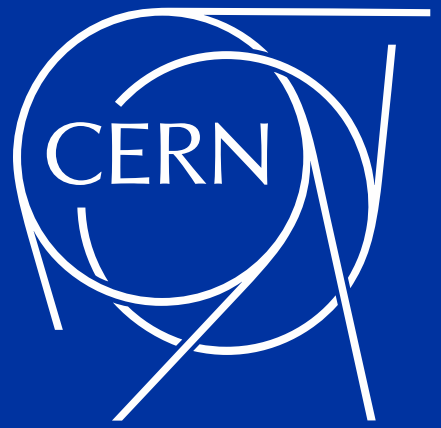

Power load to IR3 warm magnets due to beam losses

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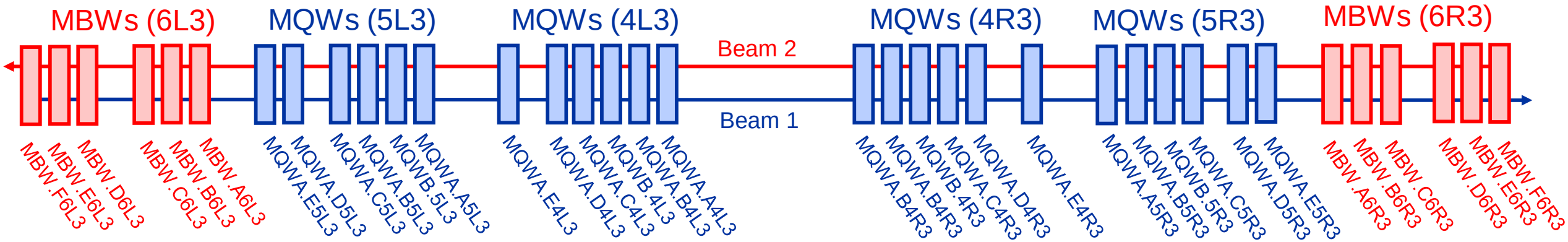
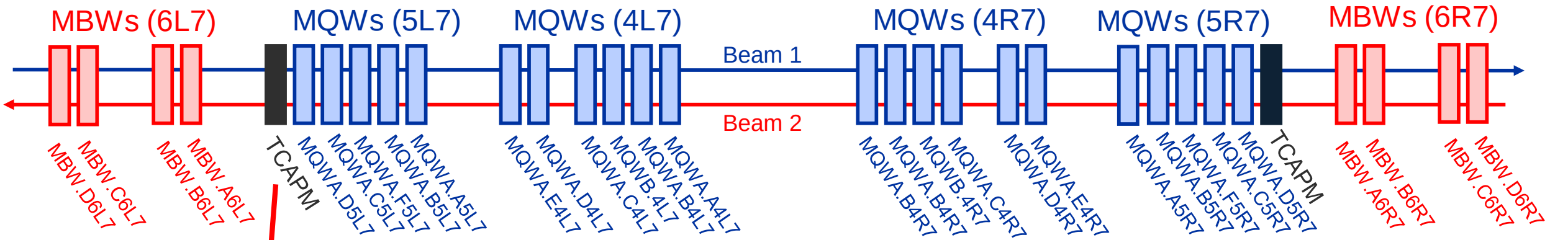
Context

- In Run 3 operation, several BLM dumps were triggered in IR3 at the start of the ramp (uncaptured particles)
- Scaling to HL-LHC parameters, this losses risk to be a performance limitation → high importance for the RF group to understand if we can increase our BLM thresholds (as also reiterated at Chamonix workshop)
- Before changing any dump thresholds, we need to revise how much beam power loss we can allow for in IR3 (mostly in the 0.1-20 sec regime)
- We aim to increase the thresholds by at least a factor of 2-3 compared to now, i.e., we want to allow for **200 kW** or higher*
- A non-negligible fraction of this power is deposited in the warm magnets (MBW and MQW) → does this pose any limitation?

For comparison, in IR7 we presently allow for **500 kW (**1 MW** in HL), but the relative leakage to warm magnets is less than in IR3*

IR3 vs IR7: warm magnet layouts



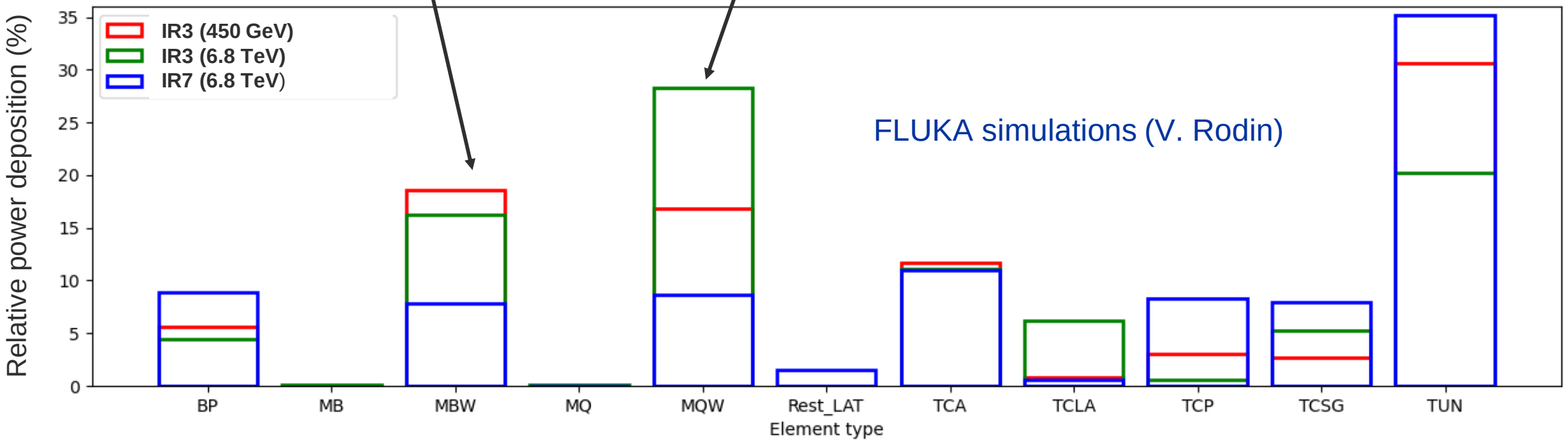


Power deposition in magnets depends on collimator + mask locations

IR3 vs IR7: rel. power deposition in warm magnets

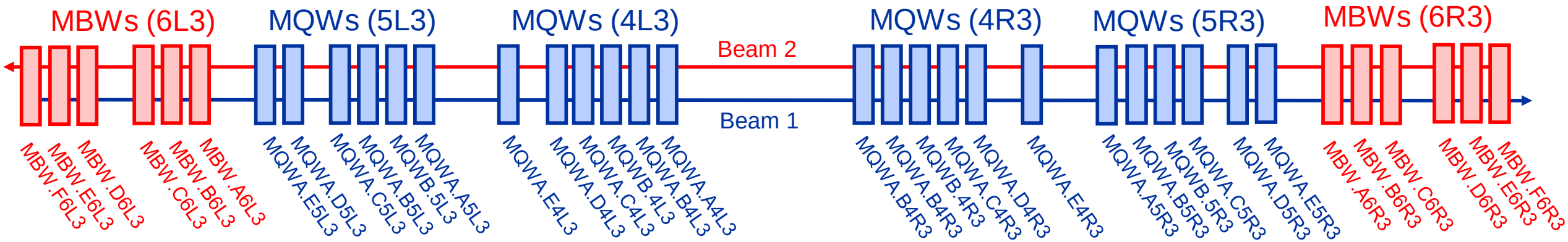
Sum of power deposited in all **MBWs** in IR3 or IR7 (in magnets + shielding inserts)

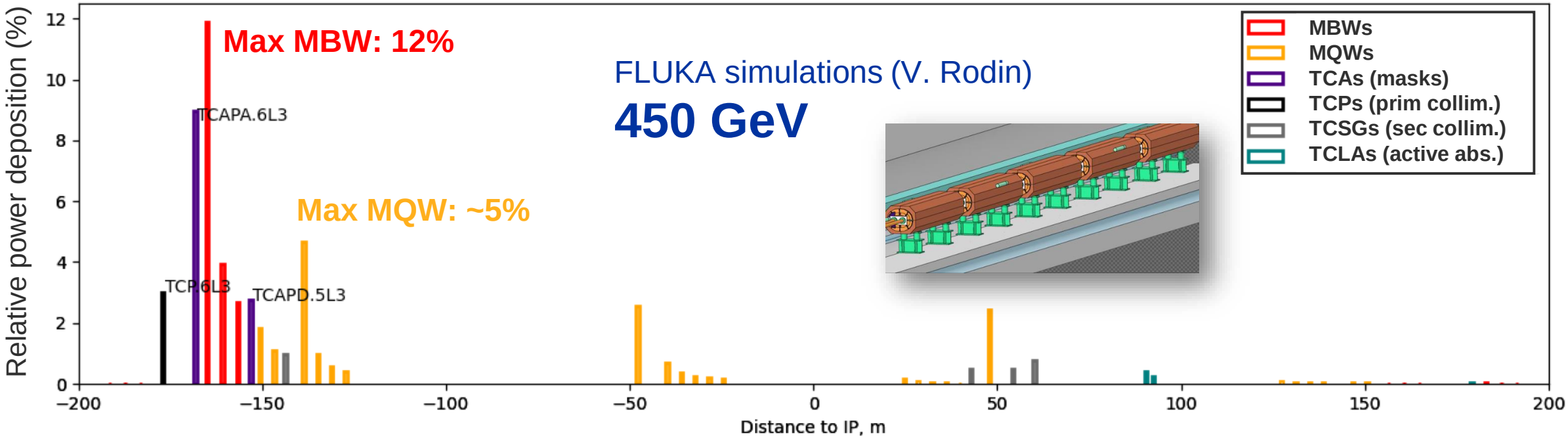
Sum of power deposited in all **MQWs** in IR3 or IR7 (in magnets + shielding inserts)



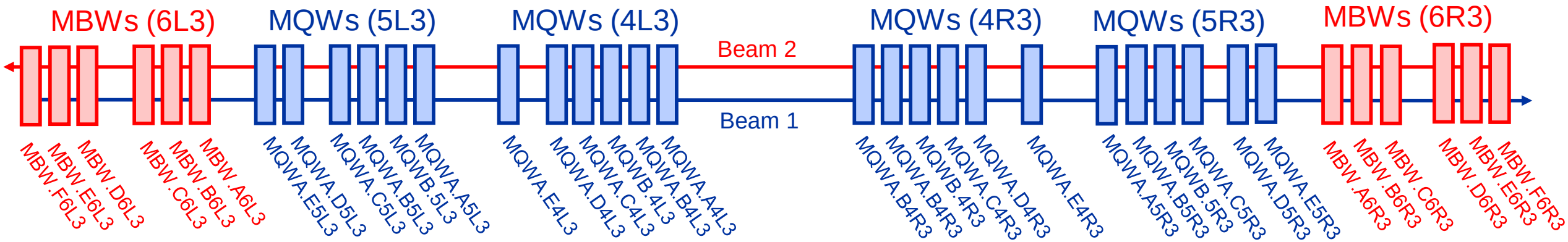
In IR3, about **35-45%** of the power is deposited in warm magnets, while it is **<20%** in IR7

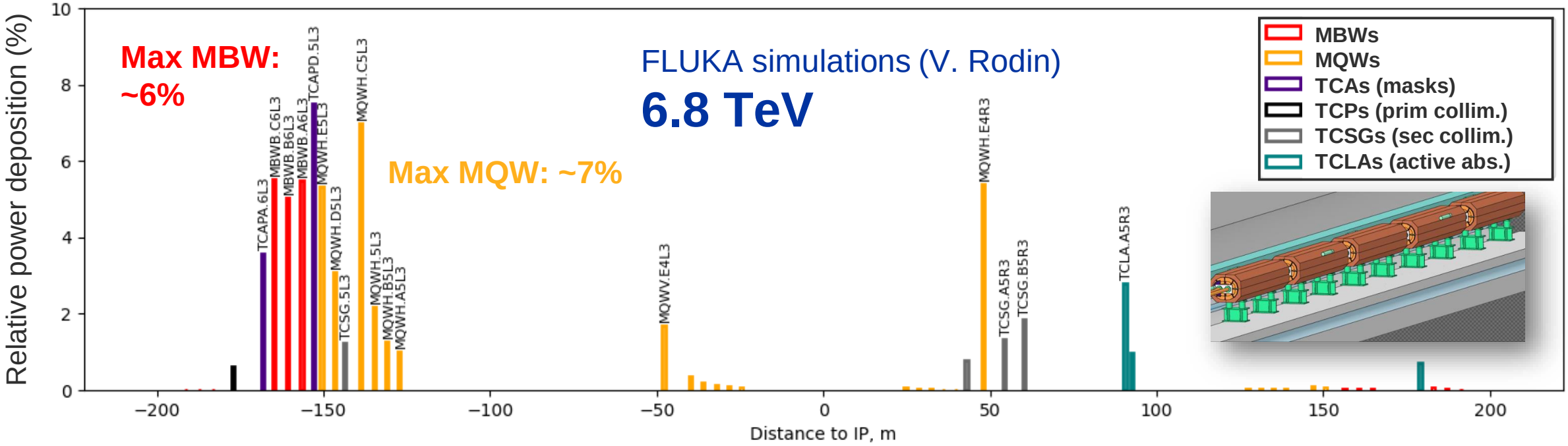
IR3: relative power deposition (450 GeV)





IR3: relative power deposition (6.8 TeV)





Max. power deposition per MBW / MQW

Power deposition in most exposed MBWs and MQWs ***for possible IR3 target power loss values****:*

IR3	200 kW	300 kW	500 kW
450 GeV			
MBW	24 kW	36 kW	60 kW
MQW	10 kW	15 kW	25 kW
6.8 TeV			
MBW	12 kW	18 kW	30 kW
MQW	14 kW	21 kW	35 kW

Beam power loss

Power deposition in magnets

Power deposition in most exposed IR7 MBWs and MQWs in ***Run 3*** *(500 kW) and* ***HL*** *(1 MW)*

IR7	500 kW	1 MW
6.8 TeV		
MBW	23 kW	46 kW
MQW	9 kW	18 kW

Beam power loss

Power deposition in magnets

FLUKA simulations (V. Rodin)

Power deposition limits for MBW and MQW?

Our present assumptions for the max allowed power deposition in a single MQW date back to Run 1:

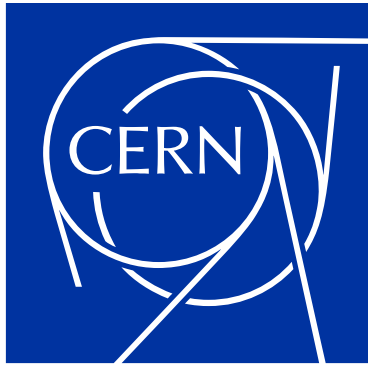
Coil temperature interlocked at 65 deg C

Water Flow (Q)*	22l/min
Water Temperature*	20 to 30 °C
Max allowed ΔT Water	35 °C
Max Power evacuated $P_{cool}=Cp\ Q\rho\Delta T$	53.6 kW
Nominal Magnet Current	360 A
Ohmic Losses $P_{Ohm}=R * I^2$	4.8 kW

Max allowed power deposition from beam losses in a single MQW = **49 kW (at nominal magnet current, w/o safety margin**)

Questions:

- Are these assumptions for the MQWs still valid?
- Do the same assumptions apply for the MBWs?
- Is there also a limit on the total power deposition in all warm magnets? Are they in the same cooling circuit?
- Are the shielding inserts cooled by the same circuit, or do we have to distinguish between the power deposition in the shielding inserts and yoke/coils?



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