White Paper R&D WP7
Facilities and Component Analysis for Detector R&D

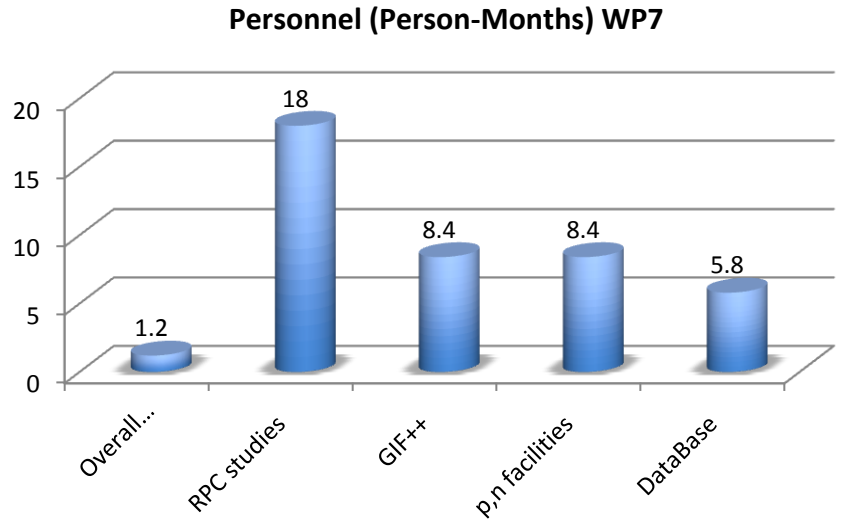
http://cern.ch/WP7

- In this talk:
  - Optimization of the closed loop gas systems for the RPCs at LHC
  - Materials DB
  - GIF++
- Upgrade of the irradiation facilities at the PS (M.Moll)

WP7 Resource Overview

Yearly averages 2008 - 2010

- Running budget
  - 35% Running Expenditure related to all activities (FSU, subsistance…)
  - 35% Consumables (RPC Gas is a significant expense!)
  - 30% Long-term Investments for GIF++ and the PS Irradiation Facilities
- Personnel



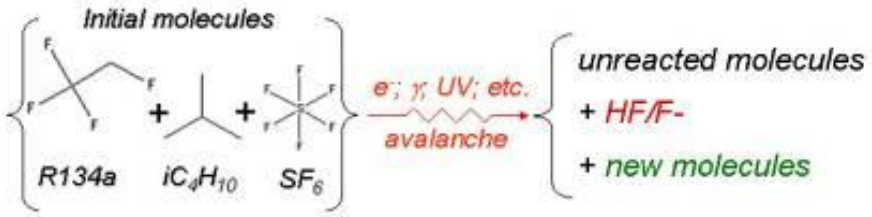
≈ 3.5 FTE /year

RPC studies

- **Motivation:** Study the impurities produced in RPC chambers irradiated in the GIF radiation field in order to understand the properties of possible absorbers and improve the closed-loop gas systems at LHC.

  ATLAS and CMS rely strongly on RPCs for triggering at LHC so long term survival is crucial.

  - 15 m^3 of gas volume in ATLAS and CMS RPCs systems (closed-loop gas systems, nowadays running cost is ~700 €/day)
  - Need efficient removal of impurities

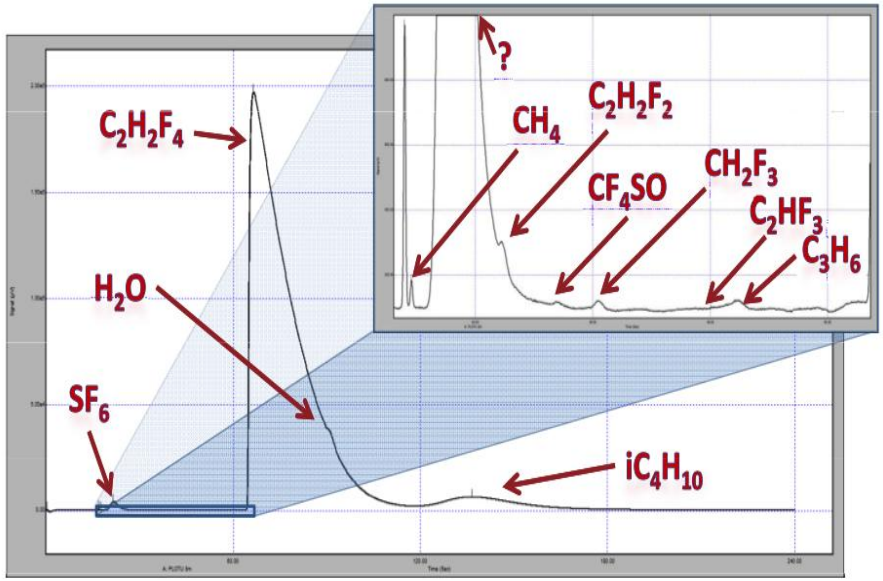


- **Team:** R.Guida (50% - *Physicist responsible*), I.Gluskov (WP7 fellow), S.Rouwette (WP7 Tech. Std. since Feb), Summer students (3 in 3 y) and Technical help from the Gas Group

  + Collaboration Gas Group, ATLAS and CMS RPC teams

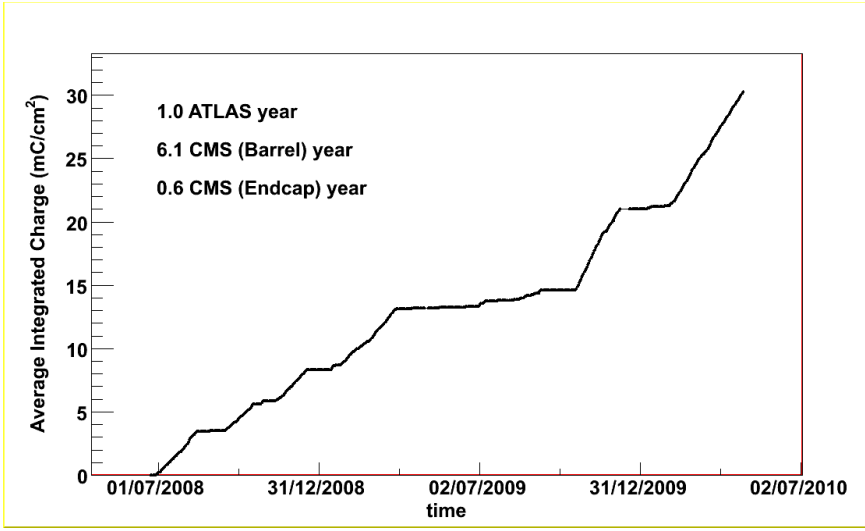
RPC studies

- Recovered GIF set-up (RPC chambers, DCS, built a environmentally controlled test stand…)
- Built new gas racks and installed fancy analysis devices (GC/MS, Fluoride station…)
- The recovered GIF set-up is also being used by other groups (CALICE, ATLAS MDT and RPC upgrade, LHC Beam Line Monitor, NA62 soon…).
- We chair a weekly GIF run meeting to discuss results and coordinate work in the area.



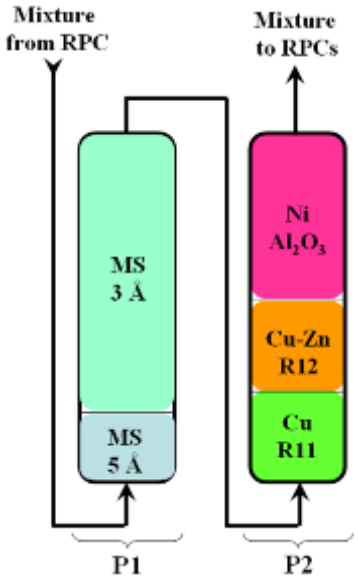
Outcome

- Characterized RPC gas mixture (fresh, irradiated, circulated)
- Monitored long-term chamber performance (currents, resistivity)
- Characterized 9 possible absorbers
- Found optimal combination of absorbers, in terms of filtering capacity, removal of pollutants and simplification of operation



RPC studies

Current configuration at LHC



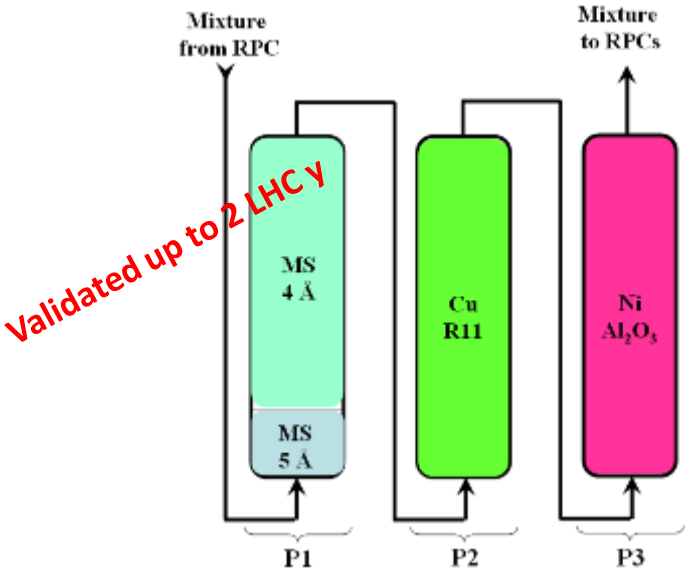
P1: Mol Sieve > Filters H_2O

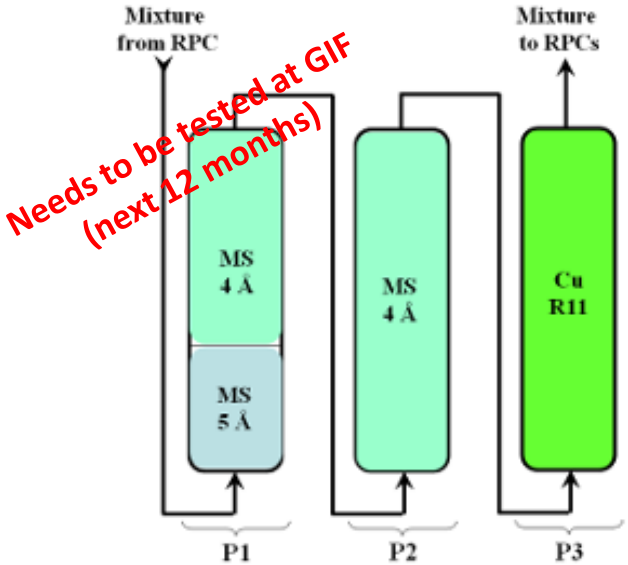
- Saturates too fast (1.4 days) > limits the gas flow
- Regenerated too often > it ages too fast

P2: Metallic > Filters O_2

- R11: OK
- R12: does not filter impurities, can pollute mixture
- $NiAl_2O_3$: reacts with the mixture

Proposals, under test



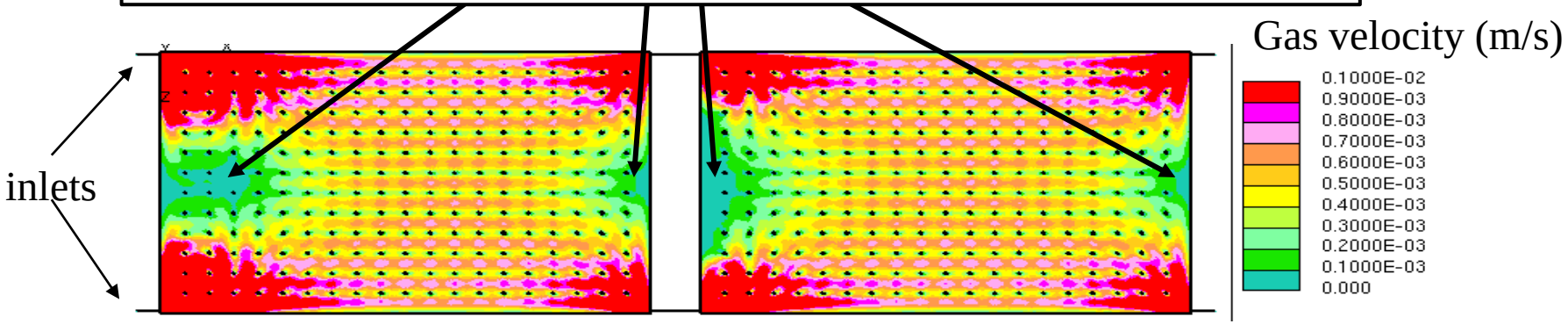


- New study -
Gas Flow distribution inside RPC chambers

Why RPCs under high radiation need a up to **0.5 - 1 gas vol exchange per hour** while other gas detectors typically run at 1 vol exch/**day** and less?

The velocity field map shows areas where the gas is basically stagnant

1. Those areas will age faster
2. The overall gas flow in the RPC systems is defined by those areas

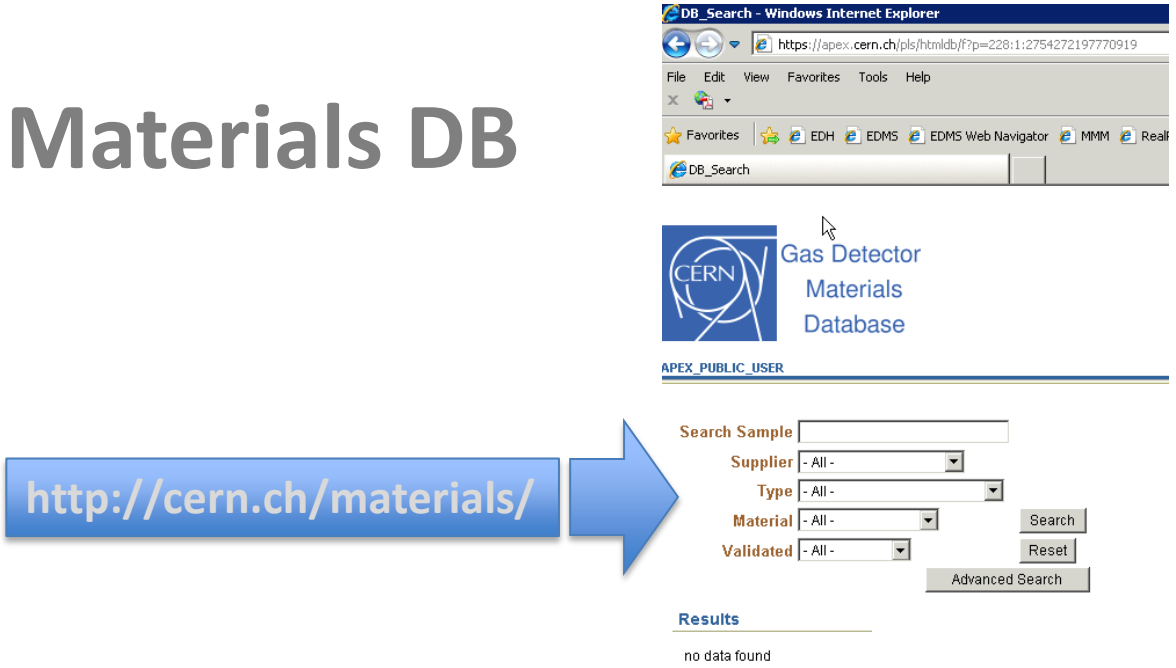


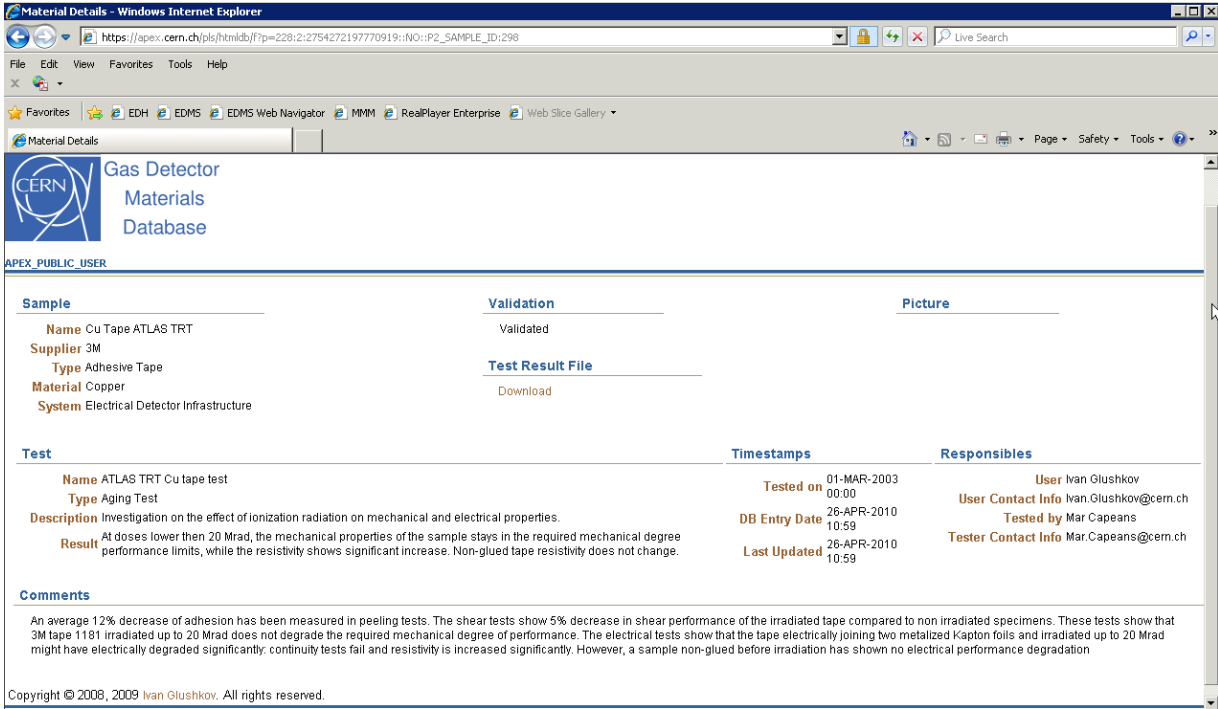
Room for improvement?

- Built a flexible RPC prototype (gas inlet/outlets, HV sectors….) and test it at GIF
- Input to new RPC stations for CMS, upgrades of existing systems

Materials DB

- **Motivation:** Extend the available knowledge on materials for detectors and gas systems and, in collaboration with LHC detector groups, collect and classify the available data in the best possible way. In particular important for LHC detector improvements and upgrades.
- **Team:** I.Glushkov
- **Status:** Technically in reasonable shape. Need time (resources) to populate correctly the DB





GIF++: gamma irradiation facility combined with a high-energy particle beam

- **Motivation:**
  - Strong needs from the LHC and sLHC detector and accelerator communities.
  - GIF++ follows up on the very successful GIF facility in the SPS west area, which lost its access to a particle beam in 2004 and which currently suffers from a lack of sufficient source intensity and aged infrastructure.
- **Timescale defined by**:
  - Availability of White Paper funds (2008-2011)
  - GIF lifetime *(Cs source exceeds the original 10 y lifetime)*
  - Agreed to liberate the GIF area in the West hall at the beginning of 2011
- **Team:** M.Capeans, R.Fortin and C.Rembser have been collecting user requirements and linking to EN to specify and develop plans for the new GIF++ facility

GIF++ Project Timeline

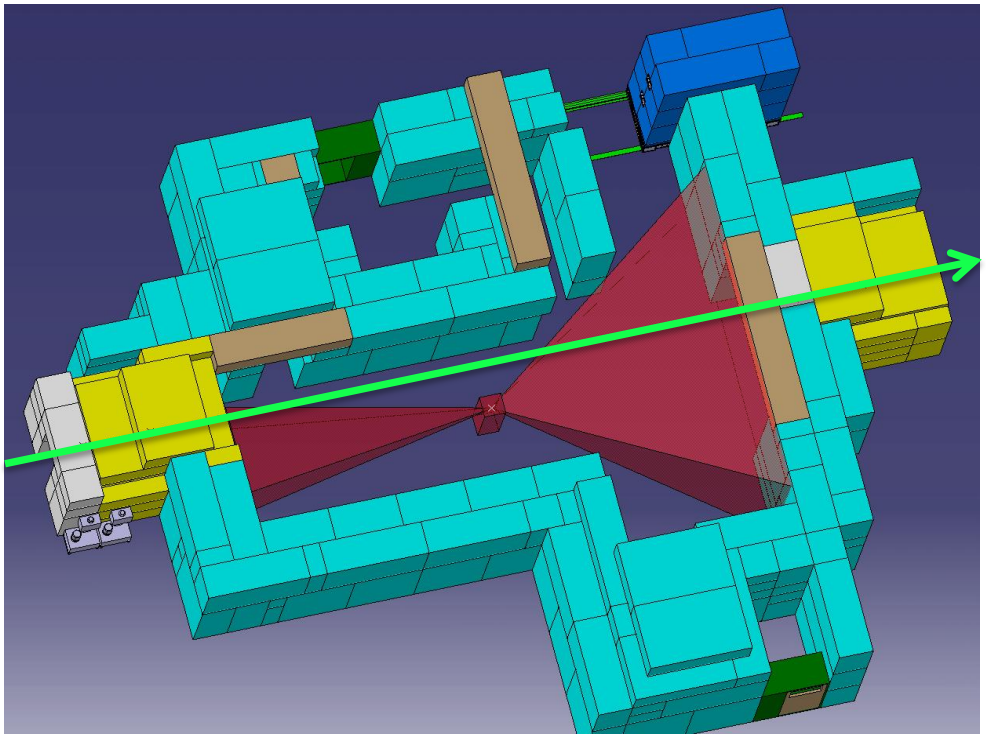
- **Nov 07:** White Paper R&D WP7 established, with GIF Upgrade as one of its tasks
- **Feb 08:** budget allocation, start of activities. Launched Questionnaire
  (>> Irradiation Facilities Working Group, chaired by L.Linssen)
- **Aug 08**: Presented outcome of Questionnaire *(38 responses)* and 1st implementation plan to users
- Several proposals worked out by EN Dept. and discussed with users
- **April 09:** Implementation plan at SPS/H4 beam line presented to users
- **June 09:** Improved implementation plan presented to users:

>> Current Proposal <<

GIF++ at H4 beam line in the EHN1

As submitted to SPSC in Sept 09

- **Area:** 8m(W) × 12m(L) × 4m(H) irradiation area, 2 irradiation zones and optimized infrastructure for testing large detectors
- **Source**
  - ^{137}Cs 662 keV photons, ~7-10 TBq
  - Up to ~2 Gy/h at a distance of 50 cm
  - 30 y isotope half-life
- **Particle Beam**
  - EHN1 location in the SPS H4 beam
  - 100 GeV muons
  - 10^4 particles/spill traversing 10x10 cm^2
- **Operation**
  - 6-8 weeks/year as primary beam user; go-through muons as parasitic users of tests installed downstream the beam line
  - Operation throughout the year with the source



Max. expected doses at sLHC	Equivalent time at GIF++ (~ 50 cm from source)
Si-trackers: ~ MGy/y	>> years
Calorimeters: ~ 20 kGy/y	< 1 year
Muon systems: ~ 0.1 Gy/y	~ minutes

GIF++ Project at the SPSC, RB

- **Sept 09:** Request SPCS to endorse the scientific case and to support the implementation of the facility in the H4 location

Minutes SPSC Nov 09

7.6 GIF++

The SPSC recognizes that the GIF++ is an important experimental facility at CERN.

The SPSC encourages further studies of the detailed design and of the exact location of the GIF++, in particular in order to minimize interference with the existing beam lines.

- **Dec 09:** Research Board

Minutes RB Dec 09

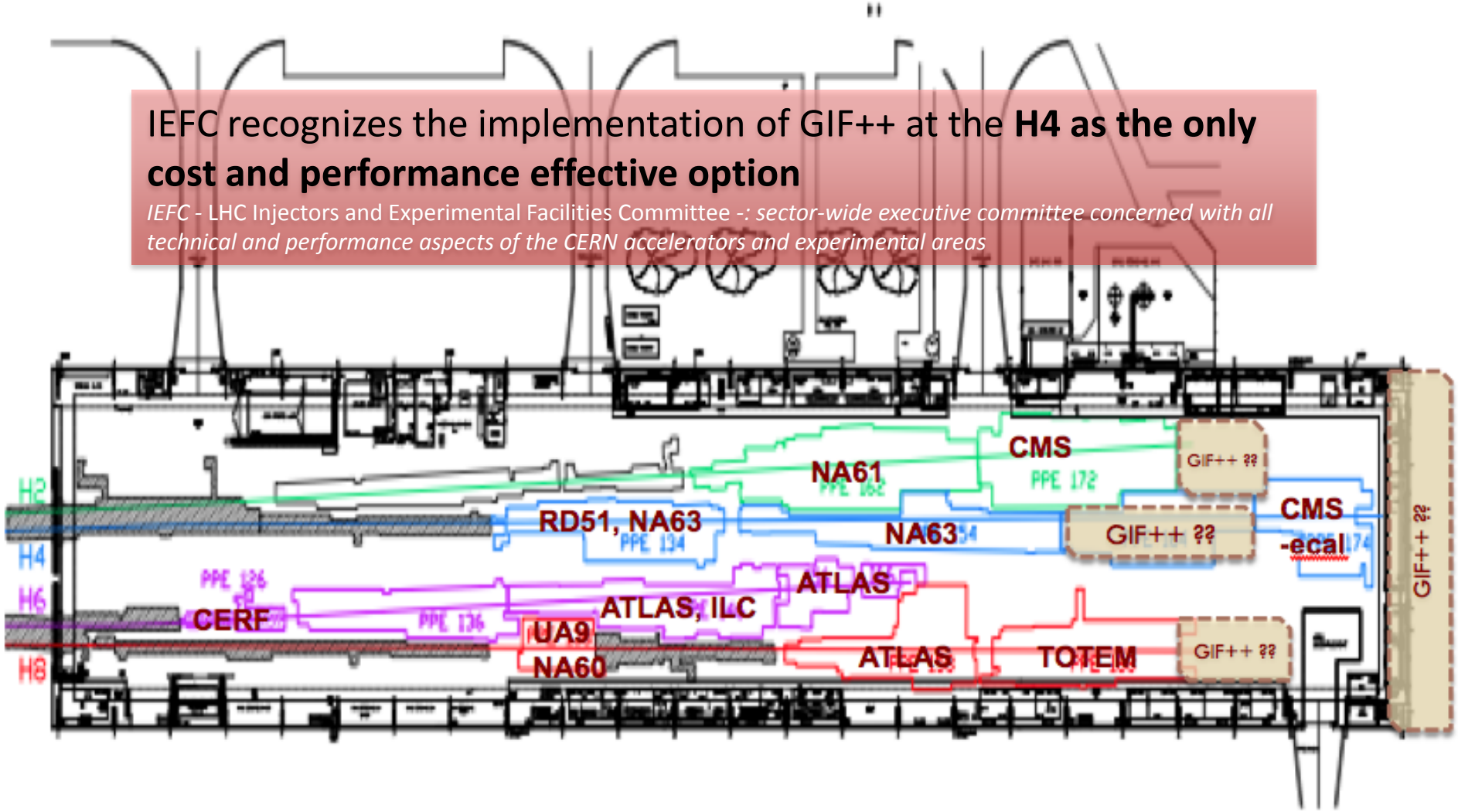
which currently suffers from limited source intensity. The H4 beam line currently provides an electron beam, used by CMS, which could be affected by the proposed installation. An alternative site for the facility in the H8 beam line would avoid interference with the electron beam use, but would entail restricted space and access, which might have safety implications. The SPSC recognizes that GIF++ represents an important experimental facility for CERN, and encourages further studies to be made of the detailed design and its optimal location. **The Research Board endorsed this recommendation, in particular concerning investigation of the future use of the unique electron beam, and of safety issues.**

RE-study of locations (RB Feb 2010, I.E.)

7 Present & known future users of EHN1 beam lines

IEFC recognizes the implementation of GIF++ at the **H4 as the only cost and performance effective option**

IEFC - LHC Injectors and Experimental Facilities Committee -*: sector-wide executive committee concerned with all technical and performance aspects of the CERN accelerators and experimental areas*



Issues raised at the LEAF meeting (Nov 09)

- Availability of **manpower** in EN to prepare the facility
  - EN will prepare an overall resource-loaded schedule with all the other projects to be carried out by EN: HiRadMat, NA62, NA61, Cloud, GIF++.
  - The consequence will be most likely a delay in the availability of the GIF++.
- **Financing** of the project
  - Overall cost estimate: 1.3 MCHF
  - Resources from the **White paper** (300k in 2009, 200k in 2010)
  - Allocation from **EN** (100k)
  - Missing funds (700k): discussed favorably with Research Director, EN and PH Depts
  - Users in-kind contribution via **AIDA** (FP7 IA, 2011-2014) > Radiation filters, Cosmic trigger, DAQ, DCS

End 2011 remains as Target for GIF++ Ready for Users

WP7 in 2011 and beyond

- **Studies at GIF**
  - Long-term validation of new, optimized filter configuration for the RPC gas systems at LHC
  - RPC Gas flow optimization studies
  - Aging Test of NA62 straw prototype
    - 12-18 months (or till GIF is dismantled)
    - R.Guida, S.Rouwette + continued collaboration with RPC groups
- **Detector Materials DB**
    - Work can continue slowly
    - M.Capeans and detector people
- **GIF++**
  - Secure funding and start implementation in 2011
    - M.Capeans, C.Rembser, R.Fortin. Need additional resources to supervise construction and commission the facility (New Fellow + Leading physicist from the user community)