Wire compensator in IR1:

radiation levels and impact on the machine

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With input from A. Bertarelli and L. Gentini

WP10   Energy deposition & R2E

Overview

- Introduction: simulation configuration

- Reiterate the results presented at WP2/WP13 HL-LHC Satellite Meeting [1]

    - dose and energy deposition levels on the beam wire compensator
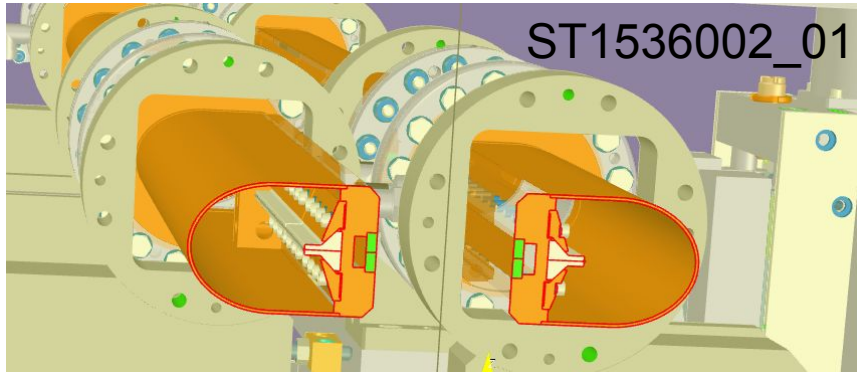
- Future plans.

[1] Marta Sabate Gilarte, Energy deposition studies,
https://indico.cern.ch/event/1168738/contributions/5044051/

Configuration overview

- HL-LHC: IR1 – right side.

- Optics v1.5 Nov.19 *(v1.8 just released)*

- Horizontal crossing with a half crossing angle of 250 μrad towards the external side of the ring.

- β* = 15 cm

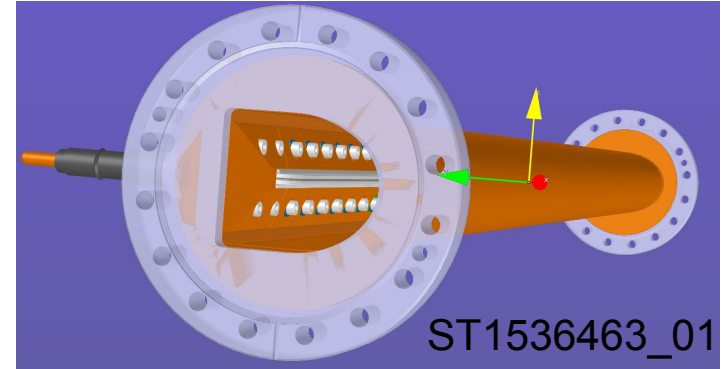- Collision at IP1 considering 7 TeV per proton beam.

- Inclusion of the wire compensator model in the tunnel file:
  - Only for: distance from the wire to the center of the vacuum chamber: 15 mm
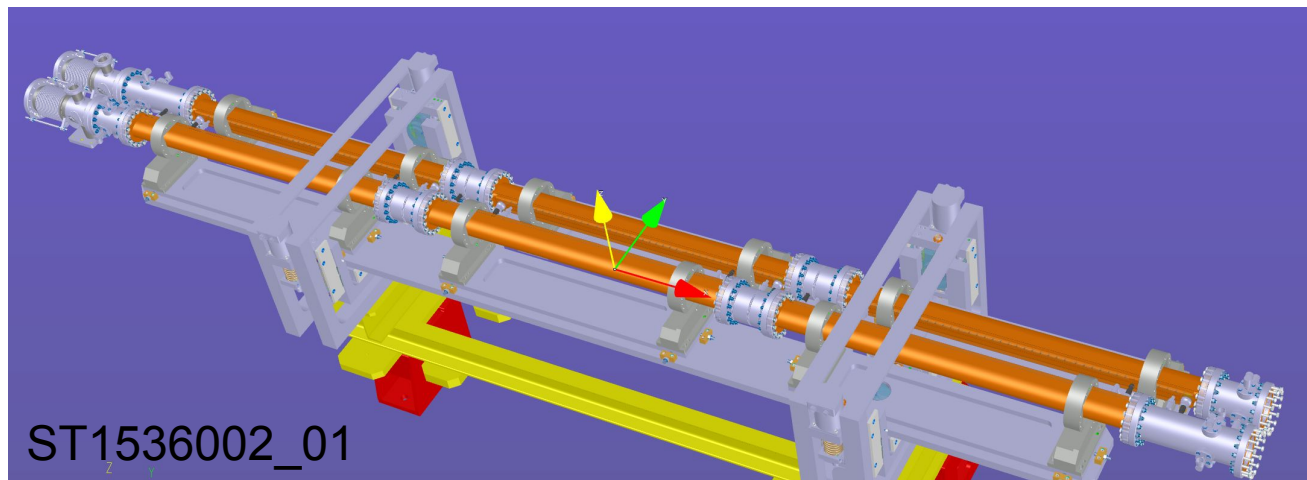 - Dose levels and energy deposition.

Geometry model
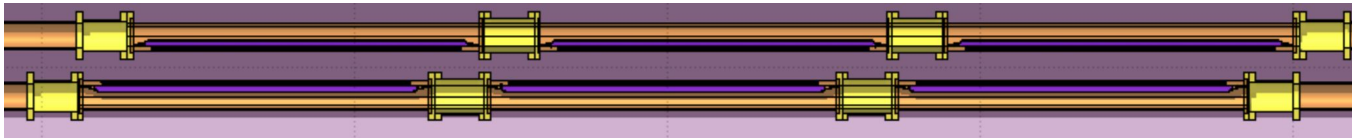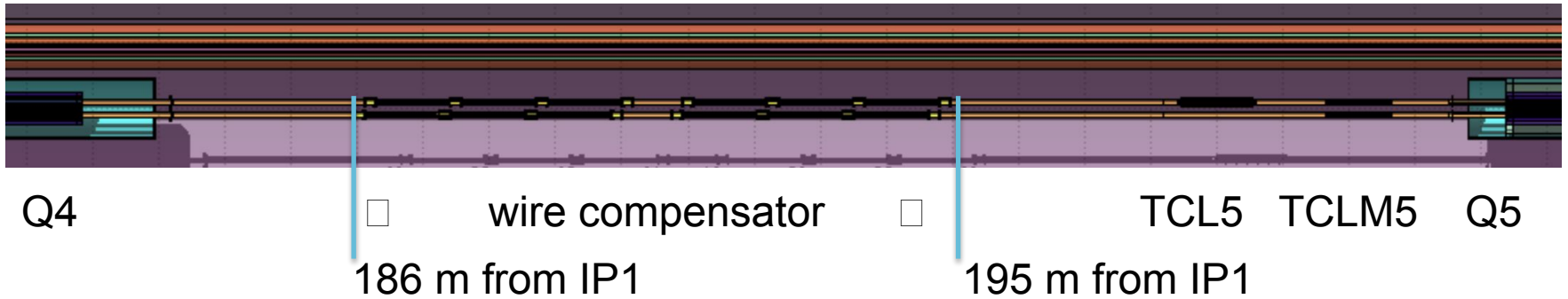

ST1536002_01

Incoming beam   Outgoing beam

ST1536463_01

ST1536002_01

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Geometry model: implementation in FLUKA

Q4   □   wire compensator   □   TCL5   TCLM5   Q5

186 m from IP1   195 m from IP1

2 modules of 3 compensators in each beam line.

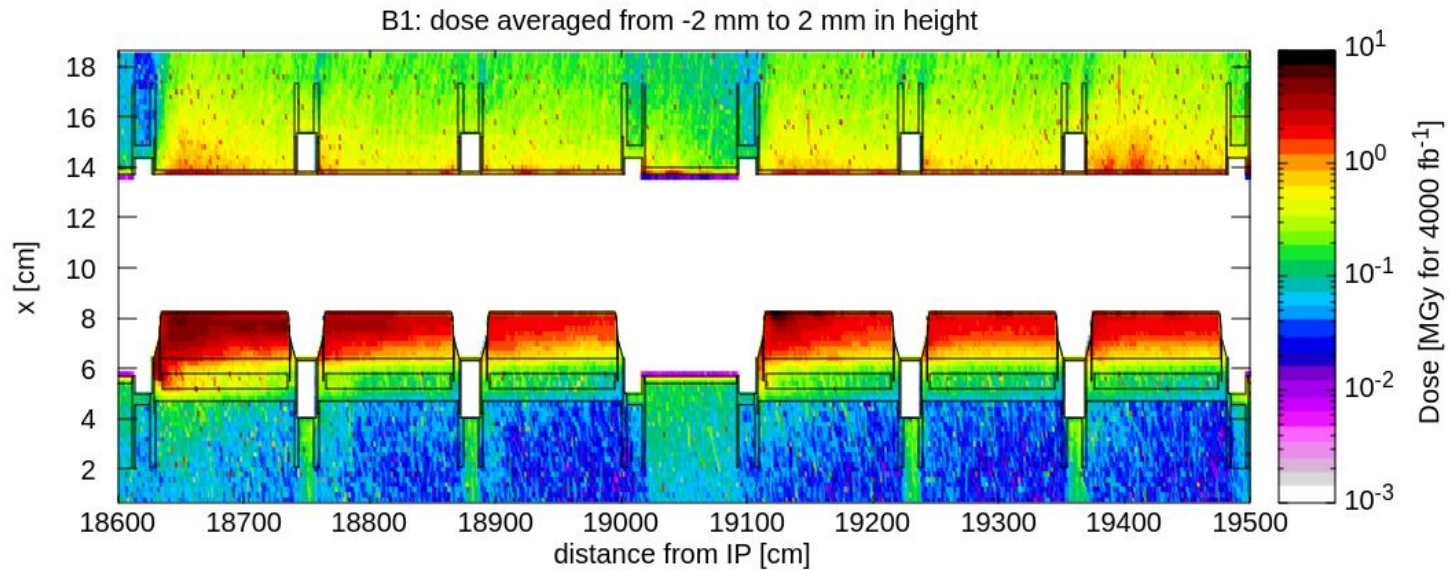Distance from the wire to the center of the vacuum chamber: 15 mm
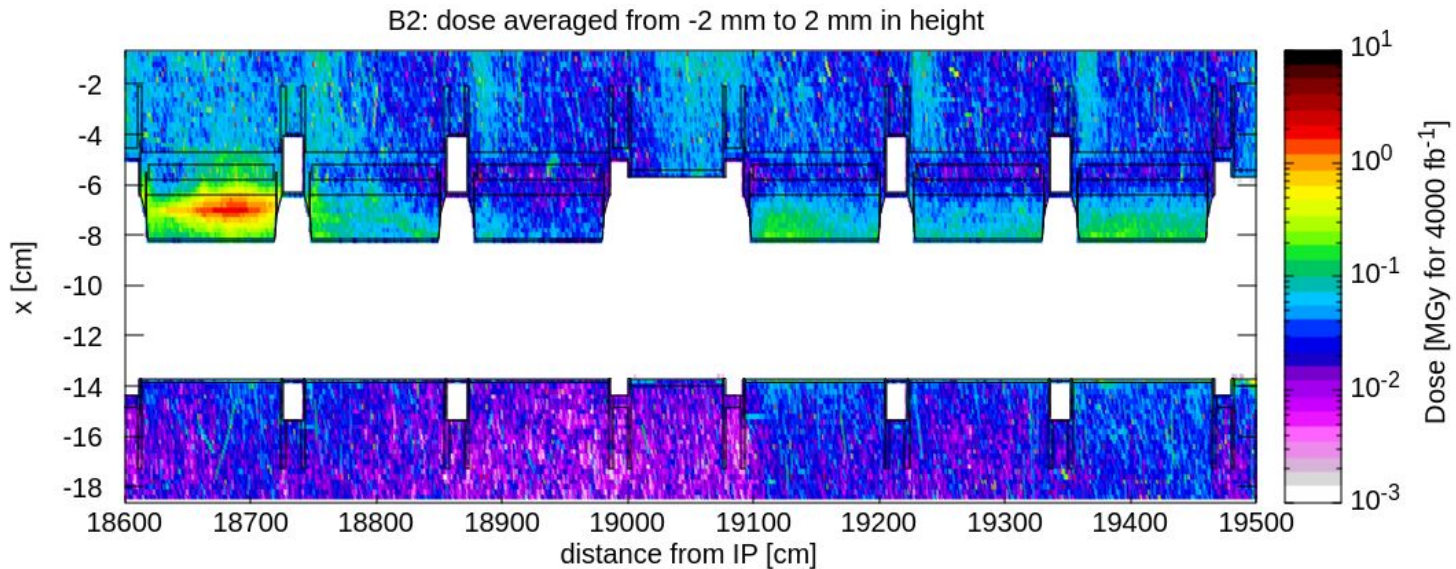

Outgoing beam

Incoming beam

Dose levels in the wire compensator
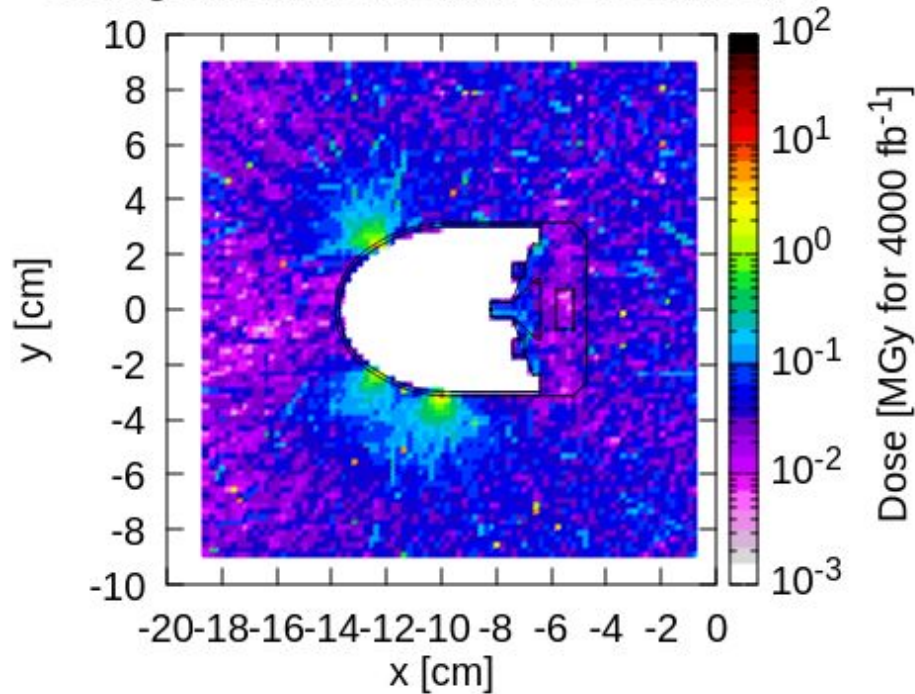
Outgoing beam

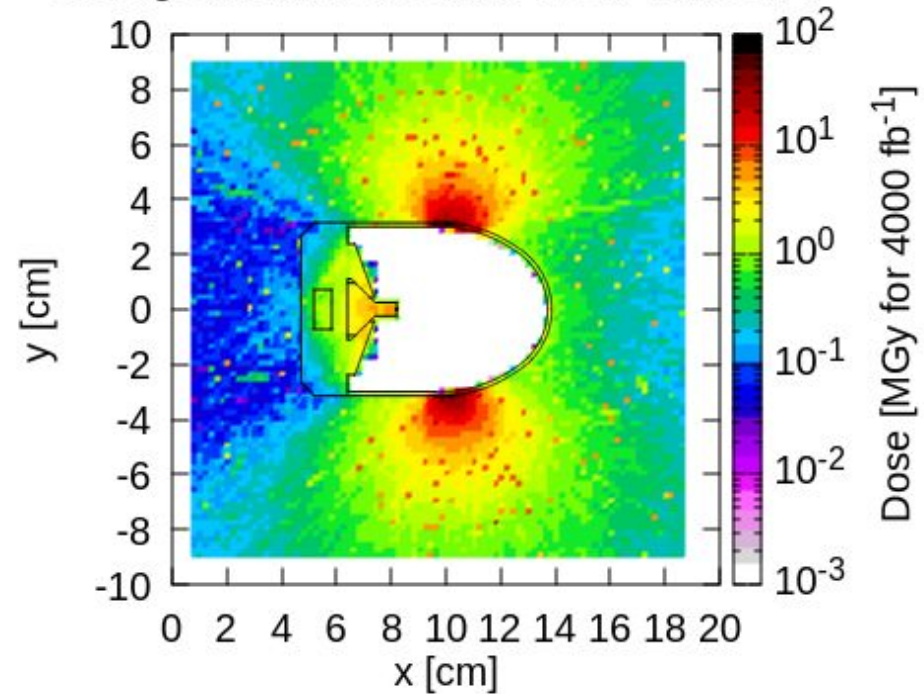Incoming beam

Dose levels in wire compensator at peak

B2: dose at maximum
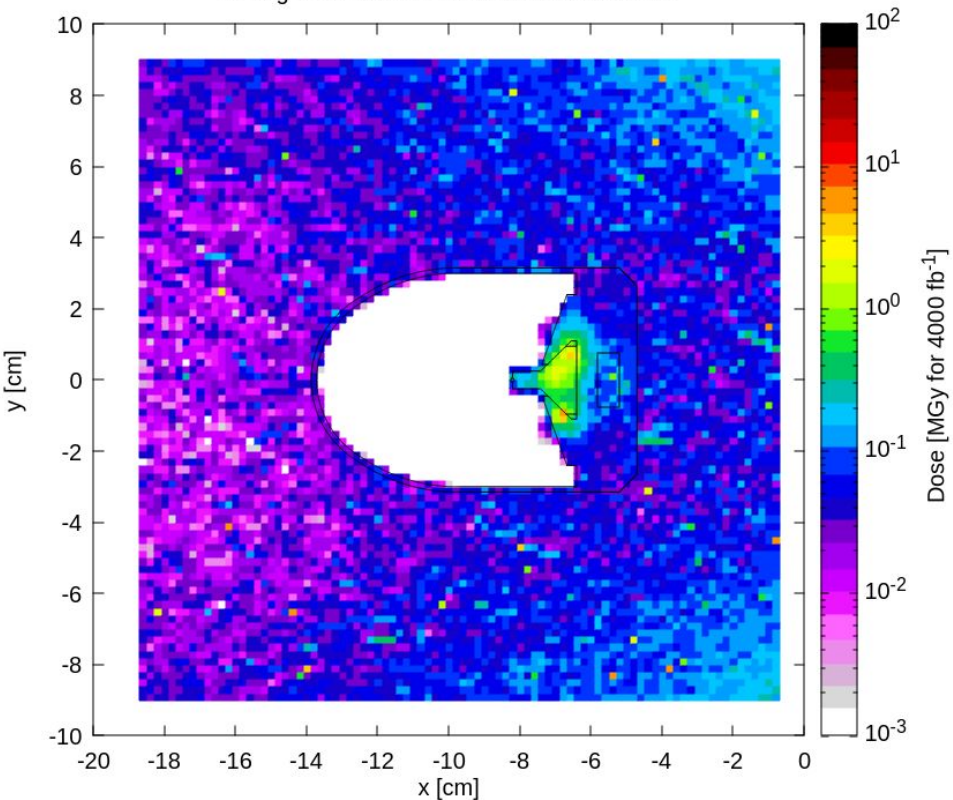averaged from 191.05 m to 191.06 m from IP

B1: dose at maximum
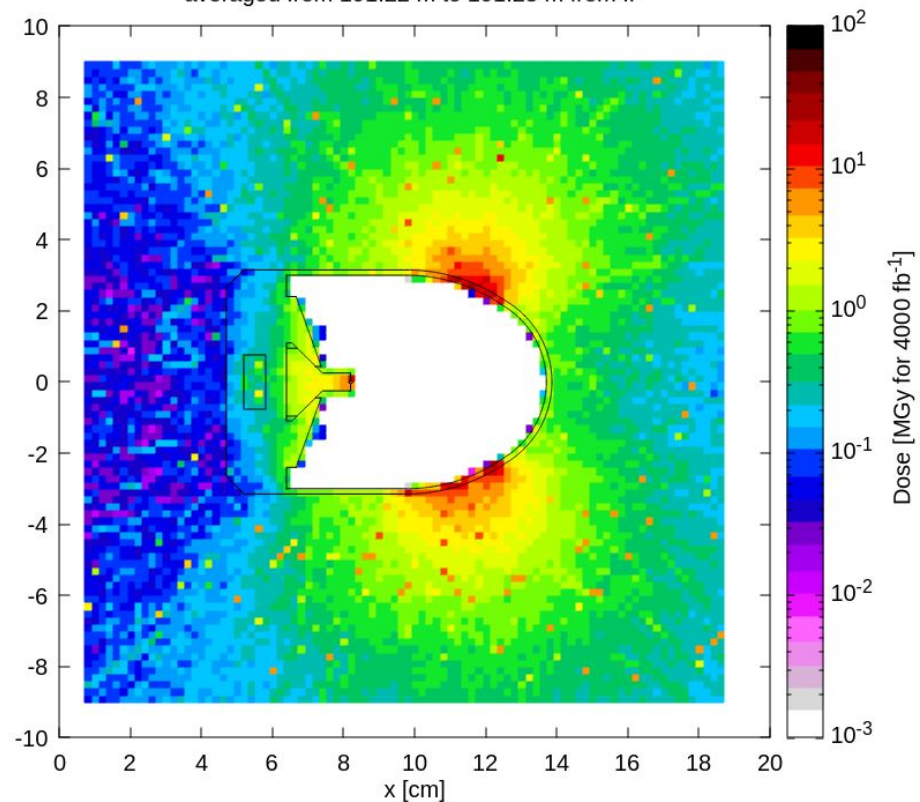averaged from 186.43 m to 186.44 m from IP

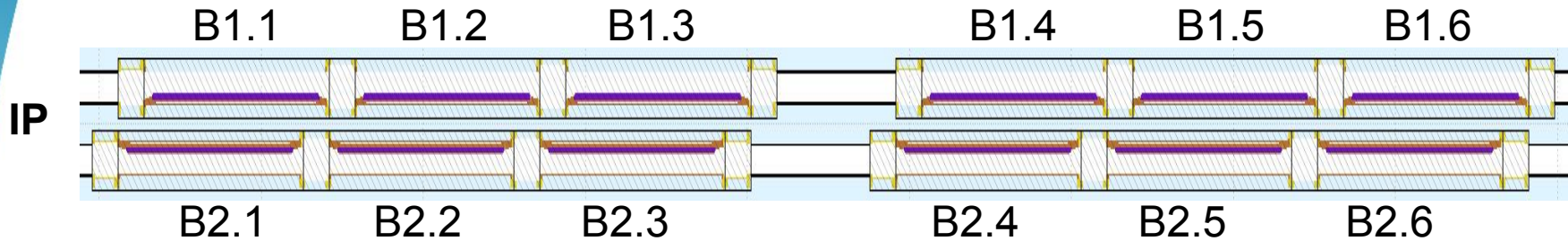# Dose levels in wire compensator at peak in the wire

B2: dose at maximum
averaged from 186.74 m to 186.75 m from IP

B1: dose at maximum
averaged from 191.22 m to 191.23 m from IP
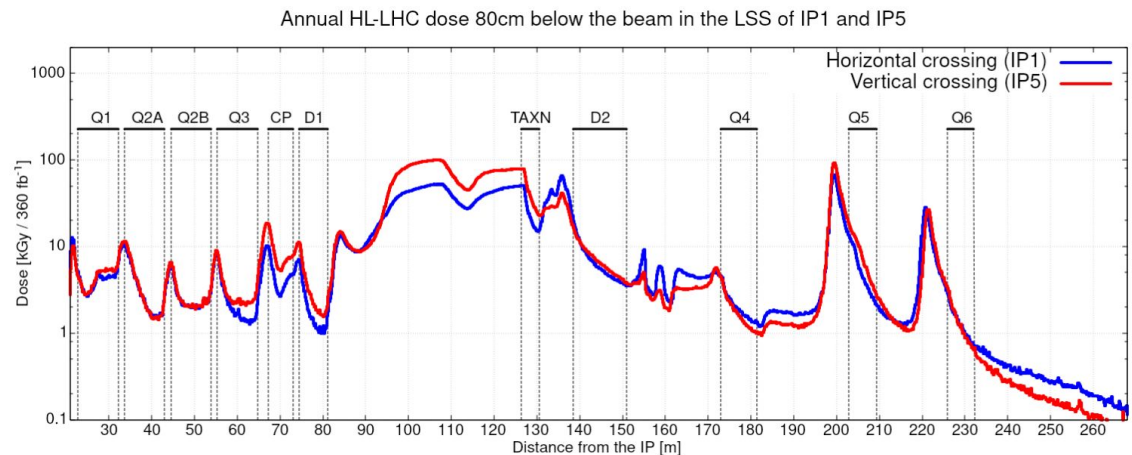
Energy deposition in the wire compensator

	B1.1	B1.2	B1.3	B1.4	B1.5	B1.6
IP						
	B2.1	B2.2	B2.3	B2.4	B2.5	B2.6

Total power in the Mo wire (**W**) for 7.5 Lo	.1	.2	.3	.4	.5	.6
B1	0.6×10^{-3}	0.4×10^{-3}	0.3×10^{-3}	1.2×10^{-3}	0.4×10^{-3}	0.4×10^{-3}
B2	24×10^{-4}	14×10^{-6}	6×10^{-6}	23×10^{-6}	15×10^{-6}	24×10^{-6}

Total power in the full compensator (**W**) for 7.5 Lo	.1	.2	.3	.4	.5	.6
B1	0.4	0.2	0.2	0.3	0.2	0.3
B2	0.04	0.02	0.01	0.02	0.02	0.02

Negligible compared to the RF dissipated power in [1].

[1] Benoit Salvant, Impedance and RF heating, Slides 24-25,
https://indico.cern.ch/event/1168738/contributions/4952782

Future plans

- Up to now:

  - Estimated the radiation levels on the beam wire compensator itself.

- To Do: Estimate:

  - The changes in the radiation levels compared to the baseline HL-LHC configuration [1,2].

  - Any other implications.

Annual HL-LHC dose 80cm below the beam in the LSS of IP1 and IP5

[1] Giuseppe Lerner et al, Radiation level specifications for HL-LHC, Fig. 2.3, https://edms.cern.ch/ui/file/2302154/1.1/hl_spec_document.pdf
[2] Giuseppe Lerner et al, Update of the HL-LHC radiation level specification document, in 14th H-LHC Collaboration Meeting, Genoa, https://indico.cern.ch/event/1421594/contributions/6077911/

Thank you for your attention!

Questions?

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