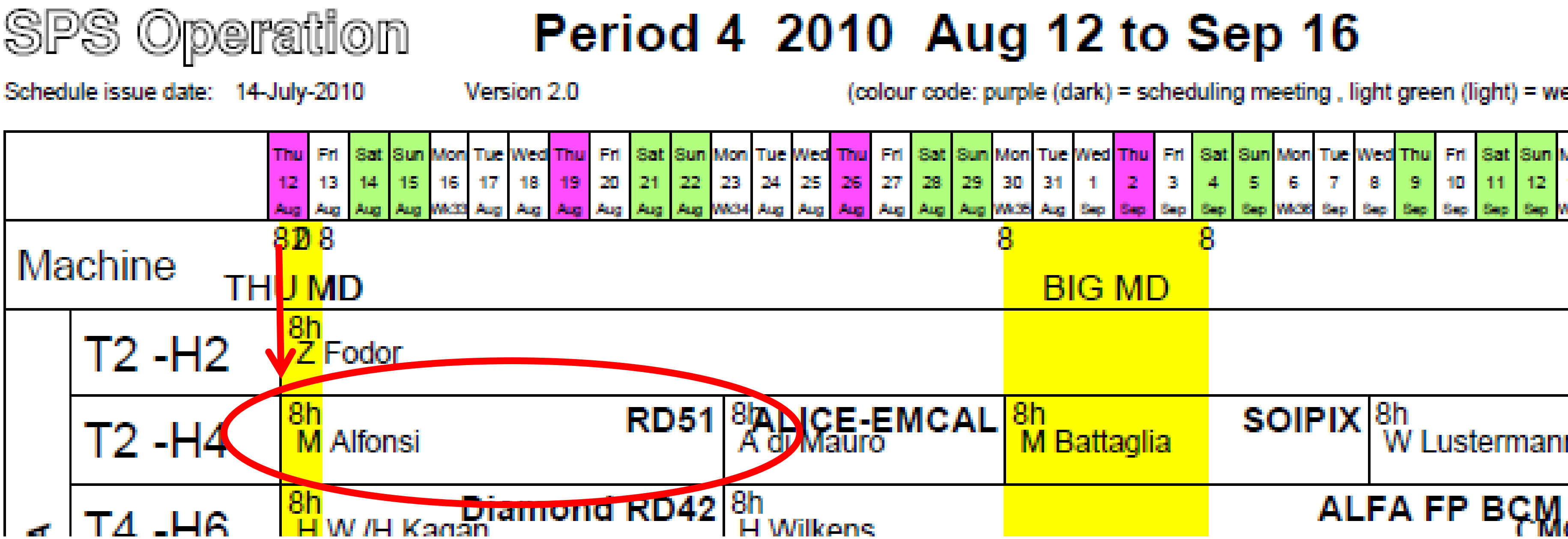
Summary from WG7

- Results from previous test beam runs
- Next run in October
- Reminders

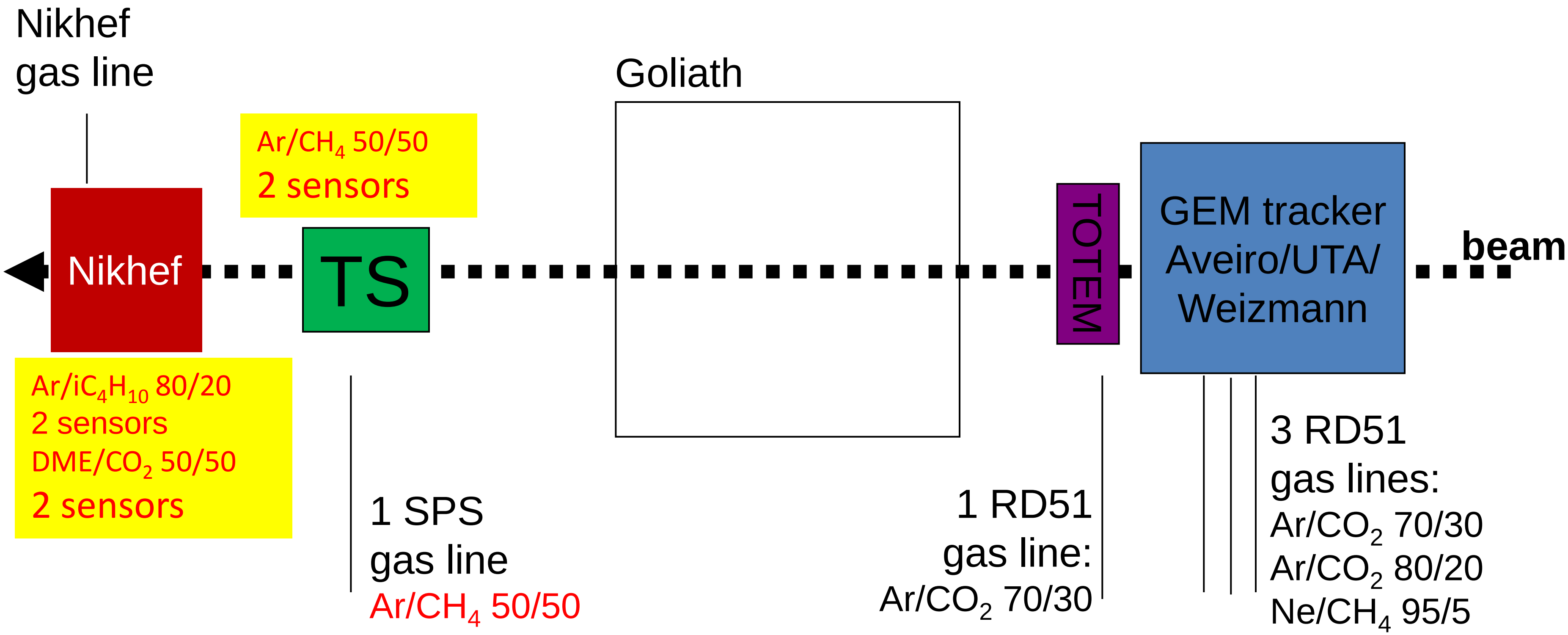
Matteo Alfonsi (CERN)

Last test beam in August



- 10.5 effective days from August 12th to 23rd
- No special problem with the beam

Period 2 (August 12th – 23rd)



- 4 involved groups, setups upstream and downstream Goliath
- No magnet, but several flammable gas
- Very interesting preliminary results!

Thick-GEM sampling element for DHCAL: First beam tests & more

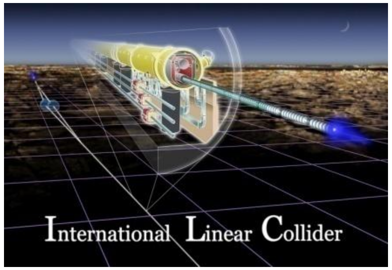
A. Breskin, R. Chechik, M. Cortesi, L. Arazi, M. Pitt
Weizmann Institute of Science – Israel (RD51)

A. White, S. Park, J. Yu
UTA – USA (RD51)

J. Veloso, H. Natal da Luz, C. Azevedo, D. Cavita
Aveiro & Coimbra Univ. – Portugal (RD51)

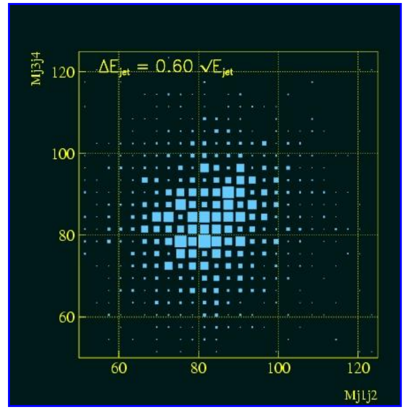
M. Breidenbach, D. Freytag, G. Haller, R. Herbst
SLAC - USA

Digital Hadron Calorimetry for ILC



Precision studies of new physics

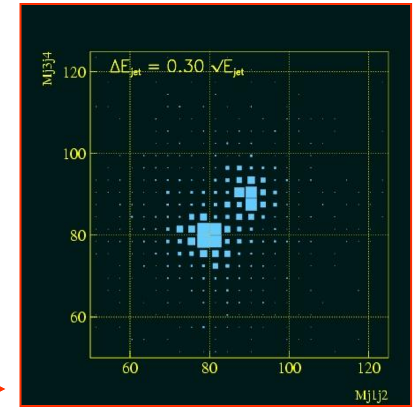
ILC: Separate W,Z boson masses on event-by event basis



60%/√E

Best JET resolution with traditional calorimetry

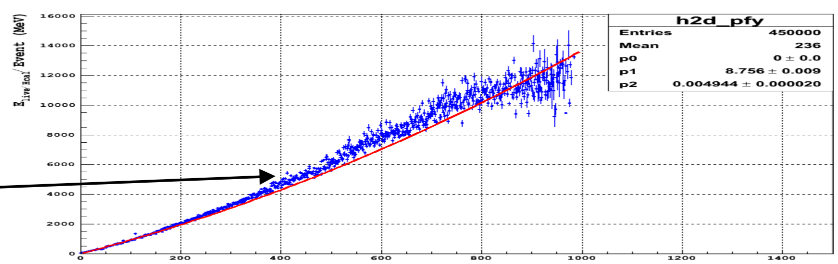
Need 30%/√E



Generally need σ/E_{jet} ~3-4%

Digital calorimetry

associate "hits" with charged tracks, remove hits, measure neutrals in calorimeter using **hits vs. energy**

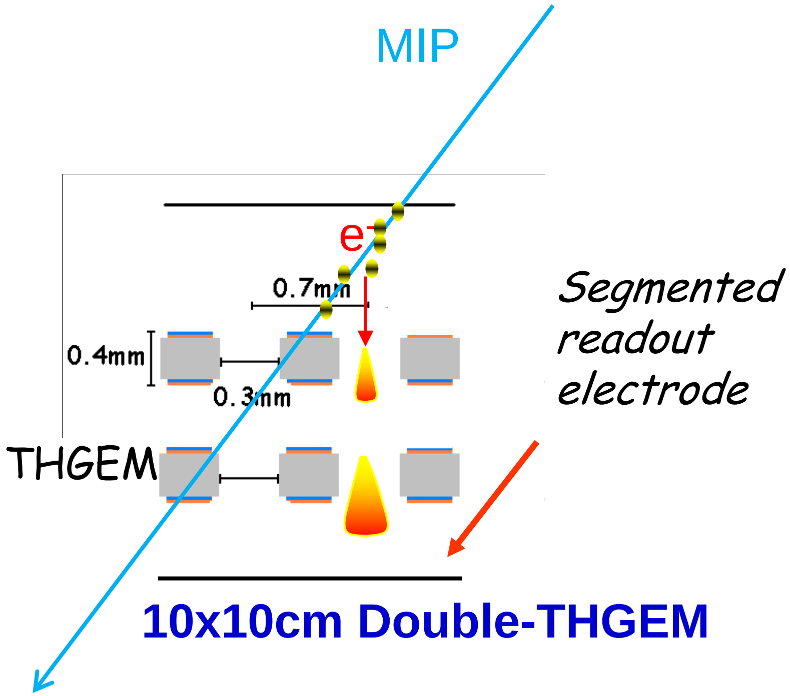


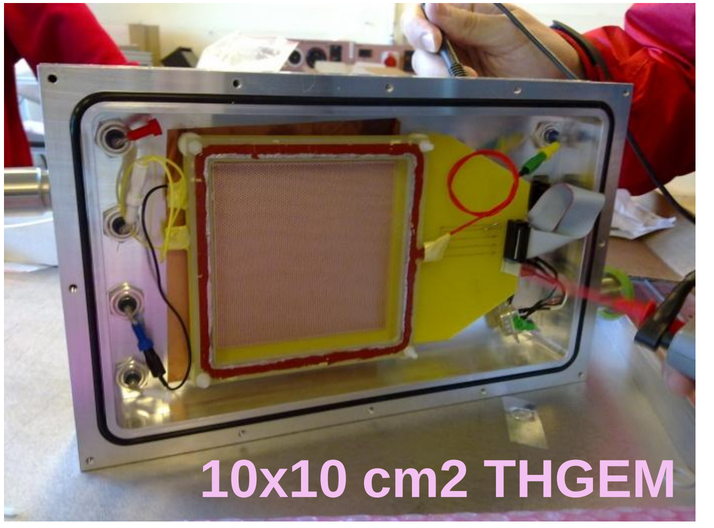
Particle Flow Algorithms now achieve the required energy resolution!

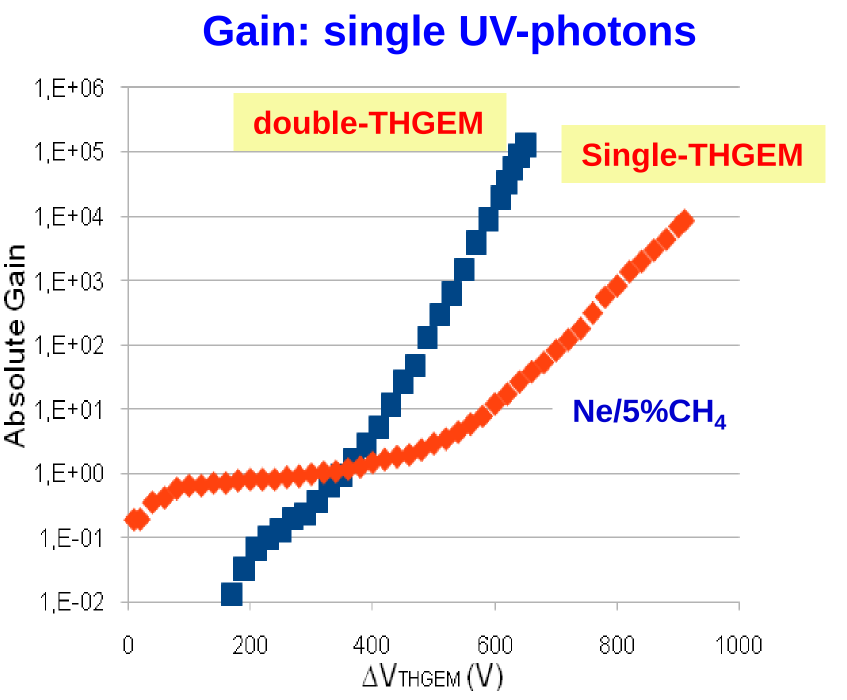
Requires thin, efficient, highly segmented, compact, robust medium,
(**competitors**: **D-GEM, Micromegas, RPC, THGEM**)

Gain: THGEM in Ne-mixtures

2009 *JINST* 4 P08001

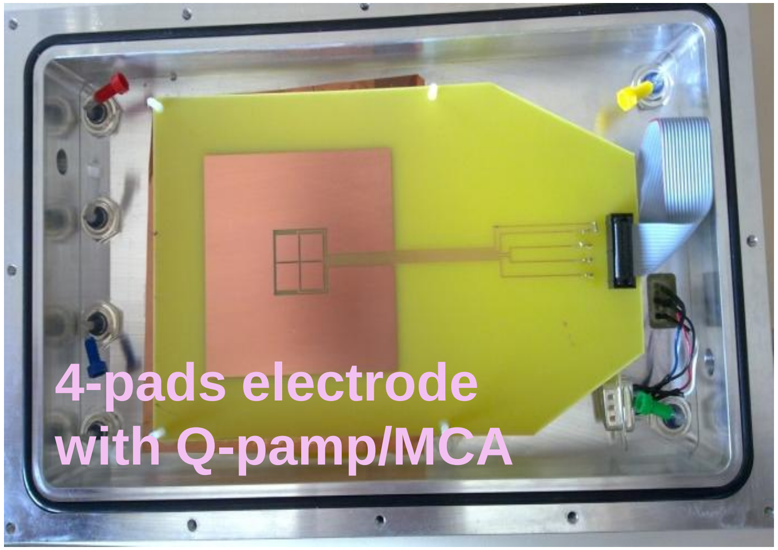


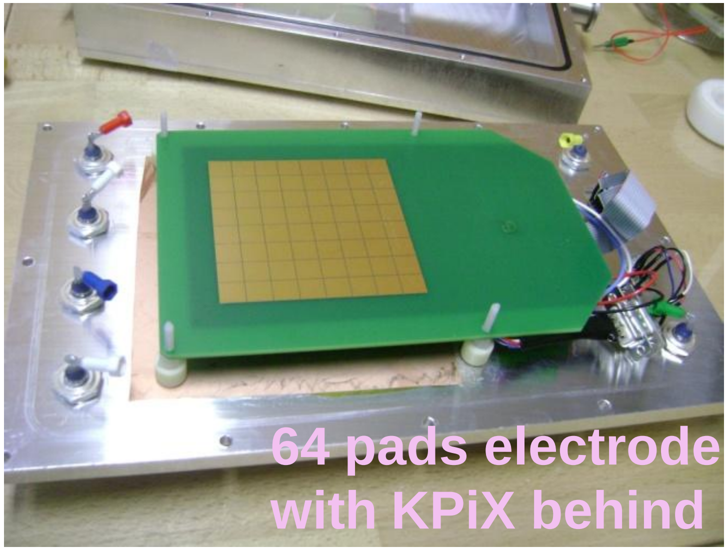


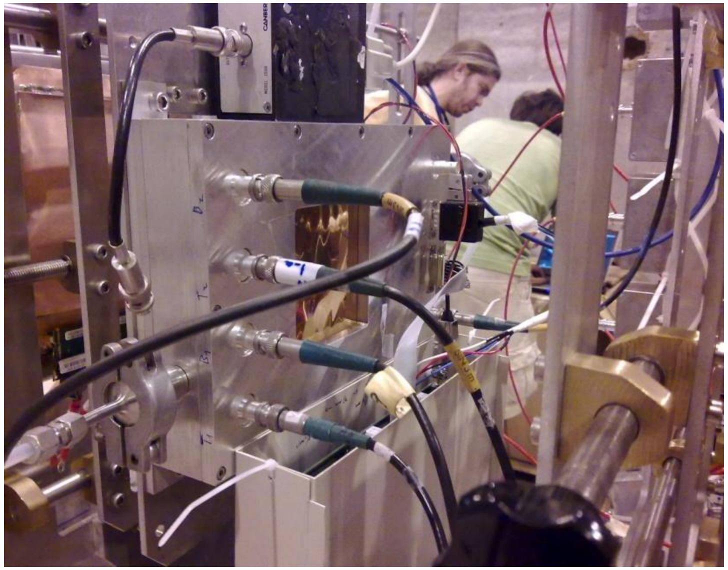


- High gain in Ne mixtures
- **2-THGEM: higher gains/lower HV**
- But: low ionization (**n_{tot}~40 e/MIP**)

CERN test-beam detector



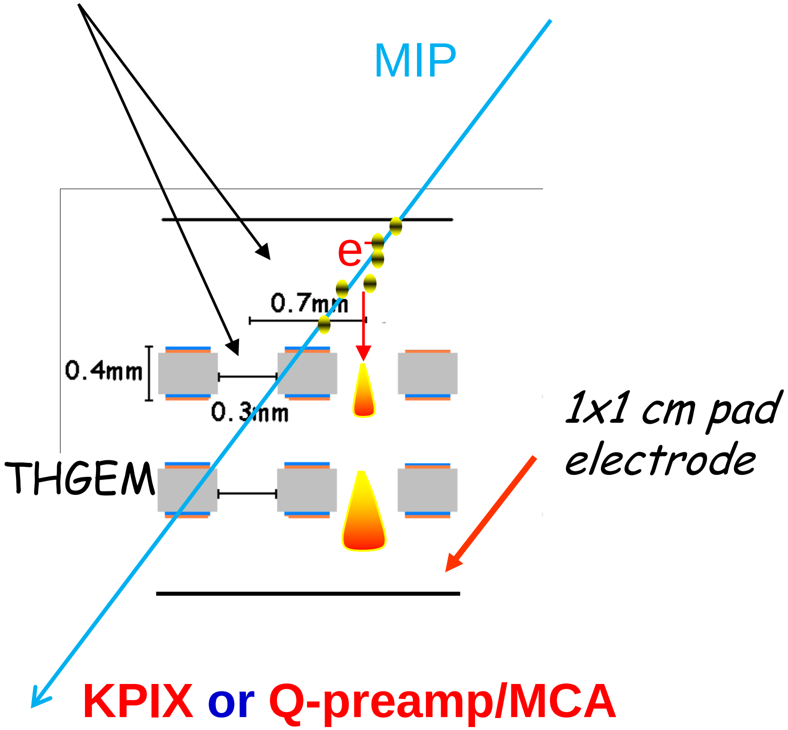




Muons w Double-THGEM
KPIX or Q-preamp/MCA

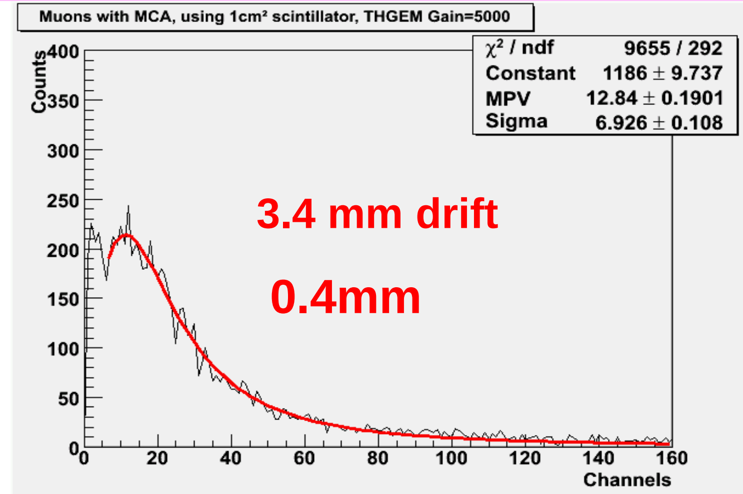
Here we had:

0.5mm holes / 1mm space



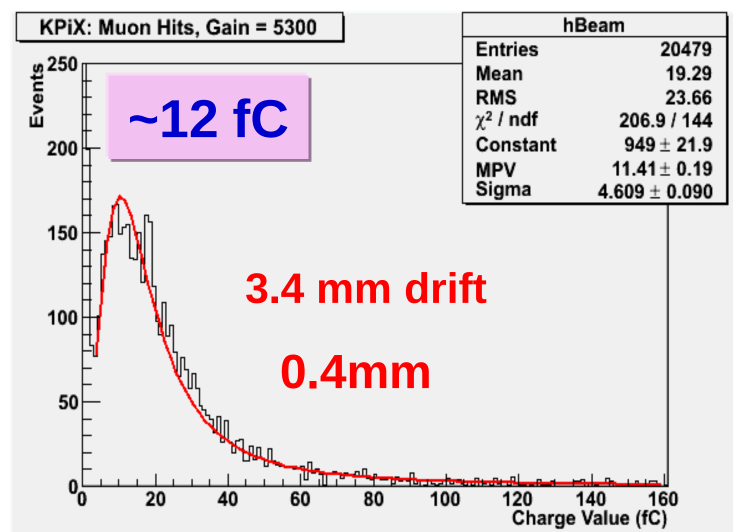
August 2010

2-THGEM BEAM TESTS with Q-preamp/MCA



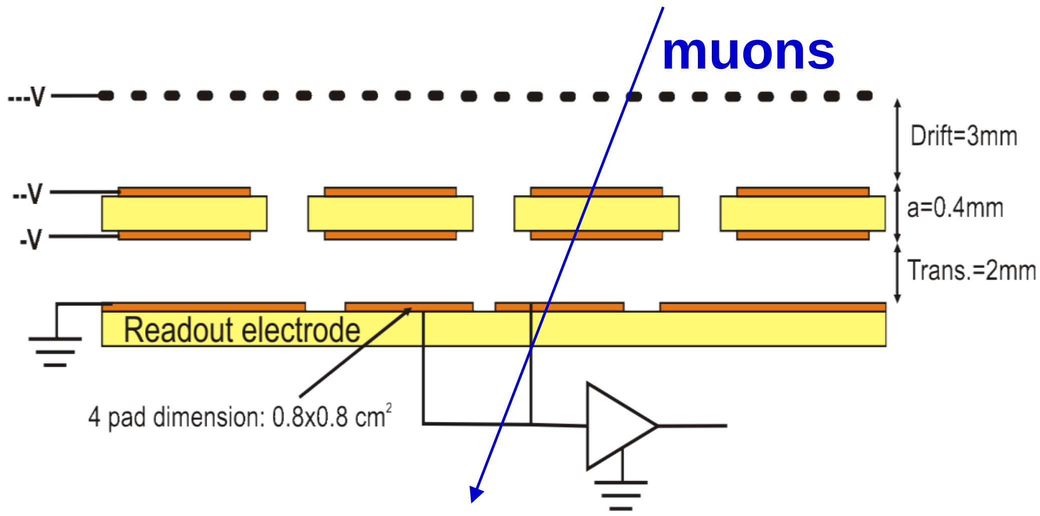
Double-THGEM, Ne/5%CH4; Average gain ~5000

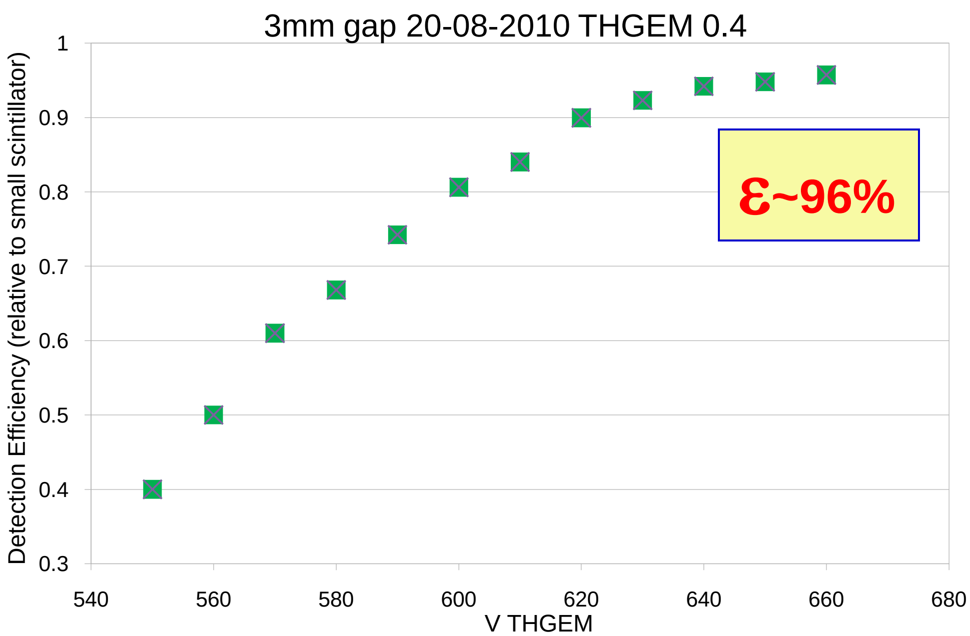
2-THGEM BEAM TESTS with KPIX



Double-THGEM, Ne/5%CH4; Average gain ~5300

Single-THGEM with muons: efficiency





Single THGEM
10x10 cm
Thicknes: **0.4 mm**
Particles: muons
Gas: Ne/5%CH_4
Drift gap: **3 mm**
Charge preamp/MCA
0.5 cm^2 trigger

THGEM for DHCAL: next…

- October 2010: run at CERN with muons/pions
- Investigations with **1-THGEM & 2-THGEM with KPIX**
- Gain & Efficiency
- Crosstalk between pads
- Discharge rates with μ/π (continuation study)
- With SLAC: improving KPIX protection
- 30x30 cm THGEMs
- **OCT RUN**: New multiplier geometries & operation modes

  ➔ **well, gain in ind gap, resistive film…**
- Other gases (Ne/CF4?)

Large GEM detector

August TB results

E. Graverini

on behalf of

University of Siena / INFN Pisa – CERN GDD Group

Large GEM Detector

"A large area gem detector", Serge Duarte Pinto et al., 2008 IEEE Nuclear Science Symposium Conference

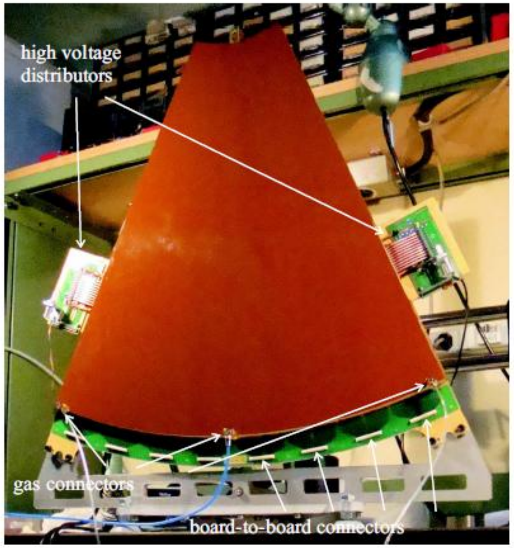
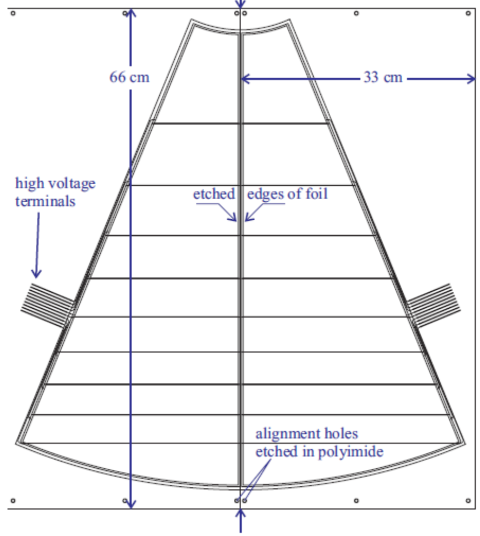
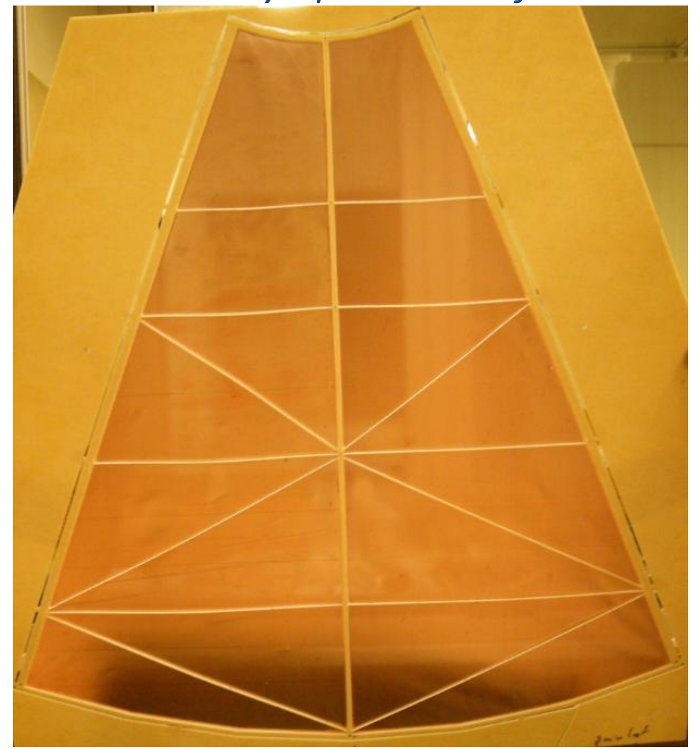


Figure 12. The prototype large area triple GEM detector, mounted on its support.

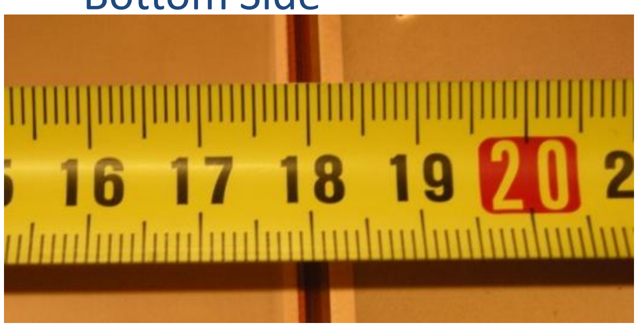


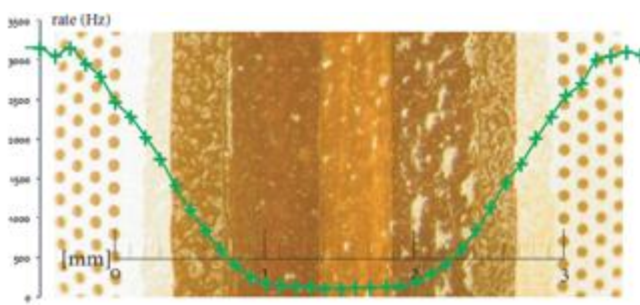
ure 14. Layout of the GEM foils used for the prototype. The top electrodes divided in sectors of ≤ 100 cm^2 to keep the capacitance per sector below F.



GEM foils splicing

Bottom Side





Top Side

A measure of the counting rate over the seam of two spliced GEM foils

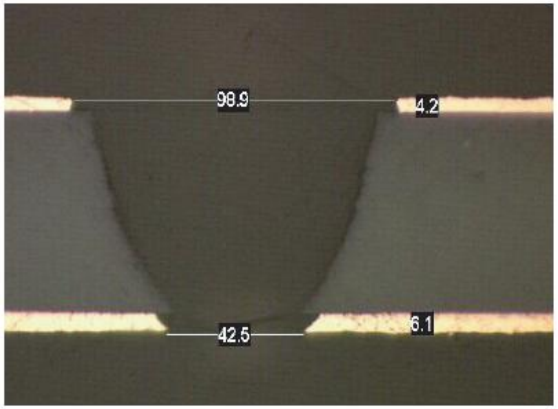
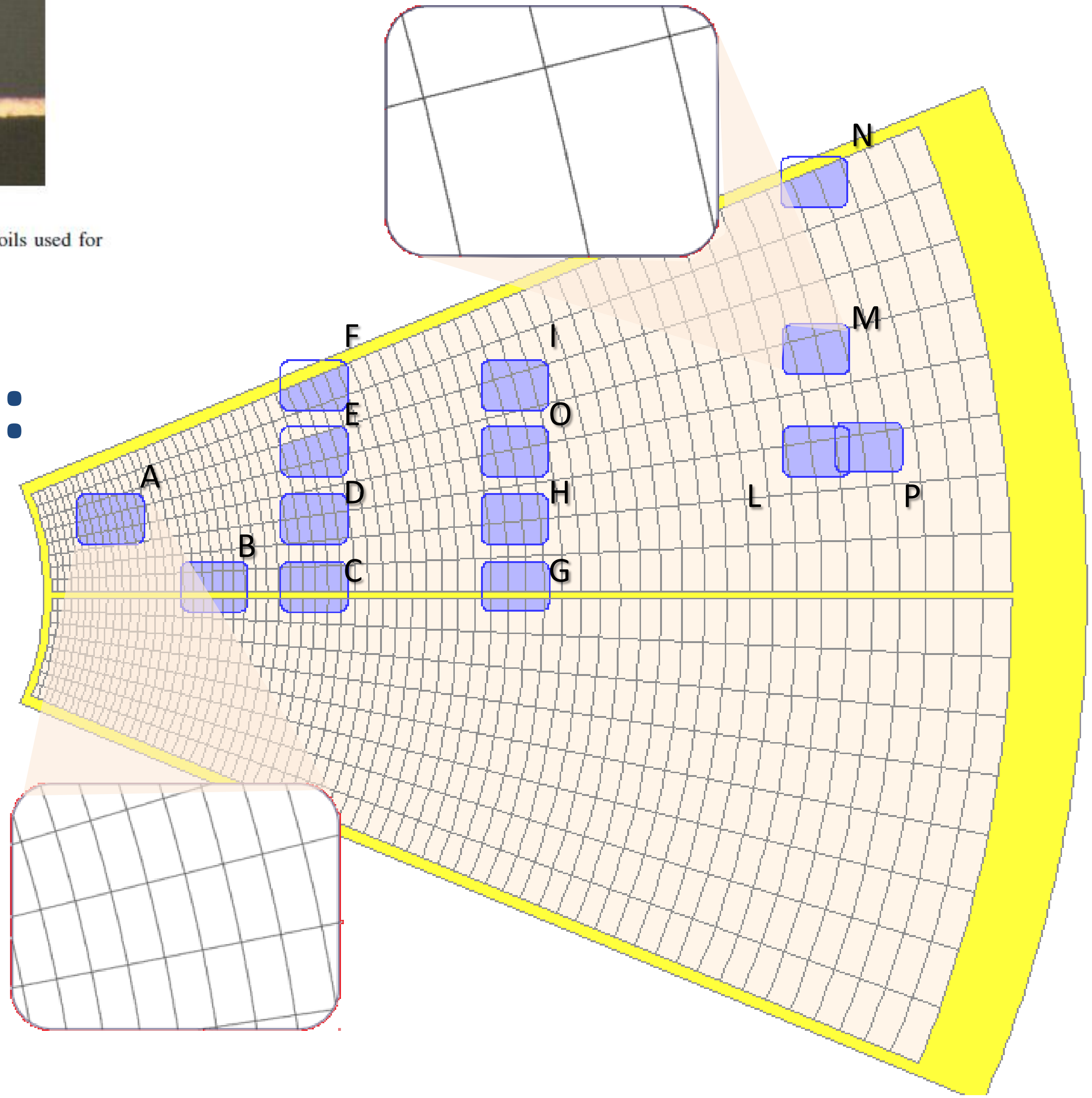


Figure 7. Cross section view of a hole, representative of the foils used for making the prototype. Indicated dimensions are in microns.

The foils used for the LG prototype are single-mask etched.

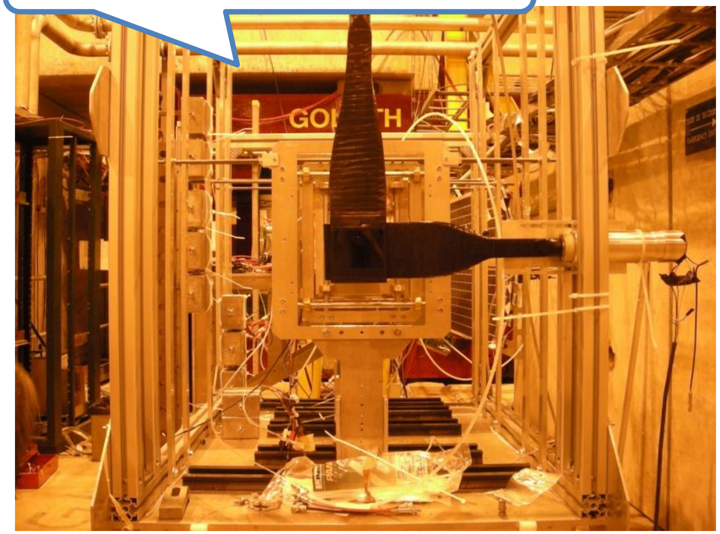
Readout Plane: pads

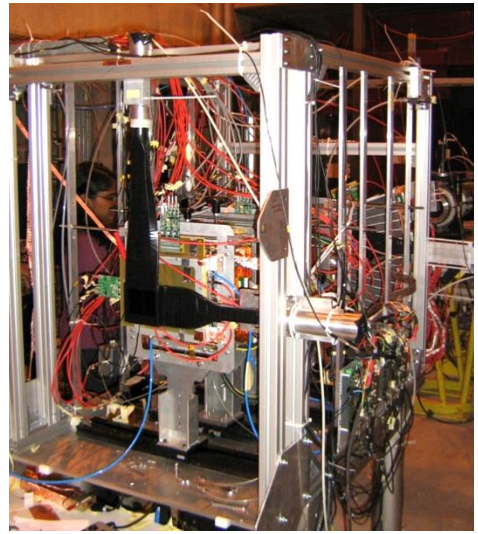


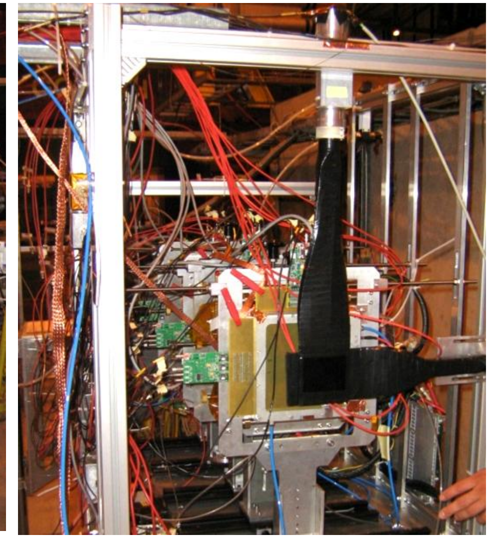
During the TB we tested the chamber over the regions A – P.

RD51 2010 Test Beams: SPS-H4

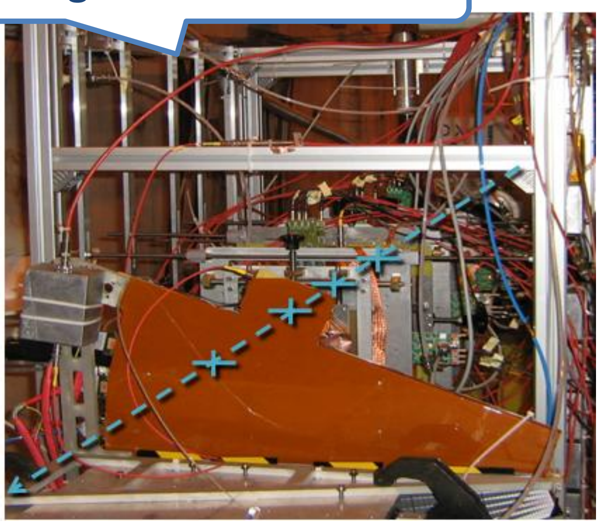
RD51-GDD Tracker setup

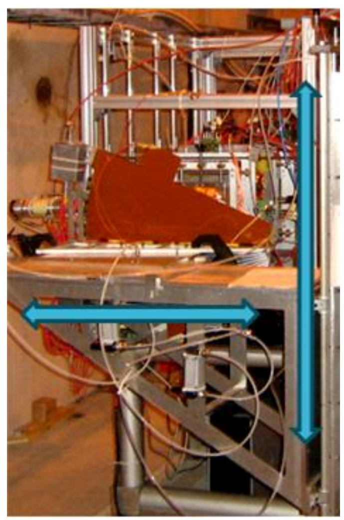




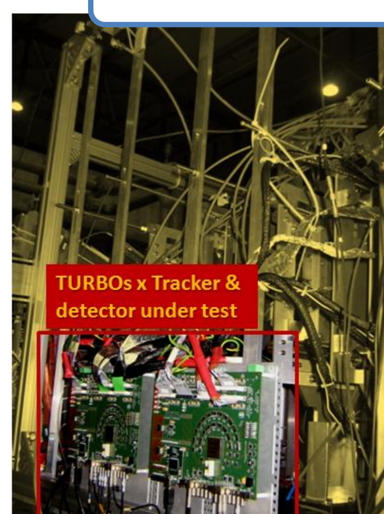


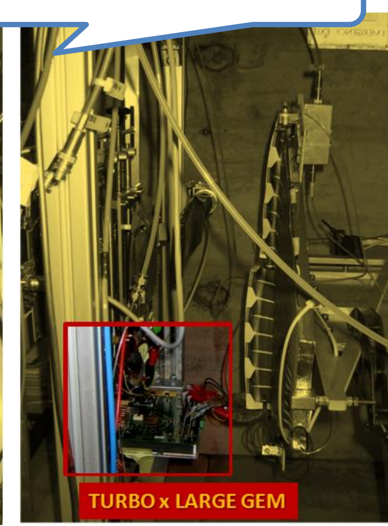
Large GEM installation



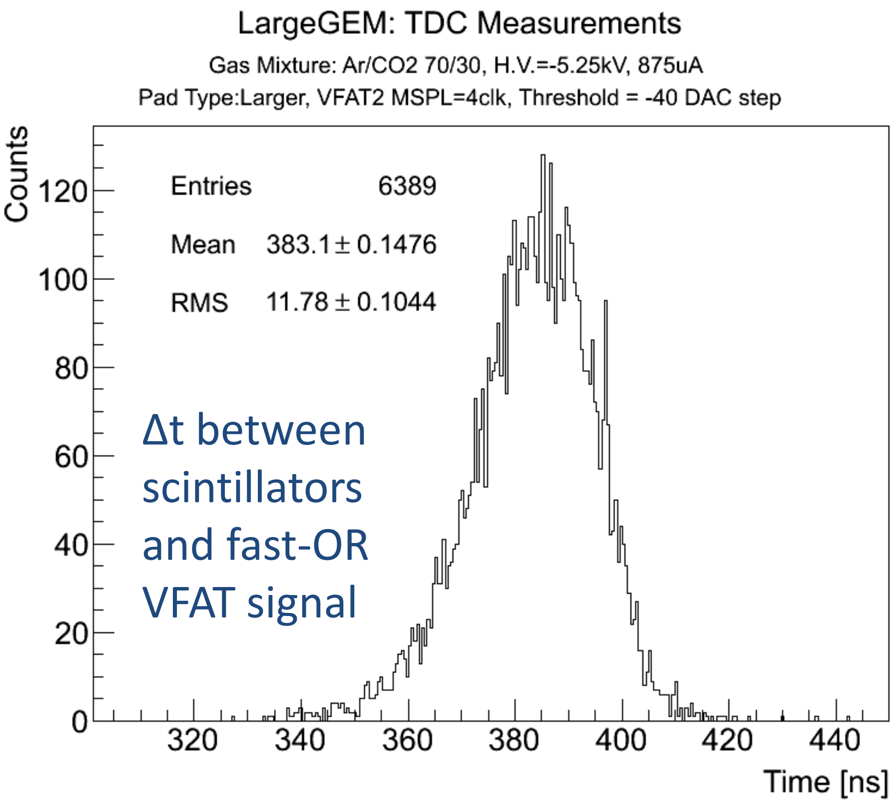


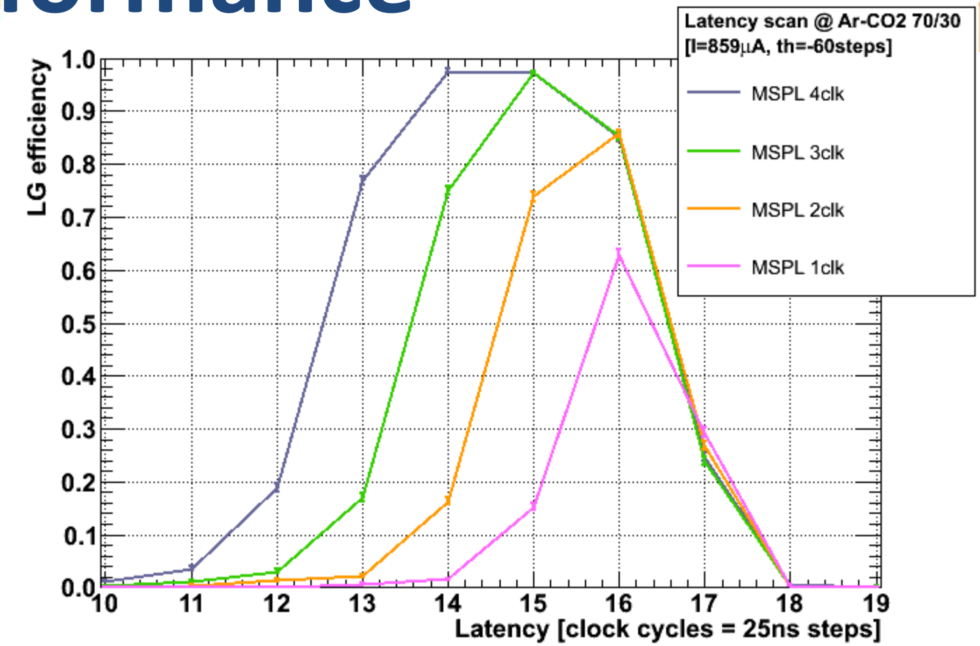
TURBO Slow Control & Readout





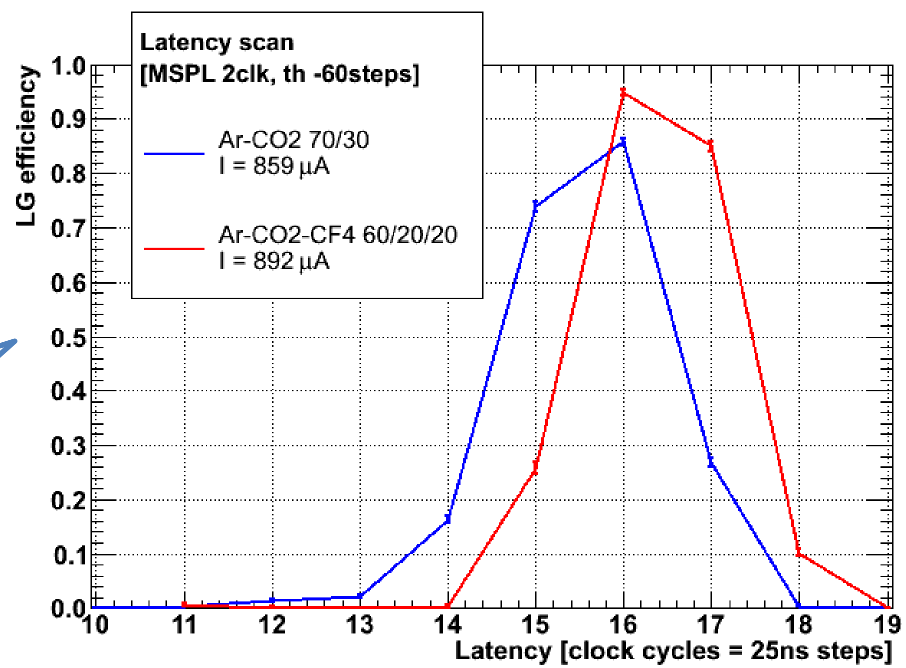
Time Performance





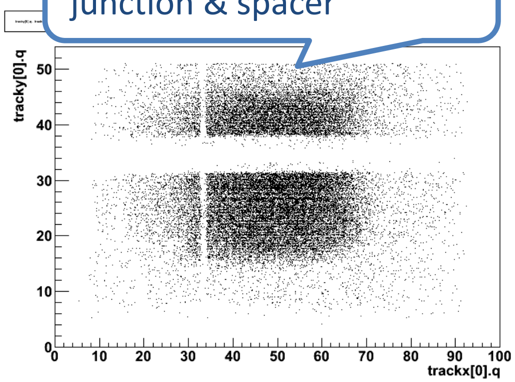
Fully efficient with at least **MSPL=3clk** (75ns)

Data taken adding **CF4** to the standard Ar/CO2 70/30 gas mixture (**same internal voltages** and fields as for Ar/CO2, detector **not optimized** and **asyncronous** beam).

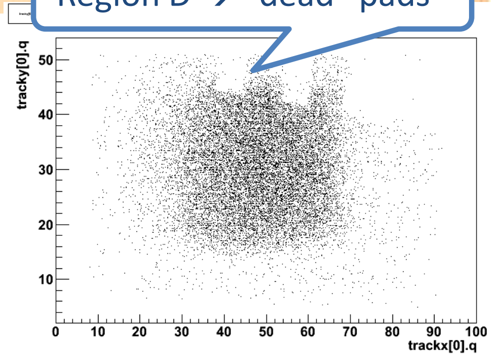


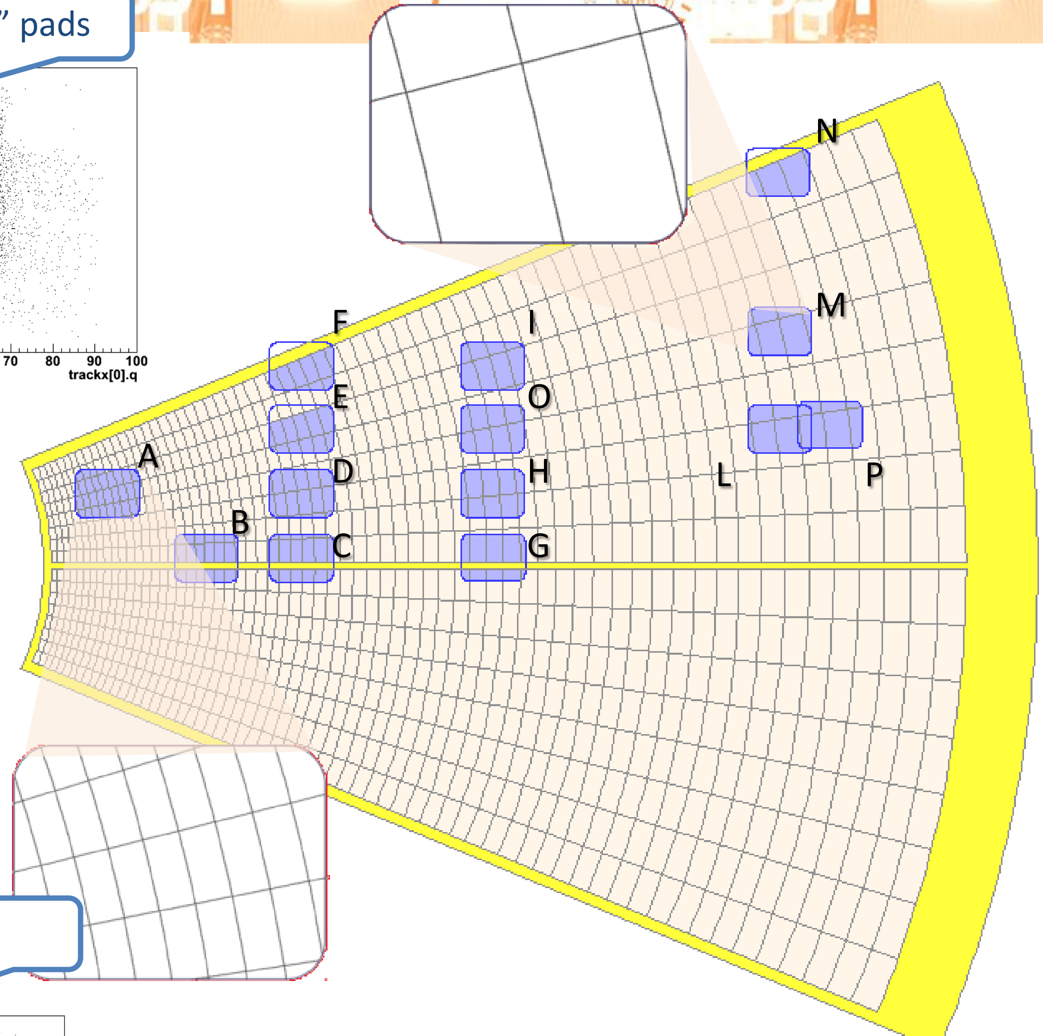
Large GEM prototype imaging!

Region B → GEM foils junction & spacer

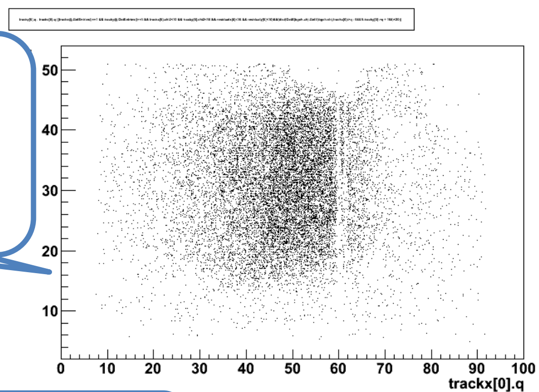


Region D → “dead” pads

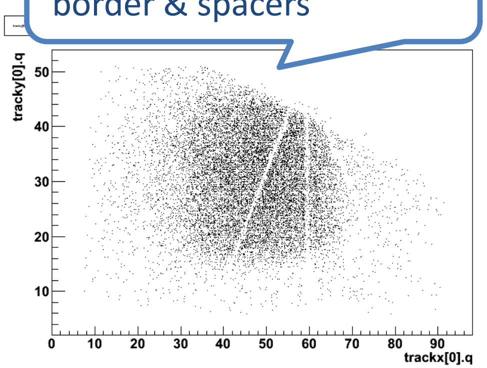




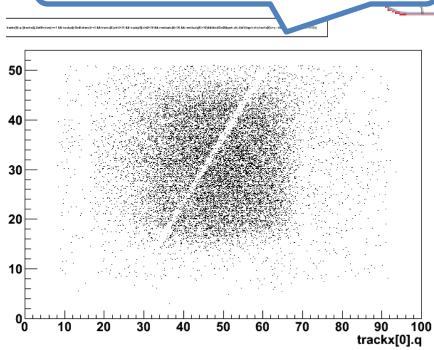
Region M → GEM sectors gap, dead pad & spacer



Region N → detector border & spacers

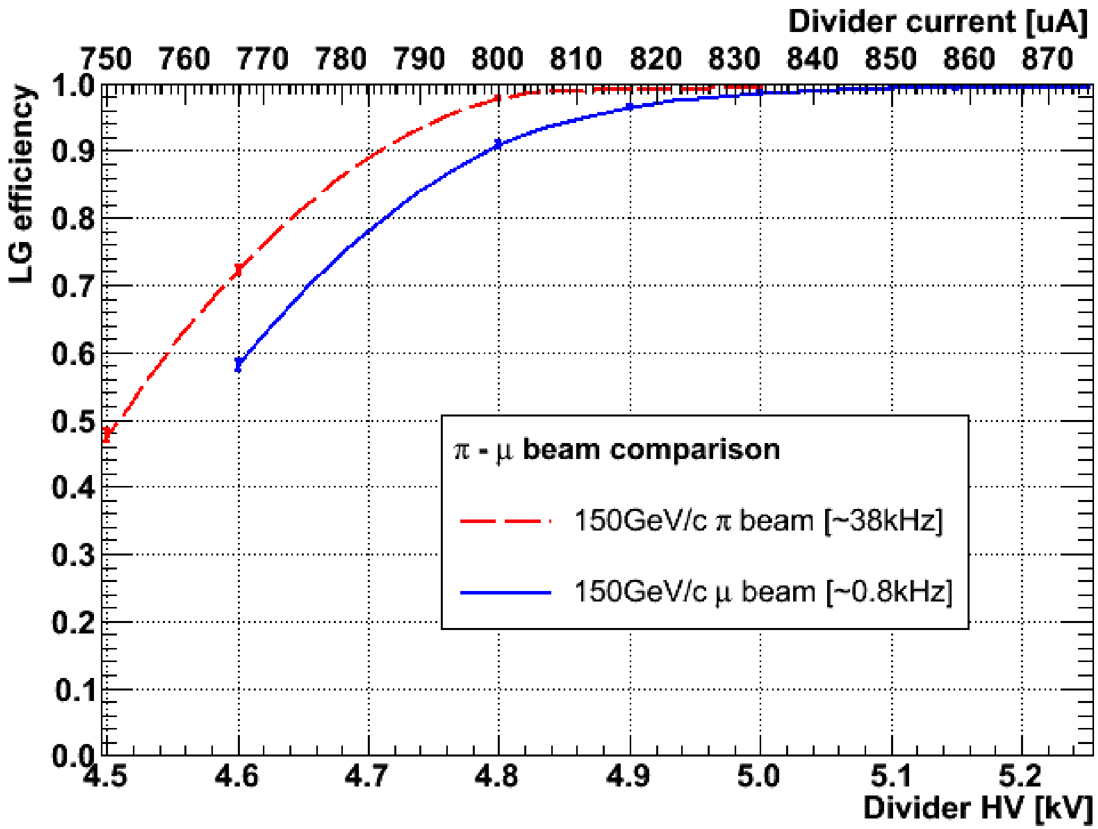


Region H → spacer

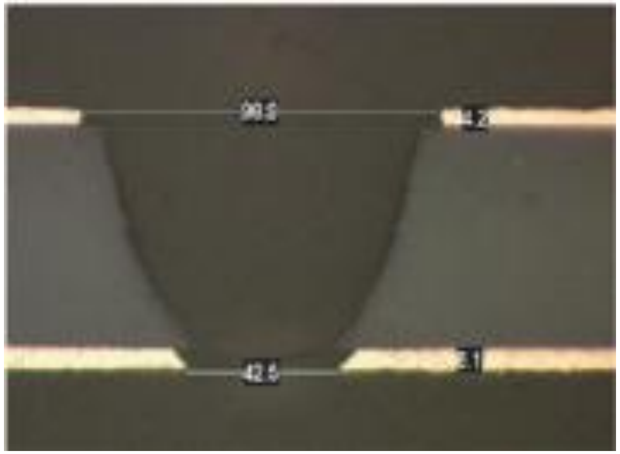


Open question: fall of the gain/efficiency on the bottom side of the LG prototype!

Hadrons beam



Charging up effects for high intensity beam (to be checked!)



If the difference can come from the two **different beam rates** (**charging up** effects), it should have affected the **absolute gain curves** obtained with Cu X-Rays (~300 e- per photon, @ 6KHz interaction rate ≈ **60kHz** equivalent MIP).

THGEMs for RICH applications

S. Levorato INFN Trieste

On behalf of
Alessandria ,CERN, Freiburg, Liberec, Prague, Torino, Trieste Collaboration

Outlook

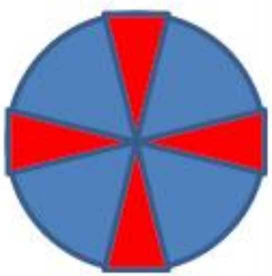
- detector setup description
- first results from the test beam
- critical review of some detector/setup aspects
- future improvements

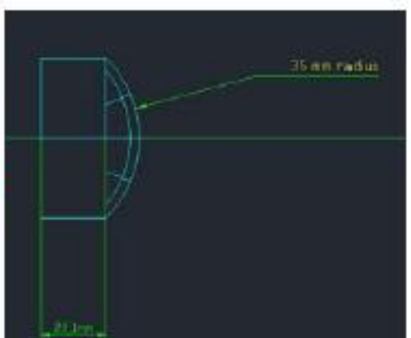
Detector characteristics

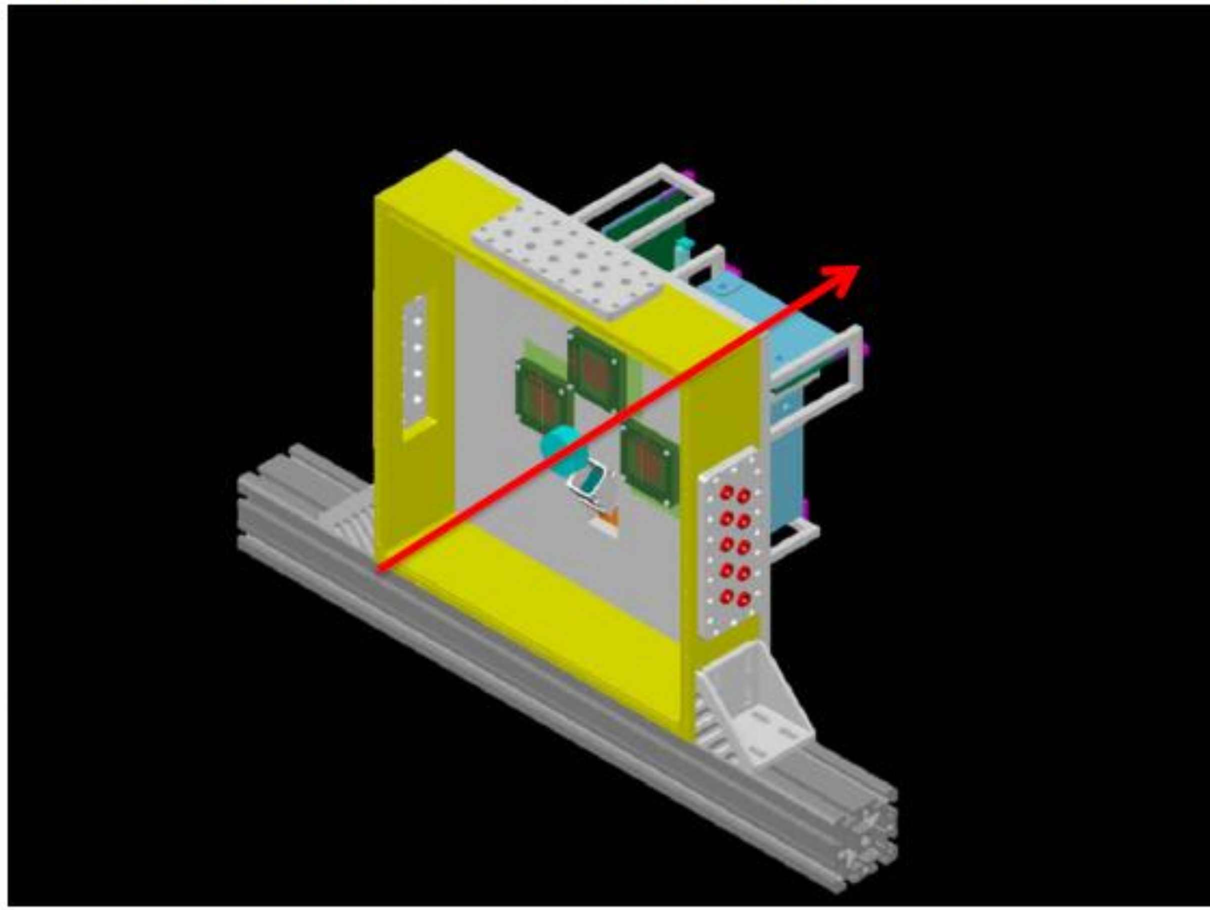
3 Triple THGEM 0.4 mm hole diameter , 0.8 mm pitch, 0.4 mm thickness
2 triple THGEM (Jura and Saleve) identical
1 central one equipped with grid (0.6 mm holes diameter, 0.8 pitch , 0.2 mm thickness to study ion feedback

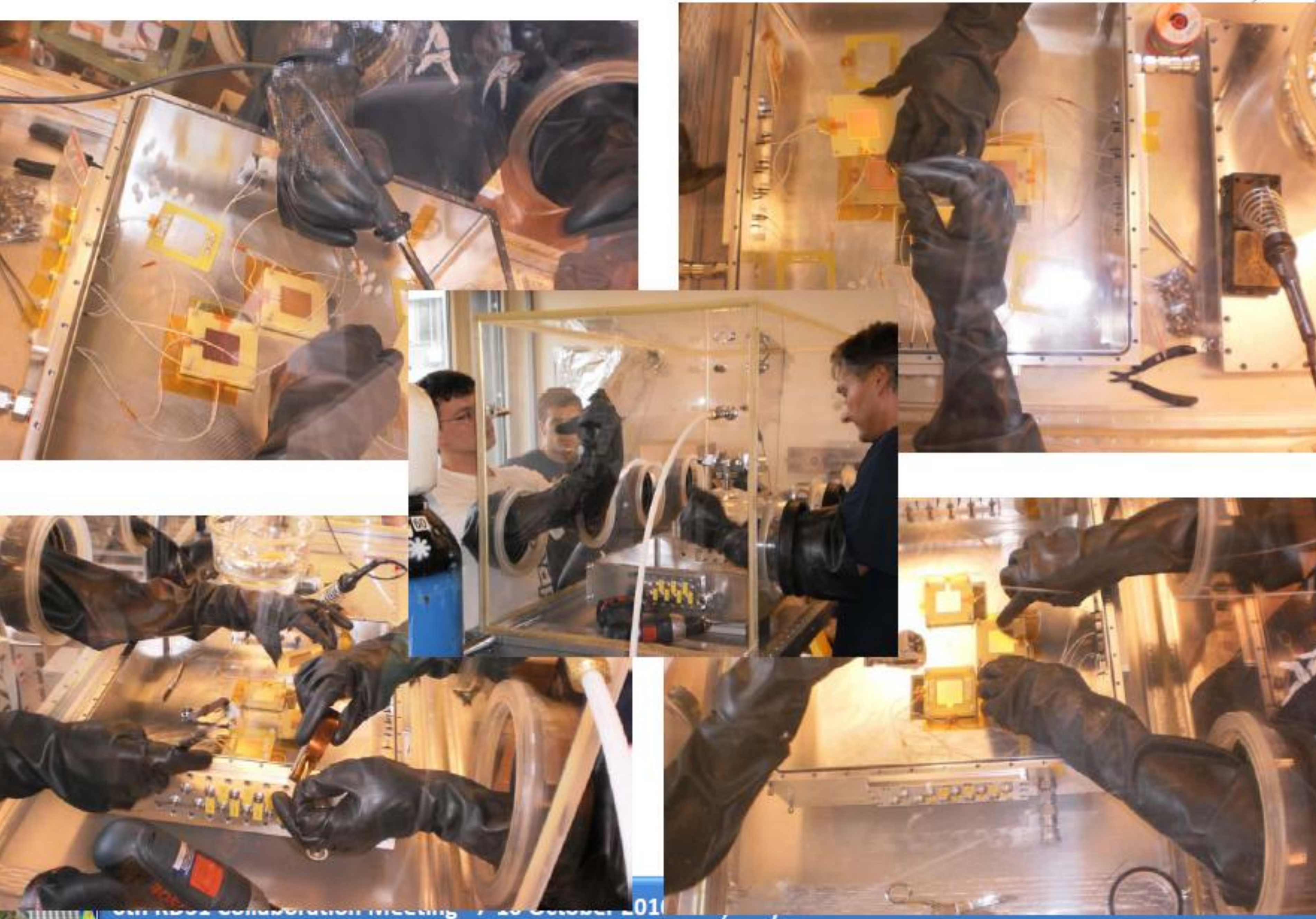
1 MAPMT R7600 M16

Quartz radiator,
Half of the radiator is darkened at sectors of nearly 40 degrees,
45 degrees rotation allows for non single photon illumination





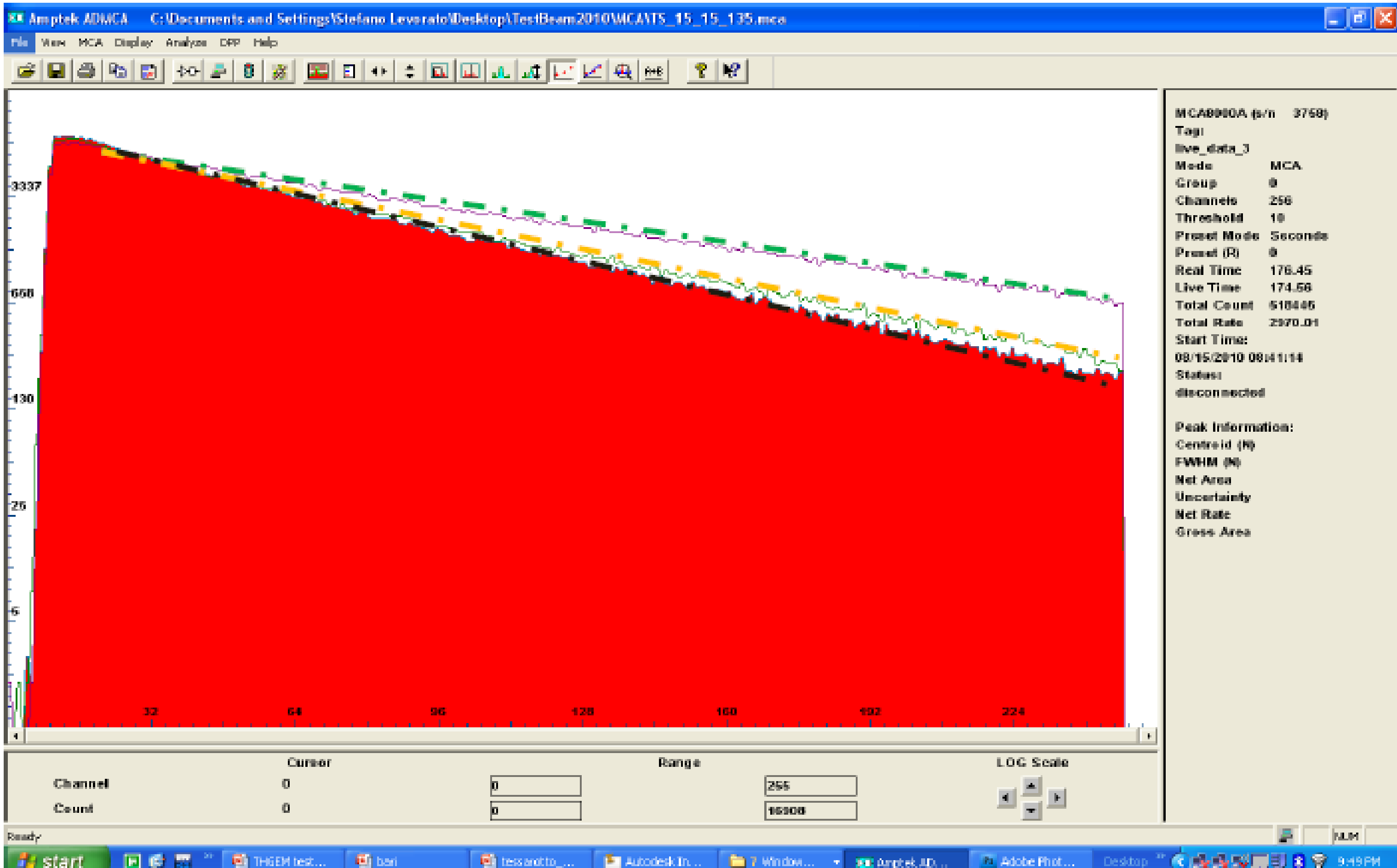




Spectra acquired with analog readout and UV LED allow for calibration and gain measurement: spectra obtained at different ΔV for the last layer

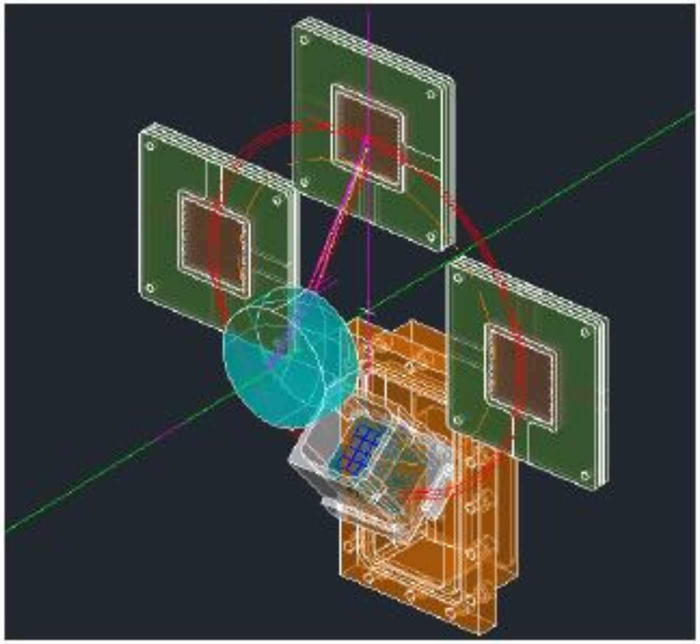
1.5 1.5 1.5 1.5 1.5 1.45 1.5 1.5 1.35

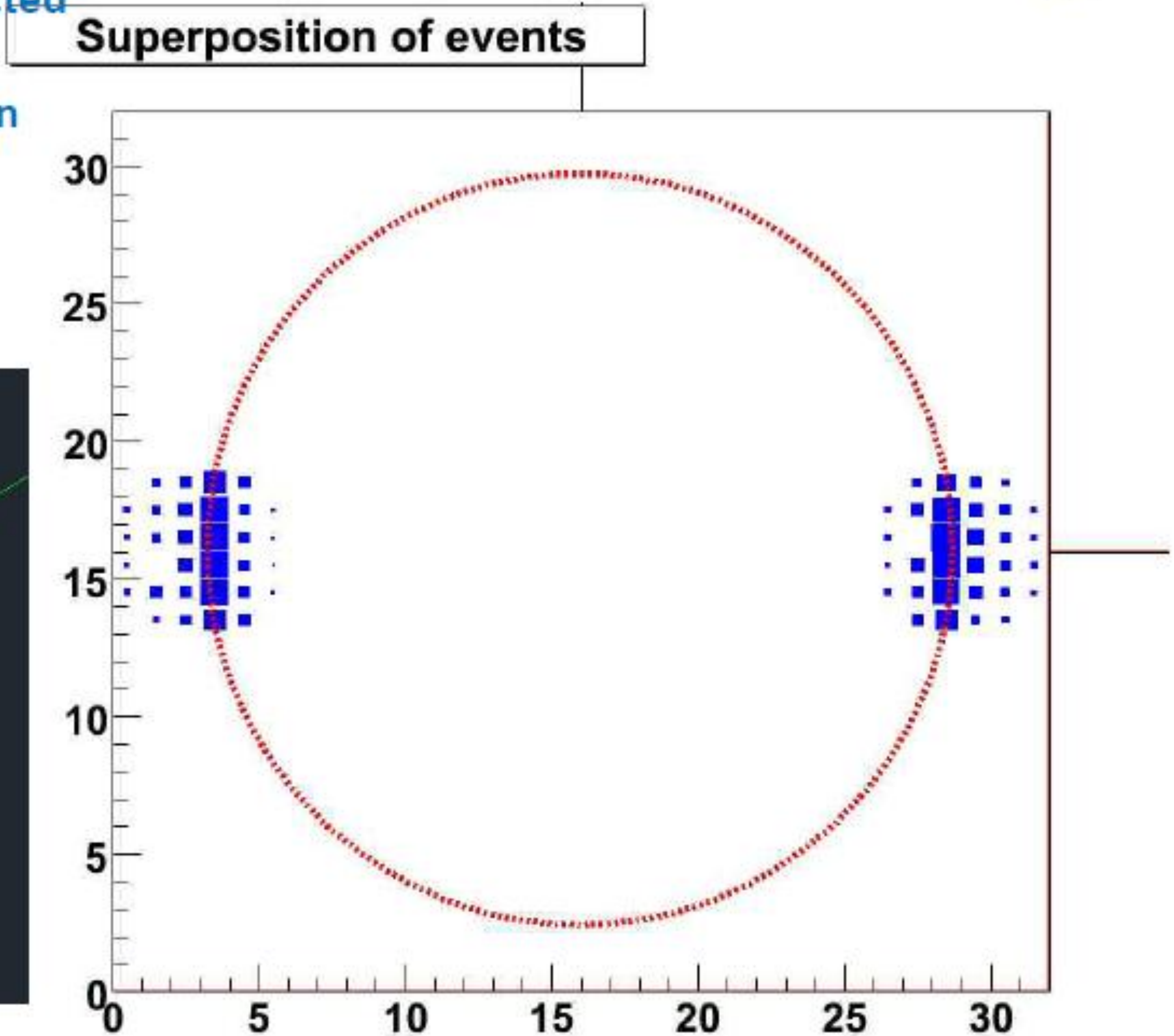
Gain from slope of the fit from 3E5 1.6E5



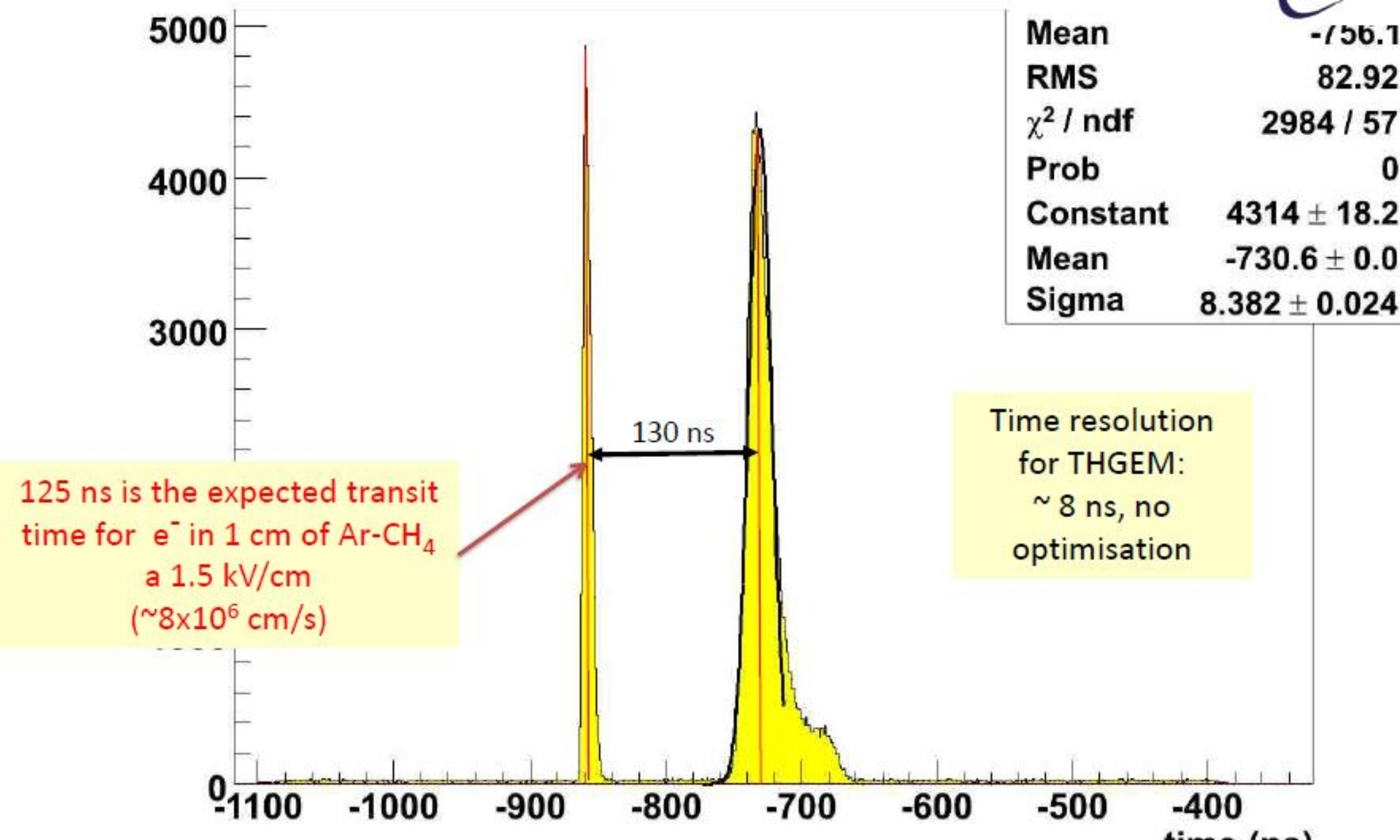
Jura and Saleve THGEM Digital Readout,
Threshold set at 3fC for each of the 32 x 2 channels,
Gain 1.2E5 overlap of events collected

The circle is the expected corona on the THGEM surface

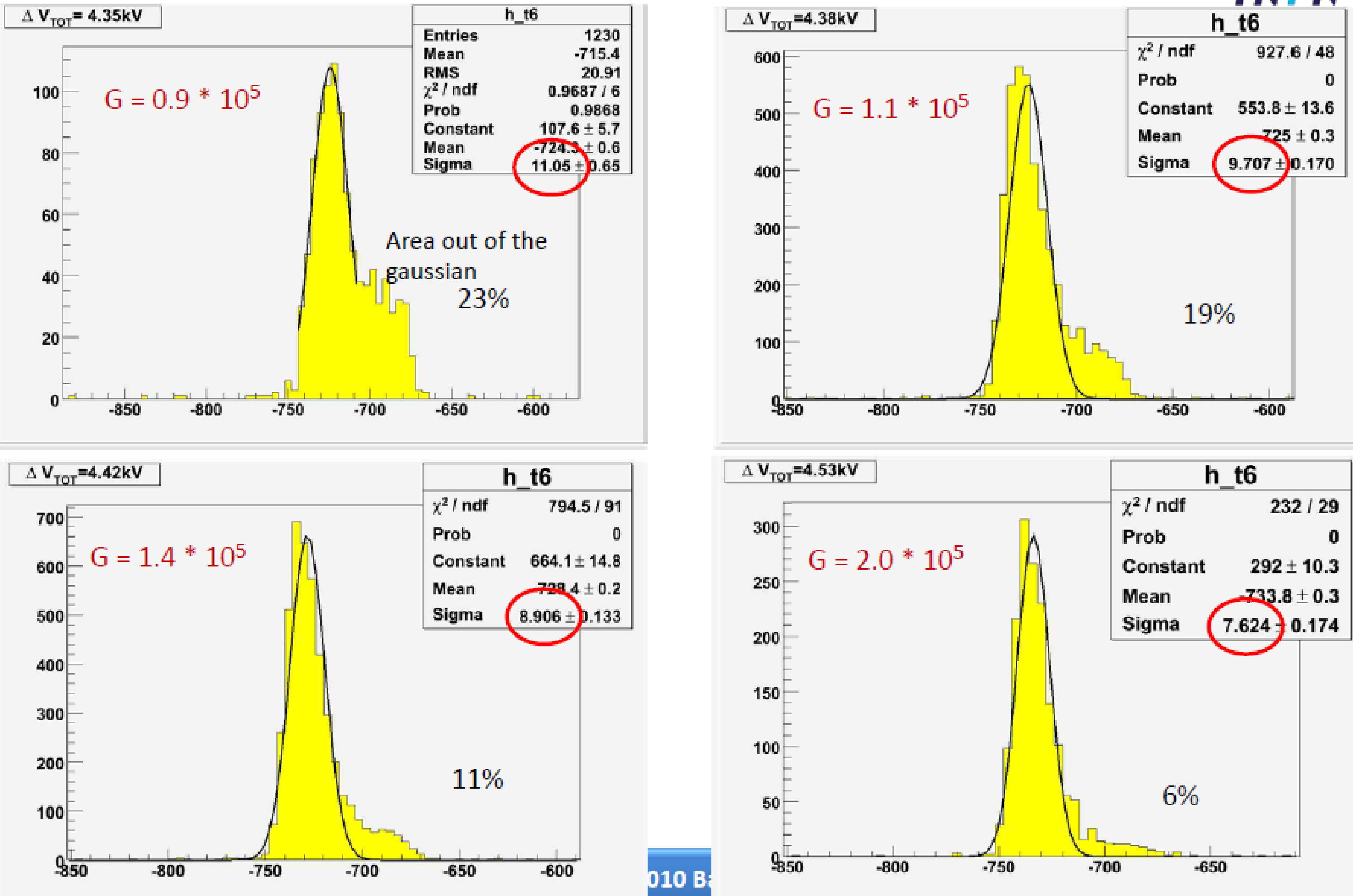




Time formation of the signal for triple THGEM detectors



Time formation of the signal for triple THGEM detectors (powered via R-divider)



Gossip testbeam August 12 – 22 , 2010

Maarten van Dijk

Martin Fransen

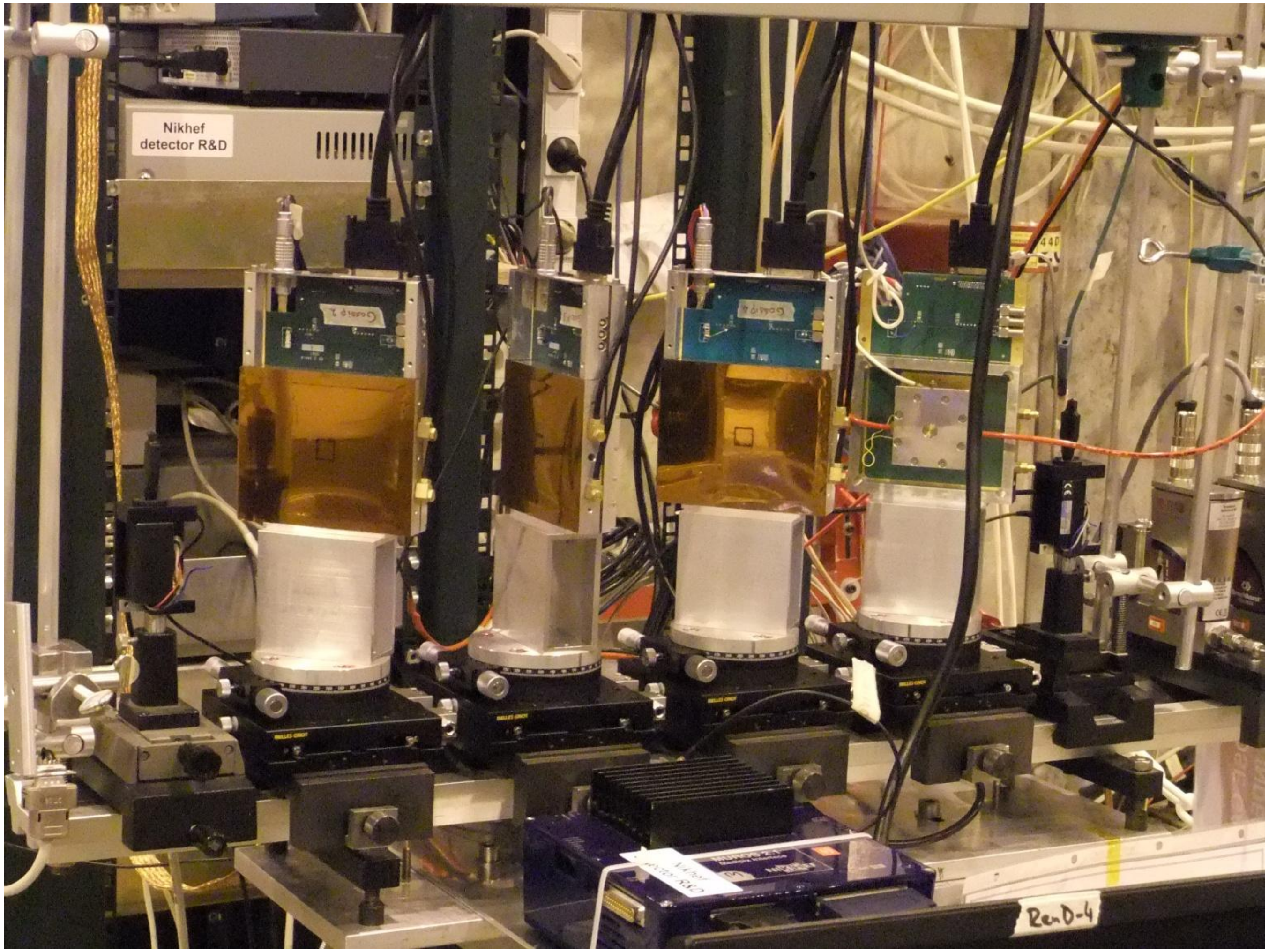
Harry van der Graaf

Fred Hartjes

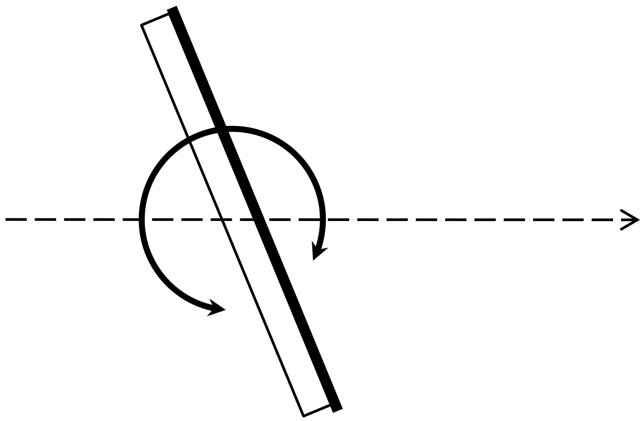
Wilco Koppert

Sjoerd Nauta

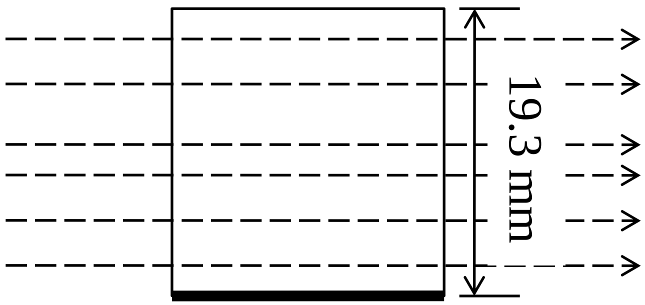
Rolf Schön



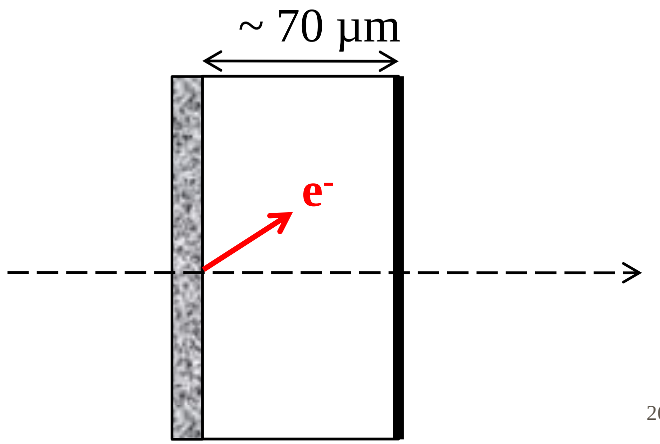
Aim of the Gossip testbeam experiment in August 2010



1. **Gossip parameters**
   - Position resolution
   - Angular resolution of track segment
   - Track detection efficiency
   - Dependence on gas gain
   - Double track separation



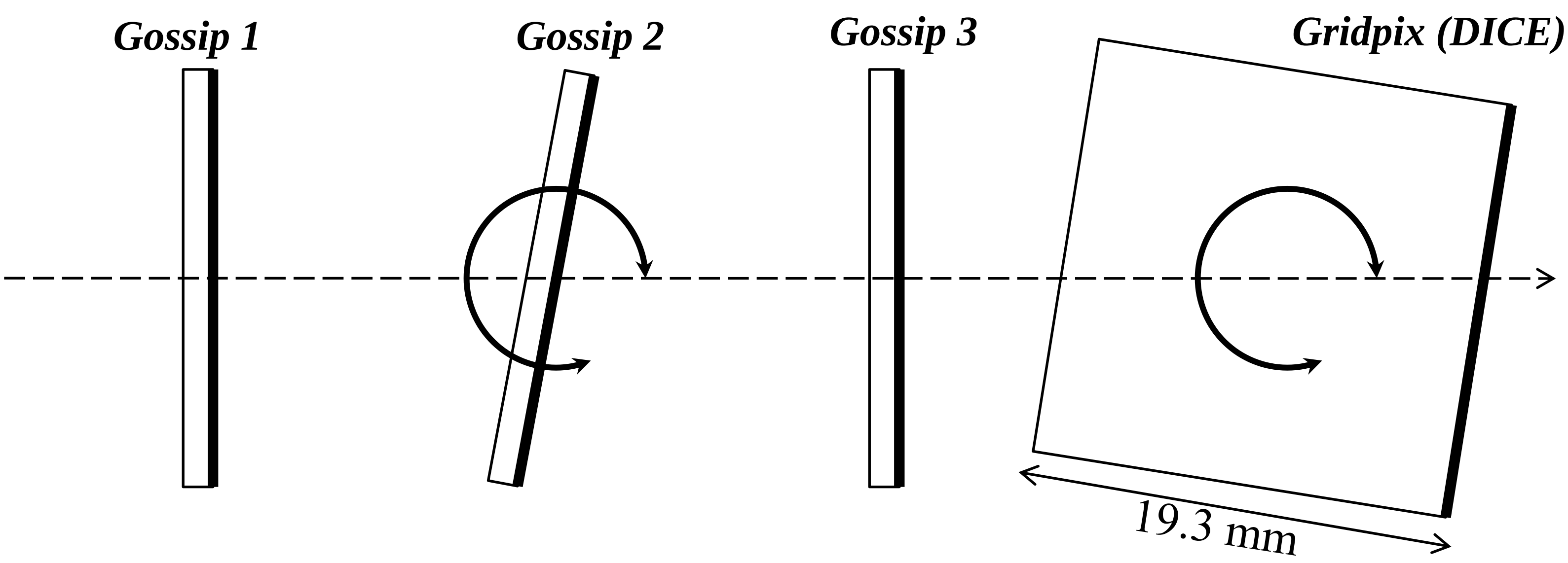
2. **Characterisation** of DME/CO_2 50/50 mixture
   - Primary ionisation/cluster density
   - Drift velocity
   - Transverse diffusion



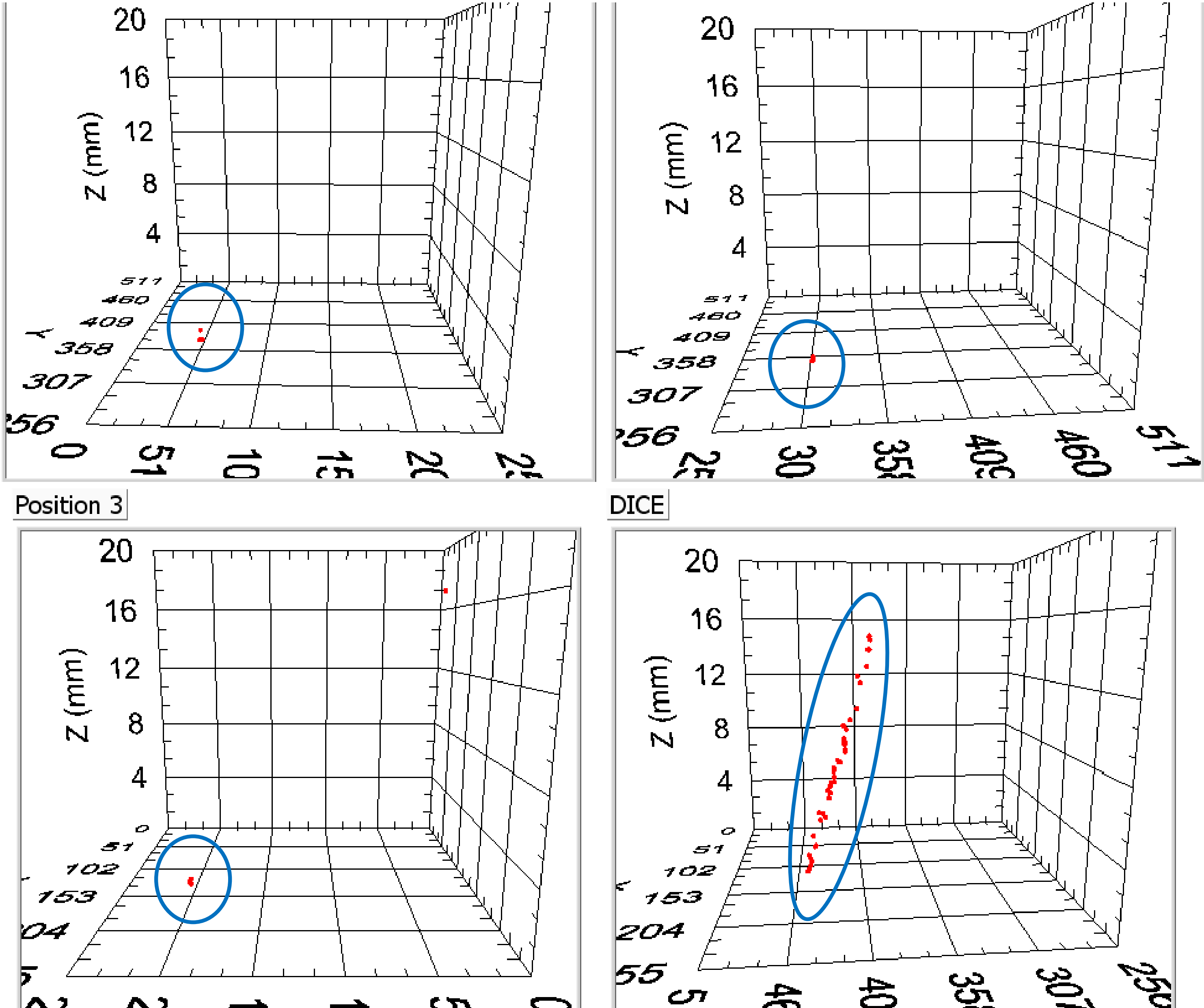
3. **Cathode emission**
   - **PillarPix** detector, NO drift gap
   - Detecting knock-off electrons from cathode surface
   - Cathode from three different materials: **doped diamond; Cu; Al**

Using Gossip/GridPix telescope as a reference

- Measurements done with Gossip 2
- Define track with Gossip 1 and 3
- Reject bad events using the Gridpix detector (19.3 mm drift gap)
  - Wrong angle (background tracks)
  - Outside fiducial volume
  - Multiple tracks (showers)



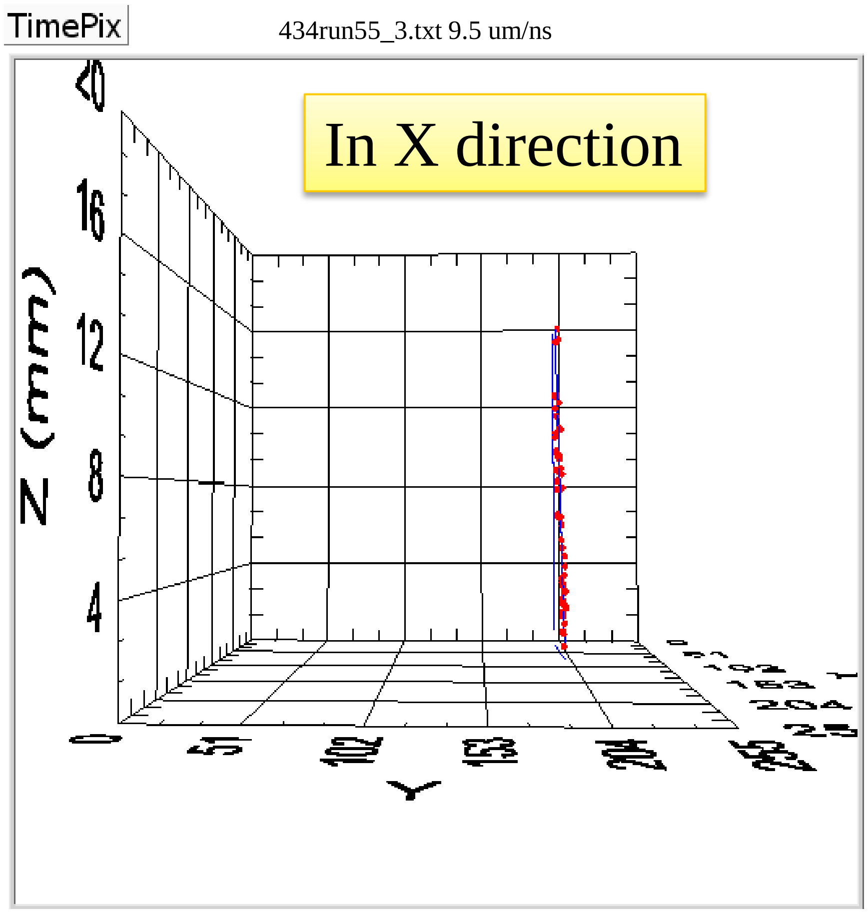
Typical event in all 4 detectors (angle 10°)



DME/CO_2 has big advantages wrt diffusion

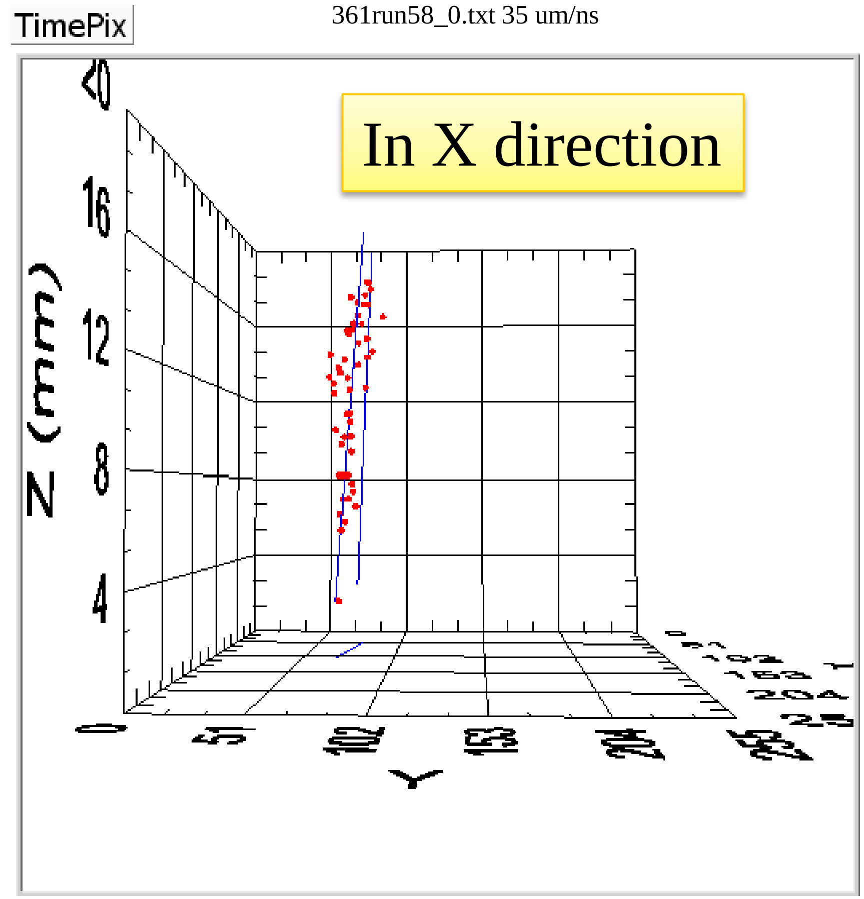
DME/CO_2 50/50

434run55_3.txt 9.5 um/ns



Ar/iC_4H_{10} 80/20

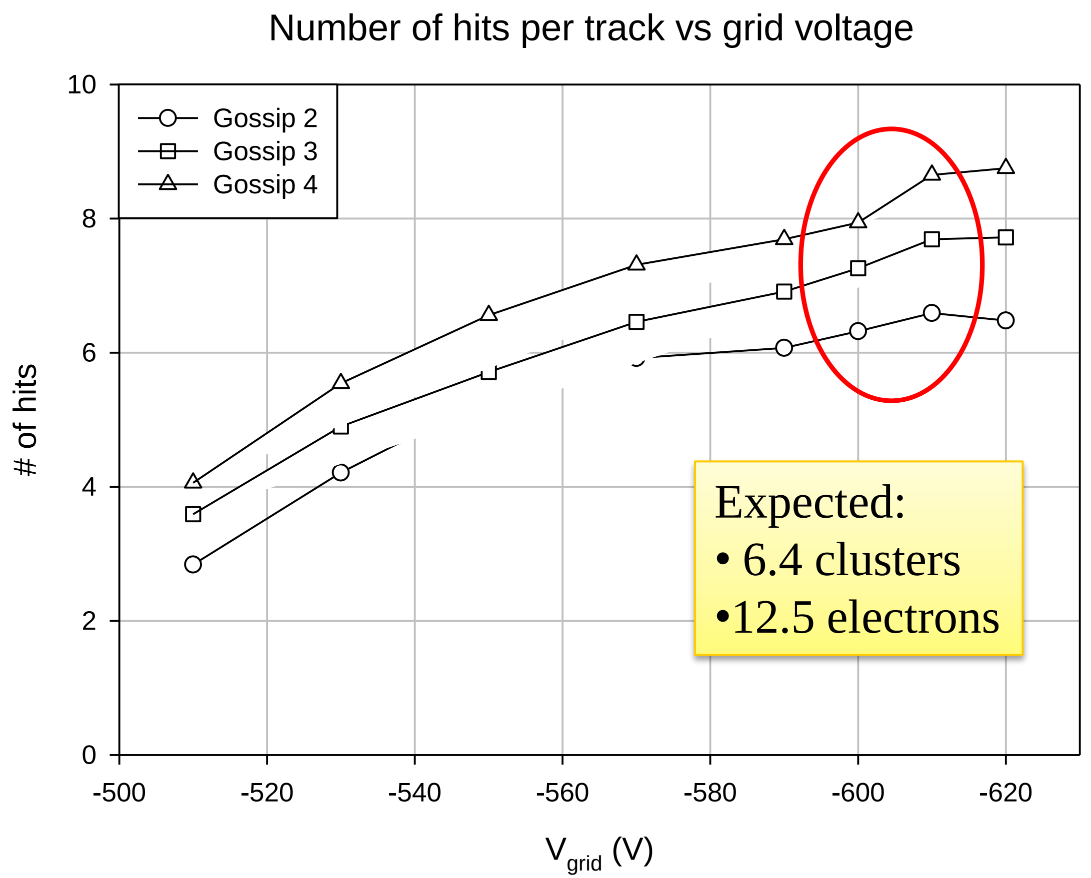
361run58_0.txt 35 um/ns

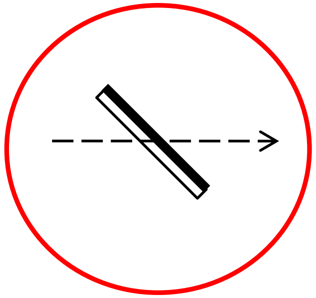


Number of hits per track in Gossip vs grid voltage

- **Unexpected difference** between the three Gossips
  - If drift gap of Gossip 3 were 1.0 mm, then Gossip 4 =>1.13 mm and Gossip 2 => 0.84
  - => not consistent with metrology (differences of 40 µm)

Tracks under 45°

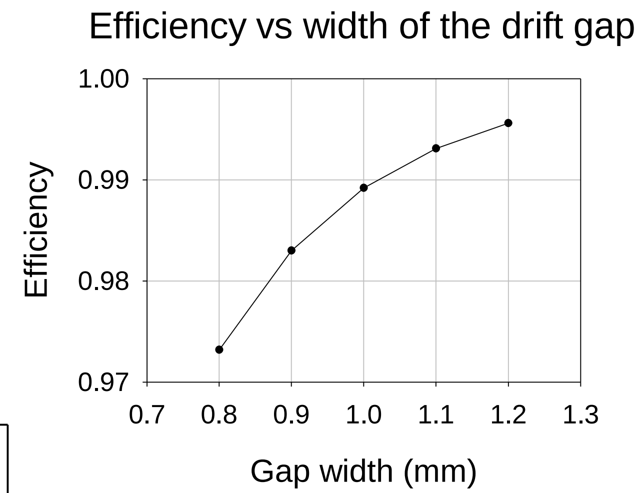


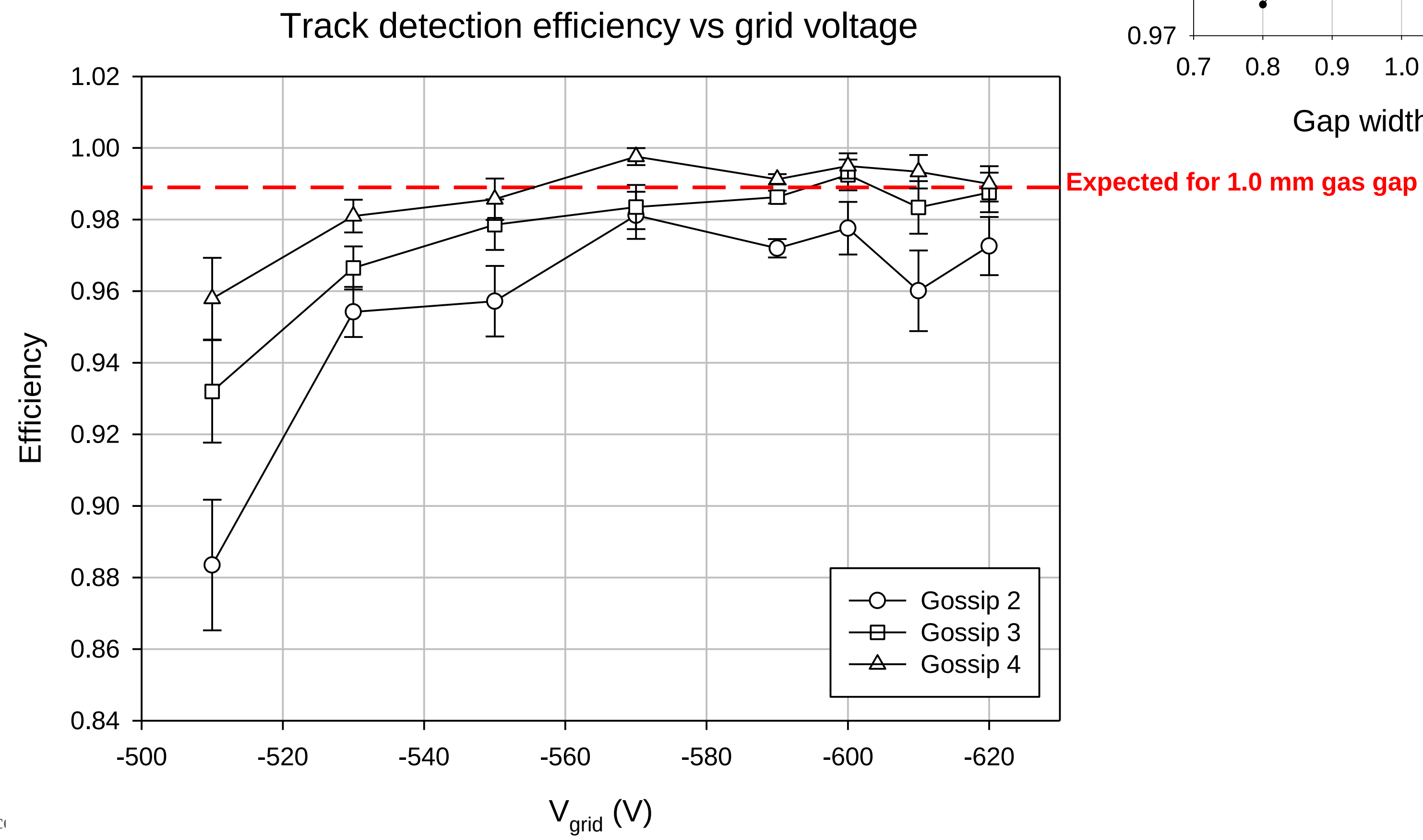


Expected:
- 6.4 clusters
- 12.5 electrons

Track detection efficiency

- Tracks selected by GridPix detector
- Completely flat plateau from ~ -570 V on
- Expected for 1.0 mm DME/CO_2: 98.9%





UPDATE AT RD51 COLLABORATION MEETING BARI

Beam Test Facilities Working Group - WG7

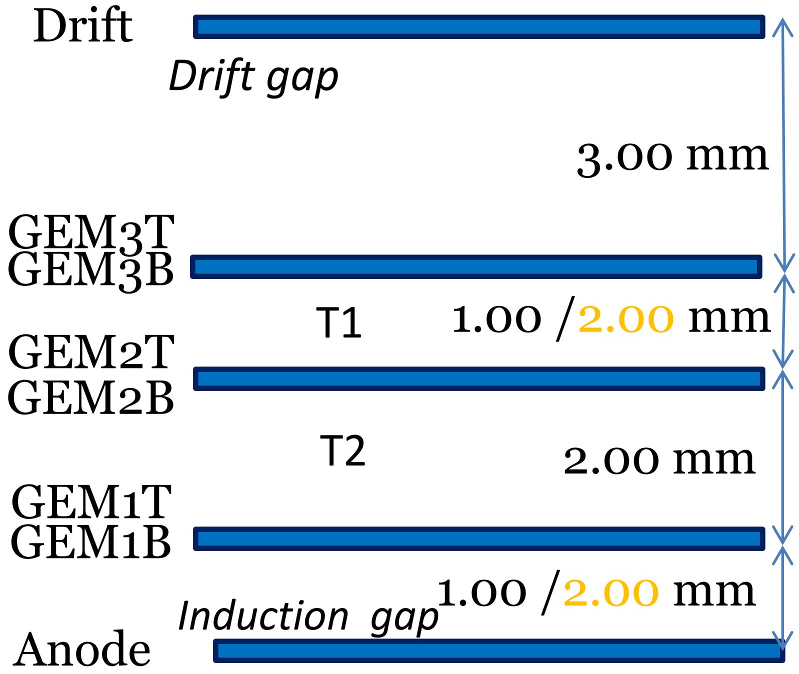
A High Eta Forward Muon Trigger & Tracking detector for CMS

Archana Sharma
For CMS High Eta Upgrade Team
(CMS, GDD and RD51)

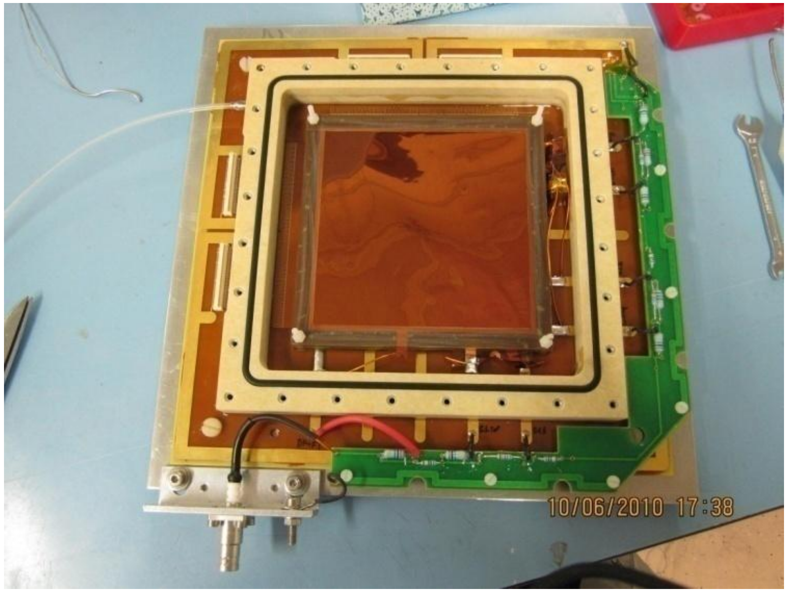
Oct 8-11, 2010

Prototype Description 1/3

Triple GEM (standard)



- GEMs active area: 10 x 10 cm²
- Double mask standard GEM
- 1D readout
- Gas mixture:
- Ar/CO_2 (70/30, 90/10)
- Ar/CO2/CF4 (45/15/40, 60/20/20)
- Gas flow: ~ 5 l/h



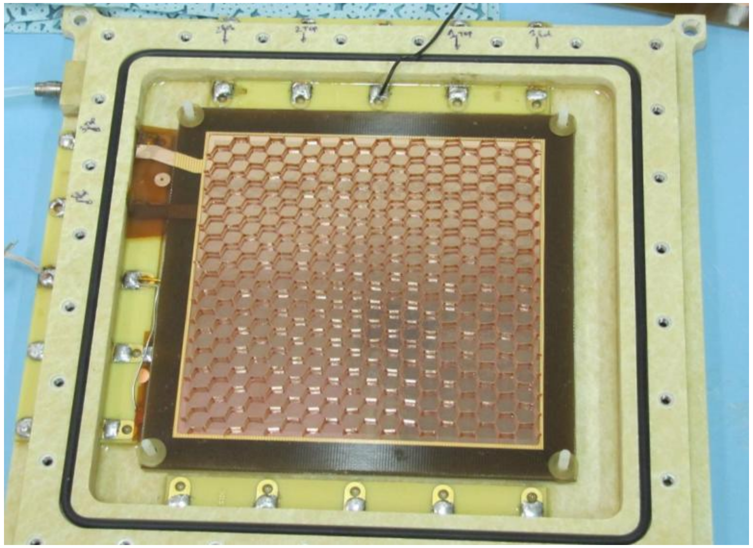
Prototype Description 2/3

Triple GEM (honeycomb)

The GEM containing honeycomb worked without any problem during the data taking.

HONEYCOMB STRUCTURES

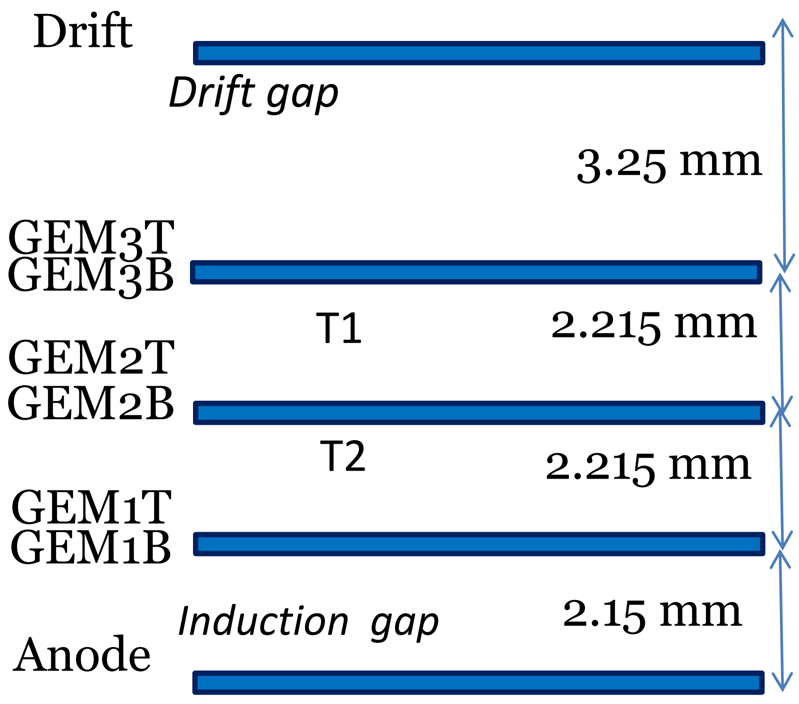
CONFIG. 1:	CONFIG. 2:	CONFIG. 3:
12mm(Drift) / *12mm*(T1) / *12mm*(T2) / *12mm*(Induction)	*6mm*(Drift) / *12mm*(T1) / *12mm*(T2) / *12mm*(Induction)	*6mm*(Drift) / *0mm*(T1) / *0mm*(T2) / *0mm*(Induction)



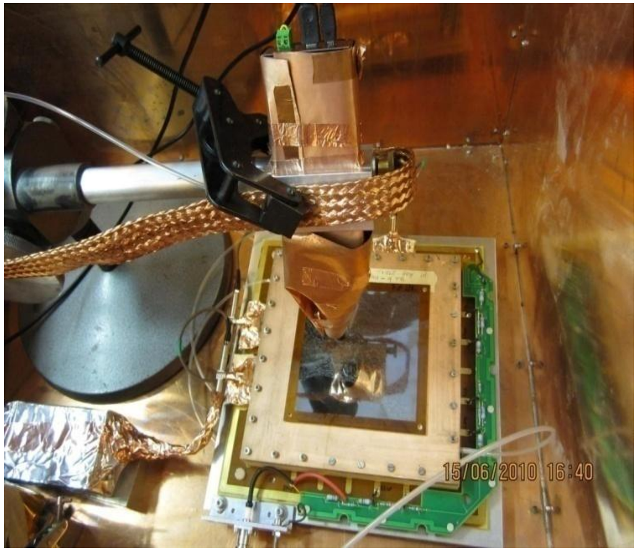
Honeycomb will allow to avoid GEM foil stretching!

Prototype Description 3/3

Triple GEM (single mask)



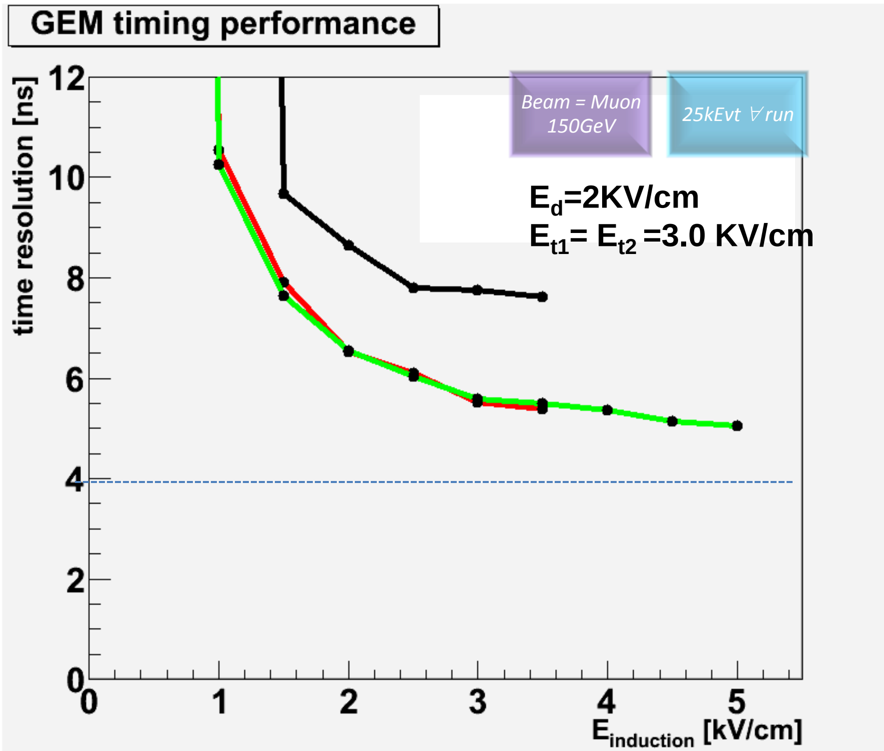
- GEMs active area: 10 x 10 cm²
- Single mask GEM
- 2D readout
- Gas mixture:
- Ar/CO_2 (70/30, 90/10)
- Ar/CO2/CF4 (45/15/40, 60/20/20)
- Gas flow: ~ 5 l/h

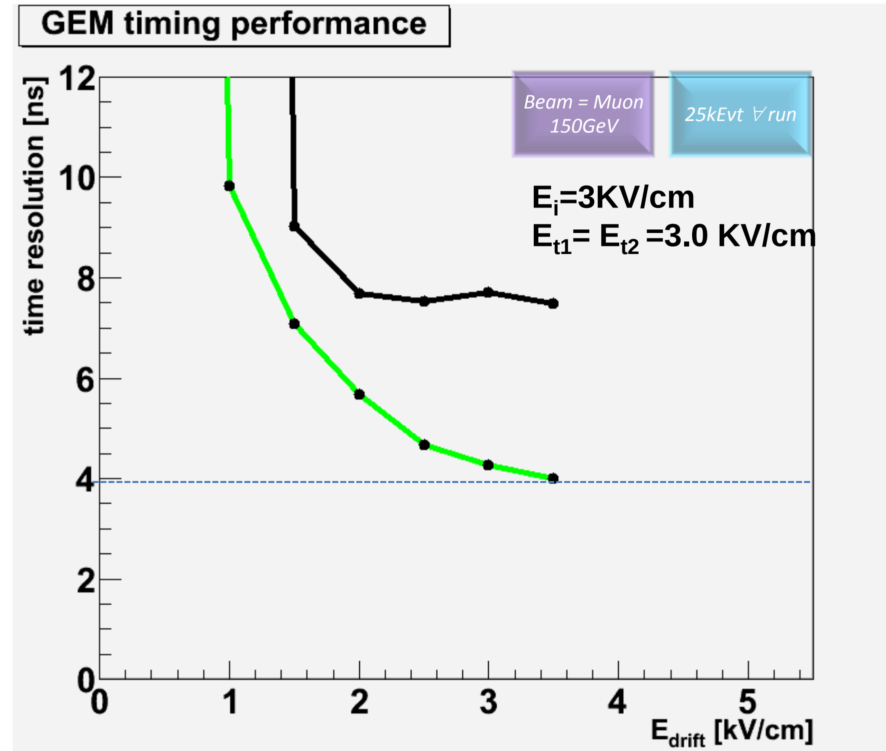


This technlogy has been used for large size detector and mass production!

Data Analysis: Timing Studies

Reached time resolution of 4ns (σ)





Standard GEM

- $Ar(70):CO_2(30)$
- [gaps 3/2/2/2]

Standard GEM

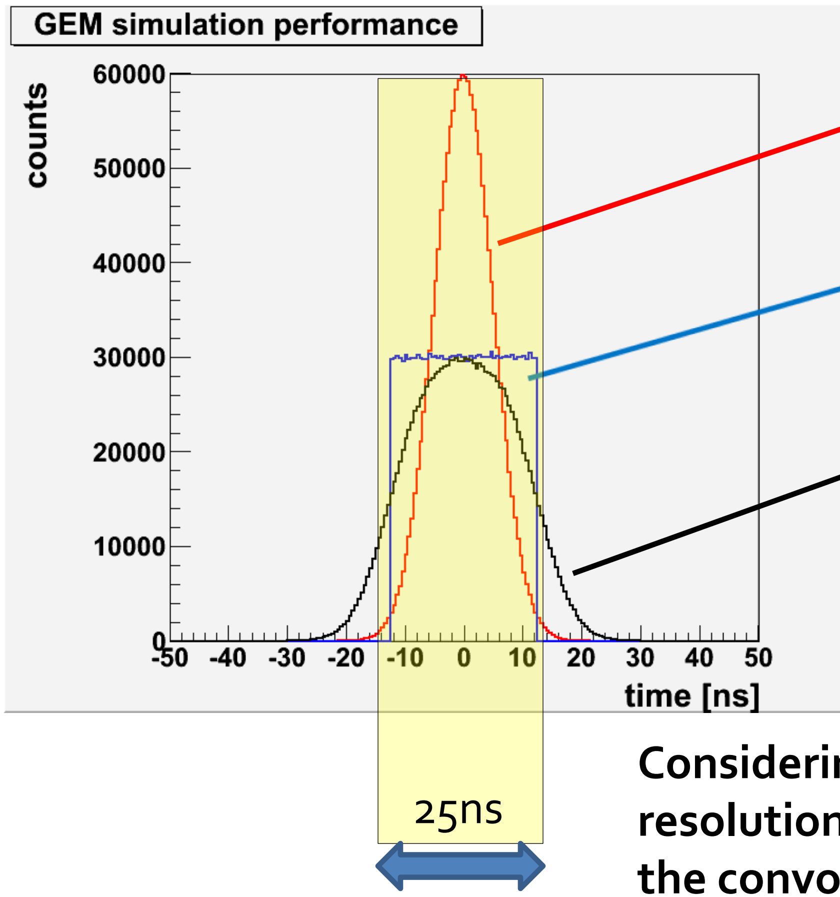
- $Ar(45):CO_2(15):CF_4(40)$
- [gaps 3/2/2/2]

Standard GEM

- $Ar(45):CO_2(15):CF_4(40)$
- [gaps 3/1/2/1]

VFAT chip: clock issue

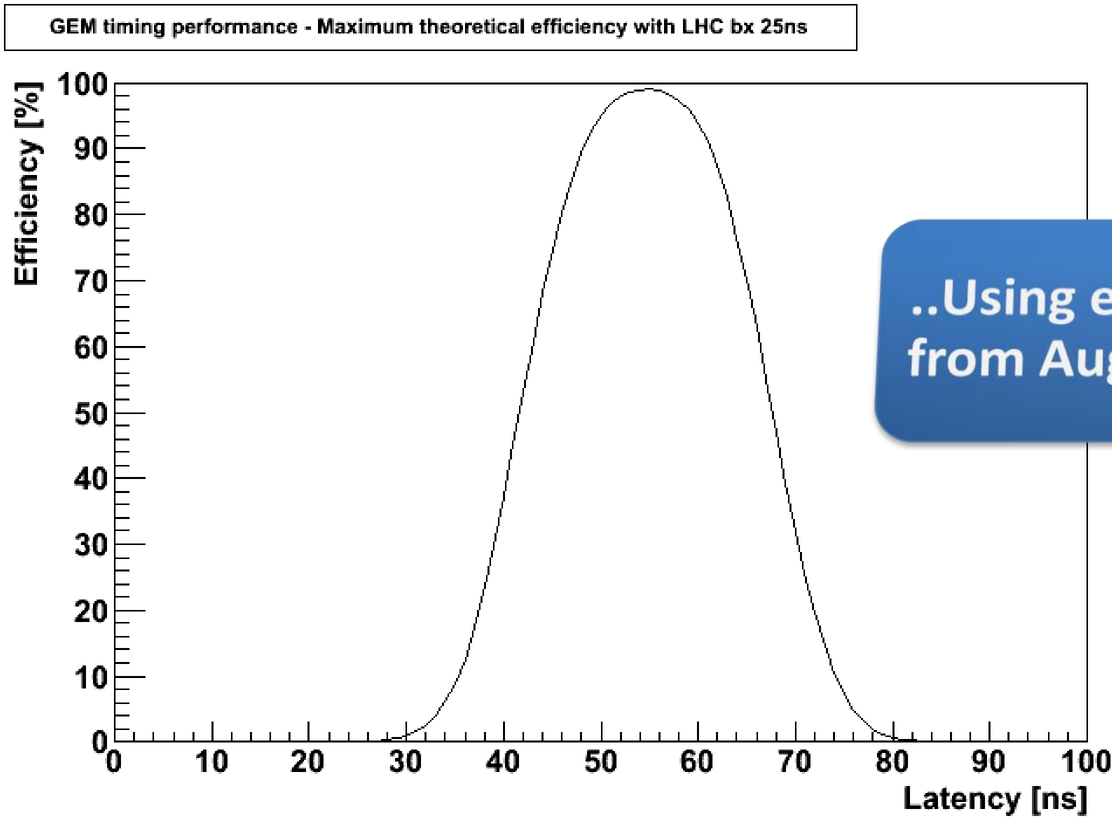
VFAT output digital signals are synchronous to VFAT clock (40Mhz, 25ns), therefore the chip is introducing a jitter to the detector signal. This is especially critical when MSPL=1.



Considering MSPL=1 (25ns) a gaussian time resolution with rms=5ns will work at full efficiency, the convoluted distribution no!

Simulating LHC conditions

In order to remove the VFAT jitter the clock of the chip and LHC should be synchronized to achieve fully efficiency.



..Using experimental data from August Test Beam..

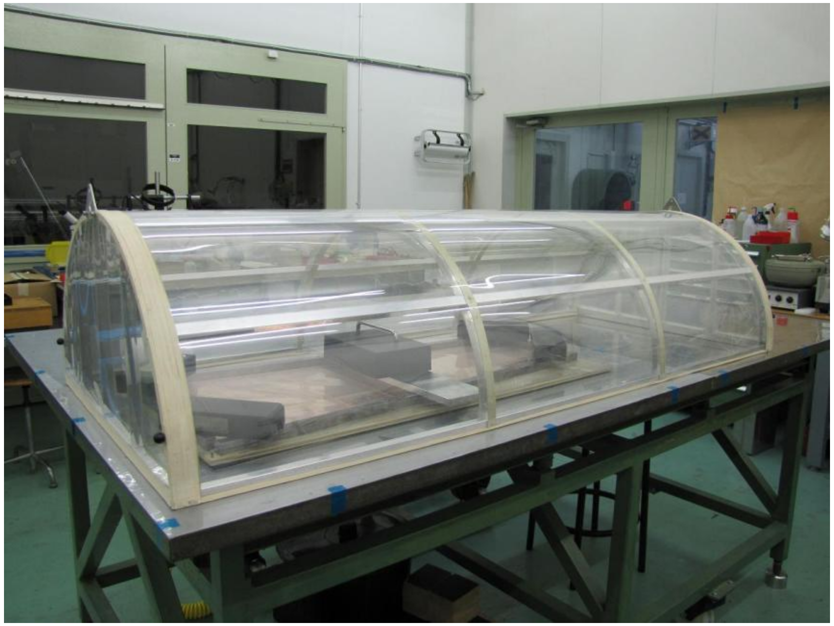
Considering MSPL=1 (25ns) a Gaussian time resolution with rms=5ns will work at full efficiency, the convoluted distribution no!

OUTLOOK FOR OCTOBER BEAM TEST

Test the large area CMS prototype for:

Gain uniformity, efficiency, noise, electronics …

Test small prototype in magnetic field

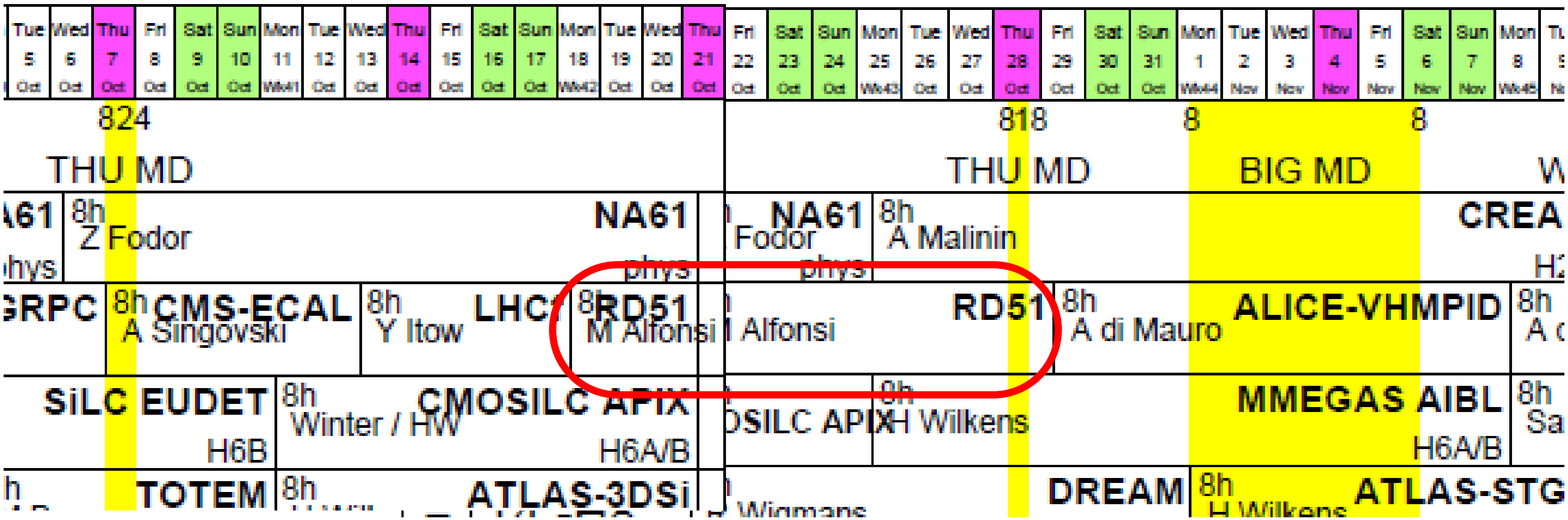


RD51 –WG7

Next test beam in October

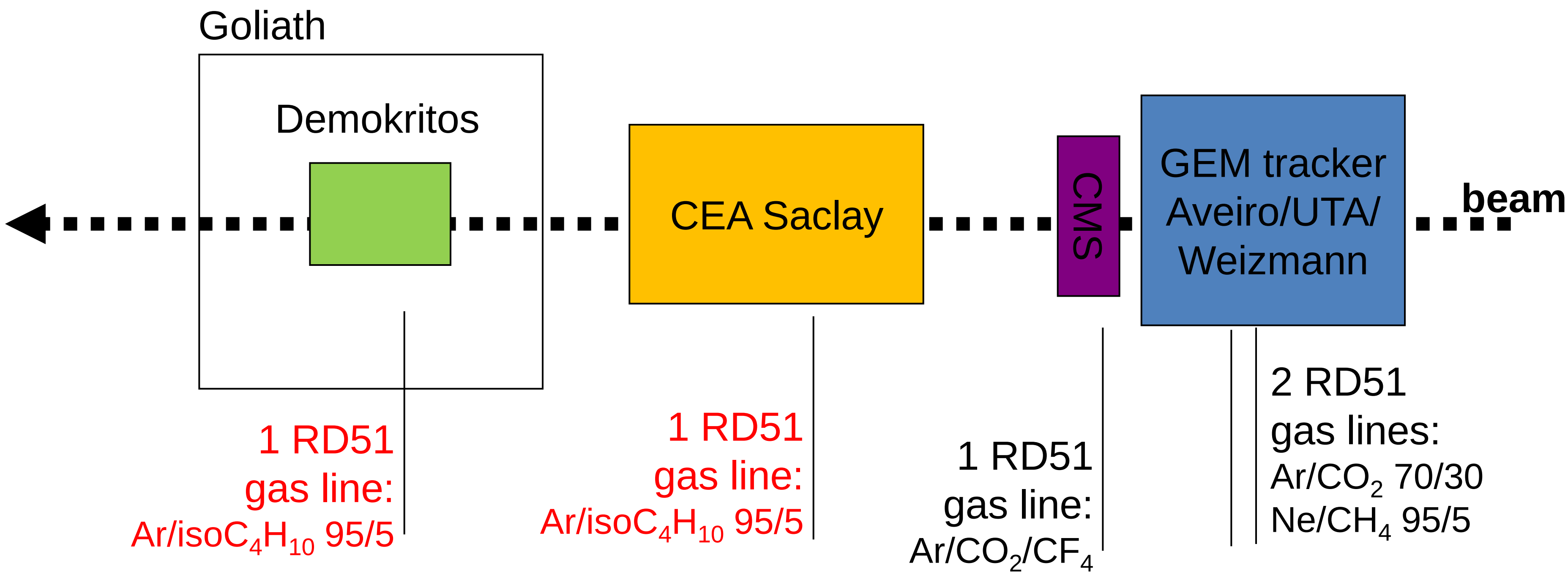
Matteo Alfonsi (CERN)

Next test beam in October



- 10.5 effective days from October 18th to 29th
- LHCf will run parassitically with us, and they could ask for one more day
- Many people would prefer dismounting on the small MD of Thursday 28th, we could give such a day to LHCf..

Period 3 (October 18th to 29th)



- Magnet and flammable gas

irfu cea saclay

Tests on resistive and GEM foil Micromegas

by CEA Saclay Clas and COMPASS groups

R&D in progress for future detectors at Clas and Compass

Compass: tracking with high hadron flux, including in beam area

Clas: high particle flux, important magnetic field (parallel and perpendicular)

Goals of October beam test studies

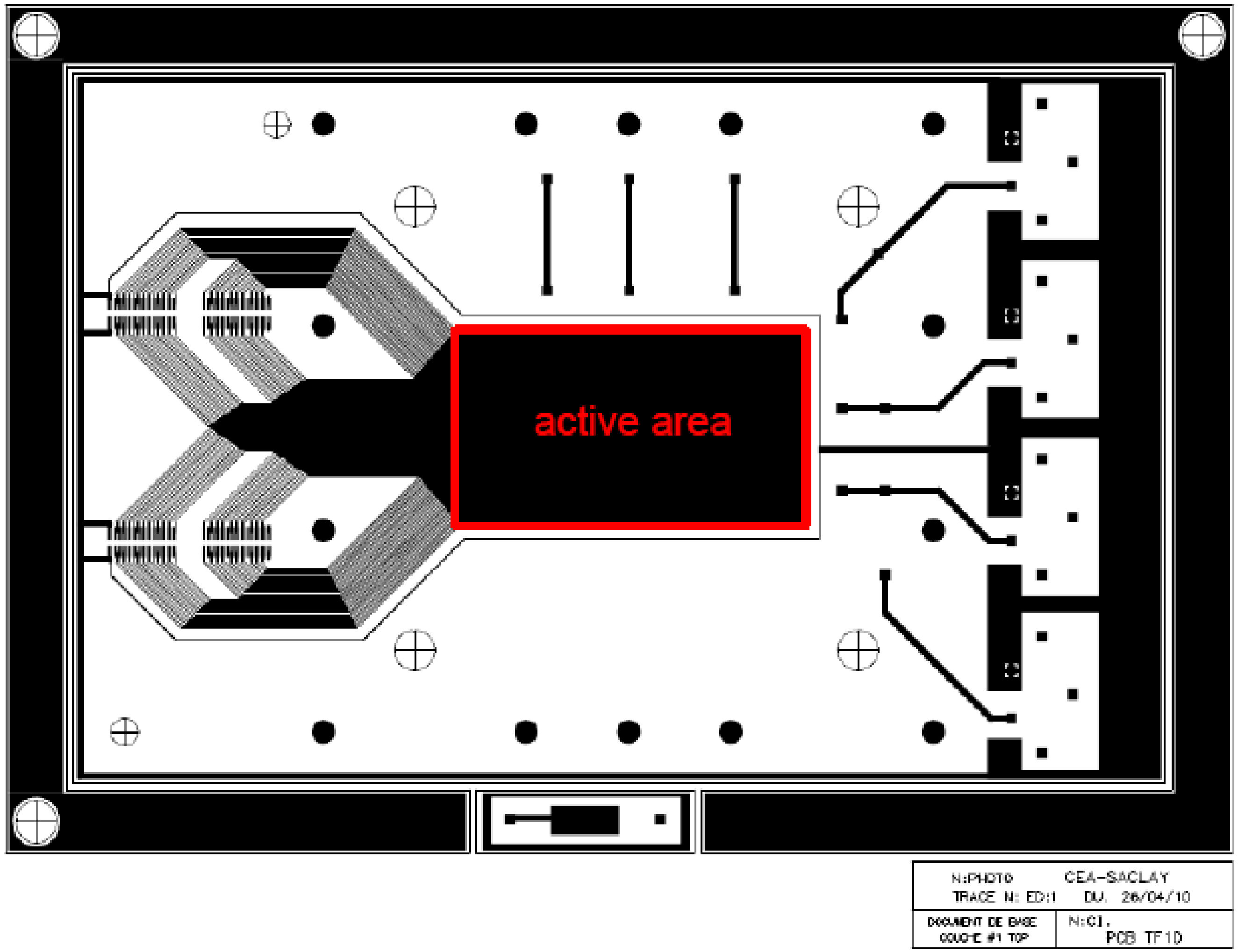
detector performances measured with muon beam

discharge rate reduction at high hadron flux (resistive layer, GEM foil)

Scheme of detectors

Standard 6x10cm detectors

144 strips with 400µm pitch



irfu
cea
saclay

Overview of detectors to study

Detectors taken as reference

4 standard bulk 5mm ionization + 128µm amplification built at Saclay and at CERN

Resistive detectors

1 bulk with resistive kapton foil (1MOhm/²) on 50µm prepreg layer

1 bulk with resistive paste (20MOhm/²) on prepreg layer

2 bulks with resistive paste on strips + coverlay walls

2 bulks with resistances buried underneath strips (from CERN TSDEM lab)

Detectors with GEM foils and others

1 standard bulk with 2mm ionization gap

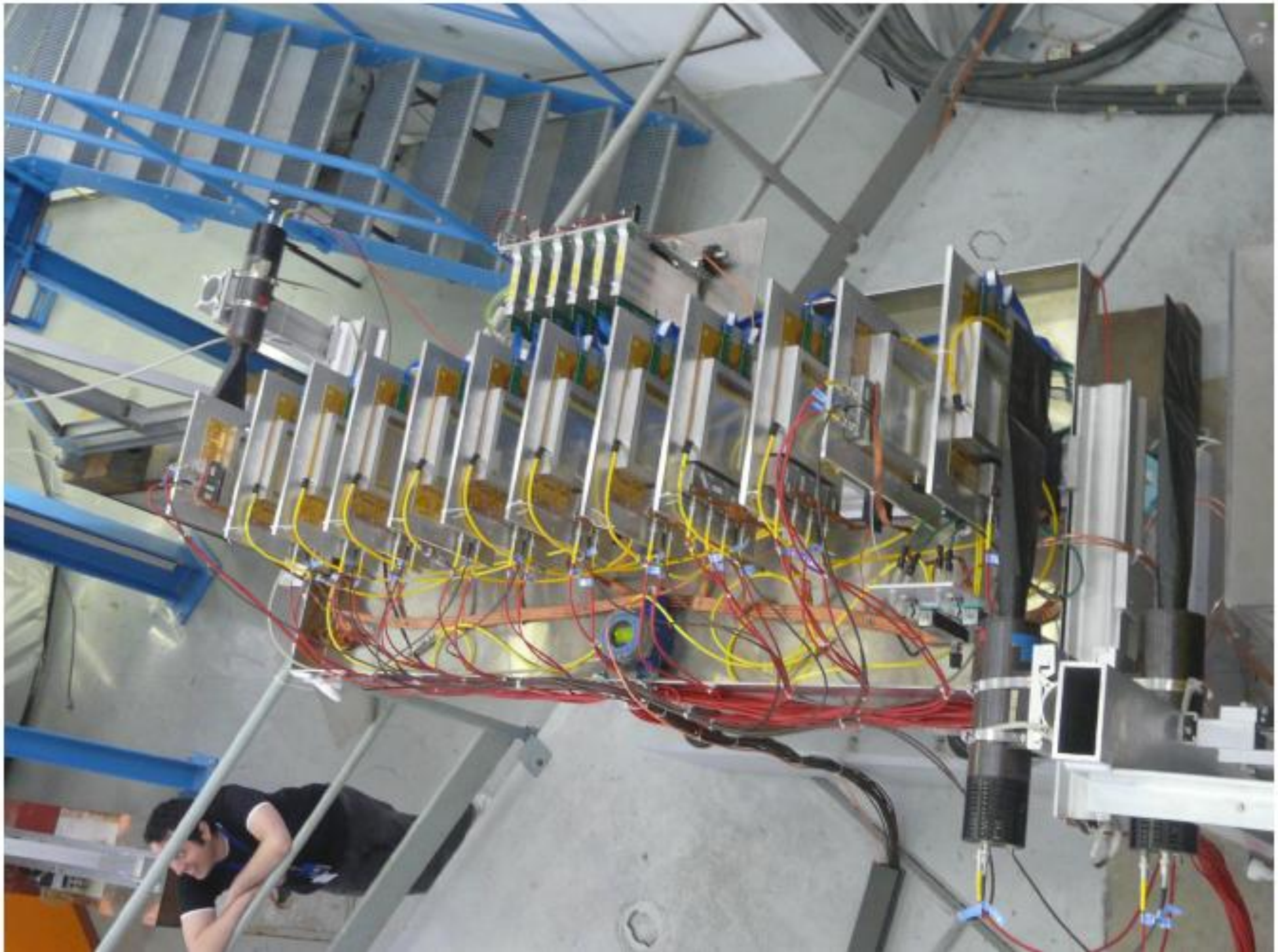
1 standard bulk with thin inox mesh electrode

2 bulks with additional GEM foil

Foreseen setup

10 detectors in front of Goliath magnet

Mechanical structure already exists



Foreseen measurements and setup

2 DAQs: AFTER/T2K and discharge counting

Scans to be done

- mesh HV (~5-10 points), drift HV (~5 points)
- GEM HV for GEM foil prototypes (~5 points)

Experimental set-up

- table installed in front of Goliath magnet (>2m long)
- 10 detectors mounted in the same time including 4 permanent std bulk MM
- external trigger from 3 local scintillators
- mostly high flux hadron beam and muon beam

Period requested: 18 to 25 October

Communications & Reminders

The filled ISIEC form

- You can find the ISIEC form to be filled attached in the agenda.
- Please send the filled ISIEC to:

Yorgos Tsipolitis yorgos@central.ntua.gr

Matteo Alfonsi matteo.alfonsi@cern.ch

by next Tuesday (IT IS URGENT!)

Next WG7 meeting

- For the finalization of the October test beam setup
- Wednesday 13^{th} of October at 14:00 GVA time

Test beam requests for 2011

- To join RD51 test beam campaign in 2011, fill the relevant form. You can find it attached in the agenda or at: http://spsschedule.web.cern.ch/SPSschedule/2011/BeamRequest2011.doc
- Send the filled form to:
  Yorgos Tsipolitis yorgos@central.ntua.gr
  Leszek Ropelewski Leszek.Ropelewski@cern.ch
  Maksym Titov titov@mail.desy.de
- A common request will be send to the SPS coordinator