A New GEM Module for the LPTPC

By

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Introduction

Maximum Sensitive Area

Gain Uniformity between 5/10%

- To be further increased with calibration efforts
- Good dE/dx resolution

Spatial resolution under 100 µm

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Introduction

Four Components

- The Backframe
- The GEMs
- Framing and Support Structure
- Anode Readout Plane

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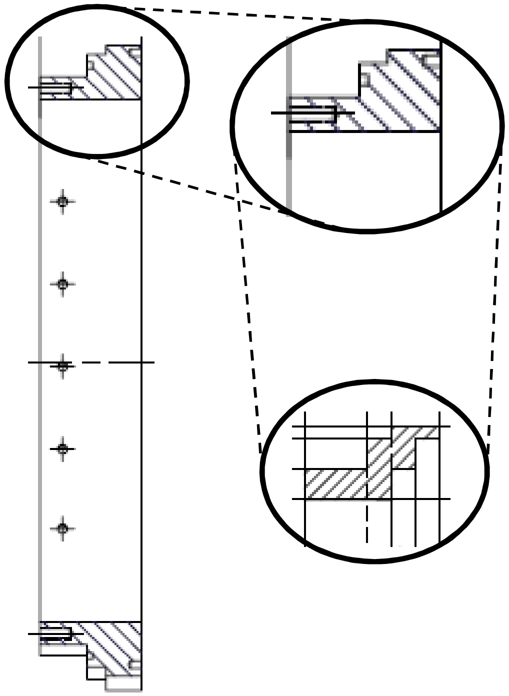
The new backframe: Design



Goal

- To increase the available space on the connector side of the readout plane

No predicted negative effect

- The element which has been thinned does only support the pad plane

Height of the module to be estabilished

- The total heigth of the module is to be estabilished once we decide for the total thickness of the GEM stack

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The new backframe: Production

Site

- The production of the backframe will be performed at the University of Hamburg workshop

Materials

- The recommended for the production of the module is the alloy Aluminum 6061 T651
- The workshop do not have that material readily available
- We are going to use AlMg4,5MN (Dogal 5080) for the first tests

Frame and Support System: Issues

Reduce the unsupported areas

- Gain uniformity limited by the GEM sagging
- To reduce the sagging we must limit the unsupported areas of the GEM

Increase the sensitive area

- Sensitive area limited by the presence of supporting materials
- To increase the sensitive area we need to reduce the width of the framing and supporting structure

Choose a stiffer material than GRP

- To meet both requirements we need an insulating material which can be made thinner remaining as resistent as a normal GRP frame
- Alumina Ceramics is almost 4 times stiffer than GRP and may be machined with widths of 0.5 mm

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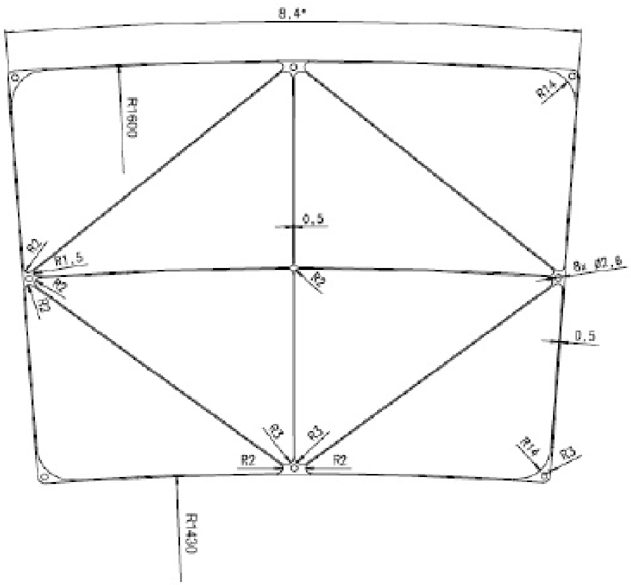
Frame and Support System: Design



Modular structure

- Every GEM can be separately framed
- The framed GEM can be piled up to form the stack using "ungemmed" frames as spacers

0.5 mm width

- The external frame and the internal grid structure are 0.5 mm wide
- There are 6 strong points for the mounting of the support structure

Mandatory horizontal bar

- The horizontal bar presence depends on the mandatory segmentation of the GEM electrodes

Grid patterns

- Many grid patterns have been considered
- Each grid emphasize a specific requirement
- E.g. The grid shown is the stiffer design considered

Production

- We got in touch with a production firm and we are evaluating the feasibility of the project

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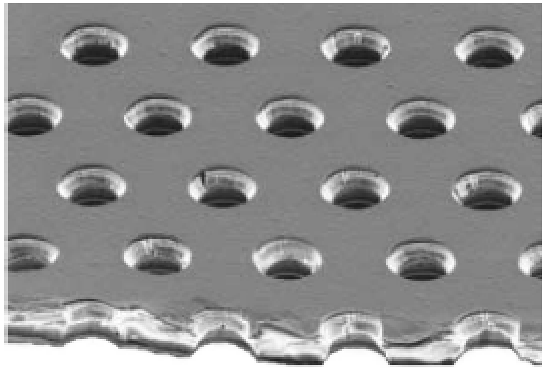
The GEMs: Design



Custom GEM

- Specifically designed to get the maximum sensitive area

Produced by CERN

- 50 μm kapton foil
- Chemical etching

Standard hole size and pitch

- 70 μm hole size
- 140 μm hole pitch

2 or 4-fold electrode segmentation

- A 2-fold segmentation will increase the sensitive area
- A 4-fold segmentation will increase the operation safety

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The GEM Stack: Features

Three GEM + possible gate

- Three GEM stack
- Optional fourth module (gating)
- The gate may be both GEM or wire based

Induction gap

- Small induction gap → better time resolution
- The induction gap effect lower than other effects

Transfer gap

- Transfer gaps and fields influence the defocussing of the stack
- The defocussing and the pad size influence the point resolution

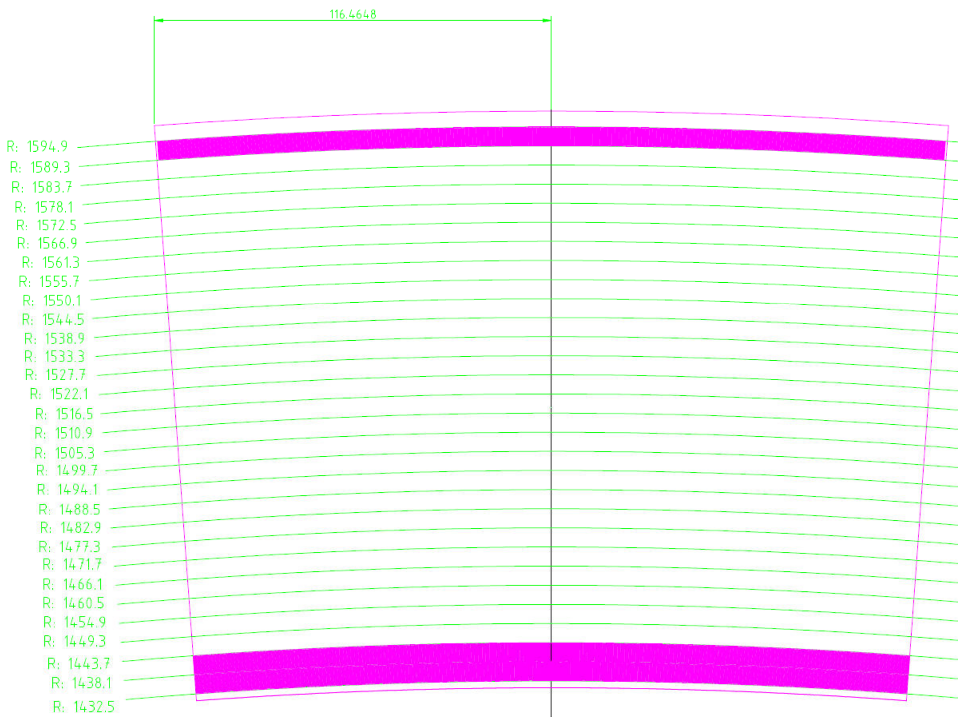
Ion backdrift

- Influenced by the fields and of the potential across the GEMs

Numbers not yet available

- I've not yet done all the calculation and simulation to find the best compromise

Anode Readout Plane: Features



Structural Features

- Ensure gas tightness
- Support the GEM stack
- Provide power to the GEM stack

Readout Features

- Pad readout
- Maximum possible sensitive area
- Readout by ALTRO electronics

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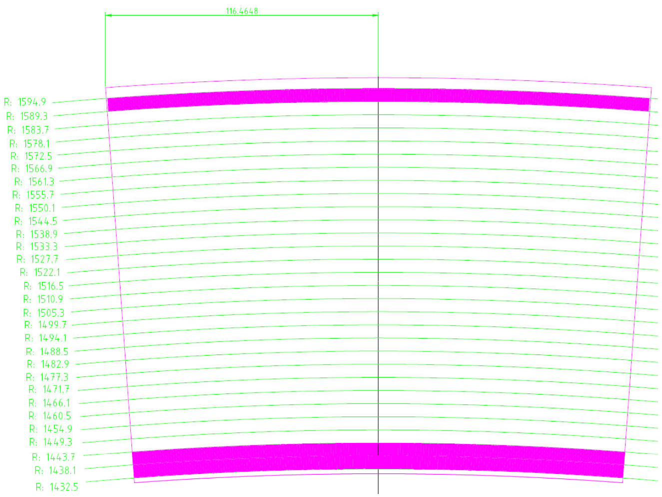
Anode Readout Plane: Design



In collaboration with Bonn University

- The design is still in his infancy
- Using the data acquired testing the Bonn GEM module

Pad size

- (1.1 ÷ 1.25) x (5.6 ÷ 5.8) mm
- 28 rows
- Row gaps aligned with the GEM segmentation gap

GEM Power supply

- Supplied from power pads on the PCB itself
- Using the ceramic structure to separate the power from the readout pads

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Something more: new measurement

Gain Calibration

- Beam calibration
- Laser calibration
- Radioactive source calibration

Gate efficiency

- Confront the efficiency of GEM and wire gates

Ion Backdrift Measurement

- We need the equipment to perform this measurements on the LP

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Conclusions

Module Backframe

- First design ready
- Looking for production solutions

Ceramic Framing

- First design ready
- Design to be updated using producers feedback

GEMs

- First design ready
- Getting feedback from CERN to update this design

Anode Readout Plane

- Design just beginning

Other ideas

- Compare gating modules
- Test the gain homogeneity of the modules
- Measure the ion backdrift in the TPC

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