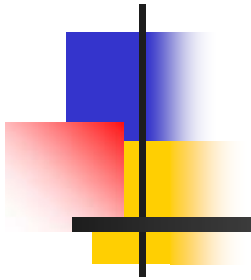


Progress on Yoke Design

Uwe Schneekloth

DESY

12.12.2008

Space between Barrel and End-cap

Presented in Chicago

- Foreseen gap between barrel and end-cap 25mm
- Rough estimate of end-cap E/HCAL cables (C.Clerc)
  - Surface of sensors ECAL: each EC is ¼ of full barrel
  - Sensors HCAL: each EC 40% of full barrel
  - → area 0.253 m^2 x 2 (for installation, tolerances)
  - → space (thickness) 20mm without muon chambers and ETD
  - Plus about 10mm for hard stops

  → Need at least 30mm
  - Will increase stray field
- Should ask components to reduce their cables a much as possible

Progress

- Large difference between ECAL and HCAL cables was due to different assumptions
  - HCAL with concentration at module level needs about 4 x ECAL cable space
  - Cable cross section smaller. In total about 7mm for routing between B and EC
  - Foreseen gap of 25mm should be fine

  - Some concern by A. Herve concerning mechanical tolerances

B Field Calculations (Chicago)

CST EM Studio 3 D calculations (A.Petrov)

- Now variable mesh size, 3 to 4 10^6 cells

Opera 2 D calculations (B.Krause)

Yoke segmentation (as in reference detector note)

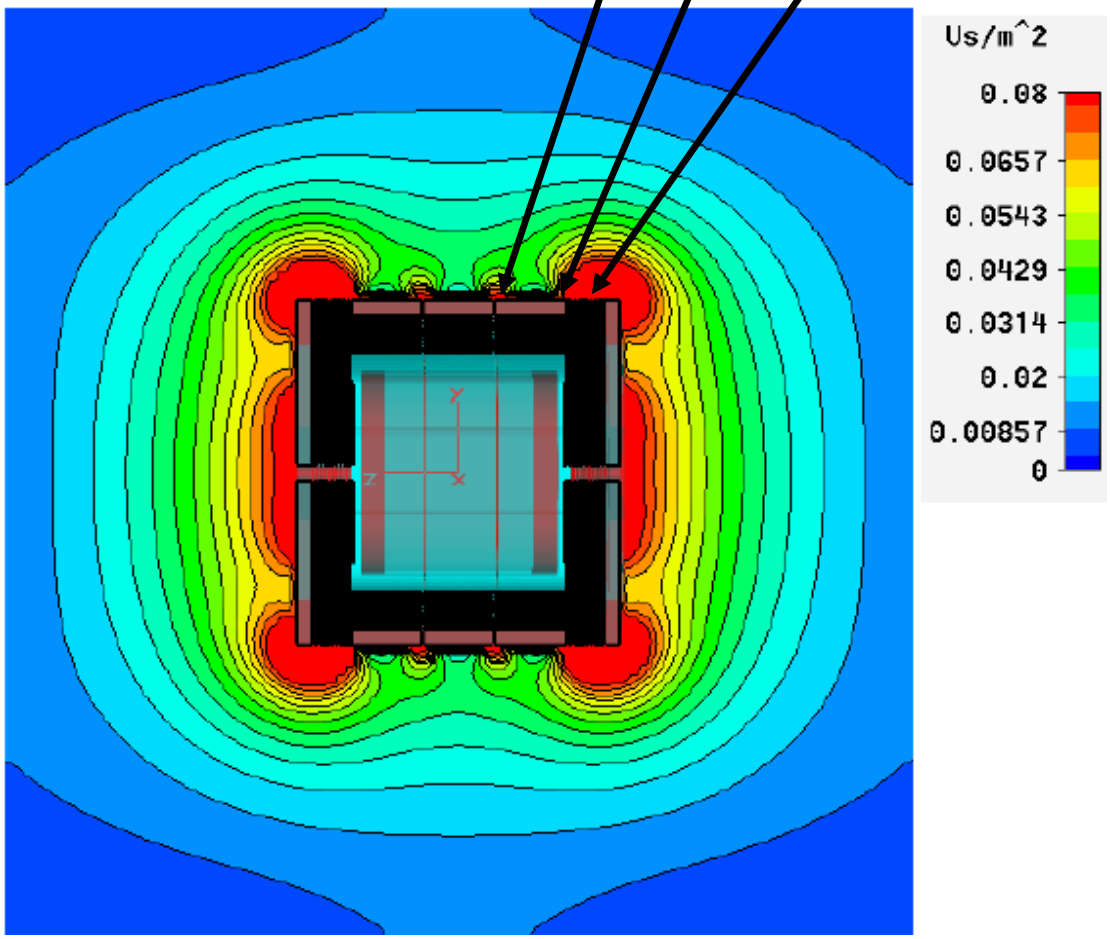
- 100mm field shaping plate only end-cap
- 10 x (100mm + 40mm gap)
- n x (560mm + 40mm gap)

Chicago MDI meeting:

- Goal <50 G at 15m from beam line

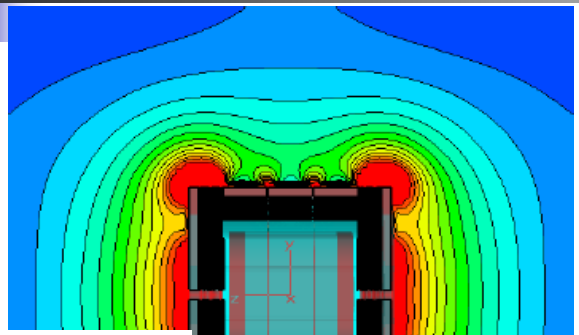
Stray Field Calculations (Chicago)

Central field 3.5 T gaps 50 25 40mm



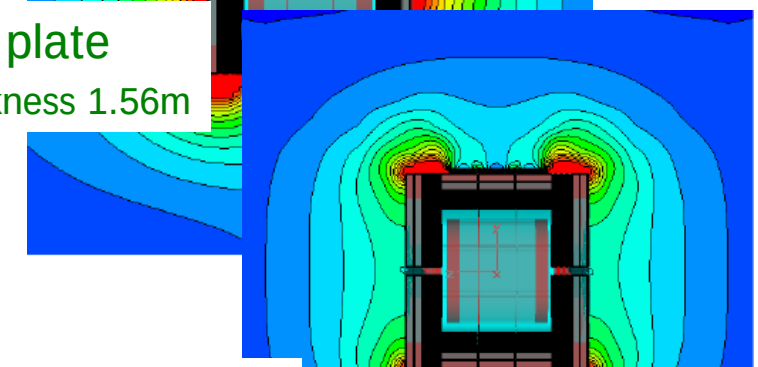
Stray Field Calculations (Chicago)

3.5 T



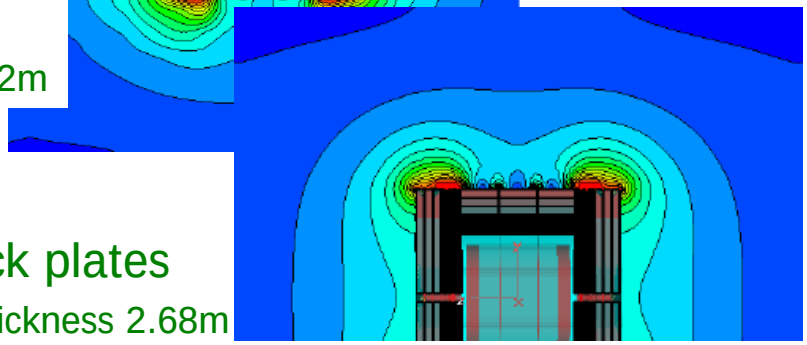
1 thick plate

iron thickness 1.56m



2 thick plates

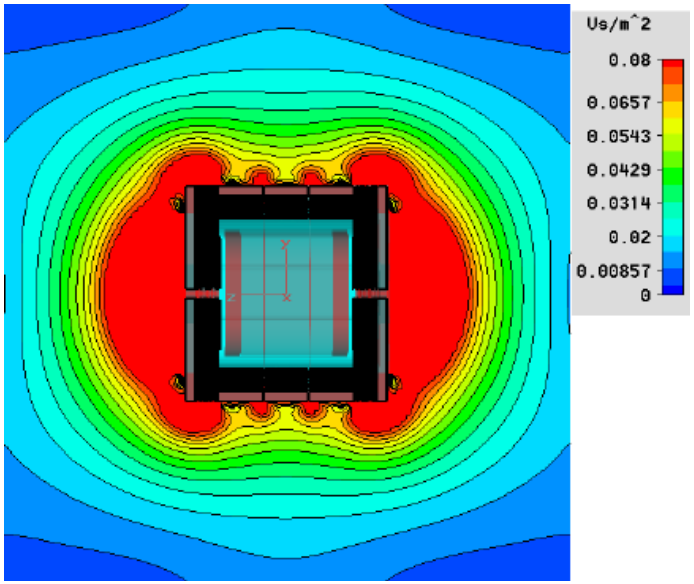
iron thickness 2.12m



3 thick plates

iron thickness 2.68m

4 T



Stray Field Calculations (Chicago)

Stray field at distance from beam line (y) and distance from iron yoke (d)

central field 3.5 T

CST EM Studio (A.Petrov)

iron yoke	1 thick plate		2 thick plates		3 thick plates	
B (T)	3.6		3.7		3.6	
z (m)	0	5.4	0	5.4	0	5.4
B stray (G)	y (m)	y (m)	y (m)	y (m)	y (m)	y (m)
200	11.5	11.8	7.1	11.8	7.7	11.3
100	16	15.1	14.1	15.8	13.4	13.9
	d (m)	d (m)	d (m)	d (m)	d (m)	d (m)
200	5	5.3	0	4.7	0	3.6
100	9.5	8.6	7	8.7	5.7	6.2

Stray Field Calculations (Chicago)

Stray field at distance from beam line (y) and distance from iron yoke (d)

central field 4 T

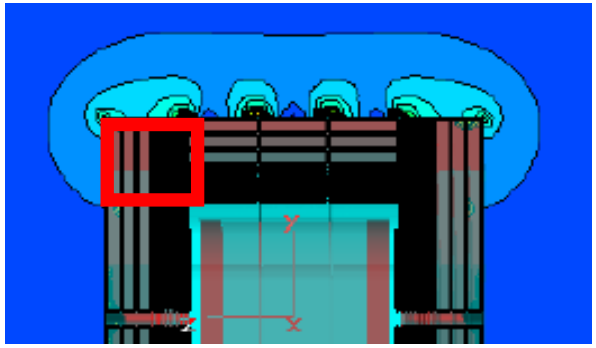
CST EM Studio (A.Petrov)

iron yoke	1 thick plate	
B (T)	3.9	
z (m)	0	5.4
B stray (G)	y (m)	y (m)
200	13.4	13.1
100	~ 18	~ 17
	d (m)	d (m)
200	6.9	6.6
100	~ 11.5	~ 10.5

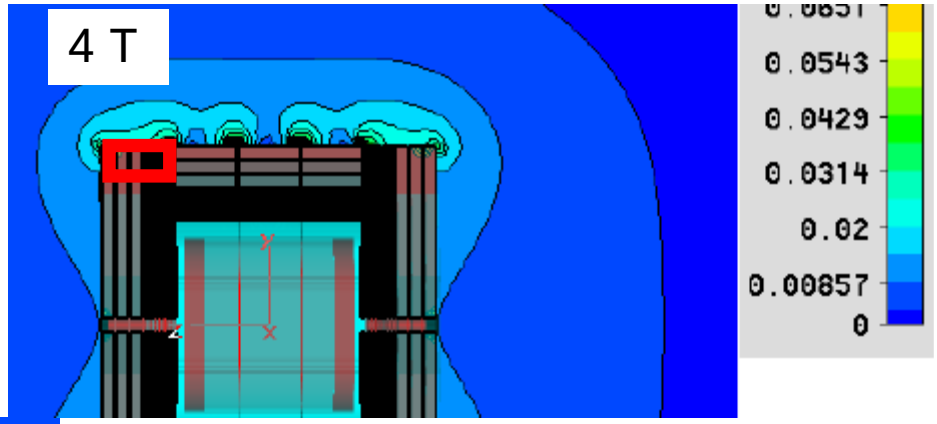
Stray Field Calculations

3.5 T

gaps filled

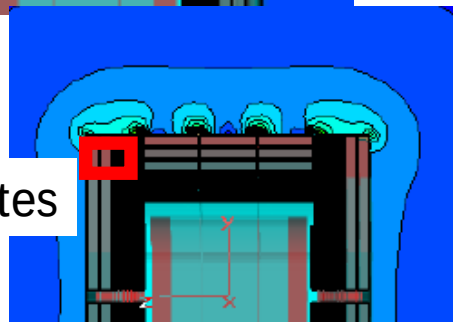


4 T



gaps partly filled

gaps partly filled, EC 2 plates

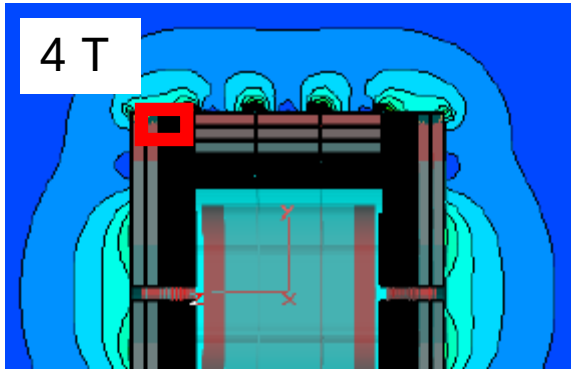


Update

iron thickness 2.68/2.12m

total thickness 3.16/2.56m

4 T



Stray Field Calculations

Chicago central field 3.5 T → update 4 T

iron yoke	3 thick plates		3 thick plates EC filled		3 thick plates EC partly filled		3/2 thick plates EC partly filled		3/2 thick plates EC partly filled	
B (T)	3.6		3.6		3.6		3.6		4	
z (m)	0	5.4	0	5.4	0	5.4	0	5.4	0	5.4
B stray (G)	y (m)	y (m)	y (m)	y (m)	y (m)	y (m)	y (m)	y (m)	y (m)	y (m)
200	7.7	11.3	7.6	7.9	7.6	7.9	7.6	8.2	7.6	8.4
100	13.4	13.9	10	10.3	10	10.3	10	10.3	10.5	10.6
50							13.2	12.6	13.7	13.2
	d (m)	d (m)	d (m)	d (m)	d (m)	d (m)	d (m)	d (m)		
200	0	3.6	0	0.3	0	0.2	0	0.5	0	0.7
100	5.7	6.2	2.3	2.6	2.3	2.6	2.3	2.6	2.8	2.9
50							5.5	4.9	6	5.5

Stray field < 50G at 15m from beam line for 4 T.

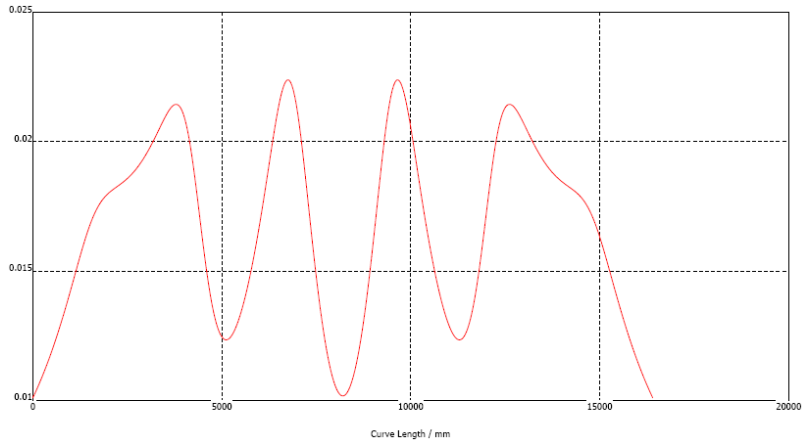
Limit as discussed in Chicago MDI meeting.

Stray Field Calculations (Chicago)

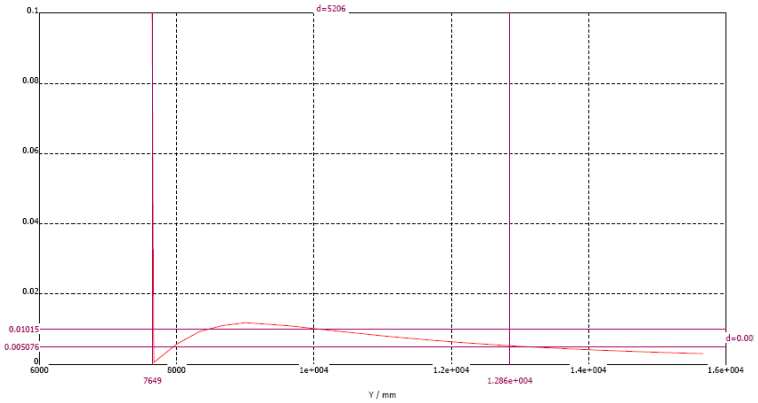
Central field 3.5 T

Gaps partly filled

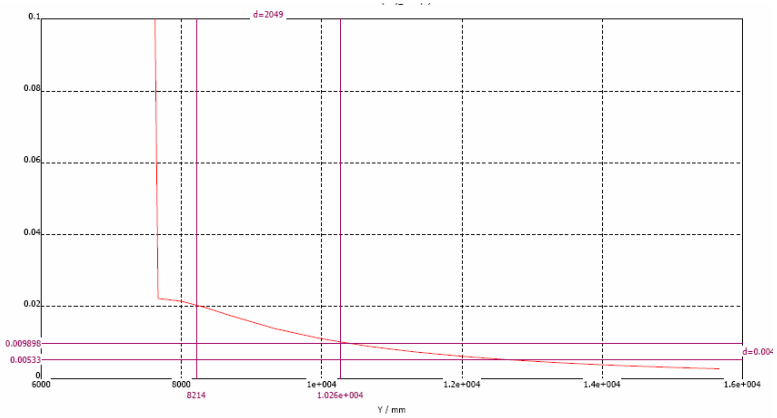
B 0.8m from iron yoke vs. z



B vs. y at z = 0



B vs. y at z = 5.425m



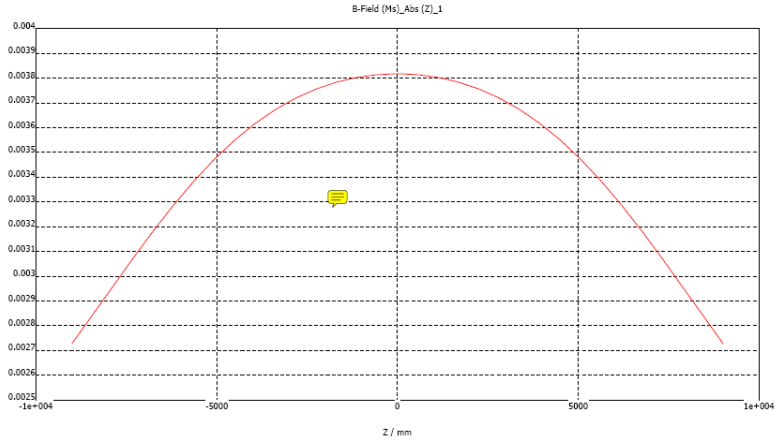
Stray Field Calculations

Central field 4 T

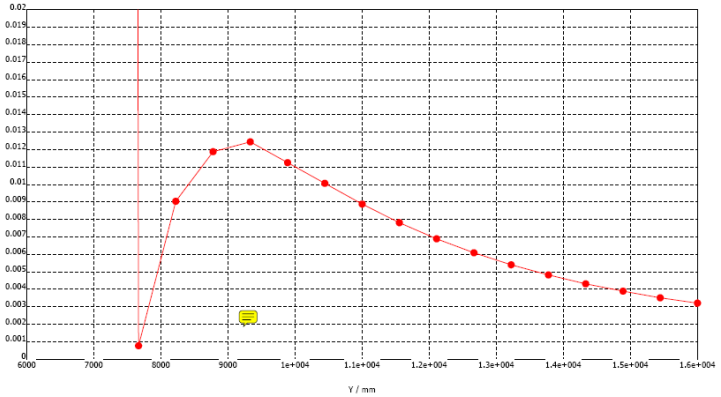
Gaps partly filled

B 15m from beam line vs. z

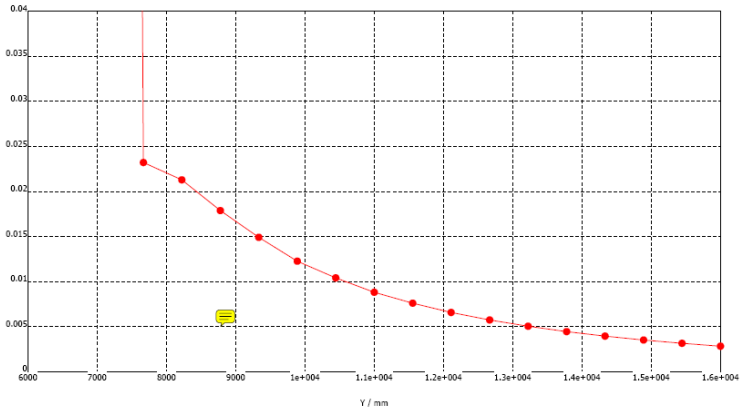
40G



B vs. y at z = 0



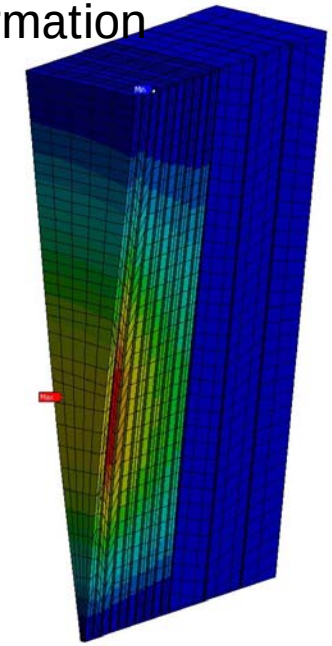
B vs. y at z = 5.425m



Mechanical Design of End-Cap

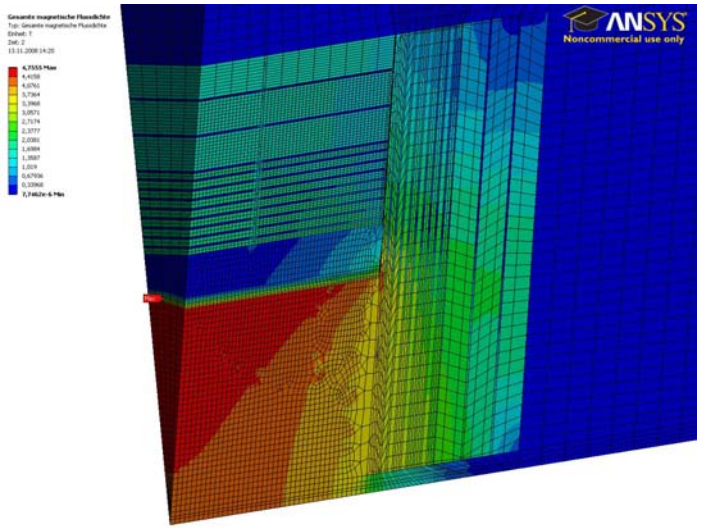
Chicago Preliminary end-cap deformation C.Martens, M.Harz

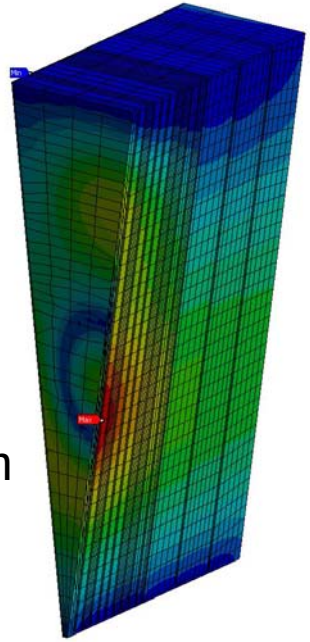
ANSYS calculations



Fixed at outer and
inner radius
max. deformation 66mm

B-field





Radial rip in
addition
max def 1mm

Next steps:

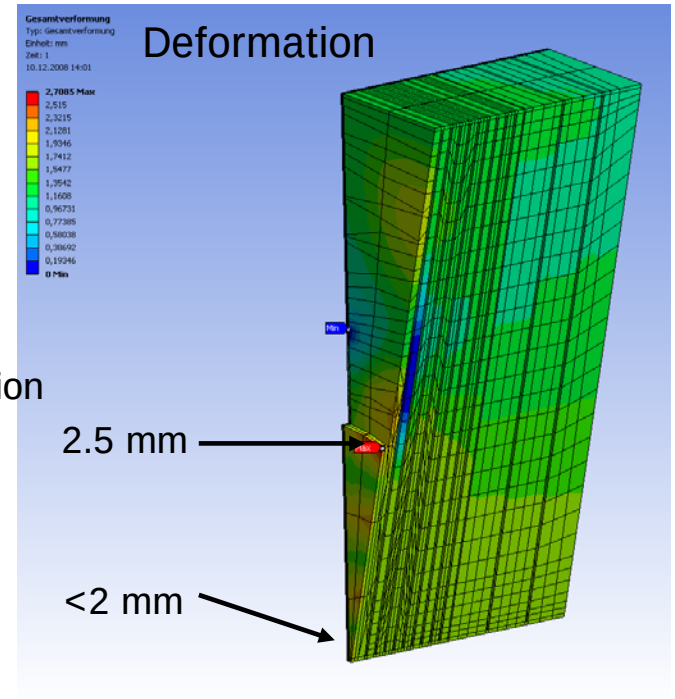
- Include field shaping plate
- More realistic boundary conditions
- Do calculations with horizontals rips

Mechanical Design Progress

Preliminary end-cap deformation and stress C.Martens, M.Harz

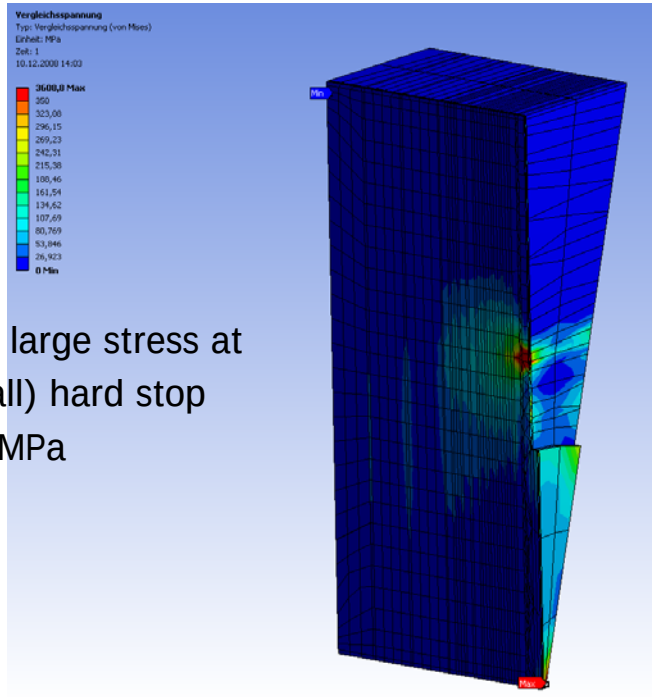
- Plates connected via radial rip, 1 per sector (1/12)
- Plates at outer and inner radius attached
- Pushing against hard stop 20x20cm at innermost barrel yoke plate
- Field shaping plate included

Deformation



von Misses stress

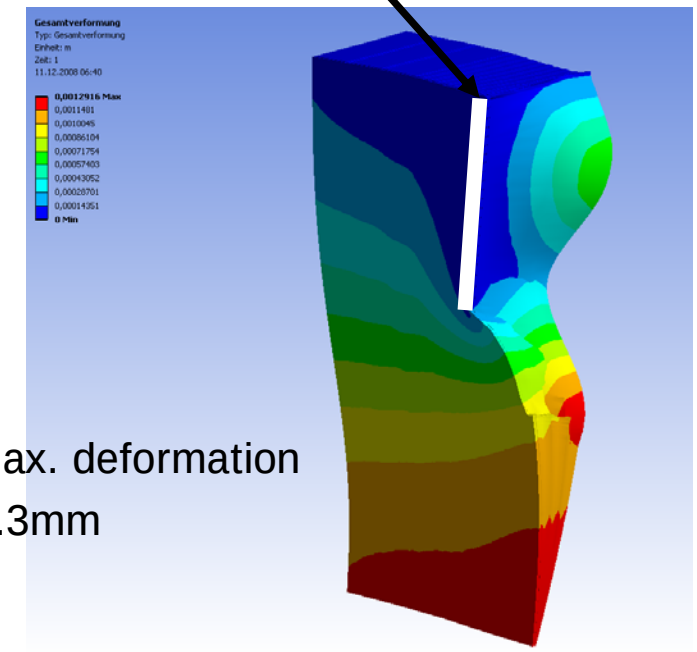
Very large stress at
(small) hard stop
480 MPa



Mechanical Design of End-Cap

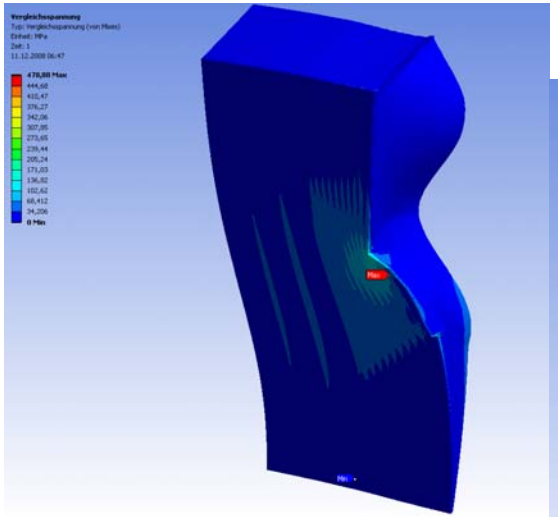
Same as previous page, but with modified hard stop

20cm wide, radially extending from first to last barrel iron plate

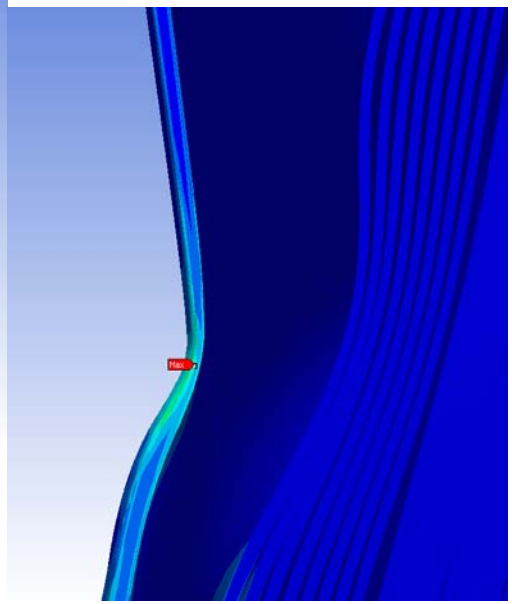


Max. deformation

1.3mm



Stress now <200 MPa



Next steps:

- Repeat calculation with 2 instead 3 thick plates
- Do calculations with horizontals rips