EURO-LABS

EUROpean Laboratories for Accelerator Based Sciences

Research Infrastructures for Nuclear and Particle Physics

WP 4: Access to Research Infrastructures for Detector R&D

Task 4.3. Irradiation Facilities

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for the Task 4.3. team

Second Annual Meeting (SAM) of EURO-LABS, Kraków, Poland, 9-11.October

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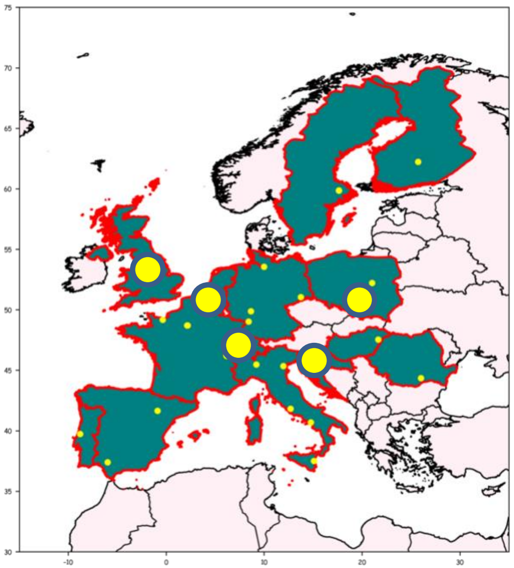
Task 4.3: Irradiation Facilities

WP4 aims at providing TA to various facilities having energetic beams and **irradiation facilities**. These measurements are necessary to study the effect of detectors and associated equipment in-beam, required for the detectors upgrades for operation at the HL-LHC and construction of new detectors for the future.

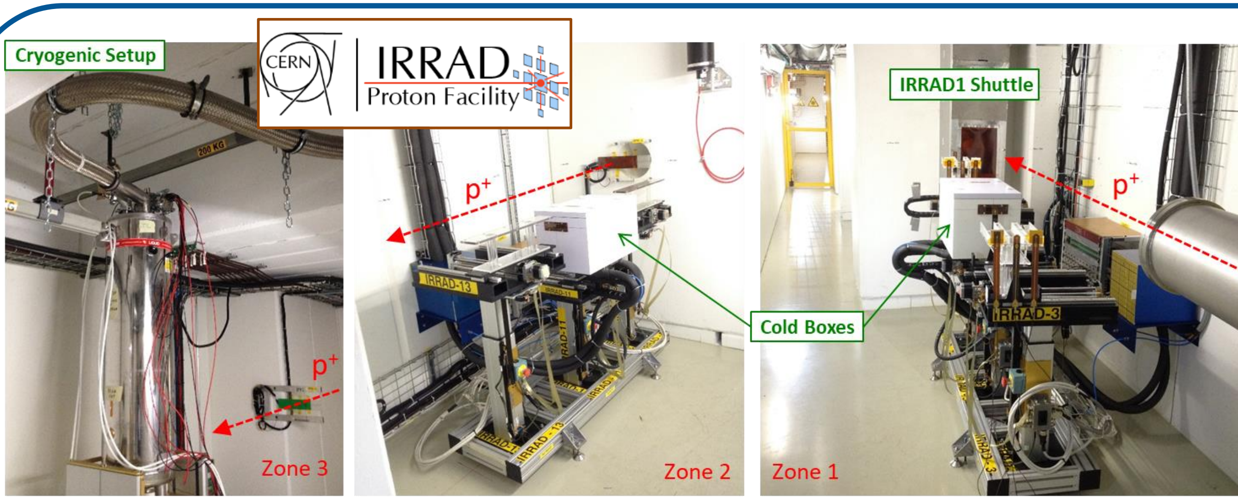
- Task 4.1. (TA): Test beams (CERN, DESY, PSI)
- Task 4.2. (TA): Detector characterizations (RBI, ITAINNOVA)
- **Task 4.3. (TA): Irradiations**
  - 4.3.1. **CERN IRRAD facility** (Geneva, Switzlerand)
  - 4.3.2. **CERN GIF++ facility** (Geneva, Switzerland)
  - 4.3.3. **JSI TRIGA reactor** (Ljubljana, Slovenia)
  - 4.3.4. **IFJ PAN AIC-144 cyclotron** (Kraków, Poland)
  - 4.3.5. **UCLouvain CRC** (Louvain-la-Neuve, Belgium)
  - 4.3.6. **Birmingham MC40 Cyclotron** (Birmingham, UK)
- Task 4.4.: Service improvements



Task 4.3. provides TA to six leading irradiation facilities in Europe with proton, neutron or mixed field sources, as well as with gamma rays. The facilities cover the actual radiation fields in high energy hadron collisions in a representative manner. In addition, some are offering single event effect testing opportunity for electronics. Main users originate from the hadron collider community, with the emerging R&D for FCC-hh requiring extremely high fluences in excess of 10^{17} $n_{eq}cm^2$.

CERN IRRAD and GIF++ Facilities

EURO-LABS EUROPEAN LABORATORIES FOR ACCELERATOR BASED SCIENCES

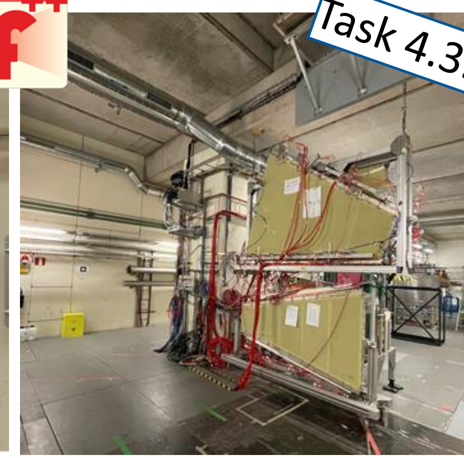


Task 4.3.1

- **24 GeV/c protons**
  - 400ms spills
- **~1.4×10^{16} p/cm^2/week**
  - beam spot: 12x12mm^2 FWHM
- **1 shuttle system** (small samples)
- **9 irradiation tables**
  - 6x room temperature
  - 2x cold boxes (-25°C)
  - 1x cryogenic setup (4.2K)

IRRAD: radiation test of solid-state/calorimetry detector components, electronics (DD,SEE), materials for HL-LHC

- **^{137}Cs γ-ray source** 12 TBq (2023)
- max. rate **~2.5 Gy/h** @ 0.5m
  - attenuator system 1:50'000
- **2 symmetric radiation field**
  - ±37º wide angle collimators
  - >100m^2 floorspace for DUTs
- **μ-beam** (100 GeV; ~10^4/spill) H4
  - gas infrastructure available



Task 4.3.2

GIF^{++}: radiation (& beam performance) test of muon detector systems, electronics (TID), gas mixtures for HL-LHC

4.3.1/2 CERN IRRAD/GIF++ 2023

2023 – status 9/2023

- **IRRAD:**
  - **37 experiments registered**
  - **>400 samples processed**
  - ATLAS ITk pixel & strips, ATLAS HGTD, CMS BRIL, CMS pixel, LHCb ECAL, LHCb PicoCal, RD53, RD50, EP-ESE, TE-MSC, SY-BI, AIDAinnova, i-FAST, …
  - in 2023, qualification experiments (detector modules, complex setup, etc.) prevailed on R&D samples
  - **priorities assigned from summer;** some samples shifted to the run 2024

ATLAS-HGDT

ATLAS-HGDT

2023 – status 9/2023

- **GIF++:**
  - **22 active user groups operating equipment in the facility**
    - **Detailed list in 'Spare Slides'**
  - 2022: 9 Weeks of shared or exclusive muon beam time
  - 2023: 6 weeks of muon beam time (shared with RD51) (due to shortened beam operation)
  - 2023: expect to deliver 48 weeks of gamma irradiation in 2023

	Set-ups participating	Date of beam period starting:						
		24.04	3.05	5.07	12.07	23.08	30.08	
Nr.	Setup / Week	17	18	27	28	34	35	Requested
1	ATL-MPI - 1&2	u	u	u	u	u	u	3x2 weeks
2	ATL-NSW MM			d	d	~~d~~	~~d~~	2x2 weeks
3	ATL-RPC -1&2	d	d	d	d	~~d~~	~~d~~	3x2 weeks
4	CMC-CSC -1	d	d	d	d	d	d	3x2 weeks
5	CMC-CSC - 2	d	d	d	d	d	d	3x2 weeks
6	CMC-CSC - 3					~~u~~	~~u~~	3x2 weeks
7	CMS-DT-MB2	u	u					1x2 week
8	CMS-GEM			d	d	~~d~~	~~d~~	2x2 weeks
9	CMS-RPC - 1	u	u	u	u	u	u	4x2 weeks
10	CMS-RPC - 2	u	u	u	u	u	u	4x2 weeks
11	EP-DT2	u	u	u	u	u	~~u~~	4x2 weeks
12	ProToV			~~u~~	~~u~~			3x2 weeks
13	RE21/CBM					d	d	1x2 week
14	RPC Ecogas			u	u	u	u	3x2 weeks
	Upstream	5	5	5	5	6	6	
	Downstream	3	3	5	5	3	3	
	Total	8	8	10	10	9	9	

U = upstream, D = downstream, ~~U~~/~~D~~ = user cancelation

4.3.4. CERN IRRAD - User support

- *IRRAD (Remote/Normal TA): 4 'remote' TA experiments run by 15 users and IRRAD staff have been performed for the total number 1519 Access Units.*
  - EURO-LABS-2023-CERN-IRRAD-01-ATLAS-ITK
    Irradiation of Si detector at small angle in IRRAD shuttle
  - EURO-LABS-2023-CERN-IRRAD-02-CMS-Pixel
    CMS Inner Tracker Pixel Sensors
  - EURO-LABS-2023-CERN-IRRAD-03-LHCb-ECAL
    SPACAL R&D
  - EURO-LABS-2023-CERN-IRRAD-04-LGAD-PPS2
    LGADs for CMS PPS2

TA facility contact:
Federico Ravotti

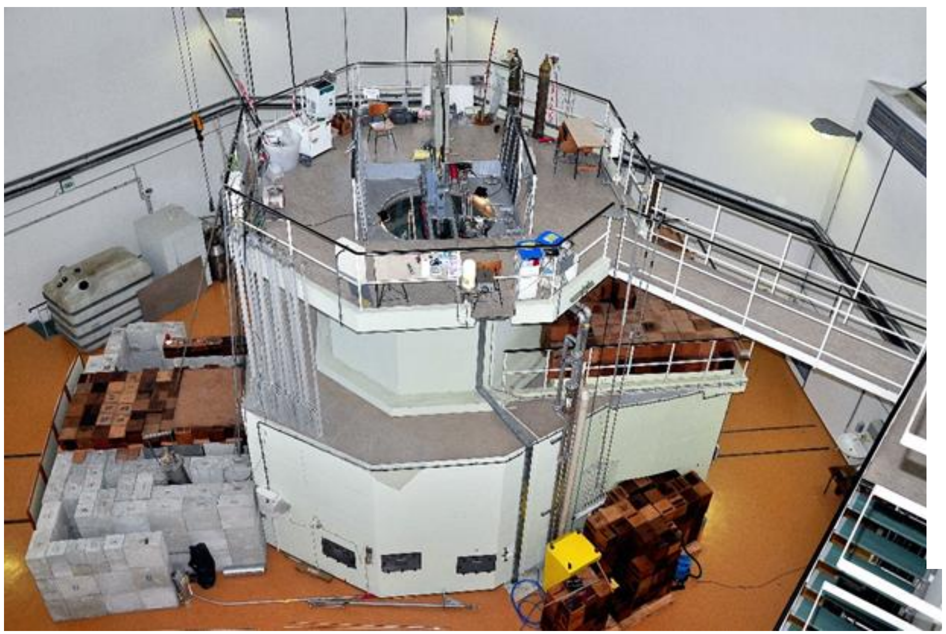
- *GiF++ ("Normal TA"): No application received.*
- *Not entirely clear why we got no application (GIF++ was in very high demand in AIDA TA), but clearly the preparations for the LHC-upgrade are driving the situation;*
  Martin: "We currently have the issue that basically our whole user community is form 2-3 LHC Experiments. So they are local and on site. And also very busy with their main experiments - leading to severe manpower problems during test beam."

Facility contact:
Martin Jaekel

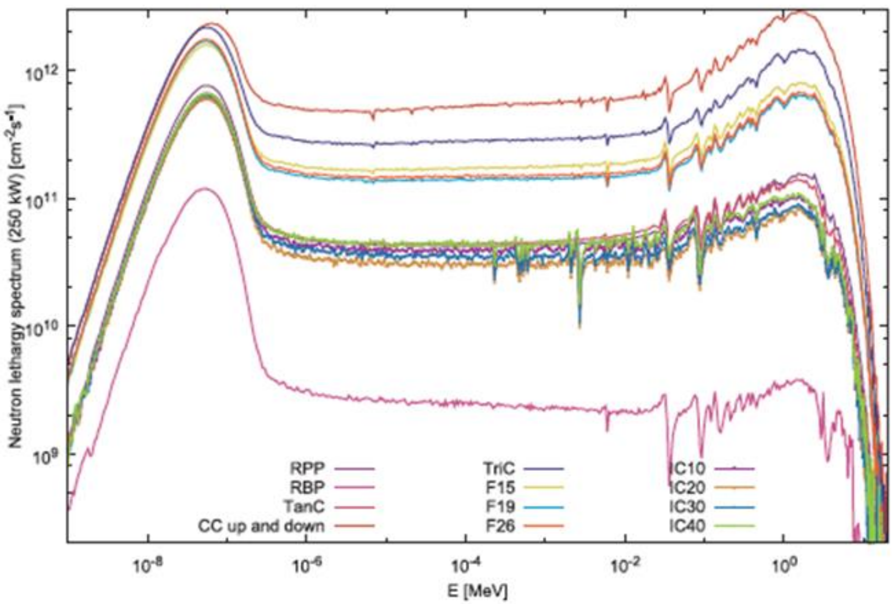
4.3.3. Jožef Stefan Institute TRIGA Reactor

Jožef Stefan Institute
Ljubljana, Slovenia

- TRIGA Mark II reactor
  - 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
  - several irradiation channels



- neutron spectra in different irradiation channels



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

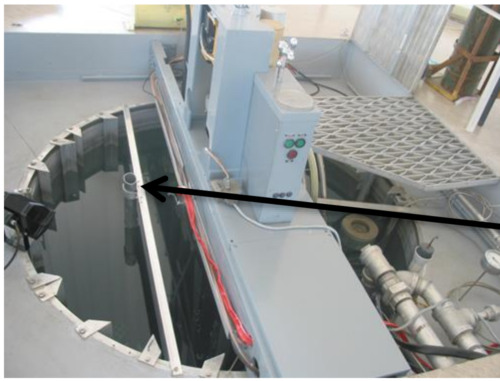
More info about irradiation channels:
https://ric.ijs.si/en/info-za-uporabnike/lastnosti-obsevalnih-kanalov

TA facility contact:
Igor Mandic

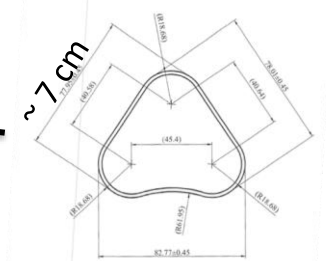
4.3.3. Jožef Stefan Institute TRIGA Reactor

Jožef Stefan Institute
Ljubljana, Slovenia

- **TRIGA Mark II reactor**
  - samples are inserted to the core through vertical channels from the reactor platform

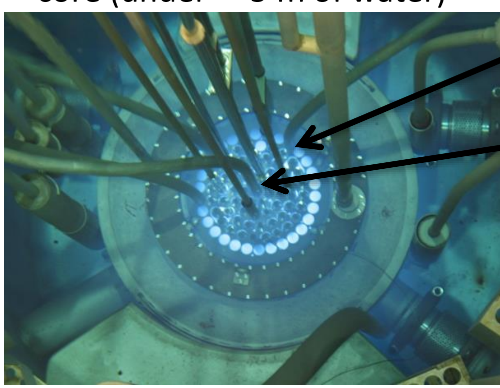


TIC channel
ϕ_{max} = **$3.6 \cdot 10^{12}\, n_{eq} cm^{-2} s^{-1}$**



TIC channel shape

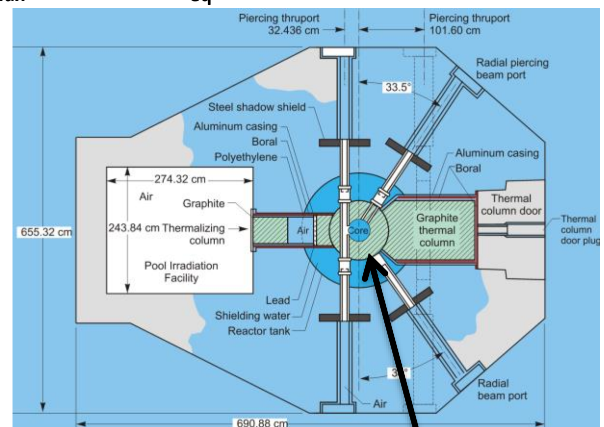
  - core (under ~ 5 m of water)



Chanel F19
ϕ_{max} = **$1.5 \cdot 10^{12}\, n_{eq} cm^{-2} s^{-1}$**

Central channel
ϕ_{max} = **$6.7 \cdot 10^{12}\, n_{eq} cm^{-2} s^{-1}$**

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



- sample inserted next to the core from the side

4.3.3. Jožef Stefan Institute TRIGA Reactor

- **Activities at JSI TIRGA reactor in the last reporting period:**

Jožef Stefan Institute
Ljubljana, Slovenia

- irradiations with neutrons in the TRIGA nuclear reactor at Josef Stefan Institute supported through EURO-LABS TA
- Access Unit (AU) is 1 hour of reactor time
- **700 Access units covered by EURO-LABS**

Last reporting period:

- **14 irradiation projects for 84 AU were approved**
- **78 AU** spent, one term long project ongoing irradiations worth of 6 AU still to be finished
  - all applications were accepted
  - one project with majority of users not working in an EU member state or HE associate country

- most projects (10) related to radiation testing of detectors and electronics for experiments at HL-LHC

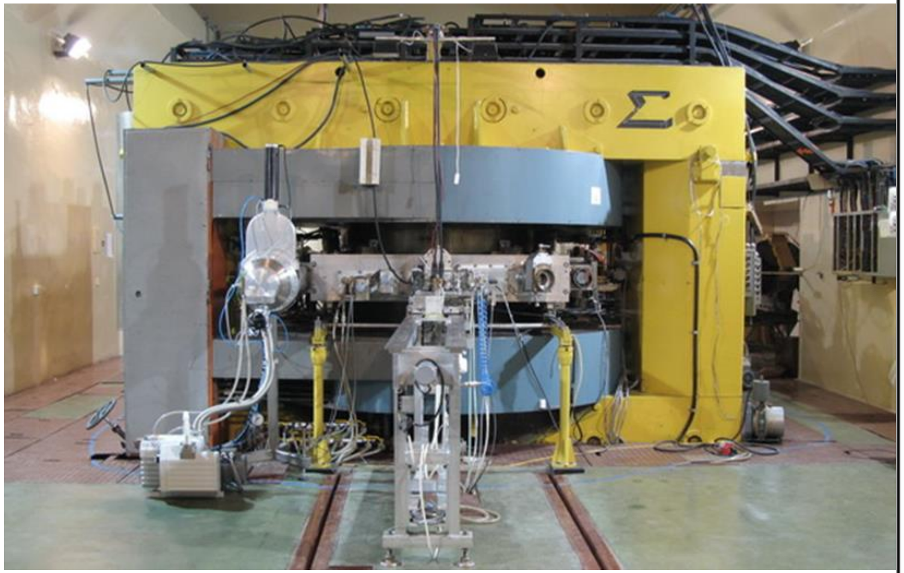
- 4 projects to other developments such as studies of CMOS DMAPS, passive CMOS detectors, improvement of radiation hardness of LGAD sensors and investigations of 3D detectors irradiated to very high neutron fluences

- **13 irradiations finished and samples sent back for post irradiation testing,**
- one long term project ongoing, first irradiation step finished, samples sent for post irradiation testing
- no problem with radioactivation of samples up to now:
  ➔ activities of isotopes below the exemption level
  → can be sent in standard packages (i.e. not as dangerous material)

Congratulations to Igor and his team; the most successful implementation of Irradiation TA in terms of number of experiments/users

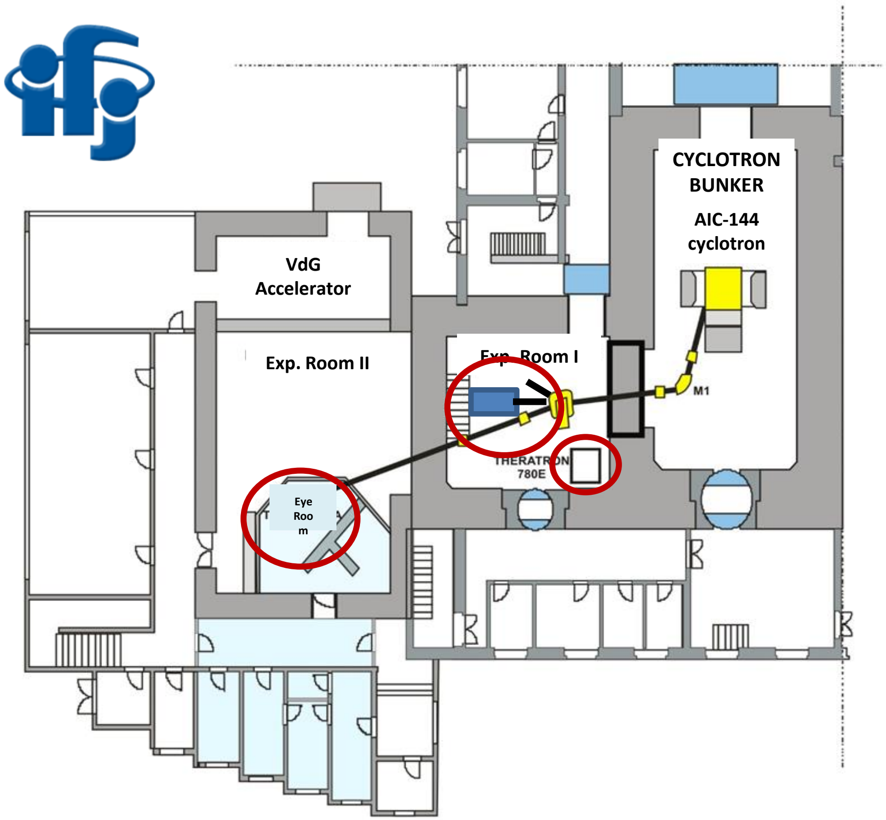
4.3.4. IFJ PAN AIC-144 cyclotron facility

The Henryk Niewodniczański Institute of Nuclear Physics Polish Academy of Sciences



- AIC-144 cyclotron

BEAM PARAMETERS:
Energy 60 MeV; RF 26.26 MHz;
Beam macro structure 50 Hz, macro pulse length 0.5 ms, beam current 80 nA *(110nA)*

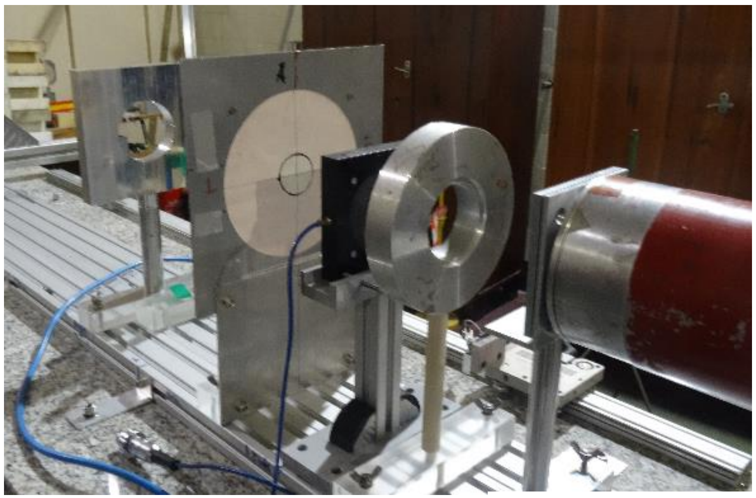


TA facility contact:
[Pawel Olko]

4.3.4. IFJ PAN AIC-144 cyclotron facility

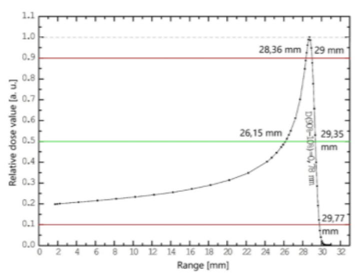
- IFJ PAN Optical lines at the AIC-144 cyclotron building

Exp. Room I ***/Small field horizontal beam line/***

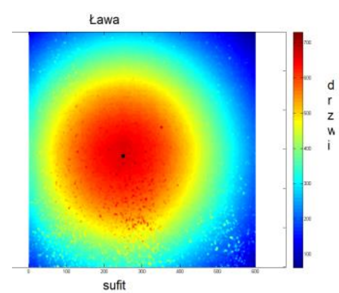


Exp. Room II ***/Small field horizontal beam line/***

Energy: 60 MeV (*10MeV-60MeV*);
Proton beam current: 2nA – 100nA;
Transmission to the experimental room 60-65% of extracted beam;
Spot size: ~ 10mm (1σ, estimated);
Flatness ≥ 15% (±10%);
High proton beam intensity and irradiation field configuration flexibility;



Depth dose distribution



Beam profile

Energy: 0-58 MeV;
Dose rate: 0.001 – 1 Gy/s (measured in water);
Single scattering;
Beam field size: ≤ 40 mm;
Field homogeneity ≥ 5%;
Min flux of protons: 5e5 p/cm2·s (50MeV);
Typical flux: 1e8 – 1e9 p/cm2·s;
Irradiation in SOBP available;
Sample positioning precision (> 0.1 mm);

4.3.4. IFJ PAN AIC-144 cyclotron facility

EURO-Labs SAM 9.10.23: **Thank you for the visit to the facility!**

control room

service improvements

history of institute

TA facility contact:
Pawel Olko

4.3.4. IFJ PAN AIC-144 cyclotron facility

- *3 TA experiments run by 11 users and IFJ staff have been performed for the total number 80 Access Units using both lines.*

  - EURO-LABS-IFJAIC-2023-002 (Details: see spare slides)
    POLAR-2, A Large-Scale Detector For Gamma-Ray Bursts Photon Polarization Measurements

  - EURO-LABS-IFJAIC-2023-003 (Details: see spare slides)
    SHARCS Computing Module Candidates Initial Test (SHARCS-CMC-IT)

  - EURO-LABS-IFJAIC-2023-004 (Details: see next slide)
    Dosimeters for FLASH proton therapy

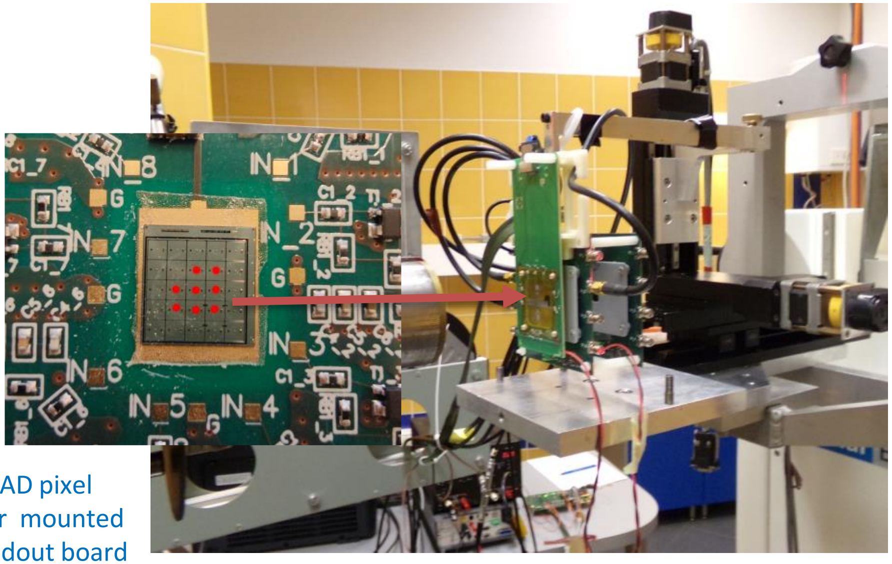
4.3.4. IFJ PAN AIC-144 cyclotron facility

- ***LGAD for dosimetry*** *[EURO-LABS-IFJAIC-2023-004]*

Low gain avalanche detectors (LGAD) can measure charged particle fluences with high timing precision and spatial resolution and are a promising technology for radiation monitoring and dosimetry. A successful measurement of both the spatial and temporal dimensions of the beam will establish LGADs as a potential technology for dosimetry.

Physics Goals

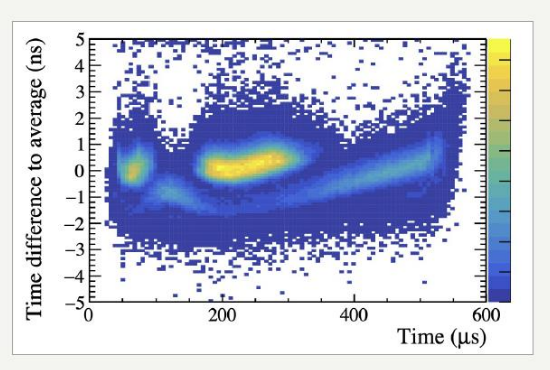
1. Understand LGAD response to AIC-144 proton beam
2. Measure beam fluence: number of protons / cm^2 / s
3. Measure beam spatial and temporal profile
4. Ascertain possibility of using LGAD as a dosimeter.



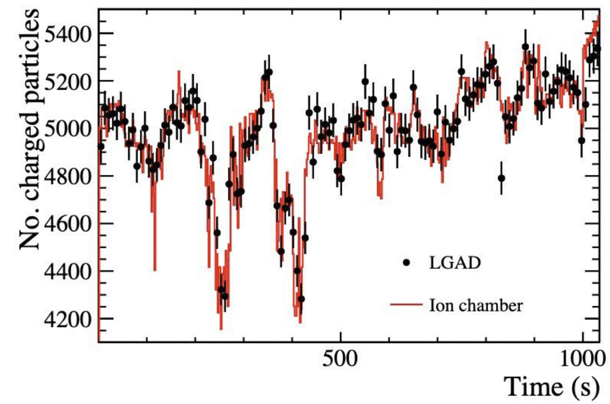
LGAD pixel sensor mounted on readout board

LGAD pixel sensor array at the irradiation facility

RESULTS



Macro-pulse structure of the AIC-144 proton beam



LGAD follows response of ion chamber

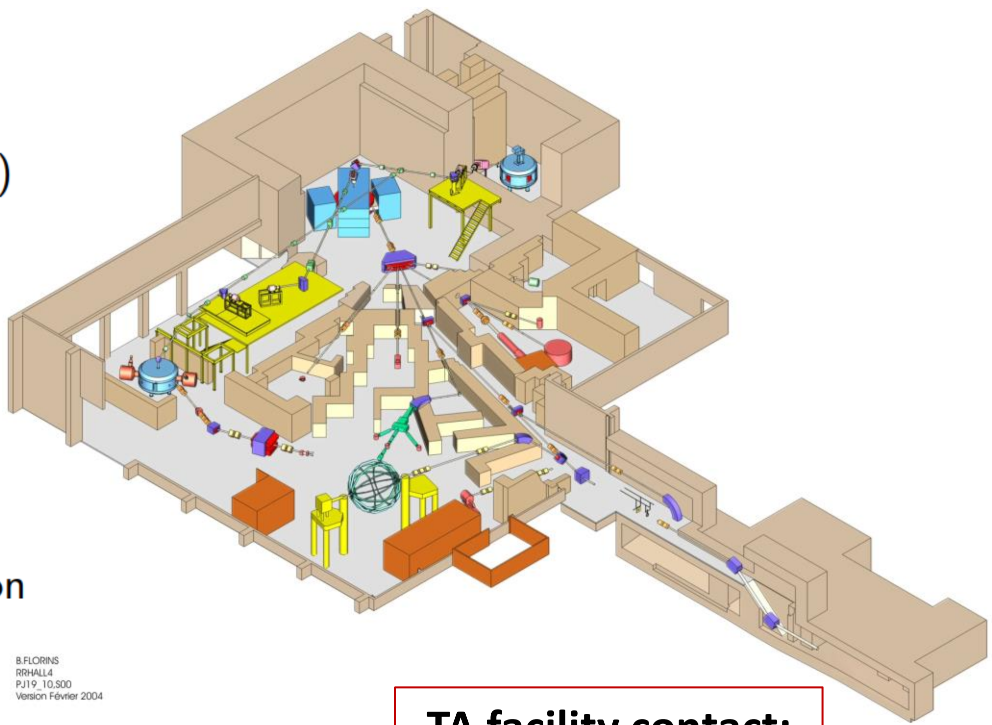
Conclusion: LCAD can be used as a dosimeter

4.3.5. CRC facilities at Louvain-la-Neuve

- Centre de Ressources du Cyclotron (CRC)
  - Institut de Recherche en Mathématique et Physique (IRMP)
  - Center for Cosmology, Particle Physics and Phenomenology (CP3)

Three irradiation facilities focused in measuring the response of electronic components to single event effects

- NIF: Neutron Irradiation Facility
  - Broad spectrum neutrons (0-50 MeV)
  - Flux: $3 \times 10^9 n/(cm^2\ s)$
- LIF: Proton Irradiation Facility
  - Protons 10-62 MeV
  - Flux: $2 \times 10^8 p/(cm^2\ s)$
- HIF: Heavy-Ion Irradiation Facility
  - Heavy Ion "cocktail"
  - Electronic failures induced by radiation



TA facility contact:
Eduardo Cortina Gil

4.3.5. CRC facilities at Louvain-la-Neuve

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HIF characteristics

- Heavy ion cocktail covering a wide range of LET and ranges.
  - Fully characterisation of SEE response of electronic components.
  - Fast ion changing (few minutes)
- Beam flux is variable between a few ions/s.cm^2 and $\sim 10^4$ ions/s.cm^2
  - Online monitoring $\rightarrow$ high precision in fluence delivered
- Redundant metrology
  - Fluence and energy
  - Moving frame, alignment system
  - ESA SEU monitor: 4x4 Mbit SRAM (Atmel AT60142F) arranged in a square region of 24mm x 24mm
- Beam homogeneity of 10% on a 25 mm diameter.
- Standard mechanical interface and feedthroughs
- Irradiations are done in vacuum and for most of the ions naked chips are needed.

M/Q	Ion	DUT energy [MeV]	Range [μm Si]	LET [MeV/(mg/cm^2)]
3.25	$^{13}C^{4+}$	131	269.3	1.3
3.14	$^{22}Ne^{7+}$	238	202.0	3.3
3.37	$^{27}Al^{8+}$	250	131.2	5.7
3.27	$^{36}Ar^{11+}$	353	114.0	9.9
3.31	$^{53}Cr^{16+}$	505	105.5	16.1
3.22	$^{58}Ni^{18+}$	582	100.5	20.4
3.32	$^{84}Kr^{25+}$	769	94.2	32.4
3.32	$^{103}Rh^{31+}$	957	87.3	46.1
3.54	$^{124}Xe^{35+}$	995	73.1	62.5

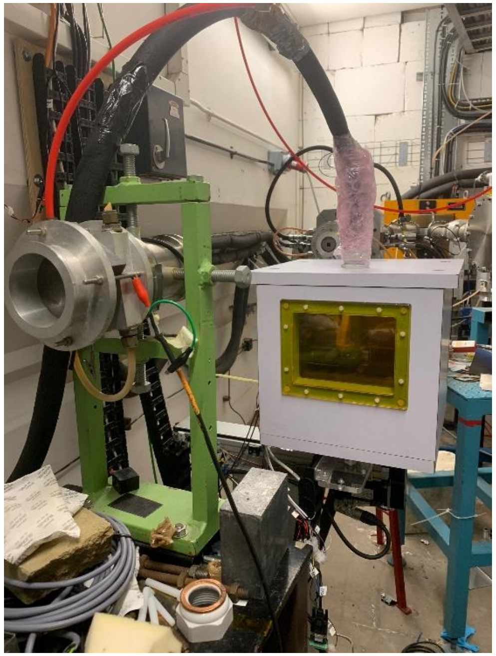
TA facility contact:
Eduardo Cortina Gil

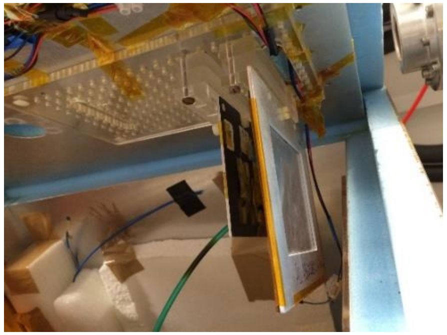
CRC facilities:

- No application received for P1.
- One request in the pipeline for P2.

4.3.6. UoB MC40 Cyclotron - Birmingham

- **27 MeV** proton beam, operating at a current of **100 – 400 nA.**
- Collimated square beam spot of **10 mm × 10 mm**.
- Samples mounted inside N2 flushed cold box (typ. **RH < 10%**), maintained at **−27°C** (possible to reach -40°C).
- Cold box mounted on tracking stage capable of both **static positioning** and **periodic scanning** during irradiation.
- 300 µm of Al foil shielding in front box entrance window to block low energy component of beam.
- Samples to be irradiated are mounted on Al plate (2 mm thick) attached to the lid of the cold box.
- Typically able to deliver up to a few 10^{15} n_{eq}/cm^2 over samples of a few cm^2 in one day.





TA facility contact:
Laura Gonella

4.3.6. UoB MC40 Cyclotron - Birmingham

- 2 projects in the reported period

TA Project Acronym	Project Title	Objectives	Achievements	Access Units	Users
EURO-LABS-2023-UOB-001	Irradiation of active DMAPS pixel sensors	Investigation of the radiation tolerance of **depleted monolithic active pixel sensors (DMAPS)** built in commercial CMOS technologies	Irradiation completed, testing ongoing, results and publications expected in the next 6 months	5	3
EURO-LABS-2023-UOB-002	Displacement Damage in I3T80 technology	Investigation into why some **DC/DC converters and LDMOS transistors** show markedly different response when exposed to protons or neutrons.	Irradiation completed, testing not yet started, results and publications will follow	7.5	1

WP4.3 Deliverables

- Each RI delivers Access Units (~beam hours) to Projects with Users
- Two access modes: physical/remote access
  - Physical: users at RI (user support)
  - Remote: users send samples to RI (handling, shipment)

Task	WP name	Institute	Facility	AU	Users	Projects	User support	Access Units [8/23 – M12]	Users [8/23 – M12]	Projects [8/23 – M12]
Irradiations	WP4.3.1	CERN	IRRAD	4000	65	16	yes/remote	1348 (34%)	15	4
	WP4.3.2	CERN	GIF++	4060	74	14	yes	0	0	0
	WP4.3.3	JSI	TRIGA	700	150	50	remote	78 (11%)		14
	WP4.3.4	IFJ-PAN	AIC-144	800	140	28	yes/remote	80 (10%)	11	3
	WP4.3.5	UCL	HIF/LIF/NIF	100	20	10	yes	0	0	0
	WP4.3.6	UoB	MC40	300	36	12	remote	12.5 (4%)	4	2

4.3. Summary

- EURO-LABS from HEP detector perspective
  - TA complement to AIDAinnova; follow up of successful TA in AIDA and AIDA2020
- **Access to irradiation facilities tailored to HEP detector R&D**
  - 6 first class European irradiation facilities participating
    - **CERN IRRAD facility** (Geneva, Switzlerand)
    - **CERN GIF++ facility** (Geneva, Switzerland)
    - **JSI TRIGA reactor** (Ljubljana, Slovenia)
    - **IFJ PAN AIC-144 cyclotron** (Kraków, Poland)
    - **UCLouvain CRC** (Louvain-la-Neuve, Belgium)
    - **Birmingham MC40 Cyclotron** (Birmingham, UK)
  - Offering **9960 AU = 9960 hours of irradiation**
- **First year remained after our expectations**
  - So far 1519 AU out of 9960 anticipated AU over 4 years delivered (only 15%)
  - Two facilities did not get any application!
  - Why?
    - LHC experiments in their final testing years for HL-LHC upgrades are running in very dense work and irradiation programs leaving little room for R&D and smaller project programs?
      - At CERN IRRAD/GIF++ facilities: Access to facilities without TA possible and fully booked for HL-LHC
      - Some hurdles/hesitations in filling documentation and handling requests ?; ….to be improved
    - **To Do:** Intensify efforts to publicize the program and the facilities and the TA funding opportunity ?; enforce TA applications at 'free facilities' ?

SPARE SLIDES

4.3. Irradiation Facilities

- Irradiations
  - 6 RI’s covering a broad range of particles and fluences
  - special campaigns foreseen for 1e17++ ballpark

Infrastructure short name	Sub-task number	Installation name	Source	Particle	Energy	Φ_{Max}
					(in MeV)	part $s^{-1}cm^{-2}$
CERN	4.3.1	IRRAD	PS	Protons	24000	10^{10}
	4.3.2	GIF++	^{137}Cs	Gamma	0.662	14 TBq
JSI	4.3.3	TRIGA Mark III	Reactor	Neutrons	<10 (Watt spectrum)	6.7×10^{12} n_{eq}
IFJ_PAN	4.3.4	AIC-144 Cyclotron	Cyclotron	Protons	10-60	10^{12}
UCLouvain	4.3.5	CRC NIF, LIF, HIF	Cyclotron	Neutrons	0-50 (cont.)	3×10^{9}
				Protons	10-62	2×10^{8}
				Heavy Ions	110 Q^2/M	10^{4}
UoB	4.3.6	MC40 Cyclotron	Cyclotron	Protons	27	3×10^{12}

4.3.1 CERN IRRAD – Latest News

- **IRRAD (EP):** **2022**
  - **54 experiments registered**
  - **>600 samples processed:**
    - **LHC Experiments:** ATLAS, CMS, LHCb Phase II upgrade
    - **R&D & expt. support:** EPRD, RD53, RD50, EP-ESE / DT
    - **CERN ATS Projects:** TE-MSC, EN-EL, R2E
    - **EU-projects & external:** AIDAinnova, CNES (FR)
  - **~50% requests exceeding 10^{16} p/cm²**
    - cold (-25°C), cryogenic & **large areas** often required
    - **irradiations to 10^{17} p/cm² level require ~1 year!**

2023

- **IRRAD:**
  - **37 experiments registered**
  - **>400 samples processed**
  - ATLAS ITk pixel & strips, ATLAS HGTD, CMS BRIL, CMS pixel, LHCb ECAL, LHCb PicoCal, RD53, RD50, EP-ESE, TE-MSC, SY-BI, AIDAinnova, i-FAST, …
  - in 2023, qualification experiments (detector modules, complex setup, etc.) prevailed on R&D samples
  - **priorities assigned from summer;** some samples shifted to the run 2024

ATLAS-HGDT

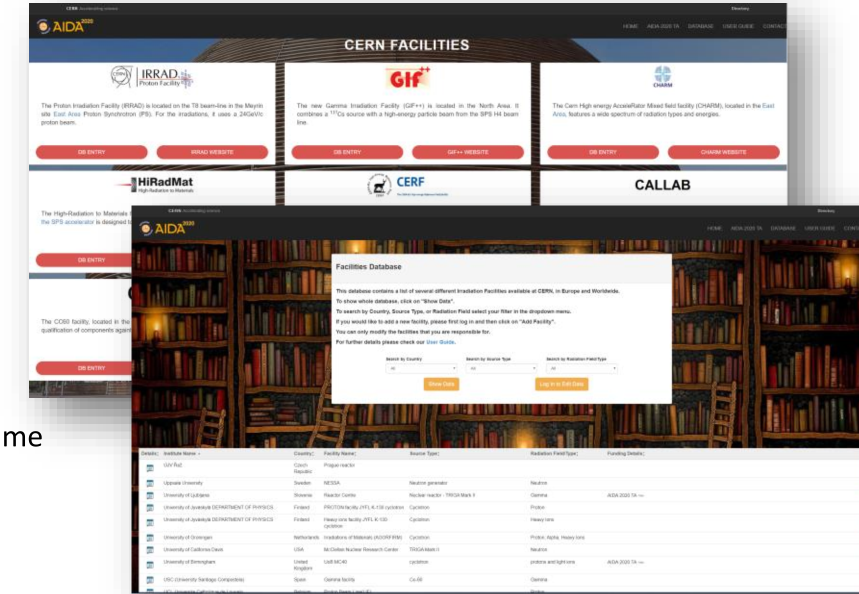
ATLAS-ITk

ATLAS-HGDT

CERN Facilities - User support

❑ CERN Irradiation Facilities Database

- www.cern.ch/irradiation-facilities
- **CERN portal + database of worldwide facilities**
- Knowledge of available external facilities important:
  - to complement in-house means (R&D, qualification, etc.)
  - to increase testing availability (shutdown periods, etc.)
- Entries maintained by the facility coordinators:
  - **more than 220 entries to date!**
  - automatic reminders for maintaining the information over time
- Tool developed within EU-project AIDA-2020



❑ Irradiation Experiments Data Management

- www.cern.ch/irrad-data-manager
- **A web application for the follow-up of the full irradiation experiment workflow:**
  - **manages users, samples, experiments, logistics, … data**
  - operational for CERN-IRRAD, being deployed for GIF++
- Being improved, new functionalities being added:
  - development continues thanks to the synergies with ongoing and new EU-funded projects

4.3.2 CERN GIF++ 2023

EP-DT Detector Technologies

Beams Department

Successful 2023 operation :

- 22 Active User Groups in 2023 so far, normally staying for several months (years) of irradiation

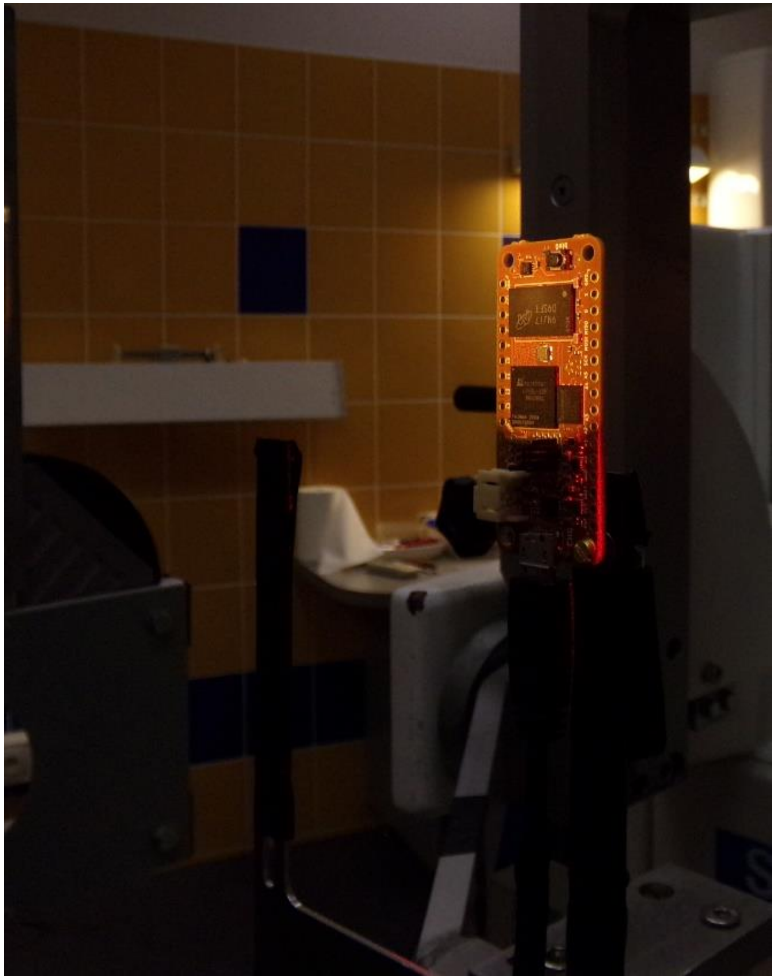
Activity	Resp. Group	Facility	Title	Description	Responsible
216465	EP-UAT	GIF	RPC - BI production test	Production test of the BI gas gaps. This will include a setup going in and out from the bunker containing 24 gas gaps. Dimensions 300x100x60, weight 200 kG.	GIULIO AIELLI (538291/EP-UAT)
216137	EP-UAT	GIF	TGC prototype irradiation	TGC irradiation tests 2023	LUCA MOLERI (763487/EP-UAT)
213815	EP-UAT	GIF	Test beam tracking MM detectors with Isobutane/ ArCO2	Test beam tracking MM detectors with Isobutane/ArCO2	VALERIO D'AMICO (803500/EP-UAT)
213813	EP-UAT	GIF	Test beam of MM production detectors with Isobutane/ ArCO2	Test beam of MM production detectors with Isobutane/ArCO2	VALERIO D'AMICO (803500/EP-UAT)
212816	EP-UCM	GIF	CMS HGCAL dry run at gIF++	Irradiation of HGCAL samples at GIF++	ALEXANDER KAMINSKIY (514197/EP-UCM)
211132	EP-UCM	GIF	Consolidation of CMS RPC : Trolley 1	Operations and Modifications CMS RPC for Consolidation TR1. We are about to complete the program for 2 chambers.. We need to continue the charge accumulation for the other 2 chambers.	MEHAR ALI SHAH (709112/EP-UCM)
210614	EP-ADP	GIF	ProTov	Rate capability and aging test on gaseous detector with small form factors	ALESSANDRO ROCCHI (818582/EP-ADP)
210342	EP-UAT	GIF	ATLAS Legacy RPC Prototype	Setup for ageing test of an RPC detector with 50 cm x 50 cm size and 2 mm gas	SINEM SIMSEK (743236/EP-UAT)
208598	EP-UAT	GIF	Performance studies for sMDT detector prototype - MPI group	Performance studies for sMDT detector prototype - MPI group	ELENA VOEVODINA (803901/EP-UAT)
208569	EP-UAT	GIF	Performance studies for RPC detector prototype - MPI group	Performance studies for RPC detector prototype - MPI group	ELENA VOEVODINA (803901/EP-UAT)
205030	EP-UCM	GIF	CMS CSC longevity studies at GIF++ - ME11	CMS CSC (ME11) test beam and longevity studies at GIF++ (maintenance, measurements).	EKATERINA KUZNETSOVA (566065/EP-UCM)
205028	EP-UCM	GIF	CMS CSC longevity studies at GIF++ - ME21	CMS CSC (ME21) test beam and longevity studies at GIF++ (maintenance, measurements).	EKATERINA KUZNETSOVA (566065/EP-UCM)
204921	EP-UAI	GIF	Eco-friendly gas mixture tests - CMS RPC Trolley 3	Studies for an eco-frendly gas mixture for the RPC's	LUCA QUAGLIA (832884/EP-UAI)
204544	EP-UCM	GIF	CMS-iRPC electronic test	CMS-iRPC chamber and electronics test	MEHAR ALI SHAH (709112/EP-UCM)
204305	EP-UCM	GIF	Rate capability for ME0 CMS GEM	Rate capability of GEM detector heavily irradiated	DAVIDE FIORINA (828894/EP-UCM)
204304	EP-DT-FS	GIF	GIF++ EP-DT R&D 2	Test of RPC gaseous detectors under gas recirculation.	MATTIA VERZEROLI (851185/EP-DT-FS)
204283	EP-CMG	GIF	CMS DT MB2 chamber irradiation upstream	Irradiation and data taking of a DT MB2 chamber + monotubes at GIF++	LISA BORGONOVI (759297/EP-CMG)
204259	EP-UAT	GIF	RPC BIS78 Modul0 and Phase 2 prototype	Performance and ageing test of the ATLAS BIS78 Module 0 and Phase2 prototypes,	GIULIO AIELLI (538291/EP-UAT)
204254	EP-DT-DD	GIF	GIF User - upcoming installations	Allowing access to bunker area for selected user in preparation for upcoming installations.	GIUSEPPE PEZZULLO (749724/EP-DT-DD)
203678	EP-UAT	GIF	Long Term Ageing of MM production detectors with Isobutane/ArCO2	Long Term Ageing of MM production detectors with Isobutane/ArCO2	VALERIO D'AMICO (803500/EP-UAT)
203676	EP-UAT	GIF	Long Term Ageing for ATLAS-NSW MM	Long Term Ageing of MM production detectors with Isobutane/ArCO2	VALERIO D'AMICO (803500/EP-UAT)

M.R. Jäkel — GIF++ Update - Section Meeting — 7

M.Jaekel
Sept.2023

4.3.4. IFJ PAN AIC-144 cyclotron facility

- ***SHARCS Computing Module Candidates Initial Test (SHARCS-CMC-IT)*** *[EURO-LABS-IFJAIC-2023-003]*



- The aim of this experiment was to assess the robustness and fault tolerance of commercially available off-the-shelf (COTS) processors, their suitability for building computing clusters ready to operate in space, and ability to withstand faults, errors, and crashes caused by radiation-induced Single Event Latch-up (SEL) and Single Event Functional Interrupt (SEFI) events.
- During the experiment three candidate modules with modern, high-performance Systems-on-Chips: RPi Zero 2W, Colibri iMX8 and an Orange Crab were tested.
- Protons in energy range 20-58 MeV were applied. The component's has been irradiated with the fluences from 3.6 E+8 – 1.1 10+10 protons cm^{-2}.
- Significant difference has been observed in response of the instruments depending on proton energy and delivered fluence. It will help by designing of the new computing systems that could overcome fault tolerant architecture.

4.3.4. IFJ PAN AIC-144 cyclotron facility

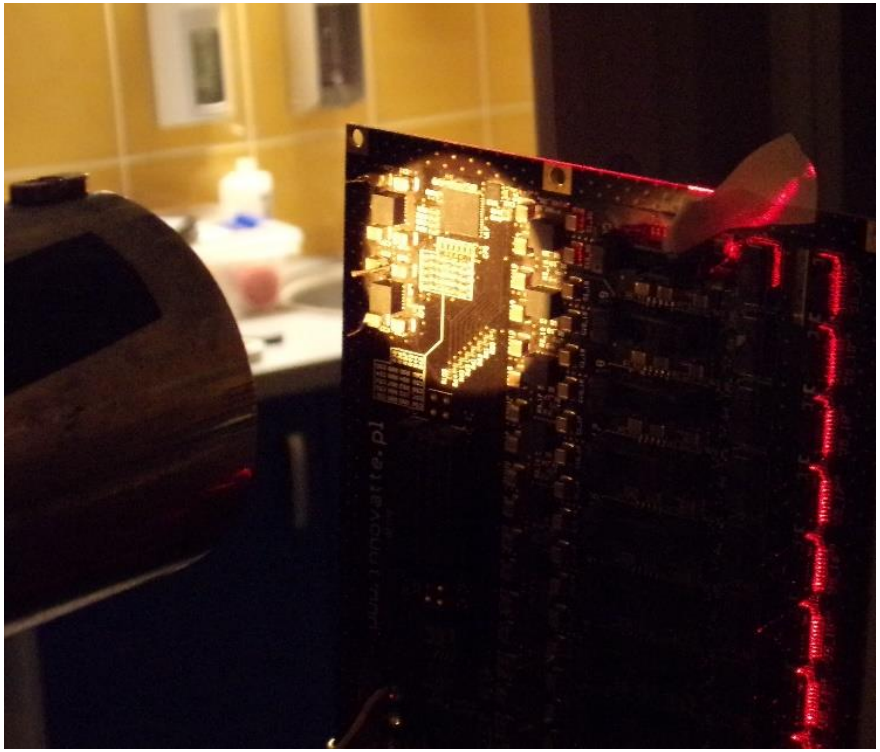
- ***POLAR-2, A Large-Scale Detector For Gamma-Ray Bursts Photon Polarization Measurements*** *[EURO-LABS-IFJAIC-2023-002]*

- The goal of irradiation campaign was to irradiate the FEE, low-voltage power supply (LVPS) and FPGA with 50MeV protons up to a dose of 0.76Gy and 0.71Gy respectively, equating to 2-10 years in space (depending on the shielding).

- Six types of detectors and electronic components were tested in the beam. SIPM preamplifiers were irradiated with fluences (1E+8 – 10+10 proton cm-2) showing some problems in response.

- It was also possible to determine response of FEE for doses of cosmic-rays relevant for space missions.

- Xilinx FPGA components applied in POLAR -2 experiment were tested for radiation hardness.



Electronic components irradiated with proton beam during the experiment