Integration issues around the TPC

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DESY

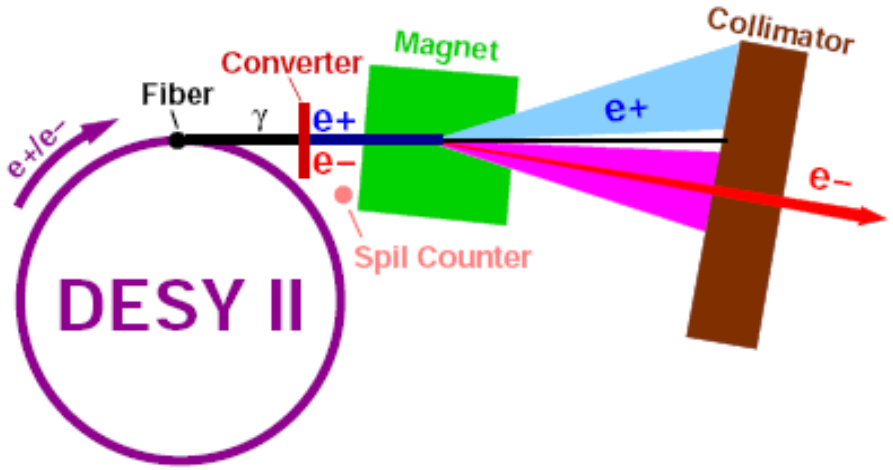
EUDET Annual Meeting 2007
08-Oct-2007

The Large Prototype LP-TPC

- First step towards LC TPC
- Field cage (FC) as EUDET project
- Serves as infrastructure for different readout structures (GEM, MicroMegas)
- First use in KEK-PCMAG at DESY-II test beam
- Silicon envelope

DESY II Test Beam Area

- Converted bremsstrahlung beams from C-fiber targets DESY II
- Bremsstrahlung 1/E dependence
- Energy distribution of electron/positron pair conversion nearly flat
- Geometry fixed by beam pipe
- Varying magnet current beam momentum



DESY II Test Beam Area

- Typical momenta of electrons reaching **T24**:
  - p = 1 … 6 GeV/c
  - spread ~ 5%, divergence ~ 2mrad
- Magnet currents, choice of target and collimator opening is under control of user
- Accelerator control room handles the fiber target

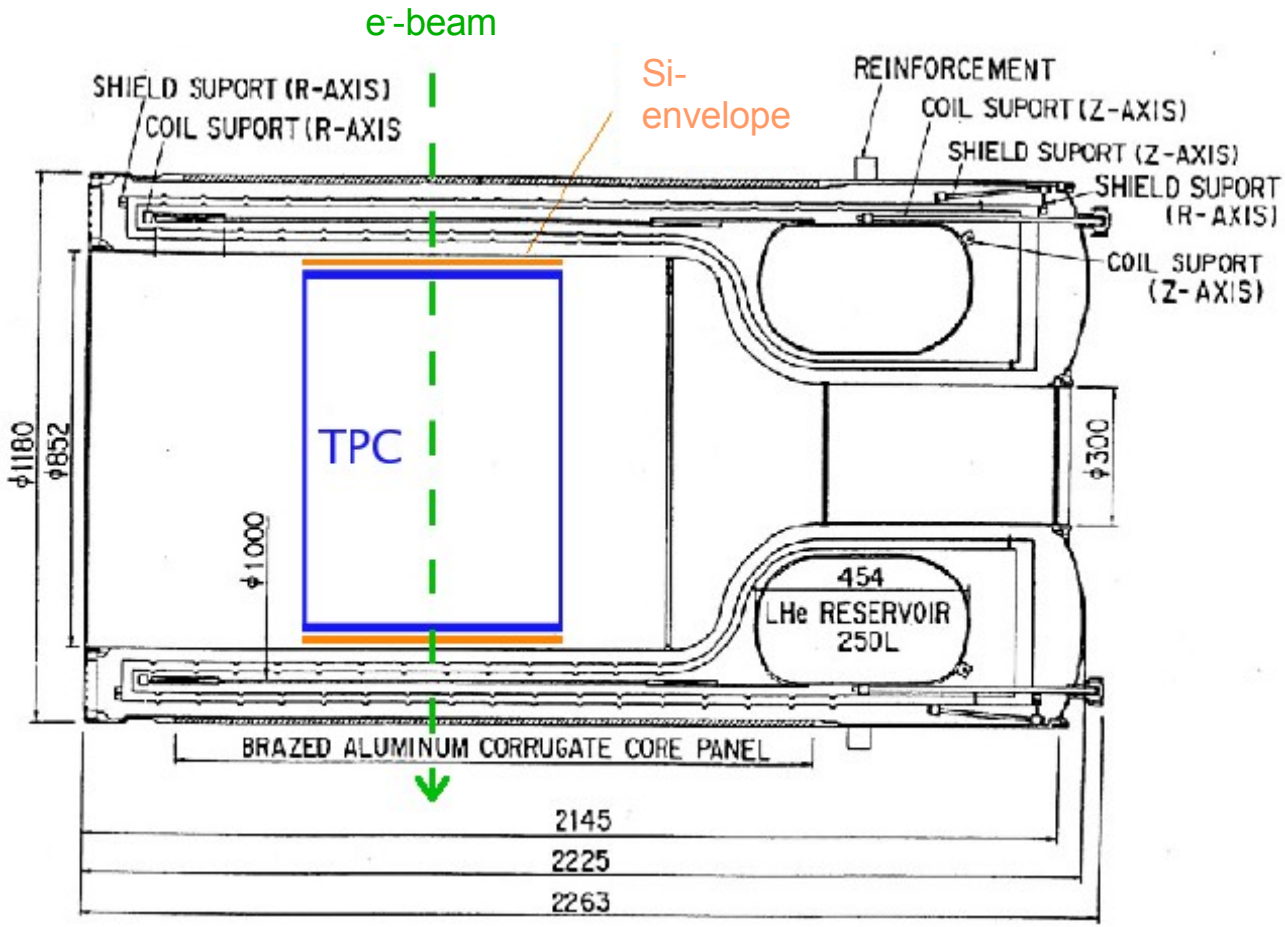
DESY II Test Beam Area

Estimated rates (per cm^2)

Energy / GeV	Rate (3mm Cu) / Hz	Rate (1mm Cu) / Hz
1	330	220
2	500	330
3	1000	660
5	500	330
6	250	160

TPC-Test beam-PCMAG

TPC-Test beam-PCMAG



$B_{max} \cong 1.25$ T

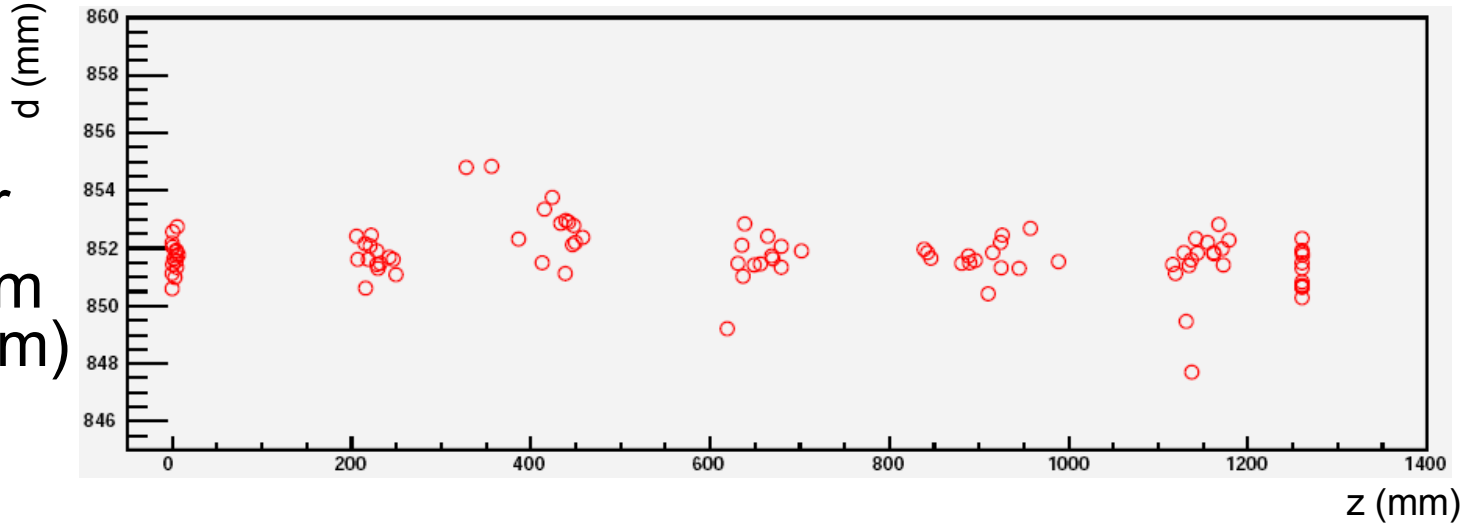
L. Hallermann, DESY

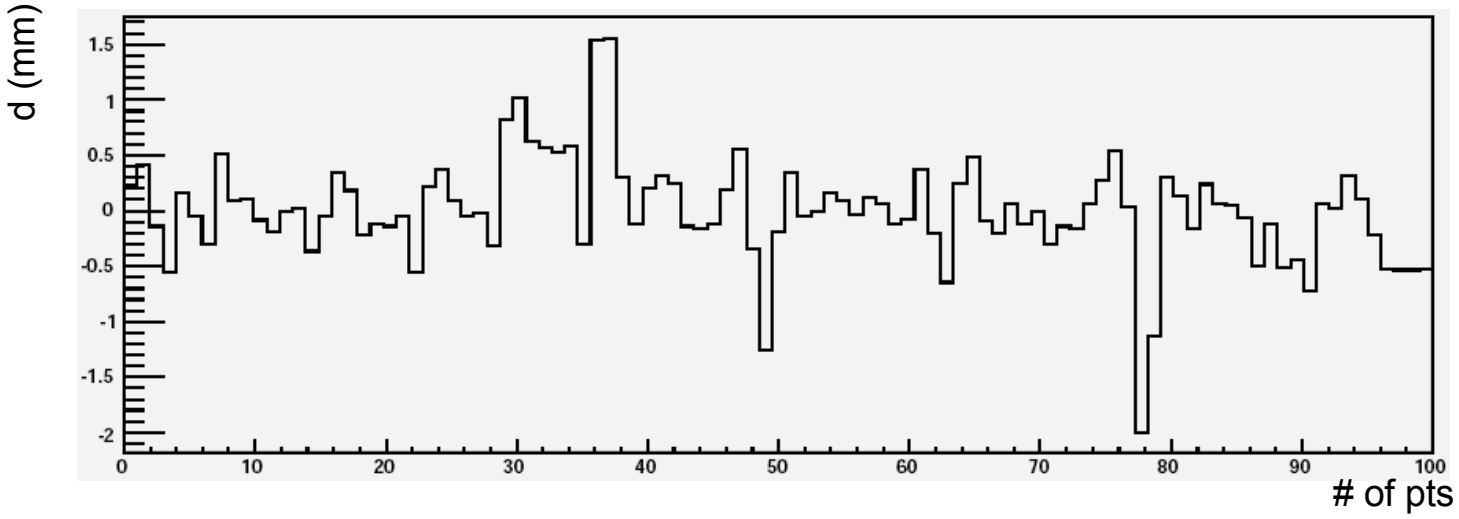
PCMAG

Survey:

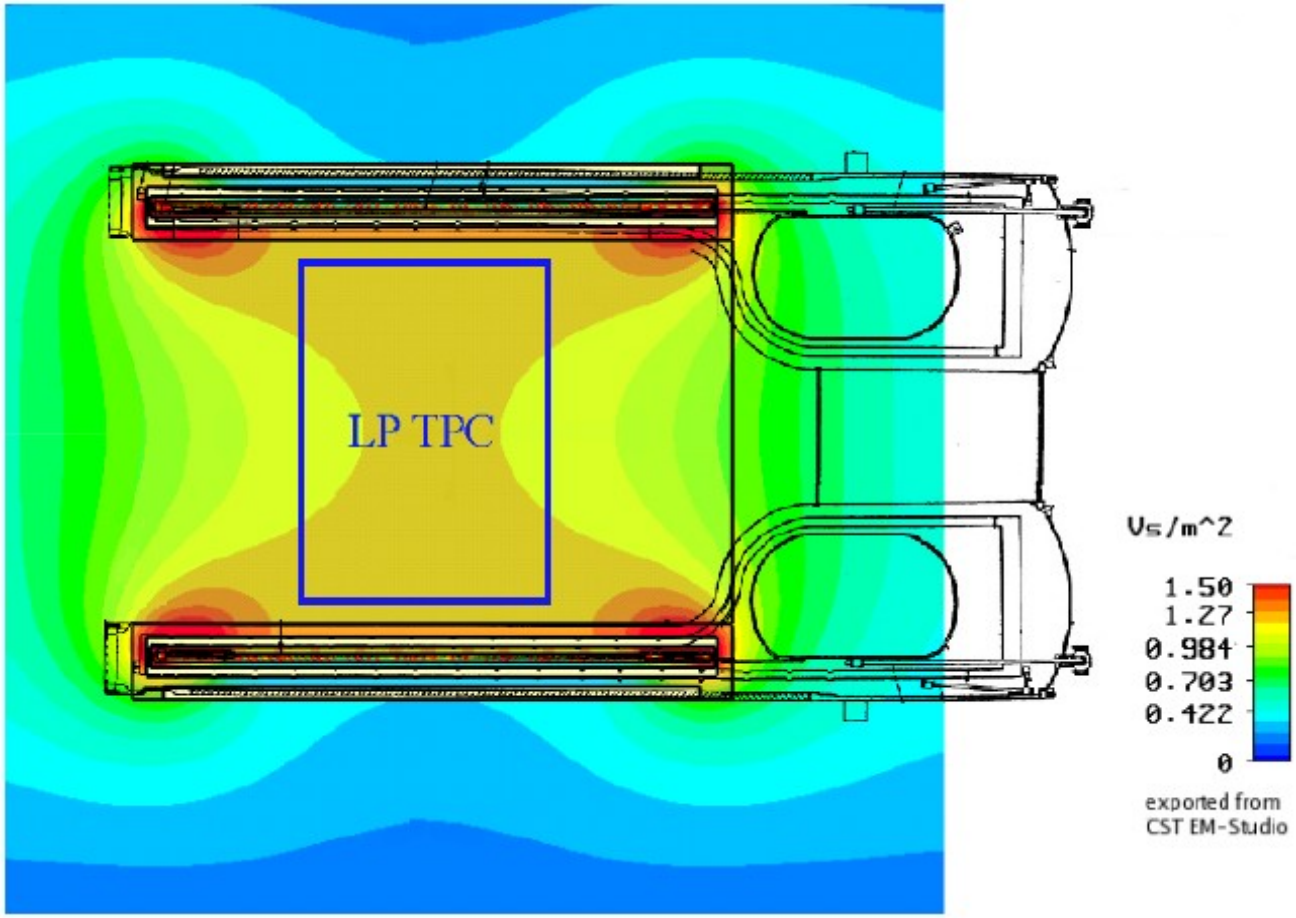
bore diameter

$\langle\phi\rangle$ = 851.7 mm
(nominal 852 mm)





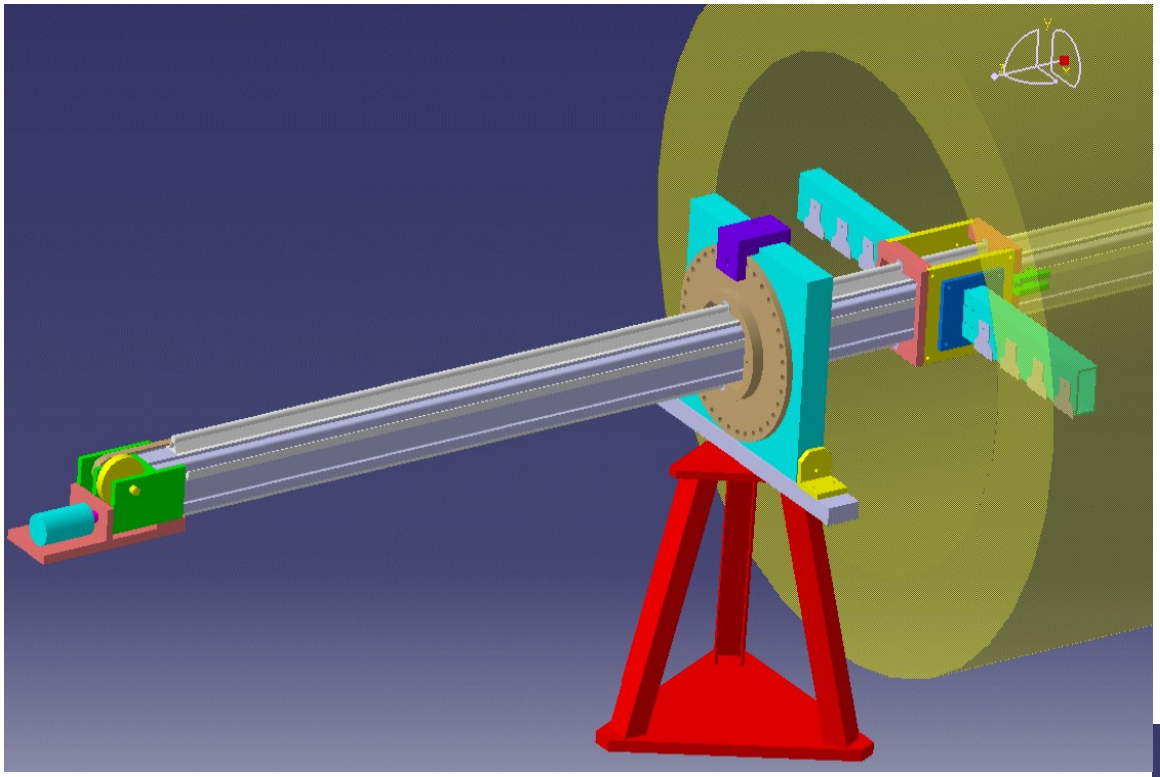
PCMAG



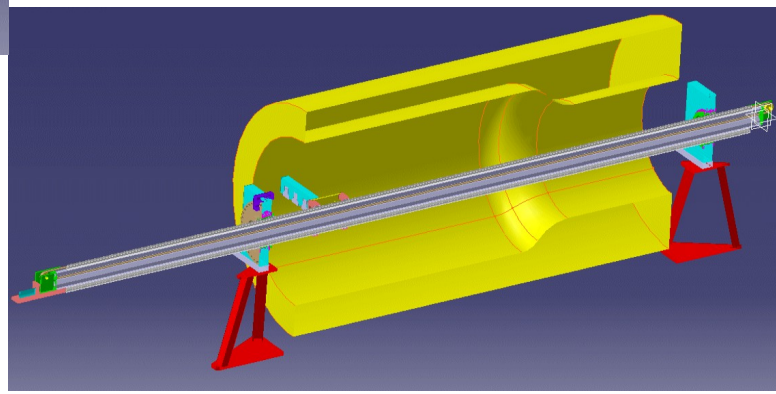
$B_{max} \cong 1.25$ T

P. Schade, DESY

Field Mapping



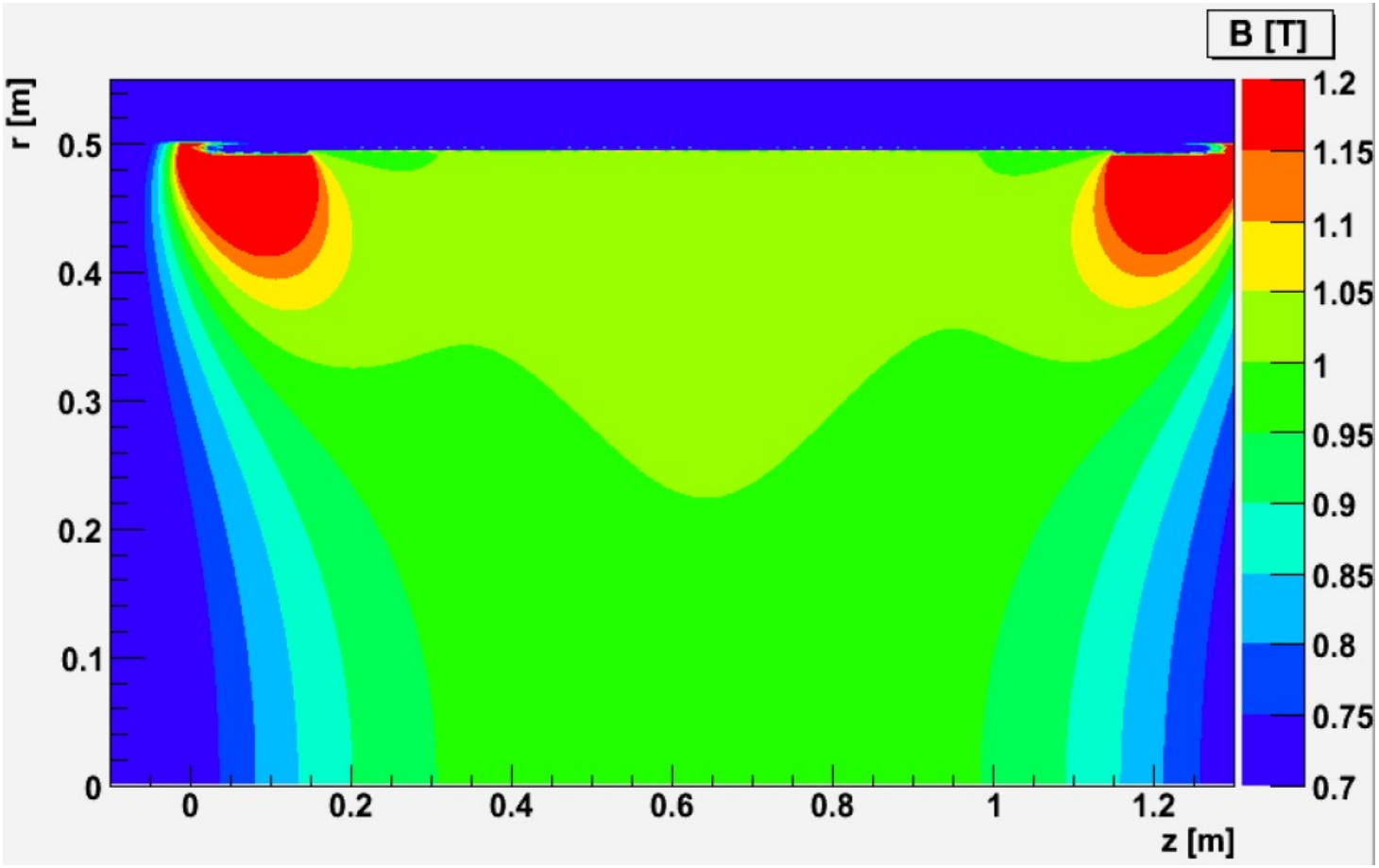
Field measurements performed in July 2007



P. A. Giudici / C. Bault

Field Mapping

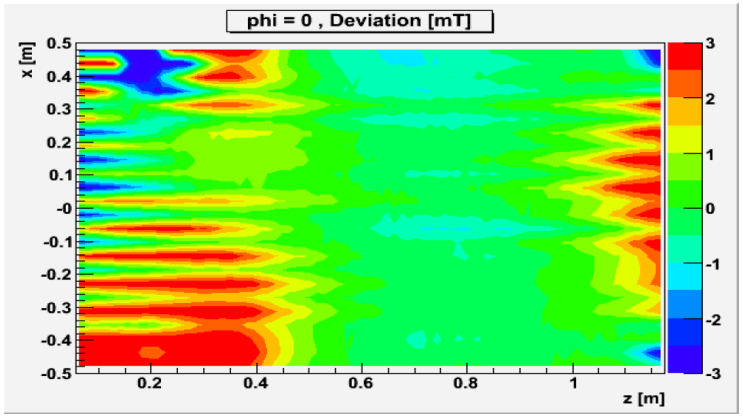
Biot-Savard yields:

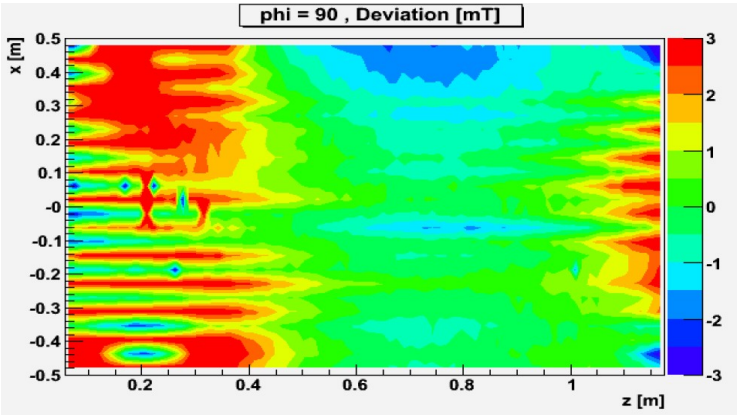


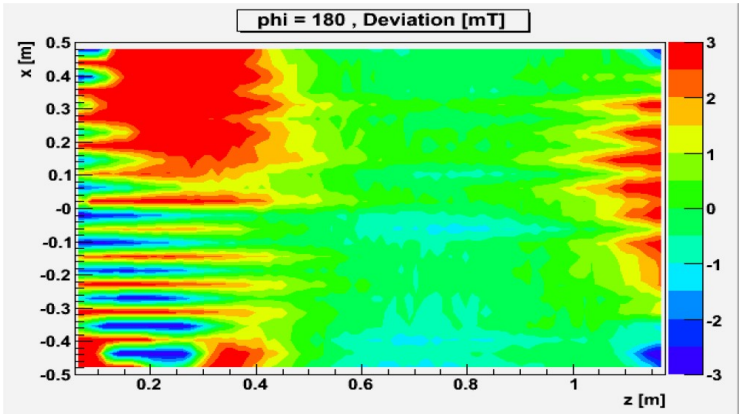
C. Grefe, Univ. of Hamburg

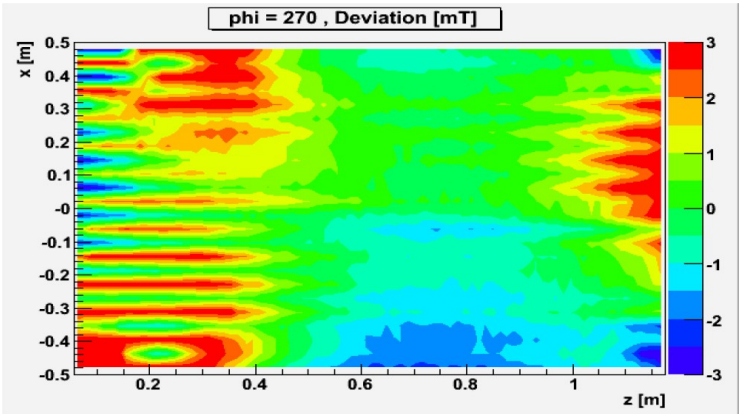
Field Mapping

Comparison Model – Field measurements
see talk of Christian Grefe in JRA1 session



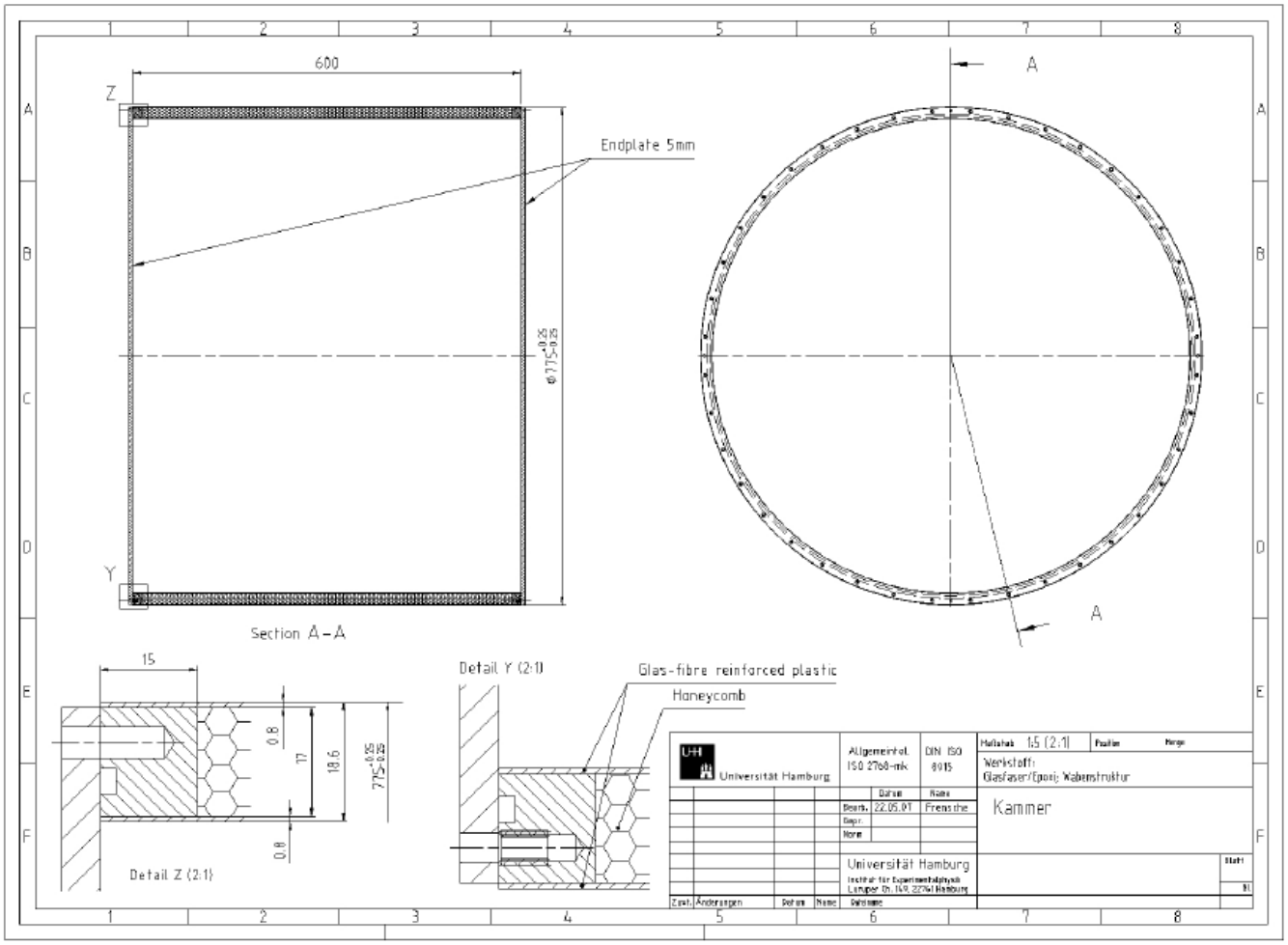






C. Grefe, Univ. of Hamburg

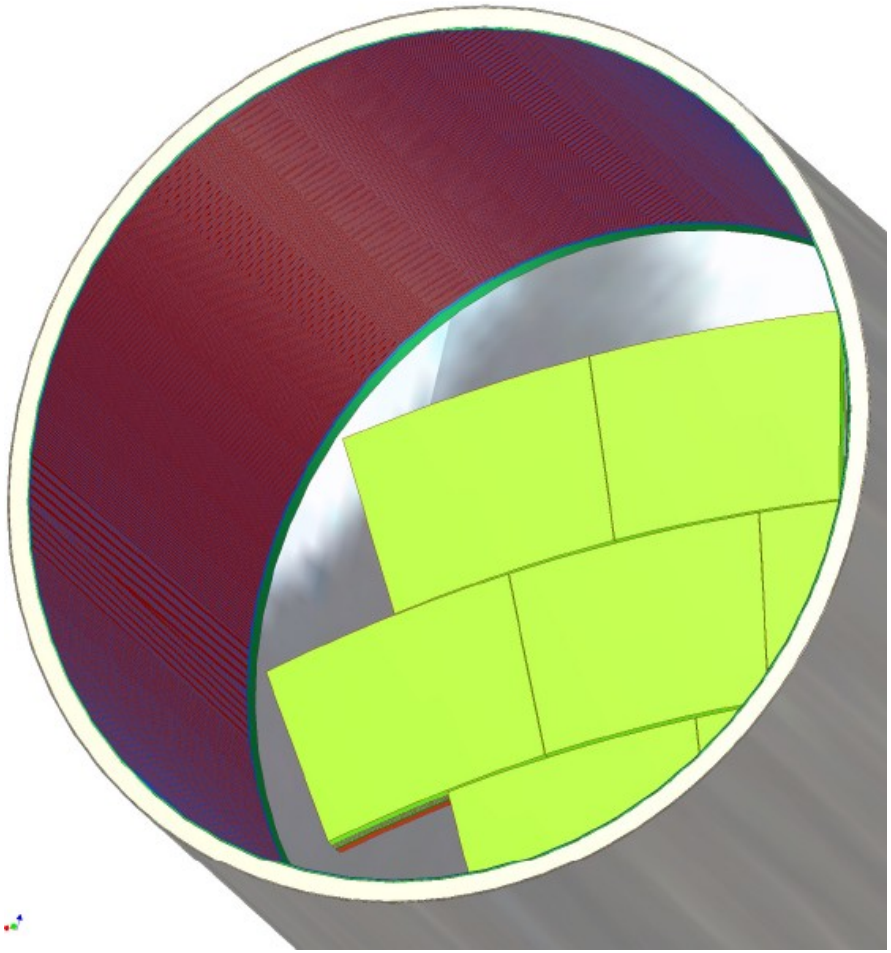
LP-TPC FC

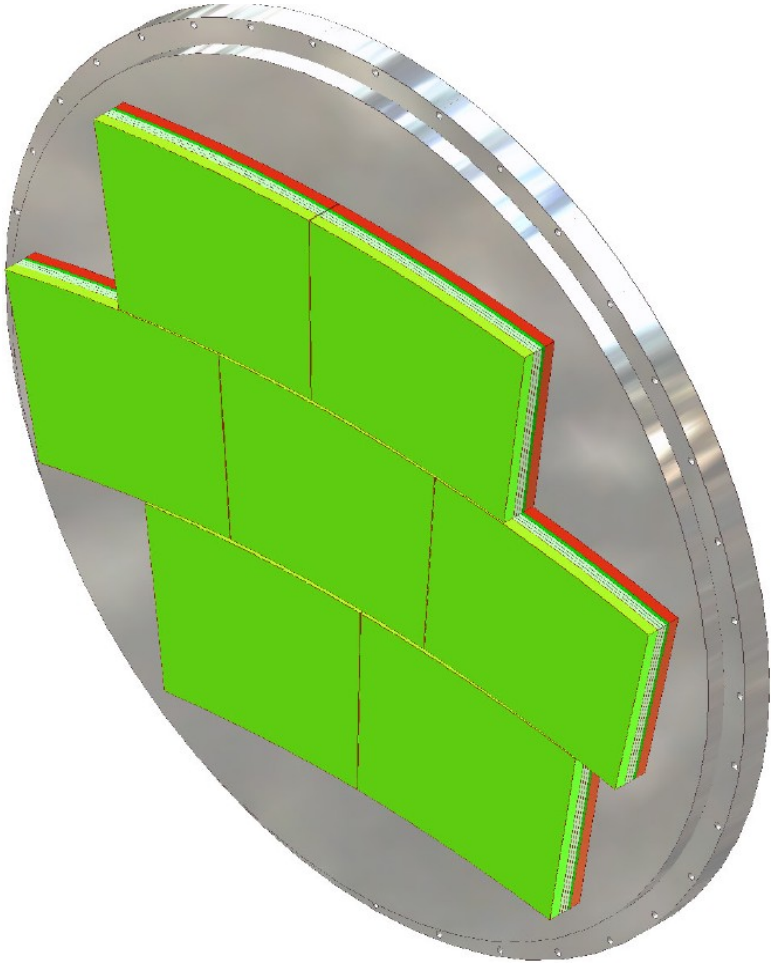


inner diameter: 730 mm, length: 60 cm, wall thickness: 2 cm

L. Hallermann, DESY

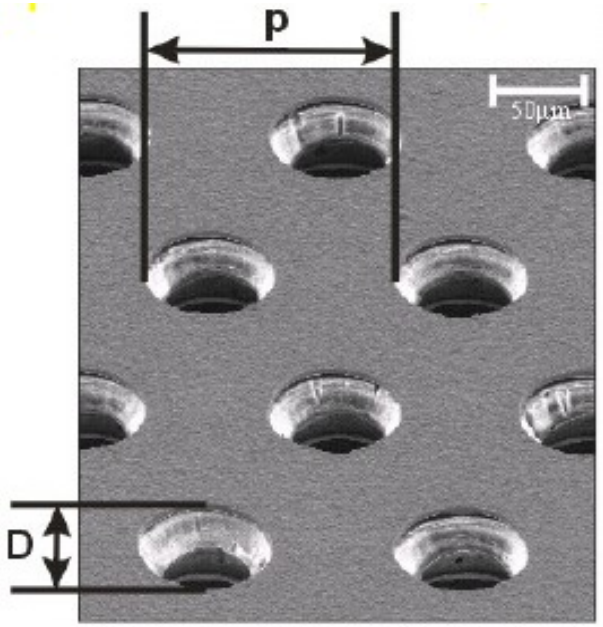
LP-TPC Endplates



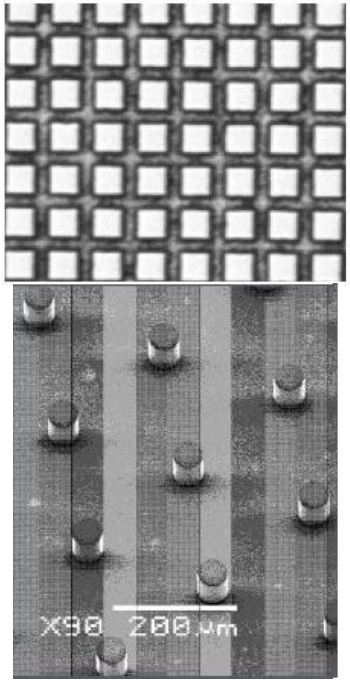


D. Peterson, Cornell

LP-TPC MPGD



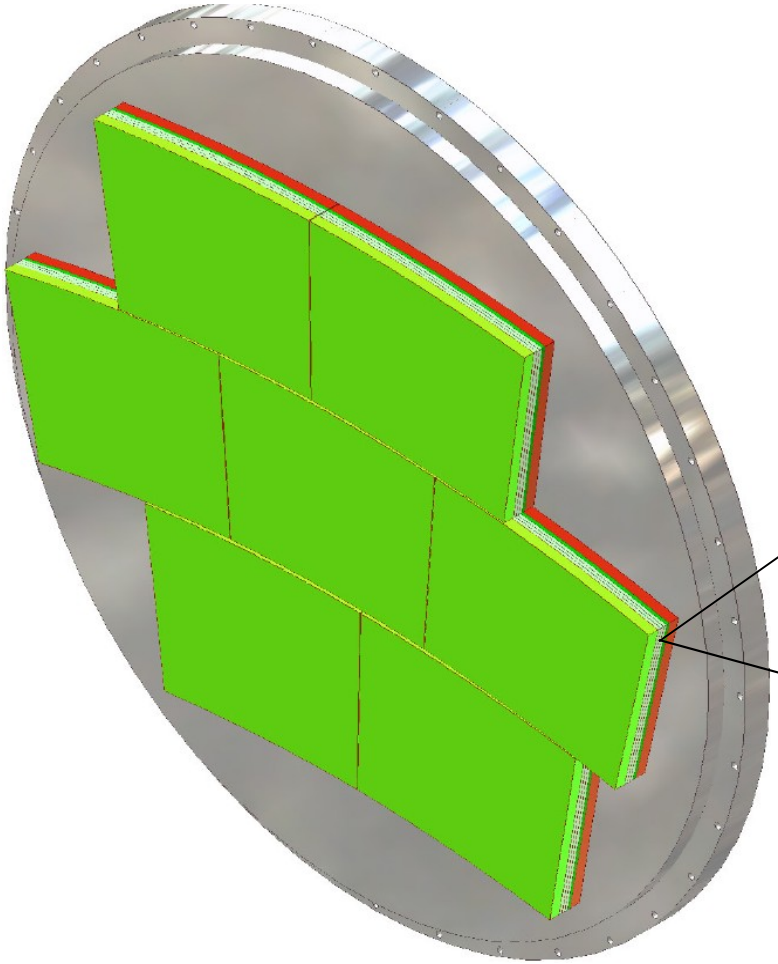
p=140µm
D=70µm

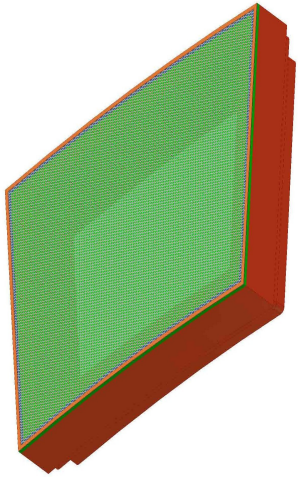


Gas Electron Multiplier (GEM):
50µm Kapton foil, each side covered with 5µm Cu clad;
multiple stage

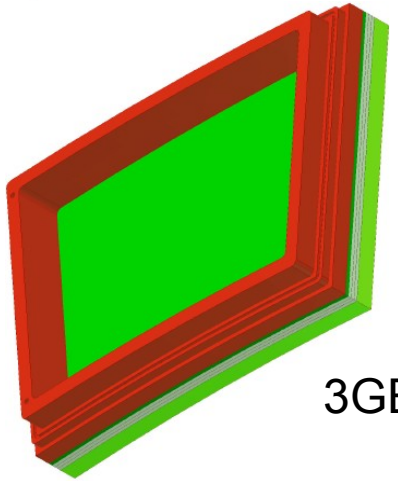
Micro Mesh Gaseous Structure (Micromegas):
micromesh sustained by 50 µm pillars, multiplication between anode and mesh;
one stage

LP-TPC Endplates





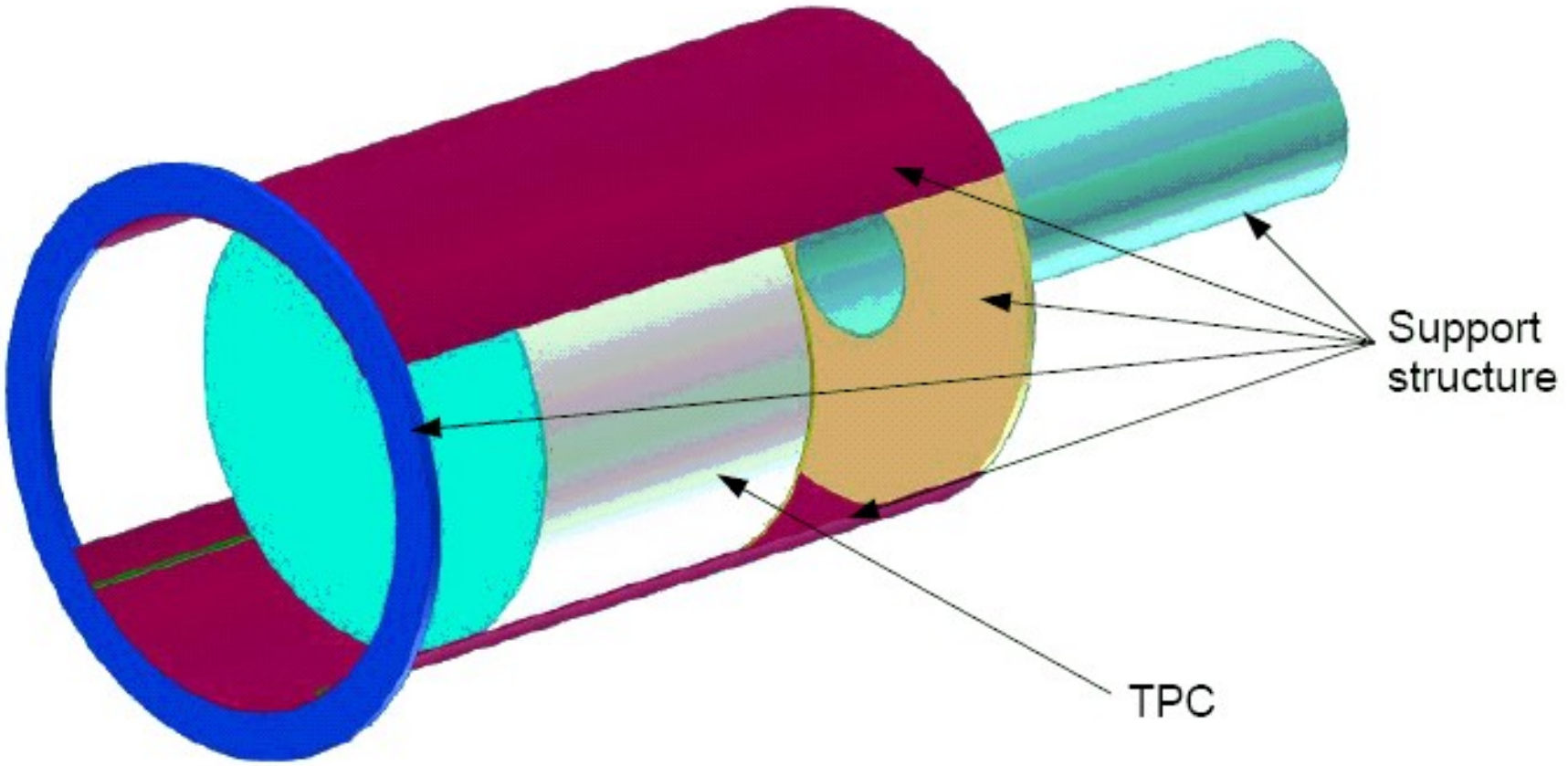
MicroMegas



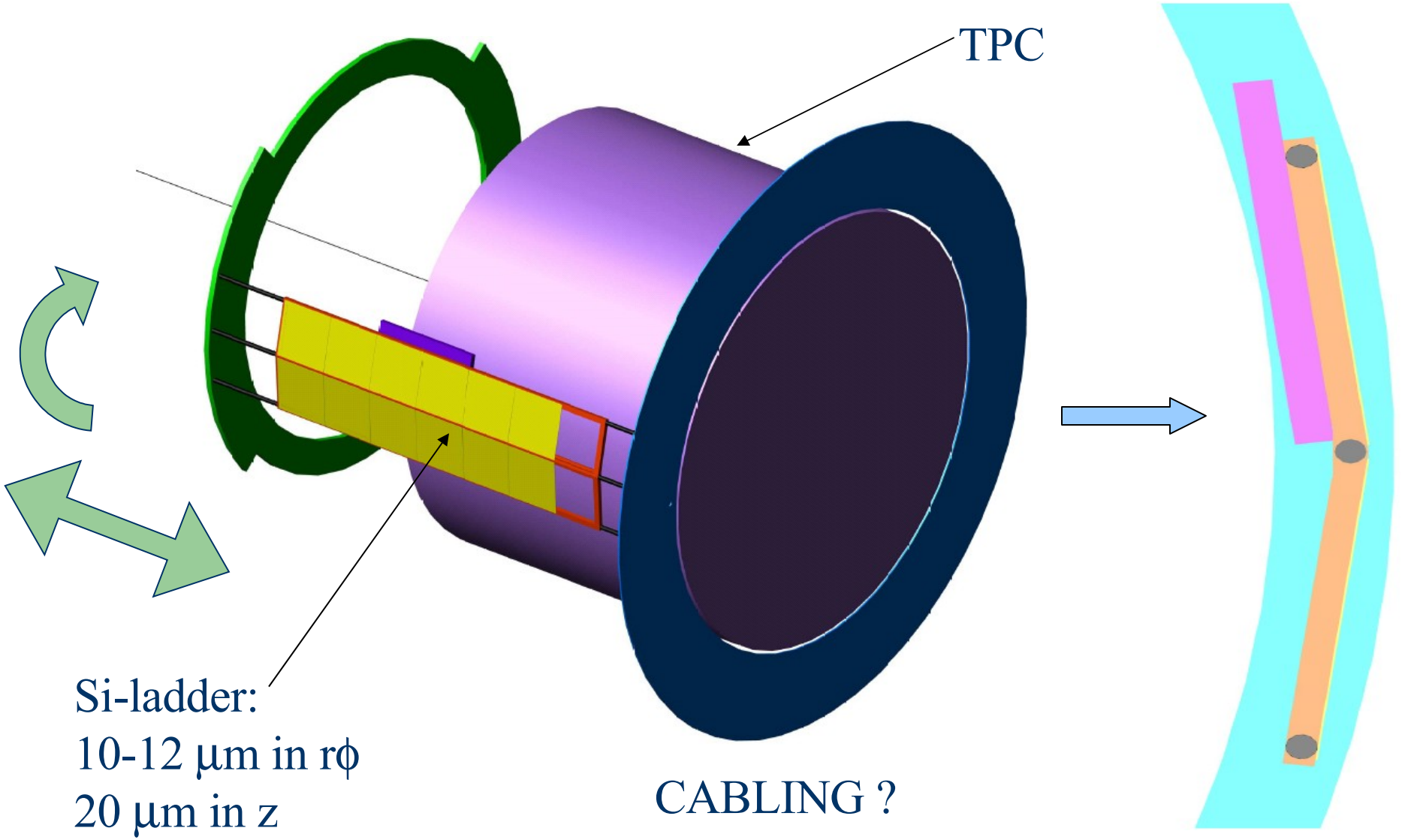
3GEM+Gate

D. Peterson, Cornell

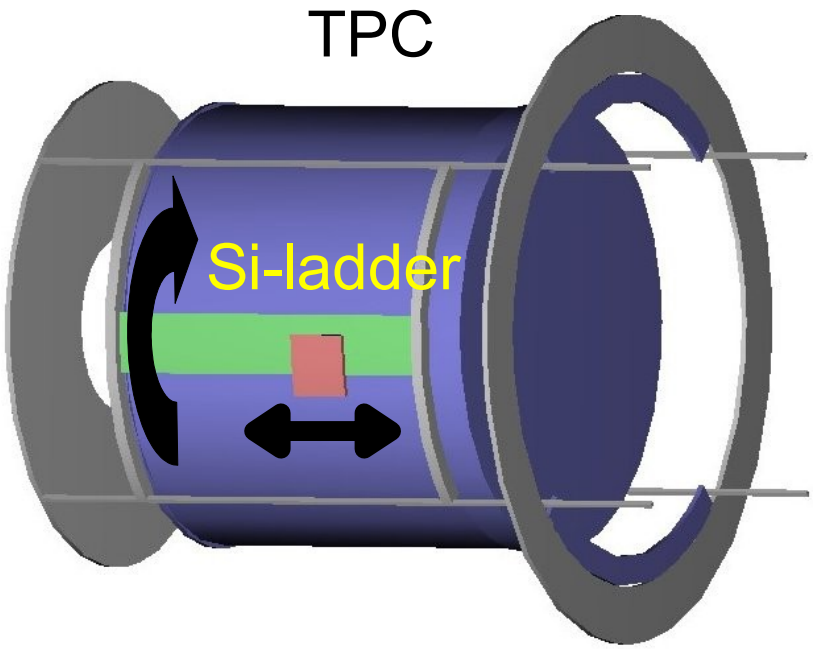
LP-TPC Support



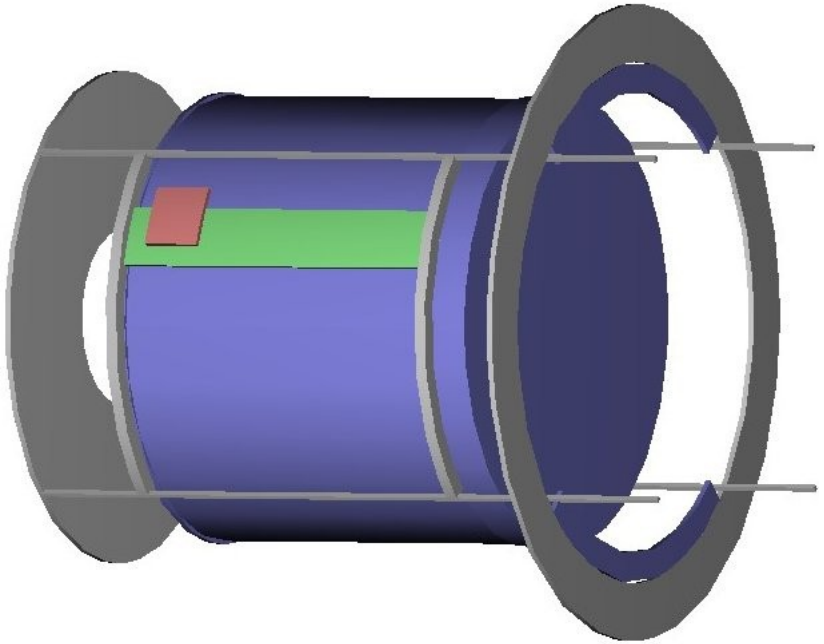
Si-Envelope



Si-Envelope

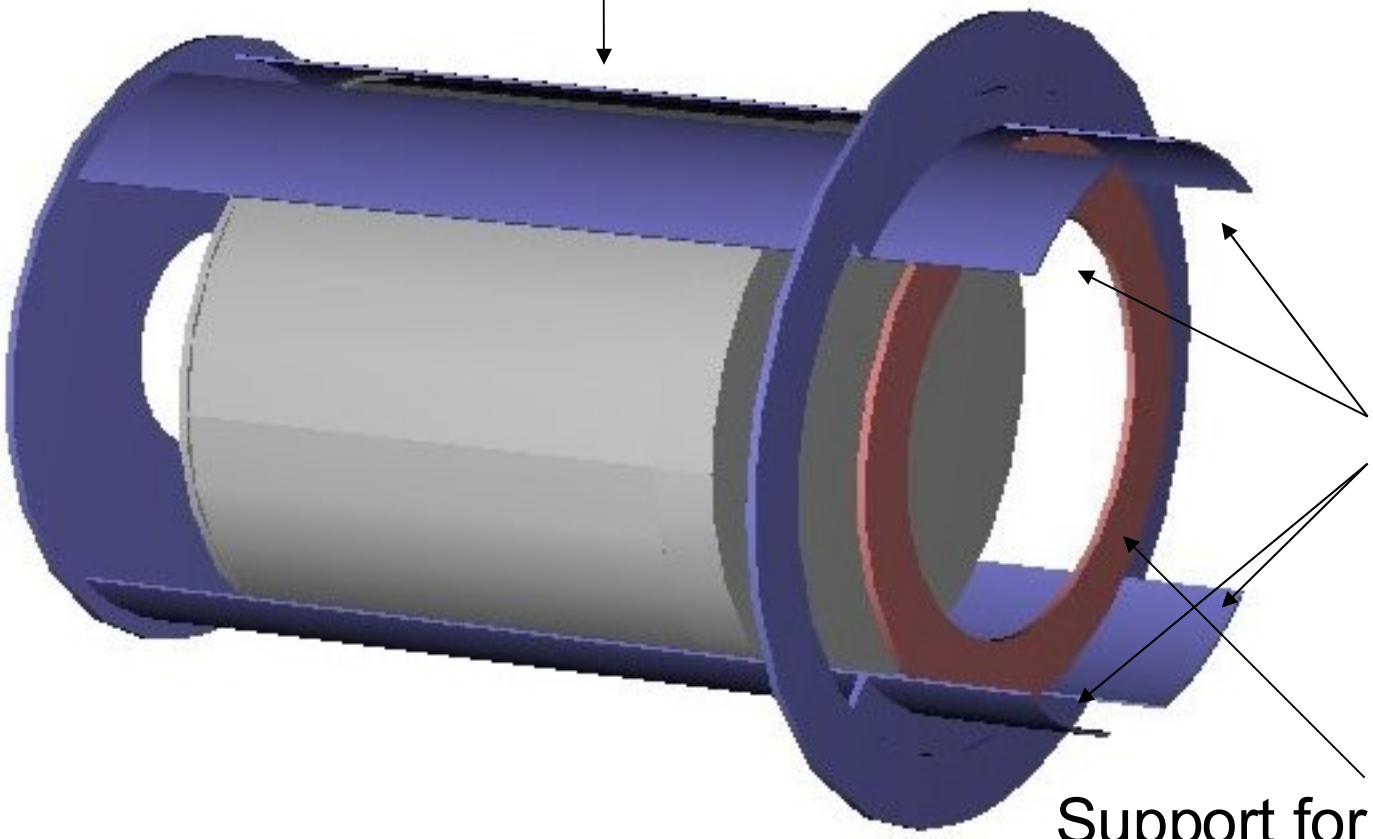


Si device: **limited** in size



LP-TPC Support

Space for Si ladder
(cosmic muon trigger setup)

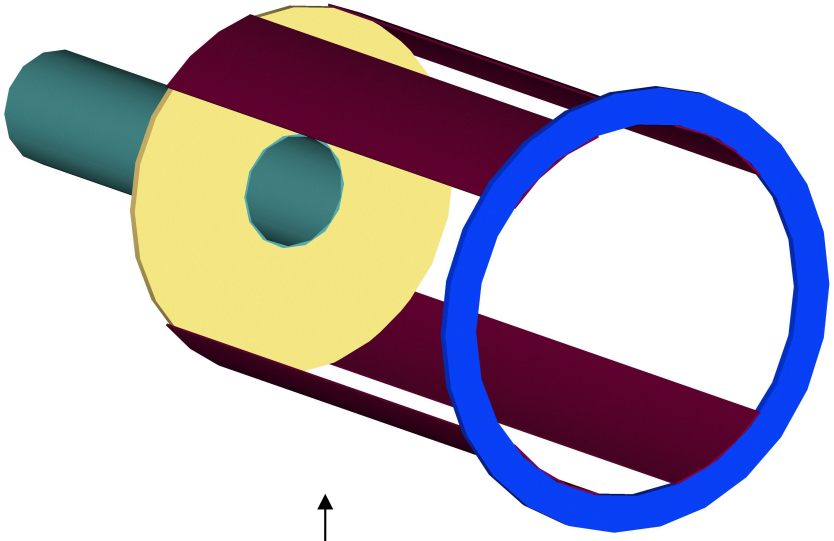


Support plates

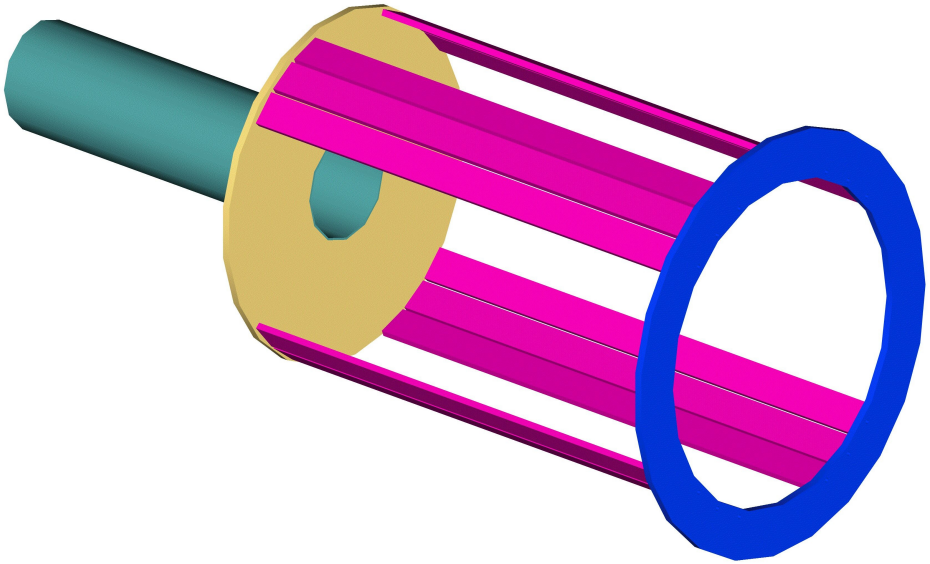
Support for electronics

LP-TPC Support

Alternative Al-support structure, depends upon stability

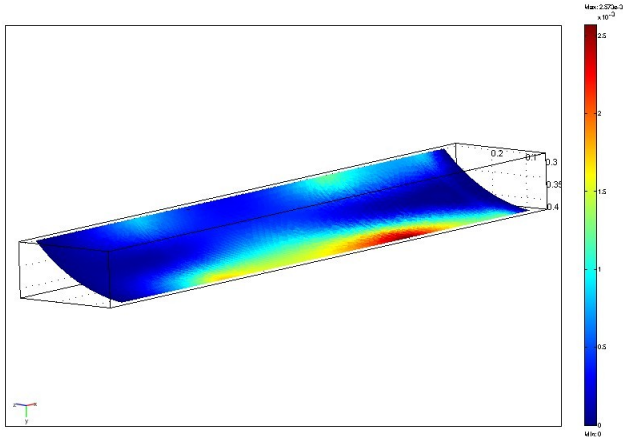


favorite structure

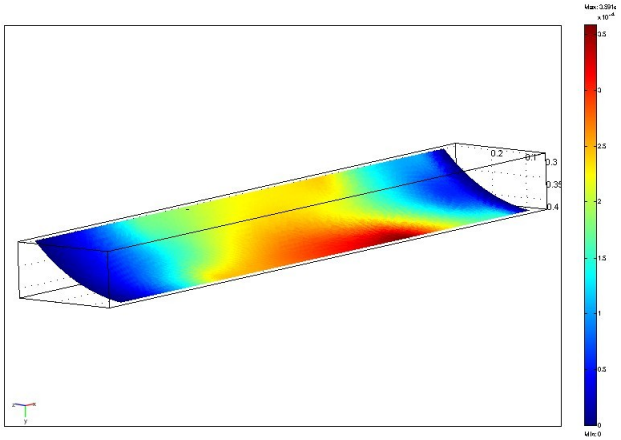


LP-TPC Support

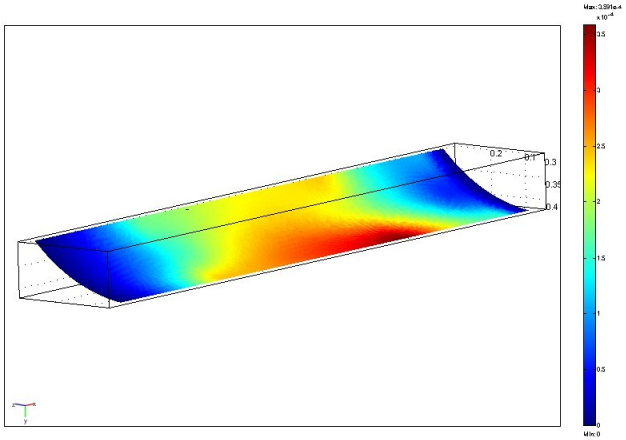
thickness: 1mm, ρ_{max}= 2.6mm



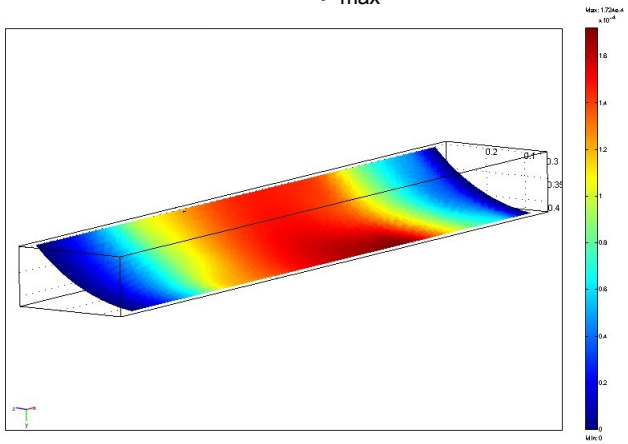
thickness: 2mm, ρ_{max}= 0.7mm



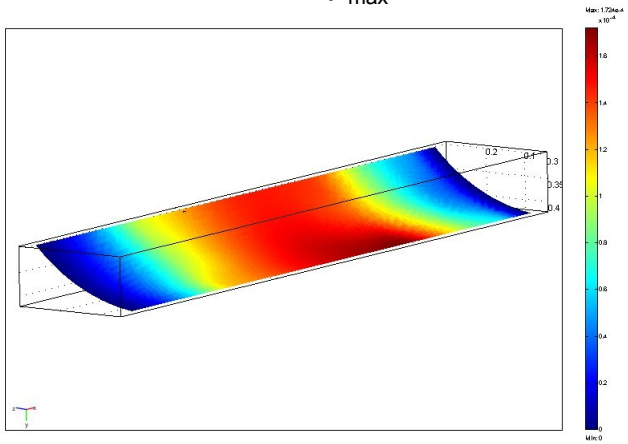
thickness: 3mm, ρ_{max}= 0.4mm



thickness: 4mm, ρ_{max}= 0.3mm



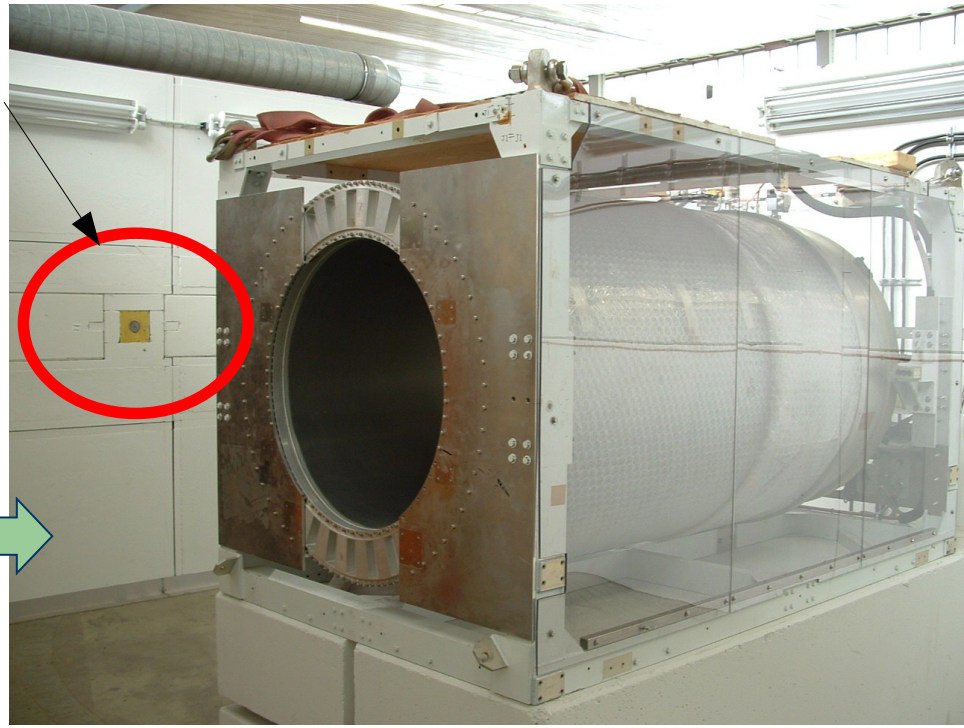
thickness: 5mm, ρ_{max}= 0.2mm



PCMAG Support

TPC will be adjusted
- horizontally
- vertically
- rotationally

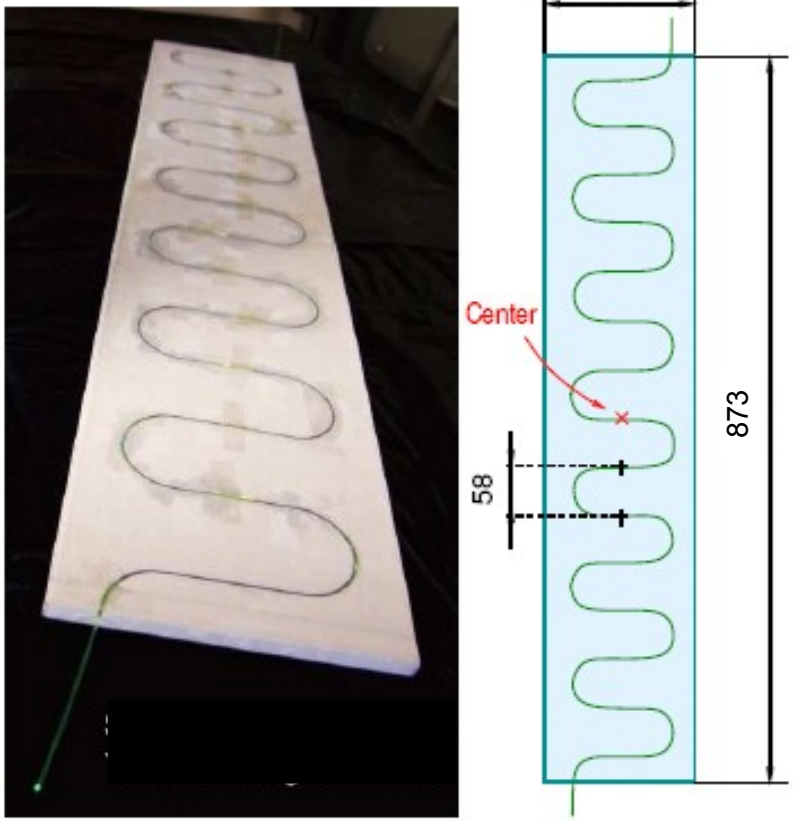
w.r.t. beam line

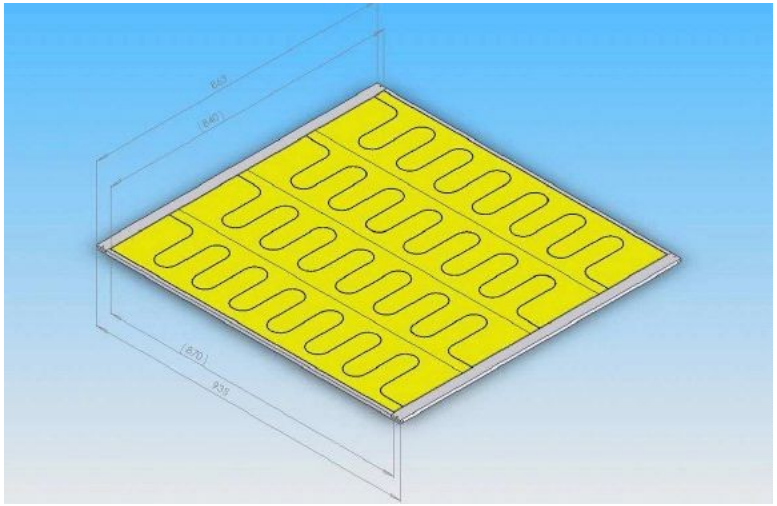


Problem: magnetizable components

Cosmic Trigger Setup

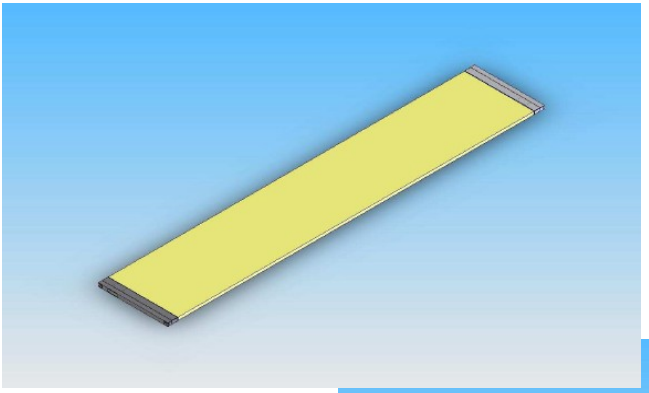
Scintillator produced by Uniplast in Vladimir (Russia)



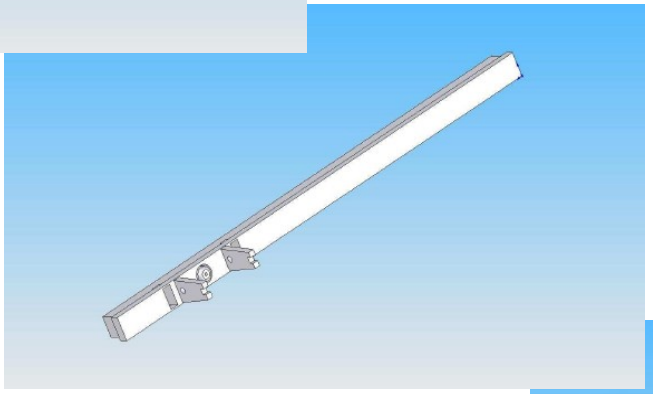


Plastic scintillator with white chemical reflector;
4 mm deep S-shape groove for WLS (ϕ = 1 mm);
WLS: Kurary Y11, double clad

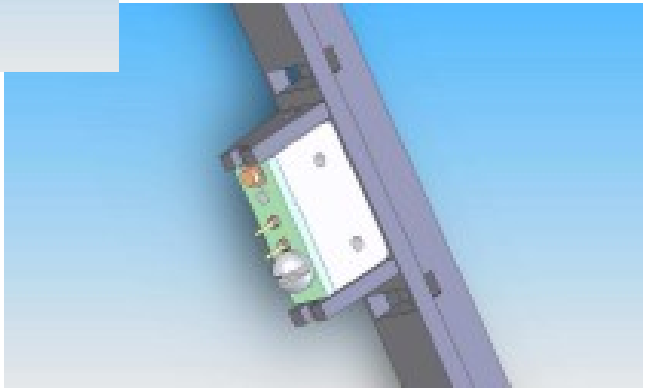
Cosmic Trigger Setup



Scintillator slab, sandwiched between two end-caps

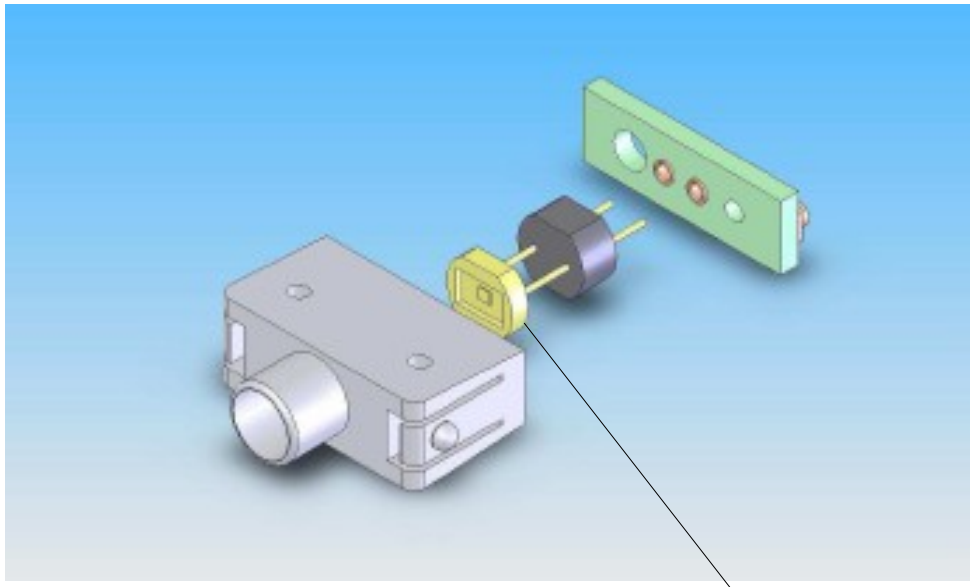


End-cap of a scintillator unit

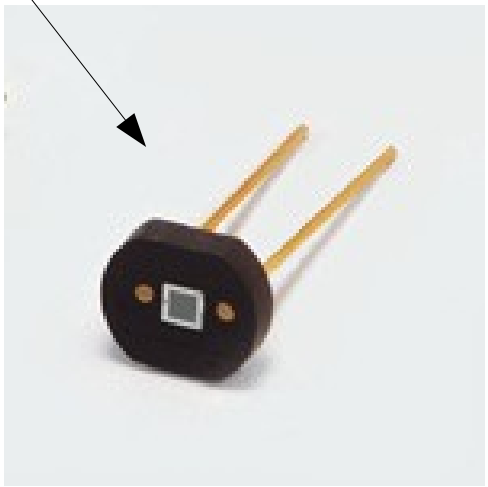


End-cap with connector in place

Cosmic Trigger Setup

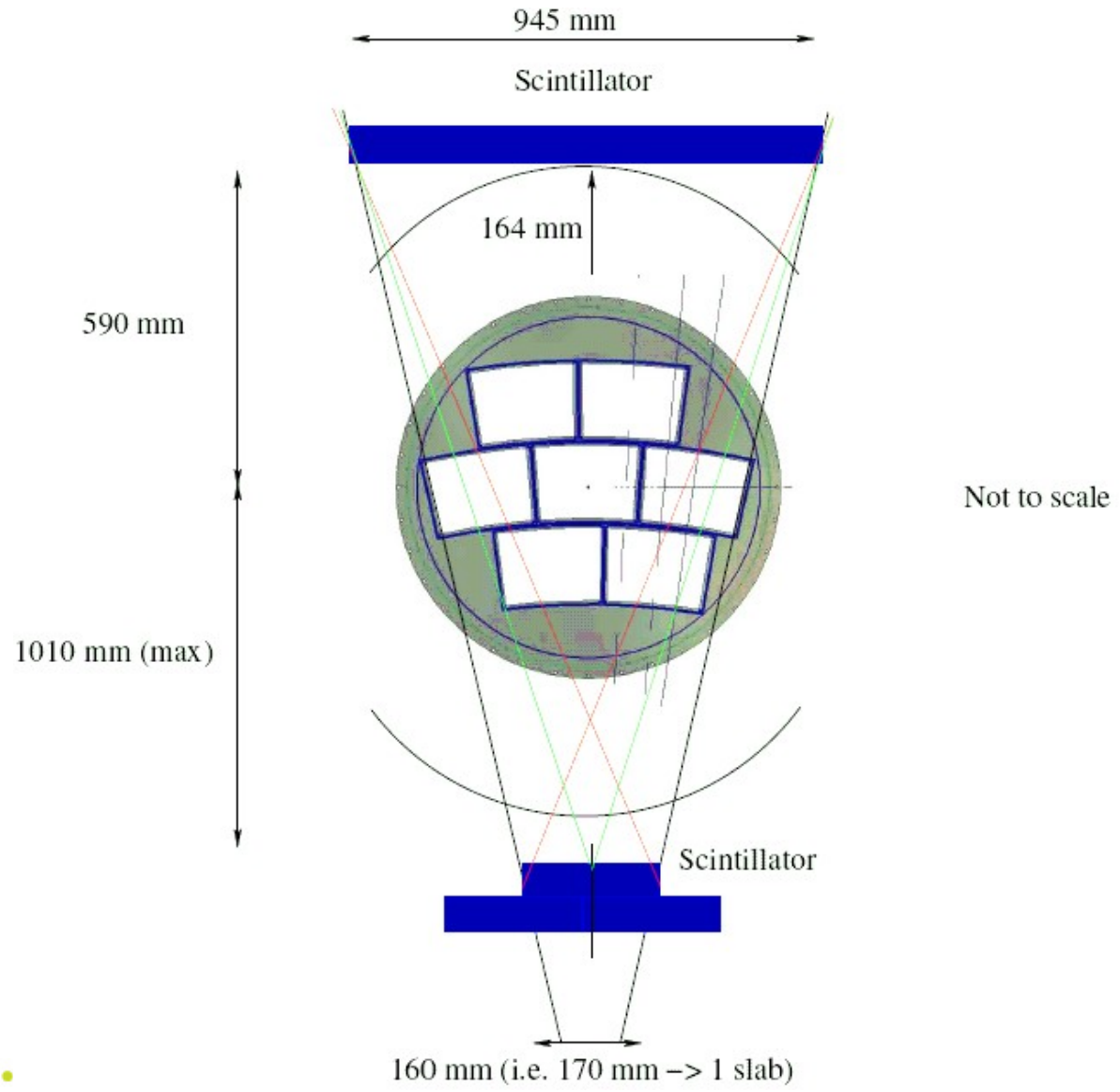


Exploded view of optical connector



MultiPhoton PixelCounter (MPPC): Active area 1 x 1 mm, pitch 100 µm, ceramic package

Cosmic Trigger Setup



Cosmic Trigger Setup

- Ordered 15 scintillator slabs → to be transported directly to Saclay
- Ordered 40 Hamamatsu Multi Pixel Photon Counter (MPPC, 100pixels, and the ceramic package)
- double-clad Y11 fiber (1 mm in diameter)
- Light tight aluminium box with holes for optical connectors
- Mounted on PCMAG frame and lifting table

PCMAG Safety

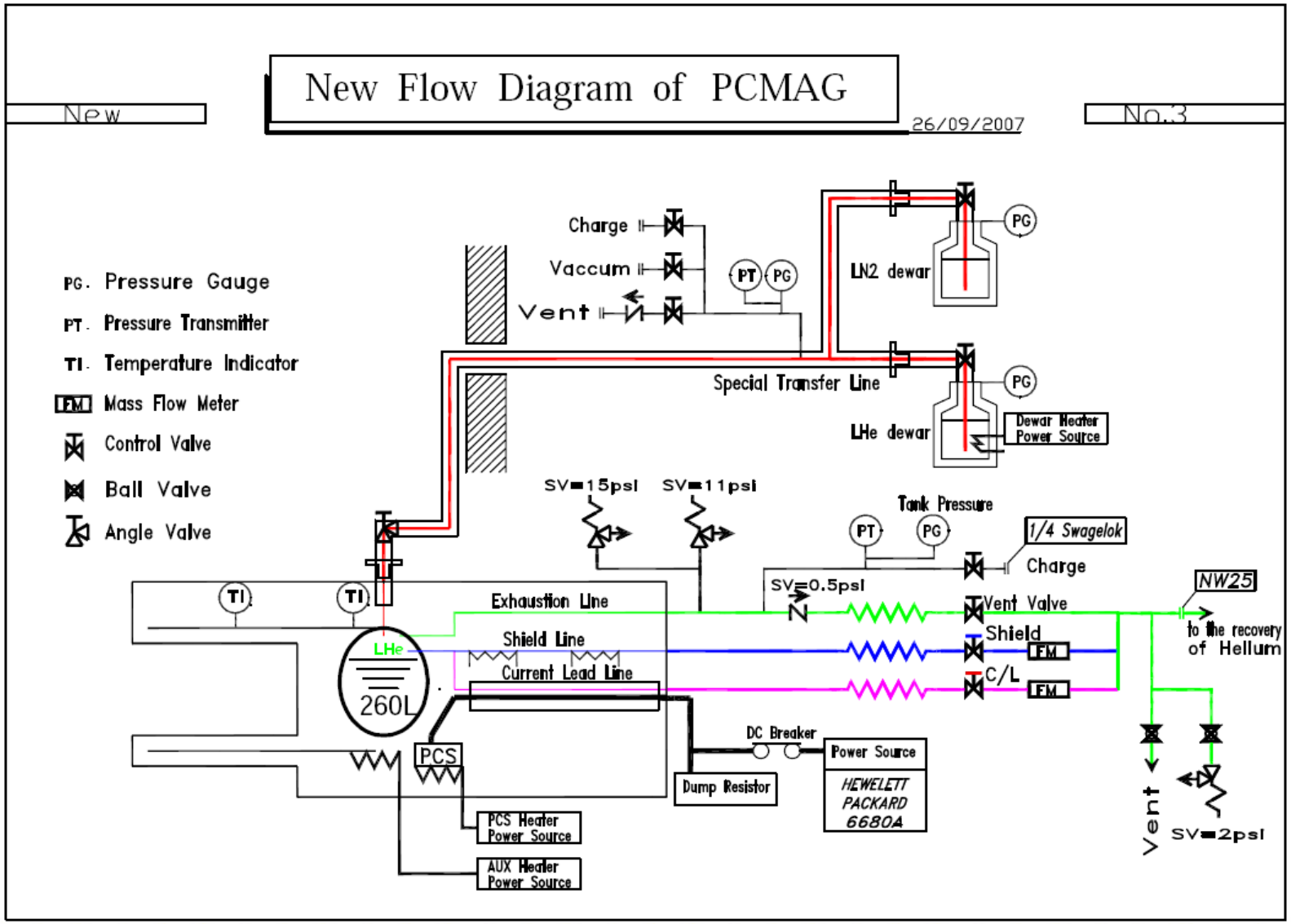
Exhausting He might cause a safety issue → back pressure / shared usage

Solution:

Increase exhaust line's diameter ?

PCMAG safety analysis ongoing

PCMAG Safety



Summary & Outlook

Integration on schedule:

- Testbeam T24 starting July 2008
- PCMAG successfully operated, field map, some modifications w.r.t. safety
- Field cage → Ralf DIENER
- Endplates / Amplification structures
- Support structure
- Trigger hodoscope → cosmic muon trigger studies
- Si envelope → Thomas BERGAUER
- Electronics / DAQ → Leif JöNSSON, Alexander KAUKHER, Ulf MJORNMARK