IDEA Test Beam
GEM e micro-RWELL

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OUTLINE

- A **list of the variables of interest** in the Tree is available online as an attachment in the twiki:
  https://twiki.cern.ch/twiki/bin/view/DREAM/DreamTBSeptember2018
  GEM – Variables of interest.pdf

- Some information about our **HARDWARE and ELECTRONICS**

- A little update about the **ALIGNMENT**

Variables of interest

GemCluster Information from clusters, which unify groups of hits	
nGemCluster	
GemCluster1d_nCluster	
GemCluster1d_plane	0, 1, 2, 3, 4 = GEM1, GEM2, GEM3, μ-RWELL1, μ-RWELL2
GemCluster1d_view	0, 1, 2, 3 = X, Y, ϕ, V
GemCluster1d_q	Charge associated to a cluster
GemCluster1d_x_cc	x-position from the centroid of the charge (we can also obtain y-position from this variable specifying the view)
GemCluster1d_nHit	Number of hits per cluster
GemCluster1d_HitIndex	Indexes of different hits which form the cluster
Res_1d	Cluster residue with respect to their tracking
Res_1d_collection	All cluster residue
h_ID_1d [plane][view]	Clusters of strips are array. This variable is the index in the array which identifies a "good cluster" for a certain plane and view. A "good cluster" is identified as the cluster with the highest charge.
h_ID_1d_collection	Index of clusters for a certain plane and view: *[*plane*][*view*]**[*0,1,2,--,
h_N_1d [plane][view]	N_1d[plane][view] *]*
h_isFire_1d [plane][view]	Number of clusters in function of plane and view Bool variable which is 1 if there is at least one hit in that plane and view.

GemHit Information from all strips separately	
nGemHit	
GemHit_nHit	
GemHit_apv	We had 10 installed APV (configuration 0 to 9)
GemHit_plane	0, 1, 2, 3, 4 = GEM1, GEM2, GEM3, μ-RWELL1, μ-RWELL2
GemHit_view	0, 1, 2, 3 = X, Y, ϕ, V
GemHit_strip	Number of strips (GEM: 128 strips; μ-RWELL: 256 strips)
GemHit_q	Charge associated to a single strip
GemHit_x	x-position (we can also obtain y-position from this variable)
GemHit_z_tpc	z-coordinate inside the drift gap
GemHit_tFD	Time read on the strip

The idea now is to introduce in the code **bi-dimensional clusters**,
taking a good cluster in X and the other one in Y to obtain a XY object.

Hardware

- **PRESHOWER**

  Two triple GEM chambers 10x10 cm^2
  128 strips
  Strip pitch: 800 µm
  HV setting: 1000/425/600/420/600/415/1000

- **MUON SYSTEM**

  One triple GEM chamber 10x10 cm^2
  128 strips
  Strip pitch: 800 µm
  HV setting: 1000/420/600/415/600/410/1000

  Two µ-RWELL chambers 10x10 cm^2
  256 strips
  Strip pitch: 400 µm
  HV setting: 2400/590

GAS mixture:
$Ar/CO_2/CF_4$ (45/15/40)

Hardware - References

μ-RWELL

- The micro-Resistive WELL detector: a compact spark-protected single amplification-stage MPGD
G. Bencivenni, R. De Oliveira, G. Morelloa and M. Poli Lener, 2015 JINST 10 P02008

- The μ-RWELL detector
G. Bencivenni et al., JINST 12 (2017) no.06, C06027, doi:10.1088/1748-0221/12/06/C06027

- Advances on micro-RWELL gaseous detector
G. Morello et al., PoS BORMIO 2017 (2017) 002, doi:10.22323/1.302.0002

- Performance of μ-RWELL detector vs resistivity of the resistive stage
G. Bencivenni et al., NIM A 886 (2018) 36, doi:10.1016/j.nima.2017.12.037

Most significant and recent measurements

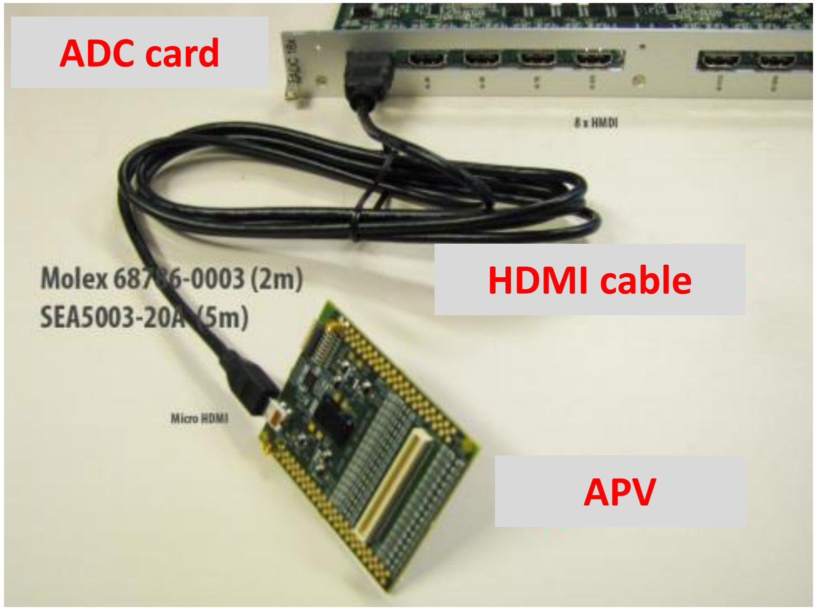
(*) some plots at the end of this presentation

GEM

- F. Sauli, GEM: A new concept for electron amplification in gas detectors,
Nucl. Instrum. Meth. A, 386, 1997; 531, doi:10.1016/S0168-9002(96)01172-2.

Readout

- **Electronics**:
  10 **APV25** front-end chips in the Master-Slave configuration
  (analogue pickup amplifier/shaper box for MPGD's)
  \+ **S**calable **R**eadout **S**ystem



- Micropattern Gas Detectors Technologies and RD51 Collaboration
  https://indico.cern.ch/event/346614/contributions/813300/attachments/683647/939075/BI_Seminar_Ropelewski.pdf

Alignment

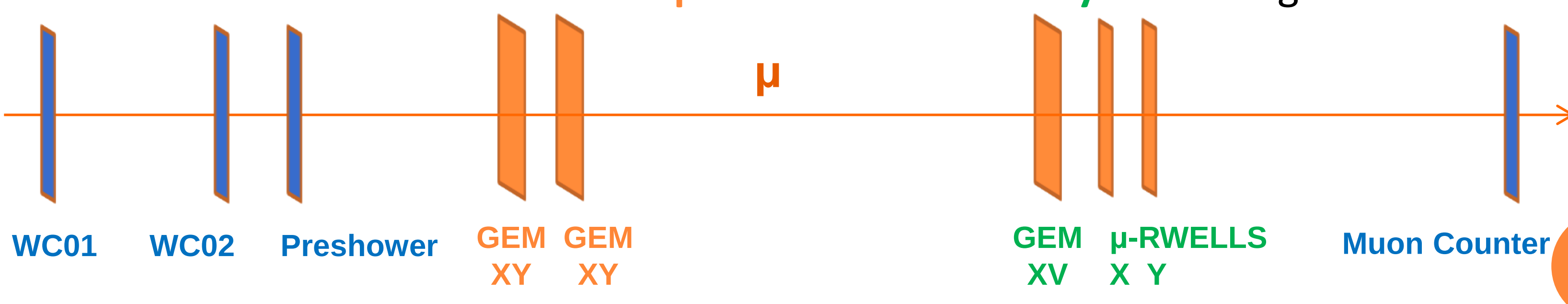
❖ The alignment using our five chambers is already implemented in the software used for the reconstruction (Riccardo is the expert).

The track is obtained from the two GEM of the preshower, which give two points in the XZ plane (X = GEM coordinate; Z = coordinate of the beam):

- we obtain a line;
- the residues are measured for each other chamber from this line;
- the distribution of the residues measures the discrepancy between the mean value and zero;
- this shift is used to align all five chambers.

❖ **TO DO:**

ALIGNMENT between ancillaries + pre-shower + muon system using runs of muons.

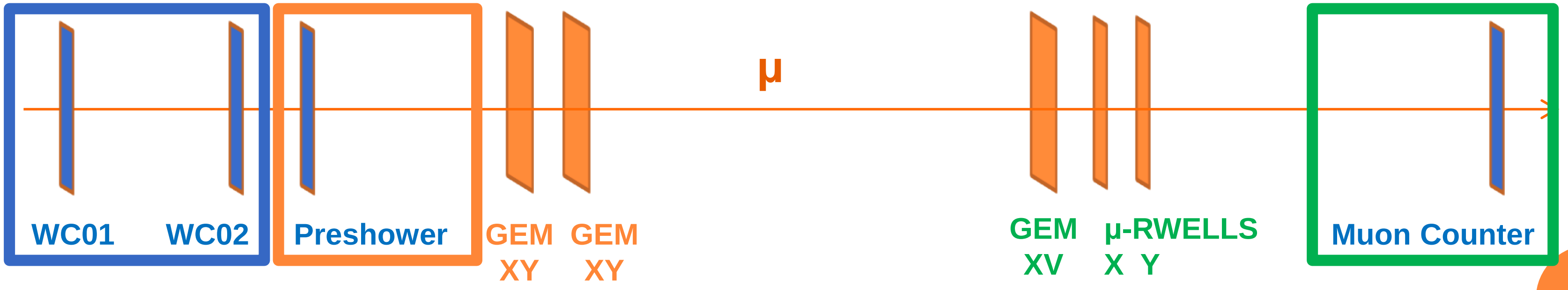


Alignment

❖ The MERGED N-TUPLES are ready for five runs of muons (correlation checked):

Run GEM	Run Calo	Beam	Offset
49	12686	40 GeV	1
51	12688	40 GeV	1
53	12690	40 GeV	2
178	12835	60 GeV	1
179	12836	60 GeV	1

❖ Ancillaries' variables in the merged n-tuples:
xy_profile_DREAM0, xy_profile_DREAM1, adc_preshower, adc_muon.



❖ OTHER INFORMATION from them?

PLANS

1. Alignment with the test beam instrumentation (for the next meeting?)

2. NEXT STEPS:
   - Study of **data quality**: charge distributions, time distributions and percentage of saturated events; efficiency of the preshower; cluster multiplicity per event and hit multiplicity per cluster with pre-shower.

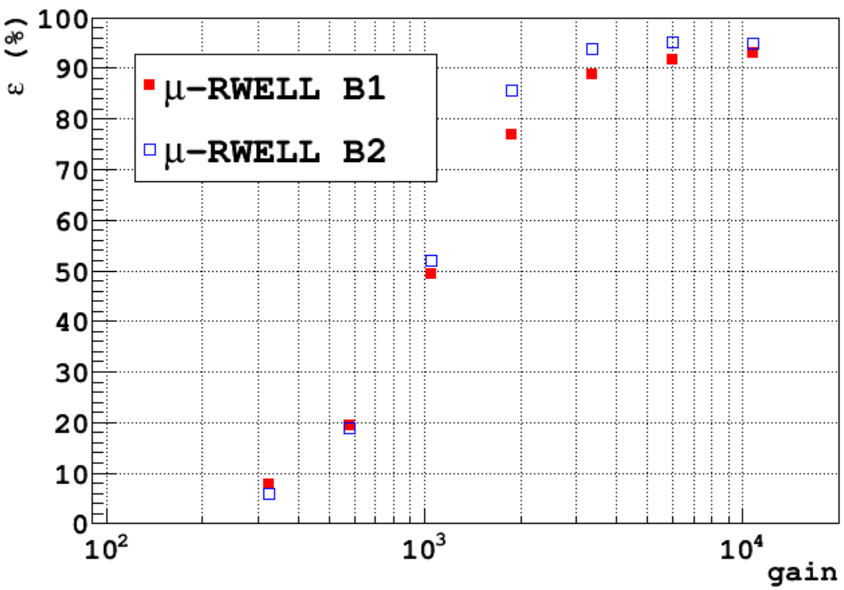
   All this information will give us indications about the feasibility of an efficient identification and reconstruction of multi-tracks events.

SOME USEFUL MATERIAL

about μ-RWELL performances

Tracking efficiency

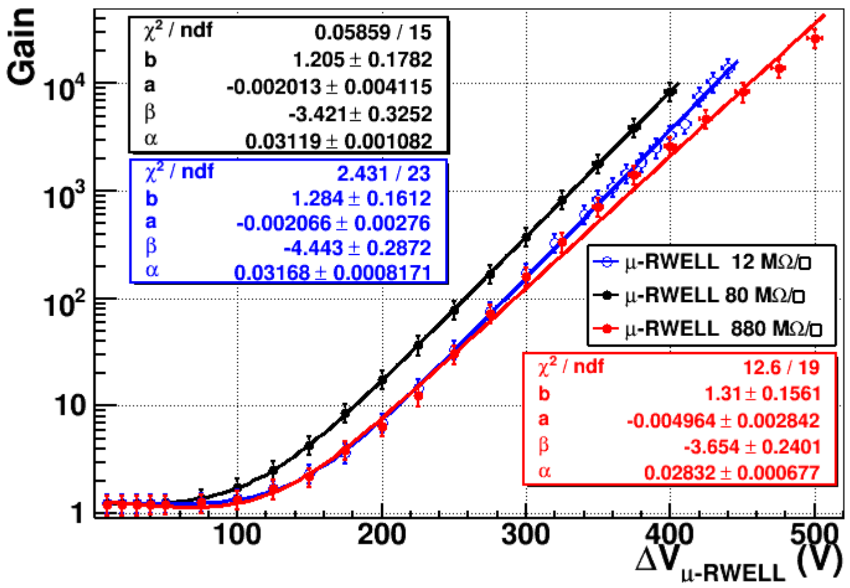
above **97%** at gain of about 3000
measured with VFAT2 FEE



Ar/CO_2/CF_4 (45/15/40)

Gain measurement

Detectors safely reach a gain ≥ **10000**



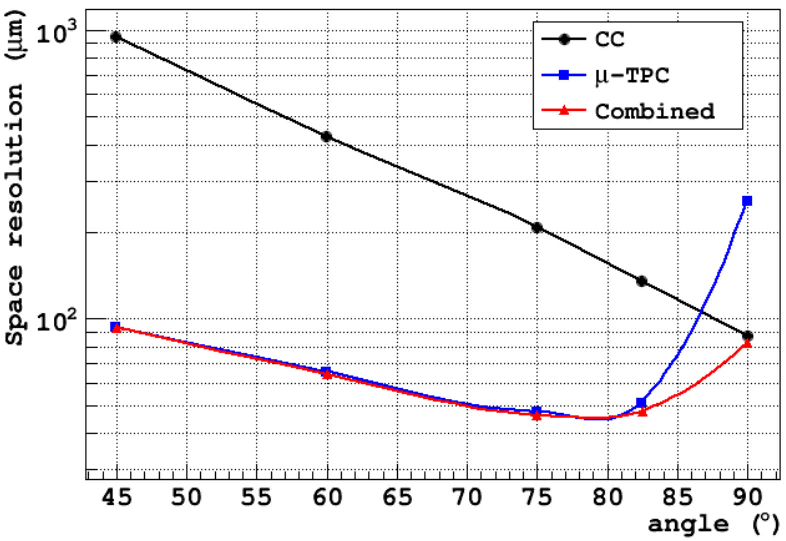
Ar/Iso (90/10)

A poster will be presented at the International Workshop on the High Energy Circular Electron Positron Collider (Pechino) realized by M. Poli Lener, G.Bencivenni, M. Gatta, G. Felici, G.Morello, R. De Oliveira, A. Ochi

SOME USEFUL MATERIAL

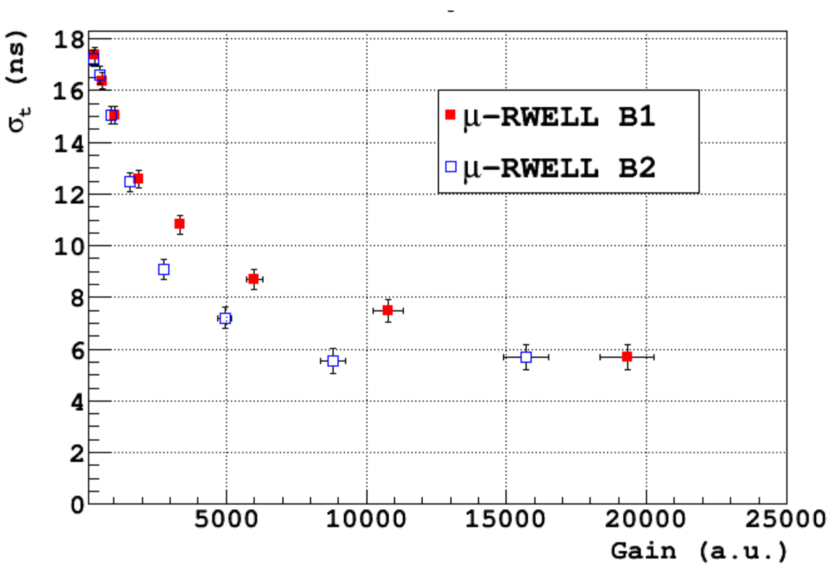
about μ-RWELL performances

Space resolution
below **100 μm**
for a wide range of incident angle



$Ar/CO_2/CF_4$ (45/15/40)

Time Resolution
of **5.7 ns** has been measured with VFAT2.



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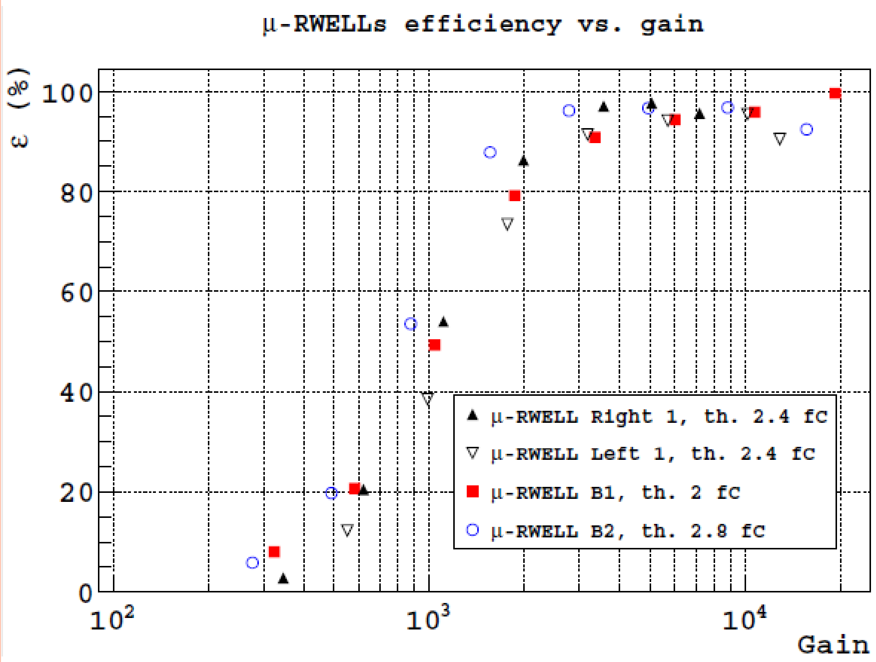
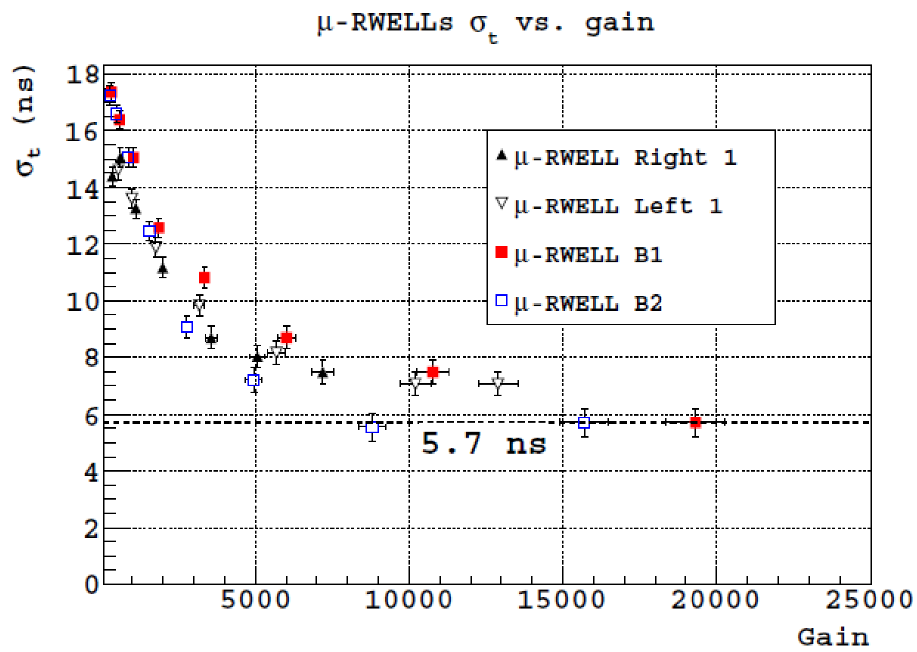
SOME USEFUL MATERIAL
about μ-RWELL performances

Chamber efficiency vs Gain



Time resolution vs Gain



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