ^{90}Sr, ^{137}Cs, ^{241}Am, ...
- ESA-certified wide-spectrum γ-source (AmBe → Cl or Fe)
- related detector systems (plastic/liquid scintillators, NaI, BGO, Si, SiC,
  CdTe, NaI(Tl), HPGe, …, pixel) for all participating particles
- 10K apparatus for low-temperature opto-electronic measurements

Tunable source of monoenergetic neutrons



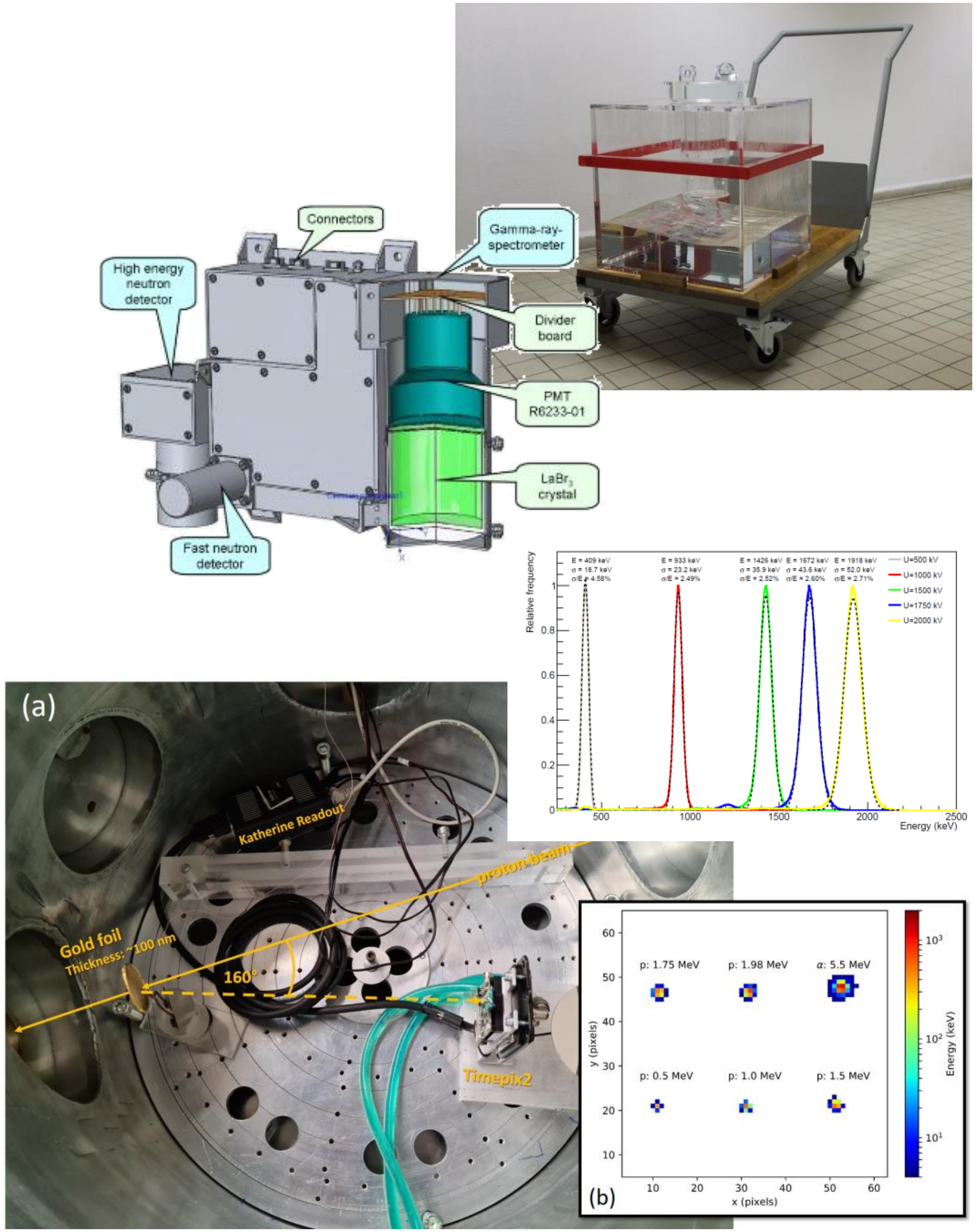
p + T (proton on Tritium): 100 keV – 1 MeV
d + D (deuteron on deuterium) ~4-5 MeV
d + T tunable between 14-18 MeV

Typical yield: ~2 x 10^7 s^{-1}
→ Fluxes of 10^4 cm^{-2} s^{-1} (@ 10 cm from the target)



Examples of detector testing activities

- Wide-spectrum γ-source to test $LaBr_3$ detector of Mercury Gamma and Neutron Spectrometer (MGNS) for the **BepiColombo mission** to Mercury
- Calibration of the response to high input charge of **Timepix2 and Timepix3** hybrid pixel detectors (low energy protons)*
- Calibration of the response of **SOI microdosimeters**** after neutron impact (1, 5 and 15 MeV)
- **Leakage current** change measurement of silicon **PIN diodes** to monoenergetic neutrons of 1, 5 and 15 MeV
- Characterization of the response of **SiC diodes** and pixelated SiC to monoenergetic neutrons



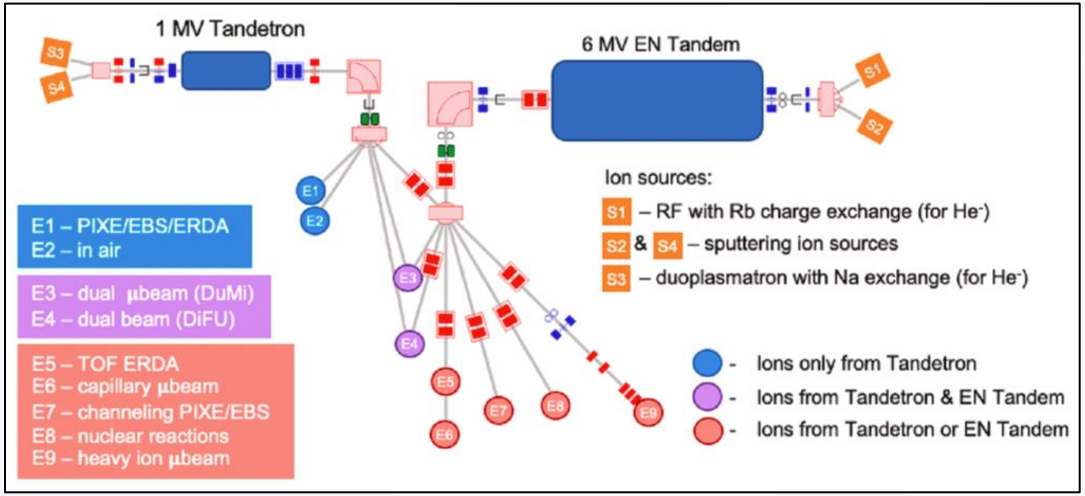
* https://iopscience.iop.org/article/10.1088/1748-0221/17/01/C01025/meta

** https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8571290

Microbeam
RBI Zagreb

Laboratory for Ion Beam Interactions (LIBI)

The accelerator center of Ruđer Bošković Institute consists of two tandem accelerators (1 MV Tandetron and 6 MV EN Tandem) and nine associated beam lines.



LIBI has a long-term experience in Ion Beam Analytical (IBA) Techniques and novel materials fabrication and modification.

How to access LIBI ?

Head of the laboratory: Zdravko Siketić. Dr.sc.

Contact: zsiketic@irb.hr

Phone: +38514571227

Transnational access:

EURO-LABS and **CERIC-ERIC** projects

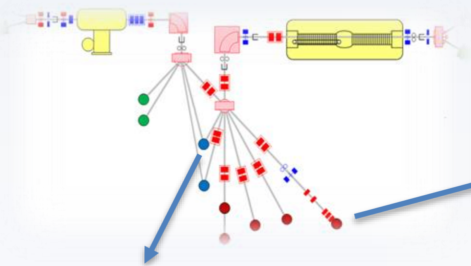
CERIC Central European Research Infrastructure Consortium

EURO-LABS EUROPEAN LABORATORIES FOR ACCELERATOR BASED SCIENCES

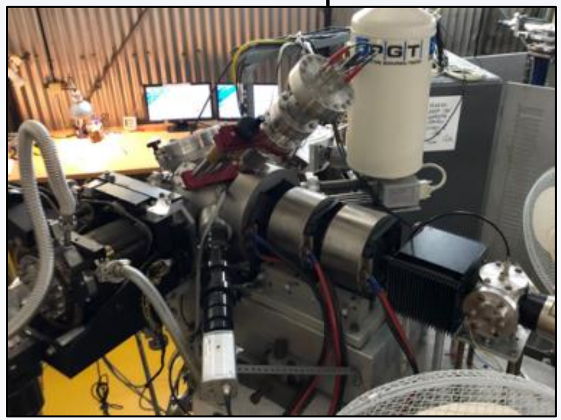
Beam usage cost for scientific community: 250 Euro/hour

Beam cost for commercial usage: 360 Euro/hour

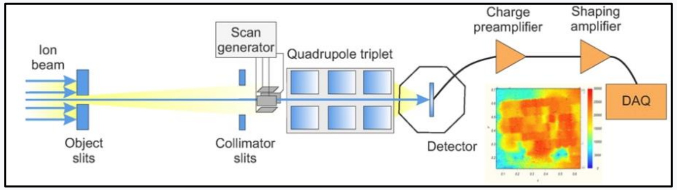
Laboratory for Ion Beam Interactions (LIBI)



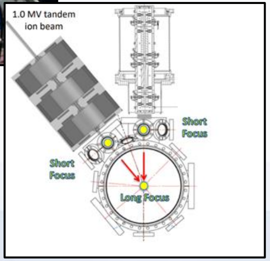
RBI microprobe



Two μ-probe end-stations



Dual Microprobe
(DuMi)



- Beam spots down to 120 nm
- Precise irradiations from low (few Hz) to high current (nA) modes.
- Scanning and imaging possibilities of areas up to several mm.
- In-house DAQ Software SPECTOR.
- Target positioning using nm precise piezo-stages.
- Alignment of samples for angular resolved studies/channeling.
- Available temperatures from 40K up to 700 ^{o}C
- Probing and damaging using two simultaneous microbeams

Laboratory for Ion Beam Interactions (LIBI)

Detector testing

AIDA 2020

2015-2019 - Advanced European Infrastructures for Detectors at Accelerators

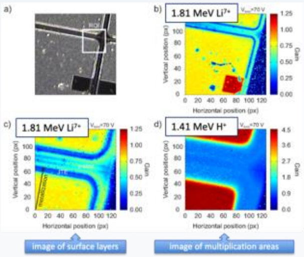
- **AIDA-2015-1**, Study of radiation damage in scCVD diamond, Jerzy Pietraszko, GSI, **Germany (26-30.10.2015.)**
- **AIDA-2015-2**, Diamond Membranes for Radioisotope Batteries, Michal Pomorski, CEA, **France (15-19.2.2016.)**
- **AIDA-2015-4**, 3D diamond, Alexander Oh, University of Manchester, **UK (11-15.4.2016.)**
- **AIDA-2016-1**, Single crystal diamond Shottky diodes for microdosimetry, Claudio Verona, **Italy (24-28.10.2016).**
- **AIDA-2016-2**, Microbeam tests of silicon telescope for dosimetry, G. Magrin, **Austria (18-20.1. and 9-10.2.2017.)**
- **AIDA-2017-1:** Diamond Membrane Microdosimeter, M. Pomorski, CEA, **France (2-5.5.2017.)**
- **AIDA-2017-4:** CVD diamond Time of Flight detector with interdigitated electrodes, W. Cayzac, **France (6-10.11.2017)**
- **AIDA-2017-5:** Polycrystalline 3D Diamond IBIC and TRIBIC characterisation, A. Oh, Manchester, **UK (27.11.-2.12.2017).**
- **AIDA-2017-2:** Analysis of graphite pillars buried in sc-CVD diamond , G. Conte, **Italy (12-14.9.2017. and 20-21.3.2018)**
- **AIDA-2018-1:** Single event upsets in CMS pixel ROC, Wolfram Erdmann, PSI **Switzerland (2.7.-6.7.2018).**
- **AIDA-2019-1:** IBIC of monolytic pixel detectors, Rogelio Pinto, University of Sevilla, **Spain (19.8.-23.8.2019).**

RADIATE

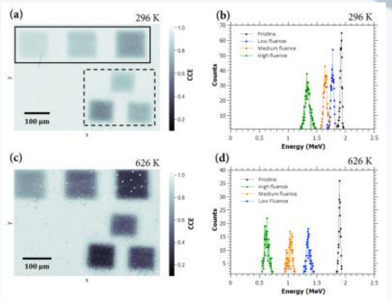
2020 – 2023 Research And Development with Ion Beams – Advancing Technology in Europe

1. **E. Vittone, Italy,** Differential IBIC analysis for the measurement of carrier lifetime in silicon pin diodes **(20.-22.5.2020)**
2. **M. Pomorski, France,** 3D scCVD diamond membrane microdosimeter for quality assurance in hadron therapy **(24.-27.8.2020)**
3. **A. Oh, UK,** Charge collection of 3D diamond and LGAD test detectors with the proton microbeam **(7.-11.6.2021)**
4. **R. Pinto, Spain,** Response in monolithic particle detector for the RD50 collaboration **(14.-18.6.2021)**
5. **C. Verona, Italy,** Characterization of ΔE-E single crystal diamond based telescope for microdosimetry application **(5.-9.7.2021)**
6. **E. Vittone, Italy,** Hydrogen thermal donors in silicon **(22.-24.2.2022)**
7. **C. Verona, Italy,** IBIC characterization of single crystal diamond devices for microdosimetry application **(7.-11.2.2022)**
8. **A. Oh, UK,** Investigation of charge collection of hexagonal and cubic 3D diamond detectors **(4. – 8.4.2022.)**
9. **M. Camarada, Switzerland,** Study of charge transport response of Silicon Carbide sensors **(2.-6.5.2022.)**
10. **M. Camarada, Switzerland,** Study of high temperature charge transport response of SiC **(planned for 19.-23.9.2022)**

2D/3D IBIC mapping



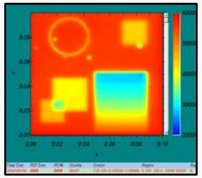
Radiation hardness

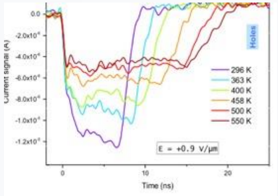


SEE

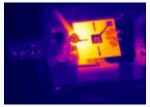
In-air

Precise irradiations

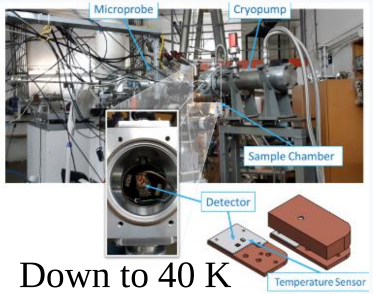




Ion-TCT



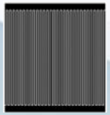
Up to 700 °C

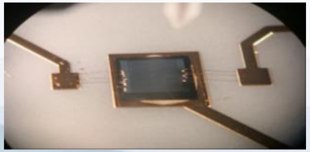


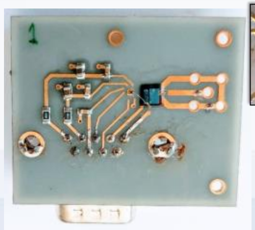
Down to 40 K

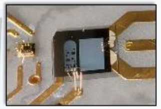
Detector development

Particle discrimination: scCVD diamond detector with patterned electrodes







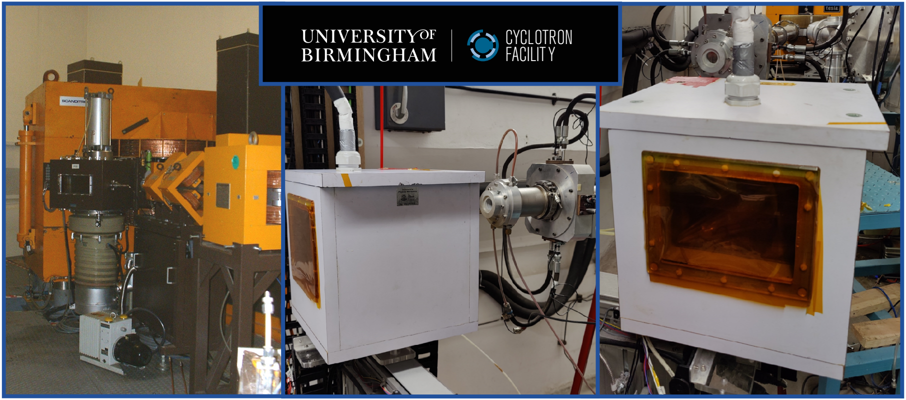


Deterministic single ion hit detection setup

Diamond membrane as a transmission particle detector for external microbeams

Irradiations

Irradiations
Birmingham

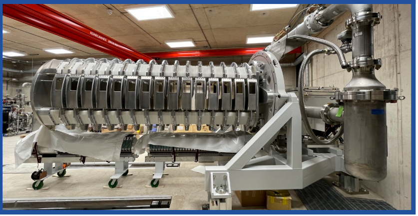


Semiconductor detector irradiation facility based at Birmingham MC40 cyclotron

- Proton beam with energy between 15 - 38 MeV (27 MeV typically used) at currents up to $\mathcal{O}(\mu\text{A})$ (400 nA typically used), hardness factors between 2 - 3
- Nominal operating scheme irradiates around $10\,\text{cm}^2$ of samples to $2 \times 10^{15}\, n_{\text{eq}}\,\text{cm}^{-2}$ in one working day (or higher fluence for smaller area, and vice versa)
- Long history of service for LHC expt. and RD50, currently provides QA irradiations for ATLAS ITk strip sensor production, **access available via EUROLABS scheme**

UNIVERSITY OF BIRMINGHAM

HIGH FLUX ACCELERATOR-DRIVEN NEUTRON FACILITY



State of the art high intensity neutron source recently began operations

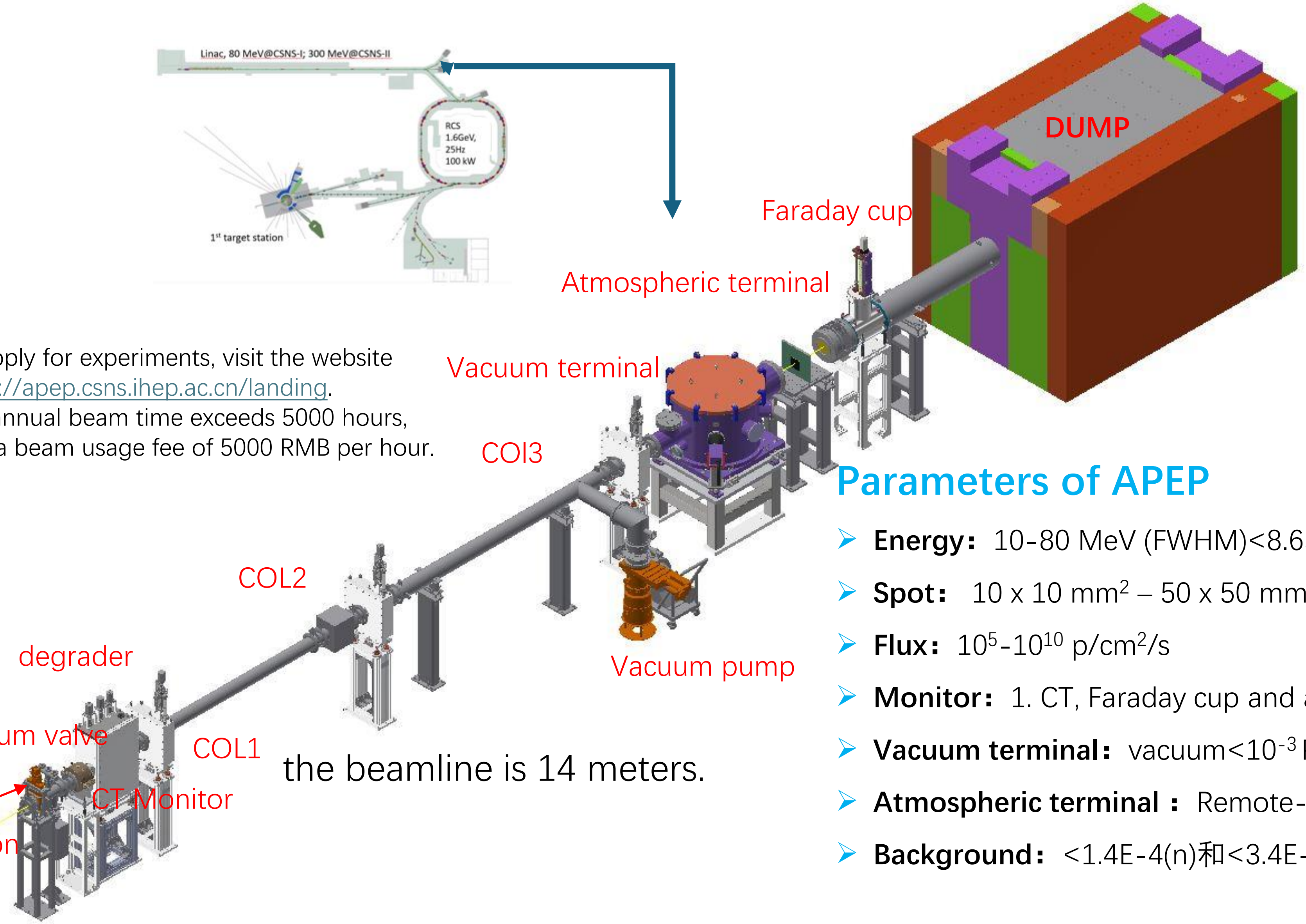
- Based on commercial system for Boron Neutron Capture Therapy (BNCT)
- Uses a 2.6 MeV proton beam on a rotating Lithium target, to produce fast neutrons (≈ 0.9 MeV) via the $^{7}\text{Li}(p, n)^{7}\text{Be}$ reaction
- With initial $> 30\,\text{mA}$ proton beam, expect fluence rate of $1.8 \times 10^{11}\,\text{cm}^{-2}\text{s}^{-1}$
- Upgrade planned to add Deuteron beam, increasing fluence rate beyond $3 \times 10^{12}\,\text{cm}^{-2}\text{s}^{-1}$ (i.e. HL-LHC fluences in minutes)

Commissioning work for semiconductor detector irradiations underway, expect completion in 2025, access arrangements still to be determined

Please contact us for more details on either facility! (andrew.chisholm@cern.ch)

Irradiations
CSNC – IHEP China

CSNS Associated Proton beam Experiment Platform



To apply for experiments, visit the website https://apep.csns.ihep.ac.cn/landing.
The annual beam time exceeds 5000 hours, with a beam usage fee of 5000 RMB per hour.

the beamline is 14 meters.

When negative hydrogen ion beams are accelerated and transmitted in the LINAC, they interact with the residual gases in the vacuum tube. A small portion of the negative hydrogen ions are stripped into protons and transmitted to the end of the linear accelerator. This is the world's first experimental terminal utilizing accompanying proton beams.

Parameters of APEP

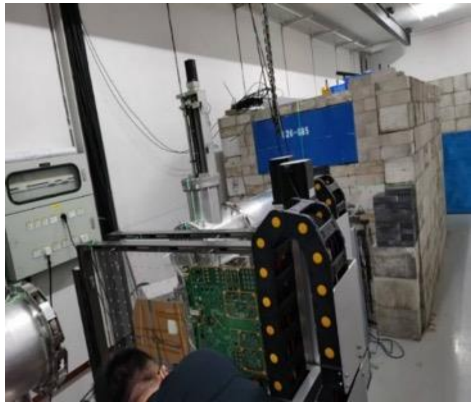
- **Energy：** 10-80 MeV (FWHM)<8.65% @>30MeV
- **Spot：** 10 x 10 mm^2 – 50 x 50 mm^2 （Continuously adjustable, uniformity > 95%）
- **Flux：** 10^5-10^{10} p/cm^2/s
- **Monitor：** 1. CT, Faraday cup and activation foil
- **Vacuum terminal：** vacuum<10^{-3} Pa, 50cm×**Ø0.8m,** Five test position;
- **Atmospheric terminal ：** Remote-controlled sample holder
- **Background：** <1.4E-4(n)和<3.4E-5(gamma) @20 x 20 mm^2

User experiment

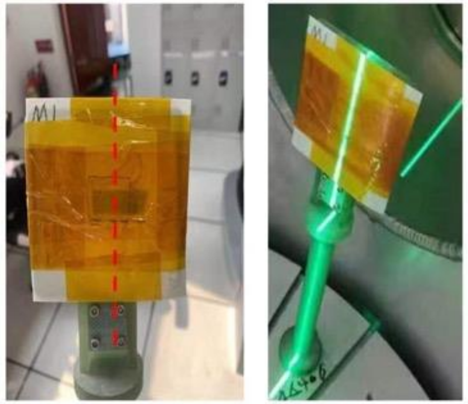
Since the start of commissioning and trial operation in October 2021, over 100 experimental studies have been completed by the first half of 2023, with beam time exceeding 1500 hours.

***Chips radiation damage;** ***Material radiation research ;** ***Detector radiation and calibration ;**

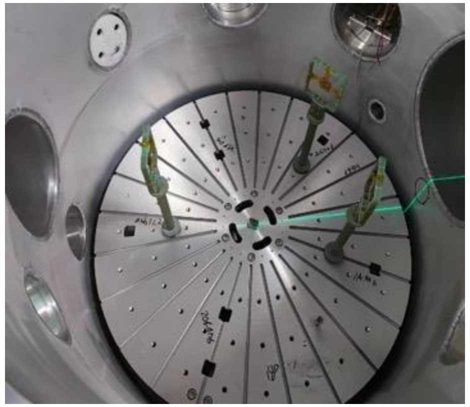
***Space Electronics radiation damage;** ***Radiation-induced mutation breeding;**



Detector radiation tests

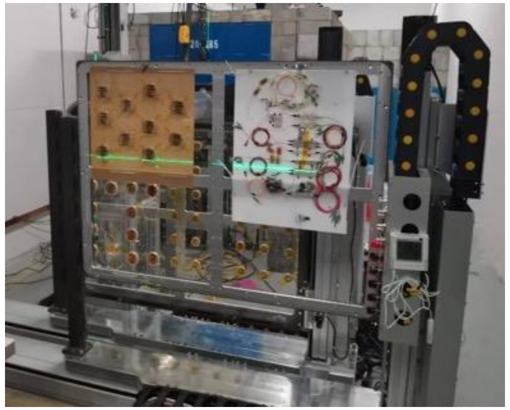


Si material radiation damage

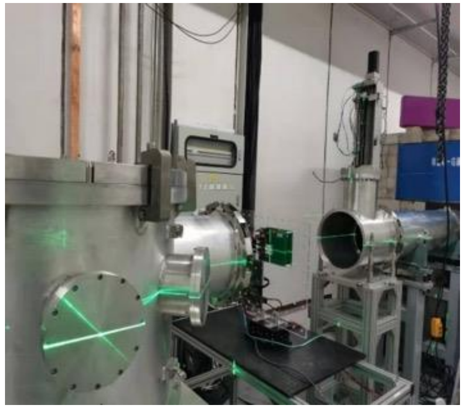


Radionuclide activity measurements

Detector calibration

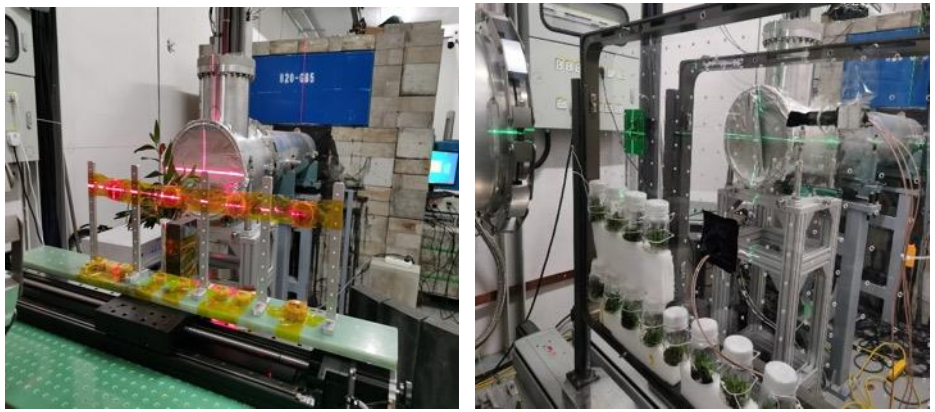


Space photoelectric device radiation



ASIC SEE for LHCb detector

ASIC SEE for ATLAS



Radiation-induced mutation breeding

Communication devices radiation

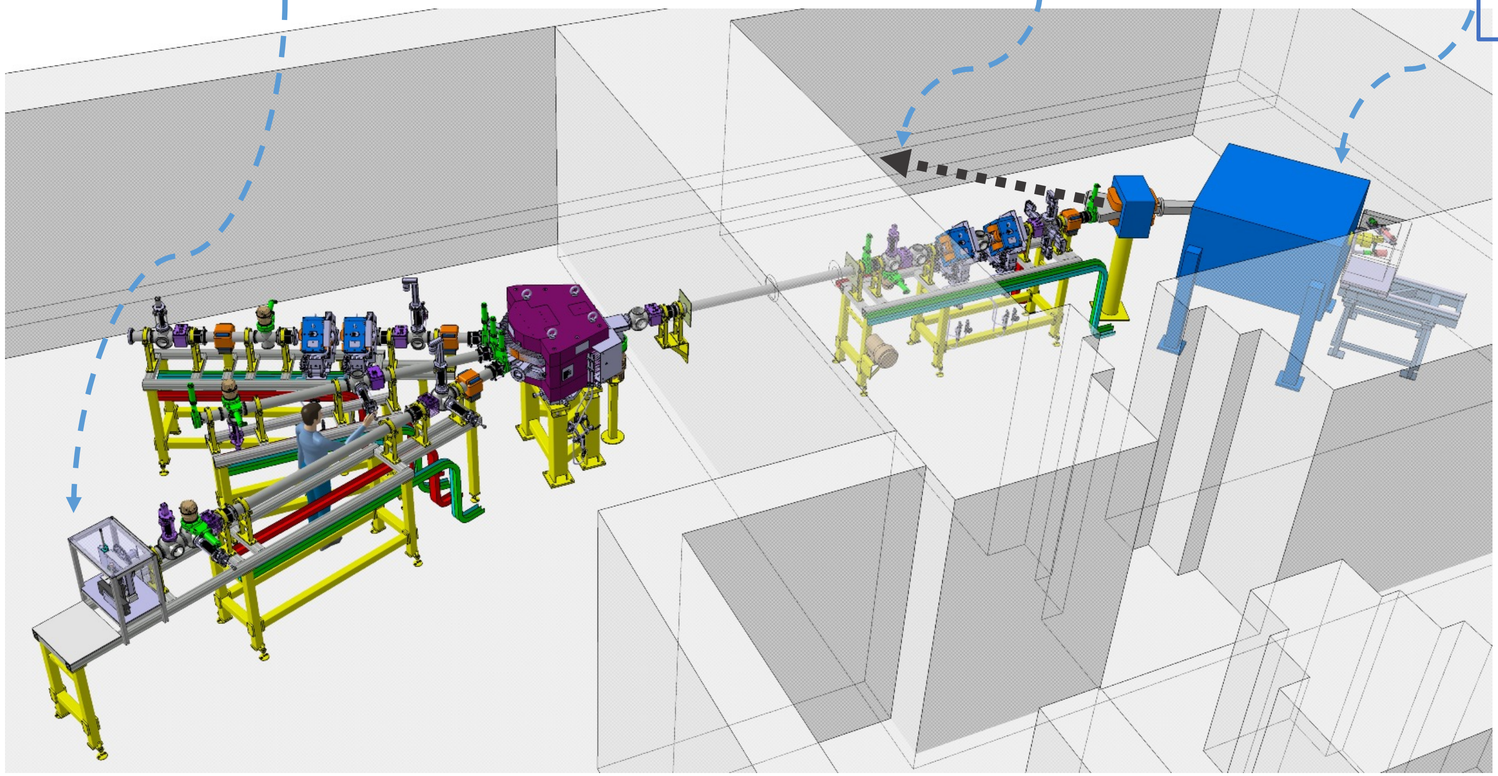
Irradiations
Cyrce Strasbourg

The Cyrcé facility at IPHC Strasbourg

Beam line in operation
Scattered beam (flat profile)
or beam scanning
Up to 10^{11} protons/cm²/s

Beam line under commisionning
for high irradiation rate
Up to 10^{13} protons/cm²/s
Beam scanning

TR 24 Cyclotron
- 16 to 25 MeV protons
- 2 exits ports
  - Isotopes production
  - Irradiation



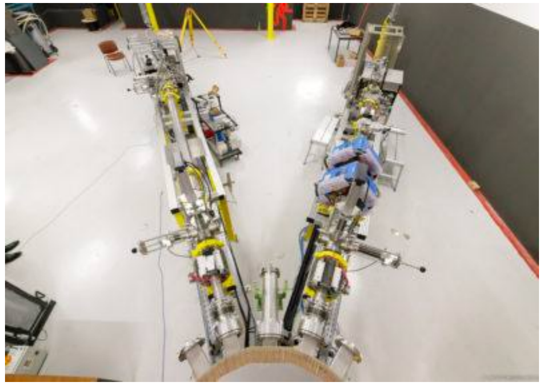
Contact:

Ziad EL BITAR :
ziad.elbitar@iphc.cnrs.fr

Michel PELLICIOLI:
michel.pellicioli@iphc.cnrs.fr

The Cyrcé facility at IPHC Strasbourg in figures

Radiation type	Protons
Energy	25 down to 16 MeV (native) down to 1 MeV with degraders
Min dose rate	0.01 Gy/min
Max dose rate	20 kGy/min
Min flux	1E3 p/s (or even less)
Max flux	Up to $10E^{13}$ p/s new beam line in vault, $10E^{12}$ beam line in irradiation area
Time structure	Beam bunch every 12 or 24 ns
Beam window	100µs to continuous
Repetition time	Down to 1ms
Irradiation area	Discs with diameters of up to 36 mm
Irradiation type	Scattered beam or scanning (up to 200x200 mm)
Access	Dosimeter or express agreement from the employer
Availability	Schedule updated monthly, programming within 2 months on average



Irradiations
PartRec Groningen

PartRec Facility

PARTREC

PARTREC is located in Groningen/Netherlands. It is a dedicated research facility functioning in synergy with the UMCG Groningen Proton Therapy Center (GPTC).

They combine technological development, preclinical studies, and patient studies with a Research and Development (R&D) programme to continuously improve proton therapy technology and treatment, while assessing the feasibility of other particles for high-precision radiotherapy.

The cyclotron delivers beams of various ions ranging from protons to oxygen, with energies up to 190 MeV (for protons) and 90 MeV per amu (for ions of helium to oxygen).

The accelerator is also used by the University of Groningen for nuclear physics research and for commercial radiation-hardness testing, with the possibility of using a heavy cocktail of ions as massive as Xe, with an energy of 30 MeV per amu.

Applying for beam time

The PARTREC accelerator facility performs proton and heavy-ion irradiations for the purpose of radiobiology research and radiation-hardness testing of electronics.

Information needed to apply for beam time

Beam particle;

Energy: 10-184 MeV for protons; Maximum 90 MeV per amu for 4He, 12C, 16O or 20Ne; 30 MeV per amu for 20Ne, 40Ar, 84Kr or 129Xe.

Flux: 1E4-1E8 protons per cm2 per second (depending on field); 10-10E5 ions per cm2 per second for heavy ions.

Field shape and size, field homogeneity;

Description of samples (dimensions/materials);

Period in which irradiation preferably takes place.

For proton and carbon beams, they can also irradiate using a ‘spread-out Bragg peak’.

More info at https://umcgresearch.org/w/partrec

Irradiations
New Mexico

Irradiation facilities in New Mexico, USA
Coordinated by Sally Seidel, University of New Mexico
seidel@unm.edu

Los Alamos National Laboratory

Beam Status (login required)

search s

LANSCE Los Alamos Neutron Science Center

ABOUT LANSCE | FOR USERS | SUBMIT A PROPOSAL | FACILITIES | NEWS & EVENTS

Target 2

Target 2 provides experimenters direct **access to the 800 MeV proton beam** as well as several flight paths.

Instrument Scientist
Steve Wender
(505) 665-1344
Email

Instrument Assistant
Kranti Gunthoti
(505) 665-8594
Email

LANSCE User Office
Email

Target 2 Overview

Target 2 is housed in the **Blue Room** in MPF-7 at LANSCE and provides experimenters direct access to the LANSCE proton beam. The Blue Room is a domed room with a diameter of 40 feet. The main floor of the Blue Room is constructed primarily of aluminum and elevated 20 feet above the basement floor to minimize neutron wall return for experiments sensitive to such effects. The proton beam enters the Blue Room from the northeast and then exits to the southwest on its way to Target 4. During Target 2 operations, the beam line is removed in the middle of the Blue Room and experiments are installed at the center of the room in the path of the beam. The Blue Room also has several secondary flight paths for use in coordination with targets installed at Target 2.

Target 2 can use either the LANSCE linac beam directly, or the high peak intensity stacked beam from the Proton Storage Ring (PSR). The linac beam to the Blue Room can normally be run up to 80 nA with substructure available for experiments that require it. Normal linac operations provide 800 MeV protons, but the facility is capable of delivering protons with energy from 200 MeV to 800 MeV. The PSR beam can run from pulse-on-demand up to 40 Hz, and up to 1 μA average current. PSR beam pulse intensity can be as high as a few 1013 protons/pulse.

Los Alamos National Laboratory, 90 miles north of Albuquerque, NM

https://lansce.lanl.gov/facilities/wnr/flight-paths/target-2/

Gamma Irradiation Facility and Low-Dose-Rate Irradiation Facility

Sandia National Laboratories, in Albuquerque, NM

Gamma Irradiation Facility and Low-Dose-Rate Irradiation Facility

The Gamma Irradiation Facility (GIF) provides high-fidelity simulation of nuclear radiation environments for materials and component testing. The GIF can produce a wide range of gamma radiation environments (from 10^{-3} to over 6.5 x 10^2 rad/second) using cobalt-60 sources and can irradiate objects as small as electronic components and as large as an Abrams M1 tank. The GIF provides in-cell dry irradiations in three test cells and in-pool submerged irradiations.

Contacts

Don Hanson
djhanso@sandia.gov
(505) 844-6969

Audrey Rotert
aevelan@sandia.gov
(505) 284-3830

Research and other activities

Radiation fields at the GIF are produced by high-intensity gamma-ray sources. The sources used at the GIF are cobalt-60 pins. The facility offers gamma dose rates from 10^{-3} rad/s to over 6.5 x 10^2 rad/s. The GIF can house a wide variety of gamma irradiation experiments with various test configurations and at different dose and dose rate levels. The in-air irradiations are conducted using three concrete test cells: two cells are 3 m × 3 m; one cell is 5.5 m × 9.1 m. Various objects are tested for their abilities to withstand the damaging radiation environments they might experience in space, near stored nuclear materials, or when they experience extreme radiation environments. Typical experiments at the GIF include the following:

Special features and equipment

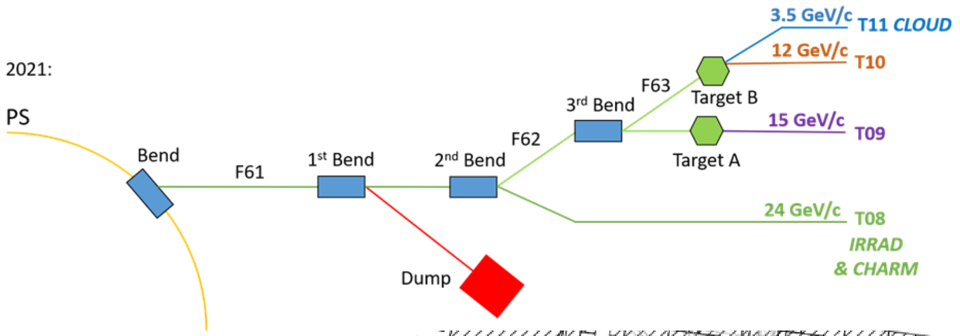
To accommodate specific irradiation needs for experiments, the following custom features have been incorporated into the GIF design:

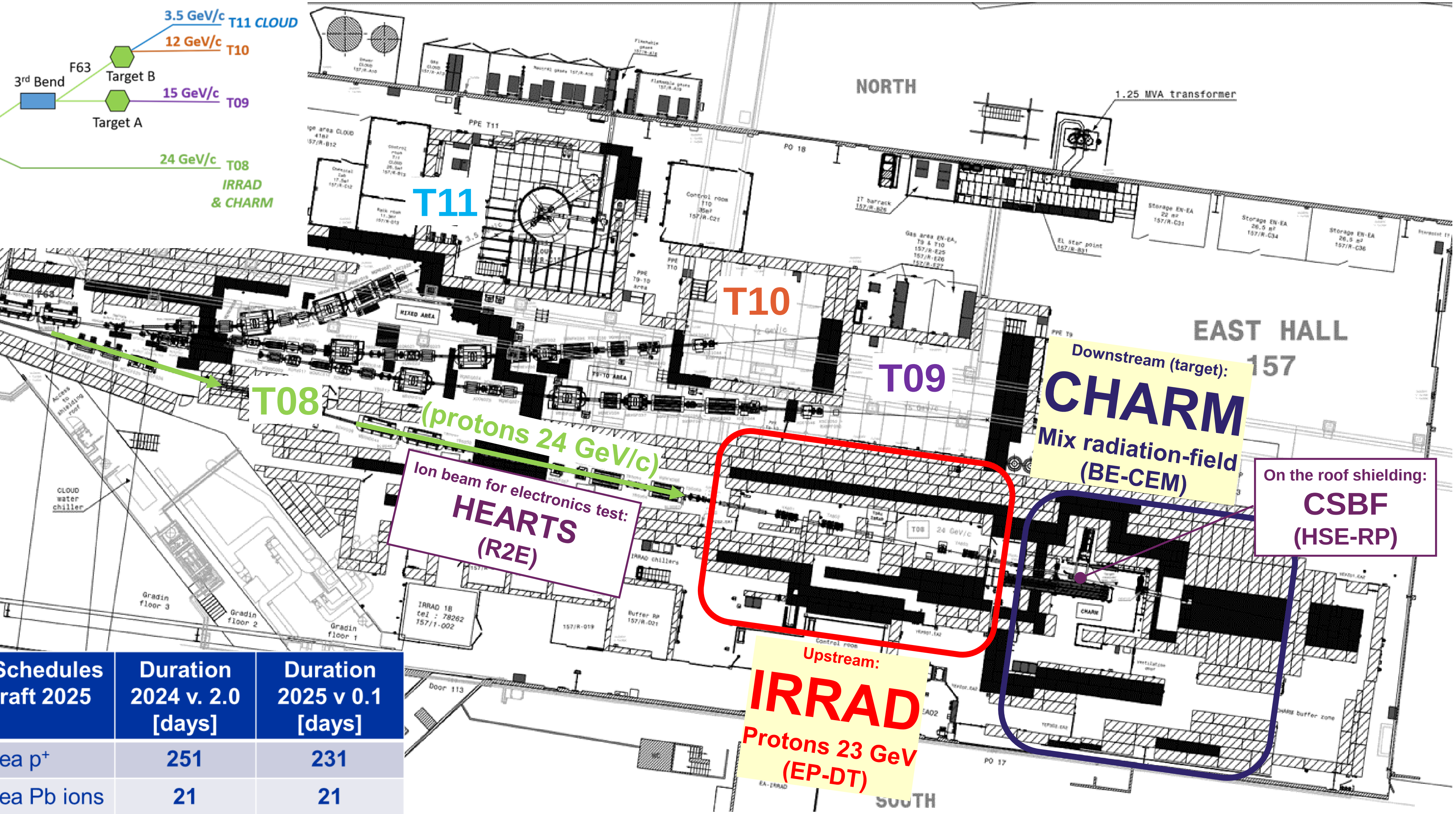
- Configurable radiation sources that provide different geometries for the source array (e.g., point, planar, and circular)
- Shielded windows that enable experiment observation during irradiation
- Remote manipulators that can be installed to facilitate experiment or source handling
- Pass-throughs in the shielding walls so that experiment power and instrumentation cables can penetrate the shield walls
- A movable wall that measures 5.5-m (~18-ft.) wide in the large cell, providing access for large components (e.g., space vehicles or military vehicles)
- Removable cell-roof-shield plugs that provide access for large and/or massive experiments
- An overhead bridge crane that spans the facility's high bay and that can access the cells through the cell-roof-shield plugs
- Dry experiment canisters are available for in-pool irradiation experiments
- In-pool experiments can be heated and purged with air or other gas

https://www.sandia.gov/research/gamma-irradiation-facility-and-low-dose-rate-irradiation-facility/

Irradiations
CERN PS

CERN PS East Area Irradiation Facility





IRRAD Proton Facility

CHARM

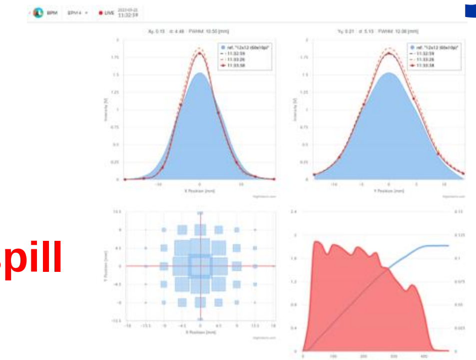
HEARTS High-Energy Accelerators for Radiation Testing and Shielding

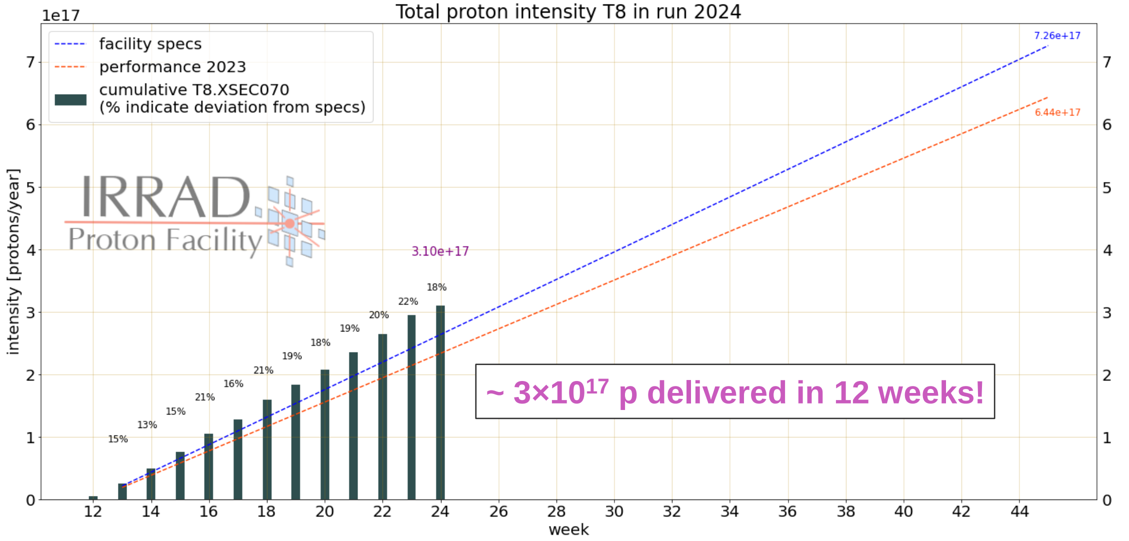
Injectors Schedules 2024 & Draft 2025	Duration 2024 v. 2.0 [days]	Duration 2025 v 0.1 [days]
PS East Area p+	251	231
PS East Area Pb ions	21	21

p+ ends 13/11/2024 and restart ~04/2025, then LS3 …

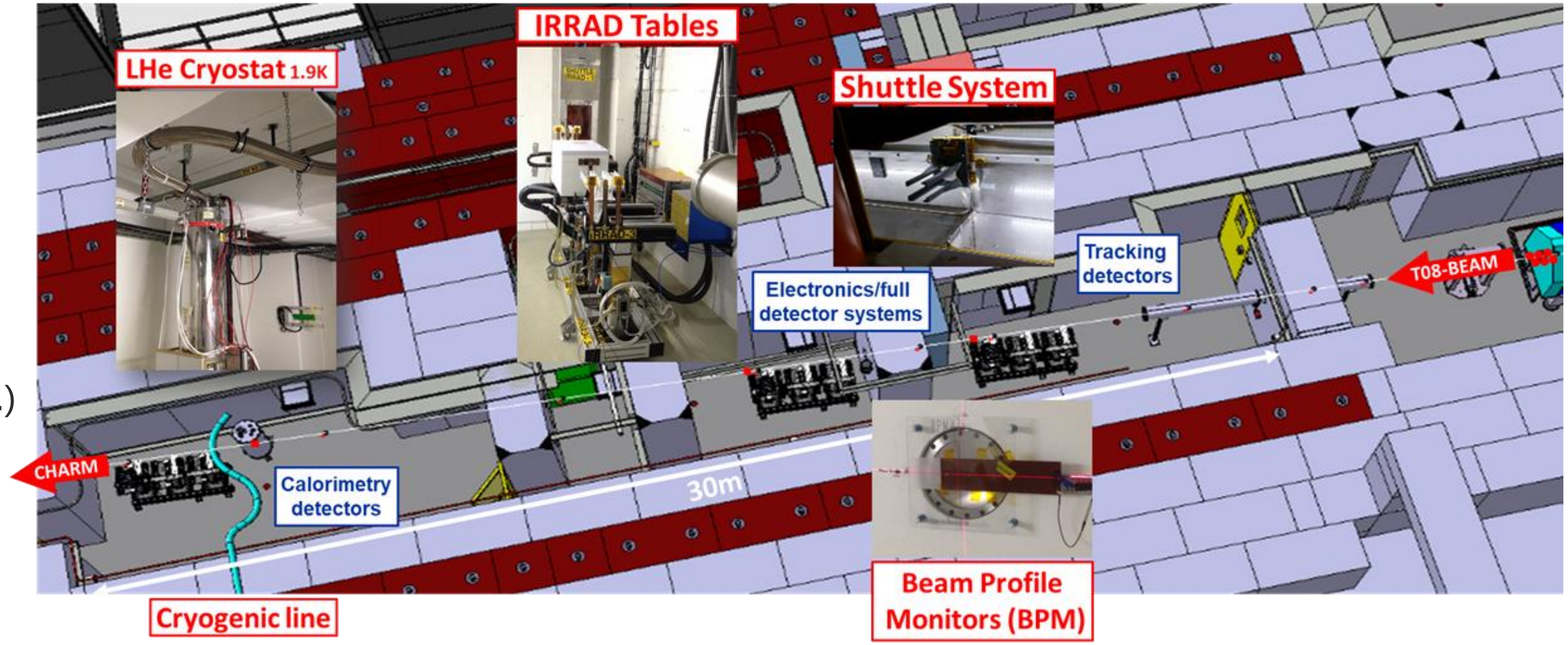
IRRAD Proton Facility

- **Proton Beam Parameters:**
  - momentum: **24 GeV/c**
  - spills of **~400 ms** every ~10 s
  - NEW extracted intensity from PS: **8×10^{11} p/spill**
  - beam spot size: **~12×12 mm^2** (FWHM)
  - average Φ on 10×10mm^2 (2024): **$>1\times10^{16}$ 1MeV$_{eq}$ n / cm^2 / week**





- **Testing Infrastructure:**
  - movable tables, patch panels, cold boxes, cryogenic system, etc.
  - NEW **BPMs with <ms sampling time**
  - reference Al-foil dosimetry (+/- 7%)
  - NEW post-irradiation storage areas, handling and **characterization lab with tools** (probe station, climatic chamber, SPA, etc.)
- **Accessibility:**
  - beam time depend on CERN injectors
  - Transnational Access Program ongoing



Irradiations
JSI Ljubljana

TRIGA Mark II reactor in Ljubljana

Jožef Stefan Institute
Ljubljana, Slovenia

EURO-LABS
EUROPEAN LABORATORIES FOR ACCELERATOR BASED SCIENCES

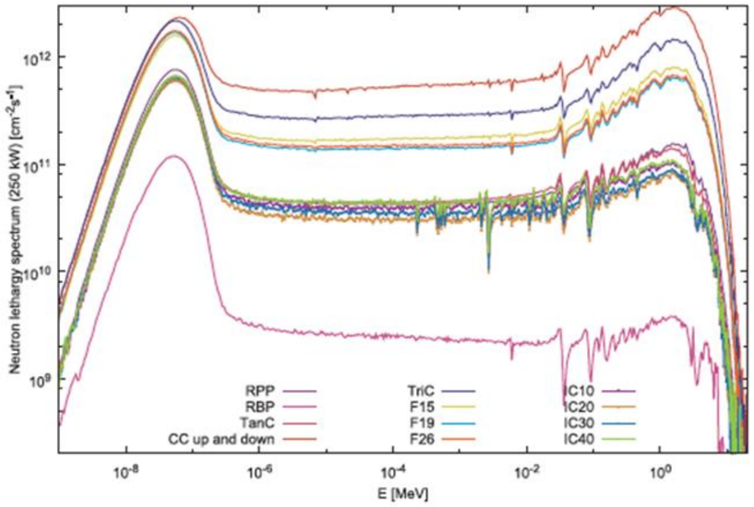
- research nuclear reactor near Ljubljana, Slovenia
- built in 1966 (General Atomics), reconstructed in 1991
- power can be set between ~ 1 W and 250 kW
  → neutron flux scales with power

➔ irradiations financed by JSI and Horizon EU project EURO-LABS https://web.infn.it/EURO-LABS/

WP4 – Transnational access to Research Infrastructures for HEP Detectors https://web.infn.it/EURO-LABS/wp4-ta-for-detectors/

- only remote access (reactor time and costs of shipment)
- facility coordinator Igor Mandić (igor.mandic@ijs.si)

- neutron spectra in different irradiation channels

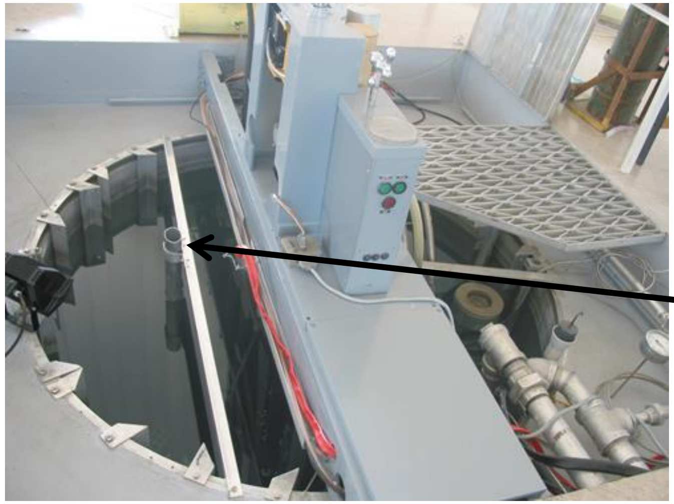


K. Ambrožič et al., *Applied Radiation and Isotopes* 130 (2017) 483-488

More info about irradiation channels: https://ric.ijs.si/en/info-za-uporabnike/lastnosti-obsevalnih-kanalov

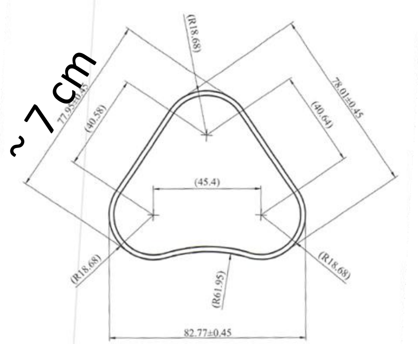
TRIGA Mark II reactor

- samples are inserted to the core through vertical channels from the reactor platform



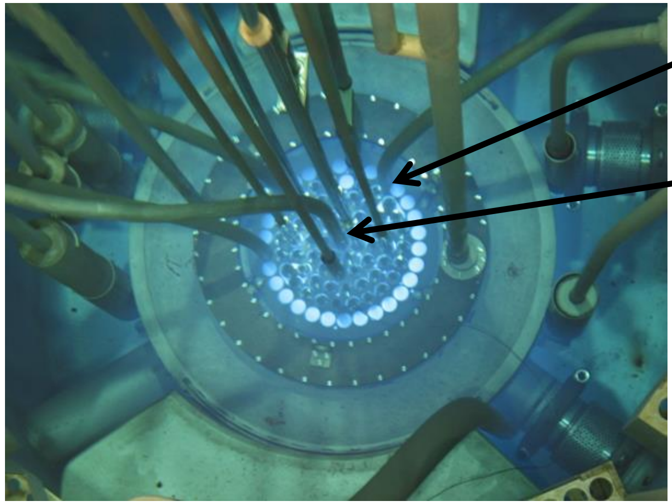
TIC channel

$\varphi_{max} = 3.7 \cdot 10^{12}\ n_{eq}cm^{-2}\ s^{-1}$



TIC channel shape

- core (under ~ 5 m of water)



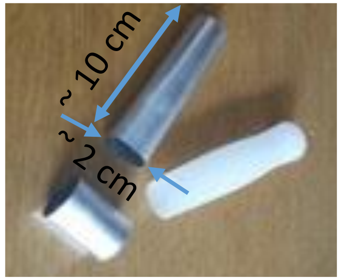
Chanel F19

$\varphi_{max} = 1.6 \cdot 10^{12}\ n_{eq}cm^{-2}s^{-1}$

Central channel

$\varphi_{max} = 6.7 \cdot 10^{12}\ n_{eq}cm^{-2}s^{-1}$

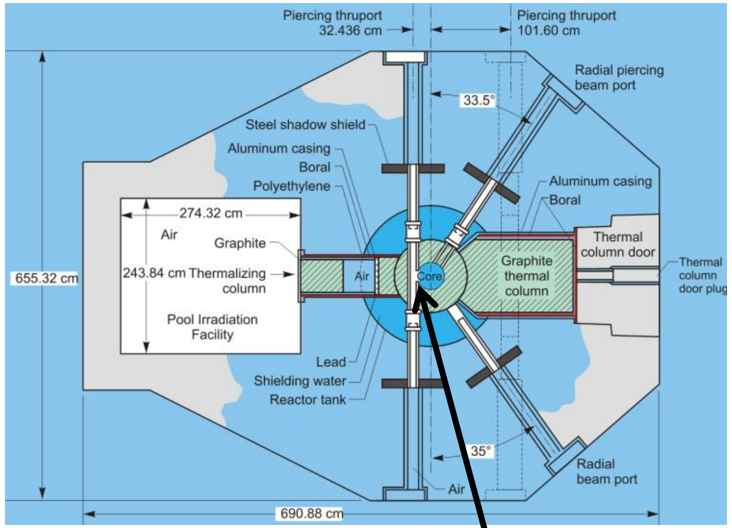
Irradiation containers



Jožef Stefan Institute
Ljubljana, Slovenia

EURO-LABS
EUROPEAN LABORATORIES FOR ACCELERATOR BASED SCIENCES

- horizontal channel for larger objects (AIDA WP15.5)
- $\varphi_{max} = 4.8 \cdot 10^{11}\ n_{eq}cm^{-2}s^{-1}$



- sample inserted next to the core from the side

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Ljubljana, Slovenia

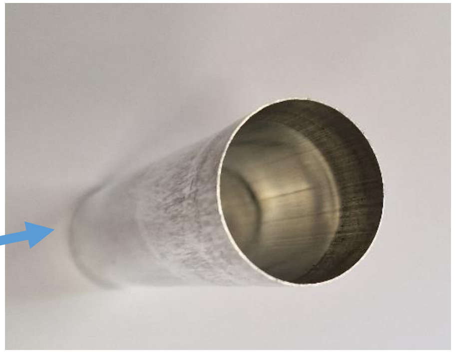
EURO-LABS — EUROPEAN LABORATORIES FOR ACCELERATOR BASED SCIENCES

Irradiation to Extreme Fluences

- irradiation campaigns up to extreme fluences, (over ~1e17) part of EURO-LABS programme

- in the Central Channel (CC) **1e18 n_{eq}/cm^2** is reached in ~ 40 hours → 5 working days
  ➔ a week of reactor time for extreme fluences booked from **19th to 23rd of August 2024**

- several irradiation channels can be used in parallel so in 40 hours we can irradiate:
  - in CC: 1e18 n_{eq}/cm^2
  - in TIC: 5.2e17 n_{eq}/cm^2
  - in F19: 2.3e17 n_{eq}/cm^2



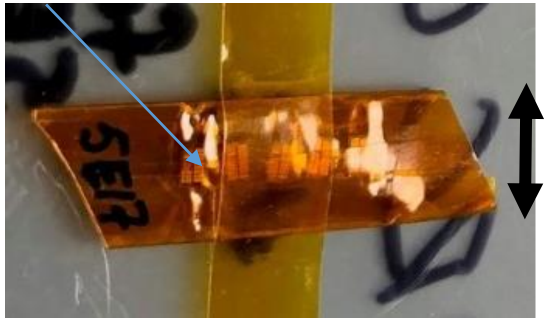
2.4 cm diameter
10 cm long

- samples from various groups will be joined together
  ➔ **only one container can be irradiated up to 1e18 in 40 hours**
  - if interested please contact facility coordinator (Igor)

- **small samples!** all must fit into cylinder with diameter 2.4 cm, 10 cm long
- only bare chips (no PCBs, connectors etc…)
  ➔ wrap samples with kapton tape

Example:

chips



~1 cm

- samples should be in Ljubljana by **the end of July 2024**

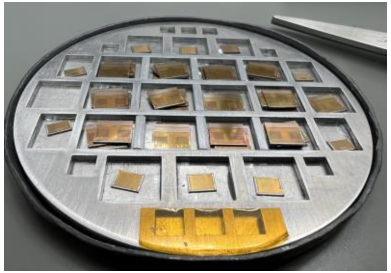
Irradiations
UJP Prague

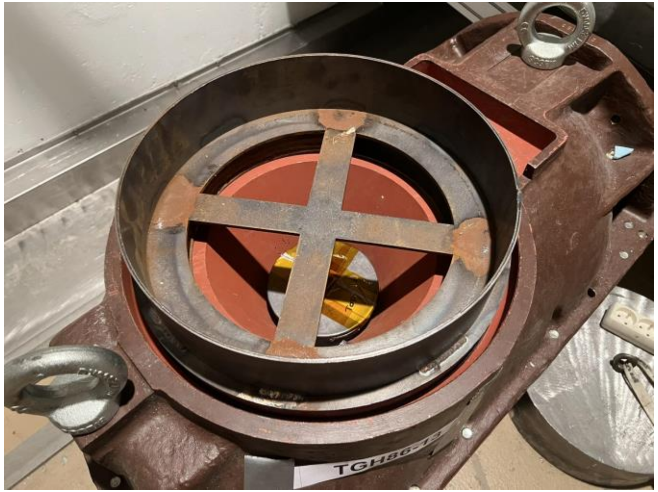
^{60}Co source at UJP Praha, a.s.

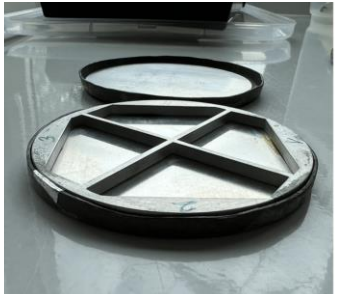
Coordinator at UJP Praha: Petr Gallus **DRD3 contact person**: Marcela Mikestikova

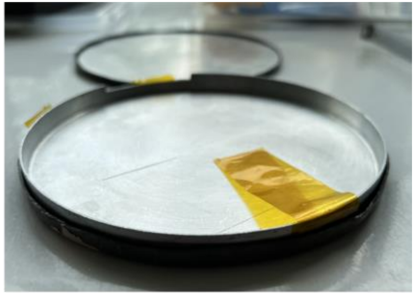
Intensive ^{60}Co source available for high TID gamma irradiations of samples

- irradiations of semiconductor samples are typically done in charge particle equilibrium (CPE) box - ESCC Basic Specification No. 22900 from ESA (document)
- dose rate depends on source and scales with distance from source (sample size or spec. requirements)
    - samples fitting into 85 mm radius CPE box: max. ~20 krad/min (1 MGy in ~80 hours)
    - irradiations of samples w/o CPE box of course possible
    - price per irradiation day ~1500 EUR







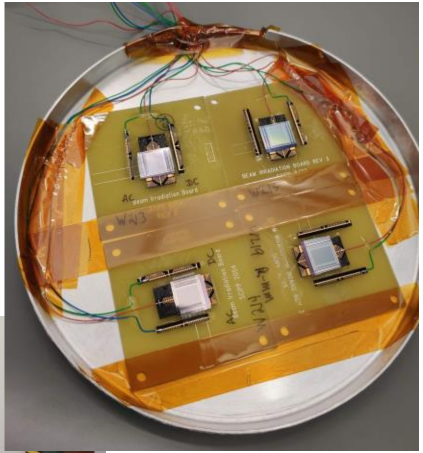
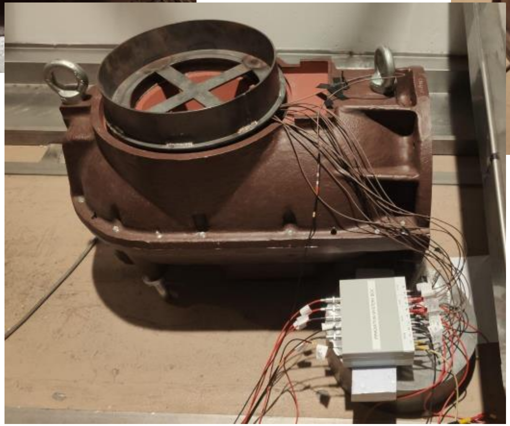
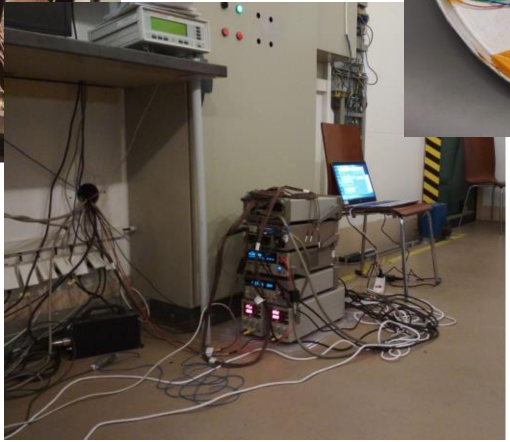


^{60}Co source at UJP Praha, a.s.

Active gamma irradiations (powered samples, continuous DUT readout, …) are possible

- ~7 meters from control room to source, cables via opening in the wall
- cooling/N_2 is not available (would have to be solved by user)

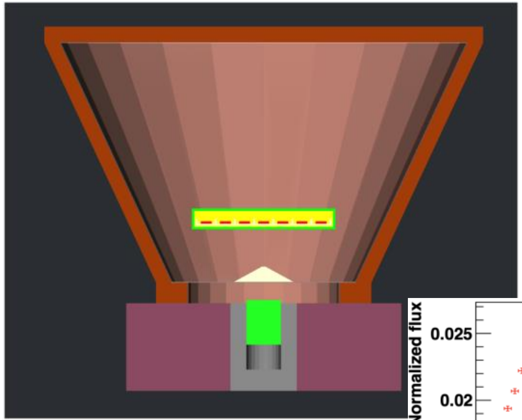


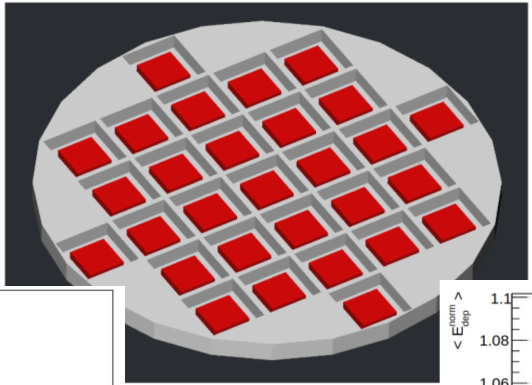




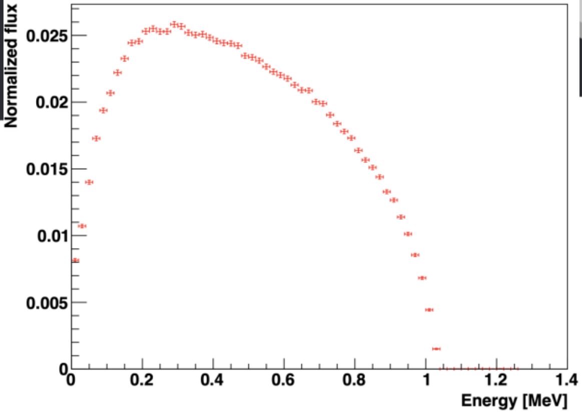
^{60}Co source at UJP Praha, a.s.

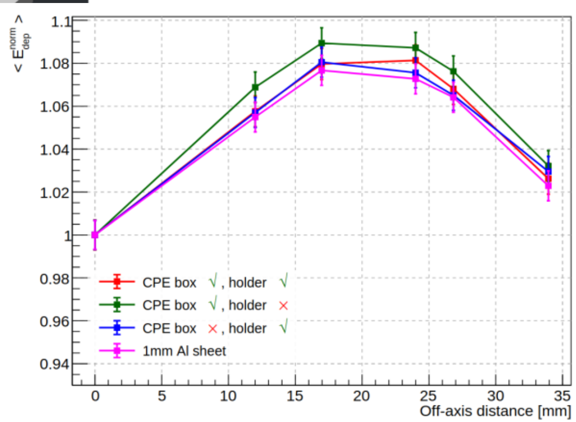
A reasonable Geant4 simulation of the ^{60}Co source is available and is used e.g. to study

- distribution of total ionizing dose as a function of distance from source axis,
- energy deposition in the individual layers for stacked samples,
- spectrum of secondary electrons produced in CPE box, …







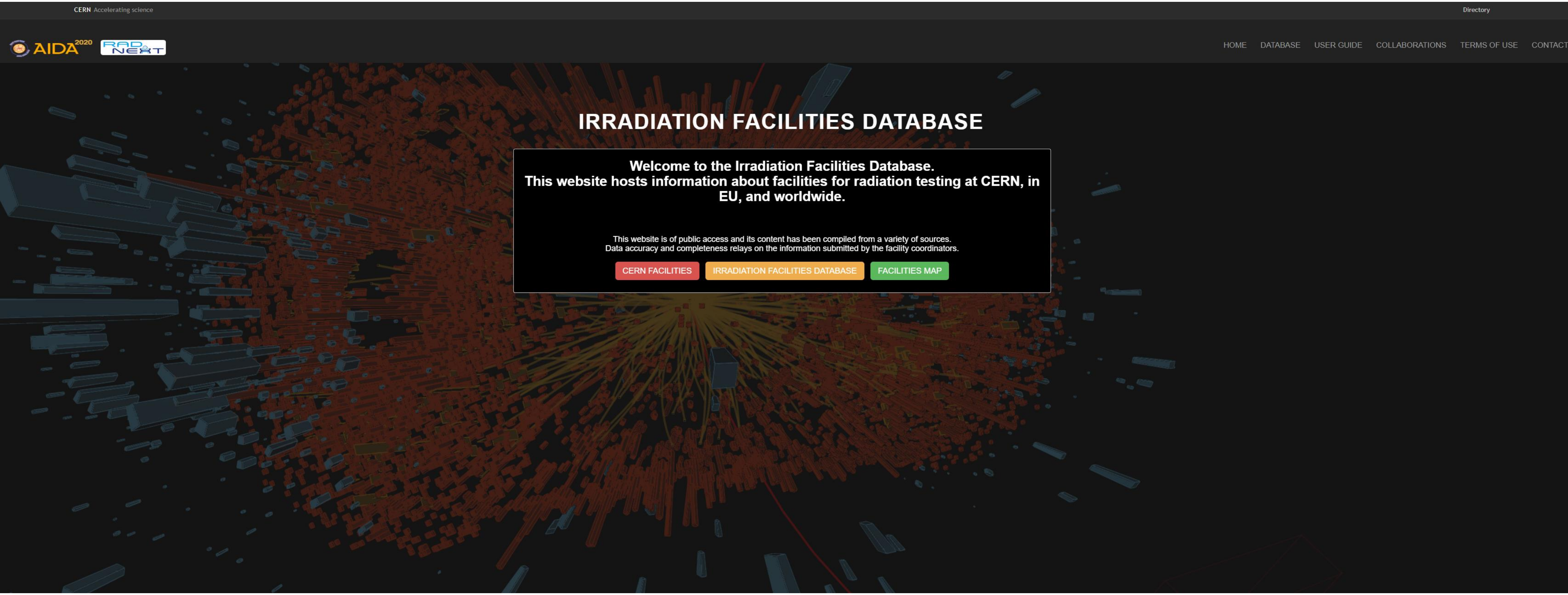


CERN Irradiation and Test Beam Facilities Databases

P. Pelissou (CERN – EP – DT)

21/06/2024

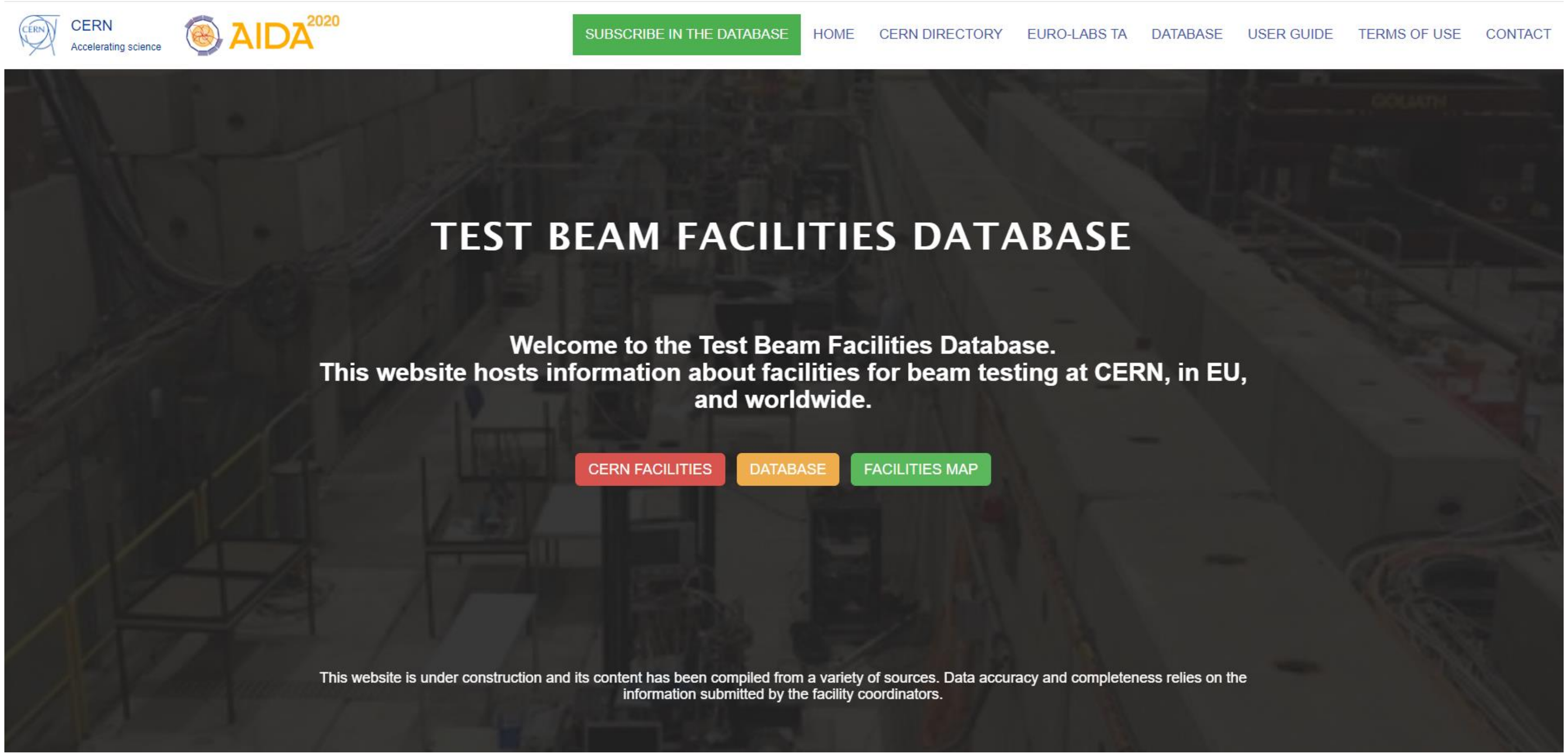
DB: Irradiation Facilities Database



A unified entry point for **CERN and worldwide irradiation facilities** with an essential collection of information

https://irradiation-facilities.web.cern.ch/

DB: Test beam Facilities Database



- A unified entry point for **CERN and worldwide test beam facilities** with an essential collection of information https://test-beam-facilities.web.cern.ch/

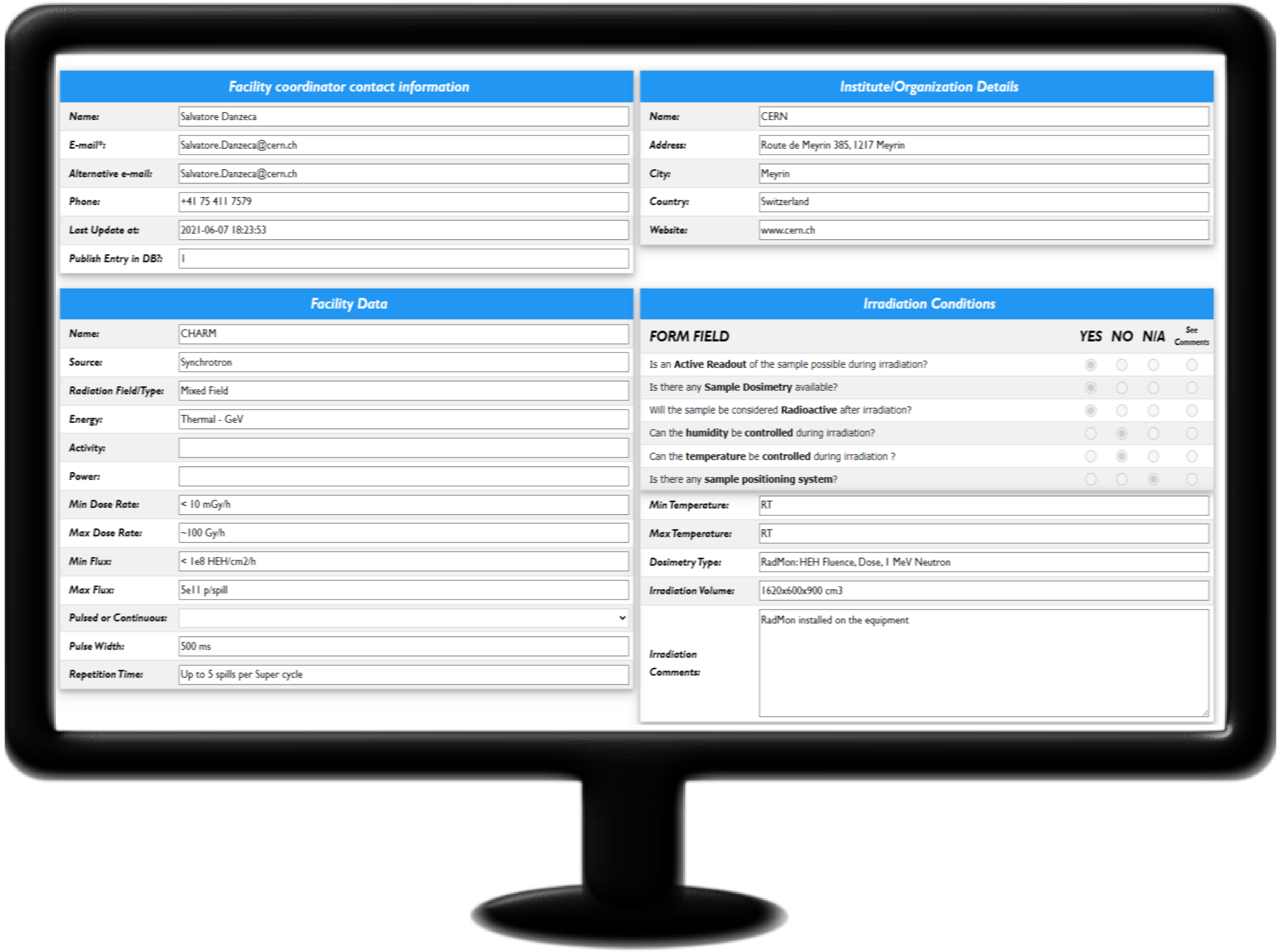
- **Contacts**: test-beam-facilities-admin@cern.ch/pierre.pelissou@cern.ch

- **A dedicated window for each facility entry:**
  - Contact information
  - Facility data, irradiation conditions, safety and accessibility

- **Search functionalities:**
  - Country, source type and radiation field/type

- **Editing functionalities:**
  - Protected by CERN authentication system
  - External “lightweight” accounts are supported

- **Contacts:**
  - Email: Irradiation.Facilities@cern.ch
  - Email: pierre.pelissou@cern.ch



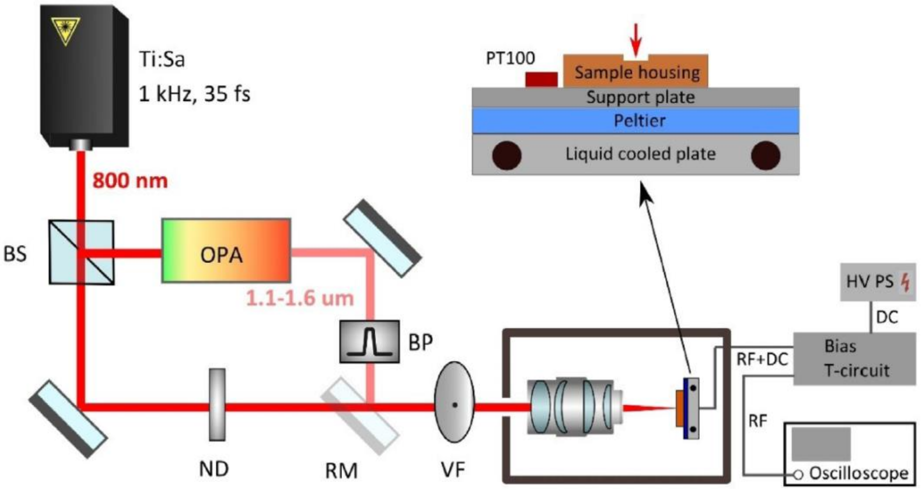
Laser facilities

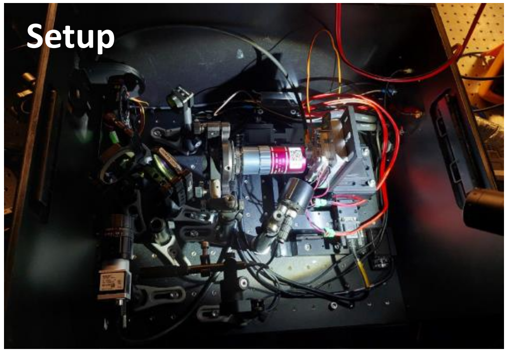
Laser facilities
ELI Prague

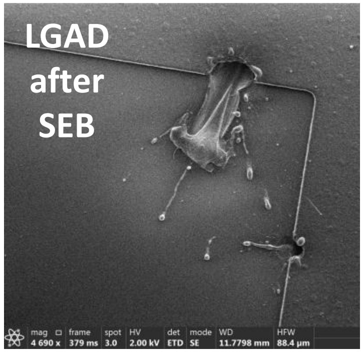
TCT setup at ELI Beamlines

Laser-based Transient Current Technique setup with single (SPA) and two (TPA) photon absorption was developed at ELI Beamlines in 2020.

- characterization of LGADs
- single event burnouts (SEB)
- gain suppression (GS)
- 2D (SPA) and 3D (TPA) scanning
- segmented sensors (inter-pixel region)
- bias dependence
- wavelength dependence,
- pulse energy dependence
- jitter measurements
- damage inspection with electron microscope







Setup available for users in ELI ERIC calls!
2020 – 2024

Users: Gordana Lastovicka-Medin (2021-2024),
Giulio Pellegrini (2024)

Detectors: conventional LGADs for ATLAS and CMS (FBK, HPK, CNM), Ti-LGAD (single, double trenched), pLGAD, 3D (planned iin August 2024)

Publications:

1. Nucl. Instrum. Meth. A, 1041 (2022) 167321
2. Nucl. Instrum. Meth. A, 1041 (2022) 167388
3. J. Instrum., 17 (2022) C07020
4. Eur. Phys. J. ST, 232 (2023) 1501
5. Sensors, 23 (2023) 6746
6. Appl. Radiat. Isot. , 208 (2024) 111288
7. Nucl. Instrum. Meth. A, (2024) in print

Setup parameters	
Operational mode	Single (SPA) and two (TPA) photon absorption
Wavelength	tunable 250-2500 nm
Pulse energy	tunable (minimal step 0.2 pJ)
Pulse duration	50-100 fs
Sensor positioning	XYZ (accuracy < 1 µm)
HV bias	0-3000 V
Leak current monitoring	accuracy 100 nA
Signal detection	6 GHz, 20 GS oscilloscope

Access to ELI Infrastructure

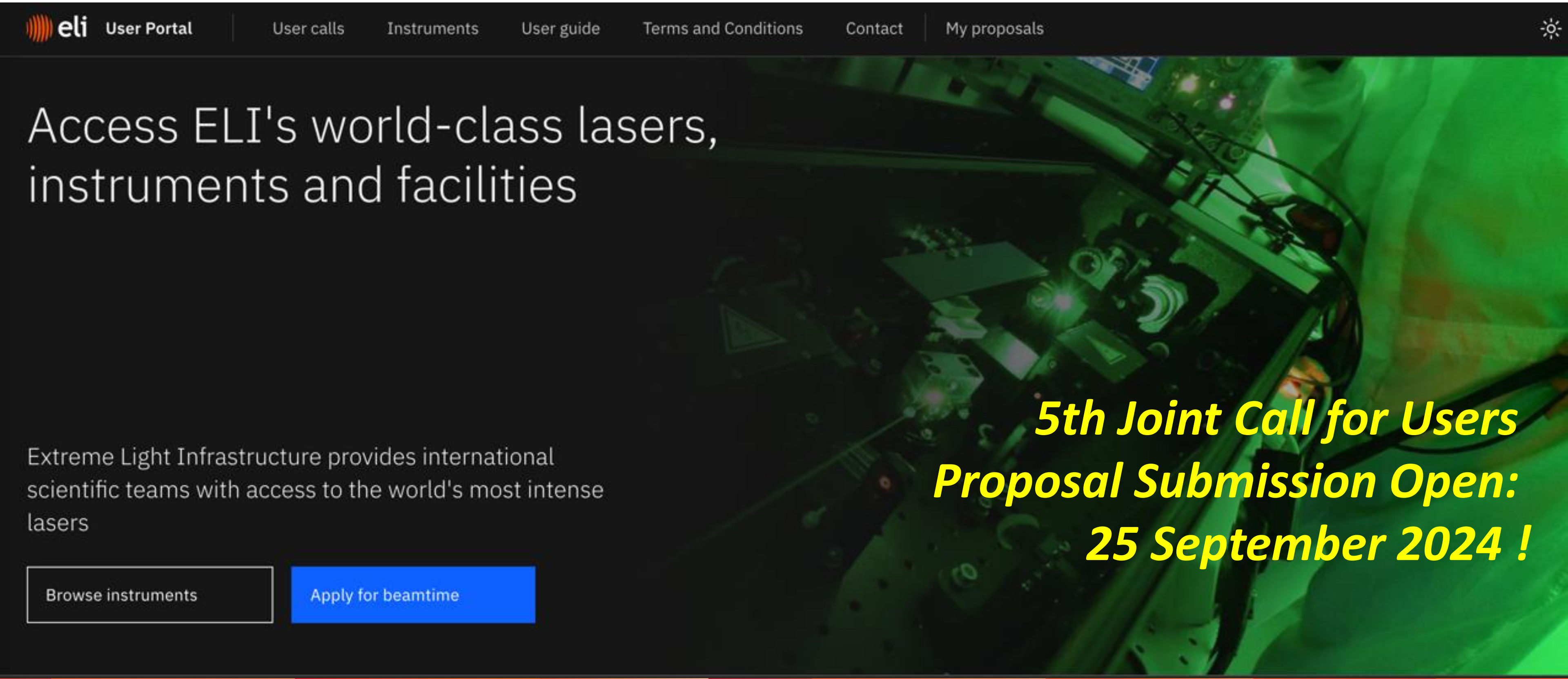
ELI ERIC is Open to the World

A user facility with three access modes

- **Excellence-Based Access** – Evaluation of proposals by international peer-review panels. ***Results of experiments published and open.***
- **Mission-Based Access** – Thematic research granted on the basis of scientific missions pursuing challenges. Proposals reviewed by international panels. ***Results published and open.***
- **Proprietary Access** – Paid access for industrial or other users. ***Results are retained by the user,*** consistent with ELI ERIC's Data and IPR Policy.

Calls for Users

User Portal: *https://up.eli-laser.eu/*



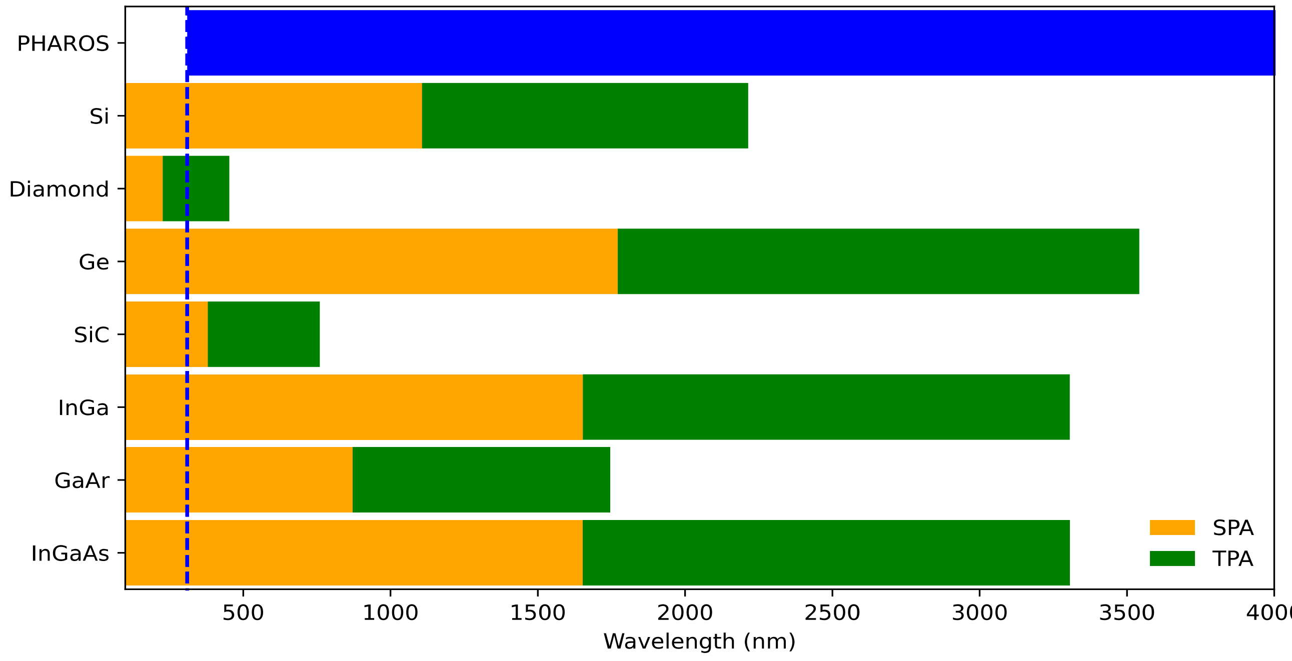
Laser facilities
Bilbao

TPA set-up (UoM)

MANCHESTER 1824
The University of Manchester

- Located at the **P**hoton **S**cience **I**nstitute
  - PSI, Manchester, United Kingdom
- Pump-laser at 1030nm + Optical Parametric Amplifier (330-16000nm)
- Ultra-fast laser pulses (~150fs)
- 3D DUT scanning capability with sub-micron precision
- Single-photon and Two-photon absorption
  - TPA Voxel size 10.4μm (depth) by 1.5μm (lateral)
- Demonstrated timing capabilities down to 8.6 ps (LGAD via double pulse TPA signals)
- TPA process showed in diamond and silicon devices
- More details on Enoch's talk
- Cost £32.86*/hour (collaborations in-kind might be considered) and local expert support if needed (link)

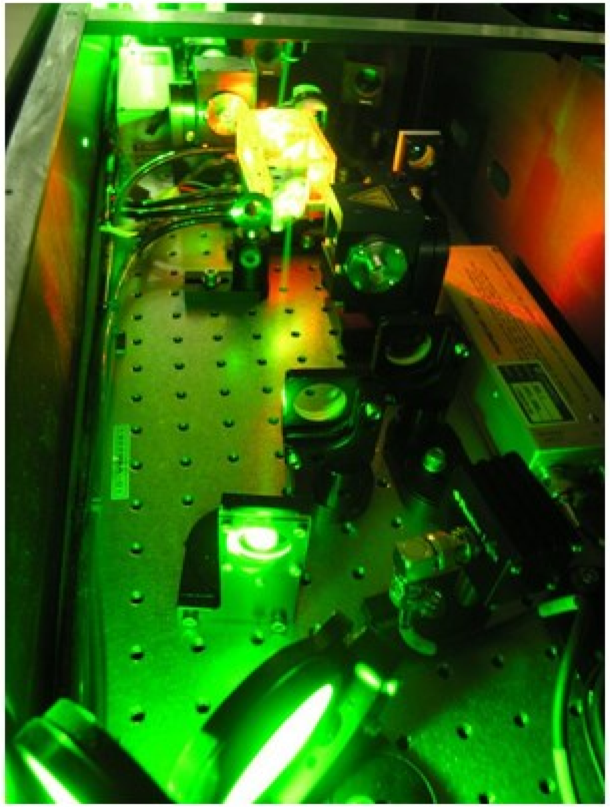
*TBC



- Access can be arranged contacting oscar.augusto@manchester.ac.uk and alex.oh@manchester.ac.uk (Physics Department) or patrick.parkinson@manchester.ac.uk (PSI)

Laser facilities
Bilbao

SINGULAR LASER FACILITY LABORATORY OF THE UPV/EHU (BILBAO FACILITY)



- nanosecond lasers (excimer lasers. Nd:YAG, different colouring systems that can be syntonized in the VIS-UV, etc.), and an ultrashort pulse system. This femtosecond laser consists of an oscillator and a Ti-sapphire regenerative amplifier, whose output is a pulse train of 40 fsec. and 2 mJ (fluencies of around 10^{14}W/cm2 can be reached using moderate focalizations). The femtosecond equipment also includes an OPA with an output that can be syntonized within the range 240-2100 nm. (extensions to the system are planned in the short term which will enable up to 200 mm to be syntonized). The Laser Facility is also equipped with the instruments required to carry out spectroscopy experiments on supersonic jets, laser ablation of metals, and PLD, etc

Offering 4-5 week of access per year (open to collaborative projects)

Contact: Ivan.Vila@csic.es.

Electromagnetic compatibility

EMC
ETSI Sevilla

Anechoic Chamber ETSI, Sevilla, Spain

Escuela Técnica Superior de
INGENIERÍA DE SEVILLA

ElectroMagnetic Compatibility (EMC) laboratory: This laboratory allows to carry out EMC tests to characterize the devices and systems designed by the research group in a controlled environment free of radiofrequency emissions. It also allows the characterization of communications systems such as transmitters and/or receivers and antennas. It comprised a semi-anechoic chamber, whose maximum operating range is certified at 40GHz, which integrates an automated positioning system for the characterization of radiation patterns and electromagnetic compatibility tests.

F.Rogelio Palomo
fpalomo@us.es

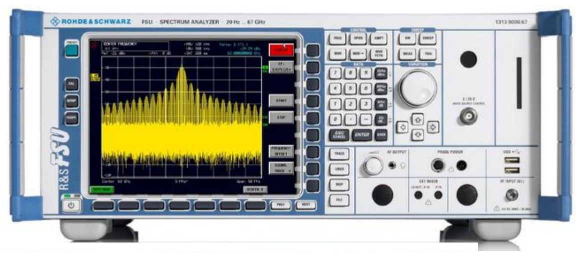
Anechoic Chamber ETSI, Sevilla, Spain

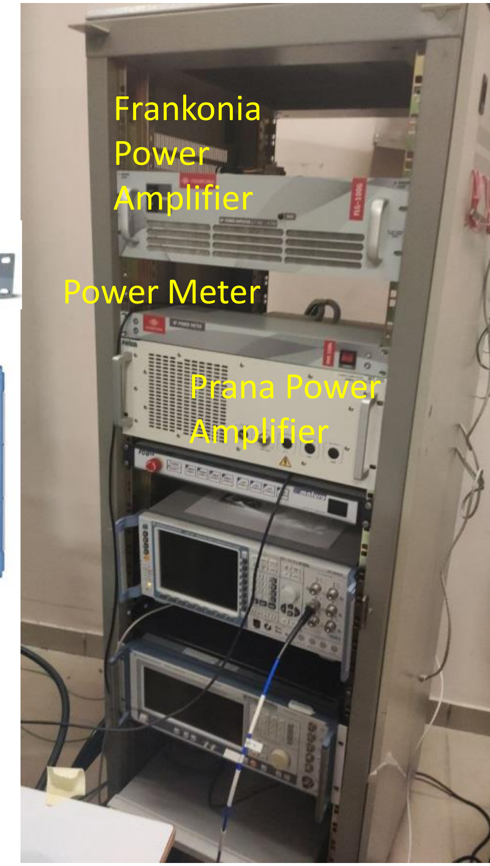
Escuela Técnica Superior de INGENIERÍA DE SEVILLA

Antennas BBHA 9120D (2-18 GHz), STLP 9128E (100 MHz - 2.5 GHz)
ETS Lindgren (3142E 30 MHz-6 GHz)
Turntable and Mast controller (using fiber optics): FCU 3.0
Turntable: Maturo TT XXX SI, Mast : Maturo AM
Spectrum Analyzer Keysight pxa n930a up to 26 GHz
Spectrum Analyzer Rohde FSU up to 3.8 GHz
Power Amplifiers up to 6 GHz (Prana 0.1-1.4 GHz,
Frankonia 1.2-3 GHz, 1.2-6 GHz)
Frankonia RF Power Meter (100 kHz-6 GHz)

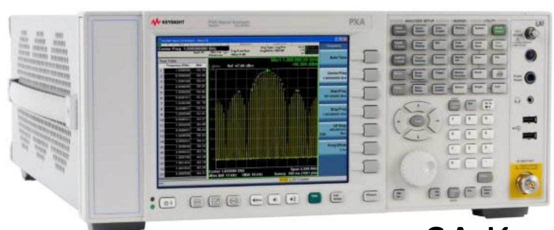
RF Meter Frankonia

SA Rohde

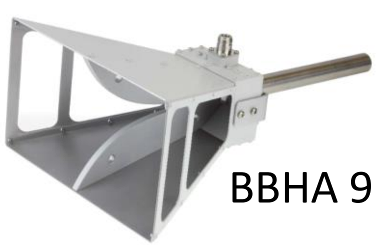




Maturo Mast, Turntable and Motion Controller



SA Keysight



BBHA 9120D

STLP 9128E

ETS-Lindgren 3142E

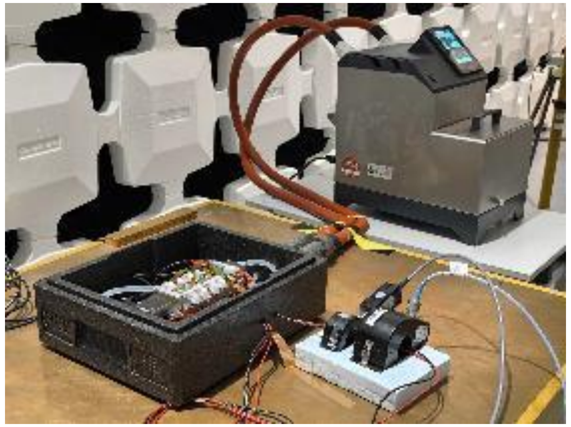
EMC
ITA Zaragoza

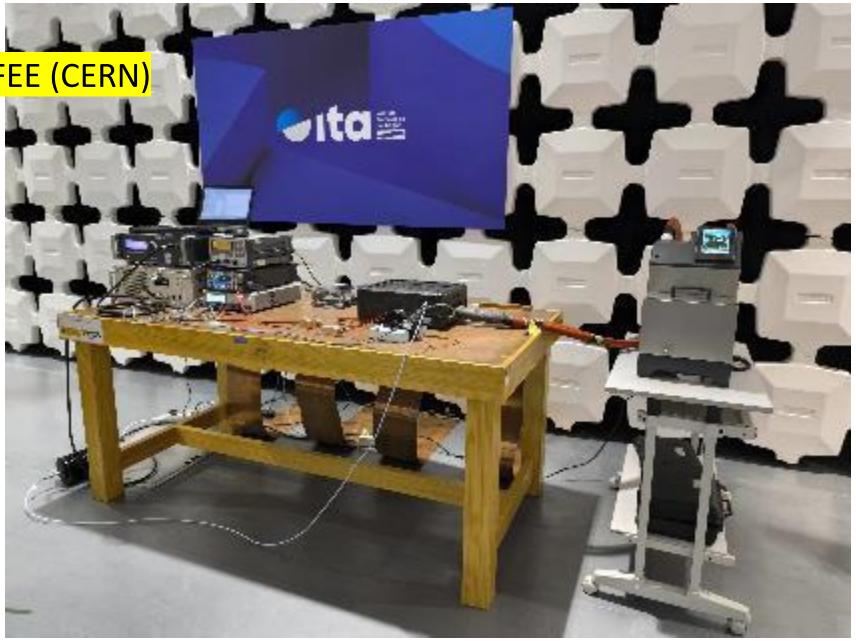
1. EMC characterization of physics detectors

- Since 2008 the EMCLab at ITA have been performed Electromagnetic Characterization of physics detectors to identify the EM noise emissions and susceptibility of detector electronics
- These activities has been performed with in EU projects, national and regional projects
  - Since 2015 ITA became a Transnational Access facility to perform EMC test within AIDA 2020 (2015-2019) and EUROLABS (2022-2026)
- These tests have been a very useful for detector designers.
- Many different systems were tested

DOSFET – Dosimeter
for synchrotron radiation facility (Elettra) & Laser Pulsed facility

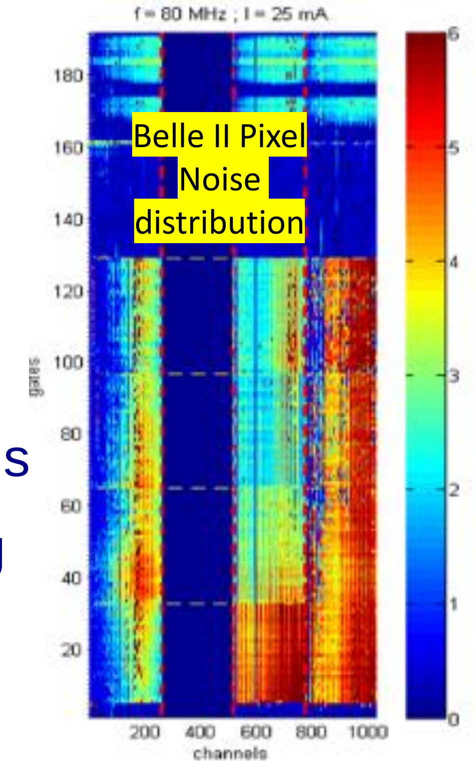
CMS Pixel upgrade phase II – FEE (CERN)

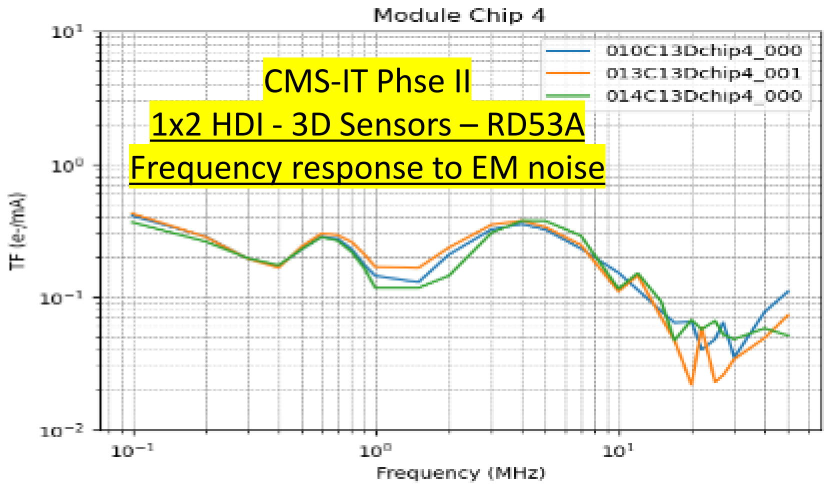




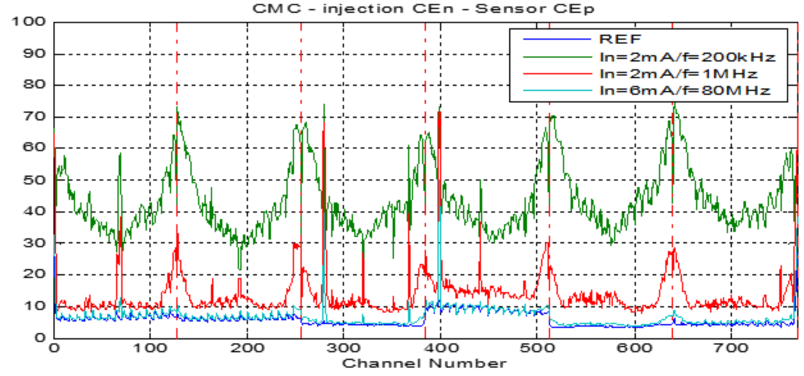
1. EMC characterization of physics detectors

- What ´s the purpose of EMC tests ?
- What is the information that can be obtained once the data is processed?....
- EMC tests are very good for:
  - ➢ Grounding topologies evaluation
    - Diagnosis
  - ➢ FEE designs
  - ➢ Detection of sensitive areas
    - FEE frequency response to nois
  - ➢ Noise distributions – EM mapping
    - Conducted or radiated
  - ➢ Filter designs
  - ➢ Noise emission specification from PS





SVD-Belle II sensor
Noise distribution



1. EMC characterization of physics detectors

- EMCLab offers via EUROLABS the possibility to perform any EMC test for a period of 4 weeks per year

EMCLab	User Projects	Total users	Tests hours
M1-M48	14	56	800

- Users are expected to request the access some weeks in advance to have a technical discussion about its specific needs
- Users may be present at ITA during the tests while ITA engineers will operate the testing equipment of the facility
  - Some travel expenses are covered
- It is possible to ask for a remote access – It is mainly focused on simple systems or
- Some EMC tests will benefit from the improvements developed in the AIDAINNOVA and EUROLABS projects (Task 4.4.5). – **New TF measurement system & cooling system**