
Sensitivity of the BLM position in SS15 to the dummy blade angle

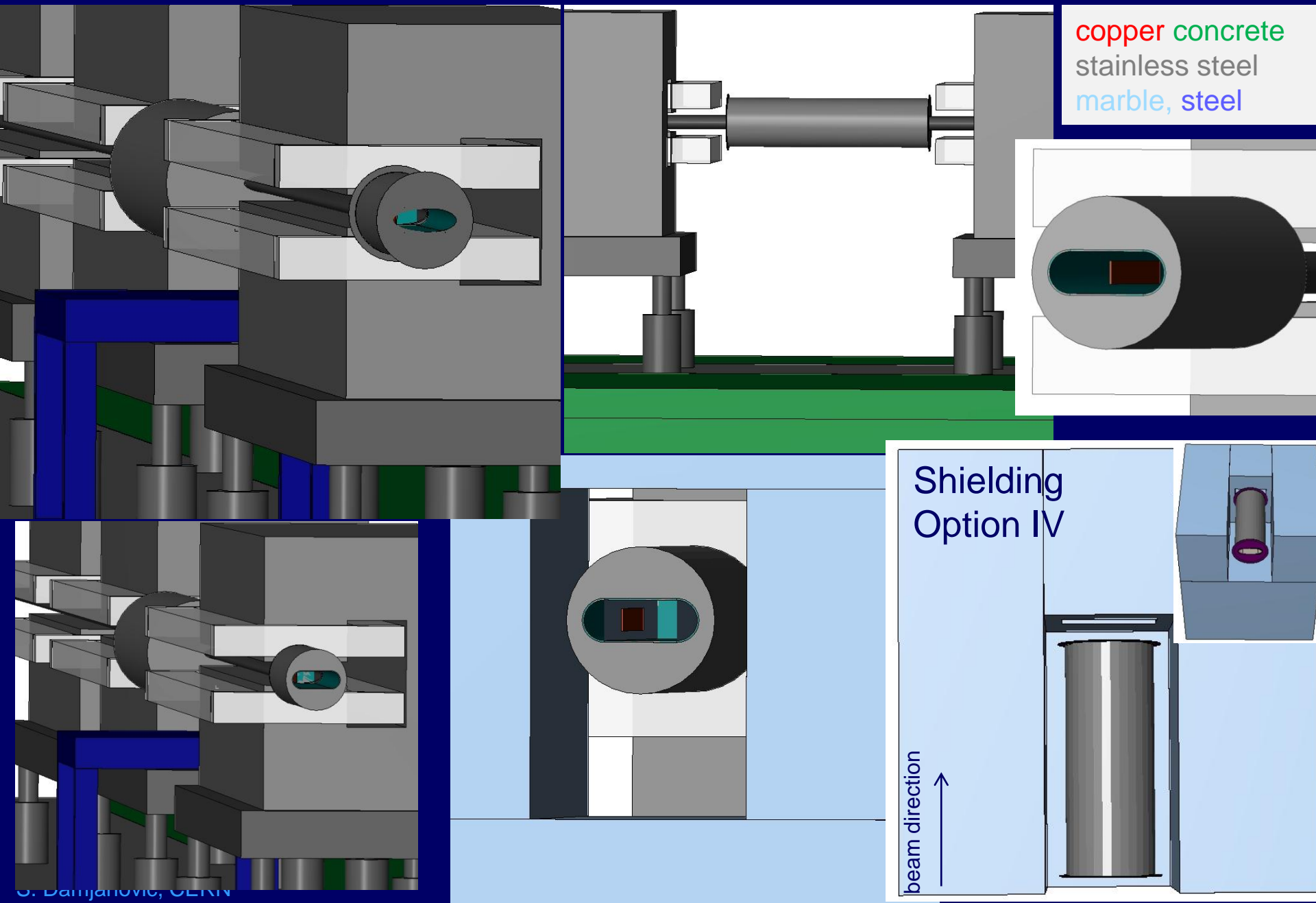
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CERN, April 26, 2012

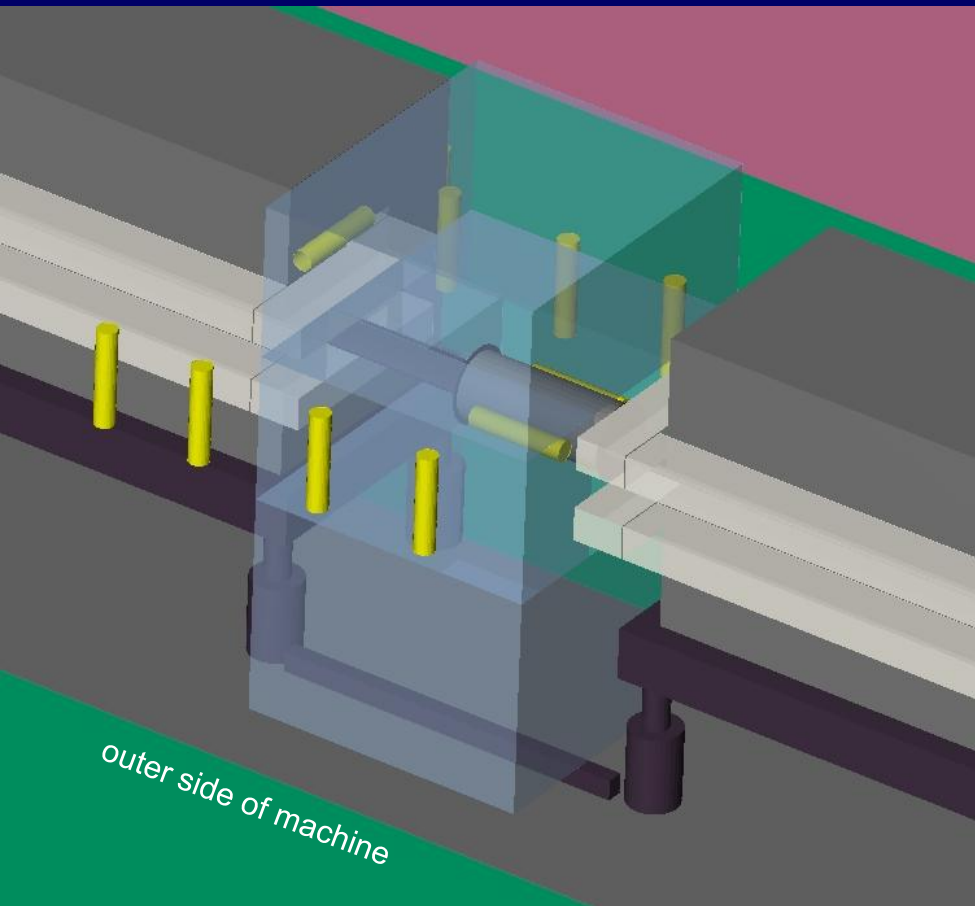
Motivation

Could Beam Loss Monitors installed in SS15 be used to check and monitor the correct alignment of the dummy septum blade?

SS15 with Dummy Septum Tank, Beam Screen Window and Blade

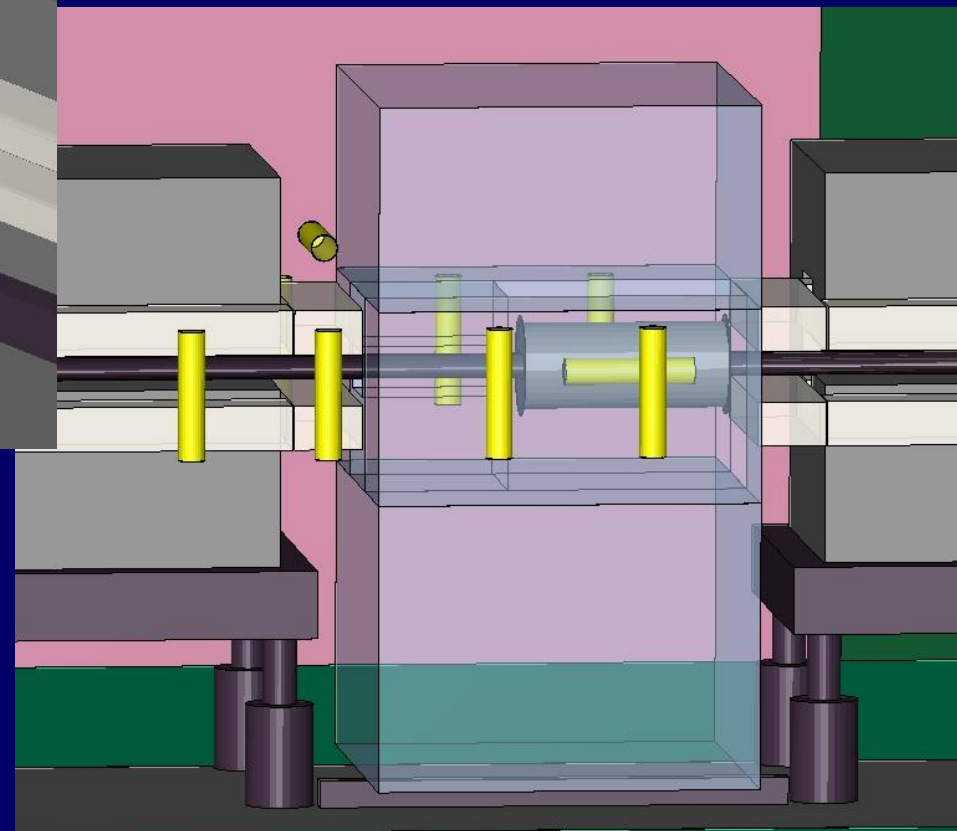


Possible positions and orientations of a LHC BLM IC



BLMs vertically oriented:
study 4×2 positions on
both sides of the beam

copper concrete stainless steel
marble stainless steel



BLMs horizontally oriented:
study 2 positions (both sides of the beam)
along the z axis in the gap between the
dummy septum tank and shielding blocks
study 1 position along the y axis on the
front face of MMU15 above the coils

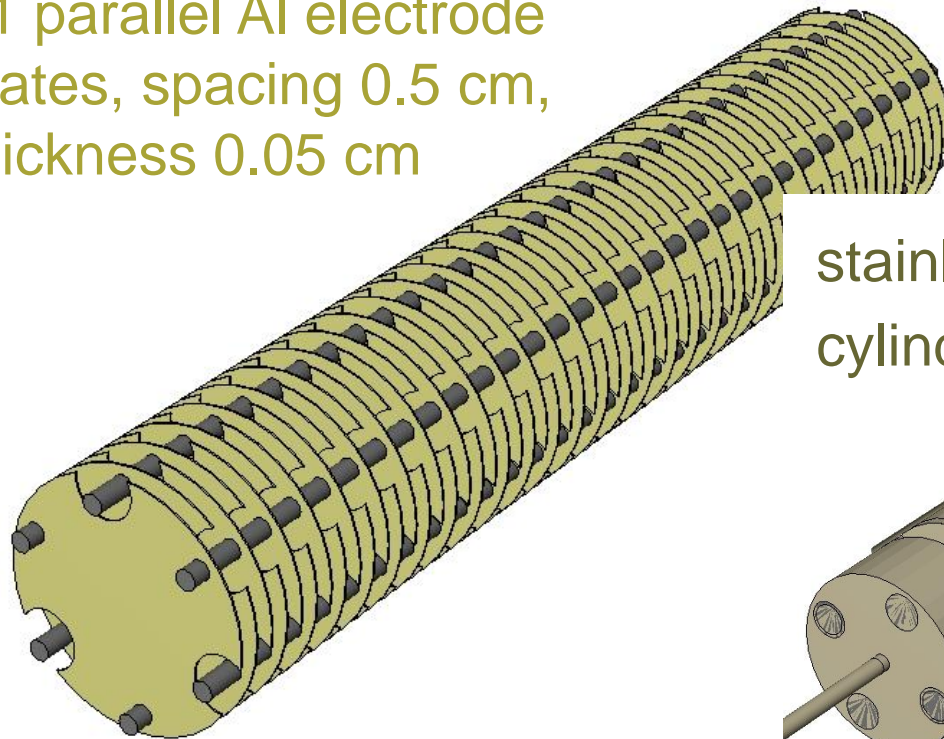
Geometry of the LHC BLM IC

exact geometry of the LHC BLM IC implemented in FLUKA
(source: FLUKA team)

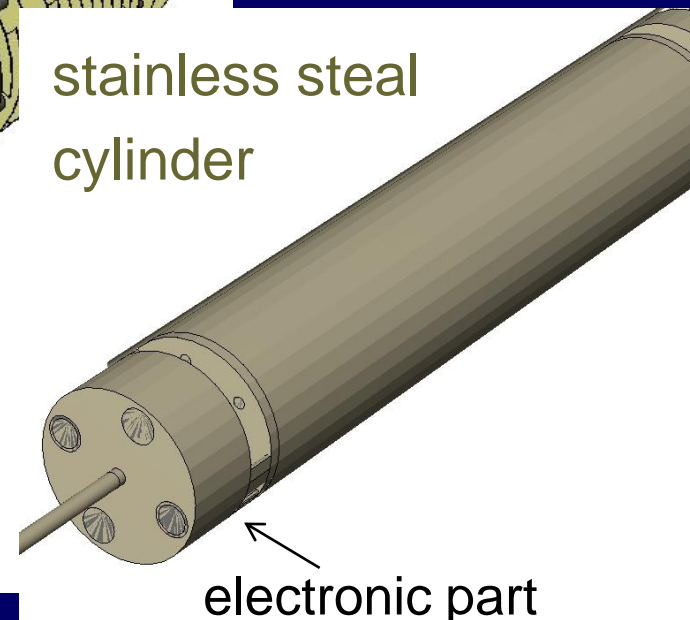


LHC BLM IC: length 59.9 cm, diameter 8.9 cm,
sensitive volume 1.5 l, filled by nitrogen at 1.1 bar

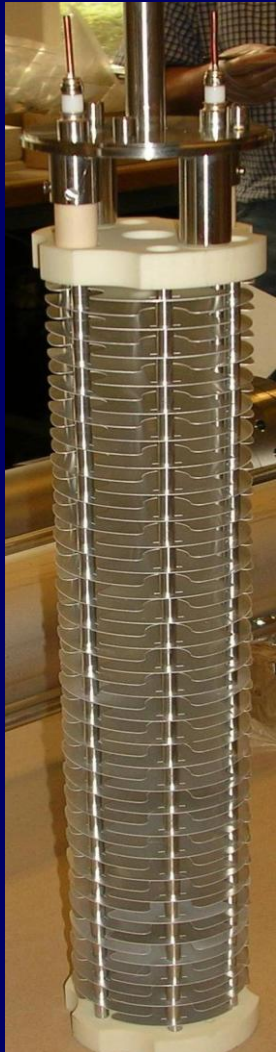
61 parallel Al electrode
plates, spacing 0.5 cm,
thickness 0.05 cm



stainless steel
cylinder



electronic part

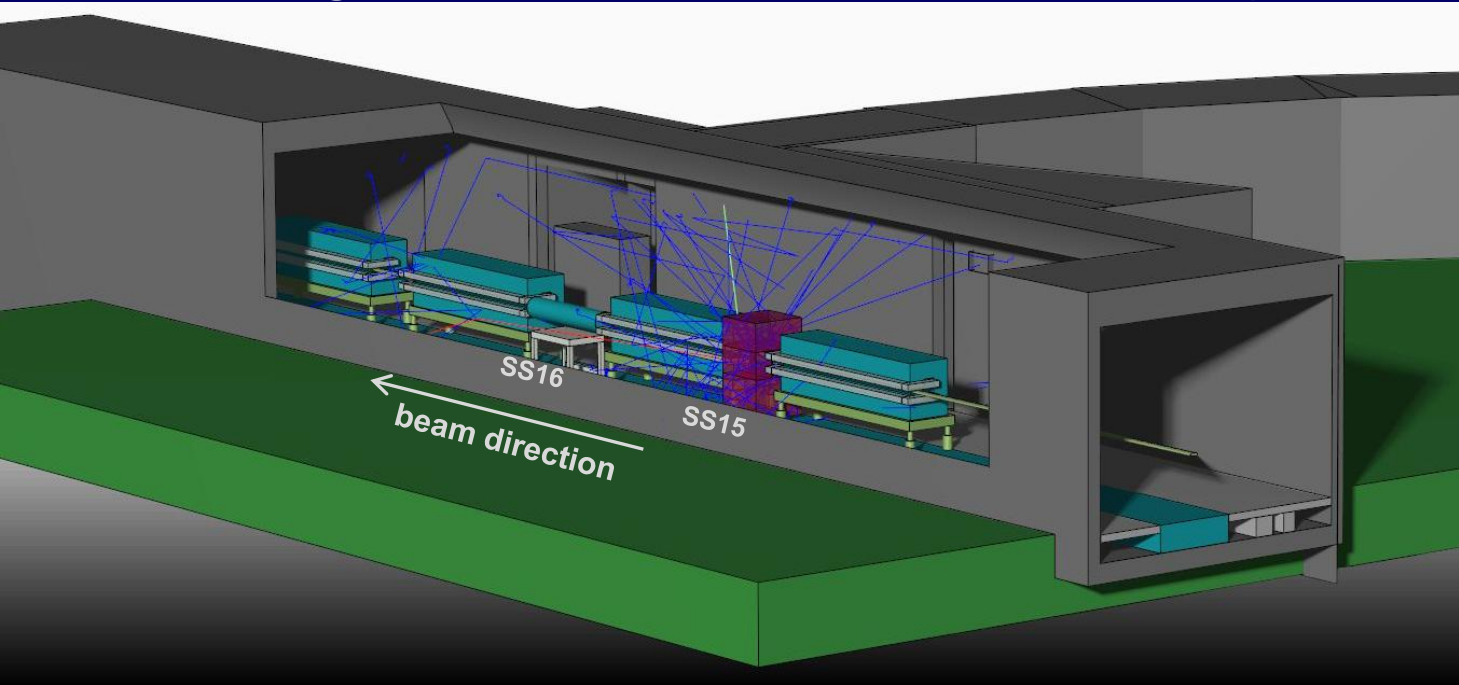


Assumptions for the simulations

- proton beam of $p=14$ GeV/c
- beam loss intensity: 10^{11} p/s ($\sim 1\%$ of the primary intensity 10^{13} p/s)
- Cu blade
- **source: dummy septum with distributed impact points**
 - along the beam direction (z) at the start of the blade
 - Gaussian distribution in the vertical direction (x) with $\sigma_x = 2.5$ mm centered in the middle plane
 - uniform distribution in the horizontal direction (y) over 3mm thickness of the blade

Rotation of the dummy septum blade around a vertical axis, placed at the start of the blade in its center; three angles considered: $\theta = 0, 1$ and 2 degrees

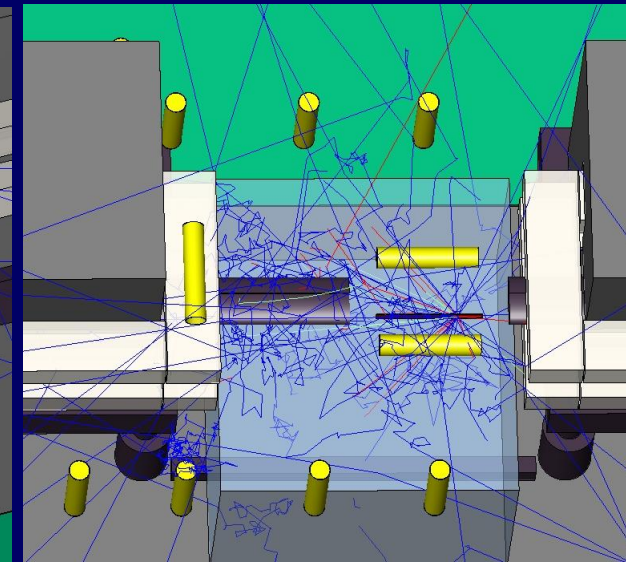
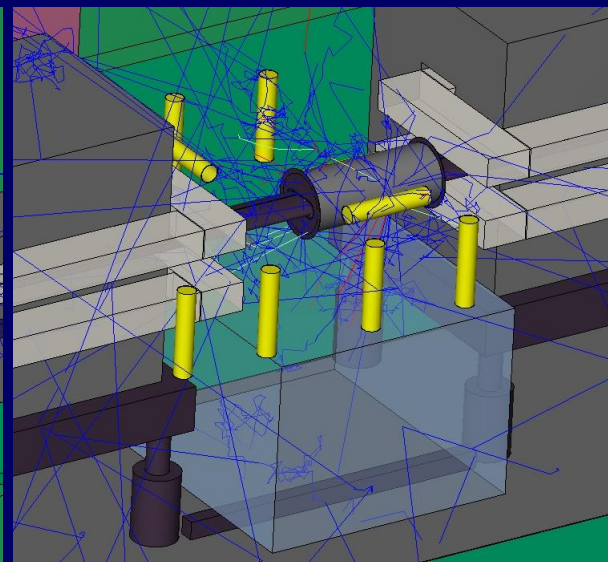
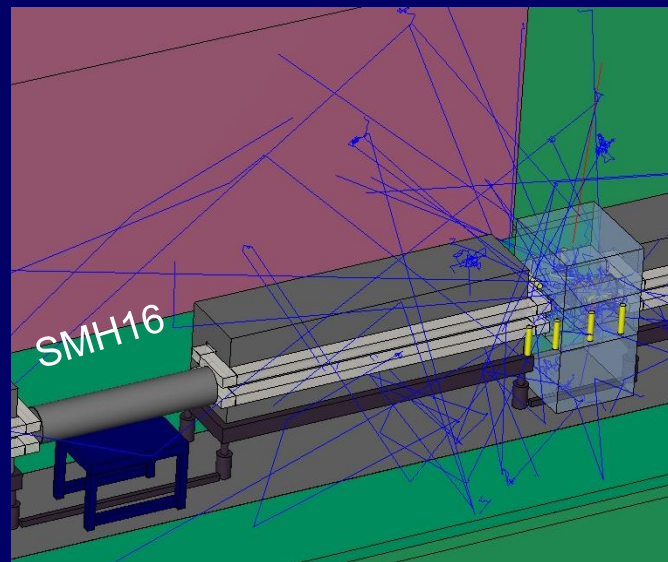
Single Event Display – blade angle $\theta=0^\circ$



most probable interaction in the dummy blade in SS15

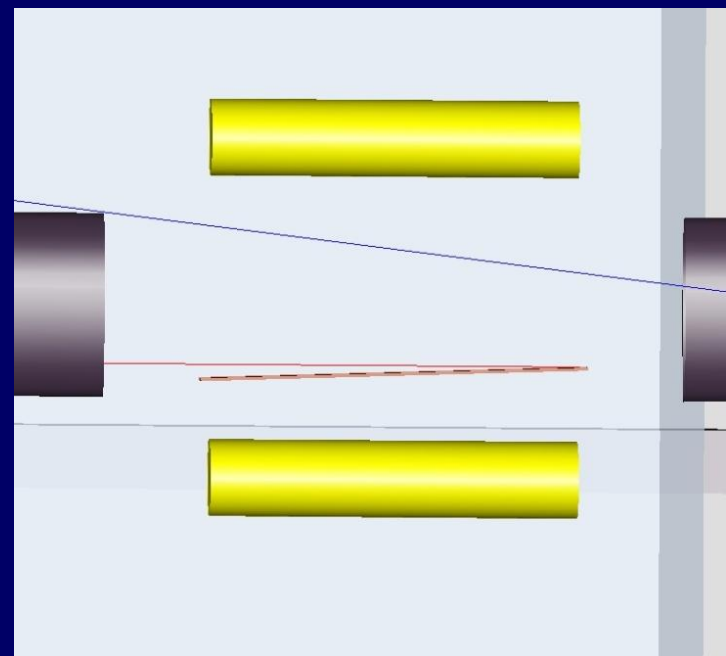
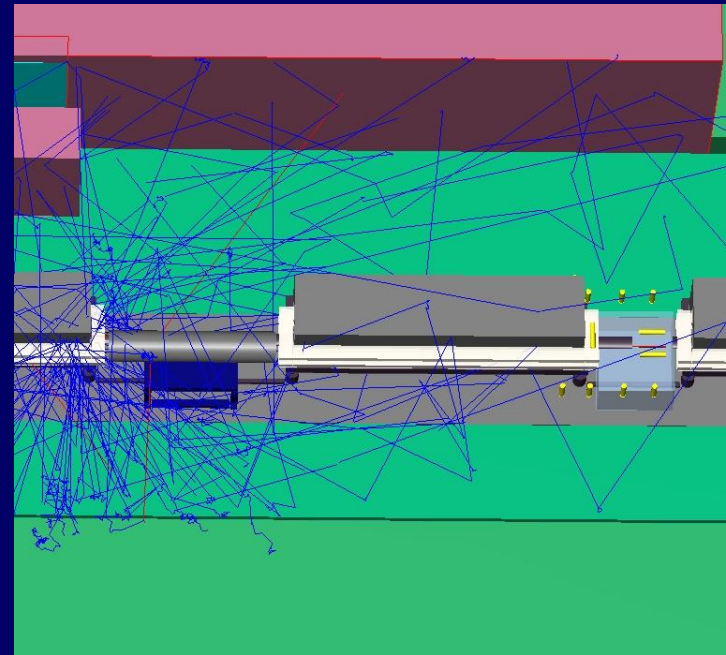
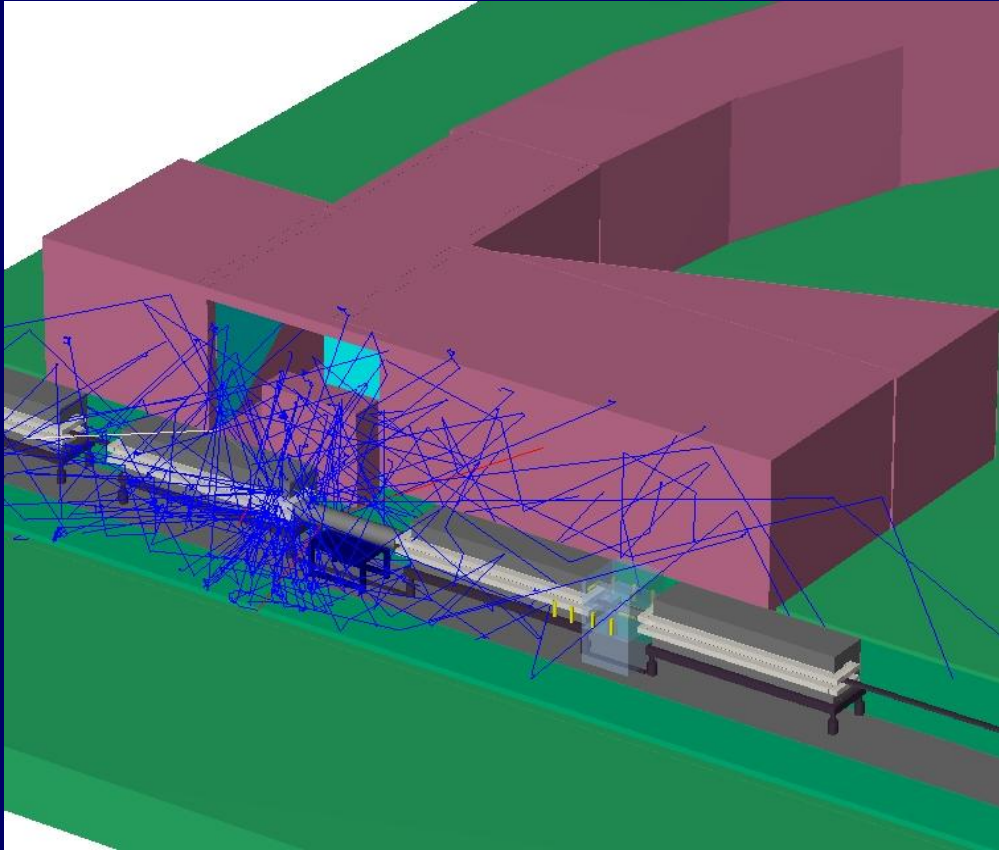
region of SS16 mostly free of interactions

protons
neutron
photons



Single Event Display – blade angle $\theta=2^\circ$

protons neutron photons

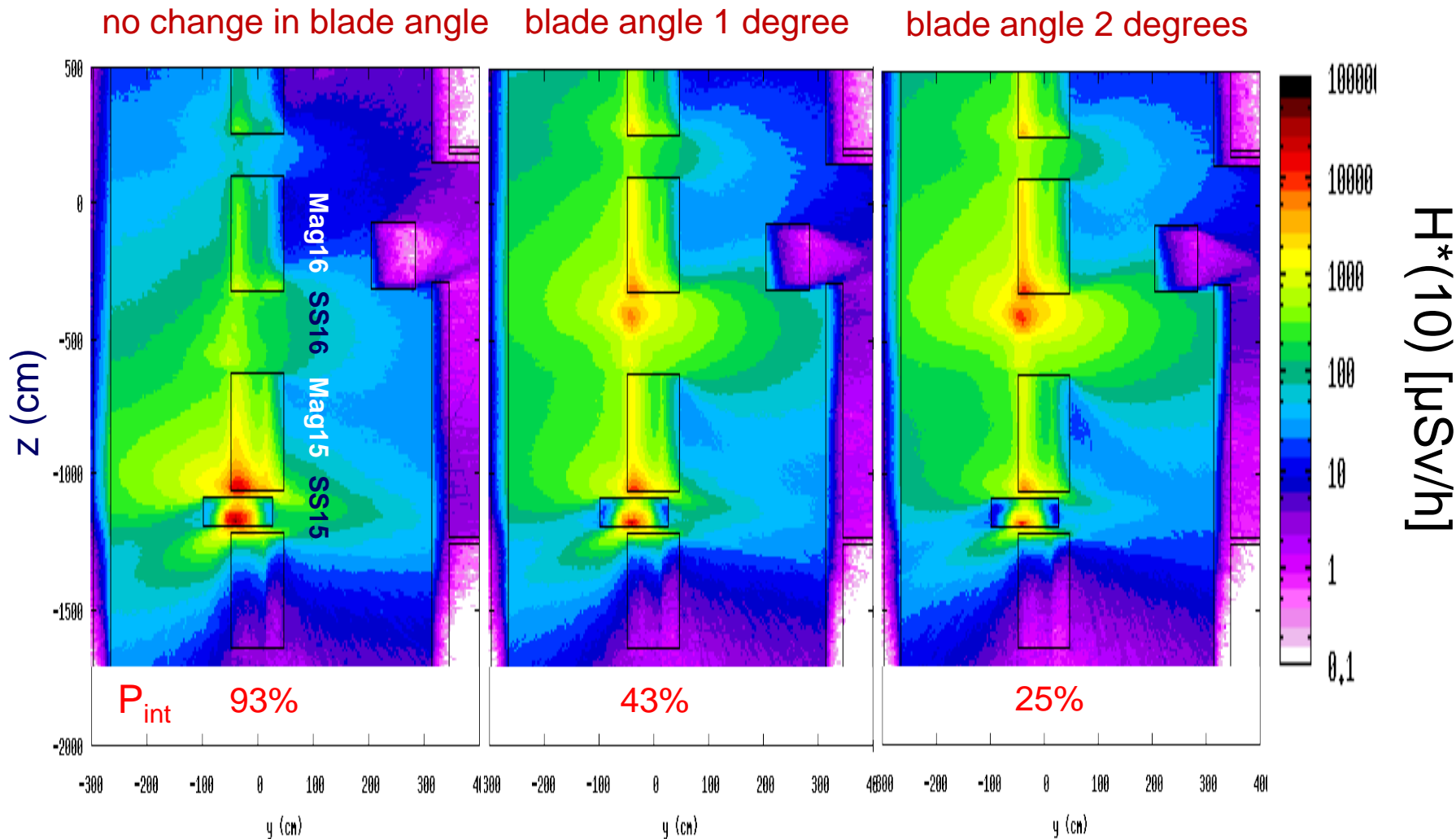


most probable interaction **not** in the dummy blade in SS15, but further downstream in the region of SS16 (mostly in the region of the second set of blades, like here)

→ BLM in SS15 still measures current

Residual Dose Rates for the 3 different blade angles

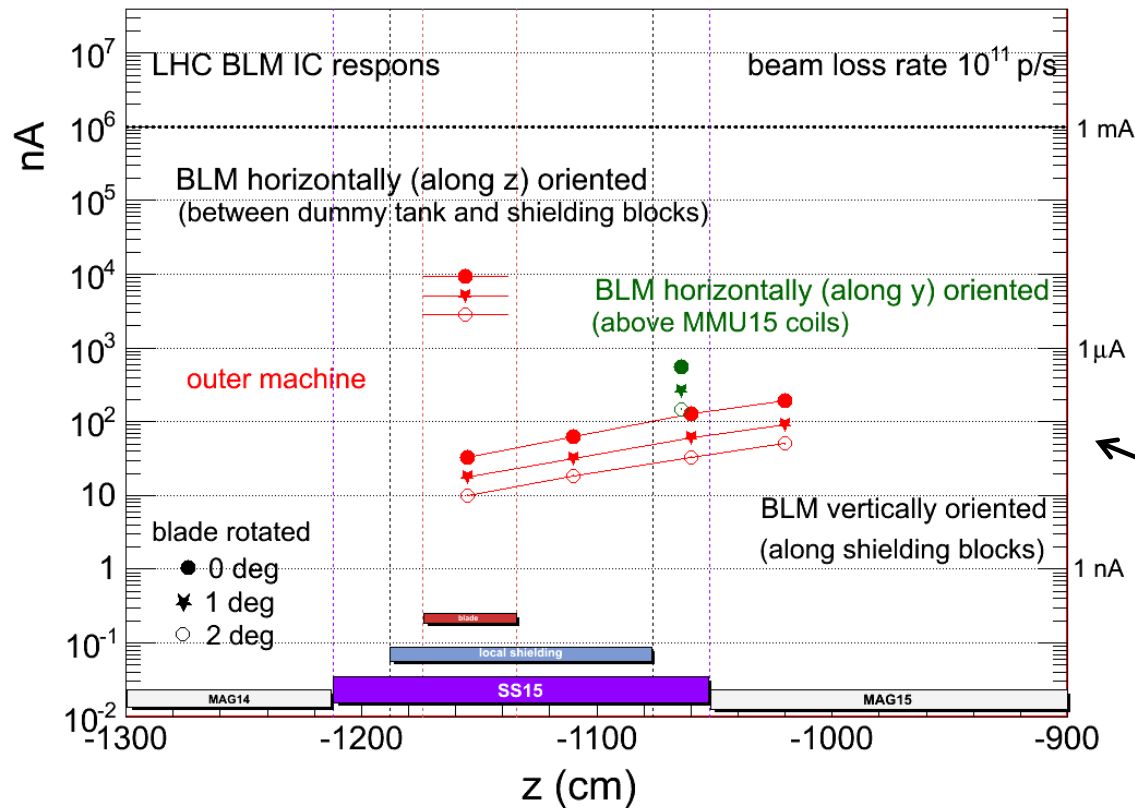
Example : Residual Dose Rate [$\mu\text{Sv/h}$] in z-y plane after cooling time of 40 days



Large differences in residual dose rate distribution

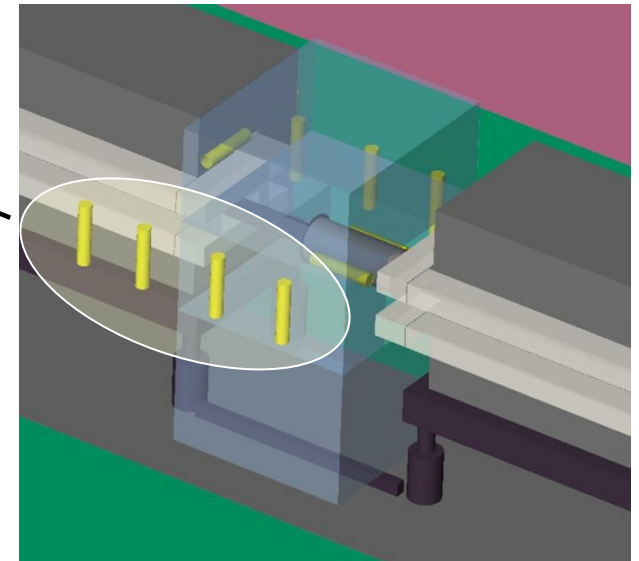
Change in the blade angle increases the residual dose rate in SS16

Response of the IC-type BLMs in nA to 1% beam loss in the dummy septum blade for 3 different blade angles



source – start of the blade

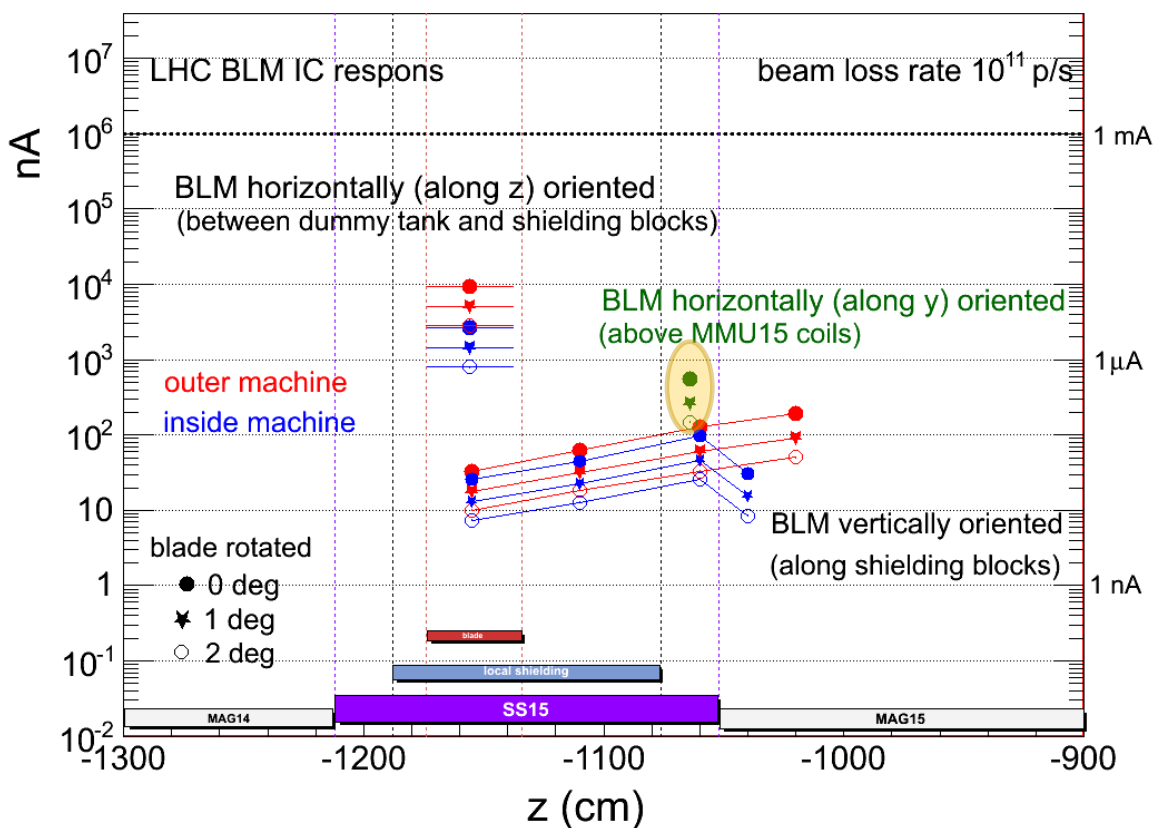
change in the blade angle :
0, 1 and 2 degrees



For fixed blade angle large differences in currents depending on the BLM position; highest signal for BLMs placed in between the tank and shielding blocks

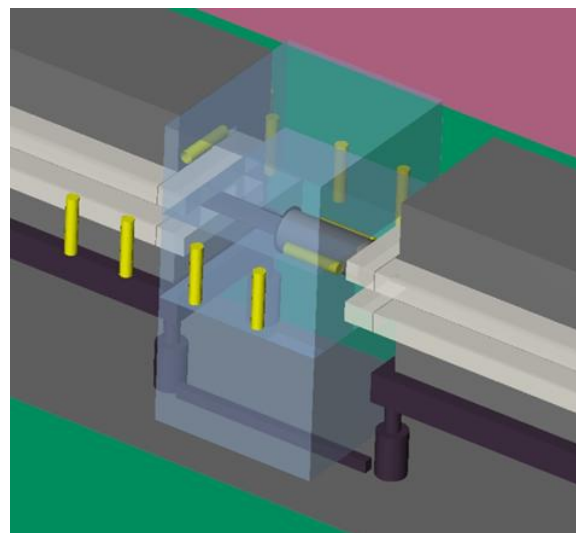
Currents for blade angle $\theta=0^\circ$ higher by factors of 1.8 and 3 compared to angles of $\theta=1^\circ$ and $\theta=2^\circ$, resp. roughly following the change in interaction probability (for W the factors would be smaller by ~30%)

Response of the IC-type BLMs in nA to 1% beam loss in the dummy septum blade for 3 different blade angles



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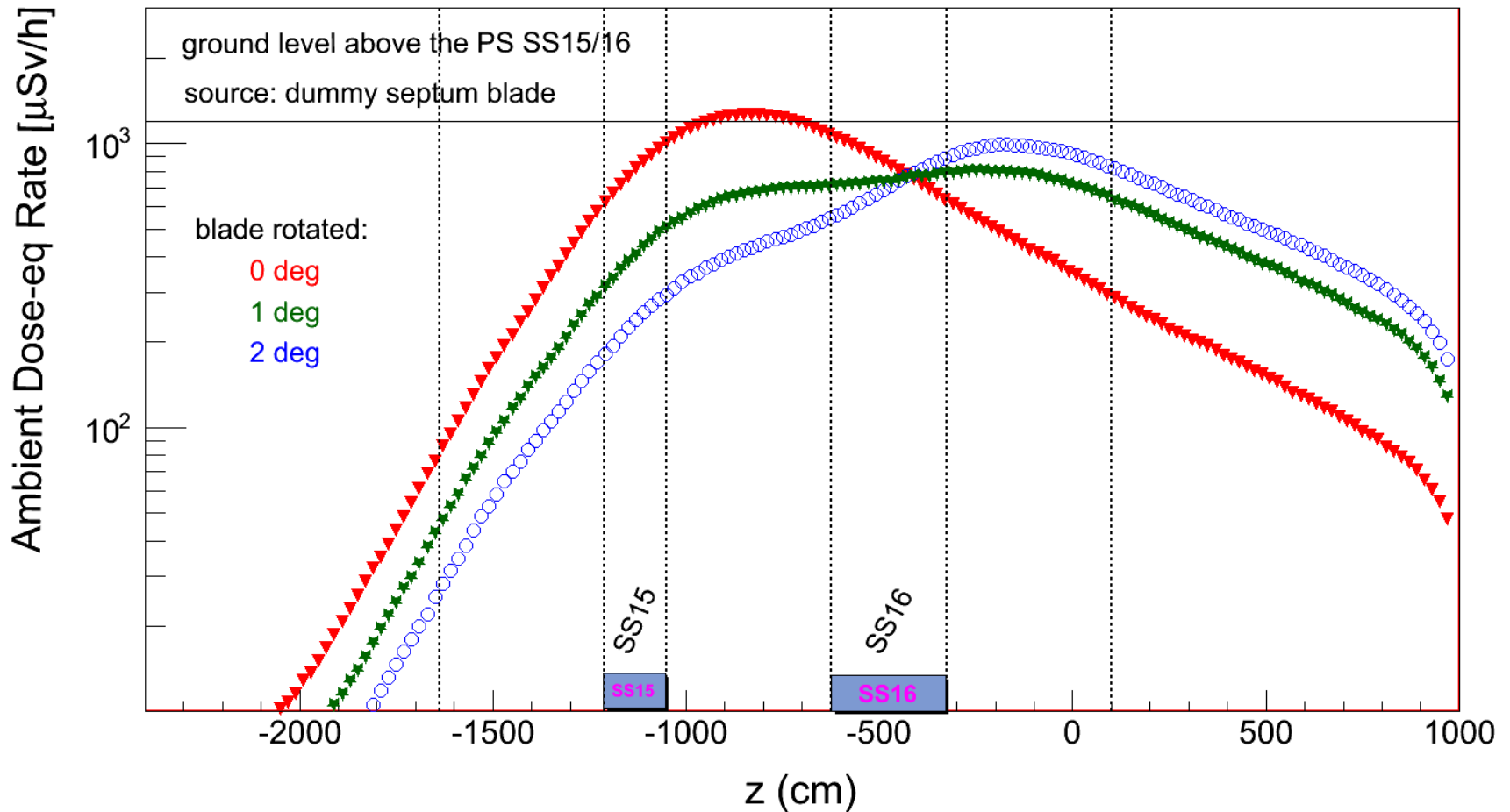
change in the blade angle :
0, 1 and 2 degrees



Higher signals for BLMs placed along the outer side of the machine

Optimal position for BLM horizontally oriented (along y) at the front face of MMU15 above the coils?

Stray Radiation on the ground level above the PS SS15/SS16 for the 3 different blade angles



Different shapes and slightly smaller maximal values of Ambient Dose-eq Rates at the ground level for blade angles $\neq 0$