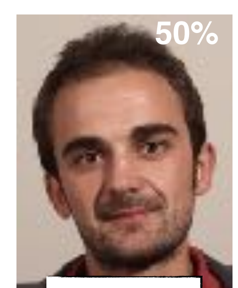
EP Irradiation Facilities

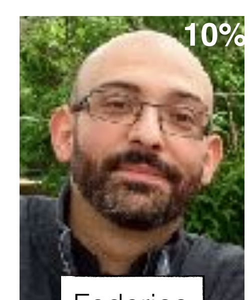
2 unique facilities

IRRAD
Proton Facility

GIF++
Gamma Irradiation Facility

EP-DT-DD





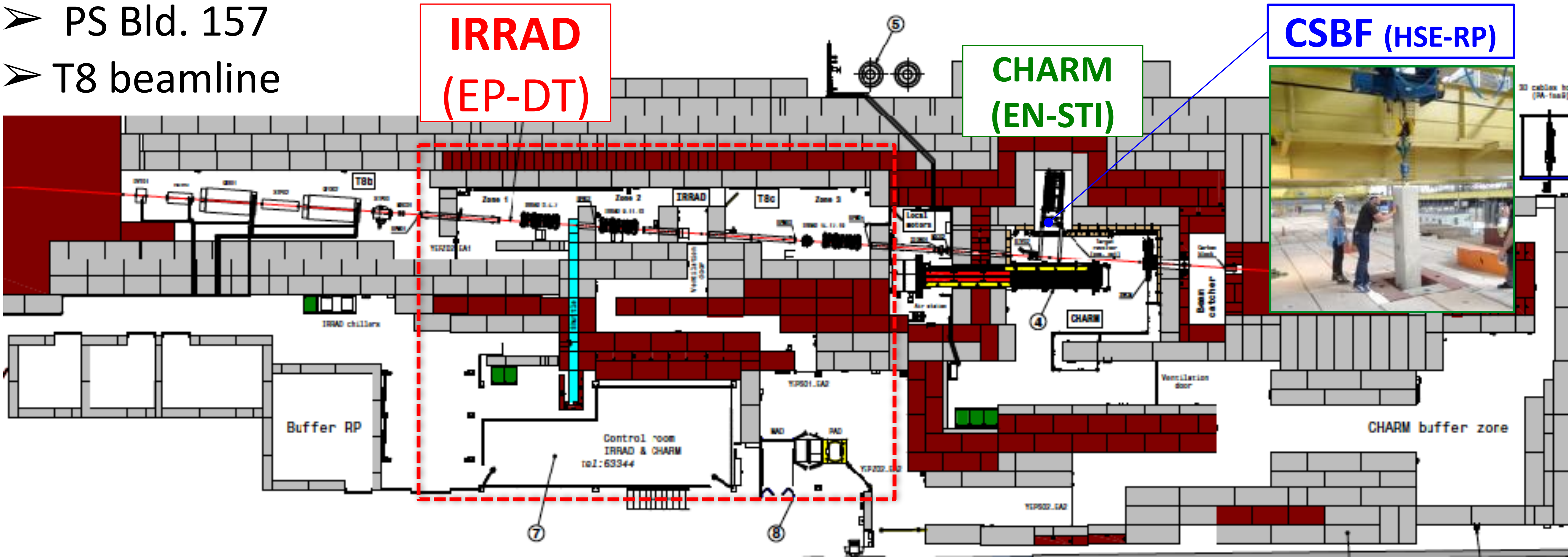
+ EN-EA

+ EP-DT-FS
+ EP-DT-DI

June 22, 2017

East Area Irradiation Facility

- PS Bld. 157
- T8 beamline

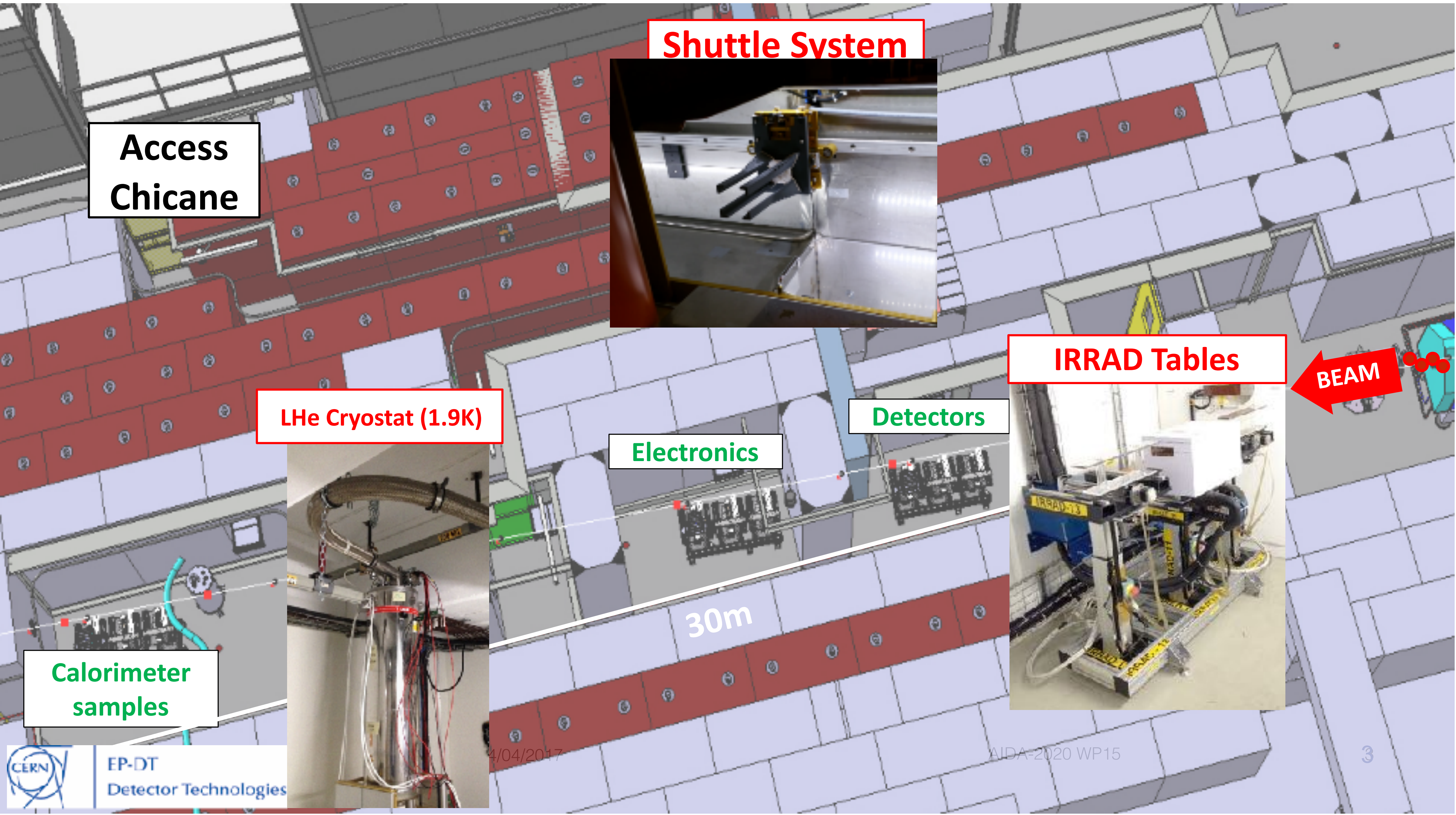


Operation 2017:

- 17 days beam setup
- **~200 days for users operation with protons** started on May 10th
  - special weeks: 4× for **cryogenic setup** in IRRAD, 3× for **heavy-materials**, 10x **water cooled equipment** in CHARM, discussing **"blown-up" beam** period;
  - 1w for CERN Shielding Benchmark Facility (CSBF).
- **Heavy Ions Run:** 4w with Xe ions for **SEE cross-section studies**

Facility Overview

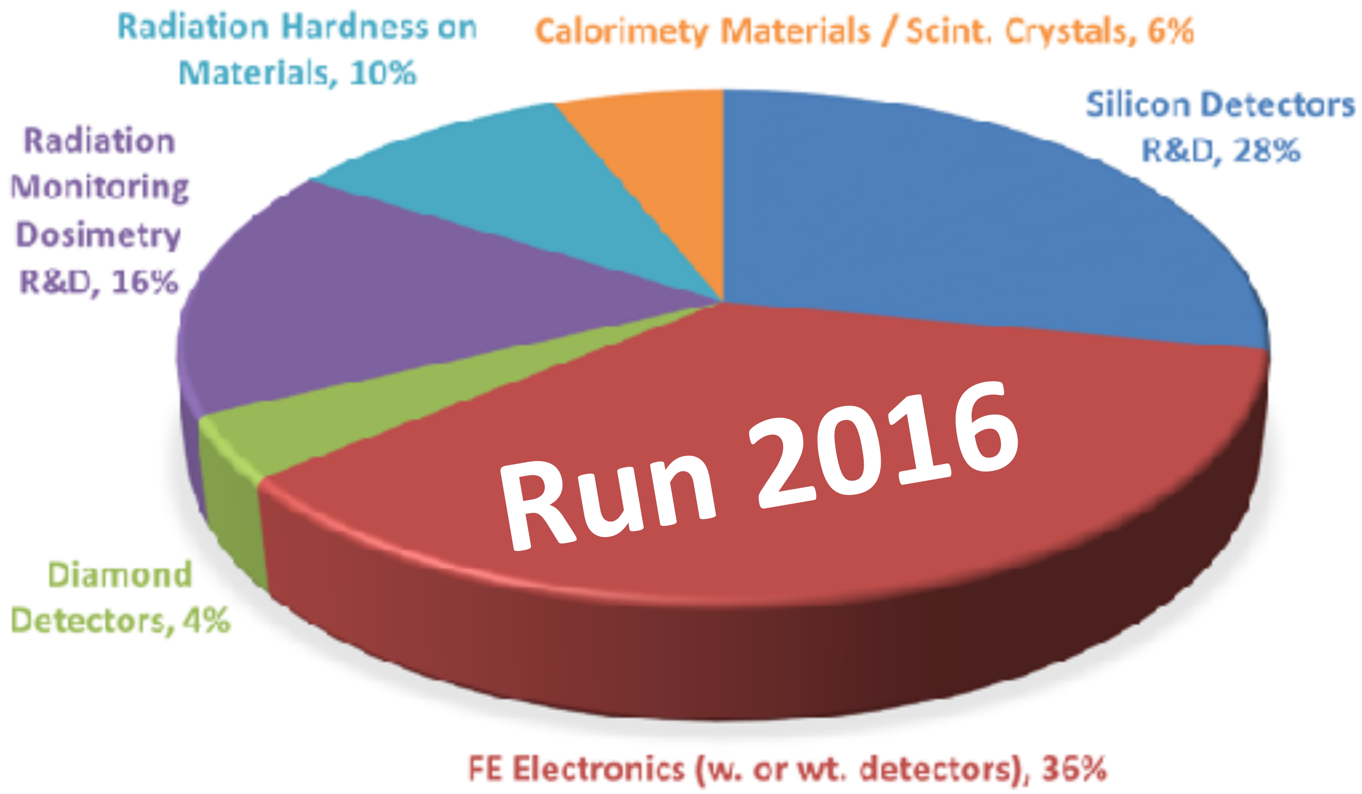
- **Testing components of the HEP experiments**
- Beam of **24 GeV/c** and size of 12×12 **mm²**
- Fluence of 1×10^{16} **p/cm² in 14 days**
- Low temperature irradiation (-25°C)



Statistics

IRRAD Proton Facility

Run 2017



Registered Experiments (web)	52	49 executed (94%)
Number of users / user teams	28	~70% LHC experiments
Number of samples / irradiated objects	**416**	246 "SET" numbers
Samples size (MIN/MAX)	2mm × 2mm	250cm × 13cm × 4cm
MAX target proton fluence per experiment	1×10^{17} p/cm^2 (5x5mm^2 FWHM)	~27MGy in silicon
Delivered proton (typical MIN/MAX)	~2×10^{11} p/cm^2 (1 spill)	~4.2×10^{16} p/cm^2 (5x5mm^2 FWHM) ~1.6×10^{16} p/cm^2 (20x20mm^2 FWHM)
Irradiation time (typical MIN/MAX)	400 ms	~60 days ~76 days

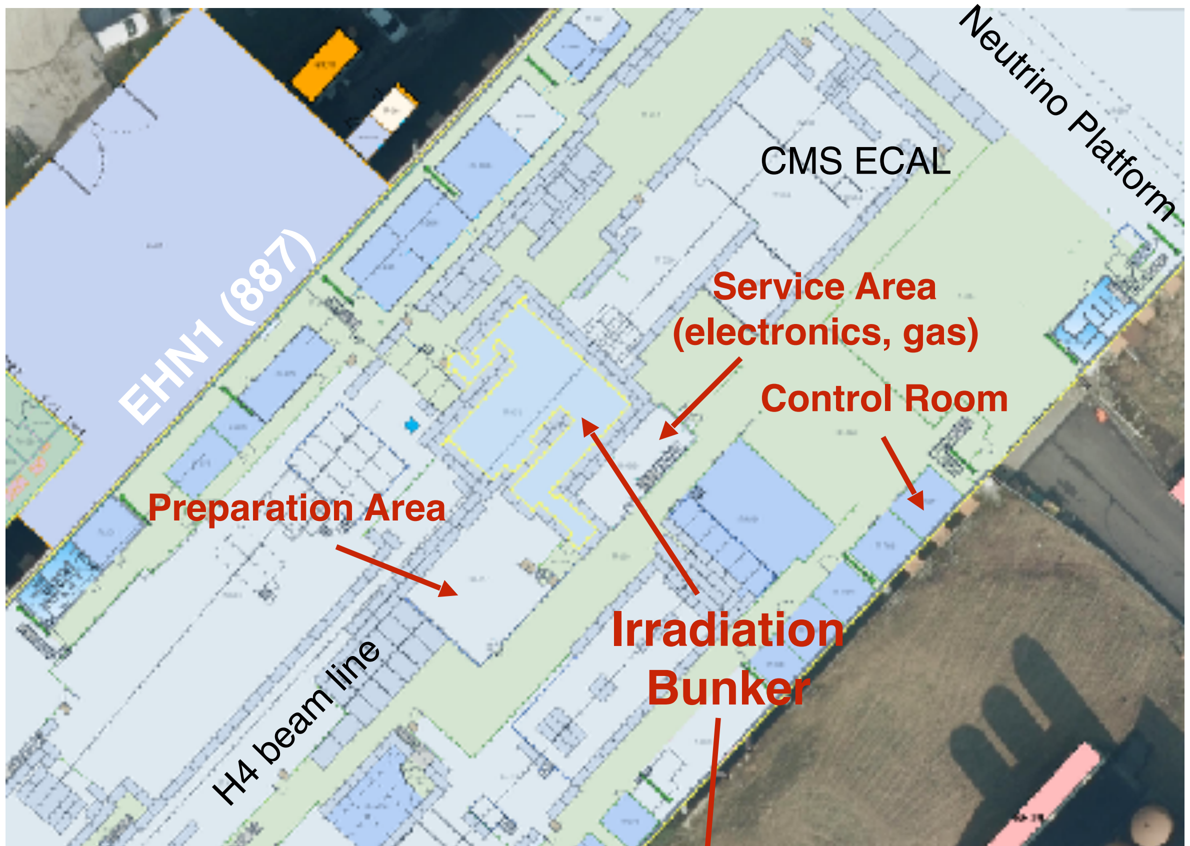
- **~280 samples registered**
  - 18 user teams
  - Max. target $\Phi = 1\times10^{17}$ p/cm^2
- **several other experiments being discussed**
- registered users: *LHCb-UT, CMS-HCAL, CMS-Pixel, ATLAS-ITK, ATLAS-Pixel, ATLAS-LARG, ATLAS-Strip, RD50, FCC WP11, BE/BI, TE/MSC and EN/EL*

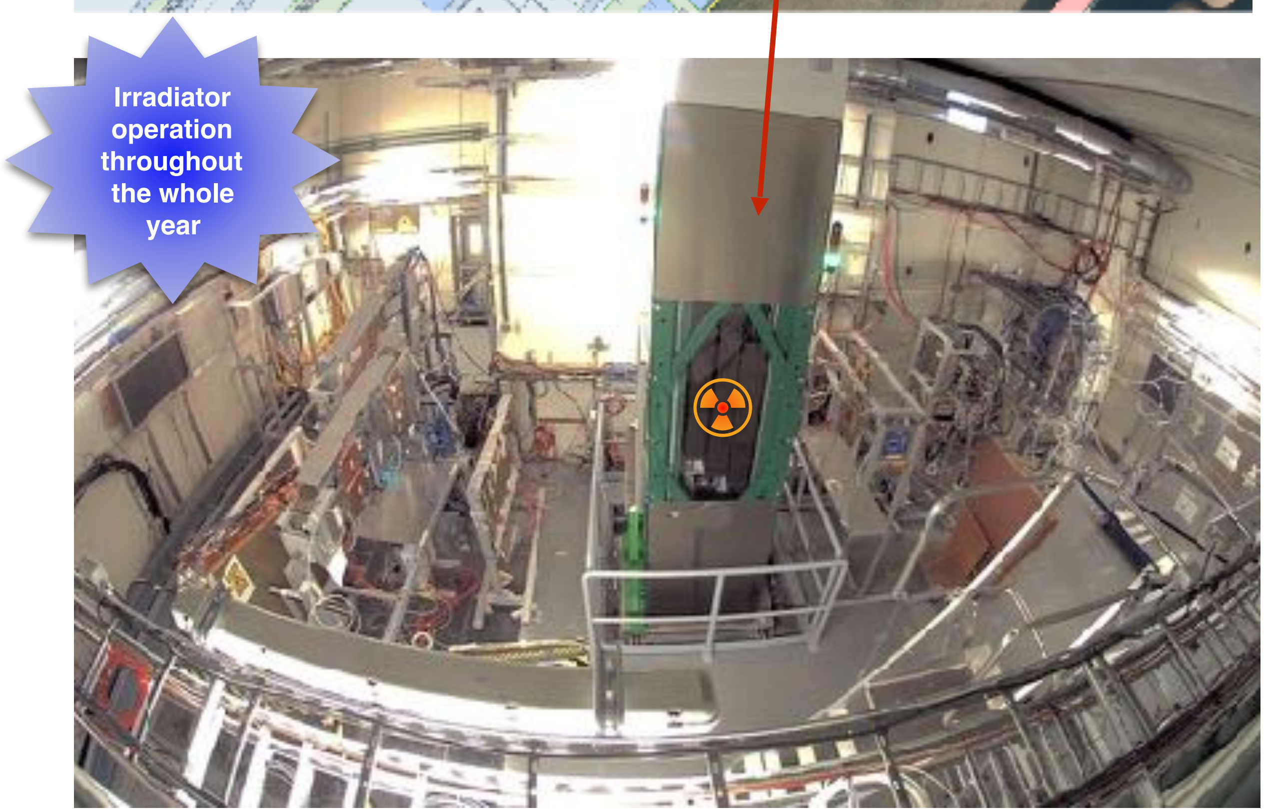
CMS Pixel on IRRAD9

➢ Radiation damage studies
➢ Test of prototypes before installation
➢ Test and calibration of components

Gamma Irradiation Facility @ EHN1

GIF++



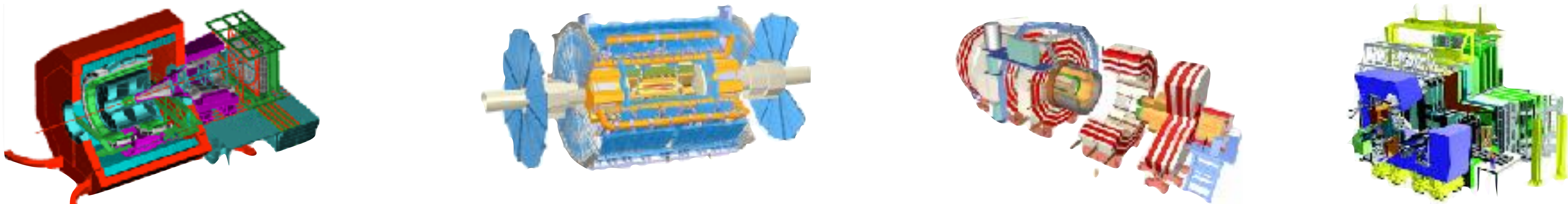


- **Joint facility, operated by EN-EA and EP-DT**
- **Combines a high energy muon beam +14 TBq ^{137}Cs gamma source**
- **Designed for testing real size detectors, of up to several m², as well as a broad range of smaller prototype detectors and electronic / optical components.**
- **100 m² irradiation bunker with 2 independent irradiation zones, separated attenuation systems**

- **All year operation from Cs-Irradiator**
- **High energy Muon beam at H4 beam line**
  9 weeks dedicated shared beam in 2017
- **Central Control System, recording all relevant parameters** (Irradiator, environment, filters, gas, beam, access conditions..) **and provides interlocks** (e.g. for wrong gas mixtures)
- **Wide range of available gases** (+ custom gases) **in bunker & service zone**

Facility Goal

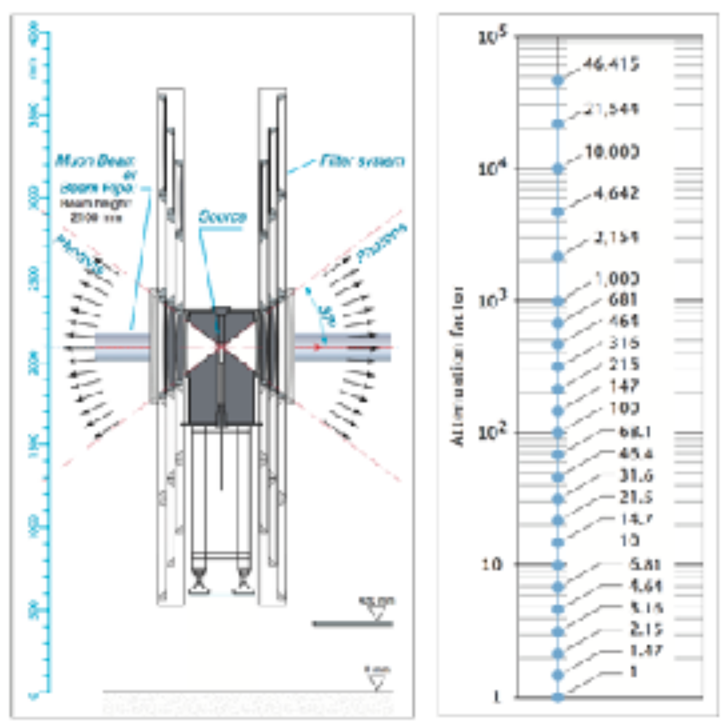
Despite their difference in detector design, all four LHC experiment rely on muon triggering and muon detection for reaching their physics goals.



With increased high radiation environment of the HL-LHC, the muon detectors will face new challenges in distinguishing muons from background an dealing with radiation induced ageing effects
=> Dedicated test facility needed !

Strong Cs Source

+



Sets of absorption filters

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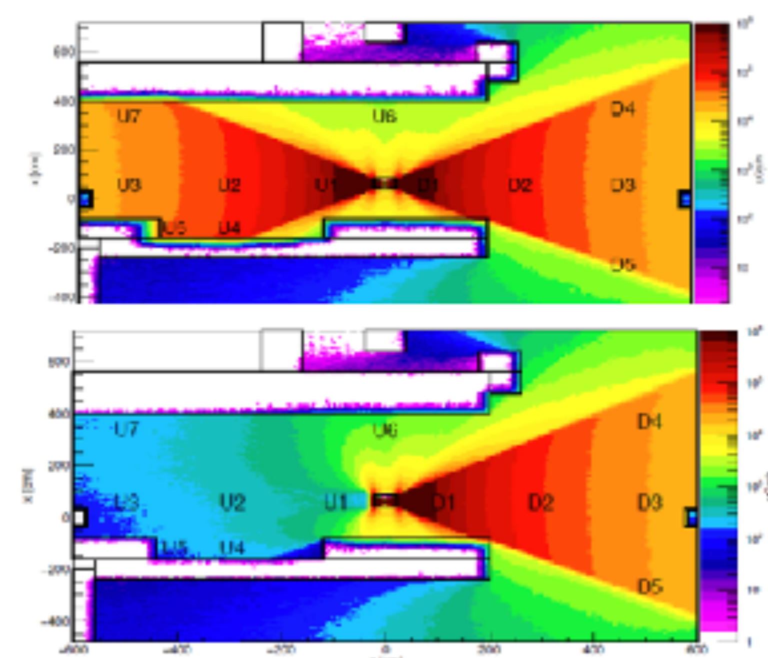
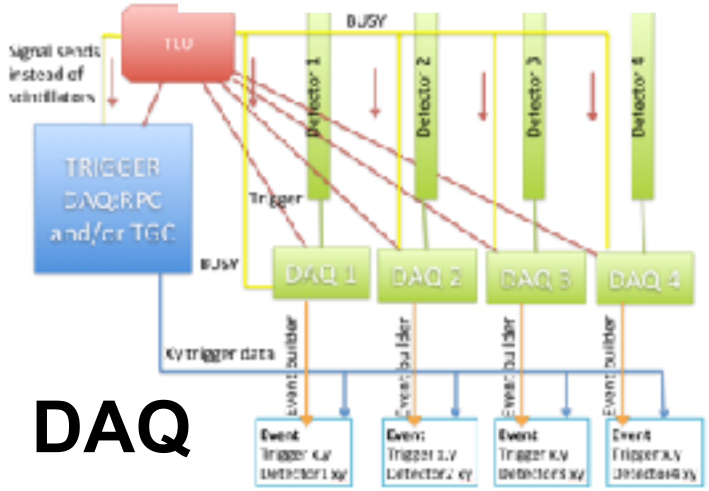


2 independently adjustable radiation fields, with background conditions similar to expected detector environment

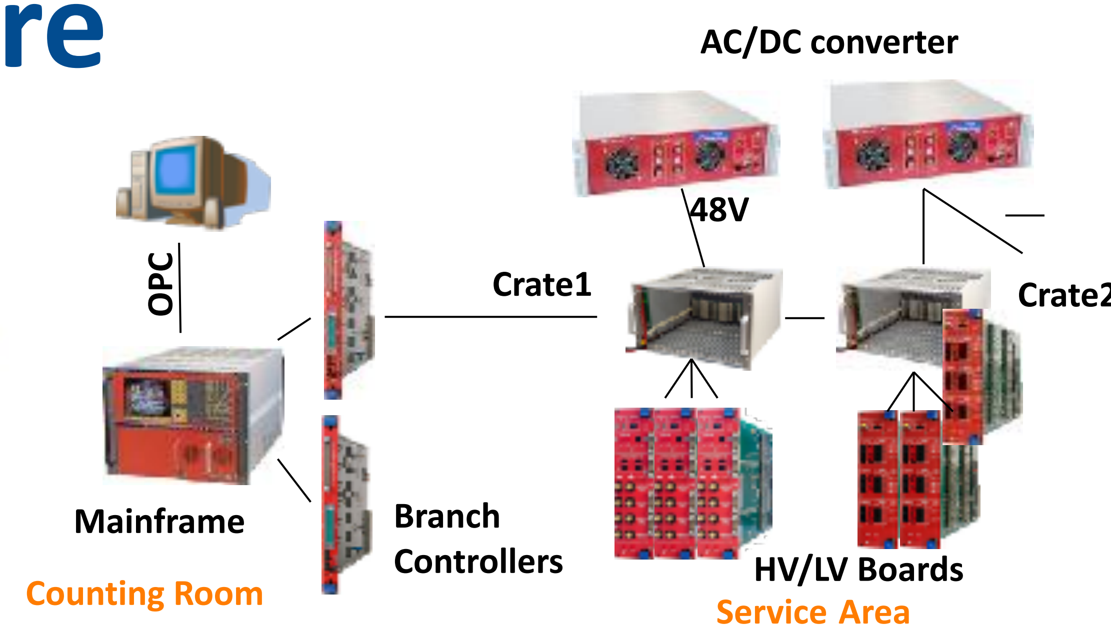
+ μ beam

GIF Infrastructure

DAQ



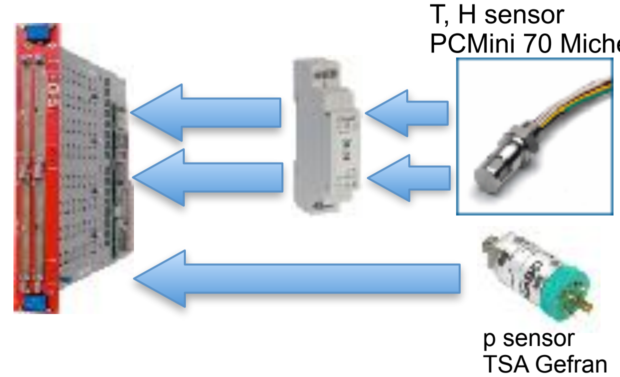
Central DCS



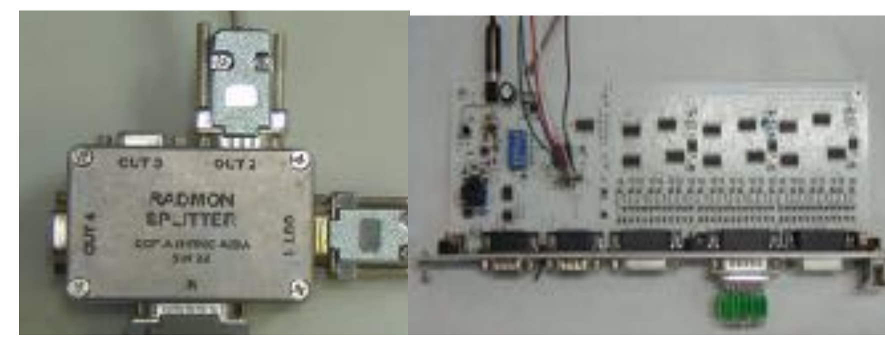
Gas System

AIDA 2020

Infrastructure development and transnational access



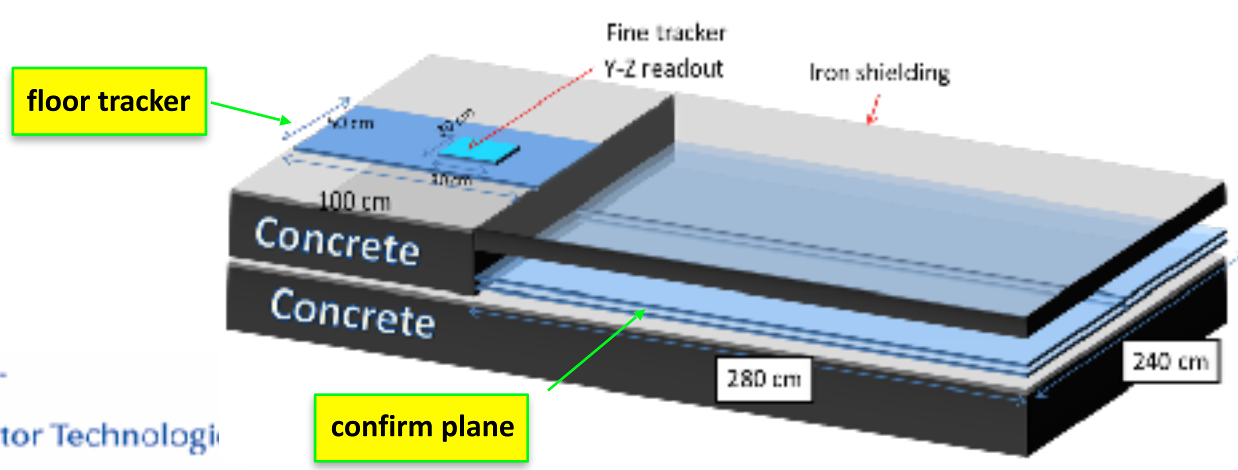
Environmental monitoring

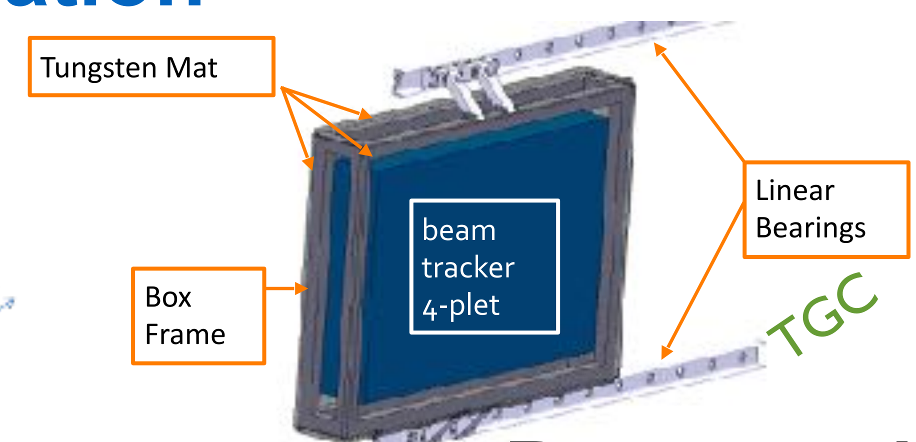


12 RADMON sensors

Under installation

Cosmic tracker



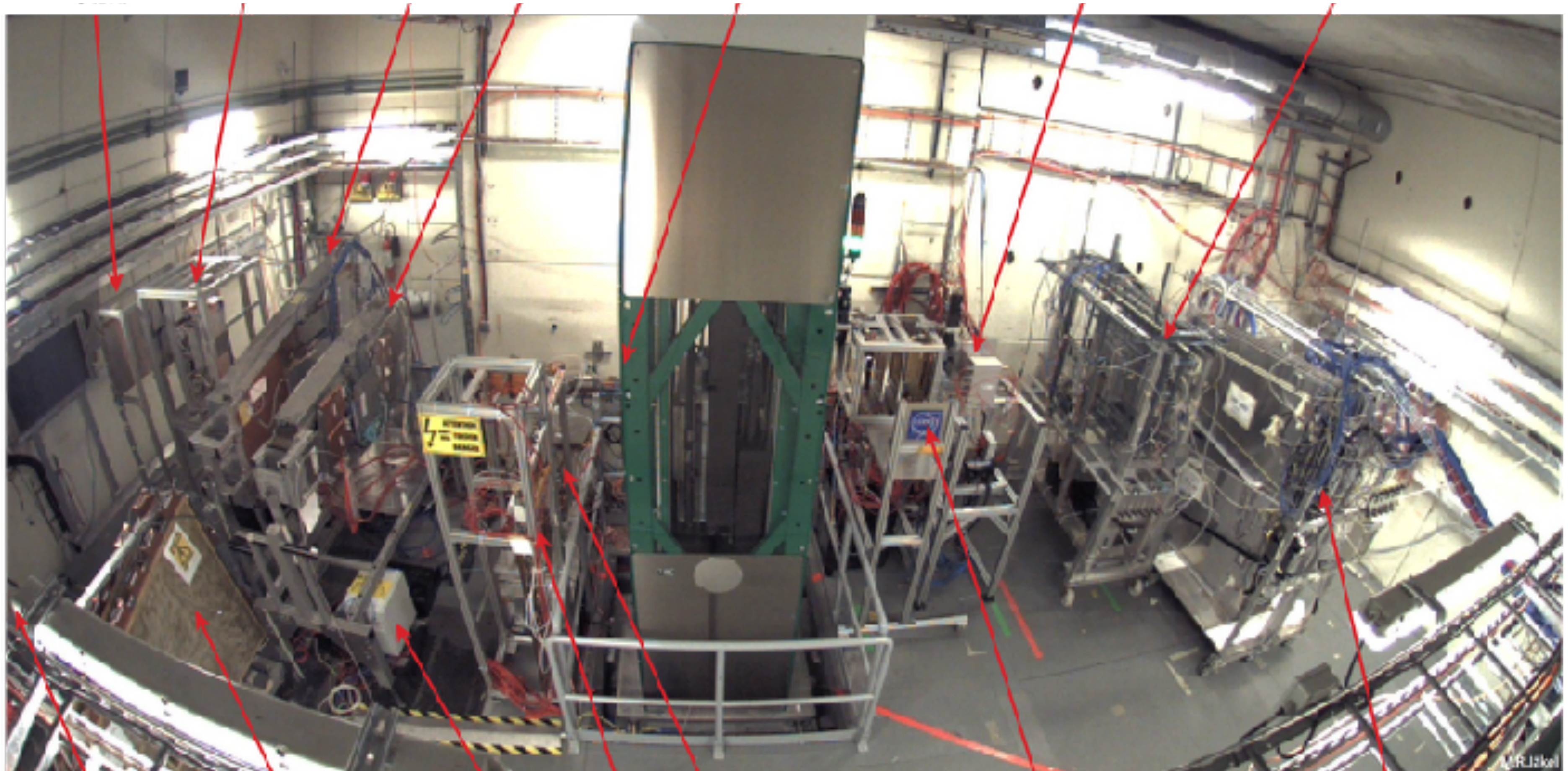


Beam tracker

GIF++

Dec 2014

MAY 2017



User Set-Up for 2017

Wide range of setups, from real size LHC gas detectors (up to several m²) to small optical or electrical components

26 Set-ups requesting beam or long term irradiation

Description of each set-up available at https://gif-irrad.web.cern.ch/gif-irrad/UserList.html

6 Gas Detector technologies

- DT, MDT
- CSC
- RPC, iRPC, GRPC
- MM
- GEM
- sTGC

ATLAS

- ATL-MDT detector
- ATL-Phase-II system test
- ATL-MM
- ATL-NSW-MM-mod0
- ATL-NSW-MM_resistive
- ATL-NSW-MM-prod
- ATL-NSW-STGC-mod0
- ATL-NSW-STGC-prod
- ATL-NSW-STGC-ELX
- ATL-RPC
- ATL-BIS78-mod0

CMS

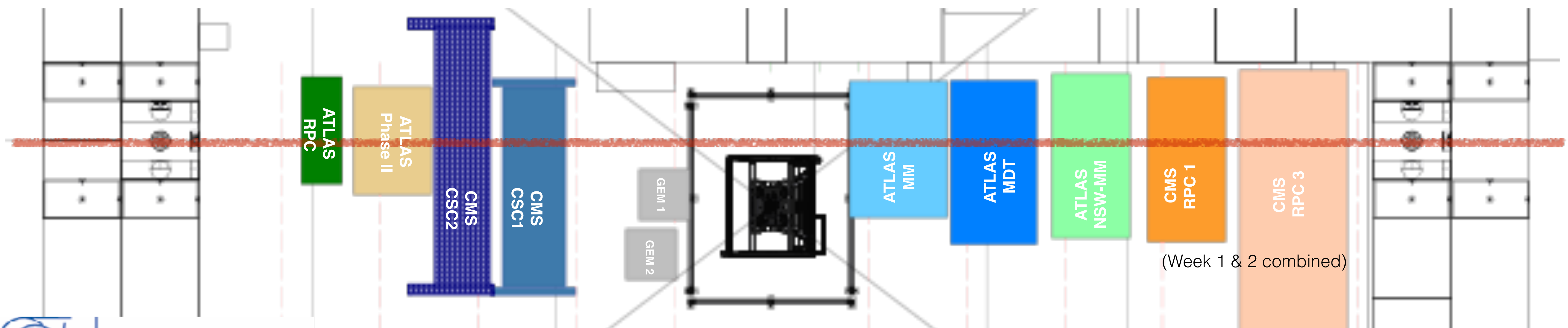
- CMS-CSC1
- CMS-CSC2
- CMS-CSC3
- CMS-DT-MB1
- CMS-DT-bycells
- CMS-GEM1
- CMS-GEM2
- CMS-RPC1
- CMS-RPC2
- CMS-RPC3

OTHER

- BE-BI-BL BLM
- EP-DT1, EP-DT2
- RE21_CBM (FAIR)
- LHCb - M1R3

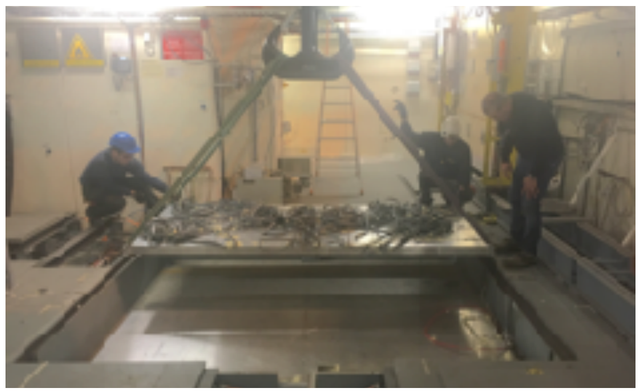
AND

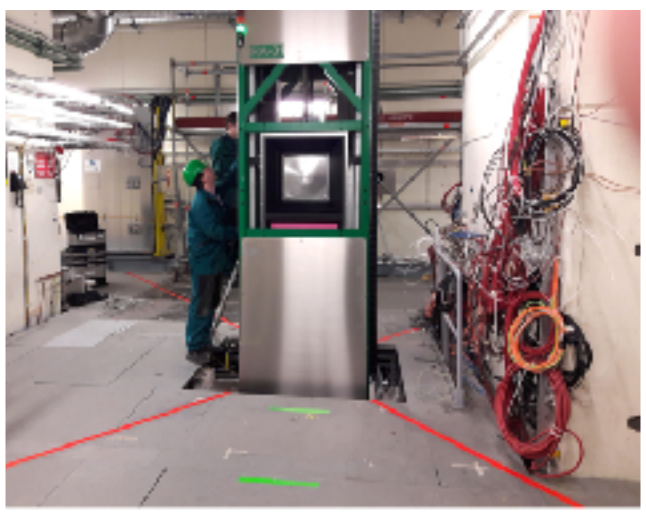
- wide range of electronic- or optical components for short time (several weeks) irradiation

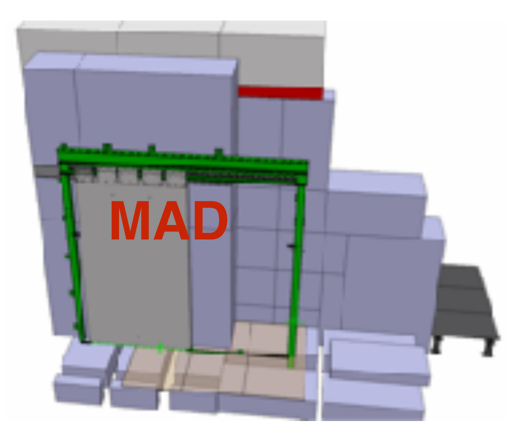


Typical setup during beam time

2017 Highlights







COMPLETED

- Intense maintenance period completed in March
- **Second cosmic trigger chamber** installed
- **Improved temperature & humidity control** inside bunker + temperature stabilisation for gas system
- Improved central control system (GCS), new web page
- Upstream XTDV installed (now independent to zone 134)
- Irradiation field markings
- **New gas detection system** installed & commissioned
- Increased rack space in service area (+ 3 racks)
- Several new setups installed

PLANNED

- **Material Access Door** (EN, 30kCHF) - scheduled for August
- Stable environmental conditions for gas racks (barrack)
- Improved irradiation field usage
- New exhaust line for gas system
- Additional hardware interlocks for detector systems
- **Irradiator improvements** (UPS, new interlock key, easier maintenance)

CONCEPT

- Enlarged irradiation bunker (discussion with EN-EA Started)

Radiation Facilities Upgrade

Name	**Facility Characteristics**	Main Purpose	FCC-driven targets (10 years operation)	Possible Upgrade
IRRAD	*Particle: p^+* *Momentum: 24 GeV/c* *Flux: ~1-3×10^{10} p/cm^2/s* *TID: ~7-10 kGy/h*	Study of IEL and NIEL effects on performance of detectors, calorimeters and FE electronics for HEP experiments.	*TID:* 90 MGy, *Φ:* 2.8×10^{17} p/cm^2. → one test takes ~1 year. *Issue*: low flux.	**Increase flux to reach target fluence faster.**
CHARM	*Particle: mixed-field* *Energy: n^0, HEH >100MeV* *Flux: 10^7-10^{11} HEH/cm^2/h* *TID: 0.01-100 Gy/h*	Test of COTS electronics in an LHC-like environment for SEE evaluation such as failure cross sections and system sensitivity to radiation.	*TID:* 100 Gy, *Φ:* 7.9×10^{10} p/cm^2. → low levels, but 4x more systems for a 100 km FCC. *Issue*: not enough space.	Larger irradiation bunker to test more racks in parallel.
GIF++	*Particles: γ + μ beam* *Energies: 0.662 MeV, 100 GeV m* *TID:~1Gy/h at 1m.(14TBq Cs137)* *Flux: 10^4 particles/spill (μ beam)*	Evaluation of detection performance and aging of muon chamber detectors in ionizing dose environment.	*TID:* 10 kGy. → one test takes >1 years. Issue: both space and dose-rate.	**Larger irradiation bunker to test bigger equipment + stronger gamma source.**
CC60	*Particles: γ (10TBq Co60)* *Energy: 1.17 MeV, 1.33 MeV* *TID:~1kGy/h at 5cm.*	Validation and test of electronic components and systems to ionizing radiation.	*TID*: 10 MGy. → one test takes >1 year. *Issue*: both space and dose-rate.	Stronger source.