



CONS and HL-LHC day 2017

Analysis of needs for LHC Collimation

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Collimation layout — LHC Run II

Two warm cleaning insertions, 3 collimation planes

IR3: Momentum cleaning

- 1 primary (H)
- 4 secondary (H)
- 4 shower abs. (H,V)

IR7: Betatron cleaning

- 3 primary (H,V,S)
- 11 secondary (H,V,S)
- 5 shower abs. (H,V)

Local cleaning at triplets

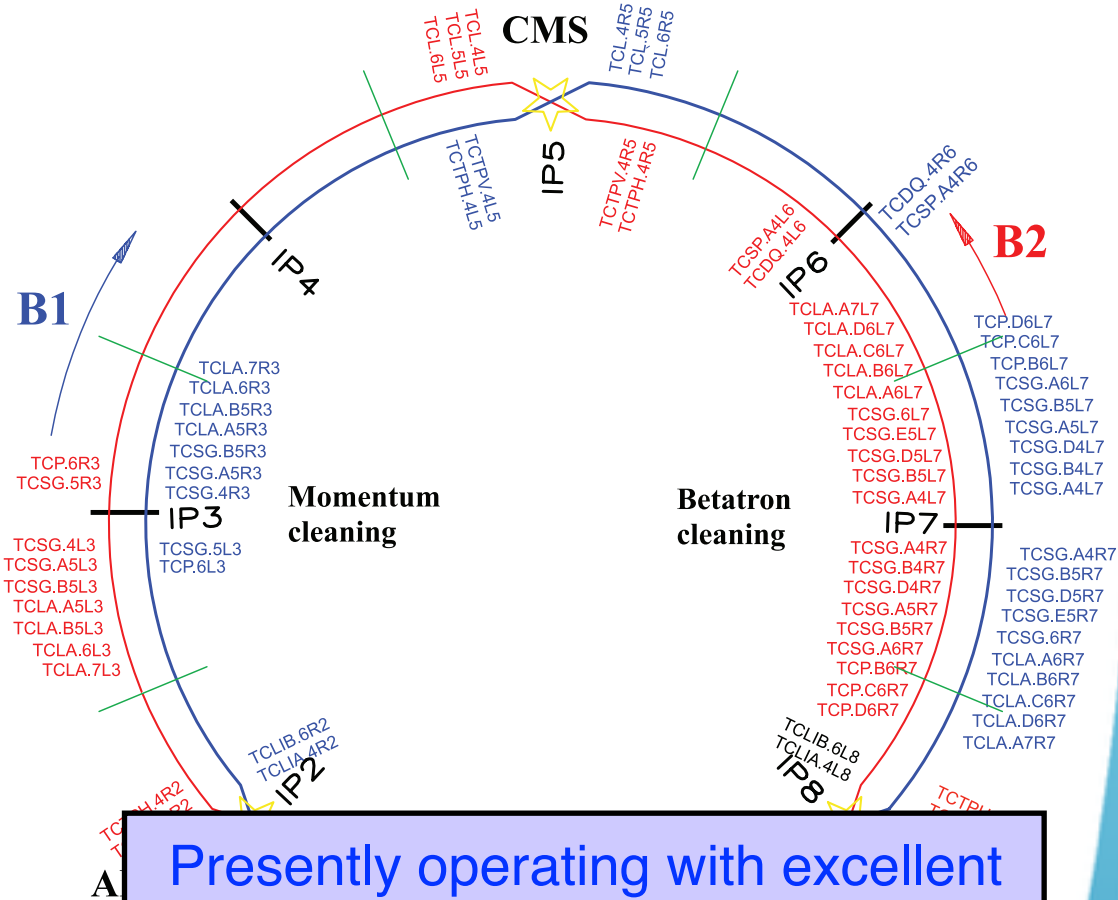
- 8 tertiary (2 per IP)

Passive absorbers for warm magnets

Physics debris absorbers

Transfer lines (13 collimators)

Injection and dump protection (10)



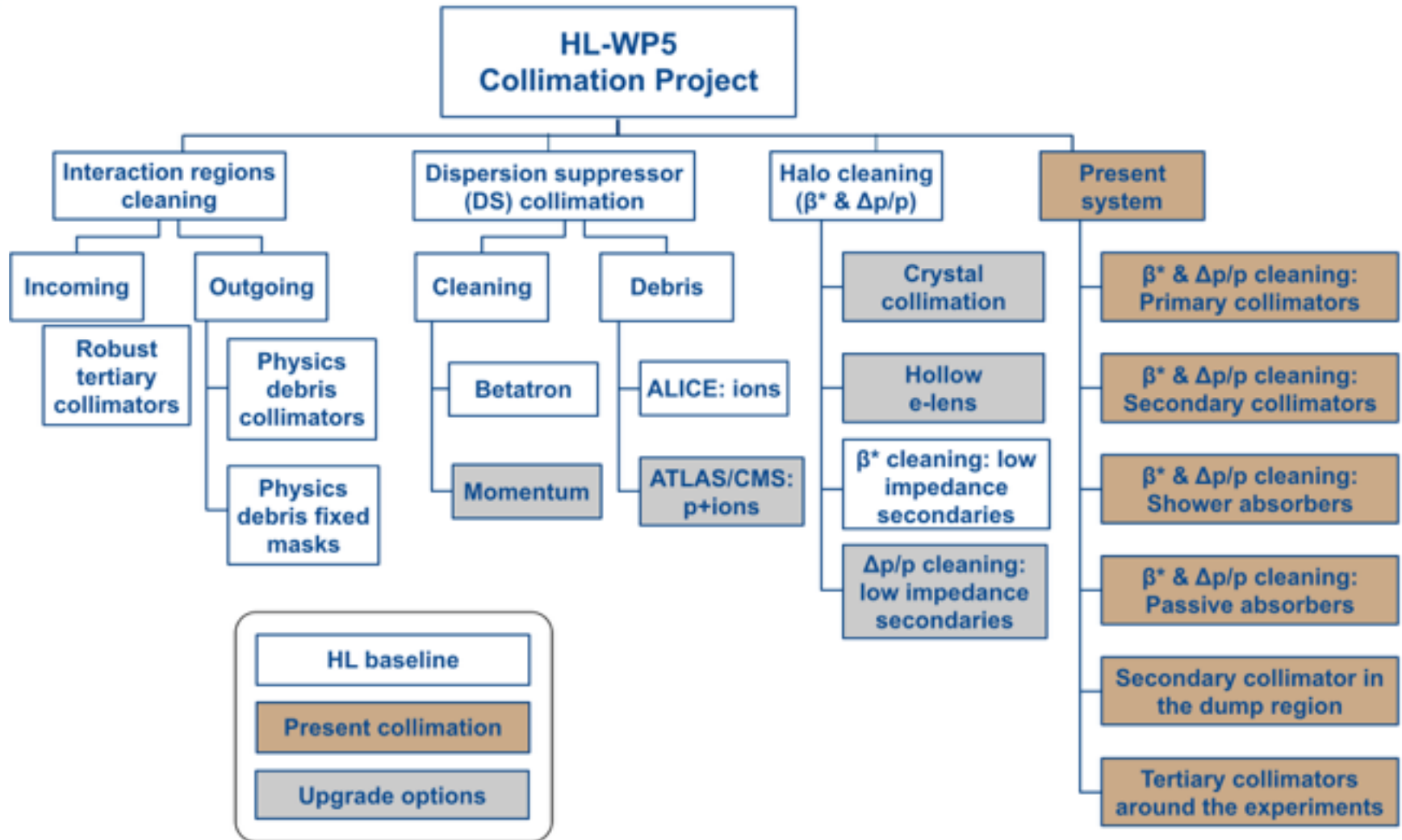
Presently operating with excellent availability — important to keep maintain this for HL!

**Total of 118 collimators (108 movable).
Two jaws (4 motors) per collimator!**

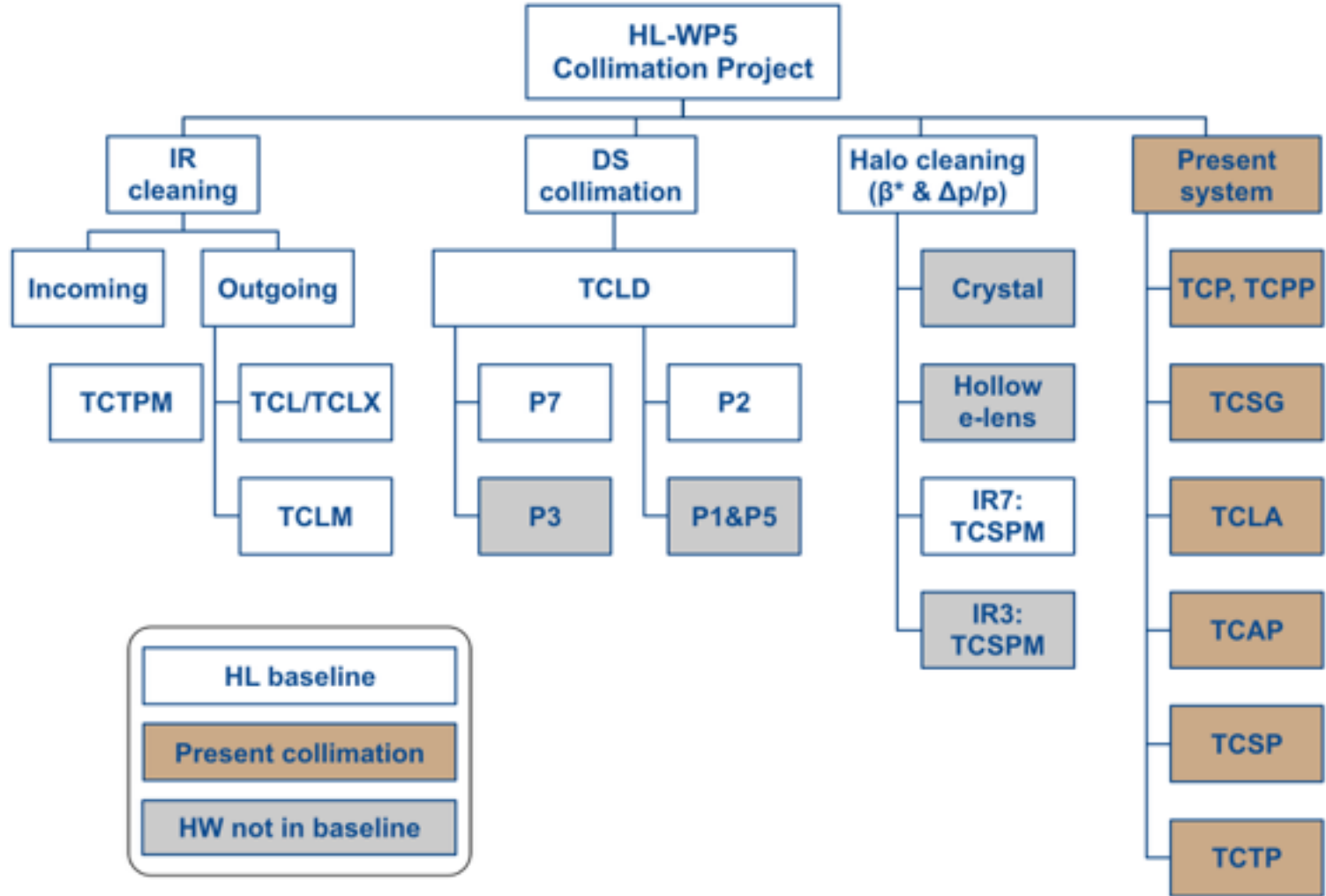
HL-LHC upgrades in a nutshell

- **LS2 plans**
 - 2 DS collimators around IR7 with 11T dipoles
 - 2 DS collimators around IR2 without 11T dipoles
 - 8 low-impedance secondary collimators in IR7
- **LS3 plans**
 - Completion of IR7 low-impedance upgrade (14 TCSPM)
 - IR collimation: new tertiary collimators
 - IR collimation: physics debris
- **Not in the baseline yet**
 - Crystal collimation for ions (LS2?)
 - Hollow electron lenses (LS3)

Collimation project devices



Code names



Scope of collimation consolidation

- Keep operational with high efficiency present collimators that are not upgraded/replaced in the context of the HL-LHC upgrade.
 - An important fraction of the present system is required to remain operational for the whole HL-LHC.
- Consolidate the performance of the whole collimation system until Run III
 - Ensure efficient operations. This is a MUST!
 - Guarantee/improve the performance within the scope of the pre-HL operations (β^* reach, alignment, ...).
 - Ensure that the collimation system does not limit machine configurations until Run III.

Collimators not upgraded as part of HL-LHC

- Primary collimators and shower absorbers of IR7
 - Equipment codes: TCP/TCLA; 6+10 devices.
- Tertiary collimators IR2/8
 - Equipment code: TCTP; 8 devices.
- Whole momentum cleaning insertion IR3
 - Equipment codes: TCP/TCSG/TCLA; 18 devices.
- Secondary collimators with BPM in IR6
 - Equipment code: TCSP; 2 devices.
- Controls upgrade for all system
 - Present controls hardware dates from 2008.

Remark: collimators built in ~2008. Continued effort to monitor hardware performance, obsolescence, etc. But: we do not have now all answers now on detailed assessment of collimator lifetime in the harsh tunnel environment.

Additional requests to CONS

- New passive absorbers in IR7 — Approved
 - Improve shielding of MQWs are removal of 1 magnet unit.
 - Timeline: LS2
- Consolidation of collimation controls for high-efficient operation — Approved
- Robust tertiary collimator in IR1/5 for Run III's β^* performance — draft 3
 - Equipment code: TCTP; 4 devices (H plane IR1/5).
 - Timeline: 2020-2021.

Approved requests

Item n.	Description	Approved Budget [kCHF]	Funding (CONS/HL-CONS) %	Budget to be allocated in the years
1	Primary collimators (TCP) — phase 1	1050	80/20	2017-2021
2	Controls upgrade — phase 1	300	100/0	2017-2019
3	Passive absorbers IR7	100	100/0	2017-2019

- TCP upgrade:
 - New TCP/PPM: BPM design, low-impedance material (MoGr)
 - Total cost estimated to ~1.75MCHF (4+1 “naked” collimator)
 - Co-funded by Collimation project ~700kCHF
 - HL contributing to low-impedance upgrade (material): <20%
 - **Assume that we can re-use existing cables and infrastructure.**
- Controls upgrade:
 - “Phase I”: prototyping and testing of new controls hardware
- Passive absorbers for Q5 in IR7:
 - Shield MQW series after removal on one magnet.

“Draft 3” requests

Item n.	Description	Approved Budget [kCHF]	Funding (CONS/HL-CONS) %	Budget to be allocated in the years
1	Robust tertiary collimators for Run III	2000	100/0	2018-2022
2	Primary collimators (TCP) — phase 2	1750	100/0	2021-2025
3	Controls upgrade — phase 2	2500	100/0	2021-2025
4	Secondary collimators IR3 (IR7)	4600	100/0	2021-2025
5	Tertiary collimators IR2/8	2000	100/0	LS4

- **Robust TCTs:**
 - Potentially very important for Run III optics performance (not for HL)
 - Trying to plan for production lines as “option”: final decision in 2018-19
- **Controls upgrade:**
 - “Phase 2”: complete replacement of hardware
 - **Costs based on Run I system, to be re-assesses after “Phase I”.**
- Items 4-5 — require **system monitoring during Run II/III:**
 - Depending of lifetime of collimators: LS3 or LS4 (or even never).
 - Similar **new request** to be put in for TCLA consolidation [**new**]
 - Detailed budgets to be revised
- To be done: **revise spare policy in light of collimators taken out of tunnel!**

Manpower

- Given “construction” budgets include manpower estimated for the production follow-up
 - FSU support + possible PJAS/fellow included
- Additional requests to CONS [NEW]
 - Two fellows/PJAS + student in ABP: 2020-2023
 - Fellow in the FLUKA team: one starting in ~2018
 - PJAS or PhD students on collimation controls, with University of Malta (~1 PJAS/year 2020-2023)
- Remarks:
 - Need to cover both proton + ion operations
 - Often, shared resources with other projects/activities (join forces with HL, for activities that require < 1 person)

