



Status report about the e- μ identifier

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Layout of the downstream subdetectors

1. Shielding and residual stray field
2. Particle tracking and transverse detector sizes
3. Design of the Cerenkov e- μ identifier

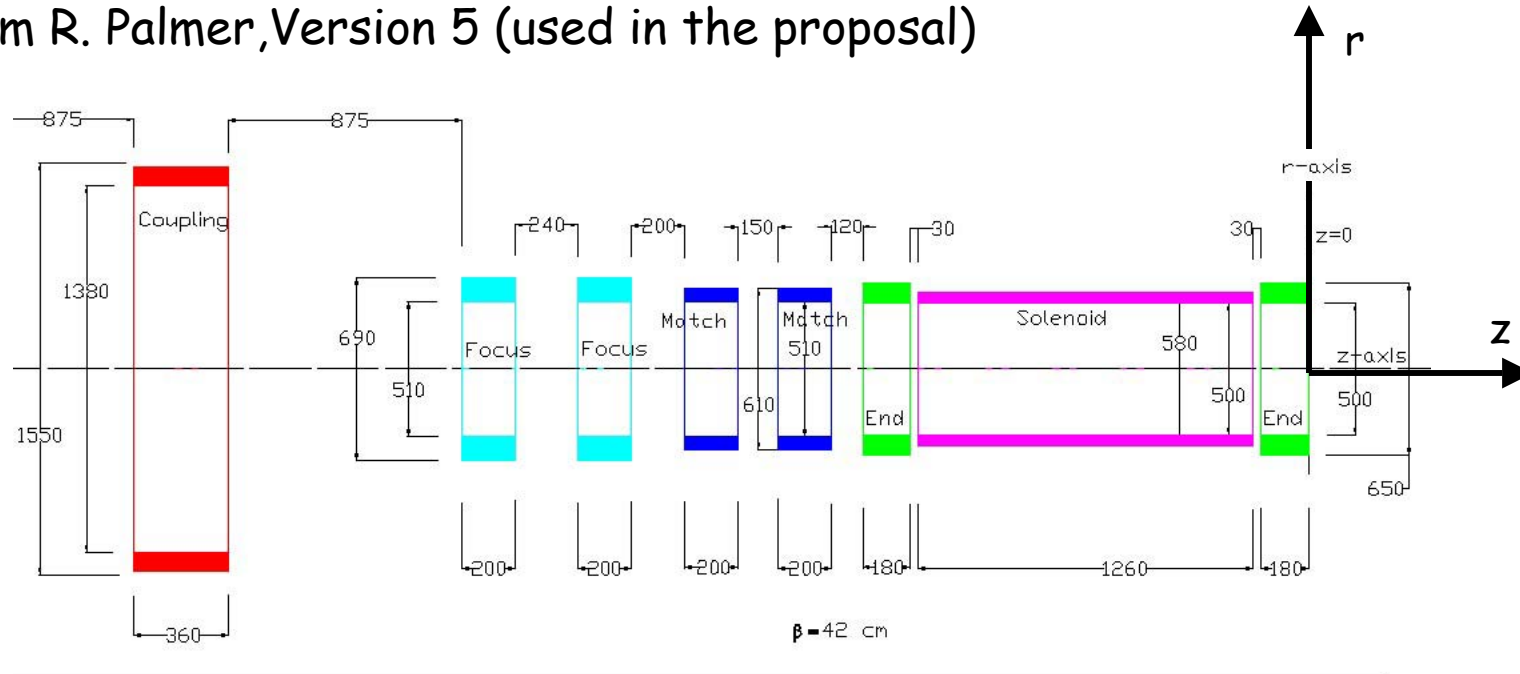
RAL, Nov 01, 2003



Active magnetic elements



From R. Palmer, Version 5 (used in the proposal)



Current densities

-105.63

-106.67

+106.67

64.25

99.35

66.67

80.95

85.93

Ref. R. Palmer Nov. 20, 2002
Version 5

Compute stray field in r - z space after the last correction coil with/without an iron shielding of variable thickness



Computations

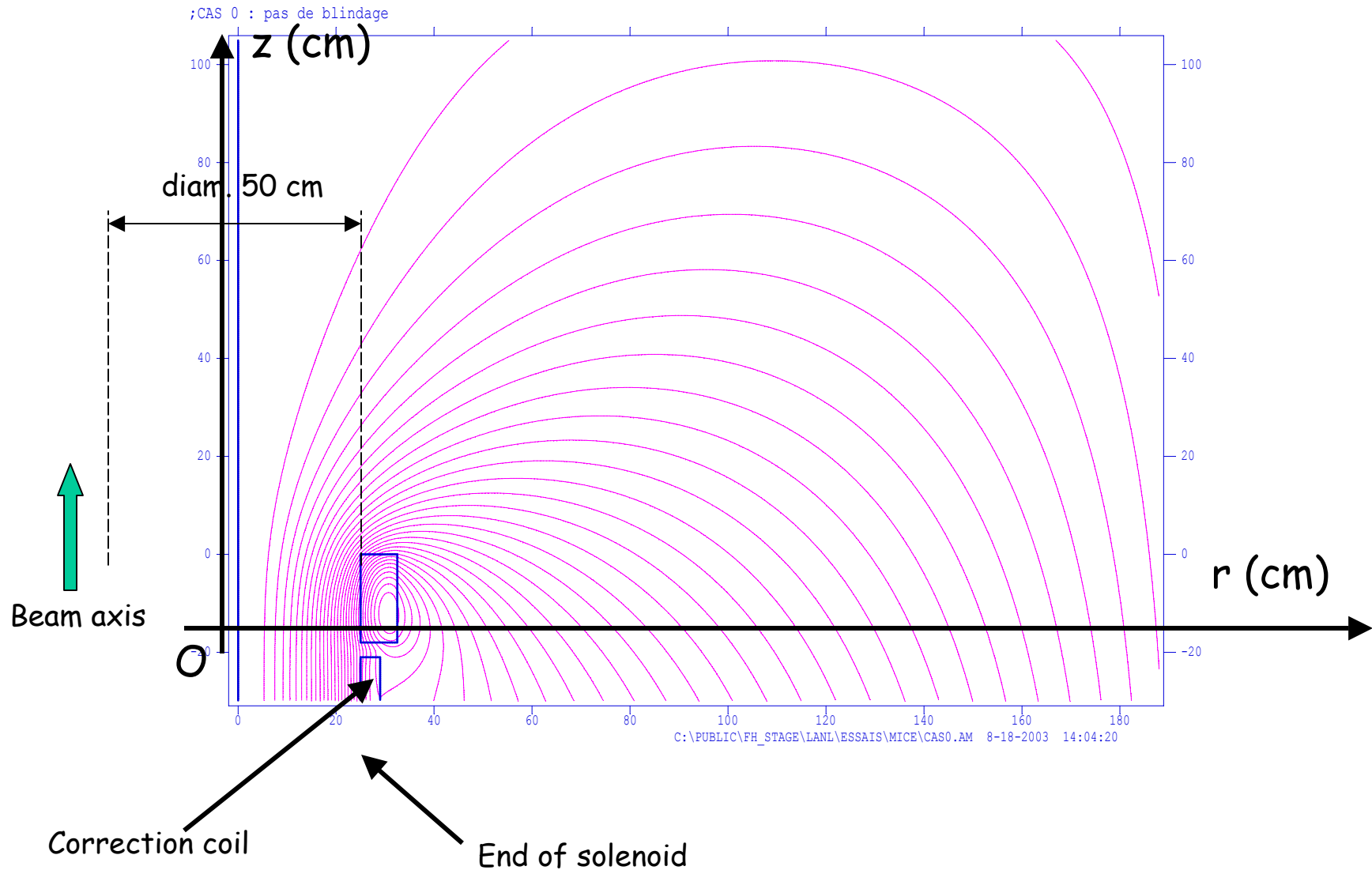
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Field equations in the presence of ferromagnetic materials
are solved with Poisson/Superfish

<http://laacg1.lanl.gov/laacg/services/possup.html>

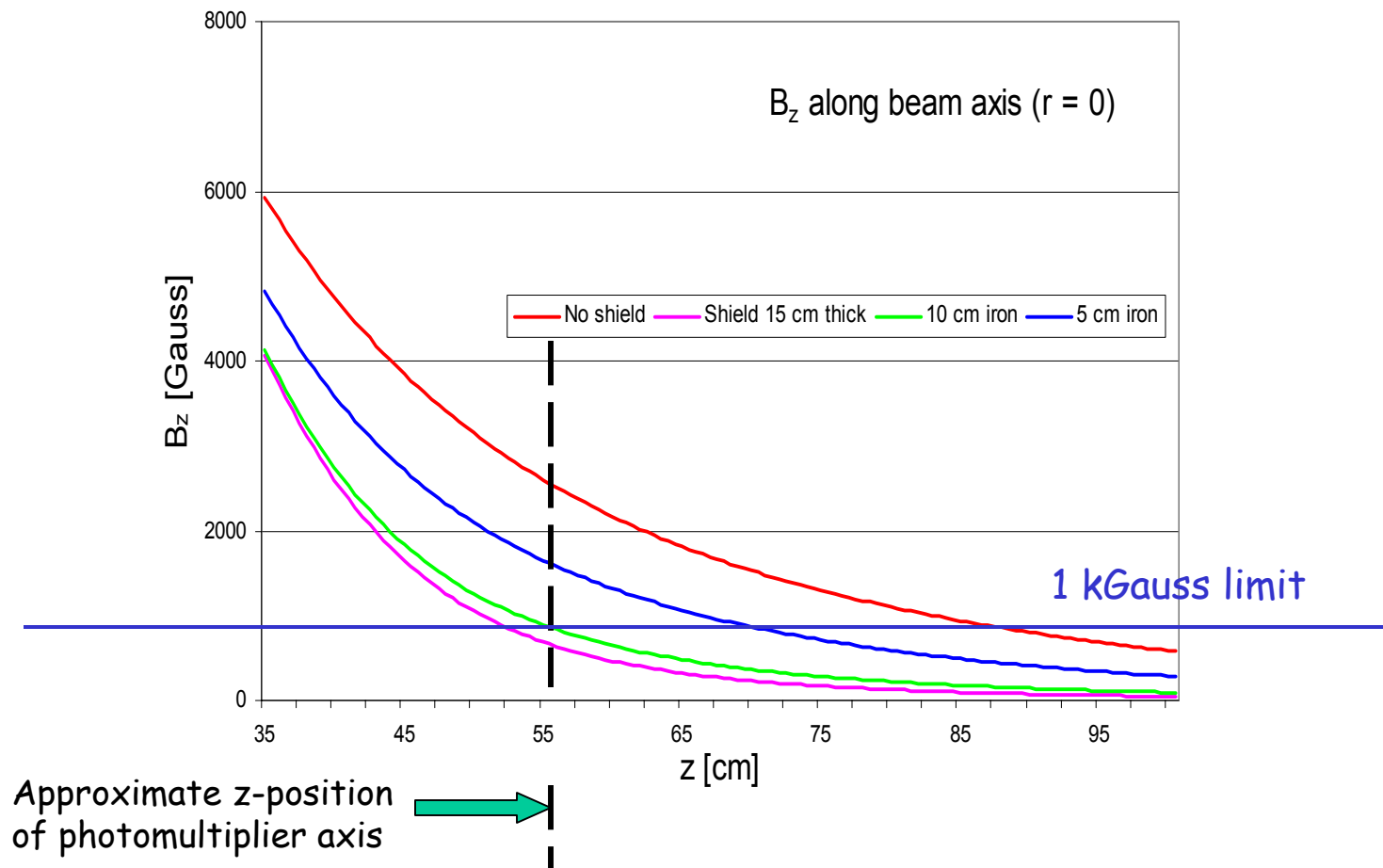


Field lines without shielding





Stray field downstream along beam axis





Assumptions



Starting points

- Shielding is made of large and thick iron slab(s)

Guess: thickness of about 15 cm (from elementary calculations to avoid saturation)

- possibly segmented
- provided with a central hole located around the beam axis.

Guess: hole diameter is 40 cm.

based on the available (simulated) particle distributions at coil end.

- The z-position of (the upstream face of) this slab is presently located 20 cm downstream of the last correction coil of the spectrometer.

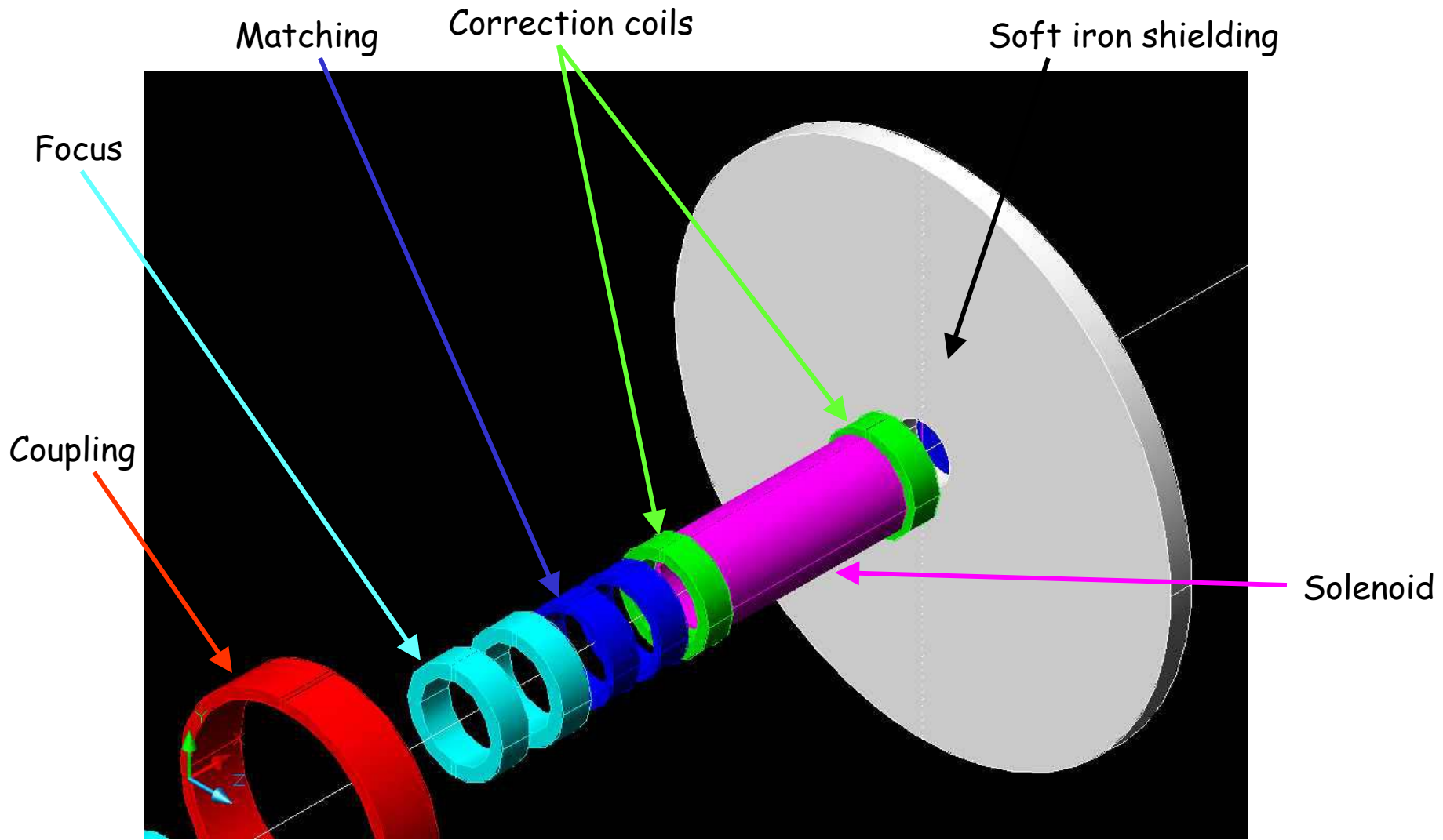
- Ref. J.M. Rey (Saclay)
- provides clearance for cryostat walls, connexions, mechanical reinforcements ...

- Preliminary dimensions of TOF, Cerenkov and calorimeter

Guess: 5 cm clearance between detectors

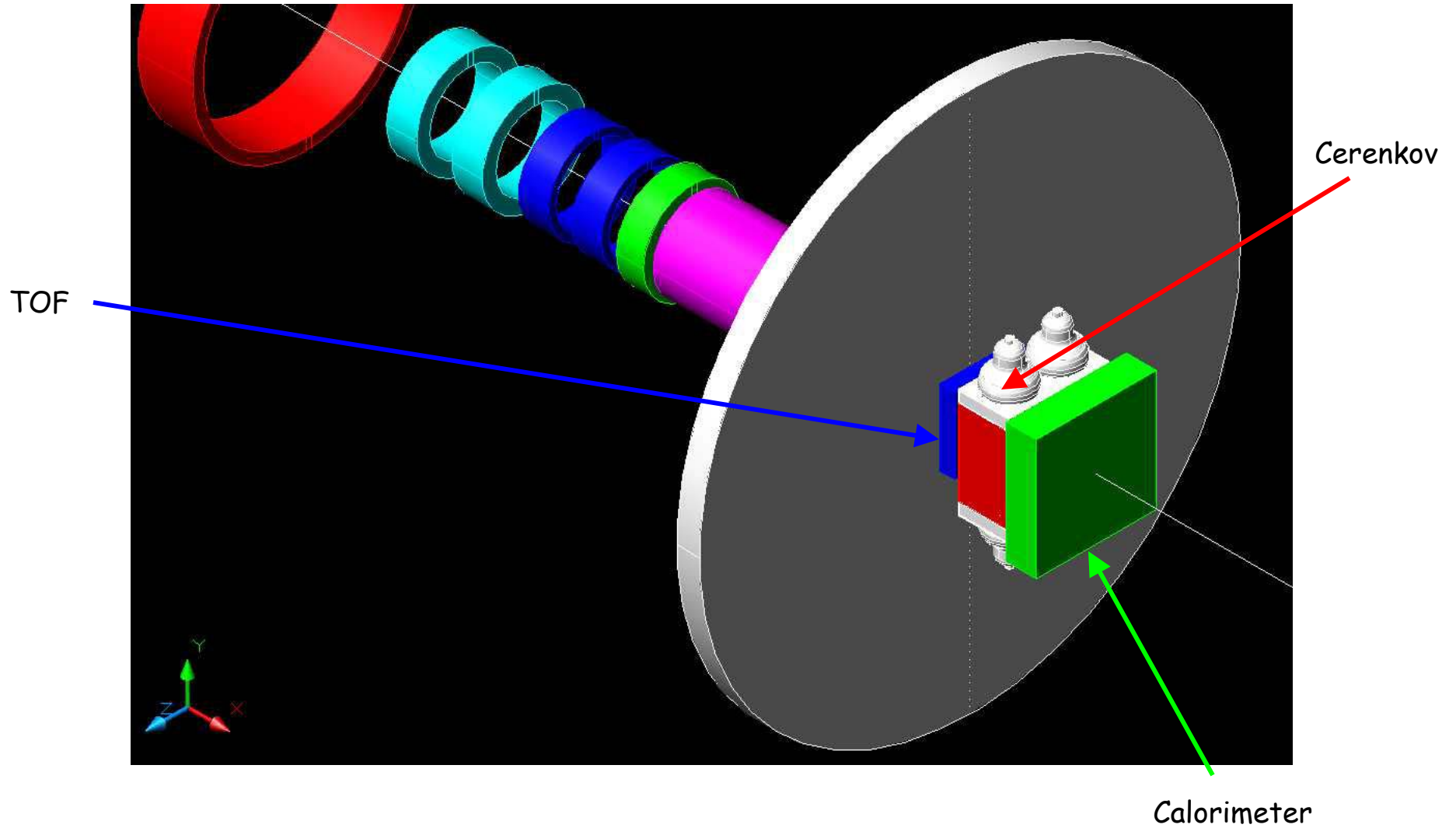


3D view of spectrometer with magnetic shielding



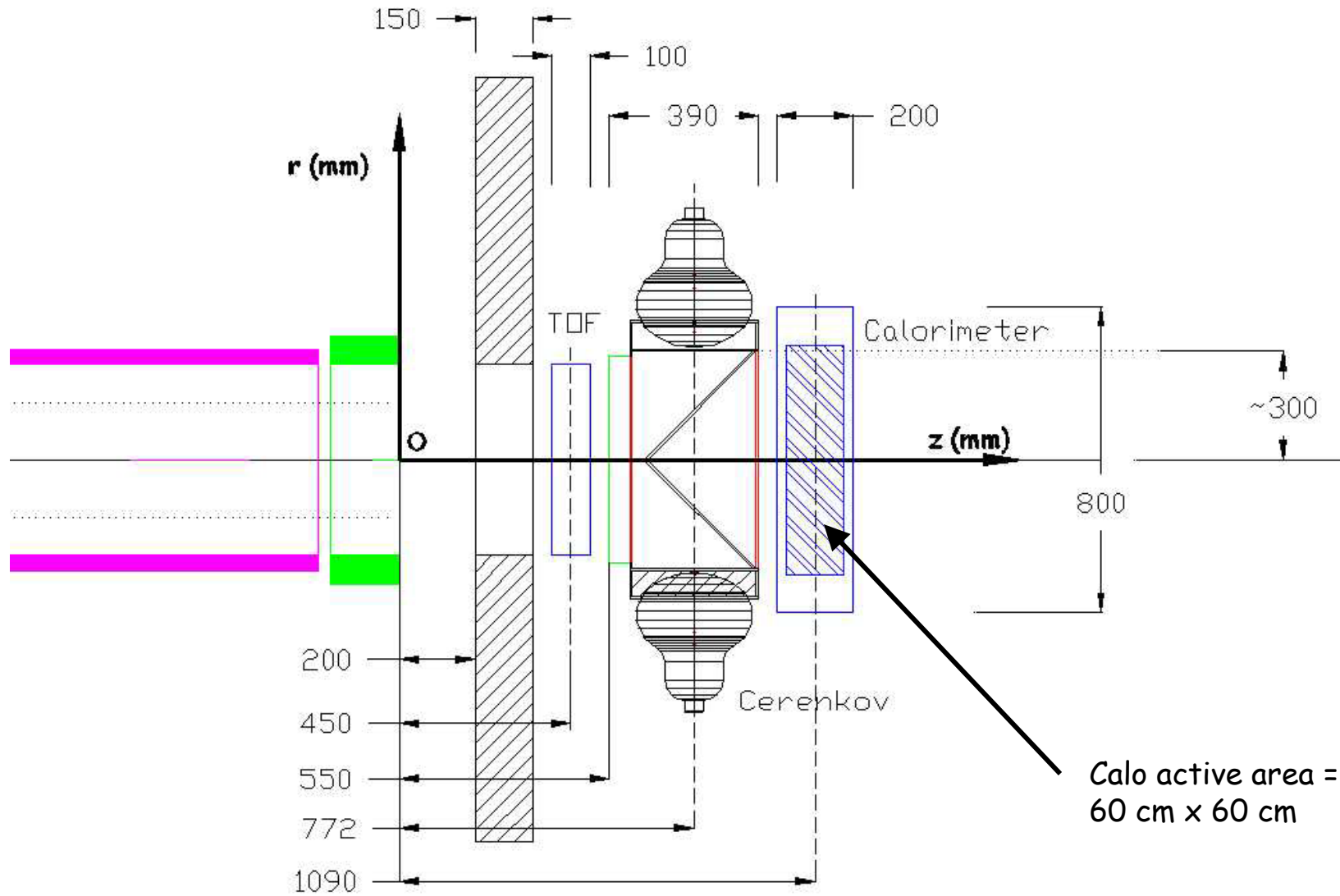


Downstream detectors



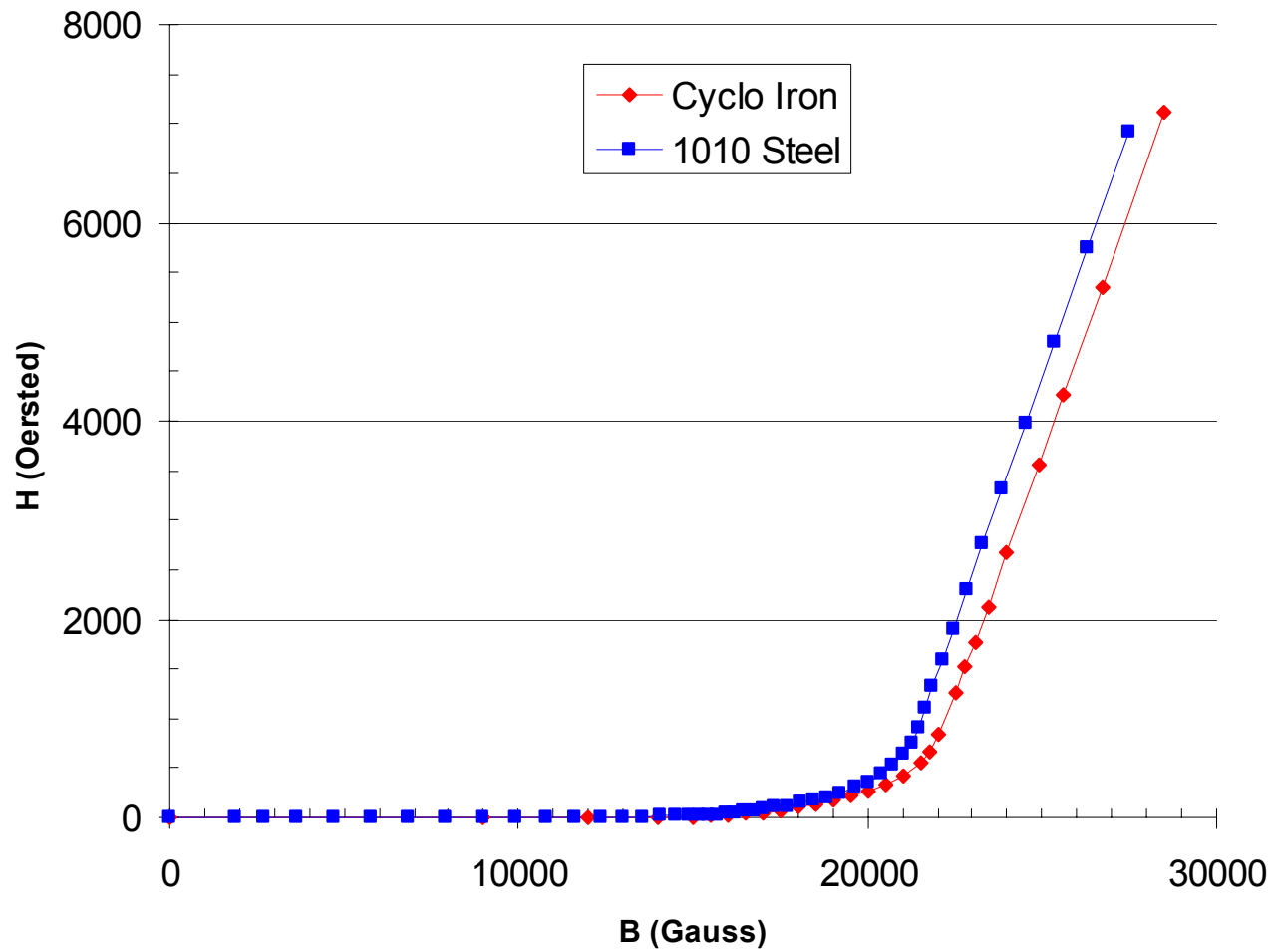


Tentative downstream layout



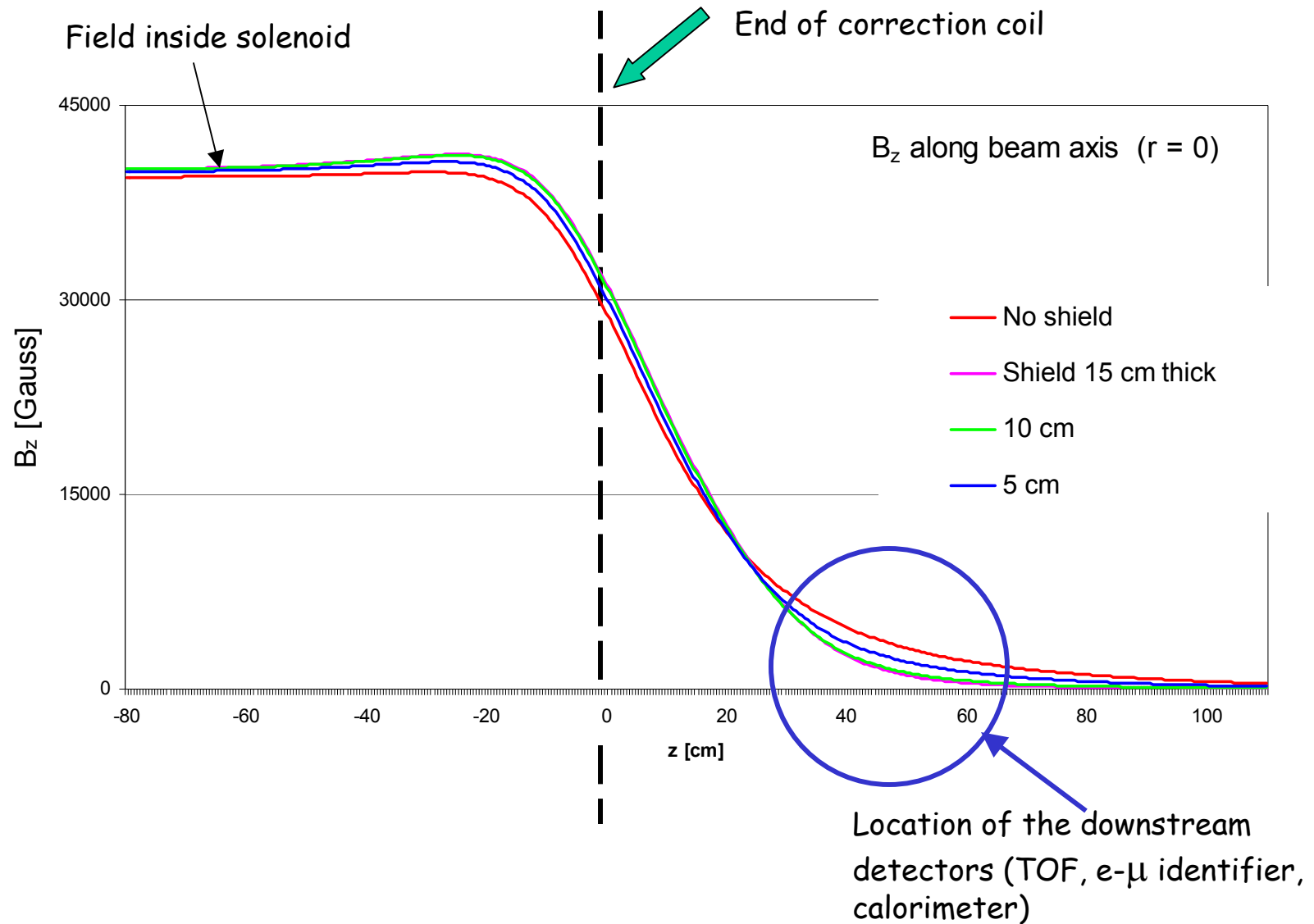


Properties of shielding materials



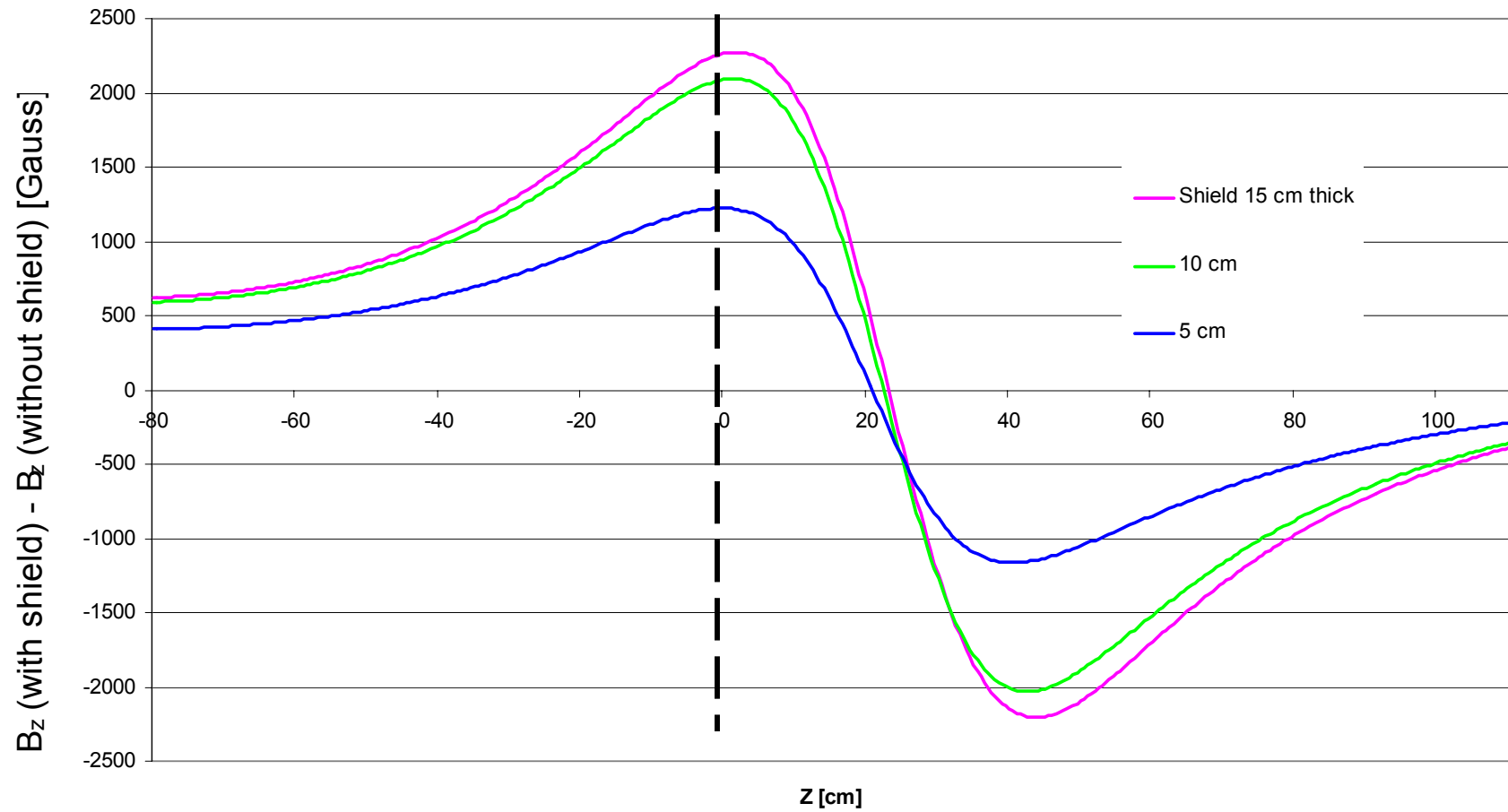


Field along beam axis





Influence of the shielding



Shown here: modifications of B_z along beam axis ($r=0$)



Construction of segmented shieldings



Slab thickness t (cm)	Nr. slabs n	Gap width g (cm)	Tot. iron thickness (cm)
1	1		
	2	13.00	2
	3	6.00	3
	4	3.67	4
	5	2.50	5
	6	1.80	6
2	1		
	2	11.00	4
	3	4.50	6
	4	2.33	8
	5	1.25	10
	6	0.60	12
3	1		
	2	9.00	6
	3	3.00	9
	4	1.00	12
	5	0.00	15
	6		
4	1		
	2	7.00	8
	3	1.50	12
	4		
	5		
	6		

Constraints:

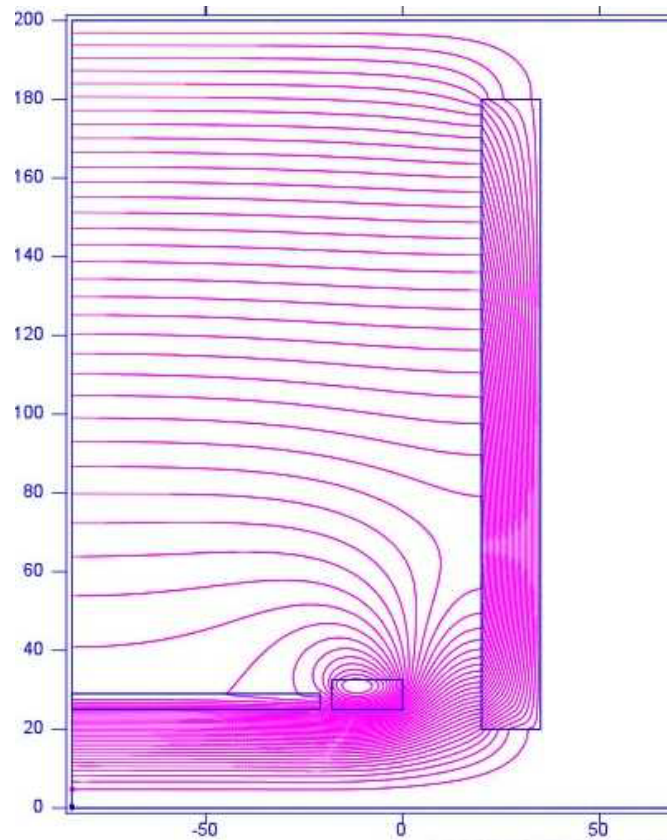
- 15 cm thick shield
- commercially available thicknesses





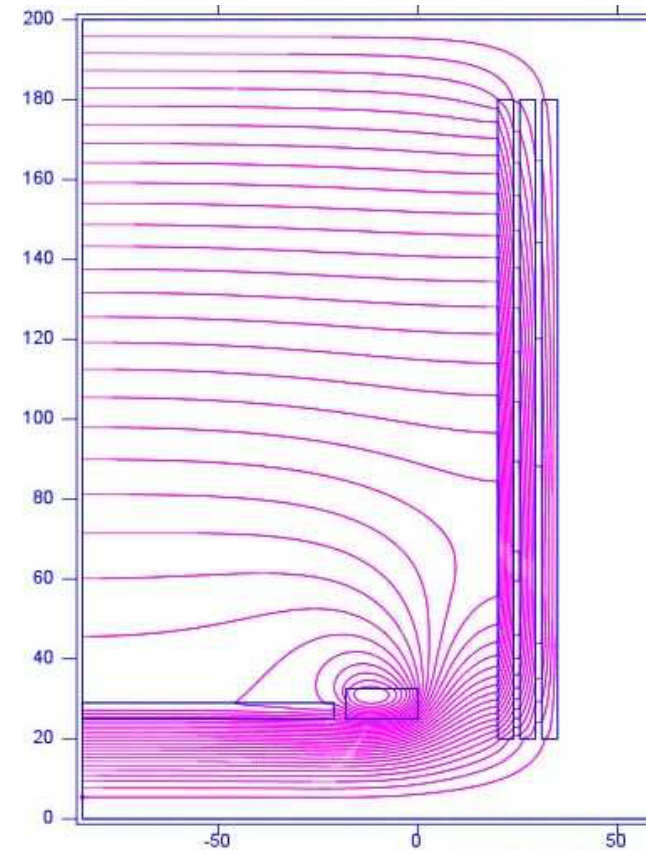
Segmented shields (I)

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Single slab 15-cm thick

(40 lines for $0 < A_\phi < 1.8 \cdot 10^7$ Gauss.cm)

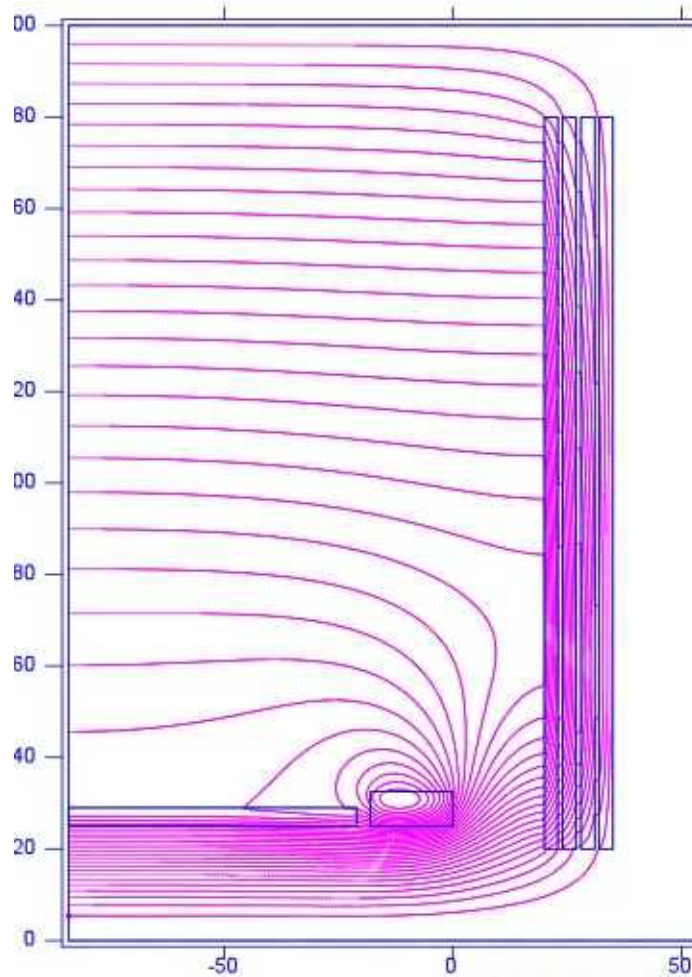


3 slabs 4-cm thick / 2 gaps 2-cm wide

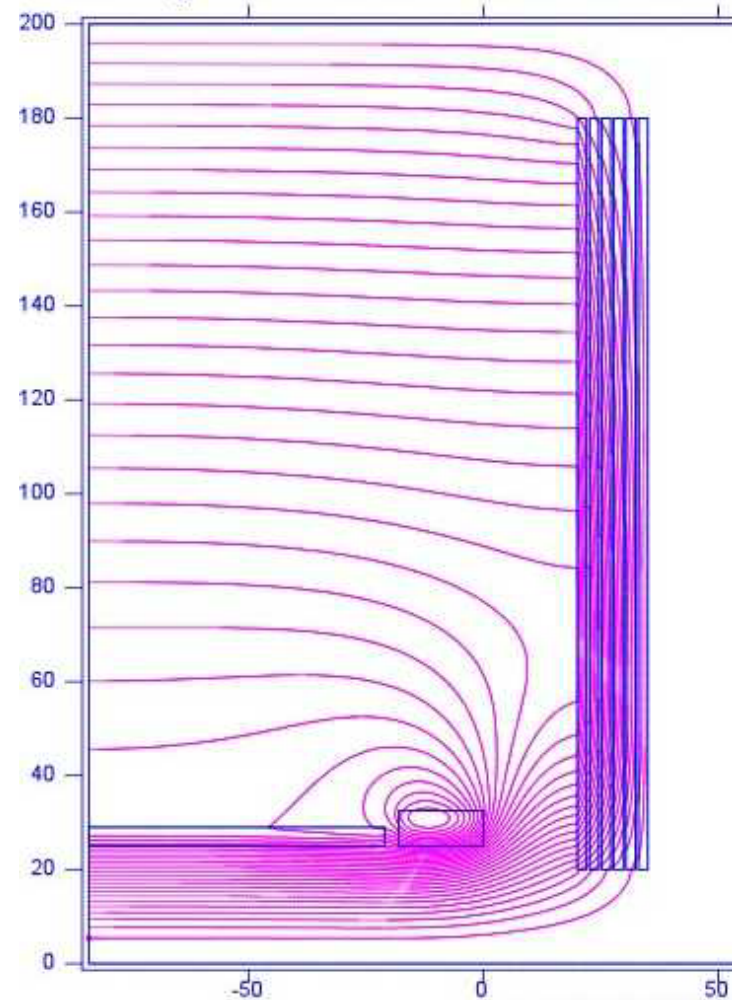
$F_z = 115$ kN



Segmented shields (II)



4 slabs 3-cm thick / 3 gaps 1-cm wide



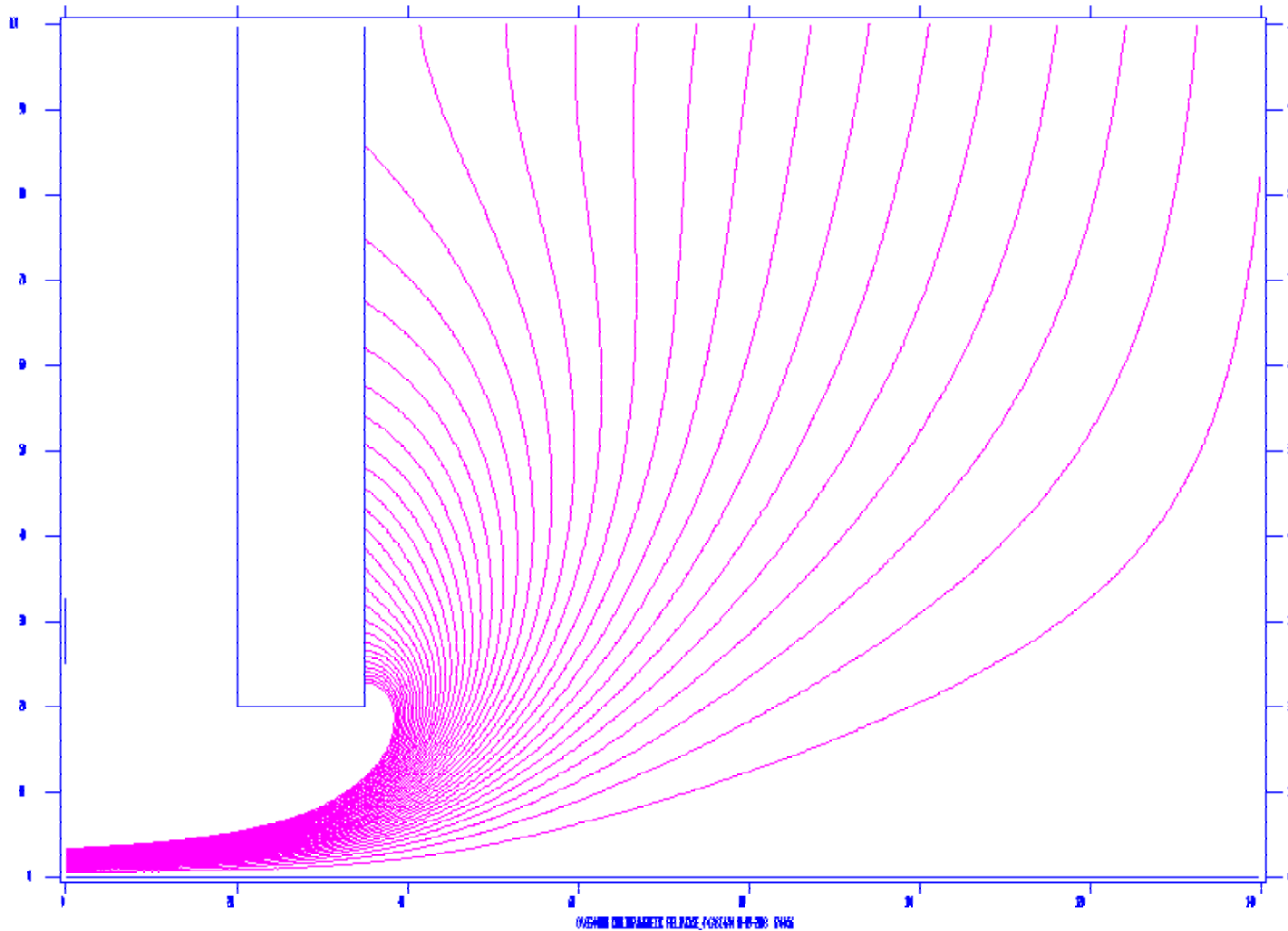
6 slabs 2-cm thick / 5 gaps 0.6-cm wide



Zoom over useful downstream region



(SEE 4) (single iron slab thickness: 55 cm (diameter of hole: 41 cm))

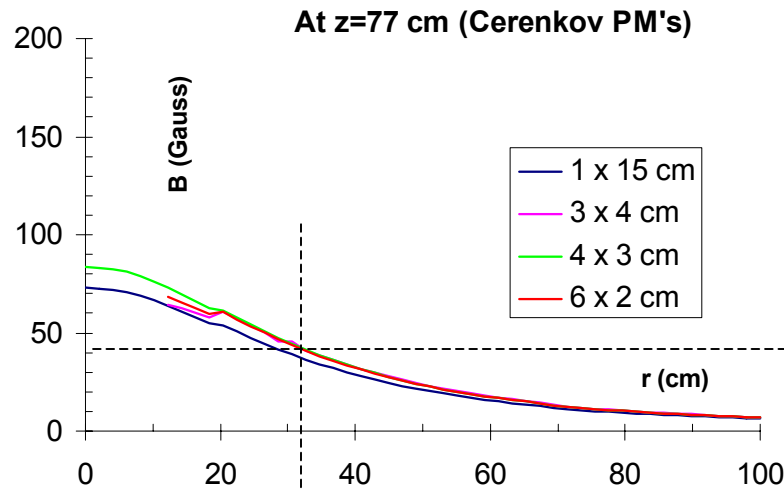


$0 < r < 100 \text{ cm}$
 $0 < z < 100 \text{ cm}$

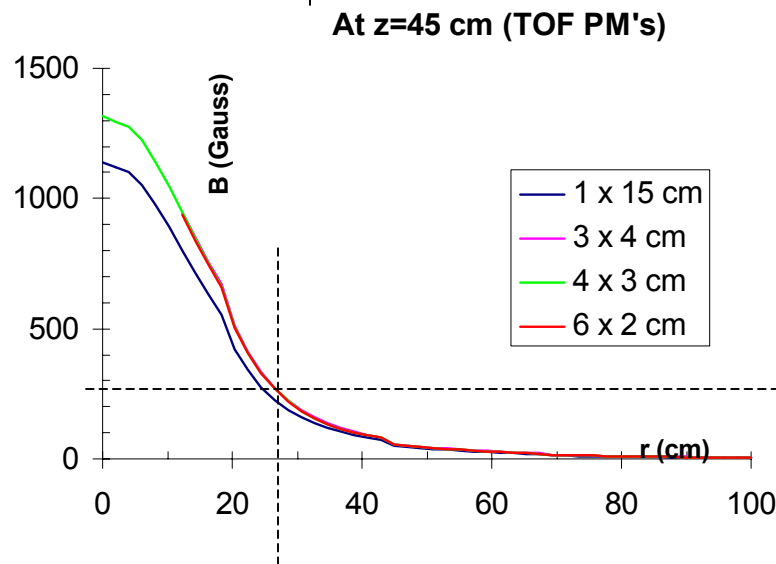
40 lines for $0 < A_\phi < 1.8 \cdot 10^5 \text{ Gauss.cm}$



Residual stray field



Approximate field
at the PM positions of the Cerenkov
(~40 Gauss)



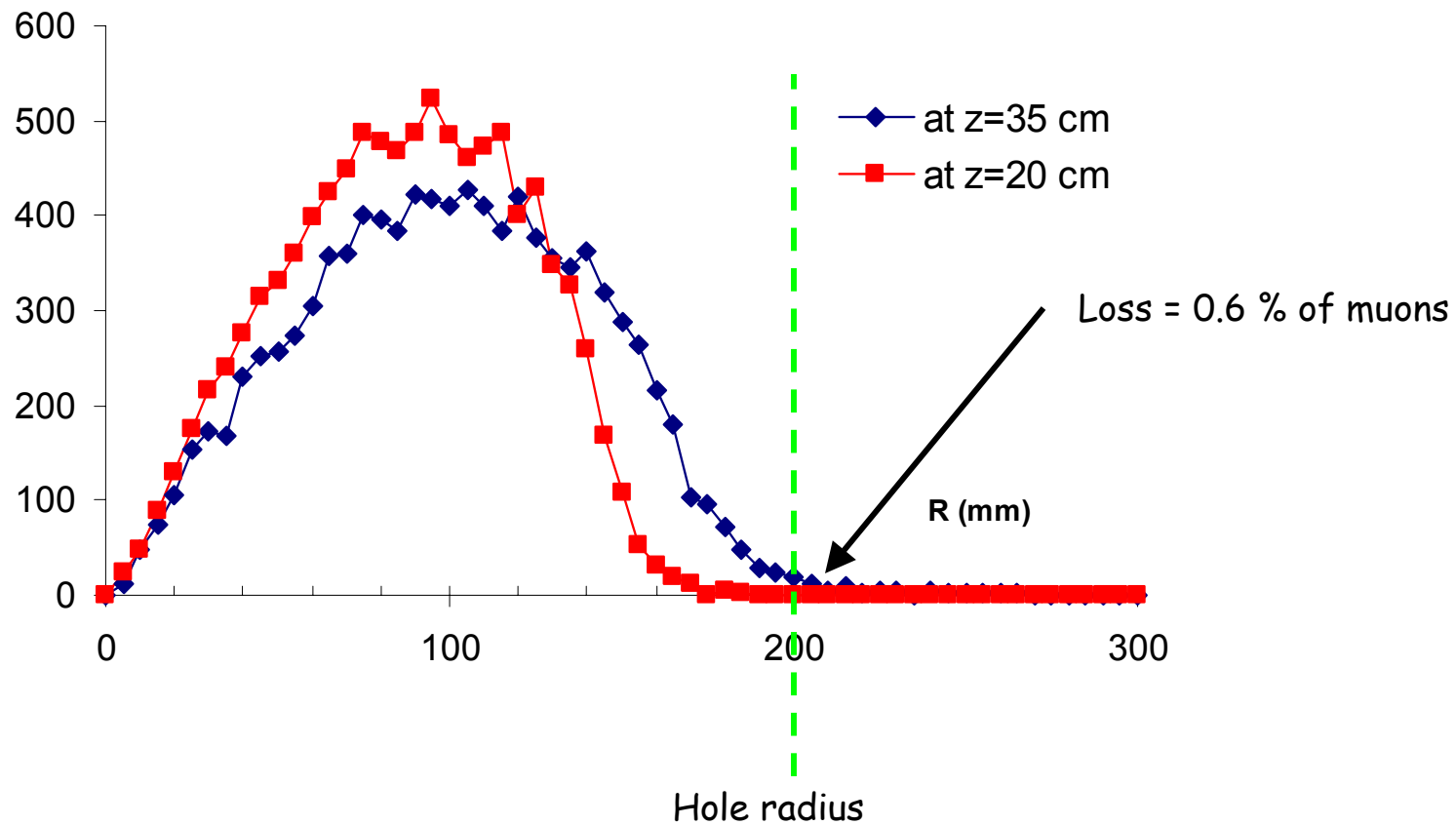
Approximate field at the PM
positions of the TOF
(~300 Gauss)



Central hole in the shielding



Is it any beam scraping by the 40-cm diameter hole in the shielding ($20 < z < 35$ cm)?



R = transverse distance of impact point of muon from the symmetry axis



Conclusions

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A soft iron shield ~**15 cm thick** with a central hole of 40 cm diameter reduces the stray field to « easily manageable » values at the PM positions (both for TOF2 and Cerenkov).

(The residual field is further reduced by a specific mumetal shield in order to use standard photomultipliers)

The presence of the shield affect:

- the magnetic field configuration of the upstream coils
- the tracking of particles and the simulations both upstream and downstream
- the construction of the containment vessel for the correction coil and the solenoid.