



10th Beam Telescopes and Test Beams Workshop

20-24 June 2022



Commissioning and First Run for the CERN Proton Irradiation Facility (IRRAD) after the Long Shutdown 2

Blerina Gkotse (CERN EP-DT) on behalf of the IRRAD Team

Outline

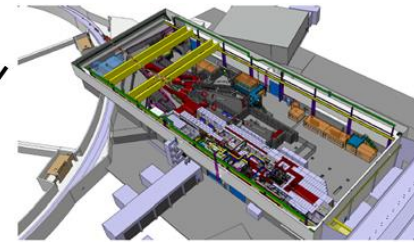
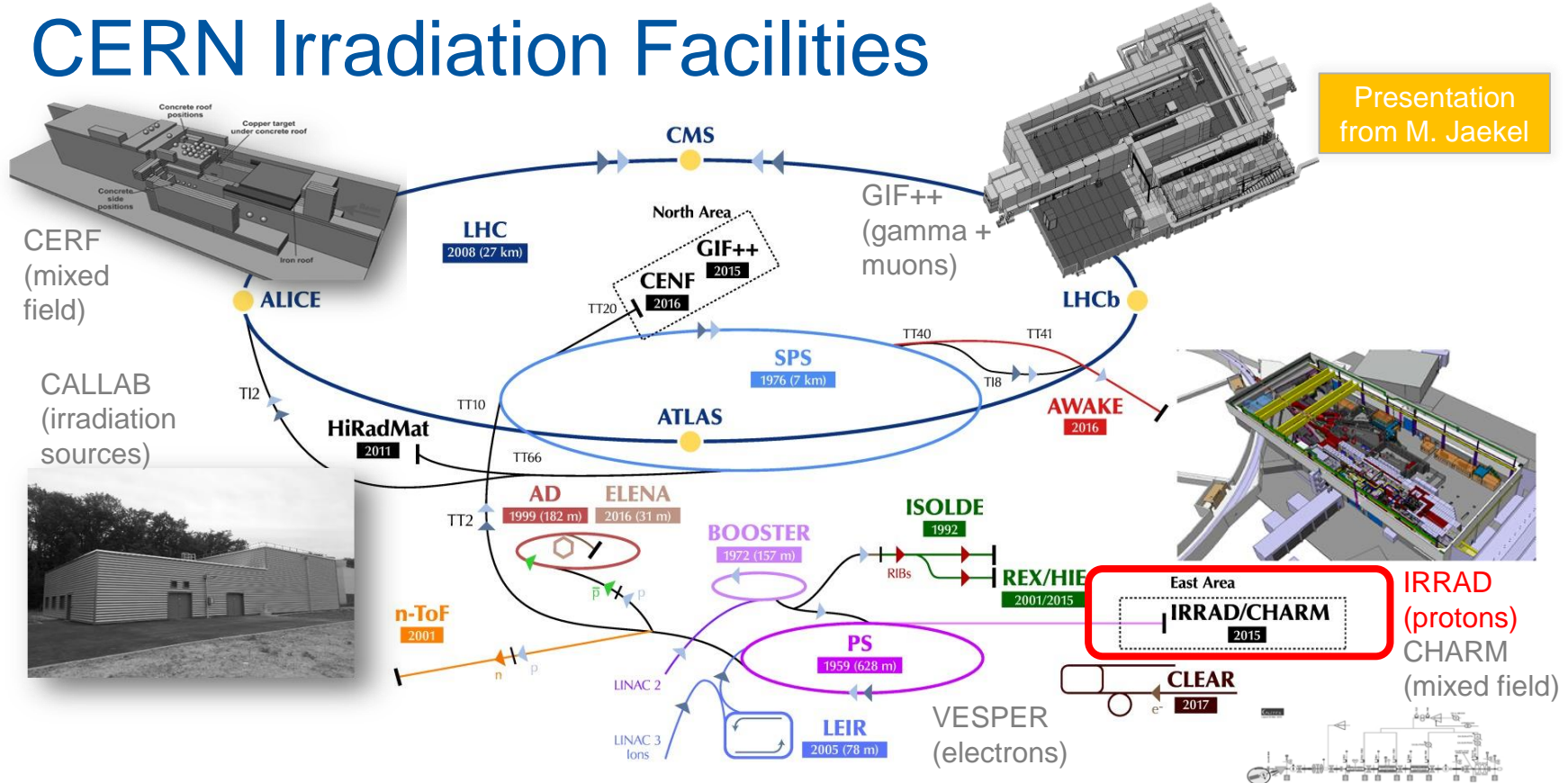
- CERN Irradiation Facilities and Long Shutdown 2 (LS2) Upgrades
- IRRAD Upgrades:
 - T8 Beam Instrumentation
 - Technical Area
 - IRRAD Software and Hardware Infrastructure
- Beam Commissioning and IRRAD runs 2021-22
- European Projects associated to IRRAD
- Summary

Outline

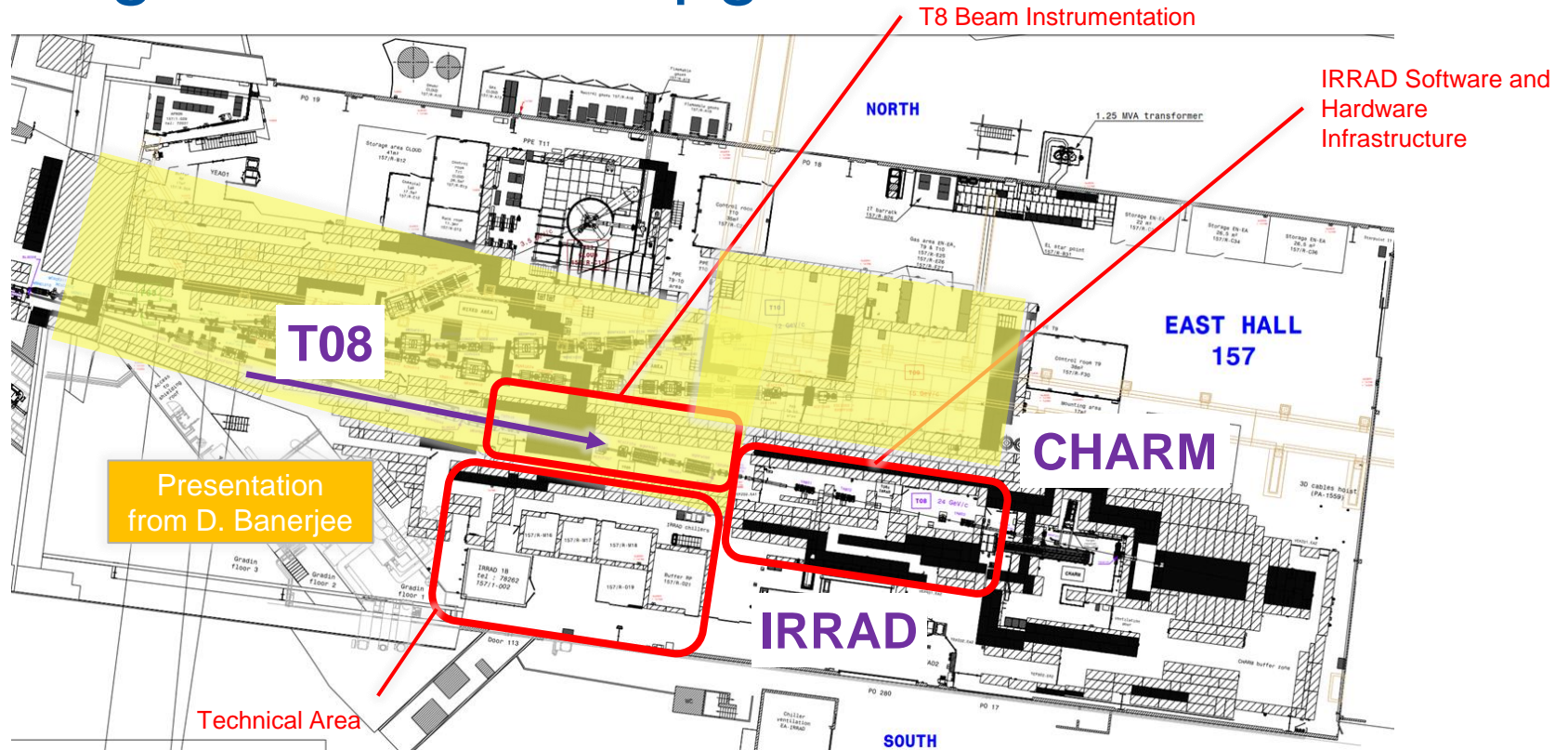
- **CERN Irradiation Facilities and Long Shutdown 2 (LS2) Upgrades**
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CERN Irradiation Facilities

Presentation from M. Jaekel



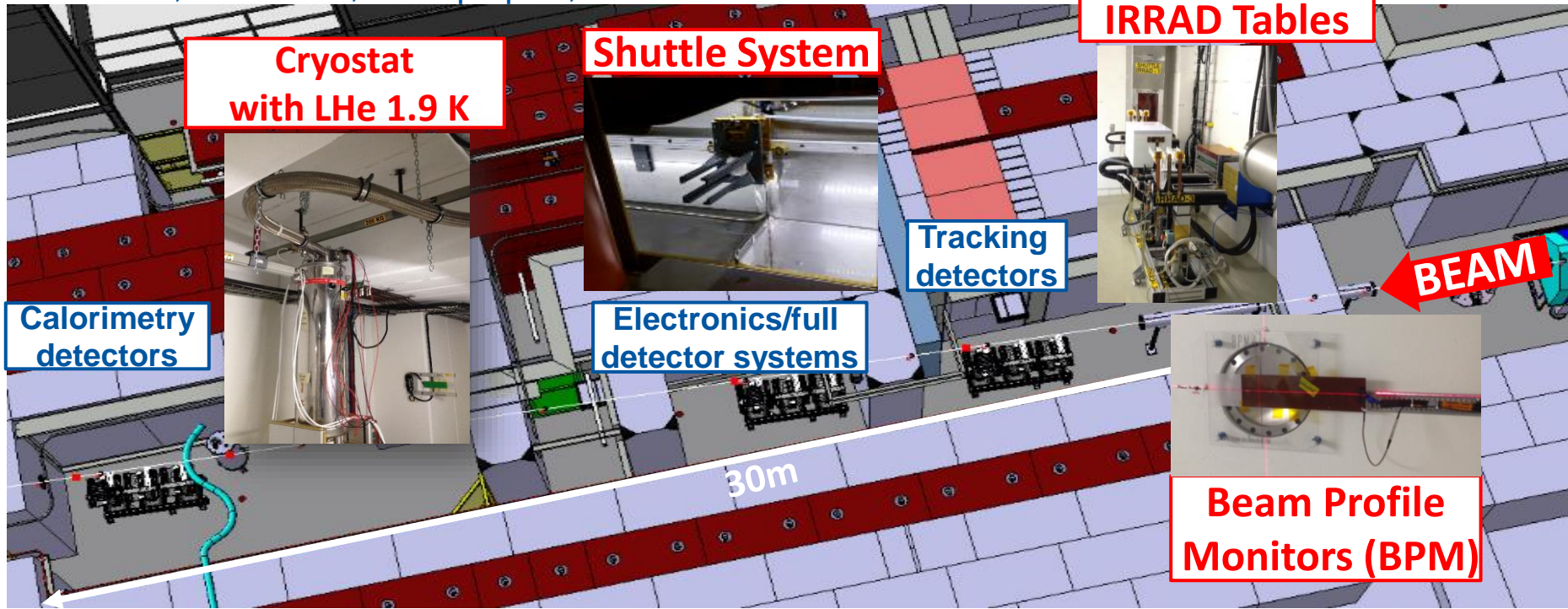
Long Shutdown 2 Upgrades



CERN Proton Irradiation Facility (IRRAD)

24 GeV/c, 400 msec, $5e11$ p/spills, 12×12 mm² FWHM

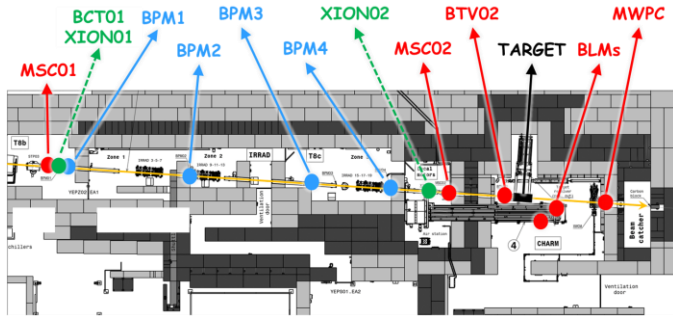
cern.ch/ps-irrad



Outline

- CERN Irradiation Facilities and Long Shutdown 2 (LS2) Upgrades
- **IRRAD Upgrades:**
 - T8 Beam Instrumentation
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Beam Instrumentation Upgrade



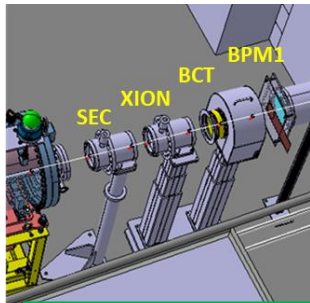
in red: responsibility SY/BI
(upstream BTV/BCTs in F61 not shown)

in blue: responsibility EP/DT

in green: new/reinstalled devices in LS2 (SY/BI)



XION02



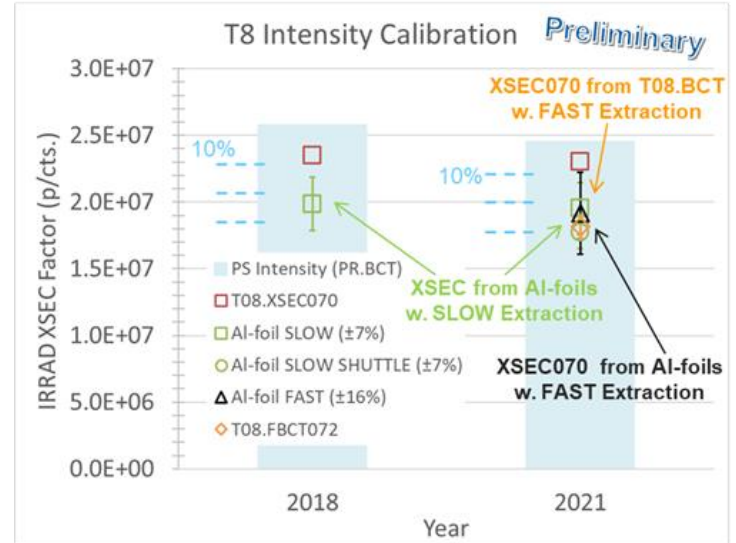
XION01 and BCT01



T08.XSEC070

T08.XION071

T08.BCTF072



IRRAD Technical Area Upgrade

Completing and equipping the new **IRRAD Technical Area & Measurement Lab**



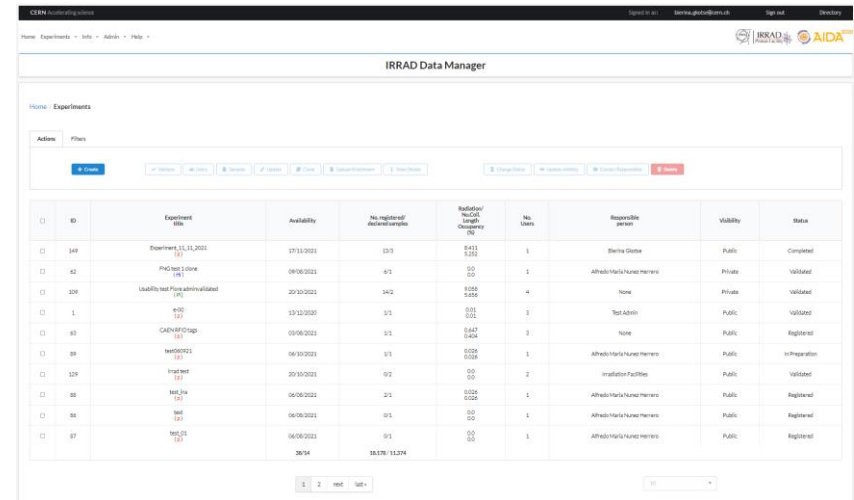
IRRAD Data Manager (IDM) Upgrades

- The IRRAD platform to register your irradiation experiment and samples
- Upgrades:
 - 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>

Register your experiment at:

<https://irrad-data-manager.web.cern.ch>

More details at: <https://ps-irrad.web.cern.ch/ps-irrad/>



The screenshot shows the IRRAD Data Manager web interface. At the top, there is a navigation bar with 'Home', 'Experiments', 'Info', 'Admin', and 'Help'. Below this is a search bar and a table of experiment data. The table has columns for ID, Experiment title, Availability, No. registered/declared samples, Radiation No. (Gy/No. of samples), No. Users, Responsible person, Visibility, and Status. The table contains 10 rows of data.

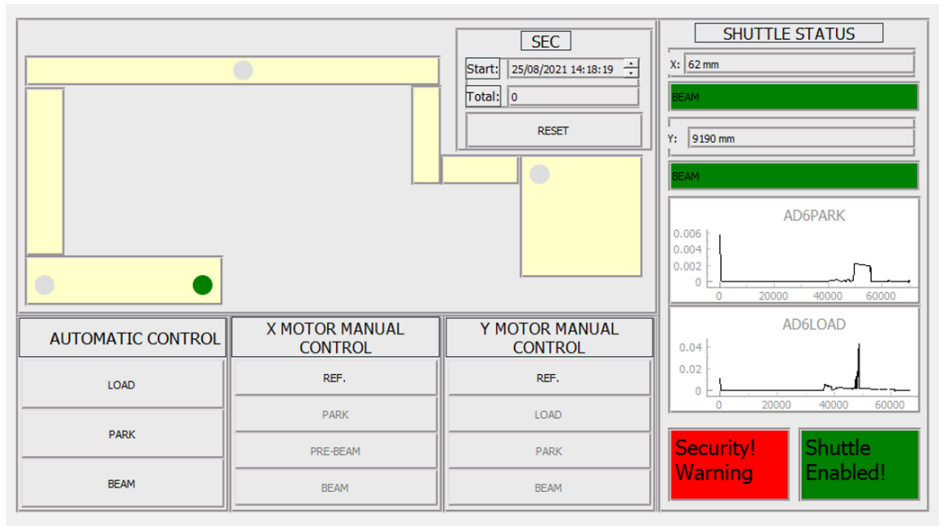
ID	Experiment title	Availability	No. registered/declared samples	Radiation No. (Gy/No. of samples)	No. Users	Responsible person	Visibility	Status
149	Experiment_11_11_2021	17/11/2021	13/3	5.411 5.332	1	Stefan Glaser	Public	Completed
152	PS-Cross-Beam (PS)	01/08/2021	6/1	0.0 0.0	1	J Alfredo Nunez-Merino	Private	Validated
109	Usability test: Plans administration	20/10/2021	14/2	0.088 0.046	4	None	Private	Validated
1	PS	13/12/2020	3/1	0.01 0.02	3	Test Admin	Public	Validated
183	CAEN-MPCOMP	01/08/2021	5/1	0.447 0.404	1	None	Public	Registered
89	ME2012	06/10/2021	5/1	0.028 0.018	1	J Alfredo Nunez-Merino	Public	In Preparation
109	Iradi test	20/10/2021	0/2	0.0 0.0	2	irradiation Facilities	Public	Validated
161	ME2_16	04/06/2021	2/1	0.024 0.024	1	J Alfredo Nunez-Merino	Public	Registered
86	ME2	06/08/2021	0/1	0.0 0.0	1	J Alfredo Nunez-Merino	Public	Registered
87	ME2_01	04/08/2021	0/1	0.0 0.0	1	J Alfredo Nunez-Merino	Public	Registered

IRRAD Data Manager

A. Nunez, Technical Student (Spain)

IRRAD Shuttle Control System

- Python-based **IRRAD Shuttle Motor Control Application**
- based on pyQT (python) as for the IRRAD Tables (2020)
- compatible with Windows and Linux



IRRAD SHUTTLE

IRRAD Remote Summer Students' team



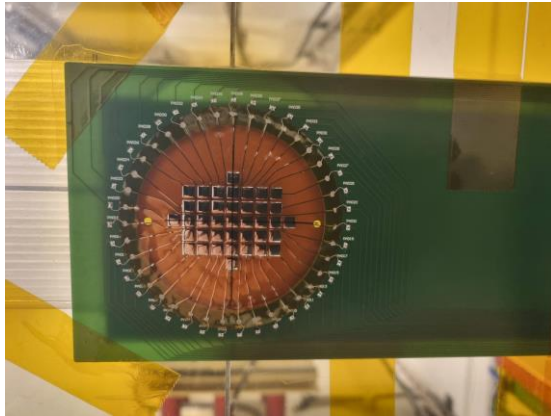
Aseel Abdulhalim (Palestine)

Tymoteusz Ciesielski (Poland)

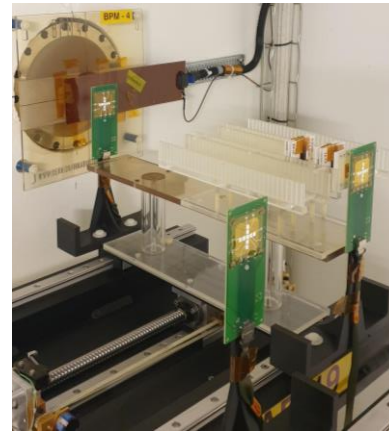
IRRAD Beam Profile Monitors Upgrade

Innovative Beam Profile Monitors:

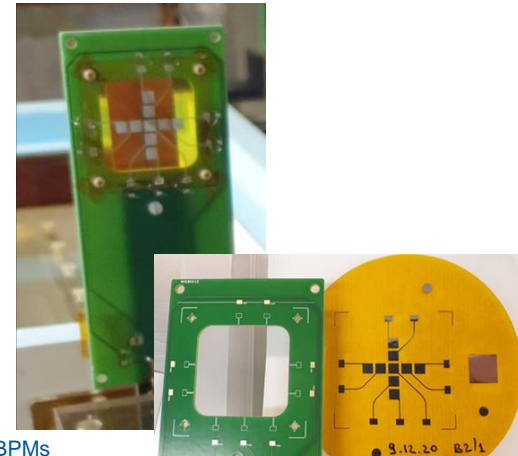
- new **mini-BPM** Al/Kapton ($0.3/25\mu\text{m}$) produced, tested in IRRAD, now operational
- large pattern **micro-BPM** Al/Kapton ($0.2/25\mu\text{m}$): first prototype tested, new production ongoing



40channel micro-BPM device

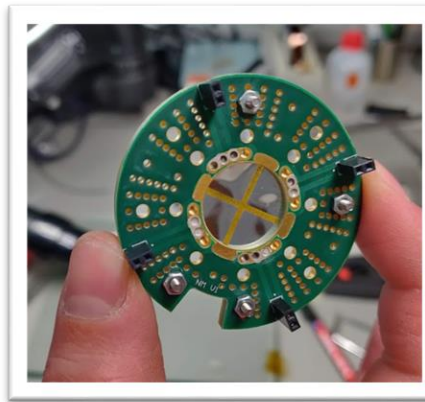


New mini-BPMs

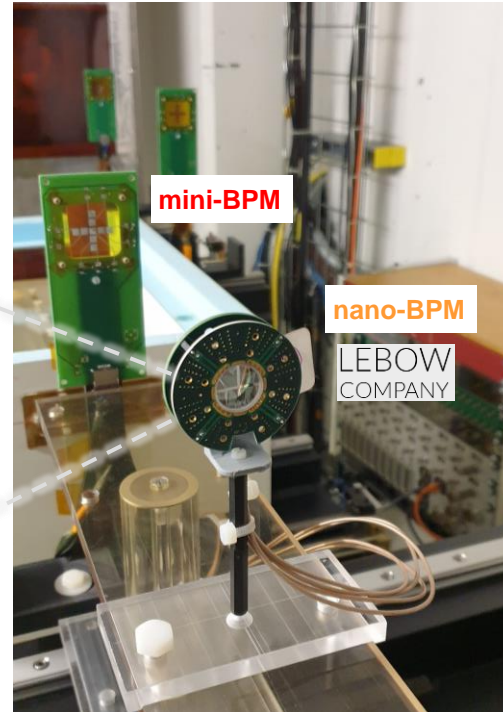


Ultra Thin Beam Position Monitors

Support the development of **nano-BPM** for AD **Al/Parylene (10/100nm)** for keV range



v&esper
clear.



IRRAD Experiment

See N. Minafra's presentation on Wednesday

© N. Minafra,
M. Doser,
R. Caravita



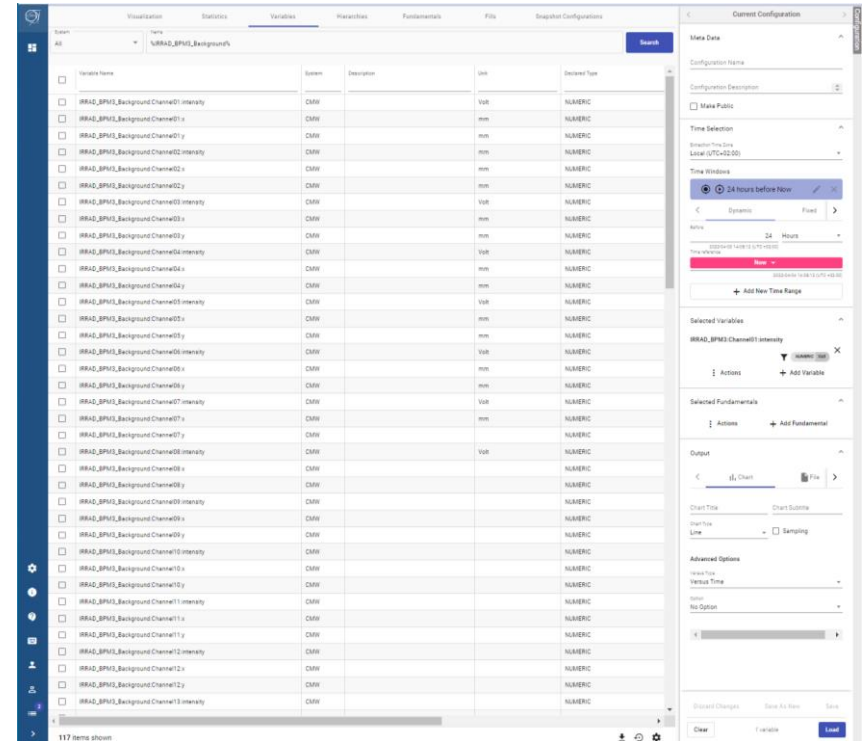
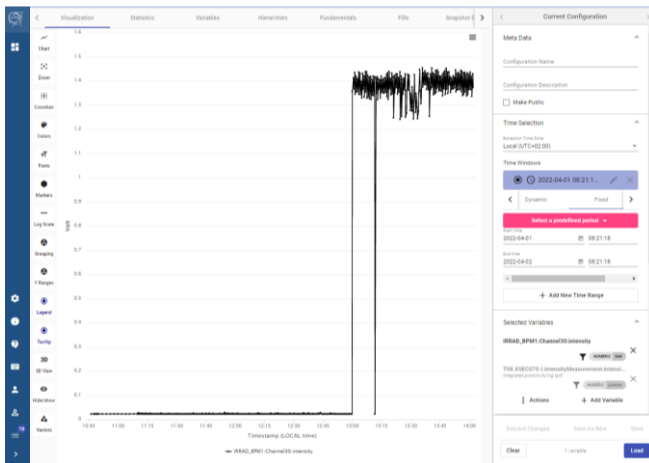
AEGIS EXPERIMENT

BPM Software Architecture Upgrade

Beam Profile Monitor (BPM) data:

- logged in NXCALS (CERN Logging System)
- published in Timber in real-time (<https://timber.cern.ch> – accessible only from CERN)

Allowing for further beam corrections by CERN Control Center (CCC)



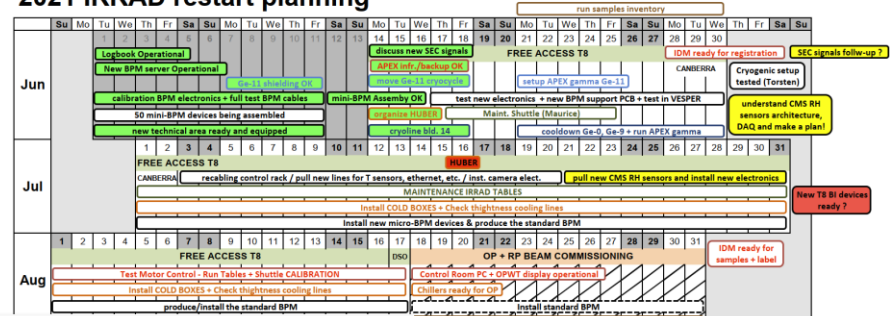
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IRRAD Restart

- Complete LS2 activities
- Commission new Beam Instrumentation
- Update Safety Docs, Safety Trainings
(<https://ps-irrad.web.cern.ch/ps-irrad/safety.php>)
- Define COVID procedures and install air recirculation systems control rooms
- New IRRAD e-log from BE-OP
- Restoring BI signals to IRRAD
- ...

2021 IRRAD restart planning





IRRAD / IRRAD

Skip to Session

Description and sessions in English

TARGET AUDIENCE: Any person entering to the installation IRRAD.

OBJECTIVE: Show you the special features of the CERN Proton Irradiation Facility (IRRAD). Teach you how to deal with the various hazards you may encounter when working in the facility. The responsibilities and expected behaviour of everyone accessing the area and the rights.

CONTENU:

- First location and general layout and equipment
- Access and Exit
- Evaluation in the event of emergency

Description et sessions en français

POPULATION CIBLÉE: toute personne devant accéder à l'installation IRRAD.

OBJECTIFS: Vous présenter les caractéristiques particulières de l'installation d'irradiation par protons du CERN (IRRAD). Vous apprendre comment agir par rapport aux différents risques que vous pouvez rencontrer lorsque vous travaillez dans les installations. Vous rappeler les bonnes pratiques pour la manipulation d'échantillons irradiés.

CONTENU :

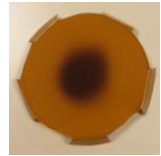
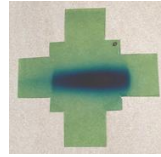
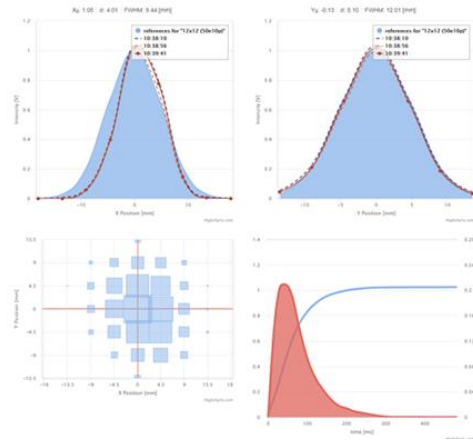
- Localisation d'IRRAD, plan général et équipements.
- Accès et sortie
- Évaluation en cas d'urgence.

Learning Type: Programme

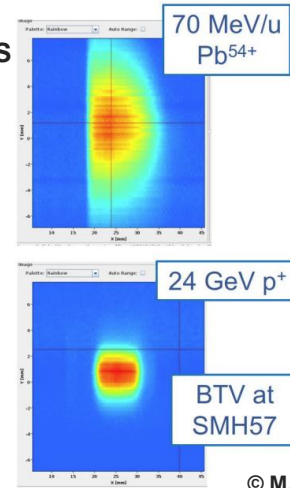
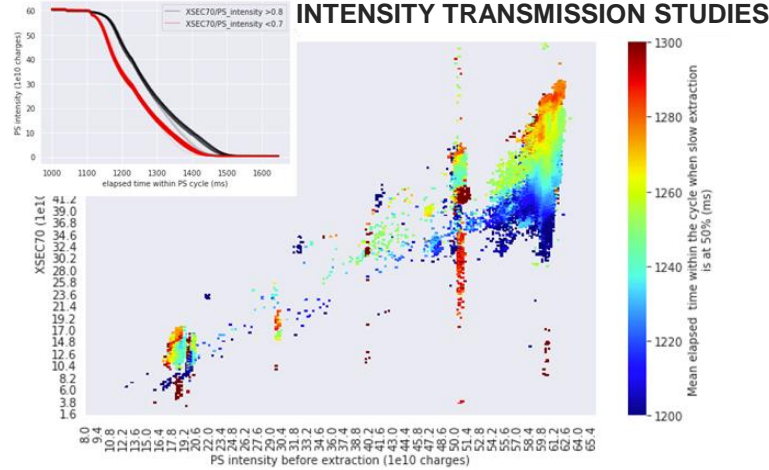
Domain: Installation Specific Safety

Mandatory Safety Training

Beam Commissioning 2021



T08 BEAM PROFILES



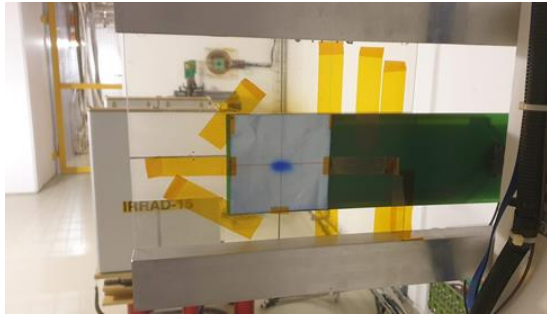
© M. Fraser (25/10)

- Beam instrumentation commissioning & tests in collaboration with SY-BI
- Optics studies to reduce the proton beam losses
- High Energy Heavy Ion beam steered down T8 with several intensity flavours (CHIMERA) – 2 weeks of HI run Nov.-Dec. 2022

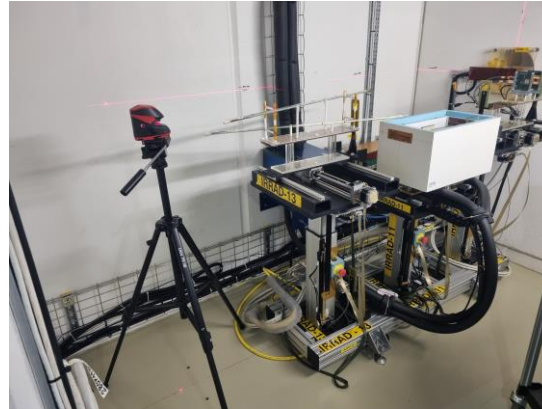
IRRAD User Run 2021

- 8 weeks run
- 18 experiments completed
- 190 samples irradiated

Priority was given to beam commissioning



Dosimetry & alignment verification measurements in IRRAD Zone 3



Samples installed in IRRAD Zone 2



Samples installed in IRRAD Zone 3

IRRAD Run 2022

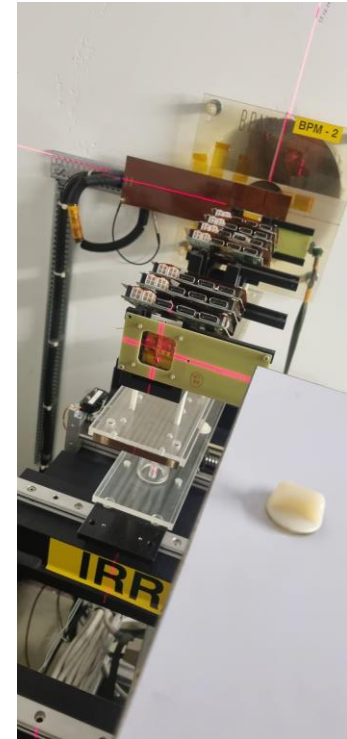
- From March to December
- 18 experiments registered in IDM, and more being discussed
 - 7 completed
 - 5 ongoing
 - 6 being prepared and scheduled
- ~300 samples registered in IDM
 - 231 being irradiated



IRRAD Zone 2 samples setup



IRRAD cold-box with VORTEX system for long-run experiments



IRRAD Zone 2 samples and micro-BPM2

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European Projects Associated to IRRAD



Started April 2021

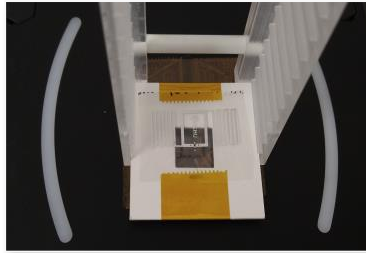


Started June 2021

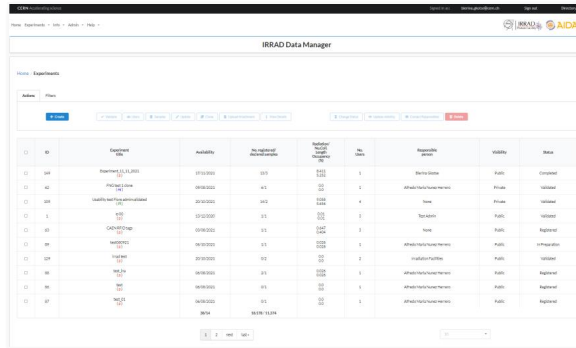


To start September 2022

- **Advancement and Innovation for Detectors at Accelerators**
- **Leading Task 4.3: Common tools for irradiation facilities quality control**
 - Generalisation of IRRAD Data Manager for ENEA-FNG and GIF++
 - Prototype of integrated system for induced activation and traceability data management
 - Dosimetry calibration set for cross-comparison of irradiation facilities by evaluation of Non-Ionizing Energy Loss (NIEL)

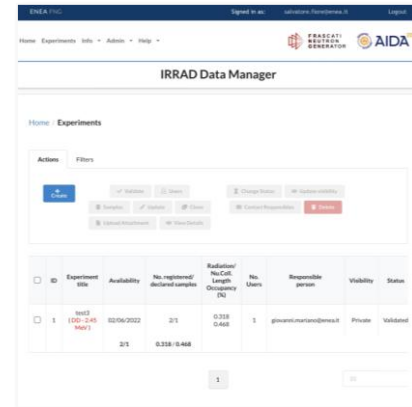


RFID measurements after irradiation experiment



ID	Experiment title	Availability	No. registered declared samples	Radiation/No. Coll. Length Occupancy (h)	No. Users	Responsible person	Visibility	Status
01	IRAD	2019-2022	100	1000	1	IRAD/Proton Facility	Public	Completed
02	IRAD	2019-2022	100	1000	1	IRAD/Proton Facility	Private	Validated
03	IRAD	2019-2022	100	1000	1	IRAD/Proton Facility	Private	Validated
04	IRAD	2019-2022	100	1000	1	IRAD/Proton Facility	Private	Validated
05	IRAD	2019-2022	100	1000	1	IRAD/Proton Facility	Private	Validated
06	IRAD	2019-2022	100	1000	1	IRAD/Proton Facility	Private	Validated
07	IRAD	2019-2022	100	1000	1	IRAD/Proton Facility	Private	Validated
08	IRAD	2019-2022	100	1000	1	IRAD/Proton Facility	Private	Validated
09	IRAD	2019-2022	100	1000	1	IRAD/Proton Facility	Private	Validated
10	IRAD	2019-2022	100	1000	1	IRAD/Proton Facility	Private	Validated

IRRAD Data Manager



ID	Experiment title	Availability	No. registered declared samples	Radiation/No. Coll. Length Occupancy (h)	No. Users	Responsible person	Visibility	Status
1	IRAD (2019-2022)	2019-2022	215	0.318 0.468	1	giuseppe.mariano@enea.it	Private	Validated

IDM for ENEA-FNG

Irradiation and Test Beam Facilities DBs

- Two separate but similar platforms for researching information about the test beam and irradiation facilities
- Maintained by the facility coordinators



Facility Name	Country	Facility Name	Source Type	Radiation Field Type	Funding Details
A.R.T.E.	Italy		Accelerator	Heavy ions	
ADVANCED RADIATION RESEARCH INSTITUTE (AREA)	Japan	PROTON facility THARA	AVF Cyclotron (K110), Tandem Ion Implanter	Proton	
ADVANCED RADIATION RESEARCH INSTITUTE (AREA)	Japan	Electron Beam Irradiation Facility	Cockcroft-walton type	Electron	
ADVANCED RADIATION RESEARCH INSTITUTE (AREA)	Japan	Gamma-ray Irradiation Facilities	Co-60	Gamma	
ADVANCED RADIATION RESEARCH INSTITUTE (AREA)	Japan	HEAVY IONS facility TIARA	AVF Cyclotron (K110), Tandem Ion Implanter	Heavy ions	
Aerial	France	feelix	Rhodoson	Electron	
Aerial	France	feelix	Rhodoson	X-Ray	
Aerial	France	feelix	Rhodoson	X-Ray	
Aerial	France	Van De Graaff	V6G linear accelerator	Electron	

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

Facility Name	Institute Name	Beamline Name	Country	Particle Type	Particle Energy	Coordinator
MAMI	University of Mainz	Beamline	Germany	gammas	< 1.6 GeV/c	fischer@kph.uni-mainz.de
MAMI	University of Mainz	Beamline	Germany	electrons	< 1.6 GeV/c	fischer@kph.uni-mainz.de
ELSA	University of Bonn	Beamline	Germany	electrons	1.2 - 3.2 GeV/c	eliner@physik.uni-bonn.de
Compton Facility	SPRING-8	Beamline	Japan	electrons, positrons	0.4 - 2.9 GeV/c	yosoi@crp.osaka-u.ac.jp
Compton Facility	SPRING-8	Beamline	Japan	photons (tagged)	1.3 - 2.9 GeV/c	yosoi@crp.osaka-u.ac.jp
SLAC	SLAC	Beamline	USA	electrons (sec.)	1 - 14 GeV/c	hast@slac.stanford.edu
SLAC	SLAC	Beamline	USA	electrons (prim.)	2.5 - 15 GeV/c	hast@slac.stanford.edu
ELPH	Research Center for Electron Photon	Beamline	Japan	electrons, positrons (conv.)	0.1-1.0 GeV/c	suda@res.tohoku.ac.jp

<https://test-beam-facilities.web.cern.ch/>

RADNEXT Facilities



Accessibility to irradiation facilities for research on radiation effects in electronics

- A network of irradiation facilities
- Transnational access to irradiation facilities

RADNEXT Facilities included in the irradiation facilities DB

Institution	Facility	Location	Beam Type	RADNEXT
University of Applied Sciences (FHWS)	Proton Facility (PFL) 4-150 particles	Germany	Proton	RADNEXT
UMS STIC Rutherford Appleton Laboratory	Orniq	United Kingdom	Spallation neutron source	RADNEXT
ISIS STFC	EMMA	United Kingdom	Neutron	RADNEXT
UCL-Université Catholique de Louvain	Neutron Lines(NF)	Belgium	Cyclotron	RADNEXT
UCL-Université Catholique de Louvain	Proton Beam Line(P)	Belgium	Proton	RADNEXT
UCL-Université Catholique de Louvain	Heavy Ion Irradiation Facility(HIF)	Belgium	Heavy ions	RADNEXT
TRIUMF	NIF	Canada	Neutron	RADNEXT
TRIUMF	PIF	Canada	Proton	RADNEXT
PHYSIKALISCH TECHNISCHE BUNDESANSTALT (PTB)	Neutron facility, high flux neutron beam	Germany	Neutron	RADNEXT
PHYSIKALISCH TECHNISCHE BUNDESANSTALT (PTB)	Neutron facility Neutron Reference Fields (NS-RNF)	Germany	Ion accelerator	RADNEXT
Paul Scherrer Institute (PSI)	Proton Facility	Switzerland	Cyclotron	RADNEXT
Nuclear Physics Institute of the CAS	GAMMA	Czech Republic	Neutron	RADNEXT
KVI	AGORF BM alpha and carbon ions irradiation	Netherlands	Alpha and carbon ions	RADNEXT
KVI	AGORF BM Proton Irradiation	Netherlands	Proton	RADNEXT
Helmholtz-Zentrum Dresden-Rossendorf (HZDR)	OSQAR	Germany	Proton	RADNEXT
GSI Helmholtz Centre	SIS 18 at GSI Darmstadt	Germany	Synchrotron	RADNEXT
GSI Darmstadt (MICROPROBE)	HEAVY IONS facility	Germany	Heavy ions	RADNEXT
GRAND ACCELERATEUR NATIONAL D'IONS LOURDES (GANIL)	HEAVY IONS facility	France	2 ECR source and 2 cyclotrons from G.60 MeV to 10.24 MeV	RADNEXT
Fraunhofer INT	TK1000	Germany	Gamma	RADNEXT
Fraunhofer INT	TK1000B	Germany	Gamma	RADNEXT
Fraunhofer INT	TK100A	Germany	Gamma	RADNEXT
Fraunhofer INT	TK100B	Germany	Gamma	RADNEXT
ESRF	ESRF	France	Accelerator	RADNEXT
FMA - French Centre of Expertise for Nuclear Safety and	FN1 French Neutron Generator	France	Neutron generator	RADNEXT



Institute	Facility	Location	Beam Type	RADNEXT Contact
CERN	CHARM	Switzerland	Mixed Field	Salvatore Danzeca salvatore.danzeca@cern.ch
TRIUMF	PIF	Canada	Proton	TAI Camille Belanger-Champagne cbchamps@triumf.ca
Institut Laue-Langevin (ILL)	TENS	France	Neutron	Manon Letiche letiche@ill.fr
TRIUMF	NIF	Canada	Neutron	TAI Camille Belanger-Champagne cbchamps@triumf.ca
KVI	AGORF BM Proton Irradiation	Netherlands	Proton	Brian Jones brian.jones@rug.nl
KVI	AGORF BM alpha and carbon ions irradiation	Netherlands	Alpha and carbon ions	
UCL-Université Catholique de Louvain	Heavy Ion Irradiation Facility(HIF)	Belgium	Heavy ions	Nancy Postiau nancy.postiau@uclouvain.be
UCL-Université Catholique de Louvain	Proton Beam Line(P)	Belgium	Proton	Nancy Postiau nancy.postiau@uclouvain.be
UCL-Université Catholique de Louvain	Neutron Lines(NF)	Belgium	Neutron	Nancy Postiau nancy.postiau@uclouvain.be
Fraunhofer INT	Neutron generator Thermo Electron D-711	Germany	Neutron	
CENTRO NACIONAL DE ACCELERADORES	PROTON facility - 1	Spain	Proton	Yolanda Morilla ymorilla@us.es
CENTRO NACIONAL DE ACCELERADORES	PROTON facility - 2	Spain	Proton / deuteron	Yolanda Morilla ymorilla@us.es
Fraunhofer INT	TK1000A	Germany	Gamma	
Fraunhofer INT	TK1000B	Germany	Gamma	
Fraunhofer INT	TK100	Germany	Gamma	
GSI Helmholtz Centre	SIS 18 at GSI Darmstadt	Germany	Heavy ions	Tim Wagner twagner@gsi.de
GRAND ACCELERATEUR NATIONAL D'IONS LOURDES (GANIL)	HEAVY IONS facility	France	Heavy ions	Eloise Dessy eloise.dessy@ganil.fr
GSI Darmstadt (MICROPROBE)	HEAVY IONS facility	Germany	Heavy ions	Tim Wagner twagner@gsi.de
University of Jyväskylä DEPARTMENT OF PHYSICS	PROTON facility JYFLK-130 cyclotron	Finland	Proton	Heikki Kettunen heikki.kettunen@jyu.fi



RADNEXT Facilities and Transnational Access

Transnational Access provides **beam time** for experiments:

- **Calls open every 3 months** (call currently open)
- A **dedicated web portal** for proposal submission was developed
- (<https://radnext-ta-portal.web.cern.ch>)
- Beam time assigned after **review** of the proposals and **facility availability**

The screenshot shows the 'RADNEXT Portal' header with navigation links (Home, Help, All Users, My Account, blerina.gkotse@cern.ch, Logout). Below the header is a progress bar with three steps: Step 1, Step 2, and Step 3. The main form area contains several fields: 'Project title *' (marked as required), 'Project acronym *', and two checkboxes for acknowledging requirements and safety assessments. At the bottom, there are 'Cancel' and 'Next' buttons.

Irradiation Experiment Proposal form

The screenshot shows the 'RADNEXT Portal' header with navigation links. Below the header is a '+ Submit Proposal' button. The main content area is divided into two sections: 'My Proposals' and 'Proposals For Review'. Each section contains a table with columns for Title, Beam type, Group Leader, and Status.

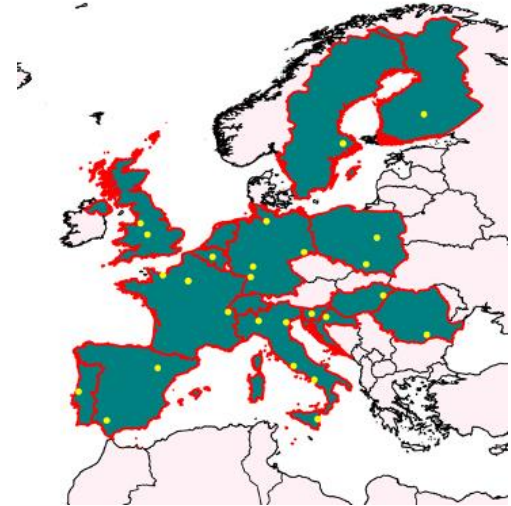
My Proposals			
Title	Beam type	Group Leader	Status
TA03-9: Test fede	Mixed field	Federico Ravotti	Submitted
TA03-14: test 10_10	Neutrons - Atmospheric	Blerina Gkotse	Submitted

Proposals For Review			
Title	Beam type	Group Leader	Status
TA03-14: test 10_10	Neutrons - Atmospheric	Giuseppe Pezzullo	Submitted

Proposals' view

EURO-LABS

- 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
- Transnational Access to IRRAD and GIF++
- **Foreseen to start 1st September 2022**



*Paolo Giacomelli <https://indico.cern.ch/event/1104064/contributions/4797462/>

Summary

- T8 Beam Instrumentation and IRRAD Upgrades
- Beam commissioning completed
- IRRAD Run 2022 ongoing
- Irradiation and Test Beam Facilities DBs fully functional and being kept updated in the best effort
- New European projects and Transnational Access:
 - RADNEXT network already available
 - IRRAD and GIF++ available soon through EURO-LABS



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