Reduction of the radiation field around SMH16 based on a new method

Dummy Septum in SS15

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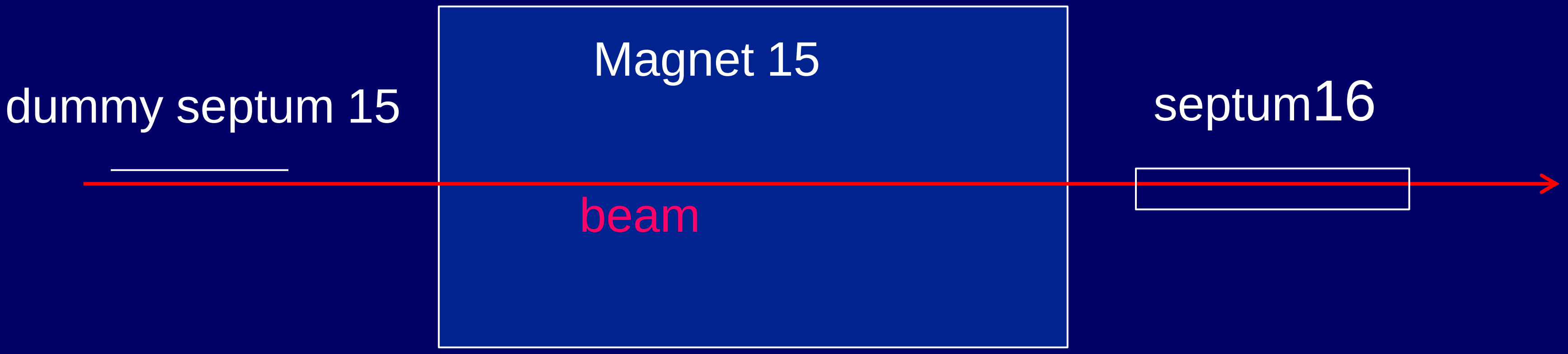
Reduction of the radiation field around SMH16 based on a new method

Install a blade in a dummy septum inside the straight section SS15, shadowing the blade in the true septum inside SS16.

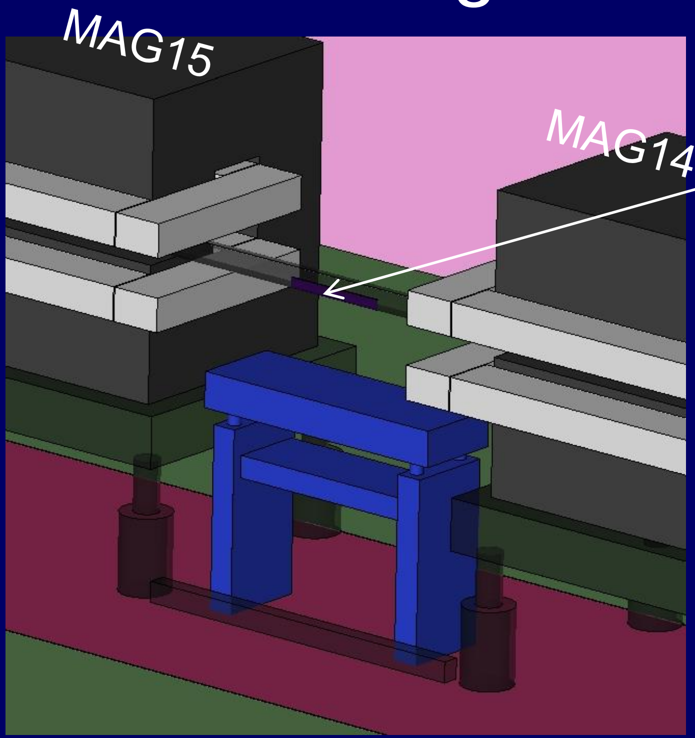


Fluka simulations very much support the proposal:

Reduction of the radiation field and resulting activation in the whole environment of SS16 by factors of 10 to 40

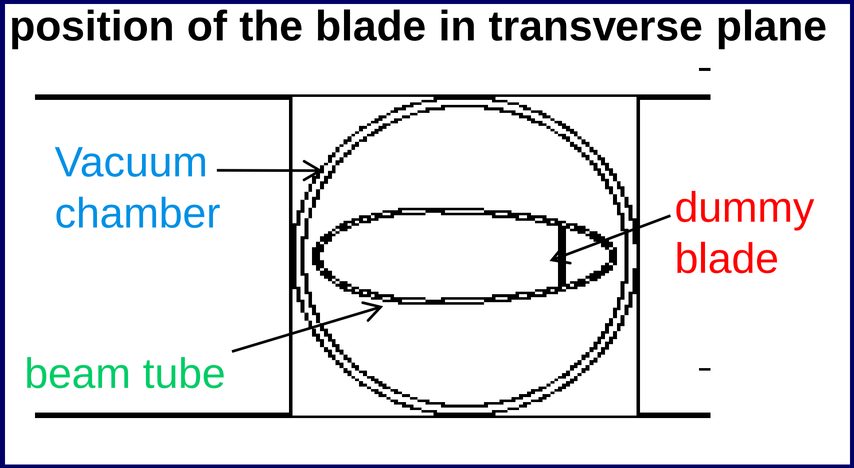
(for details see https://edms.cern.ch/document/1113268/1)

PS Straight Section 15 – Dummy Septum



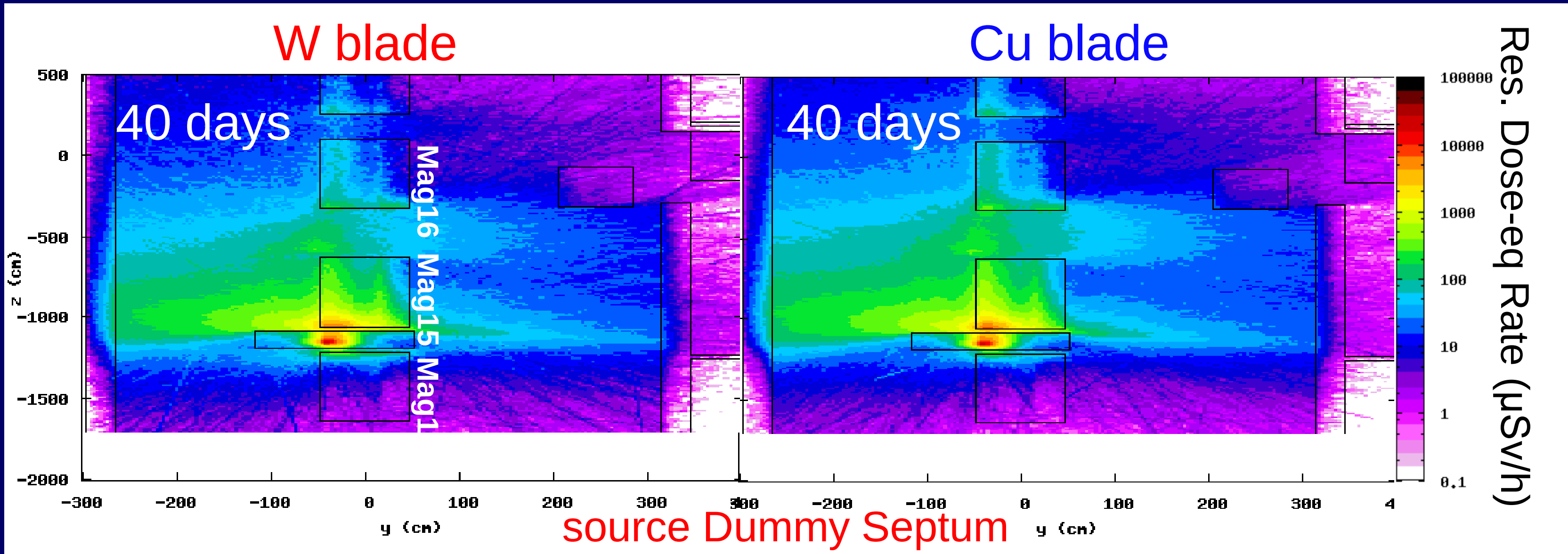
Dummy septum

- a blade of 40 cm length, 3mm thickness and 3.88 cm height
- installed in the middle of SS15 along the beam direction, placed within the beam tube, wall thickness of 3mm
- material choice W or Cu

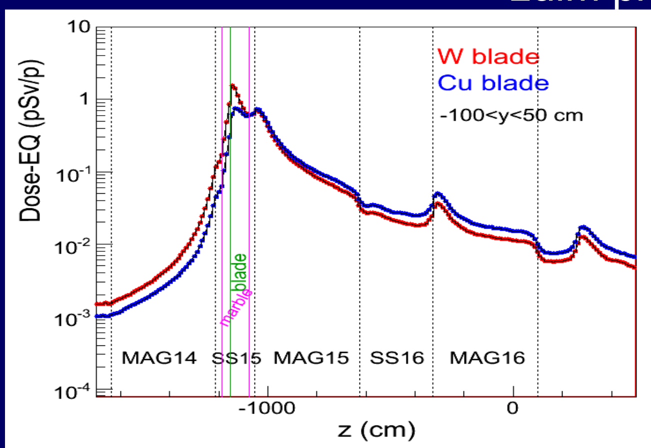


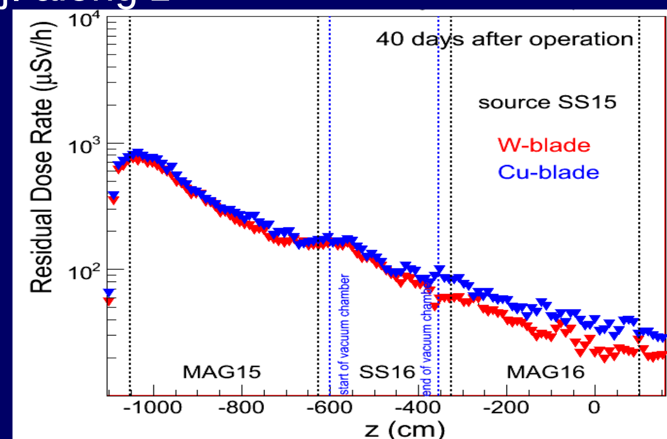
everything imbedded in a vacuum chamber of cylindrical shape with radius of 10cm and a wall thickness of 6 mm. material: stainless steel 316 LN

Blade material: W vs. Cu



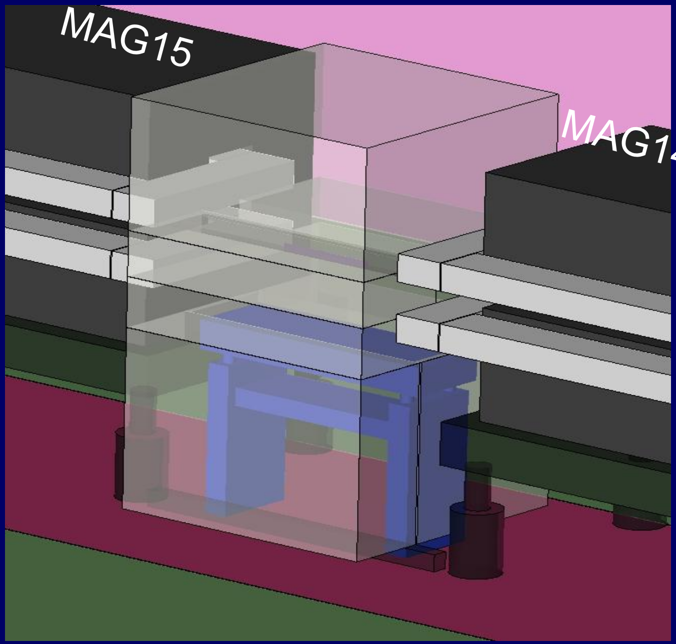
1dim proj. along z





Dose Rates downstream of SS15 consistently lower for the W than for the Cu blade. Differences mostly < 30% → probably other constraints (e.g. mechanical concept) should decide on the material choice

Local Shielding around Dummy Septum



Local shielding – dimensions
very limited space in transverse plane

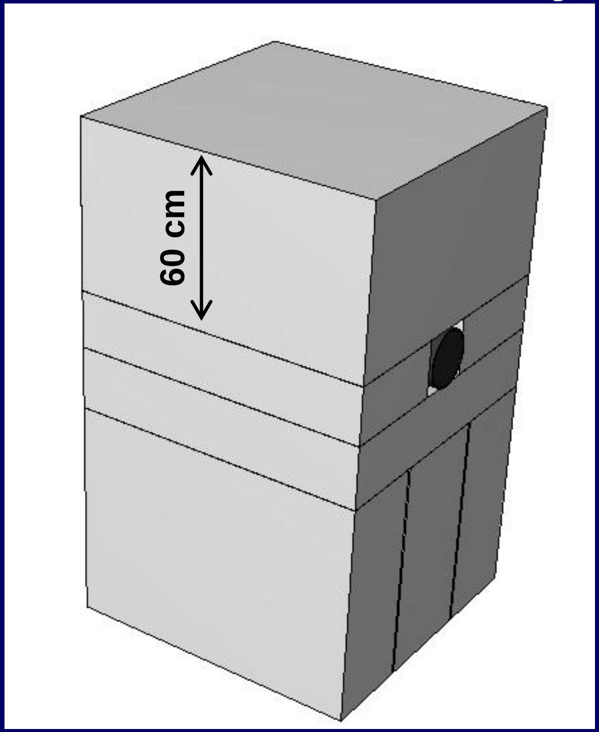
- lateral dimension:
  hardly any load permitted outside the metal part of the PS floor (red area in figure)

- longitudinal dimension:
  although the SS15 is 160 cm long, only ~110 cm available due to the magnet coils

- vertical dimension:
  dimensions taken from other (similar) shielding inside SS47/48
  further optimization with CE required

- possible material choices: concrete, steel, marble, borated polyethylen

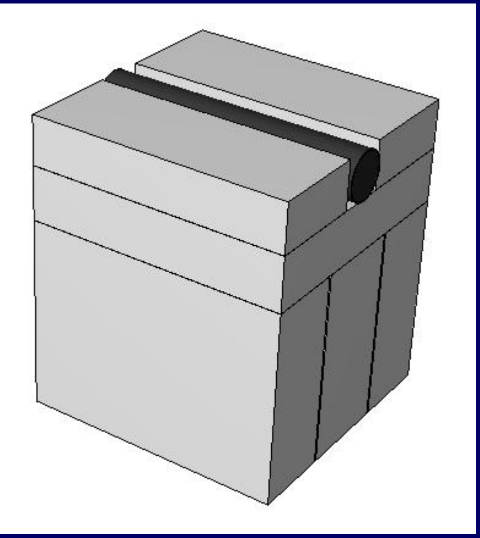
Fluka Geometry of Local Shielding in SS15

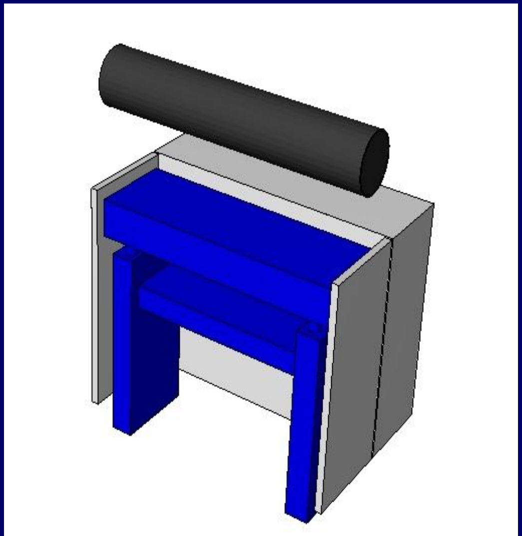


Local shielding – dimensions
very limited space in transverse plane

- lateral dimension:
  170 cm
- longitudinal dimension:
  110 cm
- vertical dimension:
  190 cm
  60 cm top part
  20 cm middle (1)
  25 cm middle (2)
  85 cm lower part

important to reduce dose rates at the ground level

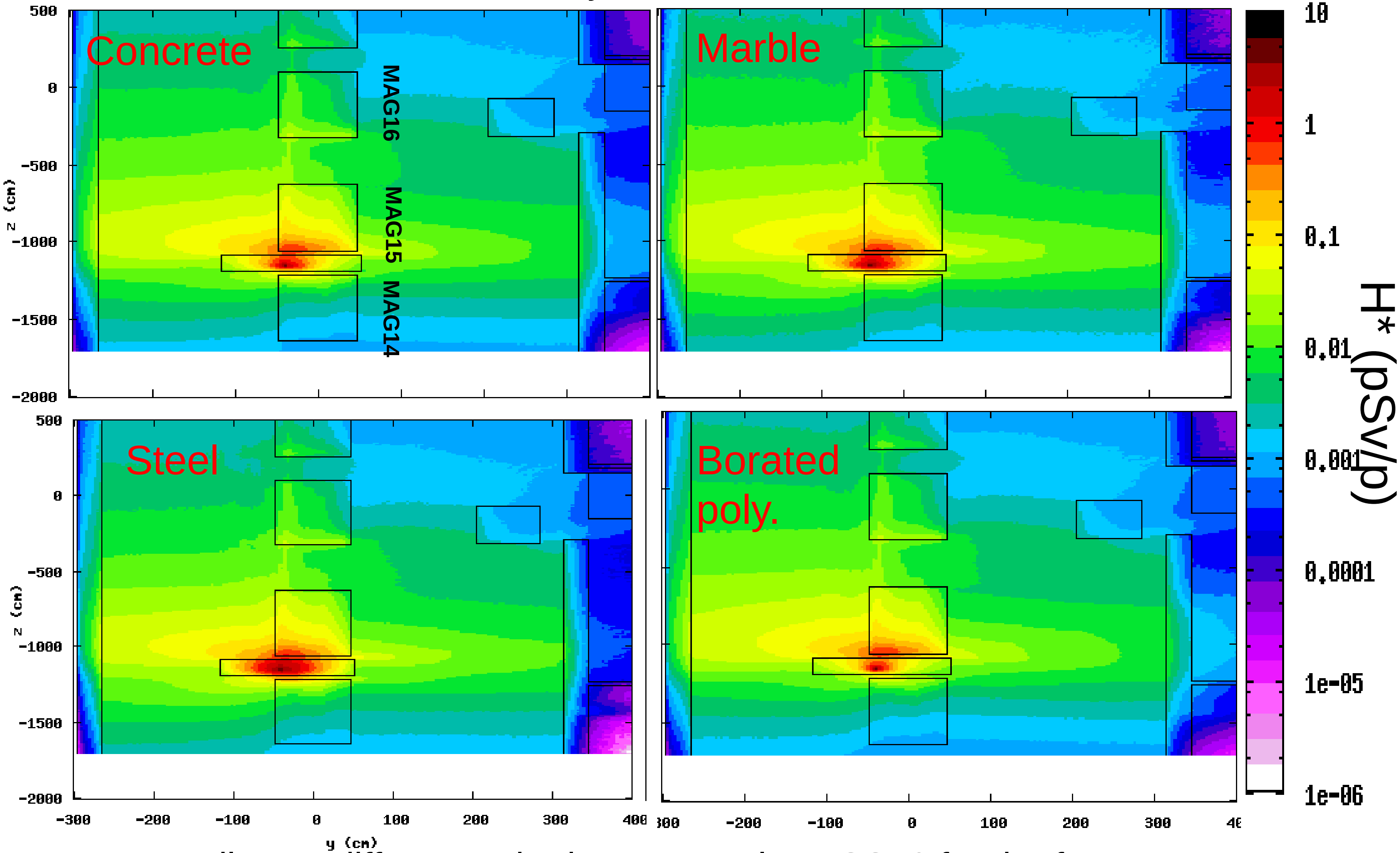




Total shielding volume 3.2 m^3

Local Shielding in SS15 - Choice of Material

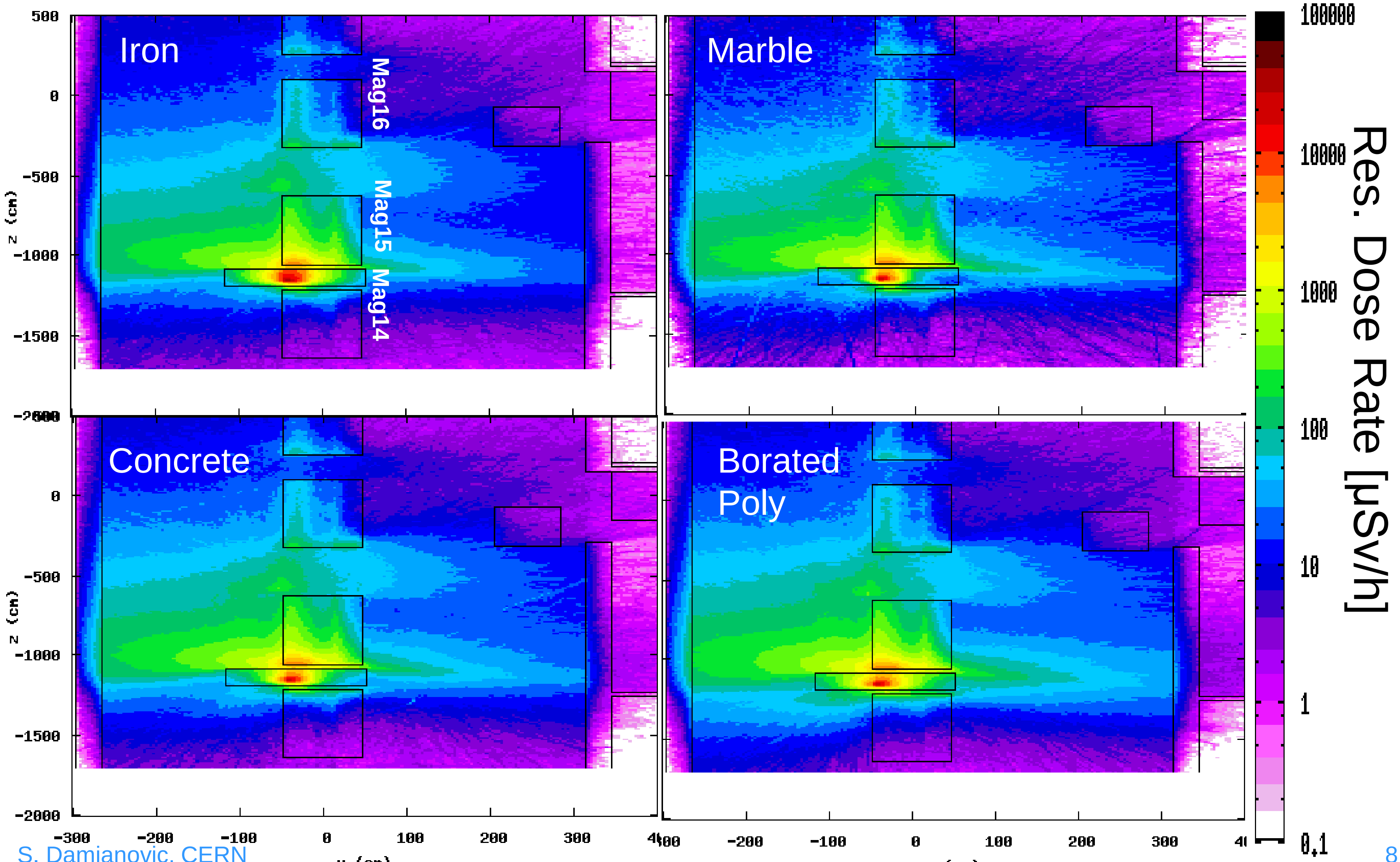
Stray radiation



Hardly any difference in dose rates along SS16 for the four different shielding materials inside SS15

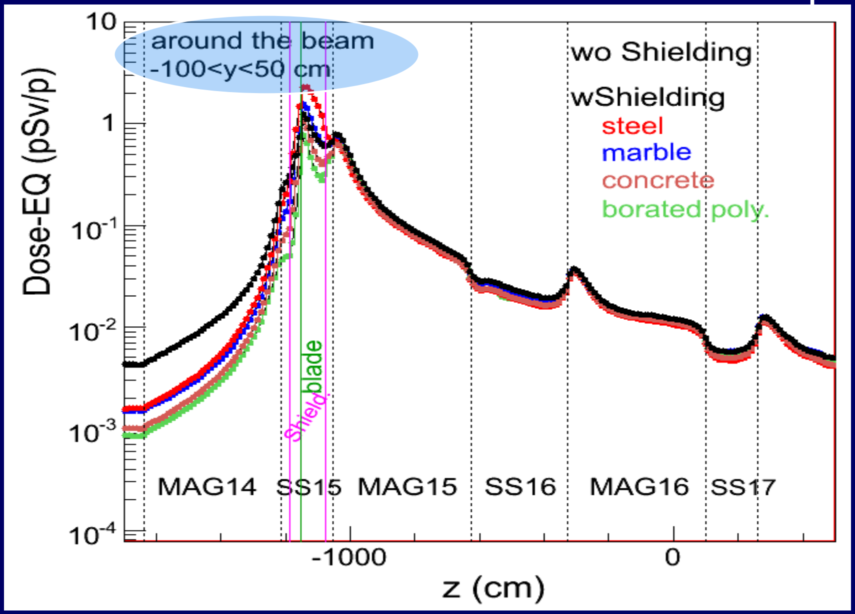
Local Shielding in SS15 – Choice of Material

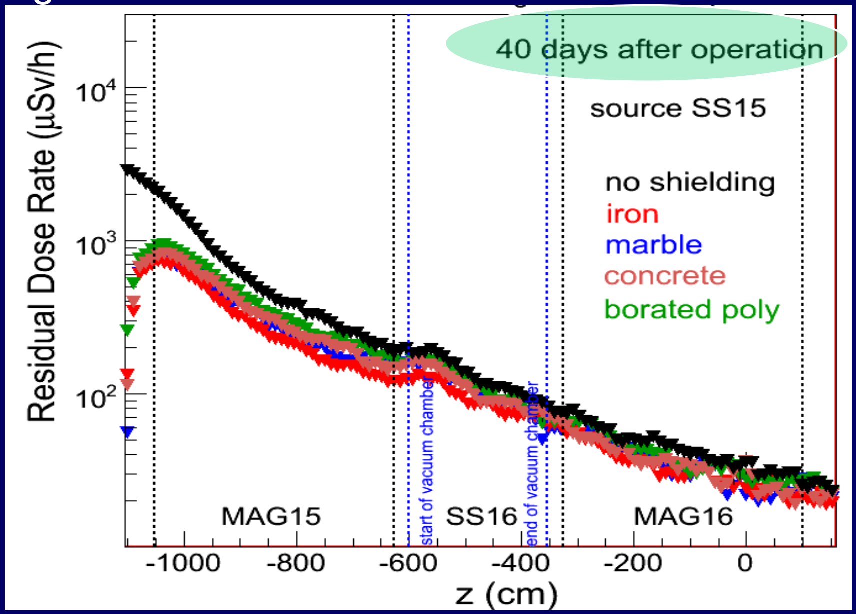
Residual dose rate (cooling time 40 days)



Local Shielding – Choice of Material

1dim proj. along z





Ambient Dose downstream of the SS15 the same to within 20% for no shielding and for the four different shielding materials inside SS15;

Shielding effects much larger upstream

Residual Ambient Dose Rate downstream of SS15 the same to within 20-30 % for all different materials

Concrete ?

(best performance/cost ratio)

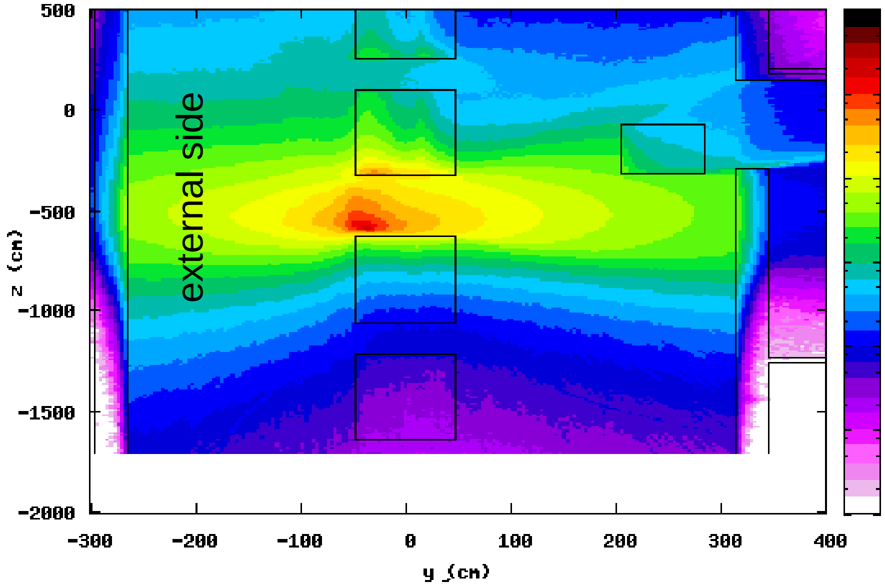
no sense to make any combination of materials

BKP

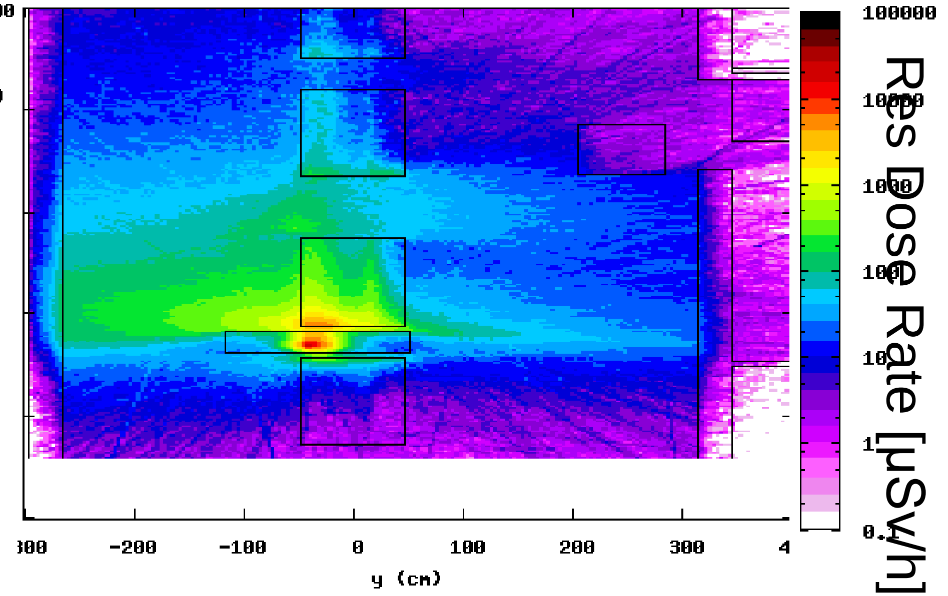
Effect of the additional (distributed) sources

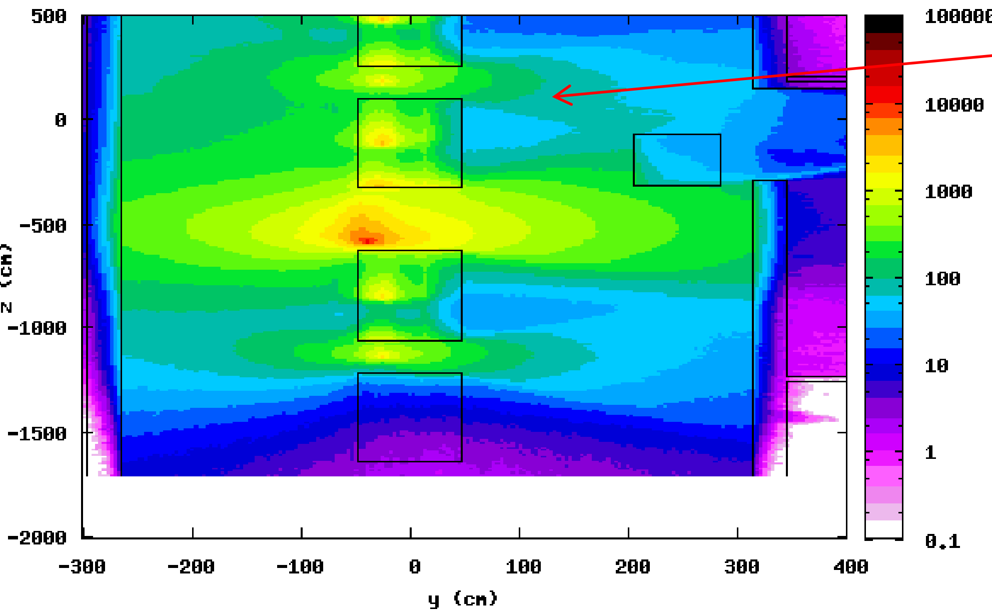
Example: Residual Ambient Dose-eq Rate – cooling time 40 days

source in SS16

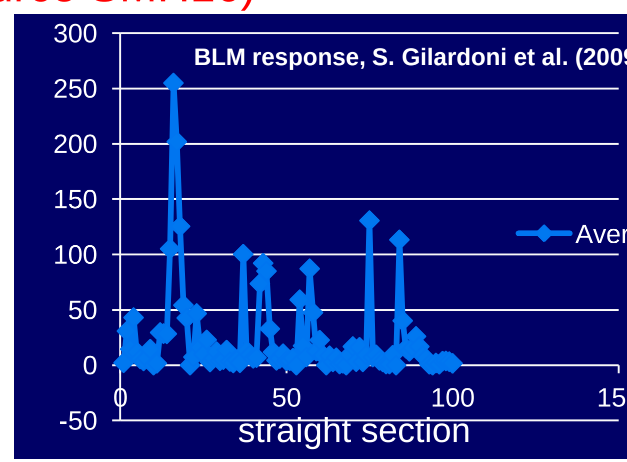


source in SS15



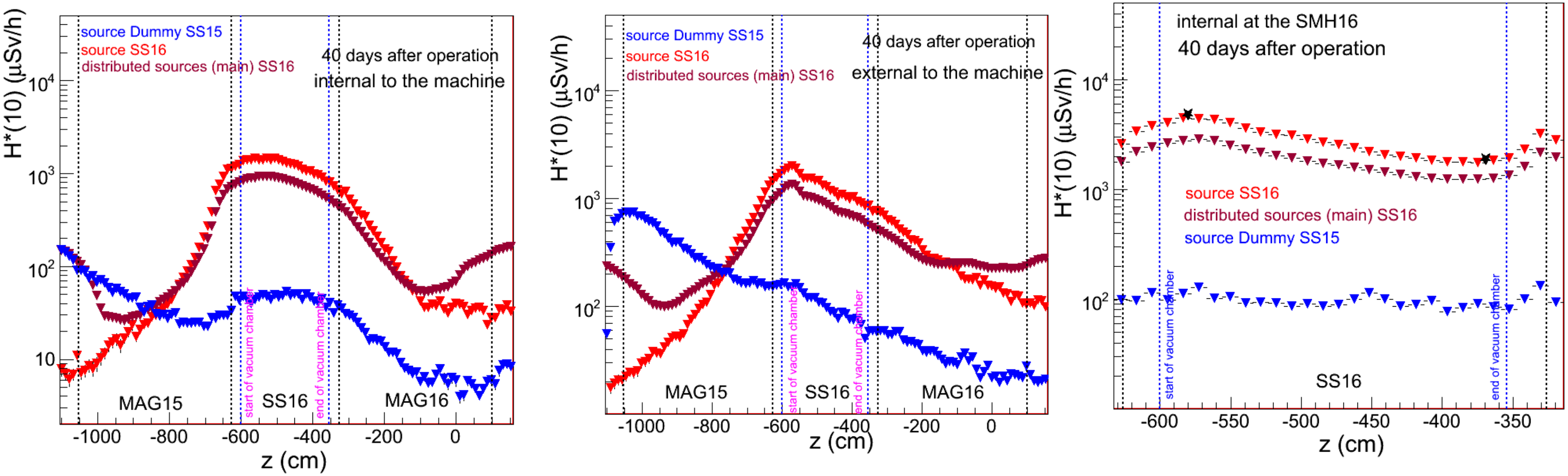


distributed sources as measured by BLM's during the MTE operation (main source SMH16)



Effect of the additional (distributed) sources

Reduction of Residual Dose Rate - example cooling time 40 days



Reduction factors by shifting the beam losses from SMH16 to Dummy Septum 15:

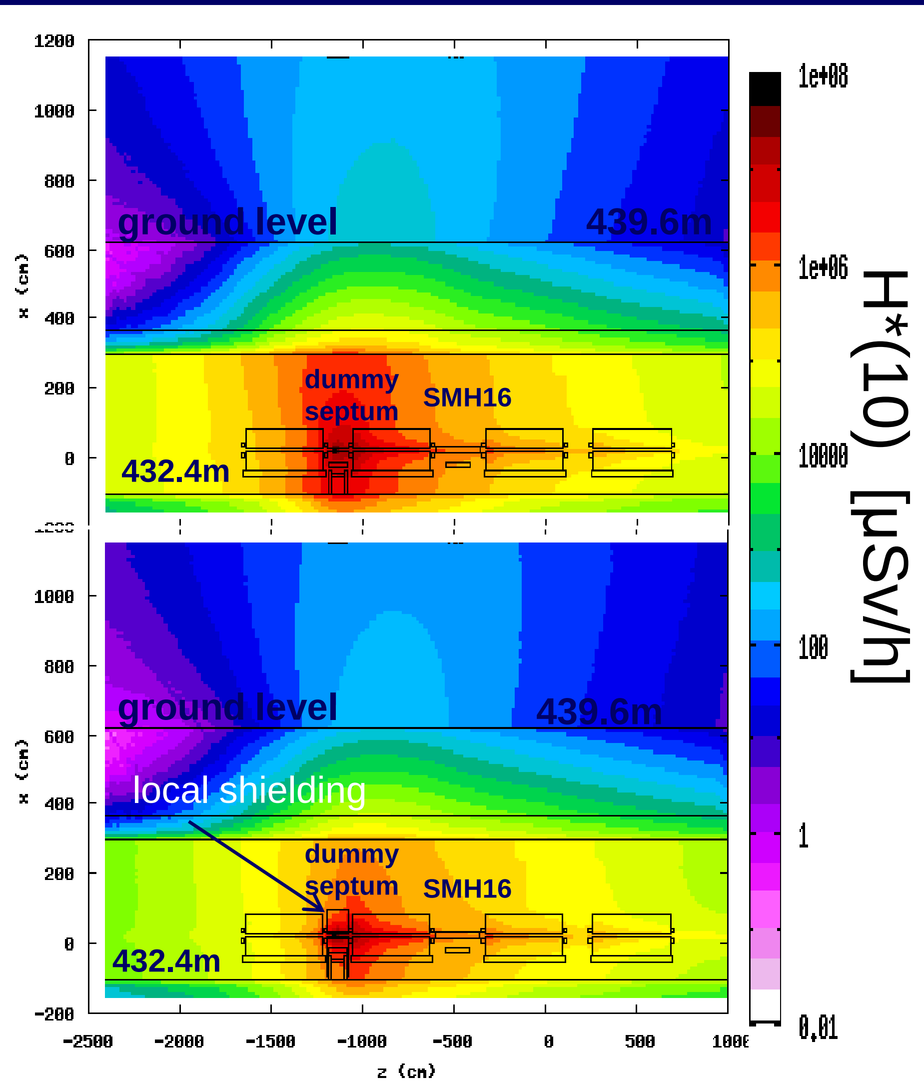
26 (source SMH16) vs. 17 (distr. sources) along SS16 - internal side of the machine

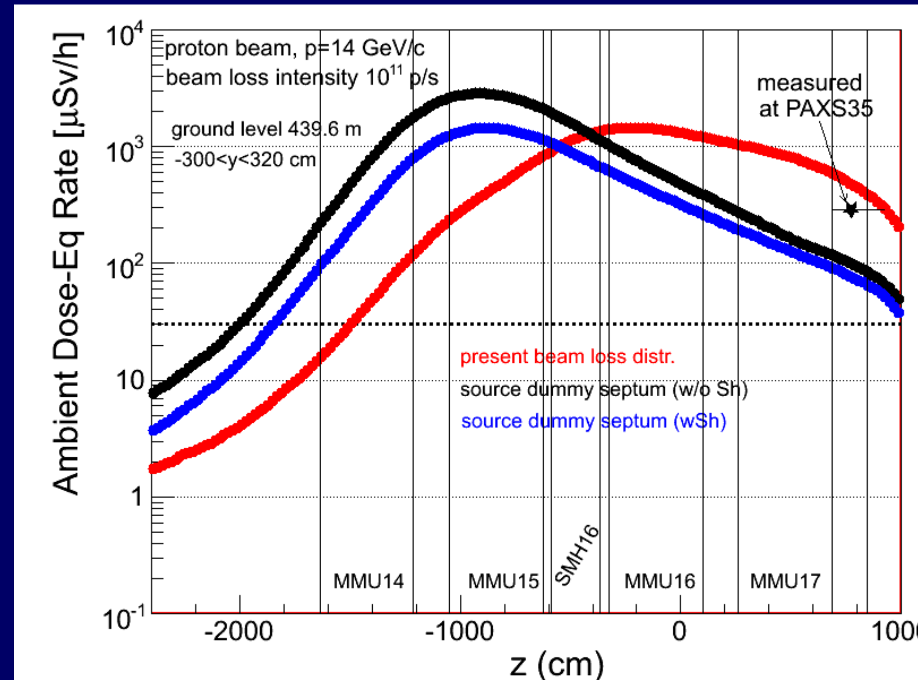
12 (source SMH16) vs. 9 (distr. sources) along SS16 - external side of the machine

30 (source SMH16) vs. 20 (distr. sources) - very close to SMH16 (internal side)

Activation can be reduced by factors of 10-40 depending on cooling time and the site. The success of the method depends on the geometrical masking of the septum blade 16 by the dummy blade 15 with the required accuracy and stability, i.e. cutting down the residual beam interactions in septum 16 by at least the same factors 10-40

Ground Level above the PS SS15/SS16





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

Additional local shielding around dummy septum

→ radiation level reduced by a factor of 2; max dose rate of ~1.2 mSv/h

Gradient steeper by a factor of 2

→ less area and consequently less shielding material required above the region of SS16

Profile of the area with H*(10)>10 μSv/h: SS16 vs. Dummy Septum

H*(10)<10 μSv/h → assures a safety margin by a factor of 3

(sufficient for required Laguna beam intensity of $3.3e^{+13}$ p/s)