

# The GIF<sup>++</sup> Facility

P. Martinengo



<http://gif-irrad.web.cern.ch/>

## DRD1 Meeting

12.12.2024

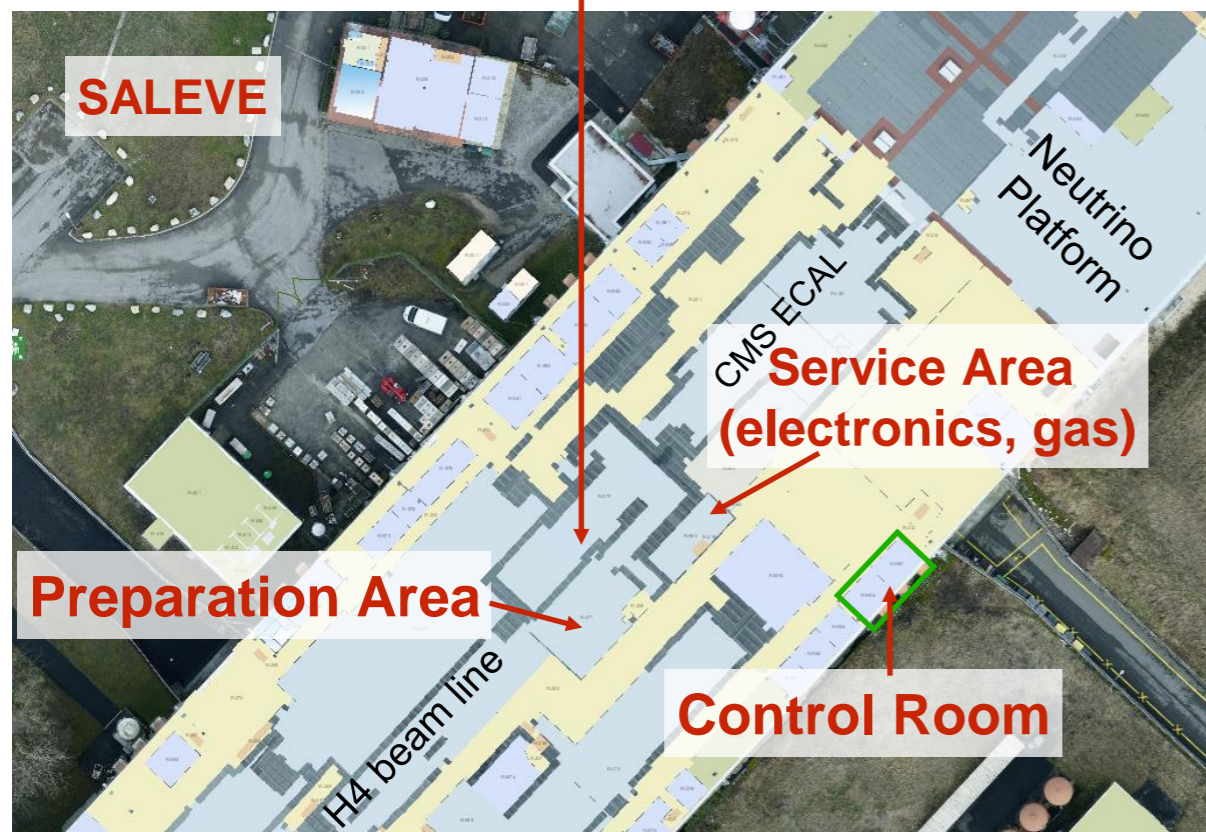
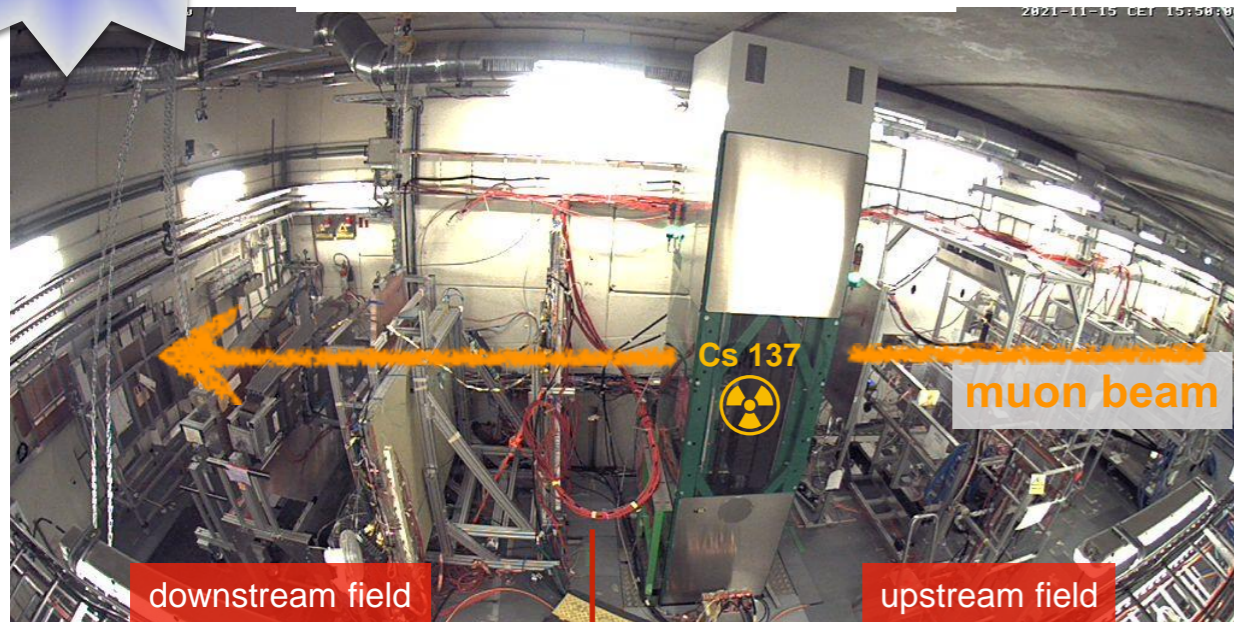


EP-DT  
Detector Technologies

Irradiator operation throughout the whole year

# GIF<sup>++</sup> @ EHN1

## Irradiation Bunker



## Introduction :

- Unique place, combining a **high energy muon beam** with a **12 TBq\* <sup>137</sup>Cs gamma source**
- Joint EP & BE facility, operated by EP-DT**
- Designed for testing **real size detectors**
- ≈100 m<sup>2</sup> irradiation fields, 2 irradiation zones with independent attenuation systems
- Central Control System, wide range of available gases (+ custom gases), common DCS...

\*) 14TBq as of 2014

## Current R&D Program :

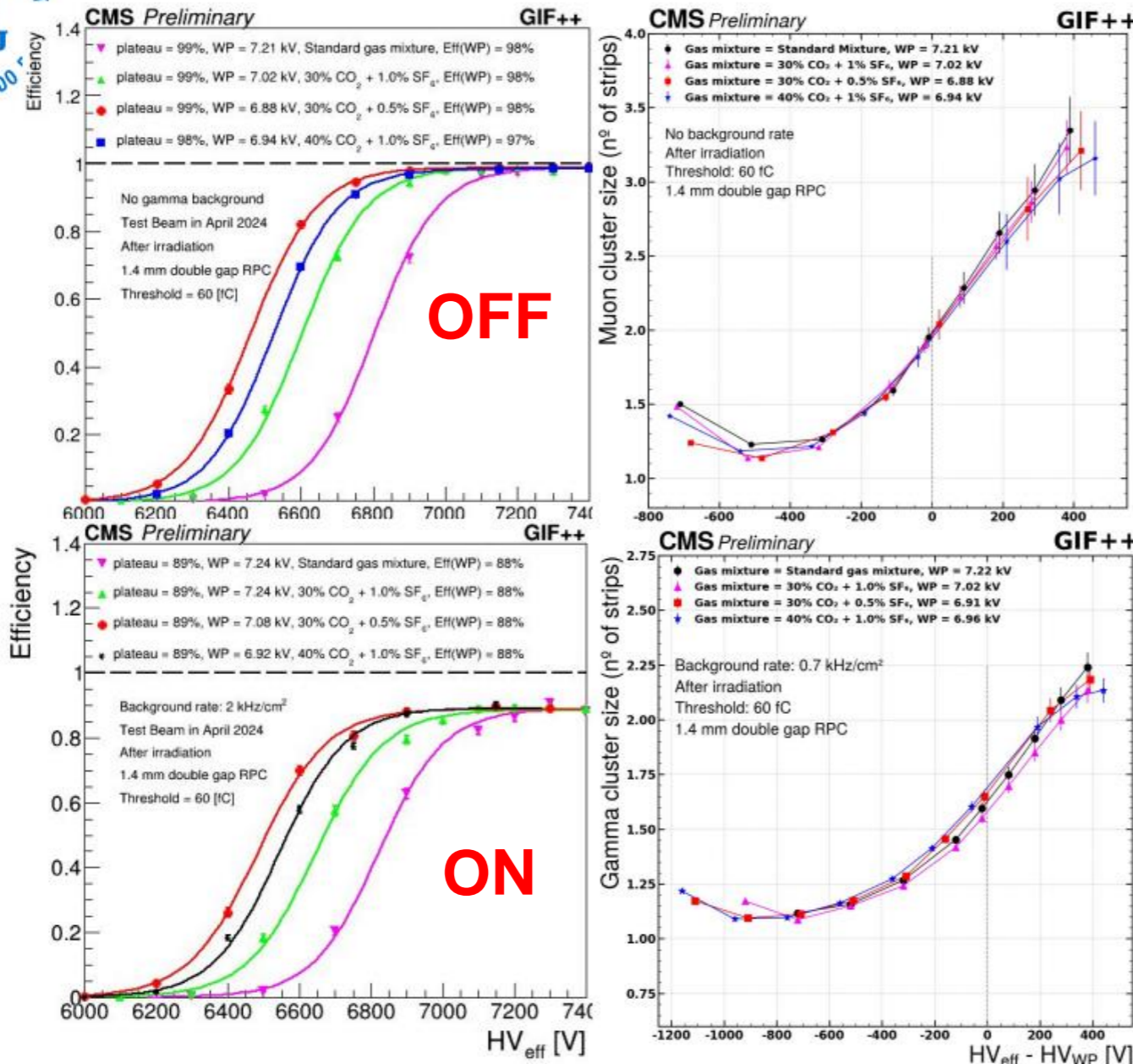
- Detector validation tests under realistic conditions: high radiation background & muon beam
- Ageing studies under HL-LHC radiation conditions
- Search for eco-friendly gas mixtures
- Mass-production test of muon chambers
- Radiation tests of electronics and optical components

Unique facility , combining a **high energy muon** beam with a **12 TBq\* <sup>137</sup>Cs gamma source**  
 mimic high occupancy/background experimental conditions

With the muon beam on (if intensity limited) it's possible to work inside the bunker

Source must be OFF, of course 😊

# TFE+CO2 based mixtures for RPC detectors



No change in the efficiency without radiation

but < 90% for 2 kHz/cm<sup>2</sup> (mostly FEB drive, no gas mixture related)

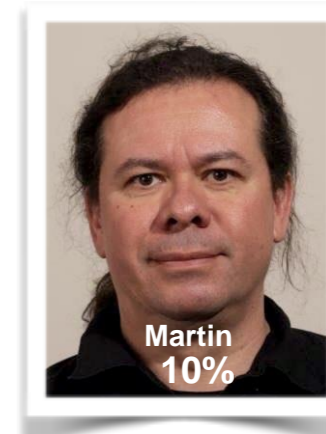
No difference between CO<sub>2</sub> based mixtures and also no changes w.r.t the results before irradiation!

# GIF++ EP TEAM 2025

## GIF Physics Coordinator

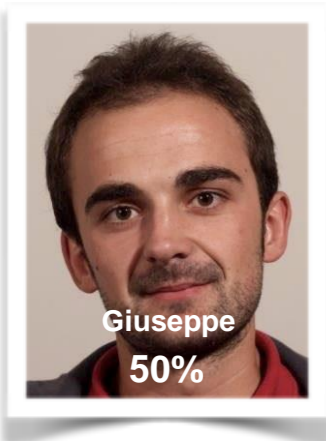


- 📌 Day-to-day Coordination
- 📌 Experiment approval
- 📌 Allocation of space and time for setups, beam time coordination....



- 📌 Overall facility responsibility
- 📌 Future development of the GIF++ facility

## GIF User Coordinator



- 📌 GIF++ & IRRAD: users supervisor, contact to EN services
- 📌 General user support
- 📌 Gas system first level support,
- 📌 Deputy EXSO

## EXSO



- 📌 EP-DT Facilities Team Responsible, IRRAD Facility Coordinator
- 📌 Irradiation Facilities EXSO

# Joined Facility BE/EP



- ▶ **EHN1 infrastructure**
- ▶ **Beam line H4**
- ▶ **General GIF++ infrastructure**
  - ▶ **Electricity, cooling & ventilation, gas primary system...**
- ▶ **Access system (contact to)**
- ▶ **General safety EHN1 (incl. GIF++)**
- ▶  **$^{137}\text{Cs}$  Irradiator**
- ▶ **Local gas distribution**
- ▶ **User operation**
  - ▶ **Irradiation requests, beam request, space management**
  - ▶ **User installations**
  - ▶ **User contact**
- ▶ **Safety (setups & users)**

# GIF++ entry points

**Weekly user meeting (Thursday 9:00 am, Zoom), feel free to join:**

**GIF++ installation and schedule meeting (12 December 2024) - Indico**

**<https://indico.cern.ch/event/1484112/>**

**Annual User Meeting (AUM):**

**8th Annual GIF++ User Meeting 2024 (3 December 2024) - Indico**

**<https://indico.cern.ch/event/1477207/>**

**Quite complete collection of presentations  
including safety, access rules,  
common infrastructures etc.**

**E-group**

**GIF-active-user**

**Wednesday, from ~8am to 6pm, by default source stays OFF  
Ideal day for visit/survey**

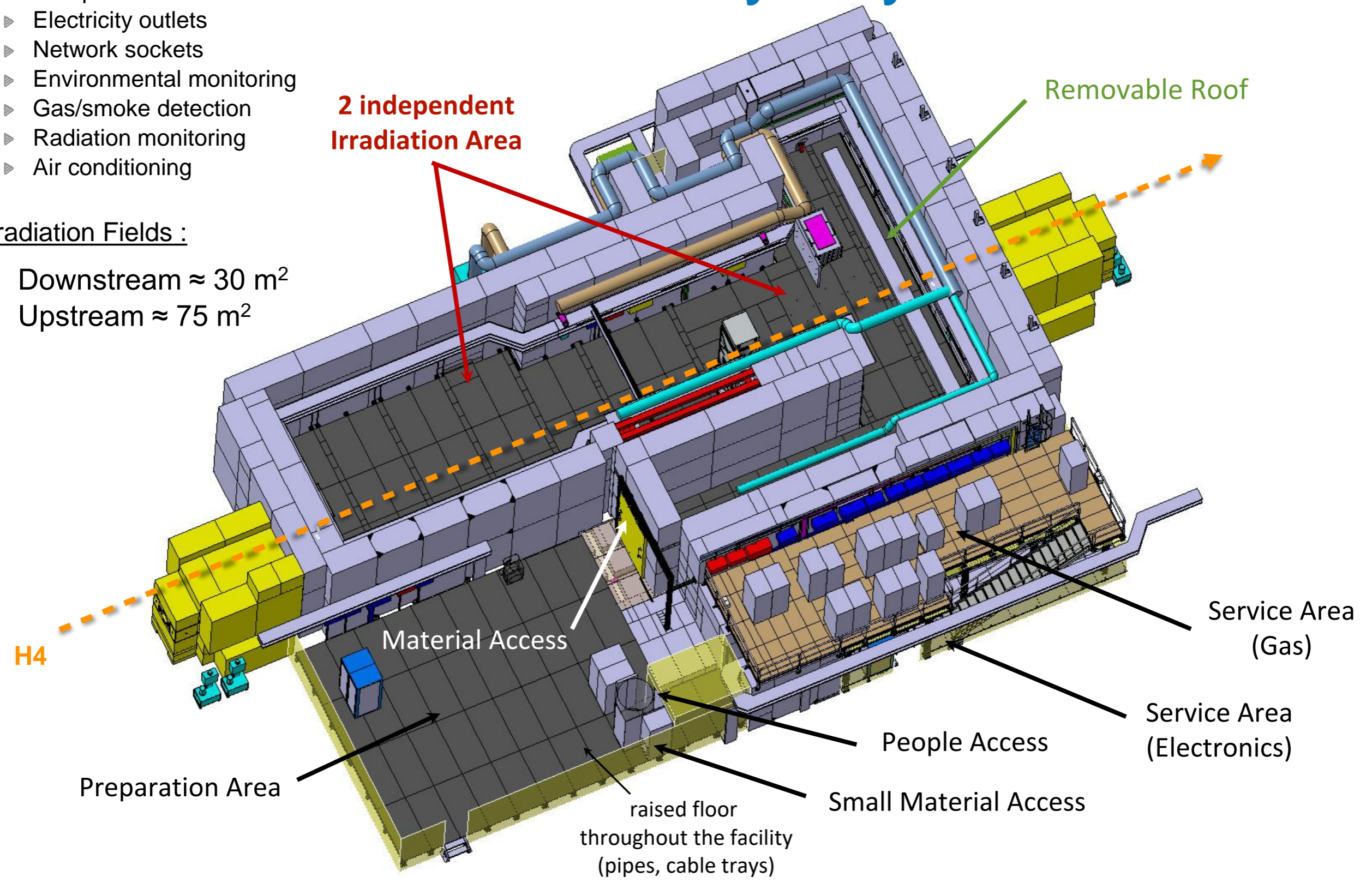
# GIF++ Facility Layout

## Bunker area contains :

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

## Irradiation Fields :

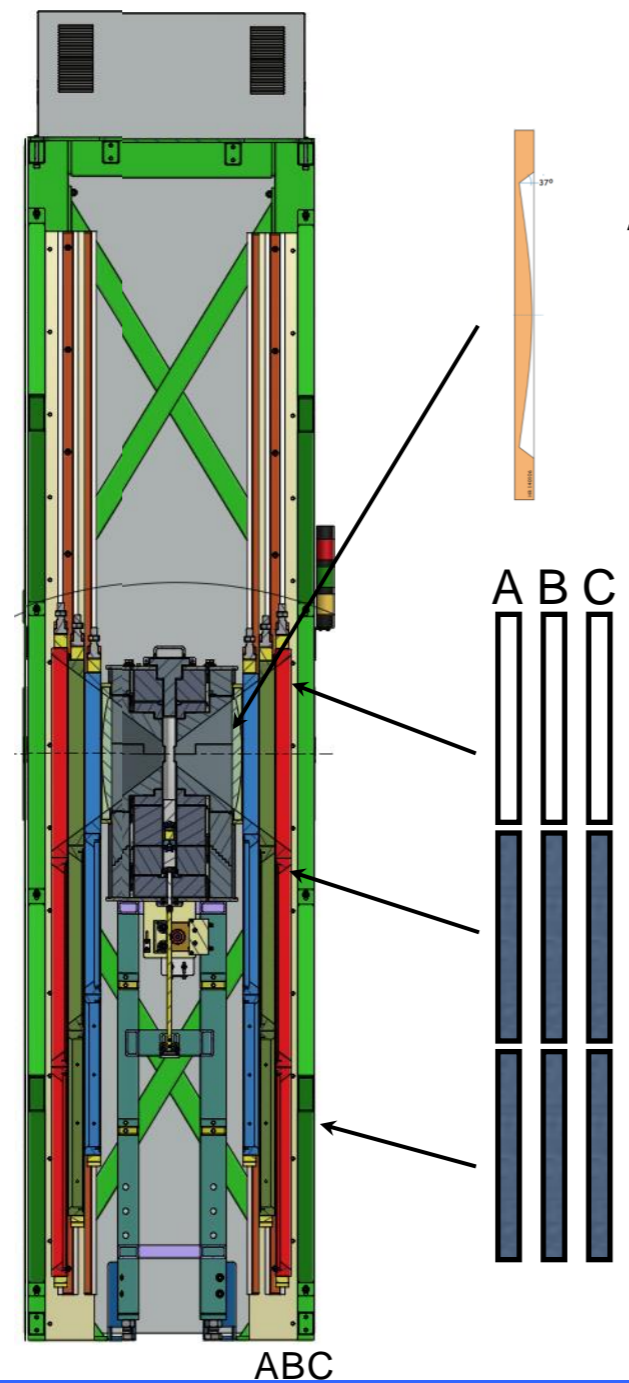
- ▶ Downstream  $\approx 30 \text{ m}^2$
- ▶ Upstream  $\approx 75 \text{ m}^2$



# GIF++ Irradiator & Attenuation Filters

One  $^{137}\text{Cs}$  source, two identical attenuation systems, each consisting of one angular correction filter (Fe) and 6 absorption filters - a total of 14 custom shaped filters

14 TBq  $^{137}\text{Cs}$  (as of 2014)  $\approx$  12 TBq now



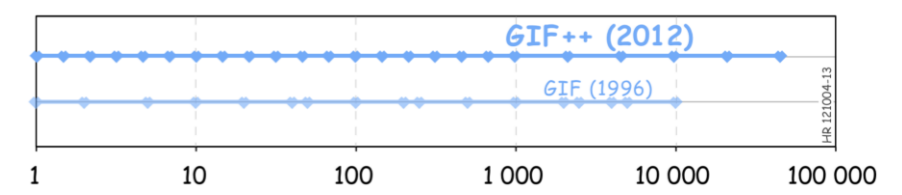
Angular correction filter provides uniform photon distribution for large area detectors

Filter System :

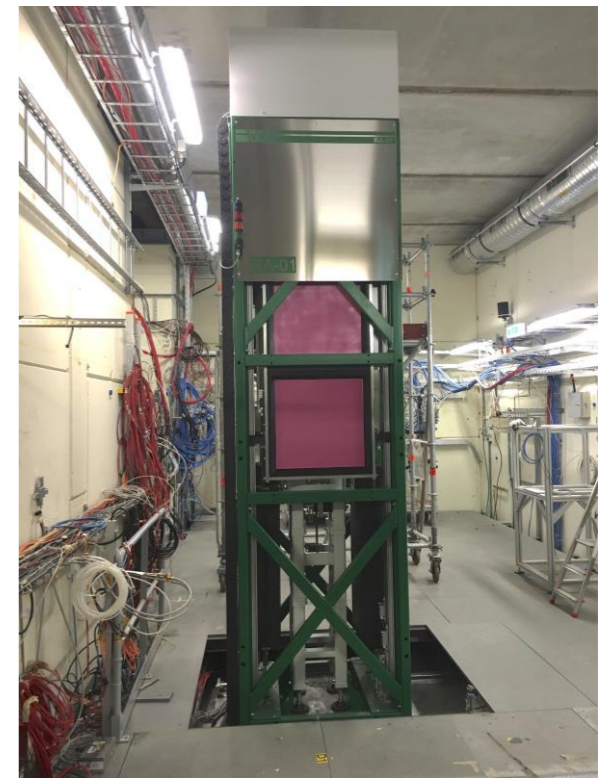
A	B	C
0	0	0
10	1.47	2.15
100	100	4.64

24 possible attenuation factors :

1	21.54	464.2
1.47	31.62	681.3
2.15	46.42	1000
3.16	68.12	2154
4.64	100	4642
6.81	146.8	10000
10	215.4	21544
14.68	316.2	46415

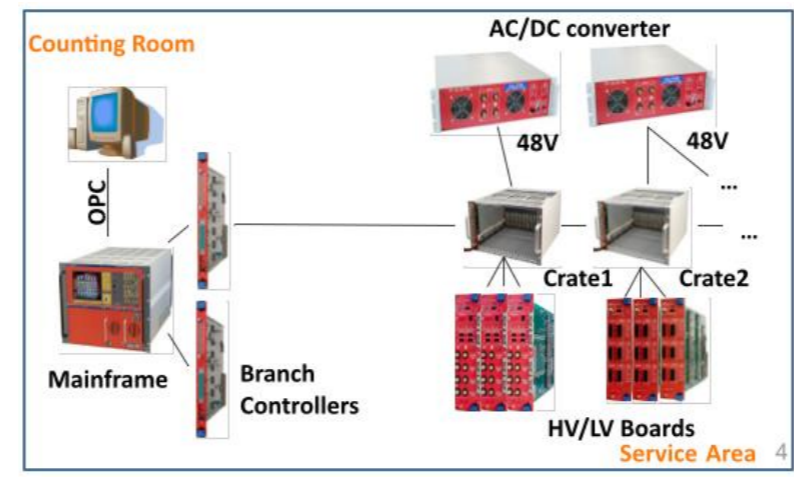


(calculated values for un-scattered gammas)





# GIF++ Infrastructure & Safety



- 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



## Access / Safety / Procedures

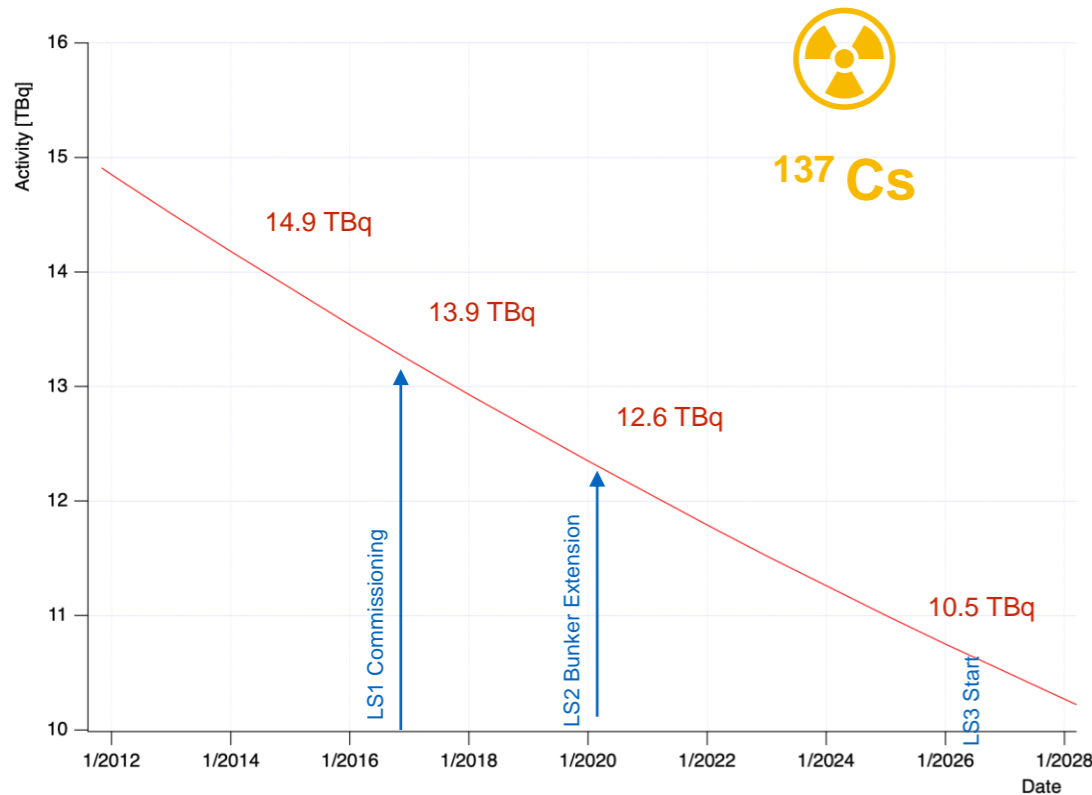
GIF ++

[Go back to main frame](#)

### Access Requirements for GIF Areas :

Zone	Access Rights & PPE	
EHN1	<ul style="list-style-type: none"> <li>CERN Card</li> <li>Personal Dosimeter</li> <li>Personal Protection Equipment</li> </ul>	
GIF Control Room	<ul style="list-style-type: none"> <li>CERN Card</li> <li>Personal Dosimeter</li> </ul> + "Control Room HNA-487 (0887-1-R87)"	
GIF Service and Preparation Areas	<ul style="list-style-type: none"> <li>CERN Card</li> <li>Personal Dosimeter</li> <li>Personal Protection Equipment</li> </ul>	
GIF Irradiation Bunker	<ul style="list-style-type: none"> <li>CERN Card</li> <li>Personal Dosimeter</li> <li>Personal Protection Equipment</li> <li>Activated (!) Operational Dosimeter</li> </ul> + ADMAS rights : "GIF++ Zone Turnstile (EHN1-GIF)" + Training Rank : "10800 : CERN - Beam Facilities" + Training Rank : "10350 Radiation Protection - Supervised Area" + Valid <b>IMPACT</b> request	

The dosimeter service (building 55) will hand out personal- and operational dosimeters to you.



## Extension of life time beyond 2025

From original 14 TBq (2014), we will be < 11 TBq by LS3

To ensure & improve the efficient operation of the facility beyond LS3, we started to look for a new source !

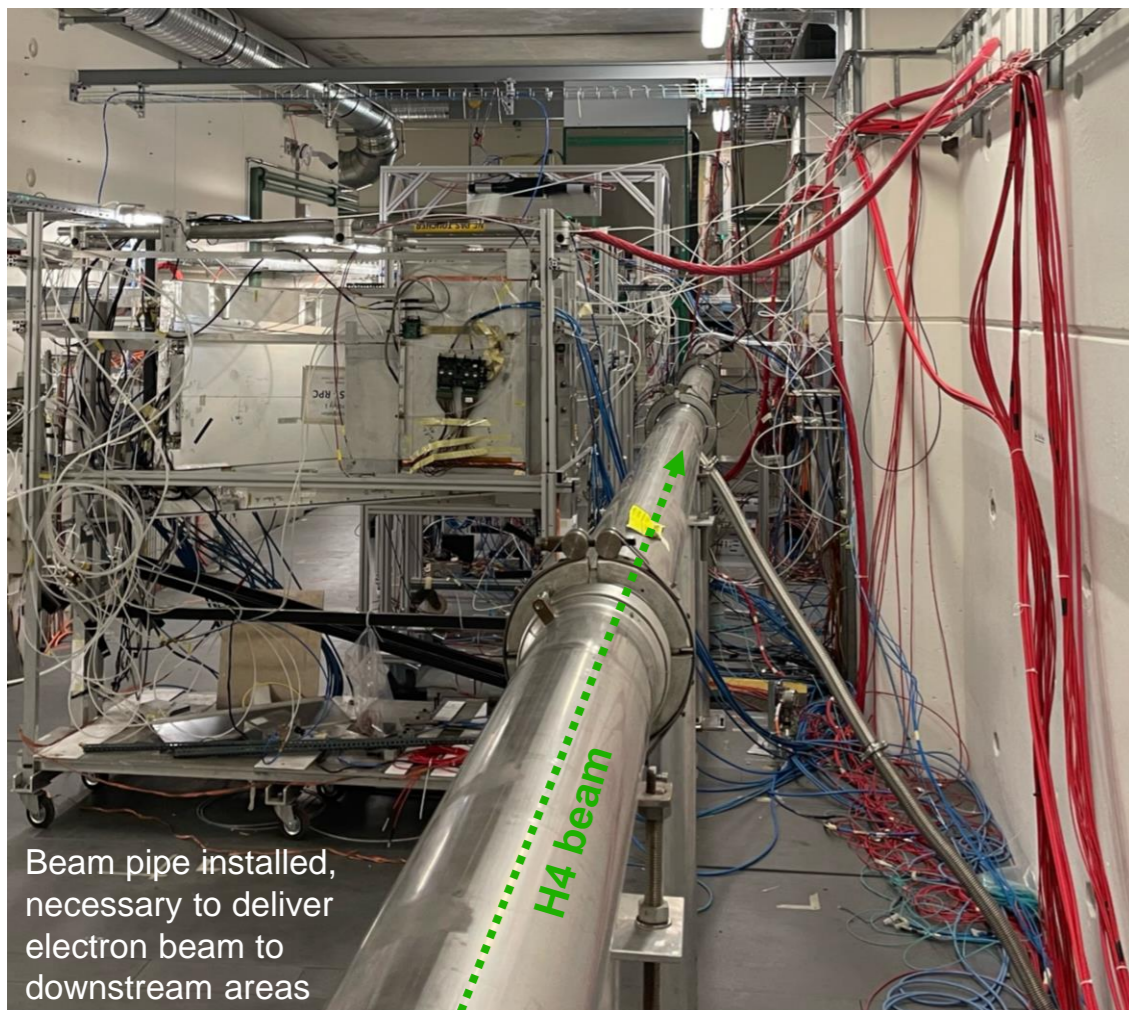
- ▶ Extension of Irradiator maintenance contract ✓ (\*)
- ▶ Market survey for new source. Currently challenging. ✗

- ▶ Difficult to plan the replacement of the current Cs source
  - Very few producer of high intensity sources, with biggest manufacturer currently not available
  - Prices of available (existing) sources are extremely high
- ▶ Current dimensions of Irradiator capsule can limit the reachable activity
  - Housing and bunker designed for  $\leq 100$  TB, but capsule dimensions will limit us to  $\approx 20$  TBq
  - On site loading of new source appears to be technical possible
  - A new Irradiator with increased dimension could be envisaged. Opens the possibility to add multiple sources in one Irradiator via loading carousel
  - Significant higher costs. Might need a redesign of the attenuator system.
  - Very challenging in current financial situation
  - [Activity was measured in November \(Nicola Ferrara\), new map soon available](#)

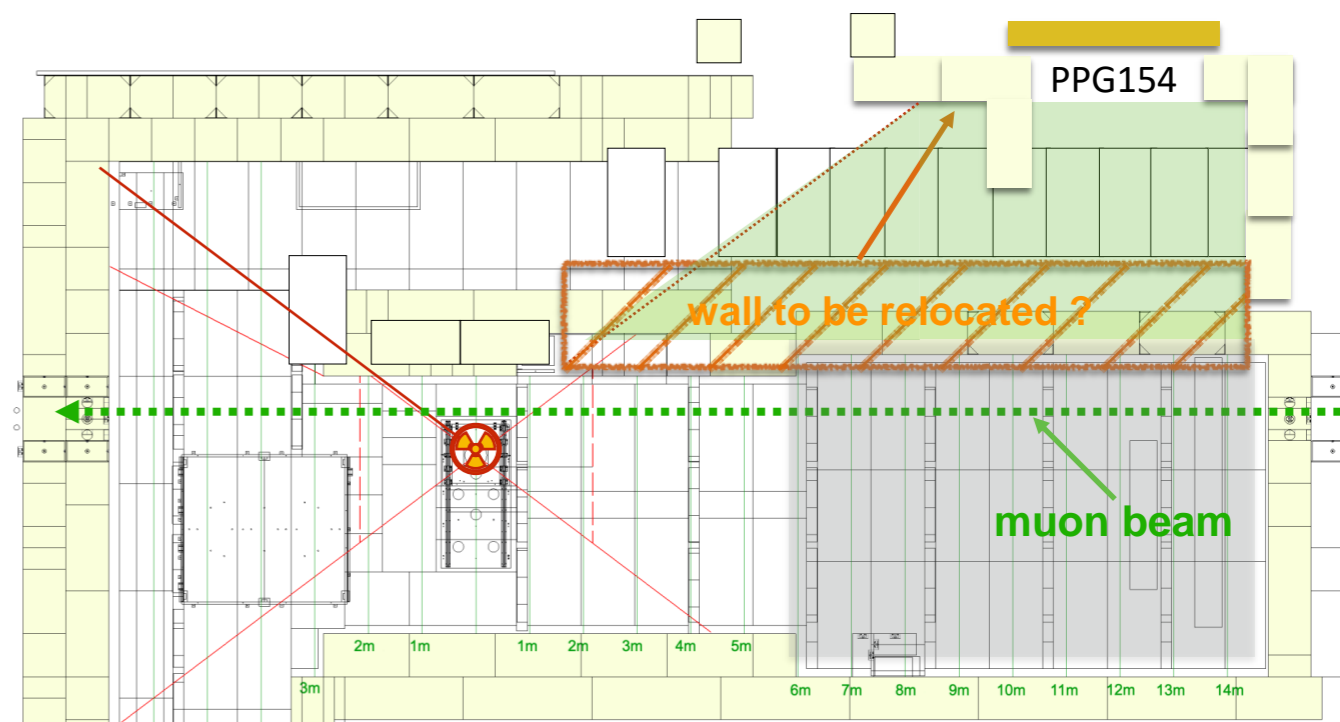
\*) Contract signed.

# POSSIBLE MAIN UPGRADE

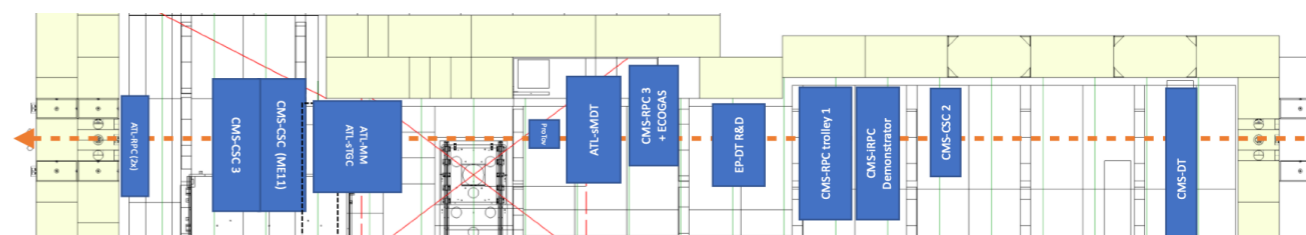
- ▶ **Proposal : Bunker extension** to increase space on the Saleve side of the beam line to **allow better distributions** of detectors, while **significantly limiting the shadowing effect** on detectors further away from the source
  - Possibility to place the full width of a detector inside the muon beam
  - No extra floor space in EHN1 needed. Dedicated preparation area converted into irradiation area.
  - Will need dedicated funding



Beam pipe installed, necessary to deliver electron beam to downstream areas



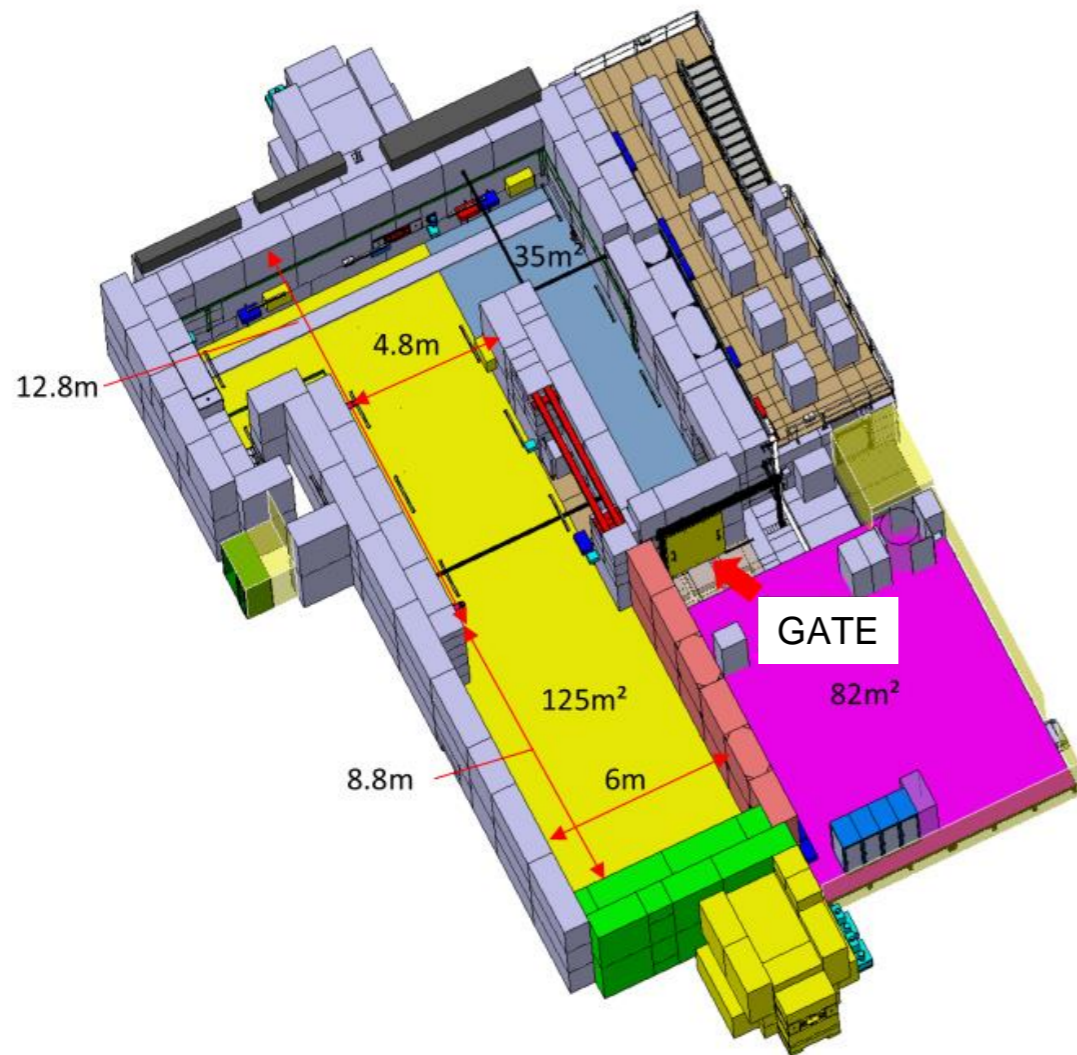
## Uneven shadowing for setups :



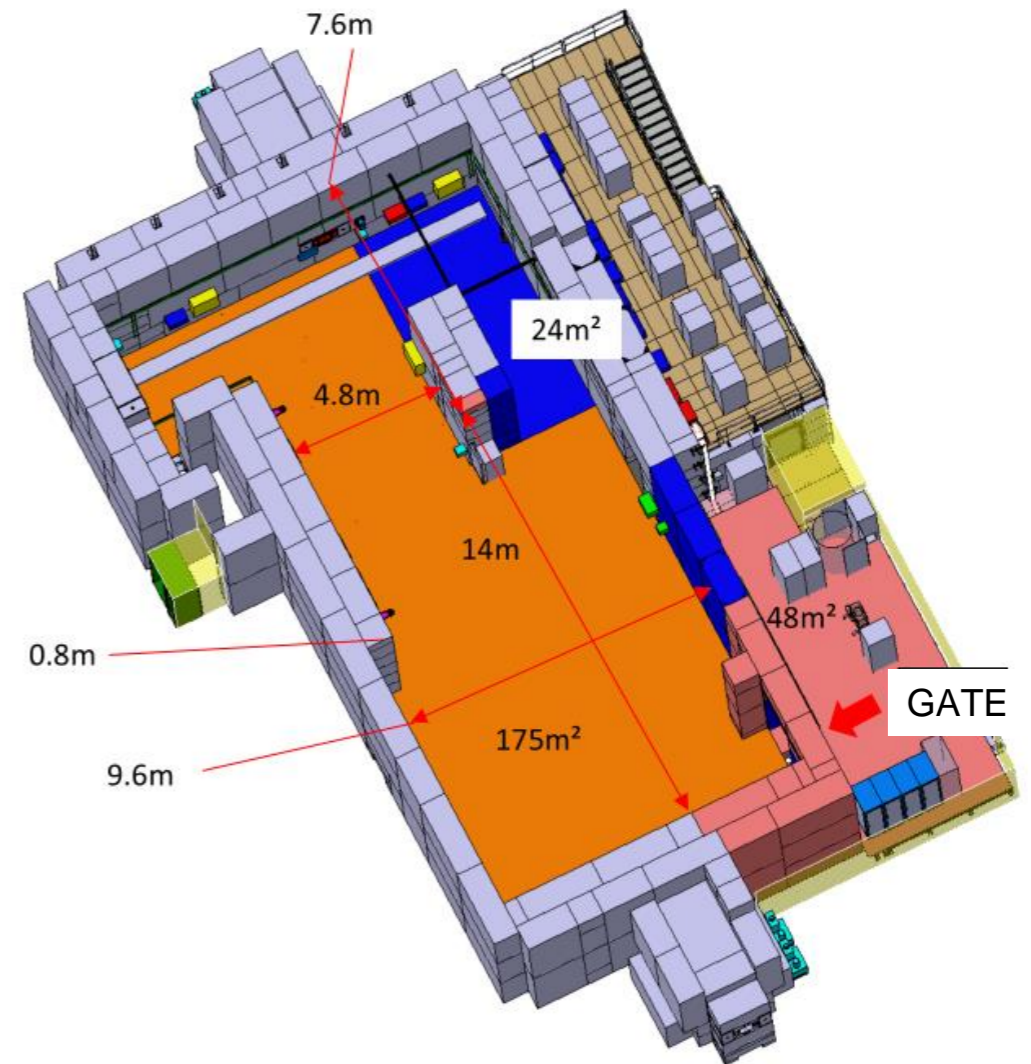
Mainly from support frames, shielding blocks, etc...

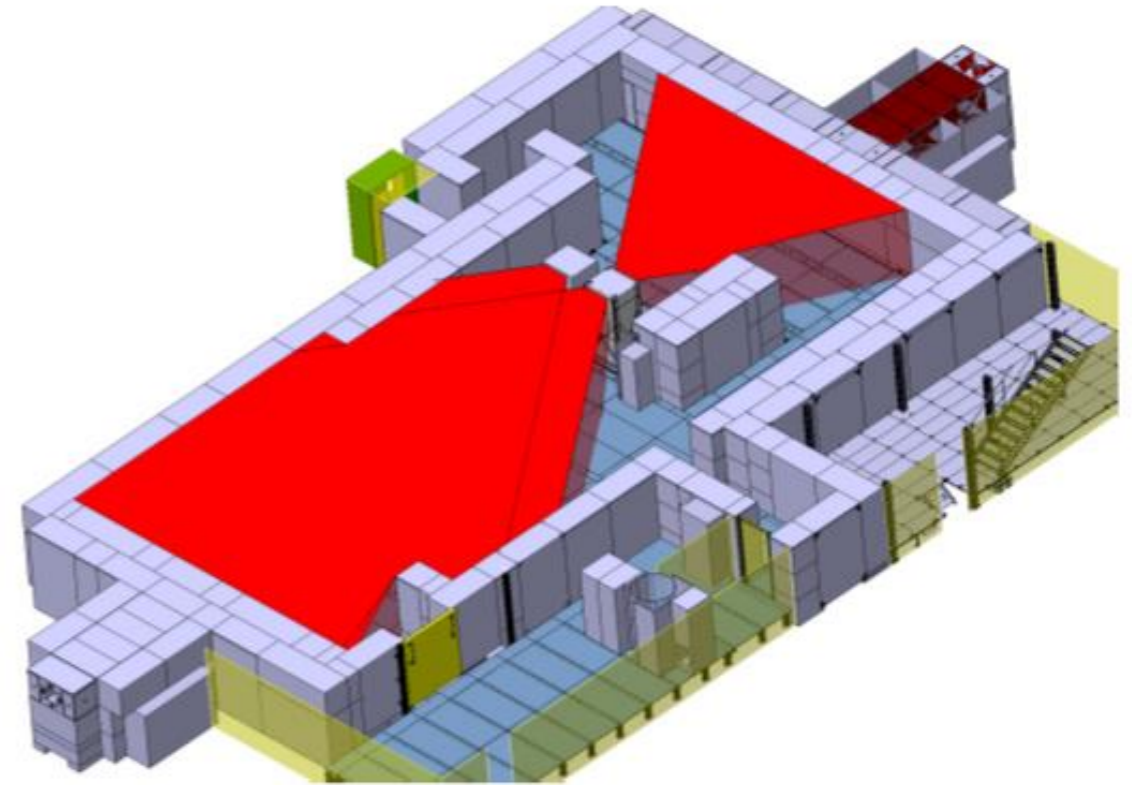
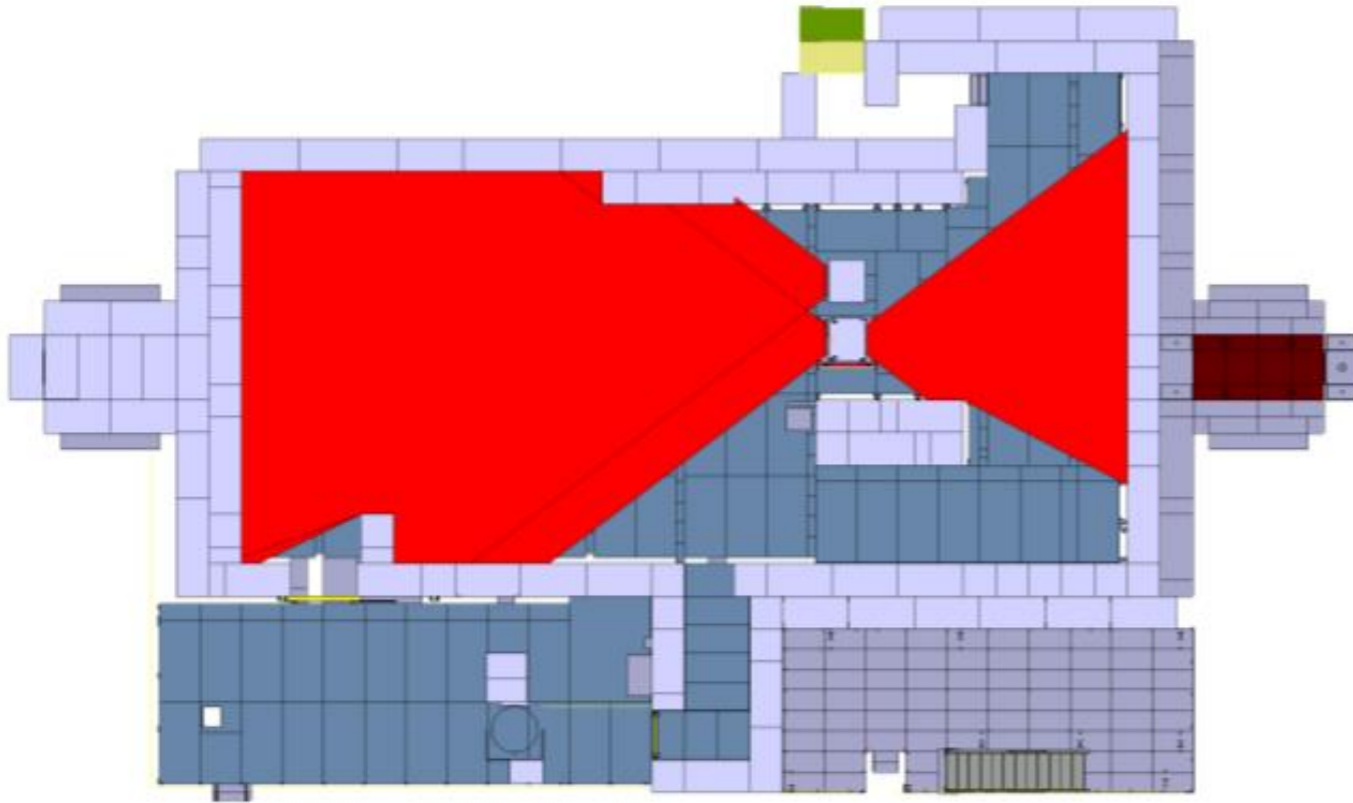
# COMPARISON GIF++ PHASE 1 / GIF++ PHASE 2

## NOW



## PROPOSAL





28.10.2024 Version 1

BE-EA-DC CLERC Vincent

5

- ECR (technical details) ~ ready, including cost
- pending approval by CERN management
- Your support is essential, if you consider the extension (and/or a new source/irradiator ) vital for your research discuss with your hierarchy (TC)

# Highlights & Conclusions

**GIF<sup>++</sup> is a unique facility purpose-built for testing detectors in realistic environment with LHC experiments readout systems & gas mixers**

**No existing alternatives worldwide**

**Thank you very much  
for your collaboration all along the year !**

**Proposal to operate the GIF<sup>++</sup> beyond Run 2 (and after LS3)  
has clear support from EP and the LHC experiments**

**Proposal to extend/upgrade the facility  
needs strong support NOW from the community**



# Merry Xmas and Happy New Year !

On behalf of the GIF<sup>++</sup>  
support team

# Upgrade to Gas Exhaust System

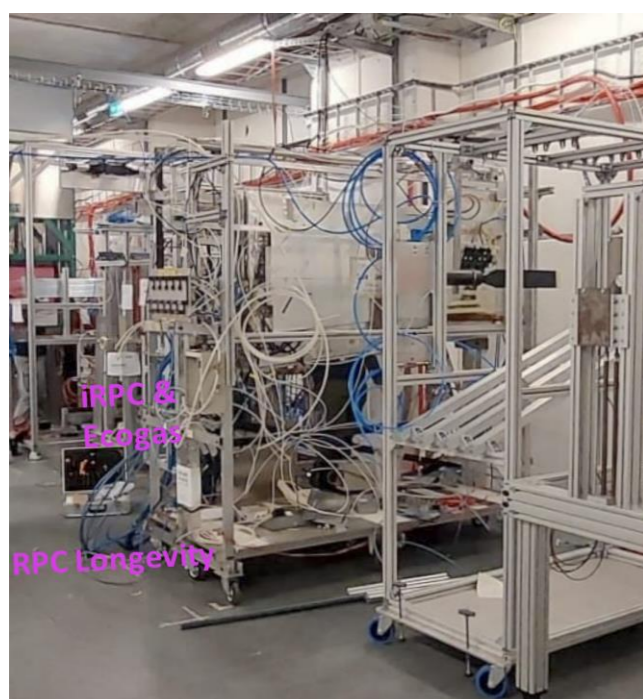
The gas system infrastructure is a key element of the successful R&D programs performed at the GIF++

Gas recirculation module



- ▶ **2023 showed a significant increase in RPC chambers tested at GIF++**
  - Increase in the overall gas consumption, especially in the RPC mixture
  - **Gas consumption / extraction no longer negligible**
- ▶ We currently have one simple exhaust line to the outside, gas consumption contributes to the **CERN environmental footprint**

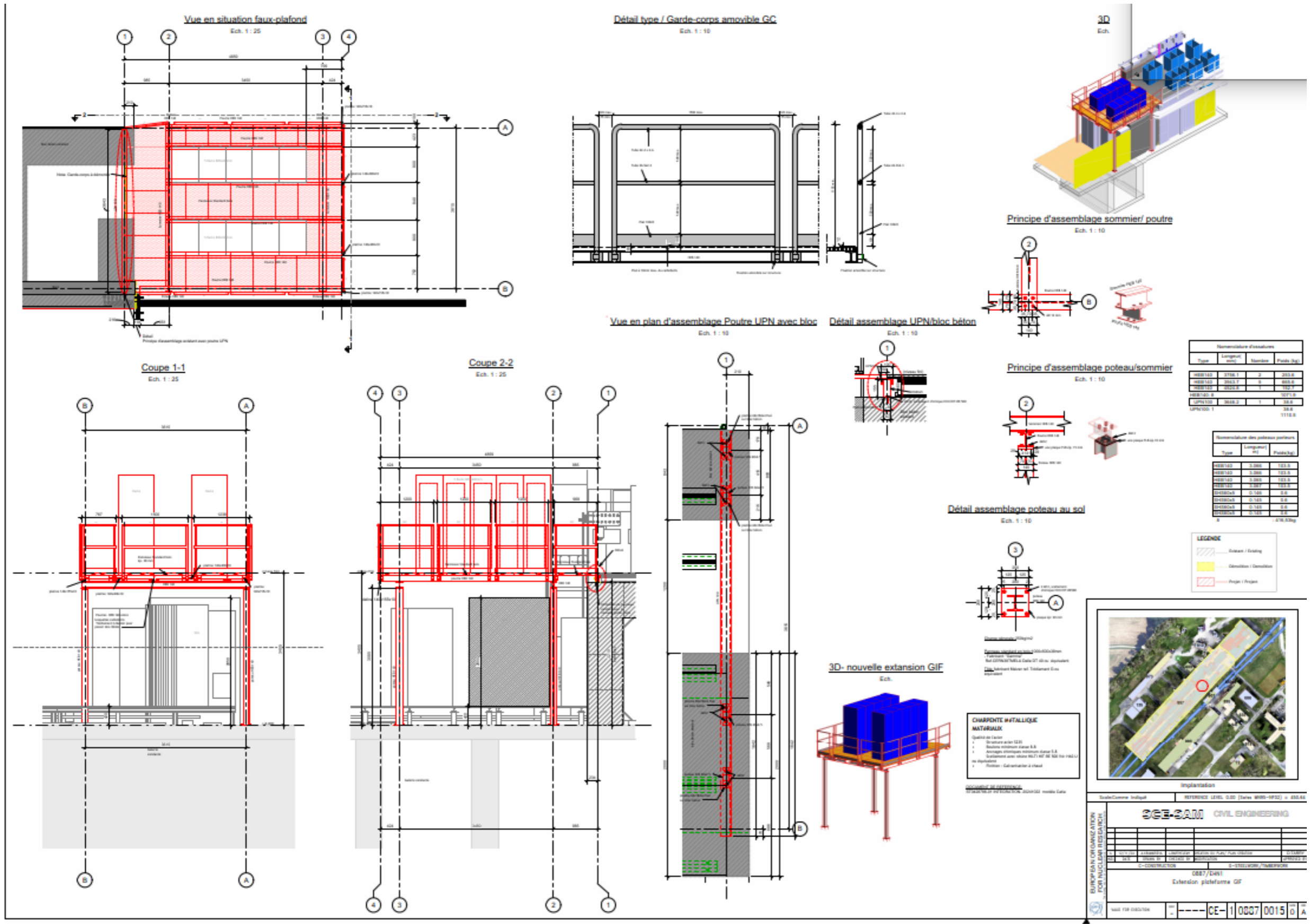
ECO-Gas



- ▶ **Proposal to install an RPC gas-recuperation system at GIF++**
  - Planning in 2024 with installation in 2025/26
- ▶ **Discussion on optional recirculation system.**
  - Only feasible for long term stable setups
  - Not suitable for systems where chambers get often swapped



# Extension of the gas balcony progressing



# GIF<sup>++</sup> Important Dates

- ▶ **Christmas Closure :**
  - ▶ Irradiator stop on WEDNESDAY morning 18.12.2024 at latest
  - ▶ Please position all set-ups in “source maintenance position” by 18.12 evening
  - ▶ gas supply stopped ~ 3h **NOW**, neutral gases restart this afternoon
  - ▶ Access will still be possible until Friday mid-day 20.12.2024
  - ▶ **STRICTLY NO ACCESS** during 21.12.2024 – 06.01.2025
  - ▶ The IDS (Intrusion Detection System) will be active - see next slides
  
- ▶ **Annual & exceptional Irradiator maintenance :**
  - ▶ First two weeks of new year: 06-17.01.2025
    - ▶ No access, priority given to VF (if you really need access contact us)
  - ▶ DSO Source Test on Thursday 16.01.2025 afternoon.
  
- ▶ **Restart of facility**
  - ▶ We expect access possible from Monday 20.01 onwards
  - ▶ Getting back into normal position of setups
  - ▶ Restart of gas supply: 03.02.2025
  - ▶ Restart of irradiator: 03.02.2025 at latest

# GIF<sup>++</sup> Important Dates

- ▶ **2025 Muon beam request call already submitted :**
  - ▶ Requests (3 x 2 weeks) for the GIF<sup>++</sup> have to be submitted via GIF<sup>++</sup> Physics Coordinator
  - ▶ Request to run (with some restrictions) during LS3 was also submitted
- ▶ **IMPACTs 2025 :**
  - ▶ As every year, we will CLOSE all active IMPACTs with the end of the operation year.
  - ▶ Please renew (clone) your IMPACT declaration
  - ▶ Review the description, modus operandi and the participant list (!)
  - ▶ With the start of the new year we will sign the IMPACT activities
  - ▶ The new IMPACT number needs to be displayed on each setup hosted in the bunker or preparation area
  - ▶ Start now !
- ▶ **SAFETEY Clearance :**
  - ▶ We have agreed to renew the safety clearance at least once a year.
  - ▶ Following the restart of the facility in February, we will organize a renewal of the safety clearance for all setups affected
  - ▶ See Federico's talk for details

# GIF<sup>++</sup> Important Information

## ▶ **Intrusion Detection System :**

- ▶ Active during the Christmas Shutdown (will be communicated when turned on)
- ▶ STRICTLY no access when the IDS light is **YELLOW** (Green = Off, Red = Alarm)
- ▶ Works like any burglar alarm. When you open the first door, you will trigger the alarm and CERN security is informed.
- ▶ Depending on their assessment (cameras), the French police will be involved

If you really need access during the CERN closure, contact Martin, Federico or Giuseppe

But do you really, really need access ? 😊

