HLLHC collimator impedance studies for IP7 and IP3

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Outline

1. IP3 & IP7 upgrade with Mo - MoC jaws
2. Only IP7 upgrade with Mo - MoC jaws
3. IP3 retraction and IP7 upgrade with Mo - MoC jaws
4. Conclusions and next steps
The HL-LHC impedance model was updated to the version (HLLHCV1.1).

The same stability threshold studies presented in HiLumi 2014 were performed for $Q' = 15$ units (based on 2012 scaling).

NB: Here we do not include crab cavity impedance and other equipment still under discussion and optimization.

→ With the present jaws in CFC we would be unstable.
→ Stability improved using either MoC or Mo collimators.
IP3 & IP7 upgrade with Mo - MoC jaws

The effect of coating was studied → we can increase the stability region.

→ Beneficial effect of Mo already visible for a coating of 5µm.
Only IP7 upgrade with Mo - MoC jaws

- What is the effect of replacing only the TCSGs in IP7?

→ Coating only IP7 we are close to the limit (for BCMS beams) with positive polarity.
Only IP7 upgrade with Mo - MoC jaws

What is the effect of replacing only the TCSGs in IP7?

→ Increased margin with negative polarity.
IP3 retraction and IP7 upgrade with Mo - MoC jaws

- The TCSG in IP3 can be retracted to reach more stability.
- NB: new baseline with slightly tighter settings (due to change in reference emittance) and added TCTs in IP5.

→ Opening the TCSG in IP3 makes the beams stable.
→ Close to instability limit with positive polarity.
IP3 retraction and IP7 upgrade with Mo - MoC jaws

- The TCSG in IP3 can be retracted to reach more stability
- NB: new baseline with slightly tighter settings (due to change in reference emittance) and added TCTs in IP5.

\[ \varepsilon_n \text{ [mm mrad]} \]
\[ N_b \text{ [ppb]} \]

\[ M=2748, \text{ damper:0p02, polarity:} - \]

→ Opening the TCSG in IP3 makes the beams stable.
→ Increased stability margin with negative polarity.
Conclusions and next steps

Conclusions:
The HLLHC beam stability can be improved reducing the collimator impedance. Different scenarios have been studied.

- All the collimators in MoC coated with 5 µm Mo.
  → Stability ensured for all type of beams and both octupole polarity (negative better).

- Only the collimators in IP7 coated with 5 µm Mo.
  → Decreased margin with positive polarity.
  → Stability margins still available with negative polarity.

- Only the collimators in IP7 coated with 5 µm Mo and IP3 settings more open.
  → Increased stability margin for both negative and positive polarity.

Next steps:
- Optimizing the stability studies (e.g. setting $Q' = +3$ units).
- Keeping the studies updated with new equipments (crab cavities, etc.)