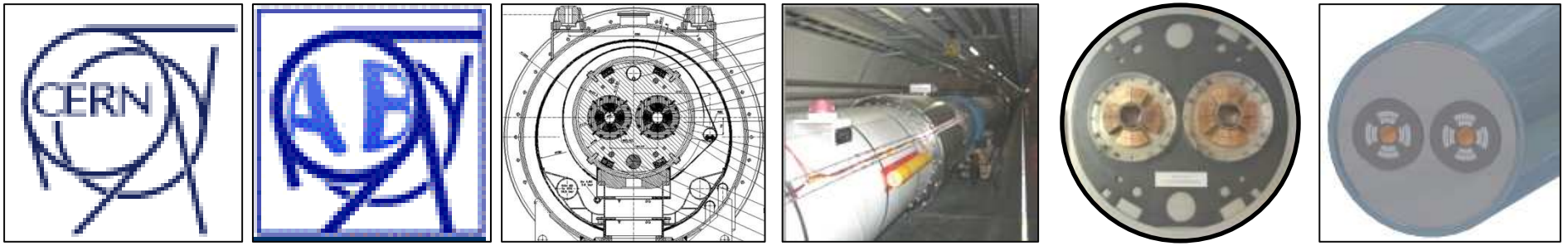


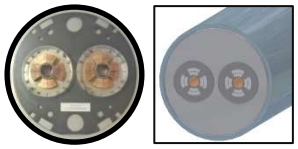
Assessment of BLM thresholds at cold magnets

Agnieszka Priebe, Mariusz Sapinski

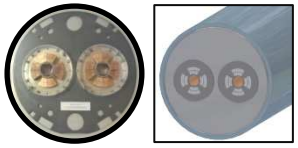
CERN
Accelerator and Beams Department
Beam Instrumentation Group
Beam Loss Monitoring Section

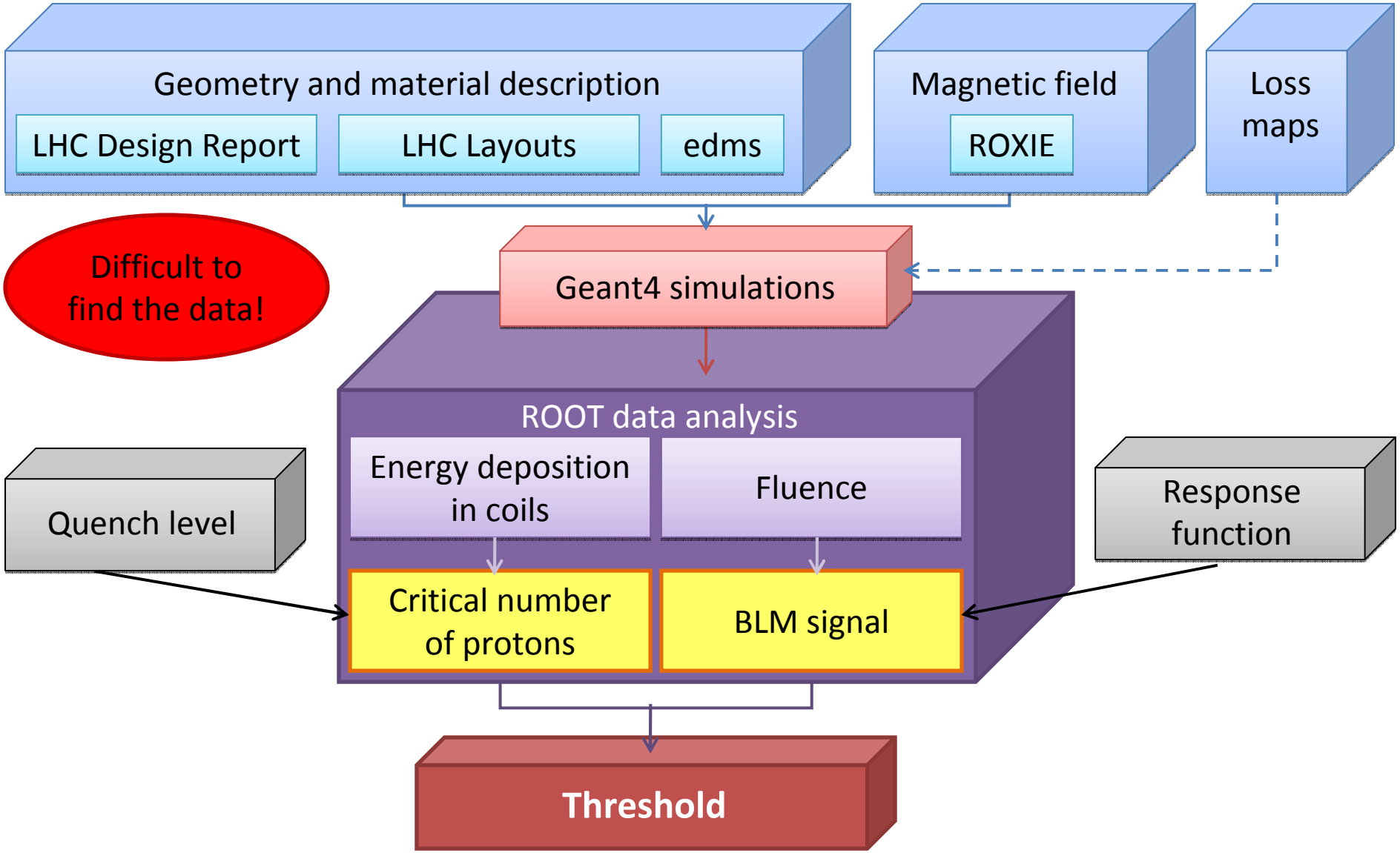
10 June 2008

Contents

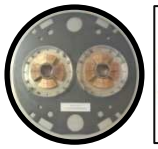


Introduction and strategy

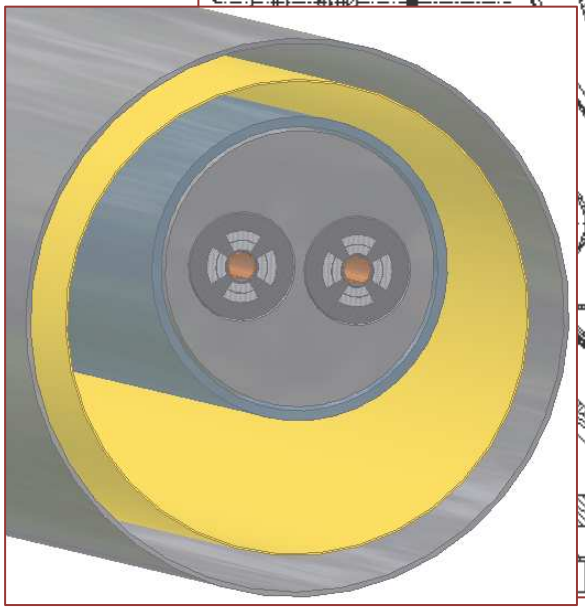


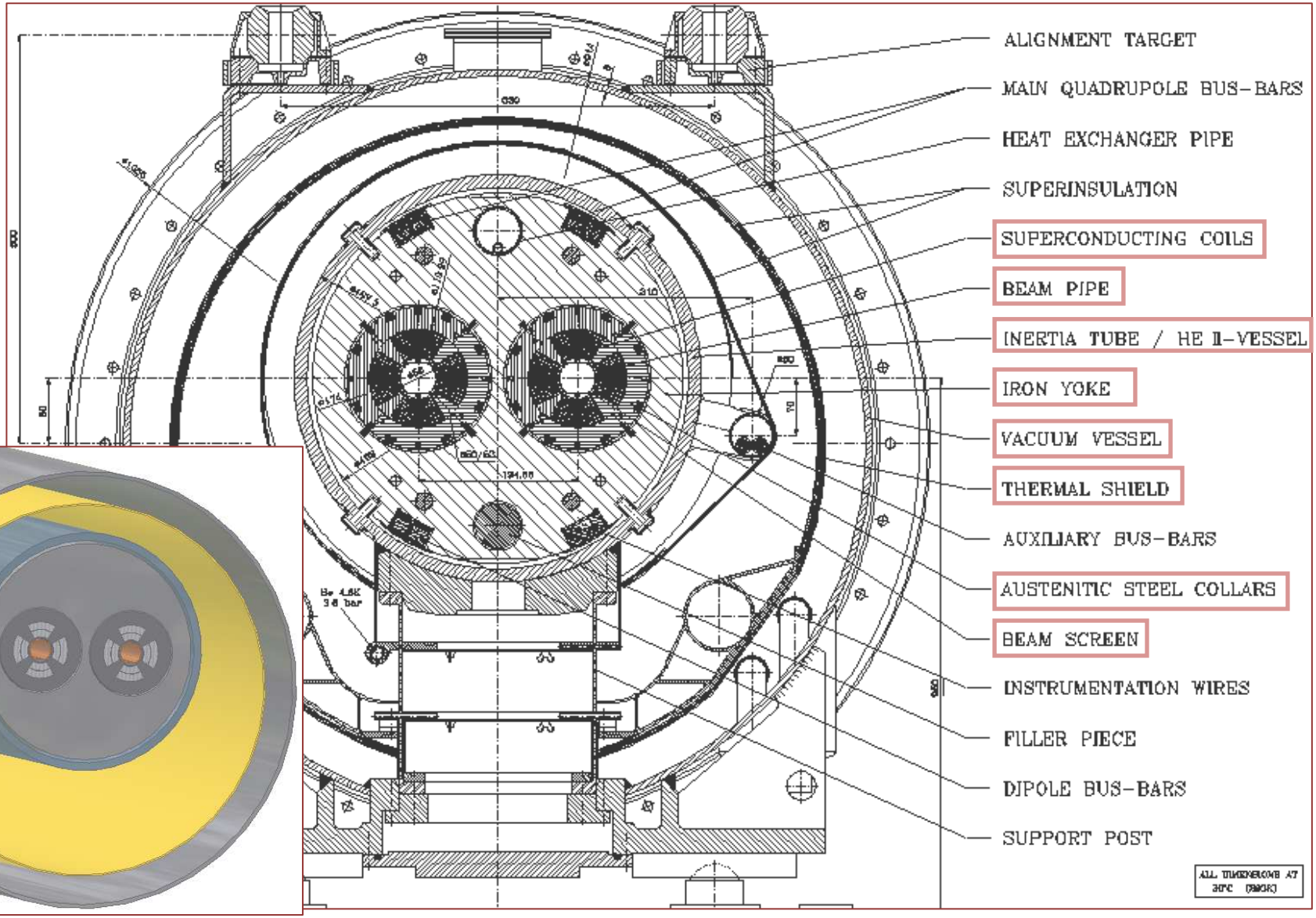


Main Quadrupole Geometry

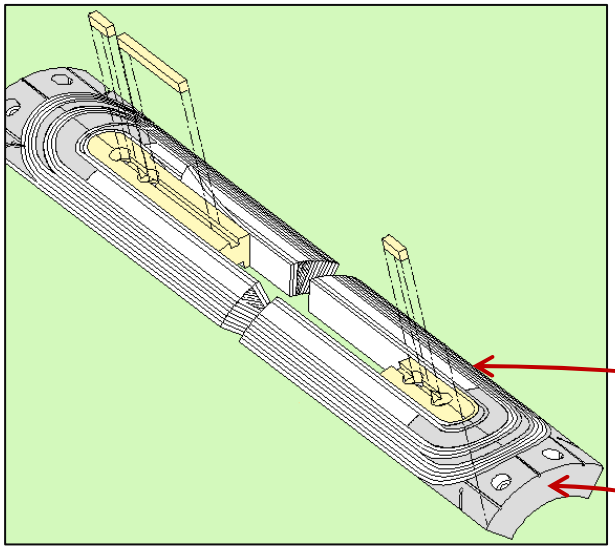


MQ





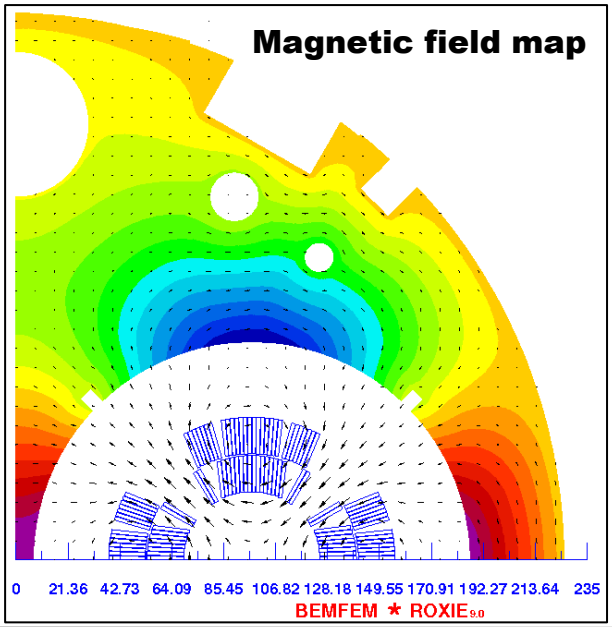
Superconducting Coils

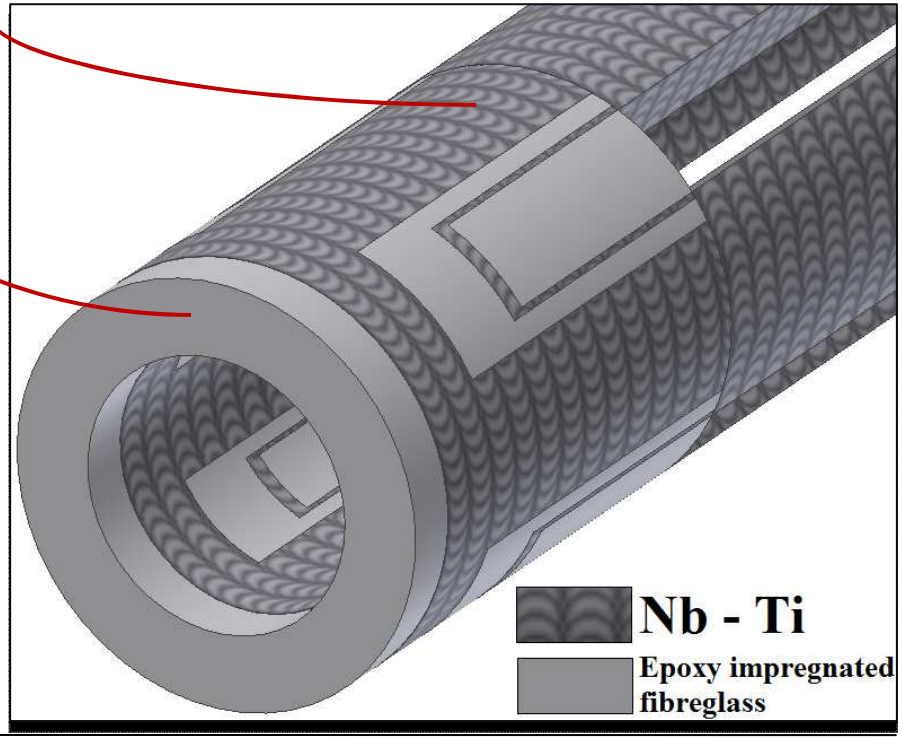


Coil simplifications:

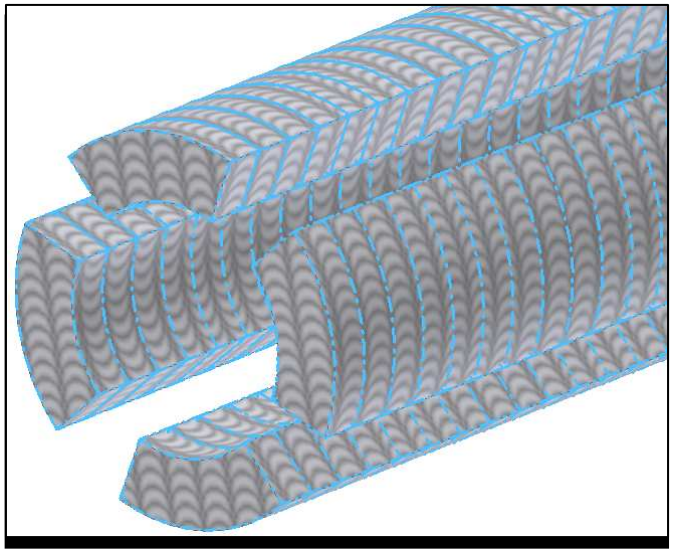
- *Cu wedges*
- *An angle (displacement respectively to a centre of a coil-creating circle)*
- *Endings*

Weighted density ρ: 7.7801 g/cm³
Copper to superconductor ratio: 1.95 ± 0.05

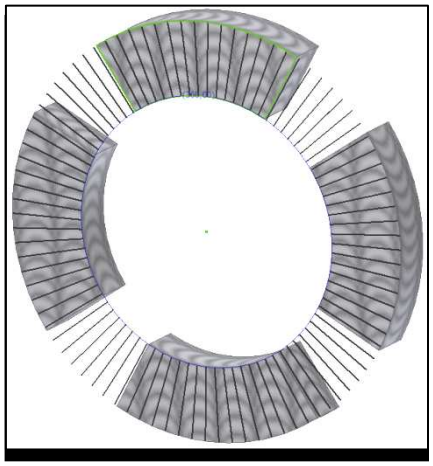




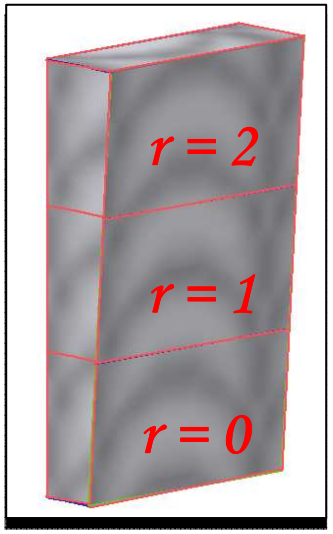
Read-out geometry



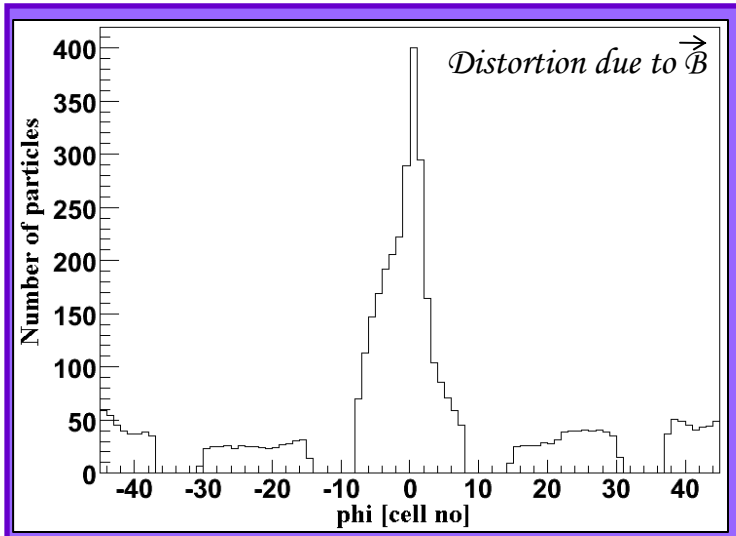
Division in z

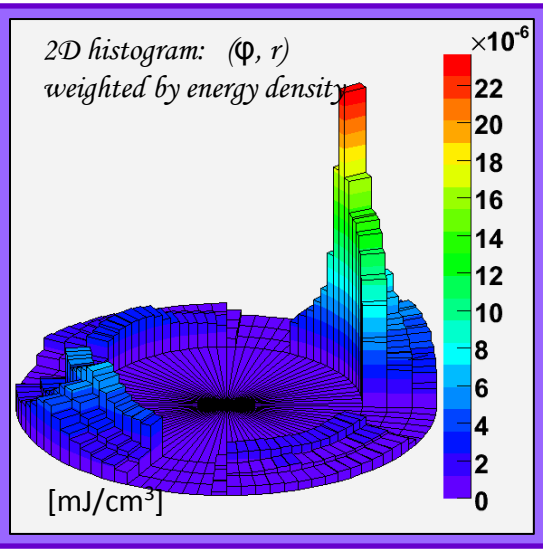


Division in φ



Division in r





THE BASIC CELL

$\Delta z = 0, 1, \ldots, 299 \rightarrow 10.53$ mm

$\Delta\varphi = 0, 1, \ldots, 89 \rightarrow 4°$

$\Delta r = 0, 1, 2 \rightarrow 5.12$ mm

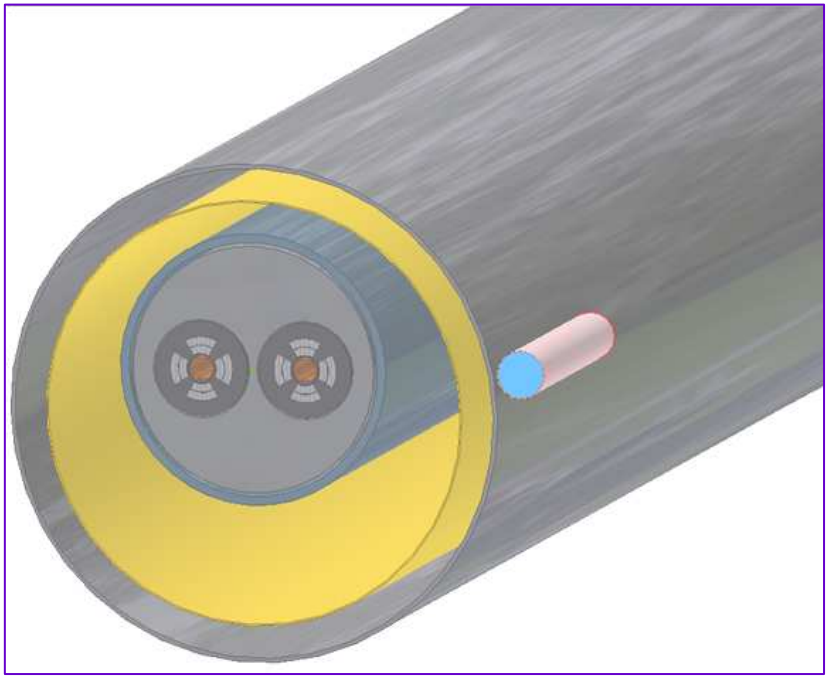
bin size << shower scale
→ binning is correct

BLMs

Scoring particles

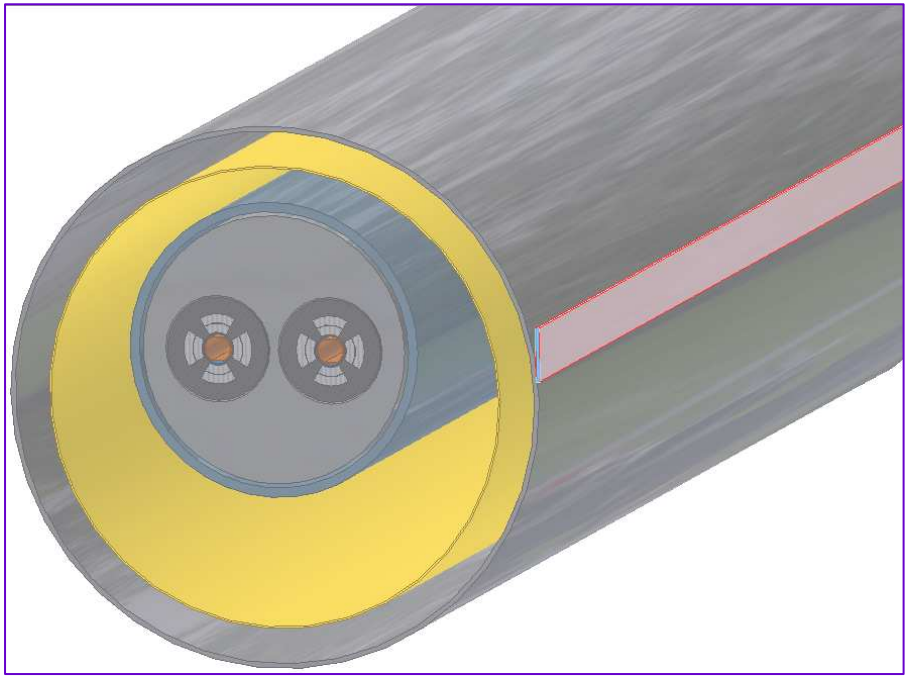
Real situation:

BLM: ø = 87 mm, ℓ = 491 mm



Geant4 simulation:

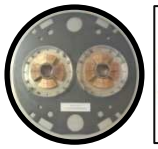
Plate: a = 5 mm, b = 90 mm, ℓ = ℓ_{sector}



Reasons of use this kind of detector geometry:

- Flexibility (different BLM positions on various magnets)
- Comparison with previous simulations

Loss locations



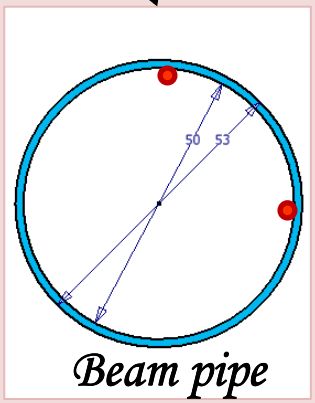
BPM | MO | MQ

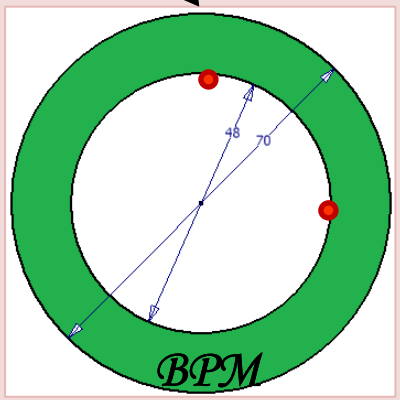
Particle: p^+
Energy: 7 TeV
Angle: 240 μrad

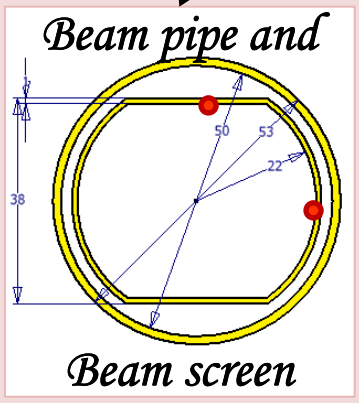
Time: 30min/p^+
→ use lsf
→ try GRID

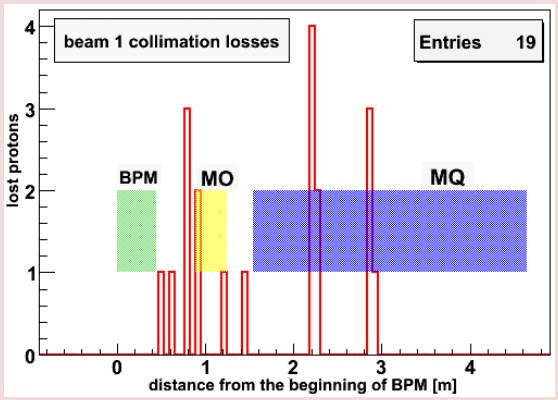
loss 1 | loss 2 | loss 8 | loss 3 | loss 4 | loss 5 | loss 6 | loss 7

Cross - section

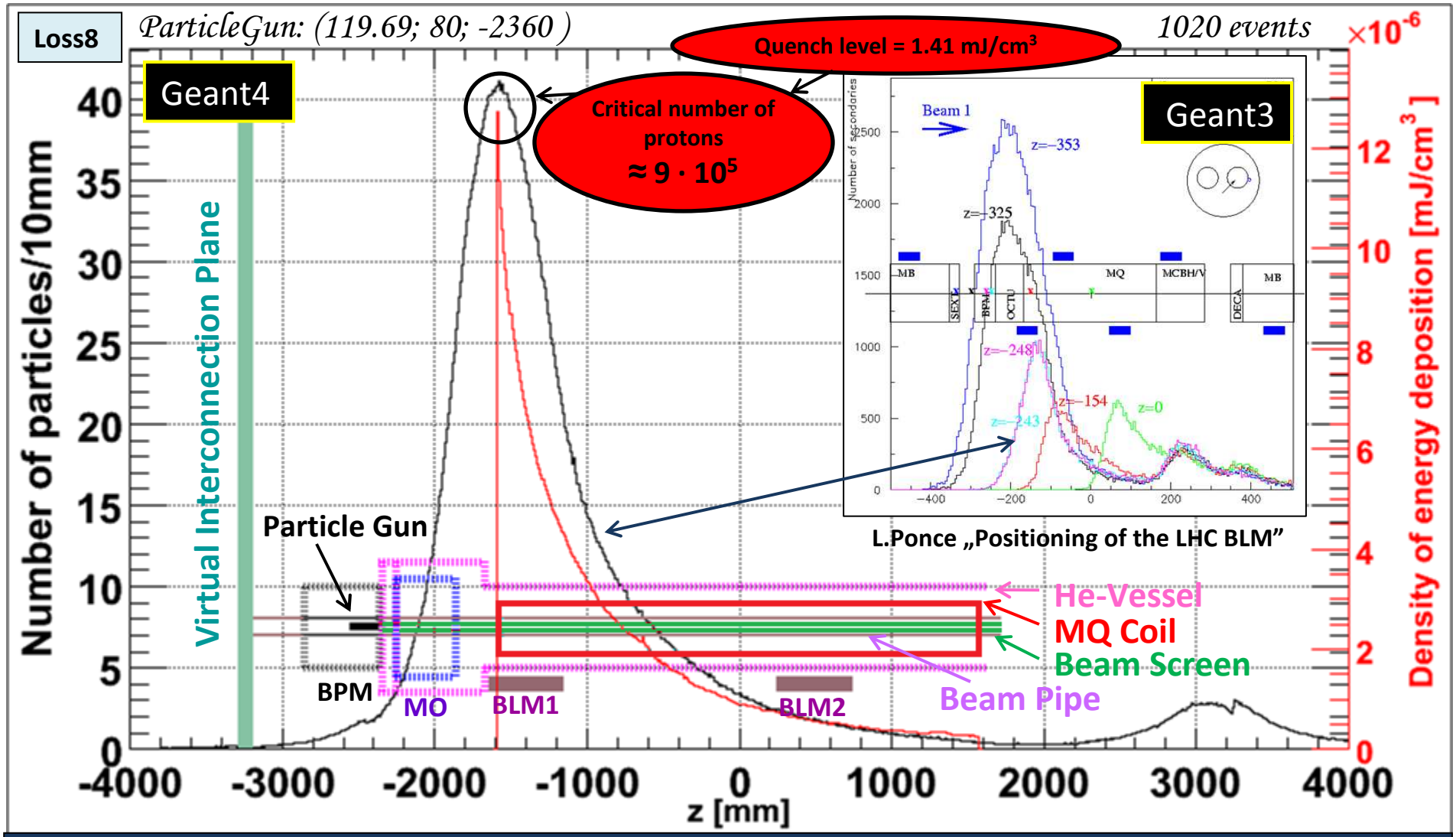






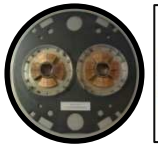


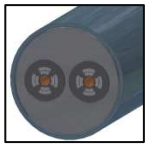
ρ_{Edep} in the coil & BLM signal



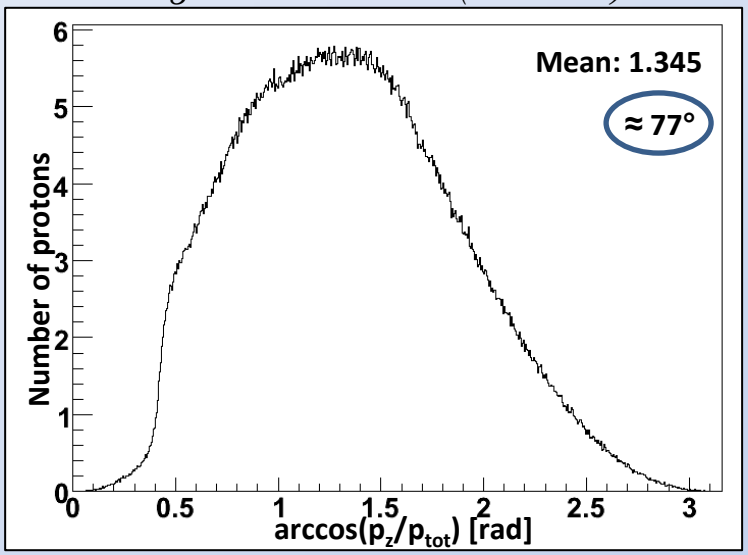
Particle number peak ~ 1m after the beam loss → *1st BLM was located correctly !*

BLM signal

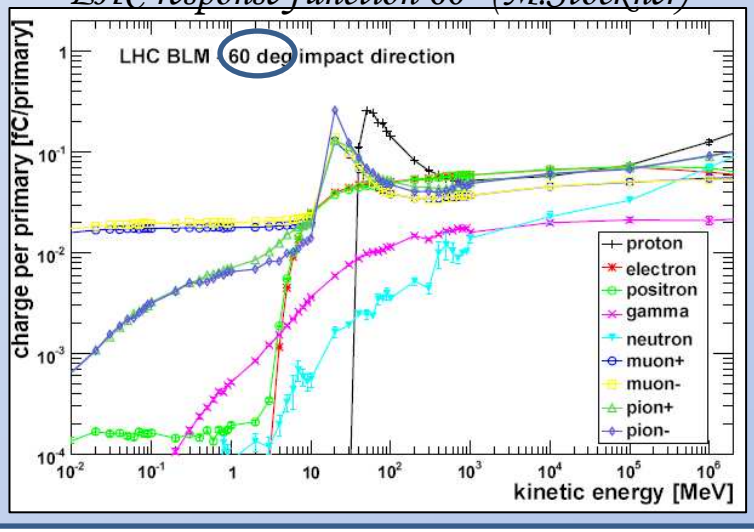




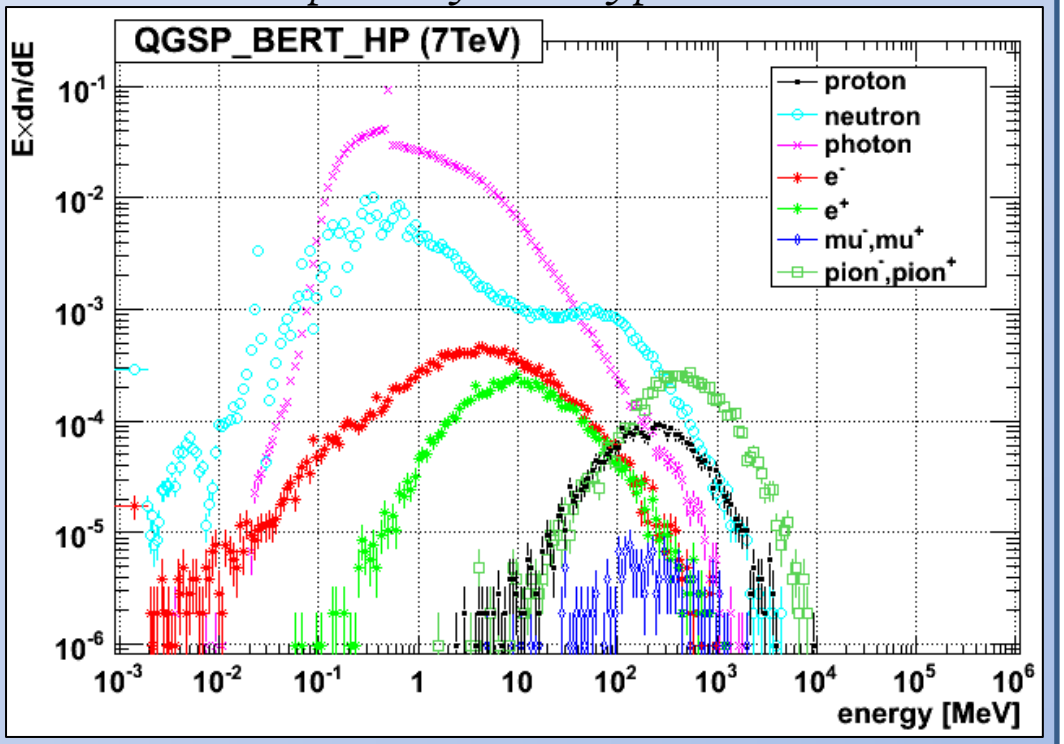
Angular Distribution (in BLM1)



LHC response function 60° (M.Stockner)



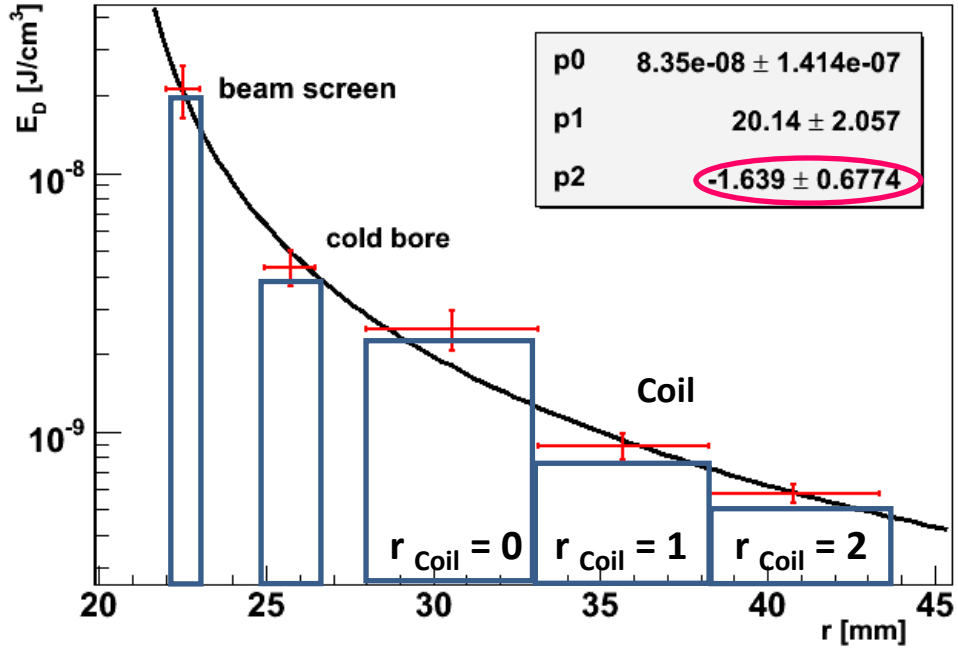
Spectrum of secondary particles



Signal folding with the response function

R.f. 60°	*7 TeV total signal: 2.2 aC/p*
R.f. 90°	*7 TeV total signal: 2.0 aC/p*

Note 44 vs. Geant4 simulation



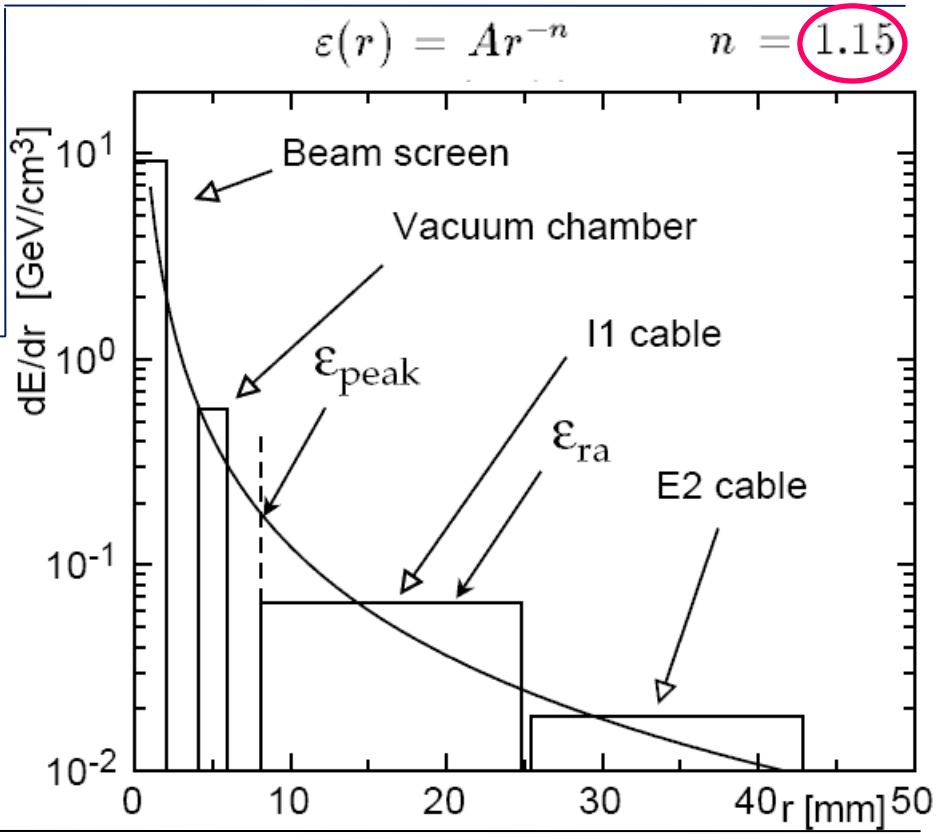
Results from Geant4 simulation

$E_D = p0 \cdot (r - p1)^{p2}$

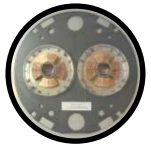
LHC Project Report 44 (CASIM simulations)

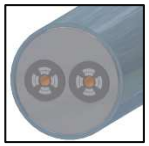
„Quench levels and transient beam losses in LHC magnets"

J.B.Jeanneret, D.Leroy, L.Oberli, T.Trenkler
1996



Summary and further aims



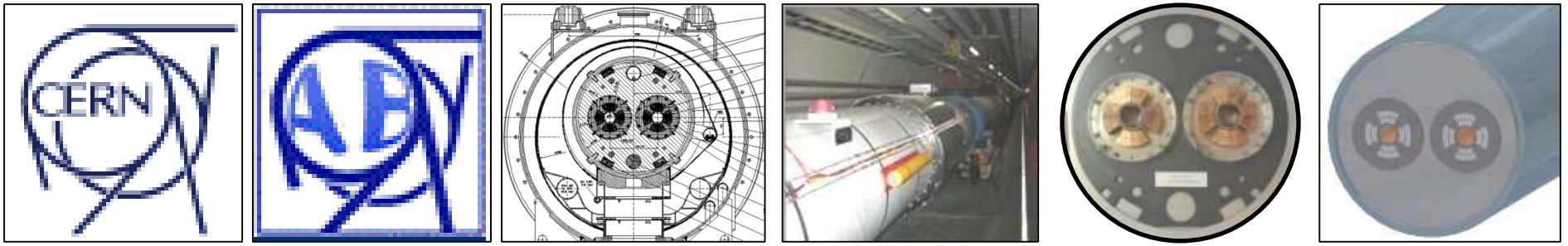


SUMMARY

- Complex magnet geometry has been implemented in Geant4.
- Preliminary threshold for the first BLM on Short Straight Section is about $7.7 \cdot 10^{-5}$ Gy (fast losses).
- Comparison with Geant3 simulations – good agreement.
- Comparison with CASIM – similar results.

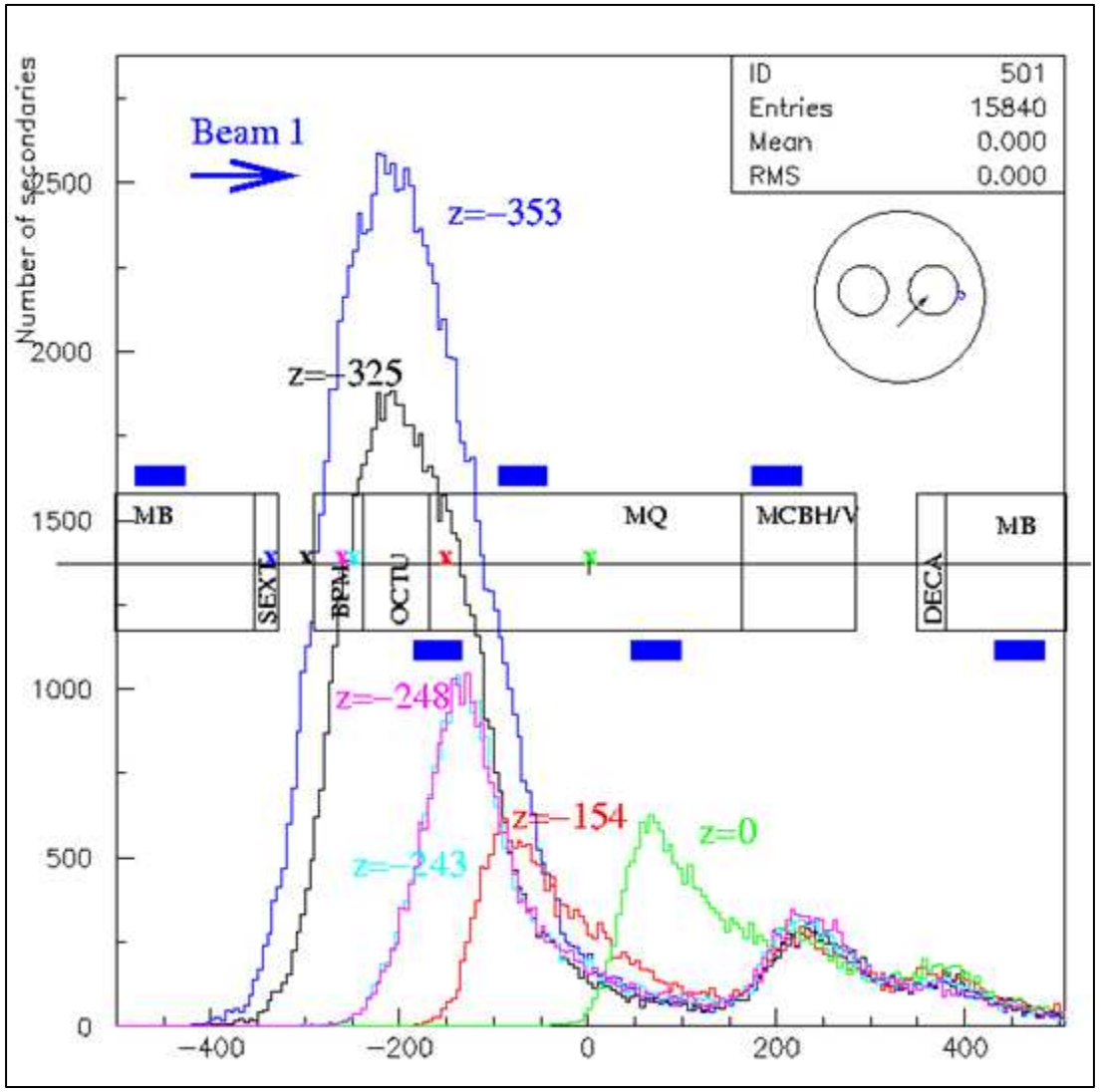
FURTHER DEVLOPMENTS

- Investigations of SSS geometry variations on threshold.
- Development of C9R7 (Dispersion Suppressor) region.
- Q6 in IP3 (large expected losses).



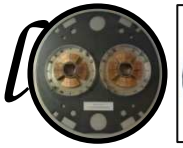
Thank you for your attention !!!

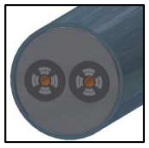
Comparison with Geant3

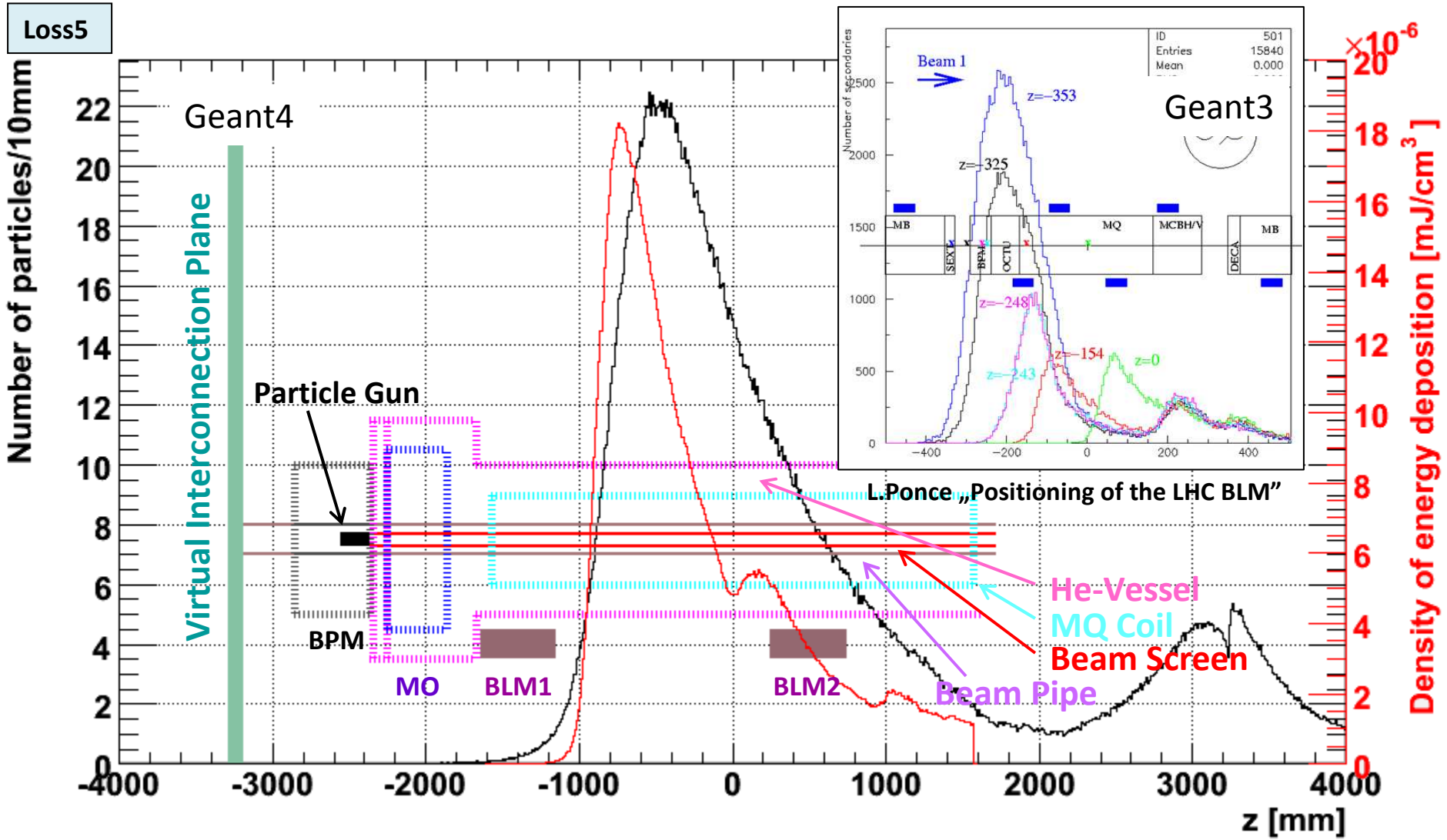


L.Ponce „Positioning of the LHC Beam Loss Monitors”

ρ_{Edep} in the coil & BLM signal







ParticleGun: (119.19; 80; -1000) *640 events* *BLM peak ~ 60 cm after the beam loss*

Problems & impediments

Guided Drawing Retrieval Result

AREA	ACCELERATORS AND MACHINE
PROJECT	
EQUIPMENT	VACUUM - SCREEN - BEAM SCREEN - GENERAL / *VSS__*

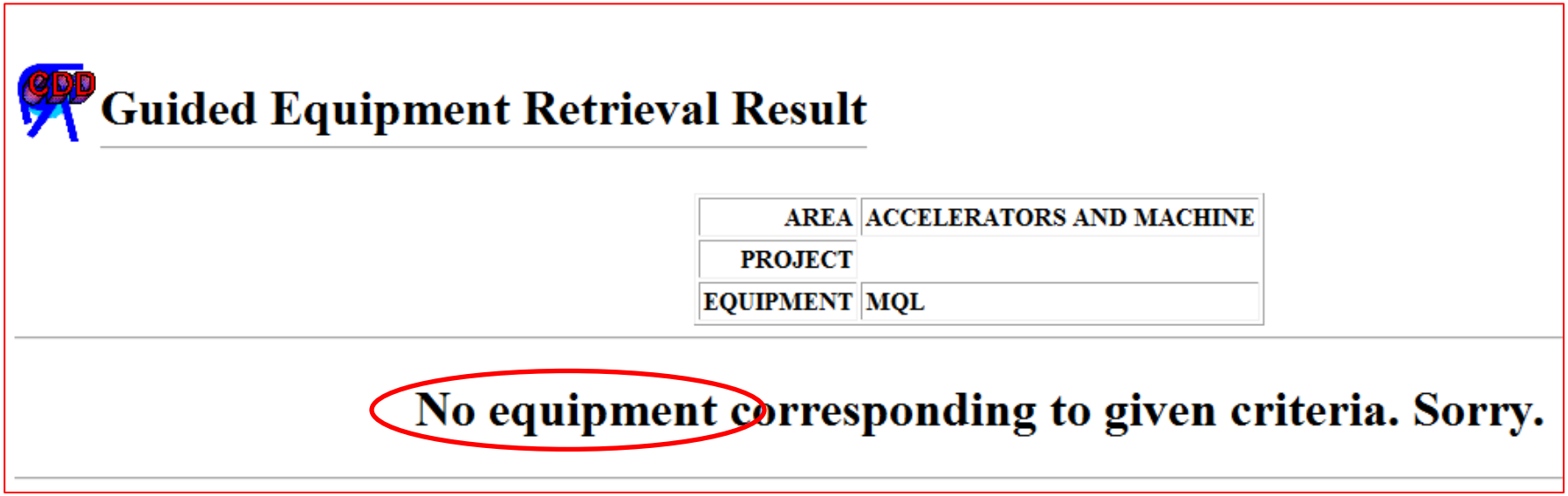
✔ Drawing is available ✖ Drawing is cancelled, obsolete or lost

Directly related drawings

Query returned 53 item(s) :

✖ LHCVSS 0001	- - COOLING TUBE - - -
✖ LHCVSS 0002	- - BEAM SCREEN UPPER SUPPORT - - -
✖ LHCVSS 0003	- - BEAM SCREEN LOWER SUPPORT - - -
✖ LHCVSS 0004	BEAM SCREEN - SUPPORT FOR COOLING TUBE - - -
✔ LHCVSS 0005	BEAM SCREEN - FIXED POINT - - -
✖ LHCVSS 0006	BEAM SCREEN - CLAMP FOR END FORMING - - -
✖ LHCVSS 0007	DISPLACEMENT SENSOR - _ CAPTEUR DE DEPLACEMENT - _

Problems & impediments



Guided Equipment Retrieval Result

AREA	ACCELERATORS AND MACHINE
PROJECT	
EQUIPMENT	MQL

No equipment corresponding to given criteria. Sorry.

Problems & impediments

Visualization Problem

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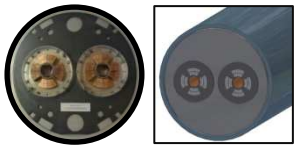
STEPHAN **PETIT**	stephan.petit@cern.ch
FRANCIS **SORIANO**	francis.soriano@cern.ch
CDD **SUPPORT**	cddmgr@mail.cern.ch
ERIC **VAN UYTVINCK**	eric.van.uytvinck@cern.ch
FRANCOIS **VILLAGRASSA**	francois.villagrassa@cern.ch
ZORNITSA **ZAHARIEVA**	zornitsa.zaharieva@cern.ch

Problems & impediments



EDMS Document Search

QUANT	DESCRIPTION	POS	MAT.	OBSERVATIONS	REF.CERN
1	RF-CONTACT (MB-SSS)	2		LHCVBMB_0020	
1	RF CONTACT BELLOWS U- TYPE	1		SKODOCK B0102900	
	ENS./ASS.			S.ENS/S.ASS.	

VACUUM - BELLOWS - MODULE - 50MM

MB-SSS PLUG-IN MODULE SERIES

–

–

ECHELLE SCALE 1:1 2:1 4:1

DES/DRA.	V PETROV	2002-02-21
CONTROLLED	C MENOT	2006-01-20
RELEASED	R VENESS	2006-01-25
APPROVED	-	-

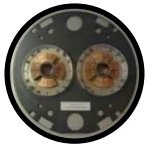
LHCV,VHNSA_BEAMSCR000,V001,V0012879PL

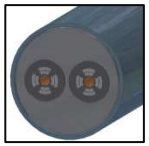
REMPLACE/REPLACES

RELEASED BY PROJECT ENGINEER | FOR INFORMATION | QAC – | LHCVBMB_0003 | SIZE 2 | IND. A

362454 v.1	Manufacturing Drawings Skodock	Draft For Discussion
Access denied		
362680 v.PRR	Manufacturing Drawings Bellows	In Work
Access denied		
362687 v.f	Manufacturing Drawing B0102500f	In Work
Access denied		
362691 v.e	Manufacturing Drawing B0102501e	In Work
Access denied		
362692 v.d	Manufacturing Drawing B0102502d	In Work
Access denied		
362694 v.c	Manufacturing Drawing B0102503c	In Work
Access denied		
362695 v.a	Manufacturing Drawing B0102504a	In Work
Access denied		

Cell volume





$r = 0, 1, 2$

$\rho = 0, 1, \ldots, 90$

$z = 0, 1, \ldots, 300$

$r_{Coil,inner} = 28$ mm

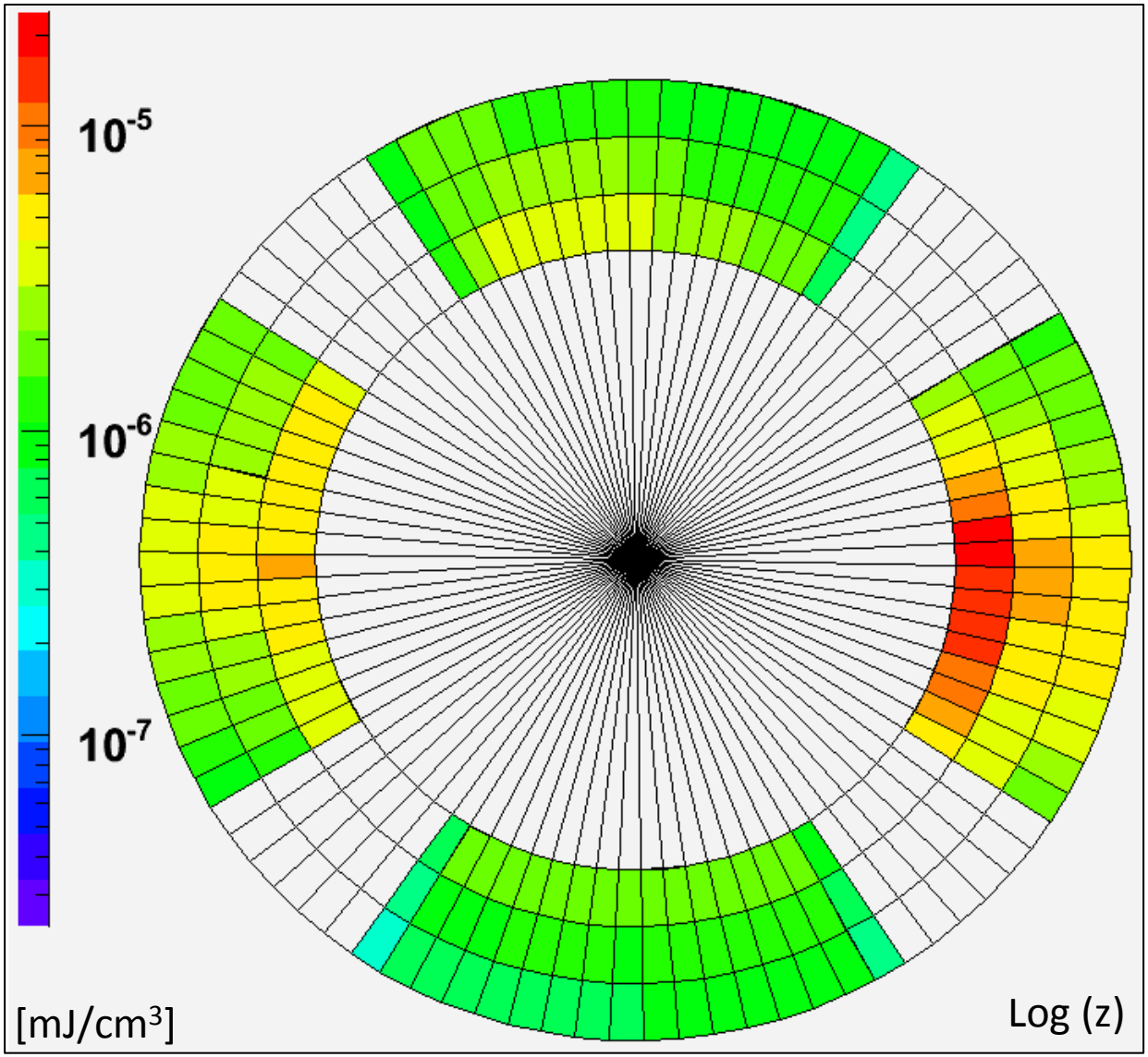
$r_{Coil,outer} = 43.36$ mm

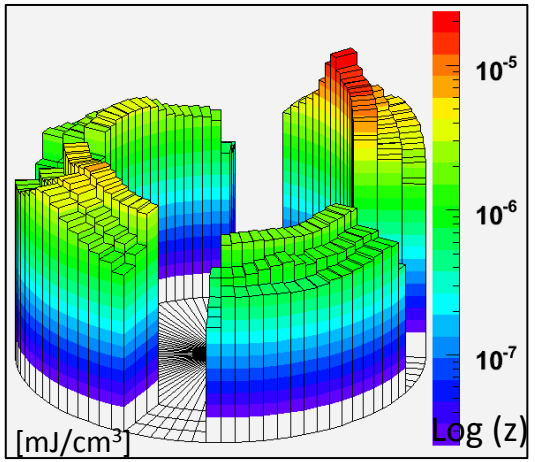
$r_{Cell,inner} = 28 + r \cdot (r_{Coil,outer} - r_{Coil,inner}) \cdot \frac{1}{3}$

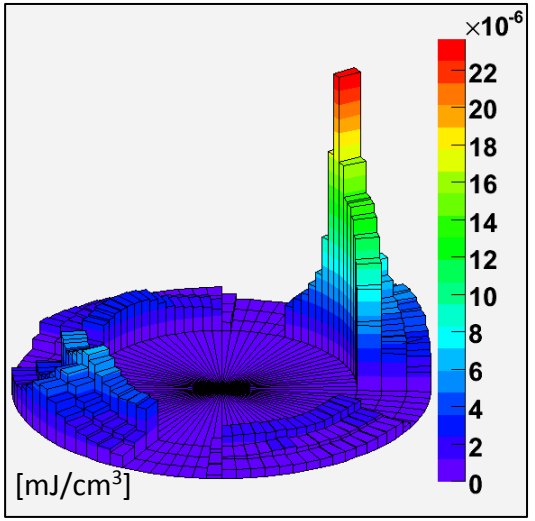
$r_{Cell,outer} = 28 + (r+1) \cdot (r_{Coil,outer} - r_{Coil,inner}) \cdot \frac{1}{3}$

$$V = \pi \cdot [(r_{Cell,outer})^2 - (r_{Cell,inner})^2] \cdot z \cdot \frac{1}{300} \cdot \frac{1}{90}$$

Energy depositions in the coil







2D histogram: (φ, r) weighted by energy density

Cross - section