Performance study for the absorber of the muon spectrometer in the ALICE experiment

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9 july 2013

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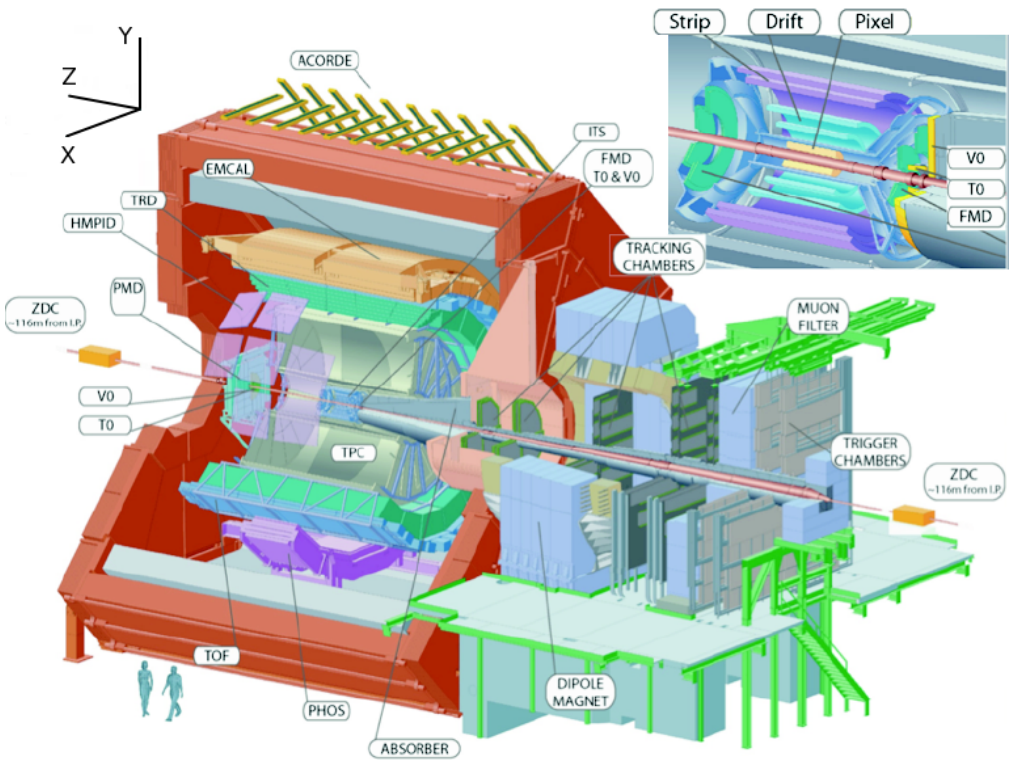
Contents

The ALICE experiment



PbPb at $\sqrt{s}$= 2.76 TeV, centrality 0%-10%.

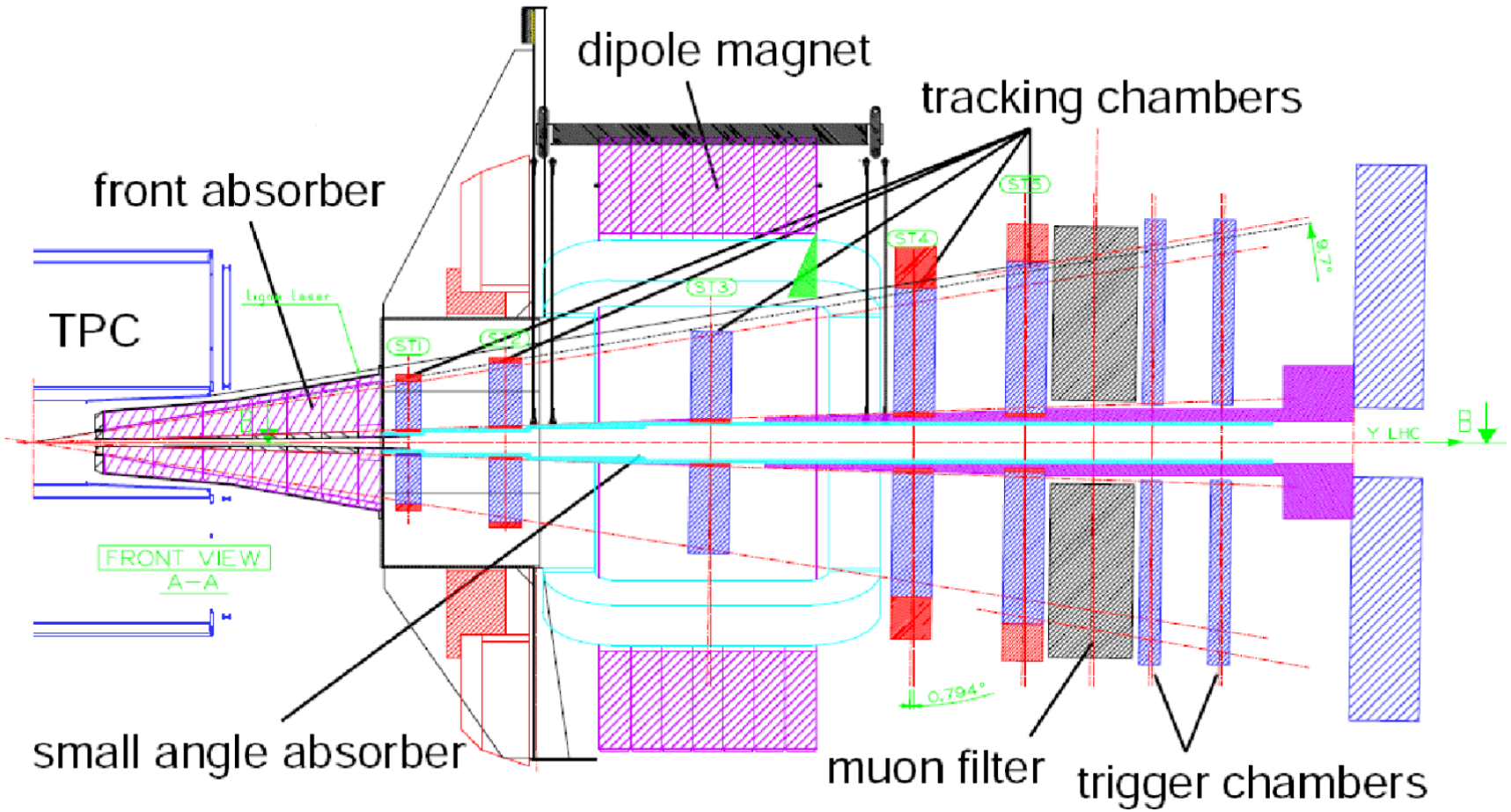
8000 part/ev/η estimed in 1990.

1600 part/ev/η mesured nowadays.

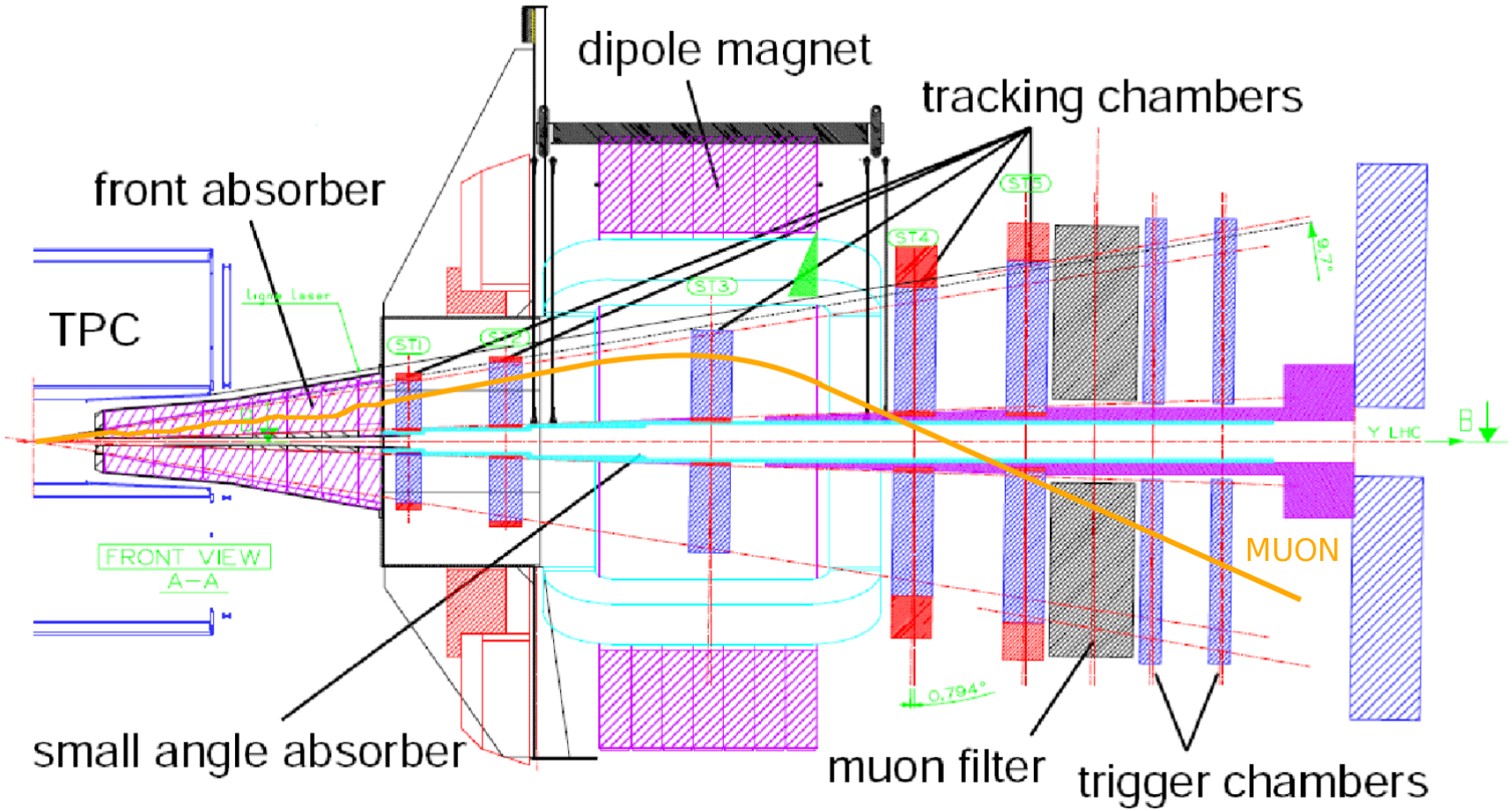
pp at $\sqrt{s}$=7 TeV.

pPb at $\sqrt{s}$=5.2 TeV.

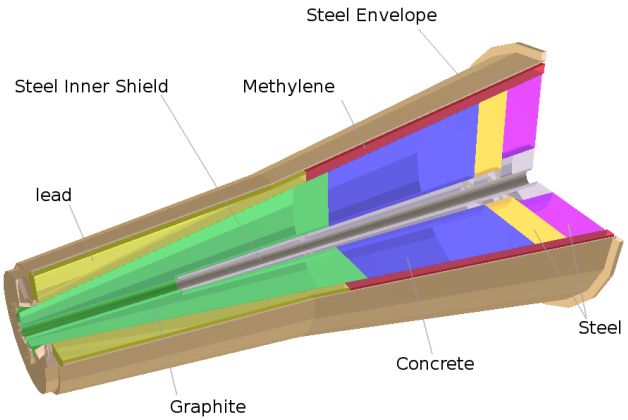
The muons spectrometer

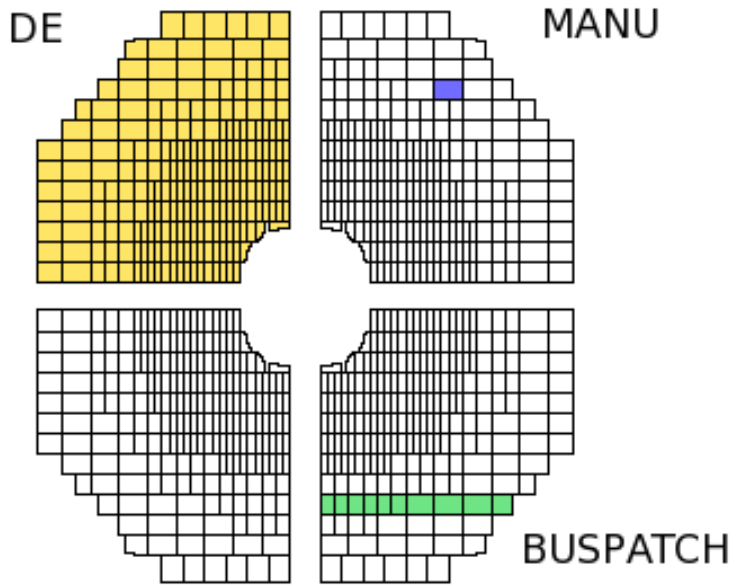


The muons spectrometer



The absorber and the tracking chambers



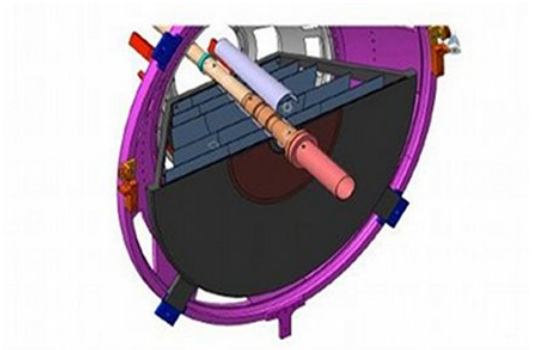


Trajectography chamber 1

- $171° \leq \theta \leq 178° (-4 \leq \eta \leq -2,5)$
- $0 \leq \phi \leq 2\pi$
- $p \geq 4\ GeV$

Muon Forward Tracker

Projet under study since 2009, possible upgrade of the spectrometer in 2018.



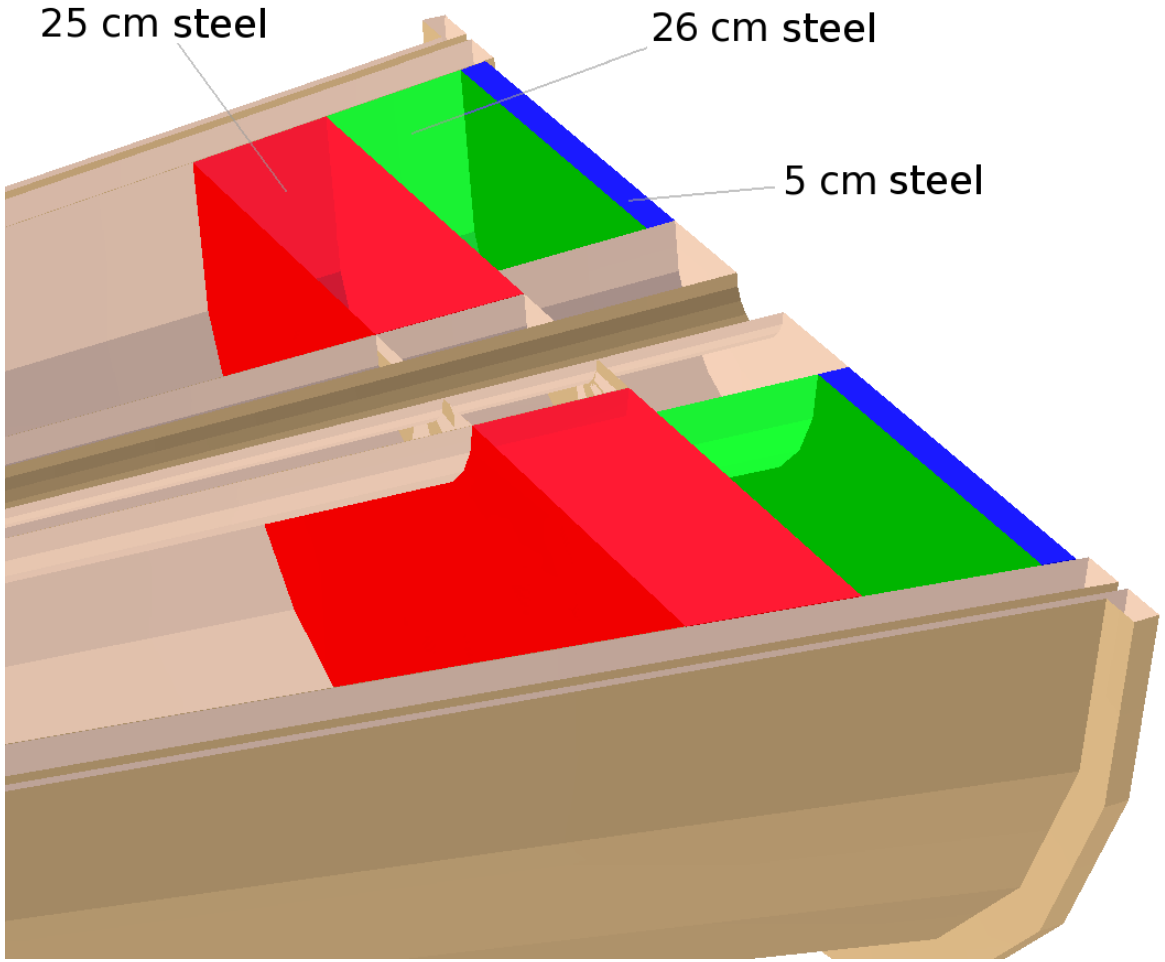
Motivation

- Better determination of muons vertex.
- Higher resolution of the J/ψ mass spectra.

Drawback: energy loss.

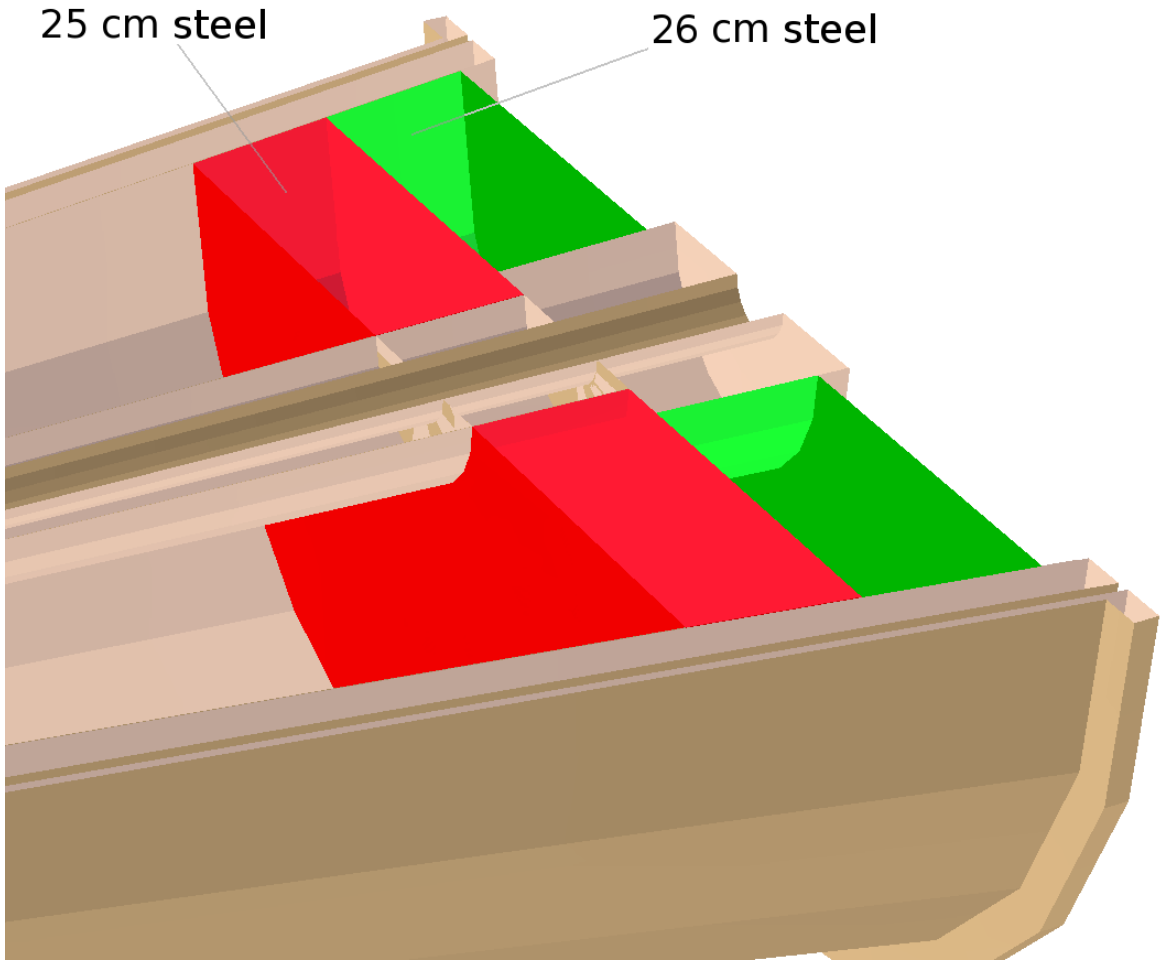
- Improvment in the p_T cut for the observation of vectors mesons ρ, ω, φ and ϕ.

Four configurations studied



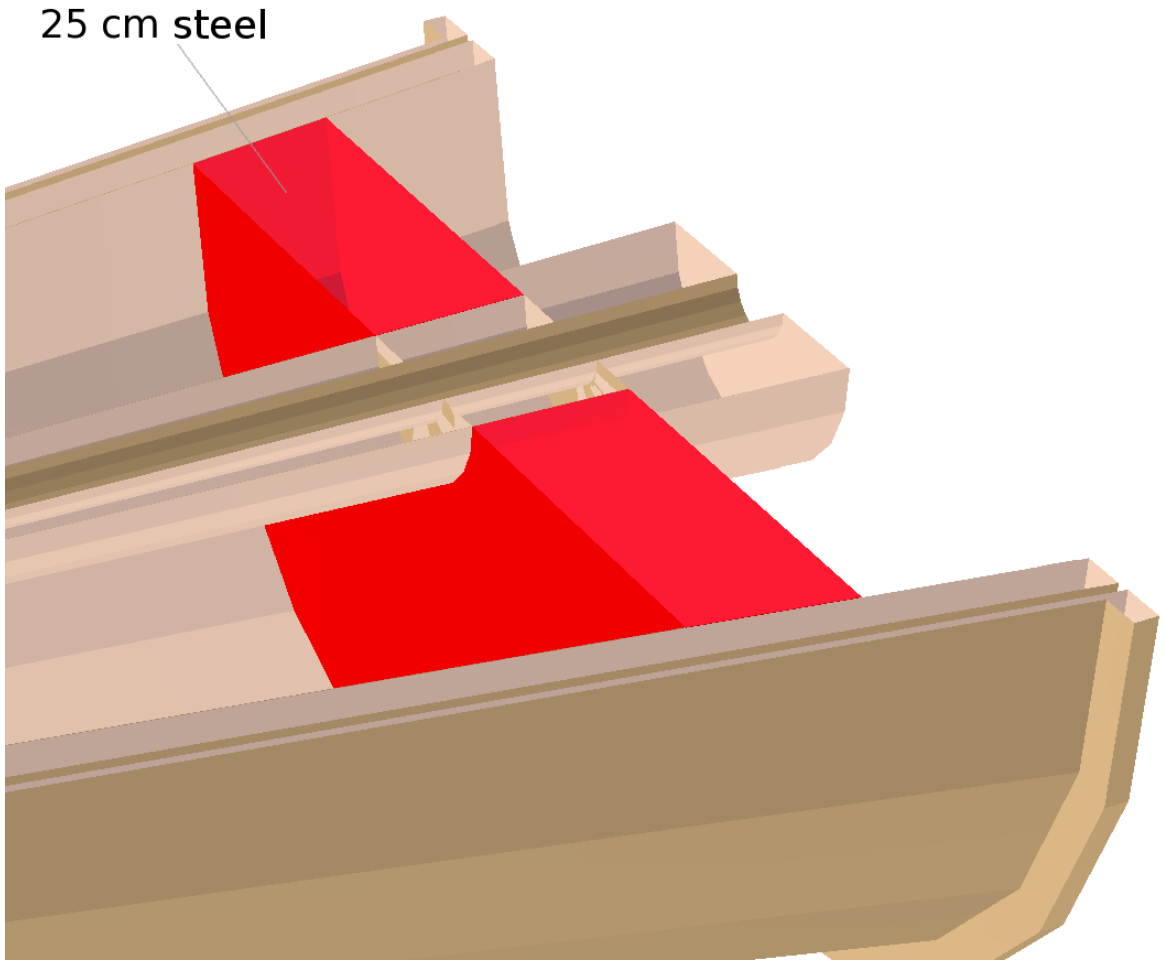
1st case
56 cm steel

Four configurations studied



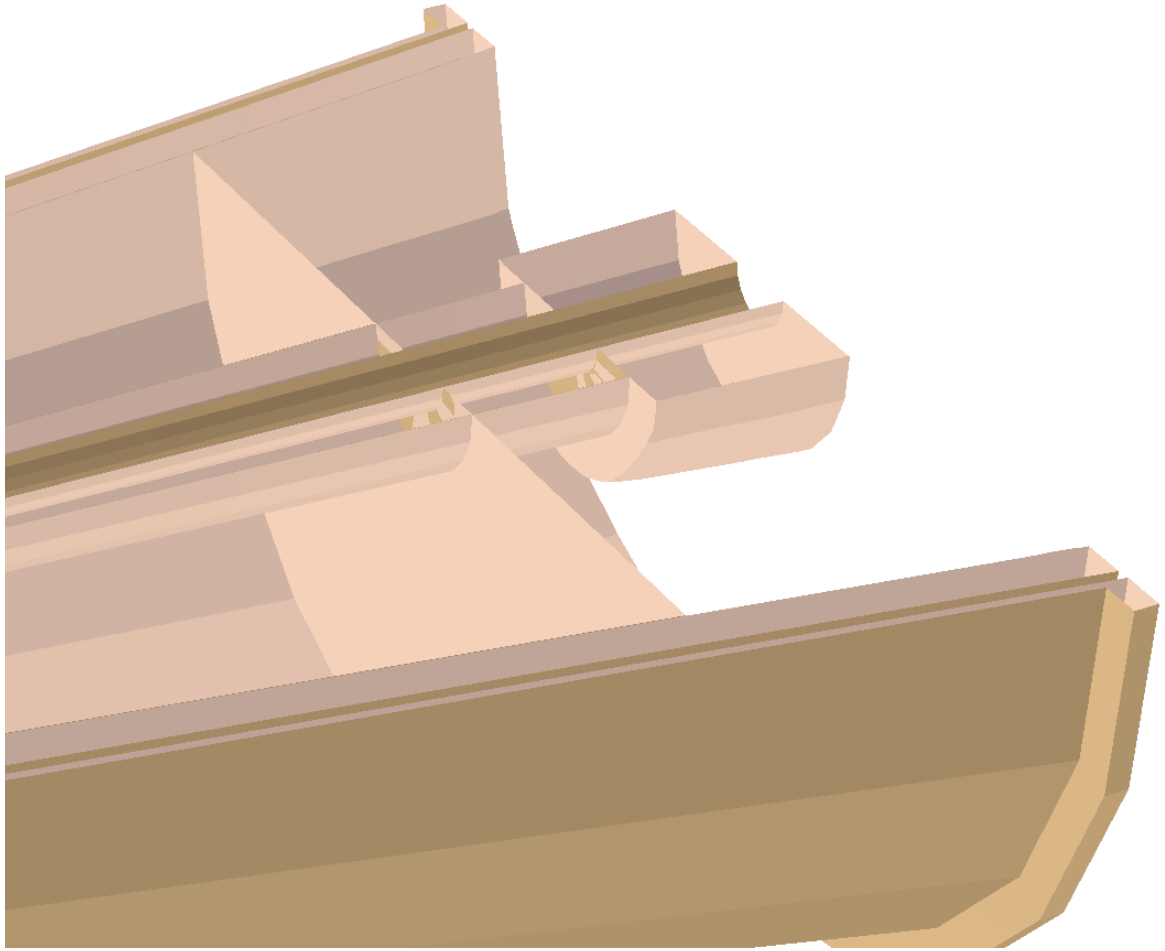
2nd case
51 cm steel

Four configurations studied



3rd case
25 cm steel

Four configurations studied

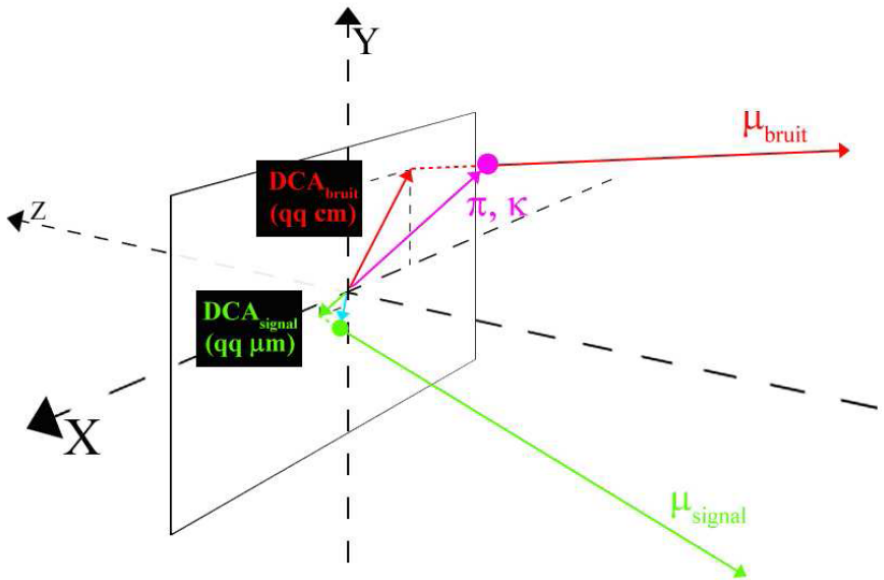


4th case
Without steel

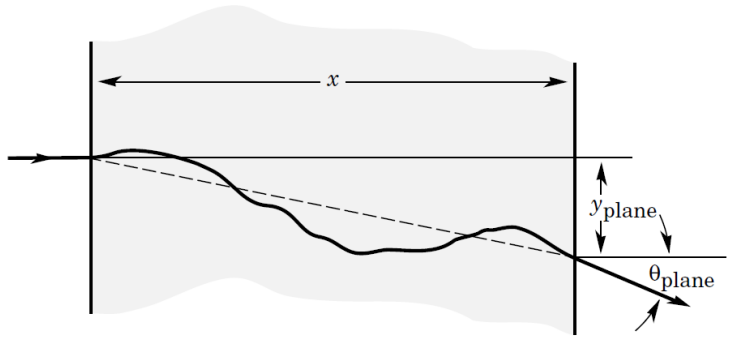
Distance closest approach

Goal: reject background tracks.

DCA: Distance between the real and the reconstructed vertex in the plane *xy*



Coulomb multiple scattering



Gaussian distribution of θ_{plane} with $\sigma_{\theta_{plane}} \propto 1/p$

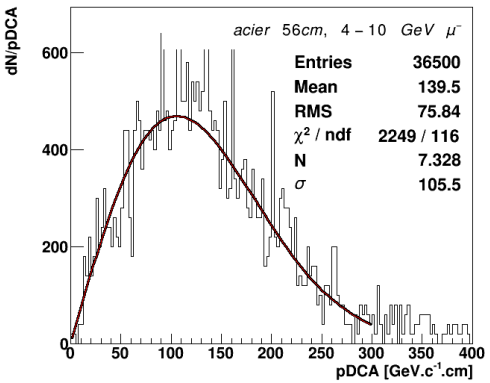
We will use the p×DCA

$$P(pD) \simeq N.r.exp\Big(-\frac{r^2}{2\sigma^2}\Big) \text{ avec } r = \sqrt{DCA_x^2 + DCA_y^2}$$

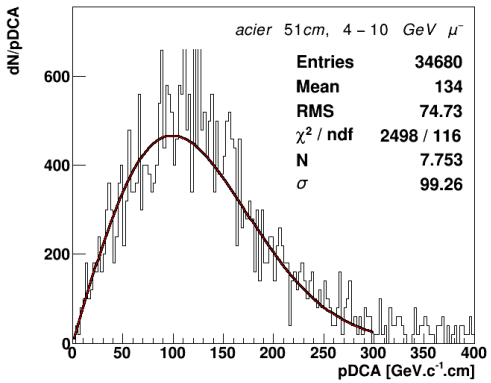
pDCA distribution - simulation of μ^- from 4 to 10 GeV

56 cm steel

$\sigma = 105.5 \pm 0.3$ Gev.c^{-1}.cm

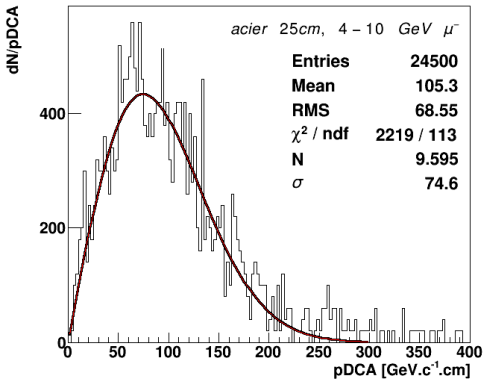


51 cm steel

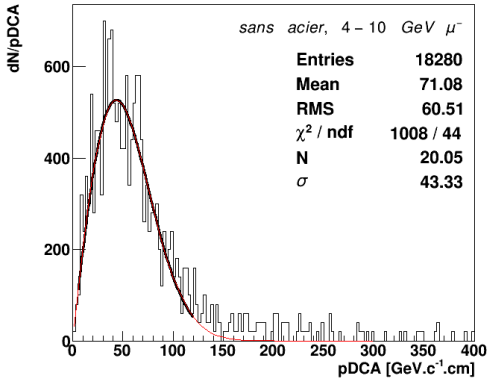


$\sigma = 99.26 \pm 0.3$ Gev.c^{-1}.cm

$\sigma = 74.60 \pm 0.3$ Gev.c^{-1}.cm



25 cm steel

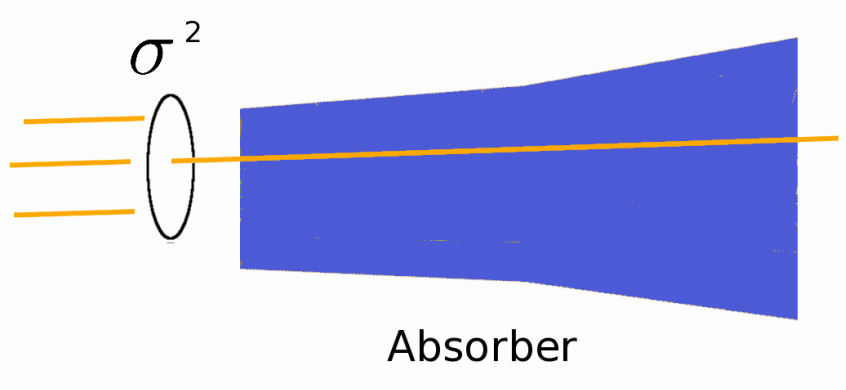


Without steel

$\sigma = 43.33 \pm 0.2$ Gev.c^{-1}.cm

pDCA

σ^2 describe a surface where the particule is seen before the absorber.



Square of the pDCA FWHM.

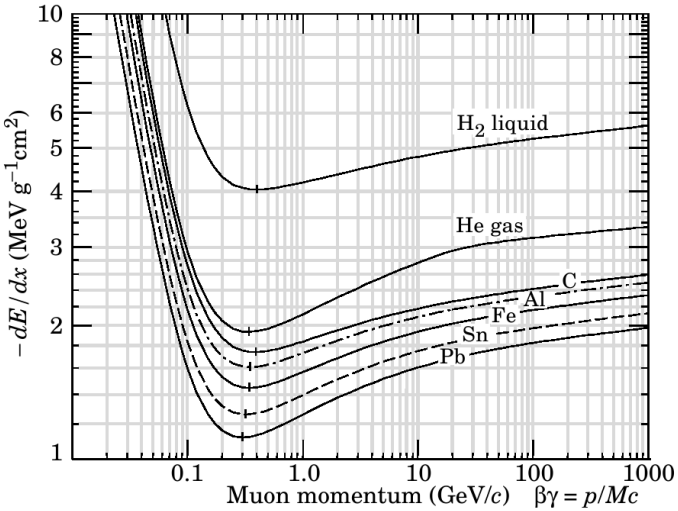
Configuration	$(\sigma_{modif}/\sigma_{current})^2$
51 cm steel	0.88 ± 0.006
25 cm steel	0.5 ± 0.004
Without steel	0.17 ± 0.002

Energy loss

Energy loss in steel of muons from 10 to 100 GeV with Bethe formula.

Configuration	Energy loss
56 cm steel	880 MeV
51 cm steel	800 MeV
25 cm steel	400 MeV

Decrease of almost 1/4 of the muon energy loss through the absorber without steel.



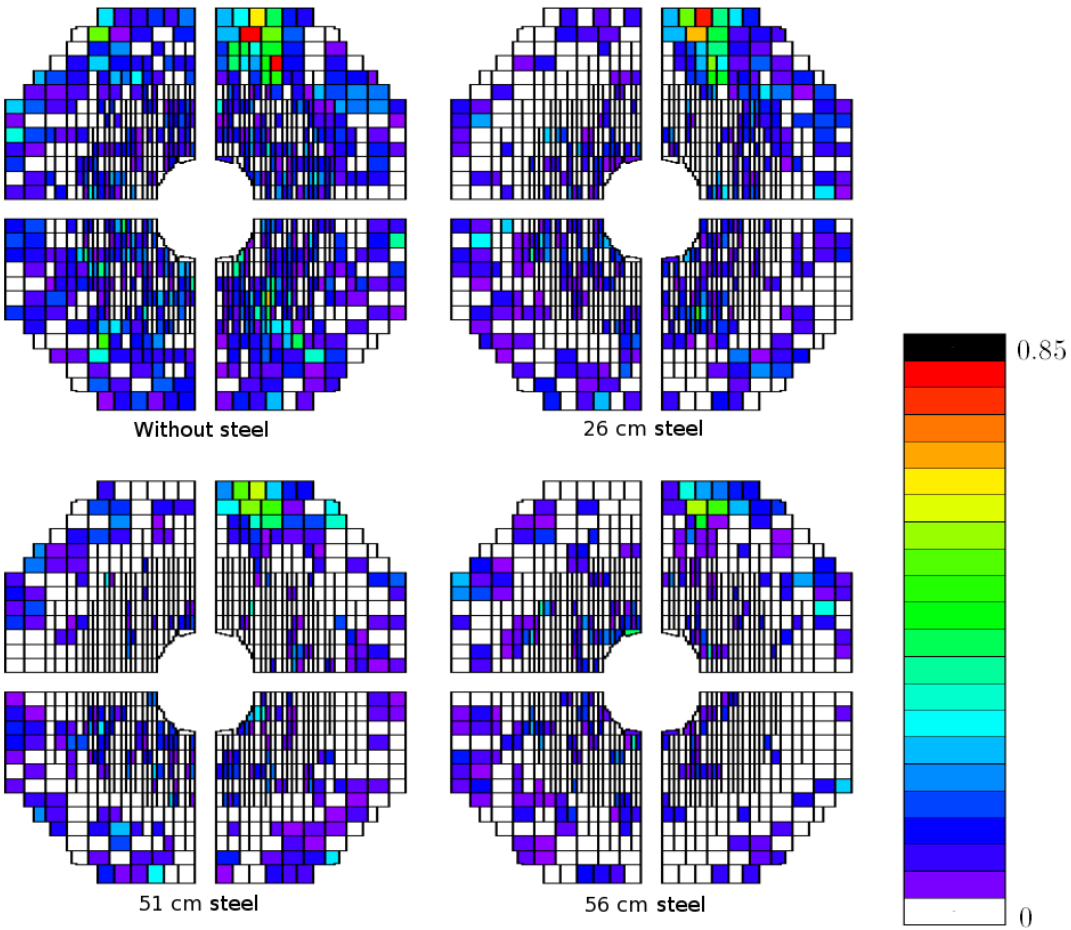
The energy loss must be compared with the one from the MFT.

Hijing simulations

Hijing simulations PbPb $\sqrt{s}$= 5.5 TeV.

- Centrality 0-10%.
- Same kinematic for each event.
- 10 simulated events.

Occupancy rate in MANU



Chamber 1
1 events

Occupancy rate of chambers, 10 events

Station	Chamber	56 cm	26 cm	Without steel
1	1	1.16e-2	1.56e-2	5.83e-2
	2	1.42e-2	1.62e-2	5.41e-2
2	3	2.09e-2	2.14e-2	4.55e-2
	4	1.99e-2	1.96e-2	4.21e-2
3	5	1.21e-2	1.25e-2	1.87e-2
	6	1.25e-2	1.25e-2	1.93e-2
4	7	0.931e-2	0.857e-2	1.18e-2
	8	0.967e-2	0.968e-2	1.15e-2
5	9	0.972e-2	0.897e-2	1.10e-2
	10	0.989e-2	1.02e-2	1.17e-2

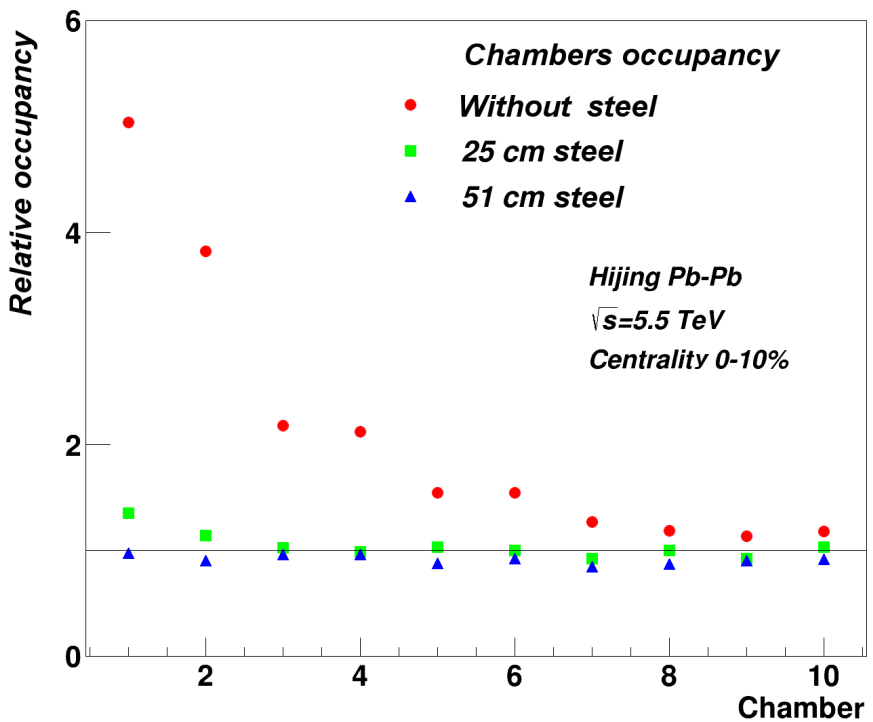
Current configuration, occupancy rate lower than 2%.

In the case without steel, occupancy rate over 5%.

Relative occupancy rate of chambers

We introduce the relative occcupancy rate by:

$$\frac{Simulated\ occupancy}{Current\ occupancy}$$

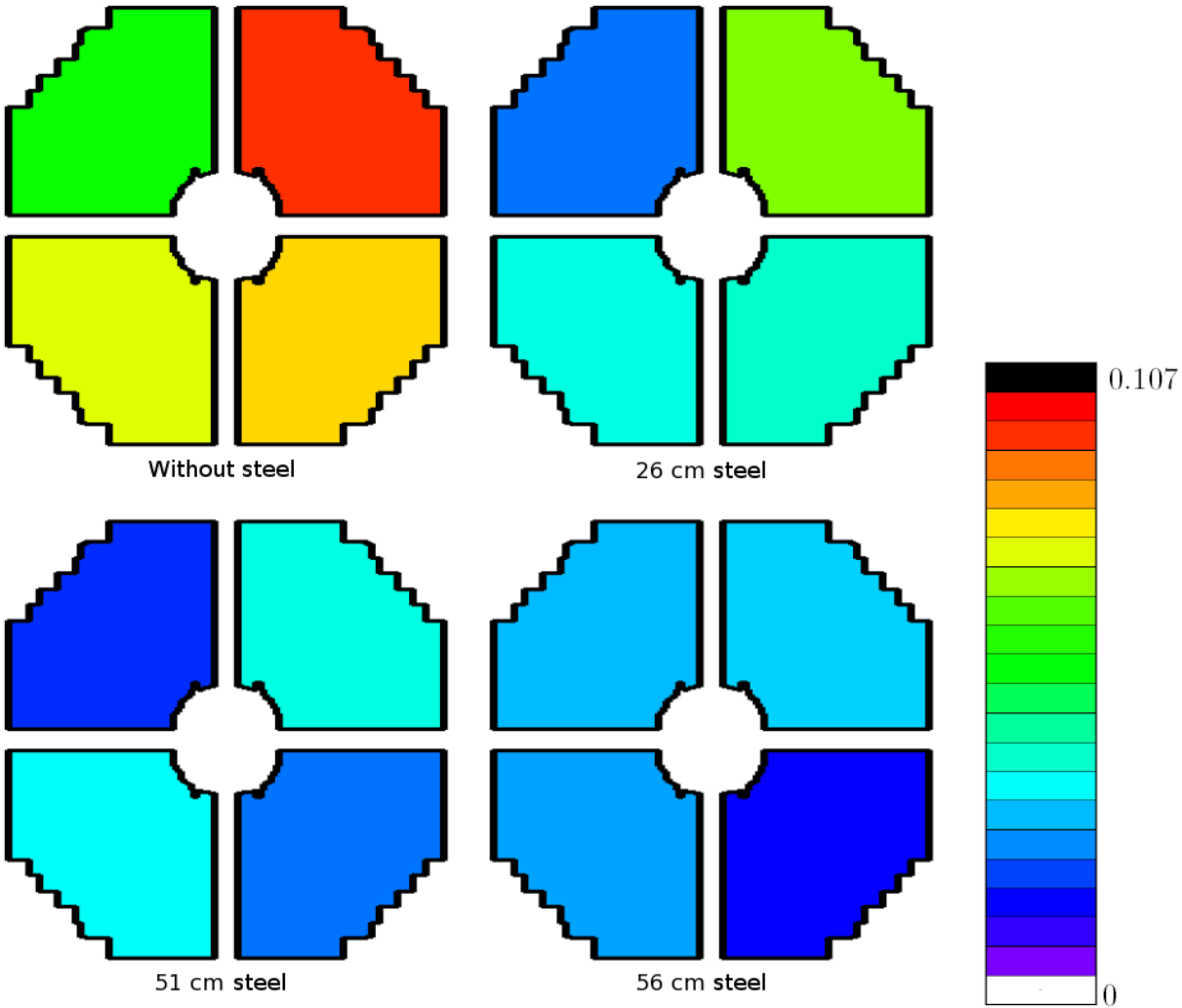


10 events

Importante increase of the occupancy rate in the case without steel.

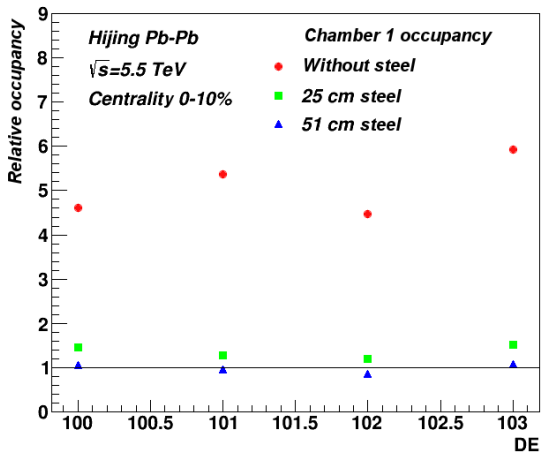
Slight increase for the others configurations.

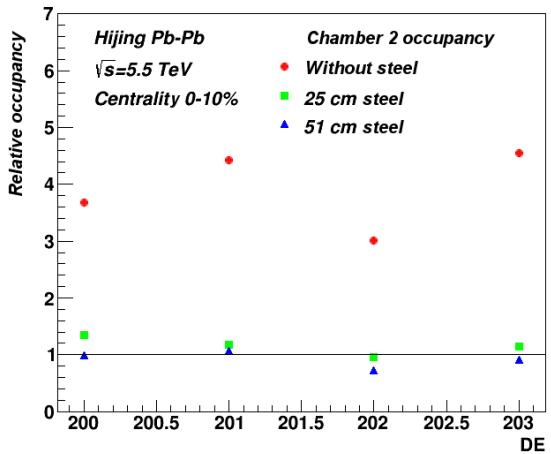
Occupancy rate in DE

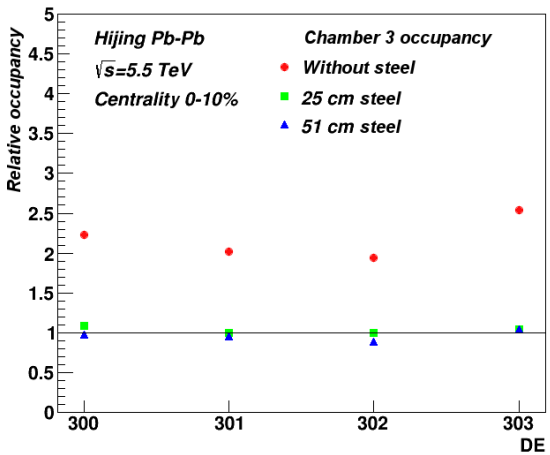


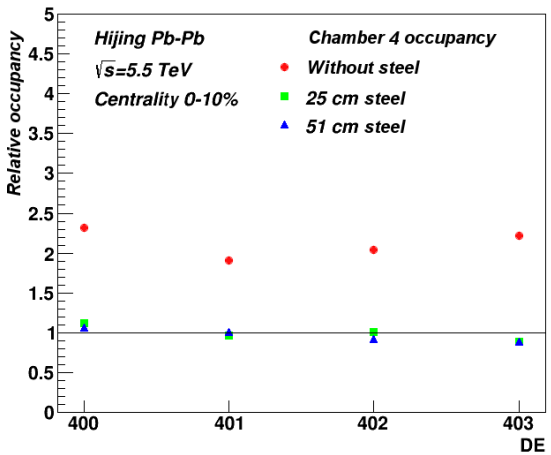
Chamber 1
1 event

Occupancy rate in DE, 10 events









Conclusion

- We have performed simulation of the muon spectrometer with a modified geometry of the absorber.
- We studied the improvement in the pDCA method: decrease of σ_{pDCA} by 40 $GeVc^{-1}cm$ (decrease of the surface by 2) in the case with 26 cm of steel and by 60 $GeVc^{-1}cm$ (decrease of the surface by 6) in the case without steel.
- Slight increase of the occupancy rate in the case with 25 cm of steel. Occupancy rate higher than 5% in the case without steel.
- It would make the study of vectors mesons easier with lower p_T cut and improvement of the invariant mass resolution.

$\Rightarrow$ Compromise to be reached and see if the removal of steel is technically feasible.