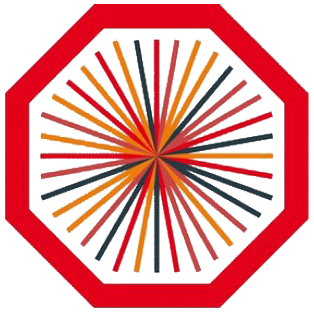
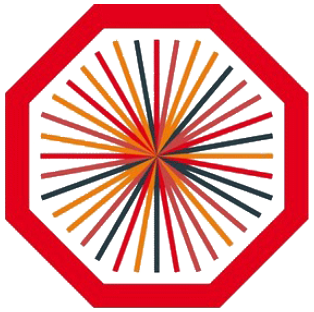
ALICE



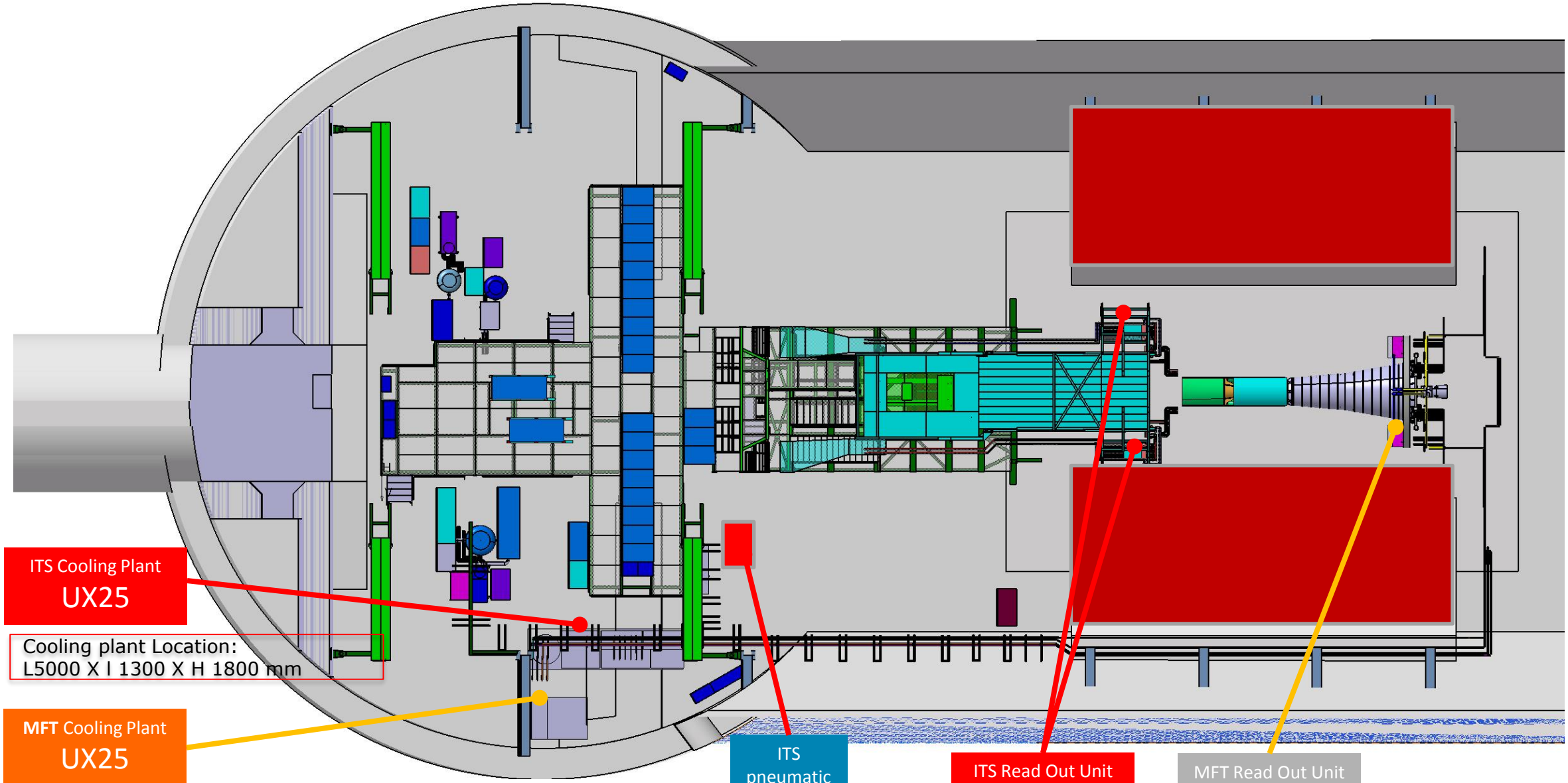
Environment



Cavern Installation

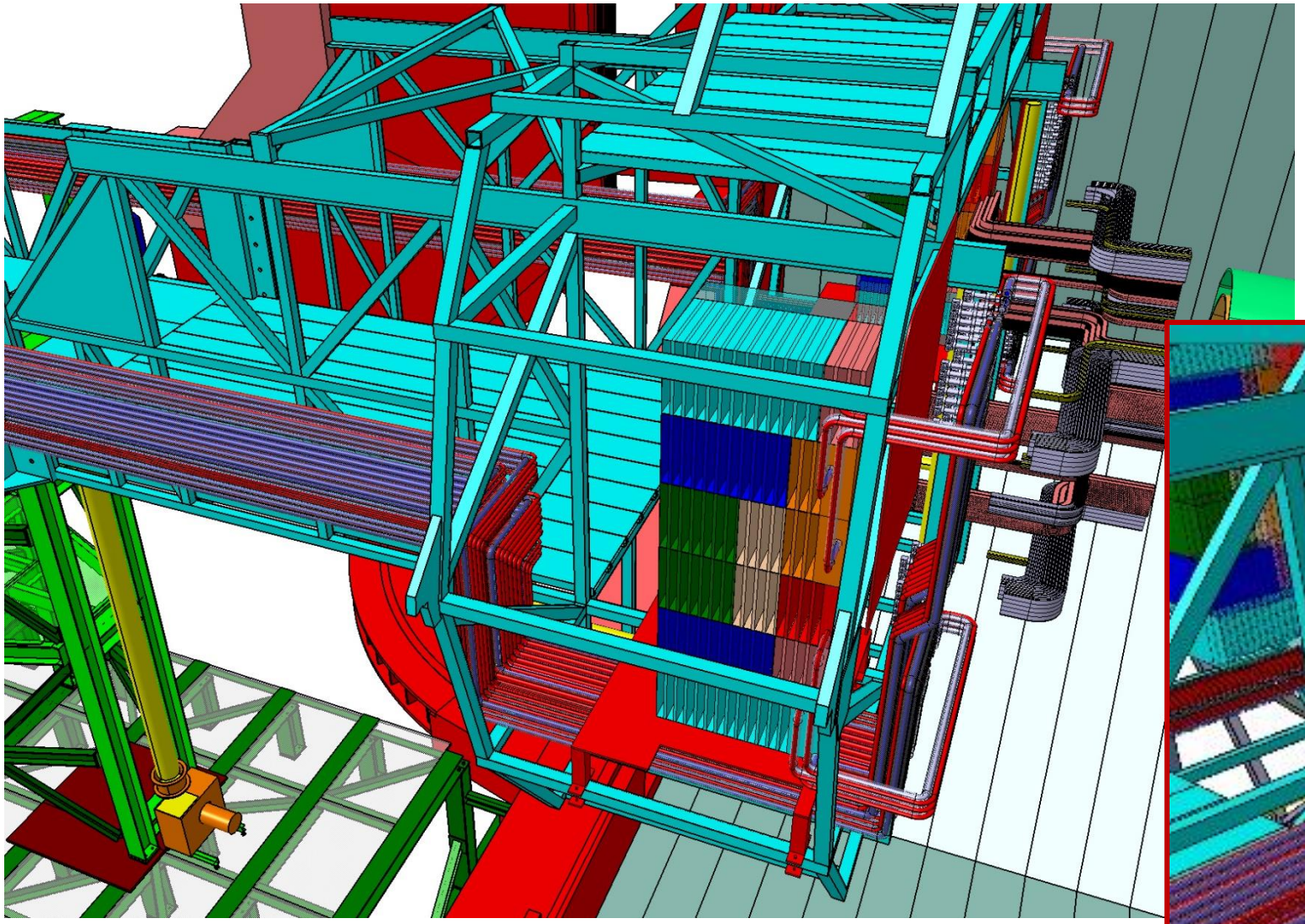
Layout – ITS crates placement

Elisa

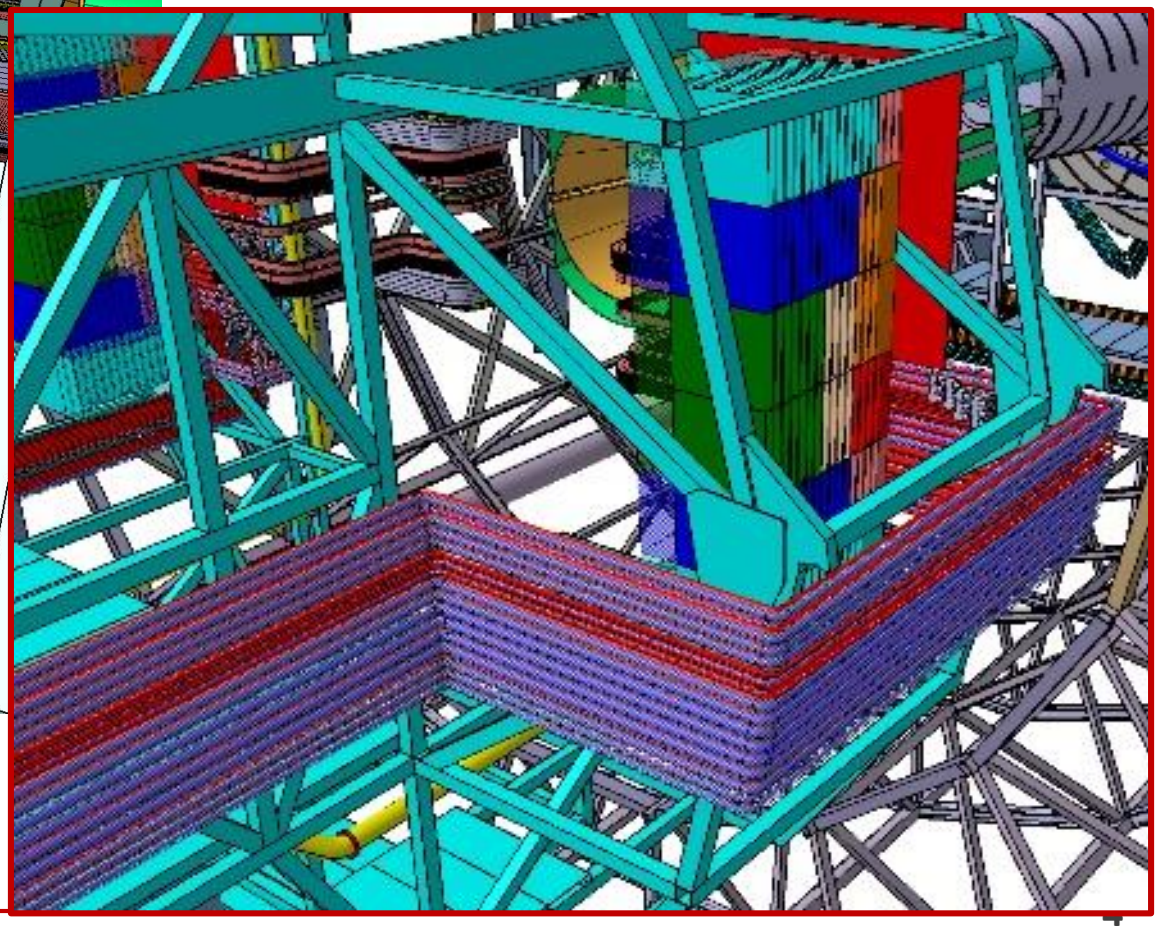


Cavern – ITS crates placement

Elisa



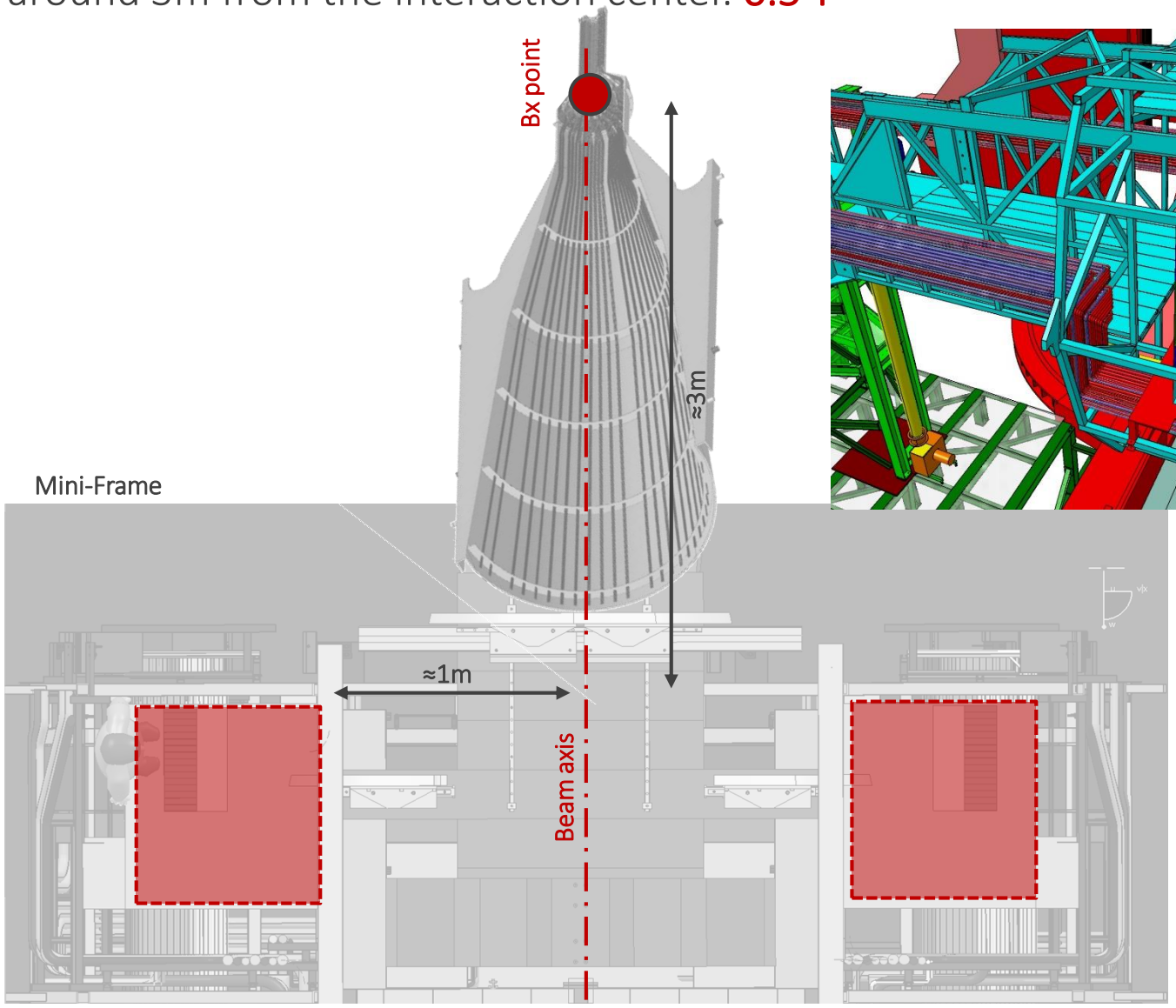
New routing for the cooling lines of the ITS on the Miniframe to avoid siphons due to the bends.
To be verified if in real configuration there is enough room.

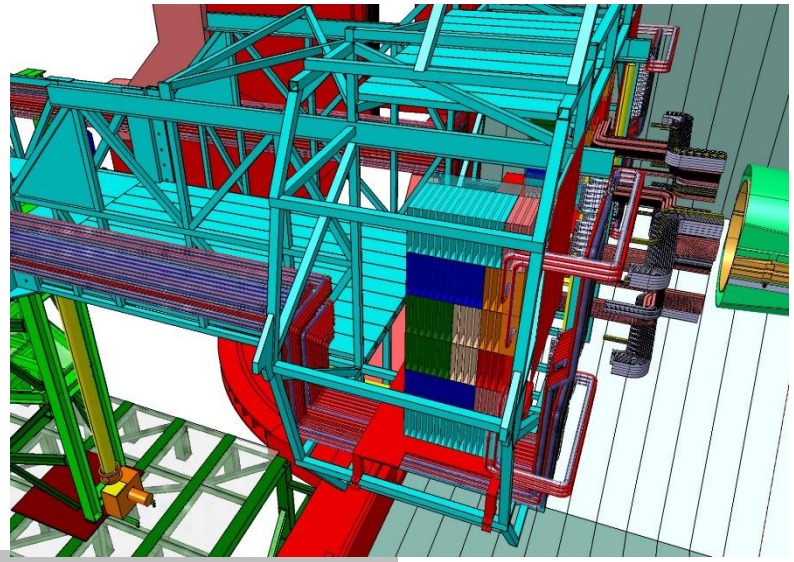


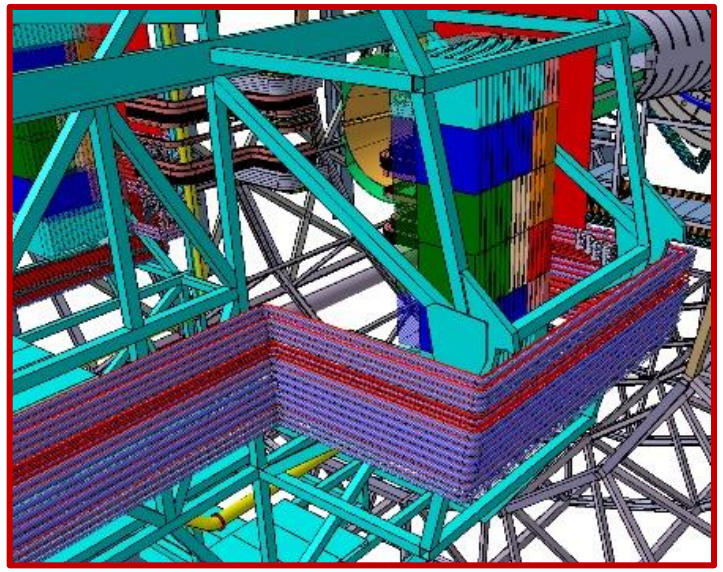
New cooling lines for the off detector electronics crates has been added. 2 lines each crate To verify the accessibility and space available.

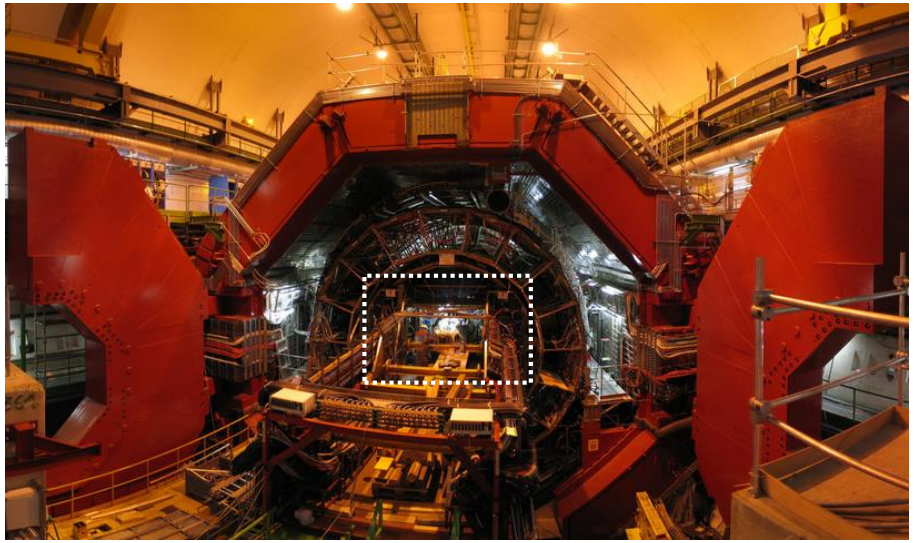
Cavern – Readout Electronic placement

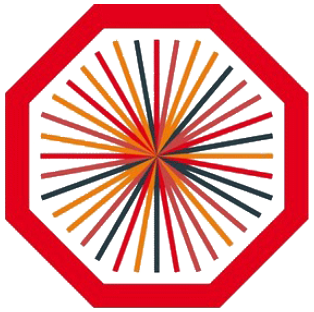
The readout electronic will be installed in two racks in the so-called mini-frame, about 1m from the beamline axis at around 3m from the interaction center. 0.5 T







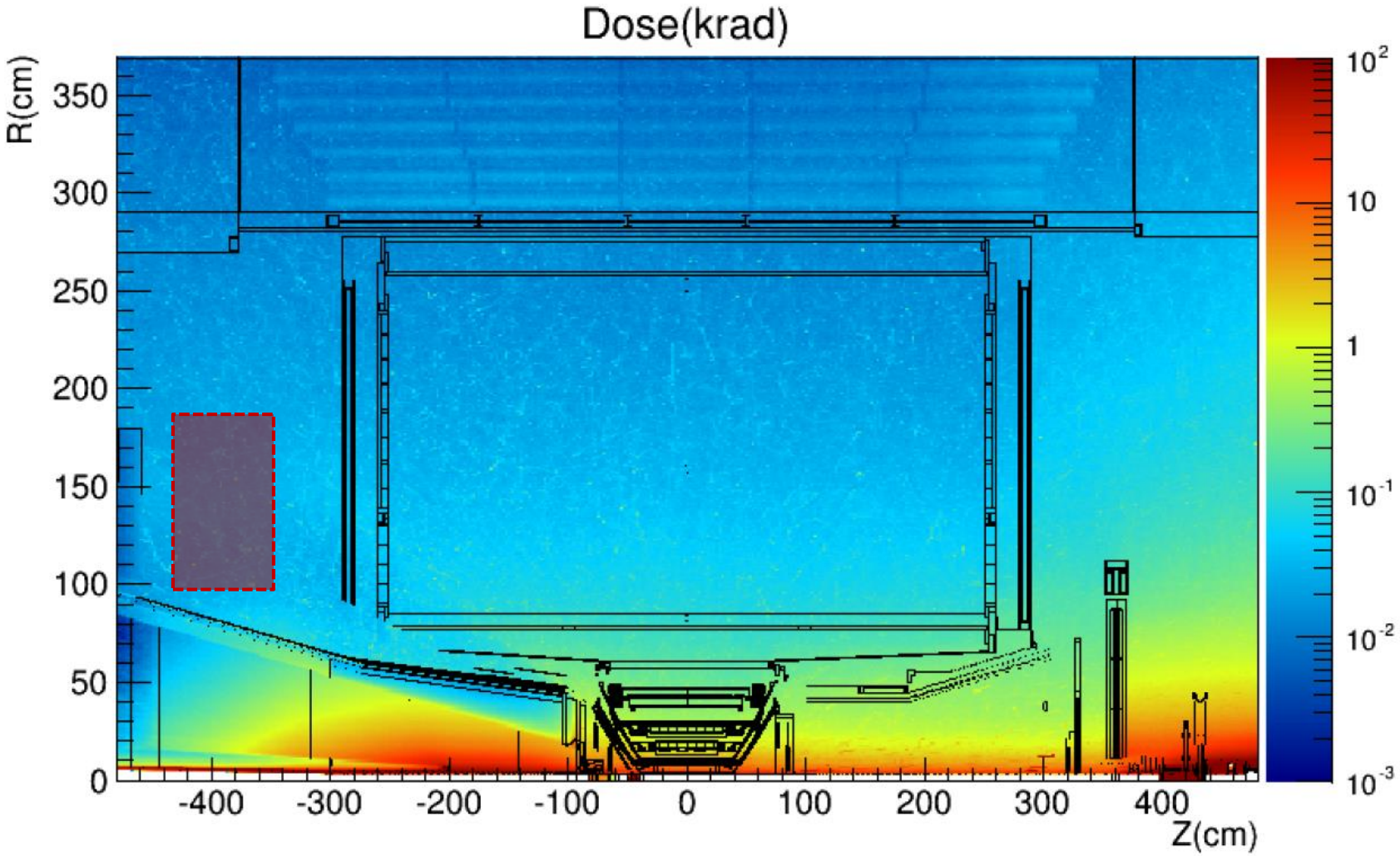




Radiation Levels

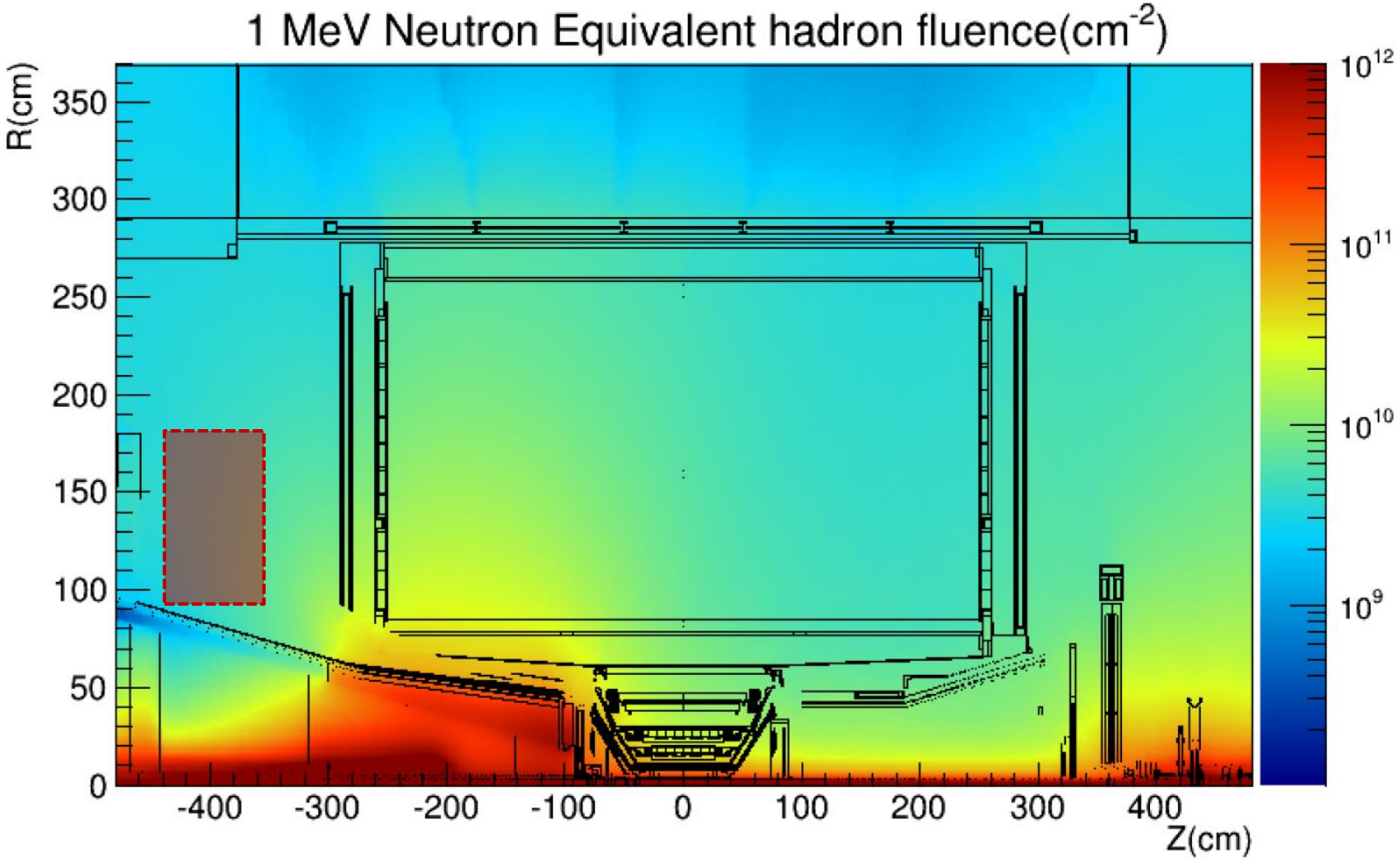
Radiation – Total Ionizing Dose

TID levels (10k considering 10× safety factor) are of no practical concern for modern microelectronic technologies, nor for material degradation. Test has been anyway carried and/or planned to ensure components resistance.



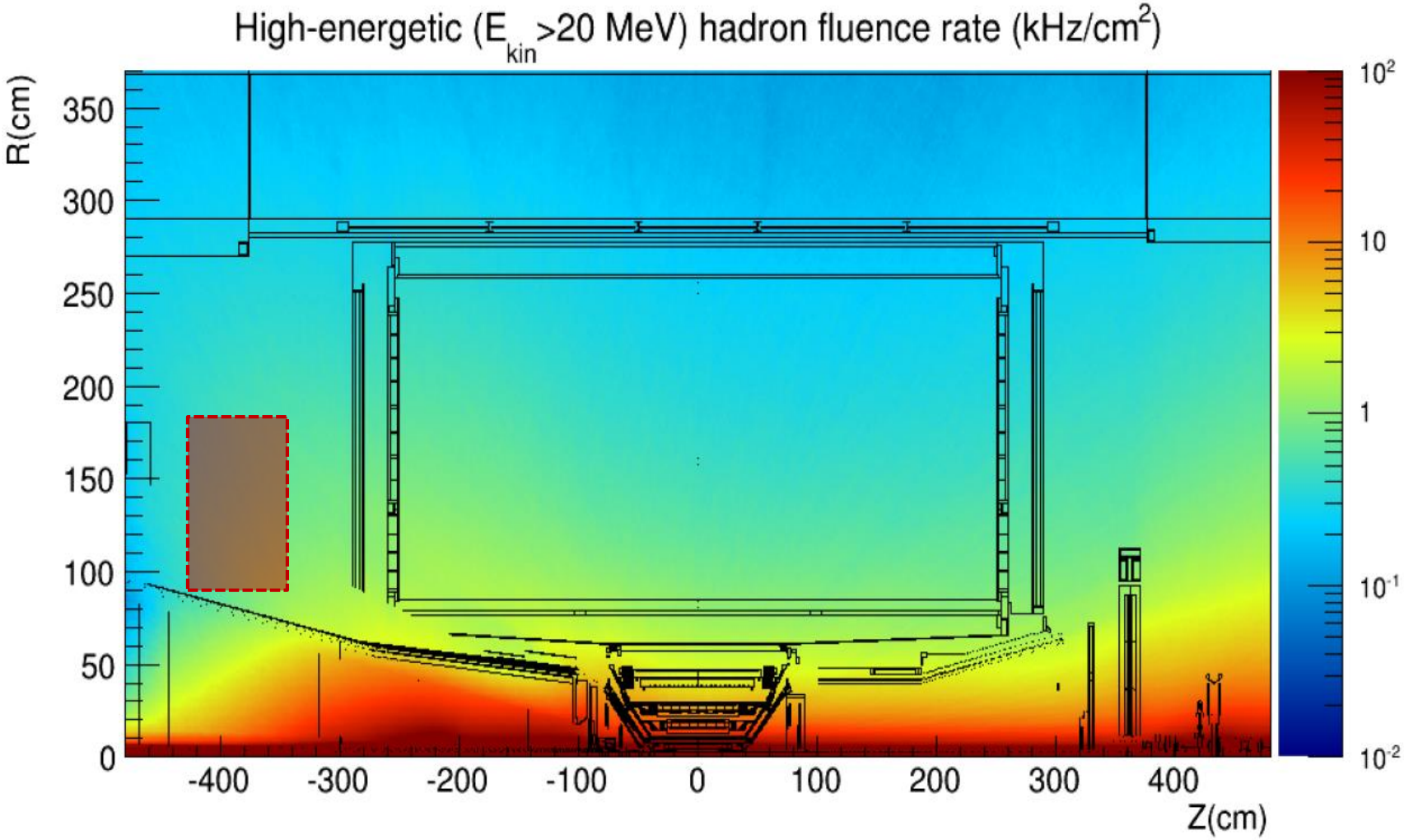
Radiation – 1 MeV Neutron Equivalent hadron fluence

As for the TID, foreseen NEF levels (10^{11} including 10× safety factor) are not a concern for material degradation and component reliability.



Radiation – High Energetic hadron fluence

High energy (> 20 MeV) hadrons are the real concern, as the can cause latch-ups in electronic components and SEU on logic devices. Testing did show that latch-ups will not be a problem, while proper design is required to mitigate the SEUs effects.



Radiation levels – summary (all included)

- TID & 1 MeV fluence sum tables 1 and 2, with efficiency and safety factors.
- Ionizing particles flux are the maximum from table 1 (Pb-Pb)

Position respect to beam			Radiation levels (total)			
r	z	Name	TID	1 MeV neq fluence	**High energy hadron flux***	Charged particle flux
[cm]	[cm]		[krad]	[cm^{-2}]	[kHz cm^{-2}]	[kHz cm^{-2}]
2.2	[-13.5 ÷ 13.5]	ITS L0	2734	1.7×10^{13}	765 (770)	890 (910)
43	[-73.7 ÷ 73.7]	ITS L6	20	8.1×10^{11}	3.4 (4.9)	4.5 (6.7)
79	[-260 ÷ 260]	TPC In	5.6	7.0×10^{11}	1.35 (1.8)	1.7 (3.45)
100	**330**	**RE**	**≈ 5**	**≈ 1.6×10^{11}**	**0.86**	**1.7**
258	[-260 ÷ 260]	TPC Out	0.86	1.4×10^{11}	0.27 (0.37)	0.2 (0.3)
290	[-290 ÷ 290]	TRD	0.6	1.2×10^{11}	0.23 (0.31)	0.15 (0.23)

- TID & fluence = (table 1 × $1.3_{\text{data taking efficiency}}$ + Table 2 / $10_{\text{better vacuum}}$) × $10_{\text{safety factor}}$
- Safety factor of 10 on top of TID and fluence calculated as in the above line.
- **Hadrons and charged particles as for 50 kHz Pb-Pb collisions** (table 1, worst case scenario).
- The average value within the z span is reported first, in brackets the peak value within the z interval.
- * Momentum > 20 MeV.

We will assume 1 kHz cm^{-2} for simplicity as baseline.

Radiation levels – due to primary collisions (table)

Expected radiation levels due to primary collisions only. To obtain the total expected value, look at following slides. No safety factors here.

Position respect to beam			Radiation levels (primary collisions)			
r	z	Name	TID	1 MeV neq fluence	**High energy hadron flux***	Charged particle flux
[cm]	[cm]		[krad]	[cm^{-2}]	[kHz cm^{-2}]	[kHz cm^{-2}]
2.2	[-13.5 ÷ 13.5]	ITS L0	68.7 (80.3)	9.8 (10.3) × 10^{11}	765 (770)	890 (910)
43	[-73.7 ÷ 73.7]	ITS L6	0.39 (0.81)	2.2 (5.2) × 10^{10}	3.4 (4.9)	4.5 (6.7)
79	[-260 ÷ 260]	TPC In	0.14 (0.24)	2.0 (4.5) × 10^{10}	1.35 (1.8)	1.7 (3.45)
100	330	RE	0.13	8.3 × 10^{9}	0.86	1.7
258	[-260 ÷ 260]	TPC Out	0.032 (0.038)	6.2 (8.4) × 10^{9}	0.27 (0.37)	0.2 (0.3)
290	[-290 ÷ 290]	TRD	0.019 (0.025)	5.2 (7.1) × 10^{9}	0.23 (0.31)	0.15 (0.23)

- TID and 1 MeV neq fluence calculated for nominal physics program (13 nb^{-1} **Pb-Pb +** 50 nb^{-1} **Pb-p +** 6 pb^{-1} **p-p**).
- **Hadrons** and charged particle flux calculated for **50 kHz Pb-Pb** collisions (worst case scenario).
- The average value within the z span is reported first, in brackets the peak value within the z interval.
- * Momentum > 20 MeV.

Radiation levels – due to beam gas collisions (table 2)

Expected radiation levels due to beam-gas collisions. To obtain the total expected value, look at following slides. No safety factors here. Relevant for pp collisions only (ions collisions have much less frequency, hence gassing).

Position respect to beam			Radiation levels (beam gas collisions)			
r	z	Name	TID	1 MeV neq fluence	High energy hadron flux*	Charged particle flux
[cm]	[cm]		[krad]	[cm^{-2}]	[kHz cm^{-2}]	[kHz cm^{-2}]
2.2	[-13.5 ÷ 13.5]	ITS L0	1690 (1780)	$3.2\ (3.3) \times 10^{12}$	28.6 (30.2)	1160 (1210)
43	[-73.7 ÷ 73.7]	ITS L6	10.8 (16.5)	$1.3\ (3.4) \times 10^{11}$	0.79 (1.2)	7.2 (9.1)
79	[-260 ÷ 260]	TPC In	2.5 (3.1)	$1.2\ (2.7) \times 10^{11}$	0.42 (0.53)	1.7 (1.8)
100	330	RE	≈ 2.3	$\approx 5 \times 10^{10}$	≈ 0.3	≈ 1.4
258	[-260 ÷ 260]	TPC Out	0.36 (0.45)	$3.5\ (4.7) \times 10^{10}$	0.09 (0.12)	0.14 (0.17)
290	[-290 ÷ 290]	TRD	0.27 (0.43)	$2.9\ (4.0) \times 10^{10}$	0.07 (0.10)	0.09 (0.13)

- TID and fluence from beam-gas collisions assuming the vacuum conditions of Fill 2736 (average pressure 2.3×10^{-8} mbar).
- High energy hadrons and charged particles flux are those expected for HL-LHC.
- The average value within the z span is reported first, in brackets the peak value within the z interval.
- * Momentum > 20 MeV.