HL-TCC Technical Coordination Committee
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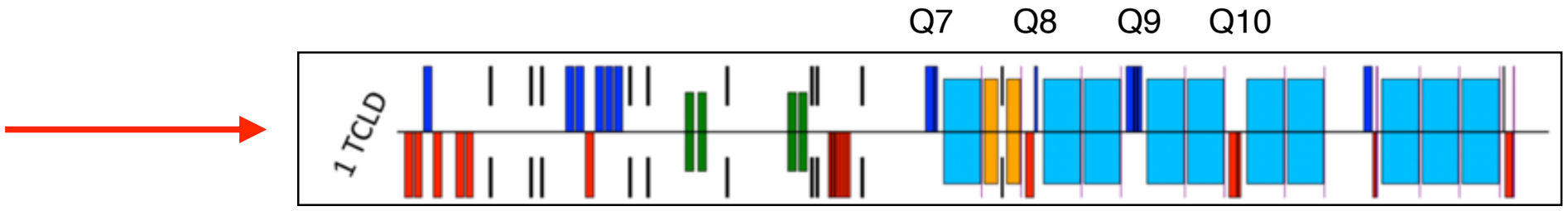
Recap. of collimation losses in the IR7 dispersion suppressors

C. Bahamonde, R. Bruce, F. Cerutti, A. Lechner, S. Redaelli
On behalf of WP5

Acknowledgements: G. Arduini, R. Van Weelderen, G. Iadarola, G. Rumolo, et al.

IR7 baseline layouts



Baseline 2016

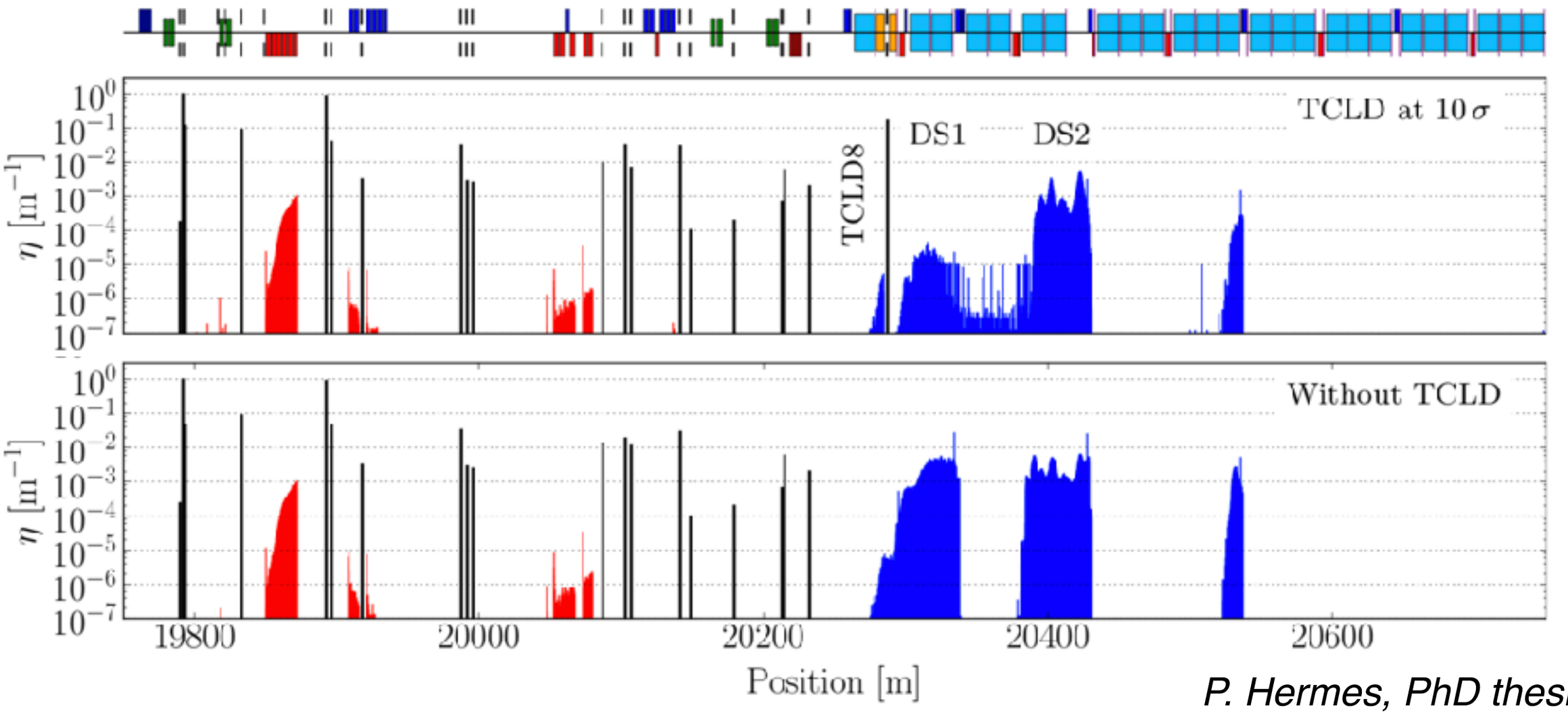
Re-baselining in 2016 removed the second unit near Q10.

Studied also other locations between Q8 and Q9. Not discussed here.

Layouts studied in detail through simulations (tracking+energy deposition). Main focus was on quench limits from peak power deposited in SC coil. More recently, simulation results re-interpreted to assess other limitations.

Key reference: Collimation Review 2013
Annual meeting Daresbury, 2013
Annual meeting Madrid, 2017 + Chamonix 2018

Beam losses



P. Hermes, PhD thesis

Tracking simulations for protons and ions are used as input for energy deposition simulations.
Benchmark to experimental data indicate that a factor x3 need to be added to the simulation result to reproduce loss pattern. Included in all numbers shown here.

Possible limitations

Three sources of limitations from collimation losses identified:

— Quench limit, from peak power in super conducting coil;
— Total energy deposited in the coil (specific for 11T dipole);
— Total power on cryogenics cells.

Here: review inputs from simulations (WP5/WP10 + WP2) to cryogenics team.

All numbers given for nominal HL-LHC parameters, 7 TeV:

Protons†: 2760 bunches of 2.3e11protons

Lead ions: 1248 bunches of 2.1e8 ions

Loss scenarios: **0.2h** beam lifetime (BLT) for 10 seconds

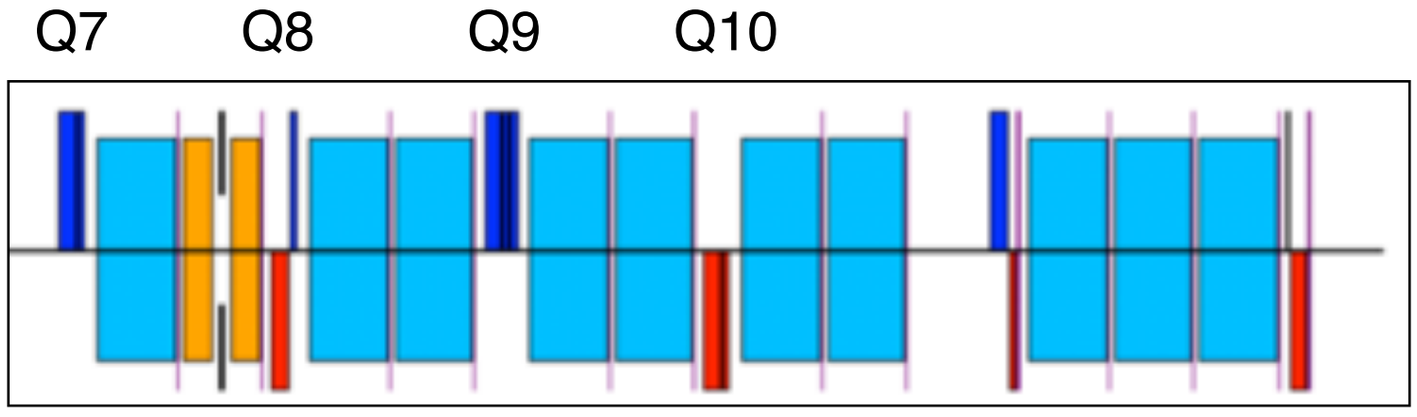
1.0h for indefinite times.

†: Updated compared to my presentation at Chamonix: 10% effect from n_b.

Peak losses in SC coils

Summary of limiting location for present and HL layouts

0.2 h beam lifetime



Without upgrade, peak losses in dipoles coil for **0.2h lifetime** are

21 mW/cm^3 (protons) and 58.2 mW/cm^3 (lead ions)

With the TCLD/11T dipole upgrade, losses are:

STD MB: 8.6 mW/cm^3 (protons) and 35.4 mW/cm^3 (lead ions)

11T dipole: 10.6 mW/cm^3 (protons) and 21.3 mW/cm^3 (lead ions)

Note that limiting locations after upgrade are in cell 9-11.

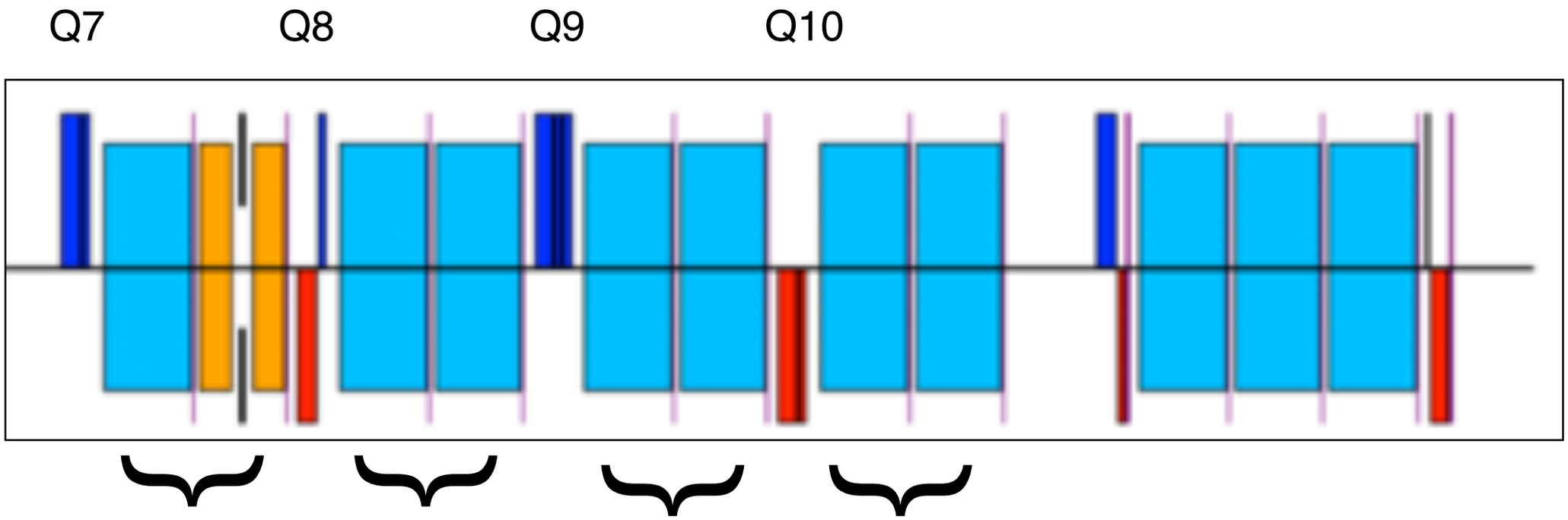
Total power in 11T dipole coil

1h beam lifetime

	Peak power (mW/cm^3)	coil + beam-pipe (W)
Protons	2	12
Ions	4	21

Total coil + beam pipe: obtained by summing up energy deposition estimated for coil and cold bore for the 1h beam lifetime scenario.

Total loads on cold masses



1h beam lifetime

Protons:	40W	20W	~0W	70W	Max/cell = 70W
Lead ions:	70W	25W	~0W	140W	Max/cell = 140W

Other sources of beam-induced loads on cold masses (inputs: WP2/10)

Ecloud: negligible

Beam-gas interactions: < 1W (both protons and ions)

Impedance, synchr. rad.: negligible