Optimization of the local shielding around the dummy septum 15

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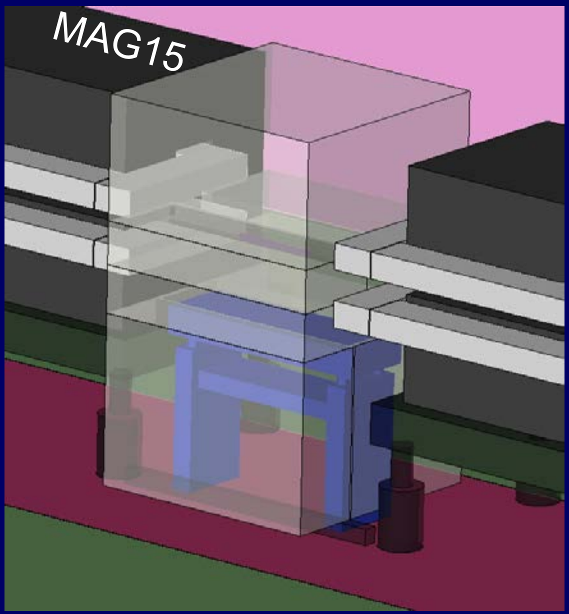
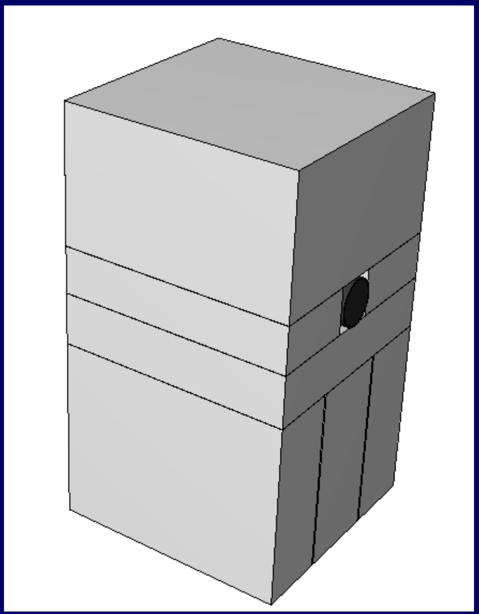
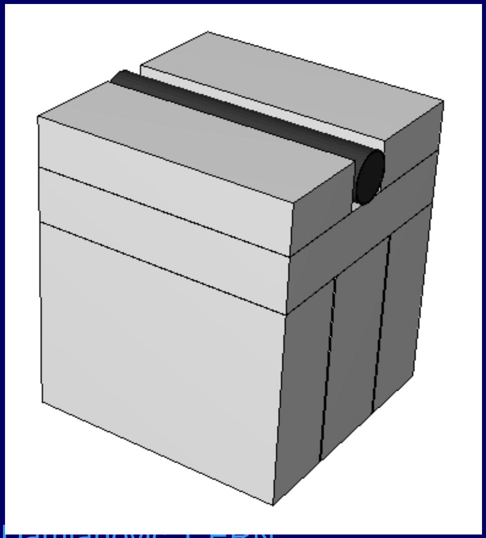
Original Fluka Geometry of Local Shielding in SS15

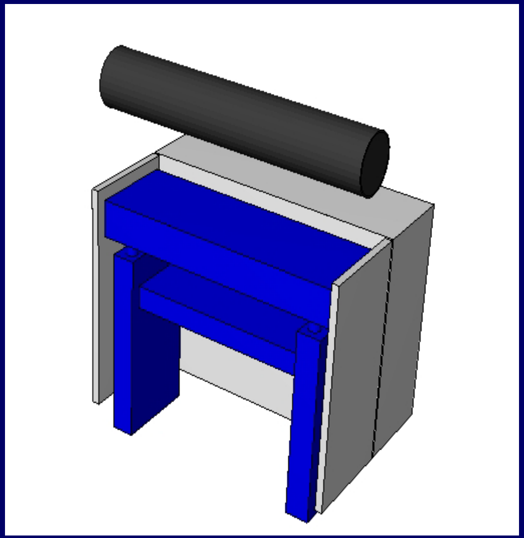
(see Technical Note : https://edms.cern.ch/document/1113268/1)





- lateral dimension:
  120 cm
- longitudinal dimension:
  110 cm
- vertical dimension:
  200 cm
  - 60 cm top part
  - 20 cm middle (1)
  - 25 cm middle (2)
  - 95 cm lower part

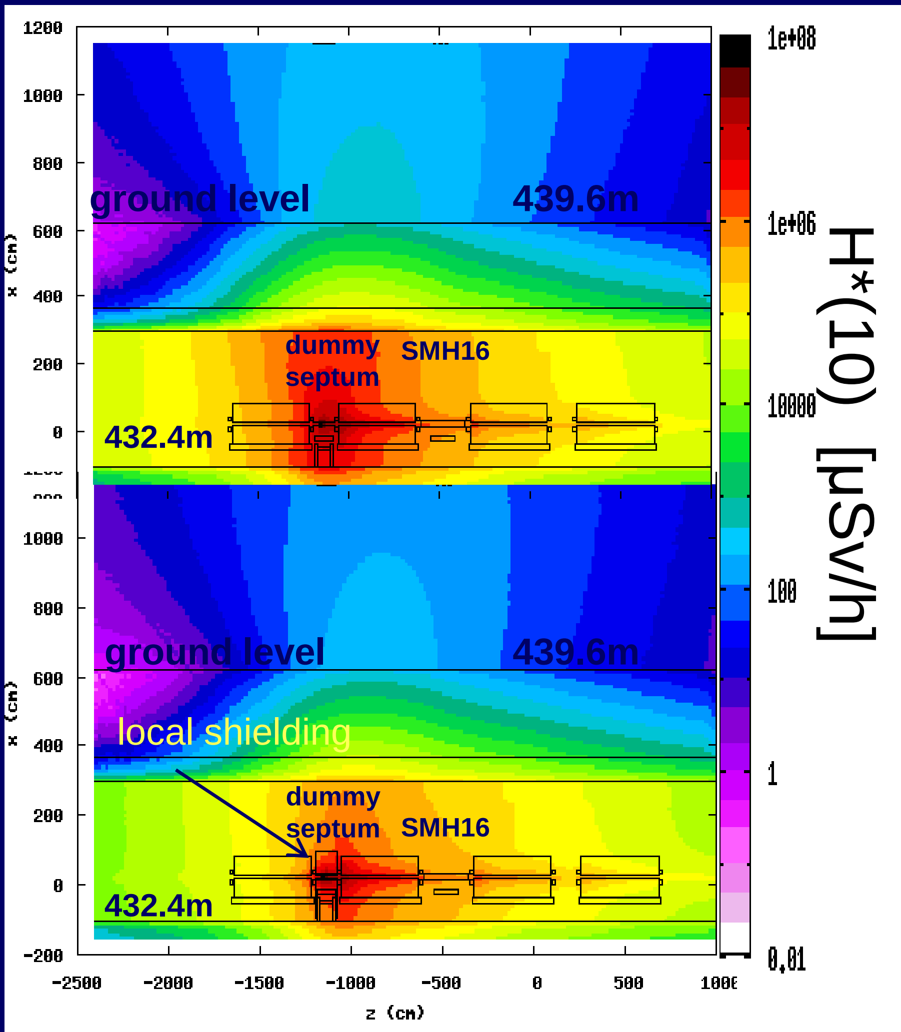


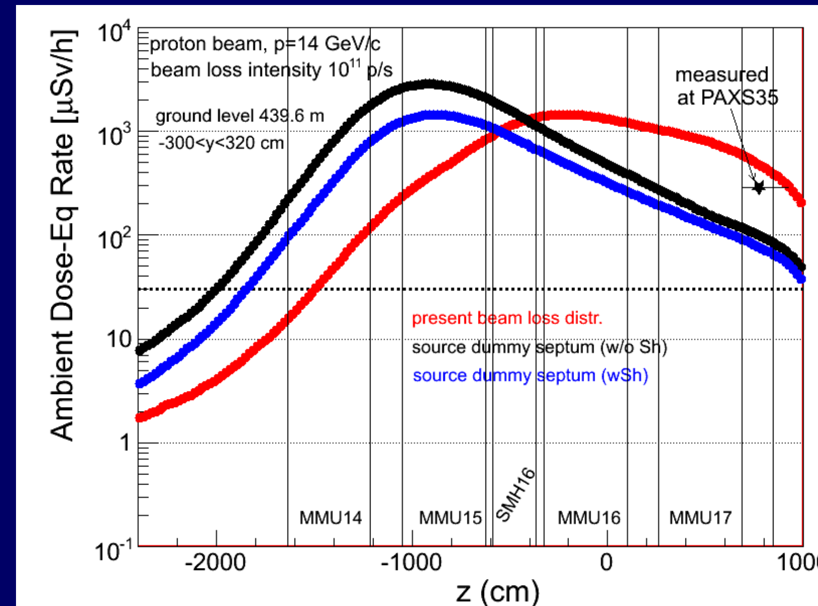


Shielding effective if it reduces
1) the residual dose rate along SS16
   and/or
2) the stray radiation on the ground level directly above

Shielding Effects – Dose Rates on the ground level above the PS SS16

(Technical Note in preparation)





Shifting the beam losses to the dummy septum also shifts the "hot spot" on the ground level

Due to isolated single source, max rates higher than for the present extended beam loss distribution, but gradient steeper

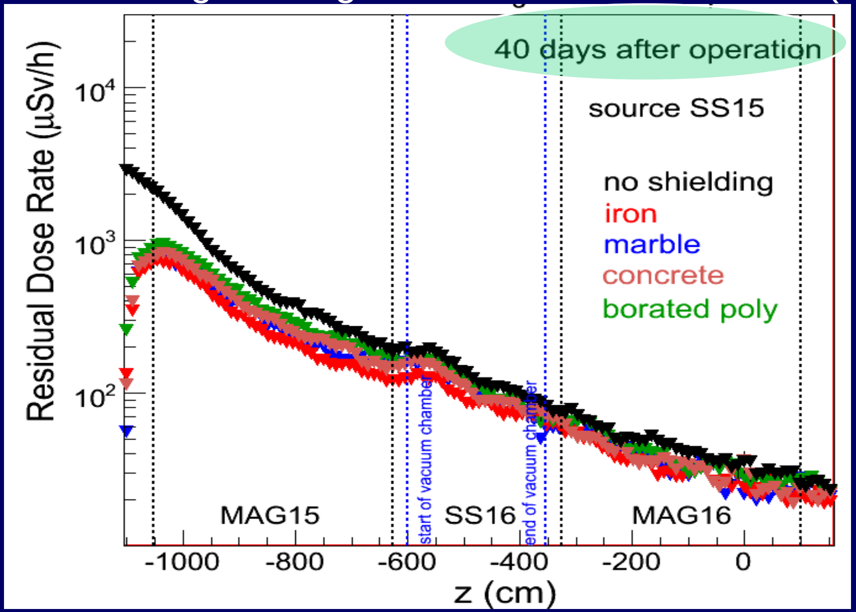
Planned shielding design on top of the PS complex assures a safety margin by a factor of 3 with reference to the maximum dose rate of 1.2 mSv/h

Local shielding around dummy septum (total height 200 cm, 60 cm on top of the septum) reduces radiation level by a factor of 2 → max dose rate of ~1.2 mSv/h

Shielding Effects – Residual Dose Rates along the SS16

(see Technical Note : https://edms.cern.ch/document/1113268/1)

1dim projections of residual ambient dose-eq rates external to the PS ring averaged over 1 m from the floor (x)



Residual Ambient Dose Rate downstream of the SS15 the same to within 20-30 % for no shielding and for the four different shielding materials inside SS15

The effects of shielding larger upstream

Overall conclusion on effects of original local shielding:

- hardly any reduction of residual dose rates along SS16
- reduction by a factor of 2 of stray radiation on the ground level directly above

Can further optimization of local shielding improve the situation at all?

Further optimization of the local shielding

4 different options considered:

Option I: similar to the previous shielding with a number of small changes (see next slide)

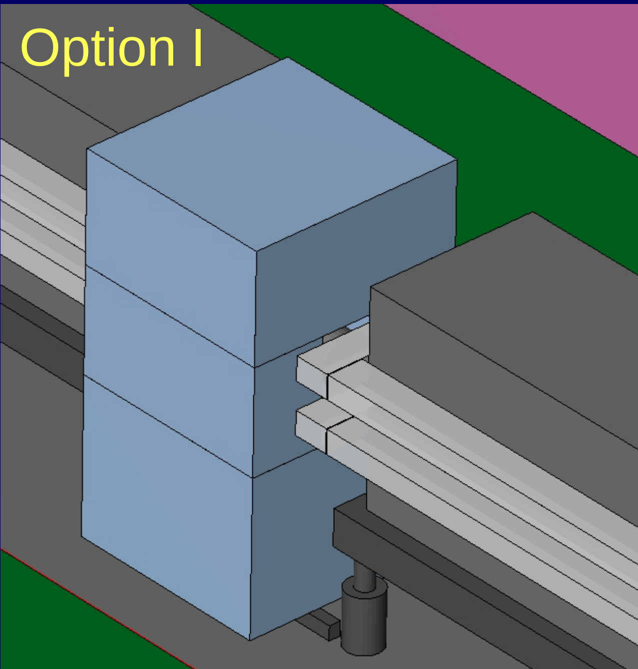
Option II: lateral dimension extended

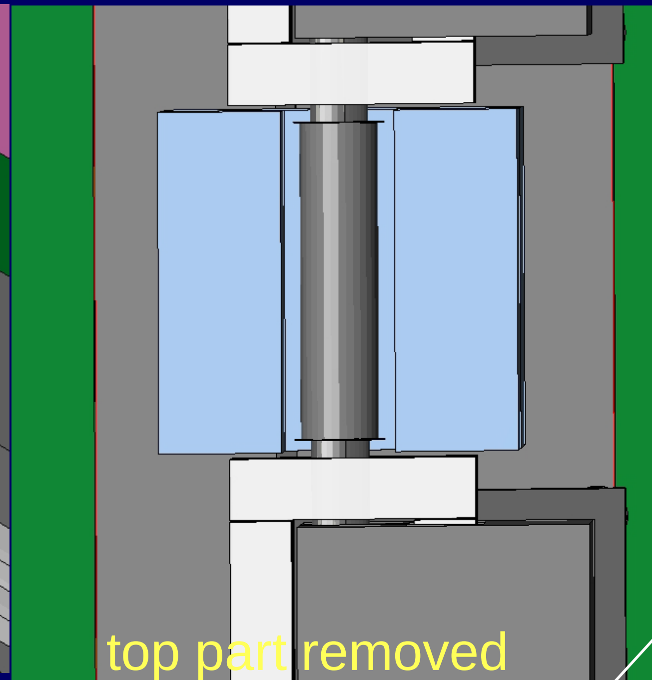
Option III: lateral and vertical dimensions extended

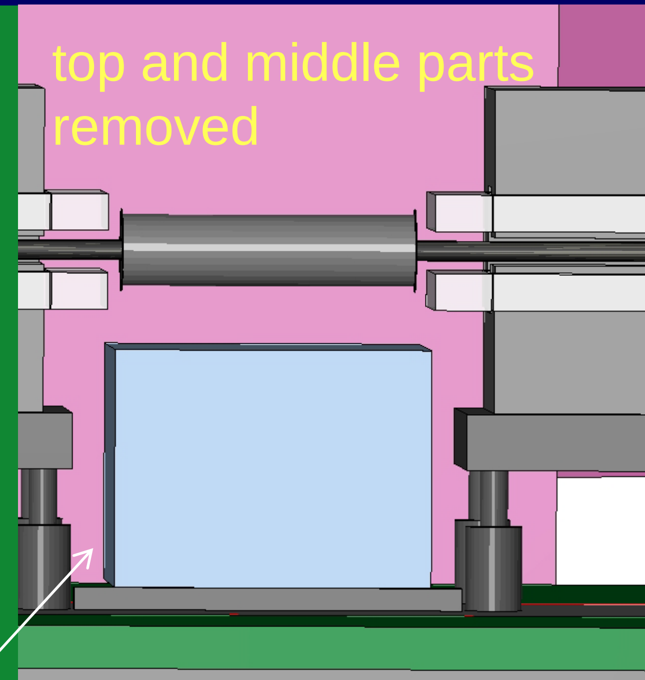
Option IV: dummy septum blade shifted 40 cm upstream allowing for an extra 40 cm shielding downstream of the blade

→ extract residual dose rates along the SS16 and stray radiation on the ground level directly above for each of the 4 options

Local Shielding in SS15 - Option I







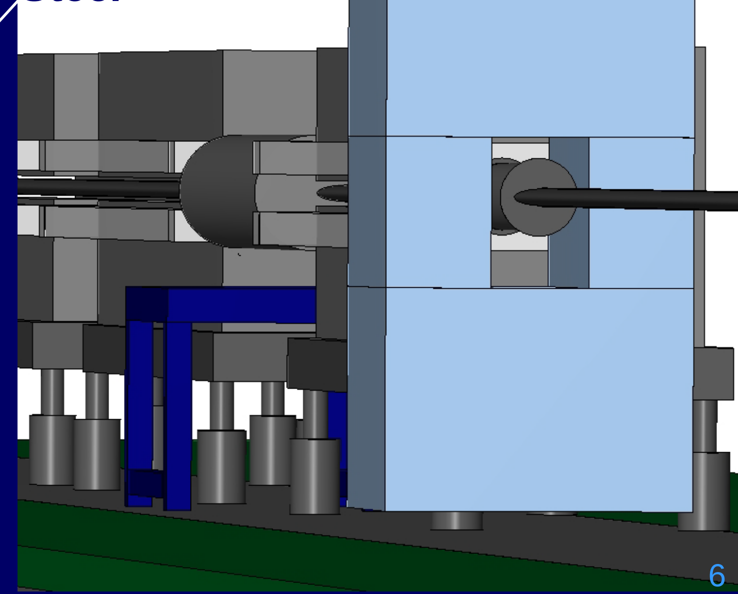
Concrete, Stainless Steel, Marble, Aluminum, Concrete, Steel

- lateral dimension:
  120 cm
- longitudinal dimension:
  110 cm
- vertical dimension:
  210 cm
  60 cm top part
  60 cm middle
  90 cm lower part

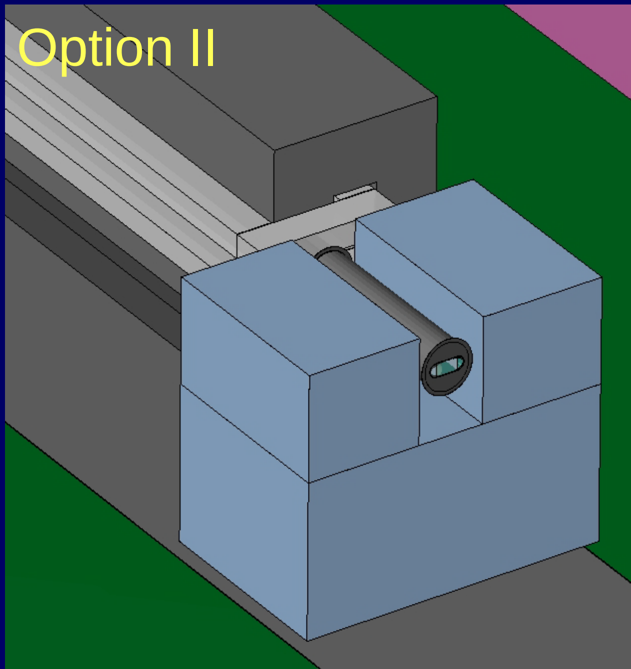
- material: marble

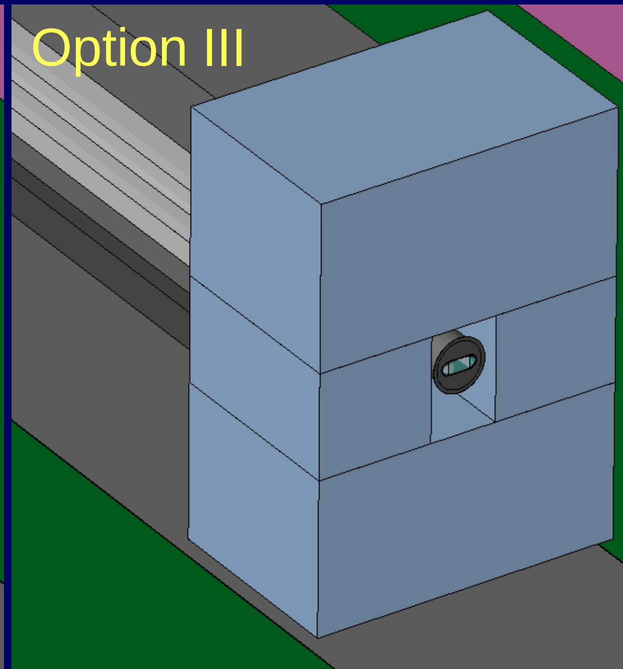
- support table removed,
  replaced by marble volume

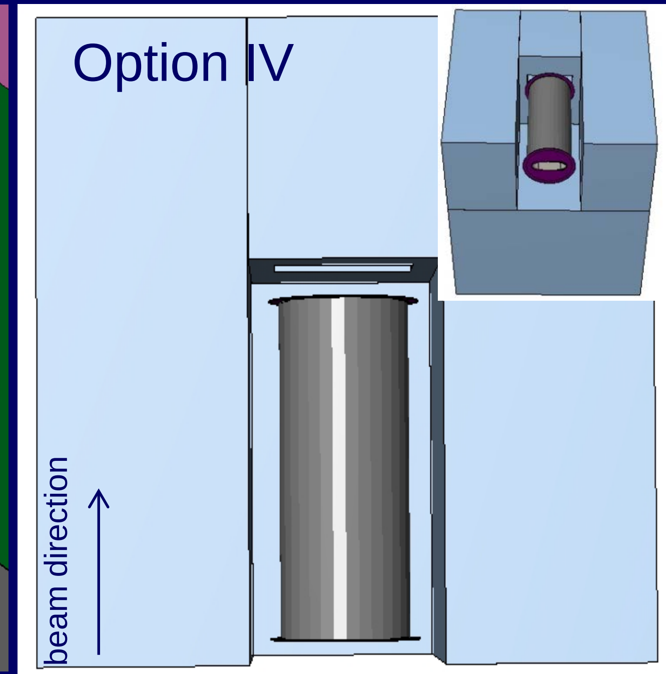
- slight increase of the total height to 210 cm to leave more space in between the tank and the shielding blocks



Local Shielding in SS15 - Options II, III and IV







Concrete, Stainless Steel, Marble, Aluminum, Concrete, Stainless Steel

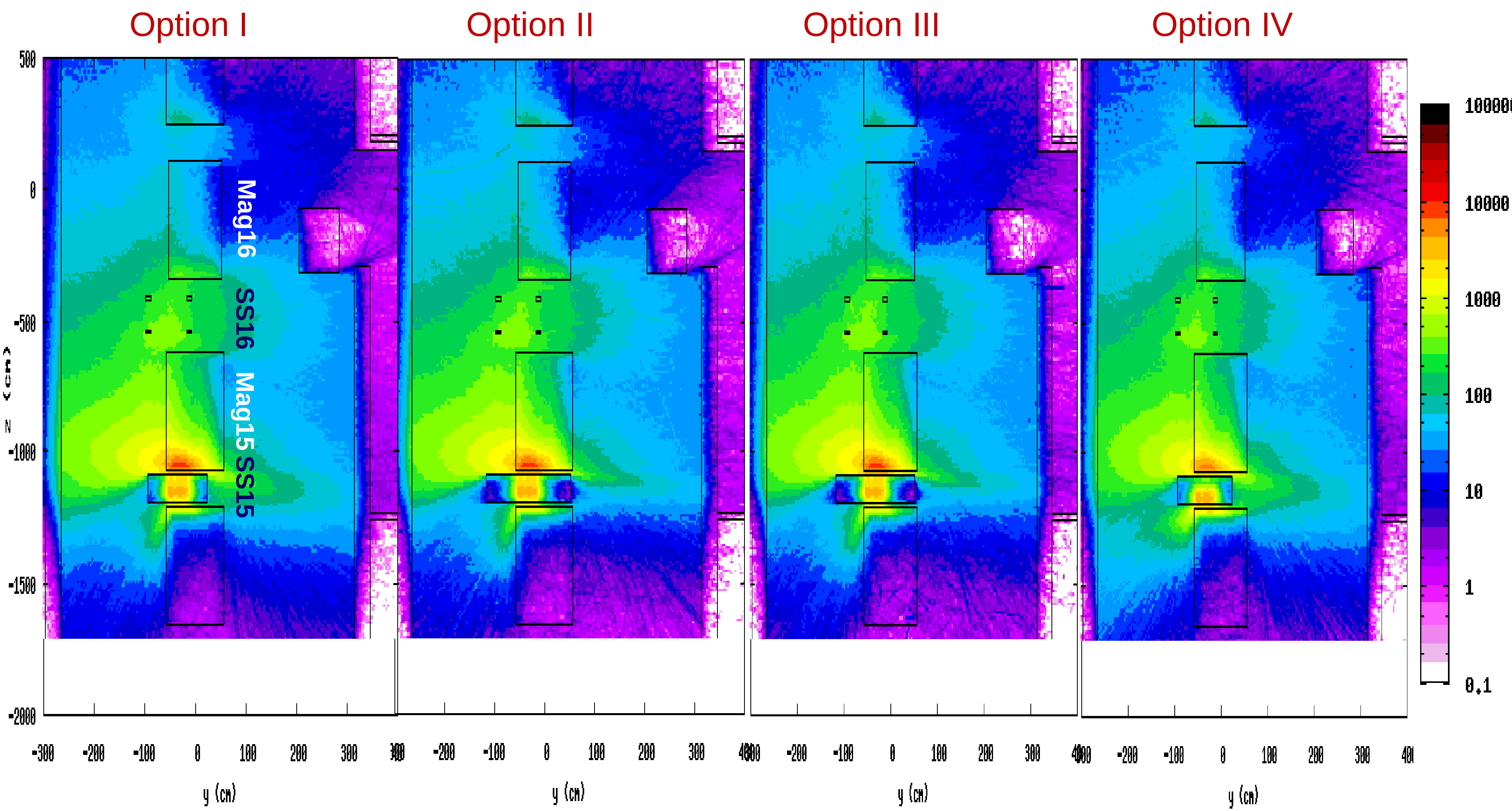
Option II :
- further increase of the lateral dimension from 120 to 170 cm (170 cm max allowed)

Option III :
- further increase of the lateral dimensions, from 120 to 170 cm
- further increase of the vertical dimensions, from 210 to 250 cm
- vertical dimension of the top part 100 cm

Option IV:
- shift of blade 40 cm upstream
- shorter dummy septum tank (length 60cm)
- additional 40 cm thick shielding block upstream of the septum tank
- no extension of lateral and vertical dimensions

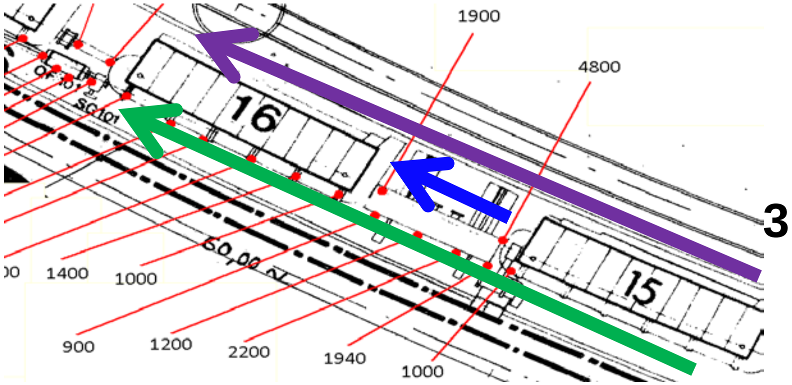
Residual Dose Rates for the 4 different options of the local shielding around the dummy septum 15

Example : Residual Dose Rate [μSv/h] in z-y plane after cooling time of 40 days



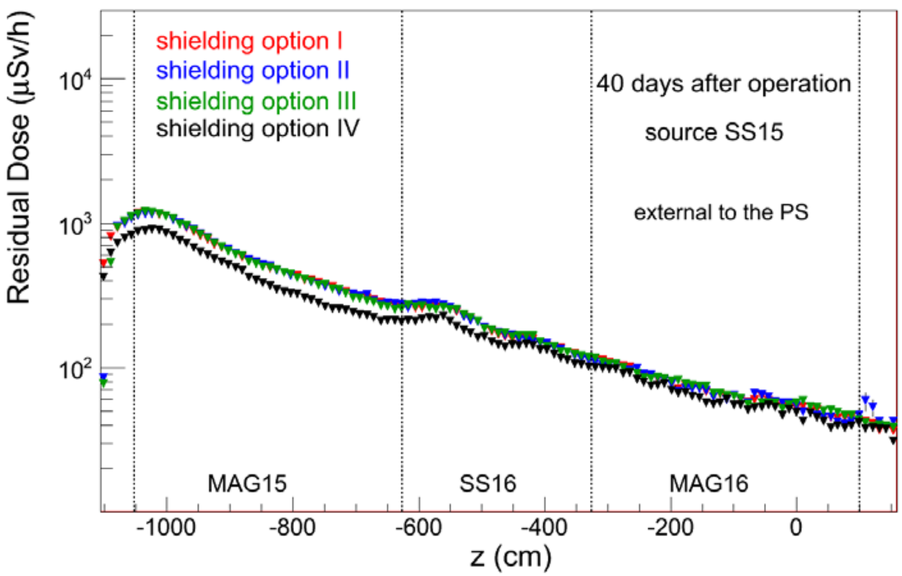
Hardly any difference in the region of SS16

Residual Dose Rates for the 4 different shielding options

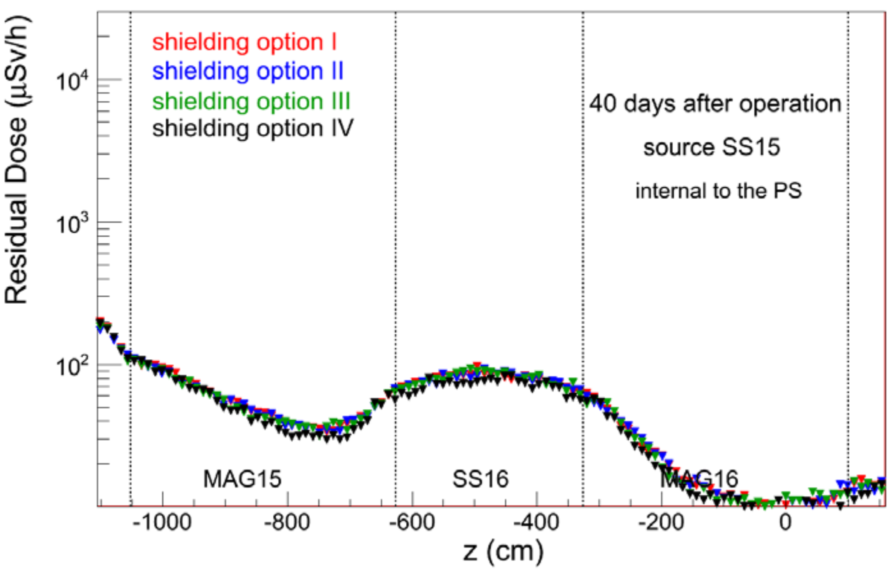


- external to the PS along the measured line from MMU15 until the end of MMU16
- internal to the PS along the measured line, i.e. only inside the straight section SS16
- internal to the PS along MMU15, SS16 and MMU16

Residual ambient dose-eq rates external to the PS ring (along green line) averaged over 1 m from the floor (x) after cooling time of 40 days



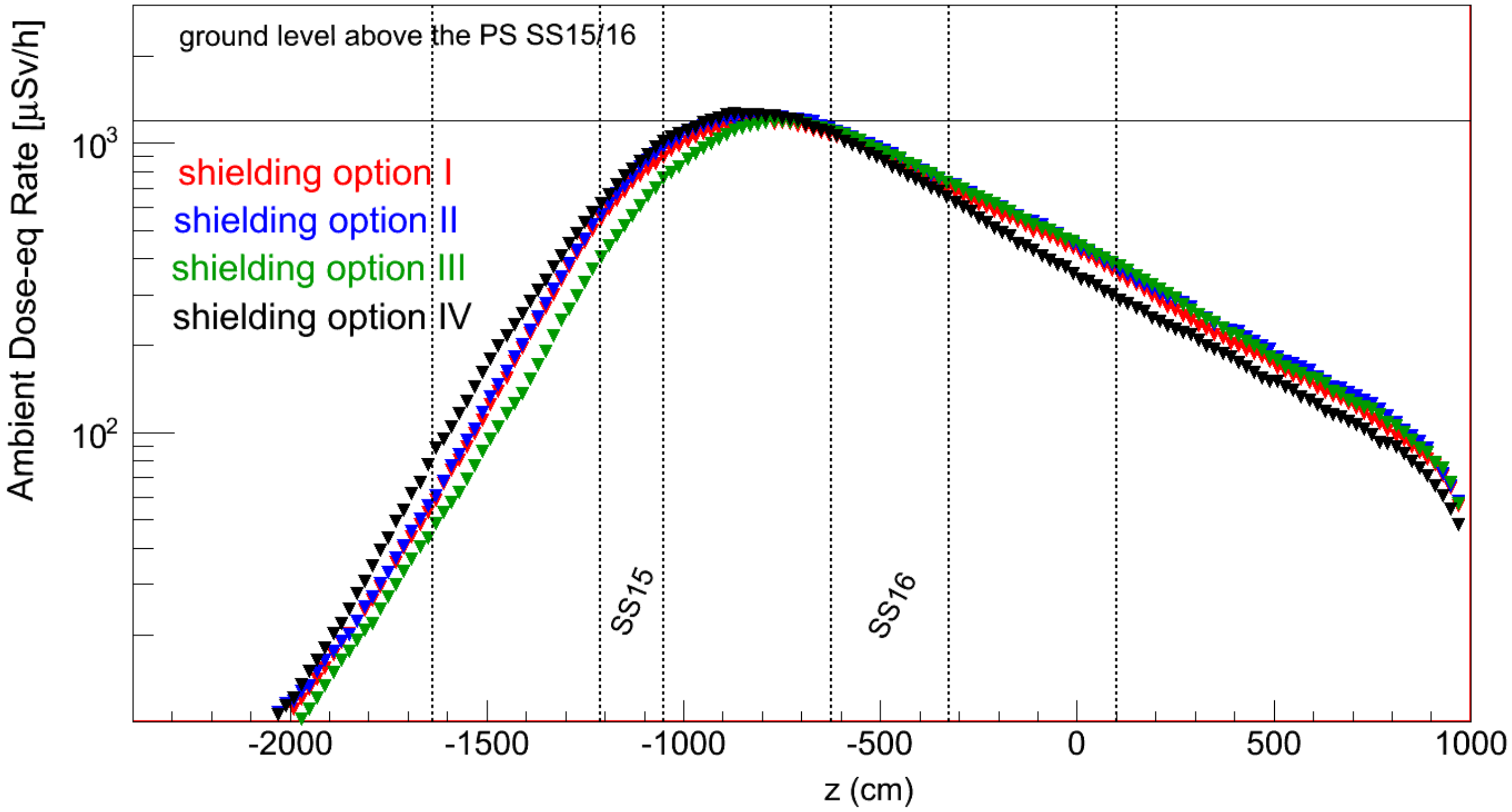
Residual ambient dose-eq rates internal to the PS rung (along pink line) averaged over 1 m from the floor (x) after cooling time of 40 days



Residual Ambient Dose-eq Rate downstream of the SS15 about the same for all Options, with Option III slightly more efficient (~30 %) in the area external to the PS ring

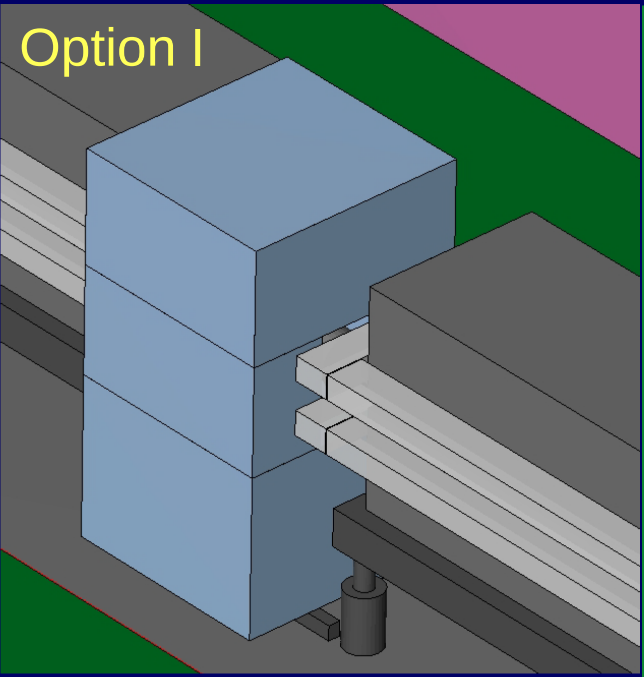
Stray Radiation on the ground level above the PS SS15/SS16 for the 4 different shielding options around the dummy septum 15

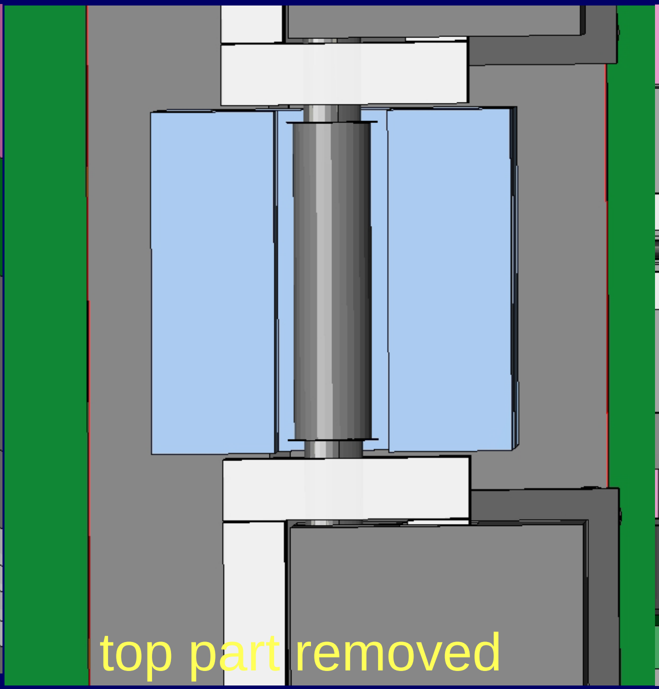
1dim projections of Ambient Dose-eq Rates at the ground level above the PS SS15/16

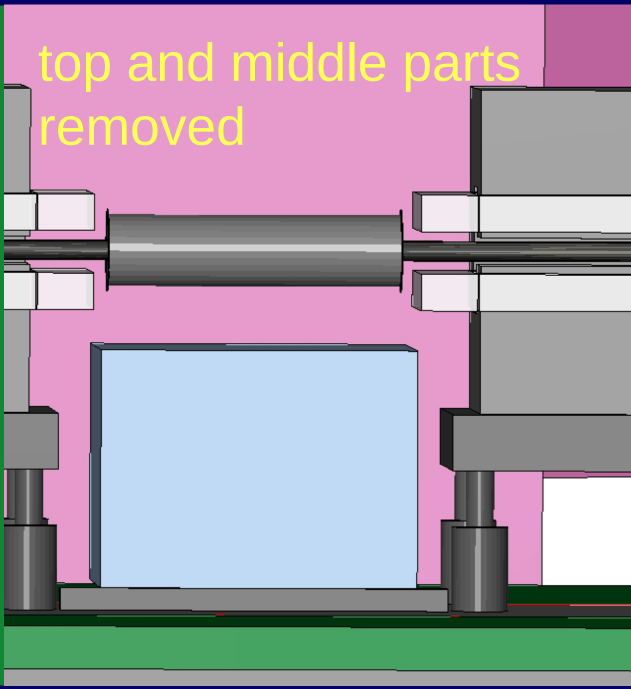


Slightly different shapes, but the same maximal values of Ambient Dose-eq Rates at the ground level for all four Options

Conclusion: Consider Option I as sufficient







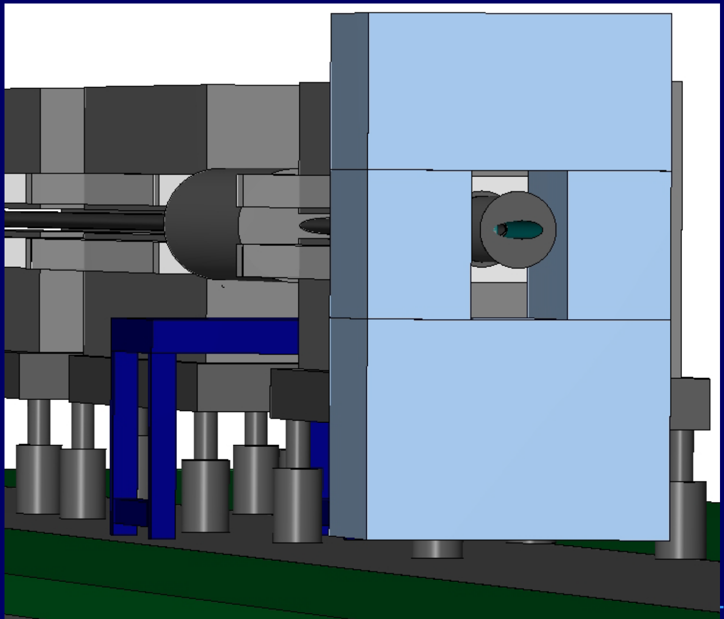
- lateral dimension: 120 cm
- longitudinal dimension: 110 cm
- vertical dimension: 210 cm

Total Volume ~ 2.5m^3

top part:
60×120×110
(height × width × length)

2 middle parts each:
60×40×110
(height × width × length)

bottom part:
90×120×110
(height × width × length)



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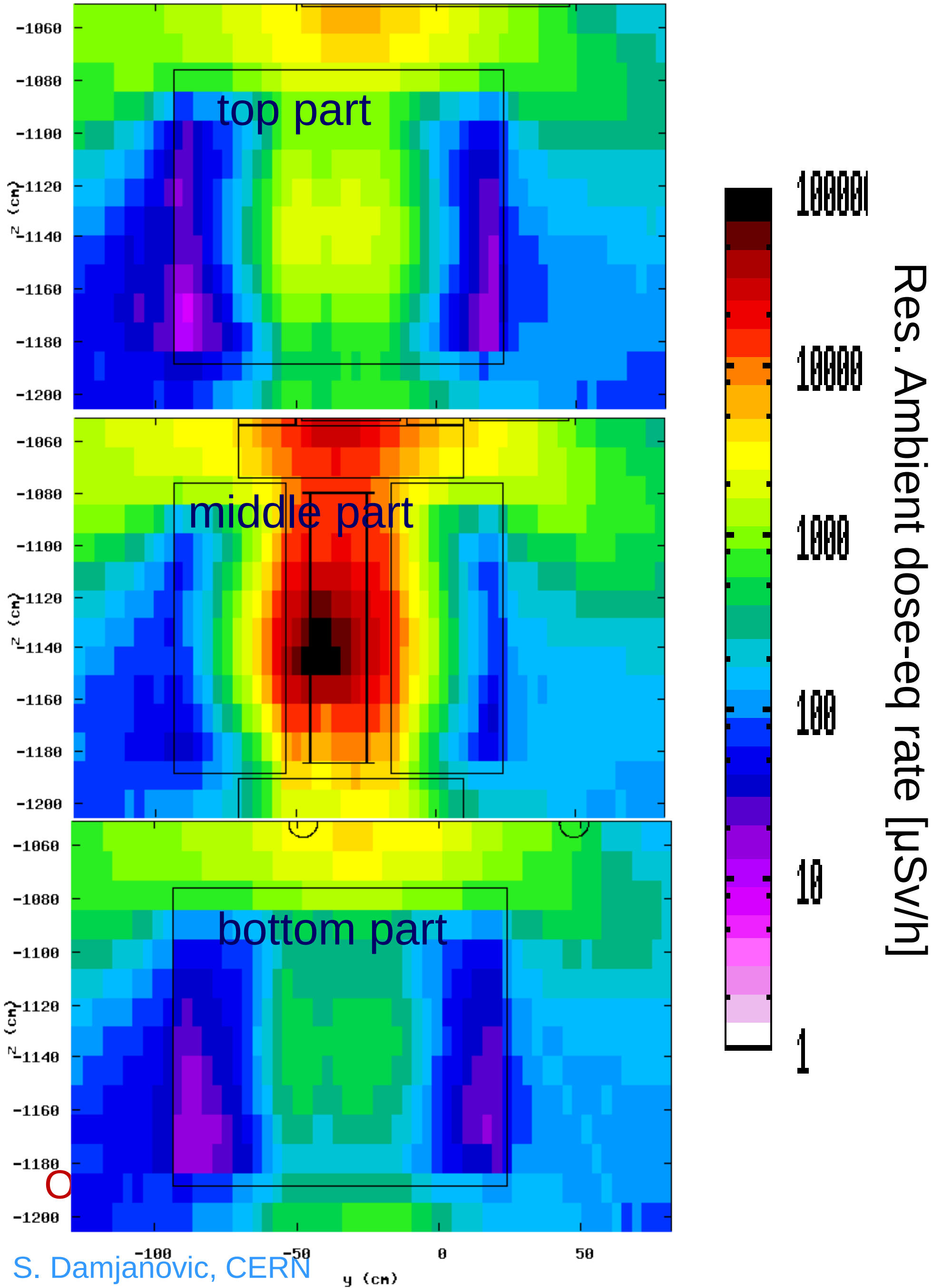
Residual Dose Rates around the Local Shielding Blocks



after cooling time of 40 days

Top part of the shielding

<H*(10)> = 150 µSv/h at 10 cm from the top part of the shielding blocks

Middle part of the shielding

<H*(10)> = 250 µSv/h at 10 cm from the middle part of the shielding blocks

Bottom part of the shielding

<H*(10)> = 150 µSv/h at 10 cm from the bottom part of the shielding blocks