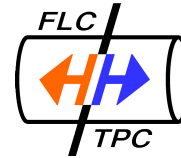


Ralf Diener
Peter Schade

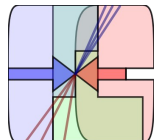


The ILC TPC Large Prototype : status and plans

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



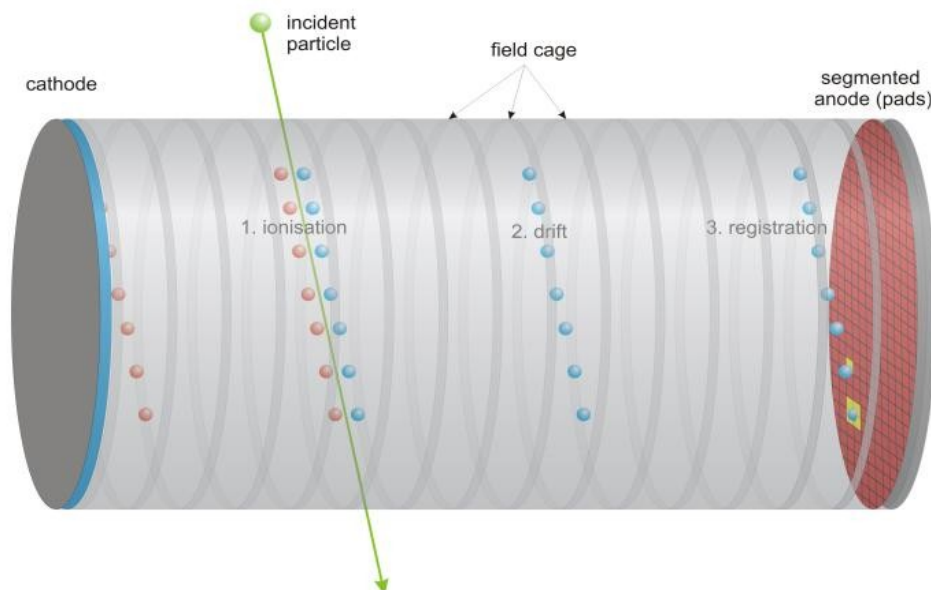
Universität
Hamburg



bmb+f - Förderschwerpunkt
Elementarteilchenphysik
Großgeräte der physikalischen
Grundlagenforschung

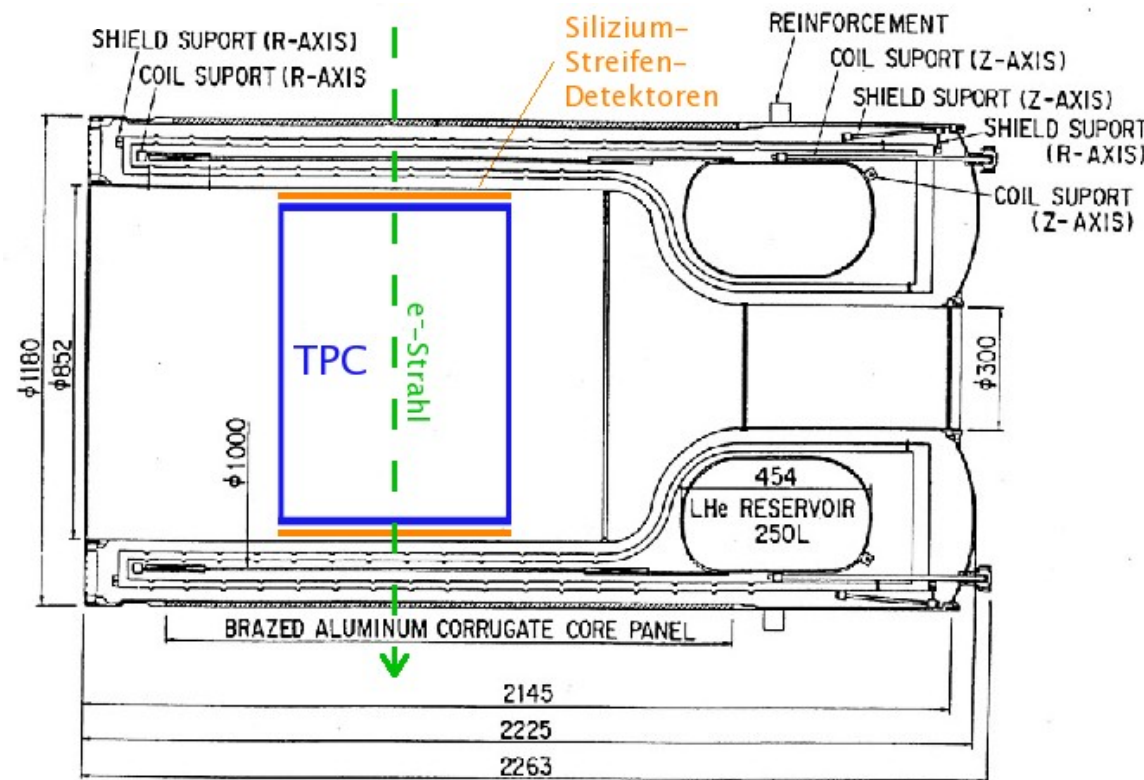


The Large TPC Prototype Setup



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

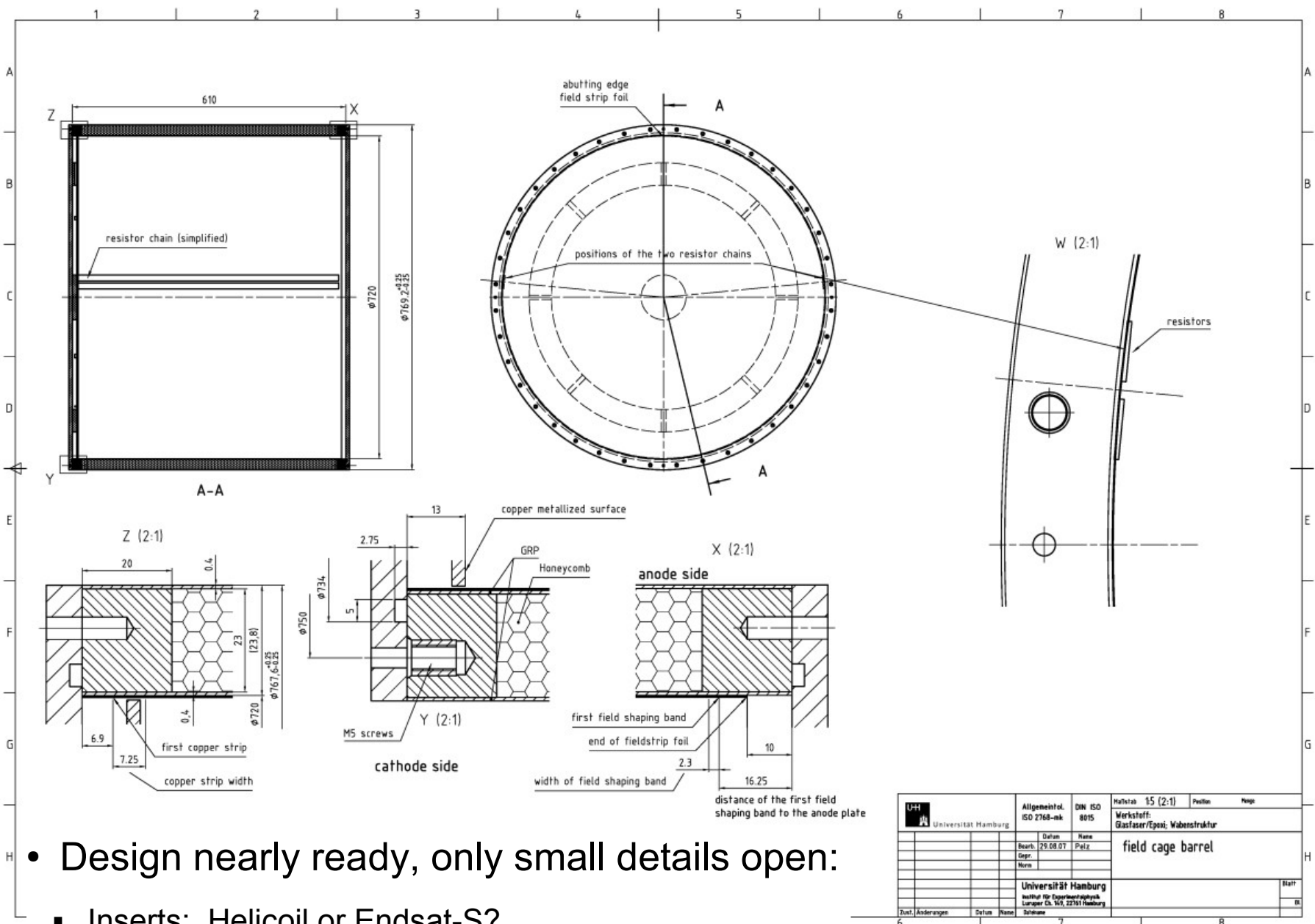
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- 5) Schedule



Latest Technical Drawings of LP Fieldcage

The Large TPC Prototype

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

Universität Hamburg	Allgemeintol. ISO 2768-mk	DIN ISO 8015	Maßstab 1:5 (2:1)	Position	Neige
	Datum	Name	Werkstoff: Glasfaser/Epoxy; Wabenstruktur		
	Bearb. 29.08.07	Paßz.	field cage barrel		
	Gepr.				
	Norm				
	Universität Hamburg				Blatt
	Institut für Experimentelle Physik				18
	Luruper Ch. 93, 22761 Hamburg				
Zust. Änderungen	Datum	Name	Sichtweise		



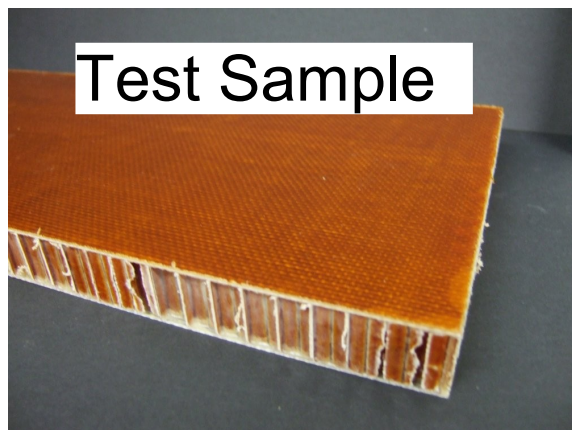
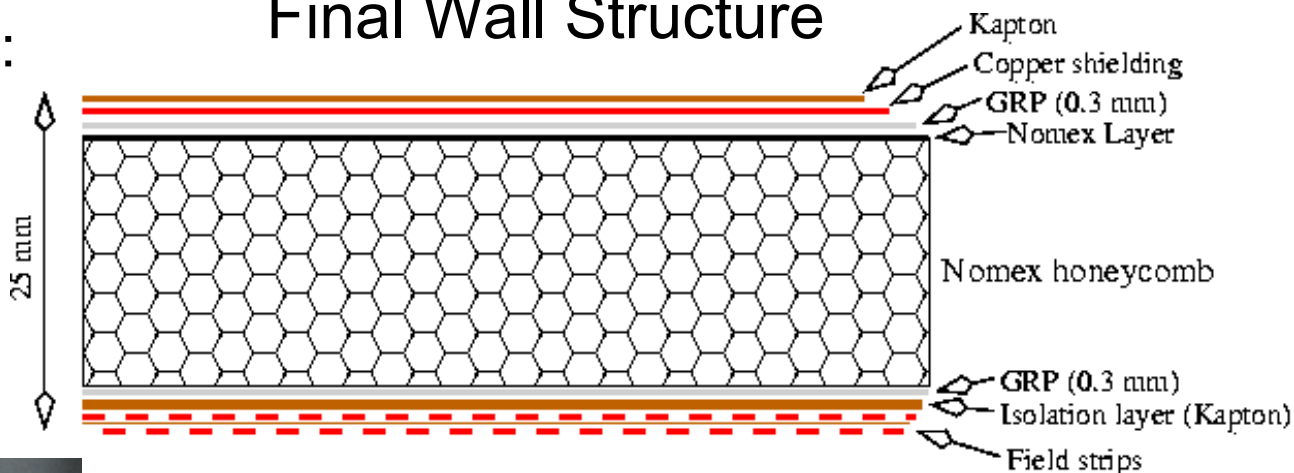


Fieldcage Wall

• Wall cross section:

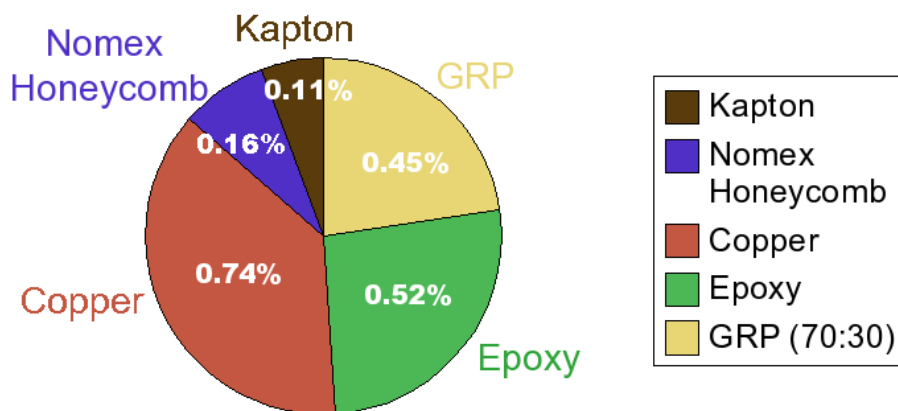
- shielding
- honeycomb with GRP layers
- field strips

Final Wall Structure



Test Sample

Radiation Length in % of $X_0 = 1.98\%$



- 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)

Material	Rad length [cm]	Thickness	% of X_0
Kapton	28.57	4x75 μ m = 0.0300cm	0.11
Nomex Honeycomb	1430.00	2.3cm	0.16
Copper	1.43	3x 35 μ m = 0.105cm	0.74
Epoxy	19.40	~1000 μ m = 0.1cm	0.52
GRP (70:30)	13.31	2 x 300 μ m = 0.06cm	0.45

some numbers are estimations!

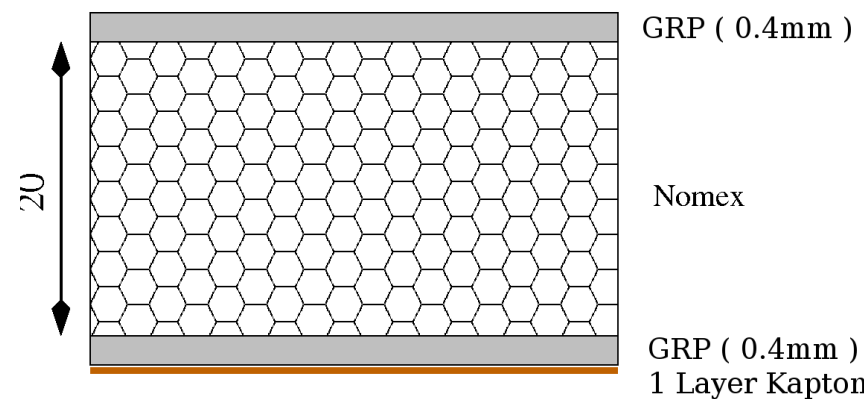
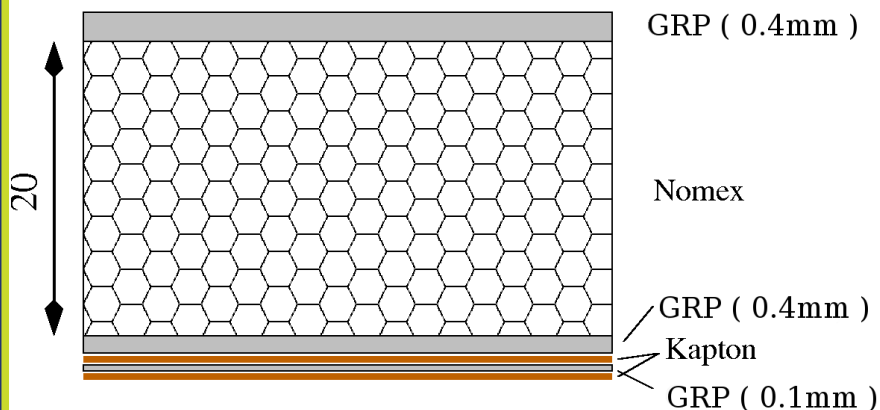
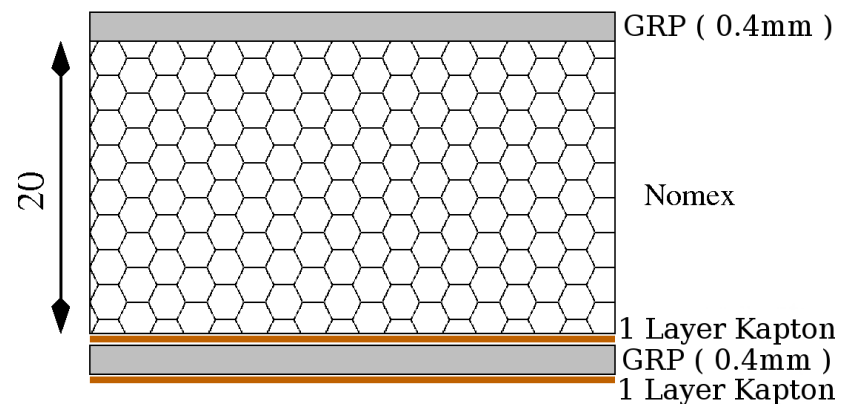
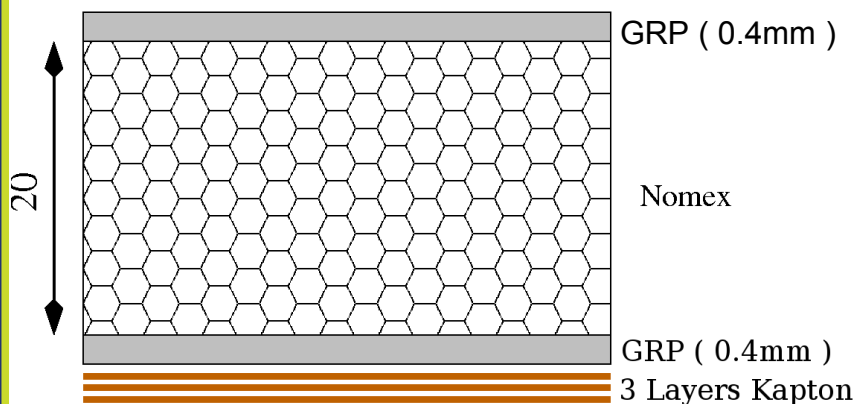
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Fieldcage Wall Test Samples

- 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



The Large TPC Prototype

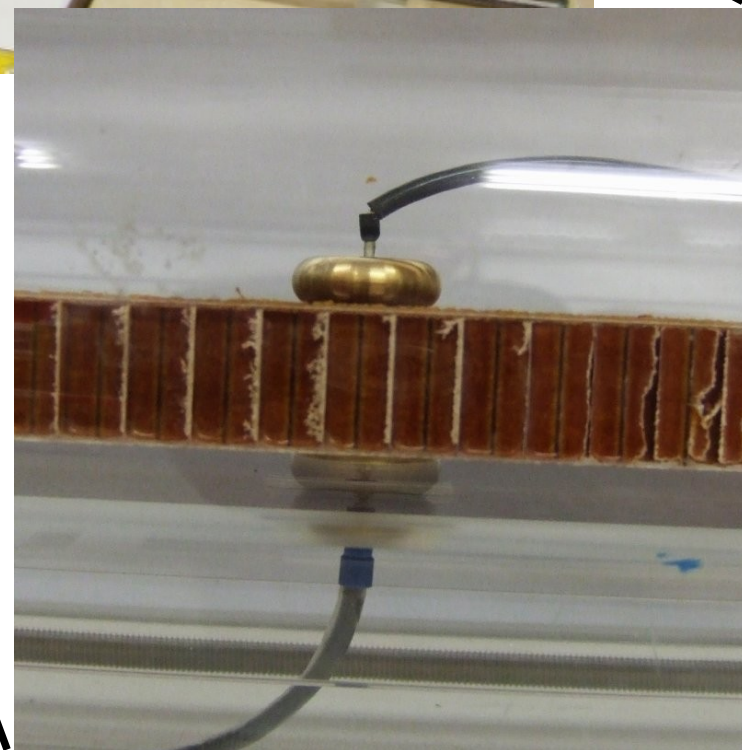
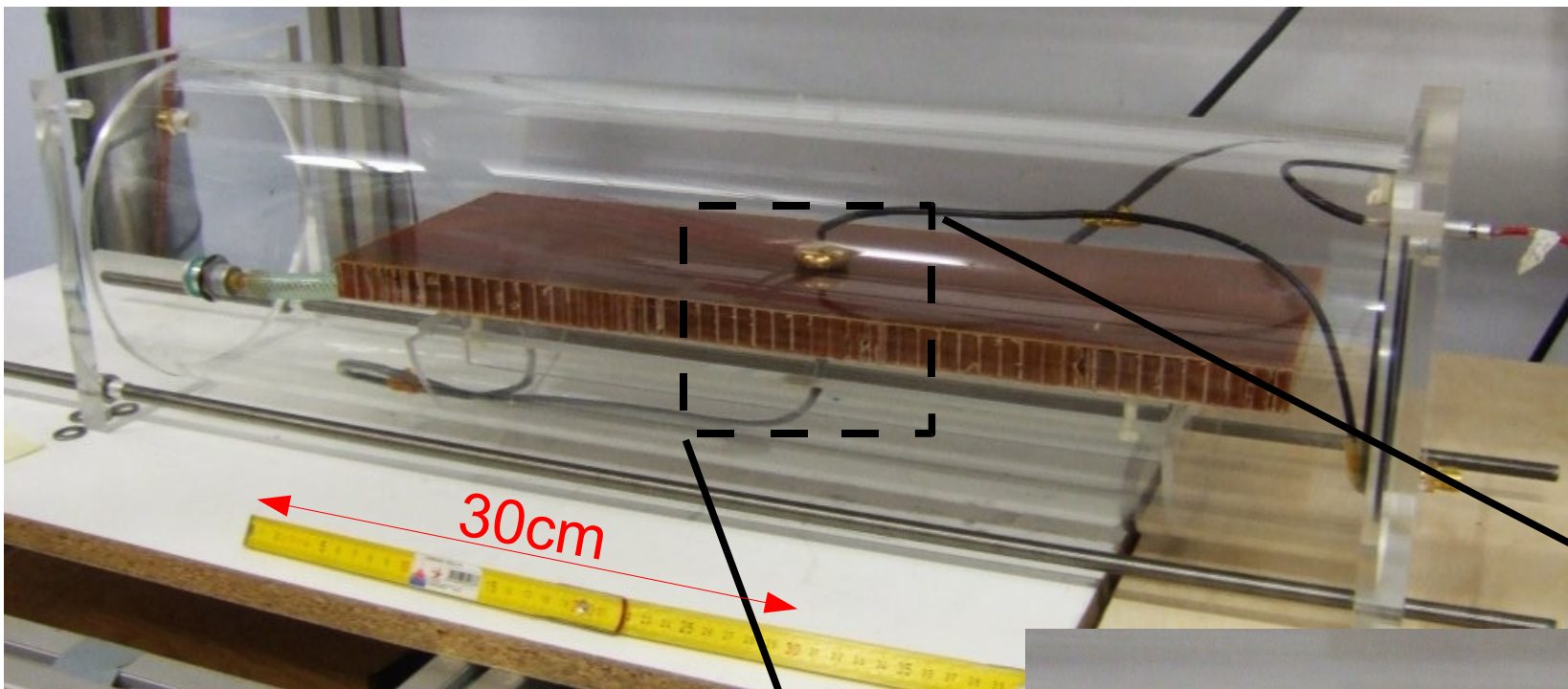
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Hamburg University





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

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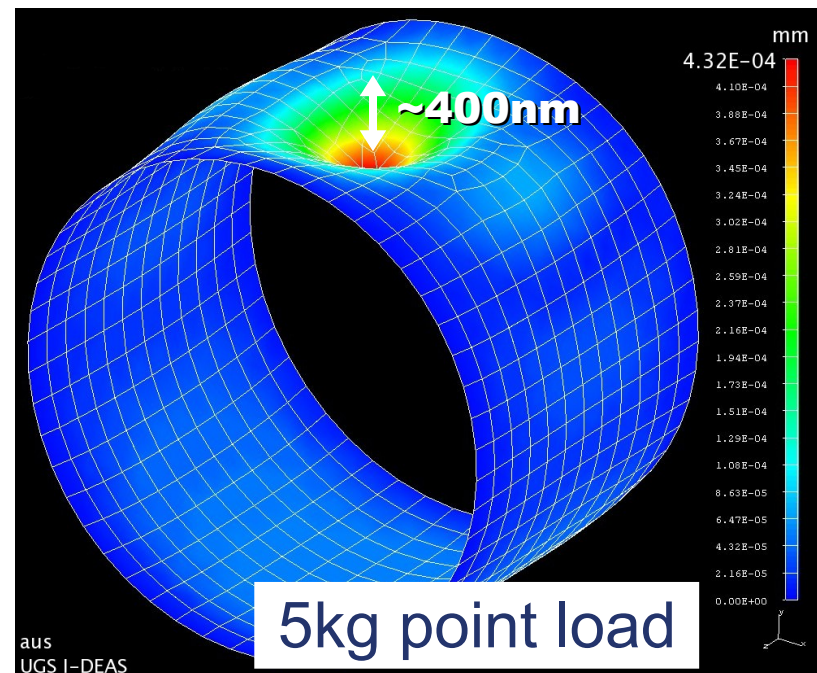
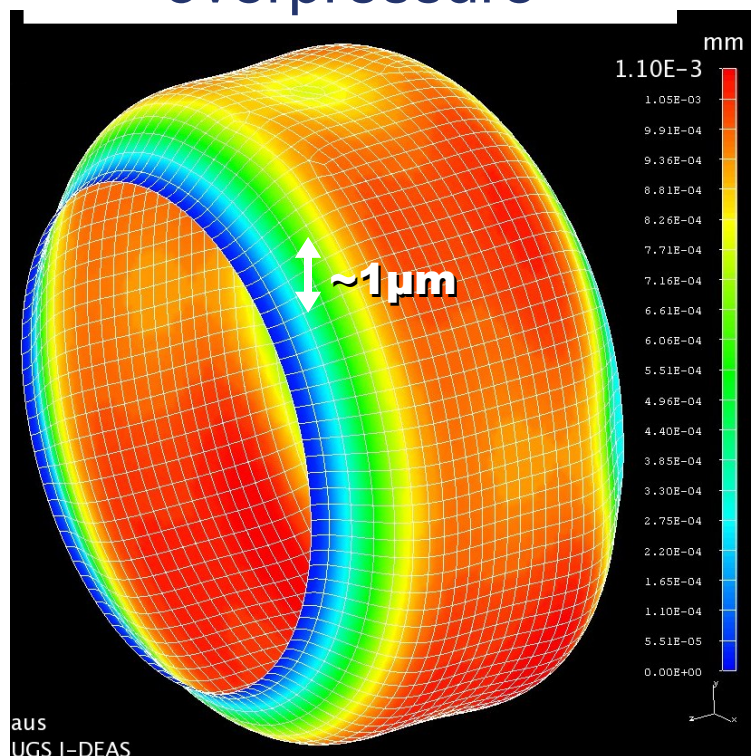
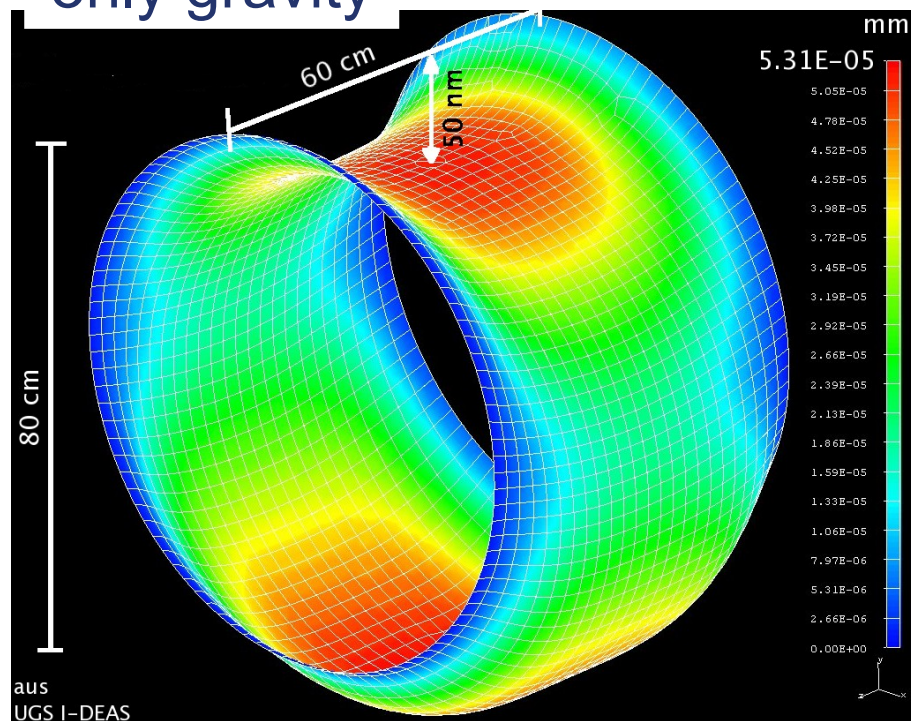


Mechanical Stability

- 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



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The Large TPC Prototype

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- Gas Tightness

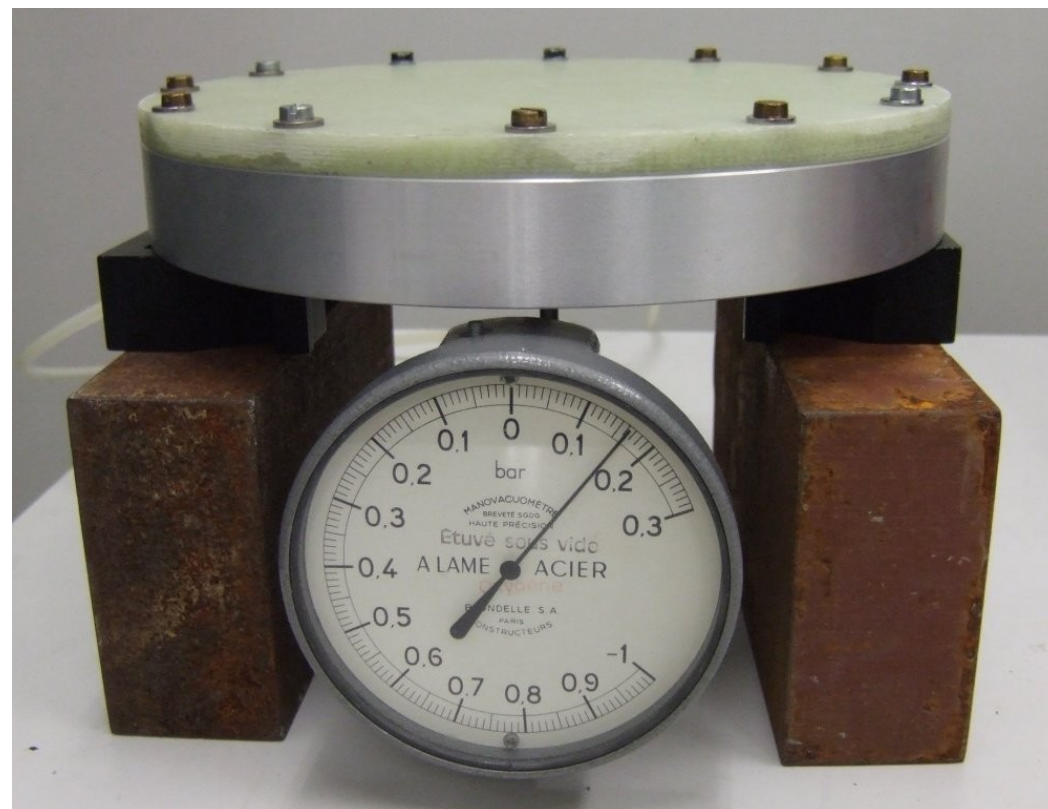
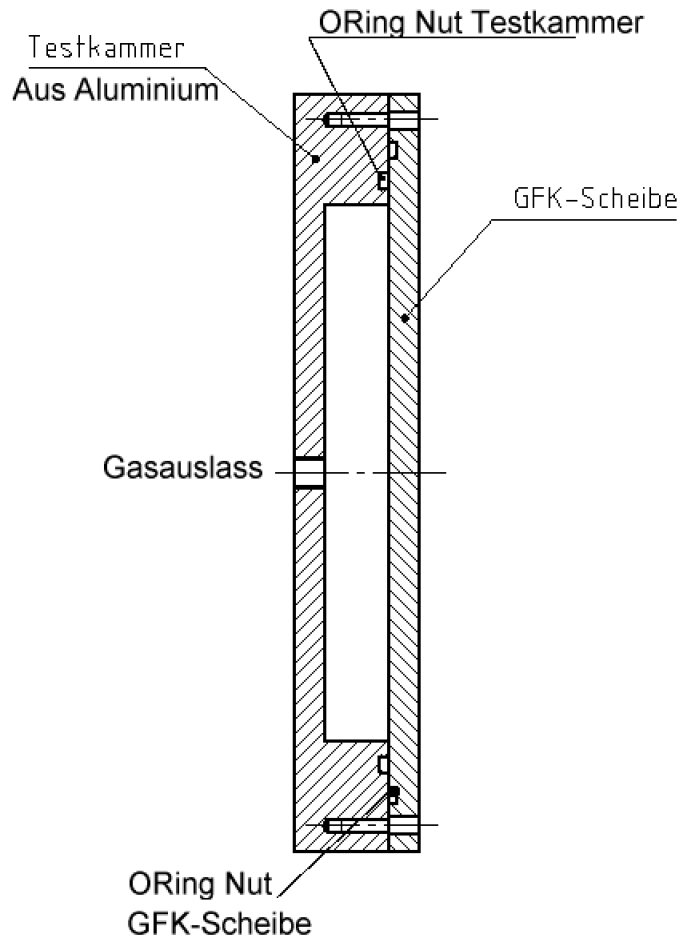
3. Field Strip Foil

- Layout
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4) Endplate

5) Schedule

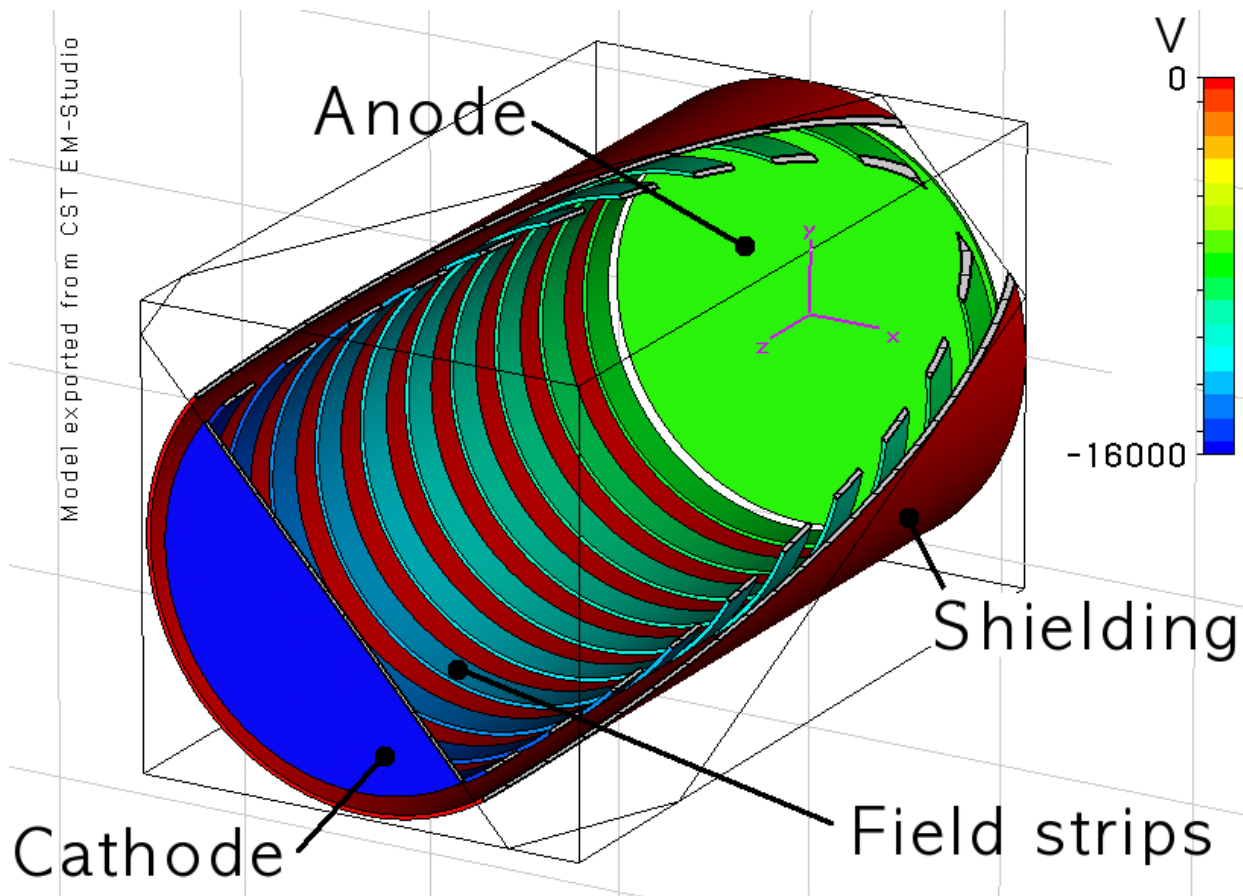
Gas Tightness Tests



- 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)



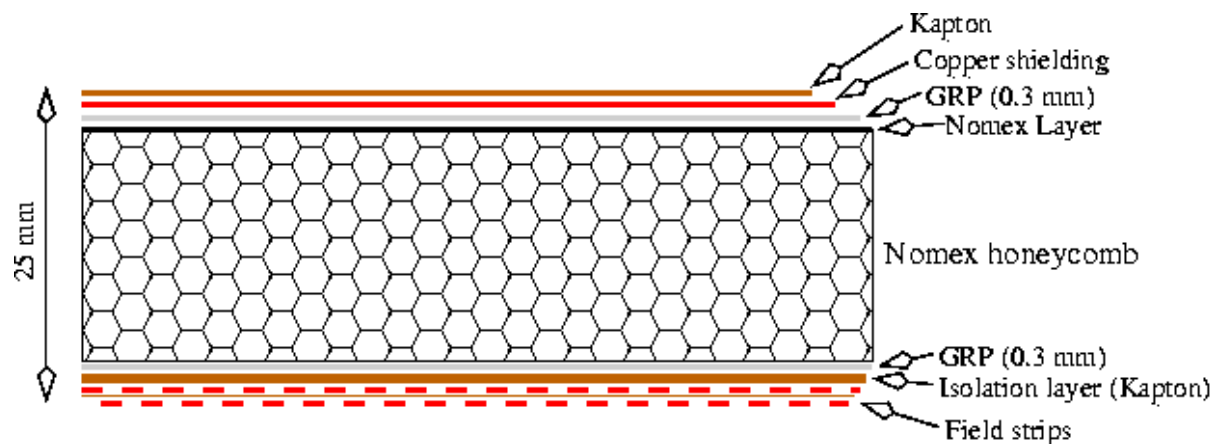
Layout of the Fieldstrip Foil



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

• Wall cross section:

- shielding
- honeycomb
- field strips



The Large TPC Prototype

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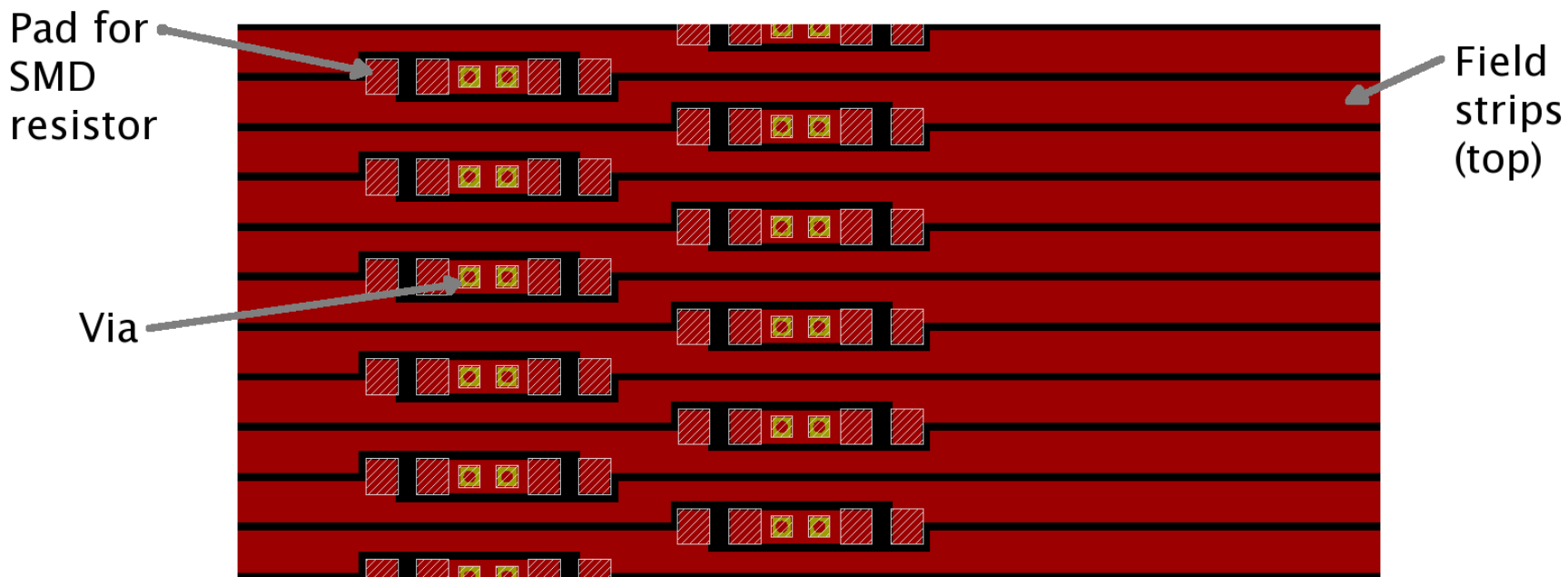


Fieldstrip Foil: Layout

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

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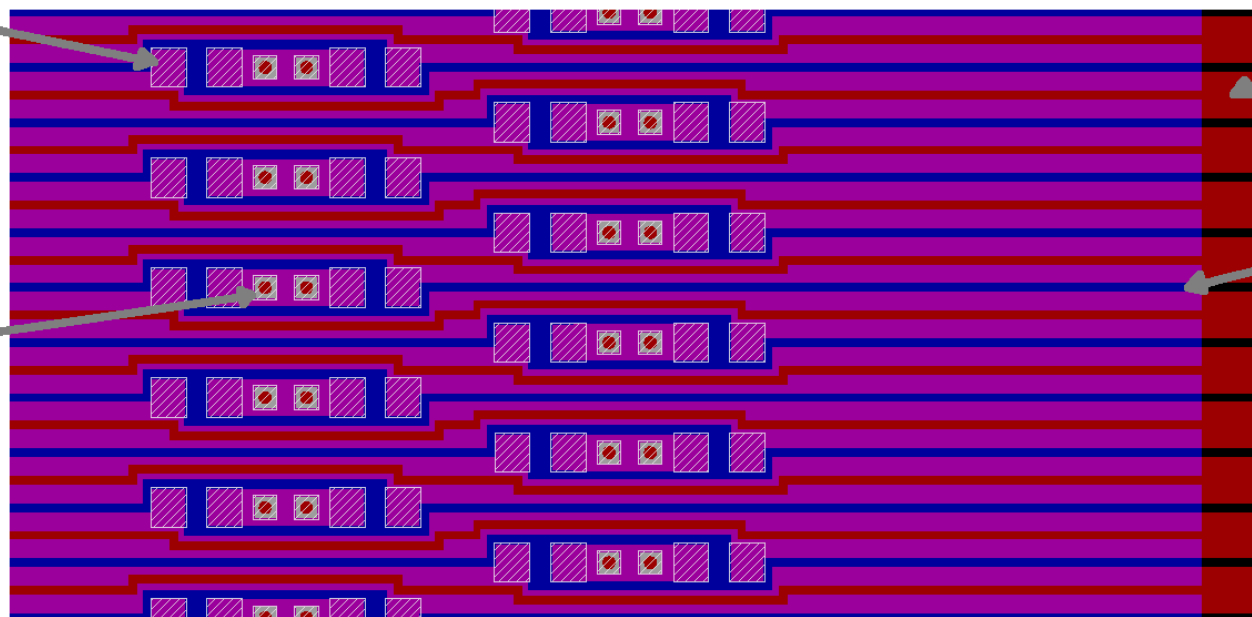
5) Schedule

Fieldstrip Foil: Layout

- Field strips for homogeneous field: 2.3mm width, 0.5mm gap
- 1M Ω 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

Pad for
SMD
resistor

Via

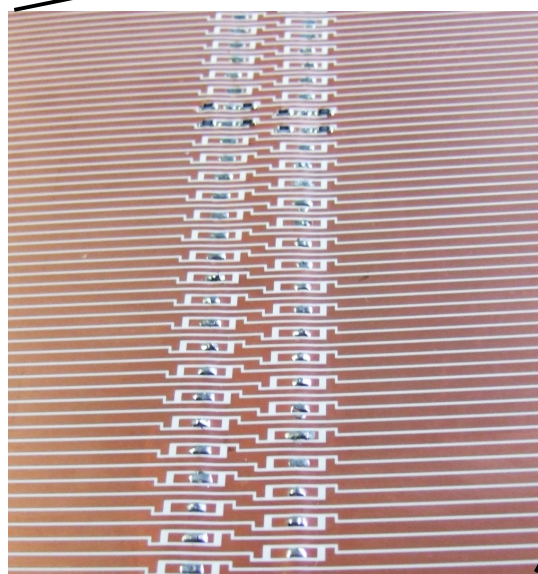
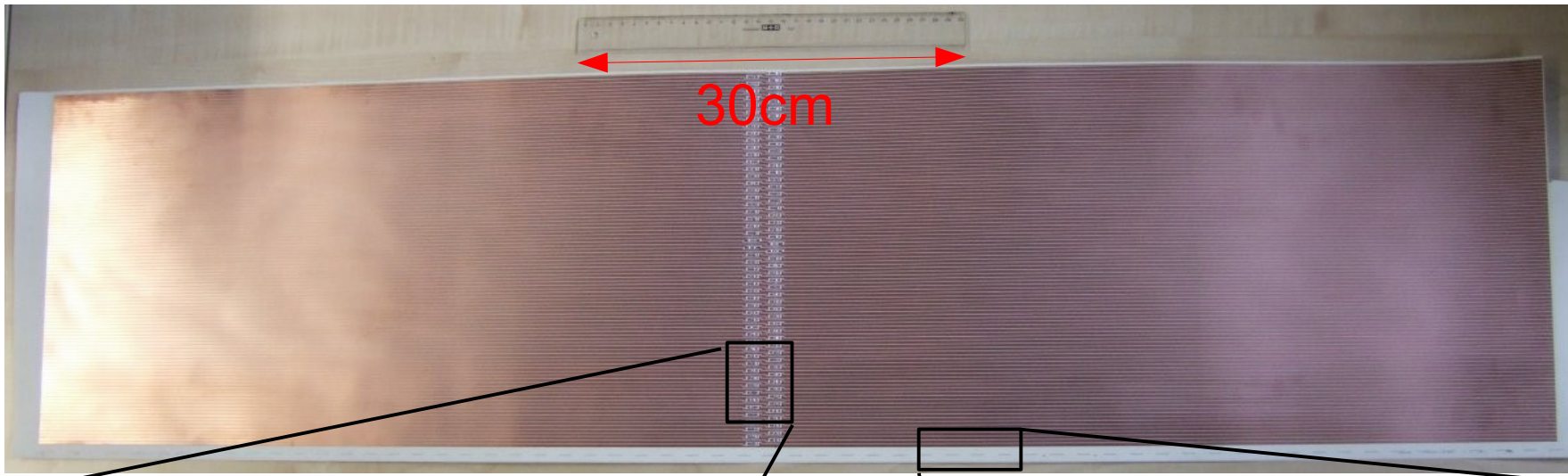


Field
strips
(top)

Field
strips
(bottom)

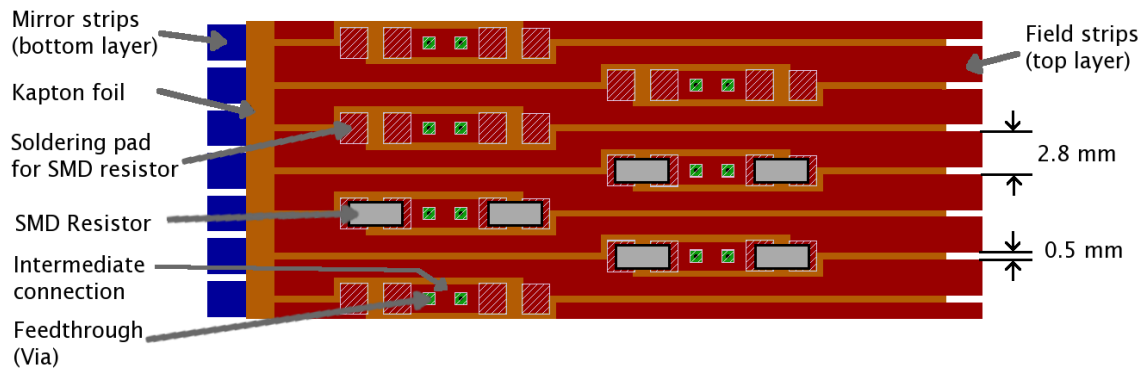


Sample Piece of the Fieldstrip Foil



- Produced in two layers that are glued together

- ~100V between two strips possible in operation



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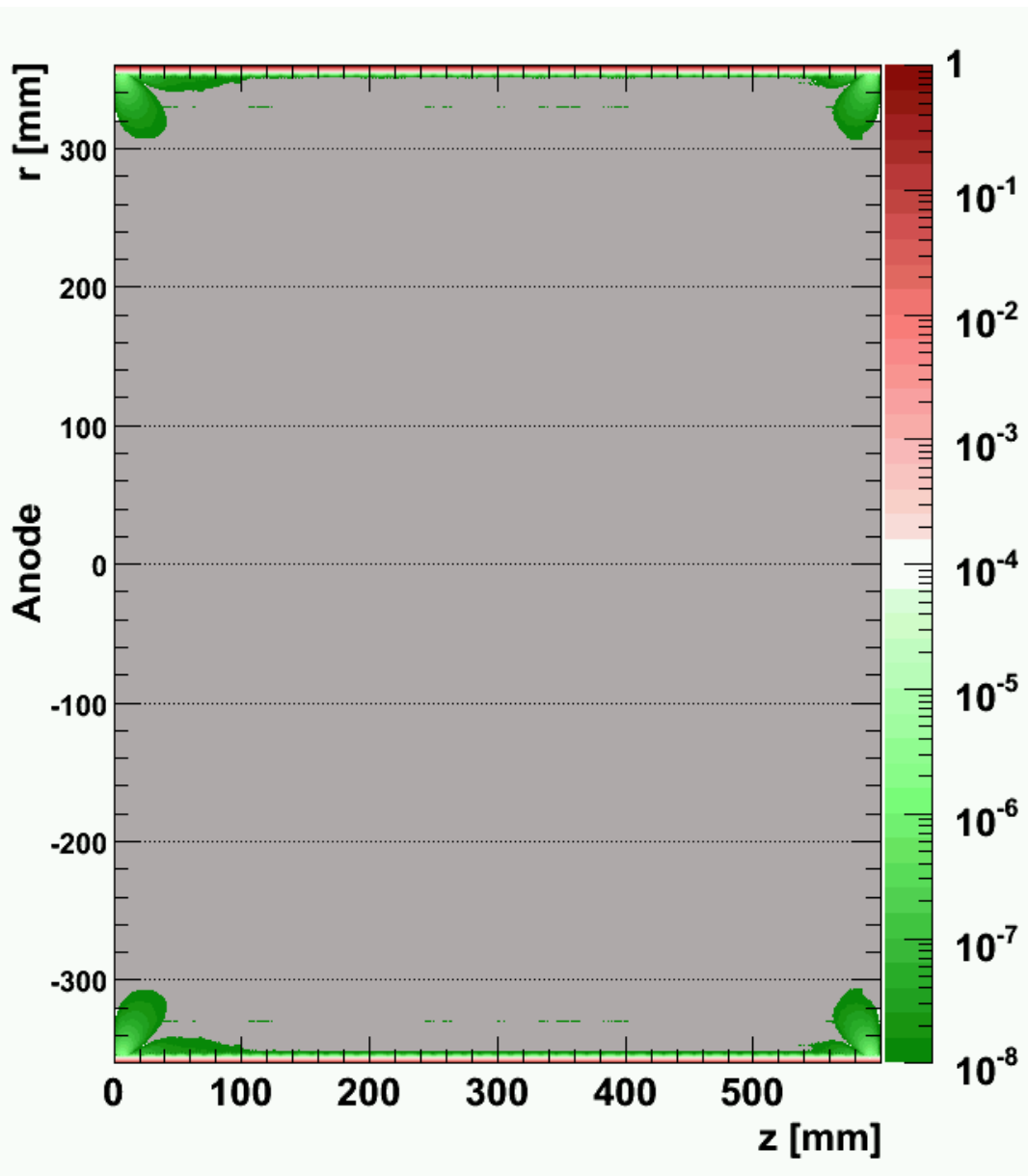
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Field Calculations

- Field with mirror strips and strip layout shown before



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

Goal:
 Deviations
 below 10^{-4}

= Value below Accuracy Limit

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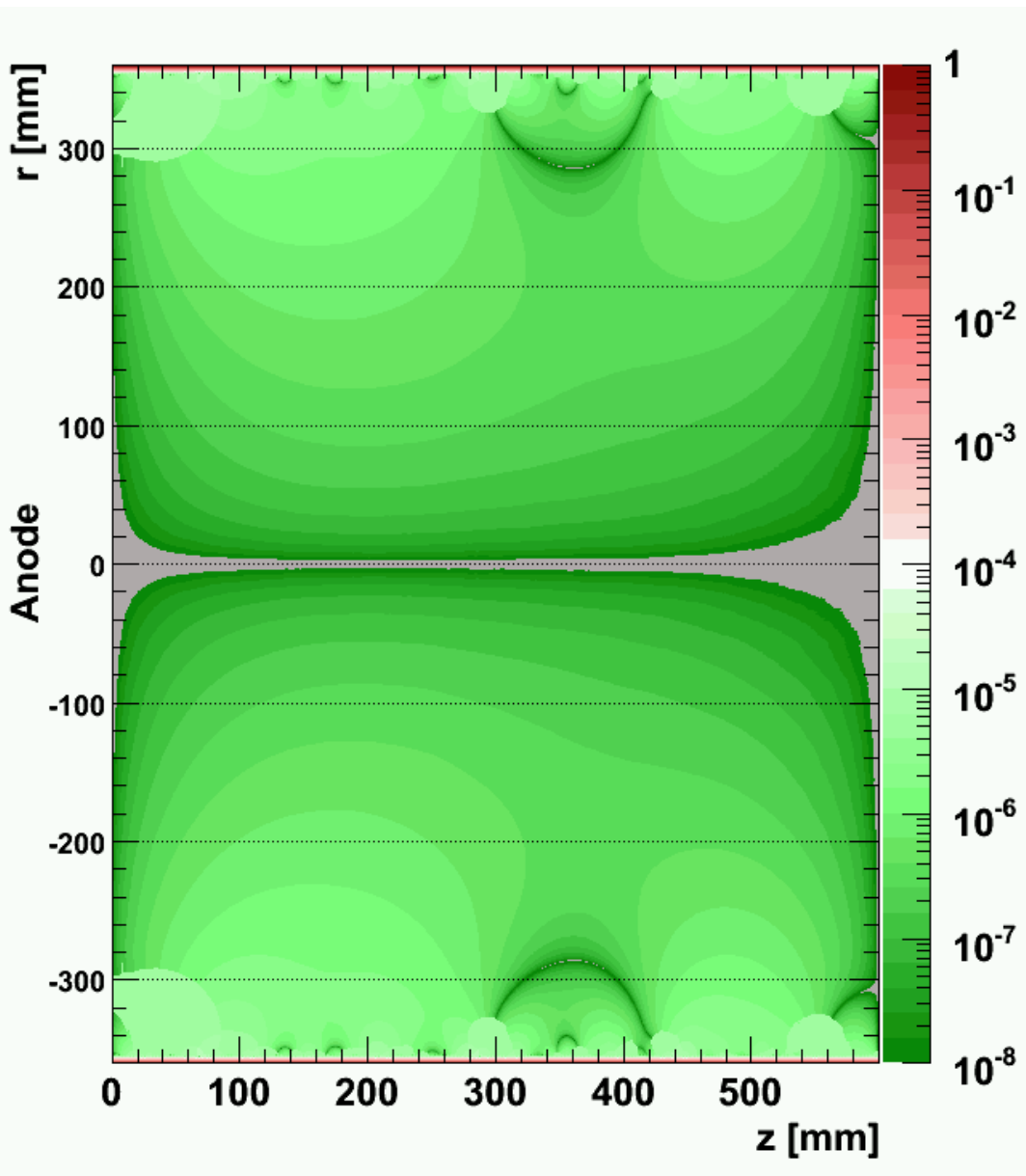
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 Hamburg University





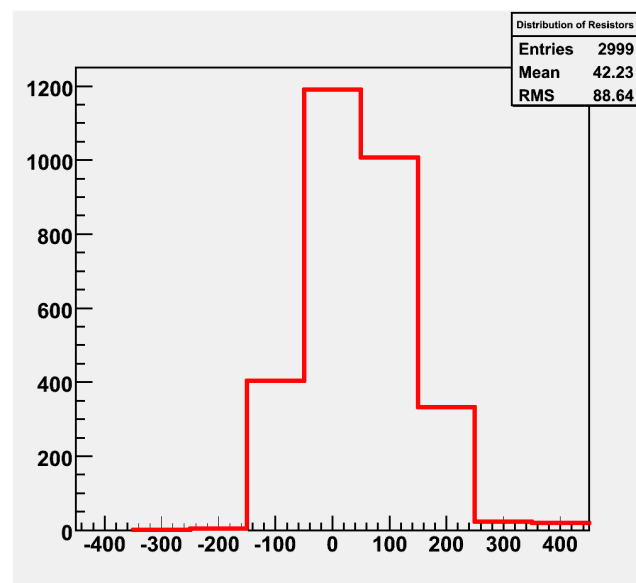
Field Calculations

- With Non-Perfect Resistors: $1\text{M}\Omega \pm 0.2\text{‰} (=200\Omega)$



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

Goal:
 Deviations
 below 10^{-4}



= Value below Accuracy Limit

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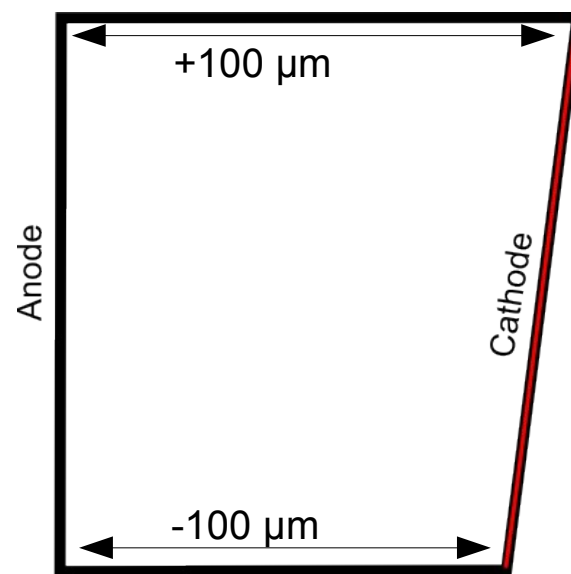
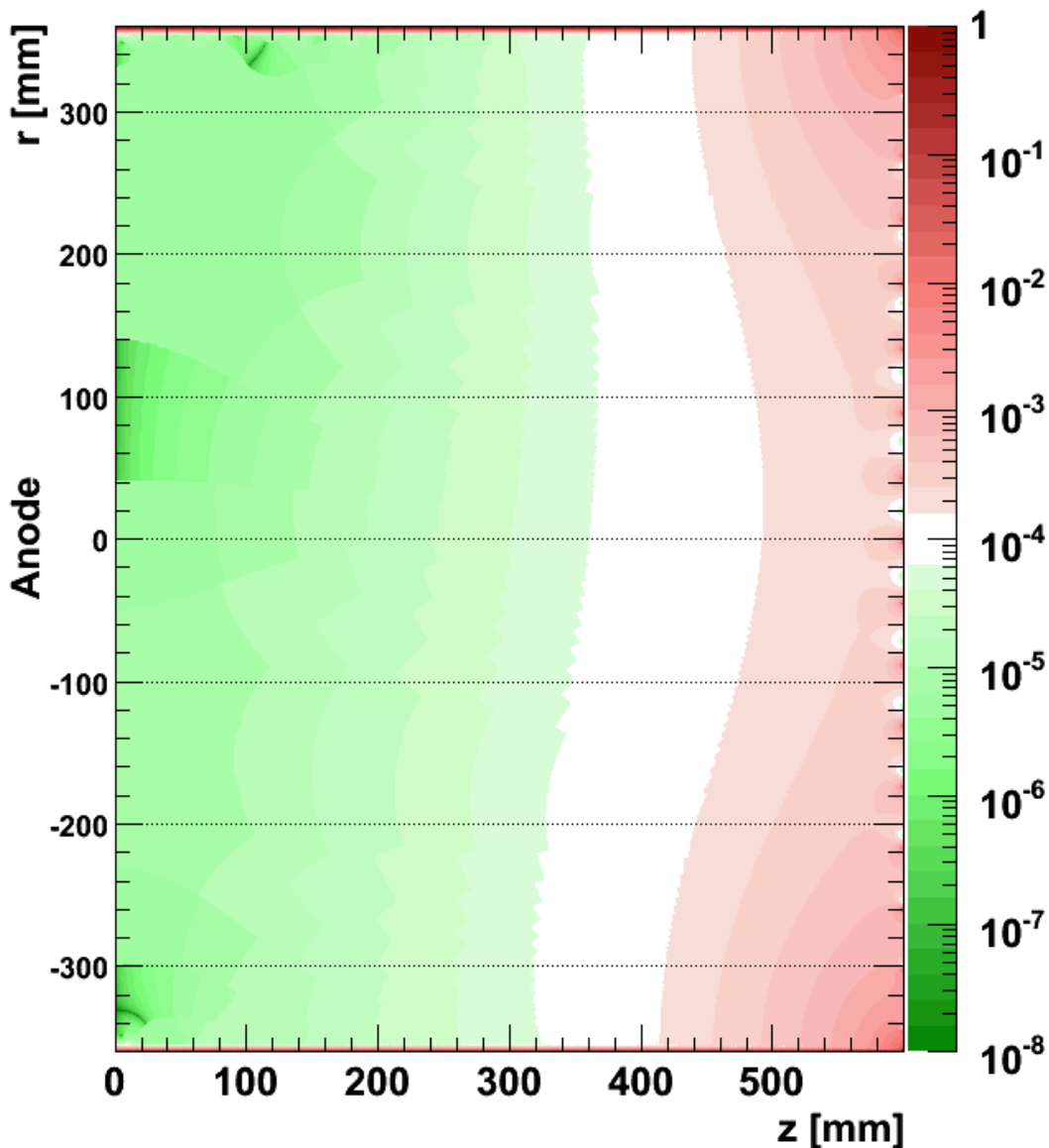
Field Calculations

- With Non-Perfect Resistors and Tilted Cathode

(manufacturing accuracy)

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

Goal:
 Deviations below 10^{-4}



= Value below Accuracy Limit

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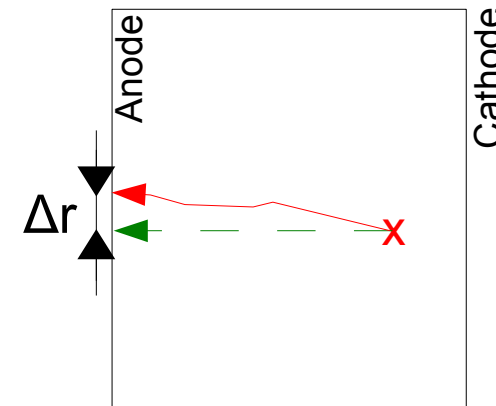
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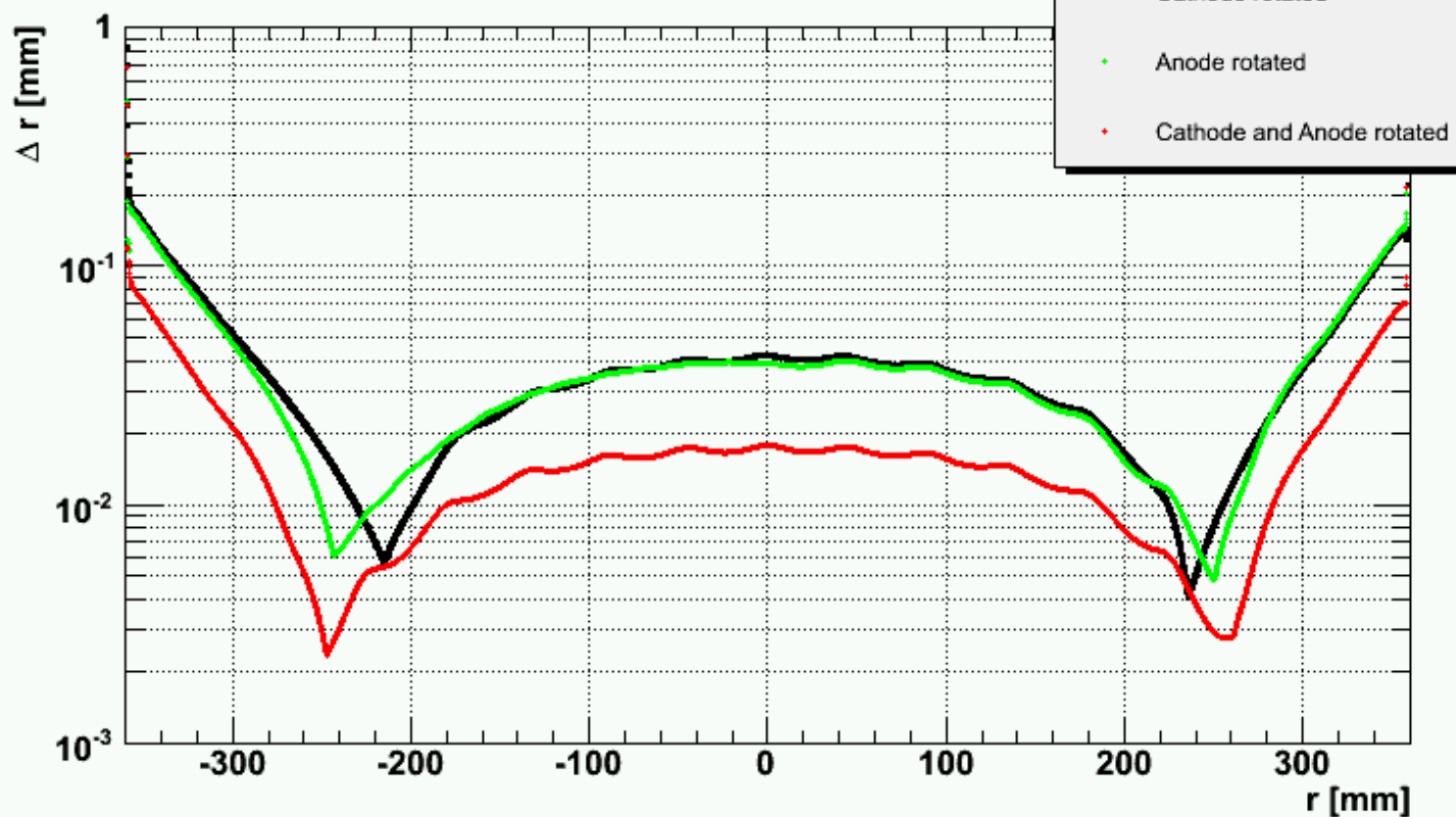


Field Calculation: Effect without Magnetic Field

- 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



Radial displacement

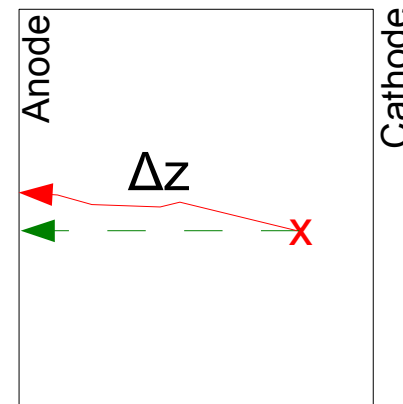


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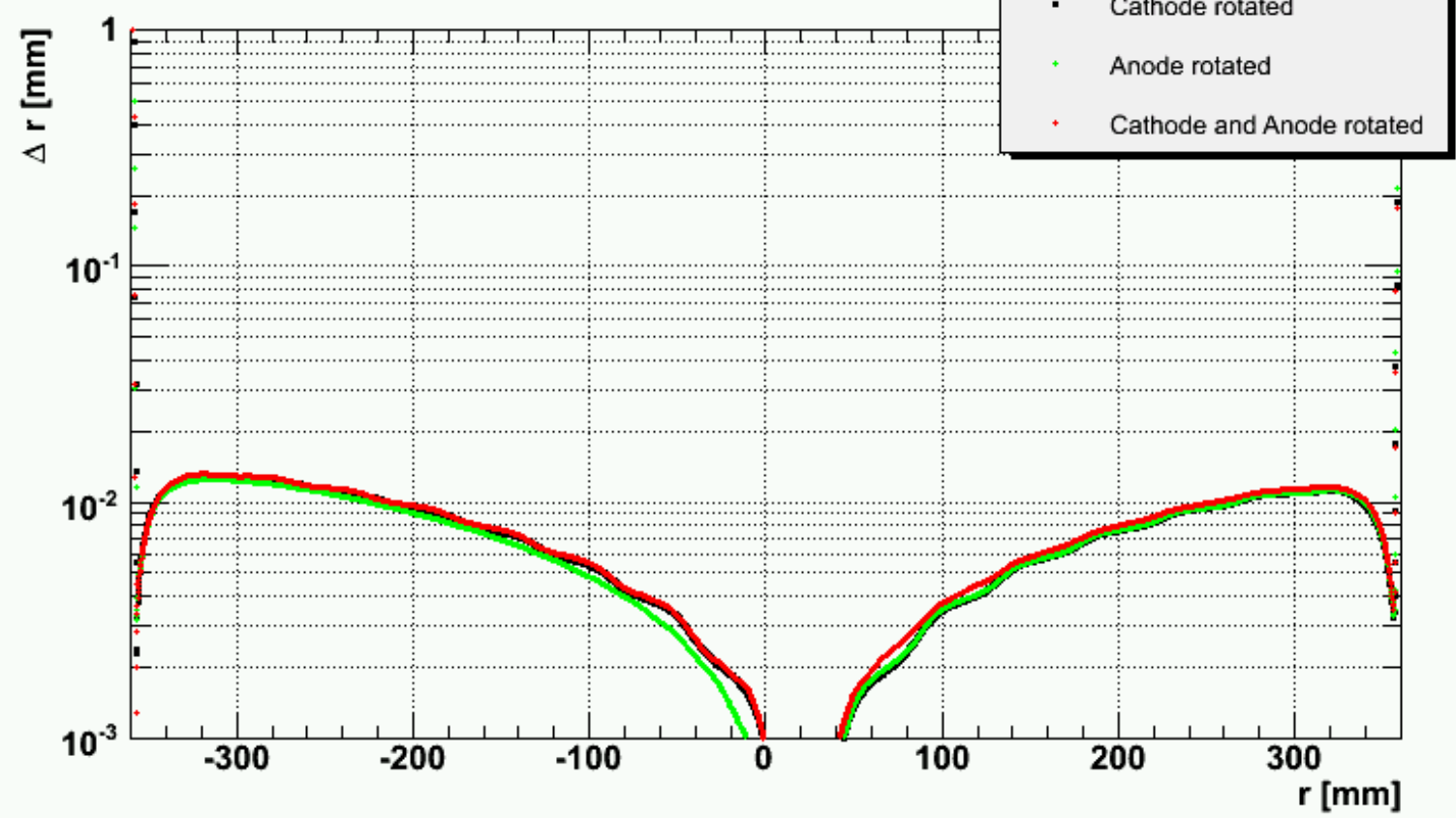


Field Calculation: Effect without Magnetic Field

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



Longitudinal displacement



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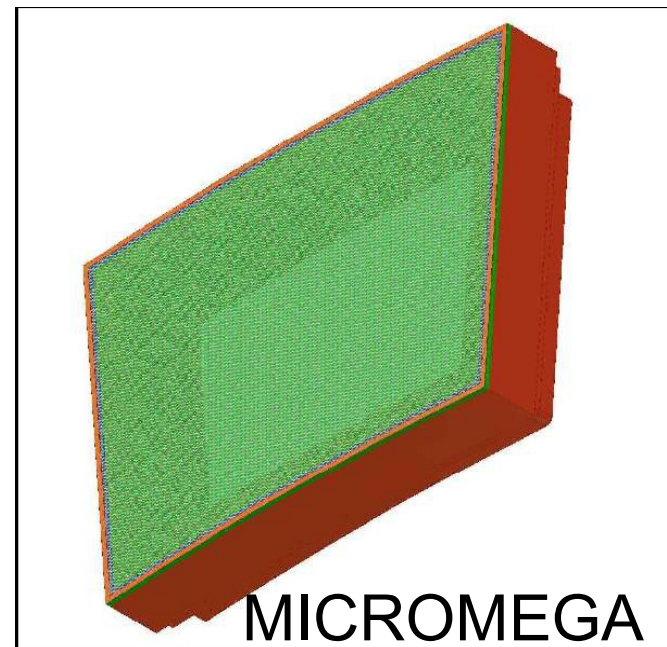
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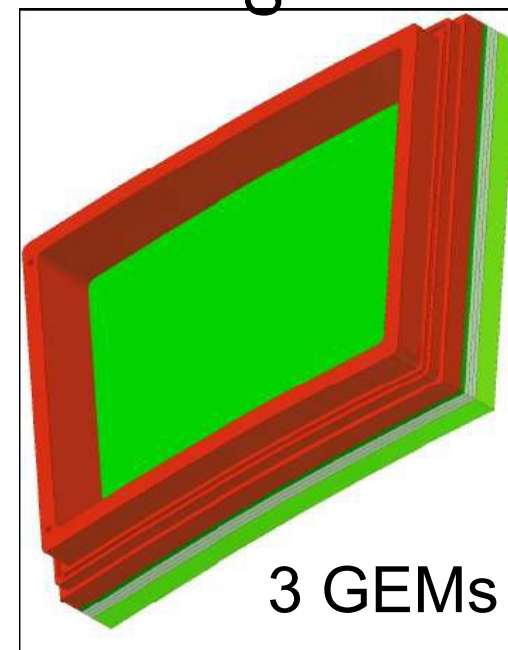
Endplate Design (from Cornell)

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

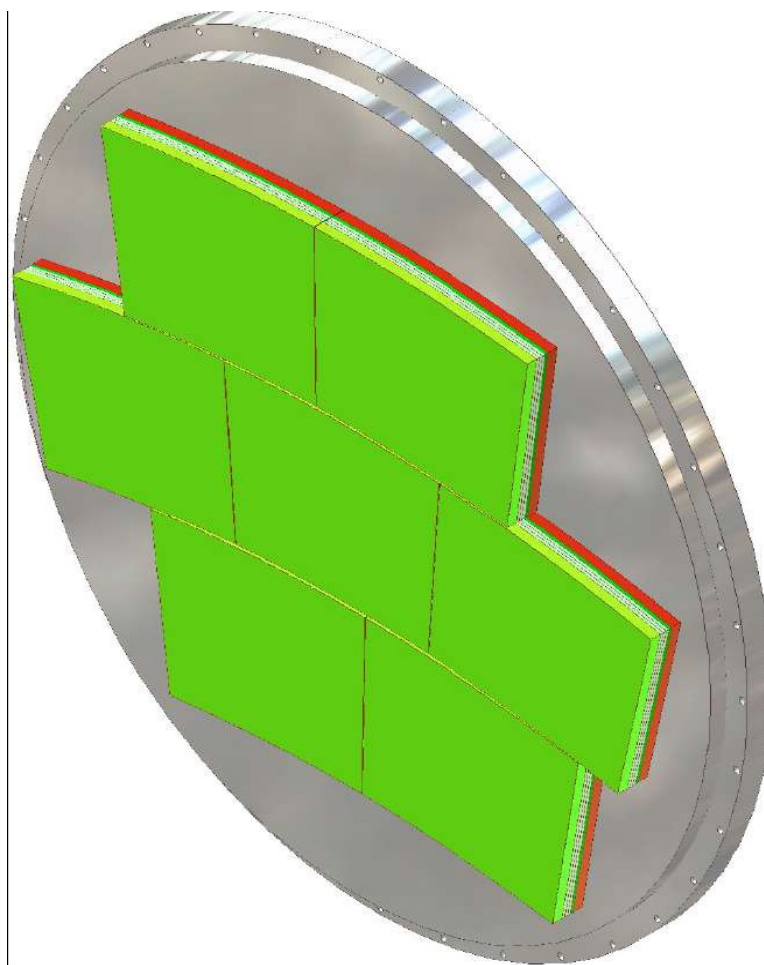


MICROMEGA

S



3 GEMs



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Endplate Design (from Cornell)

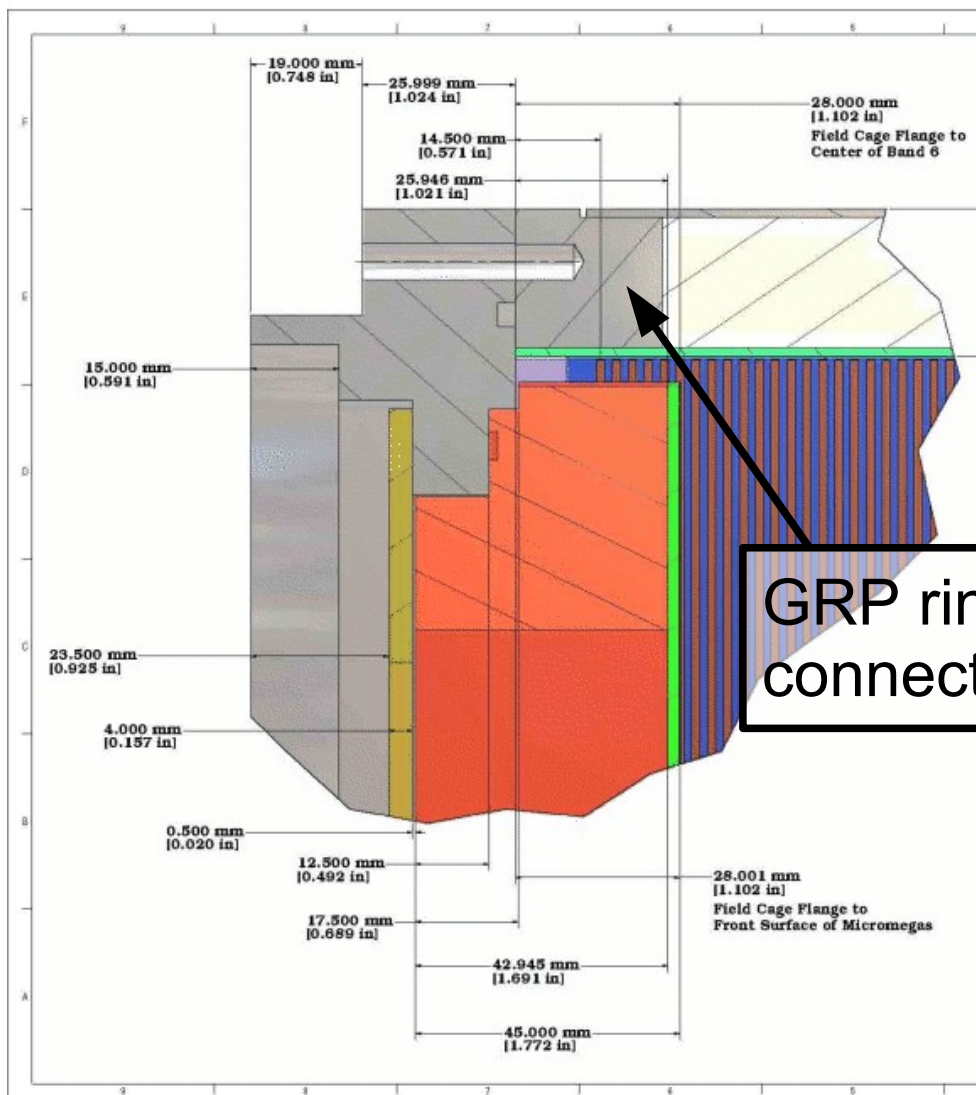
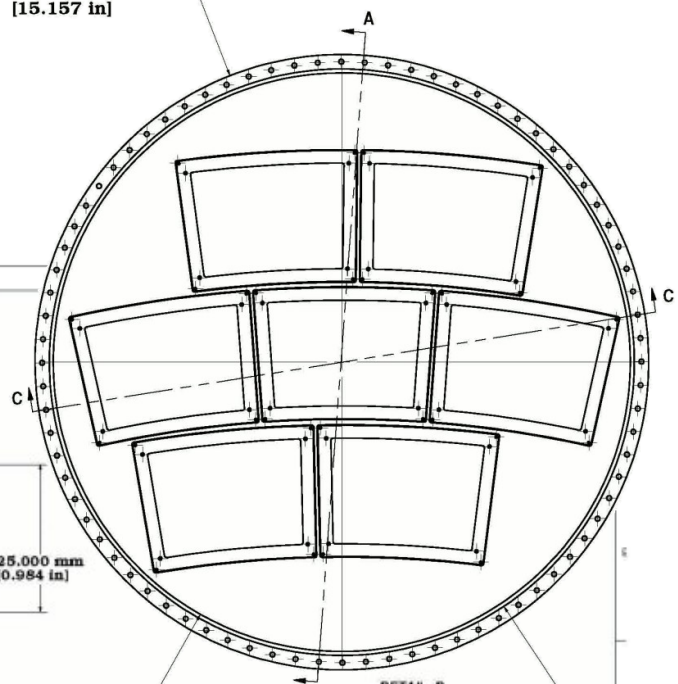
- Most dimensions already fit to current fieldcage design, the rest is close and both designs are converging

R385.000 mm REF
[15.157 in]

25.000 mm
[0.984 in]

R362.000 mm REF
[14.252 in]

R367.000 mm REF
[14.449 in]



GRP ring in fieldcage:
connection to endplate

ITEM	DWG. NO.	DESCRIPTION	Q1	Q2	Q3	REMARKS	REV.
1	8089-122	8089-122 Micromegas Module A Endplate Rev					
DRAWN BY: MDC CHECKED BY: P. B. / 8/2007 DATE: 8/2007 SCALE: 1:1 SHEET: 6 OF 6							

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Hamburg University





The Large TPC Prototype

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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