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Tracking and vertexing in the linear e^+e^- collider

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LINEAR COLLIDER COLLABORATION

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Agenda

Charged particle detection performances of CMOS Pixel Sensors designed in a 0.18 um CMOS process based on a high resistivity epitaxial layer	*WINTER, Marc*
DEPFET detectors for future electron-positron colliders	*MARINAS PARDO, Carlos*
SemRm 4, DESY Hamburg	09:20 - 09:40
R&D status of FPCCD VTX and its cooling system	*SUGIMOTO, Yasuhiro*
SemRm 4, DESY Hamburg	09:40 - 10:00
3D Deep N-well CMOS pixel sensors for the ILC vertex detector	*RE, Valerio*
SemRm 4, DESY Hamburg	10:00 - 10:20
UK activities and progress	*WILSON, Fergus*
SemRm 4, DESY Hamburg	11:00 - 11:20
Current status of the Chronopixel project	*SINEV, Nick*
SemRm 4, DESY Hamburg	11:20 - 11:40
R&D on sensors and readout for the CLIC vertex detector	*ARFAOUI, Samir*
SemRm 4, DESY Hamburg	11:40 - 12:00
Physics-performance optimization of the CLIC vertex detector	*ROLOFF, Philipp*
SemRm 4, DESY Hamburg	12:00 - 12:20
Novel sensor technologies for tracking and vertexing...	*CURRÁS, Esteban*
SemRm 4, DESY Hamburg	12:20 - 12:40
Simulation of ILC-type DEPFET Sensors	*SCHWENKER, Benjamin*
SemRm 4, DESY Hamburg	12:40 - 13:00
Super-capacitor characterization for FTD-ILD sub-detector power distribution system	*ARTECHE, Fernando*
SemRm 4, DESY Hamburg	12:15 - 12:35
Fiber Bragg Grating Sensors for Smart-Trackers	*MOYA MARTIN, David*
SemRm 4, DESY Hamburg	12:35 - 12:55

Beam Tests of the DESY GridGEM Module	*MÜLLER, Felix*
SemRm 2, DESY Hamburg	11:00 - 11:20
Studies of a GEM based readout for the ILD TPC	*ZENKER, Klaus*
SemRm 2, DESY Hamburg	11:20 - 11:40
Results from the 2012 beam test of the Asian GEM modules	*TIAN, Junping*
SemRm 2, DESY Hamburg	11:40 - 12:00
Production and Applications of Integrated Pixel Readouts for a Linear Collider	*KRAUTSCHEID, Thorsten*
SemRm 2, DESY Hamburg	12:00 - 12:20
ALICE TPC Update	*BALL, Markus*
SemRm 4, DESY Hamburg	16:00 - 16:20
Positive ions backflow in the LCTPC: status of the possible gating systems	*GROS, Philippe*
SemRm 4, DESY Hamburg	16:20 - 16:40
Hit finding and pad response function for the LCTPC using resistive Micromegas	*BELLERIVE, Alain*
SemRm 4, DESY Hamburg	16:40 - 17:00
Occupancy studies for the CLIC_ILD TPC with pad and pixel readout	*KILLENBERG, Martin*
SemRm 4, DESY Hamburg	17:00 - 17:15
Power pulsing scheme based on a back-end current source for the analog electronics of the vertex detectors at CLIC	*FUENTES, Cristian*
Engineering studies for the inner region of the CLIC_ILD detector concept	*DUARTE RAMOS, Fernando*
SemRm 4	16:50 - 17:10
Ultra Low Mass Cooling for Fine Pixel Detectors	*RUIZ-VALLS, Pablo*
SemRm 4	17:10 - 17:30
Forward tracking at the next e+e- collider: experimental challenges and detector design	*VOS, Marcel*
SemRm 4	17:30 - 17:50

Disclaimer: Impossible to make a summary of 24 talks in 10 minutes…

→ My very personal selection

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Pixel technologies

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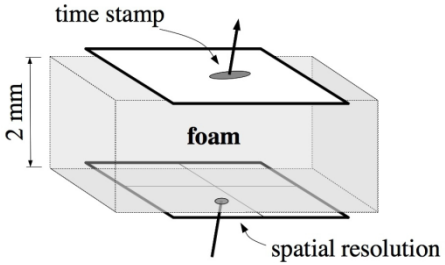
MAPS Jérôme Baudot (IPHC)



- Process 0.35 µm

3 µm / 50 µs (L1 inner), 6 µm / 10 µs (L1 outer) @ 500 GeV

MIMOSA 28 → Installed at STAR

- New process 0.18 µm

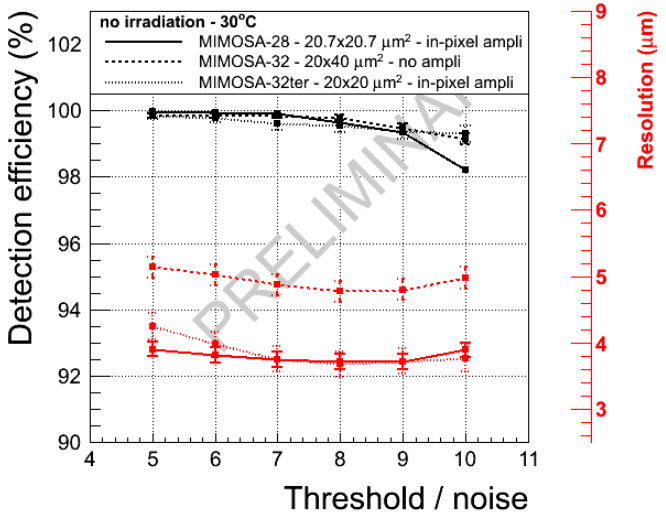
3 µm / 50 µs (L1 inner), 6 µm / 2 µs (L1 outer) @ 1 TeV

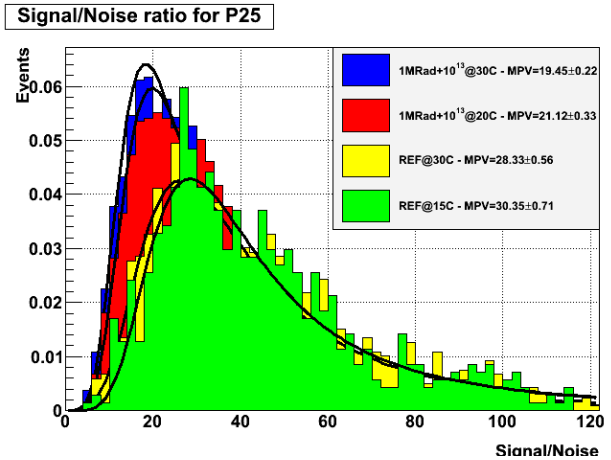
↘ Faster and higher circuitry density

Thicker sensitive volume ~40 µm
Higher resistivity > 1-2 kΩ.cm

MIMOSA 32ter → Test beam in 2012

PLUME 0.6 % X_0



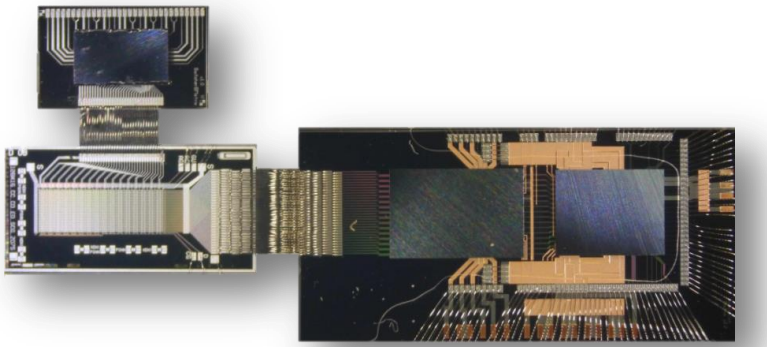


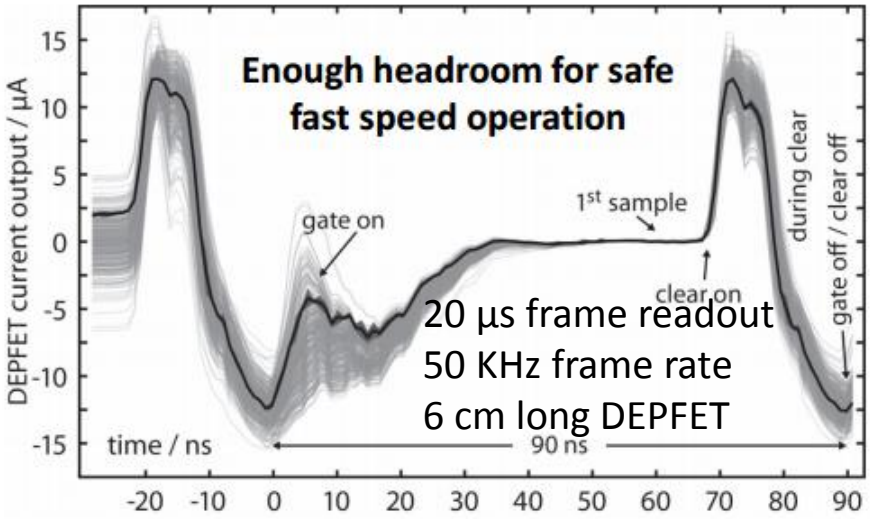
20x20 µm²
50 µm
In-pixel amplification + CDS
1 Mrad + 10^{13} n_{eq}/cm^2

Pixel technologies

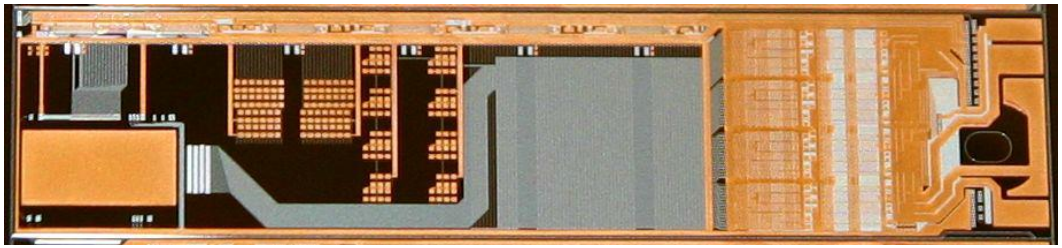
DEPFET Carlos Marinas (Bonn)
Benjamin Schwenker (Goettingen)

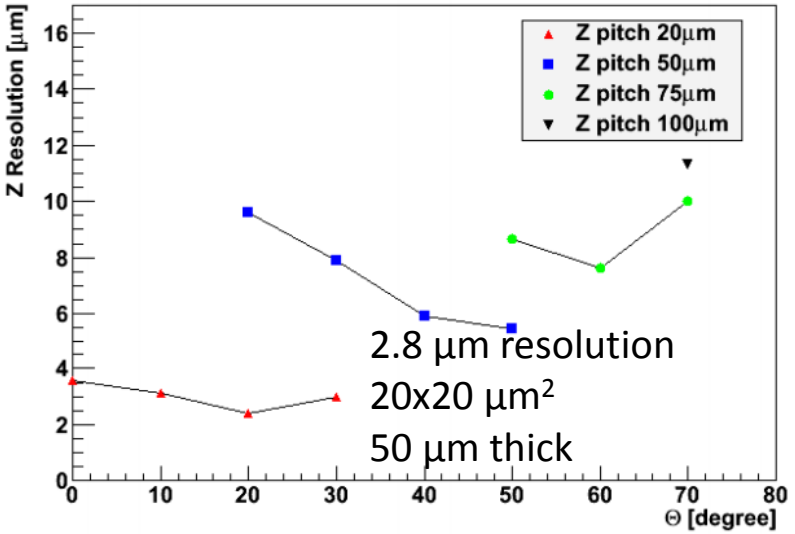
- Belle II PXD almost prototype of L1, L2 ILD-VXD
- System demonstrator:
  Small thin (50 μm) DEPFET+ final ASICS + DAQ
- TB 2013: Efficiency> 99.5 %, g_q~500 pA/e^-





- Electrically active prototype of a half ladder + flipchip





Simulation tuned with TB data

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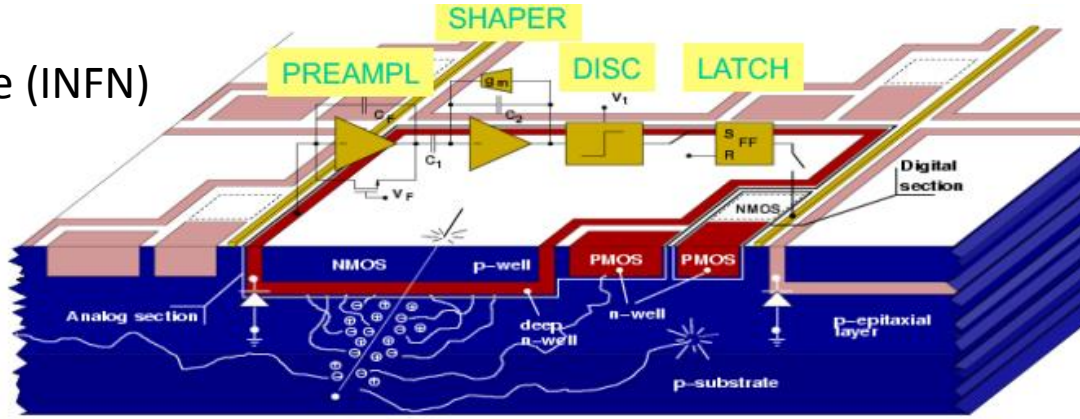
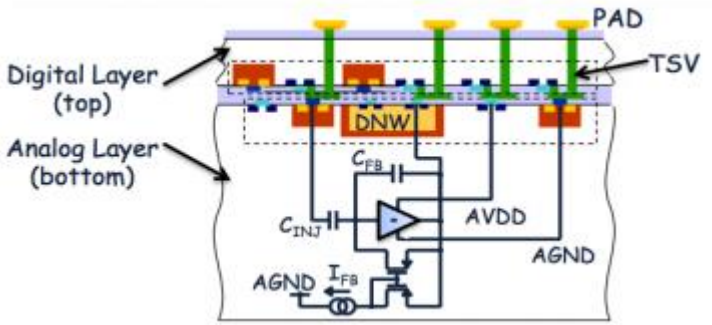
Pixel technologies

3D Deep N-well CMOS Valerio Re (INFN)

- ‘Hybrid pixel’ functionalities in monolithic devices (sparsification and time stamping) with 3D integration

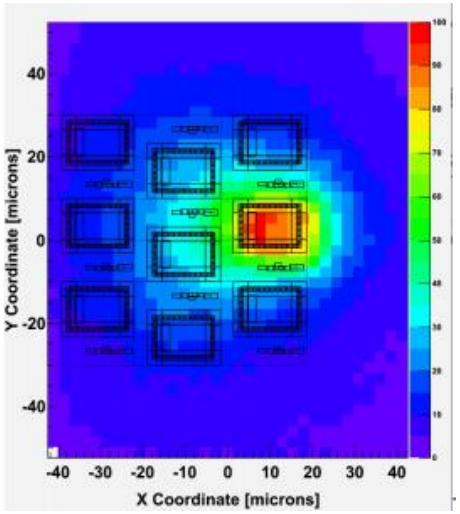


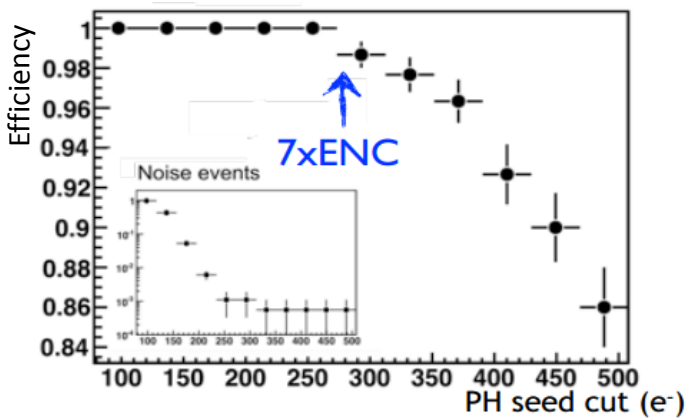
- Extended collecting electrode (Deep N-Well) for higher single pixel collected charge
- Move the competitive n-wells (PMOS) into the vertical direction to increase the fill factor and efficiency



MPW run bonded by Tezzaron
3 years turnaround process
Many technical problems

- Fully functional 3D chips produced (SDR1)
- Characterization of the analog front end: 700 mV/fC, 40 e^- ENC, 5 µW/pixel
- Test beam, lab, irradiations (1 Mrad)





Pixel technologies

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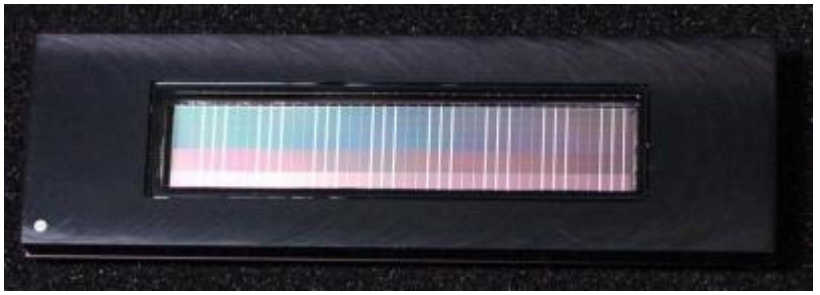
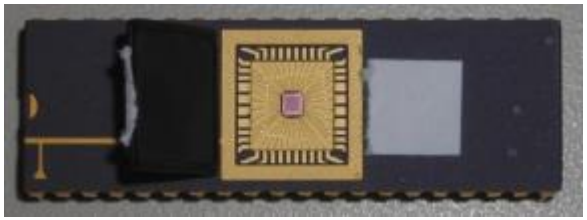
FPCCD Yasuhiro Sugimoto (KEK)



Large prototype
6x1.2 cm^2 square image area
50 µm thin wafer
6x6, 8x8, 12x12 μm^2
Test beam cancelled
Development CO_2 plant (-40ºC)

Chronopixel Nick Sinev (Oregon)

Prototype 2: all electronics inside pixels only from NMOS transistors.
IBM 90 nm. 25x25 μm^2
Crosstalk and design problems



Pixel technologies

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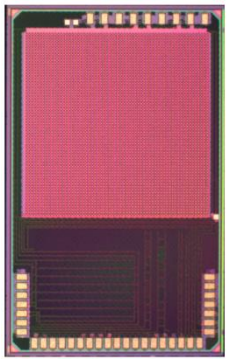
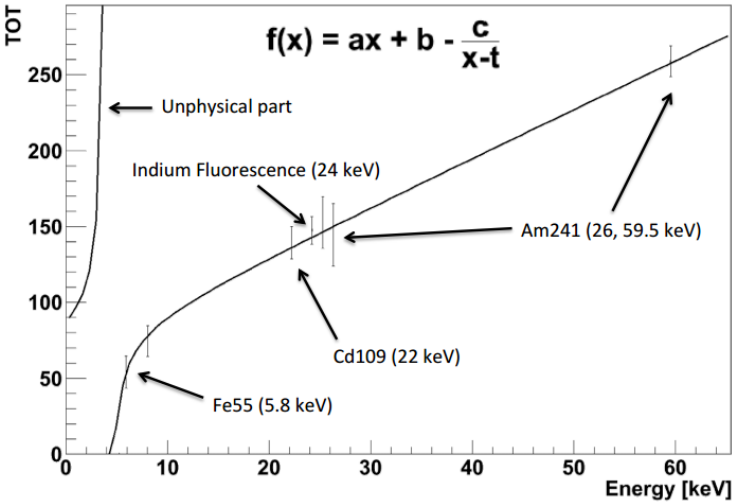
CLICPix Samir Arfaoui (CERN)

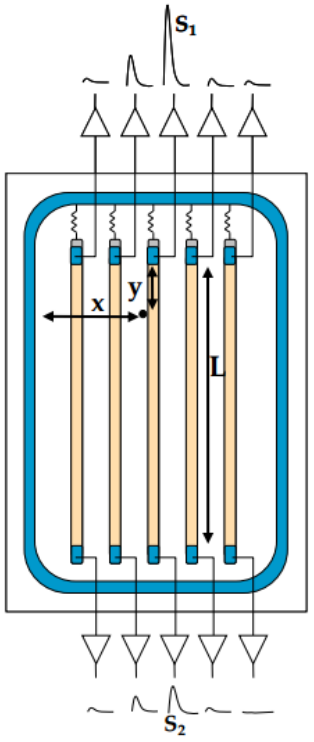
Medipix/Timepix calibration
CLICPix produced
65 nm CMOS, 25x25 µm^2, time slicing <10 ns
Readout being prepared
Medipix3 TSV done
Procurement of thin sensors (mat. budget)



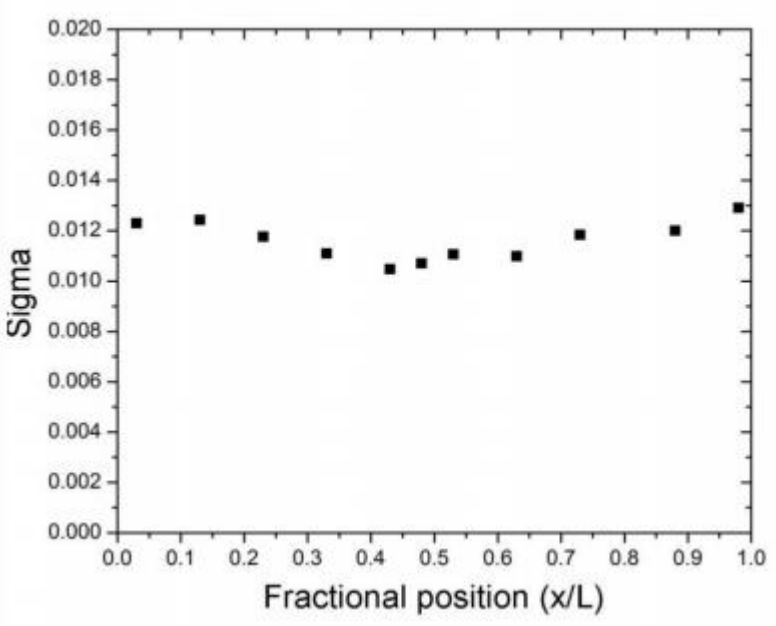


2D strips with charge division Esteban Currás (IFCA)

Getting the particle hit coordinate along the resistive strip (polysilicon) using the charge division method instead of double sided strips
2 cm long strips, 20 µm width, pith 80 µm



$$\frac{y}{L} = \frac{A_2}{A_1 + A_2}$$



Longitudinal spatial resolution for 6MIP signal: 1.2 % L = ~200 um

Air cooling and engineering

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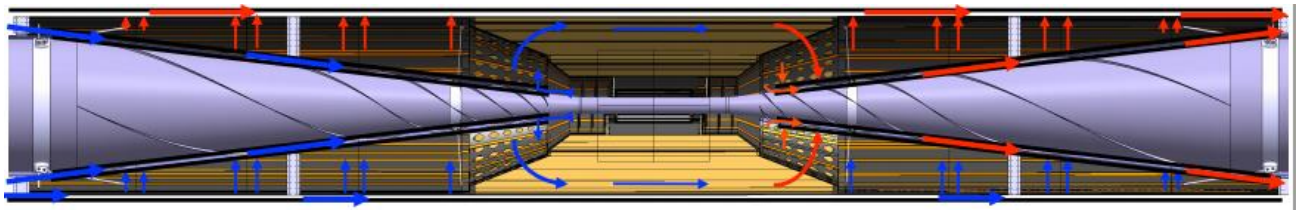
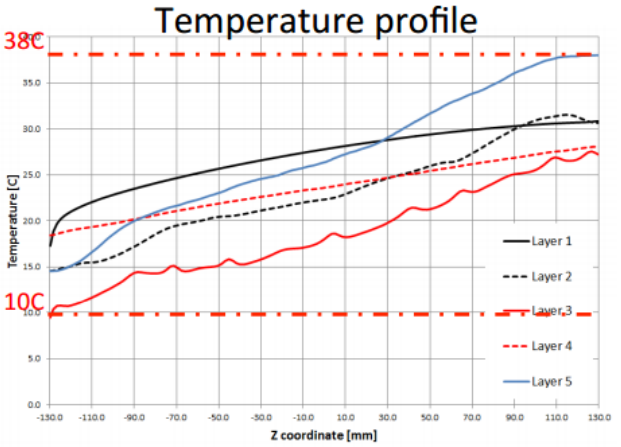
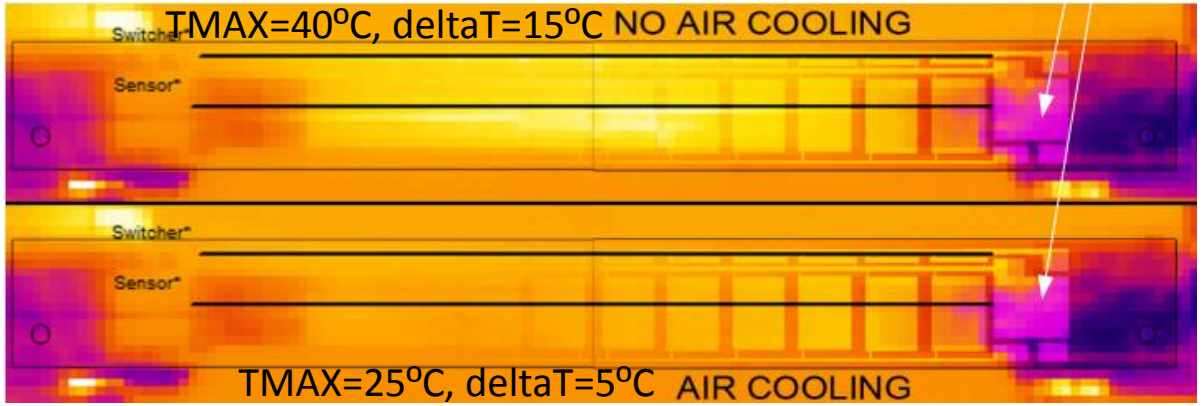
CLIC_ILD Fernando Duarte (CERN)



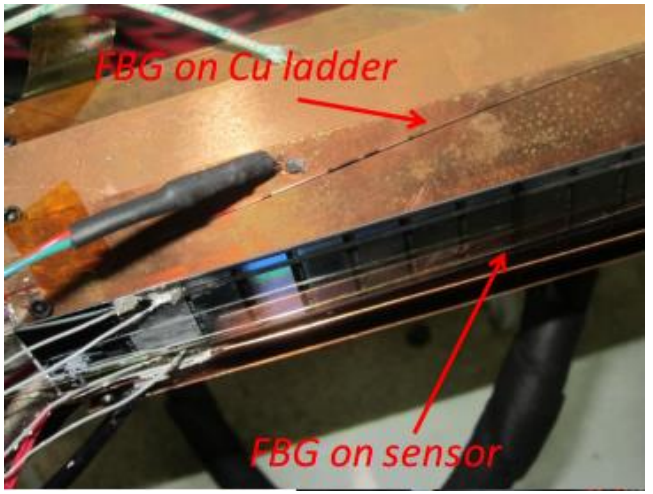
Feasibility to be demonstrated by mock-ups



Belle II Pablo Ruiz (IFIC)



Performance of convective cooling demonstrated for DEPFETs for Belle II



Belle II David Moya (IFCA)

Environmental monitor for the Belle II vertex detector based on Fiber Bragg Grating optical sensors
Control: Displacement, RH%, temperature and N2 concentration

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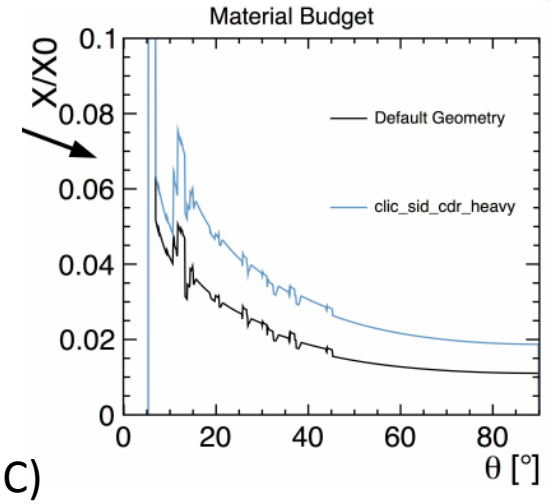
Optimization studies

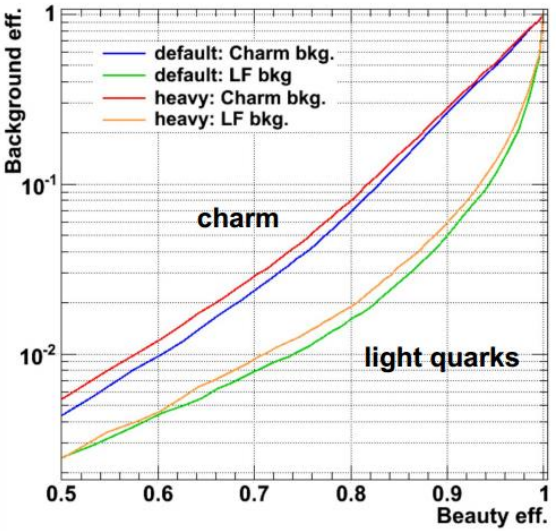
CLIC vertex optimization Philipp Roloff (CERN)

- Impact of material budget in physics performance
- Compare single/double layer designs

The barrel geometry with double layers has better performance for c-tagging and b-tagging for low-energy jets

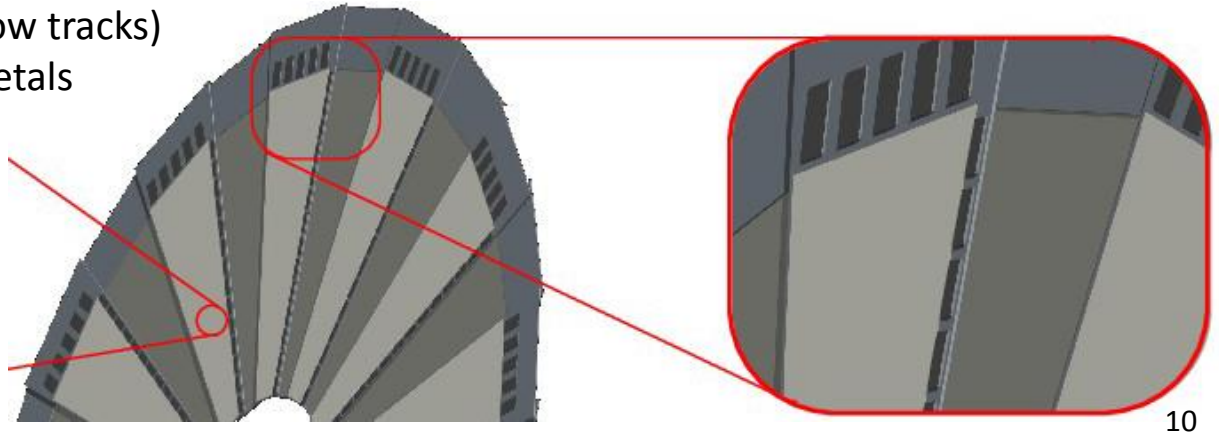
Studies ongoing





Forward region Marcel Vos (IFIC)

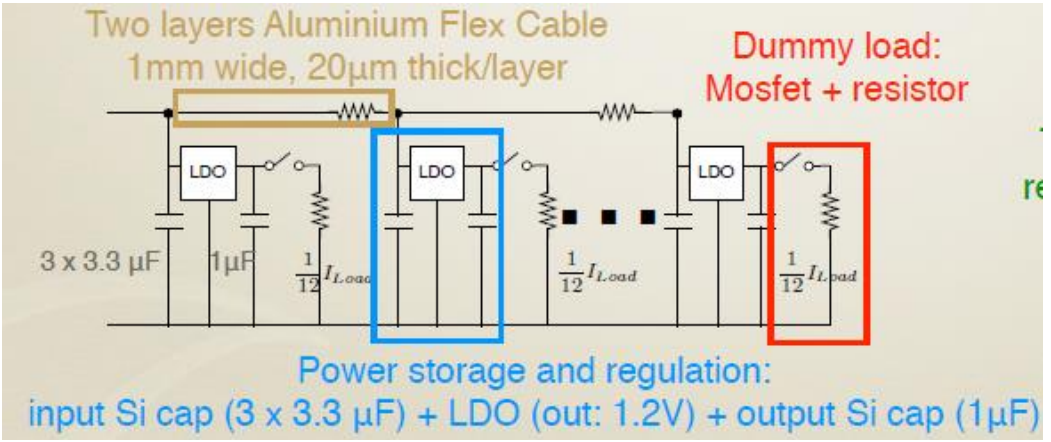
- Forward region more and more important with higher sqrt(s)
- Also very thin sensors needed (shallow tracks)
- Idea of a pixelated solution for the petals

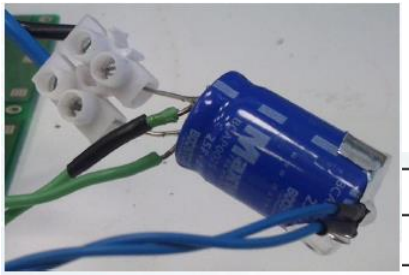


Power pulsing

CLIC Cristian Fuentes (CERN)

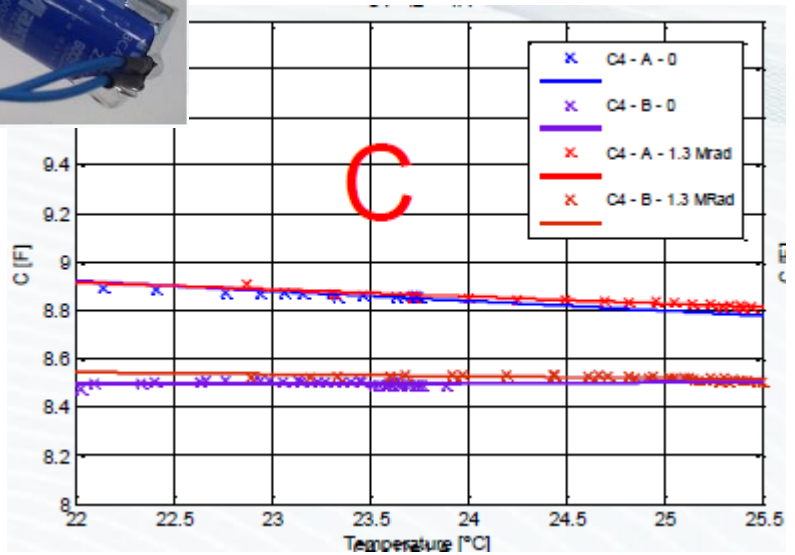
- Analog power scheme based on a back end current source.
- Integrated silicon capacitors (10 µF) connected to CLICPix with TSV.
- Silicon capacitors charged up using a back end current (60 mA) supply
- Concept demonstrated using test boards





SuperCapacitors Fernando Arteche (ITA)

- Power distribution system for the FTD-ILD
- Electrochemical capacitors with up to 25 F
- Irradiated up to 2.3 Mrad with 20 MeV electrons
- No performance degradation observed in the stress tests



TPC readout flavors

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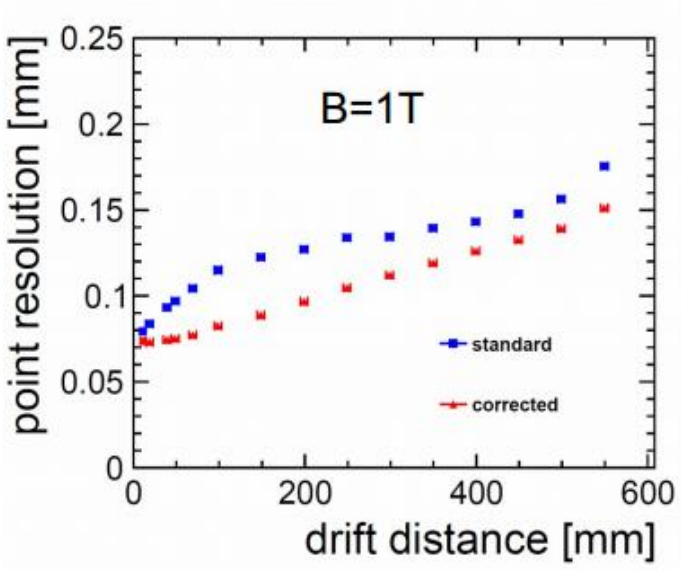
GridGEM Felix Müller (DESY)

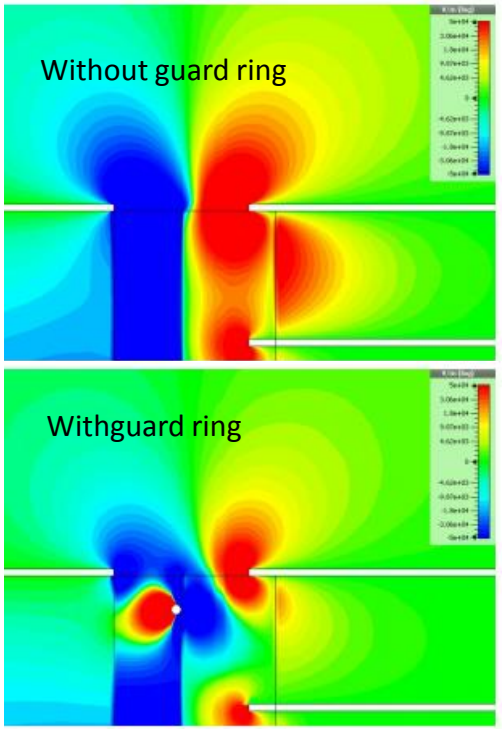
GridGEM -> GEM with integrated support structure

Field distortions between modules strongly suppressed with a guard ring
30 % higher charge collection on 1st pad

Test beam results with PCMAG: Efficiency >95% (BUT borders)

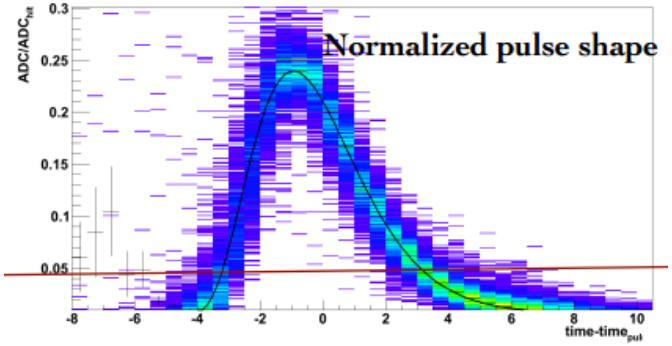
ExB distortions in the electron path (offline corrected)





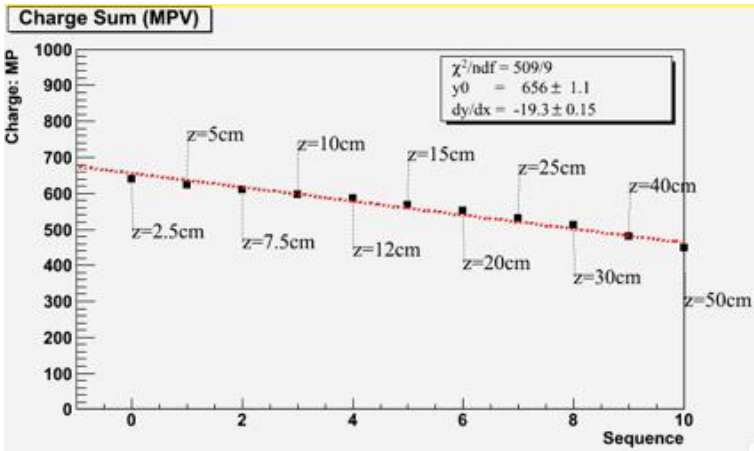
TPC readout flavors

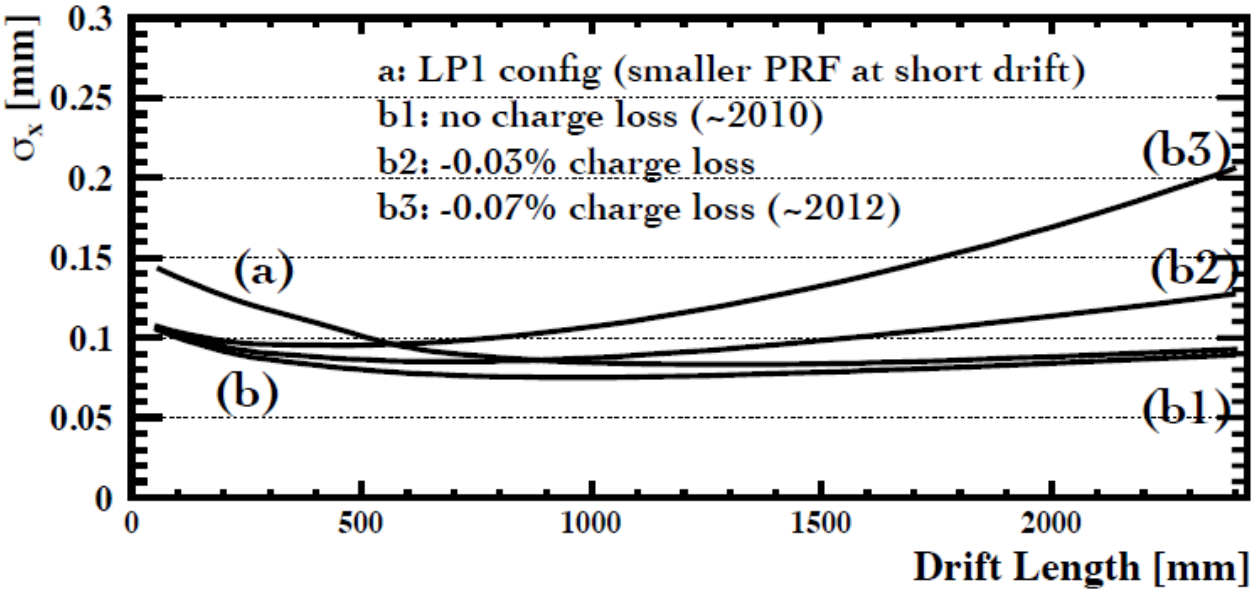
Asian GEM Junping Tian (KEK)



- Good understanding of the longitudinal diffusion pulse
- 30% charge loss found in 2012 test beam
  (Not observed in 2010)

- Extrapolation based on 2010 data copes with the requirements





TPC readout flavors

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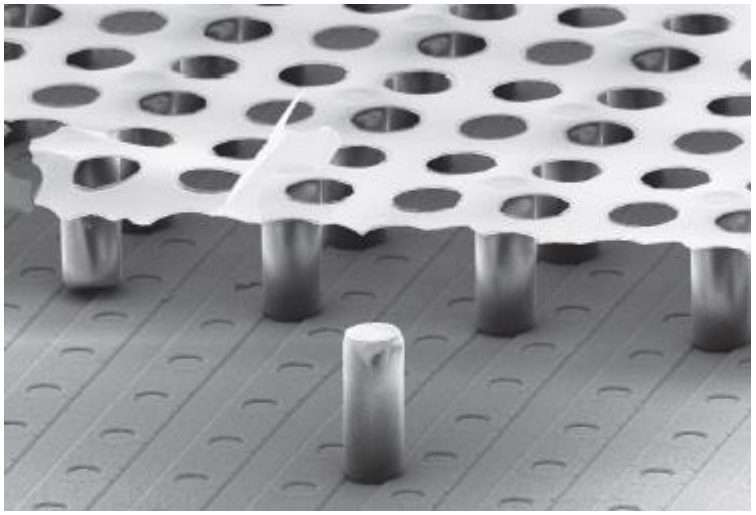
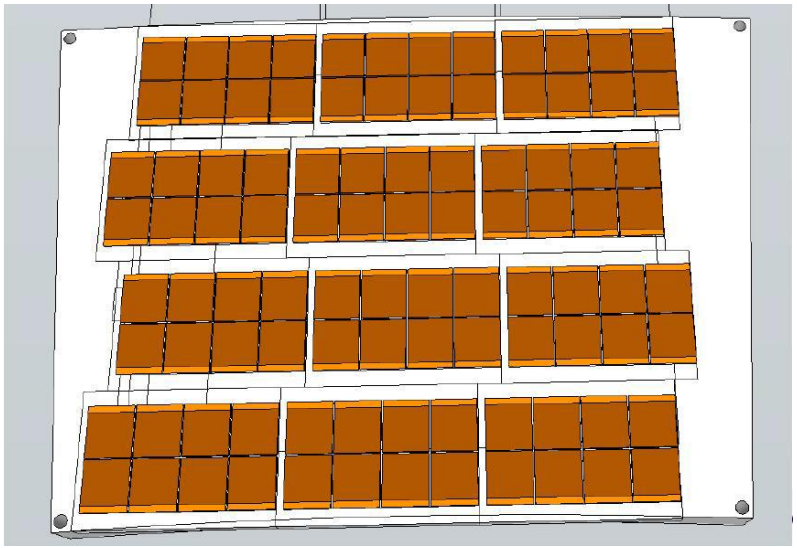
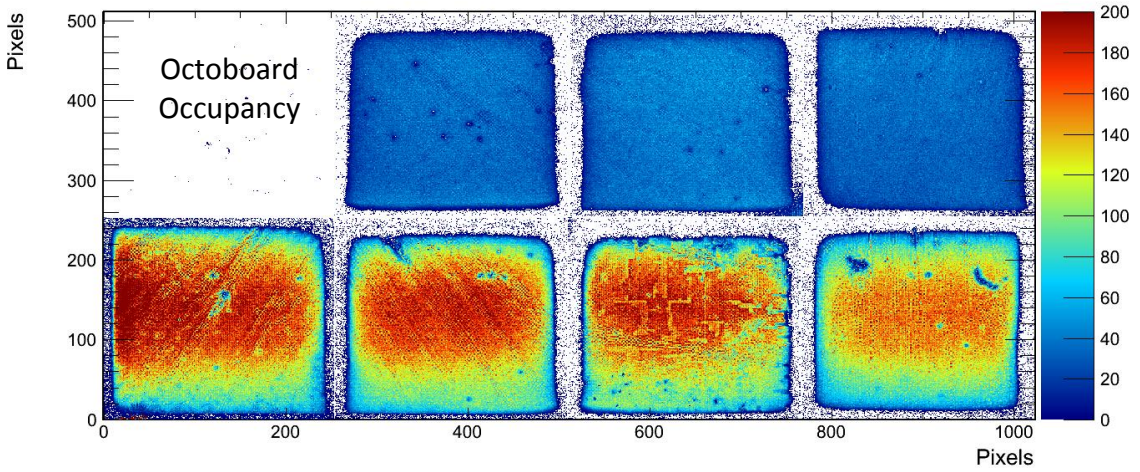
InGrid Thorsten Krautscheid (Bonn)

- Micromegas on a Timepix
- Production moved from single chip to wafer scale
- Test beam: Some defects in the active area
- Module with ~100 chips is under preparation







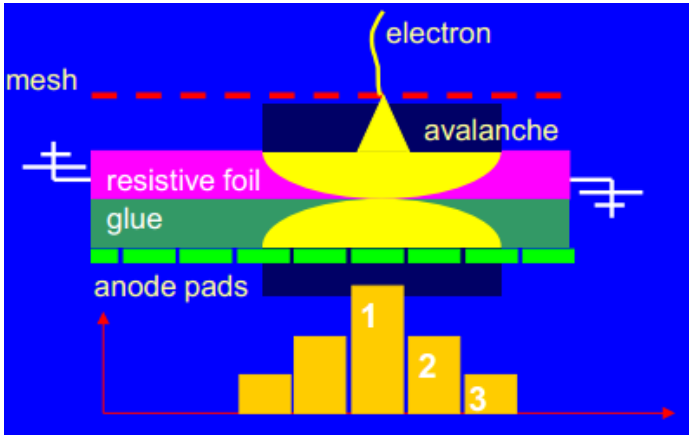
TPC readout flavors

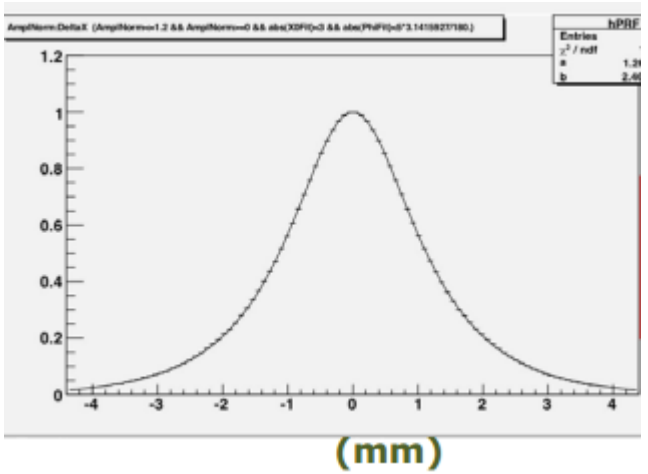
Resistive Micromegas Alain Bellerive (Carleton)

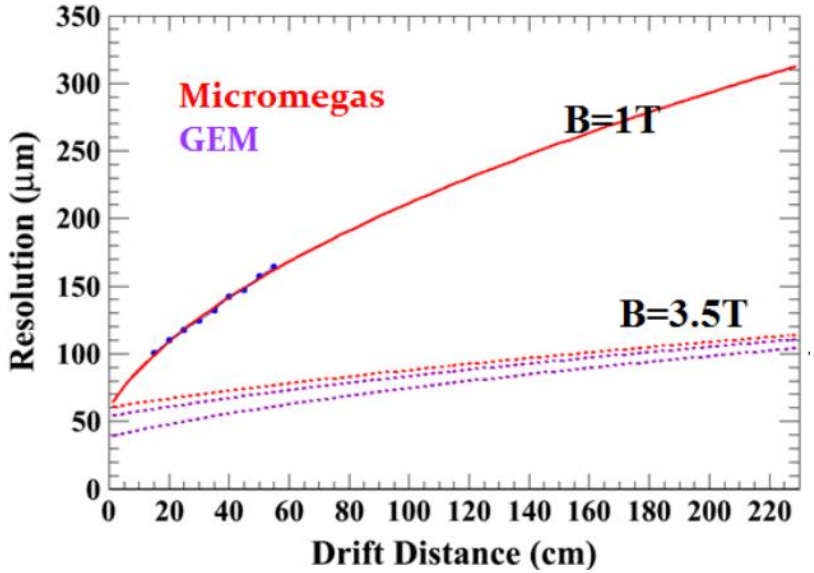
- Resistive layer film bonded to the readout pads with an insulating spacer

- Model of the Pad Response Function obtained: from the charge deposition to the hit reconstruction
  → Transverse/longitudinal diffusion, induction gap, preamp. response, resistive foil+glue

- Resolution ~100 µm if TB2013 data extrapolated to final magnetic field







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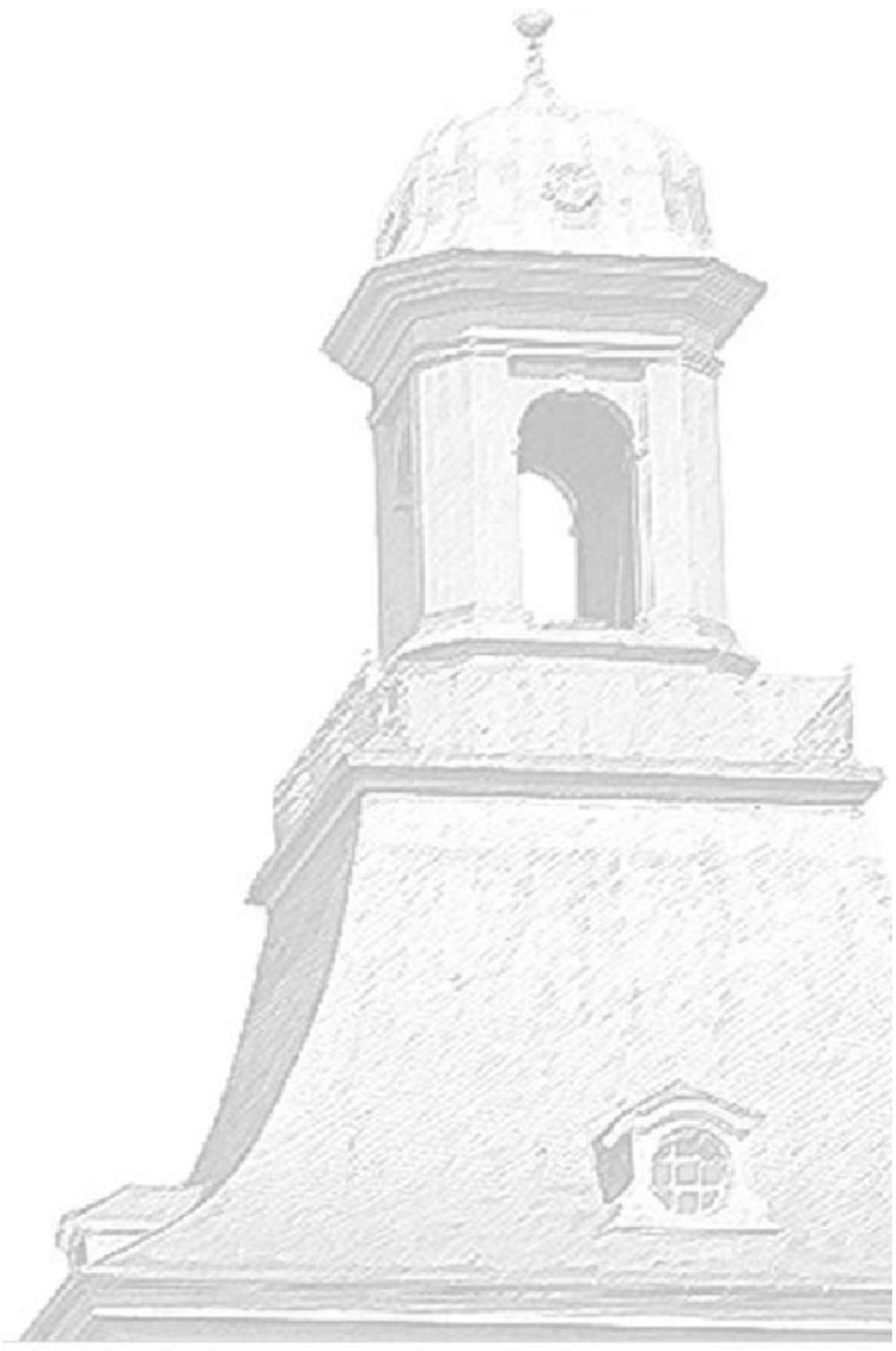
Thank you



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