

# WP15 Report

## Upgrade of beam and irradiation test infrastructure

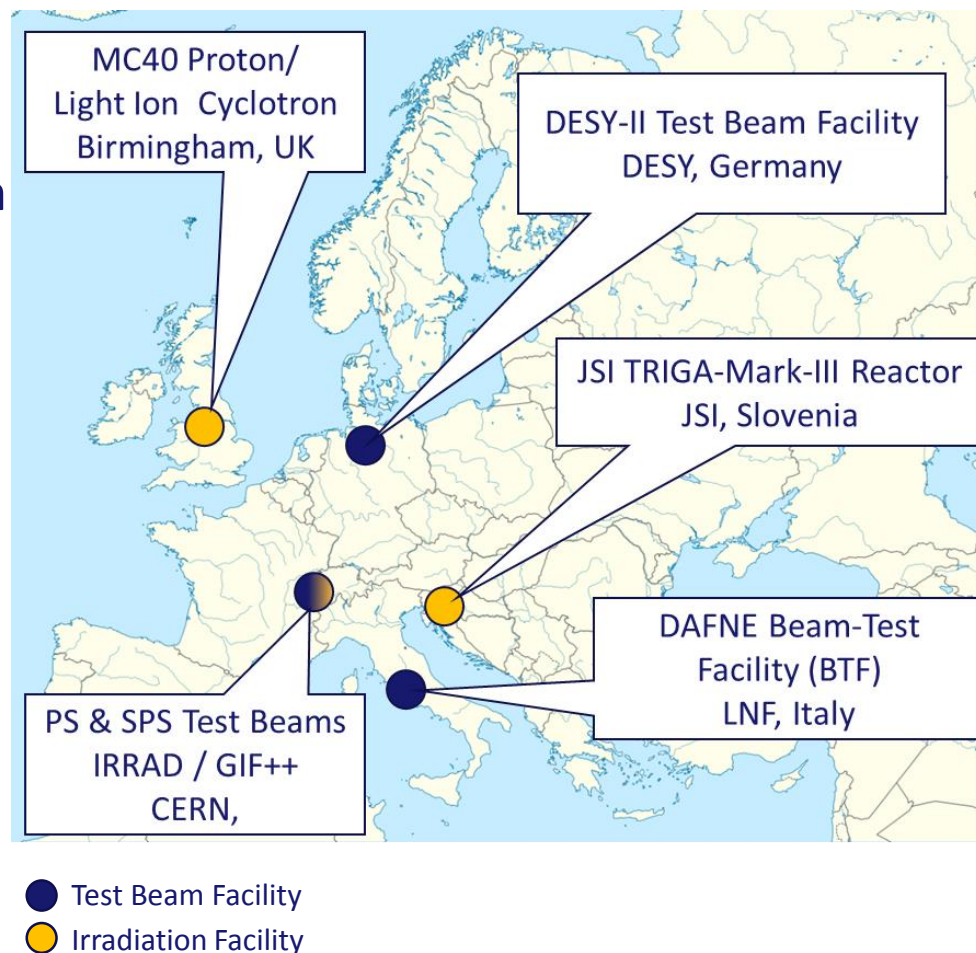
Federico Ravotti (CERN) & Marcel Stanitzki (DESY)

AIDA-2020 Final Annual Meeting

Vidyo, 29 April 2020

- **Task 15.1:** Scientific coordination (CERN, DESY)
- **Task 15.2:** Improvements of test beam infrastructure for high precision tracking (CERN, DESY)
- **Task 15.3:** Improvements of the DESY test beam infrastructure (DESY)
- **Task 15.4:** Improvements of the test beam infrastructure at LNF (INFN)
- **Task 15.5:** Improvements of the infrastructure for irradiation tests (CERN, INFN, VU, INRNE, JSI, USFD\*)

\*associated partner linked to CERN



- Chasing people for slides, Milestone & Deliverable reports and publications
- **WP15 Satellite Meetings @ BTTBs**
  - large overlap of activities and participants, moreover facilities upgrade activities were driven by user requirements ...
  - Barcelona, 2017: <https://indico.cern.ch/event/591285/>
  - Zurich, 2018: <https://indico.cern.ch/event/683891>
  - Geneva, 2019: <https://indico.cern.ch/event/731649/>



- From 2019: gather, give consistency and formalize community ideas for AIDainnova proposal!



- **Milestones:**
  - **all achieved!**
- **Deliverables:**
  - **all achieved!**
  - **INFN-LNF (D15.5)** and **GIF++ upgrade (D15.11)** reports being reviewed
- **Publications:**
  - 81 records in CDS (including 21 official reports)
  - <http://cds.cern.ch/collection/AIDA-2020?ln=en>
  - several other in the pipeline

# WP15 Structure

WP15.2

WP15.3

WP15.4

WP15.5

*J. Dreyling-Eschweiler*  
DESY

*M. Wu*  
DESY

*P. Valente*  
Frascati

*F. Ravotti et al.*  
CERN, INFN, VU, INRNE, JSI, USFD

DESY-II  
Test  
Beam  
Facility

CERN PS  
& SPS  
Test  
Beam  
Areas

DESY II  
Test  
Beam  
Facility

BTF @  
LNF

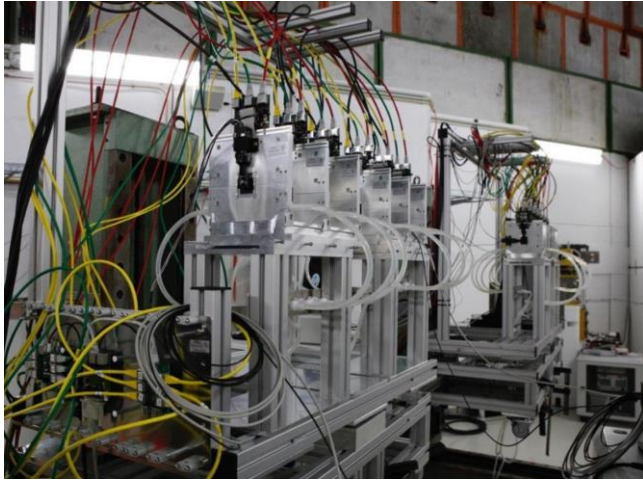
IRRAD

GIF++

JSI Triga  
Reactor

U.o.B.  
Cyclotron  
Facility

# WP15.2: Azalea is coming home..



Testing in TB22 DESY, July 2016



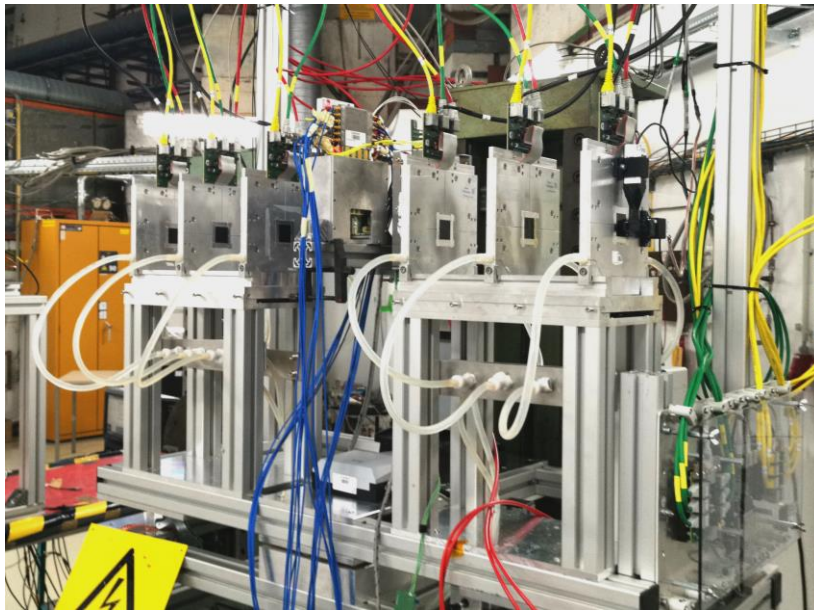
Packed and shipped  
from CERN to DESY,  
in Dec. 2018/Jan. 2019



Flying through the DESY Test Beam hall

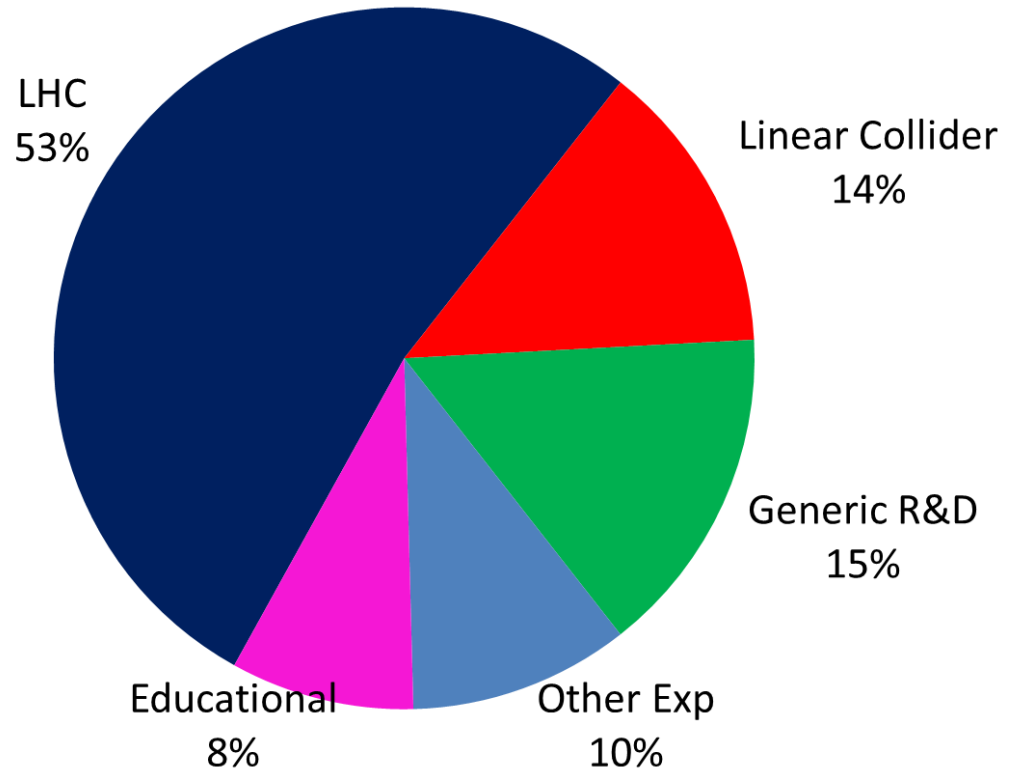


**AZALEA  
@ TB24**



TOTEM @TB24

## Telescope Usage 2019



## • Current Status

- We have 7 telescopes operating
- In operation since approximately a decade: **AZALEA is the youngster being already four years old!**
- We will keep them running for as long as possible, but we'll reach end-of-life

## • Active Discussion also with WP5

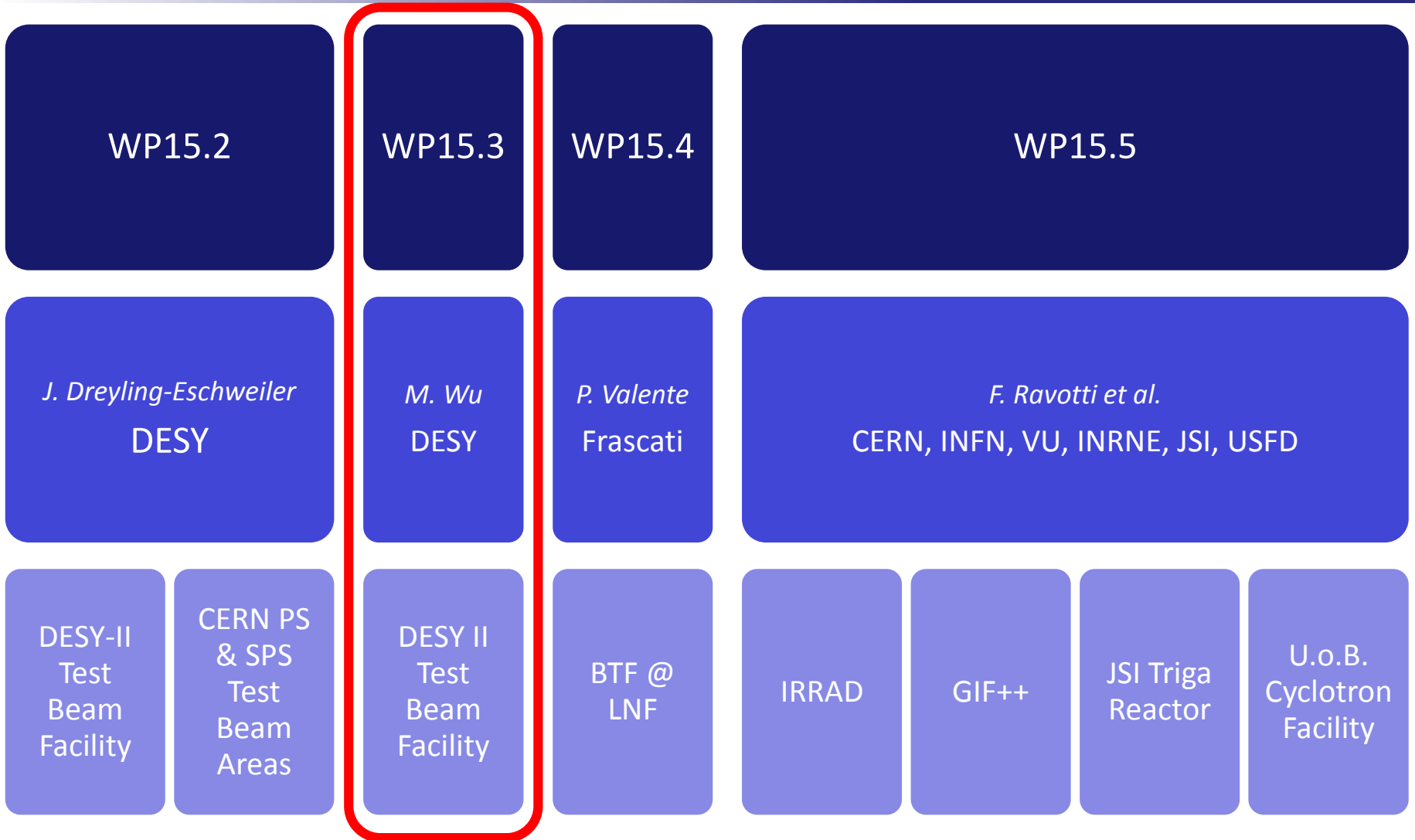
- Improve timing information,
- Maintain spatial resolution,
- Keep material budget low, etc.

## • Many of our ideas went into the AIDAInnova proposal

- Stay tuned!

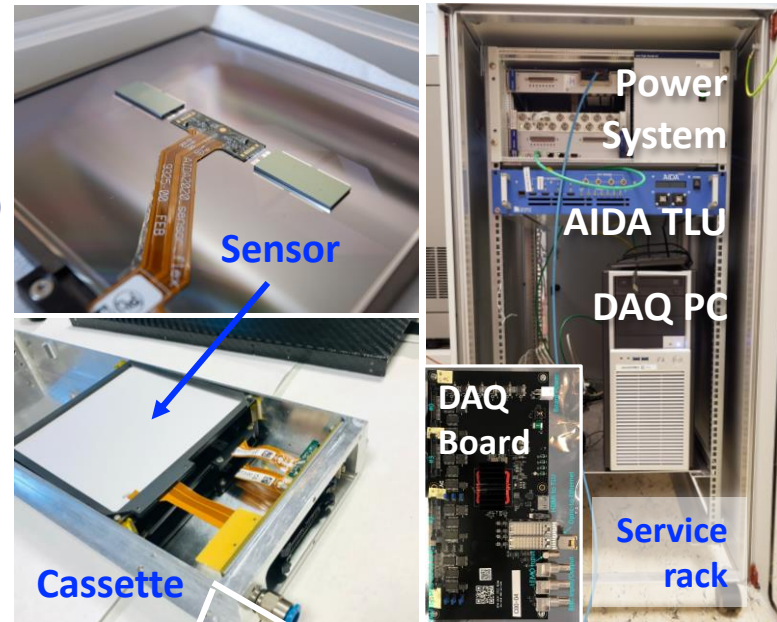


# WP15 Structure



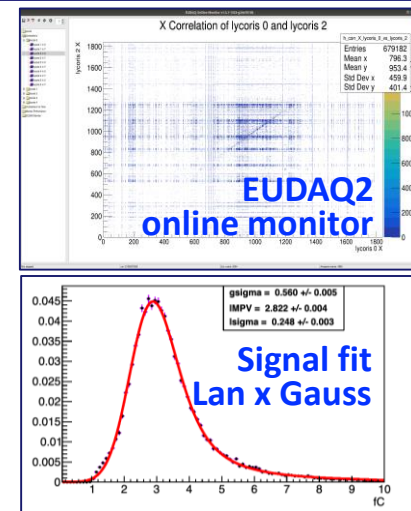
## Task 15.3.1: External silicon tracker for 1T magnet in the DESY test beam

- **Delivered** a 6-layer large active area ( $10 \times 10 \text{ cm}^2$ ) telescope of novel hybrid-less sensor
  - with better spatial resolution than required:  $dy \sim 7.4 \text{ } \mu\text{m}$  ( $< 10 \text{ } \mu\text{m}$ ),  $dx \sim 0.17 \text{ mm}$  ( $< 1 \text{ mm}$ )
- Highlight milestones:
  - July 2017 – sensor **arrived**
  - Oct 2018 – assembly quality **validated**
  - Feb 2019 – prototype's first beam commissioning test **succeeded**
  - May 2019 – production's first beam commissioning **succeeded**
  - July 2019, Mar 2020 – production performance measurements with EUDET telescope **done**



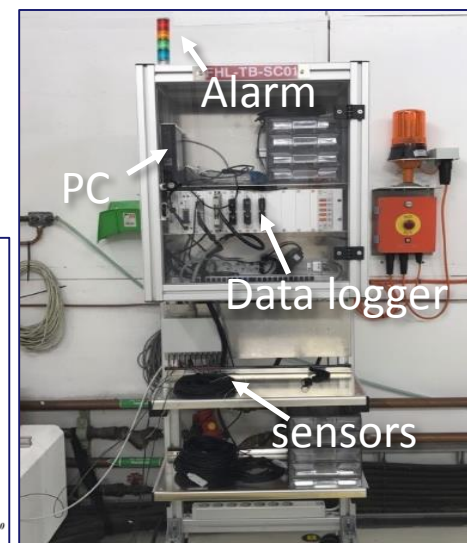
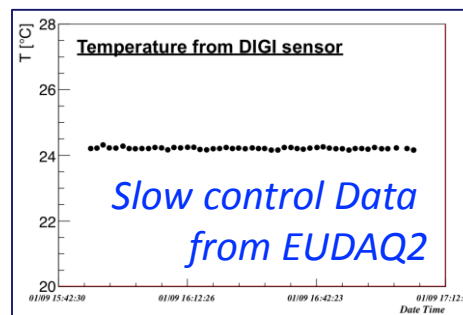
M. Wu

- **A full telescope package:** integrated to EUDAQ2 + AIDA TLU, providing a full chain data analysis framework;
- **Well documented** as a long-life project: numerical manuals available online.
- **Publications:** Journal paper progressing (first draft exp. May 2020), 2 IEEE proceedings, 1 VCI proceeding (doi:10.1016/j.nima.2019.162864)
- **Status:** waiting for the first “benevolent” user.

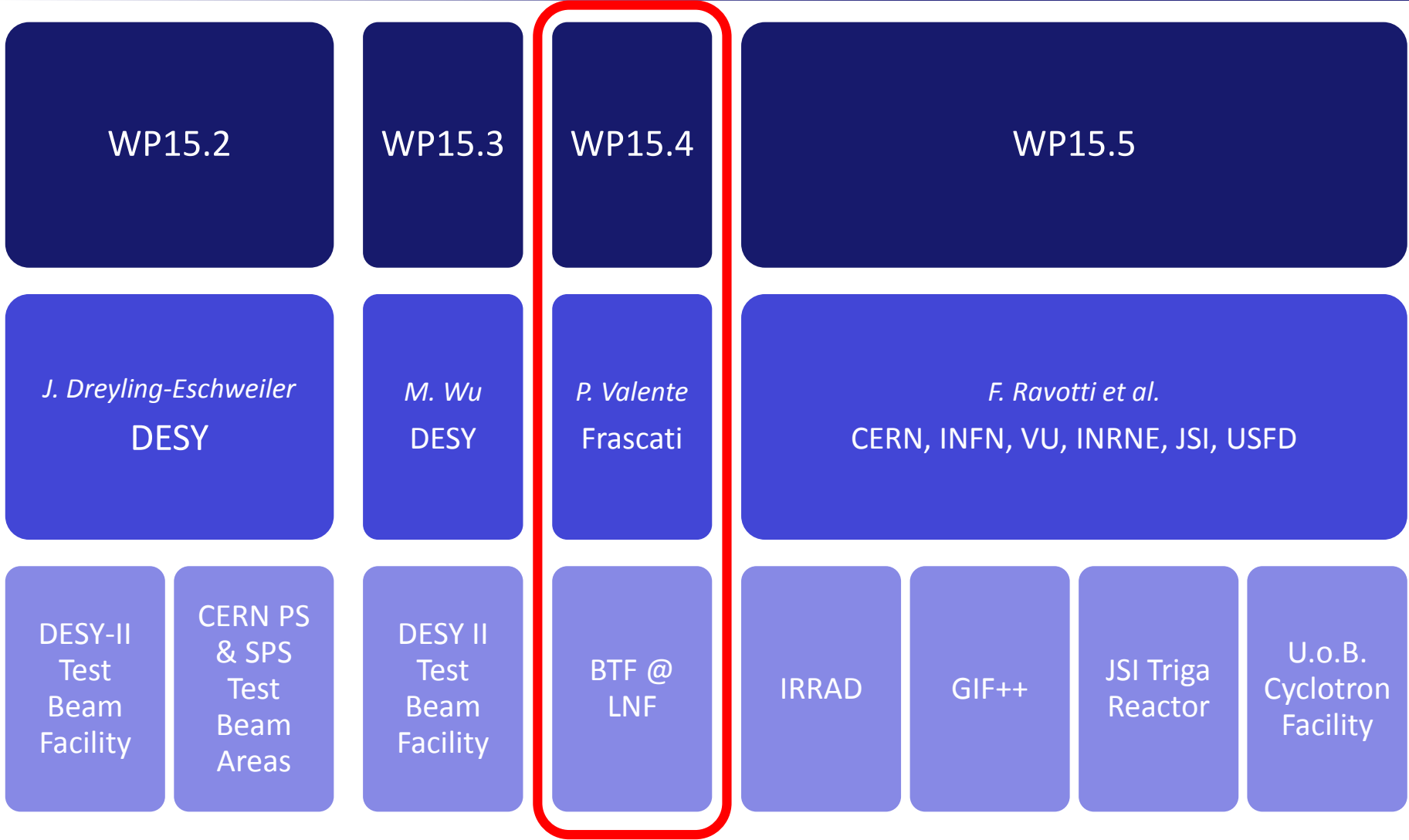


## Task 15.3.2: Environmental slow control system

- Commercial rack-based data logger, polling by EUDAQ2 via MySQL database – simple plugin for user
- **Delivered on time:** MS33 and D15.3
- Documentation: **2 user manuals** available online as AIDA tech reports.
- **Status:** Available for all users at DESY, full system now upgraded to Win10.



# WP15 Structure



- **Delay of project start**
  - LNF MAC recommended shift of priorities
  - Delay of procurement of essential components
- **Major Vacuum Incident in Early Fall 2019**
  - Beam pipe broke
  - Beryllium contamination
  - Major effort required for clean-up
- **Latest Plan (pre COVID-19)**
  - April 2020: beam for Padme
  - November 2020: test beam for users
  - 2021: installation of photon tagging
- **From a AIDA WP15 perspective**
  - Really beyond our control ...

# WP15.4: BTF-1 & BTF-2 beam-lines ready

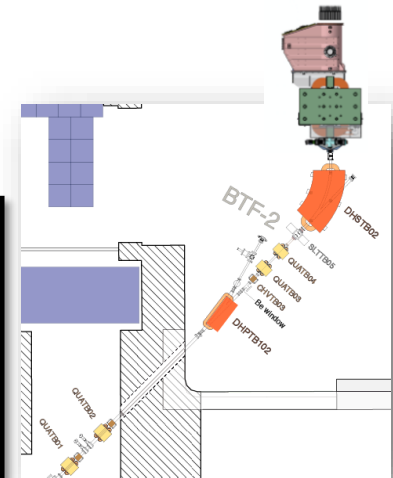
- Old beam-line dismantling
- Cables re-routing
- BTF-1 and BTF-2 branches installation
- New experimental hall control room
- New power supply hall
- Cooling, power, controls connection operative



April 2018

Long time based experiment (PADME) and external users

September 2018

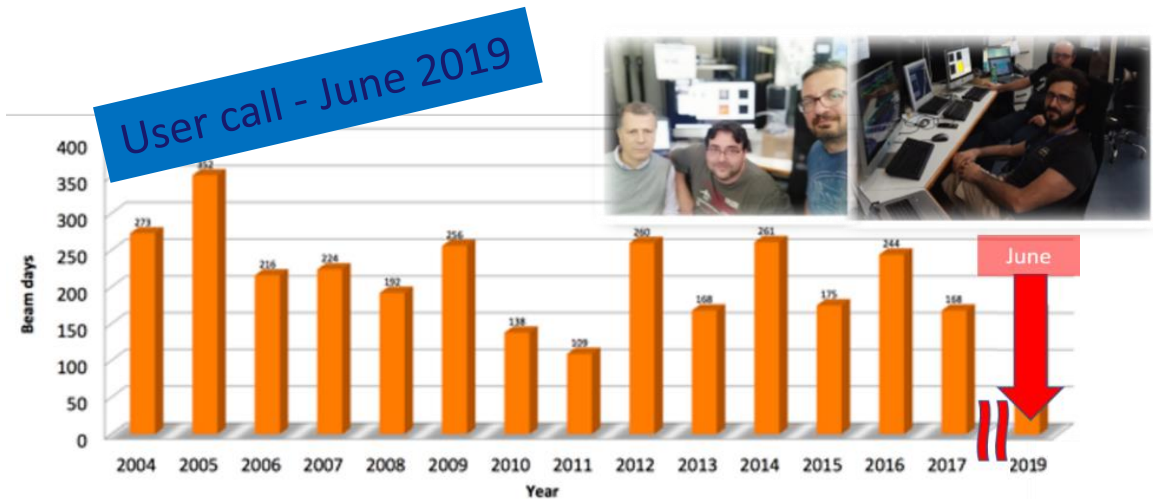
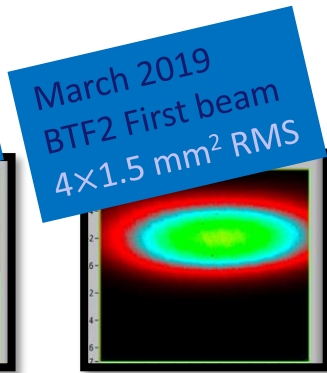


P. Valente  
B. Buonomo

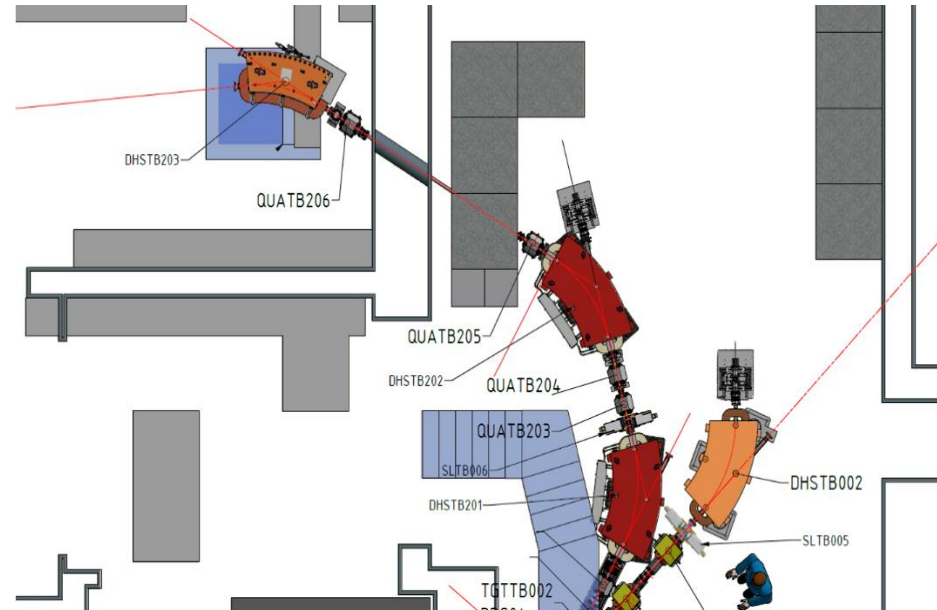
**D15.4 – New Frascati beam line components installed**, delayed from M18 to M44 due to postponed funding → achieved (report submitted)

# WP15.4: BTF-1 & BTF-2 beam-lines ready

- Commissioning with secondary electron beam (450 MeV): July 2018
- Commissioning with secondary positron beam (545 MeV): Sep. 2018
- First user on new BTF-1 line, PADME (dark photon searches) experiment: Oct. 2018 - Feb. 2019
- First users call for beam time: Jan. 2019
- User Beam Time open in June 2019: Pixel and Gas detectors tests.
- 2018/2019 Good publication number of BTF related activities (>50)



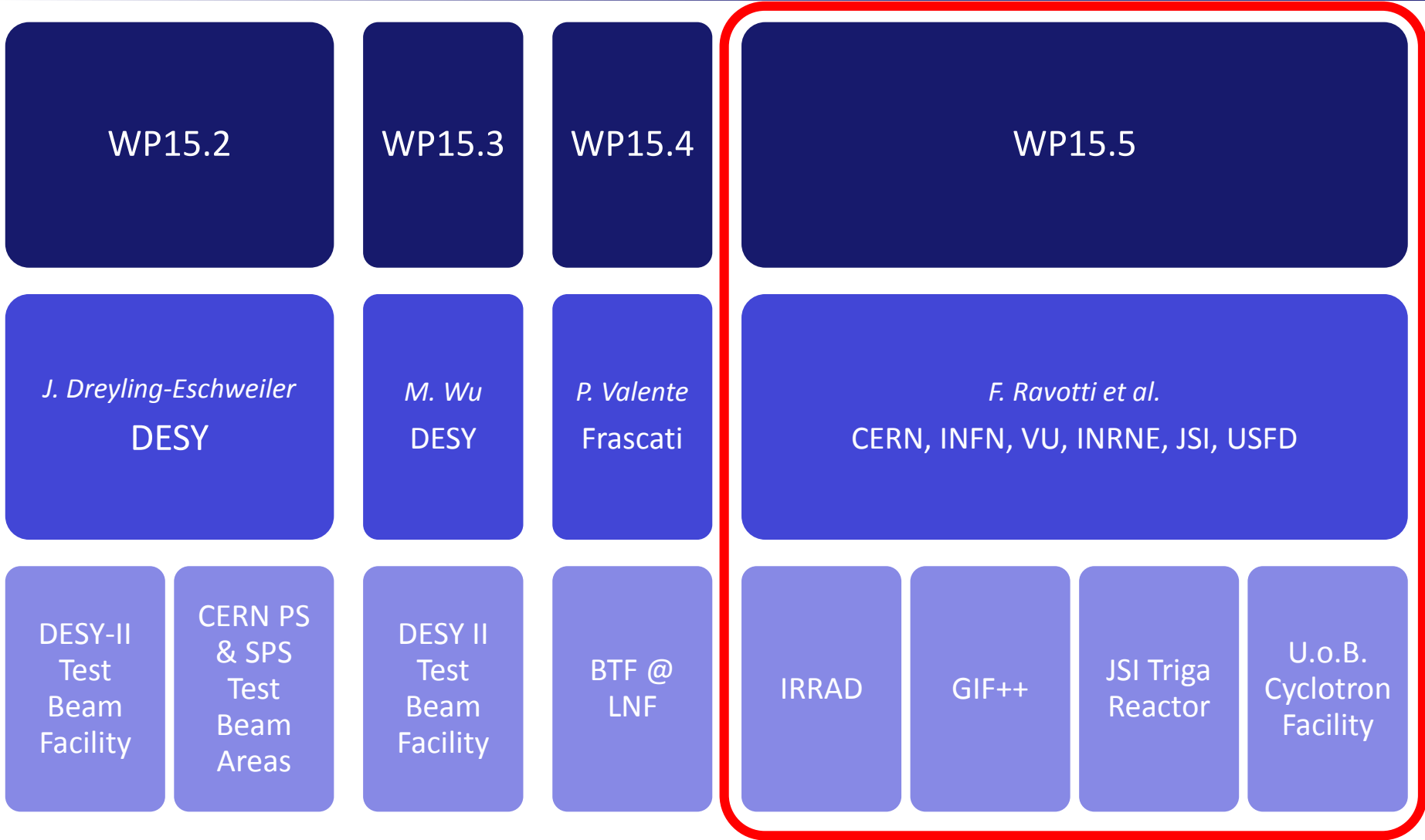
- BTF2 Extension to second hall delayed after COVID and PADME data taking
- Time scale now **2021**
- BTF2 components (Magnets, vacuum pipes, mechanics, pumps scrapers...) in final test/shipping (5%) or ready to be mounted (95%)



**D15.5** – New Frascati photon tag components installed, due to vacuum event now moved off, next installation after PADME users run and COVID19 delay → **achieved** (report submitted)



# WP15 Structure



- **D15.6 – CERN Proton Facility Upgrade**

- contactless fluence monitor (VU)
- IRRAD data manager software tool / storage area equipment (CERN)
- irradiation facilities on-line database (CERN)

**Milestones: all achieved!**

**M24**

- **D15.7 – RadHard Instrumentation for CERN Proton Facility (CERN)**

**M44**

- **D15.8 – Cold Irradiations at Birmingham Facility (USFD)**

**M36**

- **D15.9 – Large Objects Transport System for Neutron Irradiations (JSI)**

**M18**

- **D15.10 – Upgrade of GIF++ Facility Gas System (CERN)**

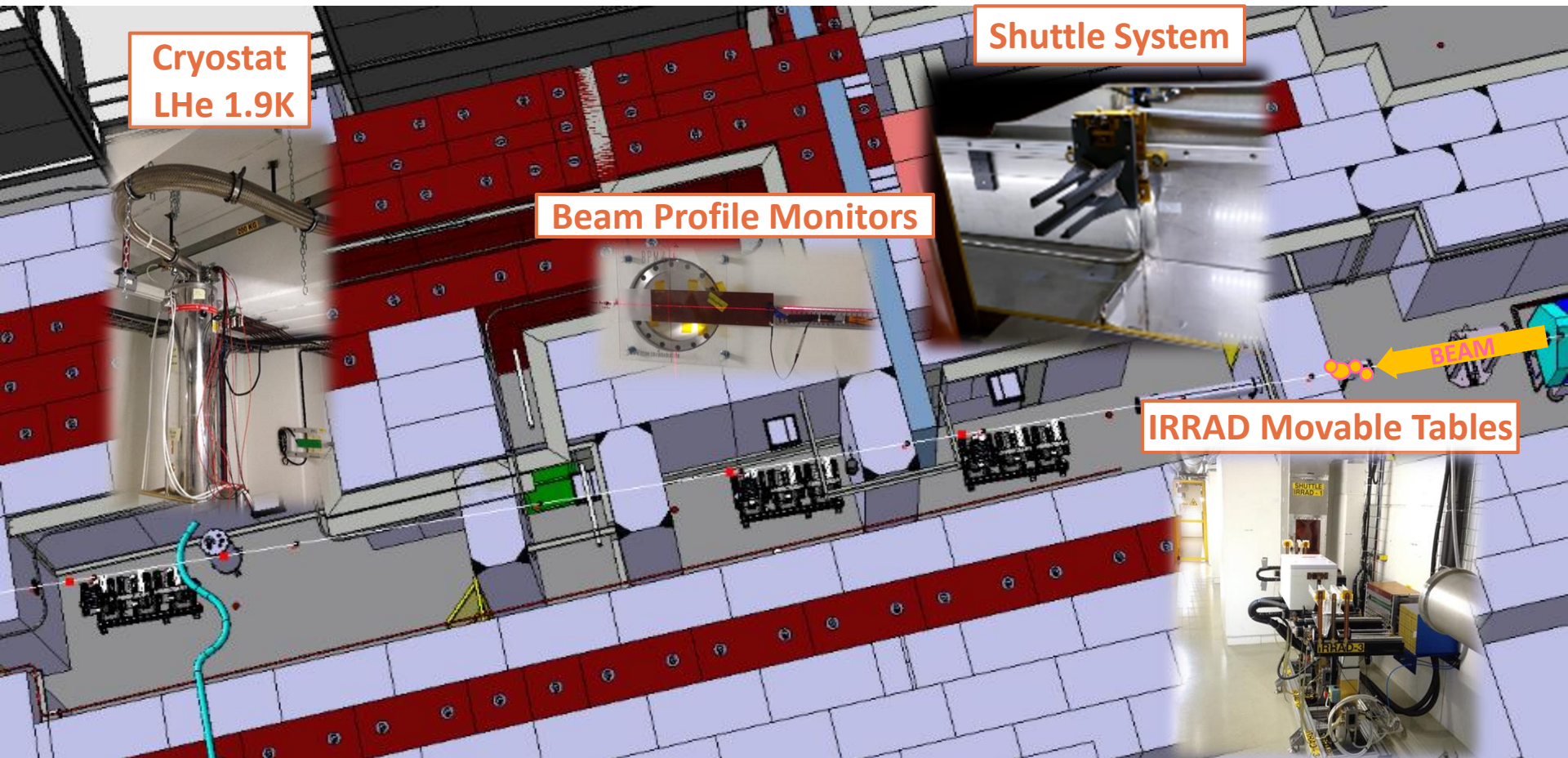
**M24**

- **D15.11 – GIF++ Facility Upgrade**

- instantaneous dose-rate monitor (INRNE)
- improved cosmic-rays tracker & demonstrator of augmented reality (INFN)

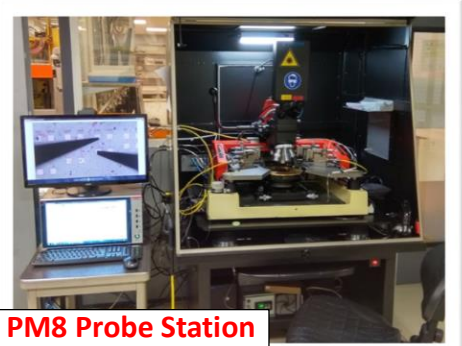
**M54**

- Testing components of the HEP experiments
- Beam of **24 GeV/c** and size of **12×12 mm<sup>2</sup>**
- Spills of **400 ms** every **~10 sec**
- Fluence of **1×10<sup>16</sup> p/cm<sup>2</sup>** in **14 days**
- Scanning also in dimensions of **10×10 cm<sup>2</sup>**
- Low temperature irradiation (**-25°C**)





"old" lab. space (irradiated components)



Suss PM8 Probe Station and Keithley 4200A



Temperature & RH Test Chamber

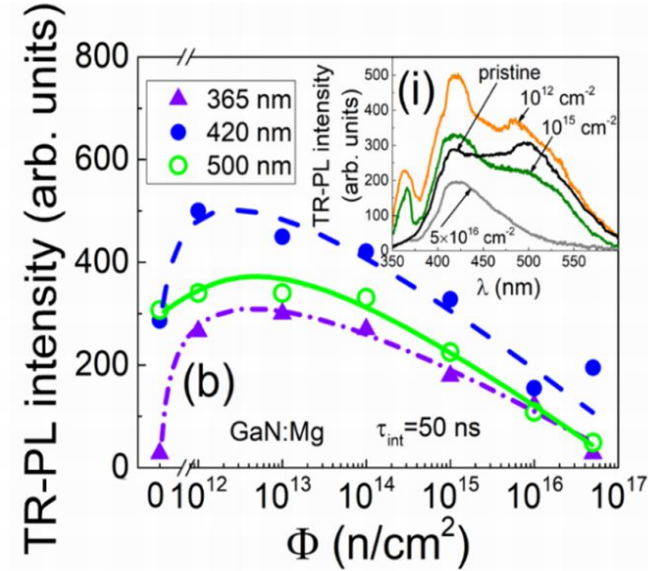
NEW IRRAD Technical Area after LS2 (end 2020 ?)



HP-Ge  $\gamma$ -spectrometer



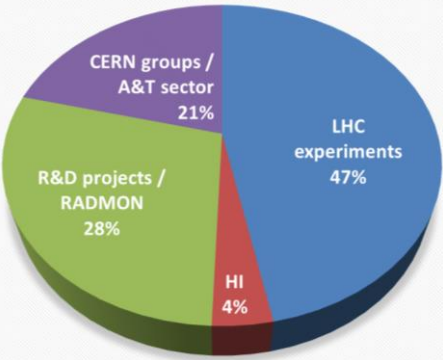
## Contactless Fluence Monitor



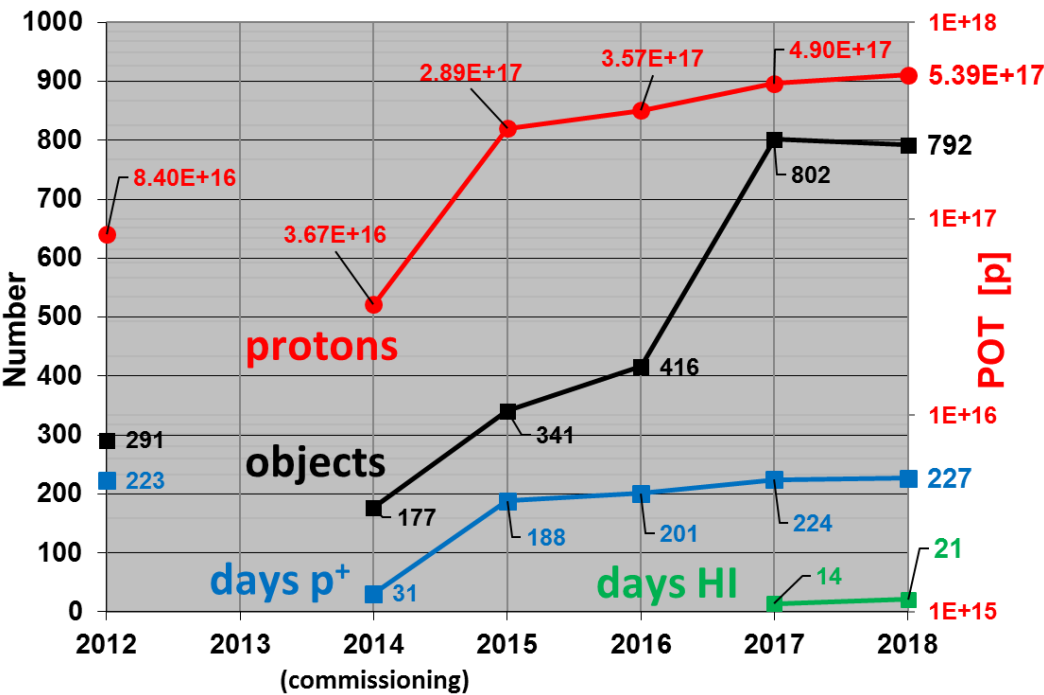
Variations of the predominant TR-PL spectral peaks with neutron irradiation fluence. In the inset (i) variations of TR-PL spectra are depicted.

within AIDA-2020: improvement of characterization techniques for irradiated semiconductor materials: GaN, a-Si

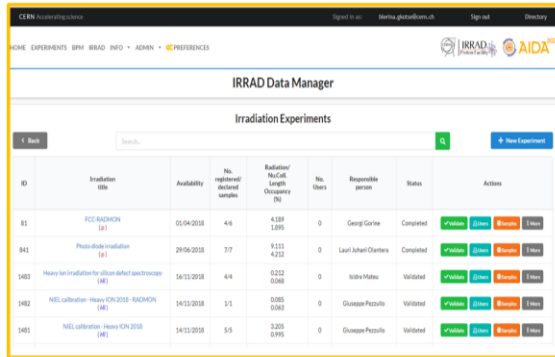
J. Vaitkus (VU)



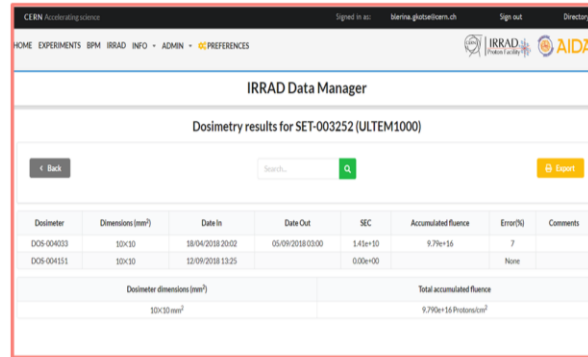
Experiments distribution during run 2018



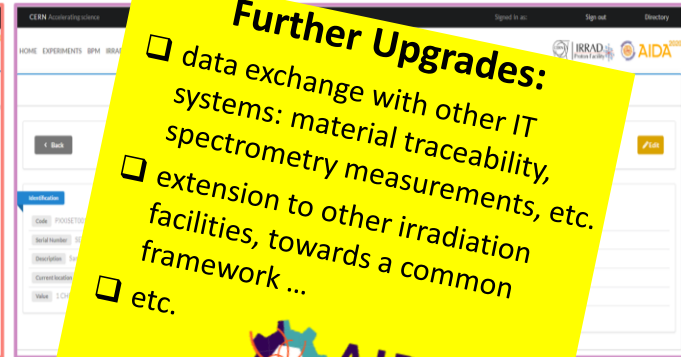
# Task 15.5: CERN IRRAD Task - IRRAD Data Manager (IDM)



ID	Irradiation title	Availability	No. registered declared samples	Radiation No. C&E Length Occupancy (%)	No. Users	Responsible person	Status	Actions
81	ROD-RADION (S)	05/04/2018	4/8	4.38 2.055	0	Georg Garbe	Completed	View Edit Delete Print
841	Photo-plate irradiation (S)	29/06/2018	3/7	9.11 4.212	0	Luigi Jahn Oertlers	Completed	View Edit Delete Print
1403	Heavy Ion irradiation for silicon defect spectroscopy (S)	16/12/2018	4/4	0.22 0.068	0	Nilsa Matus	Validated	View Edit Delete Print
1402	NEE calibration - Heavy ION 2018 - RADION (S)	14/12/2018	1/1	0.085 0.065	0	Gianluca Pizzituti	Validated	View Edit Delete Print
1401	NEE calibration - Heavy ION 2018 (S)	14/12/2018	5/5	3.205 0.995	0	Gianluca Pizzituti	Validated	View Edit Delete Print




Dosimeter	Dimensions (mm²)	Date In	Date Out	SEC	Accumulated fluence	Error(%)	Comments
DOS-004033	10x10	18/04/2018 20:02	05/09/2018 03:00	1.45e+10	9.79e+16	7	
DOS-004151	10x10	12/09/2018 13:25		0.00e+00			None
Dosimeter dimensions (mm²)					Total accumulated fluence		
10x10 mm²					9.790e+16 Protons/cm²		

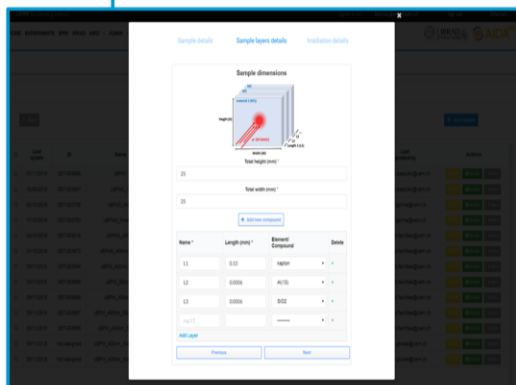


3D pixel for ATLAS ITk

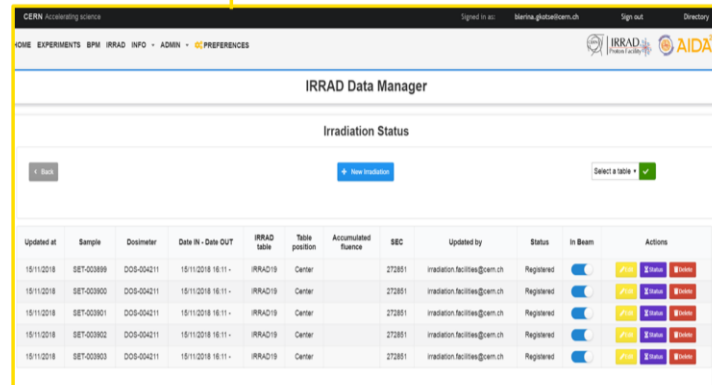
**Further Upgrades:**

- data exchange with other IT systems: material traceability, spectrometry measurements, etc.
- extension to other irradiation facilities, towards a common framework ...
- etc.





Name	Length (mm)	Serial Number	Beam
S1	0.0	1000	1000
S2	0.000	1000	1000
S3	0.000	1000	1000



Updated at	Sample	Dosimeter	Date In - Date Out	IRRAD table	Table position	Accumulated fluence	SEC	Updated by	Status	In Beam	Actions
15/11/2018	SET-023869	DOS-004211	15/11/2018 16:11 -	IRRAD19	Center	272851	irradiation.facilities@cern.ch	Registered	On	View Edit Delete Print	
15/11/2018	SET-023905	DOS-004211	15/11/2018 16:11 -	IRRAD19	Center	272851	irradiation.facilities@cern.ch	Registered	On	View Edit Delete Print	
15/11/2018	SET-023901	DOS-004211	15/11/2018 16:11 -	IRRAD19	Center	272851	irradiation.facilities@cern.ch	Registered	On	View Edit Delete Print	
15/11/2018	SET-023902	DOS-004211	15/11/2018 16:11 -	IRRAD19	Center	272851	irradiation.facilities@cern.ch	Registered	On	View Edit Delete Print	
15/11/2018	SET-023903	DOS-004211	15/11/2018 16:11 -	IRRAD19	Center	272851	irradiation.facilities@cern.ch	Registered	On	View Edit Delete Print	



Experiment Details for ATLAS ITk

Sample Details

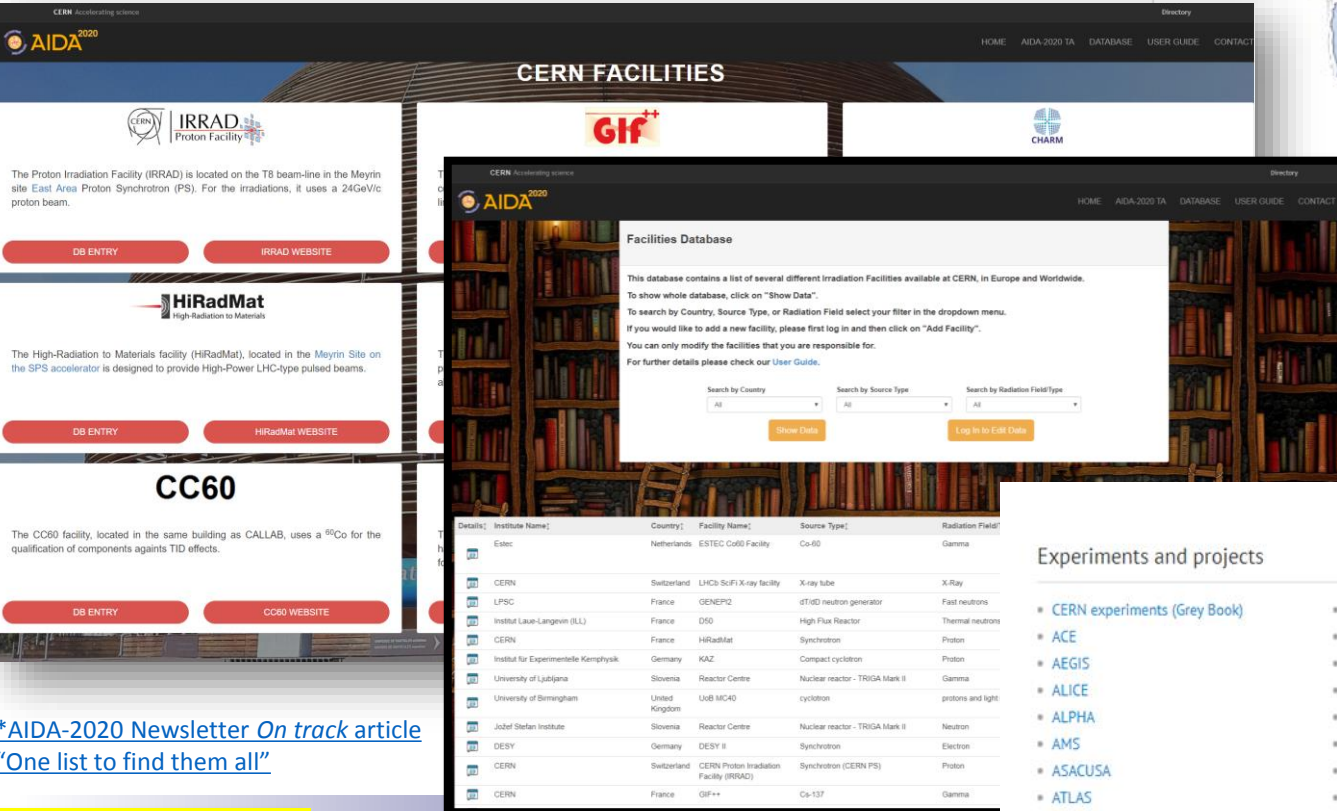
B. Gkotse (CERN)



An online platform for finding suitable facilities for irradiation experiments\*, **very important during LS2!**

- **217** irradiation facilities
- **4800** visits since first launched (February 2017)
- automatic reminders to facility coordinators

4.8k visits

**CERN FACILITIES**

**IRRAD**  
Proton Facility

The Proton Irradiation Facility (IRRAD) is located on the T8 beam-line in the Meyrin site East Area Proton Synchrotron (PS). For the irradiations, it uses a 24GeV/c proton beam.

**HiRadMat**  
High-Radiation to Materials

The High-Radiation to Materials facility (HiRadMat), located in the Meyrin Site on the SPS accelerator is designed to provide High-Power LHC-type pulsed beams.

**CC60**

The CC60 facility, located in the same building as CALLAB, uses a <sup>60</sup>Co for the qualification of components against TID effects.

**Facilities Database**

This database contains a list of several different Irradiation Facilities available at CERN, in Europe and Worldwide. To show whole database, click on "Show Data". To search by Country, Source Type, or Radiation Field select your filter in the dropdown menu. If you would like to add a new facility, please first log in and then click on "Add Facility". You can only modify the facilities that you are responsible for. For further details please check our User Guide.

Search by Country: All | Search by Source Type: All | Search by Radiation Field/Type: All

Details	Institute Name	Country	Facility Name	Source Type	Radiation Field/Type
	Estec	Netherlands	ESTEC Co60 Facility	Co-60	Gamma
	CERN	Switzerland	LHCb Soft X-ray facility	X-ray tube	X-Ray
	LPSC	France	GENEPI2	dTID neutron generator	Fast neutrons
	Institut Laue-Langevin (ILL)	France	D50	High Flux Reactor	Thermal neutrons
	CERN	France	HiRadMat	Synchrotron	Proton
	Institut für Experimentelle Kernphysik	Germany	KAZ	Compact cyclotron	Proton
	University of Ljubljana	Slovenia	Reactor Centre	Nuclear reactor - TRIGA blank II	Gamma
	University of Birmingham	United Kingdom	UoB MIC40	cyclotron	protons and light
	Jožef Stefan Institute	Slovenia	Reactor Centre	Nuclear reactor - TRIGA blank II	Neutron
	DESY	Germany	DESY II	Synchrotron	Electron
	CERN	Switzerland	CERN Proton Irradiation Facility (IRRAD)	Synchrotron (CERN PS)	Proton
	CERN	France	GIF++	Co-137	Gamma

World-Wide | Visits

[cern.ch/irradiation-facilities](http://cern.ch/irradiation-facilities)

B. Gkotse (CERN)

**CERN Directory**

Experiments and projects

- CERN experiments (Grey Book)
- ACE
- AEGIS
- ALICE
- ALPHA
- AMS
- ASACUSA
- ATLAS
- ATRAP
- AWAKE
- BASE
- CAST
- CERN Neutrino Platform
- CLIC
- CLOUD
- CNGS
- CMS
- COMPASS
- DIRAC
- ELENA
- FASER
- FCC
- GBAR
- HL-LHC
- **Irradiation Facilities**
- ISOLDE
- LHCb
- LHCf
- LIU project
- MoEDAL

\*AIDA-2020 Newsletter *On track* article "One list to find them all"



A unified database and platform for test beam facilities at CERN, in EU and worldwide

- **16 facilities, 27 beamlines**
- presented at BTTB in 2020; user guide: <http://cds.cern.ch/record/2706474>
- automatic reminders to facility coordinators

<http://www.cern.ch/tbdb>



CERN FACILITIES

**CERN PS**

The Proton Synchrotron (PS) is a key component in CERN's accelerator complex, where it usually accelerates either protons, delivered by the Proton Synchrotron Booster or heavy ions from the Low Energy Ion Ring (LEIR).

[JOB ENQUIRY](#) [WEBSITE](#)

**CERN SPS**

The Super Proton Synchrotron (SPS) is the second-largest machine in CERN's accelerator complex. It takes particles from the PS and accelerates them to provide beams for the LHC, the NA61/SHINE and NA2 experiments, the COMPASS experiment.

[JOB ENQUIRY](#) [WEBSITE](#)

**clear**

The primary focus for CLEAR is general accelerator R&D and component studies for existing and possible future machines at CERN, based on a broad internal and external user community.

[JOB ENQUIRY](#) [WEBSITE](#)



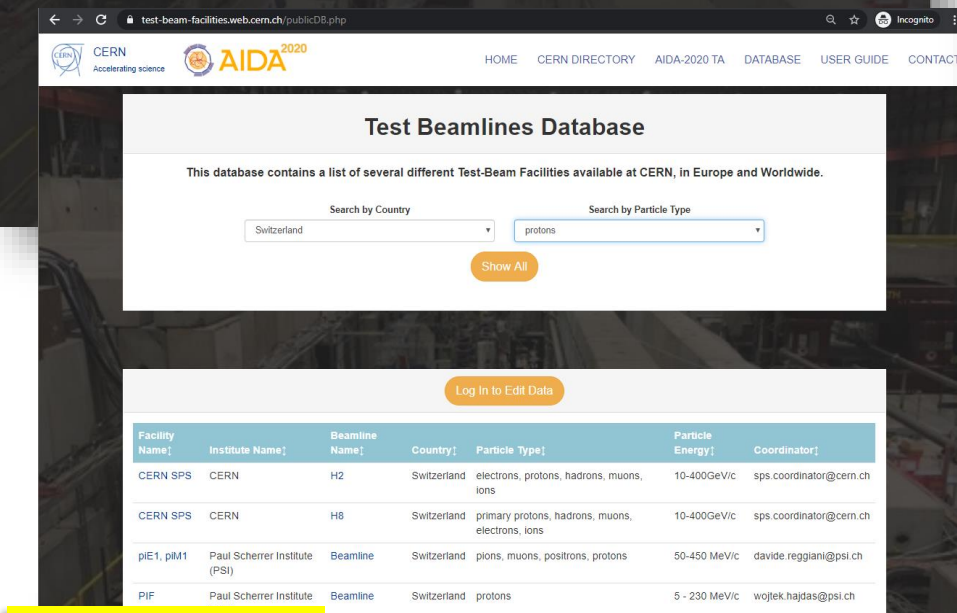
Facility coordinator contact information

Name: HVM/Bans  
 E-mail: sps.coordinator@cern.ch  
 Alternative e-mail:  
 Phone:



Institute/Organization Details

Institute: CERN  
 Facility Name: CERN PS  
 Address: Route de Meyrin, 1217, Meyrin, Genève  
 City: Geneva  
 Country:  
 Website:



Test Beamlines Database

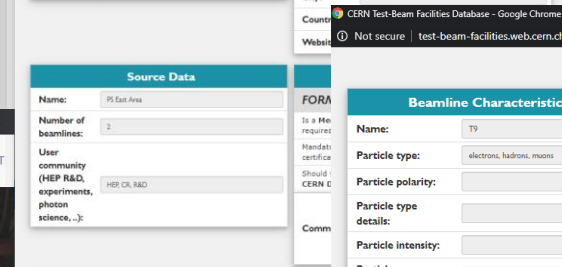
This database contains a list of several different Test-Beam Facilities available at CERN, in Europe and Worldwide.

Search by Country: Switzerland | Search by Particle Type: protons

[Show All](#)

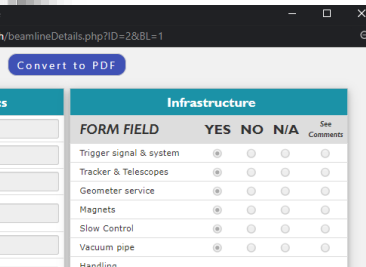
[Log In to Edit Data](#)

Facility Name	Institute Name	Beamline Name	Country	Particle Type	Particle Energy	Coordinator
CERN SPS	CERN	H2	Switzerland	electrons, protons, hadrons, muons, ions	10-400GeV/c	sps.coordinator@cern.ch
CERN SPS	CERN	H8	Switzerland	primary protons, hadrons, muons, electrons, ions	10-400GeV/c	sps.coordinator@cern.ch
piE1, piM1	Paul Scherrer Institute (PSI)	Beamline	Switzerland	pions, muons, positrons, protons	50-450 MeV/c	daVIDE.reggiani@psi.ch
PIF	Paul Scherrer Institute	Beamline	Switzerland	protons	5 - 230 MeV/c	wojtek.hajdas@psi.ch



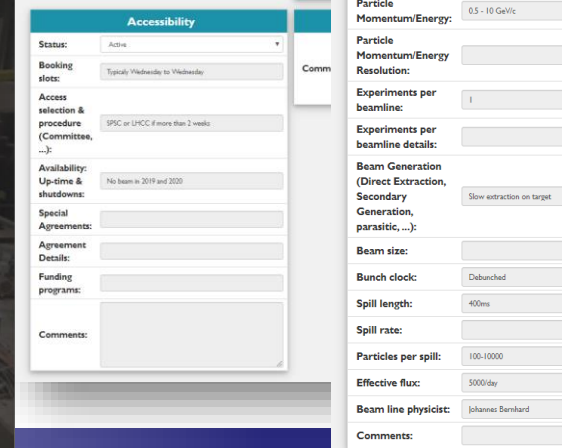
Source Data

Name: PS East Area  
 Number of beamlines: 2  
 User community (HEP R&D, experiments, photon science, ...): HEP CR, R&D



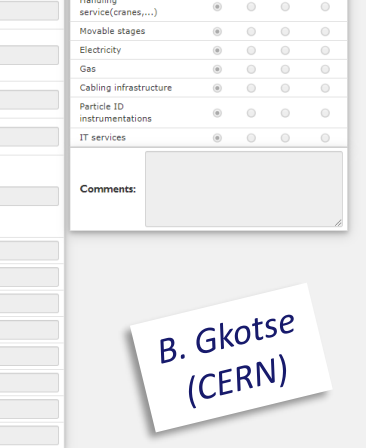
Beamline Characteristics

Name: T9  
 Particle type: electrons, hadrons, muons  
 Particle polarity:  
 Particle type details:  
 Particle intensity:  
 Particle Momentum/Energy: 0.5 - 10 GeV/c  
 Particle Momentum/Energy Resolution:  
 Experiments per beamline: 1  
 Experiments per beamline details:  
 Beam Generation (Direct Extraction, Secondary Generation, parasitic, ...): Slow extraction on target  
 Beam size:  
 Bunch clock: Debunched  
 Spill length: 400ms  
 Spill rate:  
 Particles per spill: 100-10000  
 Effective flux: 5000/day  
 Beam line physicist: Johannes Benhard



Accessibility

Status: Active  
 Booking slots: Typical / Wednesday to Wednesday  
 Access selection & procedure (Committee, ...): SPC or LHCC if more than 2 weeks  
 Availability: Up-time & shutdowns: No beam in 2019 and 2020  
 Special Agreements:  
 Agreement Details:  
 Funding program:  
 Comments:



FORM FIELD	YES	NO	N/A	See Comments
Trigger signal & system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tracker & Telescopes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geometer service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Magnets	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Slow Control	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vacuum pipe	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Handling service (cranes, ...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Movable stages	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Electricity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cabling infrastructure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Particle ID instruments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
IT services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

B. Gkotse (CERN)

during Y5 ...

## ➤ Sample Holder Material

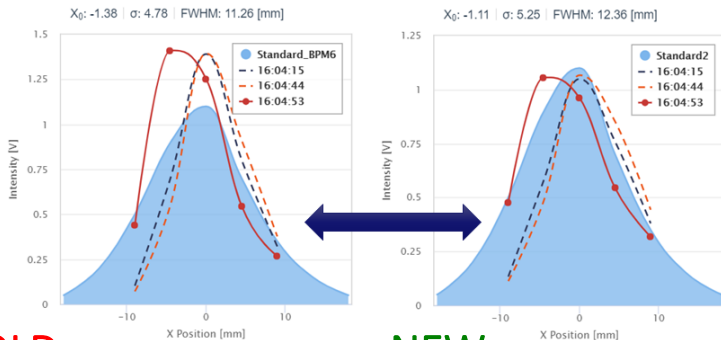
- Carbon Fibre and ULTEM good candidates after assessment of various materials

## ➤ Beam Profile Monitor (BPM):

- detailed performance analysis with different beam conditions
- engineering of BPM detectors with different patterns/granularity
- proof of concept of a **RadHard  $\mu$ -BPM based on microfabrication technologies**

**CMi** EPFL Center of MicroNanoTechnology

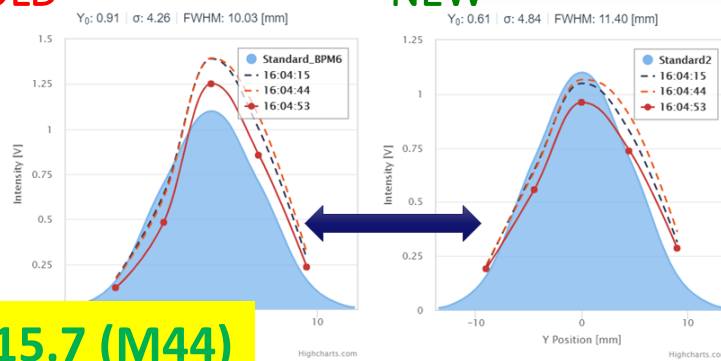
X profile



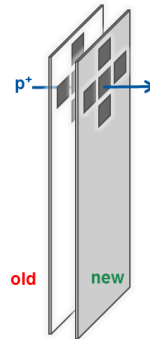
OLD

NEW

Y profile

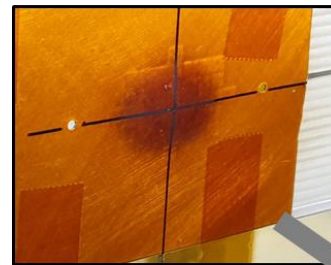


Tested in IRRAD during 2018!



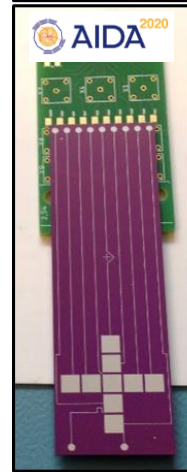
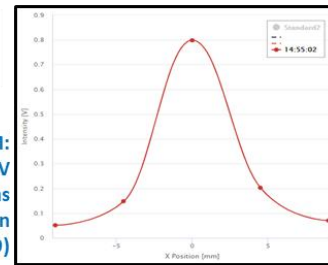
old new

J. Mateu,  
G. Pezzullo,  
G. Gorine,  
J. Bronuzzi  
(CERN)

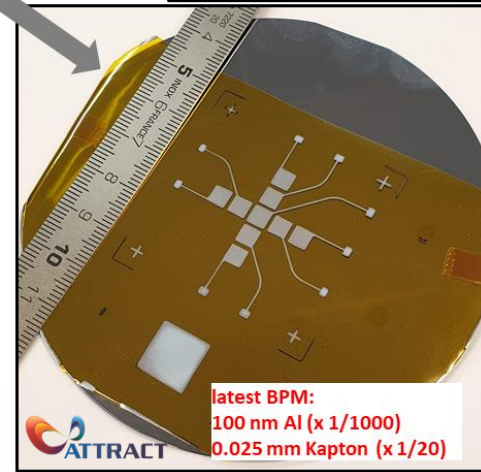


old BPM:  
0.1 mm Cu  
0.5 mm Kapton

new BPM:  
200 MeV electrons irradiation (2019)



new BPM:  
400 nm Al  
0.5 mm Si/SiO<sub>2</sub>



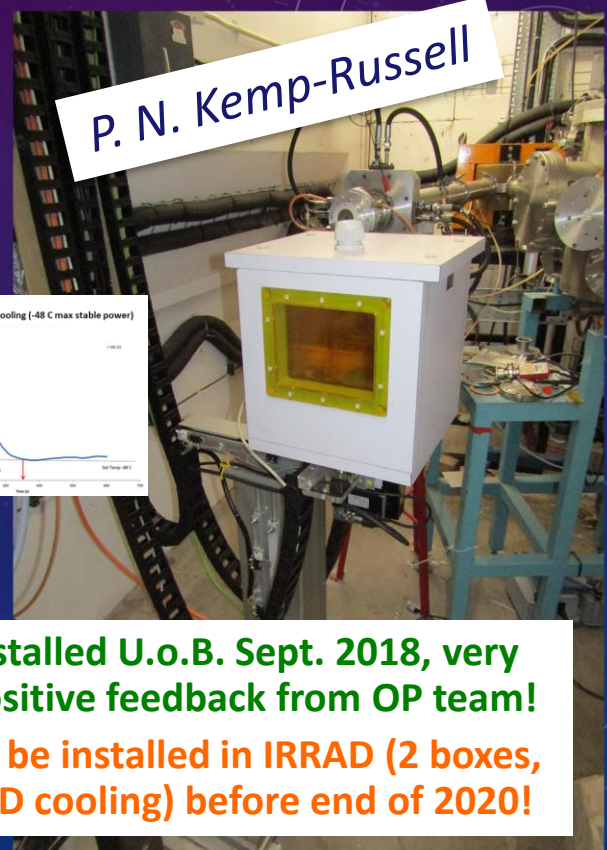
latest BPM:  
100 nm Al (x 1/1000)  
0.025 mm Kapton (x 1/20)

**D15.7 (M44)**

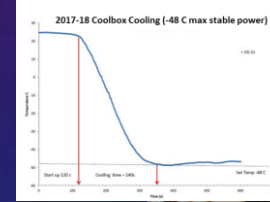
**during Y5 ...**



- **Aims of WP15.5: Improvements to infrastructure for Irradiation tests**
- Milestones and deliverables required and achieved for WP15.5
- MS: 15.8. Concept of cold box to be evaluated and a design fixed
- DEL: 15.8. Cold irradiations at Birmingham cyclotron enabled



- **Improvements made in new design**
- Greater thermal performance
- Sensor annealing well understood / avoided
- Larger sample capacity
- Reduced fan and heatsink size proportional to box
- Reduction of internal heat-load from fan.
- Cooling stable to operational (measured) irradiation temperatures at Birmingham
- Reduced service channel count
- Simplified control system
- Increased scan area
- New improved support (Z) pillar for better movement control (new).
- Robust robotic communication



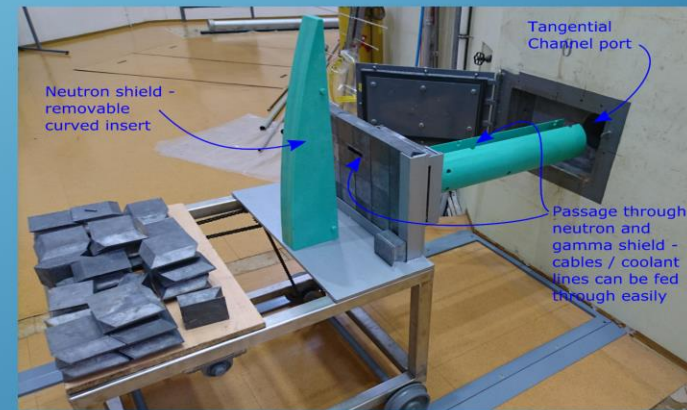
**Installed U.o.B. Sept. 2018, very positive feedback from OP team!**  
**To be installed in IRRAD (2 boxes, STD cooling) before end of 2020!**

2014-2017 system  
Small window, Flimsy pillar.

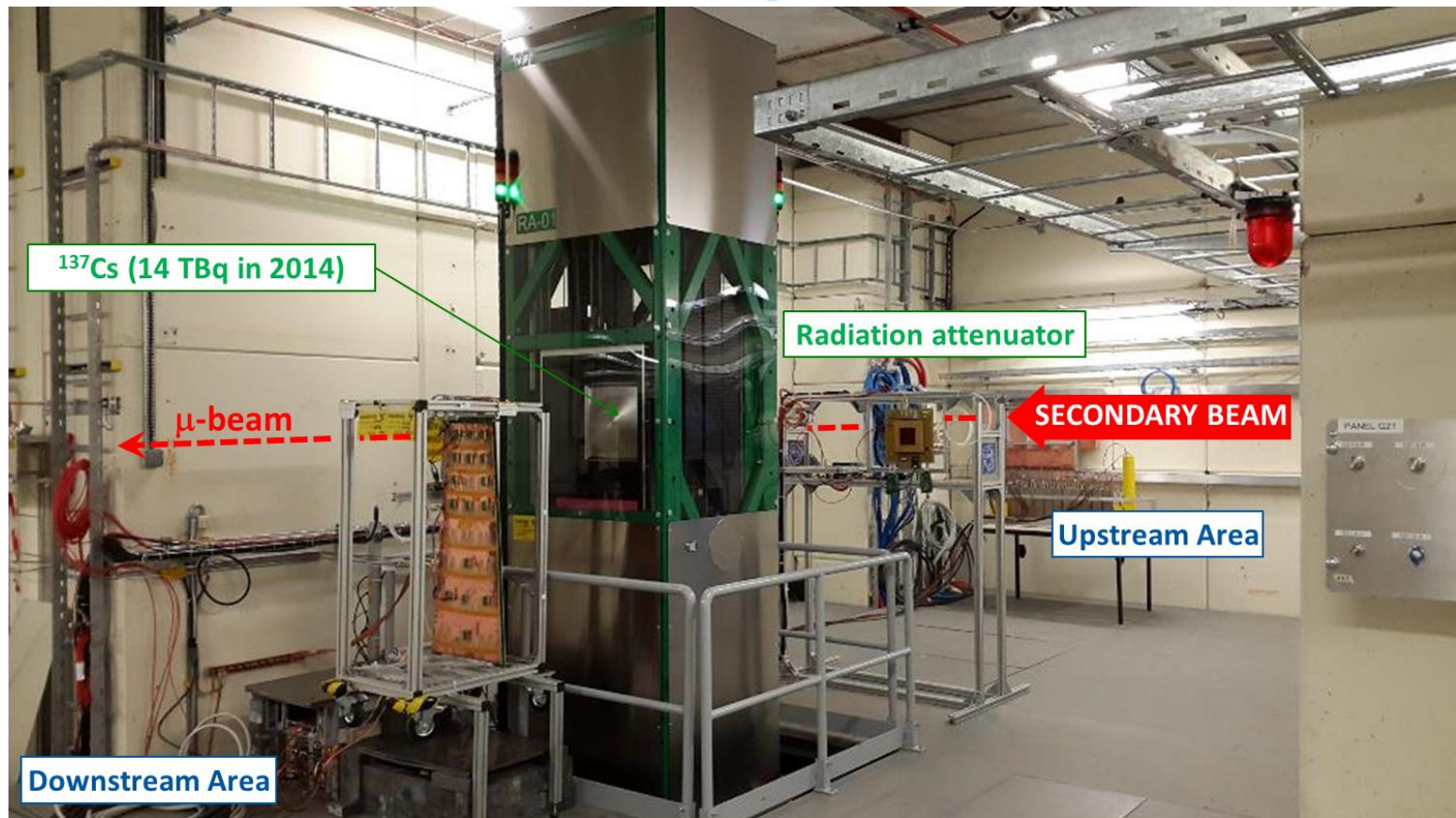
2017-2020 system  
Large window, Robust pillar

- new irradiation facility at JSI reactor installed and commissioned in 2016
- allows irradiation of  $\sim 12 \times 25 \text{ cm}^2$  samples
  - services possible
- $10^{15} n_{\text{eq}} \text{ cm}^{-2}$  in less than one hour
- 8 irradiation projects completed (electronics, sensors), 3 during last year
- ATLAS pixel module -  $10^{16} n_{\text{eq}}$
- CMS calorimeter, 7 irradiations up to  $10^{16} n_{\text{eq}} \text{ cm}^{-2}$
- ATLAS full size sensor
- AIDA funds exhausted by end of 2018
- limited amount of irradiations offered for half price

V. Cindro (JSI)



- Typically for muon systems of HEP experiments
- $E_\gamma = 0.66 \text{ MeV}$ ; max. dose-rate  $\sim 0.5 \text{ Gy/h}$  @ 1m from source ( $\pm 37^\circ$  angle) and  $2.5 \text{ Gy/h}$  @ glass contact
- Several **attenuation factors** available (up to  $\sim 50'000$ )
- $\mu$ -beam from T2 on H4 beam-line (100 GeV;  $\sim 10^4$  /spill)





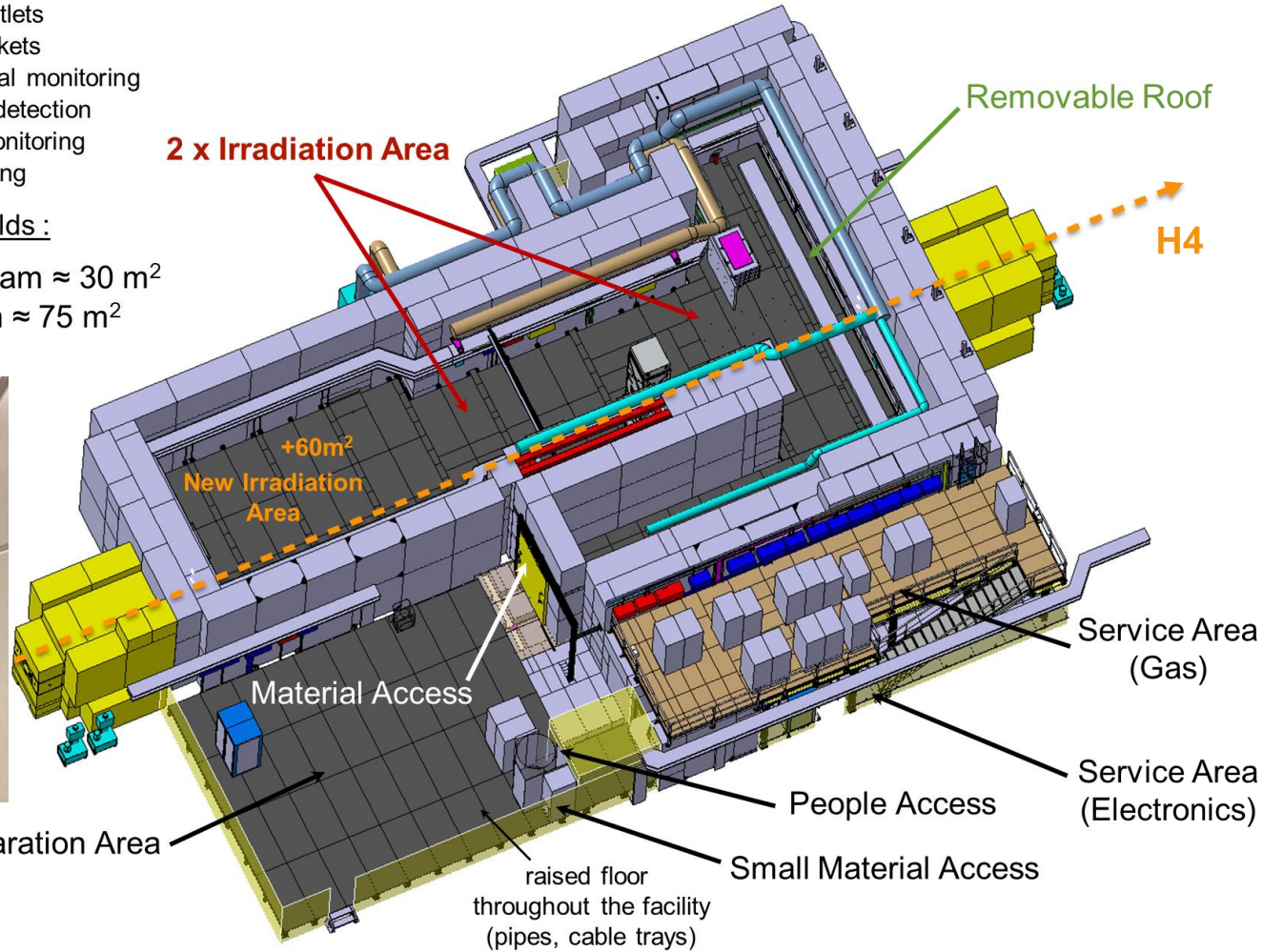
Bunker area contains :

- ▶ Gas panels
- ▶ Electricity outlets
- ▶ Network sockets
- ▶ Environmental monitoring
- ▶ Gas/smoke detection
- ▶ Radiation monitoring
- ▶ Air conditioning

Irradiation Fields :

- ▶ Downstream  $\approx 30 \text{ m}^2$
- ▶ Upstream  $\approx 75 \text{ m}^2$

**2 x Irradiation Area**



*After LS2 (July 2019)*


The gas system infrastructure is a key element of the successful R&D programs performed at the GIF++

*R. Guida (CERN)*



Mixing units, gas recirculation systems and gas analysis module are used for detector R&D studies

Wide range of available gases available  
Possibility to use pre-mixed bottles (local gas point)



**AIDA** 2020 Partial funding of the gas system equipment and two CERN technical students

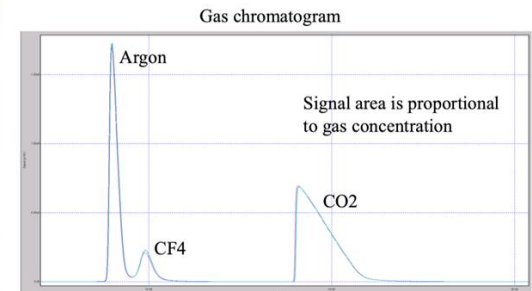


- Mixture distribution
- Monitoring of pressure, O<sub>2</sub>/H<sub>2</sub>O, temperature, atmospheric pressure
- Additional software controlled pressure regulation for very low flow regimes
- Gas mixing unit

Gas recirculation module



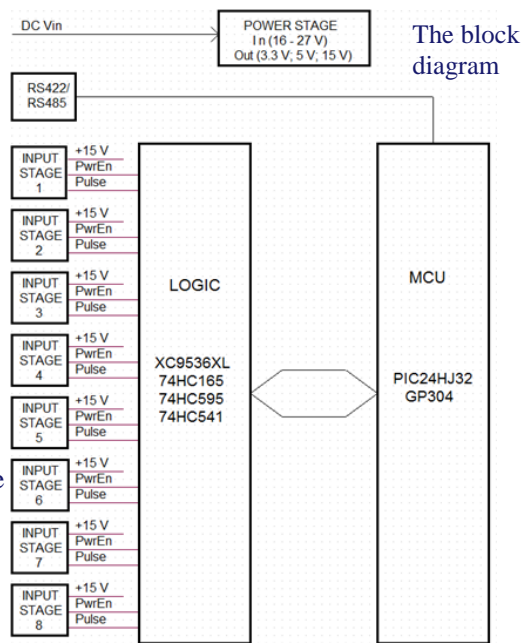
- Sampling manifold
- PC for GC software controls
- GC analyser (3 modules for large spectra gas separation)



Gas chromatographic analysis : allows monitoring gas mixture composition and presence of impurities on return from detectors under test

# Task 15.5: GIF++ Facility Upgrade (Instantaneous Dose-Rate Monitor)

## Instantaneous DRM for GIF++ and test of SiPM + scintillator as a DRM for Gif++



### Test configuration

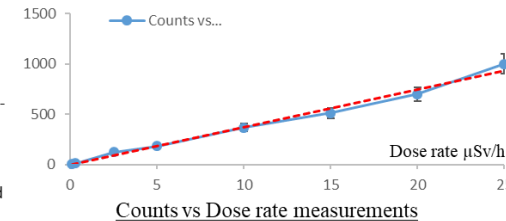
**SiPM** - Hamamatsu S13360-1325CS (57.28V)

Photosensitive area: 1.3 x 1.3 mm. Pixel pitch: 25  $\mu\text{m}$ . reduced crosstalk and dark count, Gain (typ.) -  $7.0 \times 10^5$

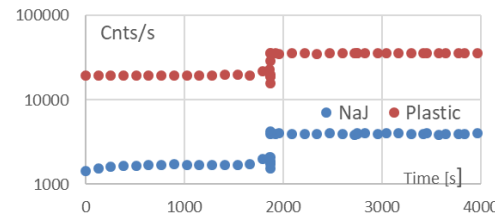
### Scintillator

- 250x10x7 mm<sup>3</sup>, extruded polystyrene bar supplemented with 1.5% paraterphenyl (PTP) and POPOP 0.01%;  
- 30-100 micron layer Uniplast acting as a diffusive reflector; Light shifter WLS Y11 KURARAY  $\Phi$  1 mm

**Amplifier** - Canberra 2024, shaping time 2  $\mu\text{s}$ .  
**ADC** - 4k, custom made



DRM with a NaI(Tl) scintillator and photomultiplier FEU-35 was assembled at INRNE for the test. The spectra of Caesium-137 measured with it is shown on the plot:



Comparison for NaI(Tl) and plastic scintillators for two attenuations at GIF++

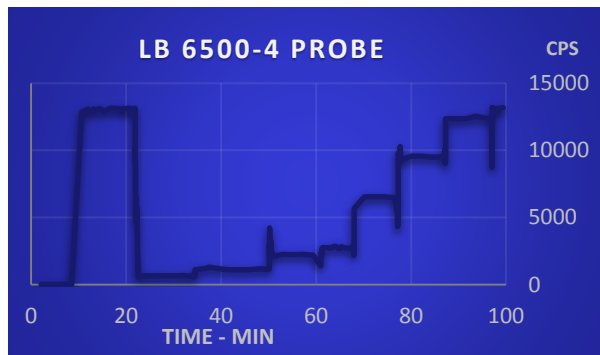
The light yield and decay time for NaI and plastic scintillators differ significantly. The test and comparison between these 2 DRM's at Gif++ (from 10 to 10000 mGy/h) could give an information for the possible use of the DRM's at substantially different dose rate conditions.

*P. Iaydjiev, L. Dimitrov,  
I. Vankov, G. Mitev, L. Ratchev*



**Test of the Berthold LB 6500 Geiger-Mueller Dose Rate Probes at several attenuations at Gif++**

Berthold LB 6500 Geiger-Mueller Dose Rate Probe for 2 and 8 channel DRM



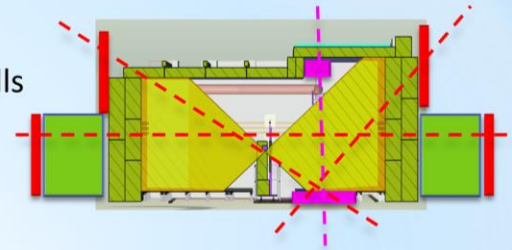


## Project description

Extension of the **present GIF++ cosmic tracker**  
via installation of **new RPC chambers** on the bunker endcap walls

### Benefits:

- Extended coverage
- Selection of harder momentum muons
- Triggering on beam-halo muons



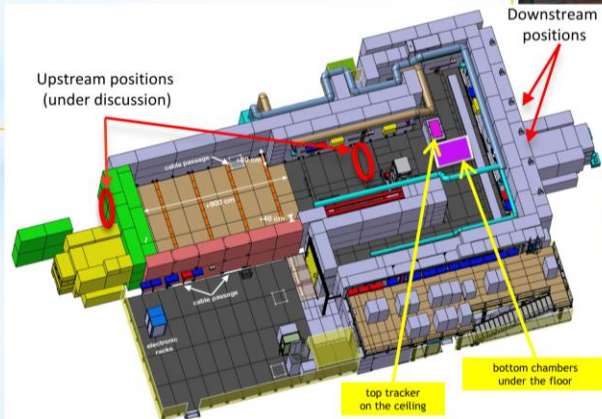
## Project deliverable

**4 RPC chambers have been constructed**

- mechanics + front-end electronics + gas volumes

### Chambers positioning:

- defined for the downstream region
- upstream region under discussion taking into account:
  - bunker extension
  - improved muon beam proposal (new pion dump)



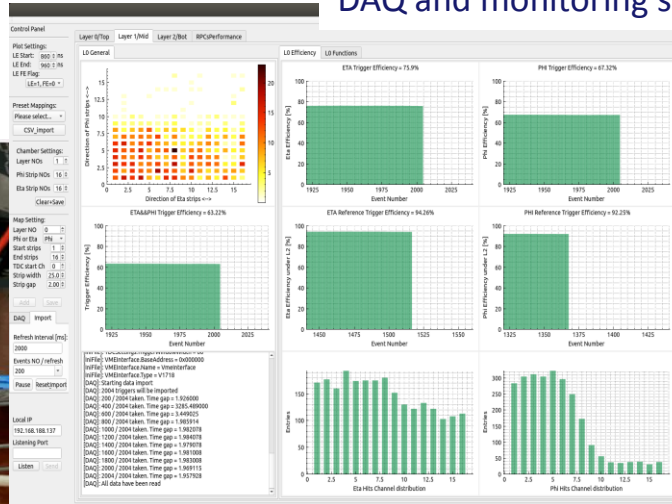
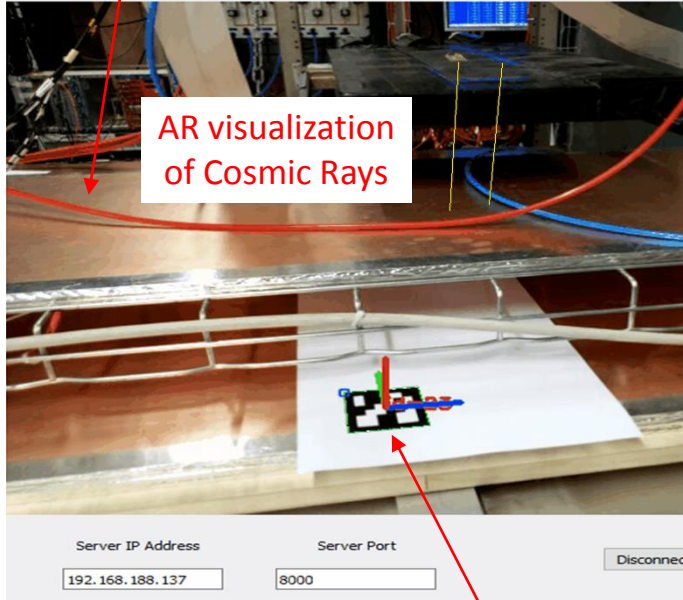
D. Boscherini

# Task 15.5: GIF++ Facility Upgrade (Augmented Reality Event-display)

## DAQ and monitoring system

### Cosmic-ray test setup at BB5

- RPC detector



AR visualization of chamber status

This application has been developed for demonstrating the concept

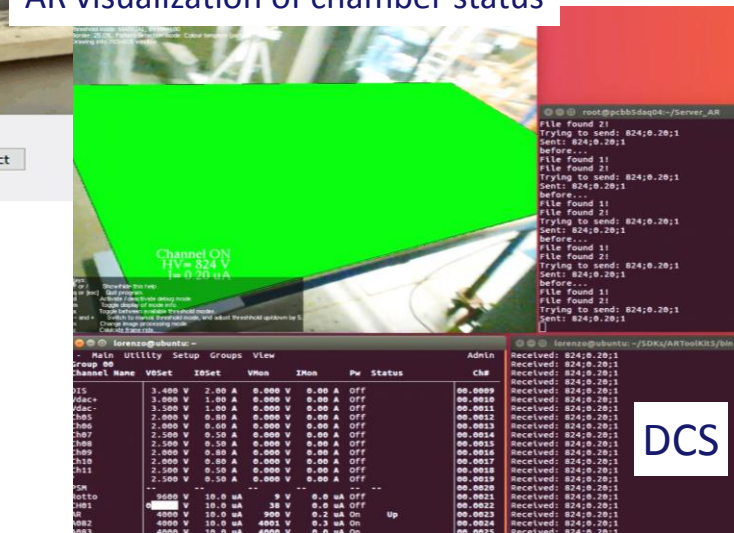
For a real use:

- Port the software on an android system
- Enable the possibility to orient the system in a complex environment using multiple markers
- Enable the possibility to increase the precision of the information localization
- Making the tracking interactive
- Making the detector interactive
- Making the DCS interactive

- Marker and AR reference frame

### Software Platforms:

- ARToolKit 5.4 for AR
- WinCC for DCS
- Qt (for porting AR on Android)
- Data acquisition & monitoring custom application



Channel ON HV= 524 V I= 0.20 uA

DCS

Group	Chn	VBSet	IDSet	VMon	IMon	Pwr Status	Admth	Chk
315	04ac+	3.480 V	2.80 A	0.000 V	0.00 A	OFF	00.0009	
	04ac-	3.500 V	1.80 A	0.000 V	0.00 A	OFF	00.0010	
	04b+	2.000 V	0.50 A	0.000 V	0.00 A	OFF	00.0012	
	04b-	2.000 V	0.50 A	0.000 V	0.00 A	OFF	00.0013	
	04c7	2.500 V	0.50 A	0.000 V	0.00 A	OFF	00.0014	
	04b5	2.500 V	0.50 A	0.000 V	0.00 A	OFF	00.0015	
	04c9	2.000 V	0.80 A	0.000 V	0.00 A	OFF	00.0016	
	04c8	2.500 V	0.50 A	0.000 V	0.00 A	OFF	00.0017	
	04c1	2.500 V	0.50 A	0.000 V	0.00 A	OFF	00.0018	
	04c2	2.500 V	0.50 A	0.000 V	0.00 A	OFF	00.0019	
	04c3	2.500 V	0.50 A	0.000 V	0.00 A	OFF	00.0020	
316	04d1	4000 V	10.0 uA	38 V	0.0 uA	OFF	00.0021	
	04d2	4000 V	10.0 uA	390 V	0.2 uA	On	00.0022	
	04d3	4000 V	10.0 uA	4001 V	0.2 uA	On	00.0023	
	04d4	4000 V	10.0 uA	4000 V	0.0 uA	On	00.0024	

G. Aielli



INFN  
Istituto Nazionale di Fisica Nucleare



- **WP15 has delivered improvements to Test Beam and Irradiation Facilities**
  - people working together, meeting & exchanging ideas, providing common infrastructures and services for the community, ...
  - **all Milestones completed**
  - **all Deliverables completed** (D15.5 and D15.11 **reports on-line soon**)
  - several of our **activities continued in Y5 beyond the Deliverables** with good results!
- ***We'd like to thank our task leaders and all contributors for making it really a pleasure to lead WP15. As in any large projects, we went through ups and downs, but at the end we all achieved everything we aimed for, and more!***
- **... and beyond AIDA-2020?**
  - WP15 has build bridges and communities and this network will probably “stay alive” beyond AIDA-2020
  - several ideas born within WP15 evolved into full AIDAinnova EoI's in key areas (development of new common tools, beam telescopes upgrade, etc.)
  - “crossing fingers” for the new proposal and looking forward to restart working together soon!

