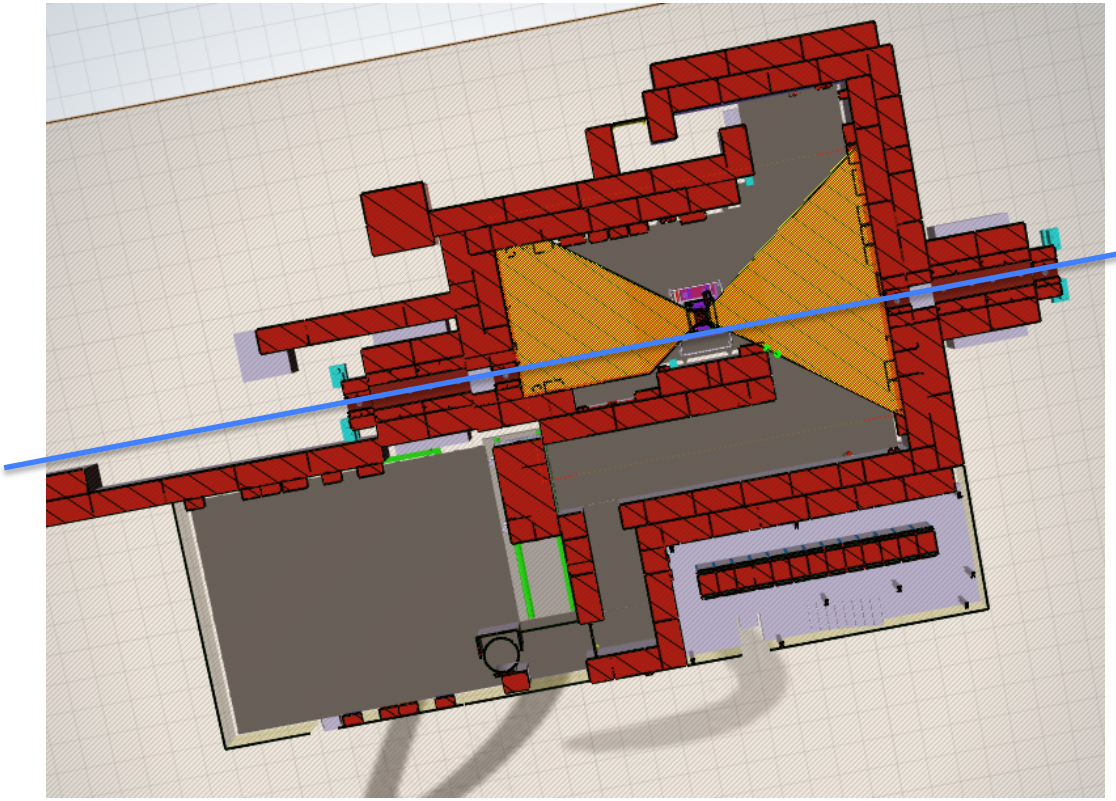
The CERN GIF++ facility user infrastructure

D.Boscherini
on behalf of the WP-8.5.3 group

AIDA Final Meeting - CERN, 9-11 December 2014

GIF++ Bunker



Source

- ^{137}Cs, ~13 TBq
- 662 keV photons
- 30 y isotope half-life

Particle Beam

- 100 GeV muons
- 10^4 particles per spill on a 10x10 cm^2 area
- available ~6-8 weeks/y (in 2-week periods)
- additional weeks (~6-8 y^{-1}) as parasitic user

Cosmics

User infrastructure items

- Beam tracker (*G.Mikenberg*)
- Cosmic tracker (*G.Aielli*)
- Gas + Environmental monitoring (*S.Bianco*)
- Radiation monitoring (*P.Iaydjiev*)
- DCS (*A.Polini*)
- DAQ (*Y.Benhammou*)

Deliverable:

D8.5.3 @ M44 (→ 30/09/2014)

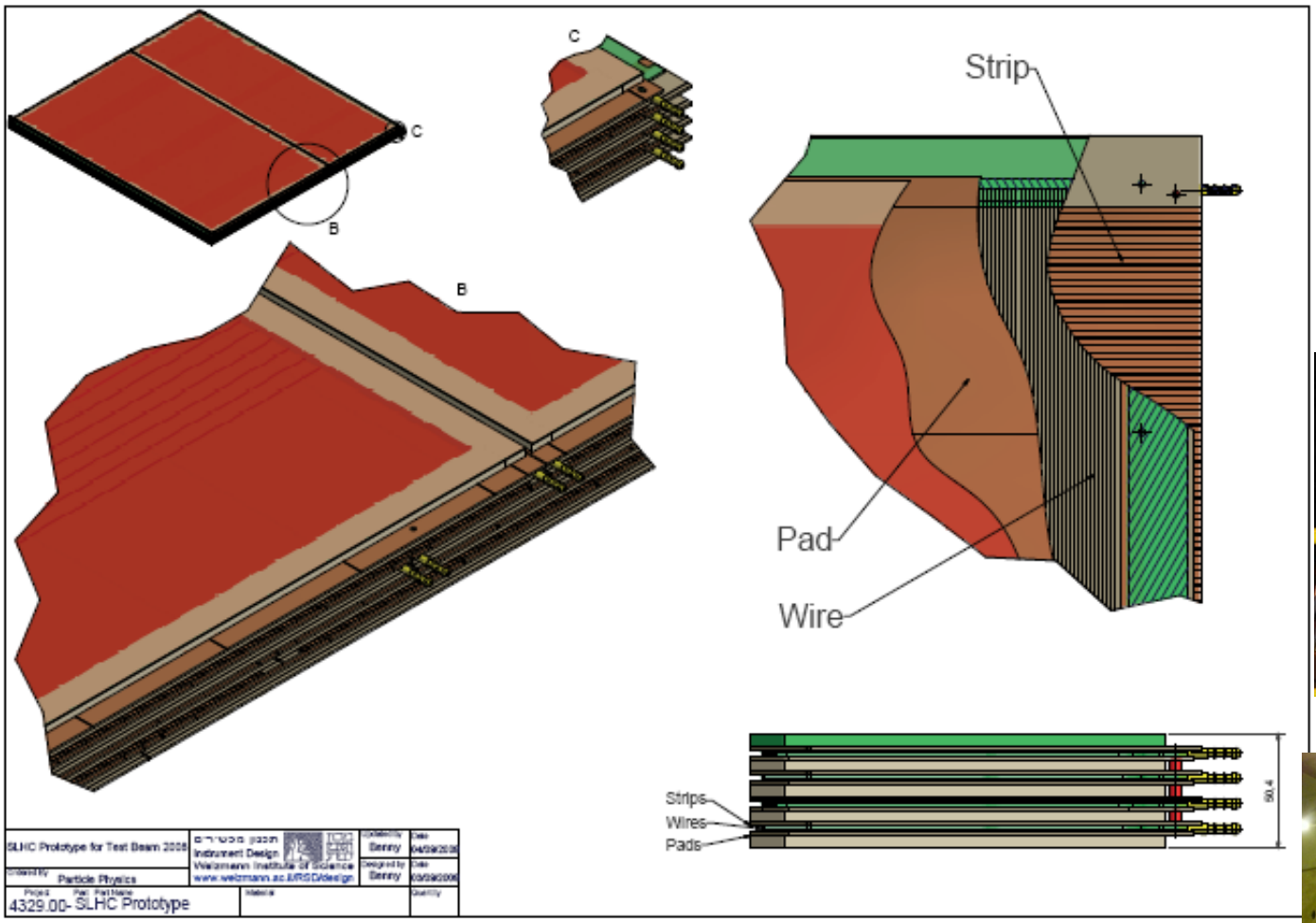
GIF++ Infrastructure commissioning and utilization

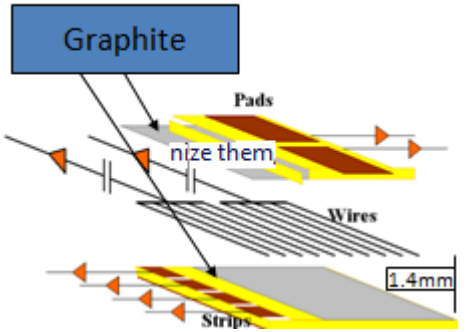
Involved institutes

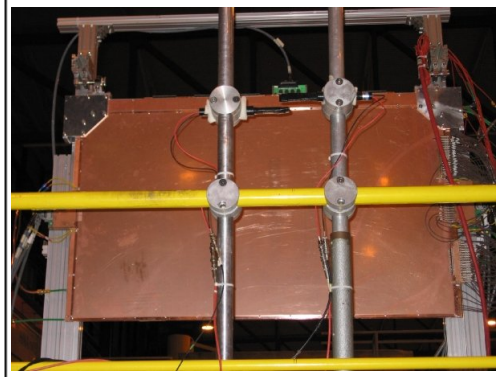
- *Bulgaria:* INRNE
- *Greece:* NTUA, AUTh, Demokritos, NCUA
- *Israel:* Weizmann, Technion, Tel-Aviv U.
- *Italy:* INFN-Bari, -Bologna, -LNF, -Rome2

Beam tracker: setup

Two **Thin-Gap-Chamber** 4-plets (60x40cm²) with strips, wires and pads in each gap





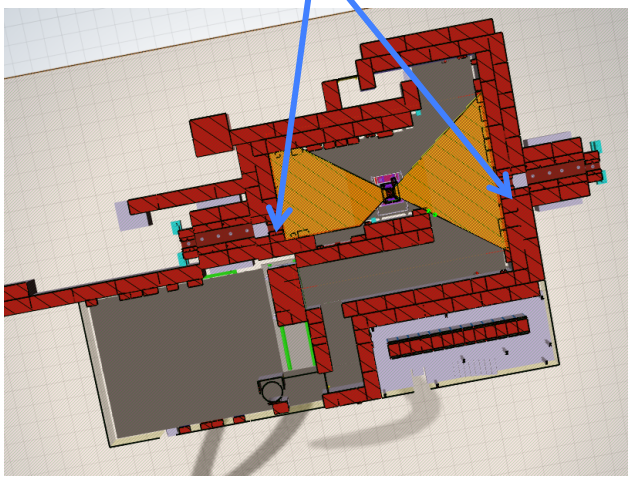


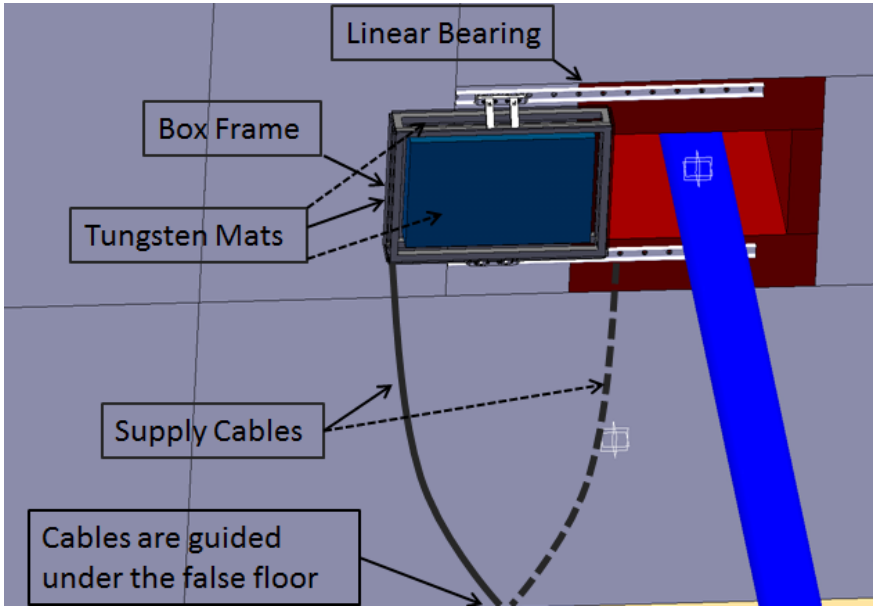
Combined pad with digital info from strips for trigger

- Arrangement of individual gaps, showing the strips, wires and pads, as well as the staggering of layers
- One multilayer of 4 gas gaps fits into 50mm

Beam tracker: positioning in bunker

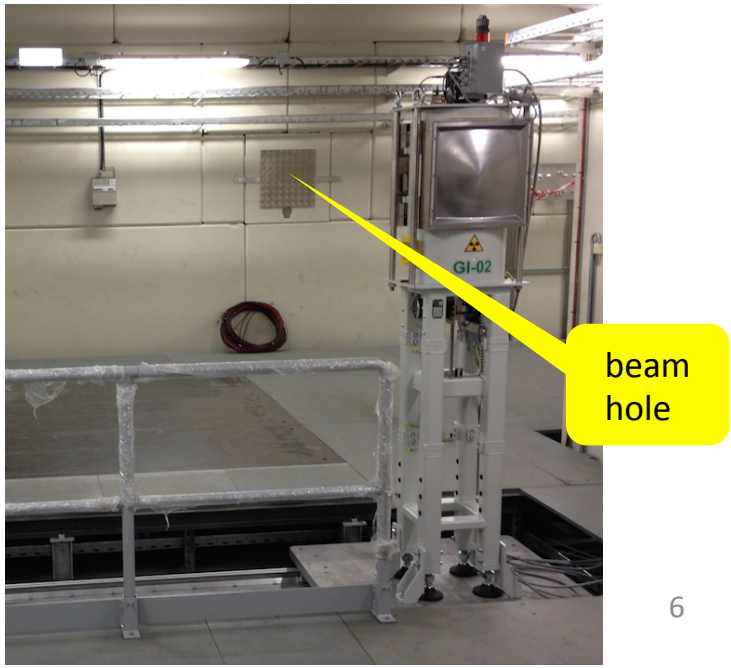
location of
beam-position detectors





Beam-position detectors have to move aside when the beam-pipe has to be installed (beam used by the downstream test area)

Support rails (made by CERN) ready to be installed



Beam tracker: status

Detectors

- Two TGC 4-plets available
- Spatial hit resolution ~70µm
  measured on test beam

Electronics

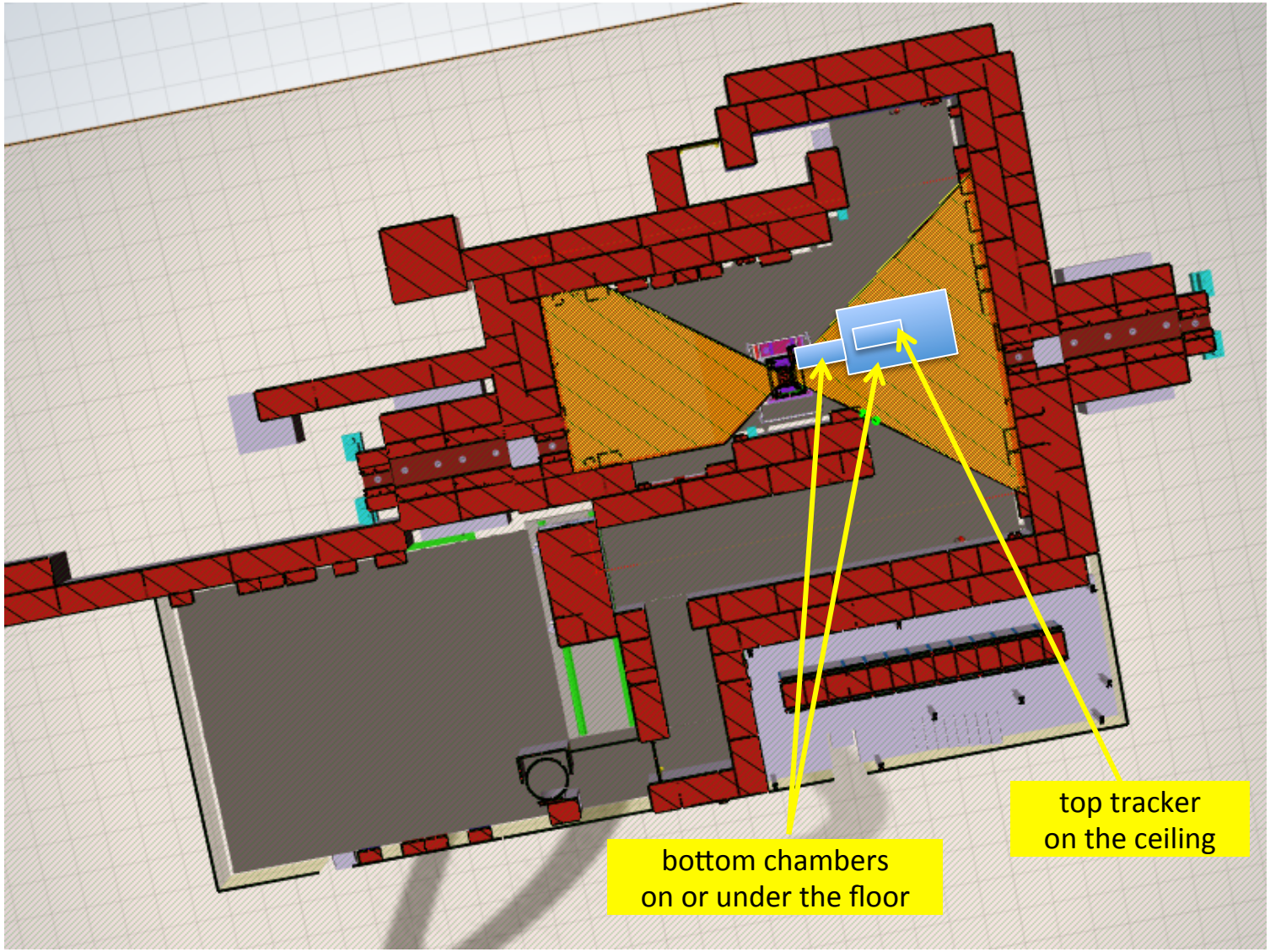
- development of electronics suffered some delay
- 4 layers (instead of 8) equipped with temporary front-end and readout electronics
- final electronics for the 8 layers will be implemented in 2015

Installation

- as soon as support rails are on place

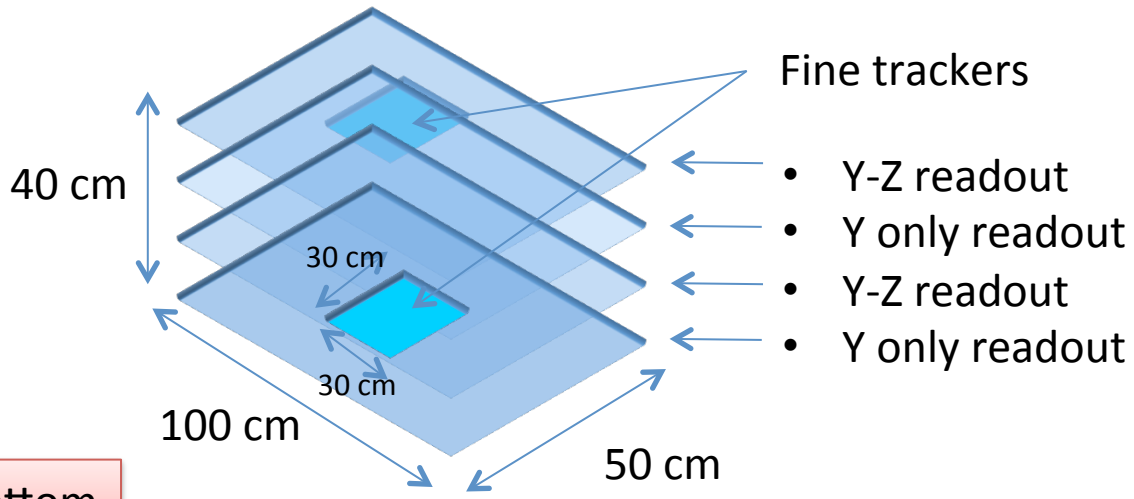
Cosmic tracker: setup

Based on **Resistive Plate Chamber** technology



Cosmic tracker: layout of top tracker

- Trigger and high time resolution
  - 4 independent detectors with area 1.0x0.5 m^2
  - strips 2.5 cm wide
    - 1 m long strips in all 4 RPCs
    - 0.5 m long strips in 2 out of 4 chambers
- Fine tracking
  - 1 or 2 RPC 30x30 cm^2 with 1 cm strips in both direction
  - centroid reconstruction in both coordinates

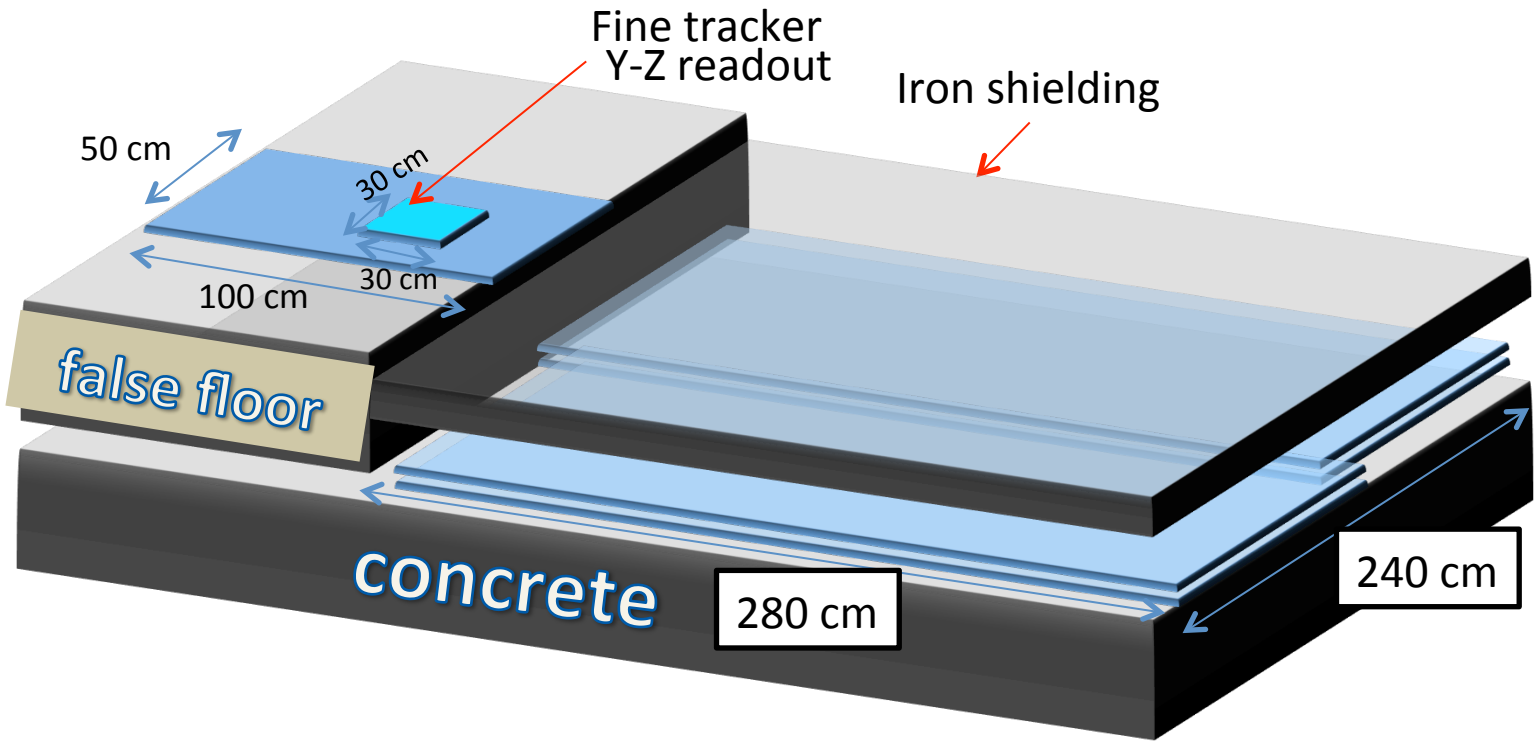


View from bottom

Cosmic tracker: bottom chambers

- Trigger and high time resolution
  - 1x0.5 m^2 chamber as for the top tracker (2.5cm wide strips)
  - fine tracking: 1 chamber 30x30 cm^2 as in the previous point (1.0cm wide strips)

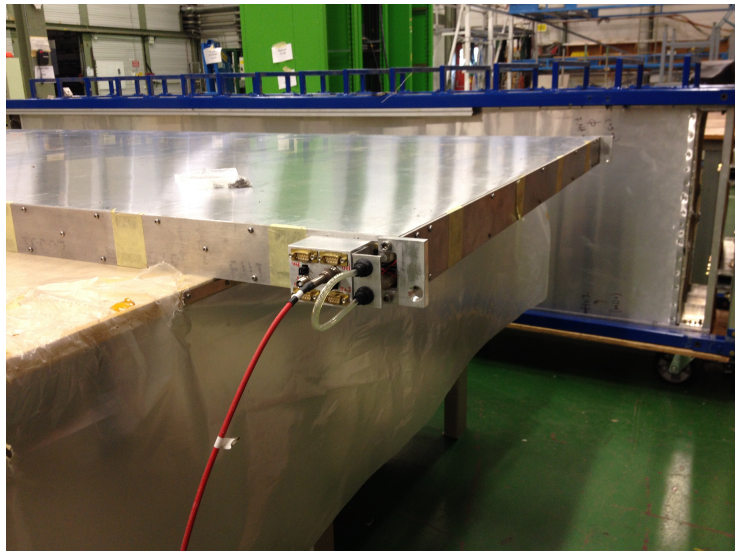
- Underground detector
  - Double layer chambers: total size 2.8 x 2.4 m^2
  - Two chambers with bi-dimensional read out with 4 cm wide strips



Cosmic tracker: chamber status

Underground chambers:

- chambers at CERN since August
- HV tests showed problems with 2 gas volumes:
  one repaired on site (improved cable insulation)
  another one (sparking) had to be replaced with a spare
- further tests in the GIF++ preparation area
  planned before installation



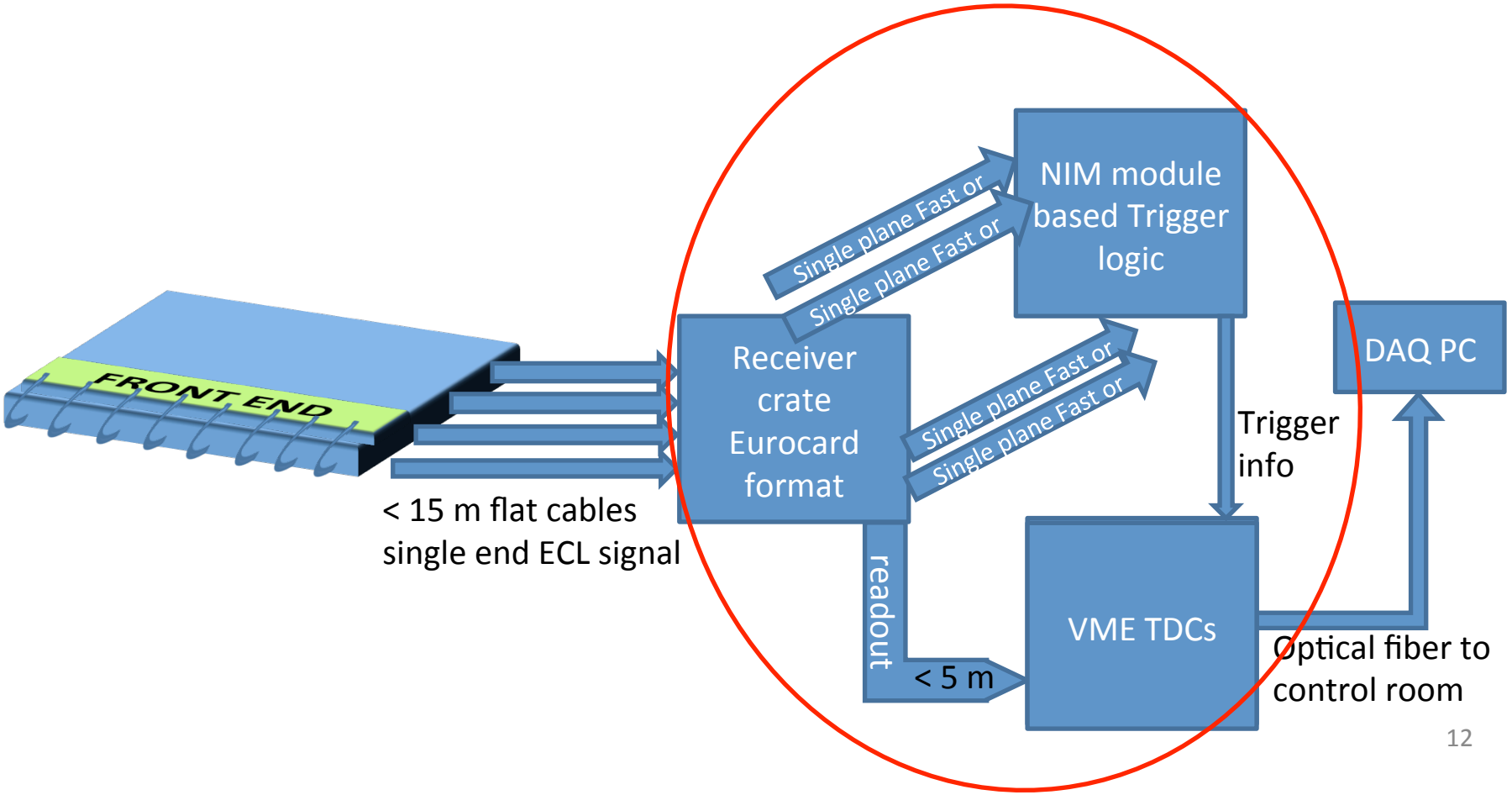
Top/Bottom tracker chambers:

- construction ongoing at the manufacturer
- delivery of chambers expected in January
- fine trackers (30x30 cm^2) later in 2015

Cosmic tracker: readout scheme

(standard chambers)

- Standard tracking trigger
  - top 4-plet and floor singlet tracker (50x100 cm^2) + underground confirm plane
  - Strip → Pre-amp → FE (on chamber) discriminated single ended ECL sent over 15 m of flat cable (not more!) → receivers

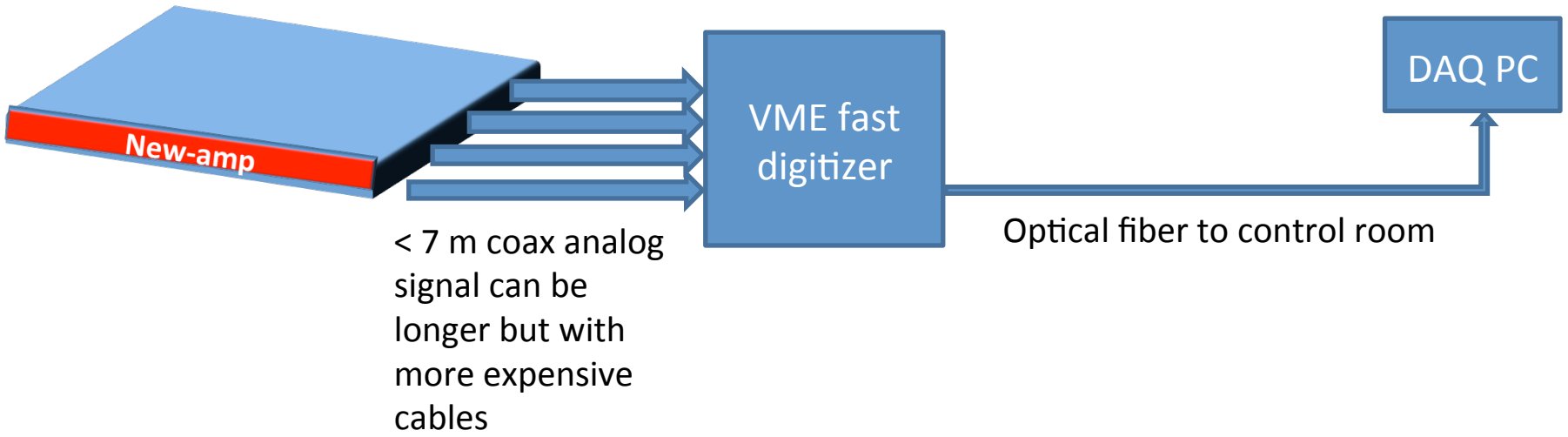


Cosmic tracker: readout scheme

(high resolution chambers)

3 high resolution trackers: 2 on roof + 1 on ground

- 30x30 cm^2 with 1 cm pitch strips
- Strip → New-amp → analog sent over <7 m of coax cable → VME fast digitizer

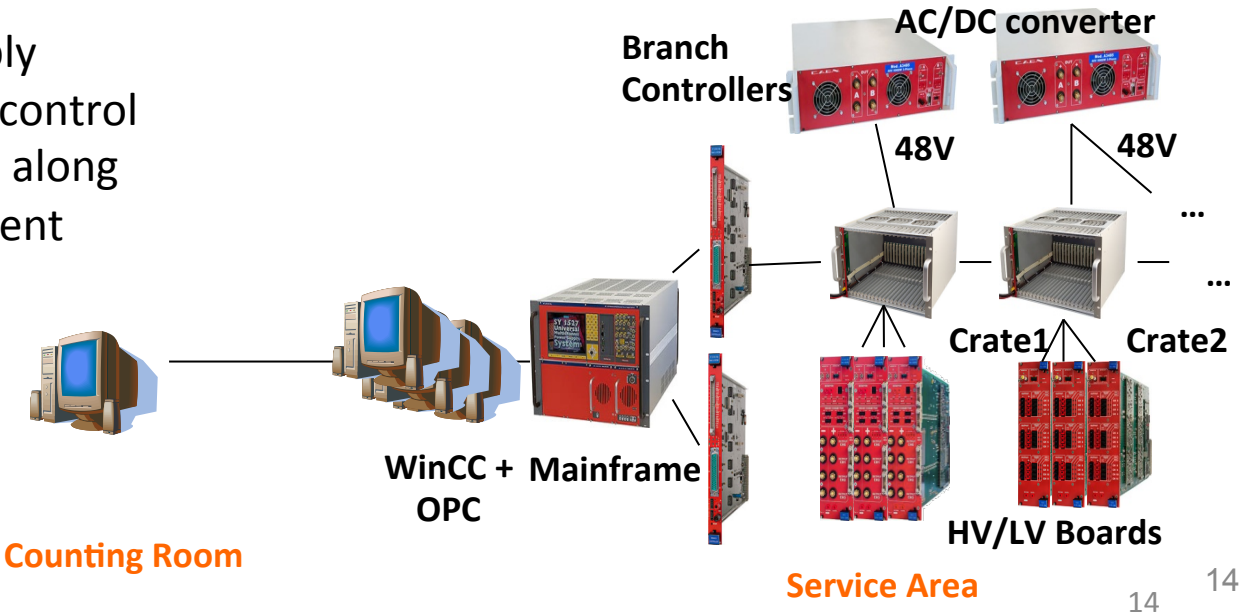


DCS scheme

- Use PVSS/WinCC OA (as in LHC experiments)
  - Many components, devices, HW and SW already available (CAEN System, CAN PSU, ELMB, ENV Sensors, VME crates etc.)
- CAEN Easy Power System
  - 1 mainframe, 1 Power Generator, 1-2 crates + with HV and LV boards(*) and 1 ADC A-3801 board for monitoring (128 channels), this includes also ENV and gas monitoring

(*) Some Low Voltage possibly external (non CAEN) with remote control via PVSS

- Mainframe and PCs possibly placed in proximity of the control room (radiation-free area) along with DAQ PCs and equipment



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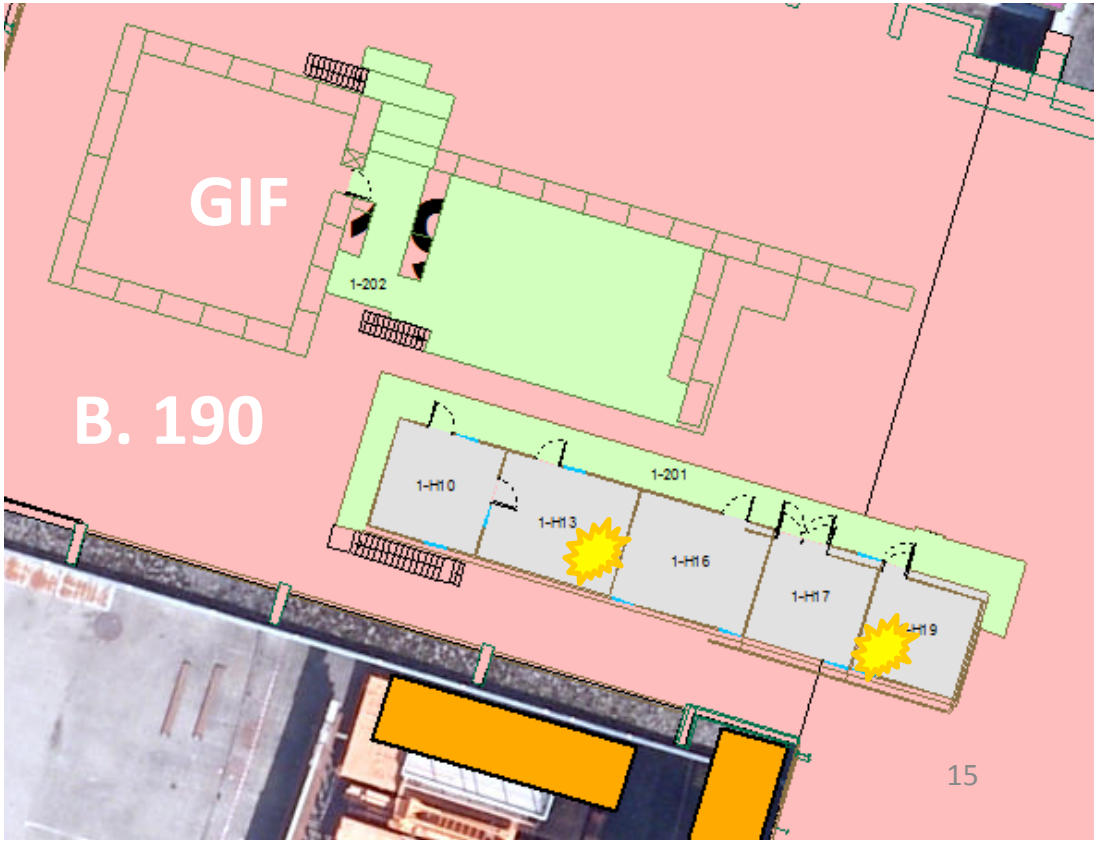
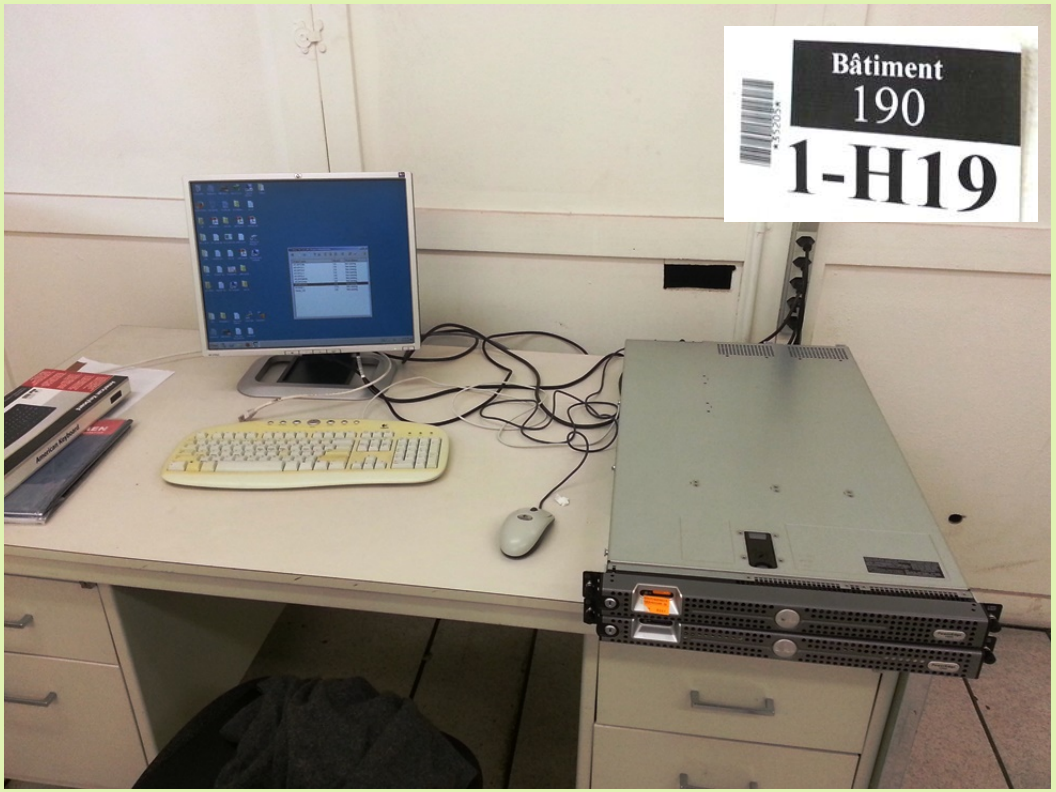
DCS Hardware Status

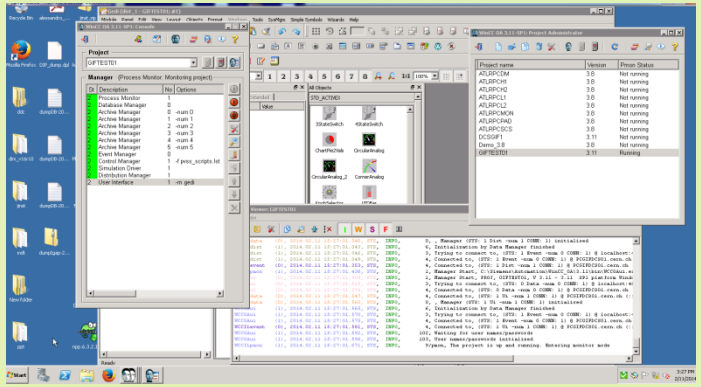
- Material installed
  - 1 CAEN mainframe (SY-1527 + PS A-1531 A-1532)
  - 1 (non-EASY) HV board A-1526P (6ch 15 kV+) (repaired ok)
  - 1 Branch Controller A-1676
  - 2 PC DELL PowerEdge 1950 (courtesy of ATLAS DCS, spare of past generation)

- Also installed
  (on loan from ATLAS Muons)
  - EASY-3000 Crate
  - 1 ADC A-3801



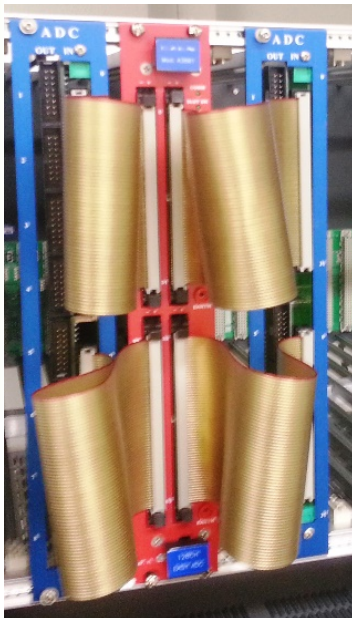
DCS: Test Location in B190 (old GIF) /1





- 2 (Dell 1950) computers installed in CMF
- Windows 2008 Server R.2
- PVSS 3.8 and WinCCOA 3.11

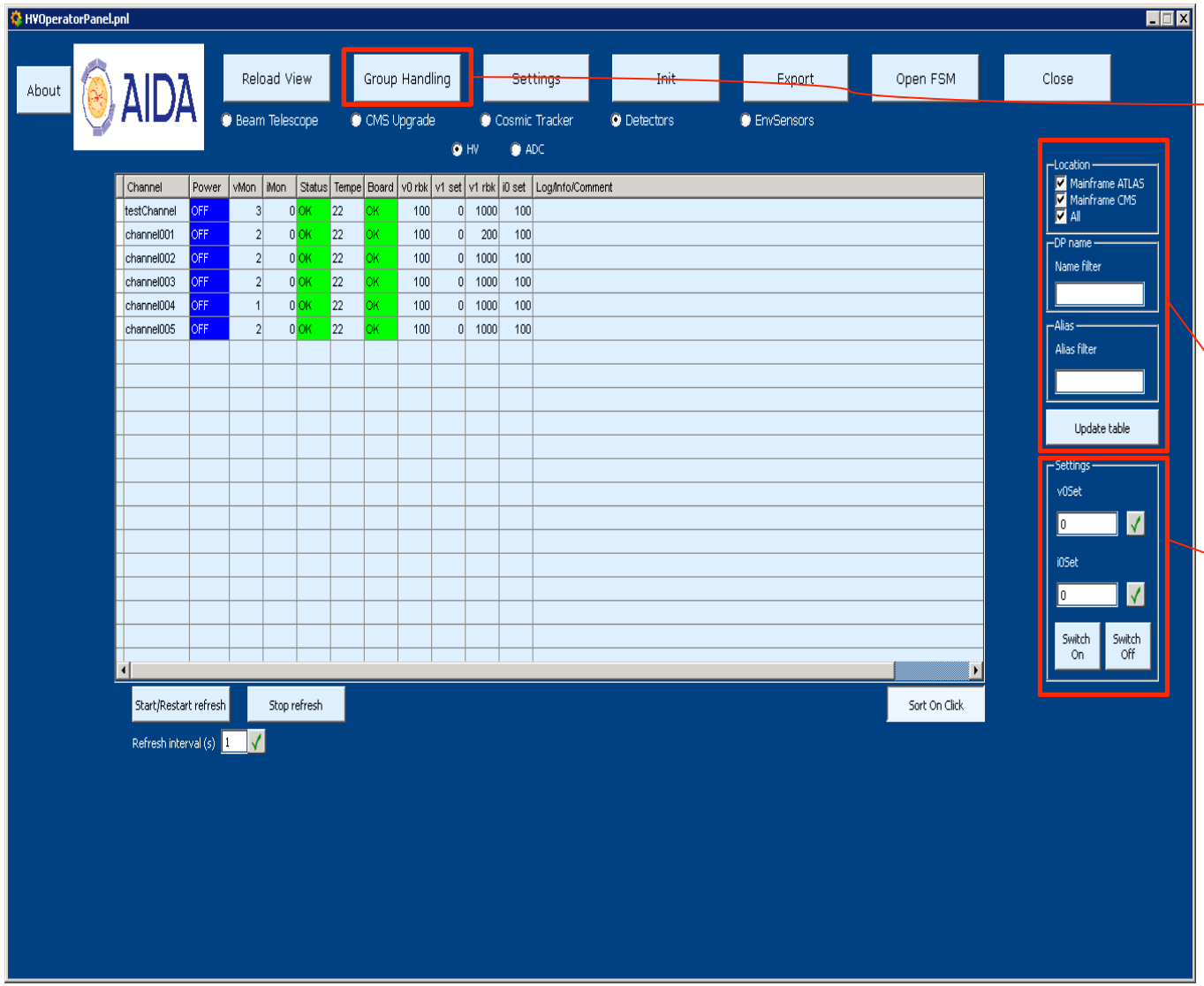
DCS: Test Location in B190 (old GIF) /2



- 1 CAEN Mainframe + 1 HV 3516P board (6 ch) 12 KV
- 1 EASY crate + 1 ADC A3801 (128 ch) +
  2 patch-panels (4x32 pair connectors → 16x8 pairs)

→ System developed/used in conjunction with the old GIF

DCS: HV Operator panel



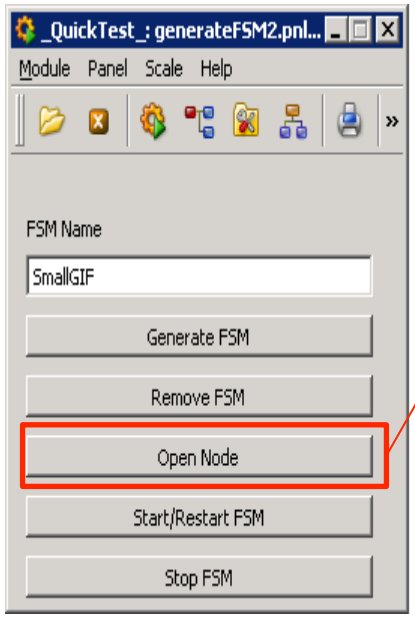
HV (and ADC) channels can be assigned to up to 5 groups

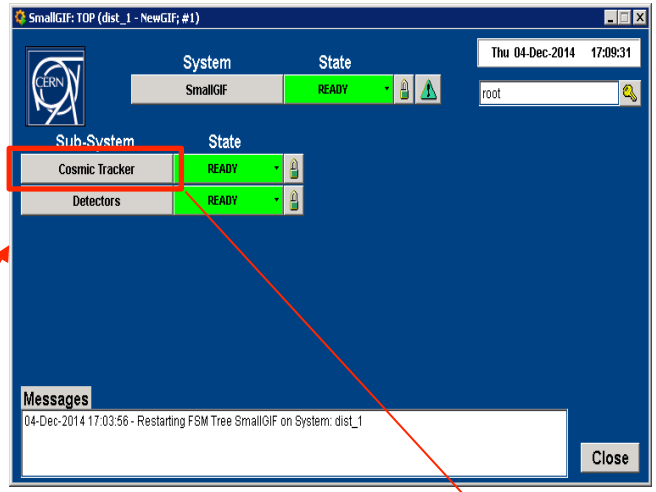
Right-click on selected columns to see the trend

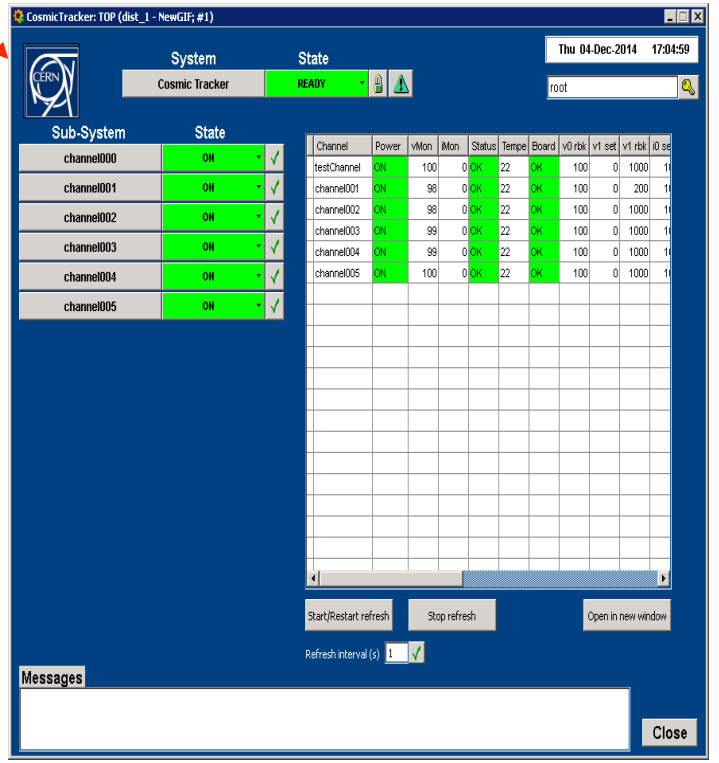
Filter masks by location/channel name/alias

Quick settings for selected channels

DCS: FSM

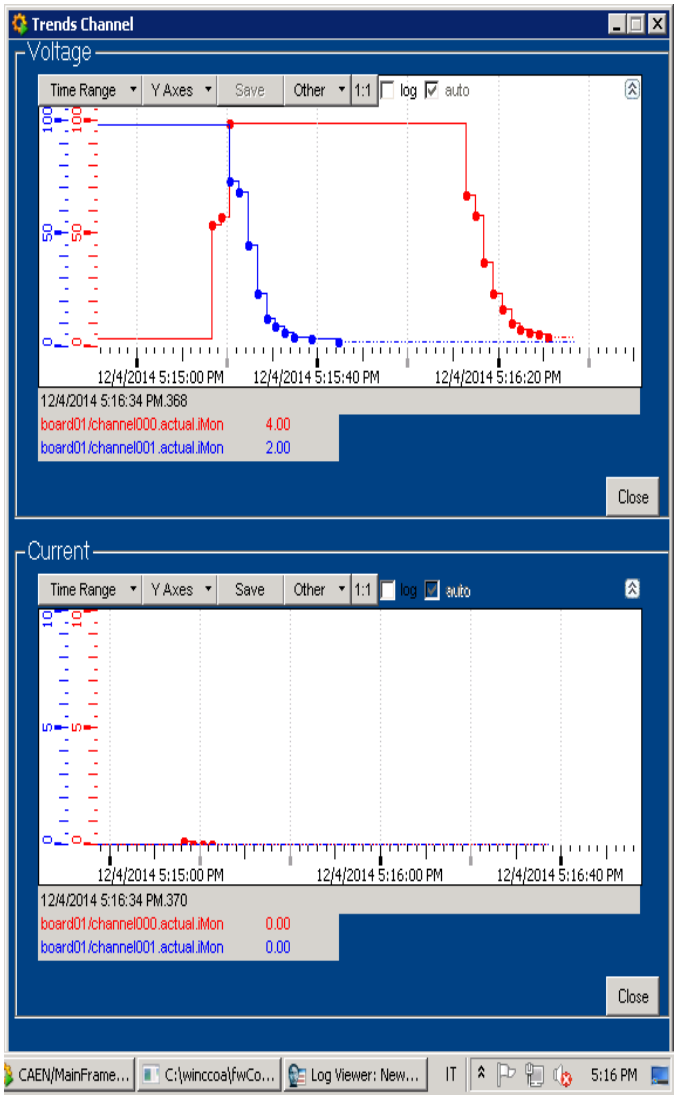






FSM can be generated on the fly
Follows the “group” structure of the operator panel
Takes into account only the HV channels for now

DCS: Trending capabilities



Right clicking on the table opens the trend for the selected column

Right clicking on the first column (channel name) shows the trend of Imon and Vmon

Up to 8 channels can be shown in one trend

DCS summary and plans

Status:

- Equipment recently moved from B190 to final location in Prevessin
- A simple baseline system has been prepared
- Ready to install in service area as soon as services are available

Next Steps:

- Finalize a baseline DCS (WinCC-OA, simple control and monitoring, data archiving) to control the HW already available
  - Exercise useful to build up expertise for next developments
  - System can be used to test parts of the final system (ENV sensors etc)
  - Options for synergies (existing GIF tests)
- Further adaptation to final needs
  ➔ precise specifications from Users/Detectors
- HW procurement

Prevessin 887-1-R87

DAQ system

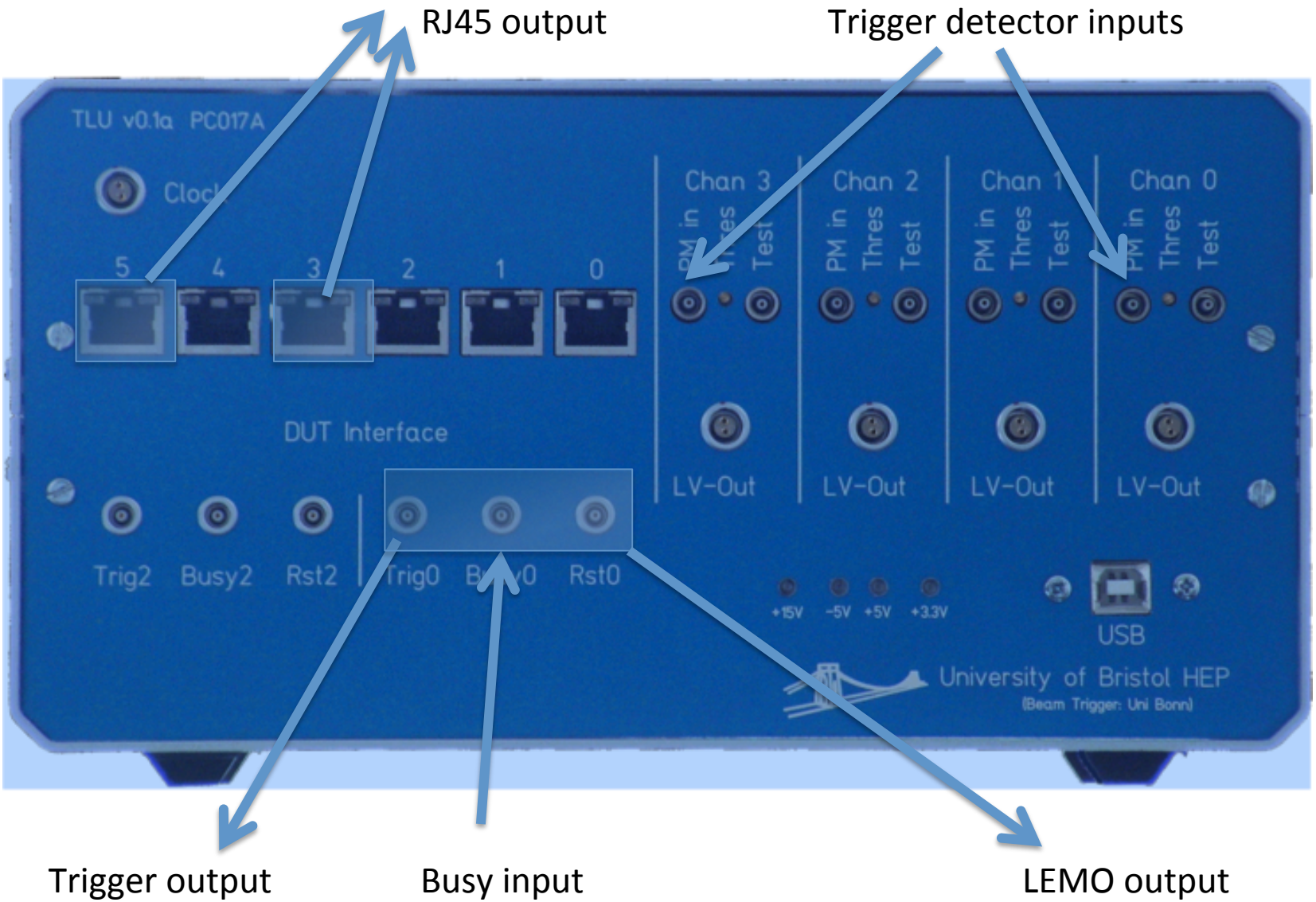
Requirements

- Create a trigger from beam tracker (TGC) and/or cosmic tracker (RPC)
- Distribute the trigger to different Detectors Under Test (currently up to 5 DUTs)
- Synchronize the events from the TGC/RPC with the DUTs for tracking/ efficiency purpose

Implementation

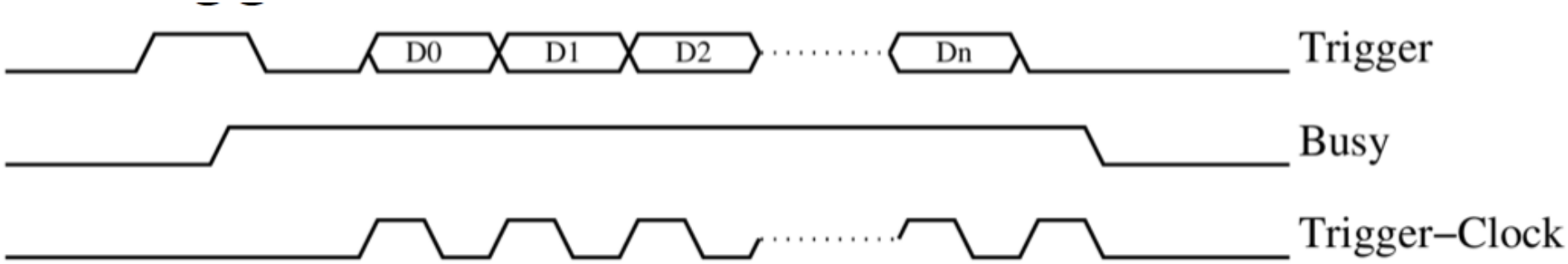
- Based on a **Trigger Logic Unit** module provided by EUDET community and intensively used in test beams (DESY, CERN, FERMILAB, …)
- Unit provides **trigger signal** and **trigger number** to all detector DAQs
- Requires busy signal from detectors DAQs
- This module synchronizes the different DAQ systems

DAQ: Trigger Logic Unit

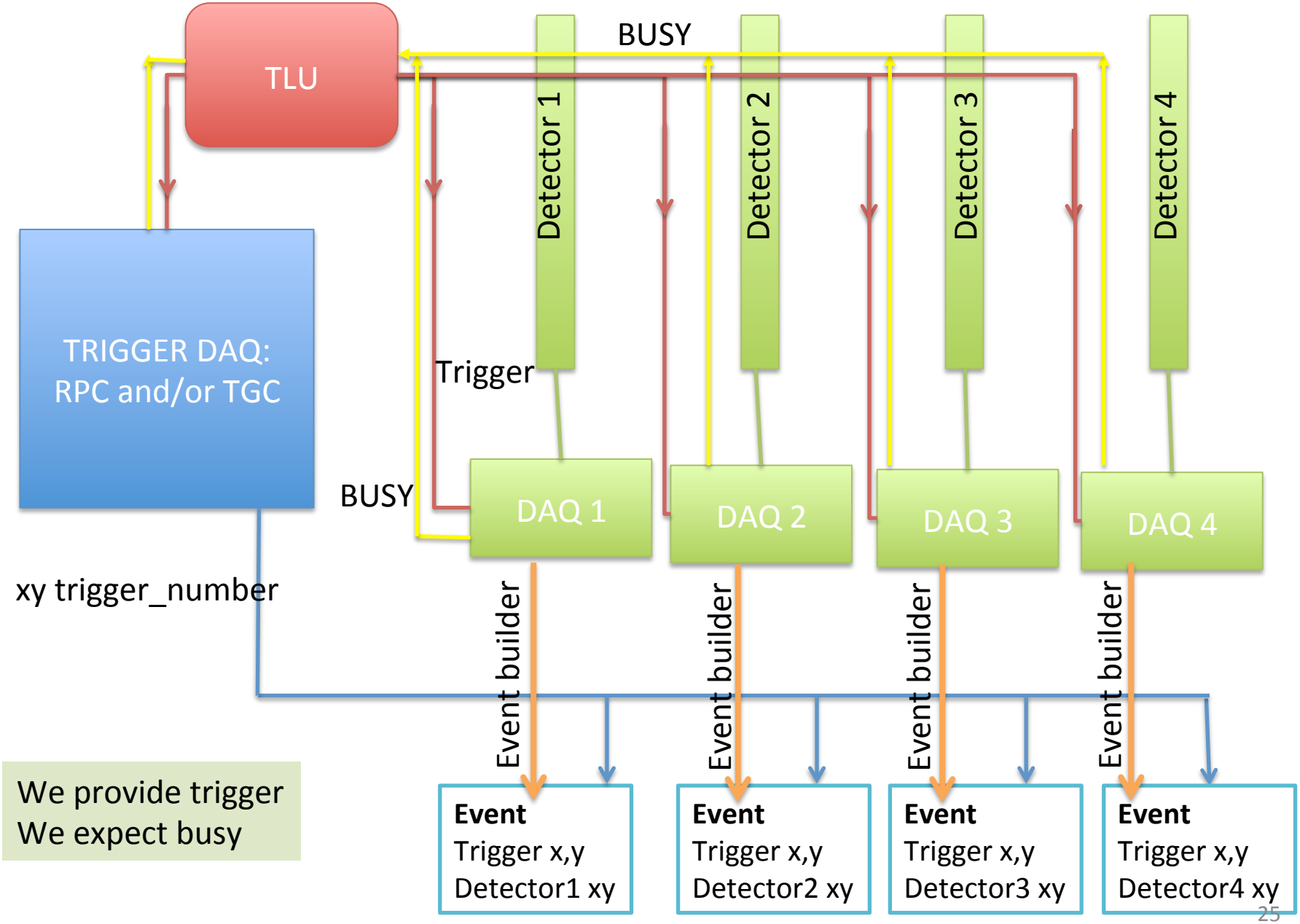


DAQ working scheme

- TLU receives a signal from the trigger detectors
- TLU asserts TRIGGER
- On receipt of TRIGGER, detector DAQs assert BUSY
- On receipt of BUSY, TLU de-asserts TRIGGER and send trigger number
- Detector DAQs de-asserts BUSY
- System is ready for the next trigger

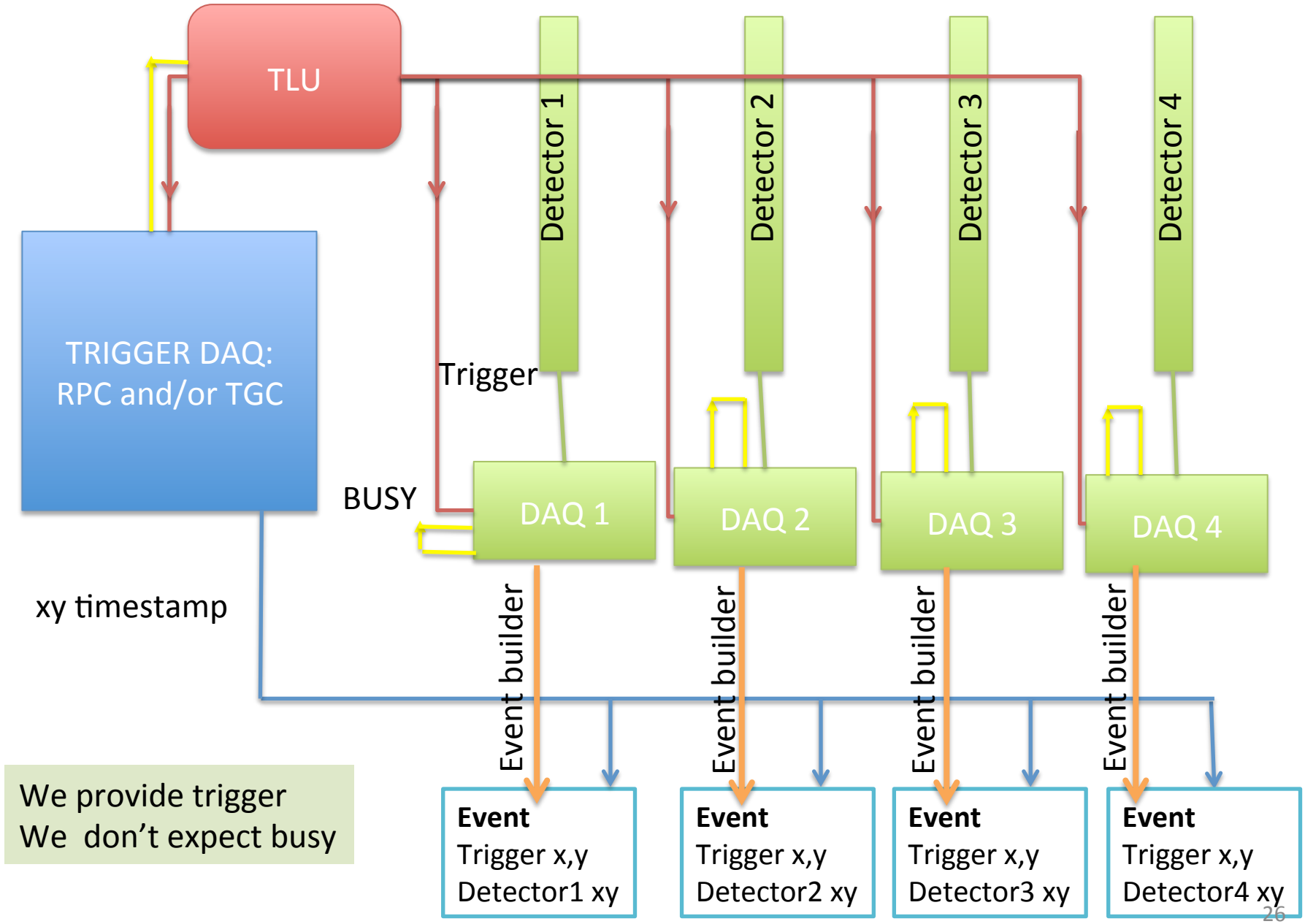


DAQ scheme with busy handling



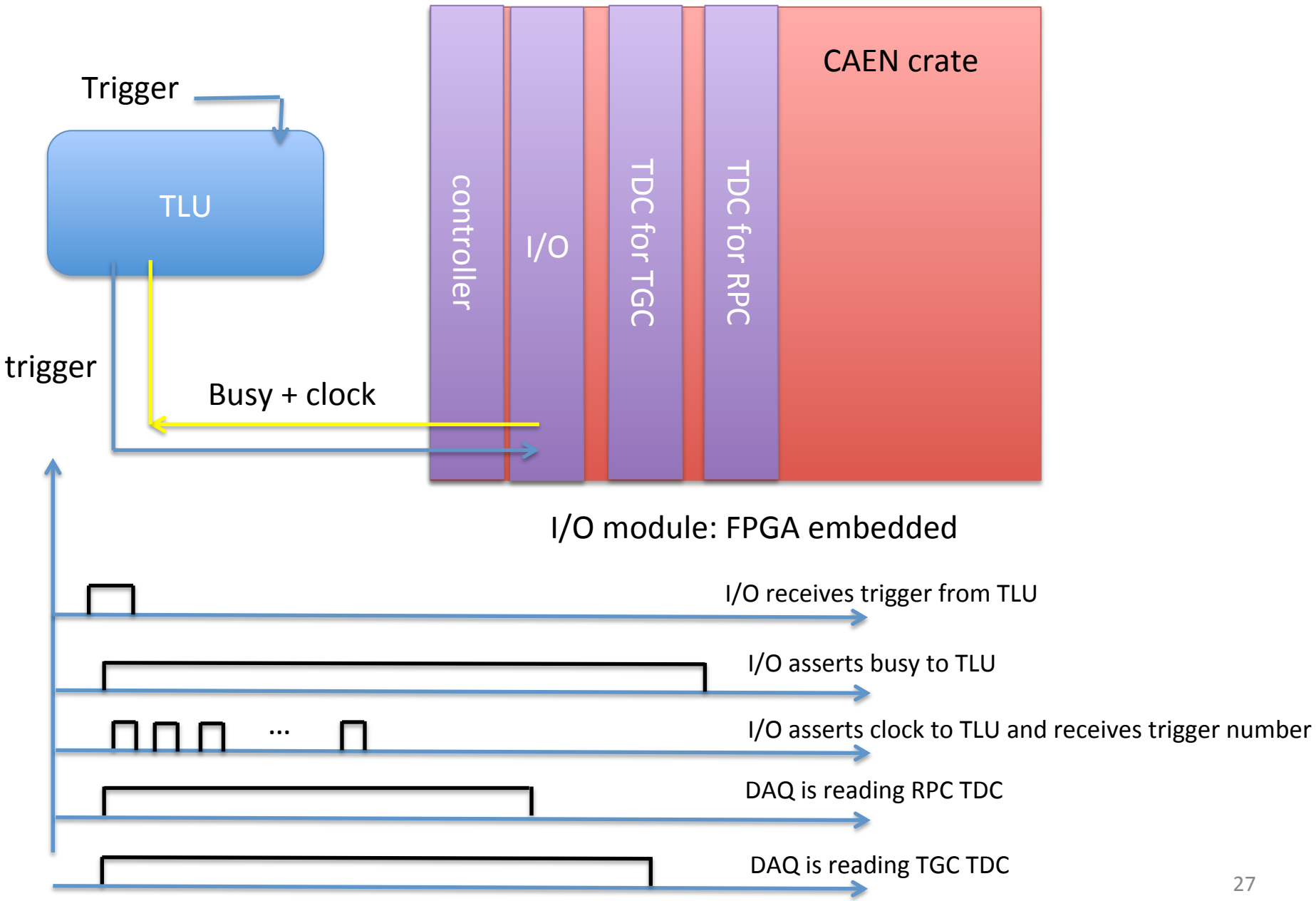
We provide trigger
We expect busy

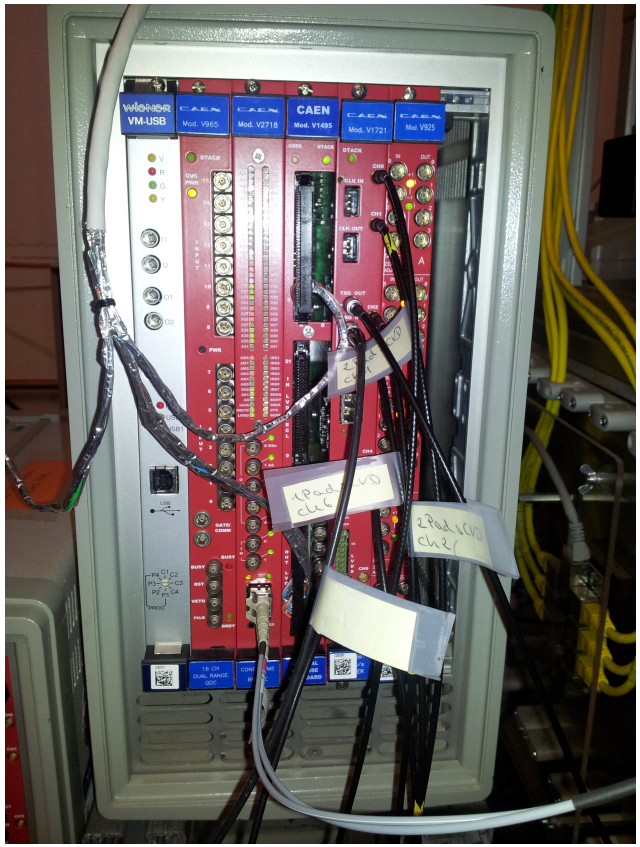
DAQ scheme without busy propagation

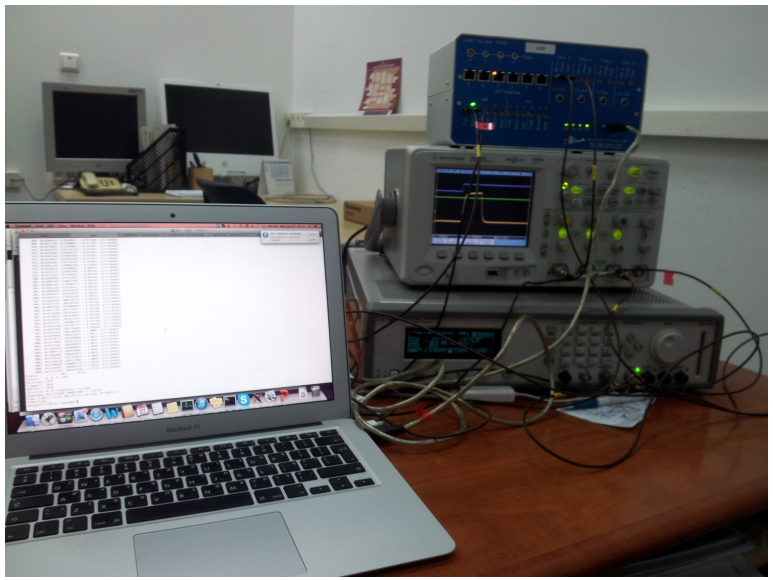


We provide trigger
We don't expect busy

DAQ: implementation scheme







DAQ:
tests at Tel-Aviv University

- Full test-bench exists in TAU :
  small TGC, DUT, readout electronics
  (one running TLU)
- TLU provides trigger and synchronization as requested
- Time stamp of the events could be a good and easy solution for the GIF++ working scheme
- The TGC readout part is working with TLU

- Need to integrate the RPC
- Need to test with real detectors and check the full chain

Radiation monitoring

Radiation monitoring for Gif++ - part of WP 8.5.3

P.Iaydjiev, INRNE-BAS

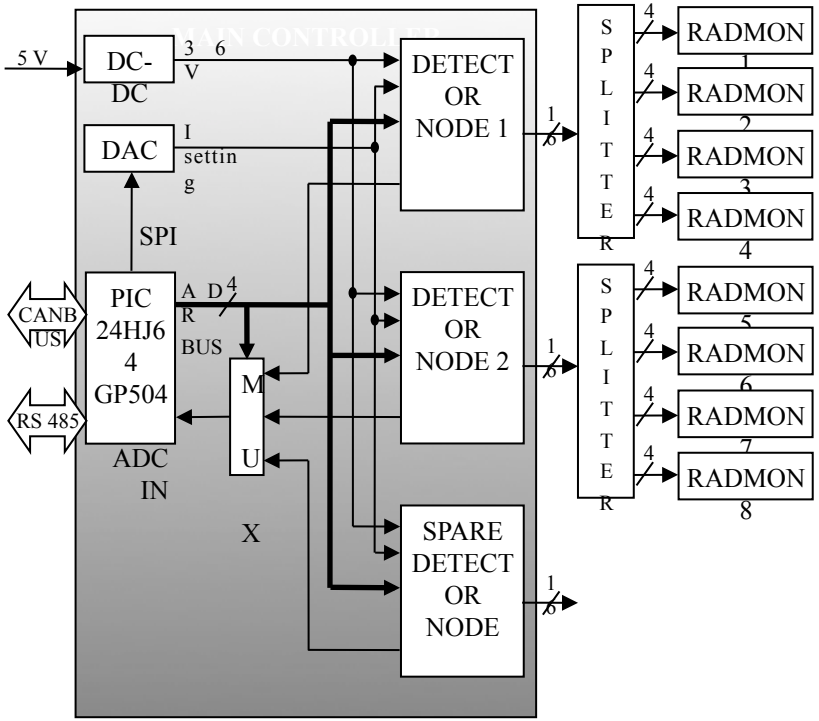
Working program

1.Assembling at INRNE and test with local Cs-137 source of 1 radiation sensor with an electronics and PC based acquisition.	M1 – M18	1 Detector with electronics and PC based acquisition
2. Test and calibration at CERN Gif	M6 – M18	Report
3. Assembling at INRNE – Sofia of 6-8 sensors for Gif++	M12– M36	6-8 radiation sensors with the necessary electronics and PC based acquisition
4. Installation and commissioning of the radiation sensors at DAQ of the Gif++	M12– M48	Report

First version of the Control board for the calibration test at Gif with 1 RADMON – 2012.

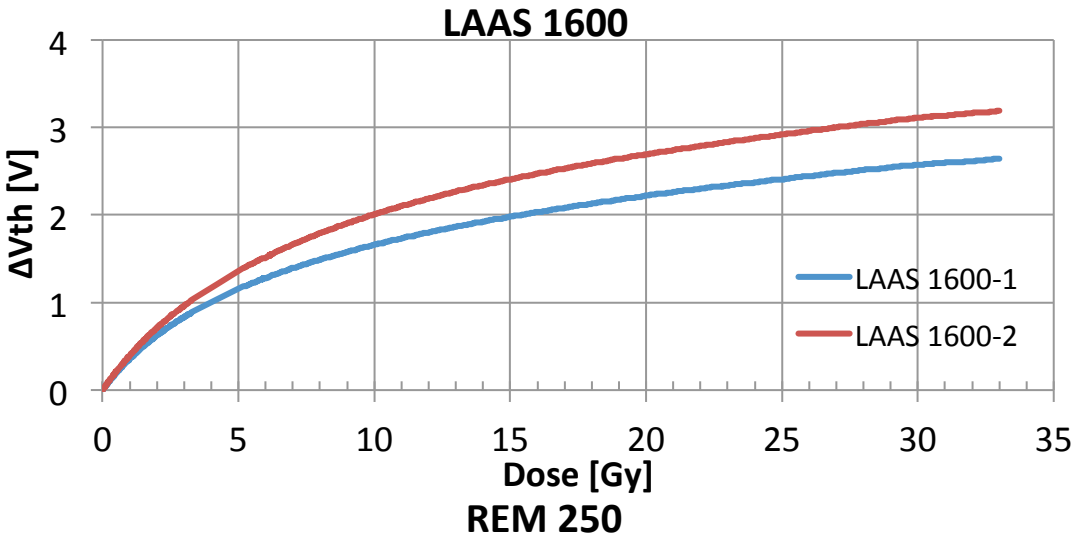
Radiation monitoring

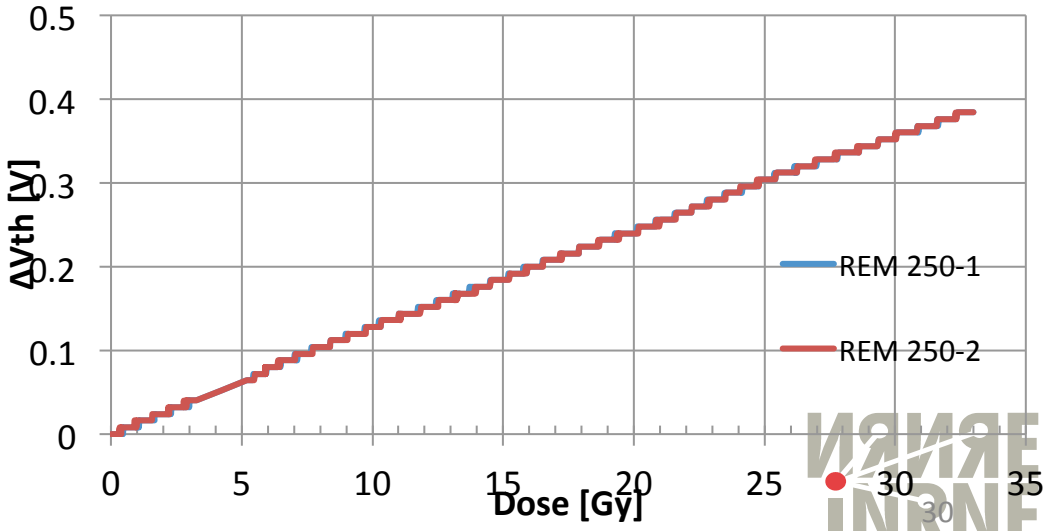
Final version of the Control board for the calibration test at GIF with 12 RADMON's



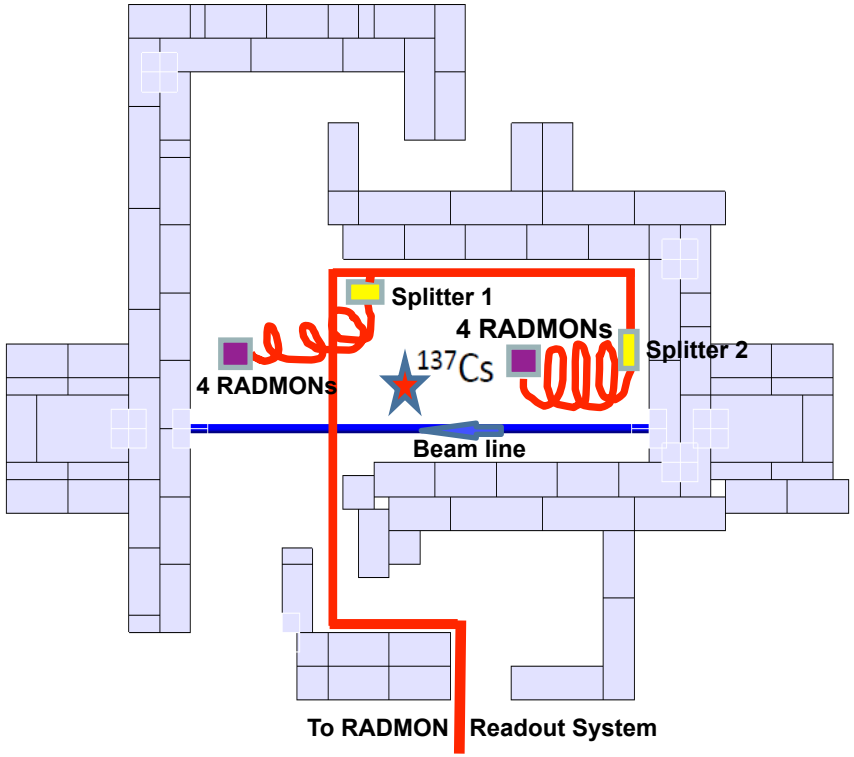
Controller board for 12 RADMON's

Calibration Test of Radfet's on RADMON 2013-2014

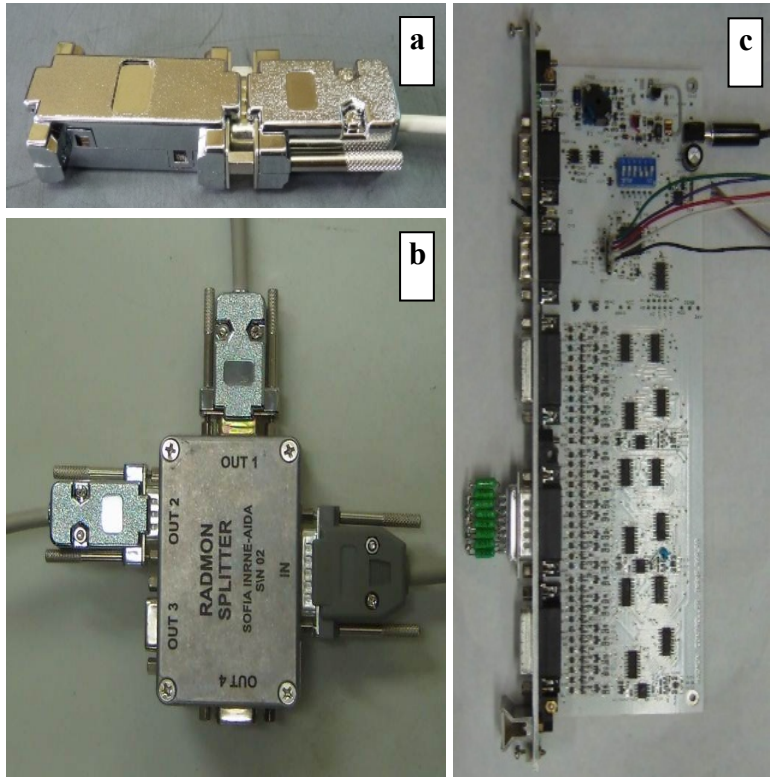




Radiation monitoring



RADMON's positioning at Gif++



a – RADMON in the protection box,
b – Splitter, c Controller

Papers:

1. Dimitrov,L., Iaydjiev,P., Mitev, G., Vankov, I., (2012) *Test a prototype of a Micro Controller Unit (µCU) for the control and reading of the RADMON radiation detectors – LAAS 1600 and REM 250* , (INRNE, Sofia and Bulgarian Science Fund – MEYS, Bulgaria) ; AIDA-NOTE-2012-004.- Geneva : CERN, 2012

2. Dimitrov,L., Iaydjiev,P., Mitev, G., Vankov, I., (2013) Radiation Monitoring at New CERN Radiation Facility GIF++, In: *XXIV International Symposium on Nuclear Electronics and Computing (NEC'2013)* – CERN, JINR, INRNE,Varna, Bulgaria,

3. Dimitrov,L., Iaydjiev,P., Mitev, G., Vankov, I., RADIATION MONITORING AT GIF++, poster, G. Mitev on behalf of INRNE AIDA Group *3rd EIROforum School on Instrumentation, CERN 2013*

Gas/Environmental Sensors

- Monitoring (for both atmospheric and gases)
  - Pressure **p**
  - Temperature **T**
  - Relative humidity **H**

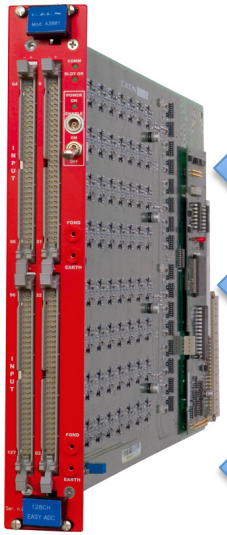
- Modular architecture
  - Baseline
    - 6 gas sampling points (1 in prep area)
    - 4 atmospheric sampling points (1 in prep area)

- Integrated in DCS monitoring system

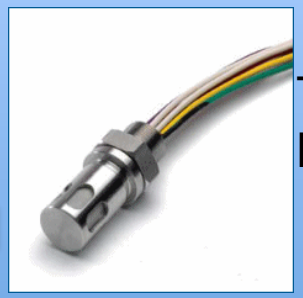
- Simple Pb shielding for irradiated areas

Gas/Environmental Sensors: specifications

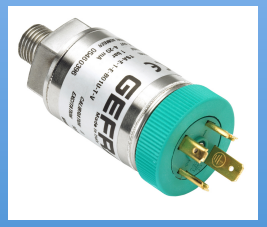
Range	Precision
$5^{o}C < T < 40^{o}C$	$\Delta T = \pm 0.2^{o}C$
$0\% < H < 100\%$	$\Delta H = \pm 2\%$
$900mbar < p_a < 1050mbar$	$\Delta p_a = \pm 2mbar$
$-2mbar < p_{g(detector)} < 5mbar$	$\Delta p_{g(detector)} = \pm 0.1mbar$
$0mbar < p_{g(off\text{-}detector)} < 100mbar$	$\Delta p_{g(off\text{-}detector)} = \pm 2mbar$



CAEN ADC 3801



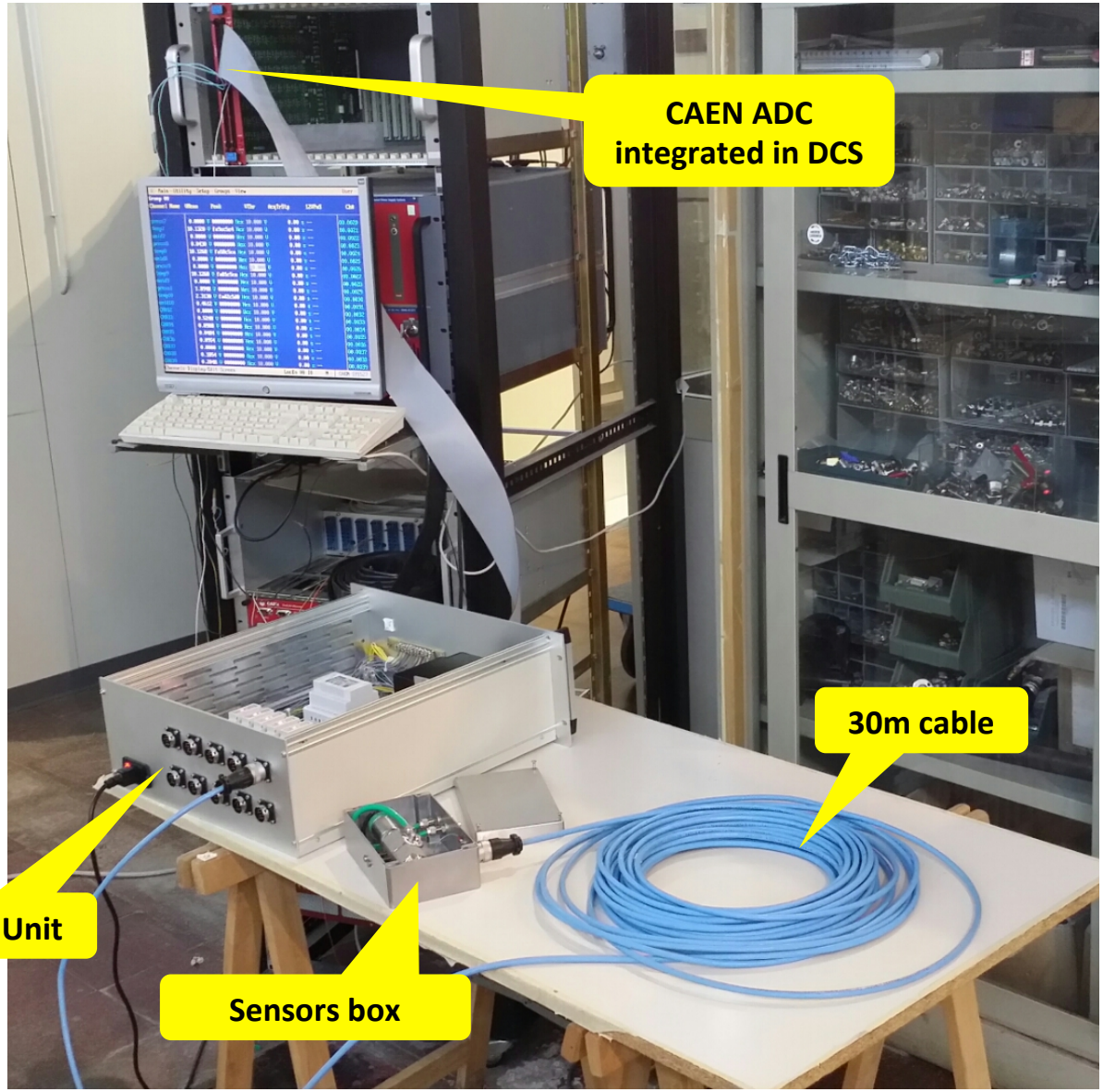
T, H sensor
PCMini 70 Michell



p sensor
TSA Gefran

Stainless steel housing
for use with F^{-}

Gas/Environmental sensors



Gas/Environmental Sensors: status

- Test system operational at Frascati … OK
- Sensors coupled to A 3801 … OK
- Short term accuracy … OK
- Study long-term stability … OK
- Freeze design and validate … OK
- Design of mechanical assembly … OK
- Sensors procurement … OK
- 10 stations assembly … OK
- Readout test in GIF++ DCS temporary setup … OK
- Cabling in GIF++ … ongoing
- Radiation shielding in GIF++…ongoing

Summary

Beam tracker:

- chambers ready though with a temporary electronics until 2015
- installation on site to be done

Cosmic tracker:

- large confirm chambers at CERN, under test before installation
- chambers for top/bottom trackers under construction, expected at CERN in January

DCS:

- basic version tested in temporary setup at the old GIF (with minimal hw infrastructure)
- setup moved to GIF++ control room (next: move to final position in service area)
- ready to include fixed detector hardware when available

DAQ:

- test-bench setup used at Tel Aviv University
- TGC already working with the proposed DAQ scheme
- test to integrate RPC postponed, due to delay in detector availability

Radiation sensors:

- dosimeters ready to be installed in the bunker area, waiting for cabling

Gas/Environmental sensors:

- sensors ready, test of readout chain done, installation as cabling completed
- shielding containers are being prepared

Final remarks

The **user infrastructure** installation is starting

Basic functionalities expected by next spring

Full functionality in summer