

## The TPC field cage



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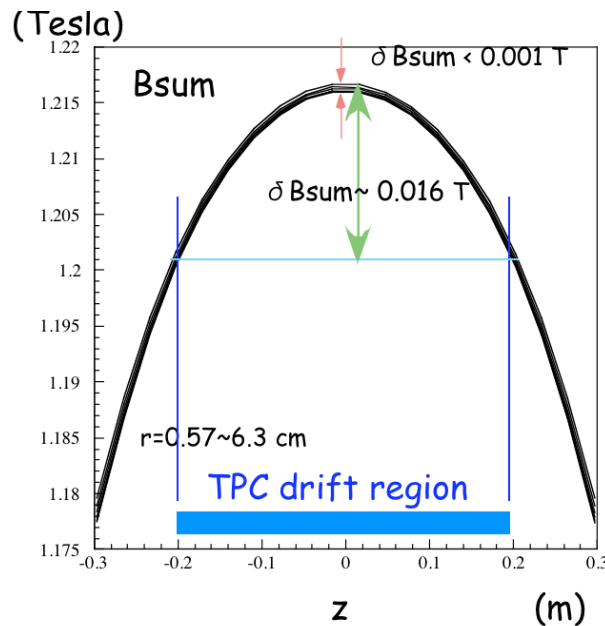
## The TPC field cage

- Task: Design, develop and build a field cage for a "Large TPC-Prototype" (LP) to be used for studies and development work towards a TPC at the ILC
- Size and boundary conditions are defined through PCMAG
  - ↳ Length: 60 cm , Diameter: 80 cm
- Field cage should be lightweight, stable and flexible
  - ↳ Composite will be used
- Field cage available until mid of 2007

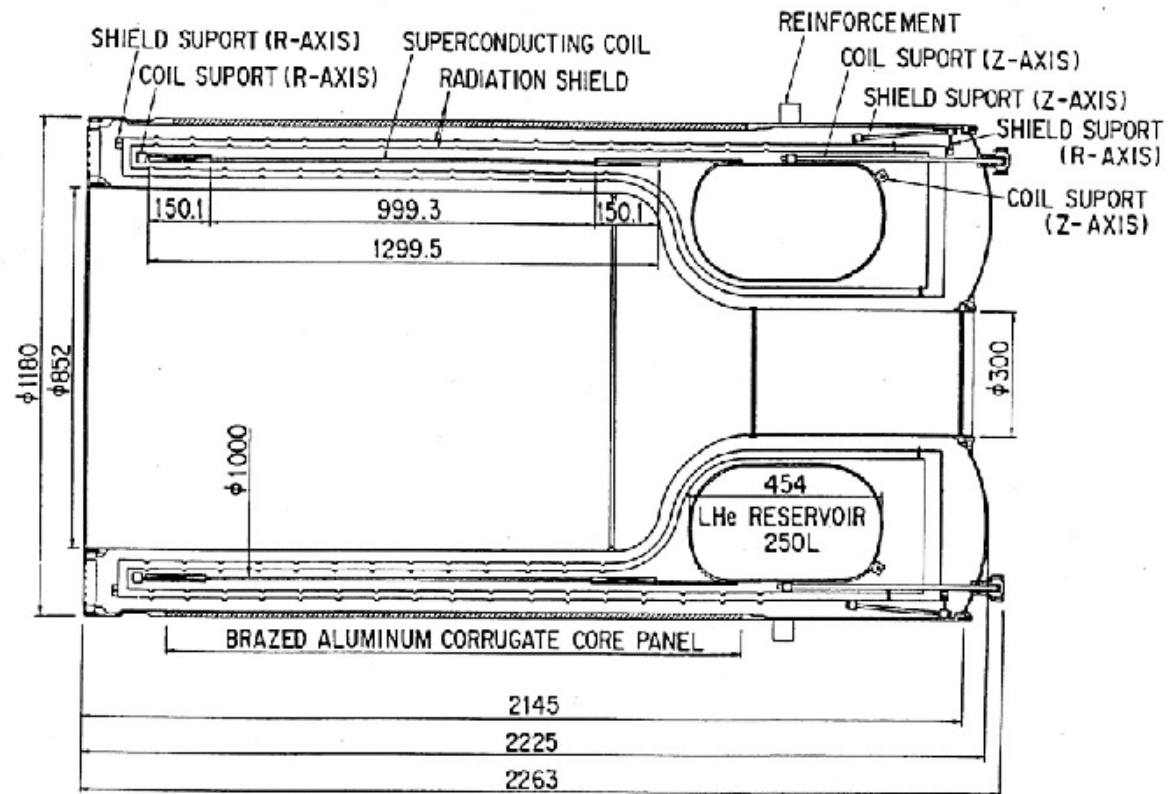
# PCMAG

- PCMAG will be installed in DESY test beam

- Diameter: 86 cm

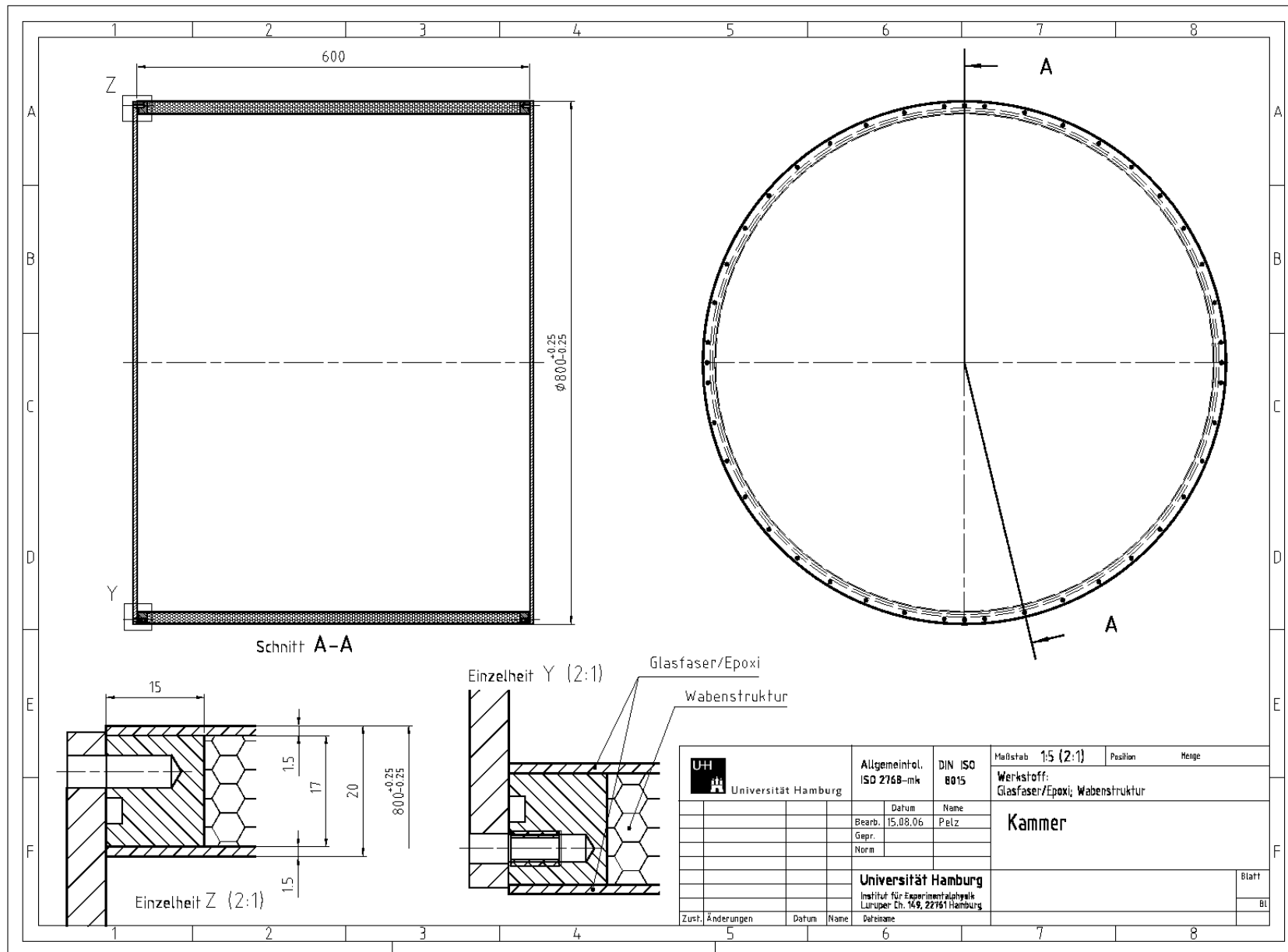


B calculation of S\_JACEE magnet, Sakamoto/Sugiyama saga univ.



BALLOON-BORNE EXPERIMENT WITH A SUPERCONDUCTION MAGNET SPECTROMETER, Akira Yamamoto, KEK, 01.12.94

# The TPC field cage construction plans

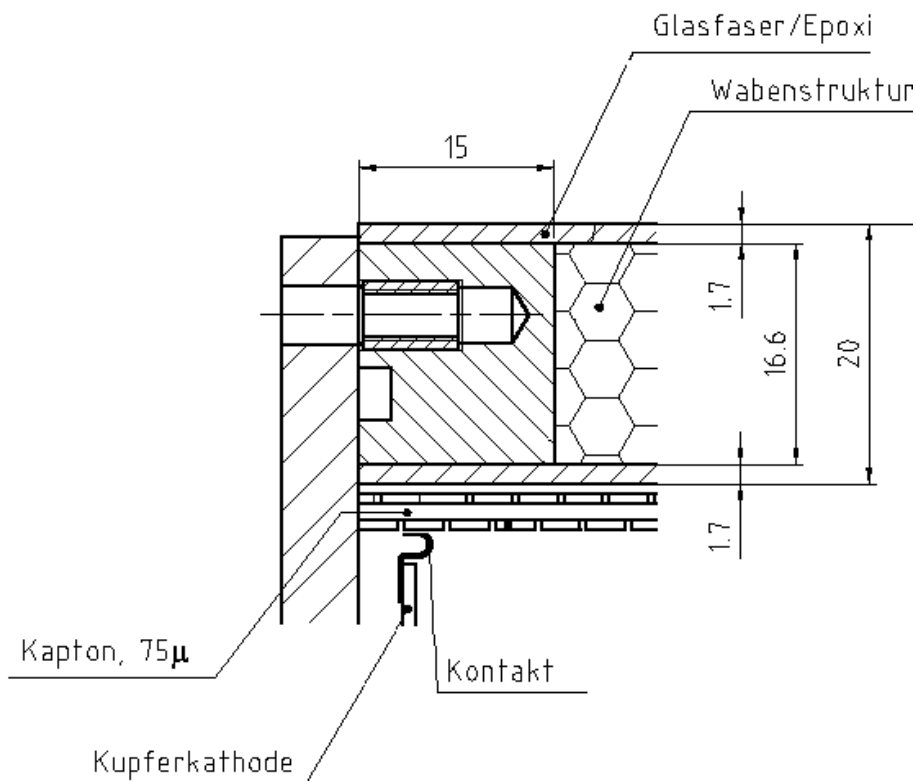


## Status

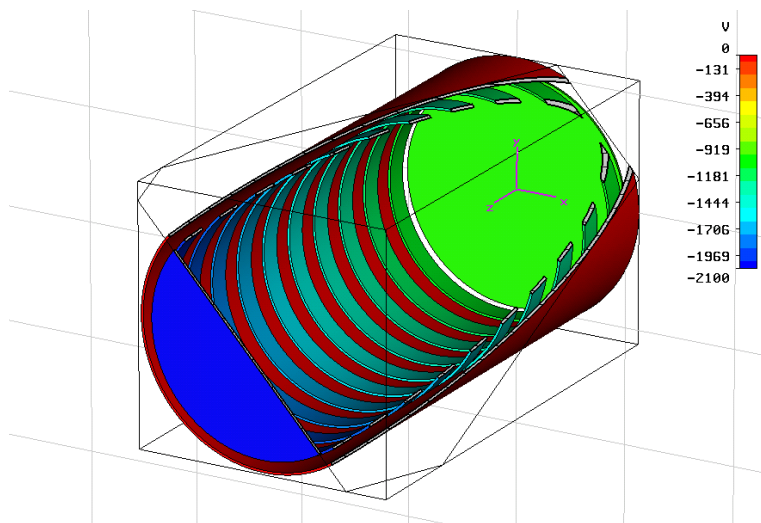
- Ongoing negotiations with industry concerning construction of the field cage
  - ↳ First acceptable cost offer
  - ↳ Construction details are under discussion (materials, accuracy, ...)
  - ↳ Share of work
  
- Design of field strips under investigation
  - ↳ 2.4 m × 0.6 m flexible circuit board with field strips needed
  - ↳ Electro-static calculations of the TPC to find optimal field strip design
  - ↳ Negotiations with industry are ongoing → production of flexible board of that size is feasible

## To be Optimized:

- Thickness of different layers and of the walls
  - ↳ Mechanical calculations will be done
- Materials of anode/cathode inlays
- Cathode and anode interfaces have to be defined
- Design of field strips
  - ↳ Field calculations were done



## Electrostatic field calculations

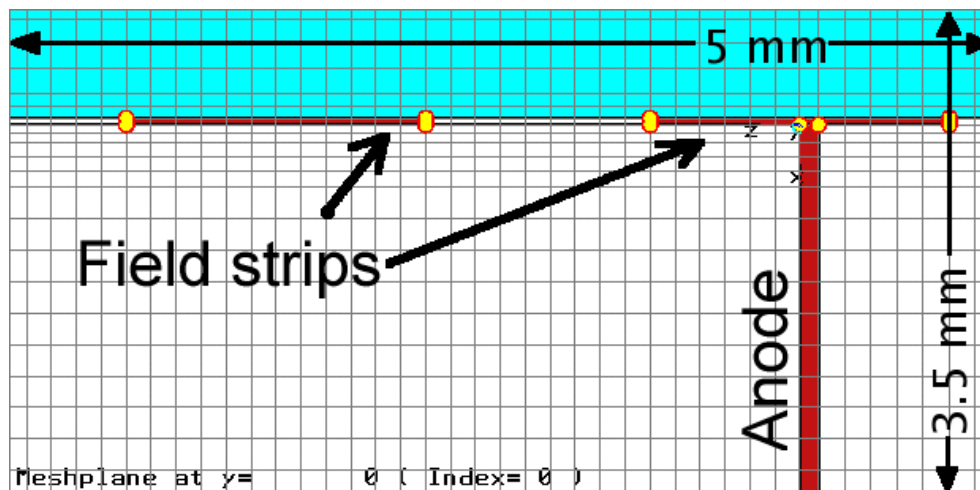


- Aim: calculate different field strip geometries to find optimal setup for the LP

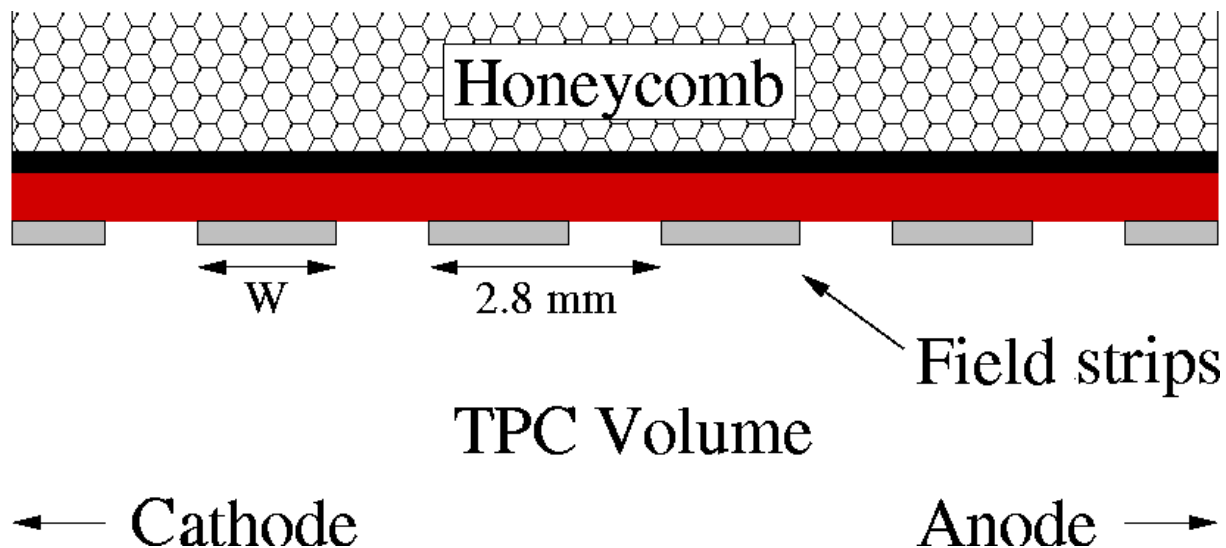
- ↳ Lost of sensitive volume?
- ↳ Field distortions?
- ↳ Strength of unwanted radial field components?

- Model for calculation:

- ↳ Rotational symmetry  
⇒ 2-dim model:
- ↳ Size: 40 cm × 60 cm
- ↳ Mesh:  $5 \cdot 10^6$  cells  
10-20 along strip

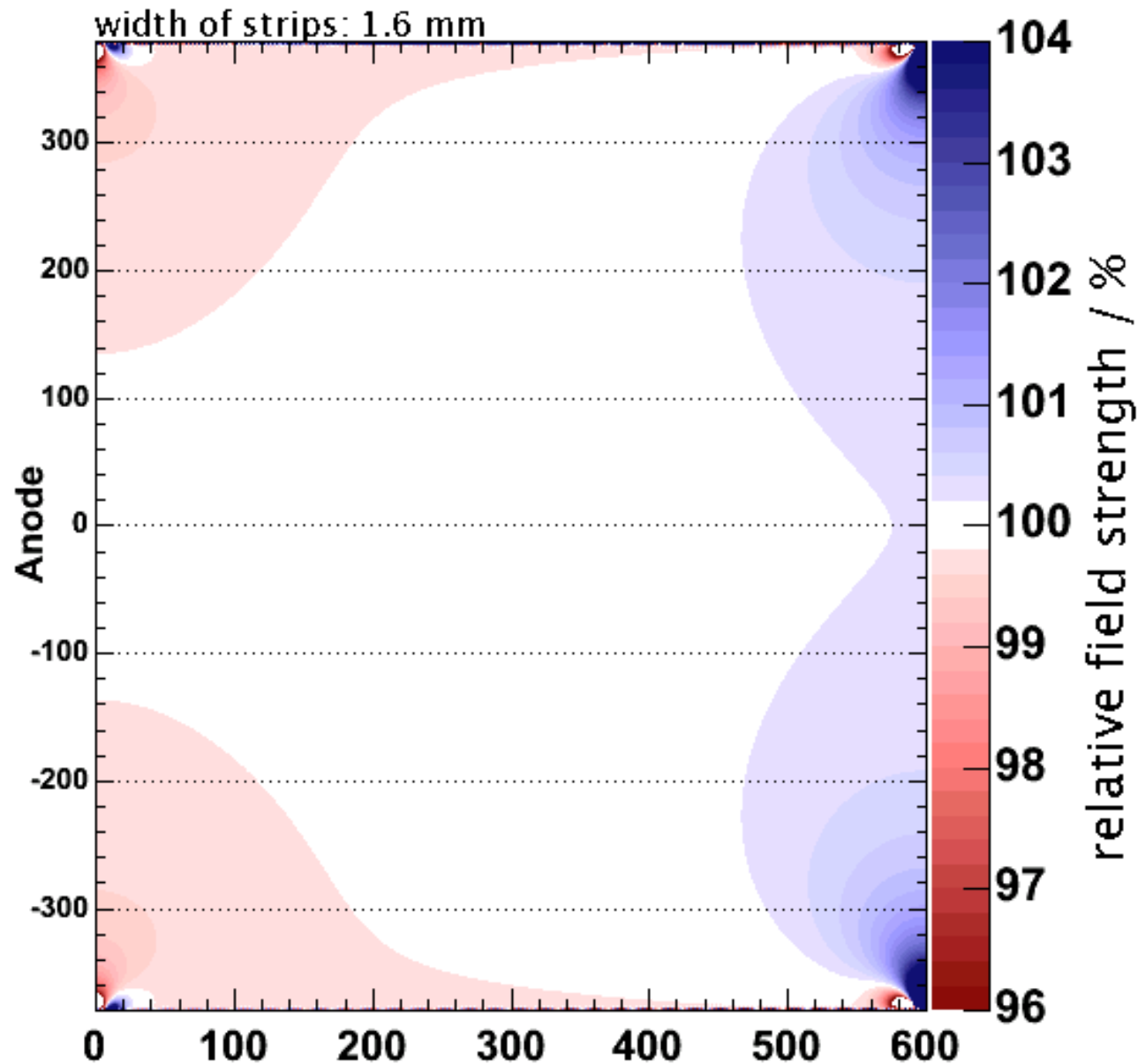


## One-sided field strips

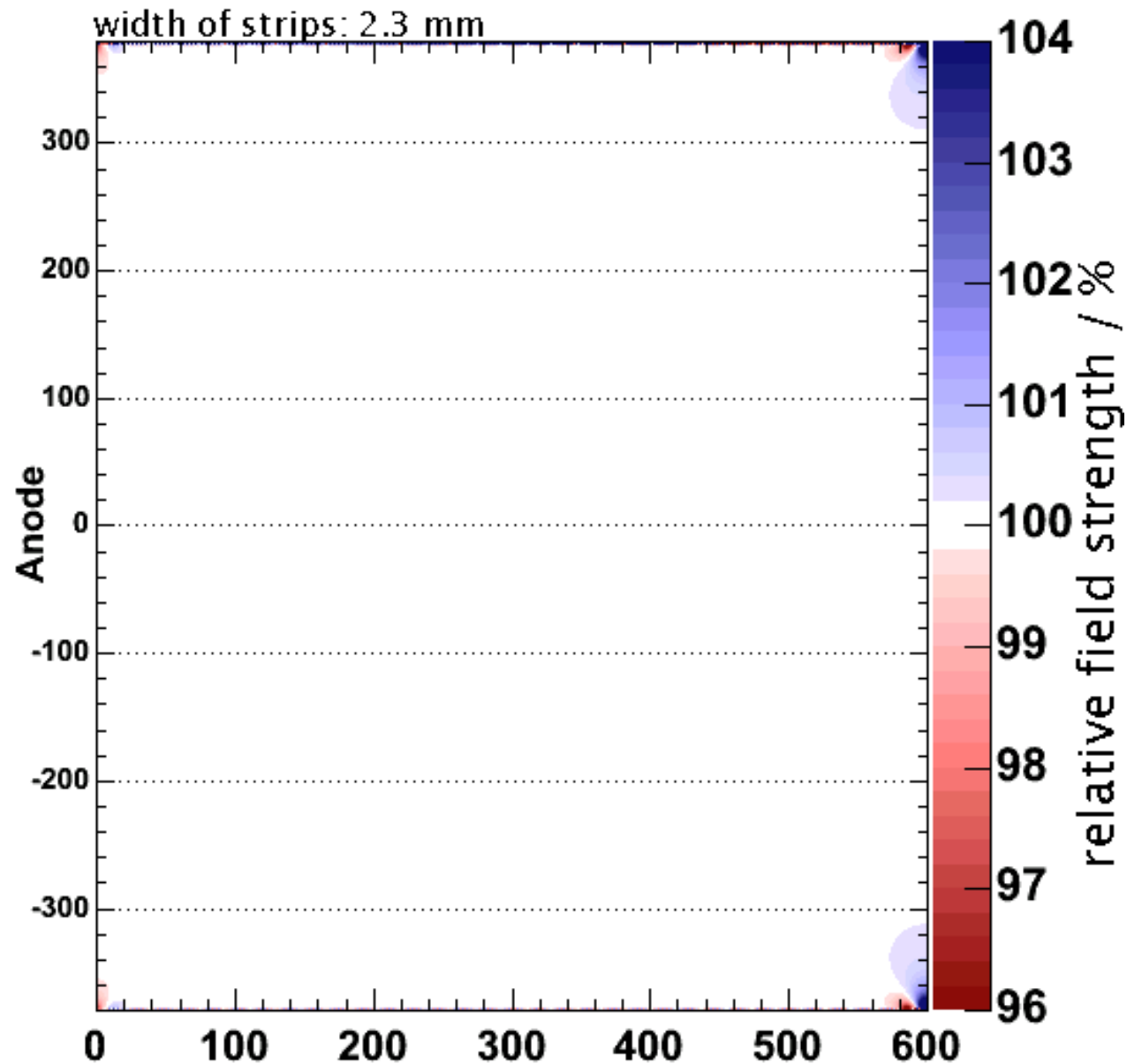


- Starting point: TPC prototype at DESY (Medi-TPC) has field strips with a width of  $w = 1.6 \text{ mm}$  (pitch  $2.8 \text{ mm}$ )
- Strips are connected by SMD-Resistors inside the chamber



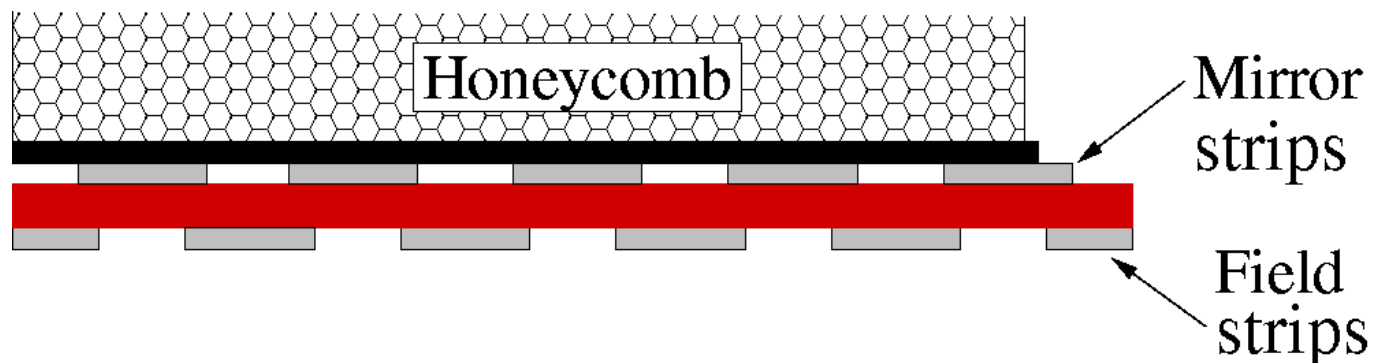


- Same design in the LP: field distortions at the anode and cathode  $> \pm 5\%$

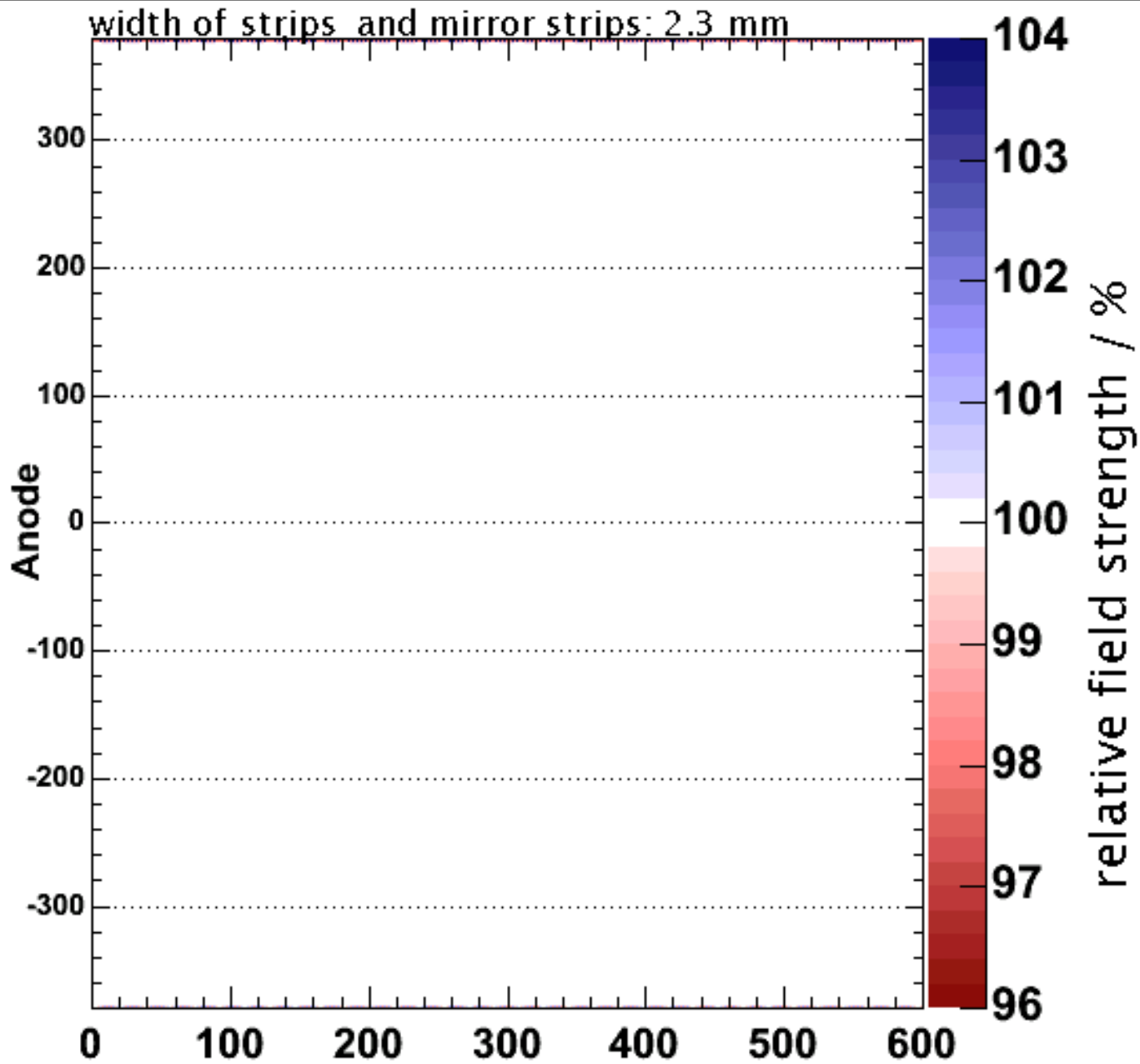


- increasing the width to 2.3 mm (keeping 2.8 mm pitch) reduces inhomogeneities

## Optimized design with mirror strips



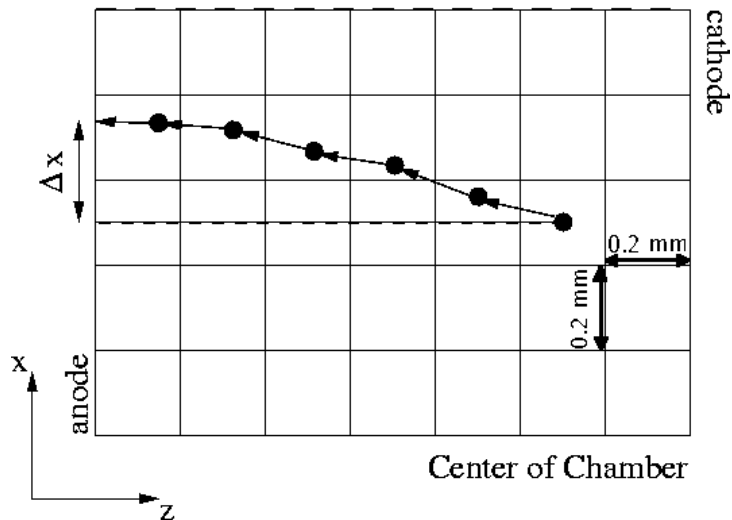
- To remove the inhomogeneities: mirror strips are placed behind the field strips
- Mirror strips have the intermediate potential of two strips in front
- Foil will have a thickness of  $75 - 100 \mu\text{m}$



# Estimating electron drift systematics

Wall of Chamber / GND

Fieldstrips

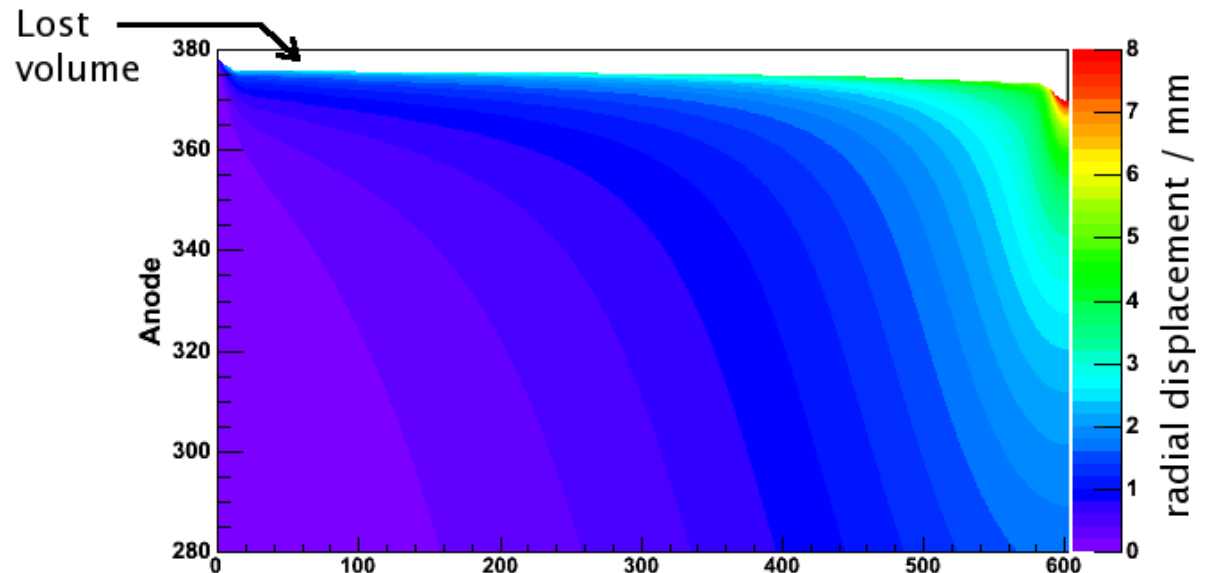


- To estimate the systematics of different strip geometries, electron drift is simulated

- ↳ Radial displacement
- ↳ Lost of sensitive volume at the corners

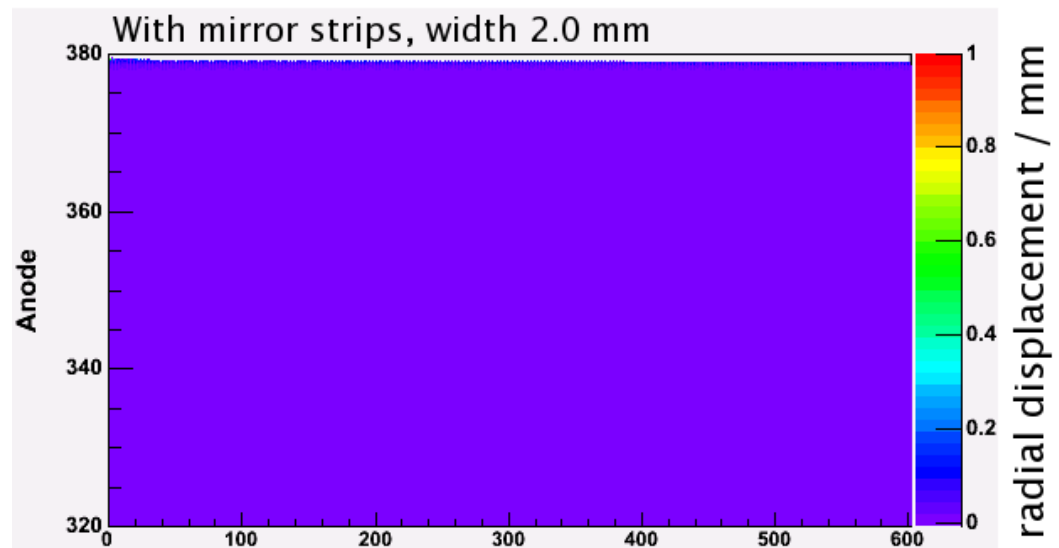
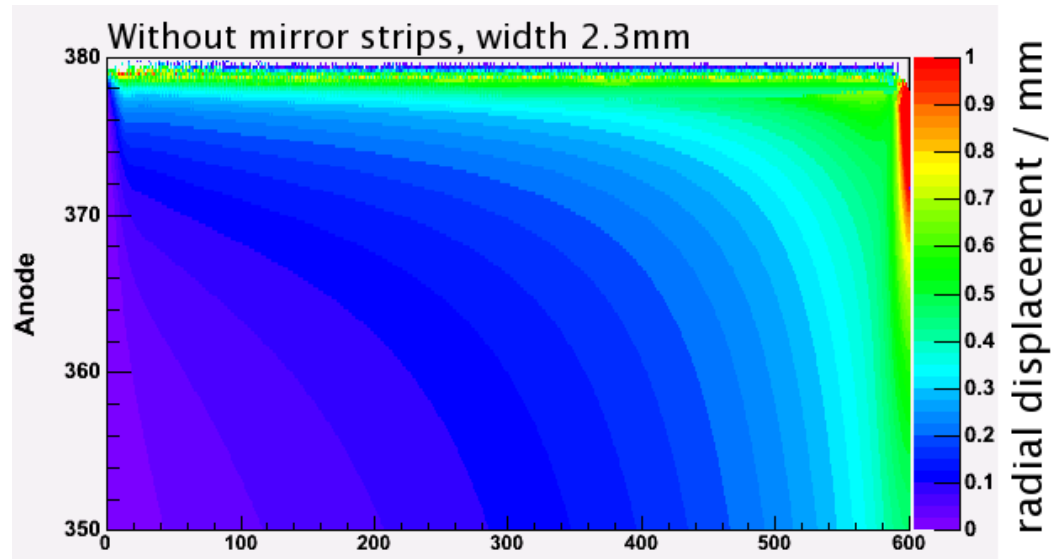
- One-sided strips, width 1.6 mm:

- ↳  $\approx 1$  cm sensitive volume is lost
- ↳ large radial displacement (4 mm) in drift volume

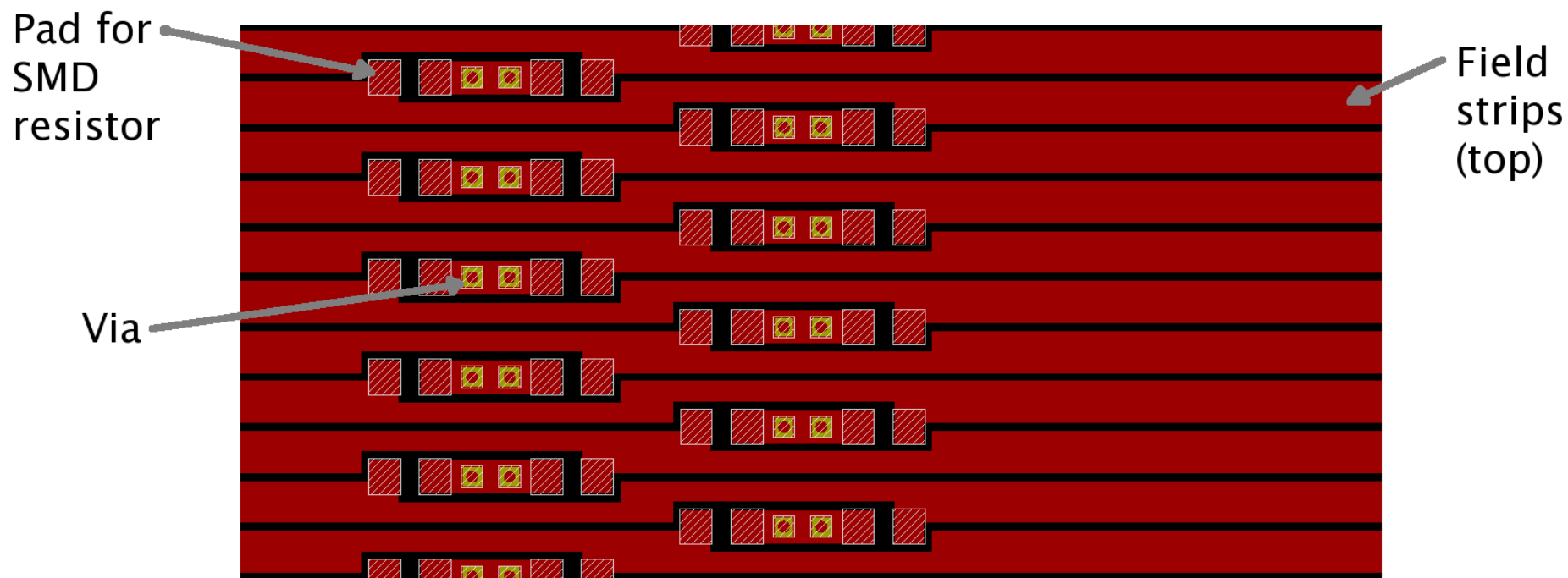


## Comparison with and without mirror strips

- No mirror strips (2.3 mm):
  - ↳ Radial displacement of order 1 mm
- With mirror strips:
  - ↳ Radial displacement  $\ll 1$  mm
  - ↳ Width of strips can be reduced to 2 mm if necessary
- Still to calculate:
  - ↳ field with  $\pm 2\%$  resistors  $\Rightarrow$  potentials get modified
  - ↳ longitudinal displacement  $\Rightarrow$  drift speed needed
  - ↳ magnetic field

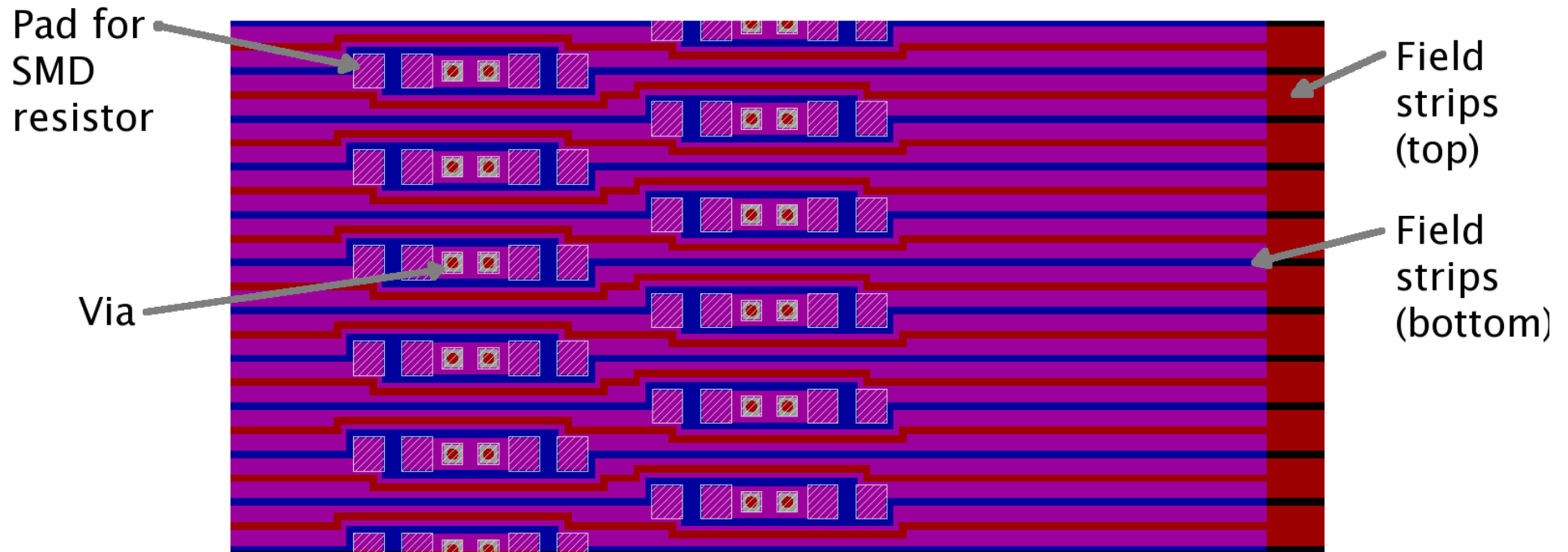


## Layout of the field strips



- SMD-Resistor chain to divide the potential inside the chamber
- Connection through the foil by vias
- 2.8 mm-pitch

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## Outlook

- Construction of field cage is planned to start at beginning of 2007
- Mechanics:
  - ↳ Static calculations planned to optimize field cage mechanics
  - ↳ Construction issues (choices of materials,... ) under discussion
  - ↳ Anode and cathode interfaces have to be defined
- Electrostatics
  - ↳ Mirror strips first choice
  - ↳ Test samples of field strip foil ordered
  - ↳ Negotiations with industry to deliver a foil carrying the field strips are ongoing
  - ↳ Foils with field strips available in January 2007 planned
- Having the field cage available mid of 2007 seems feasible