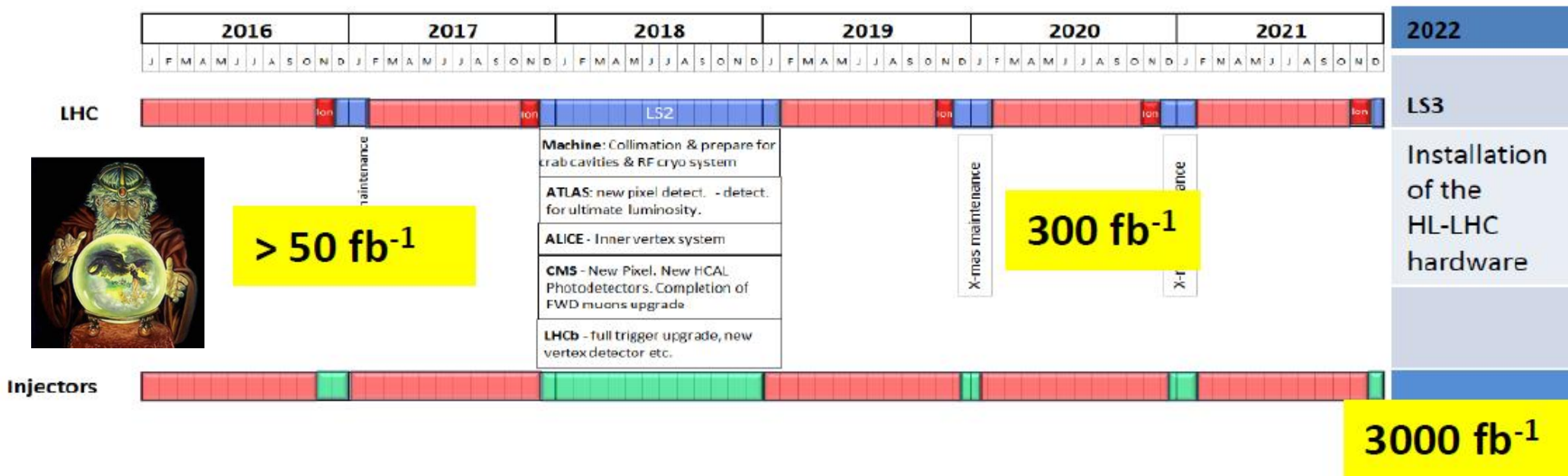
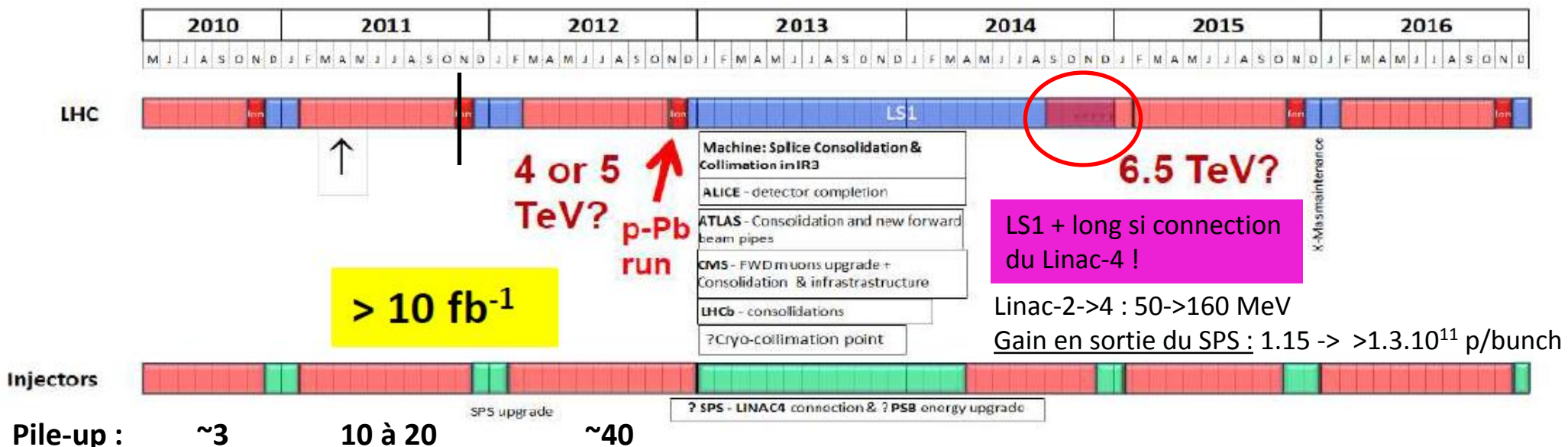


LHC schedule

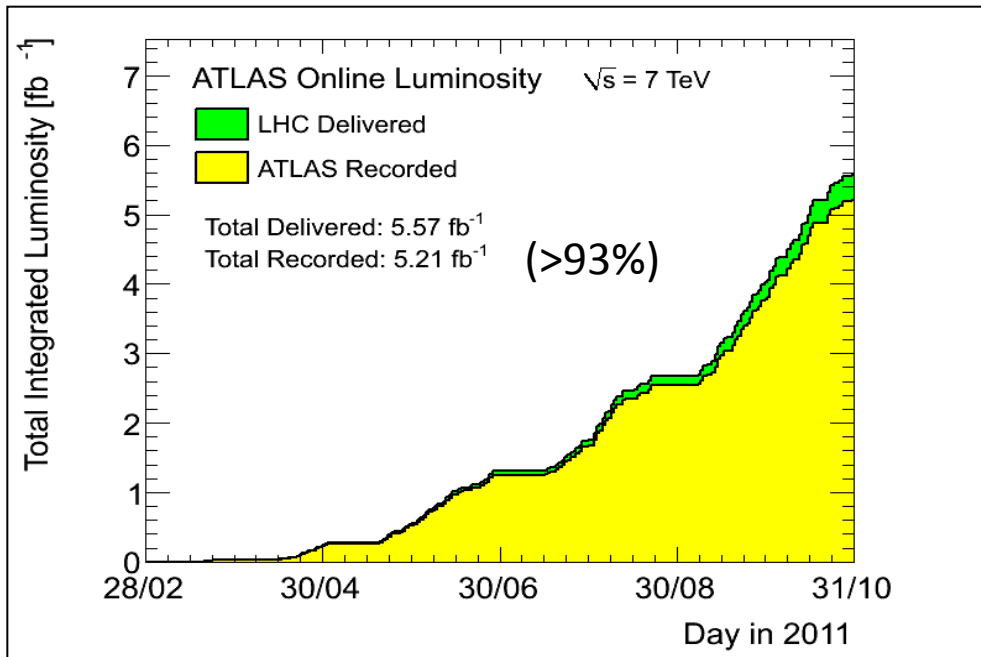
New rough draft 10 year plan

Not yet approved!



+ d'infos après le workshop de Chamonix sur la machine LHC (01/2012)

Dernières nouvelles d'Atlas



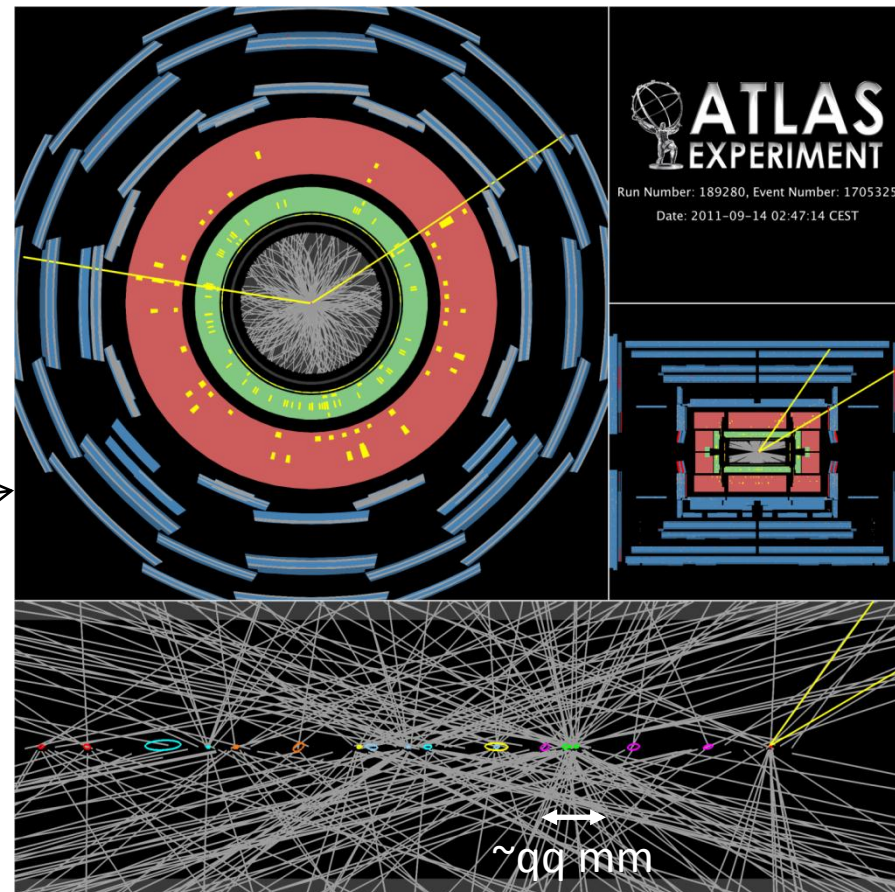
Sunday 30 October at 17h : end of the 2011 p-p run
 ($L \sim 3.10^{33}$ et 50ns entre chaque X)

$Z \rightarrow \mu\mu$ with 20 reconstructed vertices

Event du 14/09/2011 ($\beta^* \sim 1\text{m}$)

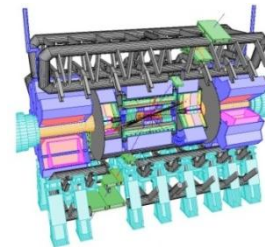
p_T track threshold is 0.4 GeV and all tracks are required to have at least 2 Pixel and 7 SCT hits

The vertices shown are reconstructed using tracks with p_T greater than 0.4 GeV



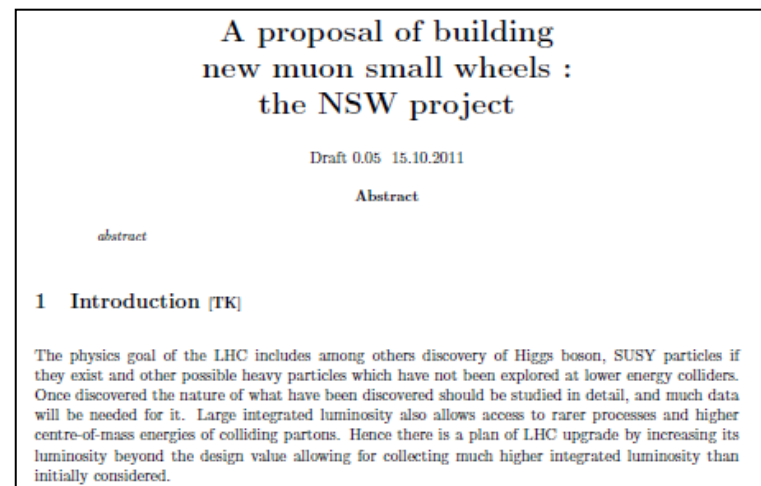
$t = 0 \dots$

Upgrade Atlas – groupe Micromegas (MAMMA) Propositions de participation au CSTS du SPP



- Pourquoi le HL-LHC
- Bruit de fond dans la caverne
- Micromegas résistive :
 - Où en est-on ?
 - Que fait-on à l'Irfu ? (dans Atlas et « autour »)
- Demandes au CSTS (2 options)
- Conclusion

Philippe Schune
Irfu-SPP



Draft du 15/10/2011 (~130 pages)
avec les trois options :

- sMDT+RPC
- sMDT+TGC
- Micromegas

Quelques sections communes
manquantes :

- Mécanique (1^{er} dessins)
- Radiation
- Alignement (1^{ère} discussions)
- DCS
- ...

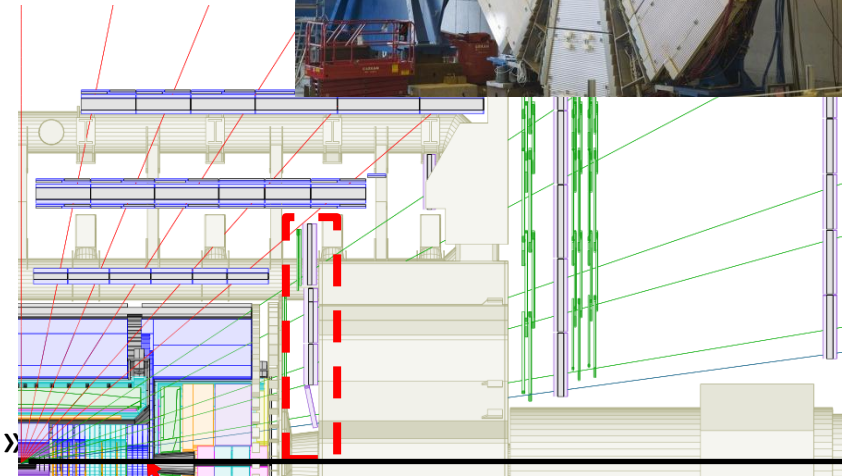
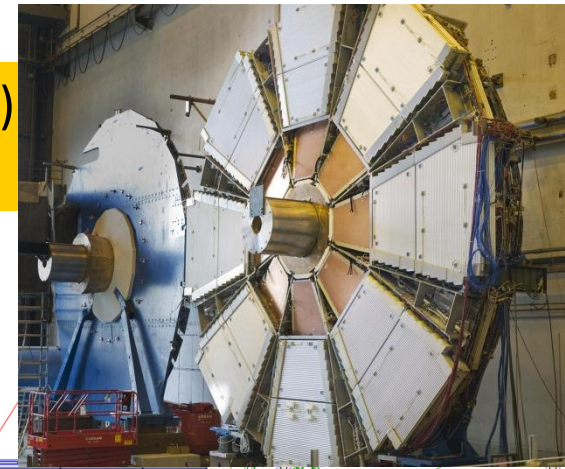
Upgrade Atlas – groupe Micromegas (MAMMA) Propositions de participation au CSTS du SPP

Vocabulaire :

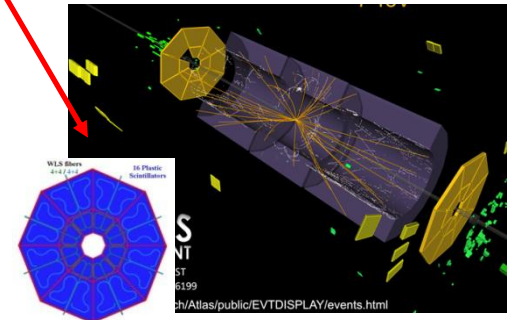
- Small wheel
- MBTS

- Pourquoi le HL-LHC
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Small wheel
 $r \sim 5\text{m}$



MBTS
 $r < 90\text{cm}$



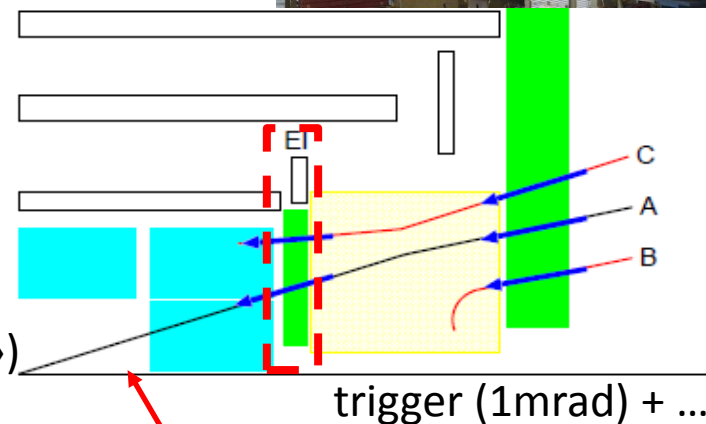
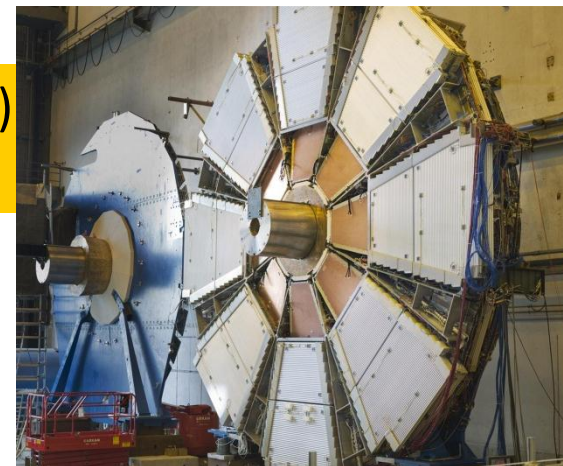
Upgrade Atlas – groupe Micromegas (MAMMA) Propositions de participation au CSTS du SPP

Vocabulaire :

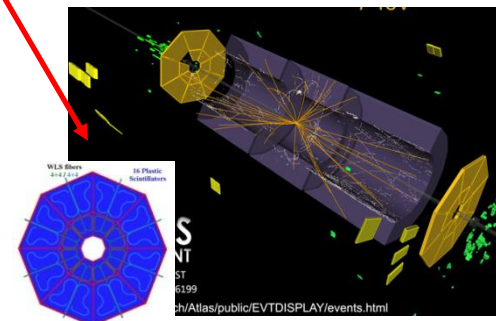
- Small wheel
- MBTS

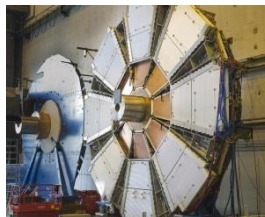
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Small wheel
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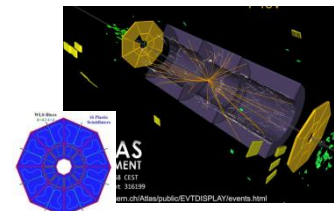
MBTS
 $r < 90\text{cm}$





Upgrade Atlas – groupe Micromegas (MAMMA)

Demandes au CSTS du SPP (2 options)



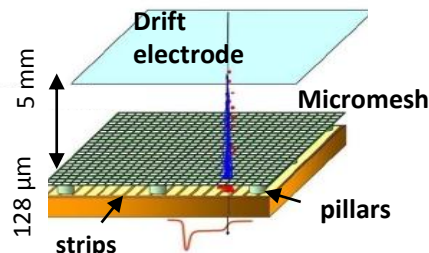
Micromegas **choisies** par Atlas pour l'upgrade des Small-Wheel

($r = 5\text{m}$, $\sim 1000\text{ m}^2$ de détecteurs)

Objectifs : arriver à un PRR (Production Readiness Review) fin 2012, puis production, etc...

Participation de l'Irfu à :

- (i) L'étude de l'assemblage de Micromegas en chambres multicouches et l'étude de l'intégration de celles-ci sur les petites roues ;
- (ii) L'étude, le développement et la production de l'électronique de déclenchement ;
- (iii) la calibration, la construction et l'installation des détecteurs (10 à 15%).



Micromegas **rejetées** par Atlas pour l'upgrade des Small-Wheel

$\sim 5\text{ m}^2$

Objectifs : se repositionner sur le projet (MBTS, $r < 90\text{cm}$) et finir d'acquérir l'expertise en cours (compréhension, industrialisation et précision).

Voir document CSTS

Participation de l'Irfu :

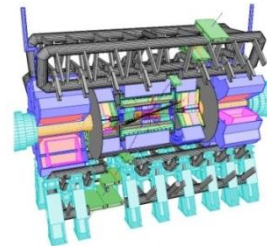
- (i) « Repositionnement » sur l'upgrade : MBTS (et électronique, intégration...) ;
- (ii) Fin des études en cours (irradiation, etc.) ;
- (iii) Participation à la construction de la première grand chambre Micromegas résistive.

Dans les deux cas (pas avec la même priorité en temps) :

Participation de l'Irfu au proto echelle-1 (avec alignement des layers pour -au moins- un des multi-layer) et suivi + participation à l'industrialisation.

=> L'objectif étant que ce détecteur puisse servir à boucher un des trous d'acceptance du spectromètre à muons (par ex. : pieds, $\eta=0$, etc.).

Upgrade Atlas – groupe Micromegas (MAMMA) Propositions de participation au CSTS du SPP



- > - Pourquoi le HL-LHC
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Selection of Physics Potential of HL-LHC

S.Hassani

- **Electroweak Physics (precision measurements)**
 - production of multiple gauge bosons ($n_V \geq 3$)
 - triple and quartic gauge boson couplings
- **Higgs physics (if Higgs discovered at LHC)**
 - Higgs rare decay modes
 - Higgs couplings to fermions and bosons
 - Higgs self-couplings
 - Heavy Higgs bosons of the MSSM
- **Strongly-coupled vector boson system (if Higgs not seen at LHC)**
 - $W_L Z_L$, $Z_L Z_L$ scalar resonance, $W_L^+ W_L^+$

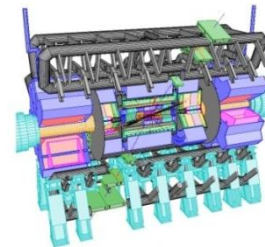
Le but est de mesurer les paramètres des particules trouvées et/ou des modèles testés –A.Djaoudi–

And beyond standard model:

- **Supersymmetry**
 - Multi-TeV squarks and gluinos
- **Extra Dimensions**
 - Direct graviton production in ADD models
 - Resonance production in Randall-Sundrum models
- **New Gauge Bosons Z'**
- **Compositeness**
 - Quark substructure

Remarque : Il vaudrait mieux monter en énergie plutôt qu'en luminosité...
(et si possible les deux)

Upgrade Atlas – groupe Micromegas (MAMMA) Propositions de participation au CSTS du SPP

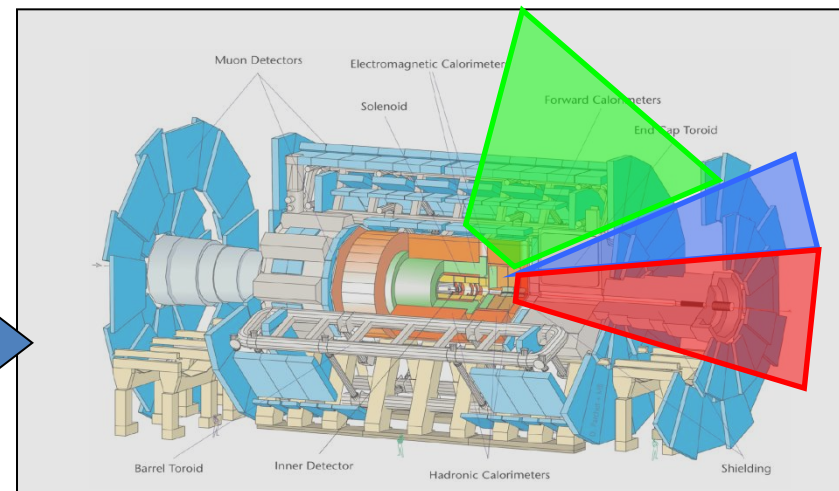


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Background in Atlas cavern

Background comes from residues of p-p interactions
(through spallation process) :

- Huge production of *neutrons*, thus creating γ , thus creating e , etc...
- Also at higher energy, n and γ create ionizing particle (mainly: p , e^+ , e^-)
- Direct background: μ and punchthrough (smaller)



Neutron "gas" in the cavern
(\rightarrow therm. of neutrons)

$E_{\text{cin}} = 10 \text{ MeV} : v_n \sim 15\% c$ (23 ns pour 1m)
 $10 \text{ keV} : \sim 5 \cdot 10^{-3} c$ (0.7 μs pour 1m), out of time

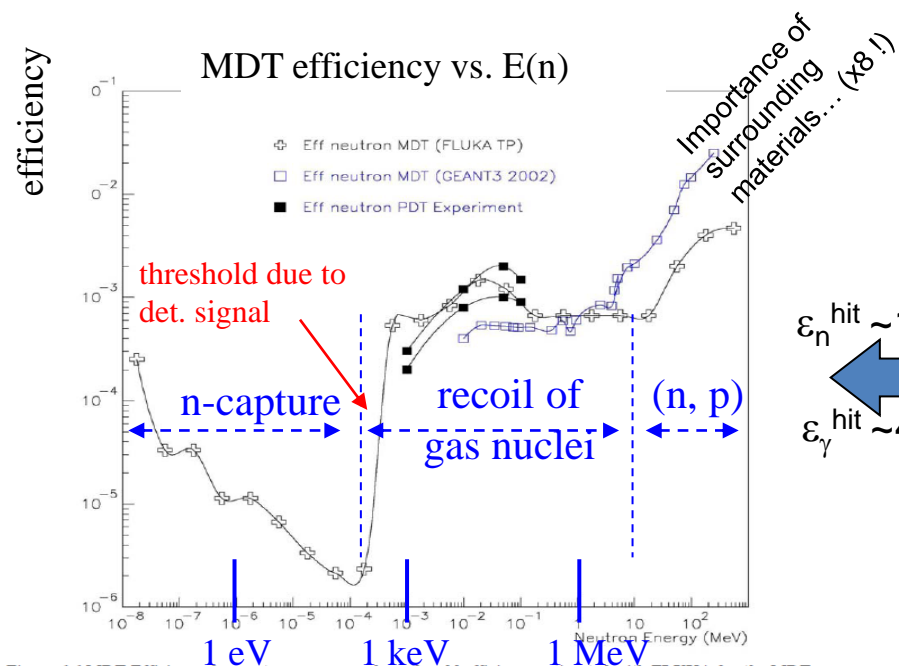


Figure 6.6 MDT Efficiency for neutrons: crosses show the old efficiency estimated with FLUKA for the MDT for the TP design with a gas composition of 90%Ar, 5%N₂, 5%CH₄ at a pressure of 3 Atm; open squares show the new GEANT3 estimate for the final MDT design with 3 Atm of 93%Ar, 7%CO₂; full squares are measurements made with Pressurized Drift Tubes at 3 Atm of 81.5%Ar, 15%CO₂, 3.5%C₄H₁₀ for different sensitive volumes [57]. See text a more detailed discussion.

10 kHz/cm^2
 $\epsilon_n^{\text{hit}} \sim 10^{-4} \text{ à } 10^{-3}$
 $\epsilon_\gamma^{\text{hit}} \sim 4-8 \cdot 10^{-3}$

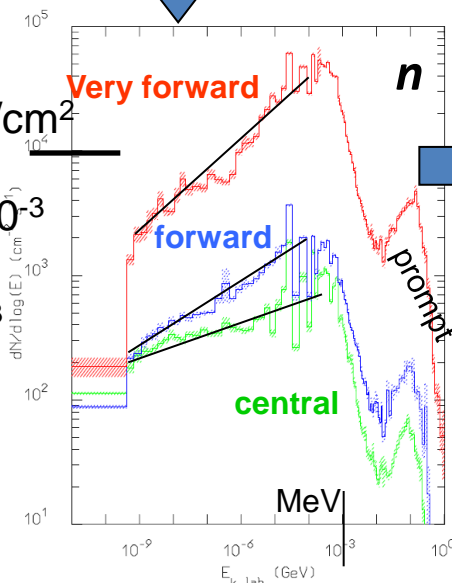


Figure 5-67 The expected neutron flux as a function of neutron energy in different rapidity regions of the muon spectrometer (top curve: $2.3 < \eta < 2.7$, middle curve: $1.4 < \eta < 2.3$ and bottom curve: $\eta < 1.4$).

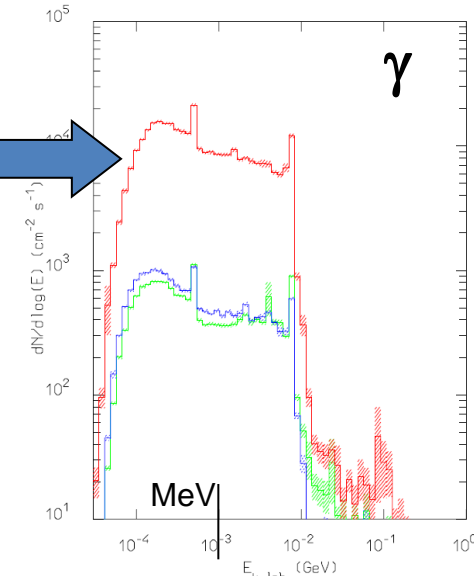
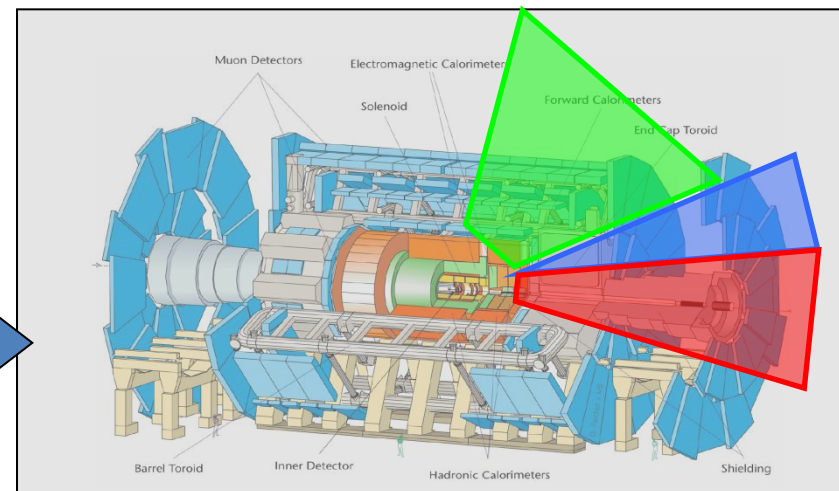


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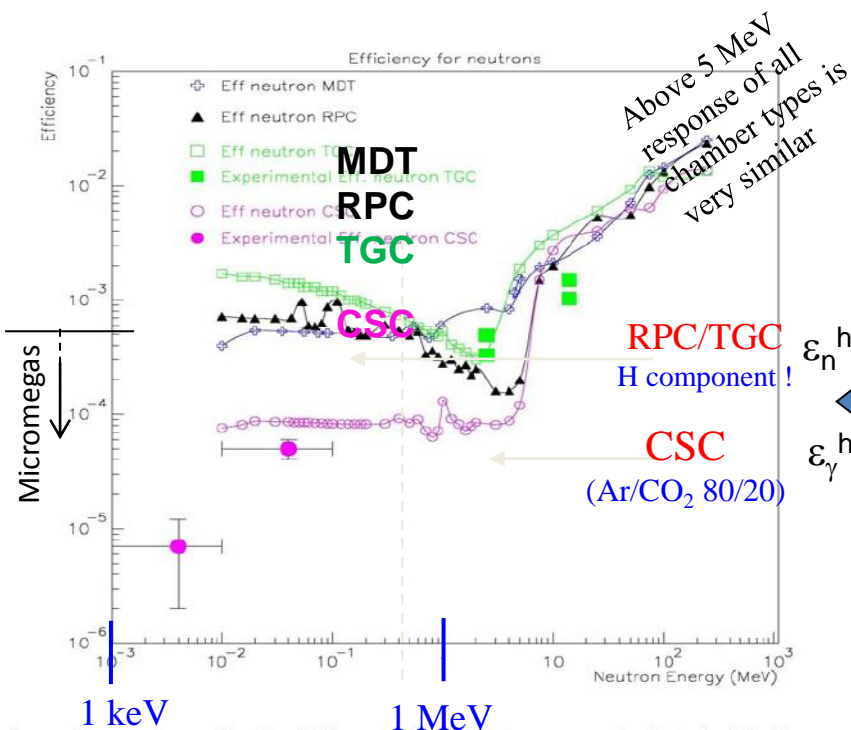
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Efficiency for neutrons for the different chamber types as calculated with Geant elements are shown for CSC [59,60] and TGC [61]. See text for more detailed

10 kHz/cm²

$\epsilon_n^{\text{hit}} \sim 10^{-4} \text{ à } 10^{-3}$
 $\epsilon_\gamma^{\text{hit}} \sim 4-8 \cdot 10^{-3}$

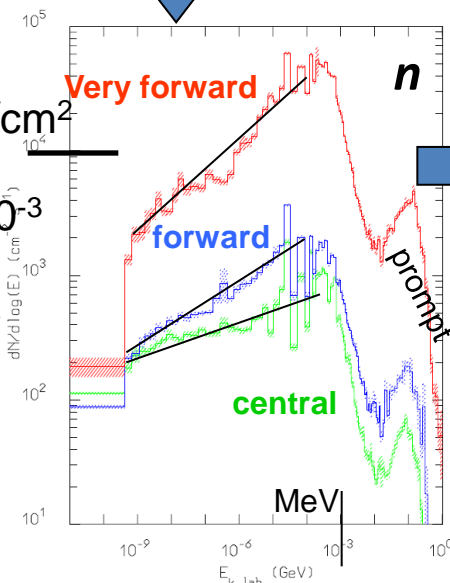


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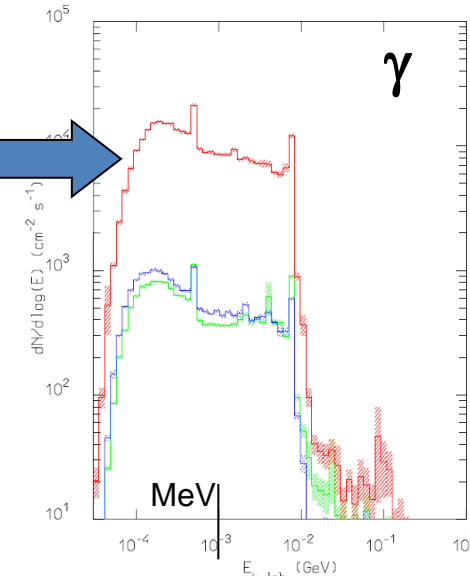
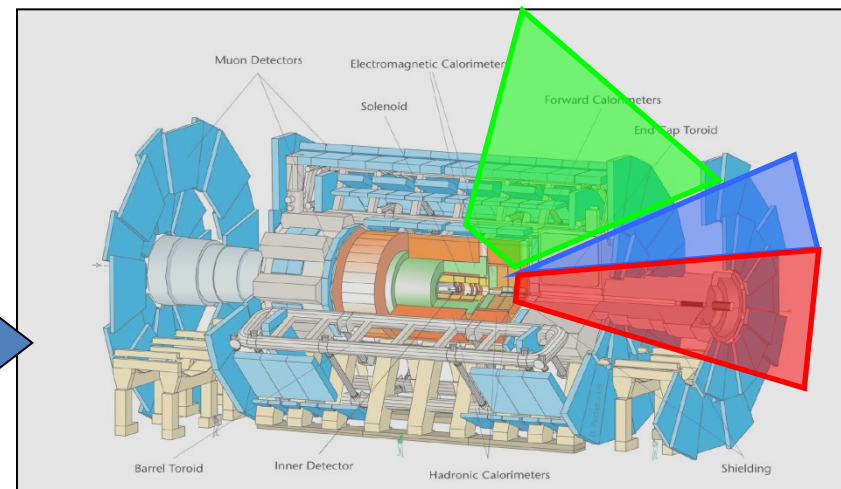


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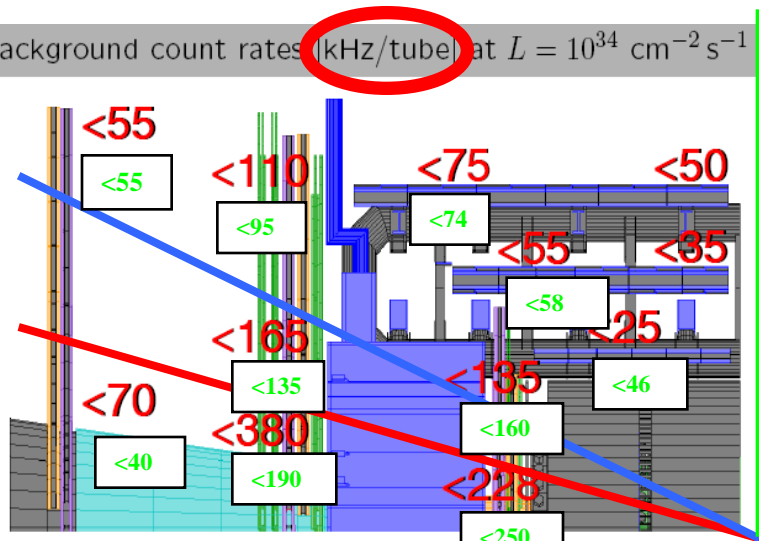
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10 keV : $\sim 5 \cdot 10^{-3} c$ (0.7 μs pour 1m), out of time

Background count rates (kHz/tube) at $L = 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$



(Numbers include a safety factor of 5.)

- pp x section for part. prod. (~ 1.2)
- d. propagation in calo. and shielding (~ 2.9)
- efficiency in chambers (~ 1.4)

Atlas needs to measure cavern background (using muon spectrometer) in order to reduce uncertainty on background for s-LHC.

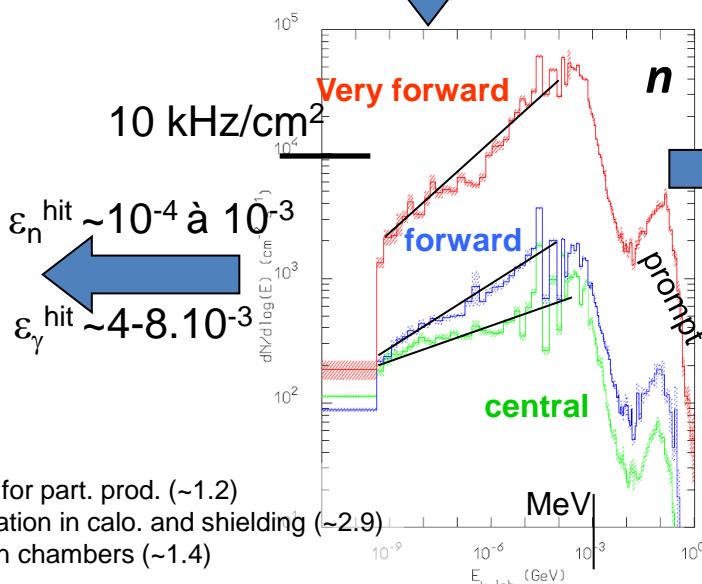


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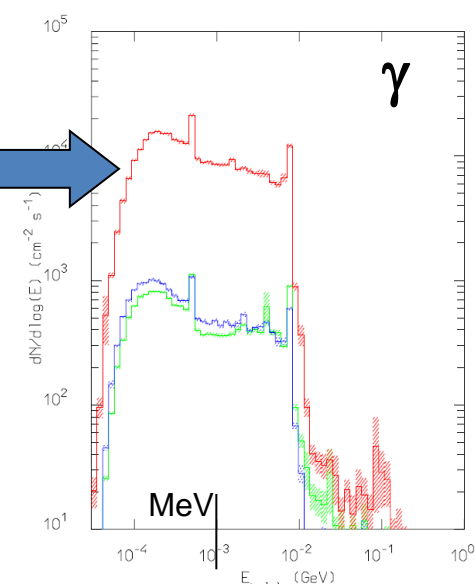
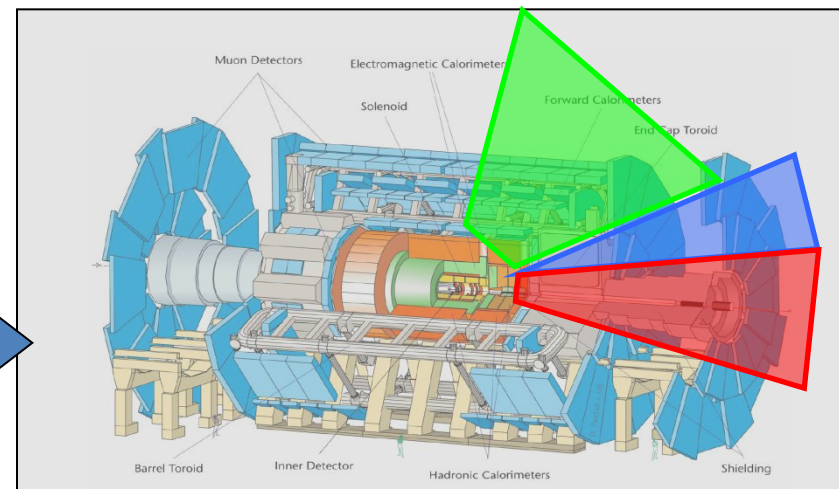


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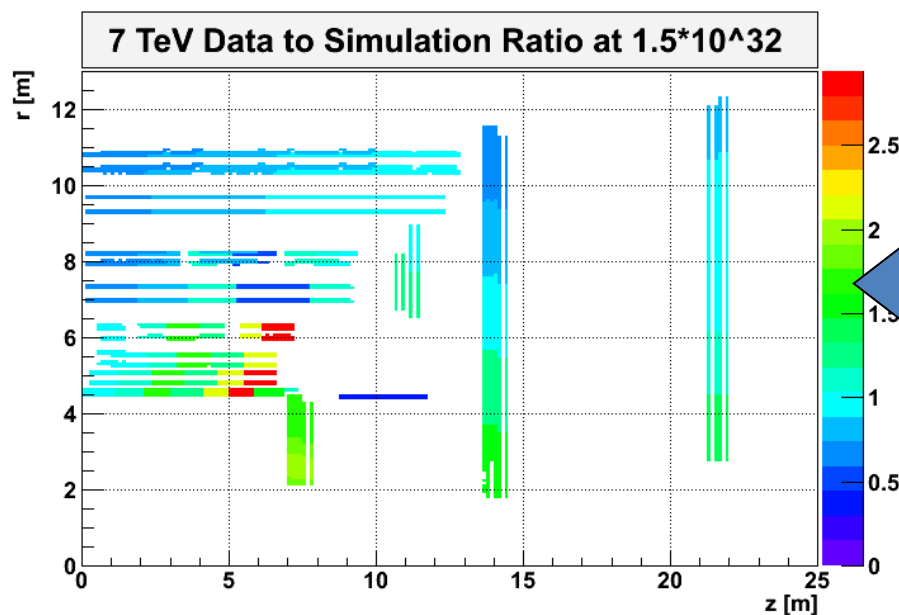
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10 kHz/cm²

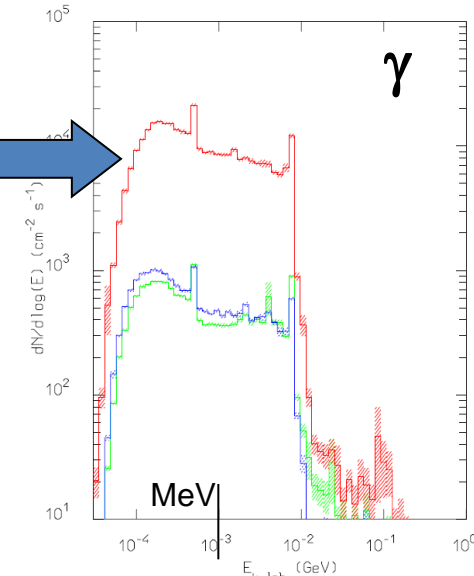
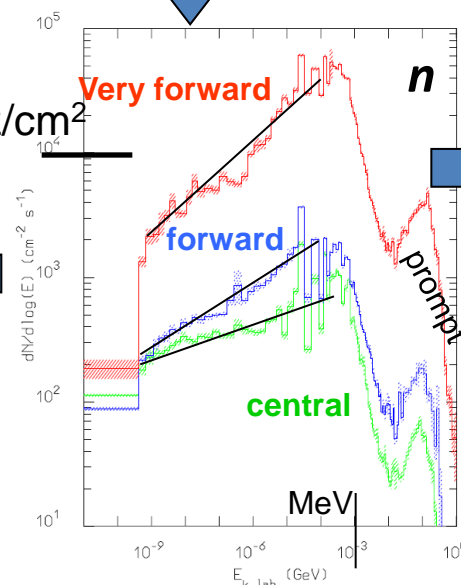
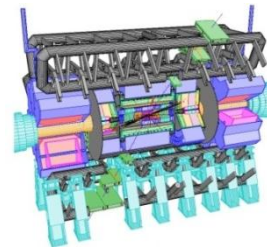


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(dernière simulation : facteur de sécurité $\sim x2$)

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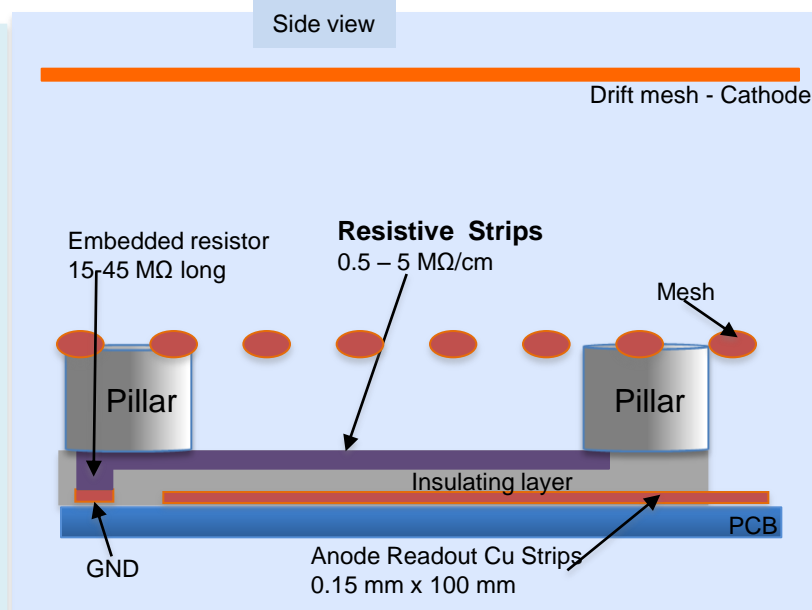
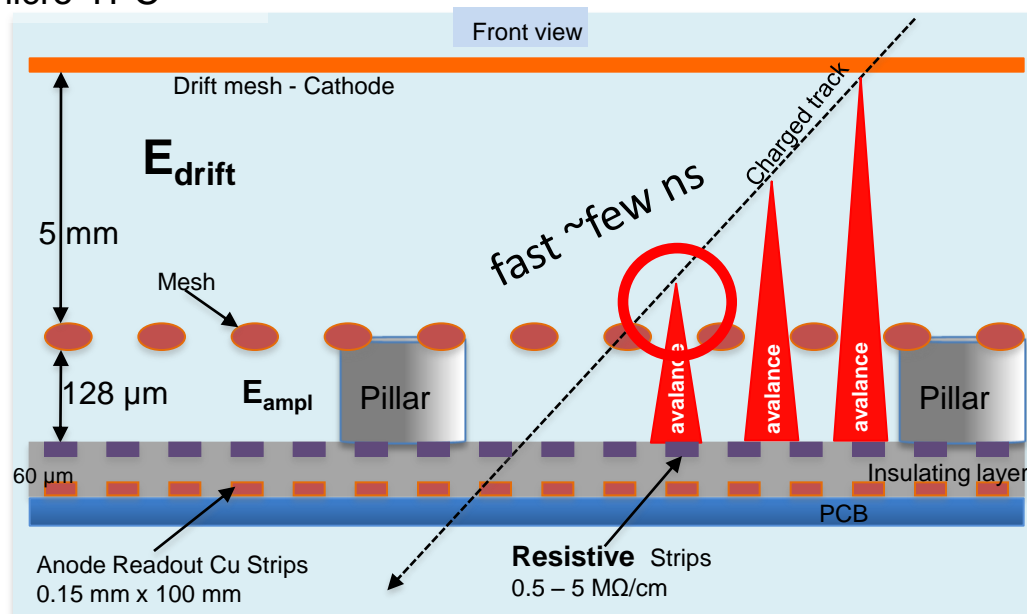


- Pourquoi le HL-LHC
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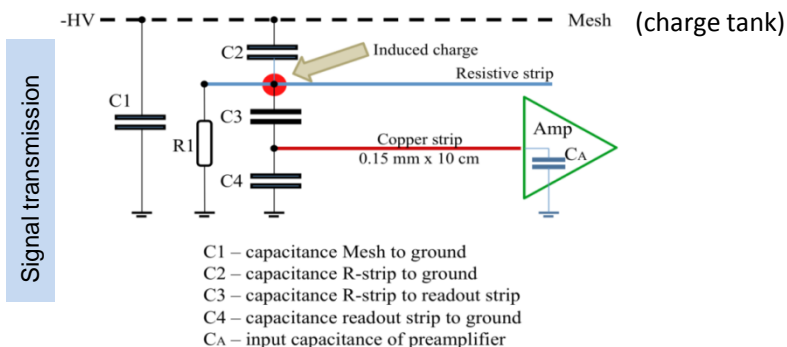
If time measurement
=> ~micro-TPC

Resistive Micromegas Structure

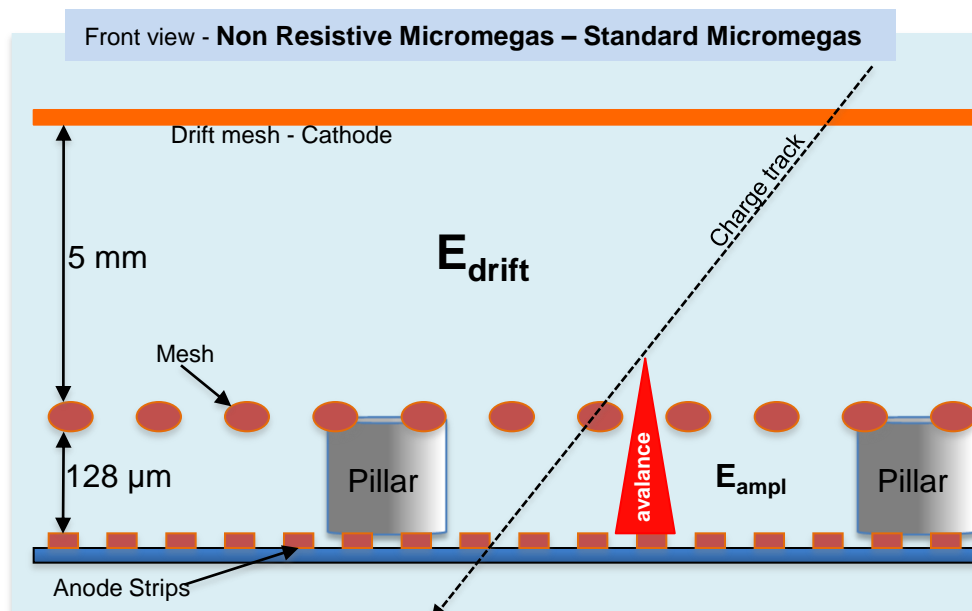
40-50 kV/cm



e- mean free path in amp. region ~few μm

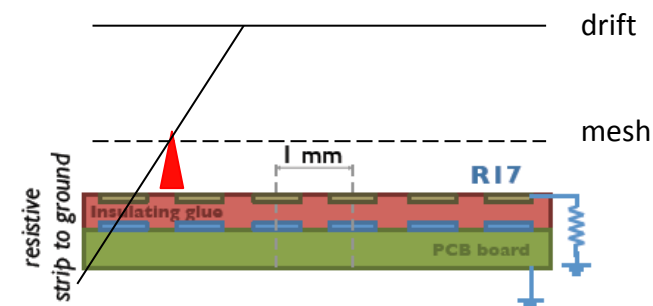
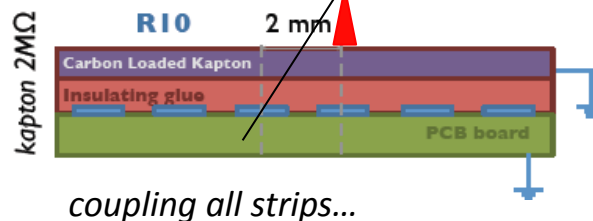


- Introduce a RC (~100 ns) to spread avalanche development in space and in time (prevent spark <~> control streamer mode)
- If 2D *strip-readout* crossed => delayed signal on strips perpendicular to resistive strips

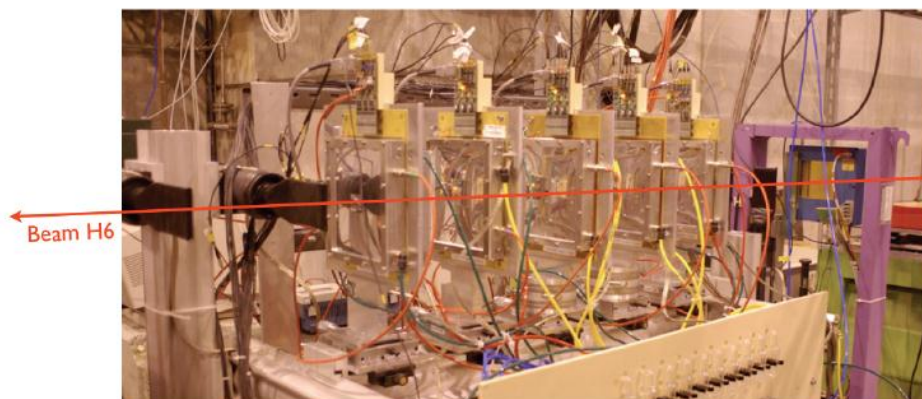
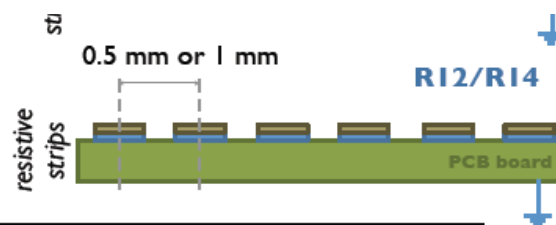


Tests of different type of anode-resistive Micromegas

- To avoid sparks on micromegas different resistive coating configuration are tested.

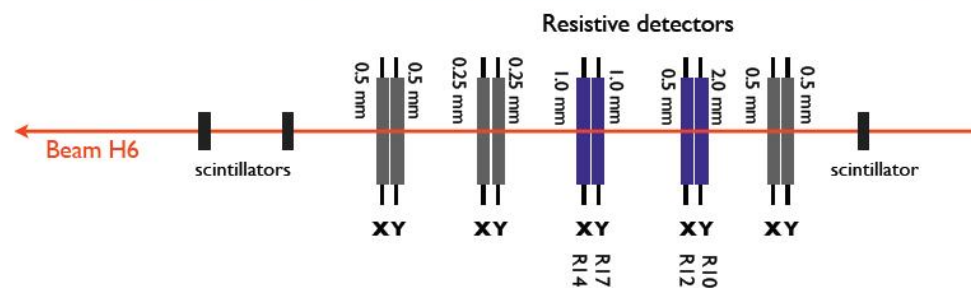


- We tested 3 different resistive technologies.

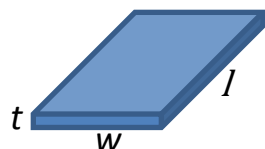


Resistive Bulk detector	pitch	Circuit type	Capacitance	Energy Resolution ^{55}Fe	Gain max
R10	2.0mm	kapton 2MΩ/□	1.67 nF	22.1% (310V)	7829 (410v)
R17	1.0mm	resistive strip to ground	943 pF	29.8% (310V)	10236 (410)
R14	1.0mm	strips 300kΩ	943 pF	36.3% (350V)	10023 (410v)
R12	0.5mm	strips 300kΩ	637 pF	24.4% (320V)	9835 (410v)

+20V on mesh HV is equivalent to $\sim x2$ for the gain

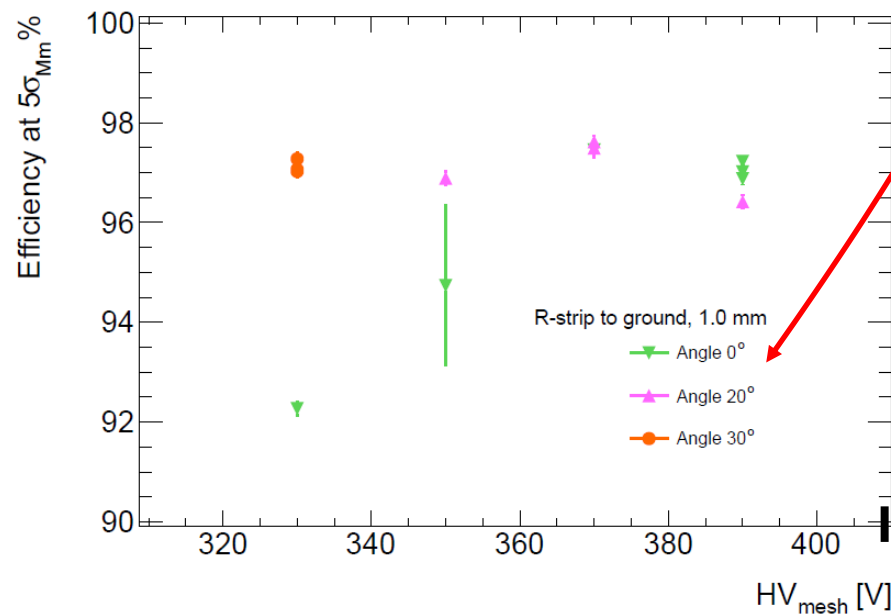
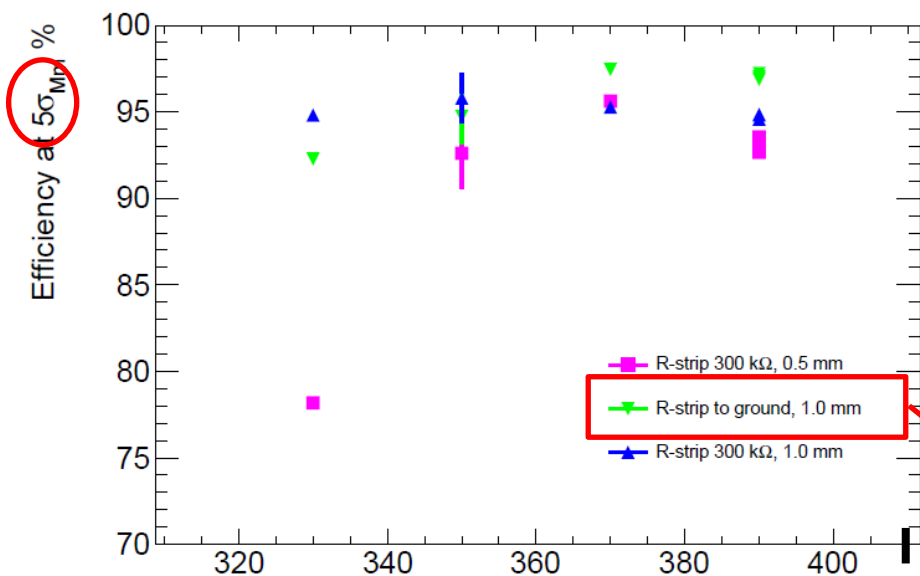


CERN- H6 pion beams ~ 100 GeV
25 up to 250 kHz/cm²

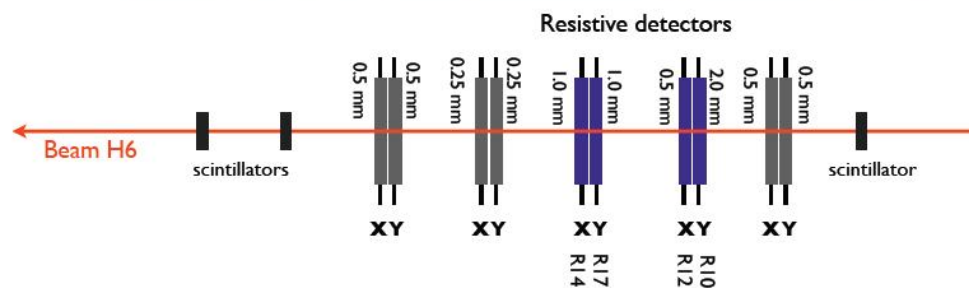
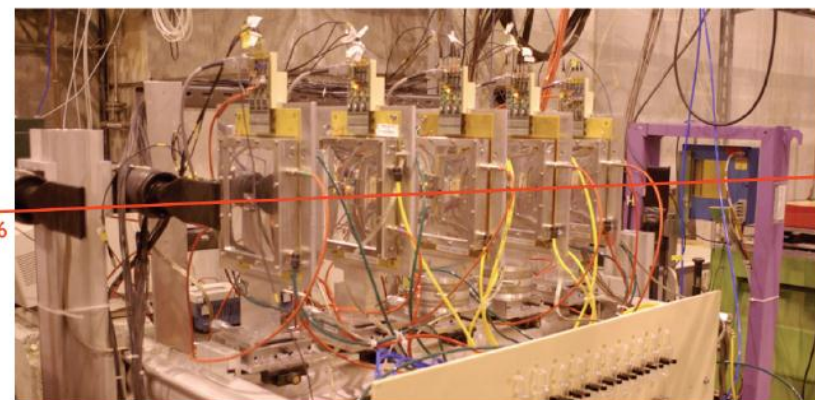
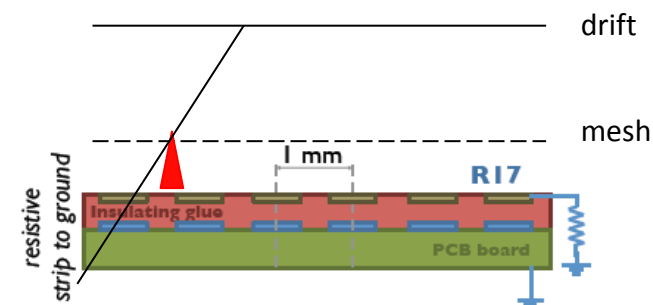


Rappel : $R = \rho \frac{l}{t \cdot w} = R_s \left(\frac{l}{w} \right)$ et R_s en Ω / \square

Tests of different type of anode-resistive Micromegas



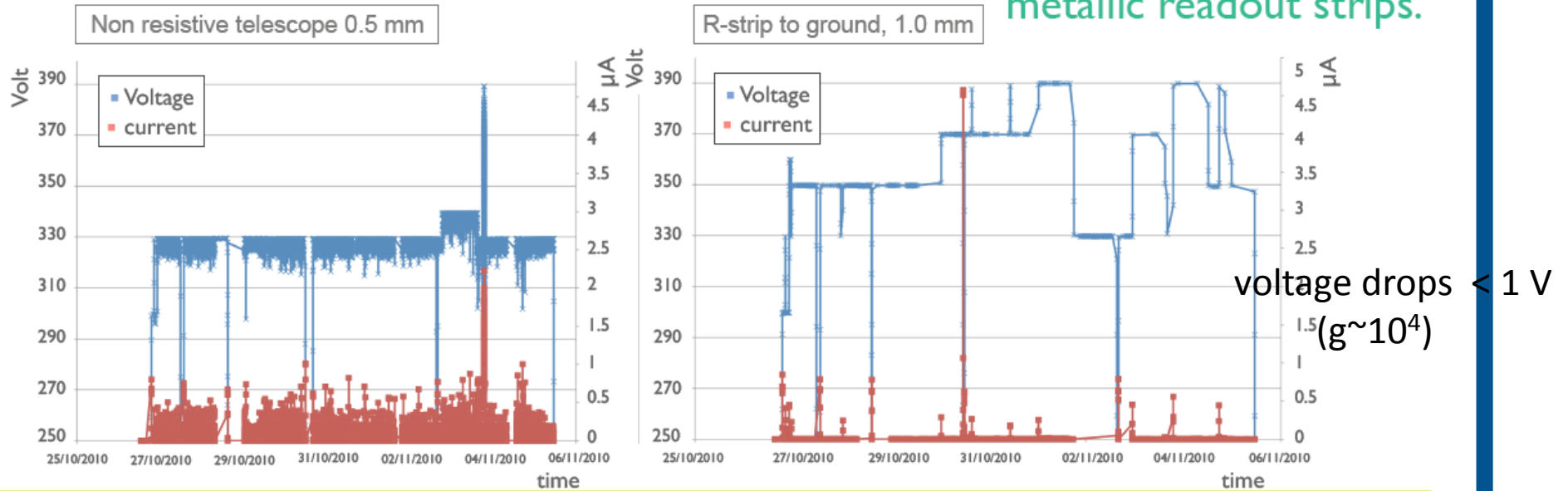
$g \sim 10^4$



CERN- H6 pion beams ~ 100 GeV
25 up to 250 kHz/cm²

4) Sparks

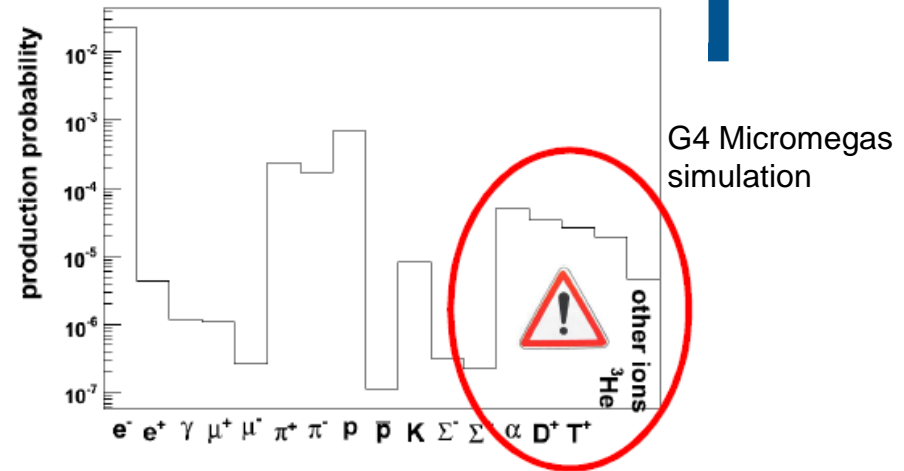
A spark is a electric arc between the mesh and the anode at ground potential, be it resistive strips or metallic readout strips.



— The non resistive chamber suffered from HV breakdowns while the resistive chambers operate stably.

Even with pions m.i.p. beam, some highly ionizing particles are present (>200 k-eV deposit) !

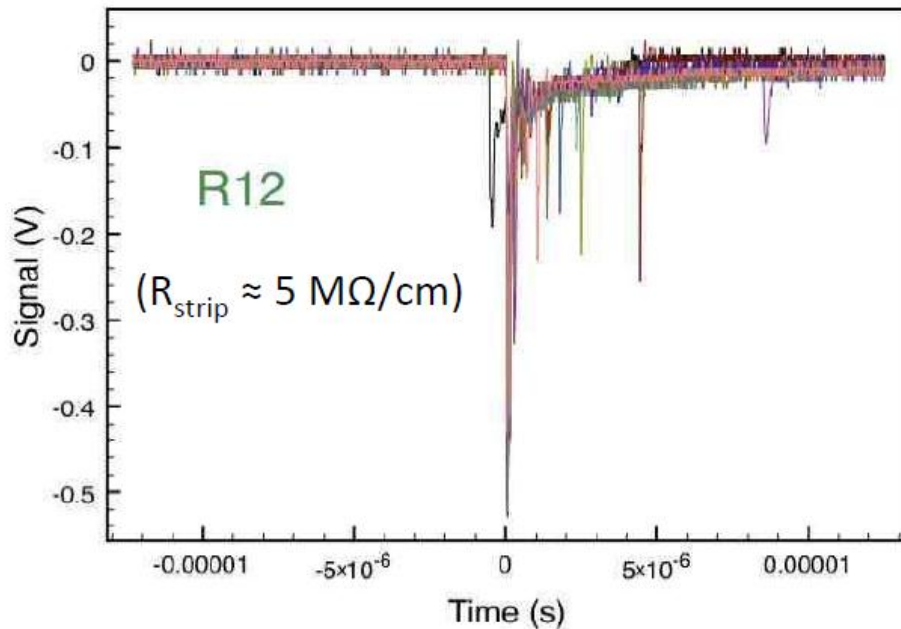
(from S.Procureur, SPhN, CLAS-12)



Micromegas under ~ 5.5 MeV neutrons beam

Theodoros Alexopoulos
NTU Athens
Demokritos

Gas: Ar:CO₂ (85:15), neutron flux: $\approx 1.5 \times 10^6$ n/cm² s



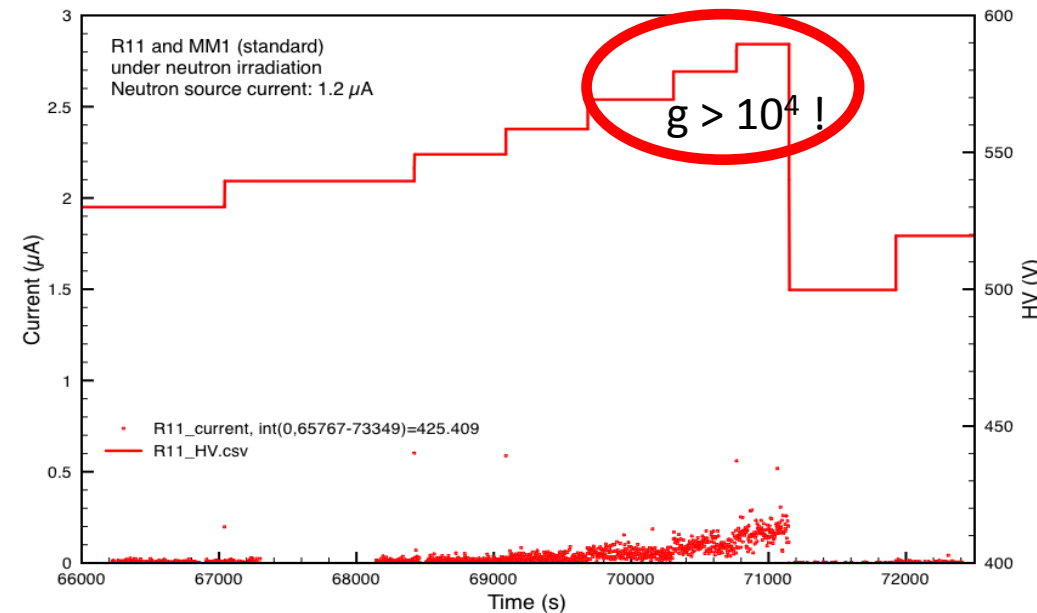
Superposition of 10 (micro)sparks (\sim streamer)
Ok within $1 \mu\text{s}$ + some overshoot $< \text{few } \mu\text{s}$
(last Micromegas version faster recover)

Resistive Micromegas :

Low currents

Despite discharges, but no HV drop

Chamber operated stably up to max HV



+ at Saclay irradiation with X-ray (8 keV Cu) under analysis + thermal neutrons (Orphée, mid of November)

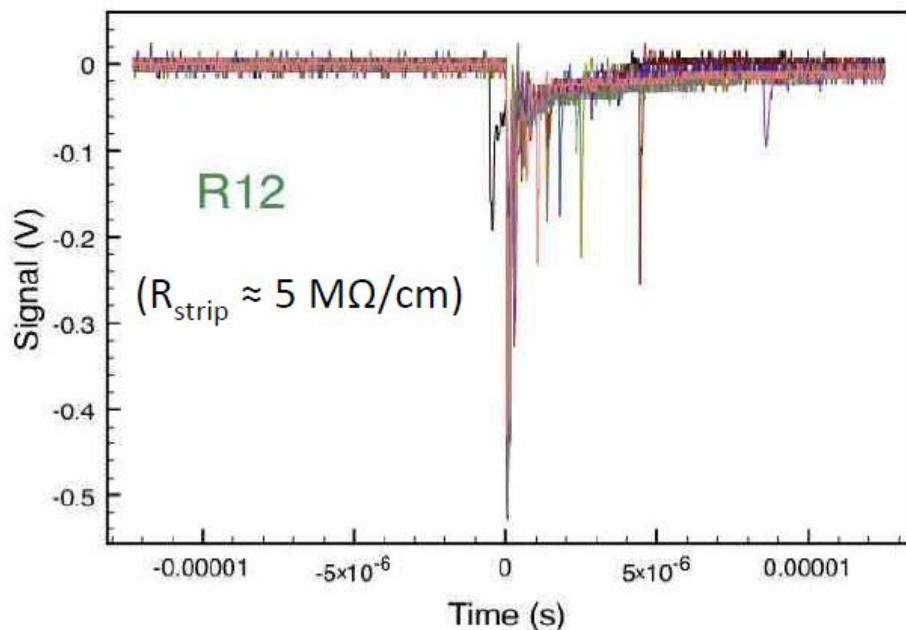
up to ~ 800 mC (i.e. ~ 200 mC / cm²)

Futur : mesure de la sensibilité aux n-thermique

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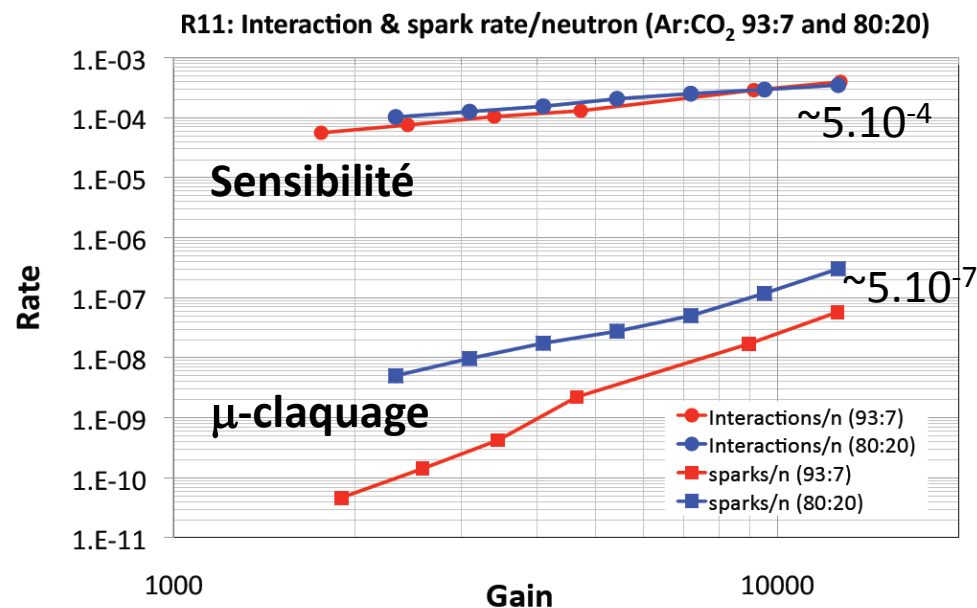
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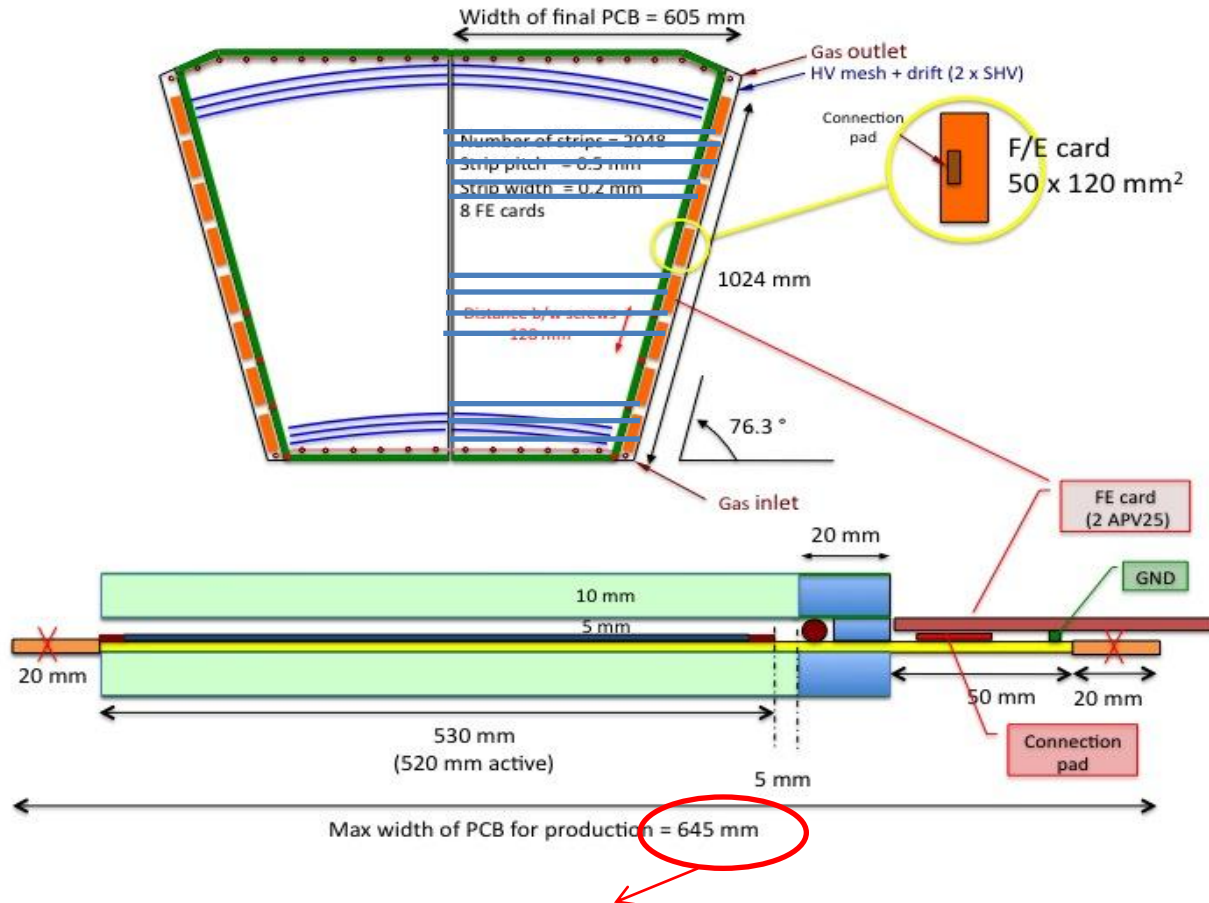
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Futur : mesure de la sensibilité aux n-thermique

Micromegas integration issues

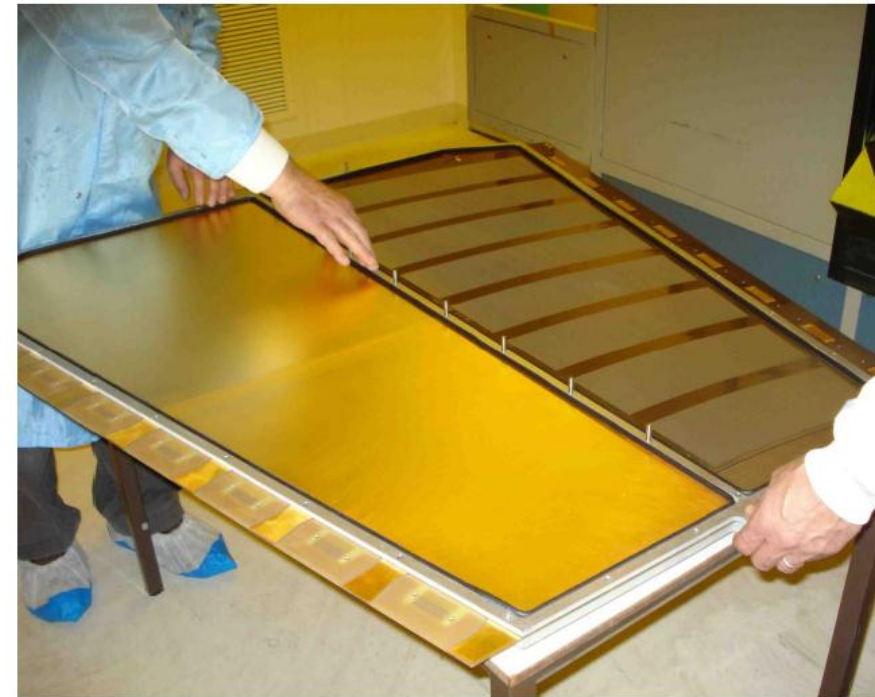
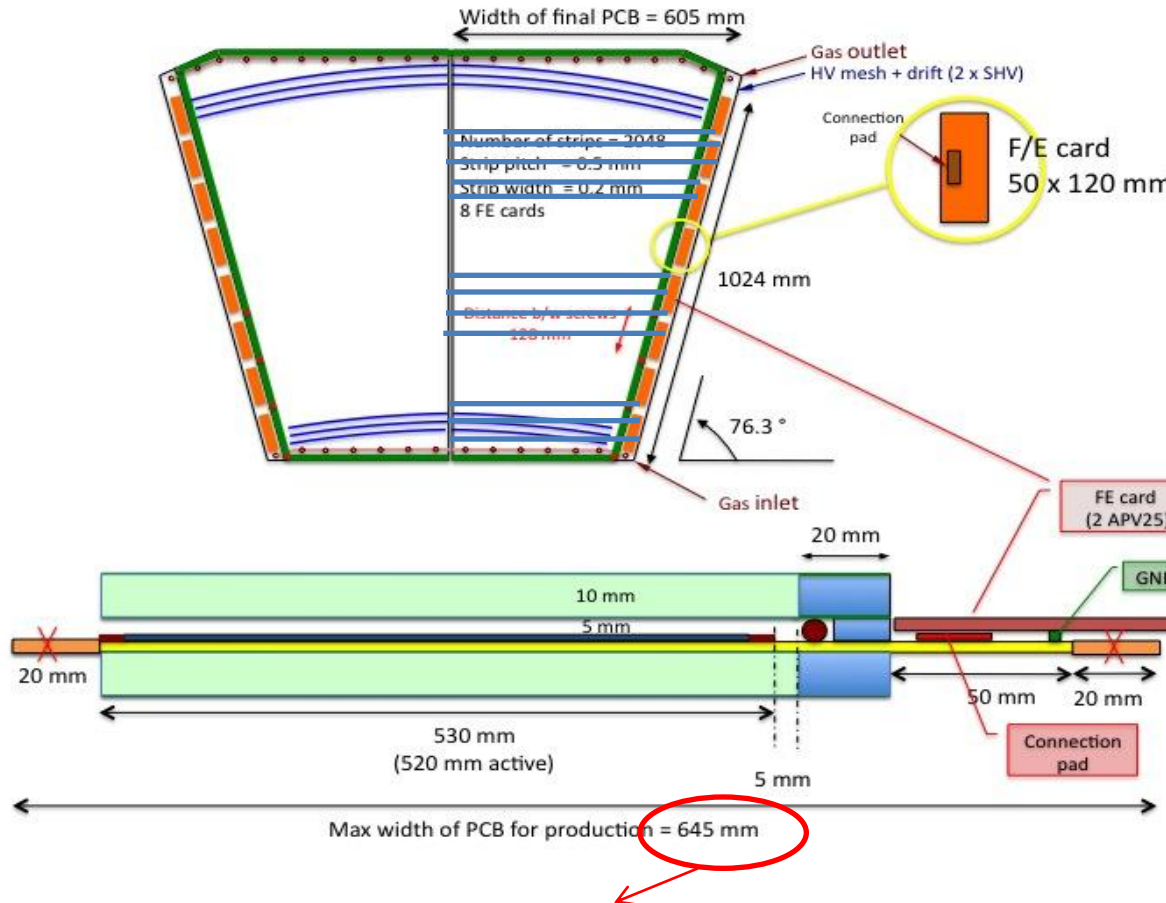
R.De Oliveira et
J.Wotschack



- with new machine in Rui's lab go to up to ~1m chambers
- long strip capacity (< 10 pF / 10 cm)
- small-wheel channel # : ~2 M-channel (0.5 mm pitch)
- Next step : industrialize "bulk" + mesh support production (including resistive layer)

Micromegas integration issues

R.De Oliveira et
J.Wotschack

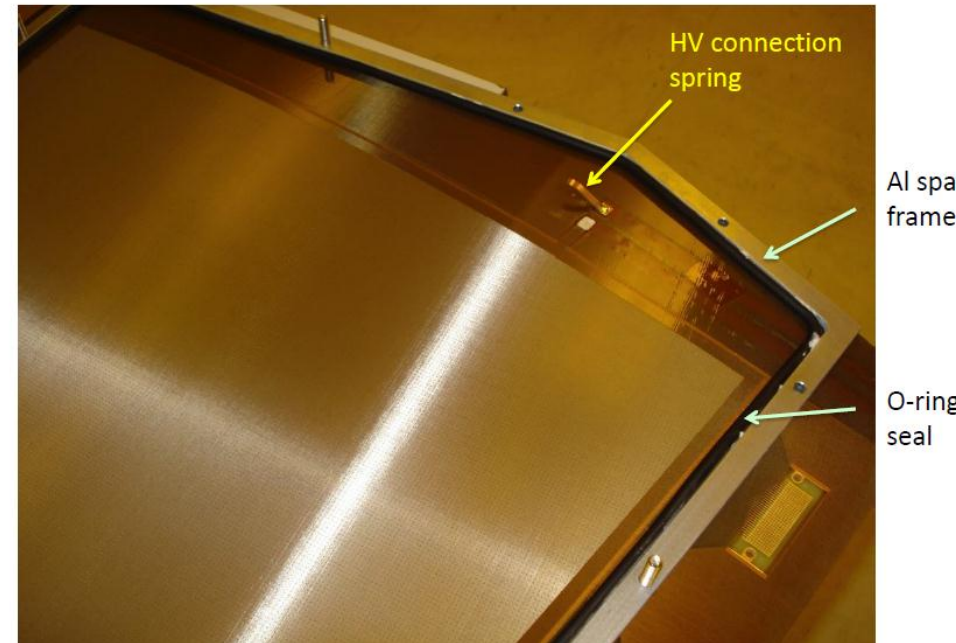
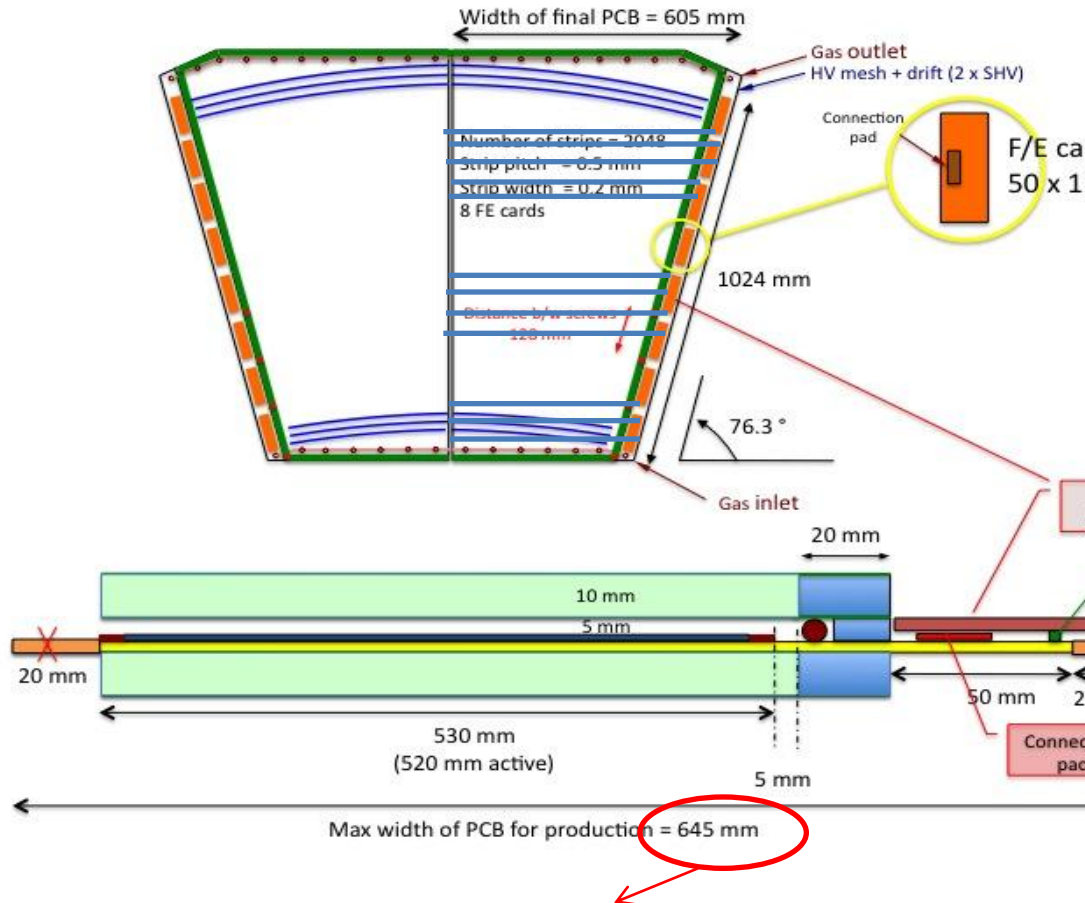


- with new machine in Rui's lab go to up to ~1m chambers
- long strip capacity ($< 10 \text{ pF} / 10 \text{ cm}$)
- small-wheel channel # : ~2 M-channel (0.5 mm pitch)
- Next step : industrialize "bulk" + mesh support production (including resistive layer)

Ne sont pas mentionnés les problèmes résolus ! (tension de la mesh, etc...)

Micromegas integration issues

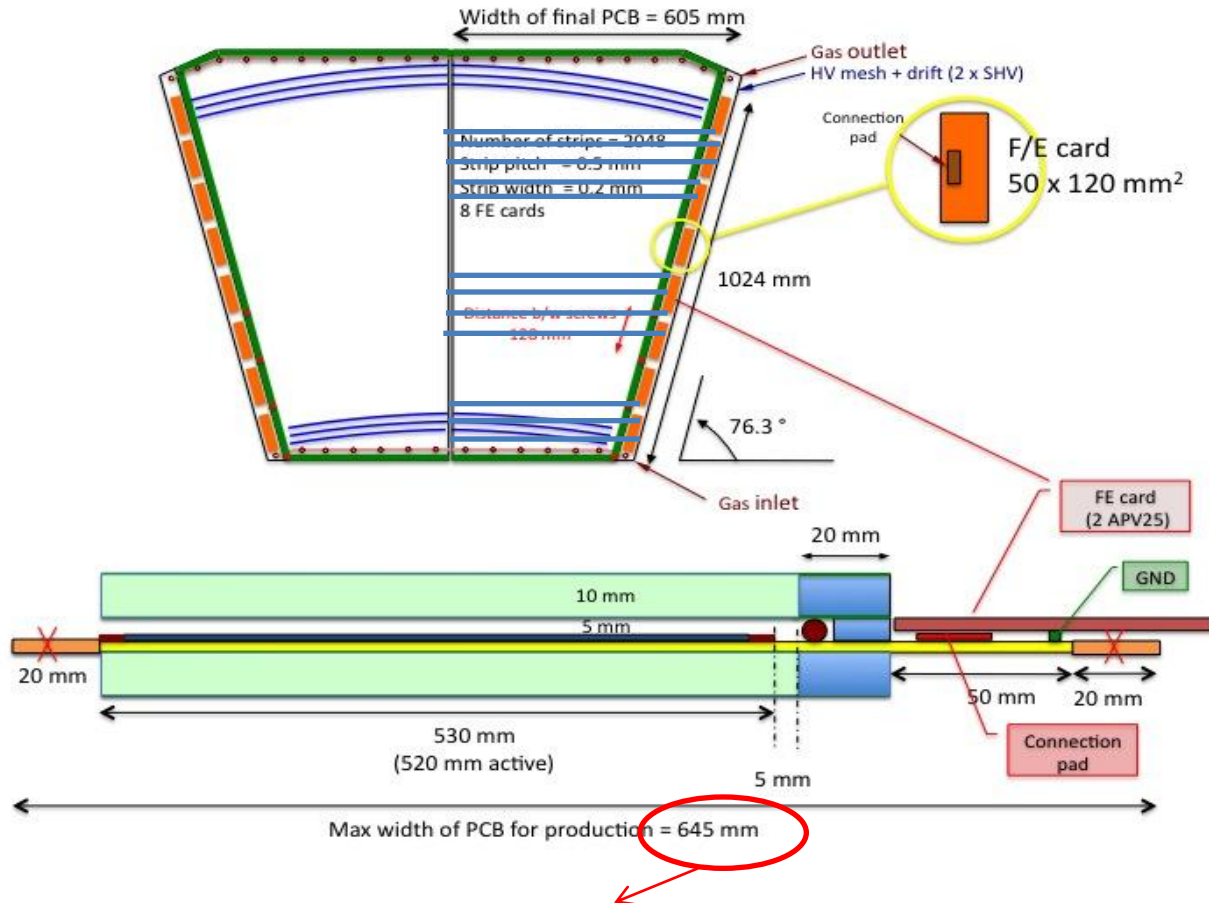
R.De Oliveira et
J.Wotschack



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Micromegas integration issues

R.De Oliveira et
J.Wotschack

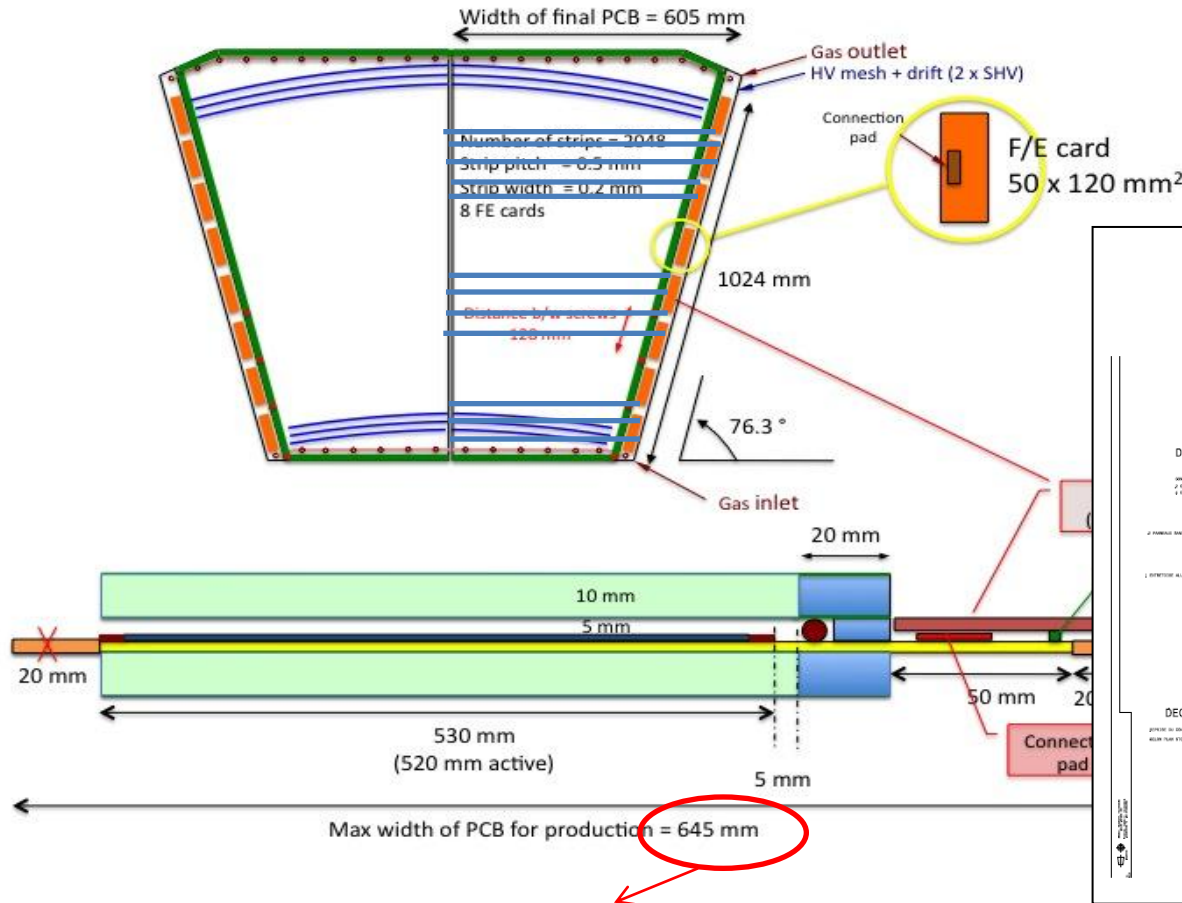


- with new machine in Rui's lab go to up to ~1m chambers
- long strip capacity (< 10 pF / 10 cm)
- small-wheel channel # : ~2 M-channel (0.5 mm pitch)
- Next step : industrialize "bulk" + mesh support production (including resistive layer)

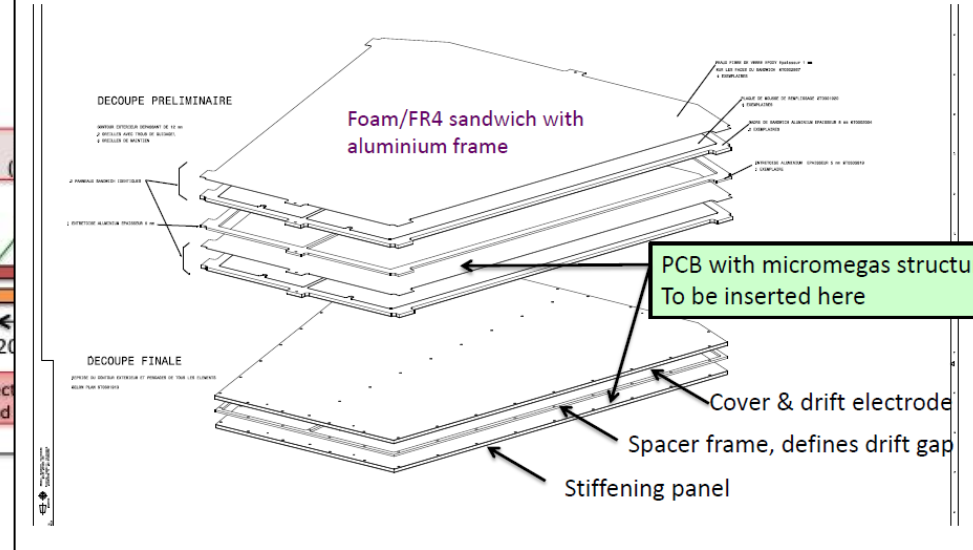
Assembly extremely simple, takes a few minutes

Micromegas integration issues

R.De Oliveira et
J.Wotschack



Mechanics – detector housing



- with new machine in Rui's lab go to up to ~1m chambers
- long strip capacity ($< 10 \text{ pF} / 10 \text{ cm}$)
- small-wheel channel # : ~2 M-channel (0.5 mm pitch)
- Next step : industrialize "bulk" + mesh support production (including resistive layer)

Micromegas integration issues

S.Herlant, Ph.Daniel-Thomas, P.-F.Giraud, Ph.S.

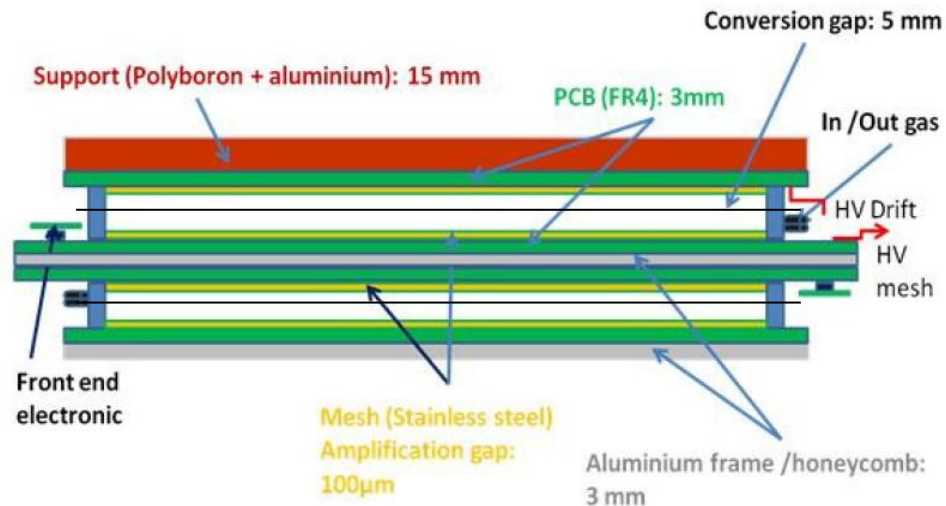


Figure 20 : Schéma d'un demi-multi-couches

All shielding will be put on JD disk (to avoid γ 's production).

To avoid present CSC assembly problems we should use reinforced PCB and have a special mounting procedure.

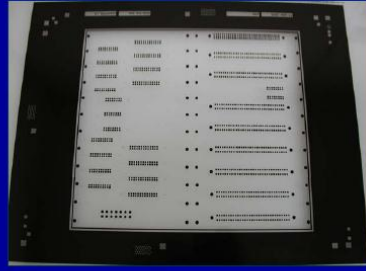
The complete assembly procedure, including inner in-plane alignment still to be defined...

Electronics: for trigger capability, using 0-suppress elx => only 30 k-channel to be considered at LVL-1 (front end chip with 64 ch.)

Ar-CO₂ mixtures are very robust, but be careful or pollutant... (H, Si, etc...)
(for a summary see M.Titov, arXiv:physics/0403055, 09/03/2004)

Photo Plotter (creating the films)

- Equipment : Barco BG7300
- Max size : 500 mm x 600 mm
- Resolution : 10000 DPI
- Minimum line width and spacing: 20µm
- Film based on Polyester 100µm thick
- Type of files : DPF, DXF, GDS2, GBR
- Software : Cadence, Pcad



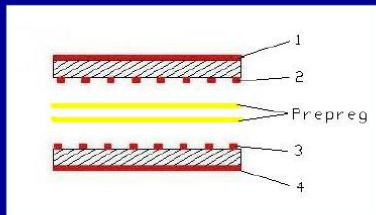
03/02/2005

ELEC-2005

5

Pressing

- Equipment : Bieffe 4 daylight
Isostatic press
- Max number of layers: 40...
- Typ pressure : 20 KG/cm²
50 Tons for a 50cm x 50cm board
- Typ temp : 180 deg C
- Typ vacuum : 0.01 Bar



03/02/2005

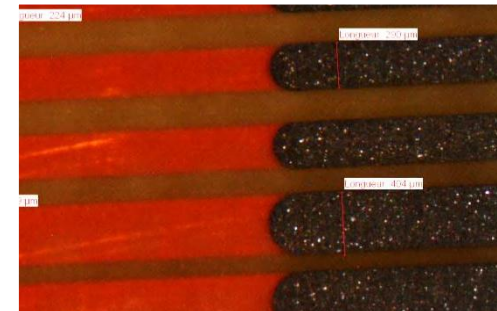
ELEC-2005

11

Diminuer les contraintes lors de la fabrication du PCB multicouches (éviter Transition Vitreuse) :

- par un abaissement de la température (ok) et un contrôle de l'humidité (ok ?) : ~20 à 40 microns possible sur ~1m ?

Nouvelle procédure à tester sur protos (R20 x-y fait et R21 à faire) et à vérifier.



Pistes résistives vs strips (Cu) ok <20 µm

Positions des bulks entre eux (?) :

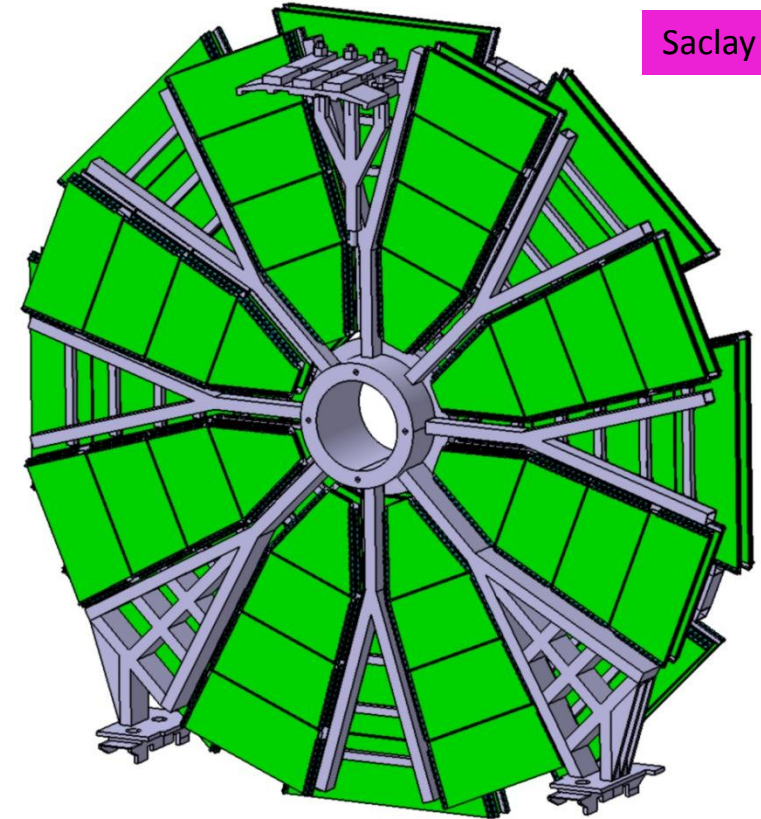
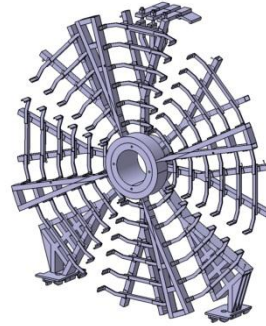
Par projection de rayons X sur les trous du bord du PCB (eux-mêmes positionnés par rapport à des mires précises <5µm) puis repositionnement des PCB (industrie).

Procédure à finaliser et à tester (métrologie)

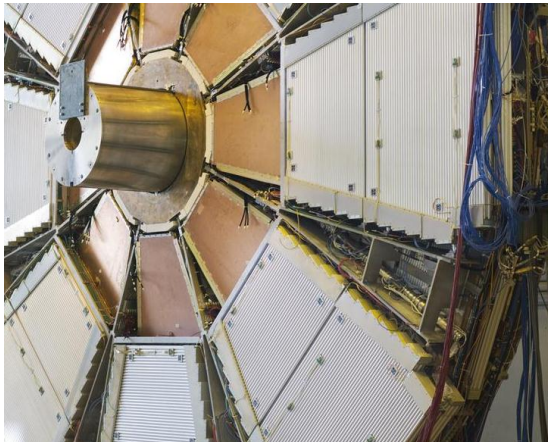
Micromegas integration issues

- 3 or 4 chambers/sector (machine limited)
- 2 x 4 layers/chamber
- Spacer of ≈ 300 mm
- Eta strips precision (pitch 0.5-1mm)
- Phi strips (or stereo) for 2nd coordinate (pitch 1–2 mm)
- Pads if required
- Precision measurement and 2nd coordinate in same layer
- Max strip length ≈ 1.2 m

- Total # readout ch. ≈ 2 M
- Total # trigger ch. ≈ 30 k



Saclay



Pending questions:

- Accessibility: could the wheel supporting the chambers be decoupled to the shielding disk ? (support of inner part)
- Alignment required up to innermost chamber (without saloon-door effect)

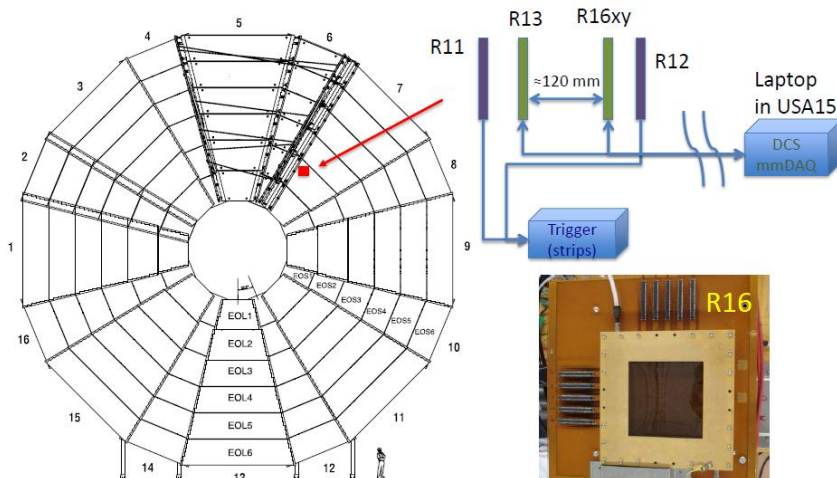
Brandeis (quelque soit la solution choisie)

Micromegas : autres performances / études

BNL - Athens

CERN

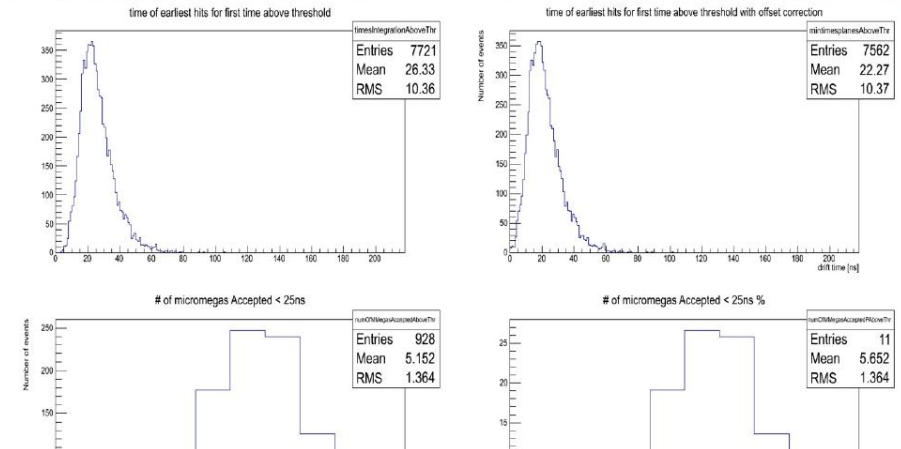
MM location on HO structure side A



Rate measured is ≈ 3 times lower than in MDTs

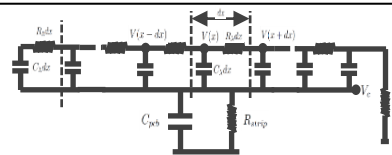
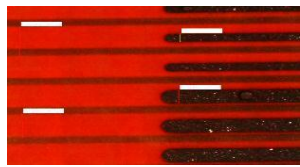
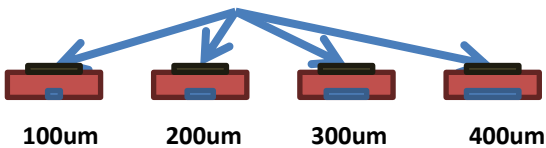
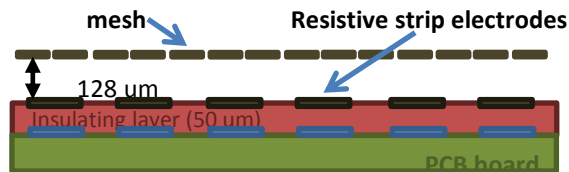
Integration time **50ns**, drift Gap **5mm**, drift velocity **4.7cm/us**, $q_{thres} = 1e$
earliest time for all planes - small wheel application and chambers accepted for times $< 25ns$ - ($70^\circ < \theta < 30^\circ$)

Above threshold Technique

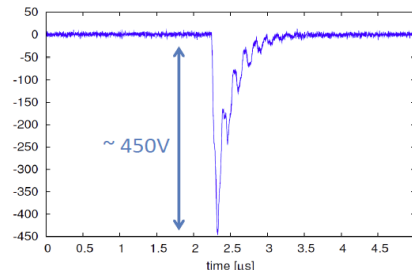


$\sim 99\%$ des traces dans $< 25ns$ si logique de 5/8 plans
(seuil \gg bruit)

Javier Galan (SEDI), post-doc MIRO



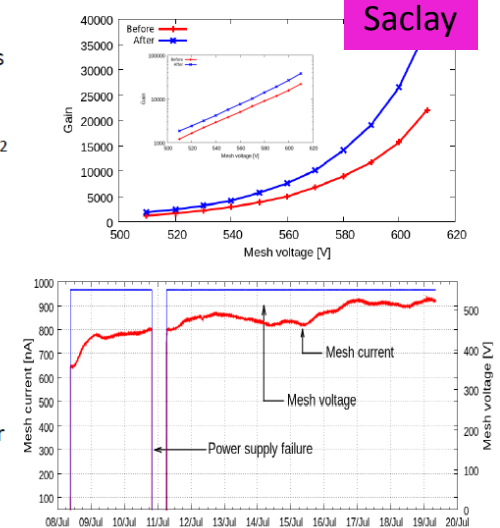
Spark studies in resistive and standard detectors



"Transient analysis of the townsend discharge", P. Auer (60's)

Long-time X-ray exposure of resistive MMs

- This spring a resistive-strip MM has been exposed at CEA Saclay to 5.28 keV X-rays for ≈ 12 days
Accumulated charge: 765 mC/4 cm²
- Expected accumulated charge at the smallest radius in the ATLAS Small Wheel is 30 mC/cm² over 5 years at $L = 5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$
- No degradation of detector response in irradiated area (nor elsewhere) observed; rather the contrary (to be understood)
- Will repeat the exercise with better control of environmental parameters



Trigger & readout*)

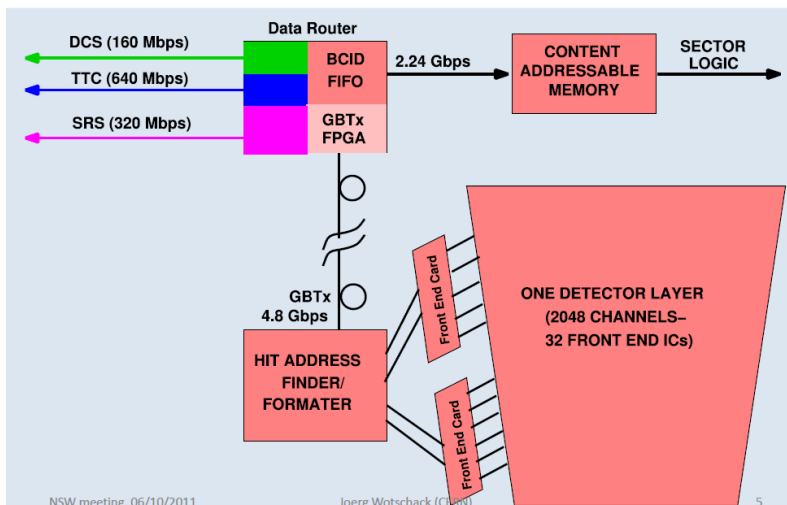
- New BNL chip: 64 channels; on-chip zero suppression, amplitude and peak time finding
 - Trigger out: address of first-in-time channel with signal above threshold within BX
 - Data out: digital output of charge & time for channels above threshold + neighbour channels
- Trigger signals and data driven out through one (same) GBTx link/layer (one board/layer)
 - Trigger: track-finding algorithm in Content-Addressable Memory (as FTK) or in FPGA in USA15; latency estimated 25–32 BXs
 - Small data volumes thanks to on-chip zero-suppression and digitization

*) See talk by V. Polychronakos (23 Sept. 2011)

BNL

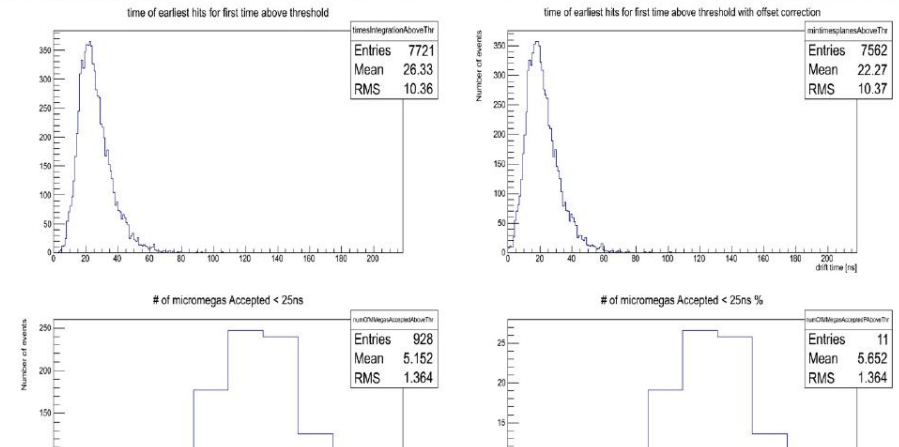
Besoin d'un chargé d'évaluation (20%) afin de chiffrer l'implication potentielle de l'Irfu

Trigger/DAQ Block Diagram



Integration time **50ns**, drift Gap **5mm**, drift velocity **4.7cm/us**, qthres = **1e**
 earliest time for all planes - small wheel application and chambers accepted for times <25ns - ($7^\circ < \theta < 30^\circ$)

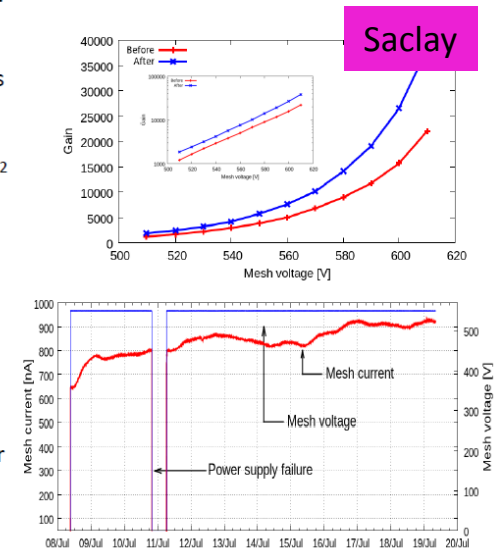
Above threshold Technique



~99% des traces dans <25ns si logique de 5/8 plans
 (seuil >> bruit)

Long-time X-ray exposure of resistive MMs

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Saclay

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 earliest time for all planes - small wheel application and chambers accepted for times <25ns - ($7^\circ < \theta < 30^\circ$)
Above threshold Technique Ar:CO2 93:7

- New BNL chip: amplitude and
- Trigger out: a threshold with
- Data out: digi threshold + n
- Trigger signals GBTx link/layer
 - Trigger: track (as FTK) or in
 - Small data vo digitization

BNL

Be
ch

Performance requirements

- Rate capability: 10 kHz/cm² ✓
- Spatial resolution: 60 μm/track segment ✓
- Angular resolution: 0.3 mrad/segment ✓
- Good double track resolution ✓
- Trigger capability: BCID (angle ≈ 1 mrad) ✓
- Efficiency: 'at least as good as now' ✓
- Radiation resistance: tbd (✓)
- Good ageing properties: tbd (✓)

(meeting avec les referees NSW, 16/10/2011)

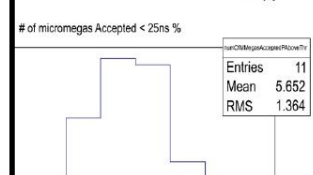
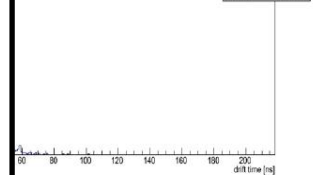
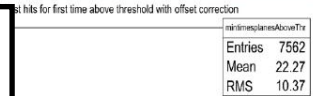
NSW meeting, 06/10/2011

Joerg Wotschack (CERN)

FORMATER

Front End Card

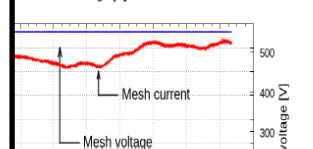
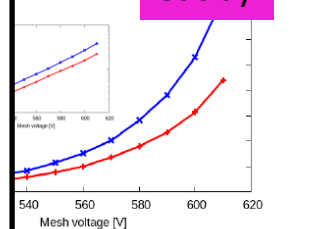
- Will repeat the exercise with better control of environmental parameters



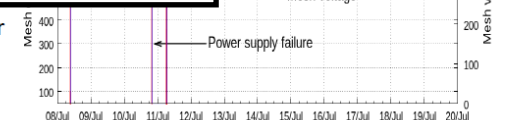
que de 5/8 plans

Resistive MMs

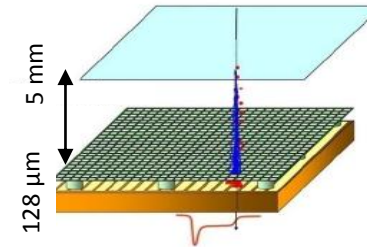
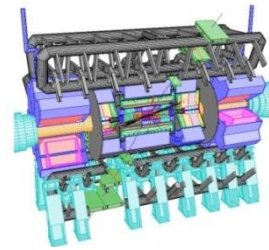
Saclay



11



Upgrade Atlas – groupe Micromegas (MAMMA) Propositions de participation au CSTS du SPP



- Pourquoi le HL-LHC
- Bruit de fond dans la caverne
- Micromegas résistive :
 - Où en est-on ?
 - Que fait-on à l'Irfu ? (dans Atlas et « autour »)

- {
- Demandes au CSTS (2 options)
 - Conclusion

Participation de l'Irfu 2010 et 2011 au projet MAMMA

2010 :

Main d'œuvre : **2,25 FTE** (dont SEDI : 1,25 FTE (1 A1 + 0,25 A2) et SPP : 1 FTE)

Dépenses : **22 k-euros**

Missions : 70 jours (45 j. faisceau test, voyages à ajouter, et 25 j. réunions MAMMA ou Atlas)

2011 (jusqu'à fin octobre) :

Main d'œuvre : **3,8 FTE** (dont SEDI : 2 FTE sur 7 personnes (1,7 A1 + 0.3 A2) et SPP : 1,8 FTE)

Dépenses : **9 k-euros** (fin août)

Missions : shift, réunions CERN, physique Atlas-France

Conférences : MPGD à Kobe, Japon (1 présentation orale + 1 poster), suivi de la réunion RD-51 (1 présentation orale), et IEEE à Valence, Espagne (1 présentation orale). Proceedings avec referees (MPGD), sans (IEEE).

Personnes impliquées en 2011 (et % correspondant) :

- D.Attié (total à 22% car à 5% depuis mai 2011), G.Cauvin (stagiaire M2 SEDI-SPP du 3/10/2011 au 30/03/2012), E.Ferrer-Ribas (10%), J.Galan-Lacarra (post-doc Miro, vieillissement et tests électronique SRS, 50%), A.Giganon (détecteurs, 30%), P.-F.Giraud (alignement, précision assemblage des Micromegas, 10%), S.Herlant (40%), F.Jeanneau (40%, chef de projet), J.Manjarres-Ramos (PhD, 75% ; depuis mi-octobre passage à une analyse de physique), Ph.Schune (75%, resp. scientifique) et ponctuellement M.Boyer.
- Installation prototype Micromegas en caverne : F.Bauer (5%)
- Dessins d'intégration (SIS) : Ph.Daniel-Thomas (au total < 1 semaine), P.Ponsot (discussions)
- Simulation Micromegas dans Atlas (SPP) : L.Chevalier (5%) et J.-F.Laporte (5%)

Saclay people

- **Depuis janvier et jusqu'à novembre 2011:** (D..Attié), (M.Boyer), (E.Ferrer-Ribas), (A.Giganon), F.Jeanneau, (J.Manjarres-Ramos), Ph.Schune

3 octobre : arrivée de G.Cauvin (stagiaire M2, 10/2010 à 03/2011)

- **Micromegas prototype installation en caverne :** F.Bauer

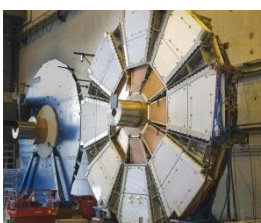
- **depuis mi-mars :** S.Herlant, Ph.Daniel-Thomas (intégration mecanique)
J.Galan-Lacarra (vieillissement (+etude claquage))

- **nouvelle implication court terme :**

Électronique (logique) : demande d'un chargé d'évaluation

L.Chevalier et J.-F.Laporte : simulation de Micromegas dans Atlas HL-LHC (géométrie)

P.F.Giraud : integration mecanique



Micromegas choisies par Atlas pour l'upgrade des Small-Wheel

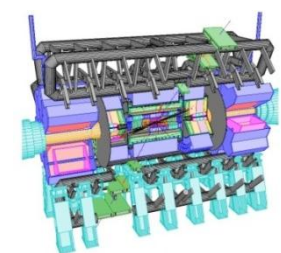


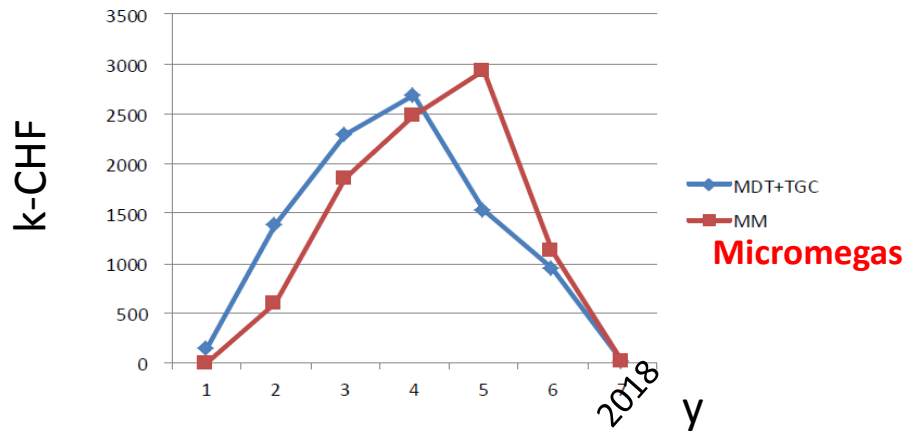
Table 19: Cost estimate (VERY VERY PRELIMINARY)

	Item	Details	Nb of units	Cost/unit (CHF)	Costs (MCHF)
~1/3 ->	MM detectors	PCB, resist. strips, bulk	1024	2–3000/m ²	2–3
	Housing + supports	Stiff. panels, spacers, etc.	128	2–3000/pc	0.25–0.4
	Alignment	Complete with electronics			0.6
~1/2 {	Trigger, readout, LV	Chip development + production	2 M	1.1/channel	2.2
		Front-end cards			0.6
		GBTx + fibres			0.4
		Cont. Addr. Memories			0.8
		Scalable Readout System			1.0
		Services			HV supplies + cables
	Gas distribution	0.1			
TOTAL					8.5–9.6

(10/2011)

Voir document CSTS

CORE expenditures timeline for sMDT+TGC and Micromegas



Profil de dépense (total ~9 MCHF), incluant le travail d'installation et la mécanique l'alignement. Le décalage du profil des dépenses s'explique par le retard des Micromegas à l'industrialisation.

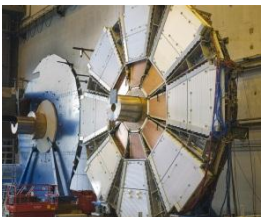
Demande d'une implication de l'Irfu à hauteur de 10 à 15%. Cela permettrait :

(i) D'avoir une visibilité sur le projet
(ii) D'acquérir une expérience et des compétences importantes sur :

- Fonctionnement à haut flux
- Industrialisation
- Chambres multicouches

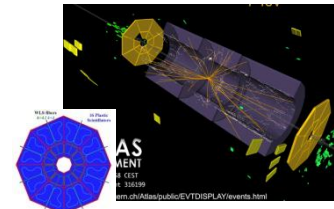
(sans être trop exposé sur ce projet)

Cela représente déjà **~2x T2K-Micromegas** pour :
~100m² de détecteurs, ~200 k-canaux d'électronique à tester pour un investissement de ~1 M-euros.



Upgrade Atlas – groupe Micromegas (MAMMA)

Demandes au CSTS du SPP (2 options)

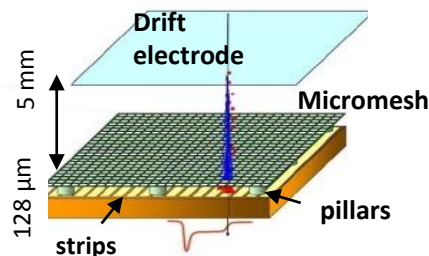


Micromegas **choisies** par Atlas
pour l'upgrade des Small-Wheel
($r = 5\text{m}$, $\sim 1000\text{ m}^2$ de détecteurs)

Objectifs : arriver à un PRR (Production Readiness Review) fin 2012, puis production, etc...

Participation de l'Irfu à :

- (i) L'étude de l'assemblage de Micromegas en chambres multicouches et l'étude de l'intégration de celles-ci sur les petites roues ;
- (ii) L'étude, le développement et la production de l'électronique de déclenchement ;
- (iii) la calibration, la construction et l'installation des détecteurs (10 à 15%).



Micromegas **rejetées** par Atlas
pour l'upgrade des Small-Wheel

Objectifs : se repositionner sur le projet (MBTS, $r < 90\text{cm}$) et finir d'acquérir l'expertise en cours (compréhension, industrialisation et précision).

Voir document CSTS

Participation de l'Irfu :

- (i) « Repositionnement » sur l'upgrade : MBTS (et électronique, intégration...) ;
- (ii) Fin des études en cours (irradiation, etc.) ;
- (iii) Participation à la construction de la première grand chambre Micromegas résistive.

Dans les deux cas (pas avec la même priorité en temps) :

Participation de l'Irfu au proto echelle-1 (avec alignement des layers pour -au moins- un des multi-layer) et suivi + participation à l'industrialisation.
=> L'objectif étant que ce détecteur puisse servir à boucher un des trous d'acceptance du spectromètre à muons (par ex. : pieds, $\eta=0$, etc.).

Quelque soit le choix de la collaboration Atlas, à travers ce projet, l'Irfu a les moyens d'acquérir une expertise dans : (i) la compréhension des Micromegas résistives, (ii) l'industrialisation de leur production, (iii) la réalisation d'une chambre multicouches de précision.