Status of Muon Chamber geometry @CBM

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for the CBM collaboration
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Collaborators
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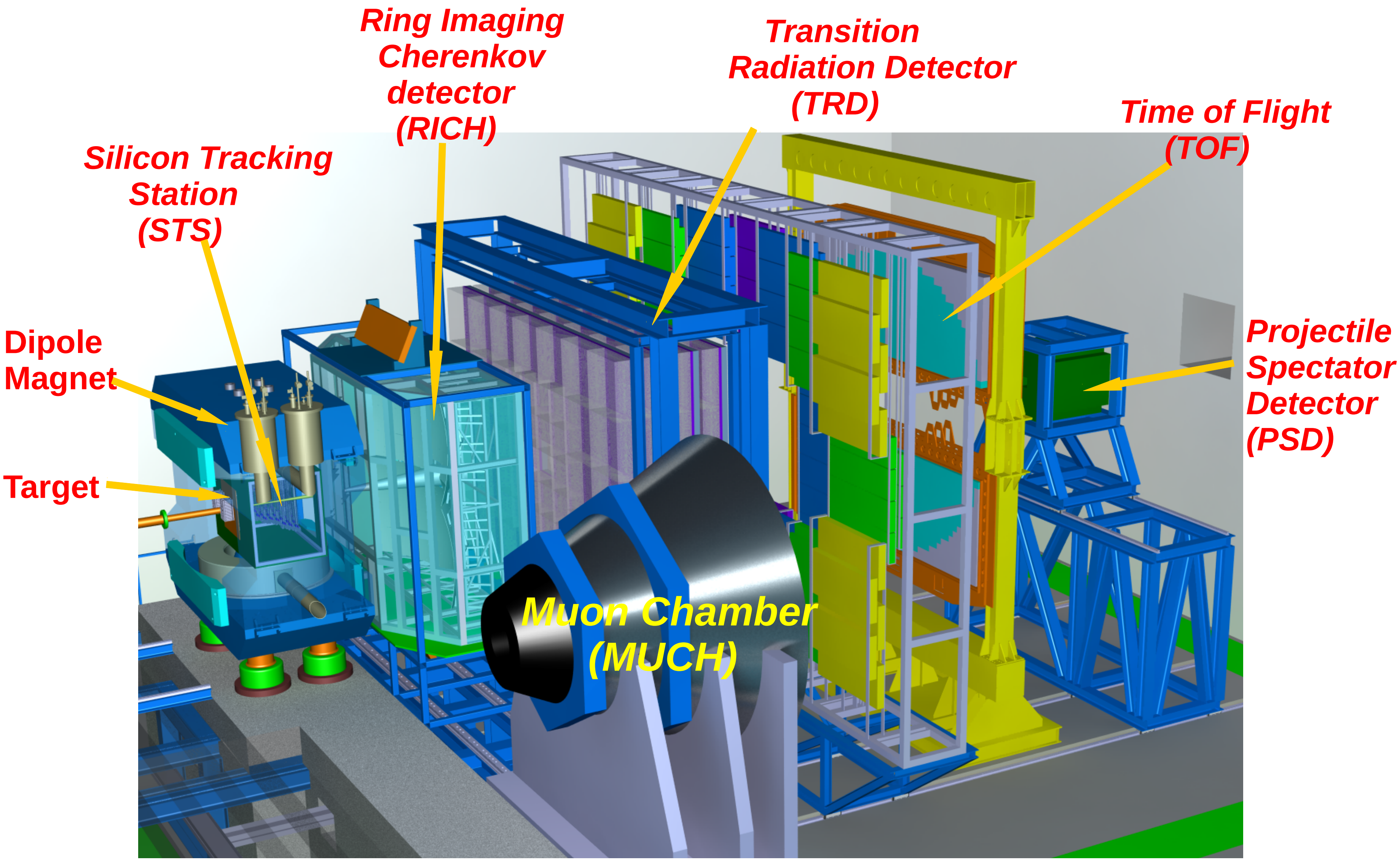
Outline

- *CBM Experimental setup.*
- *Muon detector system or Muon Chamber (MUCH).*
- *Different configurations of Muon Chamber*
- *Up gradation of Muon Chamber detector system and recent status MUCH geometry after Technical Design Report (TDR).*
- *To do list & summary.*

CBM Experimental setup

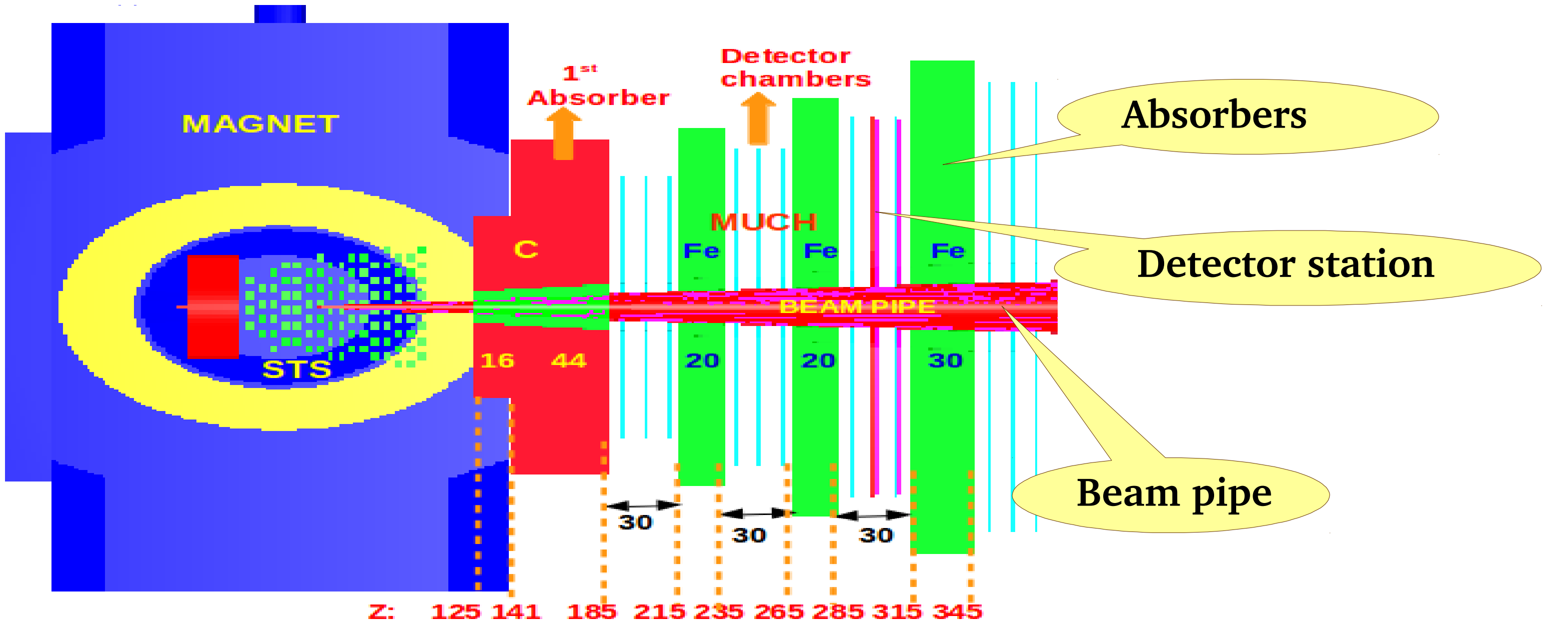


– *Upcoming fixed target Experiment at FAIR where heavy ions will be collided at* E_{lab} *=4 to 40 GeV/A.*

– *Maximum interaction rate at CBM ∼10 MHz.*

– *will make possible the precise measurement of rare probes.*

Muon Chamber design



Specifications

– Detector angular coverage 5.7° - 25°

– Total absorber is sliced and detector chambers are placed in between absorbers.

– Distance between 2 absorbers is 30 cm, where 3 detector layers are placed with 10 cm distance between consecutive layer centers.

– MUCH cave starts at 125 cm from target.

– 1st absorber made of Graphite and rest are made of Iron.

Modifications after TDR

– Beam pipe design has been changed

– shift of the position of MUCH cave

– Absorbers design have been modified

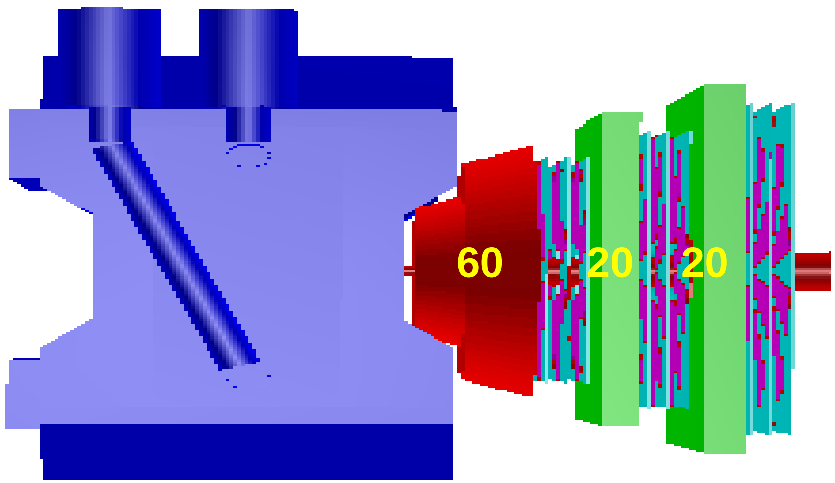
– 1st absorber shape modified

– Magnet shielding bars have been removed

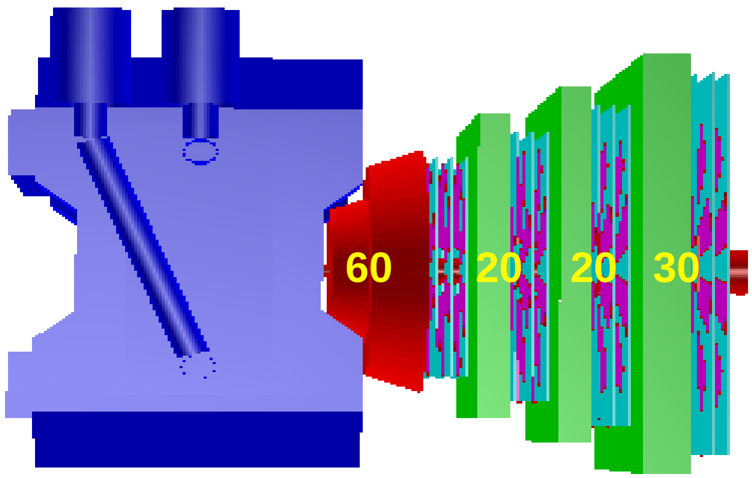
– Investigation on 2nd station size have been done

– Investigation going on for 3rd & 4th station

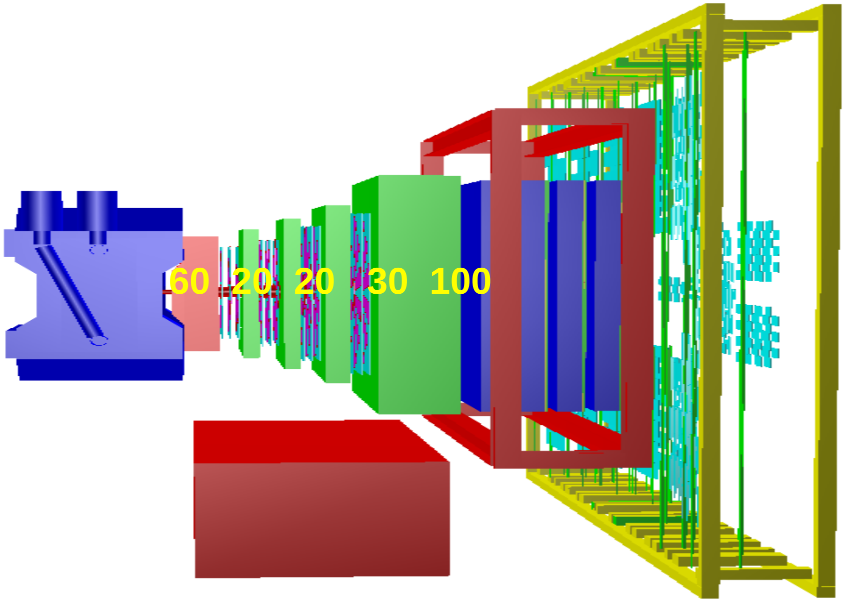
Different configurations of MUCH



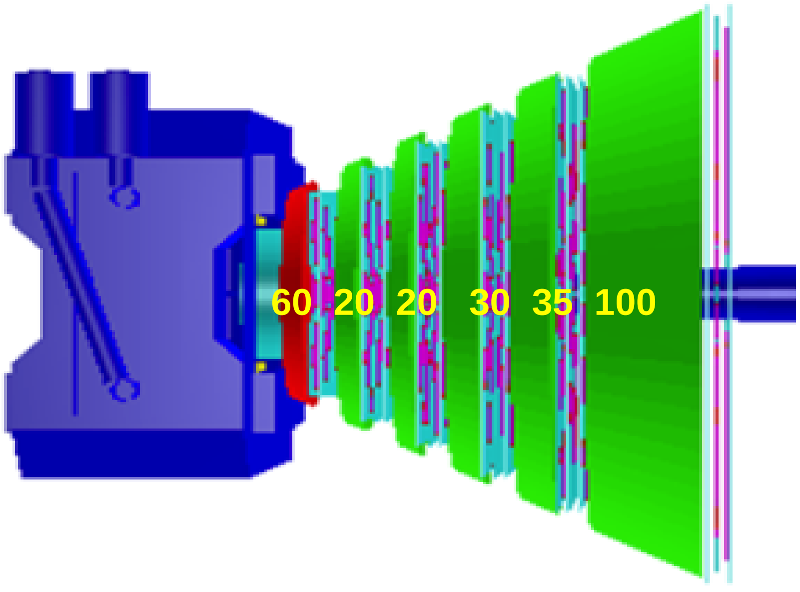
SIS100A (3 stations + 3 absorbers)



SIS100B (4 stations + 4 absorbers)



SIS100C (5 stations + 5 absorbers)



SIS300 (6 stations + 6 absorbers)

Thickness of absorbers as specified in TDR

Simulation tools

CBM ROOT framework with FAIRSOFT & FAIRROOT

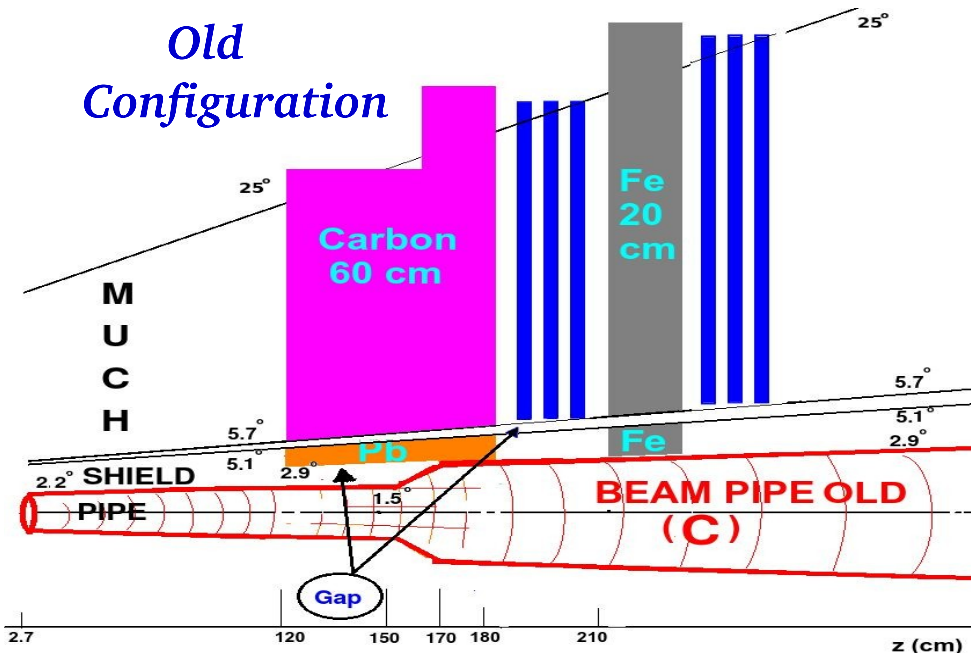
GEANT3 transport code

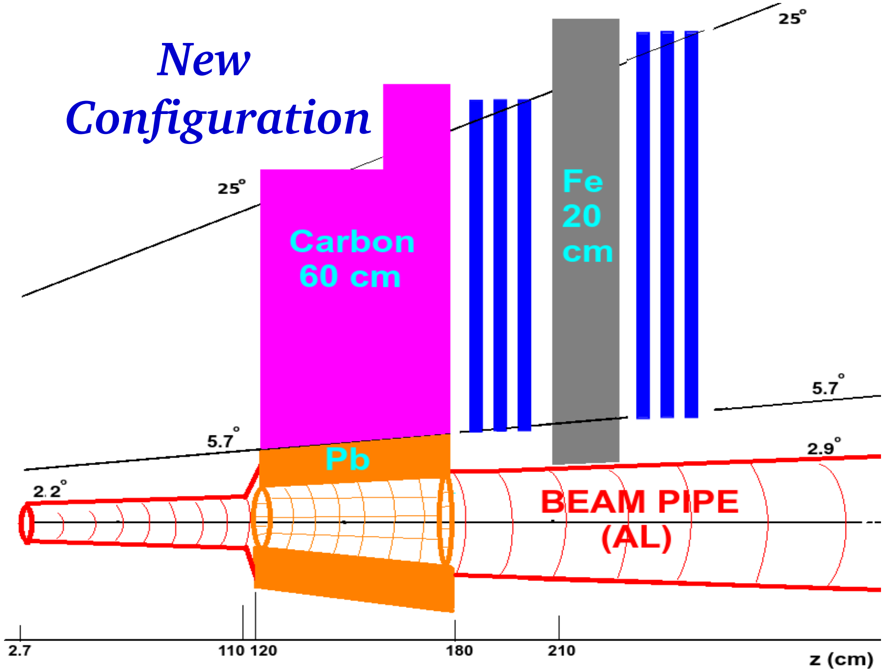
Event Generators : URQMD + PLUTO

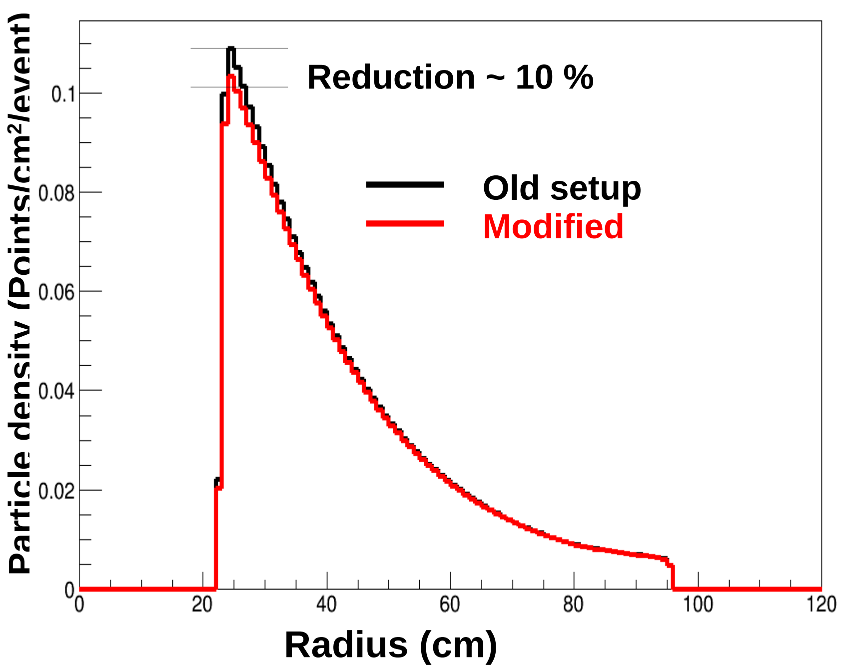
URQMD – to generate background events

PLUTO – to generate dimuons from signal
(ρ, ω ,ϕ , J/Ψ –> μ+ μ-).

(a) Modifications of beam pipe & shielding







Particle density for 1st station

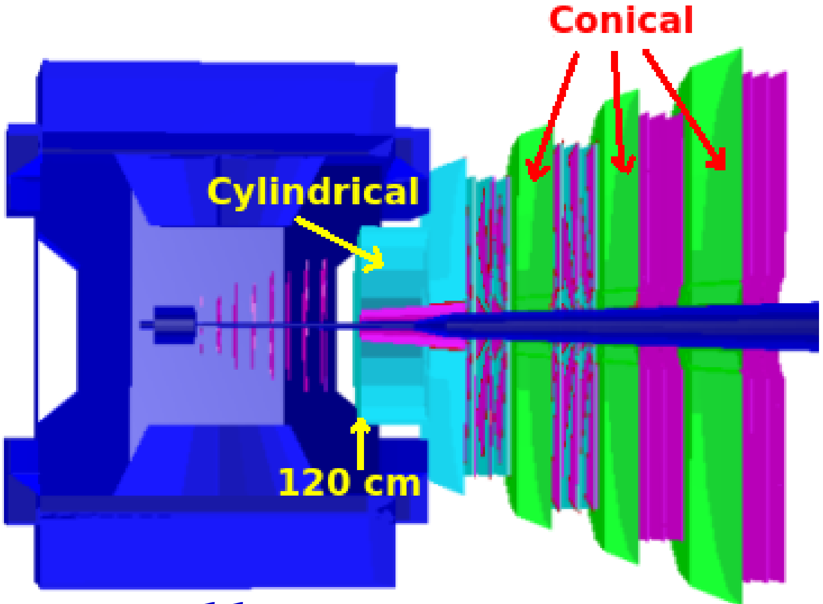
Results:

– *Particle density has reduced*

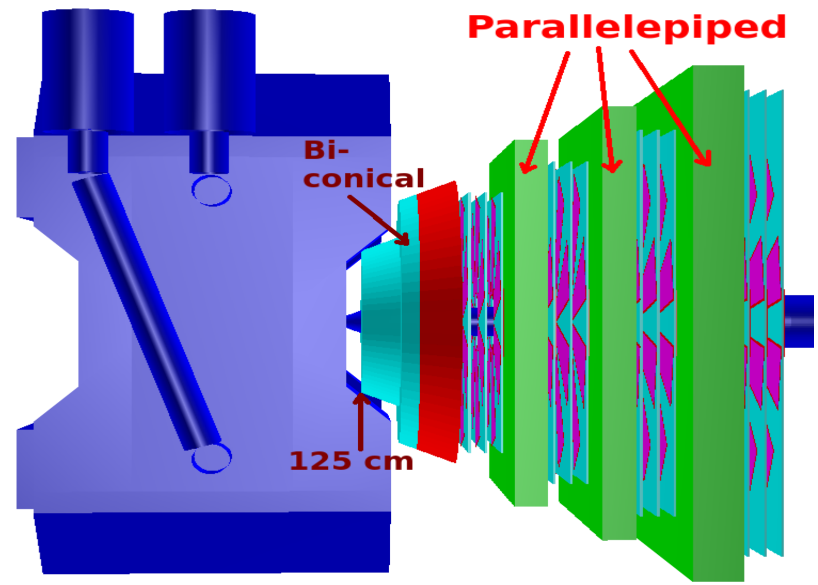
– *Signal to background ratio & efficiency nearly same*

ω	Eff(%)	S/B
Old geo	0.82	0.27
New geo	0.81	0.28

(b) Modification of Muon chamber design



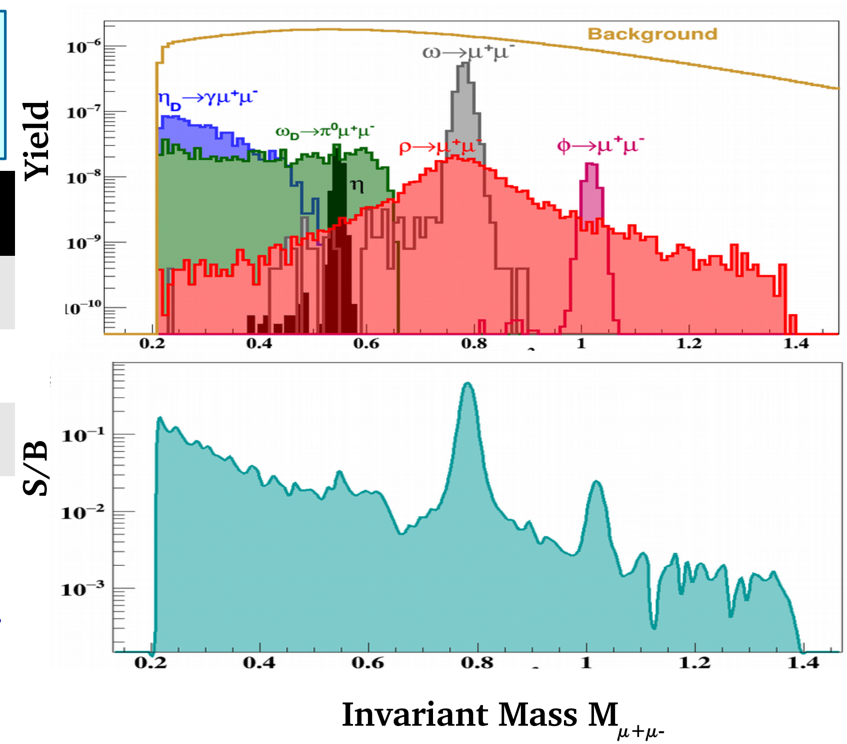
Old



Modified

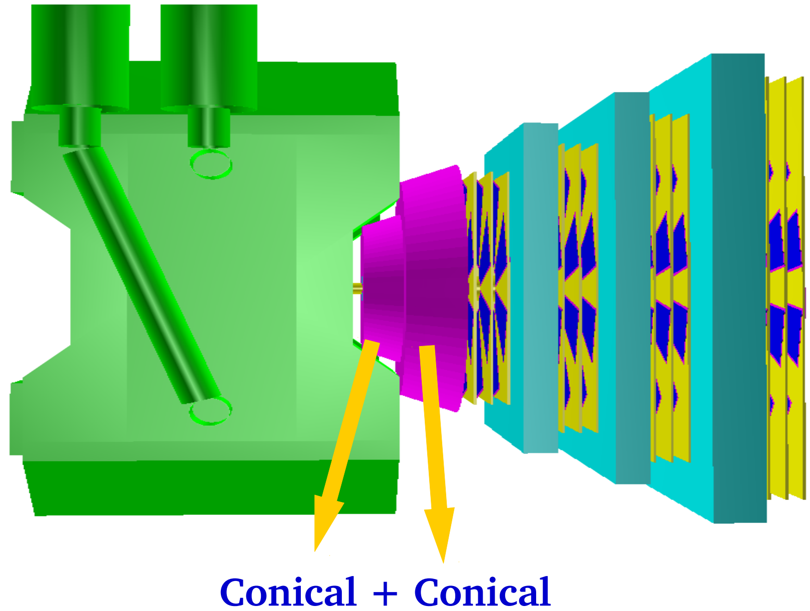
- *MUCH cave position shifted by 5 cm*
- *Absorbers shape (except 1st) conical –> parallelepiped.*
- *1st absorber cylindrical+conical –> biconical*

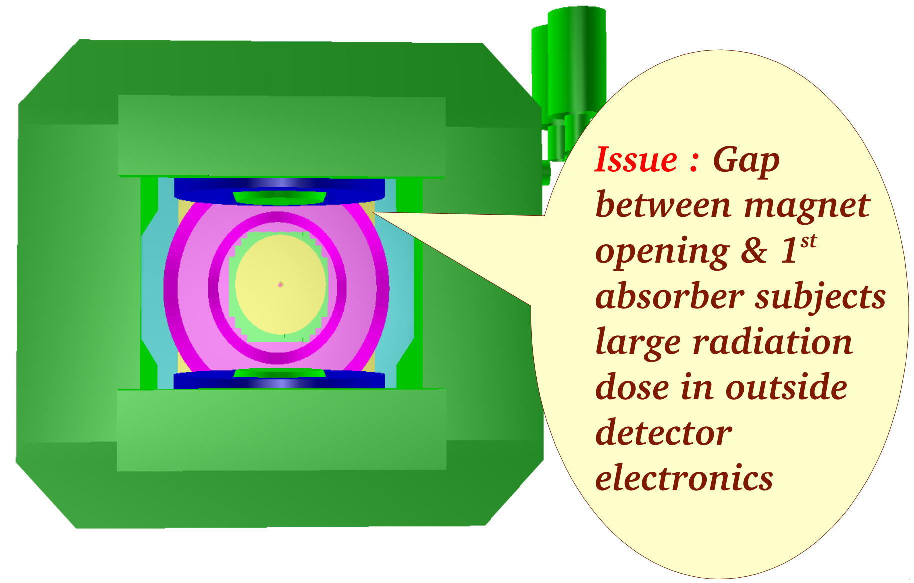
		ρ	ω	ϕ	η	η_D	ω_D
Efficiency (%)	Old	0.73	0.79	1.16	0.39	0.16	0.27
	modified	0.79	0.84	1.26	0.41	0.17	0.30
S/B	Old	0.008	0.29	0.014	0.01	0.005	0.007
	modified	0.007	0.27	0.014	0.01	0.003	0.006

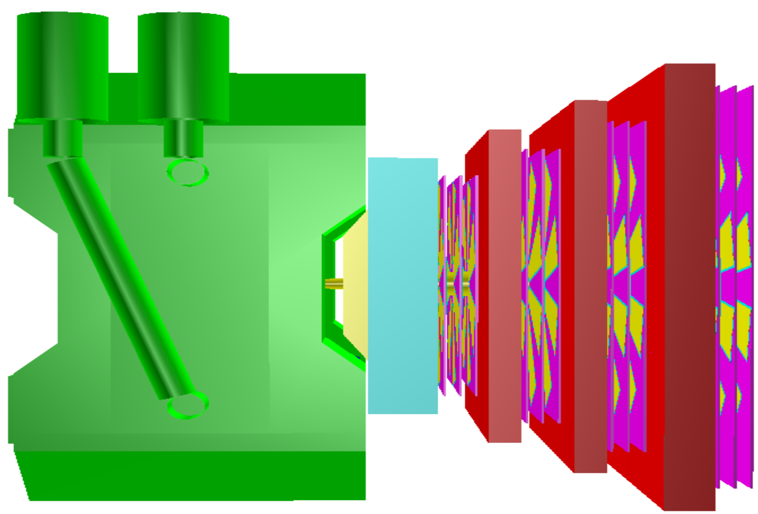


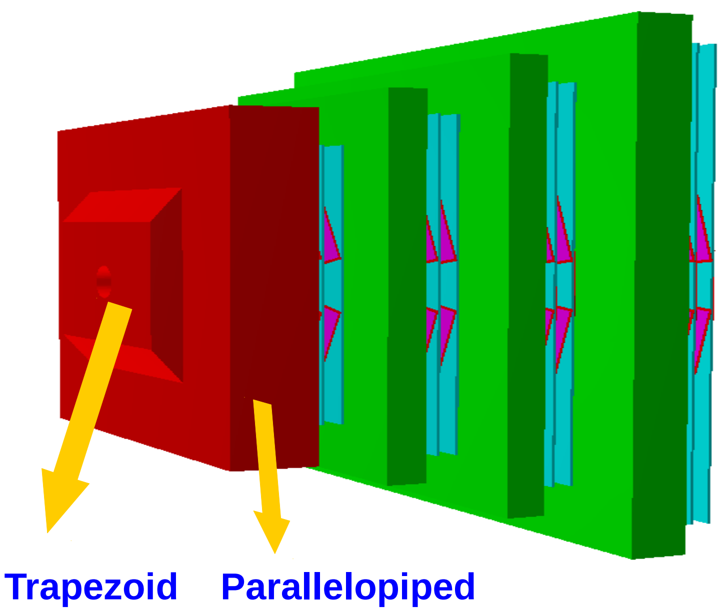
Results : No significant change in efficiency & S/B of LMVMs.

(c) Modification of shape of MUCH 1st absorber

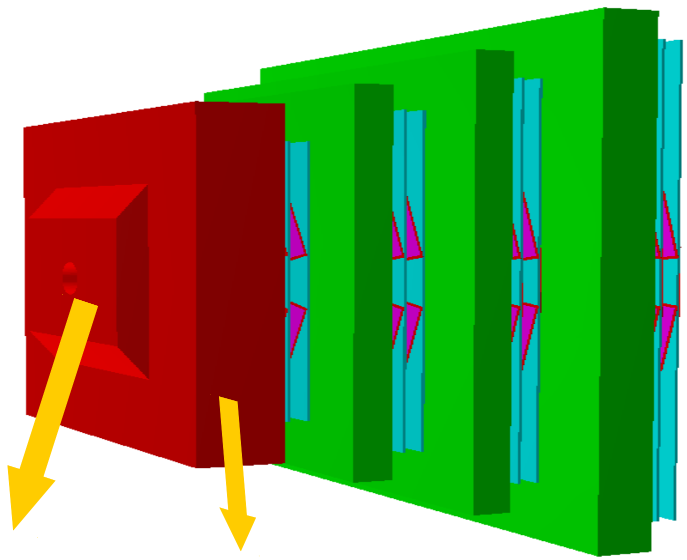


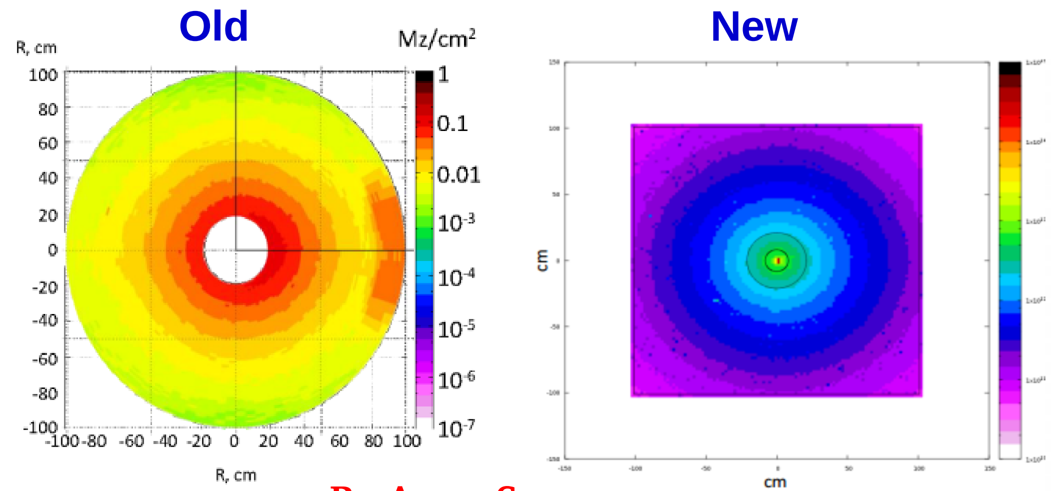




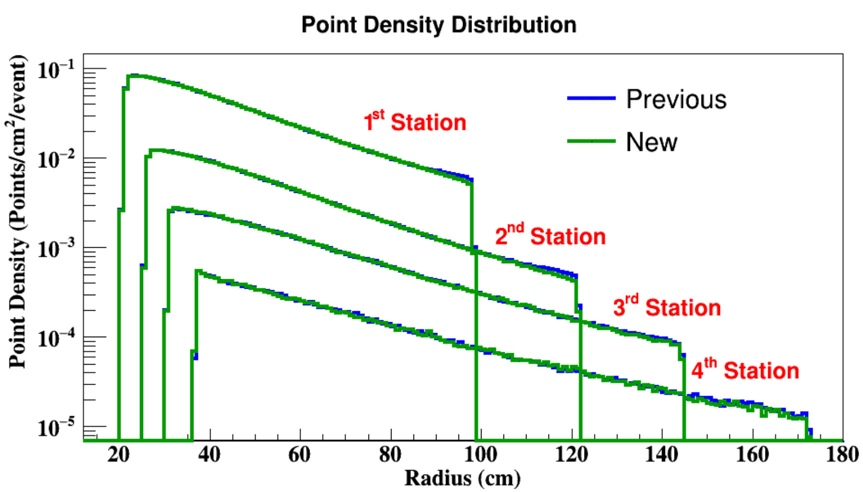


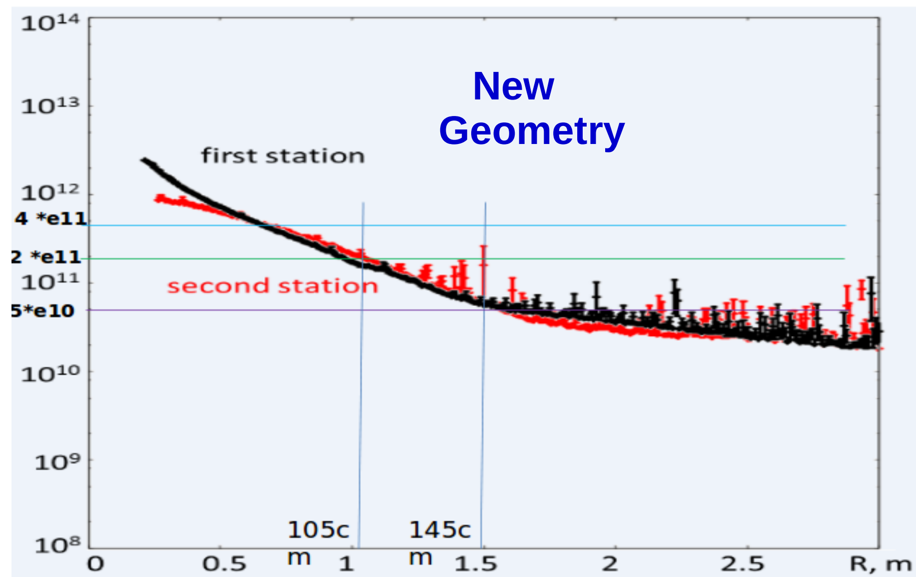
(c) Modification of shape of MUCH 1st absorber





By Anna Senger





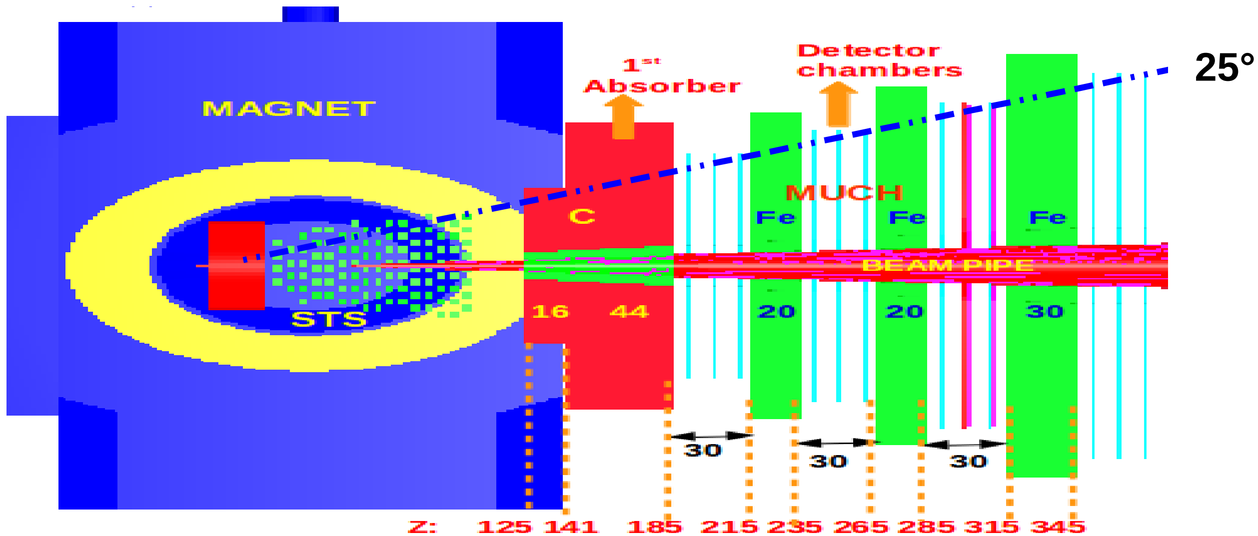
ω	Eff(%)	S/B
Old geo	0.93	0.21
New geo	0.92	0.25

Efficiency nearly same & S/B improved.

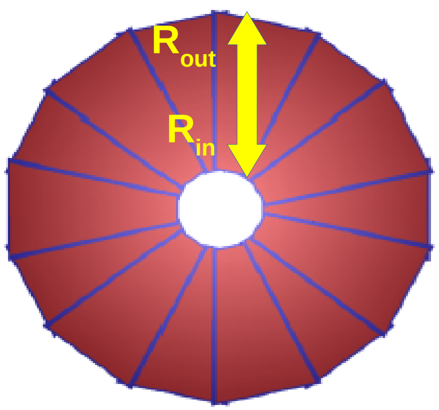
Neutron dose has reduced by a factor 6 or more

By Anna Senger

(d) Investigation on 2nd station size



$R_{out} - R_{in}$ = 97 cm (default setup)
= 90 cm (Modified setup)
= 80 cm (Modified setup)



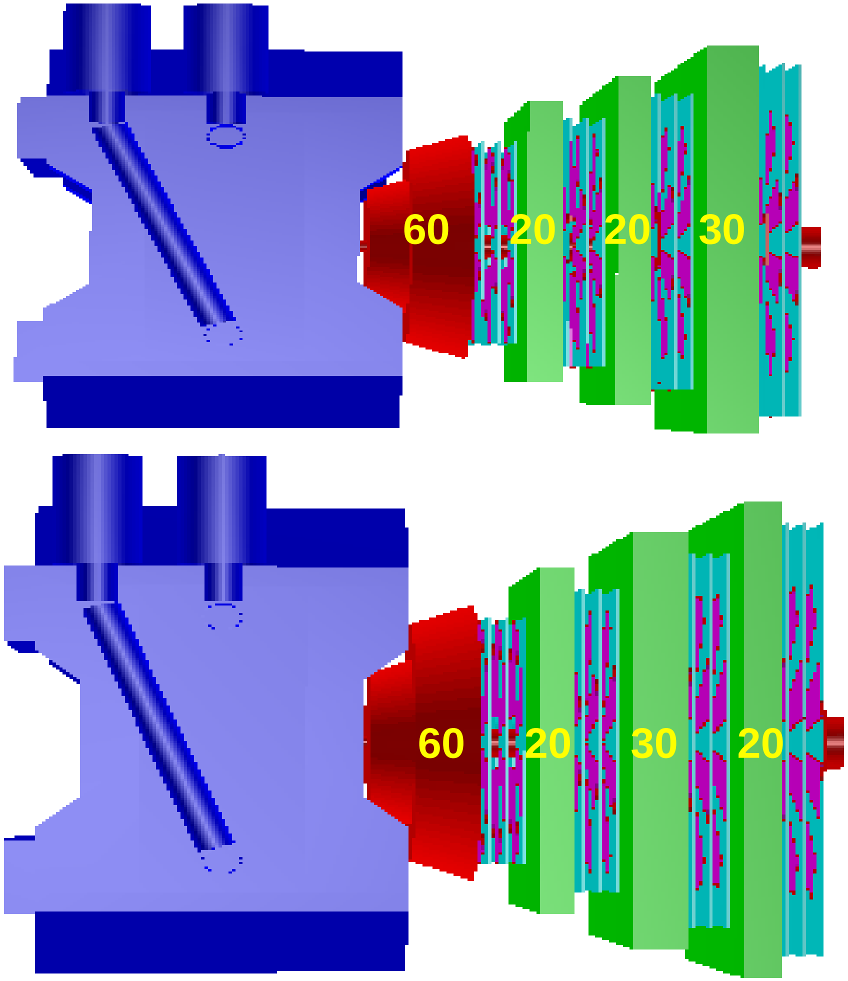
SIS100B (4 stations+ 4 absorbers)

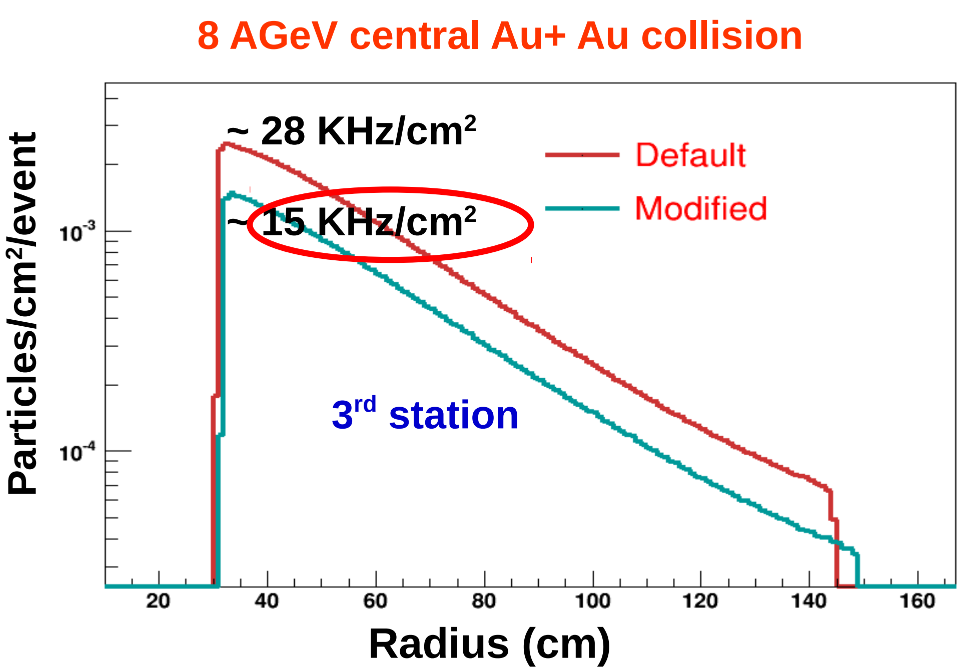
ω @ 8 AGeV	Standard $R_{out} - R_{in}$ = 97 cm	$R_{out} - R_{in}$ = 90 cm	$R_{out} - R_{in}$ = 80 cm
ω Efficiency (%)	0.92	0.92	0.85
S/B	0.25	0.22	0.21

SIS100C (5 stations + 5 absorbers)

J/Ψ @ 25 AGeV	Standard SIS100C	$R_{out} - R_{in}$ = 90 cm
J/Ψ Efficiency (%)	4.90	4.81
S/B	5.66	5.96

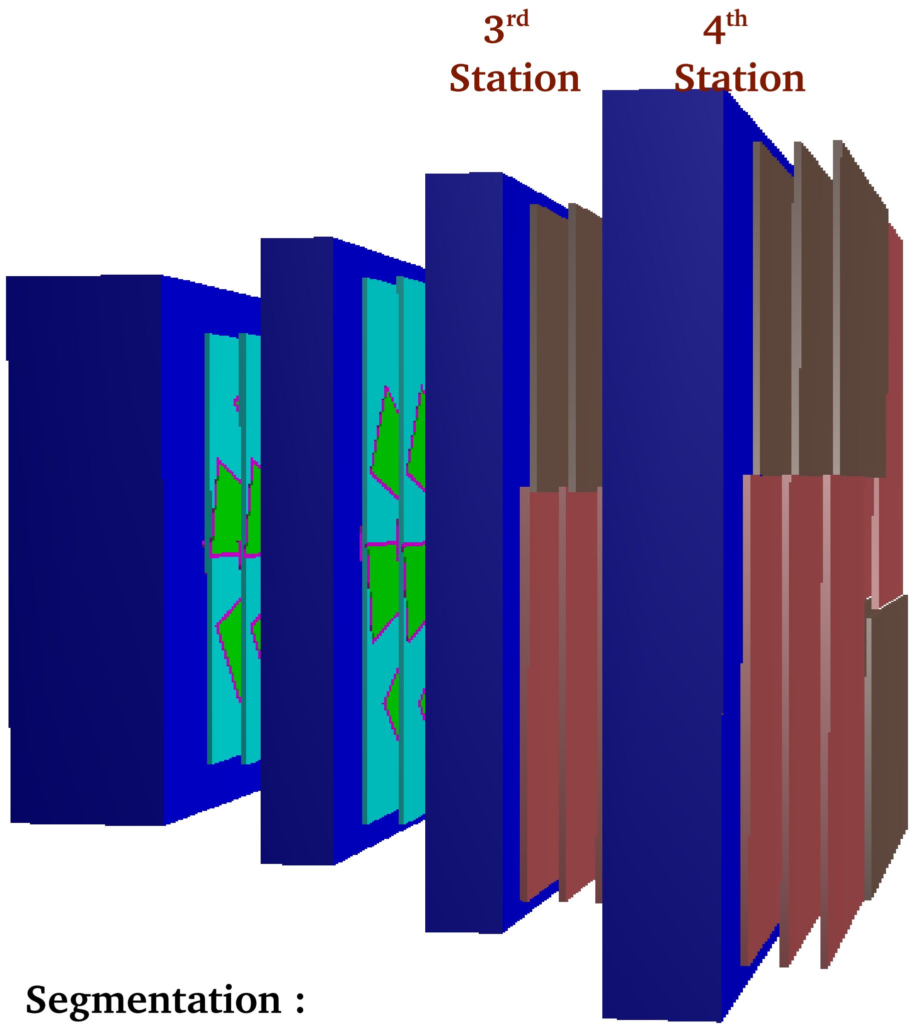
(e) Investigation on 3rd & 4th station for using RPC

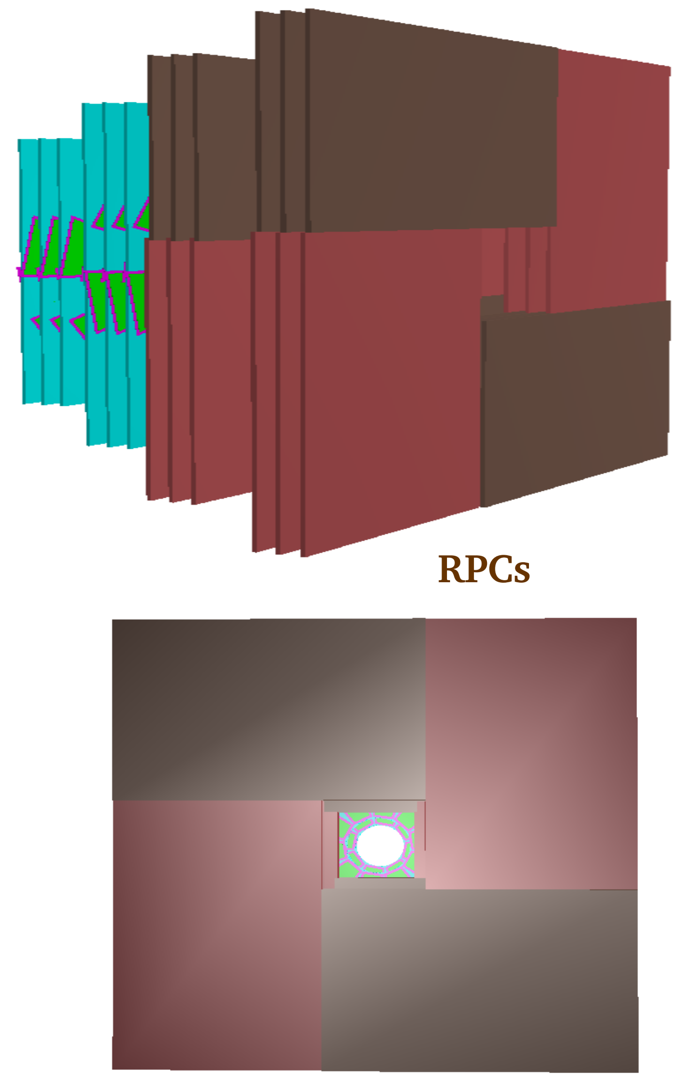




ω	Standard	Modified
Efficiency %	1.02	1.01
S/B	0.18	0.19

(e) Investigation on 3rd & 4th station for using RPC





Segmentation :
Strip / pads that has to be decided

For 3rd station 1 module size is 122 cm x 178 cm
For 4th station 1 module size is 138 cm x 206 cm

To do list

– Beam pipe design is not yet realistic.

– Investigations on 2nd station size has been done & nearly finalized.

– Suitable detector technology for 3rd & 4th station have to be determined. RPC seems to be a possible option for that. R & D is going on for that.

– Implementation of proper geometry is needed for RPC.

– Whether strips or pads will be used that has to be decided.

– RPC digitization has to be implemented in simulation

– At the simulation level, performance needed to be checked with full implementation of detector response & tracking.

Thank You