WG7: Common Test Facilities

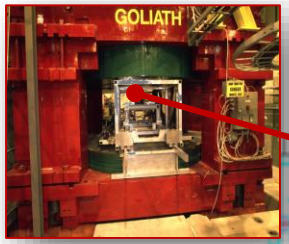
Eraldo Oliveri

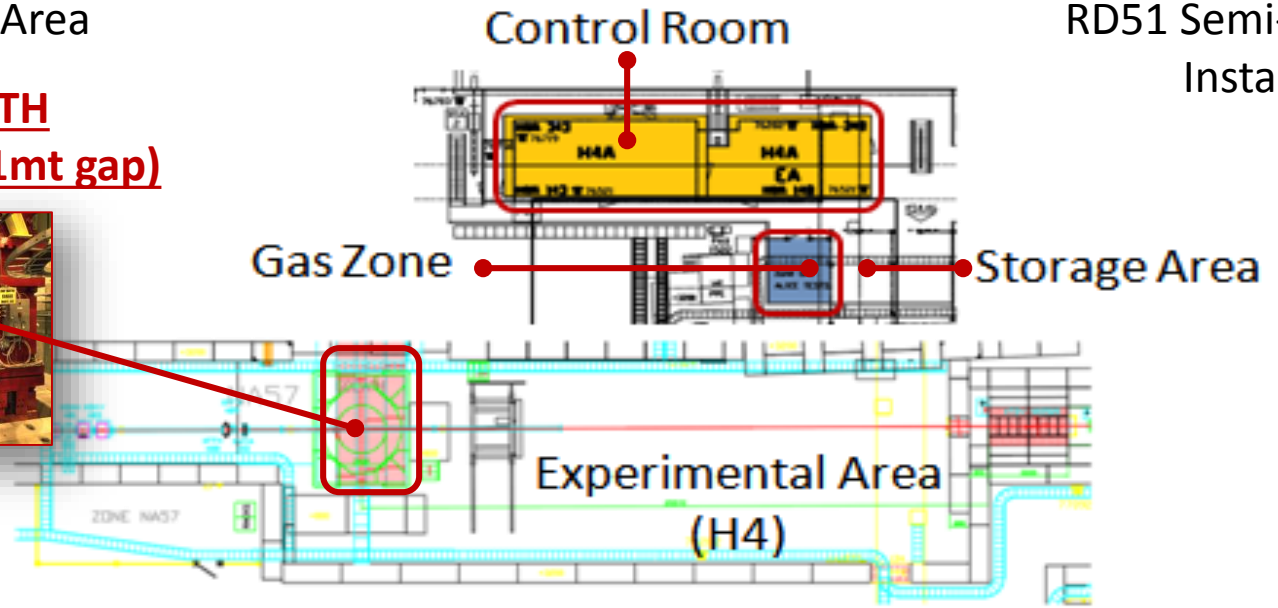
Yorgos Tsipolitis

EHN1-H4 North Area

RD51 Semi-Permanent Installation

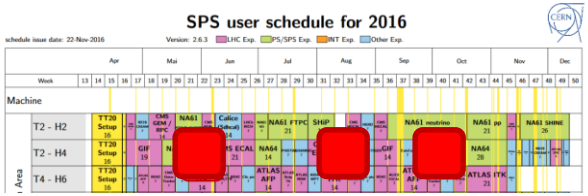
GOLIATH
(1.5T Max, 1mt gap)





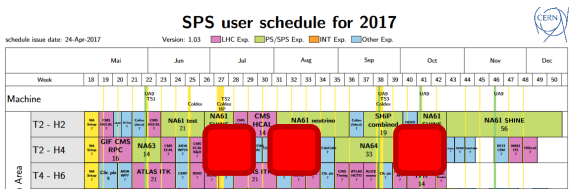
2016 RD51 Test Beams :
3 periods of 2 weeks each with GIF++
10 different groups running in parallel and total

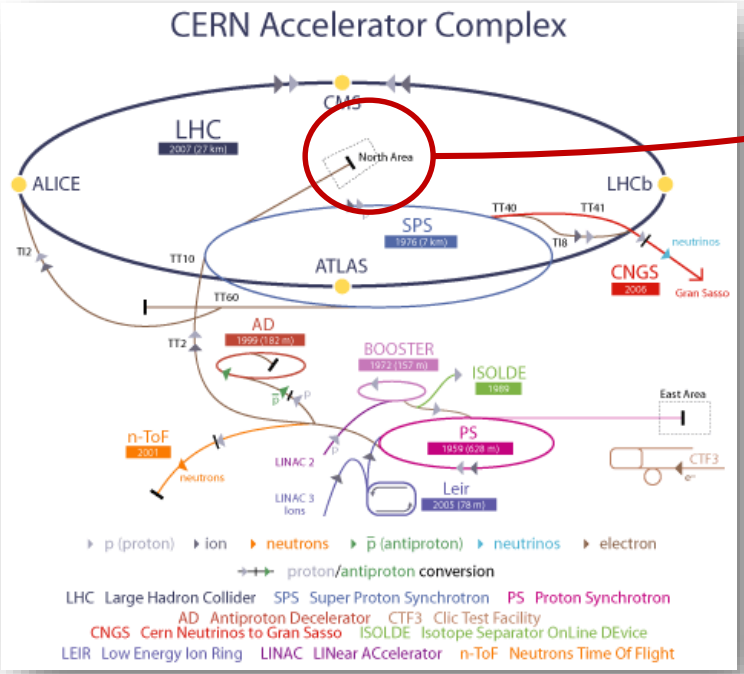
2016

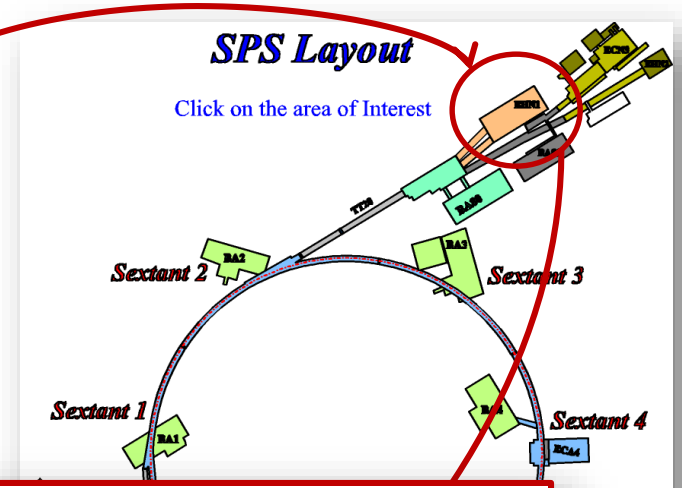


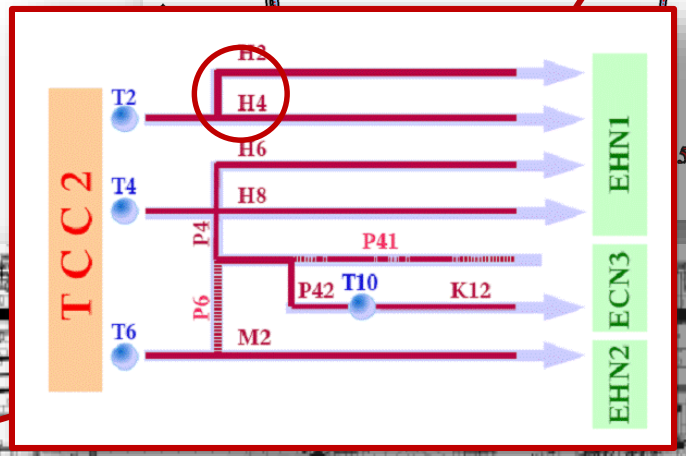
2017 RD51 & GIF++ & .... Test beams:
3 periods of about 2 weeks each with GIF++ and CMS (RPC/GEM)
Similar number of setups expected

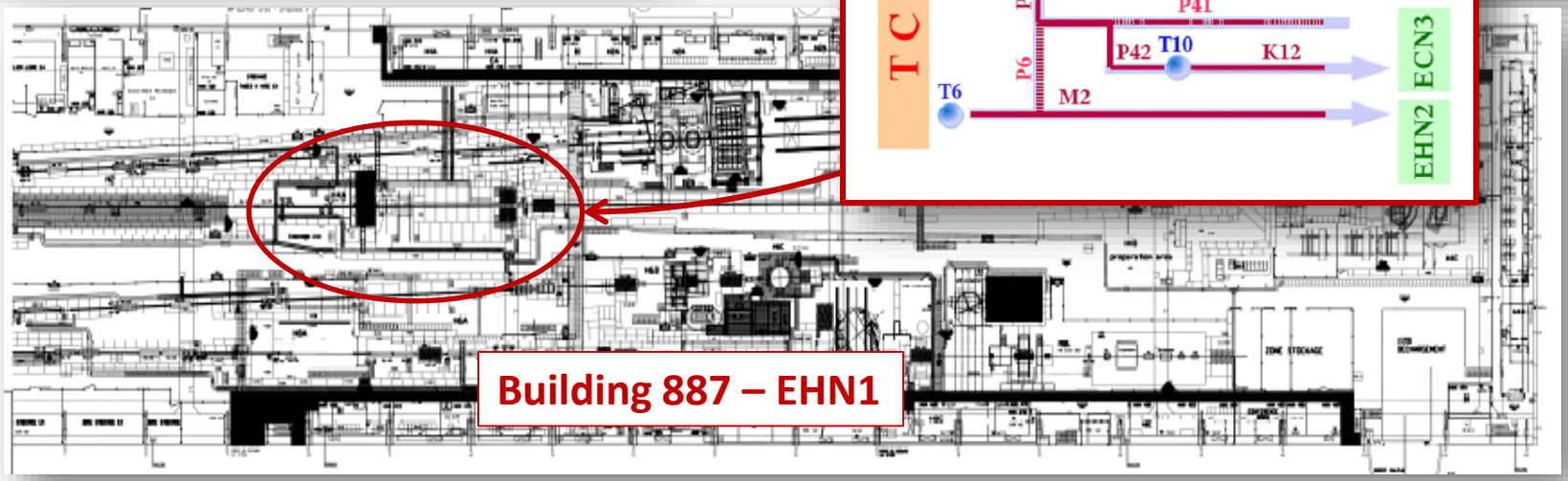
2017

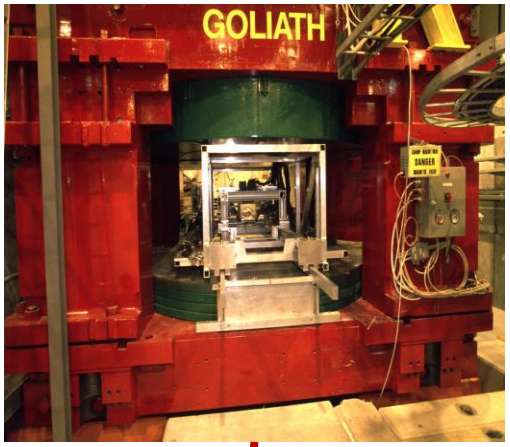


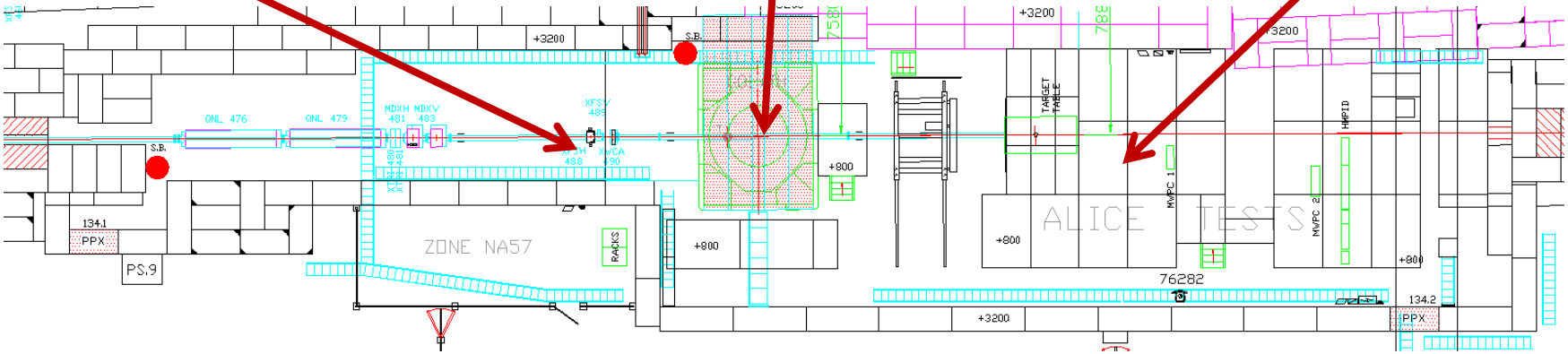

CERN Accelerator Complex
LHC
2007 (27 km)
CMS
North Area
ALICE
LHCb
SPS
1976 (7 km)
TT40
TT41
TI8
neutrinos
TT10
ATLAS
CNGS
2006
Gran Sasso
TI2
TT60
AD
1999 (182 m)
TT2
BOOSTER
1972 (157 m)
ISOLDE
1989
East Area
n-ToF
2001
neutrons
PS
1959 (628 m)
LINAC 2
CTF3
LINAC 3
Ions
Leir
2005 (78 m)
p (proton)
ion
neutrons
p̄ (antiproton)
neutrinos
electron
proton/antiproton conversion
LHC Large Hadron Collider
SPS Super Proton Synchrotron
PS Proton Synchrotron
AD Antiproton Decelerator
CTF3 Clic Test Facility
CNGS Cern Neutrinos to Gran Sasso
ISOLDE Isotope Separator OnLine DEvice
LEIR Low Energy Ion Ring
LINAC LINear ACcelerator
n-ToF Neutrons Time Of Flight


SPS Layout
Click on the area of Interest
Sextant 1
Sextant 2
Sextant 3
Sextant 4


TCC2
T2
T4
T6
H2
H4
H6
H8
P4
P41
P42
T10
K12
P6
M2
EHN1
ECN3
EHN2


Building 887 – EHN1





+ GDD/RD51 Laboratory available during test beam (to fix issue with detector/electronics)

H4 beam line

- **The** H4 beam line is located in EHN1. It is a high-energy, high-resolution general purpose beam suitable for both experiments and tests. Main parameters: Pmax= 330 (450) GeV/c, Acc.=1.5 μSr, Δp/pmax= ±1.4 % The maximum momentum is 400 GeV/c.
- **detailed user guide:** H4

- **Beam types:**
  - polarized protons for Λ0 decay, enriched low-intensity beam of anti-protons, or K+
  - electrons from γ-conversion,
  - Attenuated primary beam, Heavy ion beam

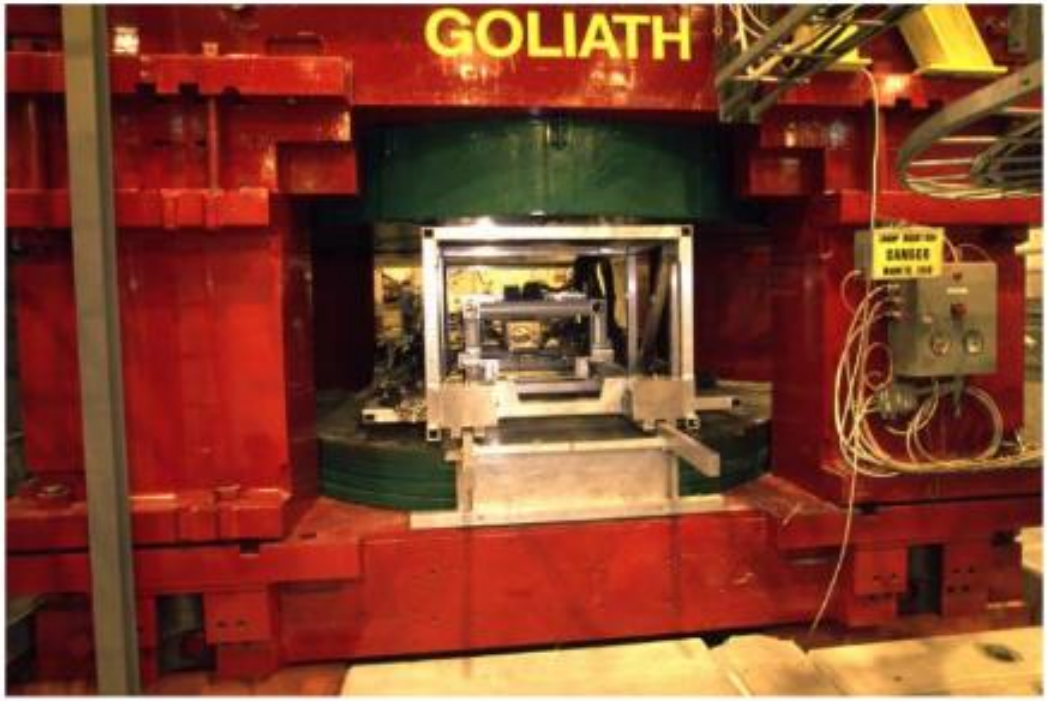
- **Maximum intensities** for 10^{12} incident protons at 400 GeV/c:
  - π+, e fluxes similar to H2
  - ~ 10^7 protons at 400 GeV/c
  - ~ 10^7 Pb

The type of particles

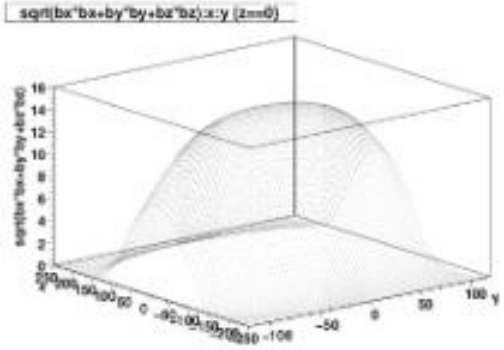
- Electrons from converted gammas
- Hadrons from decay of lambdas and kaons
- Secondary pions and protons
- Muons

Main Parameters	
Pmax:	360 GeV/c (SPS at 400GeV/c) or 400 GeV/c for primary protons
Acceptance	± 1.5 μsr (2.5 μsr at p < 200GeV/c
max Δp/p	± 1.4%
Dispersion at momentum slit (C3)	27 mm / % Δp/p
Intrinsic Δp/p with slit = 0	0.05%
Beam height in EHN1:	2060 mm
Beam lenght	~655 m

http://sba.web.cern.ch/sba/BeamsAndAreas/resultbeam.asp?beamline=H4



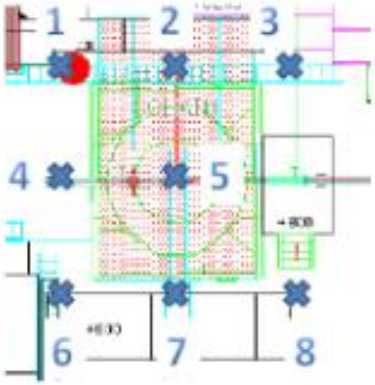
M. Alfonsi (CERN) RD51-WG7 2009-VI 28/04/2009



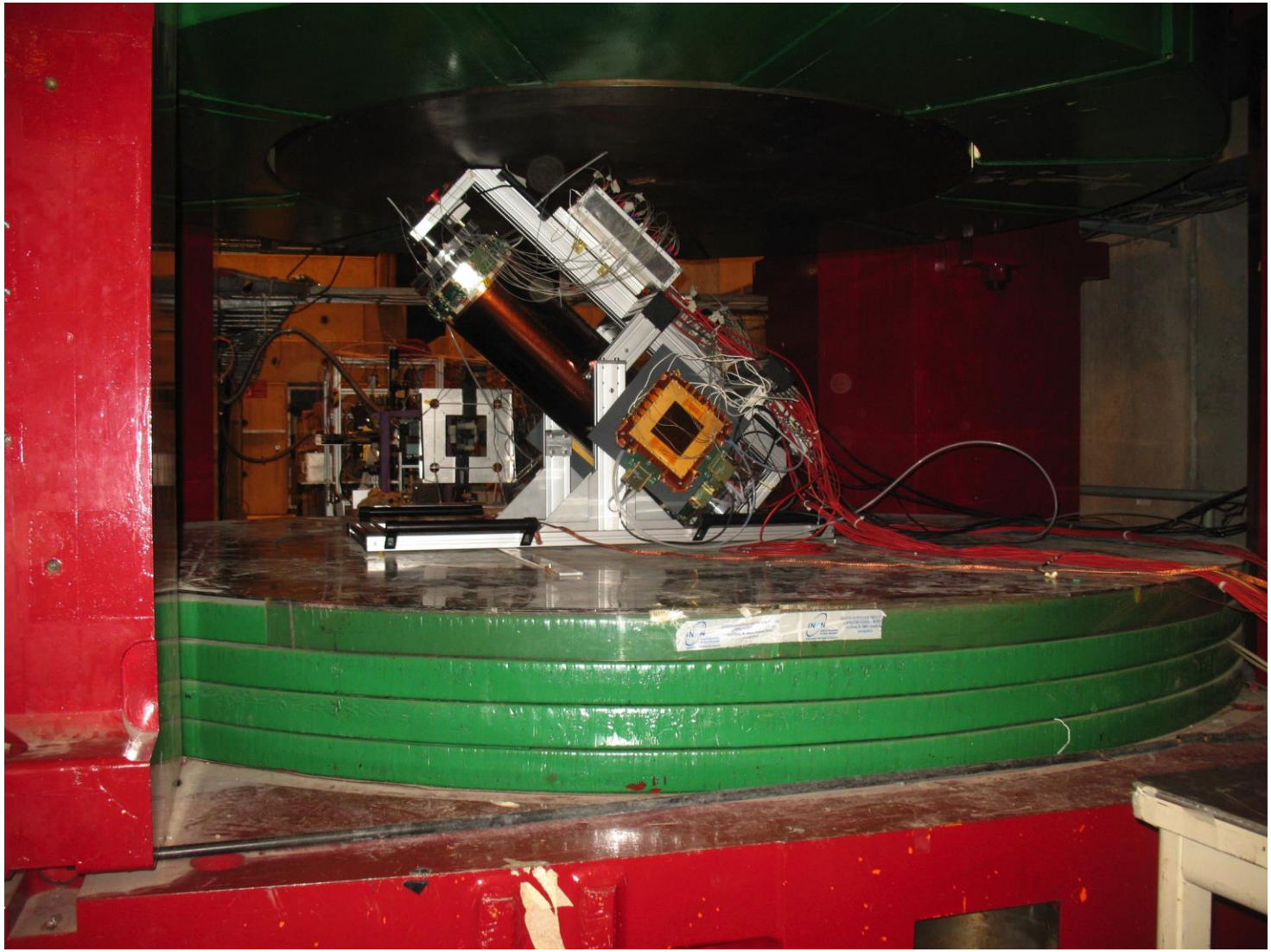
Field map realized during NA57 experiment, file decoded by Frascati group

Power: about 2MW
Maximum field: 1.4T
Gap volume: around 8 m^3

http://ab-div-po-mpc.web.cern.ch/ab-div-po-mpc/Pages/SPS_EA/Spectro/Goliath/Goliath.htm

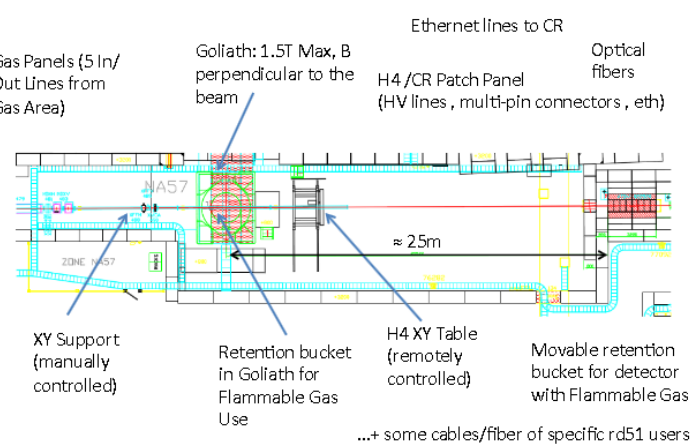


Point	Half Current	Maximum Current
1	0.0005 T	0.007 T
2	0.0004 T	0.010 T
3	0.0005 T	0.007 T
4	0.005 T	0.011 T
5	0.868 T	1.518 T
6	0.0003 T	0.006 T
7	0.0009 T	0.009 T
8	0.0004 T	0.008 T



RD51 Common Infrastructures and services

H4-Common Test Beam Facility



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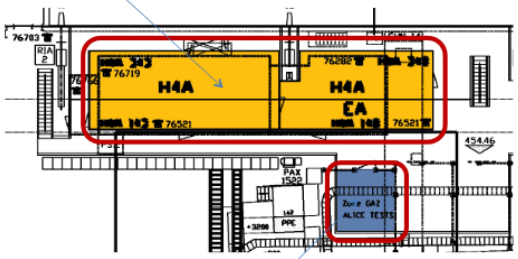
CR & Gas Zone-Common Test Beam Facility

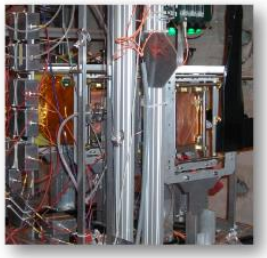
Control/Counting room

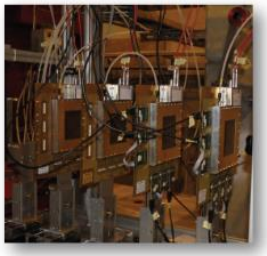


Gas Zone:
Distribution Panels to/from experimental area.
Possibility to have flammable gases.

Rd51 trackers

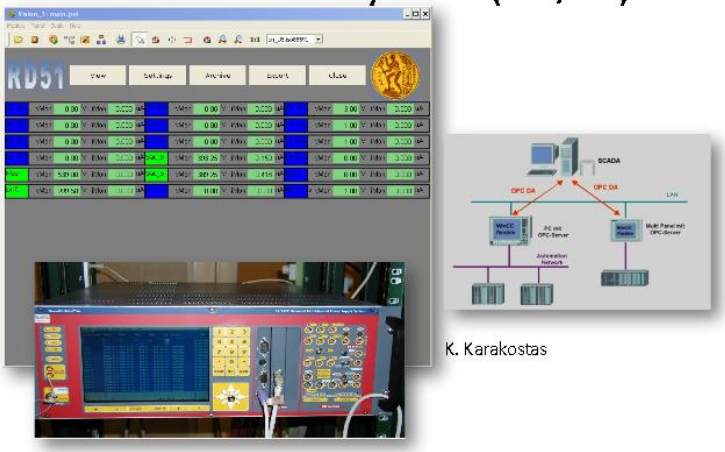
- Triple GEM Tracker
  - XY strips readout, 400um pitch
  - 10x10 cm^2
  - APV (VFAT2)
  - DAQ&FE: SRS/APV (TURBO/VFAT)
- Resistive µmegas tracker
  - XY strips readout, 250um pitch
  - 9x9 cm^2
  - APV
  - DAQ&FE: SRS/APV





06/02/2014 13th RD51 Collaboration Meeting, CERN 9

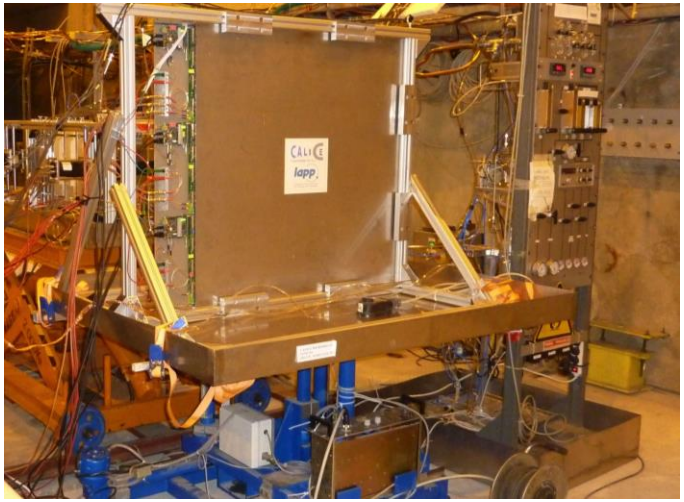
Slow Control System (HV/LV)

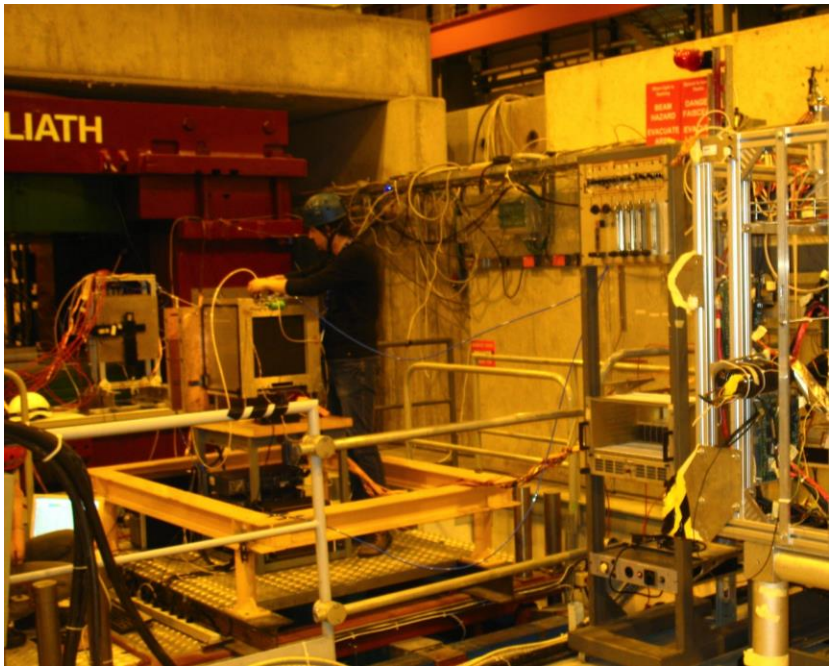


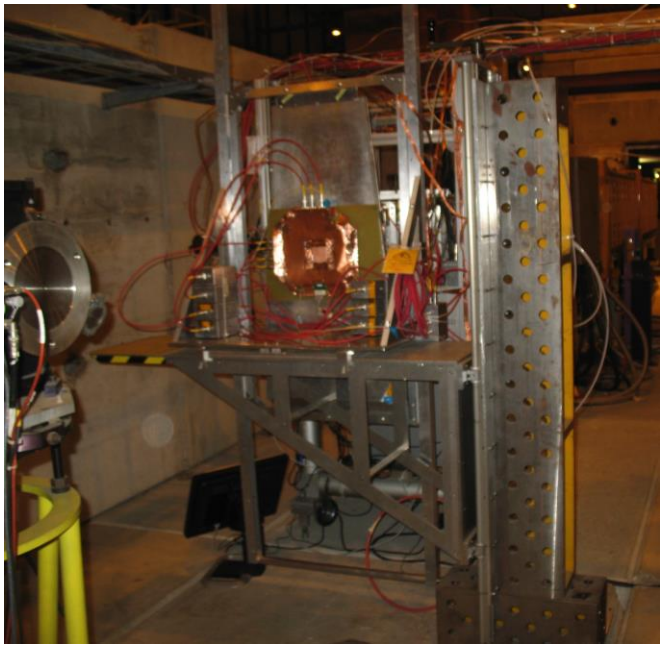
K. Karakostas

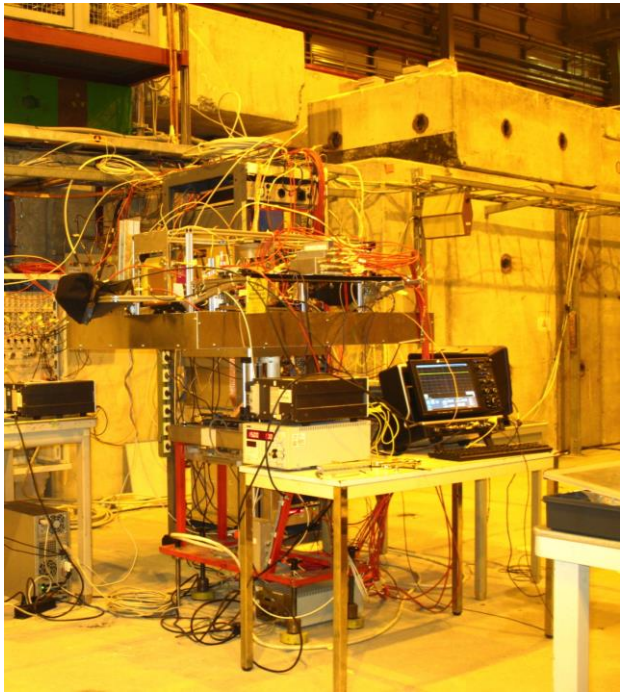
06/02/2014 13th RD51 Collaboration Meeting, CERN 10

Moving tables & supports







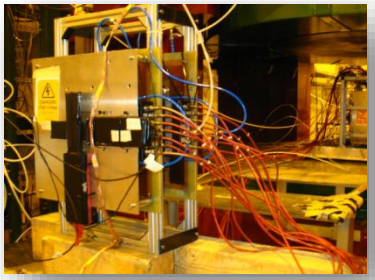


2016 Summary

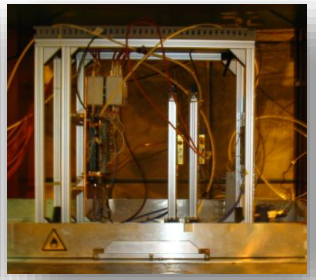
2016 Test Beam

June

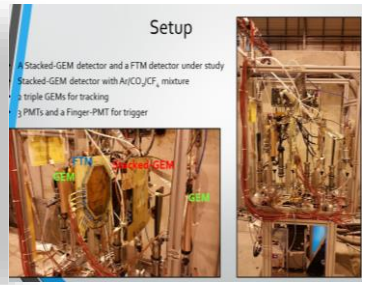
BESIII (Cylindrical GEM)



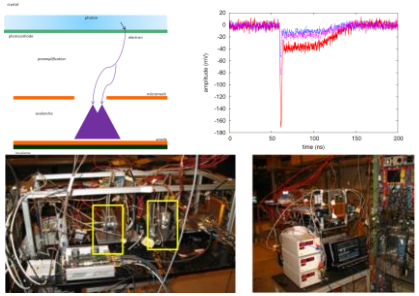
µRWell



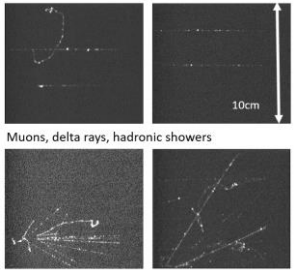
CMS GEM&FTM



PICOSEC

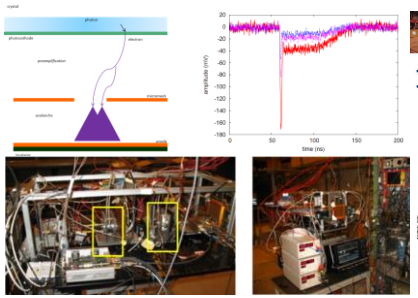


Optical readout (GEM)

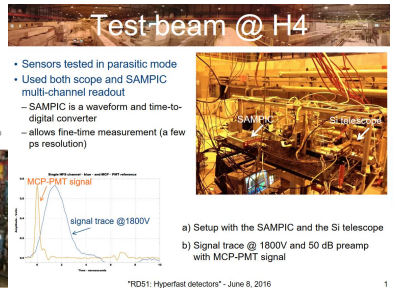


August

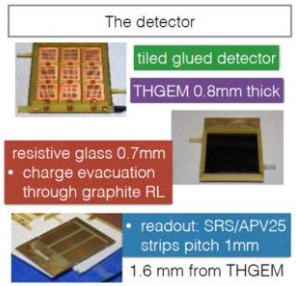
PICOSEC



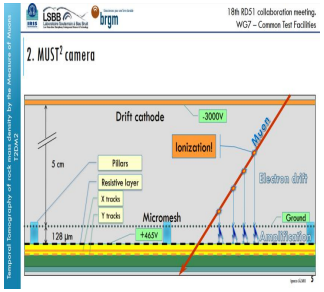
Hyperfast Silicon



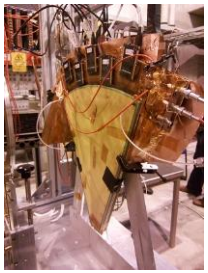
RPWELL



MUST²

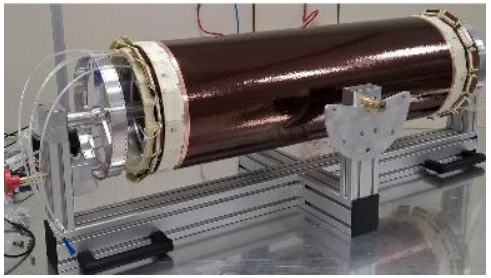


R-PHI mm (srEDM)

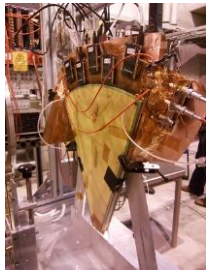


October

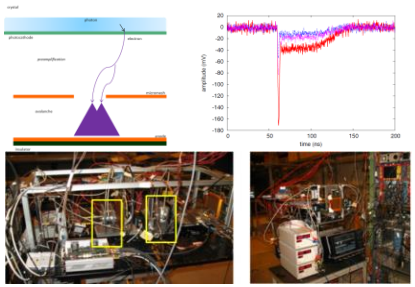
BESIII (Cylindrical GEM)



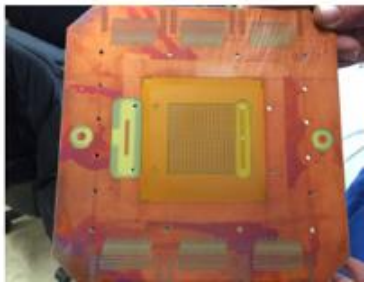
R-PHI mm (srEDM)



PICOSEC



Small Pads ResMM



SHIP Emulsion and MM

https://indico.cern.ch/event/532518/contributions/2184447/attachments/1287085/1915054/Micro-RWELL-status-report-RD51-June-2016.pdf
https://indico.cern.ch/event/532518/contributions/2195704/attachments/1287232/1915330/RD51MiniWeek_June.pdf
https://indico.cern.ch/event/525268/contributions/2298965/attachments/1335651/2008896/aveiroSeb.pdf
https://indico.cern.ch/event/525268/contributions/2297868/attachments/1336635/2010819/testBeam.pdf
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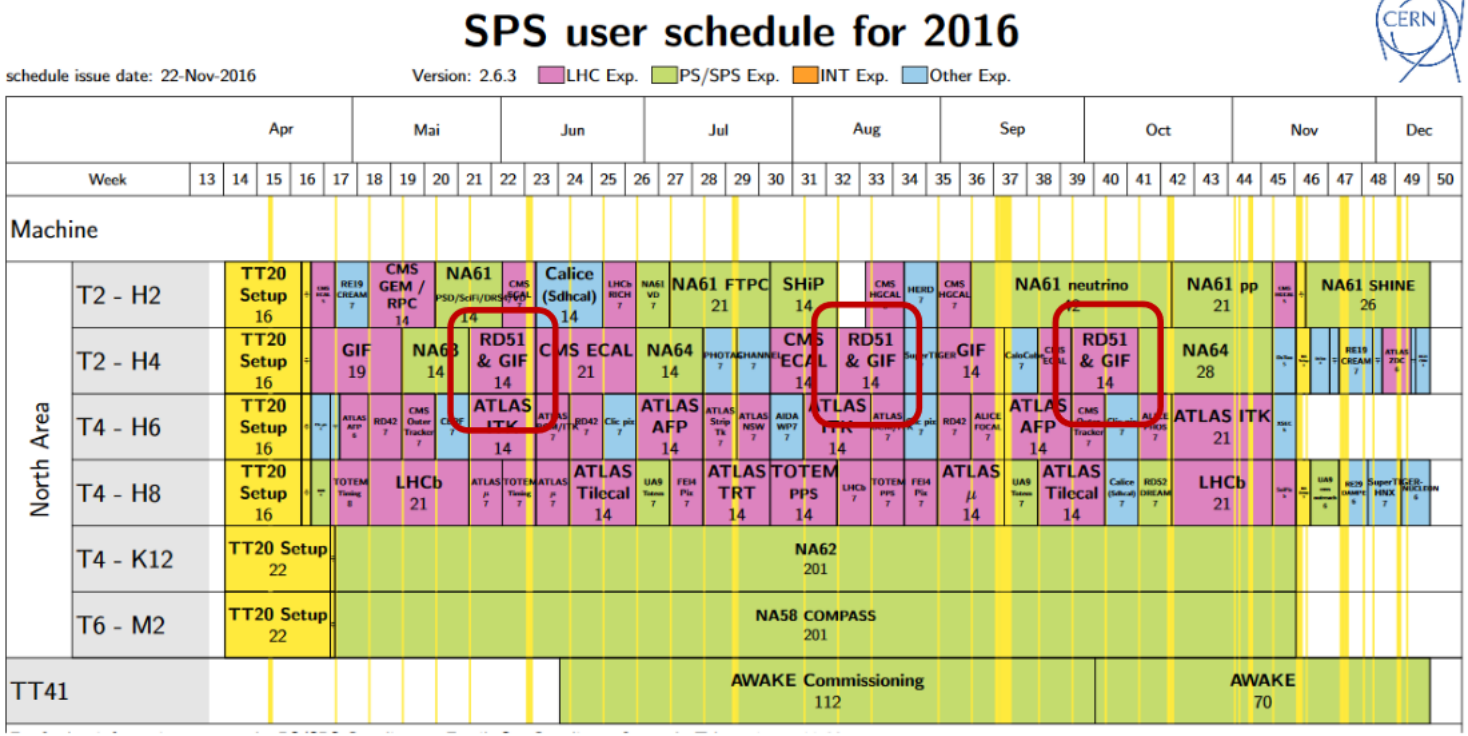
https://indico.cern.ch/event/532518/contributions/2195695/attachments/1287120/1915160/Brunbauer-MiniWeekJune2016-OpticalReadoutTestbeam.pdf
https://indico.cern.ch/event/525268/contributions/2297865/attachments/1335481/2010657/Test_beam.pdf
https://indico.cern.ch/event/532518/contributions/2195708/attachments/1287370/1915545/20160608.RD51_WG7.pdf
http://indico.cern.ch/event/588409/contributions/2379812/attachments/1387526/2112329/PadMM_RD51_131216.pdf

More deeply in 2016 test beam campaign



Three periods of two weeks each, 4 user/periods in average & GIF++

- Test on beam and characterization of final (or almost) detectors (and services) ready for experiment

(Almost) Final Detector

- Consolidated and standard MPGD technologies: R&D for short term applications in experiments/application

"Consolidated" MPGD

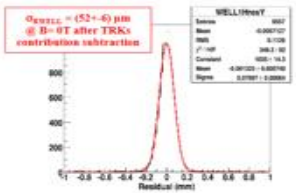
- Novel MPGD based solution: R&D for long term applications in experiments/application

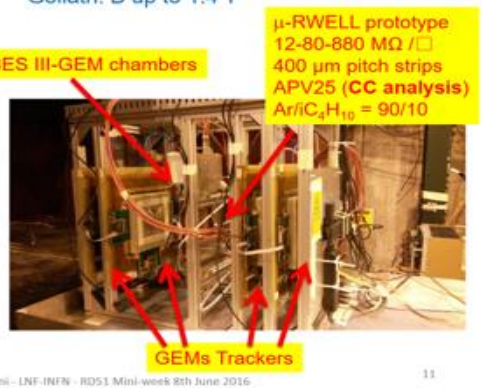
Novel Structures

Novel Structures

μ-RWELL performance: Beam Tests

H4 Beam Area (RD51)
Muon beam momentum: 150 GeV/c
Goliath: B up to 1.4 T

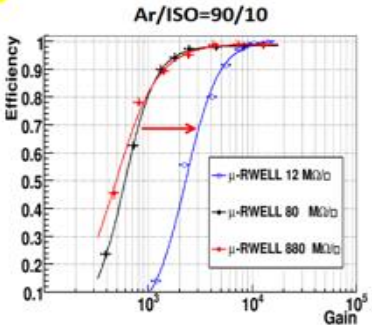


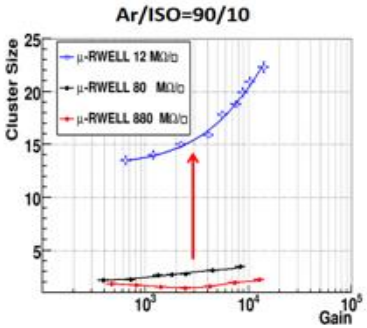


G. Bencivenni - LNF-INFN - RD51 Mini-week 8th June 2016 11

CC analysis

μ-RWELL: tracking efficiency





At **low resistivity the spread of the charge** (cluster size) on the readout strips **increases**, thus requiring a **higher gain** to reach the **full detector efficiency.**

https://indico.cern.ch/event/532518/contributions/2184447/attachments/1287085/1915054/Micro-RWELL-status-report-RD51-June-2016.pdf

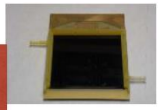
Novel Structures

Pos resolution test-beam study in RPWELL

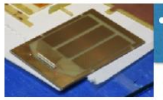
The detector

tiled glued detector

THGEM 0.8mm thick



resistive glass 0.7mm
- charge evacuation through graphite RL

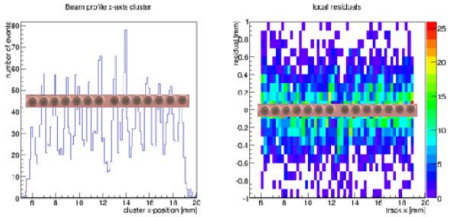


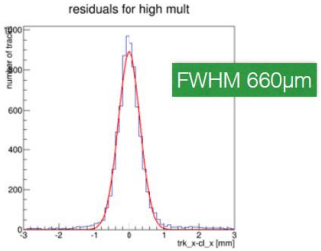
- readout: SRS/APV25 strips pitch 1mm

1.6 mm from THGEM

- gas: Ne/(5%CH_4)
- ΔV_{RPWELL} max 975V
- 50 Hz muons

Results



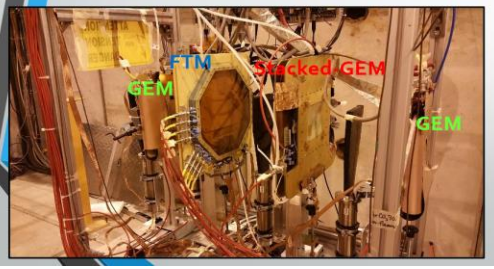


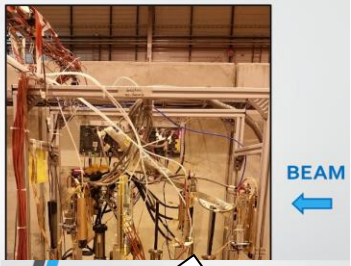
RD51 mini week - 14.12.16 - Weizmann Institute of Science

"Consolidated" MPGD

Setup

- Stacked-GEM detector and a FTM detector under study
- Stacked-GEM detector with Ar/CO_2/CF_4 mixture
- 2 triple GEMs for tracking
- 3 PMTs and a Finger-PMT for trigger

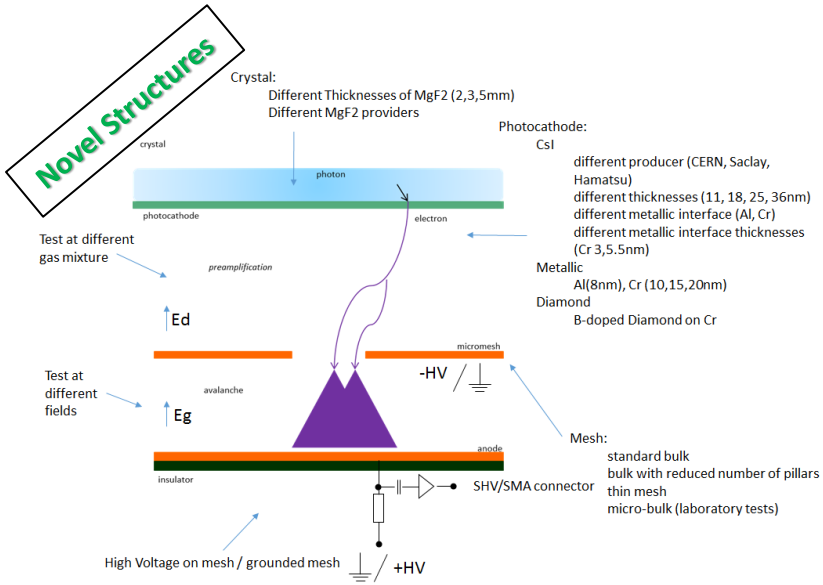




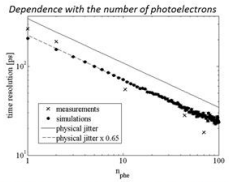
Novel Structures

GEM H4 Test Beam

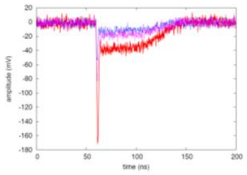
https://indico.cern.ch/event/532518/contributions/2195704/attachments/1287232/1915330/RD51MiniWeek_June.pdf



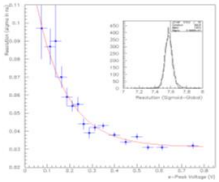
Current status of measurements, developments and tools of the Picosec Collaboration



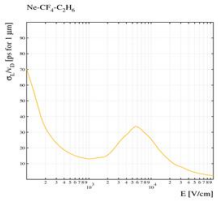
Photoelectron response (laser)

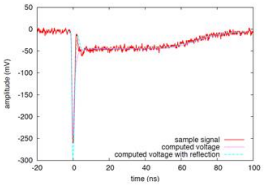


(Clean) MIPs Response (test beam)



Robust data analysis





Simulation (and prediction) of Induced Signal

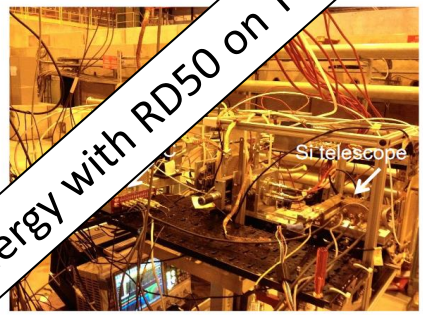
https://indico.cern.ch/event/525268/contributions/2298965/attachments/1335651/2008896/aveiroSeb.pdf
https://indico.cern.ch/event/525268/contributions/2297868/attachments/1336635/2010819/testBeam.pdf
https://indico.cern.ch/event/532518/contributions/2195706/attachments/1287366/1915899/PicosecondeTestBeam.pdf

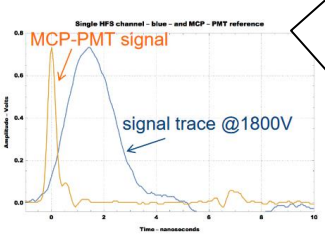
Test-beam @ H4

Novel Structures

Sinergy with RD50 on TIMING!

- ensors tested in parasitic mode
- Used both scope and SAMPIC multi-channel readout
  - SAMPIC is a waveform and time-to-digital converter
  - allows fine-time measurement (a few ps resolution)





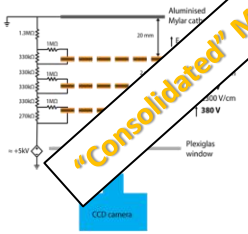
a) Setup with the SAMPIC and the Si telescope

b) Signal trace @ 1800V and 50 dB preamp with MCP-PMT signal

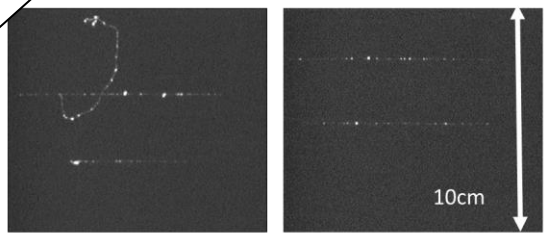
"RD51: Hyperfast detectors" - June 8, 2016 1

Optically read out GEM

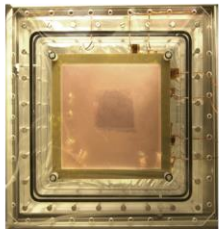
"Consolidated" MPGD

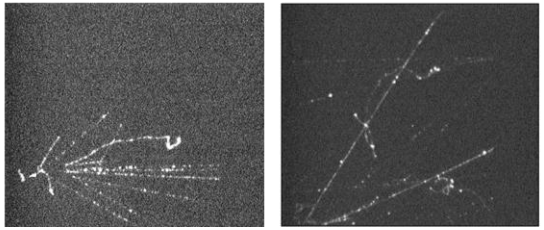


GEM read out by CCD

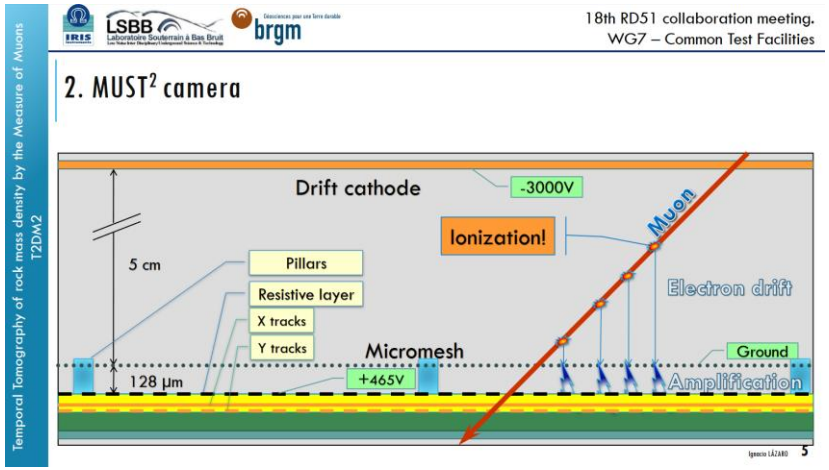


Muons, delta rays, hadronic showers





https://indico.cern.ch/event/532518/contributions/2195695/attachments/1287120/1915160/Brunbauer-MiniWeekJune2016-OpticalReadoutTestbeam.pdf



https://indico.cern.ch/event/525268/contributions/2297865/attachments/1335481/2010657/Test_beam.pdf

Geoscience

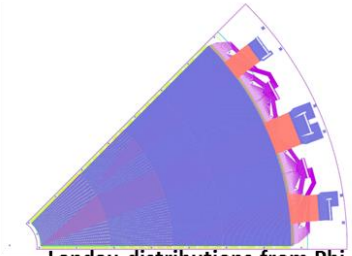
Demokritos
National Centre for Scientific Research

ARISTOTLE UNIVERSITY
OF THESSALONIKI

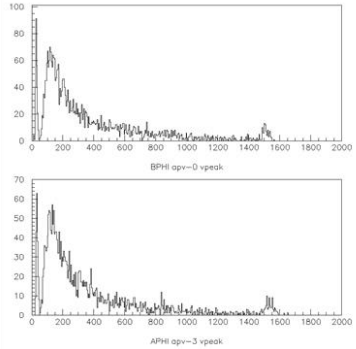
Tests of Micromegas octant prototypes towards a TPC Polarimeter for srEDM

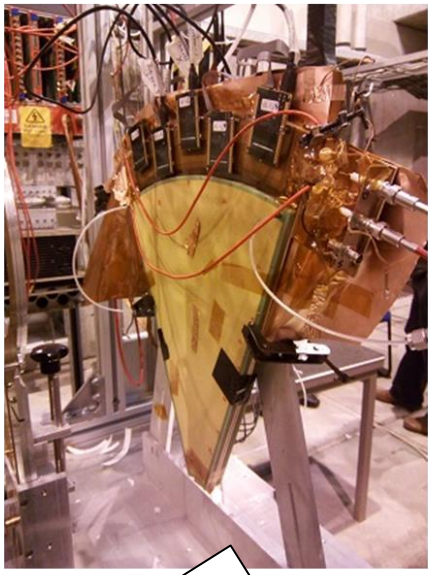
George Fanourakis (N.C.S.R. "Demokritos"), Spyros Tzamarias, Ioannis Xiotidis (Aristotle University of Thessaloniki)

Two Bulk Micromegas (resistive) prototype octants with r-phi strip structure have been constructed in the electronics lab of CERN (Rui).



Landau distributions from Phi strips



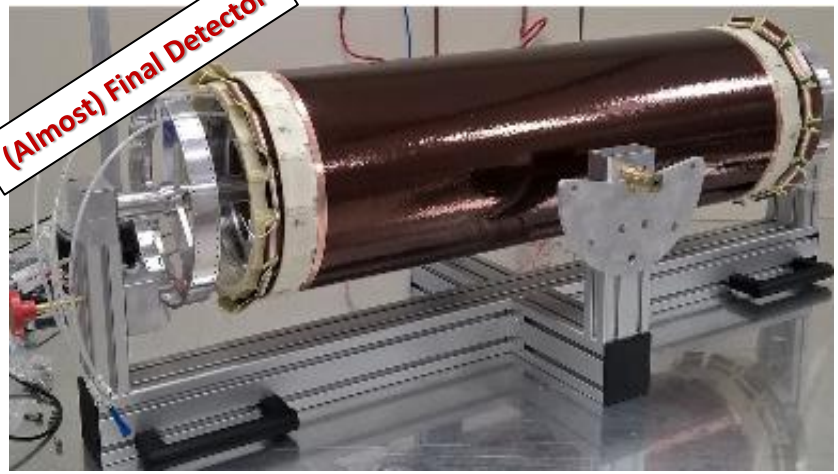


"Consolidated" MPGD

BESIII Project in RD51

(INFN Ferrara, Frascati, Torino)

(Almost) Final Detector



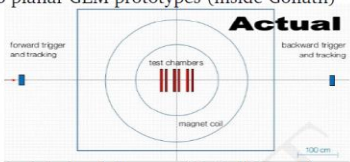
BESIII Activities at H4

(INFN Ferrara, Frascati, Torino)

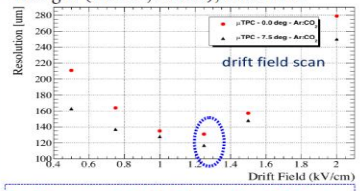
Develop a Cylindrical GEM with analog and time readout as new Inner Tracker for BESIII combining charge centroid and µTPC readout

May-June 2016

6 planar GEM prototypes (inside Goliath)



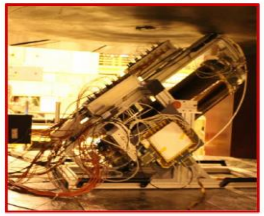
Exploit the full potential of uTPC readout wrt: gas (ArCO2, ArISO), Drift field



In 1 T magnetic field σ_x lower than 120 µm

October 2016

First test of the cylindrical prototype



Compare the performances of the CGEM with respect planar GEM

First preliminary results, with no magnetic field, shows behaviour is similar between GEM and CGEM

Spatial resolution ~ 130 µm

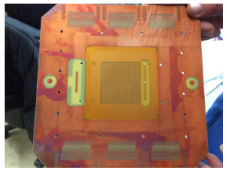
https://indico.cern.ch/event/532518/contributions/2195708/attachments/1287370/1915545/20160608.RD51_WG7.pdf

Small-Pads Resistive MM Test beam @ SPS H4

Novel Structures

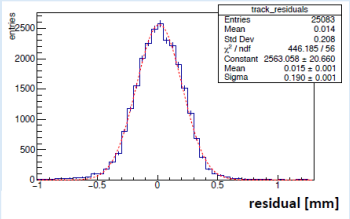
Test Setup:

- Small-pads (1x3 mm²) MM with Ar/CO2 93/7
- Double readout (xy) small size bulk micromegas as reference + 2 trigger scintillators
- DAQ: SRS+APV25



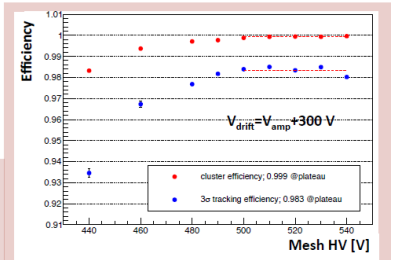
Data taken with high energy muons/pions beam to study:

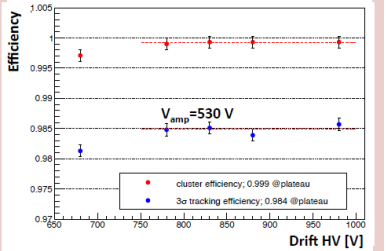
- Efficiency Vs HV;
- Spatial resolution;
- Inclined tracks
- Low/high intensity beam → rate capability
- Only results with perpendicular muons are reported.



Precision coordinate residuals distribution: difference btw the position measured from Pad-mm positionn and the reference track. → $\sigma_x \approx 190$ µm

Cluster and tracking efficiency vs drift and amplification voltage.





http://indico.cern.ch/event/588409/contributions/2379812/attachments/1387526/2112329/PadMM_RD51_131216.pdf

Semi permanent installation EHN1-H4 (SPS North Area) – RD51 Support to the collaborators

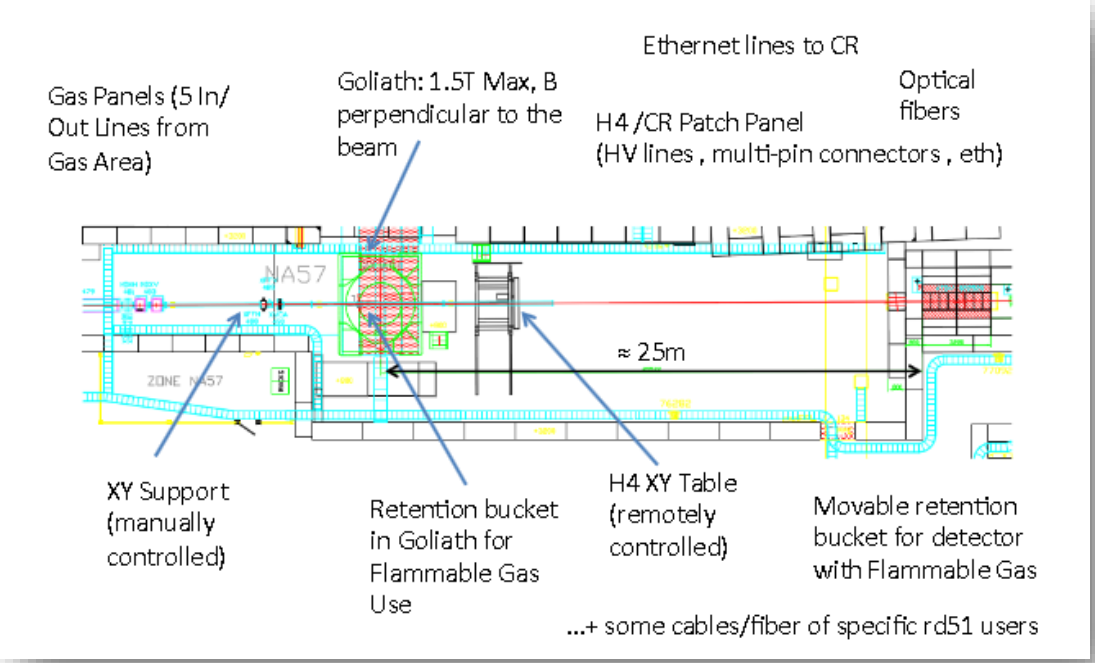
Interface with the SPS coordinator

Infrastructures (gas, HV, LV, sensors,…)

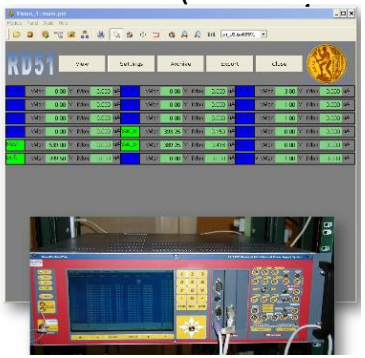
Internal (beam sharing between groups) and ***external*** (GIF++ and with any other parallel user) coordination

Typical Shift Scheme

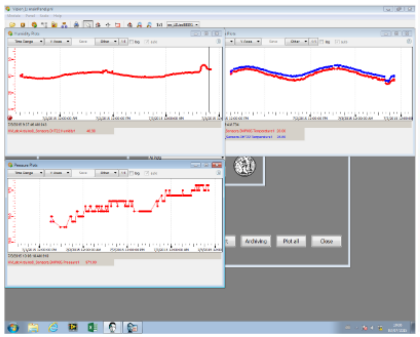
	MAIN	Parasitic1	Parasitic2
Shift1	ALICE TPC	WIS/Aveiro/Coimbra	LNF
Shift2	ATLAS NSW	ALICE TPC	WIS/Aveiro/Coimbra
Shift3	CMS GEM	ATLAS NSW	ALICE TPC
Shift4	LAPP/UA/NCSR/IRFU	CMS GEM	ATLAS NSW
Shift5	LNF	LAPP/UA/NCSR/IRFU	CMS GEM
Shift6	WIS/Aveiro/Coimbra	LNF	LAPP/UA/NCSR/IRFU
Shift7	ALICE TPC	WIS/Aveiro/Coimbra	LNF
…			



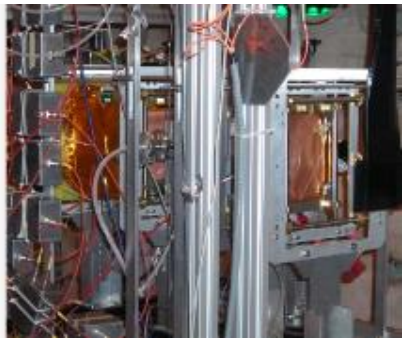
RD51 DCS (Control and monitoring)



Environmnetal plots during Test Beam



RD51 Trackers and SRS/APV25 DAQ

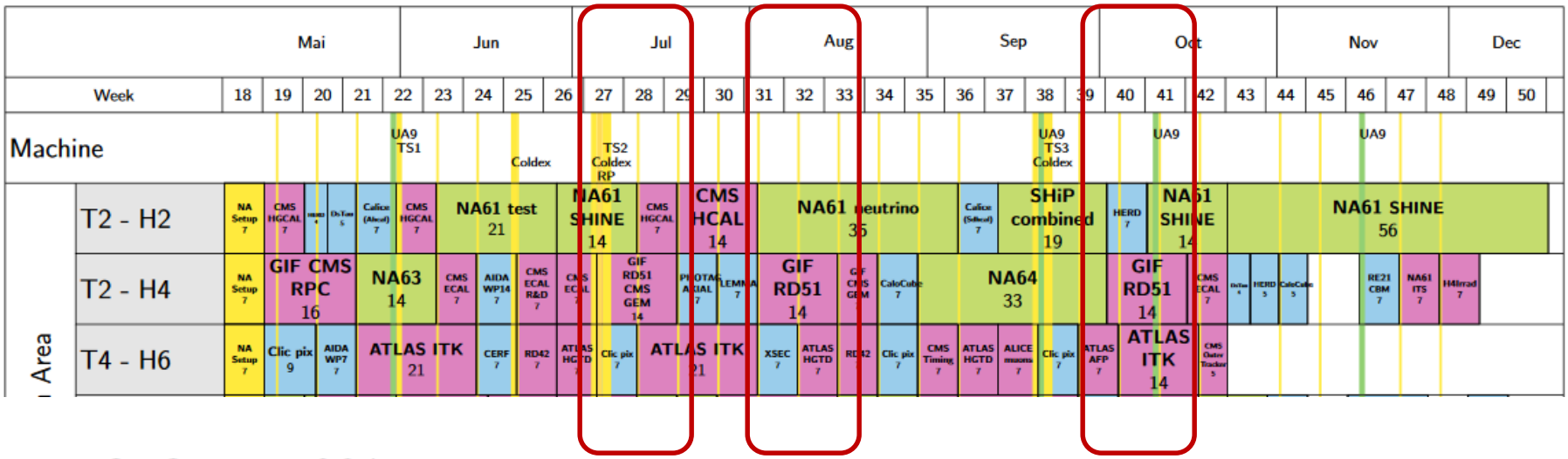


Mechanical support (Miranda)

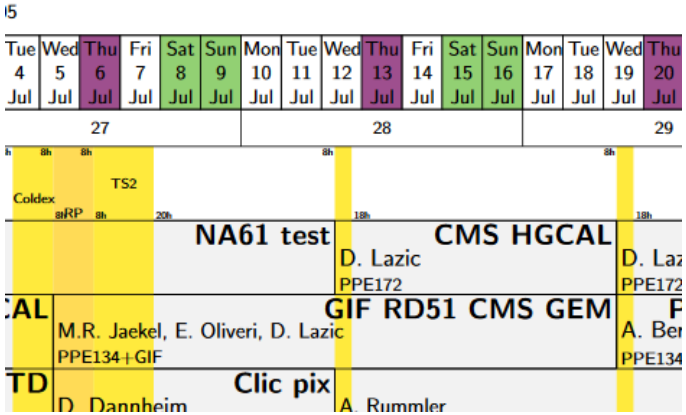
2017

SPS user schedule for 2017

schedule issue date: 24-Apr-2017 Version: 1.03 LHC Exp. PS/SPS Exp. INT Exp. Other Exp.



SPS: July 2017

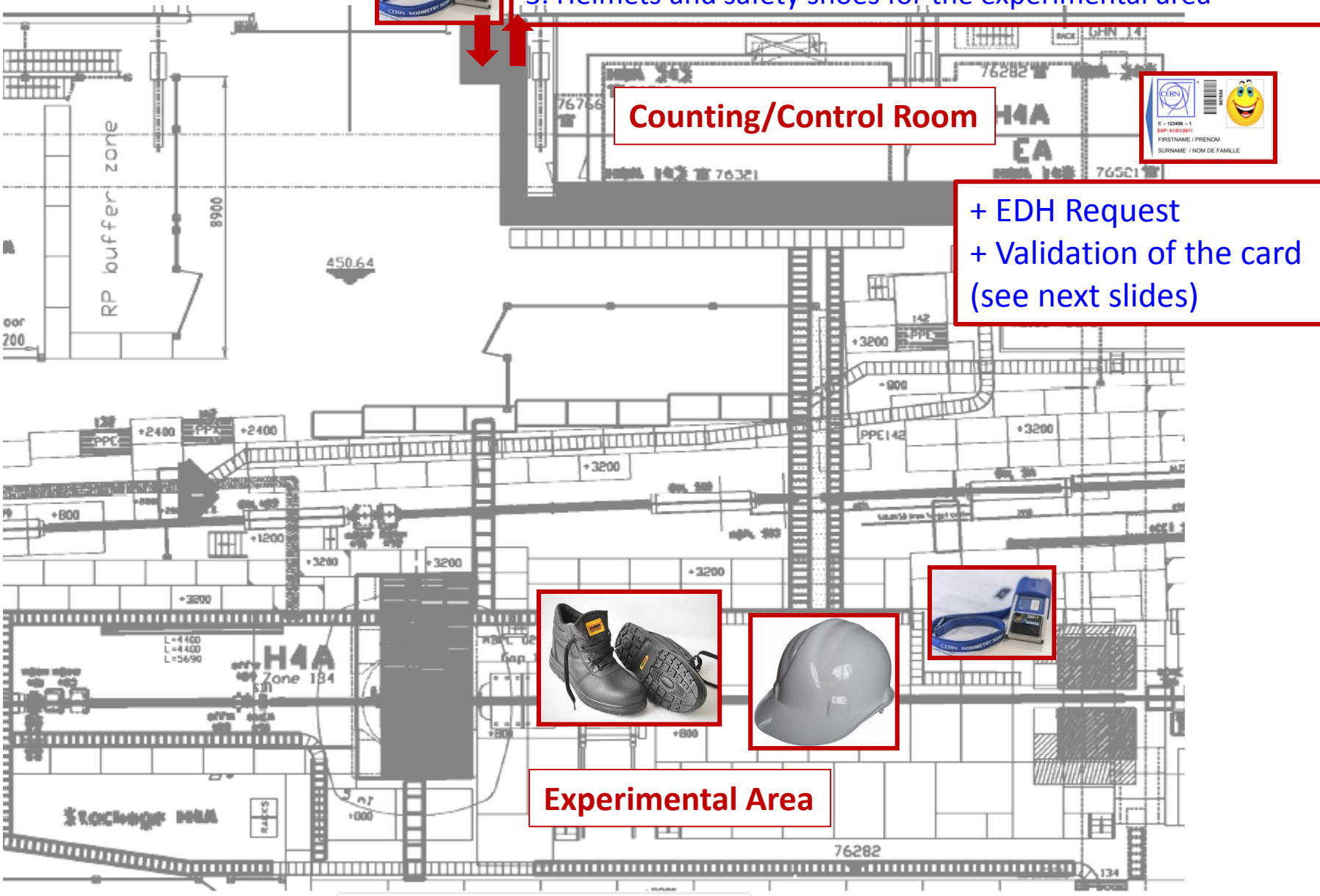


July 2017 – Confirmed setup

- bes3
- minipad
- μRWELL
- picosec

What you need to access the Test Beam

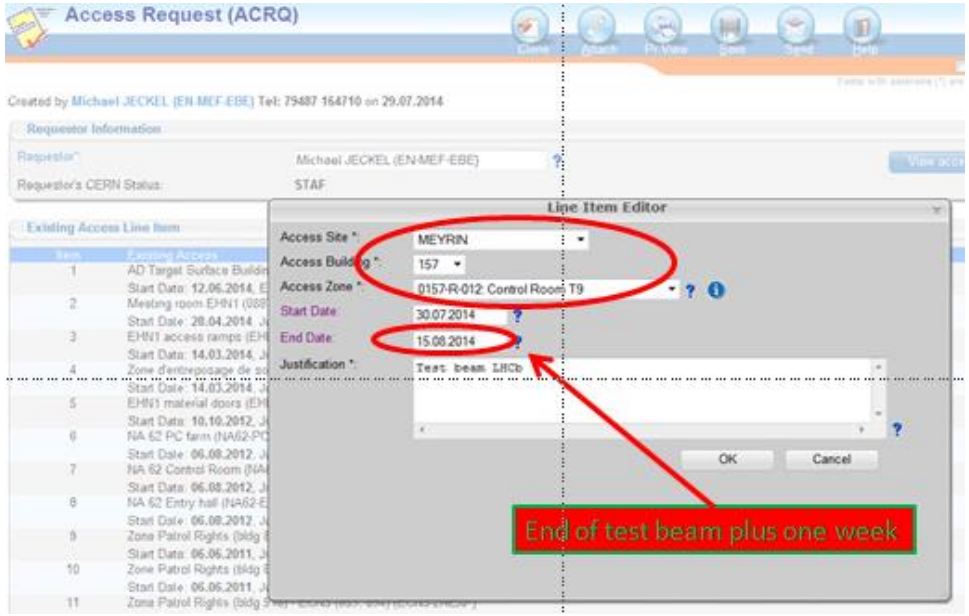
1. Valid CERN Dosimeter
2. CERN Badge + Validated Access to Counting/Control Room
3. Helmets and safety shoes for the experimental area

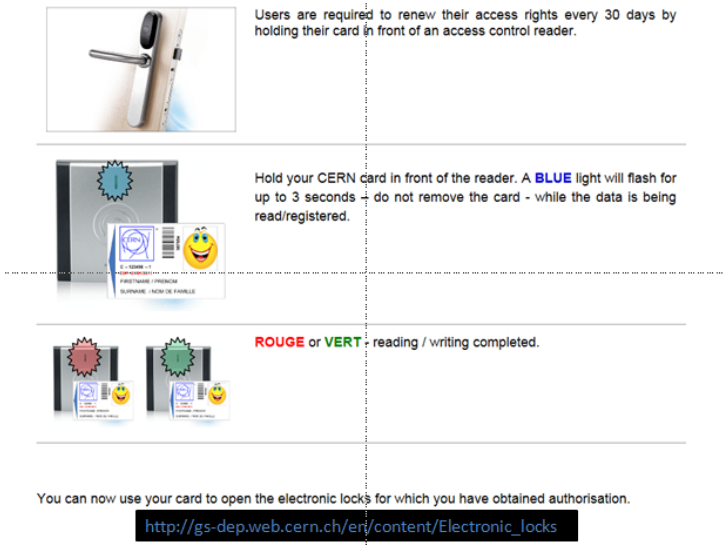


+ EDH Request
+ Validation of the card
(see next slides)

ACCESS TO THE CONTROL/COUNTING ROOM: To Be requested VIA EDH by each user

https://edms.cern.ch/document/1421828/1





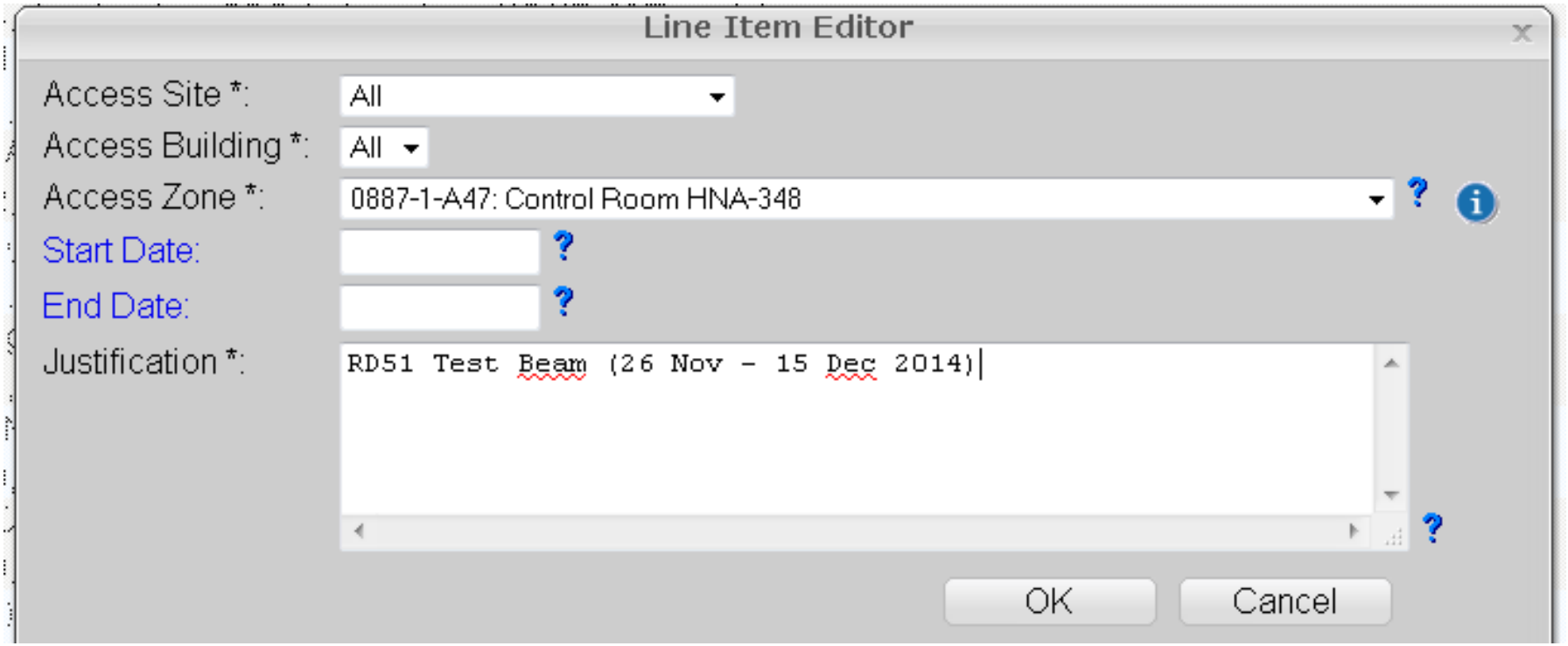
Online Reader to validate your access in: R1, R2, R3, EHN1

Ref. To previous link for more info

See next slide for the references to our Counting/Control Room

Our Counting/Control Room

SBA zone	Room number	User	Terminal	Phone	Barrack	Building / Office	Host Name
H4-134	887/R-K47	H4A	H4A	76282	HNA-348	887/1-A47	cwo-hna348-h4a



End Date: 1 week more suggested

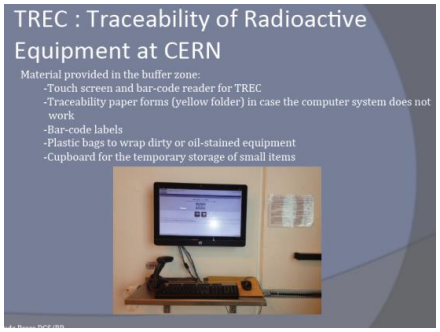
Material leaving the experimental area… just to keep in mind

any export of material from the CERN Experimental Area halls/buildings 157 (East Area), 193 (AD), 887 (EHN1), 888 (EHN2), 911 (ECN3) to an external destination must be:

registered in EDH using the Shipping Request form https://edh.cern.ch/Document/SHIP.

EDH Shipping Requests issued from the above mentioned areas (also for material declared as non-radioactive by the owner) are automatically forwarded to the relevant Radiation Protection Officer that will proceed with the compulsory radiological control before authorizing the transport.

Please note that this procedure also applies to material/goods belonging to external institutes as well as if the material is transported afterwards by the owner itself (e.g. CERN transport services not required in the EDH form).



We will take care of this but keep in mind that you cannot simply leave the area with your equipments without having RP check

New procedure, i.e. possible delay

https://sps-schedule.web.cern.ch/sps-schedule/RadioProtectionDocuments/BufferzoneEHN1-english.pdf