RD 51 Collaboration meeting
THGEM photon detector for RICH application, 2010 test beam goals and program

Outline:

- 2009 test beam result
  - -setup description
  - -results
  - What we learnt

- 2010 setup
  - -Program for the first test beam
  - - Goals and objectives

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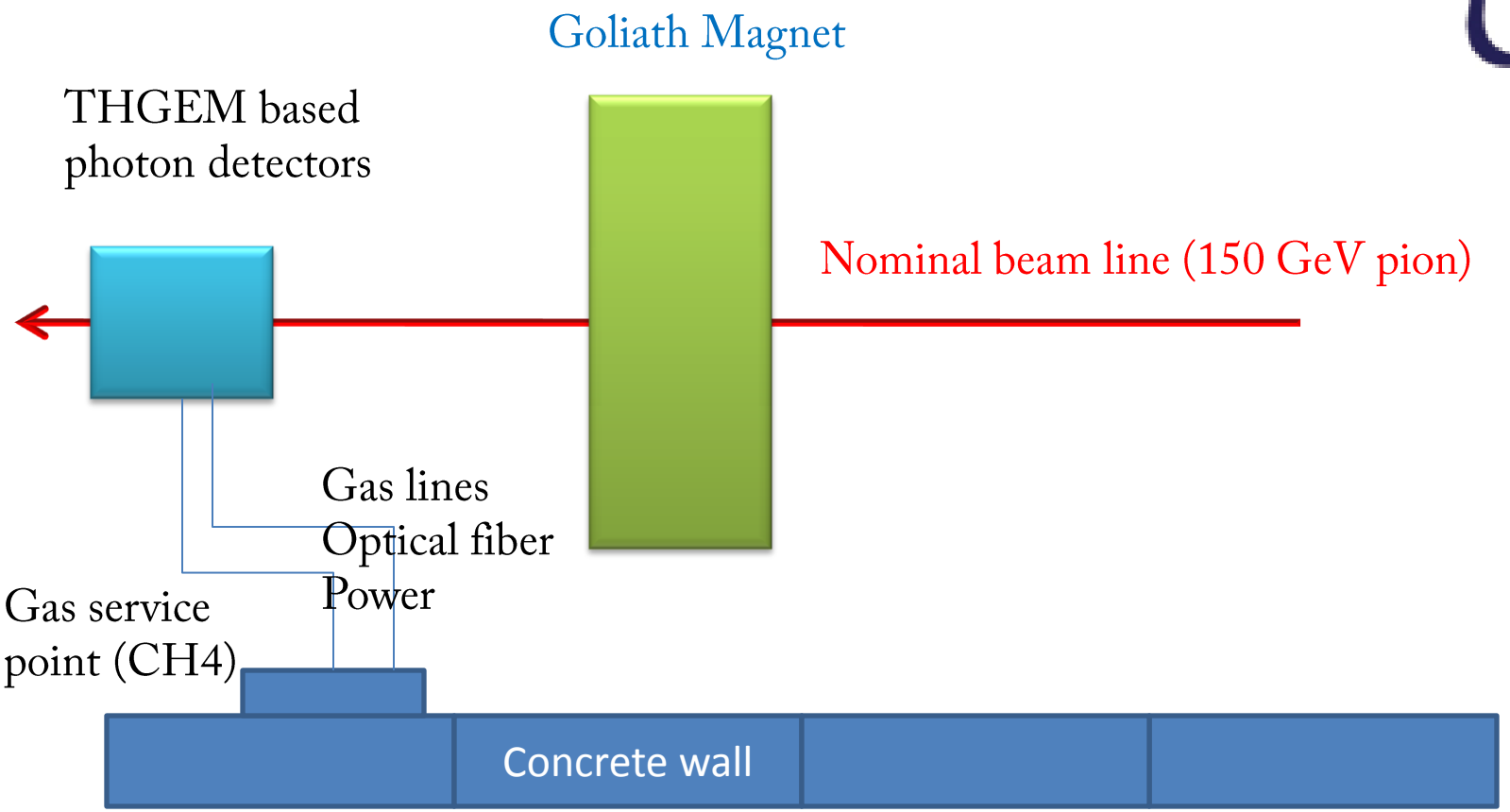
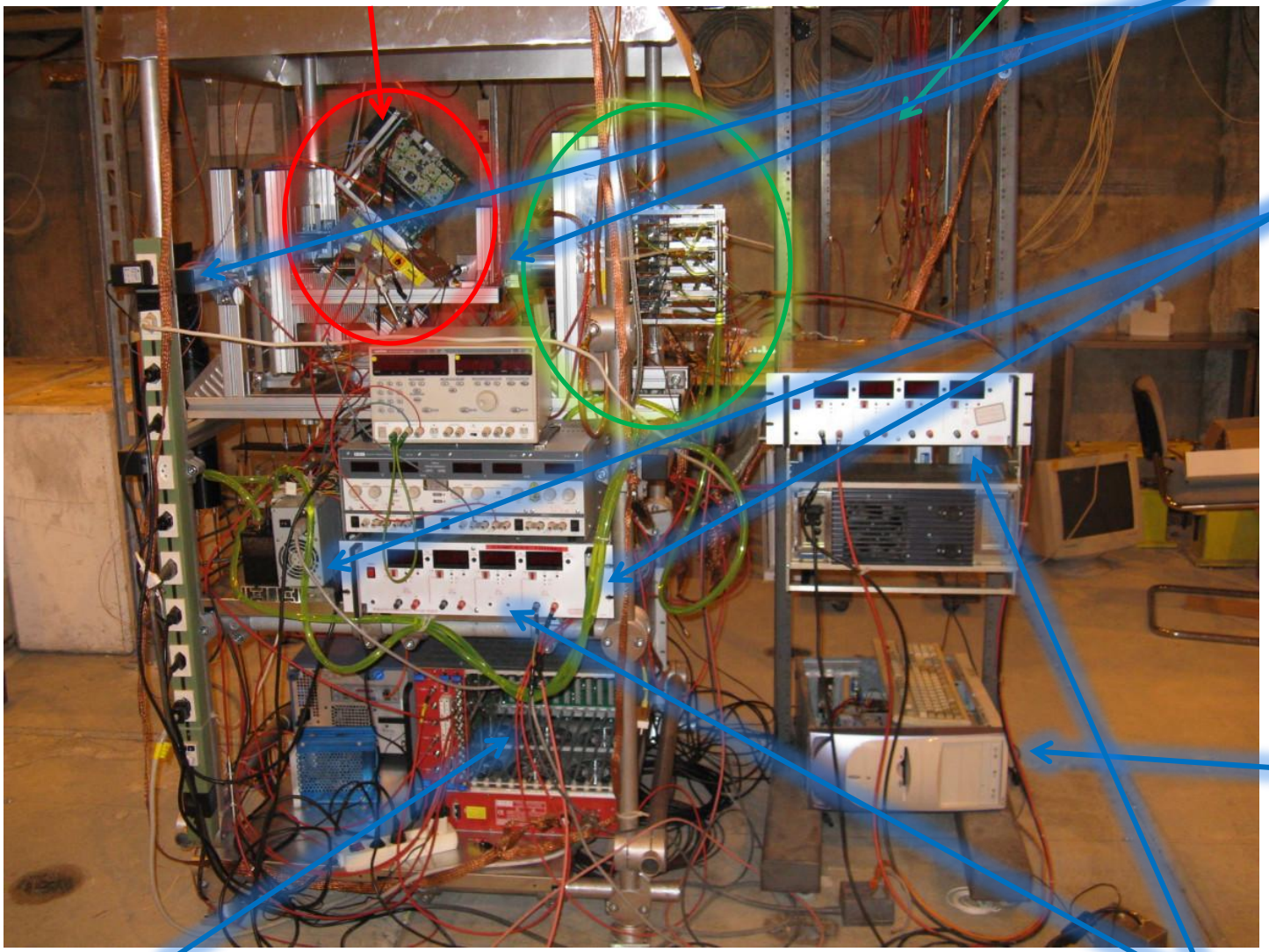
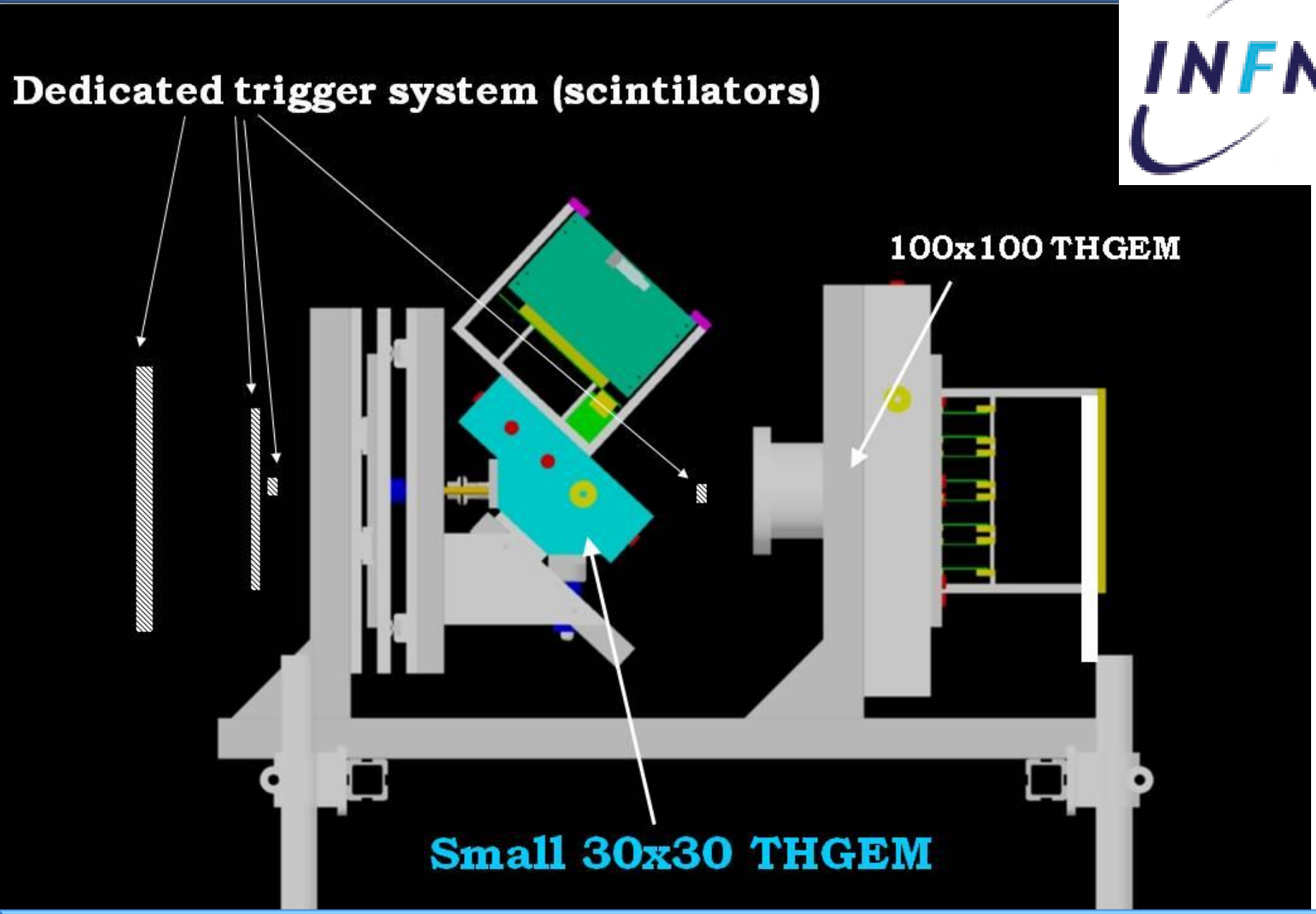
Alessandria, CERN, Freiburg, Liberec, Prague, Torino, Trieste Collaboration

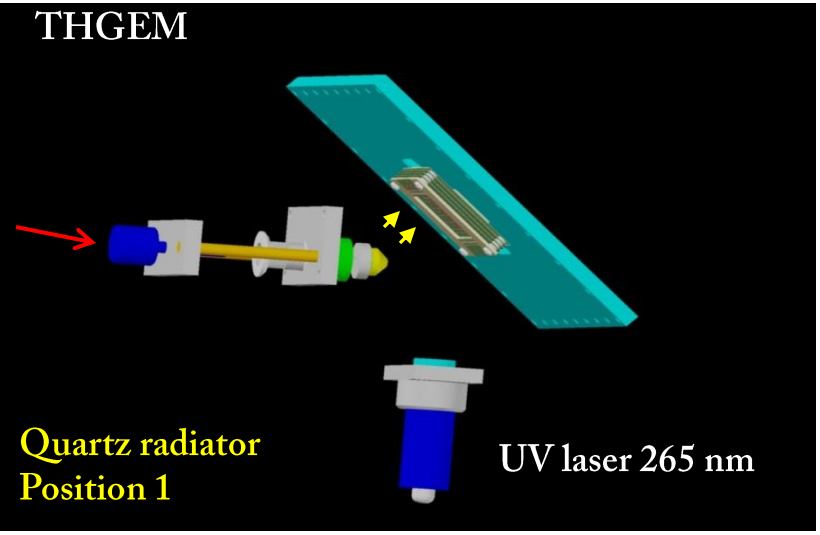

Goliath Magnet
THGEM based photon detectors
Nominal beam line (150 GeV pion)
Gas lines
Optical fiber
Power
Gas service point (CH4)
Concrete wall

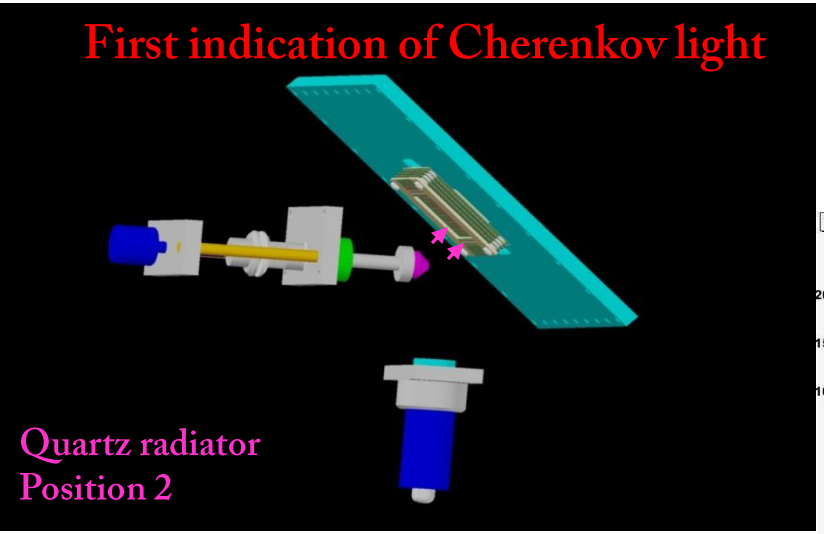

100 mm x 100 mm triple THGEM detector
Trigger System
30 mm x 30 mm triple THGEM detector
Cooling System
Remote Controlled PC
HV Power units
LV front end

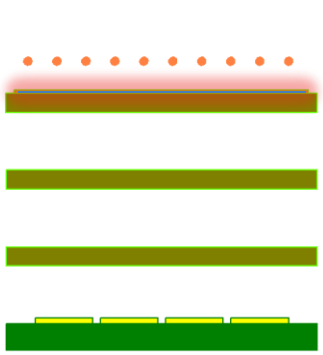

Dedicated trigger system (scintilators)
100x100 THGEM
Small 30x30 THGEM

Triple THGEM (CsI) Ar/CH_4 50/50 Diam=0.4 mm, pitch =0.8, Thick=0.4, rim ≤10 μm (GE)

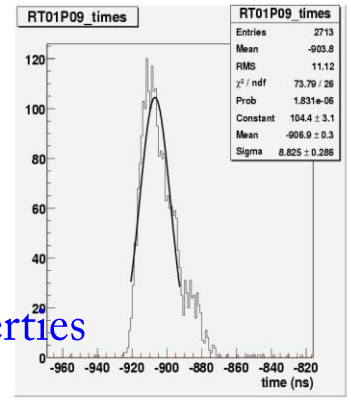
2 different positions of radiator (change of 20mm)

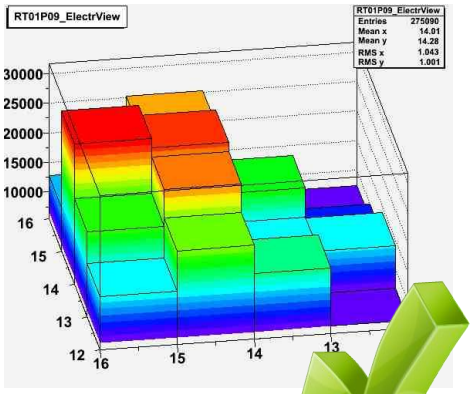


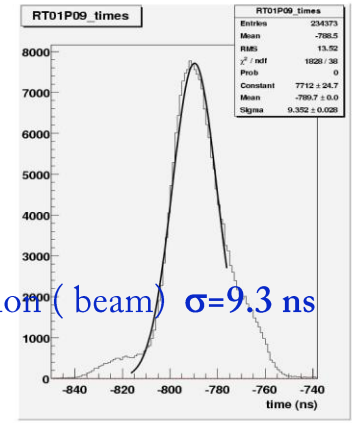




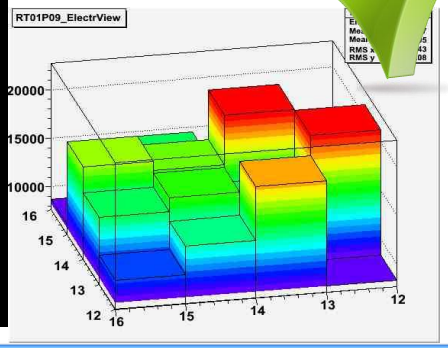
Timing properties





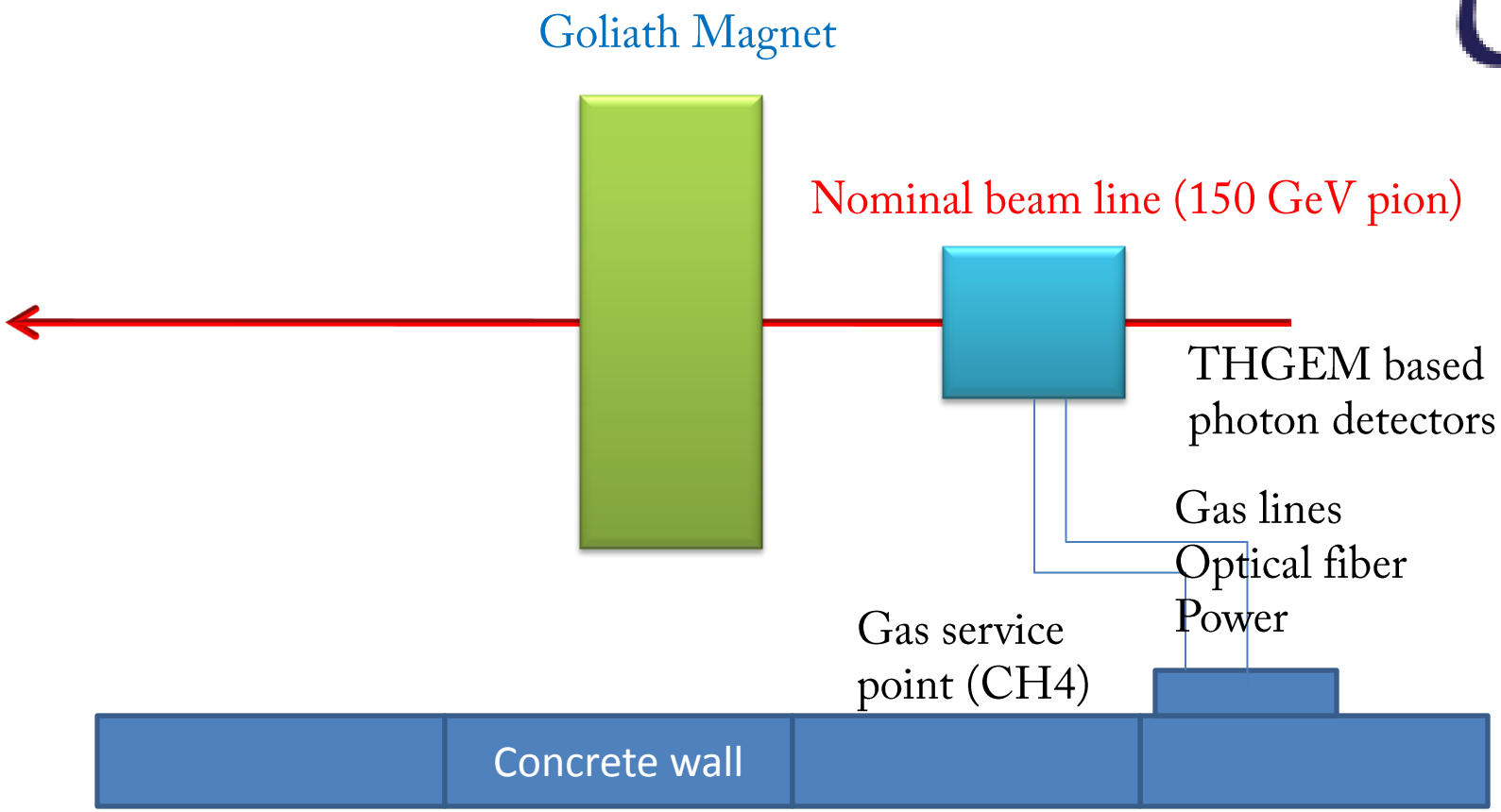


Time resolution (beam) σ=9.3 ns



Max. sustainable gain for stable operation: ~ 10^5
More studies are needed in beam conditions
(mip ionization, Ion Back Flow….)

During the First Test beam slot the detector will be installed before GOLIATH magnet



It requires the connection to a dedicated flammable gas point.
The last year gas (CH4) system distribution rack will be employed again.

Concerning the photon detectors

GOALS:

Operate a "*large*" THGEM based photon detector in beam condition and *see* Cherenkov rings

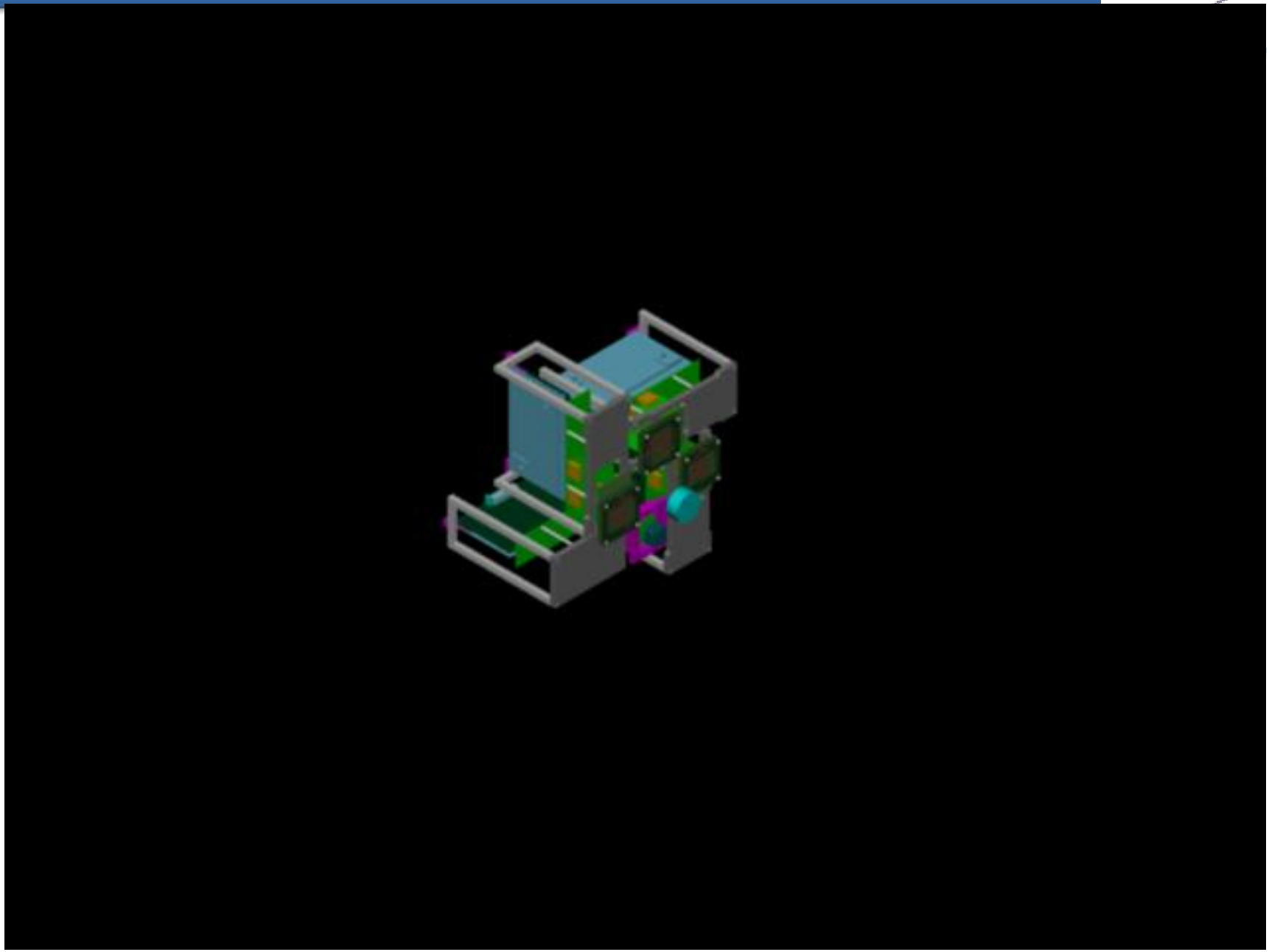
Perform a E field scan (Drift, Induction, Transfers) thanks to the new HV system (not possible last year) and check the detector response.

Test the behavior of the FE electronic coupled to a larger capacitance device with a new electronic protection circuit to save CMAD chips from damages when sparks occur

A completely new photon detector system has been designed and it's in preparation.

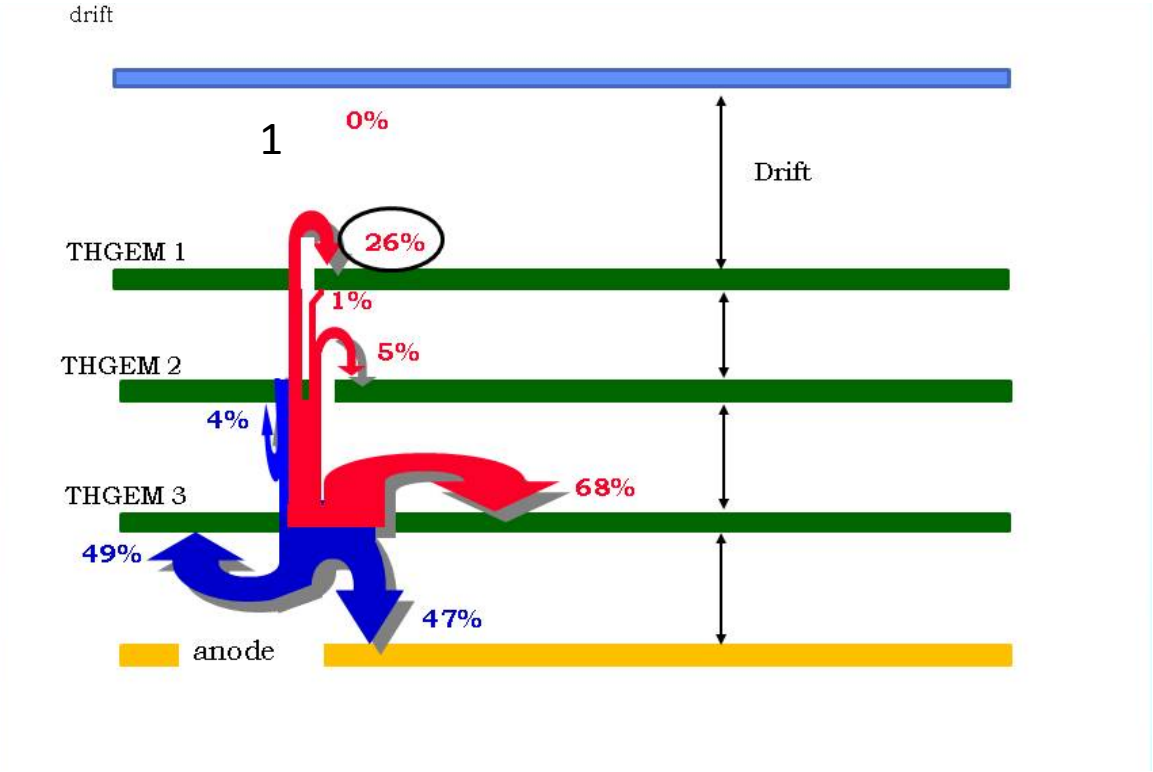
It consists of a newly designed and machined radiator lens (160 mm Cherenkov diameter) . It can be equipped at the same time with 3 independent 30mmx30mm THGEM PDs
A MAPMT R7600 will be permanently installed too.

GOALS
-Perform photon counting and extract THGEM photon detection efficiency by comparison with pmt.
- Test a possible solution for IBF reduction with one of the 3 THGEM detectors adding a dedicated electrode.



Ion Back Flow:

Main problem: Ions
-secondary *e* emission
-ion feedback
-gain & performance limitations in terms of instabilities /charge accumulation on PC



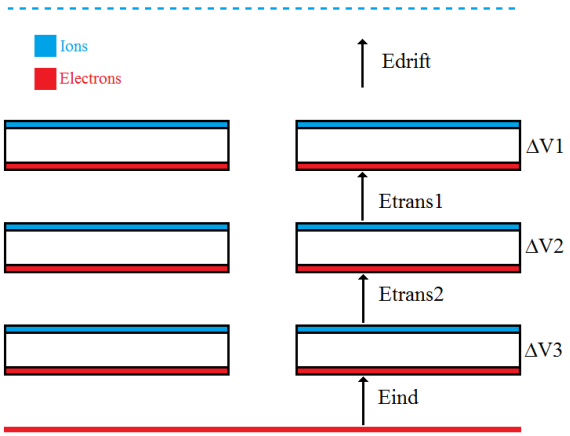
Ion Back Flow

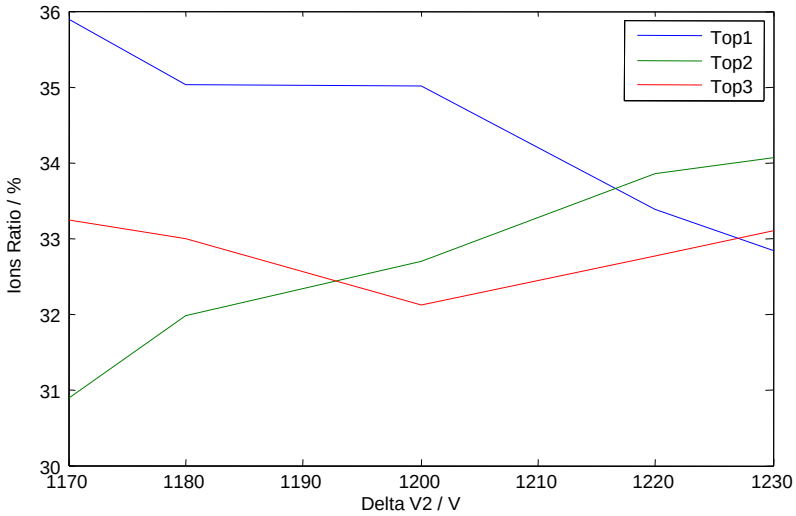
First trial: modify middle THGEM geometry
same pitch 0.8 mm and same thickness but holes from 0.4 to 0.2 mm

Induction Scan, Transfer field scan, ΔV scan and multiple combinations → *reduction possible in the order of few percent only*

E_D = 0 V/cm
E_{T1} = 500 V/cm
E_{T2} = 750 V/cm
E_I = 2500 V/cm

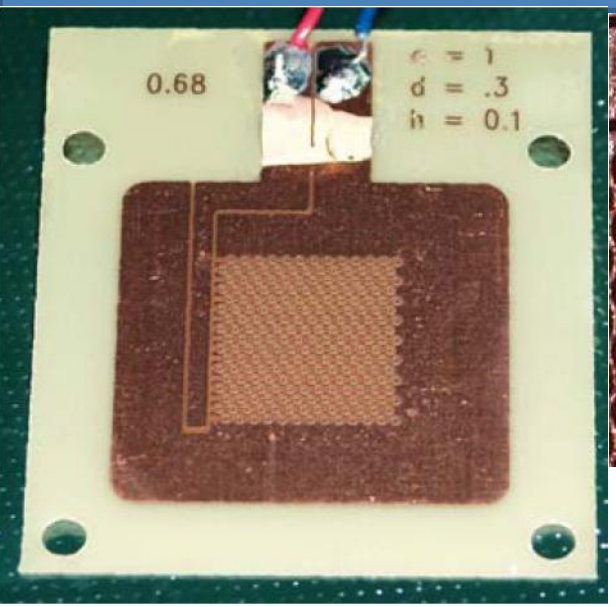
Δ V1 = 1050 V
Δ V2 = 1200 V
ΔV3 = 1000V

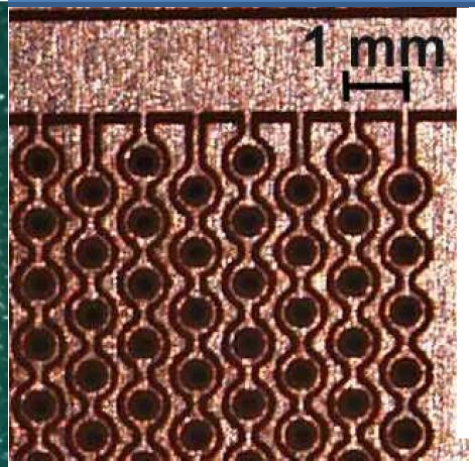


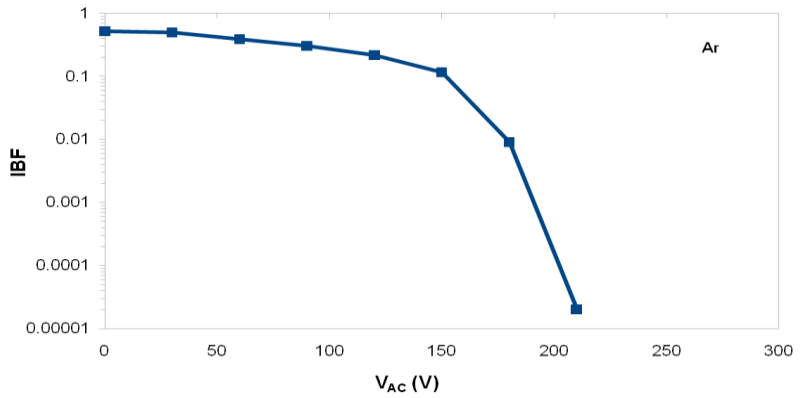


Simple geometrical solutions seem not to be sufficient, different approach needed

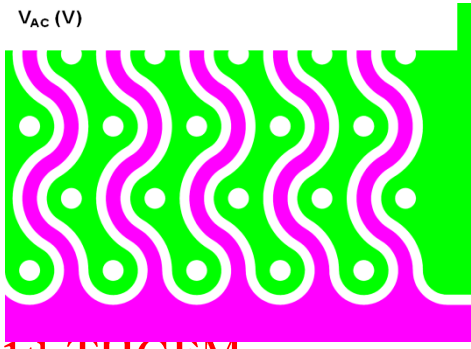
Ion Back Flow reduction







New ThickHole-Structures for Gaseous Detectors João Veloso



Single photon detection efficiency strongly affected by

Active area (electrode) / Dead area (holes) → limits on the geometry of 1th THGEM

E field on the surface → geometrical parameters of the 1th THGEM

$E_z \sim \exp(\text{diam.})$

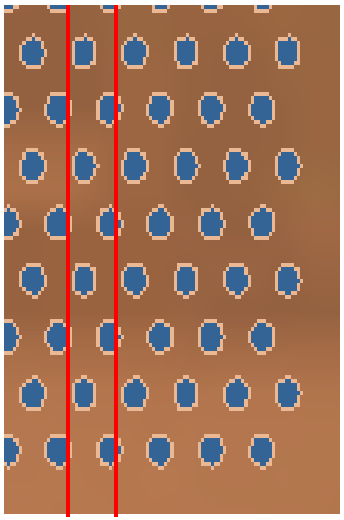
$E_z \sim 1/(\text{pitch})^4$

Impose constrains on the maximum space between electrodes for THCOBRA → pitch and hole size

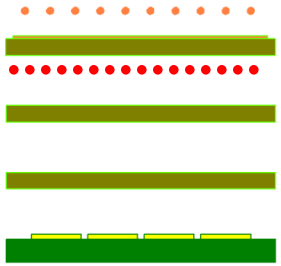
Hole	Ering	Clearance	Cobra Electrode	Pitch
400	2X80	2X80	80	800

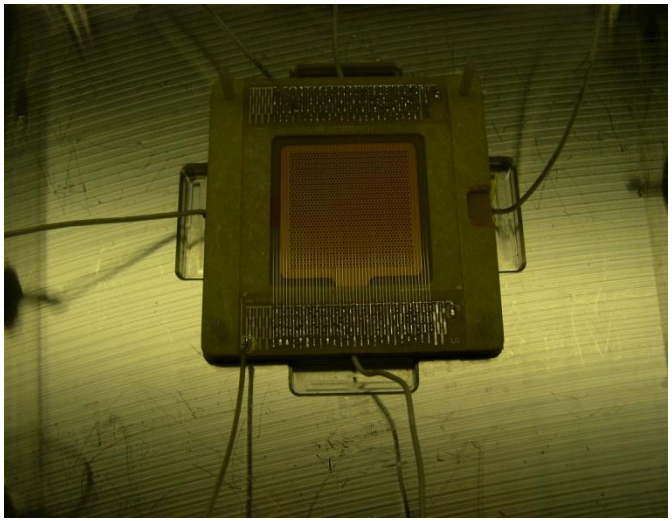
Ion Back Flow reduction

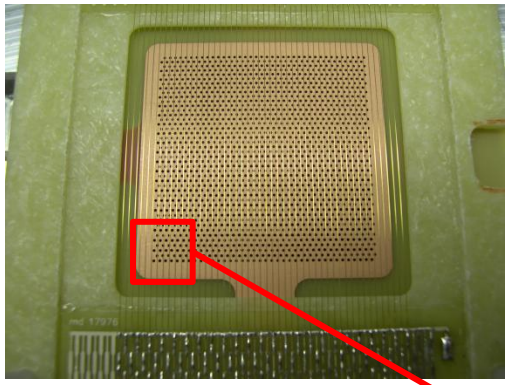
To get rid of geometrical constrains -> plane of wires facing the 1th bottom electrode



Distance from the bottom plane 500 μm
Wires spacing according to pitch of the THGEM

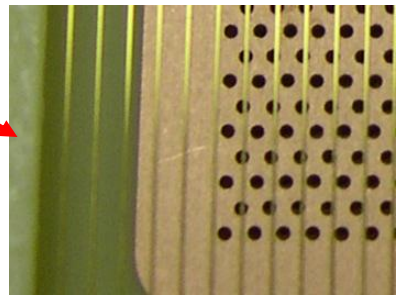




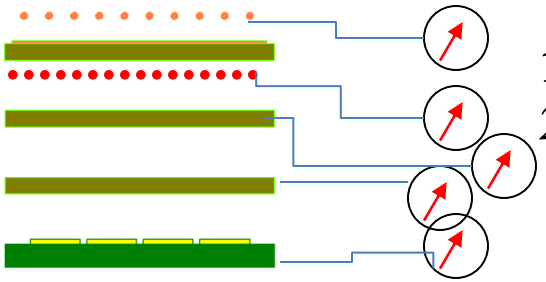


Its realization
100 μm wires

Very firs trial!



Ion Back Flow reduction

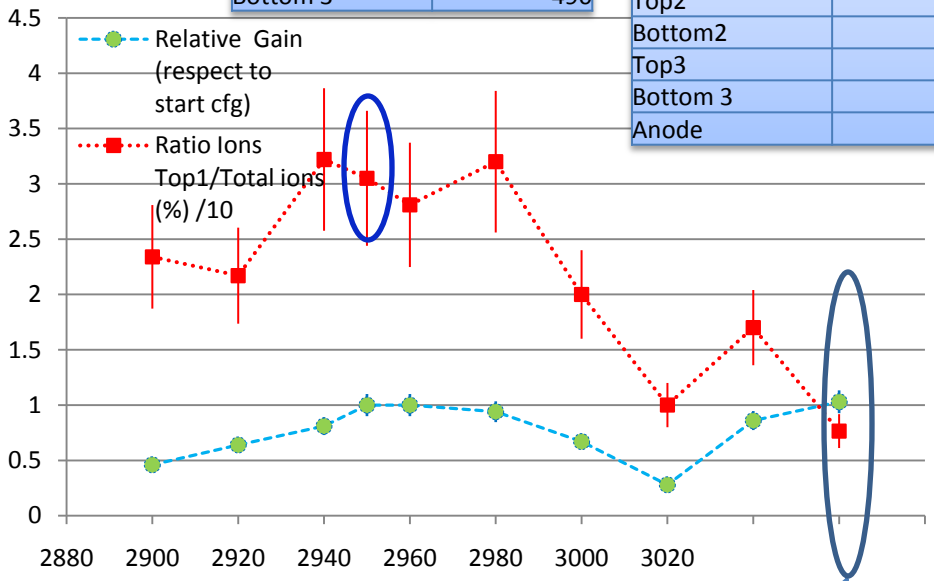


1 pA for each layer,
2mm spacing

HV	Volt
Drift	4100
Top1	4100
Bottom 1	2956
Cobra wires	3020
Top2	2807
Bottom2	1650
Top3	1510
Bottom 3	490

Anode	0
Drift	4100
Top1	4110
Bottom 1	3150
Cobra wires	3220
Top2	3000
Bottom2	1650
Top3	1510
Bottom 3	500
Anode	0

HV	Volt			E (V/cm)	Current measured
Drift	4015	Cfield	0	0	-10
Top1	4015	DV1	1059	2647.5	30
Bottom 1	2956	Edrift	16	40	0
Cobra wires	2940	Trans1	133	886.6667	0
Top2	2807	DV2	1157	2892.5	27
Bottom2	1650	Transf2	140	700	-8
Top3	1510	DV3	1020	2550	46
Bottom 3	490	Induction	490	2450	-35
Anode	0				-63



Increasing Second THGEM ΔV (200V)

Very first trial!

Other implementation possible Up to a factor 5 in ions reduction wit no gain loss!
To be investigated ! → extra electrode