IP displacement and IC misalignment effects on the triplet radiation load

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WP10

Energy deposition & R2E

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OUTLINE

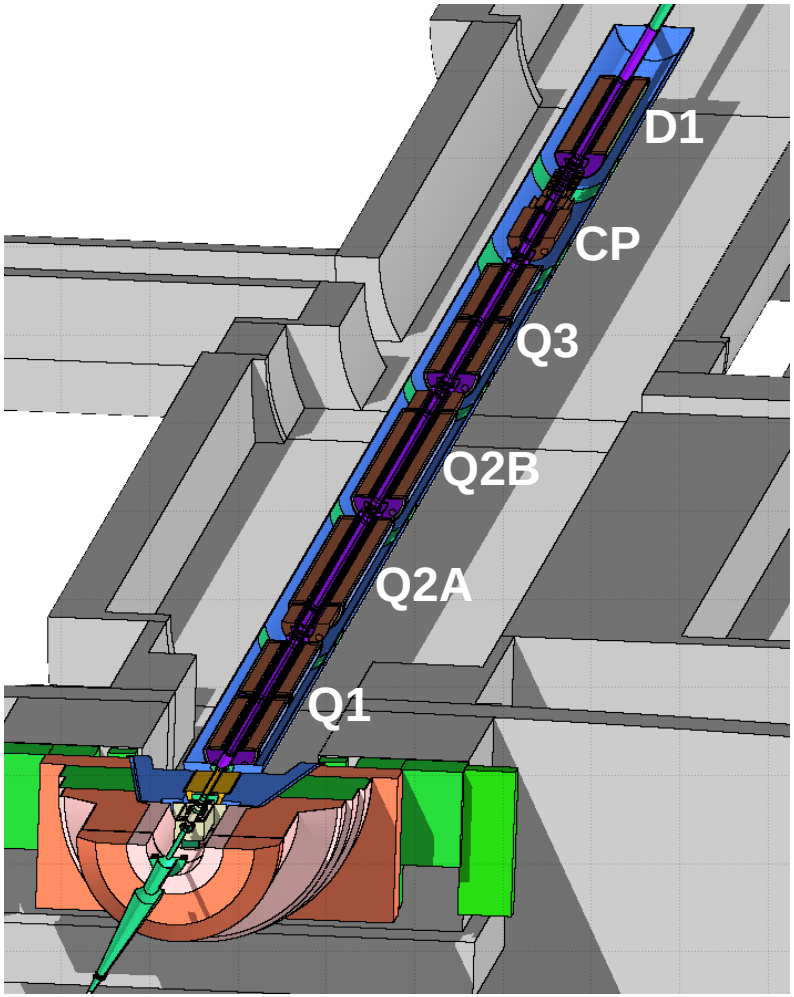
Effects on the triplet radiation load derived from:

- Displacement of the Interaction Point (IP) for horizontal crossing:
  - Horizontal: in the crossing plane
  - Vertical: in the perpendicular plane

- Misalignment of the interconnect (IC) between Q2A and Q2B for horizontal crossing:
  - Transverse shift of the IC with respect to the quadrupole and displacement of the BPM tungsten shielding

Effect of the orbit correctors orientation on their exposure

THE MODEL



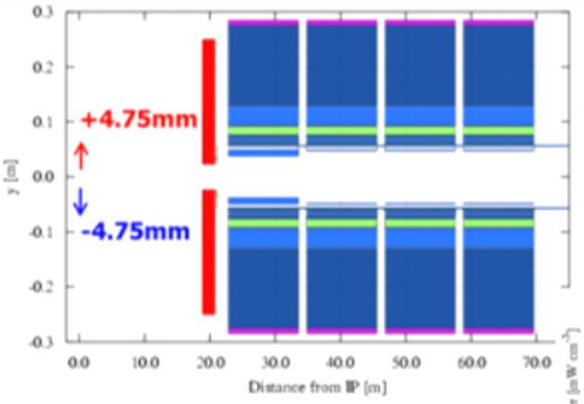
- Point 5
- Triplet - D1
- Horizontal crossing of 250 μrad
- Optics: HL-LHC v1.3

Effects of the IP displacement for horizontal crossing

essential input from R. De Maria
BE-ABP

BACKGROUND

IP DISPLACEMENT

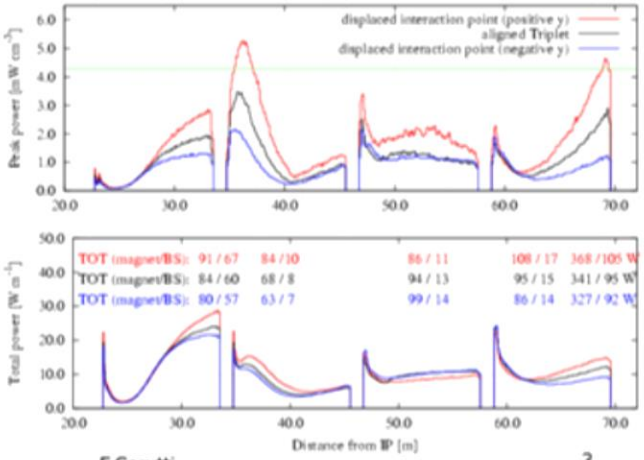


in the crossing plane

vertical axis

vertical crossing

(+225 urad half crossing angle)



+50% for peaks

+10% for totals

when the debris cone is moved to a higher field region at the triplet entrance

SLHC-IRP1, TDG Meeting, June 4th 2009

F.Cerutti

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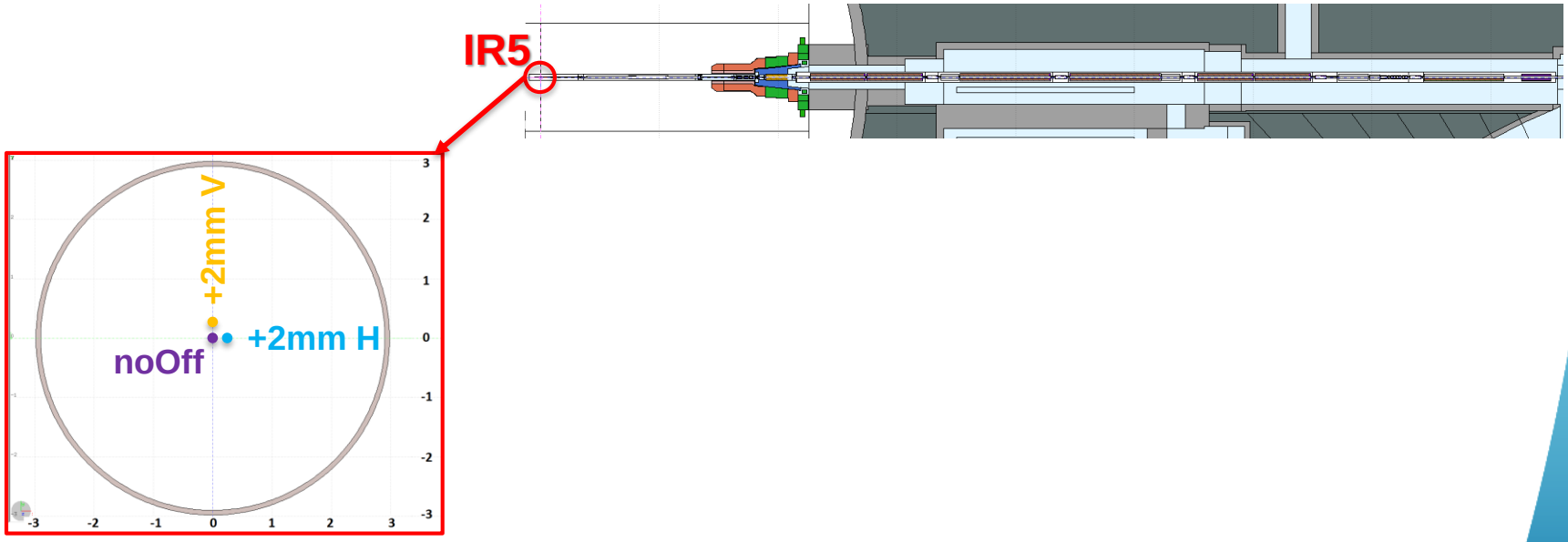
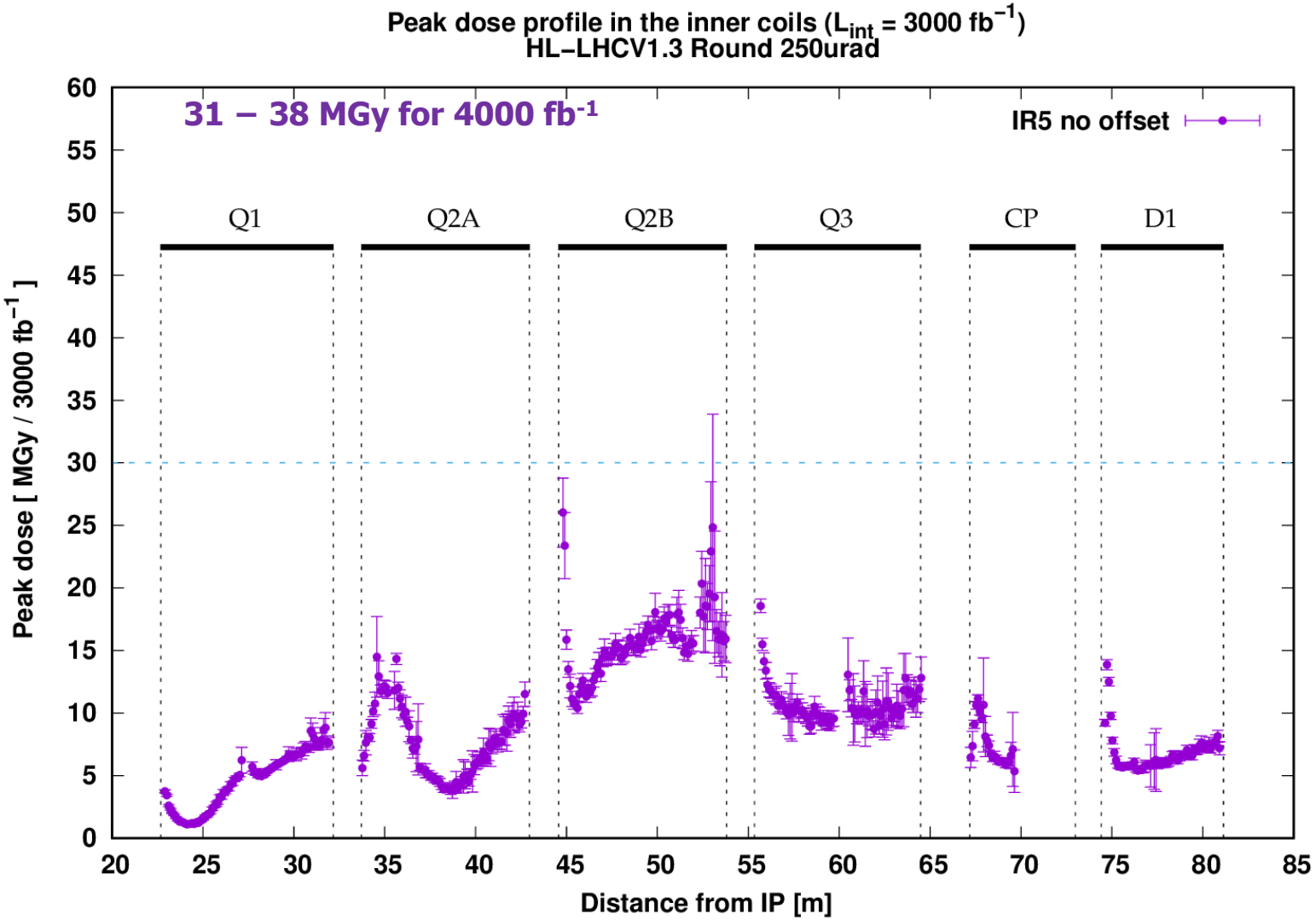
Effect to be evaluated for realistic conditions

IP displacement at IR5

- Crossing angle: 250 μrad on the horizontal plane
- Three cases:
  - Reference position (**noOff)**
  - Displacement of 2 mm on the horizontal plane (**+2mmH**)
  - Displacement of 2 mm on the vertical plane (**+2mmV**)



Peak dose distribution in the triplet-D1



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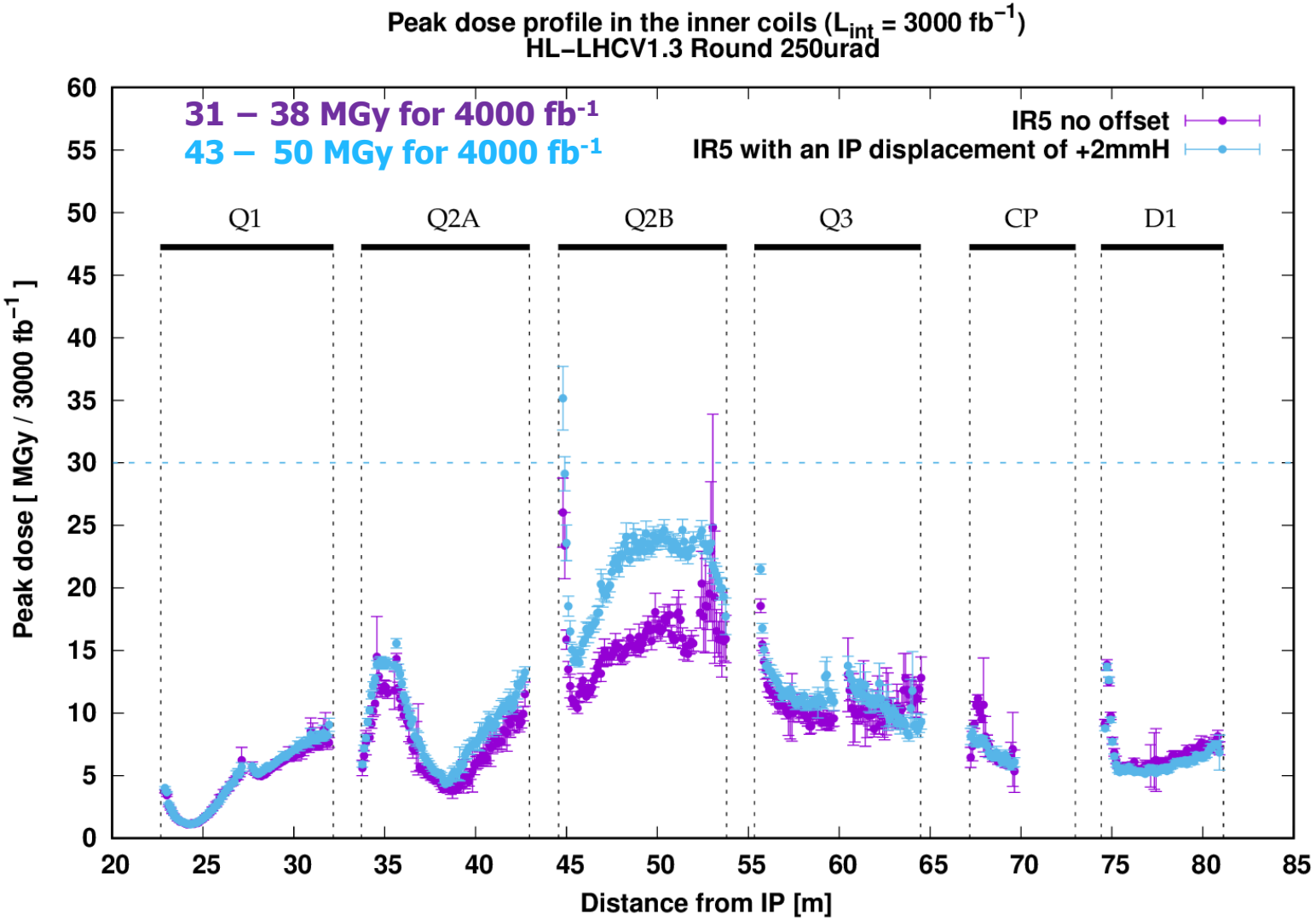

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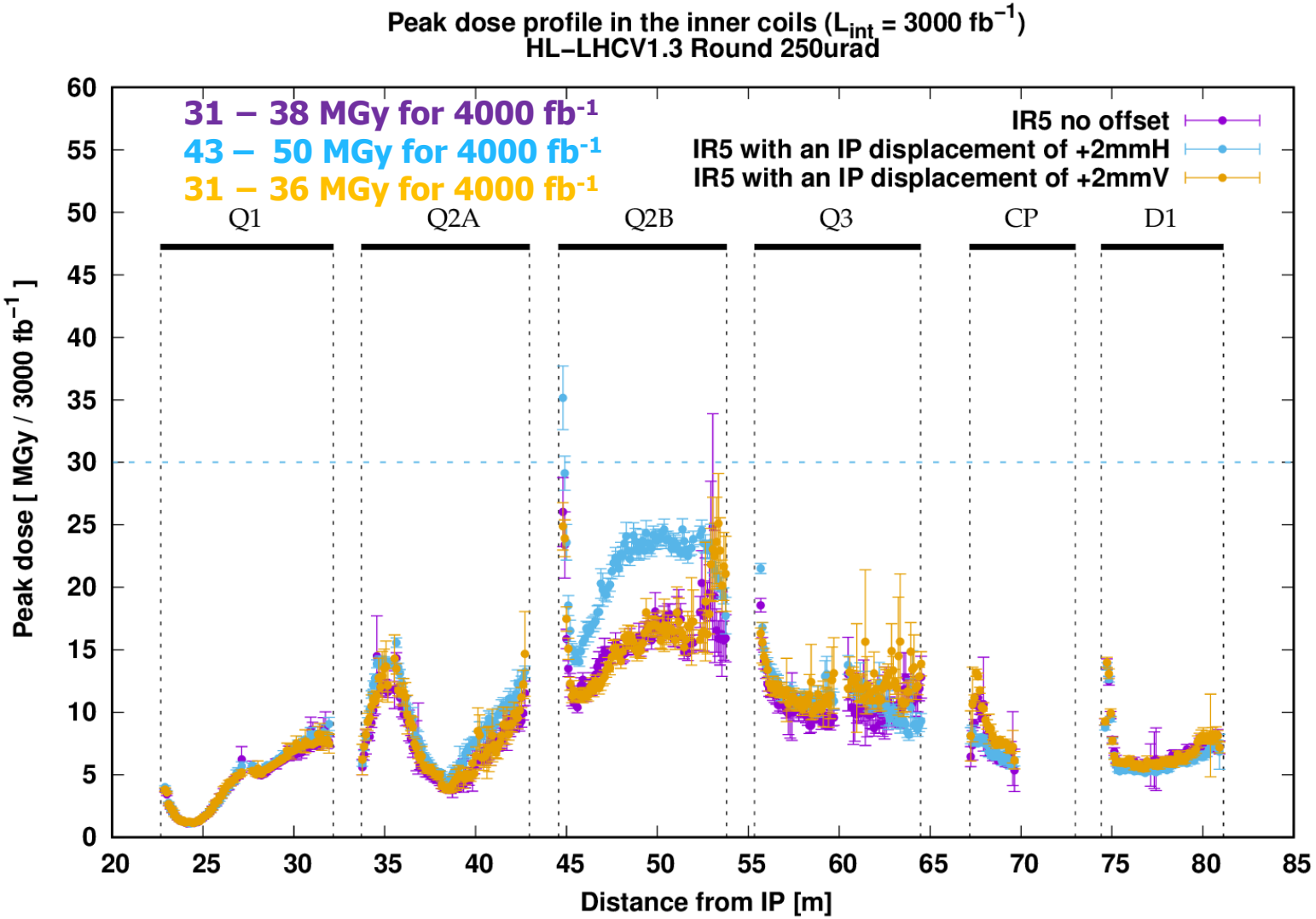

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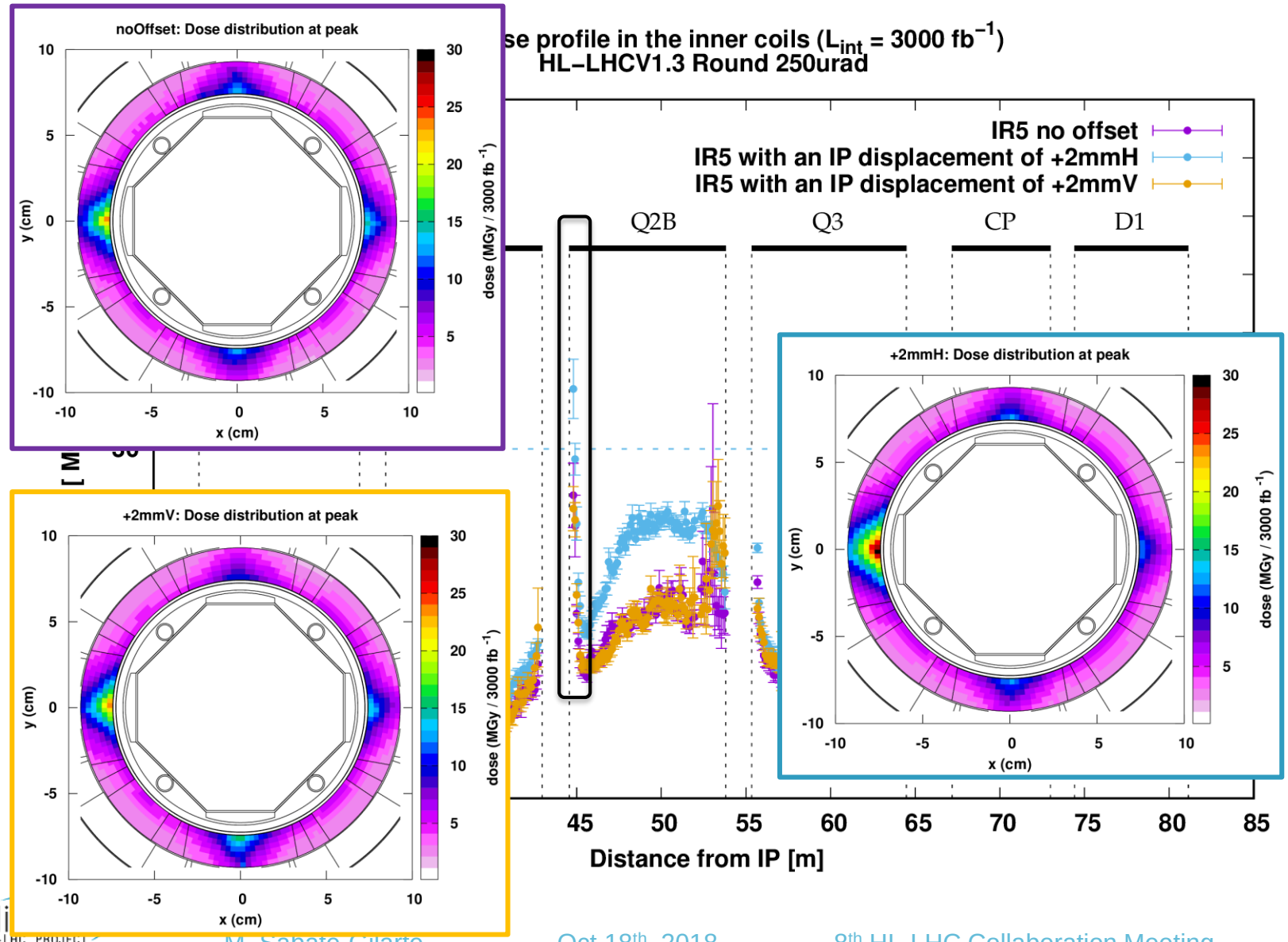

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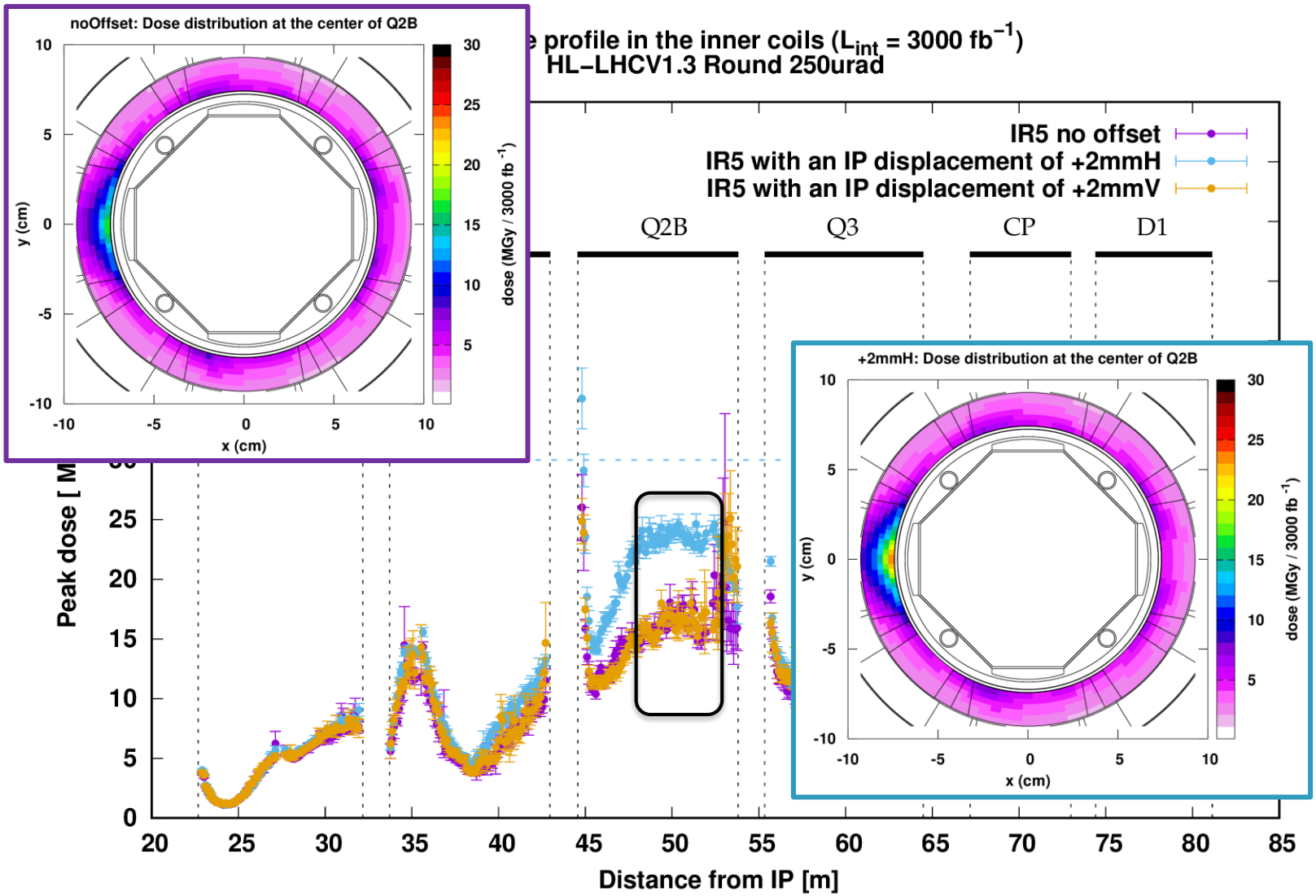
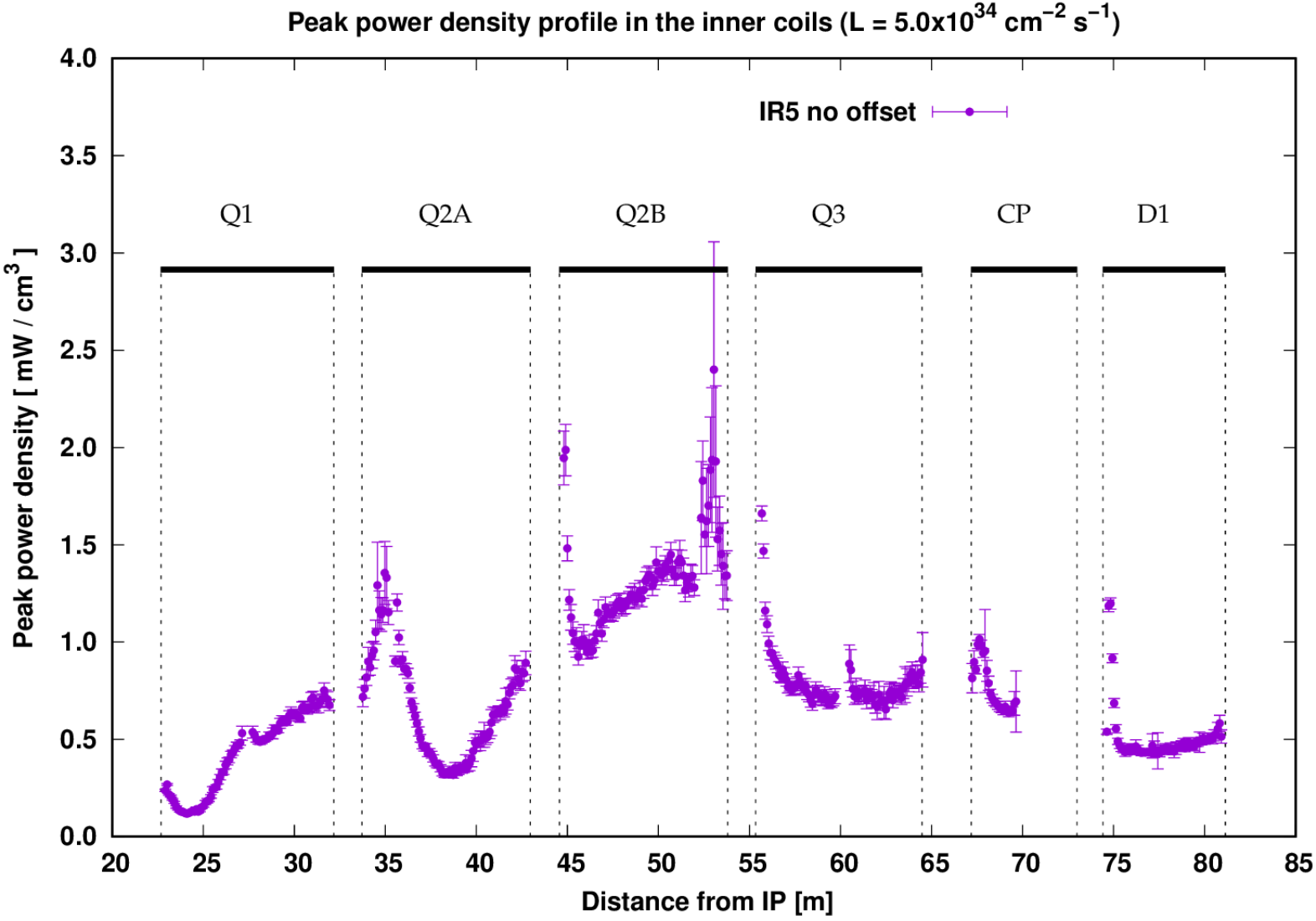
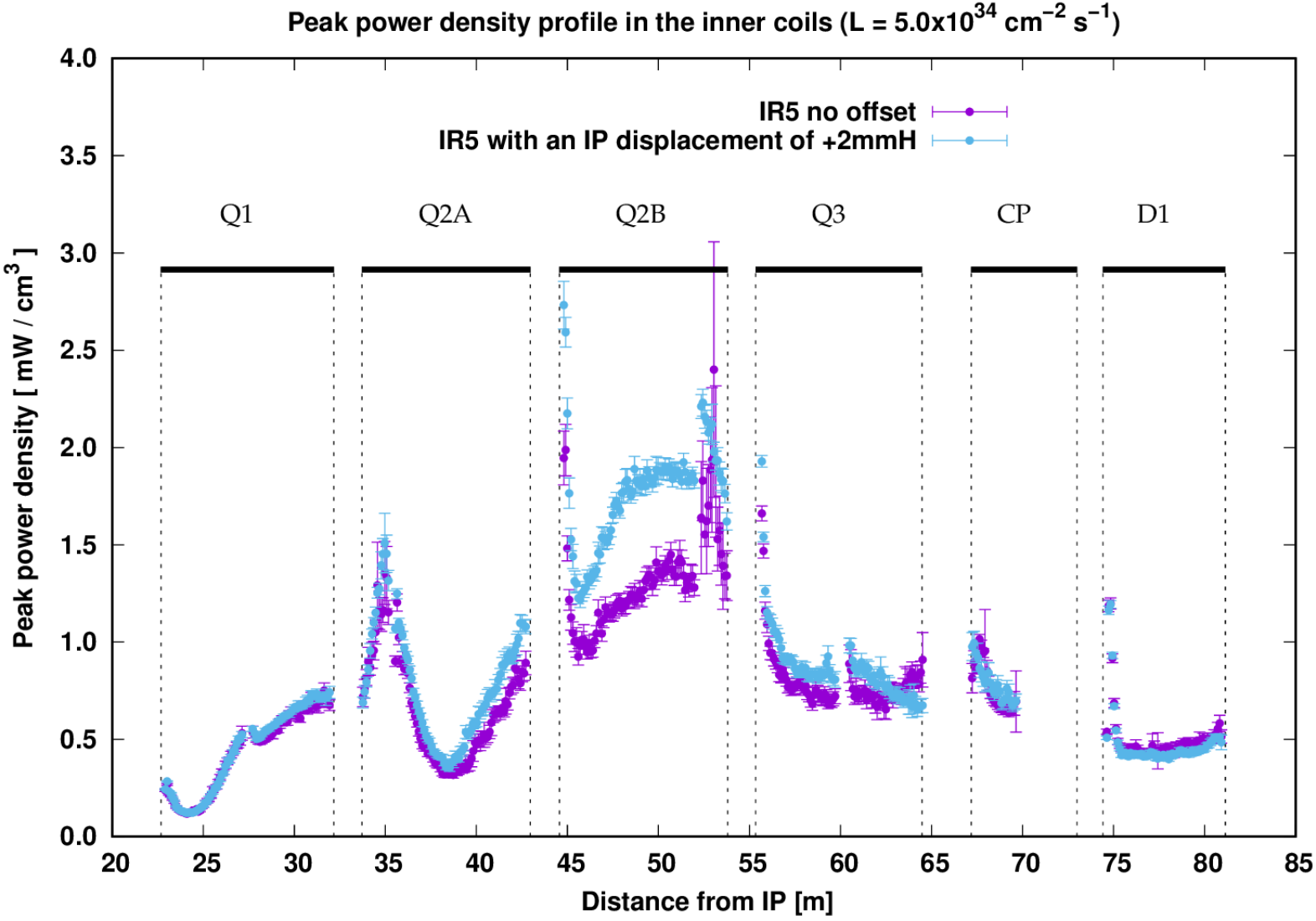


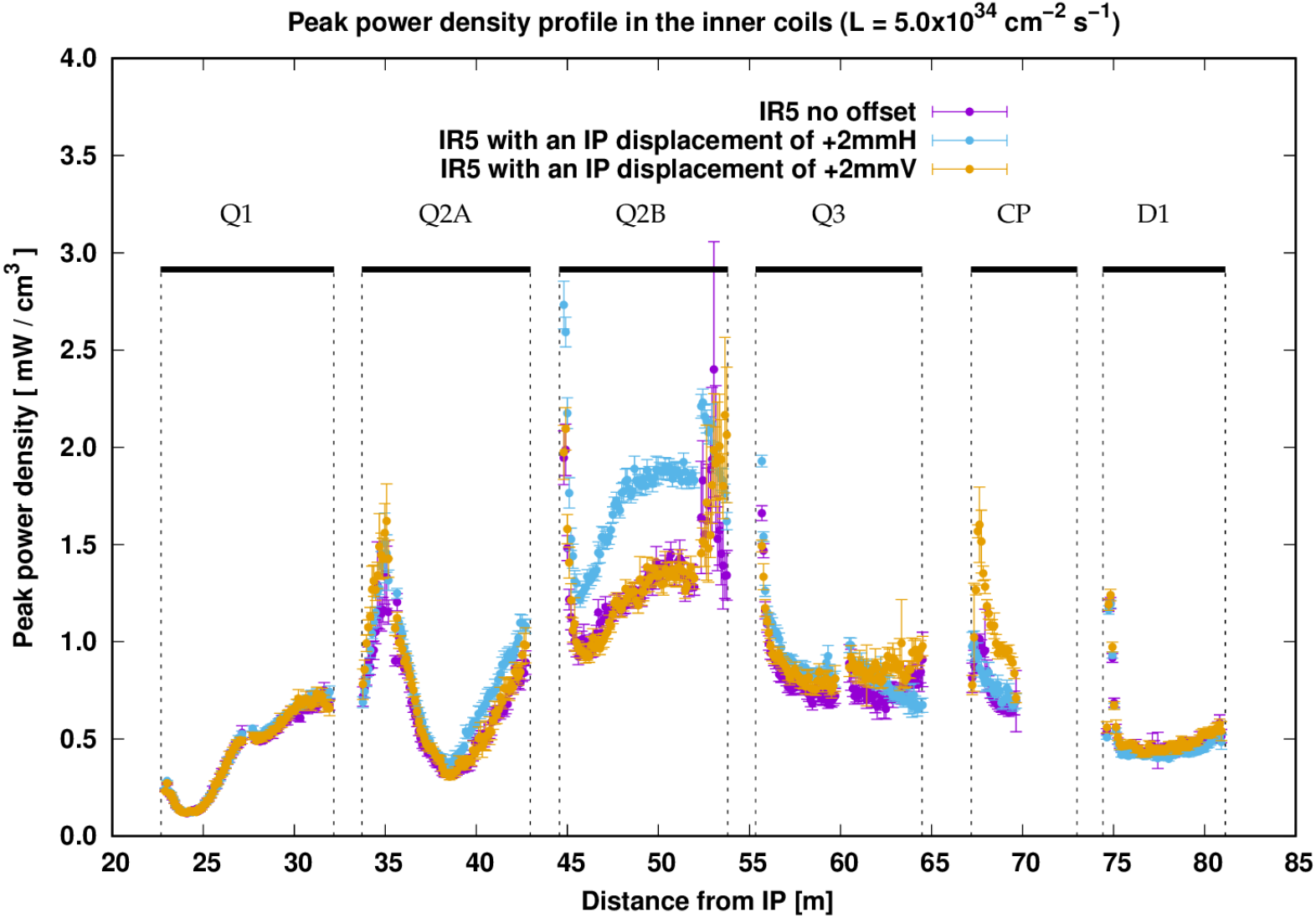
Peak power distribution in the triplet-D1



Peak power distribution in the triplet-D1



Peak power distribution in the triplet-D1



Power by region (W)

	Region	No Offset	+2mmH	+2mmV
CM	Q1A+Q1B	111	114	112
BS		165	170	167
CM	Q2A+Corr	95	101	98
BS		62	66	64
CM	Q2B+Corr	133	146	134
BS	~ 10% increase	96	110	97
CM	Q3A+Q3B	118	118	118
BS		69	69	67
CM	CP	42	37	44
BS	10-20% decrease	49	38	47
CM	D1	66	64	66
BS		46	44	46
CM	Pipe	18	19	19
BS	extension	59	57	59
CM	**total**	**583**	**599**	**>2% increase**
BS		**546**	**554**	**>1% increase**

With the last interconnect configuration

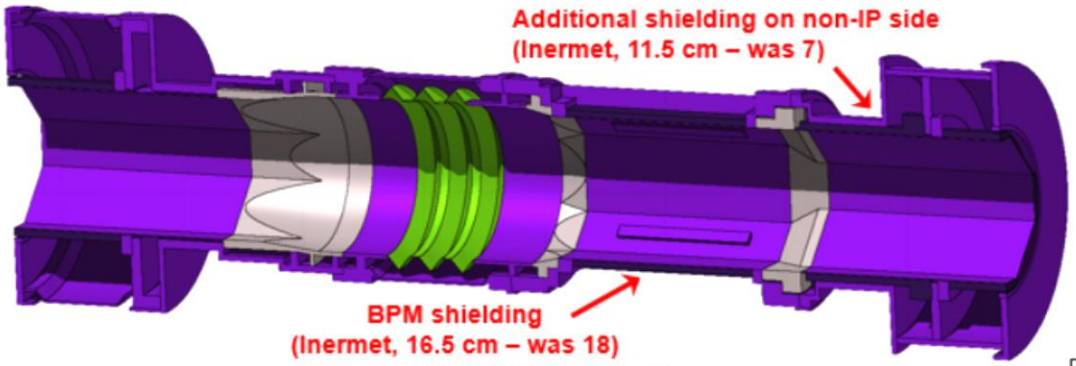
CM: cold mass
BS: beam screen

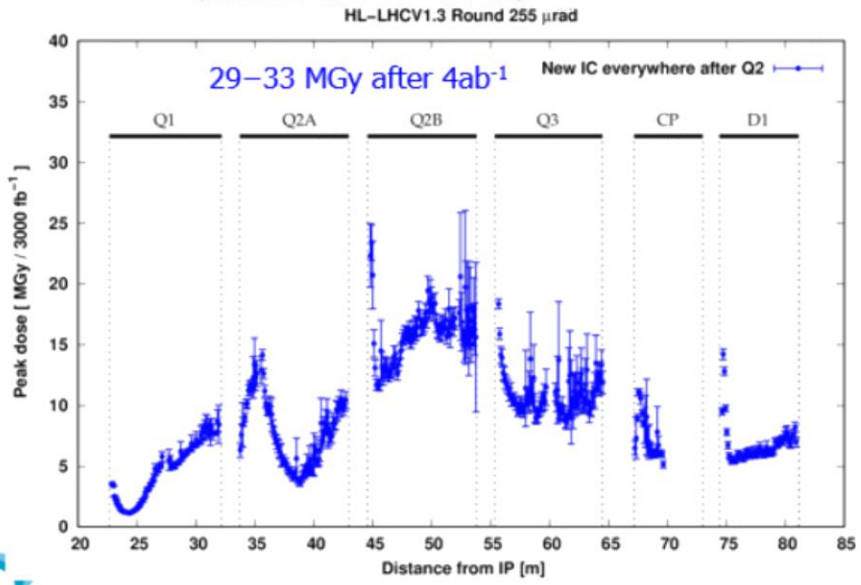
Effects of the InterConnect misalignment for horizontal crossing

essential input from C. Garion
TE-VSC

BACKGROUND

BETTER SHIELDING



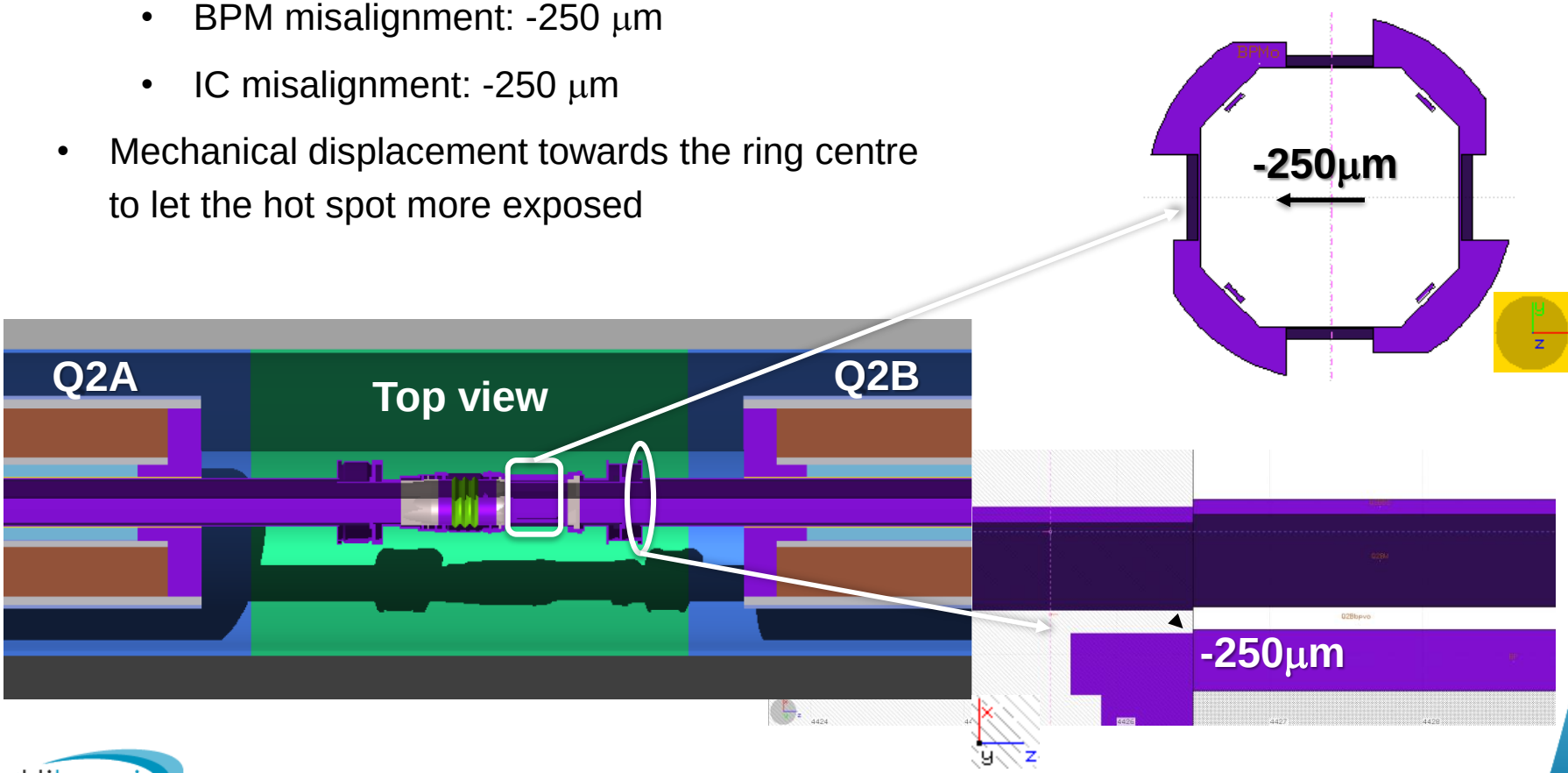


effect of BPM misalignment to be contained

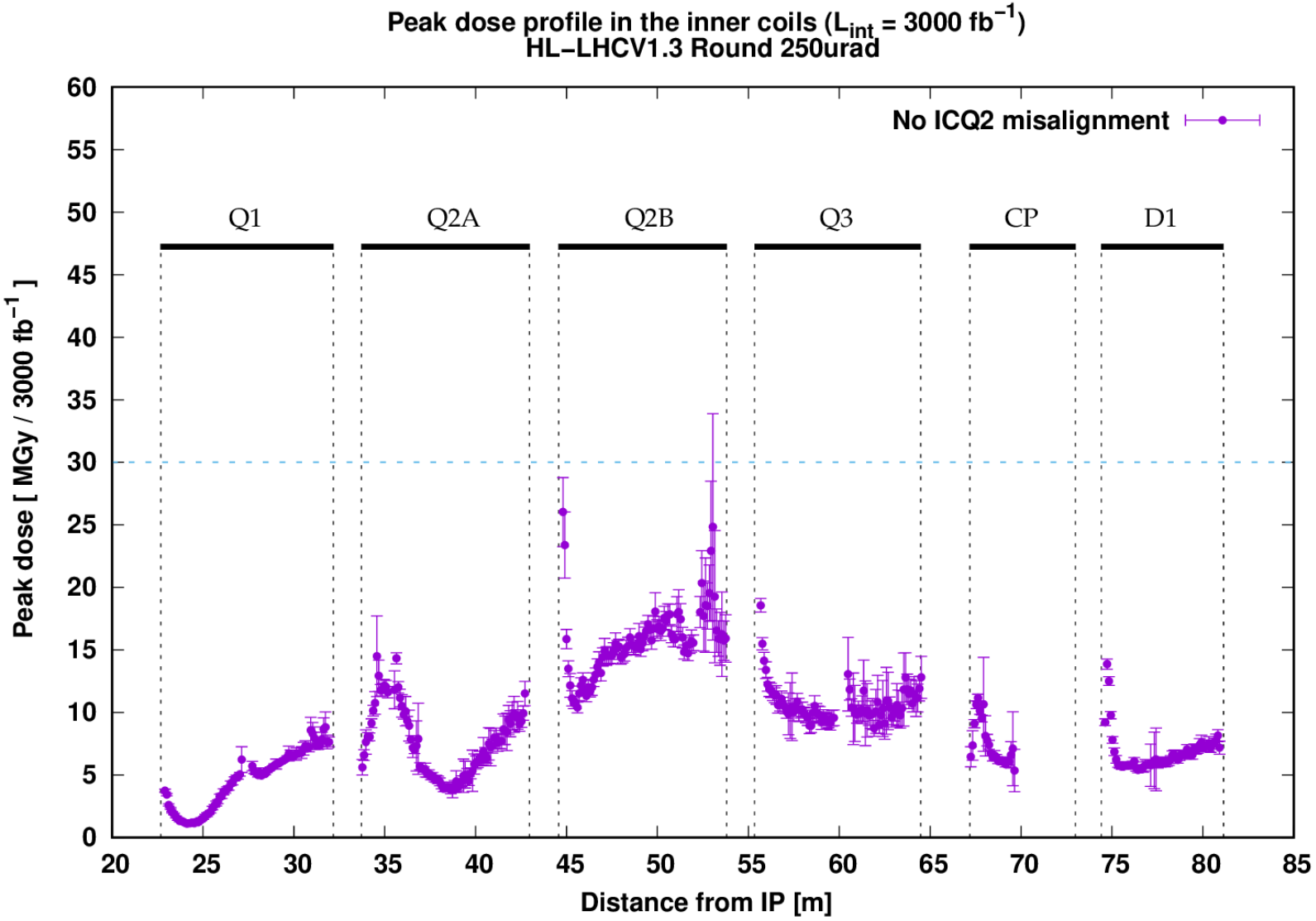
F. Cerutti Jan 30th, 2018 LHC Performance Workshop 11

IC misalignment for horizontal crossing

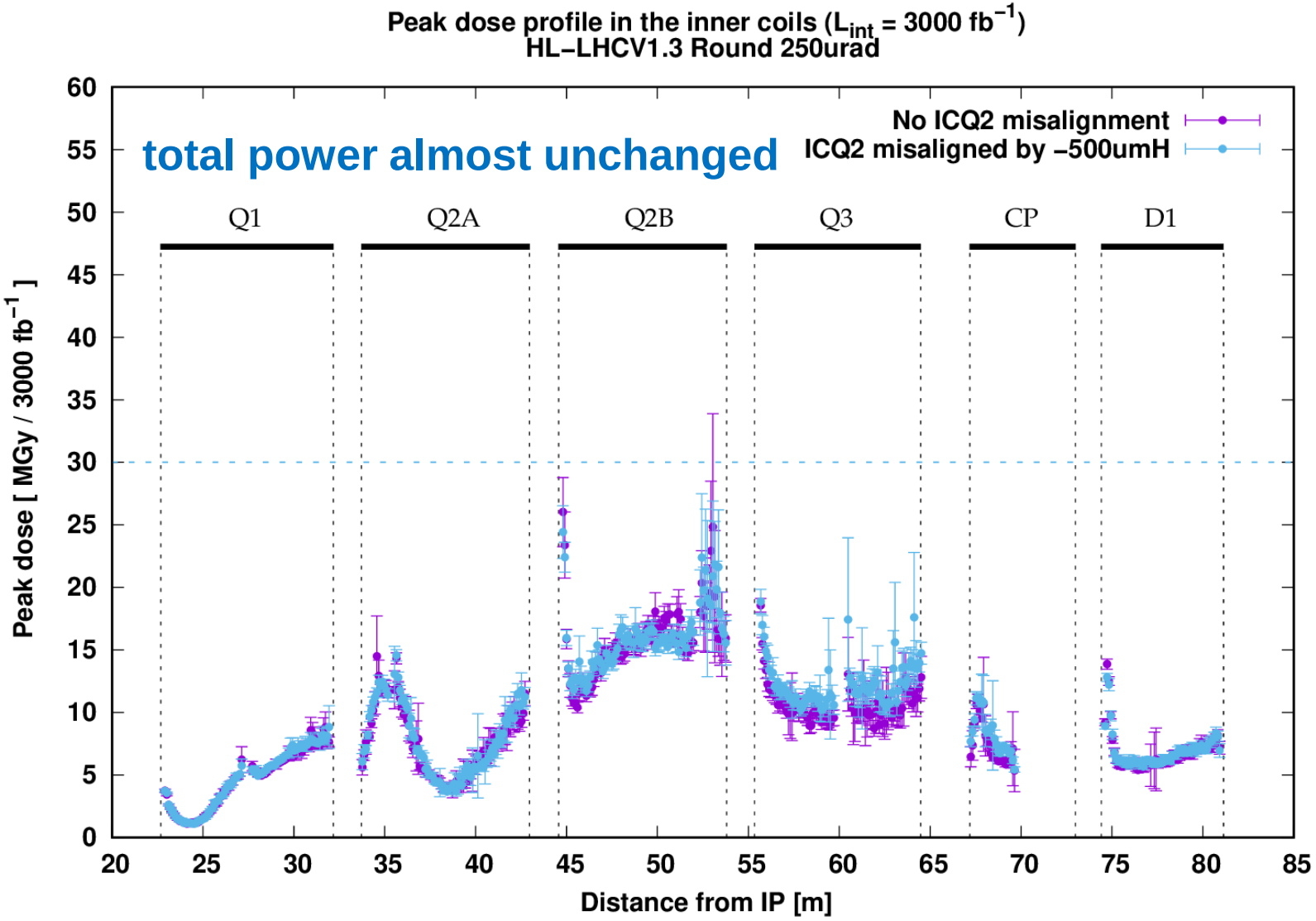
- Interconnect between Q2A and Q2B
- Crossing angle: 250 μrad on the horizontal plane
- Two contributions:
  - BPM misalignment: -250 μm
  - IC misalignment: -250 μm
- Mechanical displacement towards the ring centre to let the hot spot more exposed



Peak dose distribution in the triplet-D1



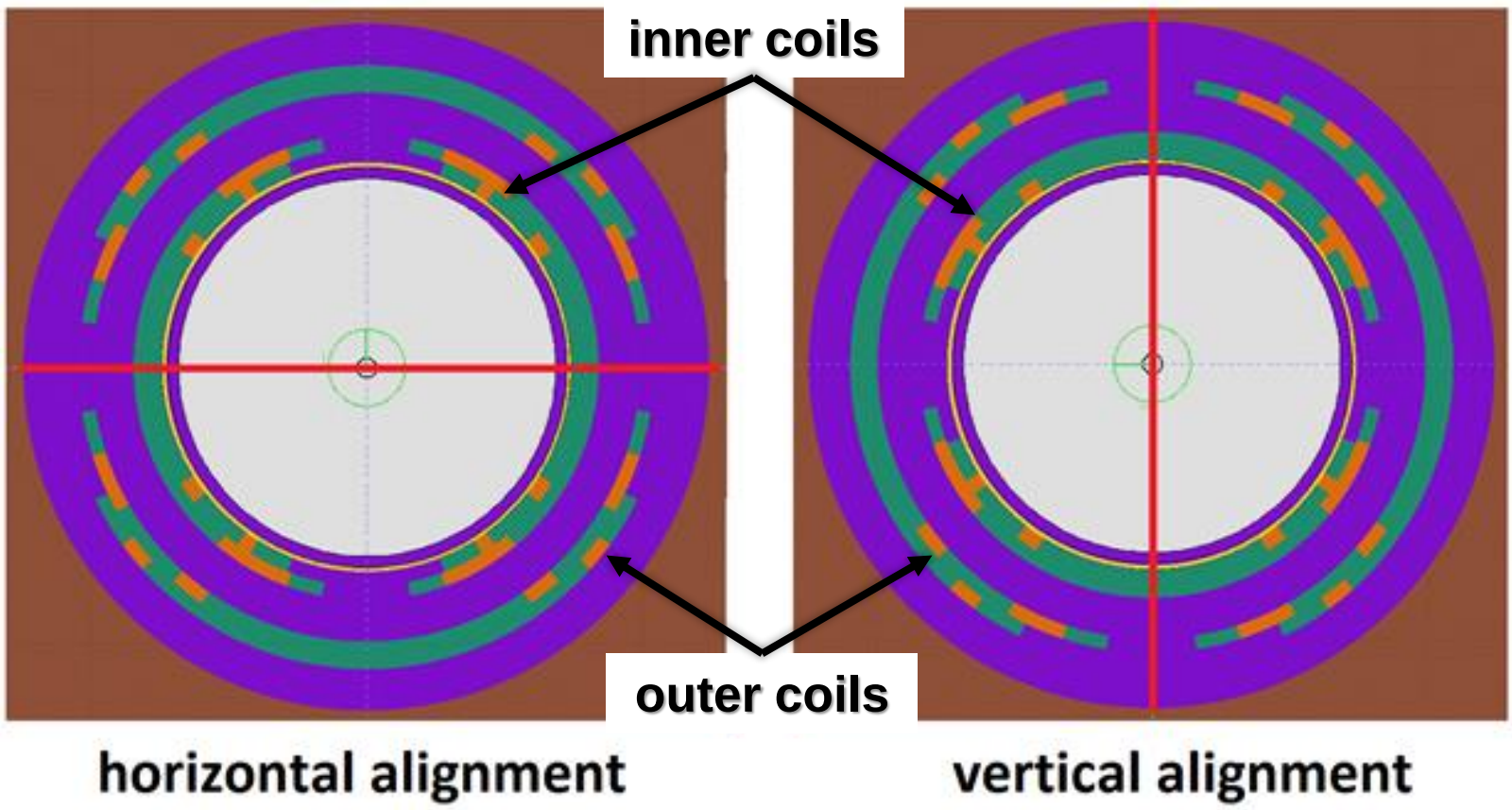
Peak dose distribution in the triplet-D1



Effect of the orbit correctors orientation on their exposure

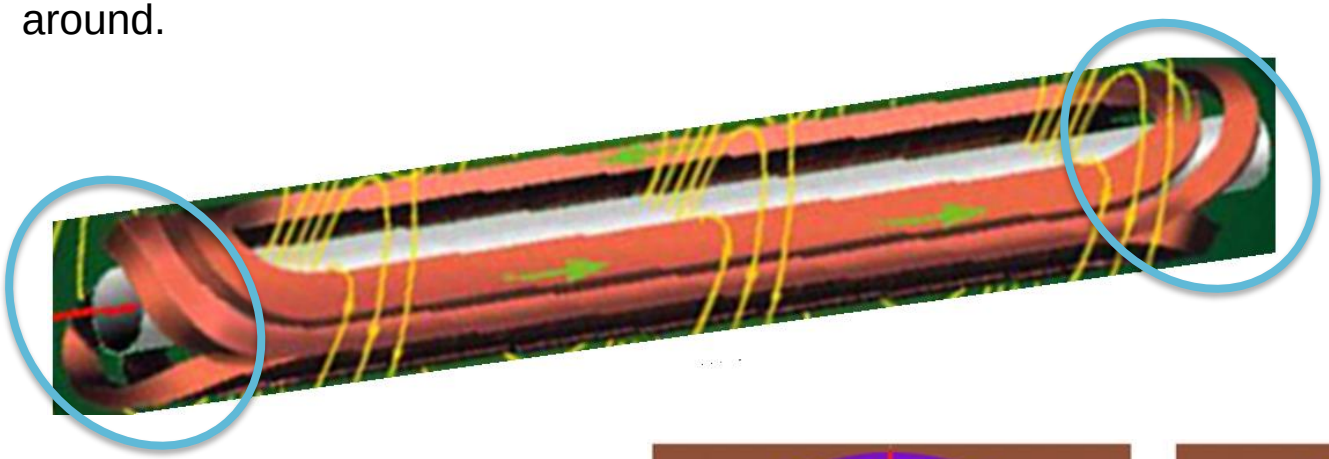
essential input from G. de Rijk
TE-MSC

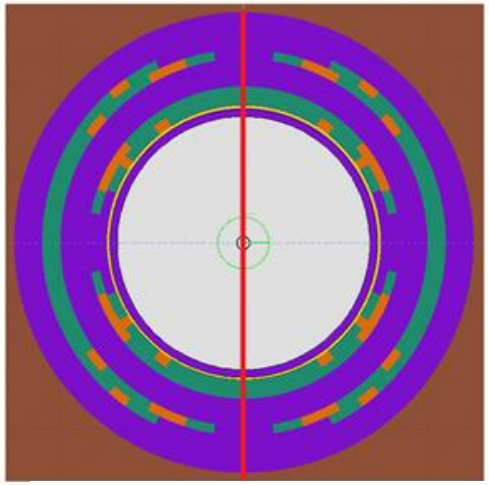
Orbit corrector model



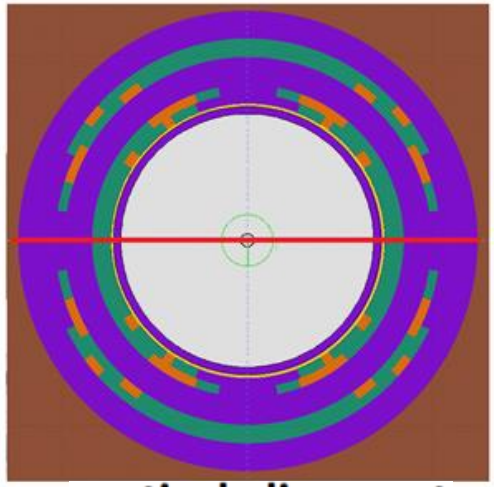
Orbit corrector model

At the magnet ends, first and last 10 cm of the mechanical length, the return coils lay in the opposite plane: in the vertical plane for horizontal alignment and the other way around.





horizontal alignment

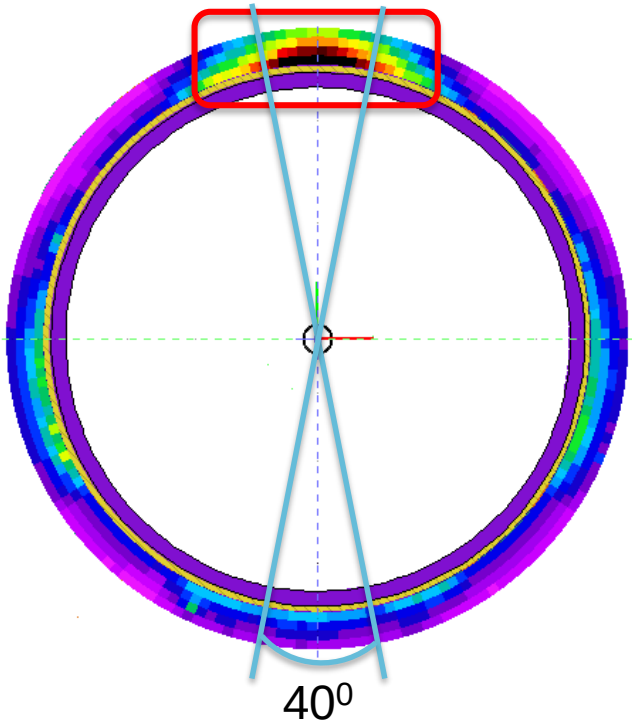


vertical alignment

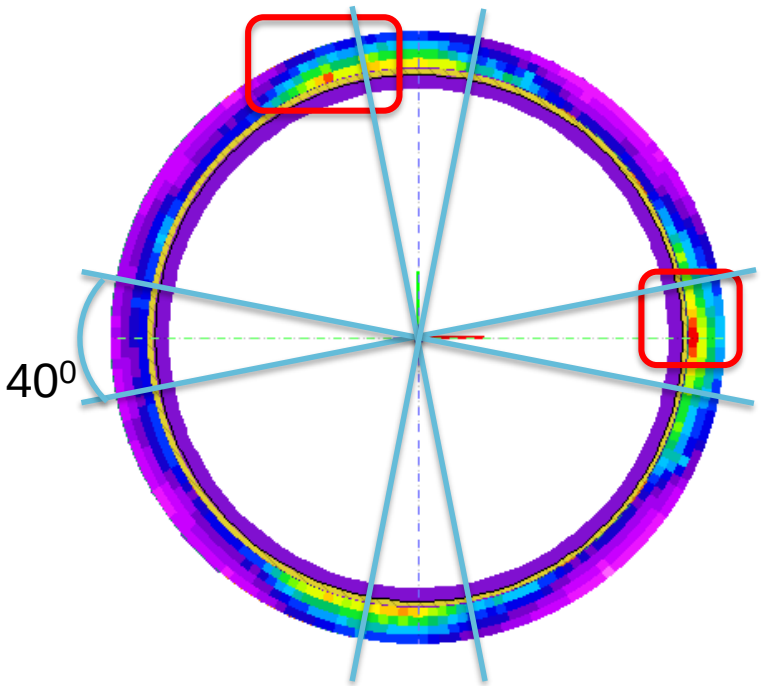
Orbit corrector model

Dose distribution transverse section at the Q2A orbit corrector:

vertical crossing

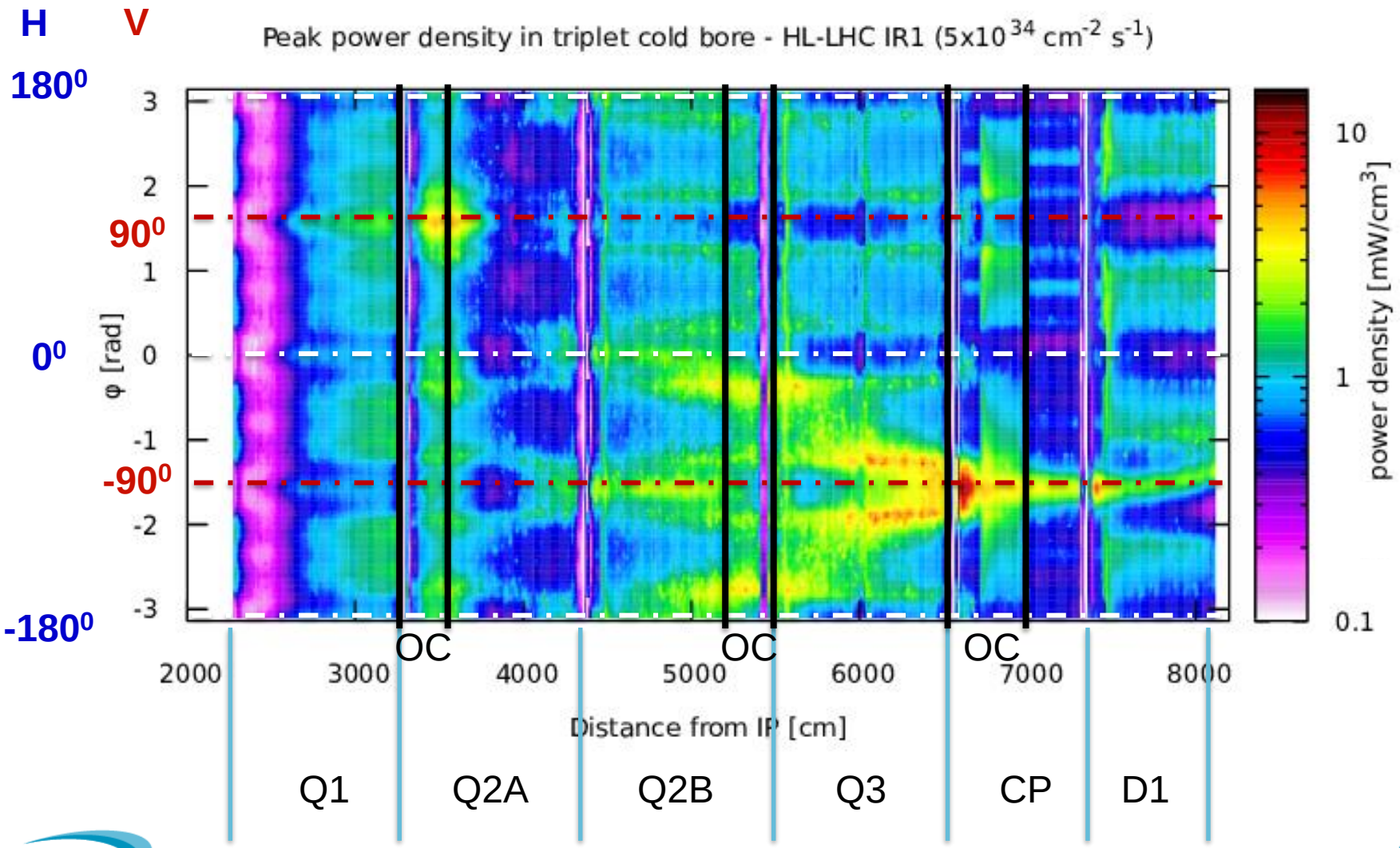


horizontal crossing



Peak Power density in the triplet for vertical crossing

OC: orbit corrector



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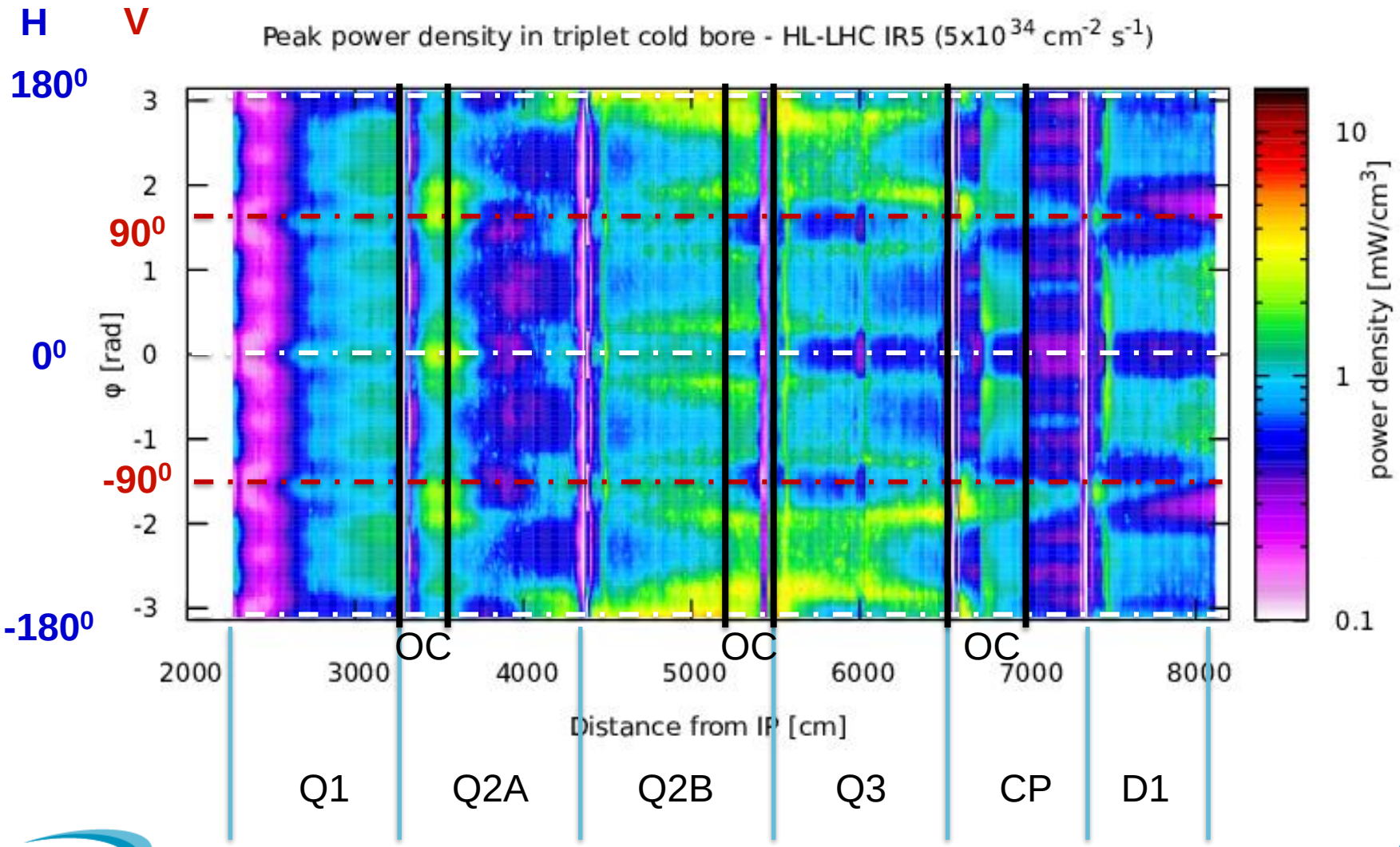
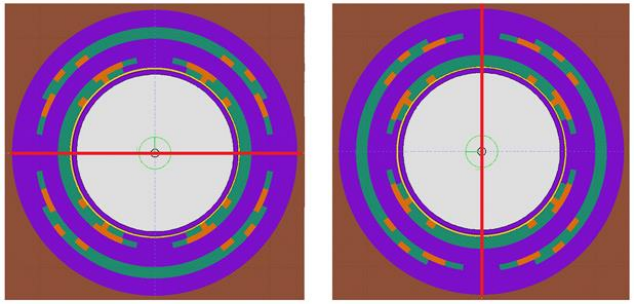
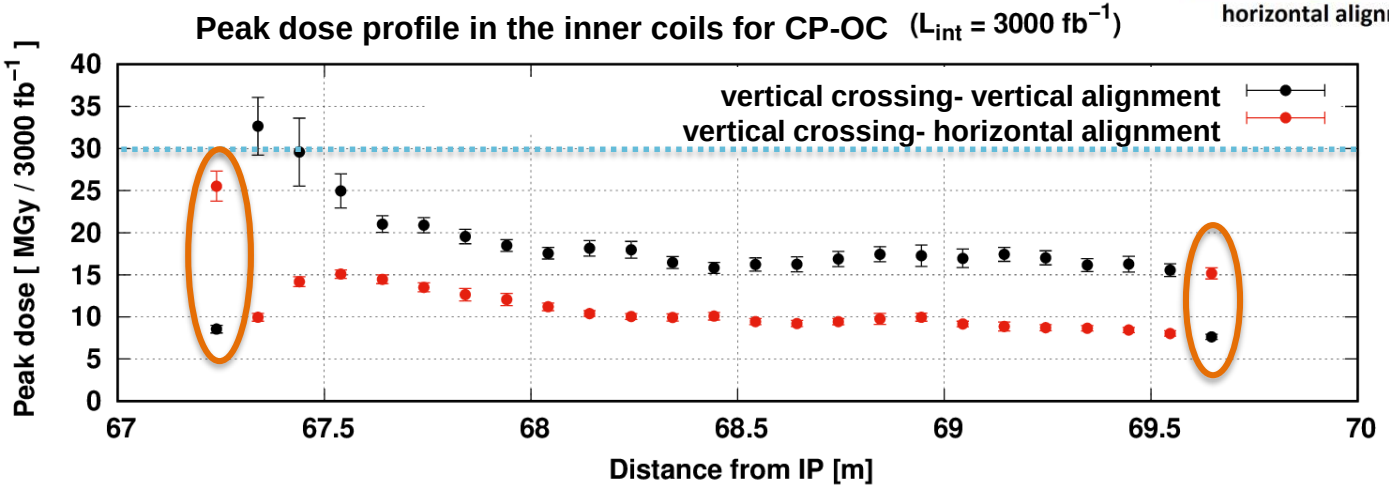
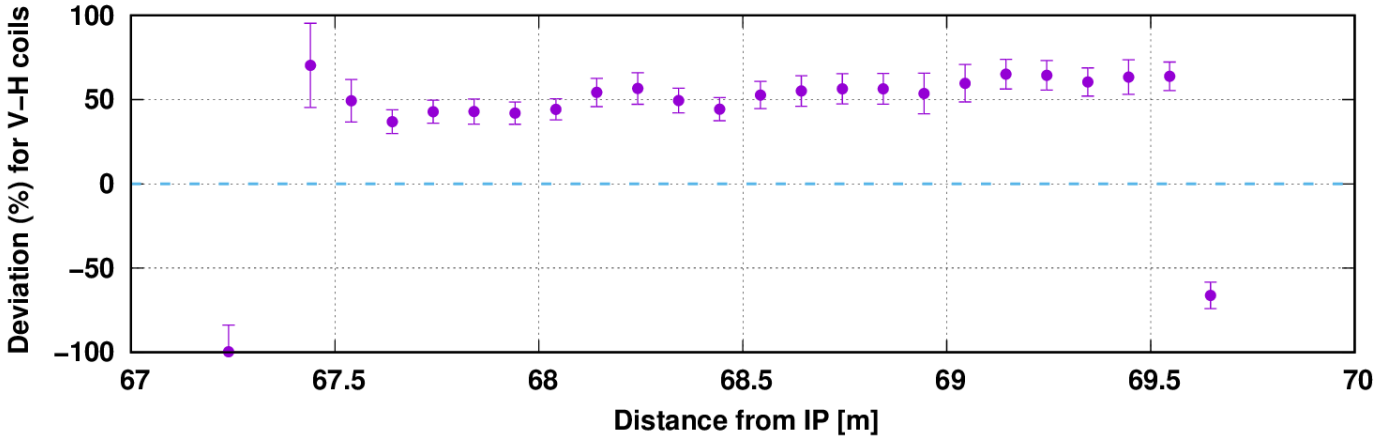


Vertical crossing orbit corrector in the CP

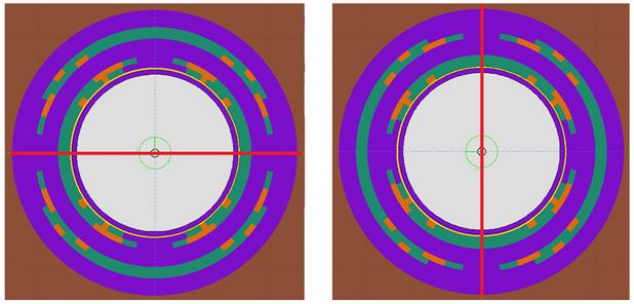


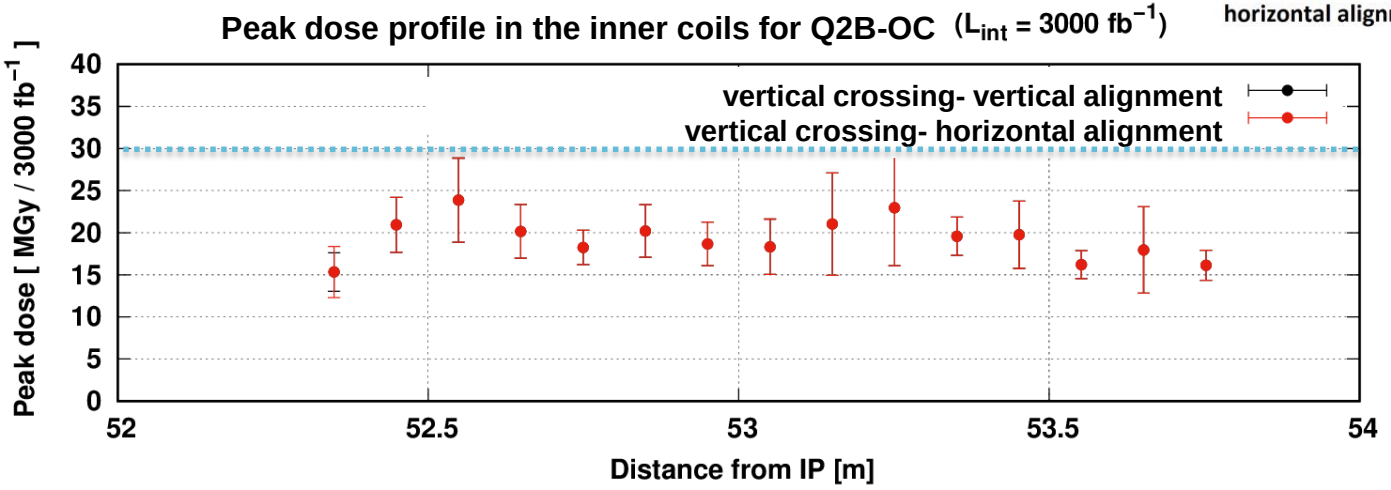


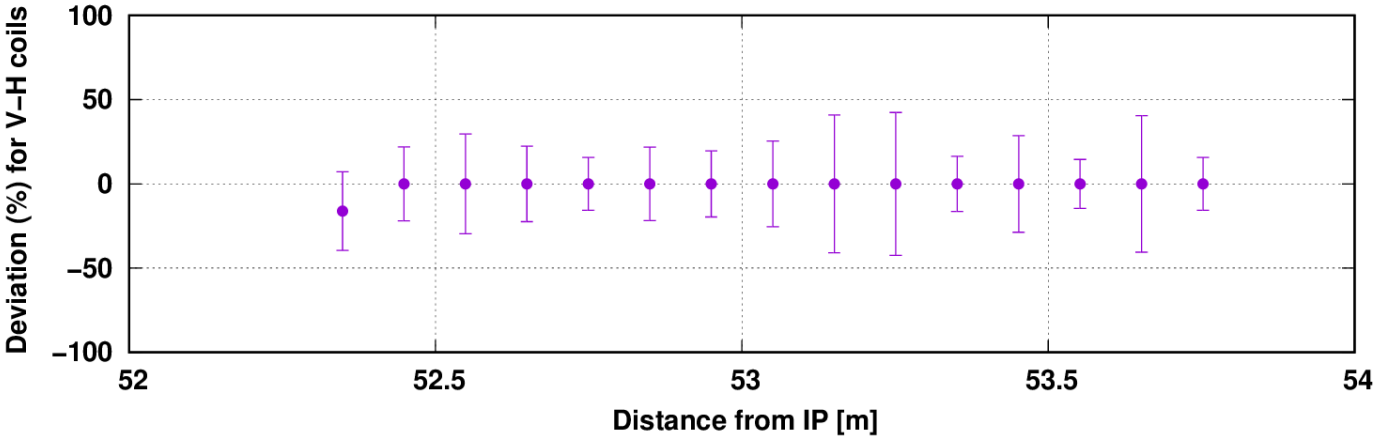
return coils



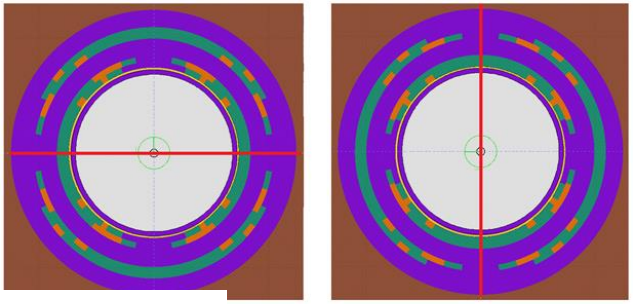
Vertical crossing
Q2B orbit corrector

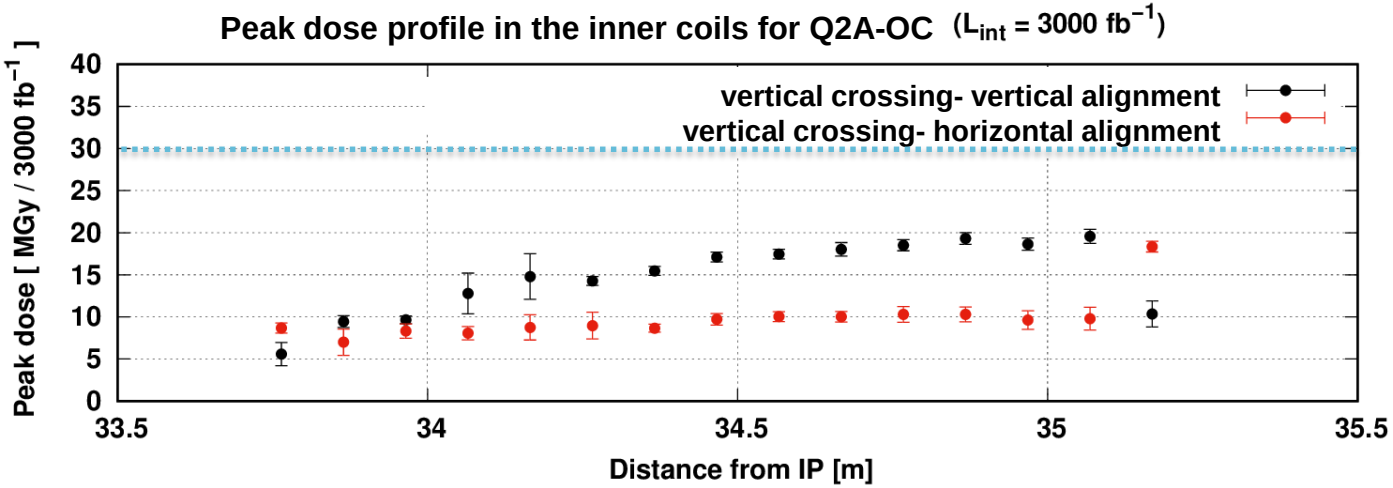


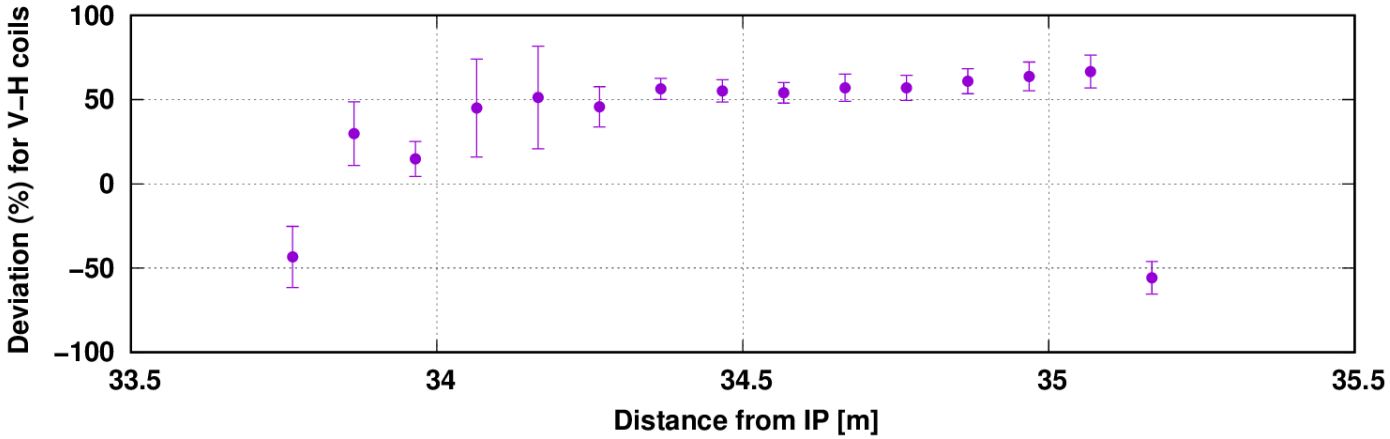




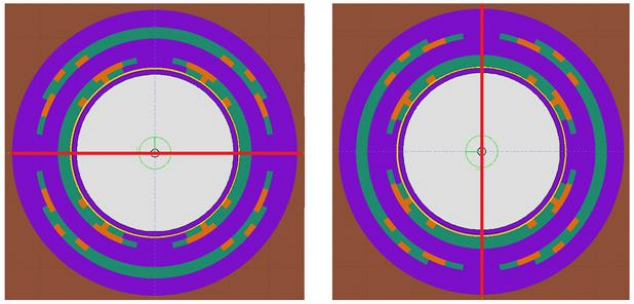
Vertical crossing
Q2A orbit corrector

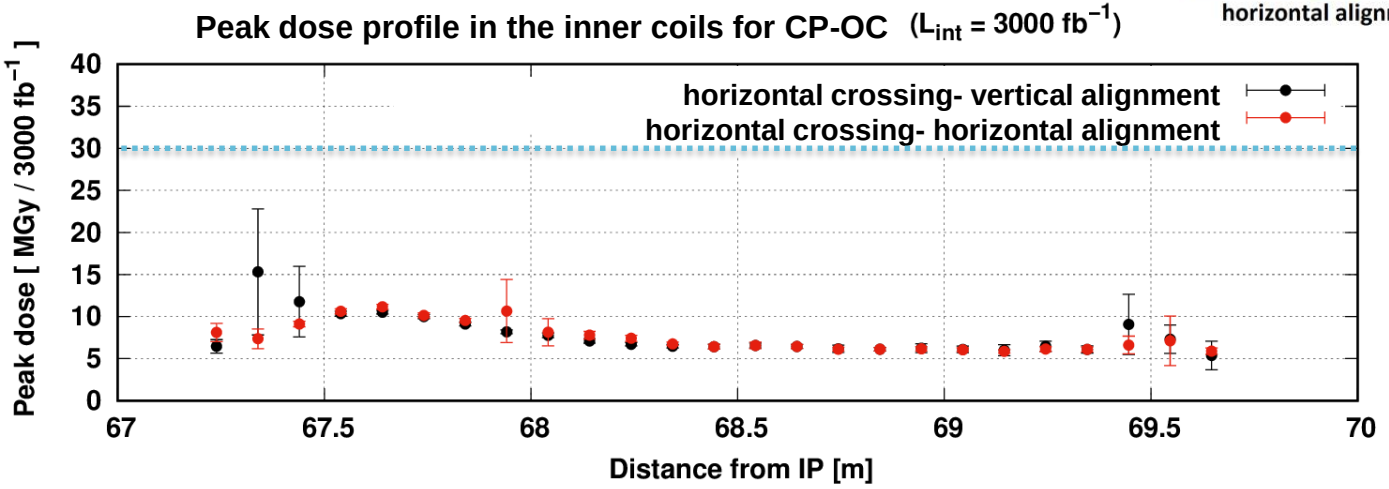


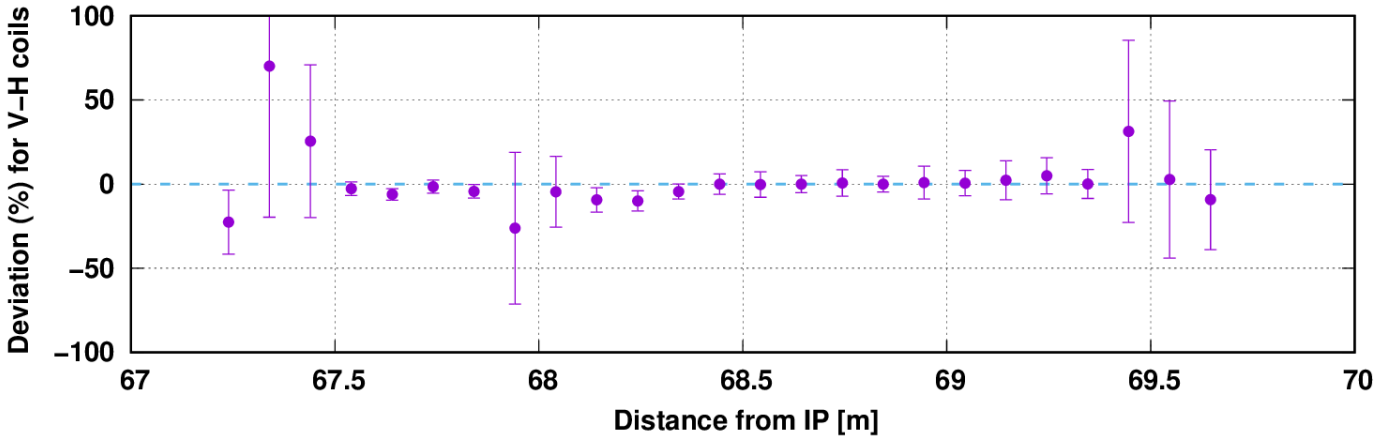




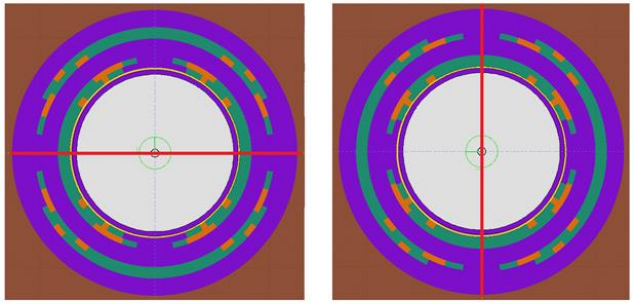
Horizontal crossing orbit corrector in the CP

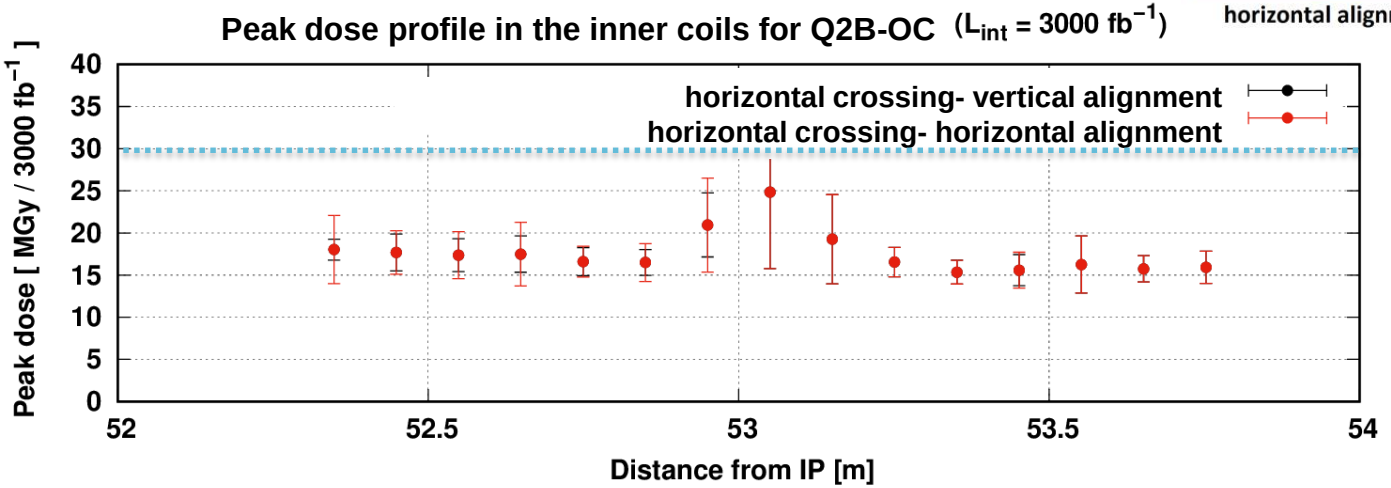


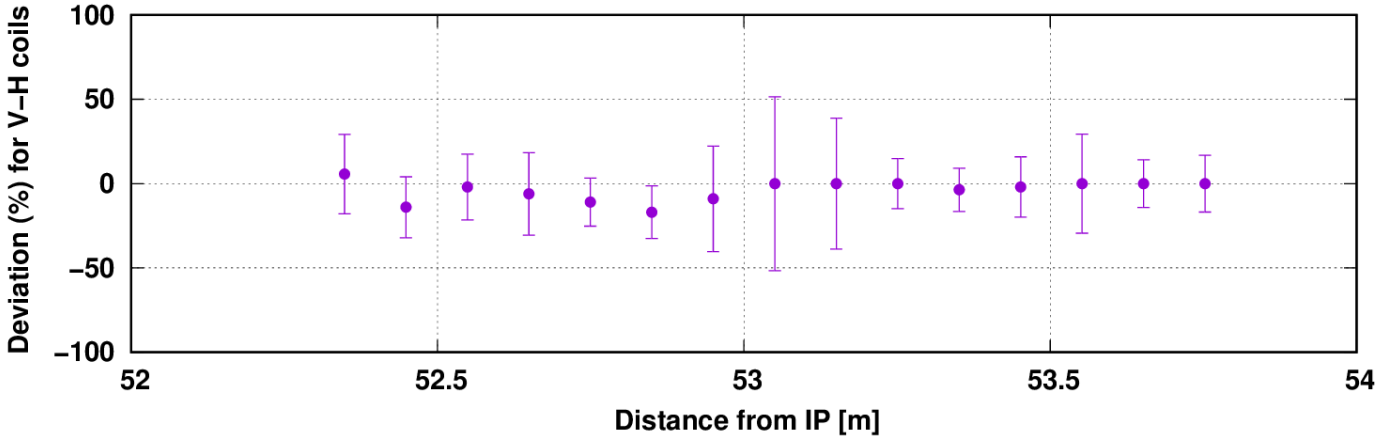




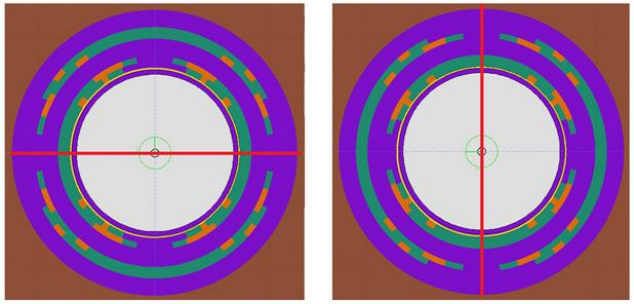
Horizontal crossing Q2B orbit corrector

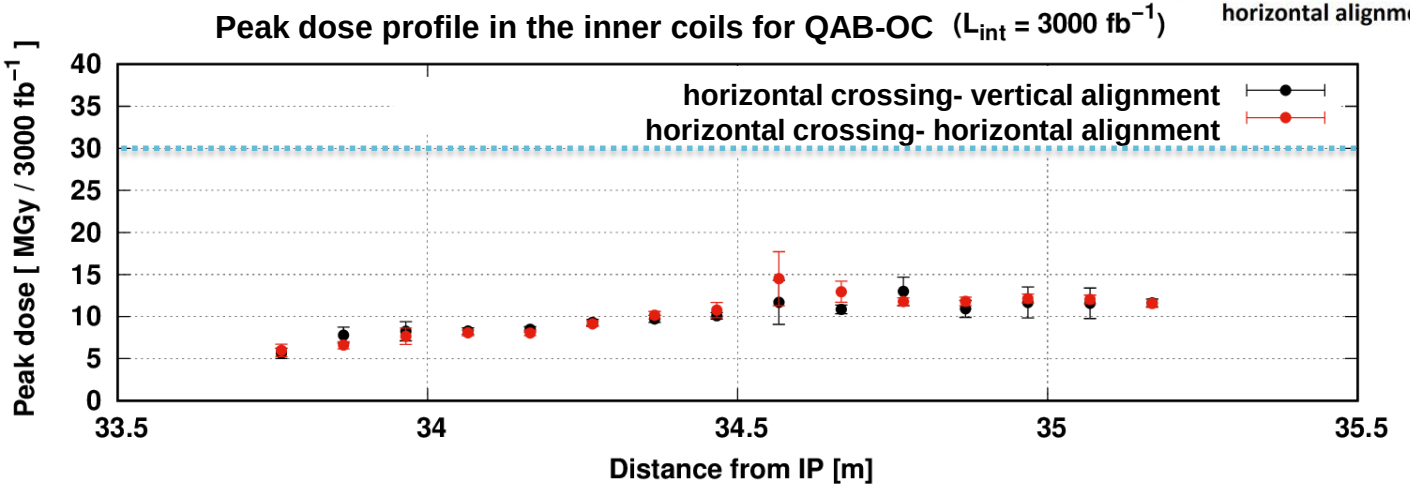


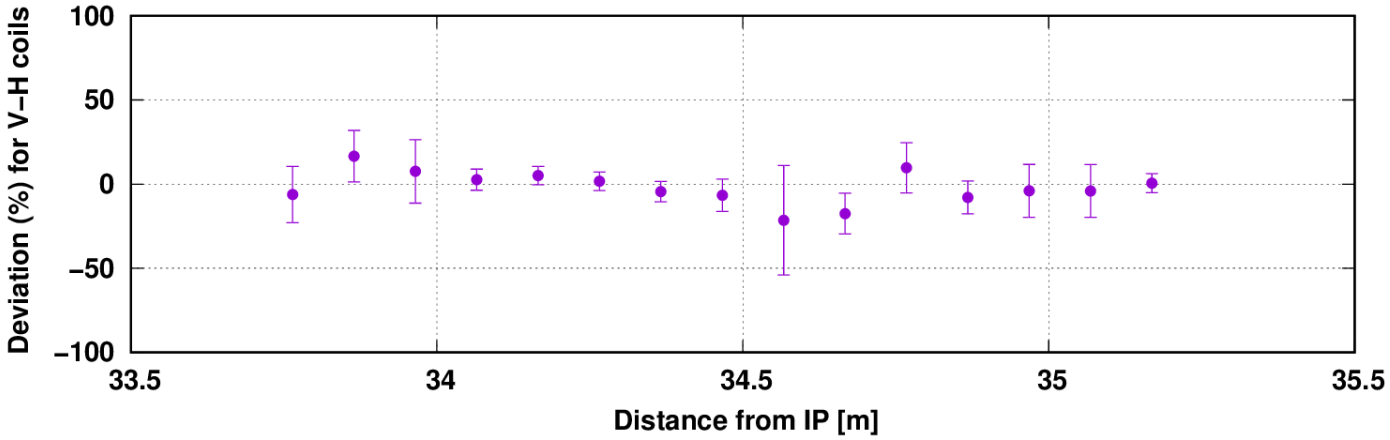




Horizontal crossing Q2A orbit corrector







Summary and Conclusions

Summary and Conclusions (I)

IP displacement:

- Results for horizontal crossing with a displacement on the IP of 2mm.

- In the crossing plane:
  - The **total dose increases** by **35%** (assuming constant displacement) when the displacement is in the same plane and has the same sign as the crossing angle.
  - The **power density arises** by **40%** but the values are much below the design limit (12 mW/cm^3 which is supposed to be three times lower than the quenching limit).
  - Even if locally the total power increases by 10%, in the Q2B, the global effect is around 1%.
  - Based on precious studies, a bump on the opposite side of the crossing angle could be beneficial.

- In the orthogonal plane:
  - The effect can be neglected.

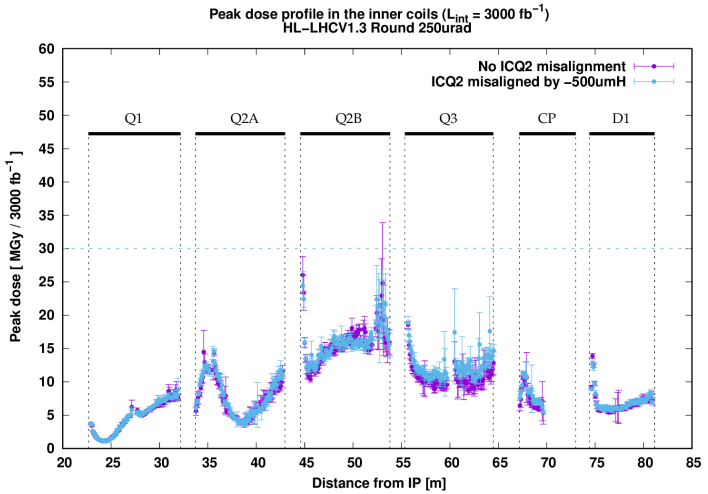
Summary and Conclusions (II)

IC misalignment:

- The displacement was modeled assuming two contributions:
  - Displacement of the tungsten shielding in the BPM by -250 μm.
  - Shift of the IC by -250 μm.

- Mechanical displacement towards the ring centre to let the hot spot more exposed.

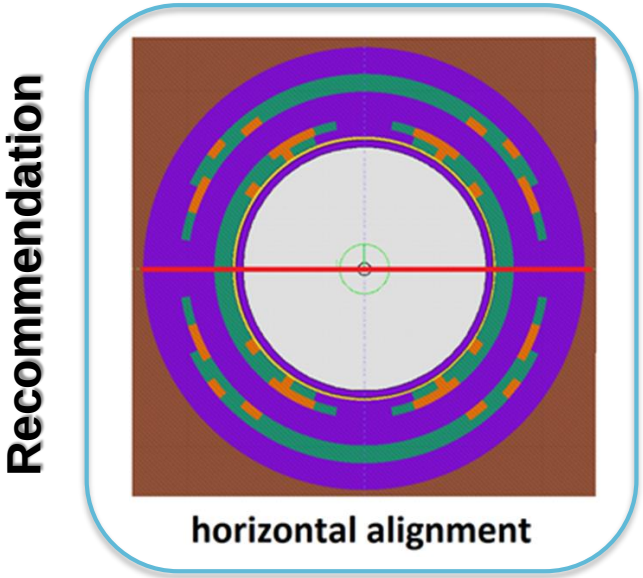
- The effect is still **negligible.**



Summary and Conclusions (III)

Effect of the orbit correctors orientation on their exposure:

- The orientation of the nested orbit correctors affects the maximum dose their coils are exposed to.
- The recommended configuration is with the **inner layer giving a vertical field**, i.e. horizontal correction.



Thank you for your attention