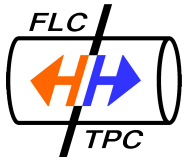
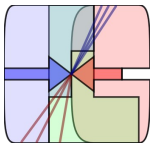
Ralf Diener
Peter Schade



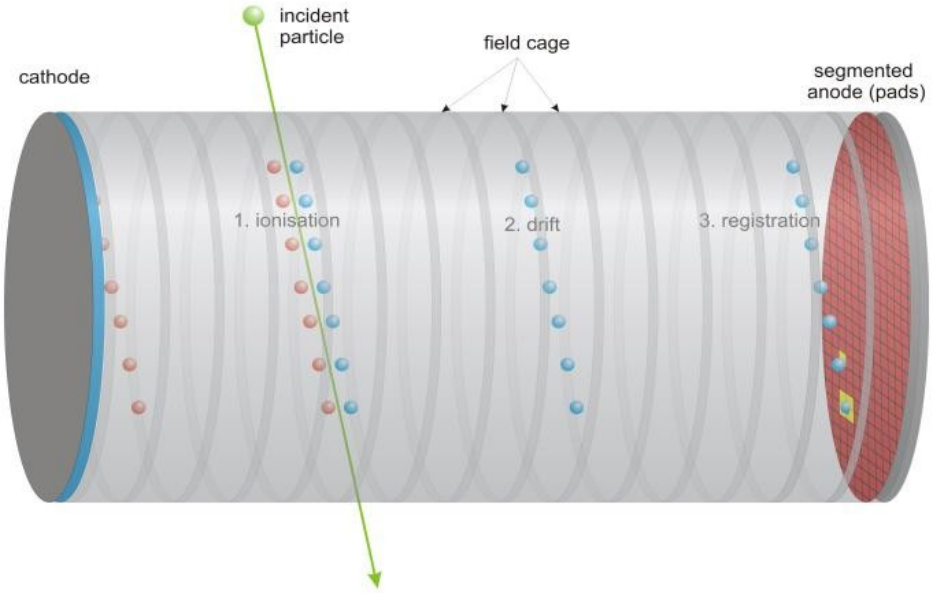
The ILC TPC Large Prototype : status and plans

- **Field Cage**
- **Field Strip Foil**
- **Time Schedule**



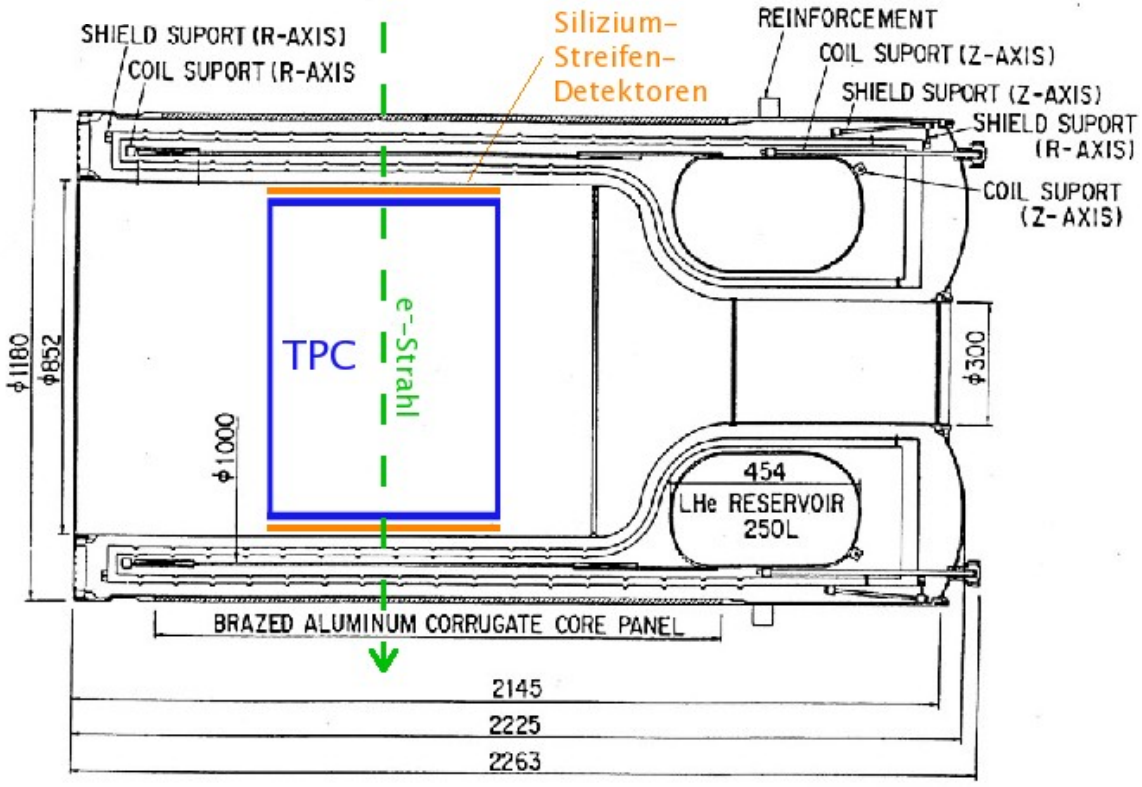
bmb+f - Förderschwerpunkt
Elementarteilchenphysik
Großgeräte der physikalischen Grundlagenforschung

The Large TPC Prototype Setup



- Reminder TPC:
  - Gas filled volume
  - High electric field inside
  - Particle ionizes gas molecules and electrons are drifted to anode
  - Should be lightweight (low material budget before Calorimeter)

- Large TPC prototype:
  - Build inside EUDET project
  - Fit into 1T PCMAG (already installed at DESY HH testbeam area)
  - Additional Si-Strips as hodoscope



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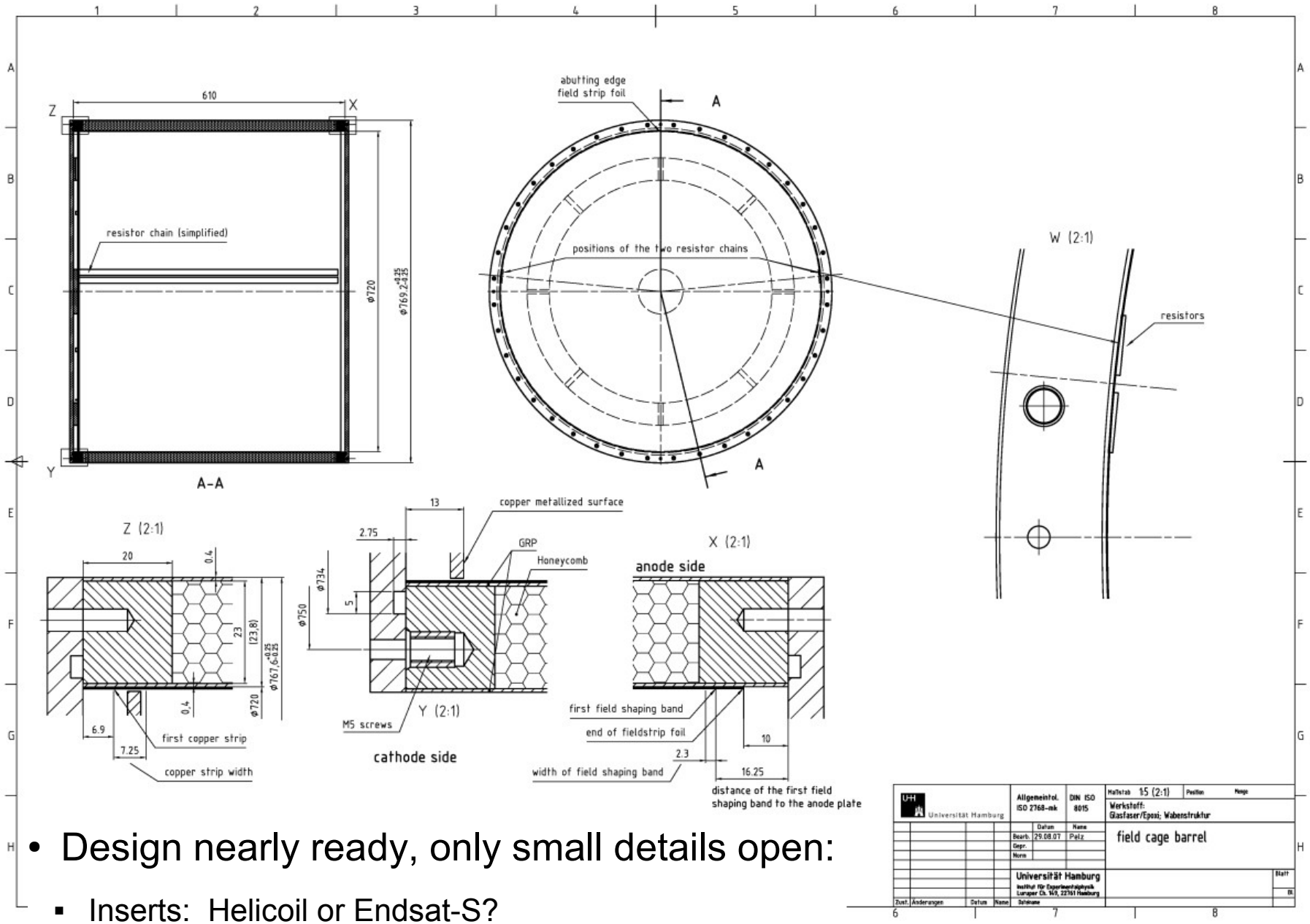
Latest Technical Drawings of LP Fieldcage



- Design nearly ready, only small details open:
  - Inserts: Helicoil or Endsat-S?
  - Screws: 5 or 6mm?
  - O-ring groove dimensions?

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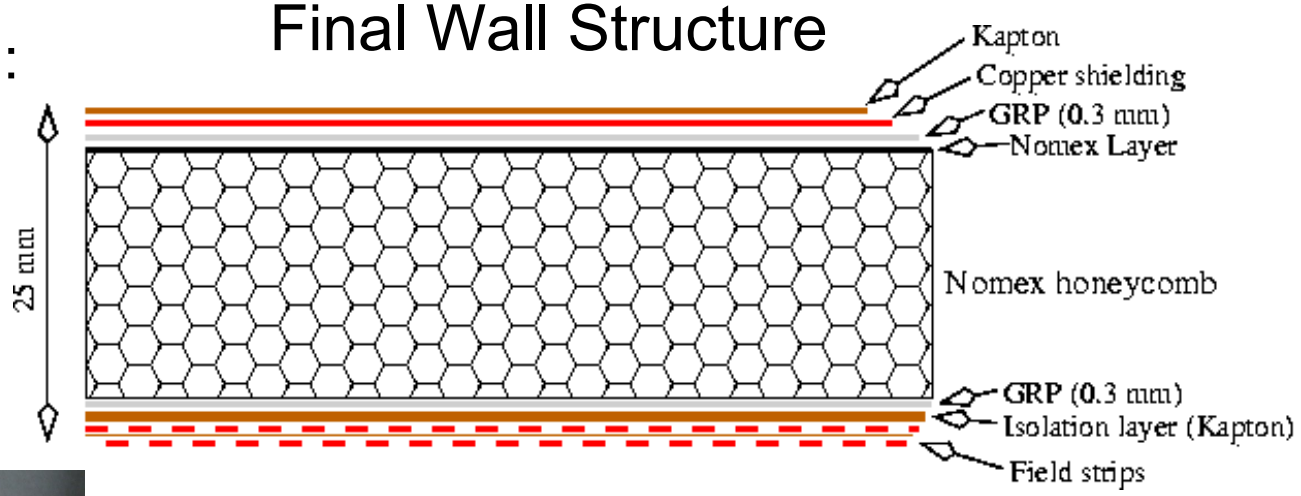
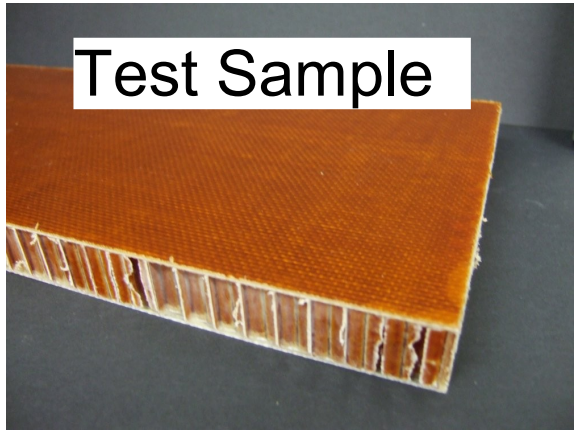
Fieldcage Wall

- Wall cross section:
  - shielding
  - honeycomb with GRP layers
  - field strips

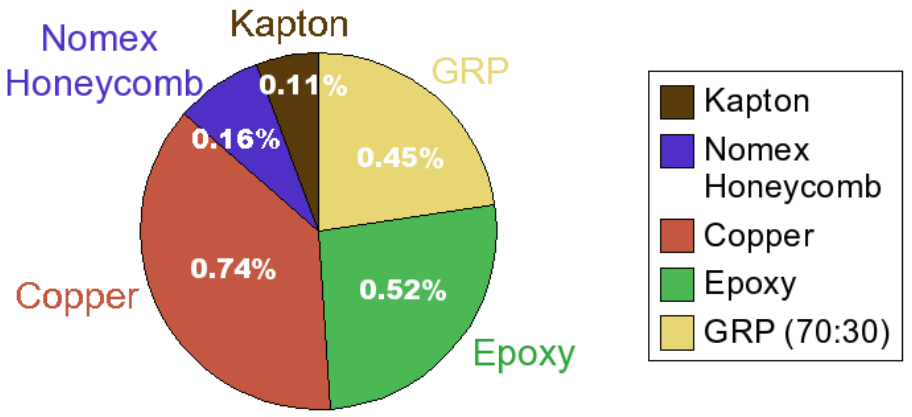
Final Wall Structure





- Estimation of radiation length of the fieldcage wall is below 2% X_0
- LP: 4.45% (2 walls + 72cm TDR or P5 gas)
- Final TPC: 4.85% (2 walls + 130cm TDR or P5 gas)

Radiation Length in % of X_0= 1.98%



Material	Rad length [cm]	Thickness	% of X_0
Kapton	28.57	4x75µm = 0.0300cm	0.11
Nomex Honeycomb	1430.00	2.3cm	0.16
Copper	1.43	3x 35µm = 0.0105cm	0.74
Epoxy	19.40	~1000µm = 0.1cm	0.52
GRP (70:30)	13.31	2 x 300µm = 0.06cm	0.45

some numbers are estimations!

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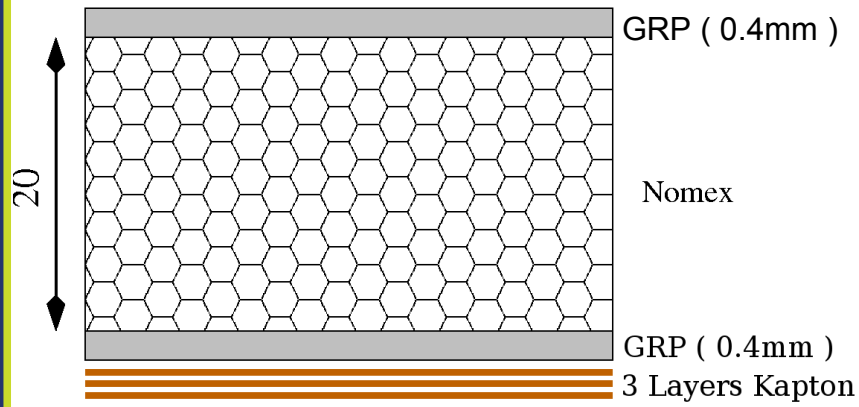
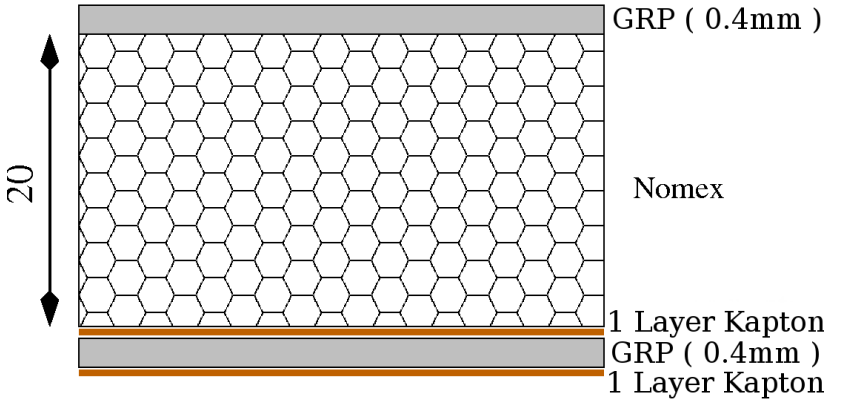
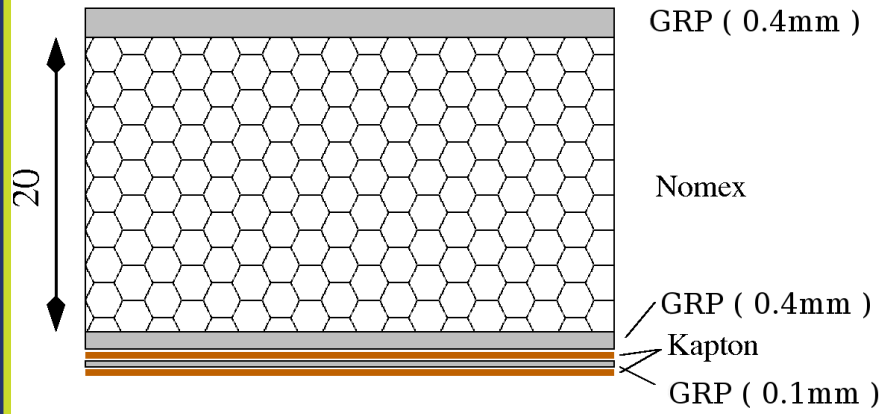
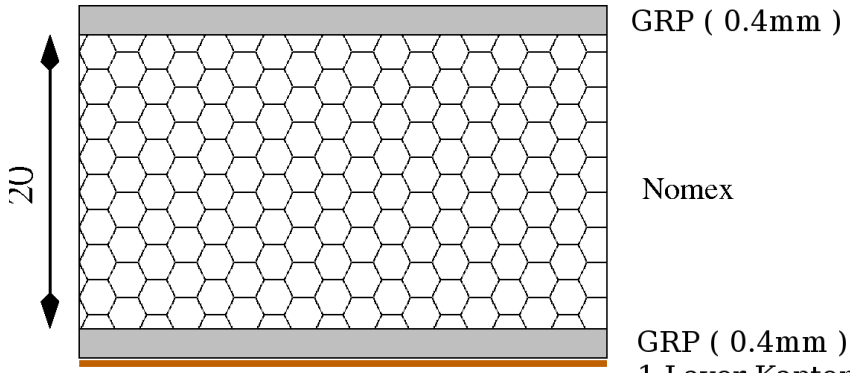
Fieldcage Wall Test Samples

- Sample pieces with different cross sections available:
  - to test high voltage (HV) stability? (partly done)
  - to test mechanical stability (presumably this week)
  - to test manufacturing procedures
    - one experience: gluing of Kapton on Kapton problematic → air bubbles









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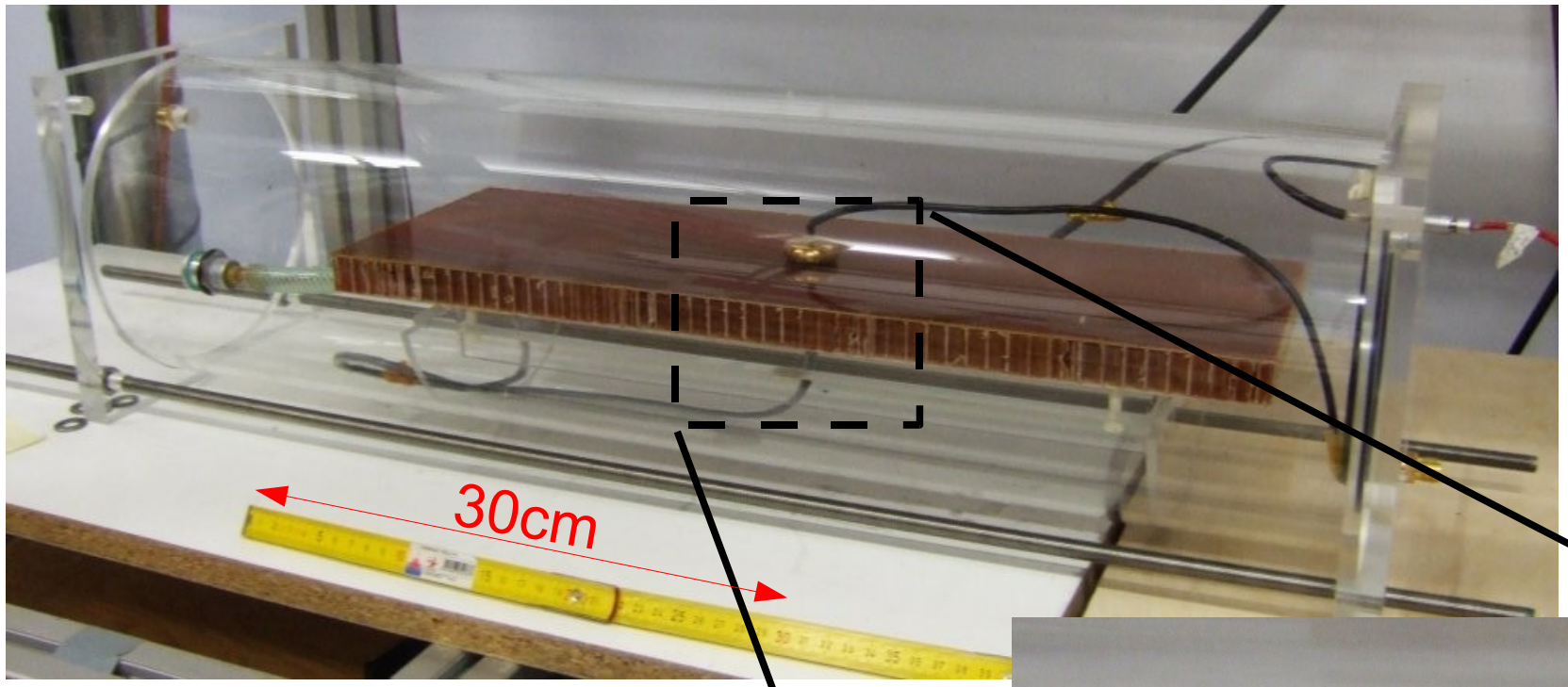
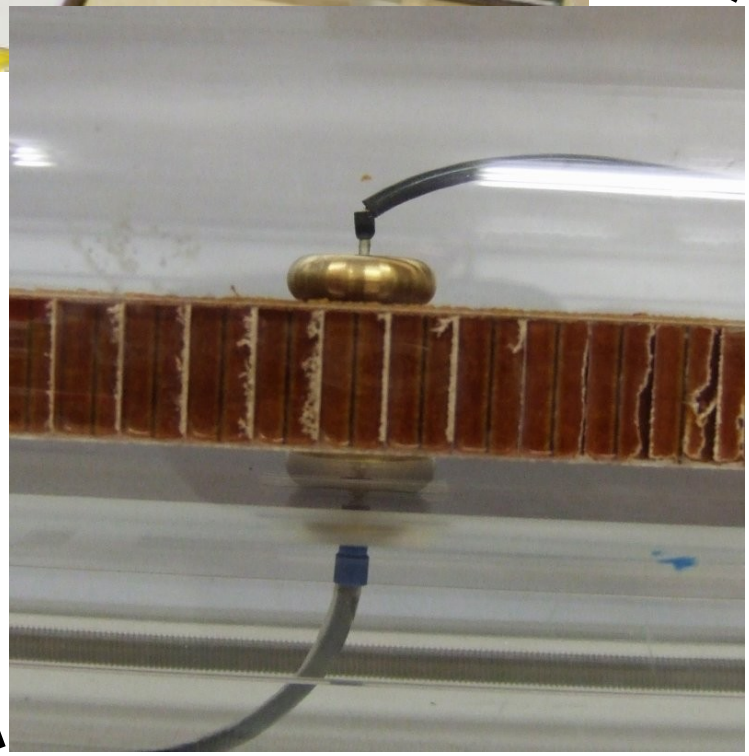
HV Tests of Fieldcage Wall



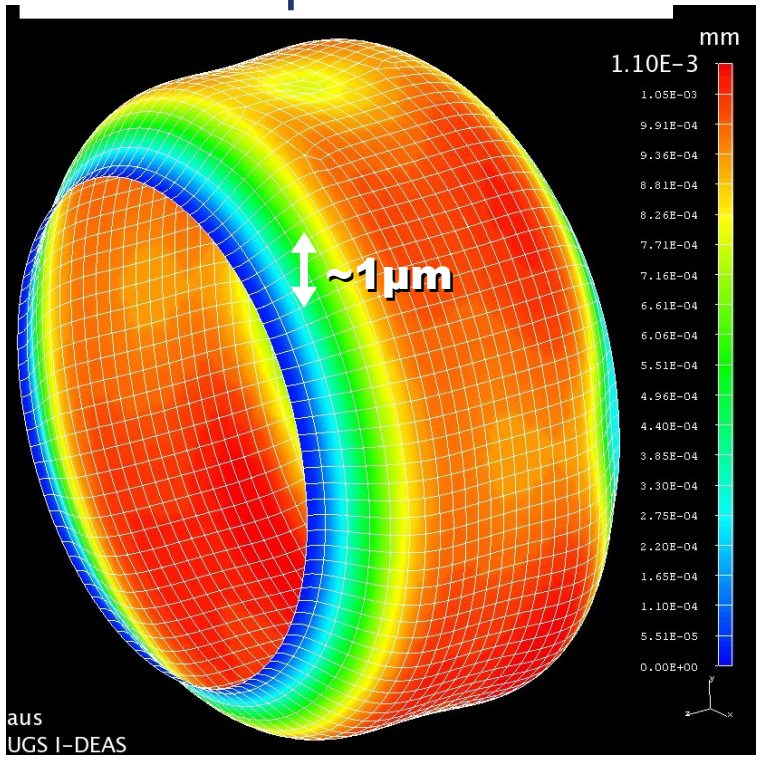


- Each sample piece tested up to 24kV
  including overnight test
- Every piece passed the test without breakdown
- This/next week: test up to 30kV

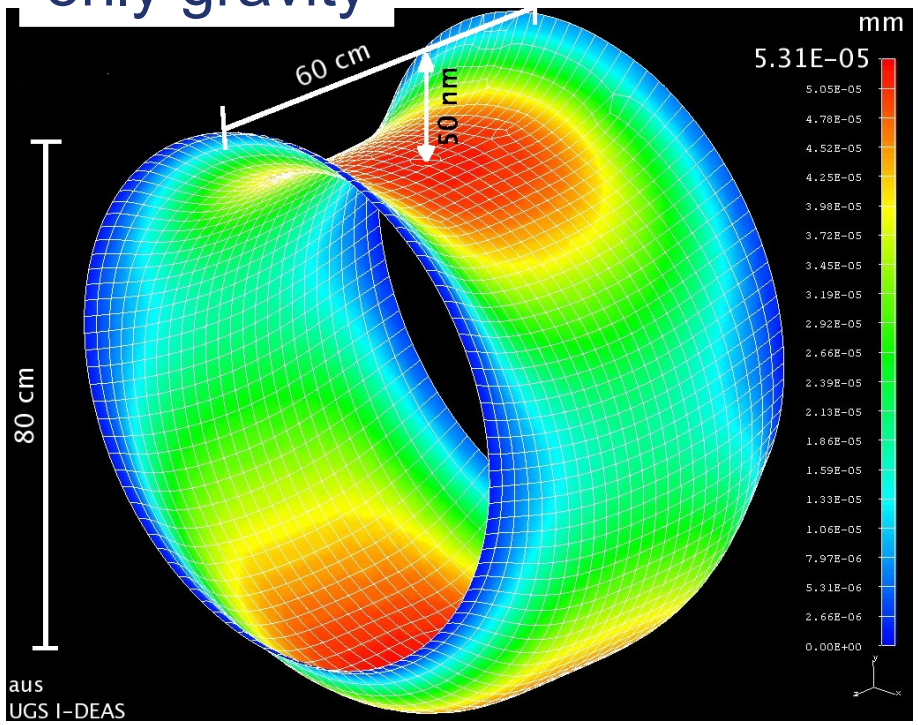
Mechanical Stability

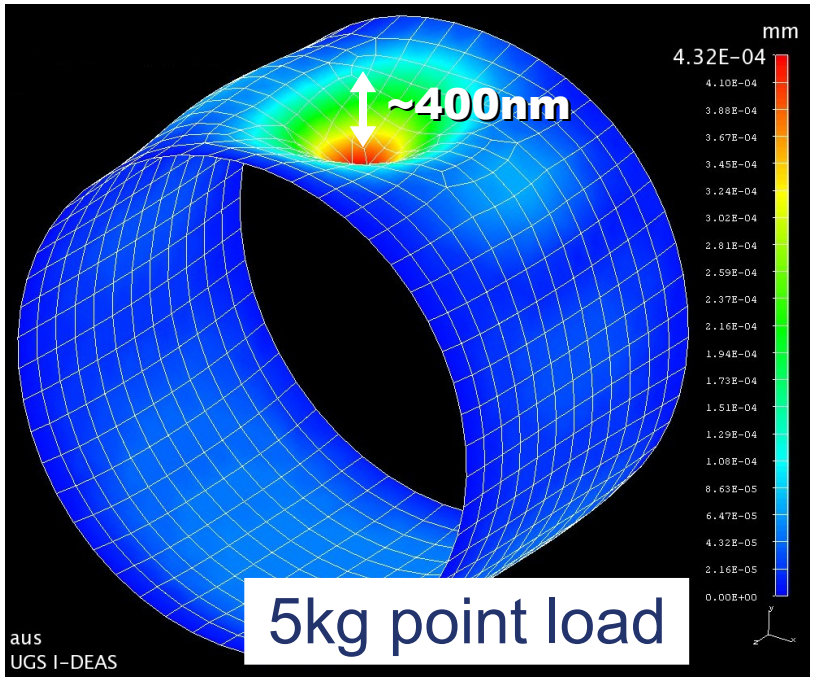
- Simulation show that wall structure is mechanically stable
- Only small deviations under normal conditions
- Mechanical test of sample pieces to validate calculation input

gravity and 100mbar overpressure



only gravity





5kg point load

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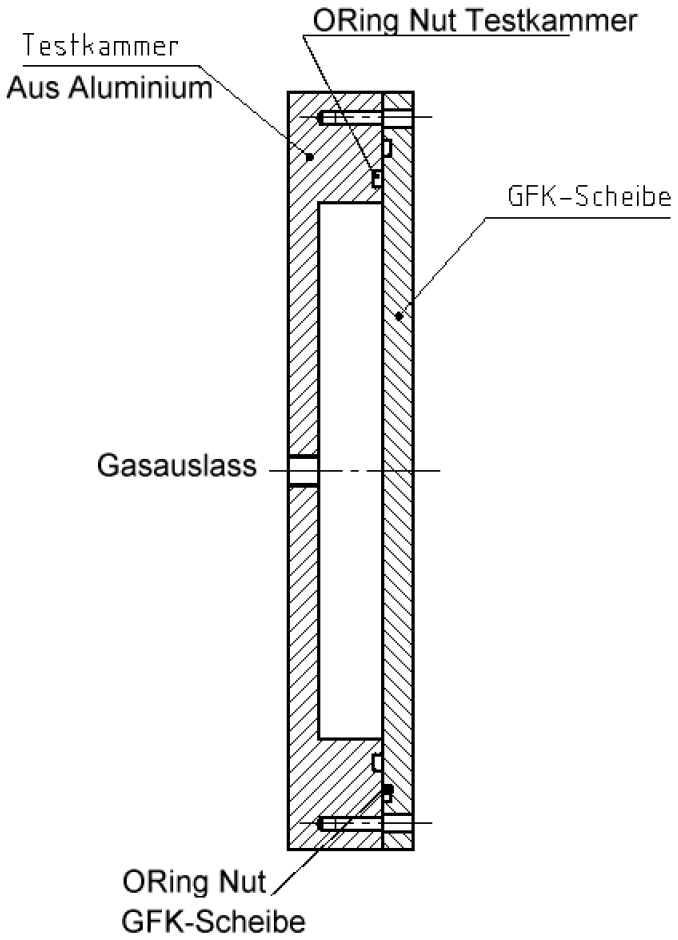
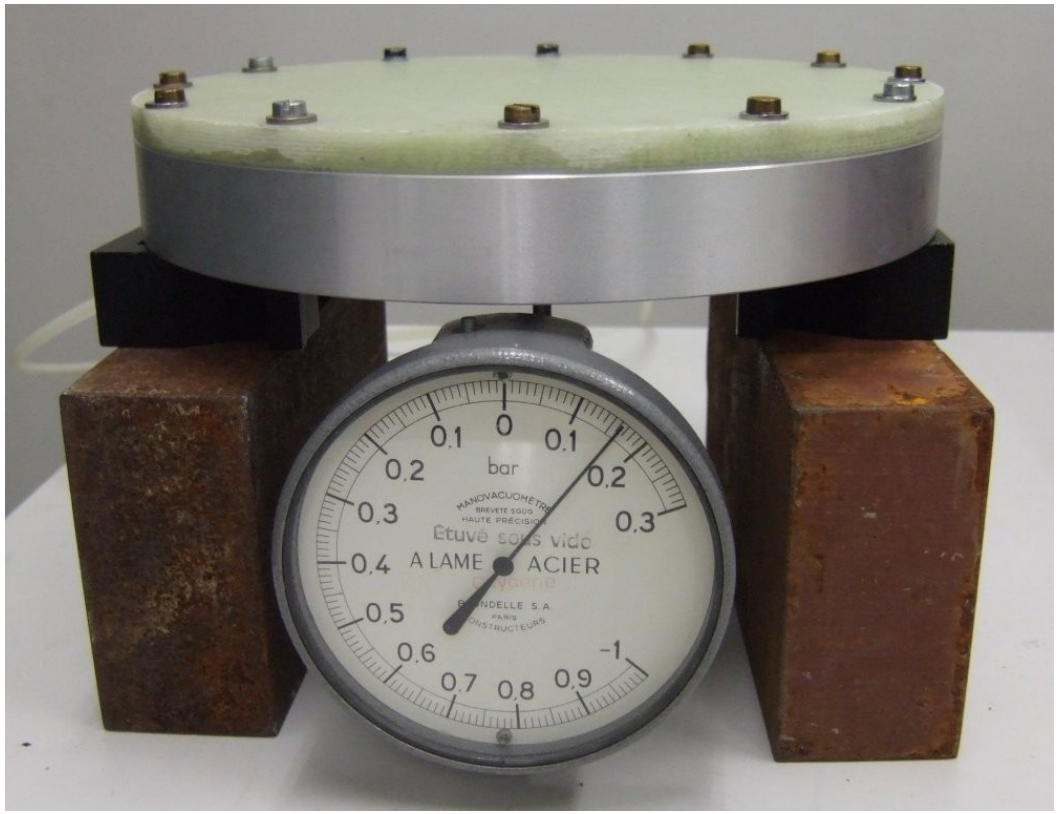
Gas Tightness Tests





- O-Ring Groove can be in GRP endplate or Aluminum chamber
  - Overpressure of 160mbar still kept after over one week with O-ring in GRP plate
  - Test with O-ring in Aluminum chamber still outstanding (but should in principle work even better)

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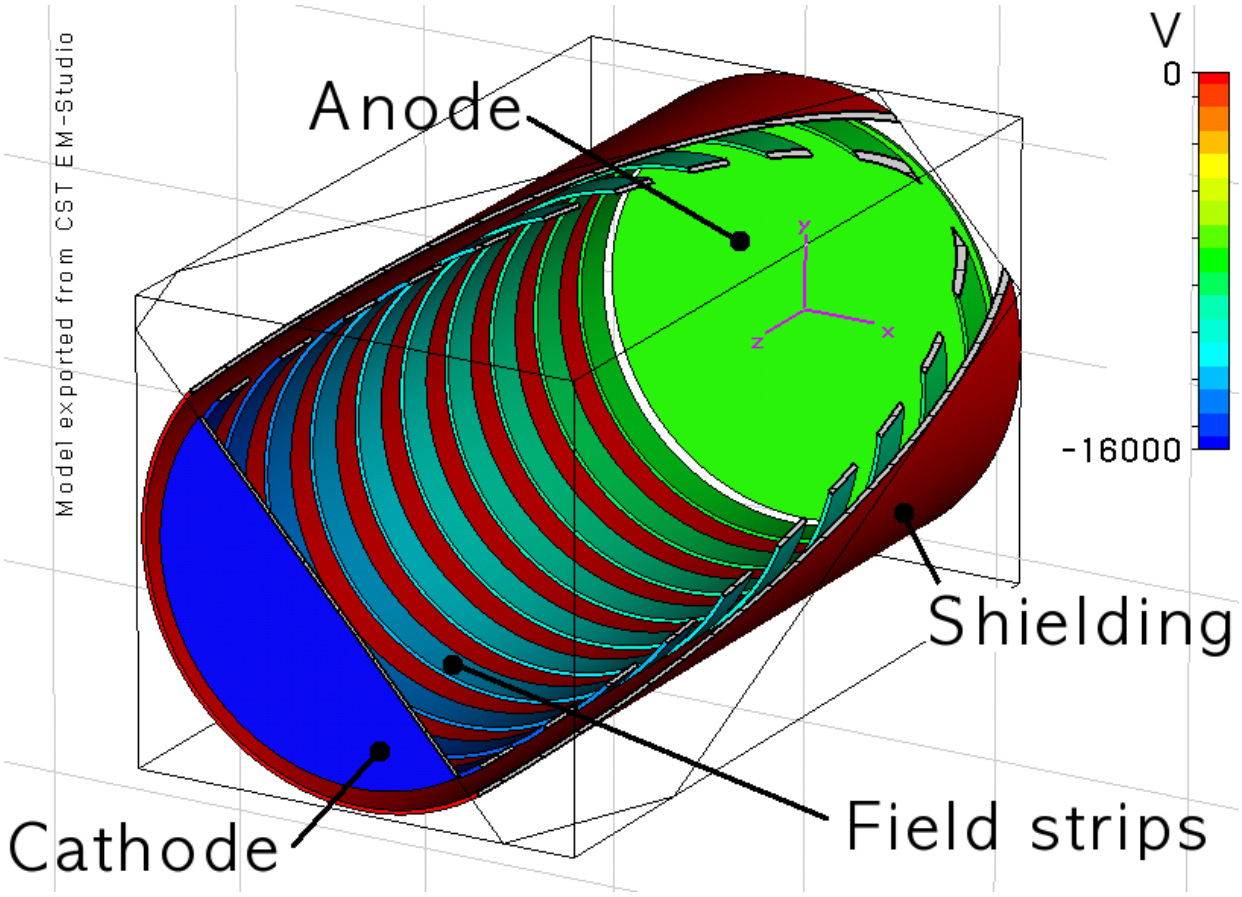
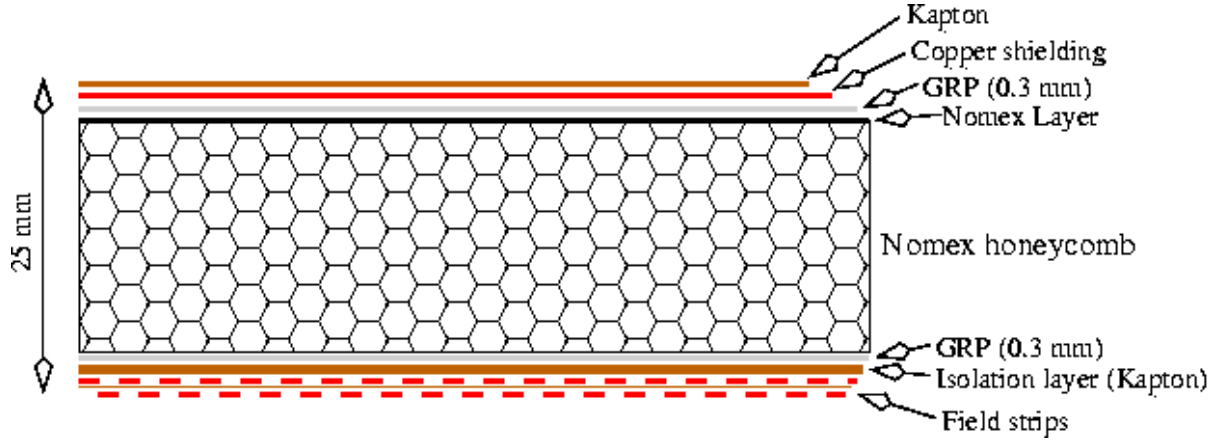
Layout of the Fieldstrip Foil



- Field strips ensure a very homogeneous electric field inside the drift volume

- Wall cross section:
  - shielding
  - honeycomb
  - field strips



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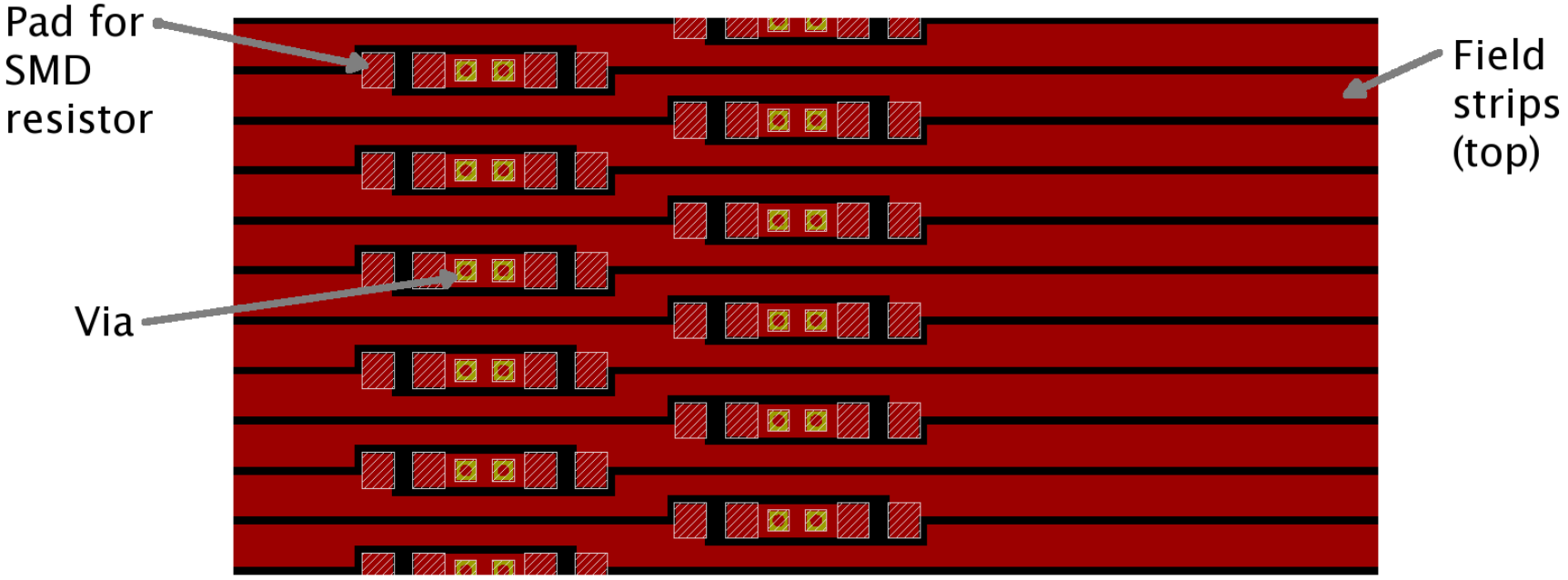
Fieldstrip Foil: Layout

- Field strips for homogeneous field: 2.3mm width, 0.5mm gap



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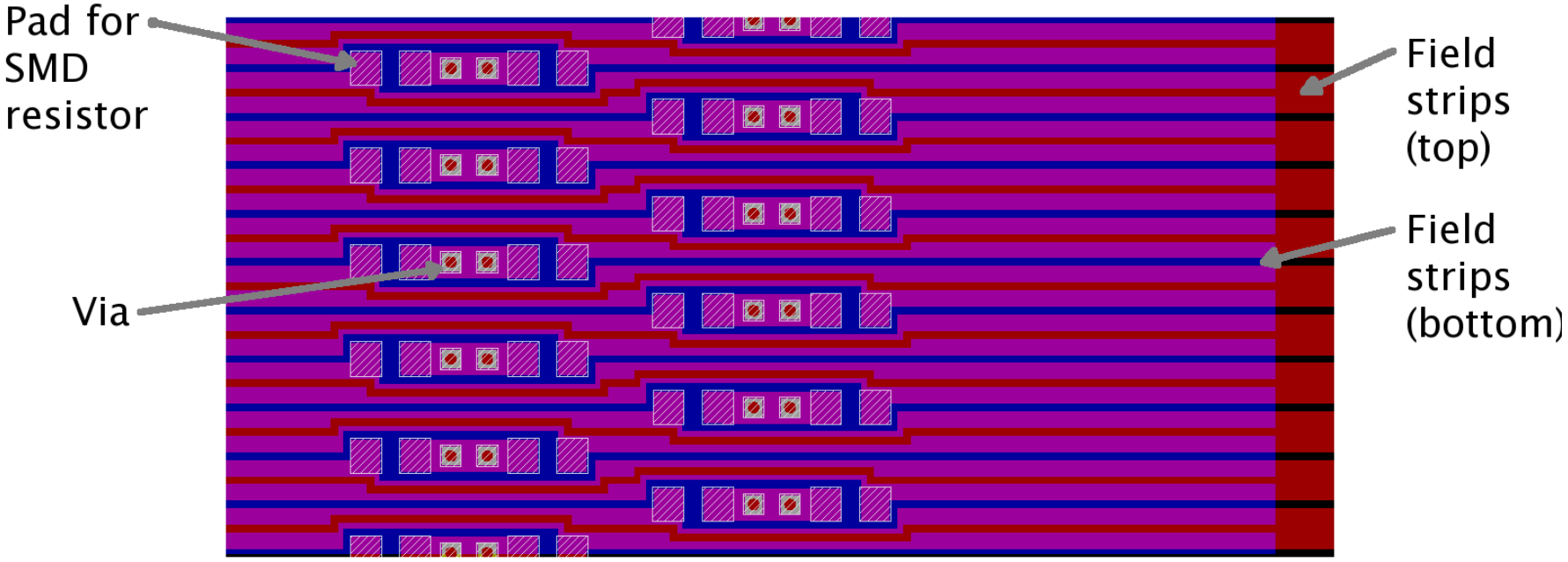
Fieldstrip Foil: Layout

- Field strips for homogeneous field: 2.3mm width, 0.5mm gap
- 1MΩ resistors connect to “islands” between 2 field strips
- Vias for connecting to Mirror Strips (behind the field strips):
  - displaced by half the pitch (2.8mm)
  - on intermediate potential
  - “shield” from ground potential on outside



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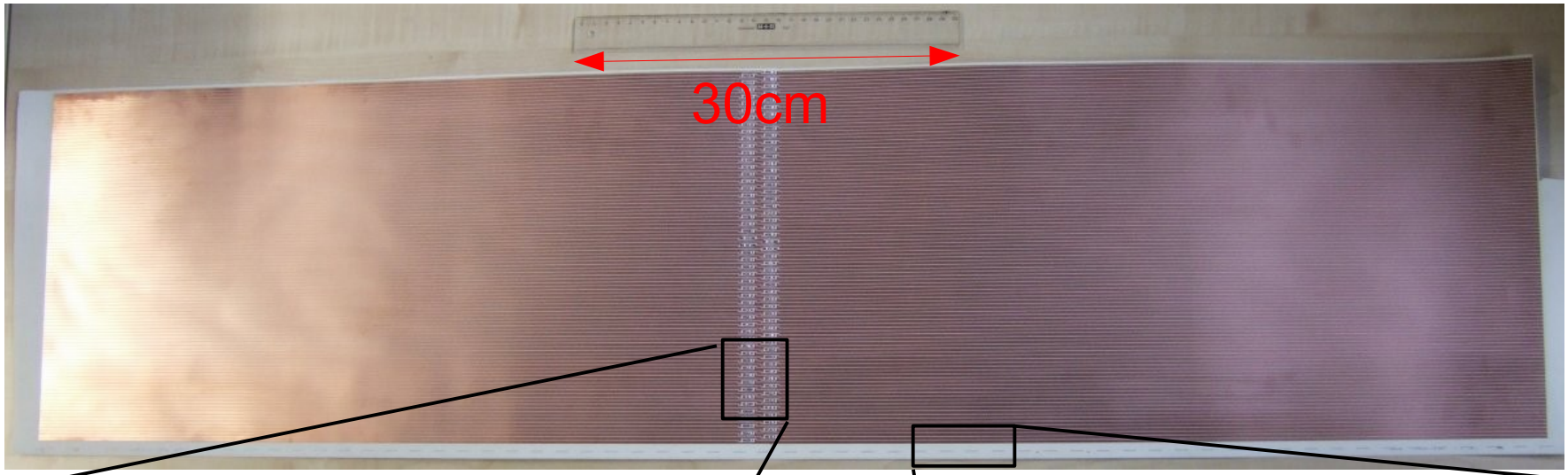
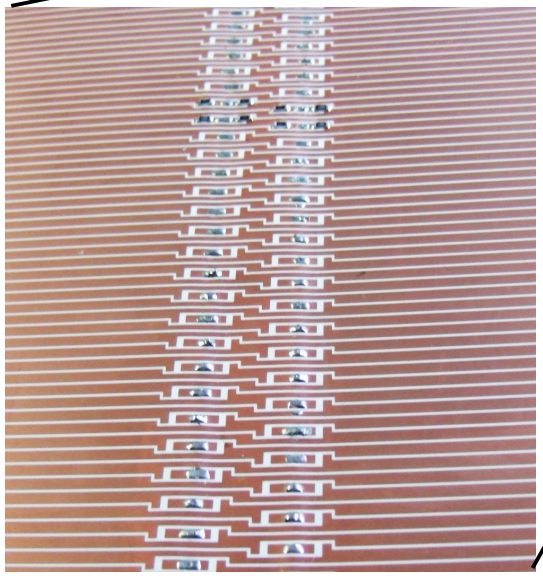
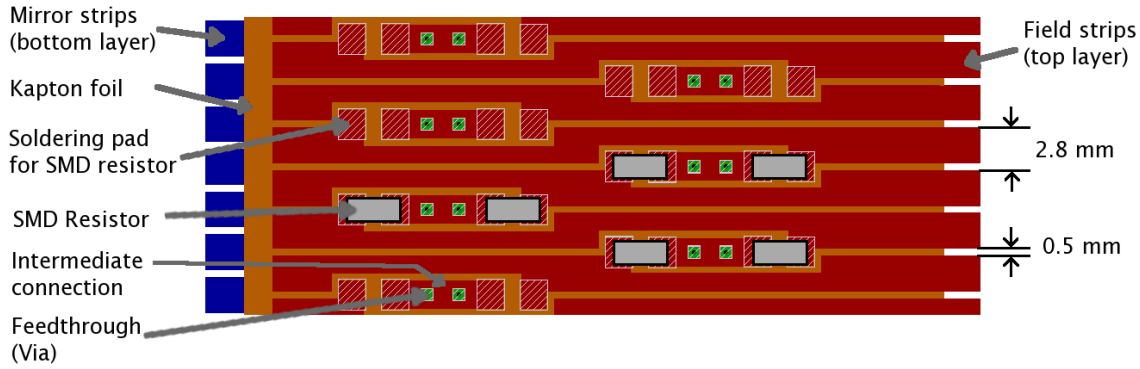
Sample Piece of the Fieldstrip Foil





- ~100V between two strips possible in operation

- Produced in two layers that are glued together



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The Large TPC Prototype

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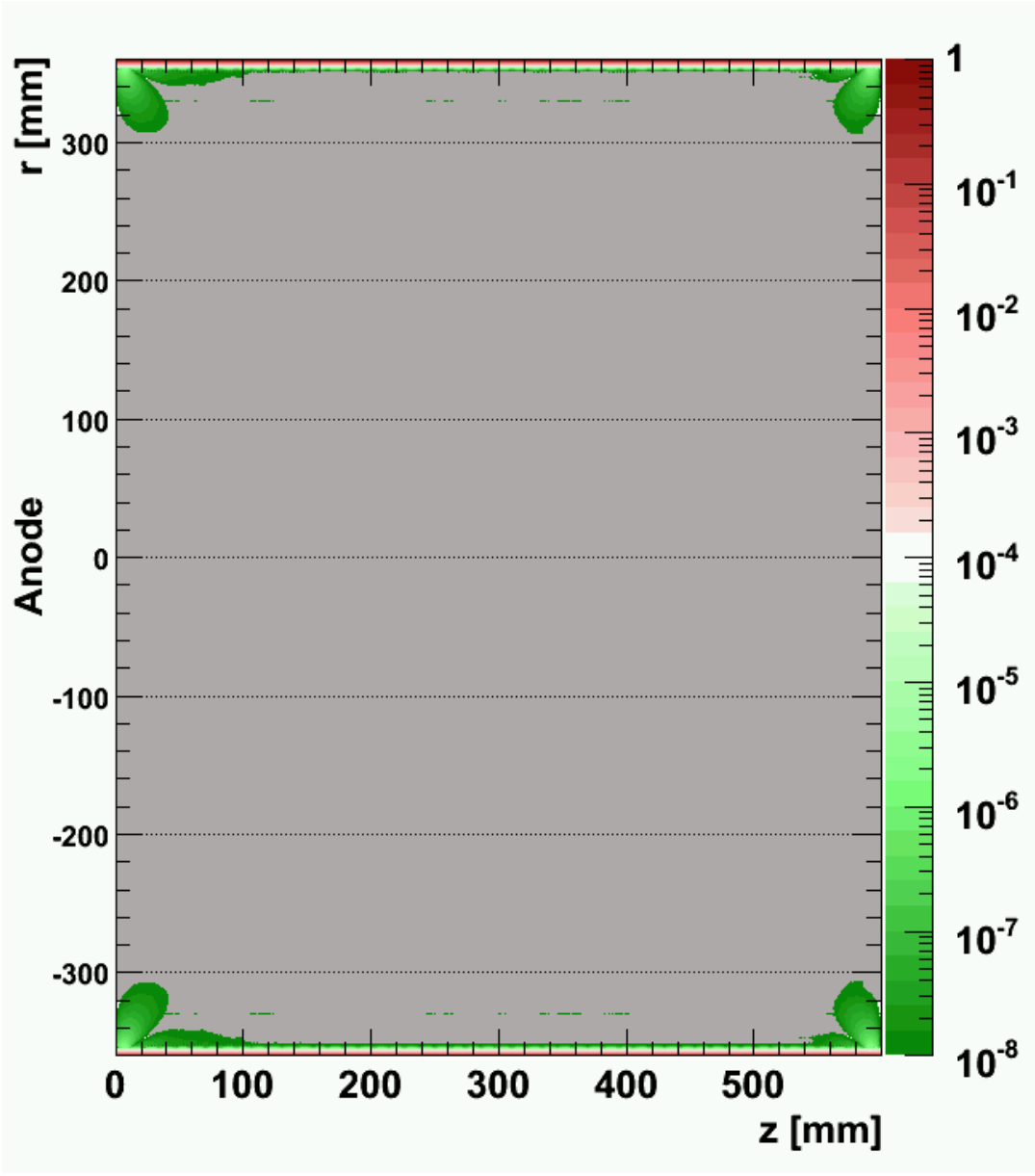
Field Calculations

- Field with mirror strips and strip layout shown before



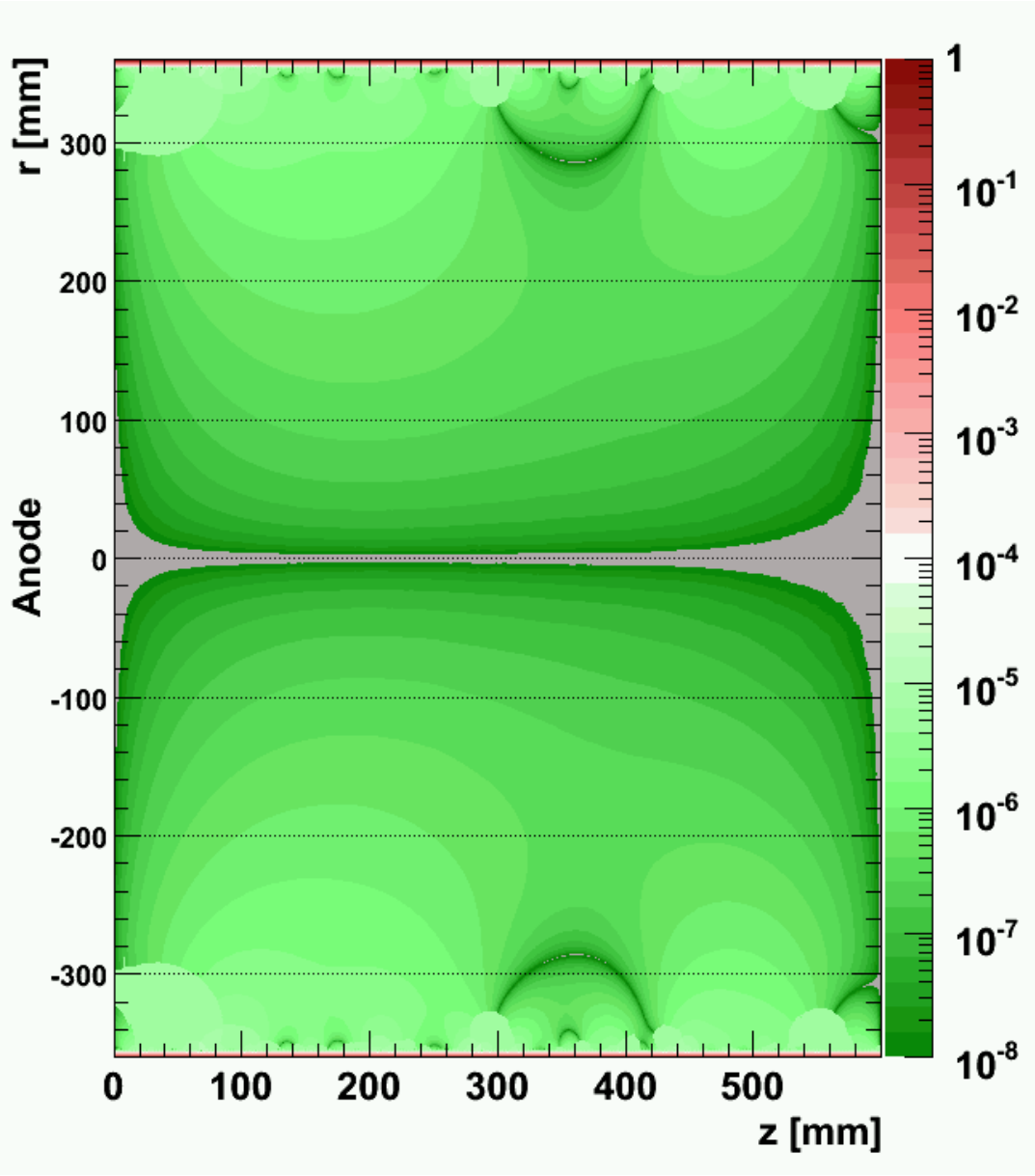
Shown:
$\Delta E / E_{nominal}$

Goal:
Deviations below 10^{-4}

= Value below Accuracy Limit

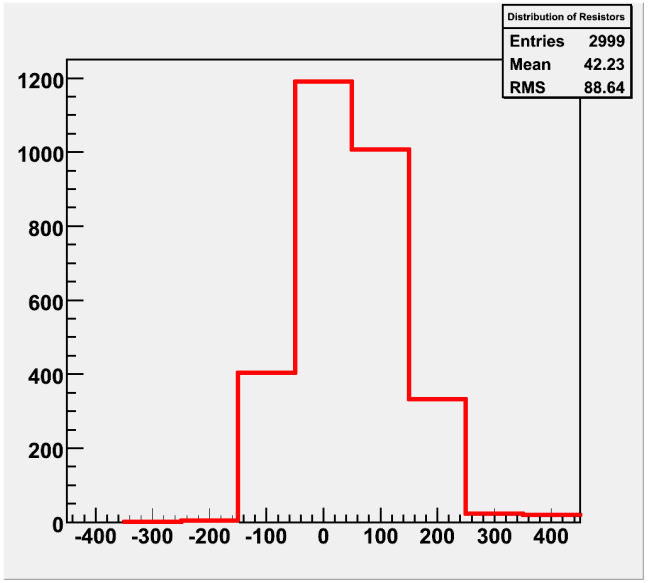
Field Calculations

- With Non-Perfect Resistors: 1MΩ ± 0.2‰(=200Ω)



Shown:
$\Delta E / E_{nominal}$

Goal:
Deviations below 10^{-4}



= Value below Accuracy Limit

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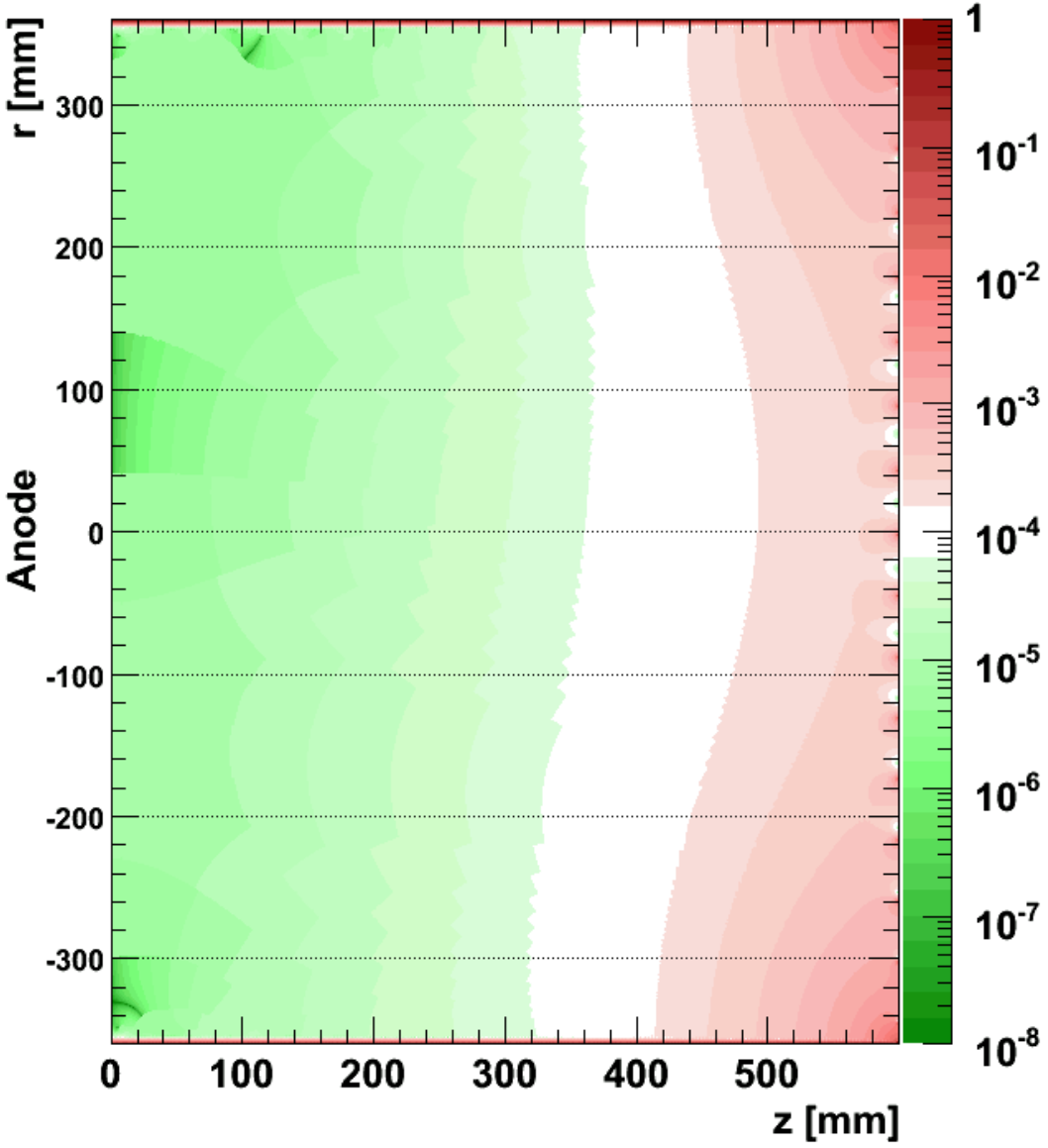
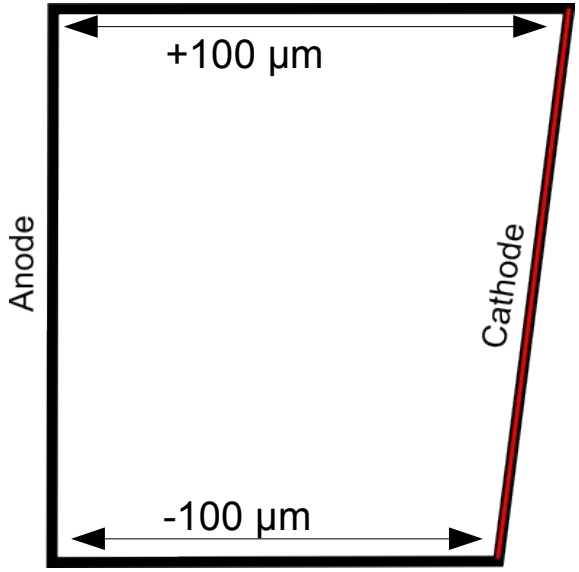
Field Calculations

- With Non-Perfect Resistors and Tilted Cathode (manufacturing accuracy)



Shown:
$\Delta E / E_{nominal}$

Goal:
Deviations below 10^{-4}



= Value below Accuracy Limit

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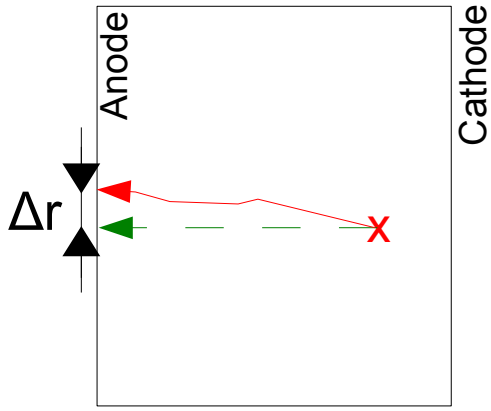
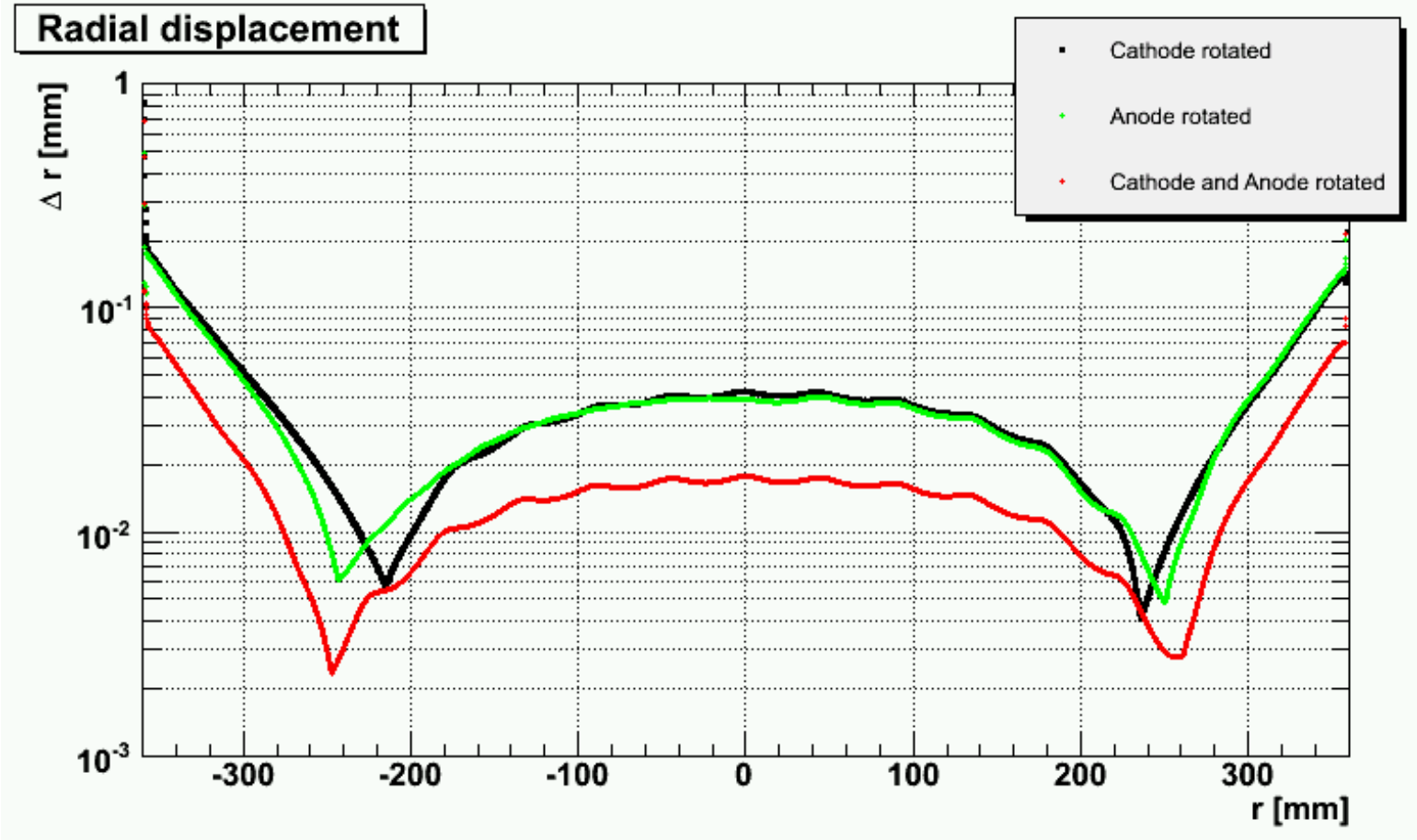
Field Calculation: Effect without Magnetic Field

- Maximal Displacement in the central area well below 40 µm
- At the edges: up to 100 µm
- Should be corrected in reconstruction
- Calculation with magnetic field on the agenda





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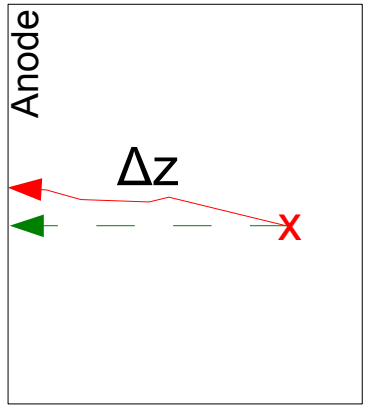
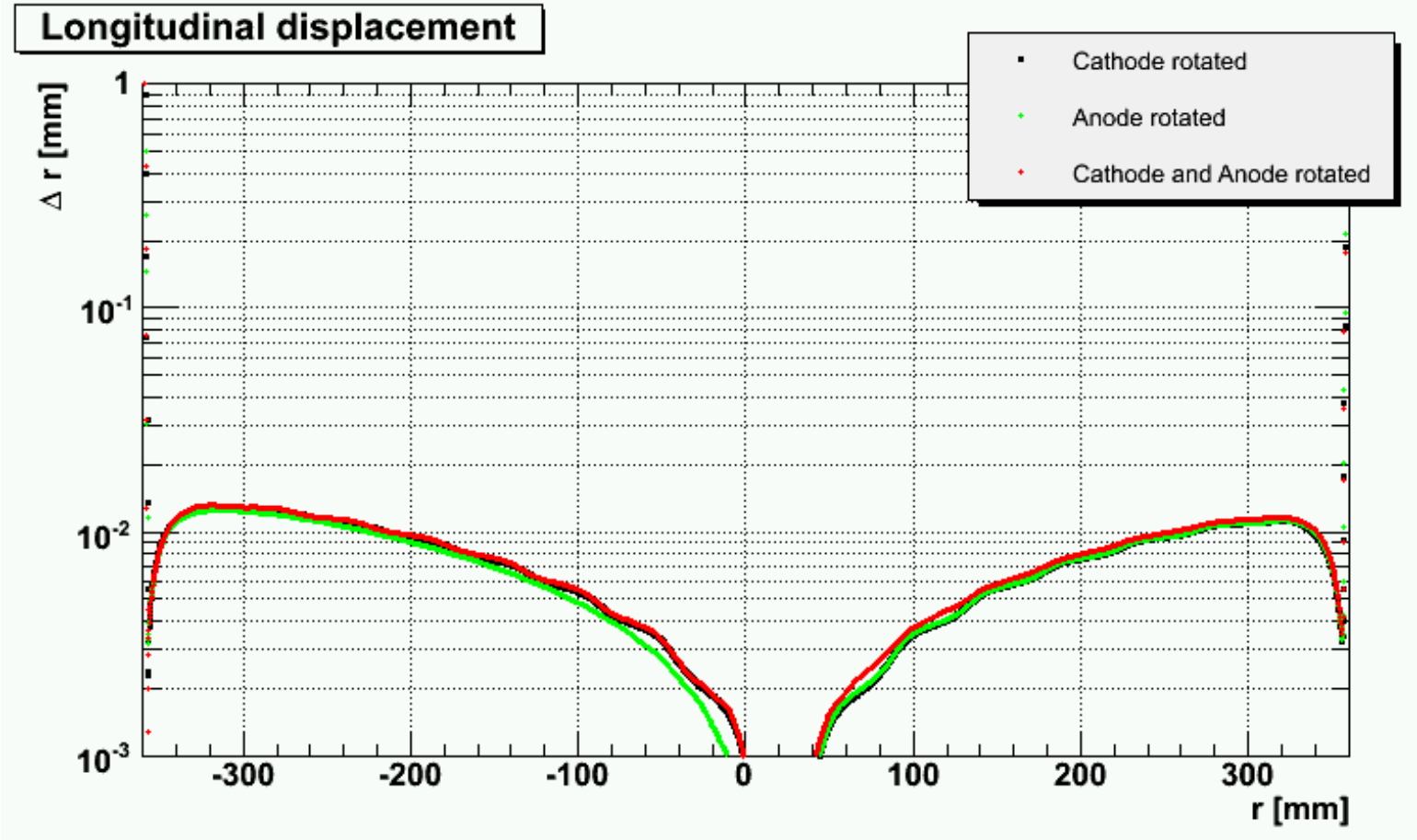
Field Calculation: Effect without Magnetic Field

- Maximal Displacement below 10µm
- Calculation with magnetic field on the agenda





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The Large TPC Prototype

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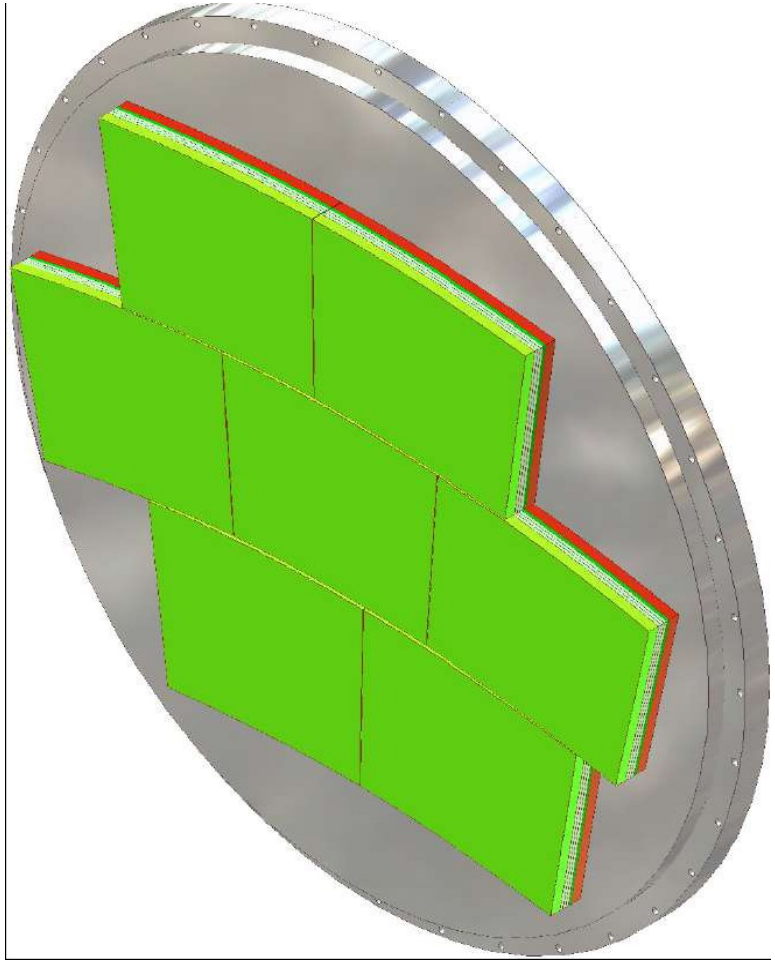
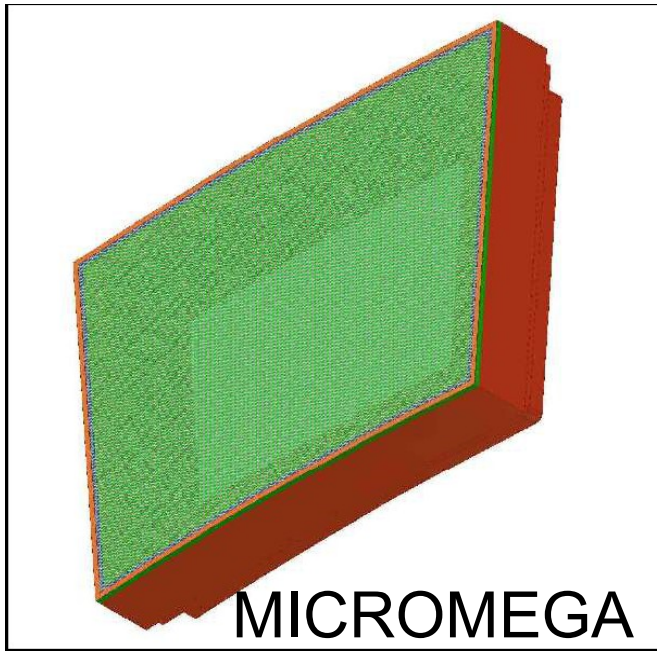
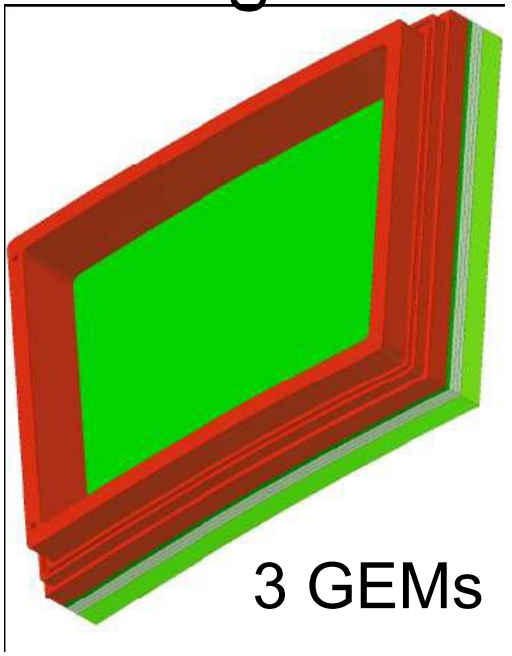
Endplate Design (from Cornell)

- Modular endplate design to allow use of different amplification and readout techniques





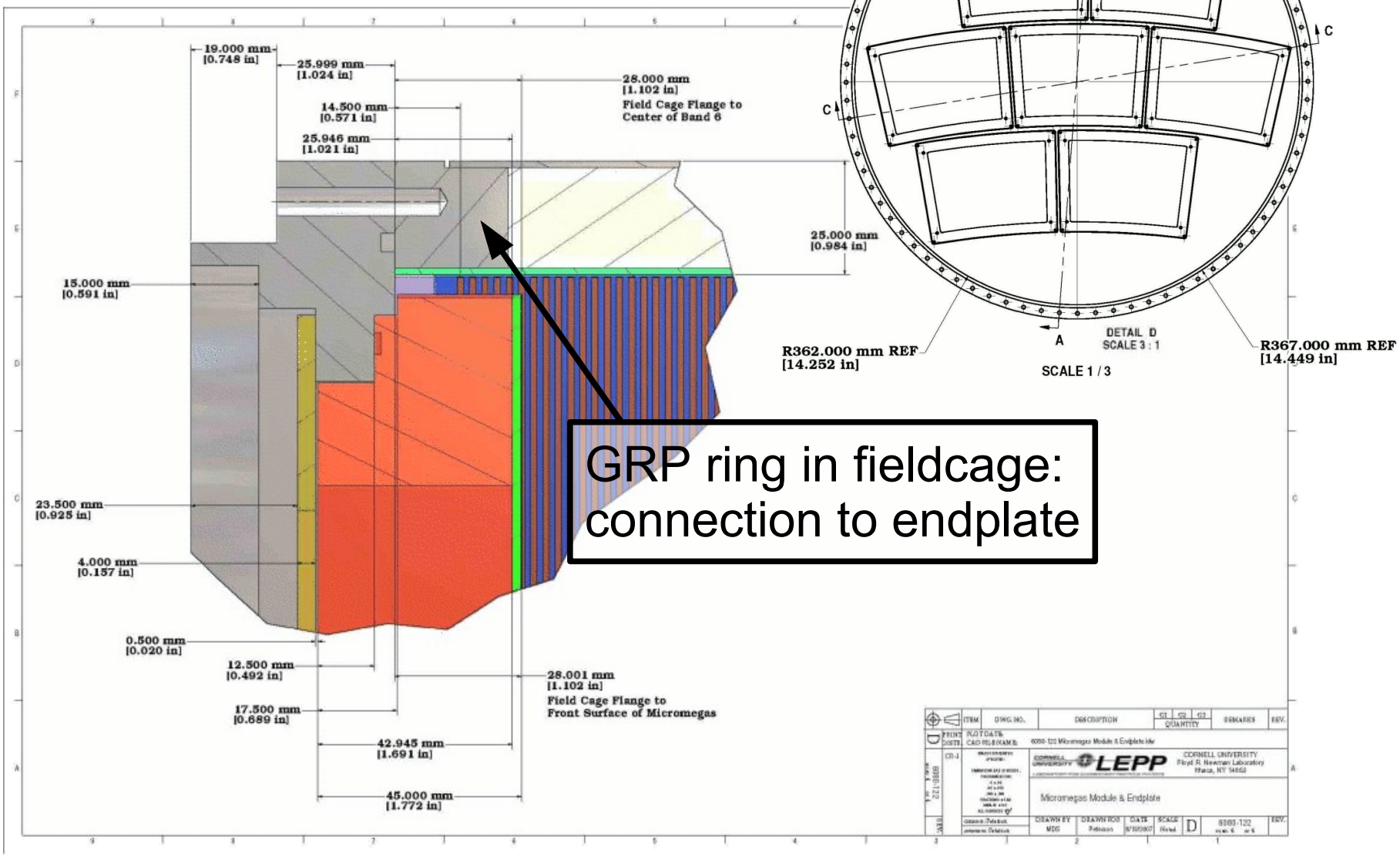
MICROMEGAS



3 GEMs

Endplate Design (from Cornell)

- Most dimensions already fit to current fieldcage design, the rest is close and both designs are converging



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Current Time Schedule

- 2007, mid October: Fieldstrip foil
- 2007, till end of October: soldering of resistors on foil
- 2007, till mid November: production of field cage
- 2007, November: trigger hardware in France for testing
- 2007, beginning of December: field cage at DESY
- 2007, Dec. / 2008, Jan.: magnet field map ready
- 2008, Jan./Feb.:
  - Silicon hodoscope support structure ready
    Begin of Installation
  - Trigger setup at DESY testbeam

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