

# **Brainstorming**

on Post-LS1 optics

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Brainstorming

# Burning questions

- What are the present requests and the implications for the optics?
  - experimental insertions (IR2/8/1/5)
  - service insertions (IR3/4/6/7)
- When and how would we like to switch to postLS3 like optics (ATS)?

# Easy answers

- What are the present requests and implications?

IR	Request for post-LS1/2	What is possible?	When is it possible?	Implications for the optics
IR3/7	Extract from the tunnel some MQW spares	Seems only feasible in IR7 according to Thys (the MQWA module on the IP-side of Q5 can be removed, provided the MQWB of Q5 is re-wired as an MQWA)	Post-LS2	None till LS2 (except eventual IR re-phasing via the DS only)
IR4	Increase $\beta$ in D3 (emittance measurement at 7 TeV with BSRT)	Solutions exist in V ( $\uparrow 350$ m), mitigation in H ( $\uparrow 200$ m) but with <b>new IR4 phase advance only</b> (ATS compatible)	Post-LS1	New IR4 injection optics with <b>new phase to be compensated elsewhere</b>
IR6	90° phase between MKD and TCDQ	Solutions exist (with some aperture loss of $\Delta n_1 \sim 0.5$ in Q5) both for nominal IR6 phase, and new phase for ATS compatibility	Post-LS1	New IR6 injection optics
IR2	- Collision optics with IT @ 205 T/m and $\beta^* = 50$ cm - VdM to $\beta^* = 19$ cm	Solutions exist but with <b>new phase advance only</b> (ATS compatible) VdM should be OK, but not checked yet for new IR2 phases	Post-LS1	New IR2 injection/ collision optics and squeeze. <b>New phase to be compensated elsewhere</b>
IR8	- 3 m collision optics with IT @ 205 T/m - New X-scheme for LHCb polarity change - VdM to $\beta^* = 19$ cm	- Solutions exist for the collision optics both for nominal IR8 phases, and new phase for ATS compatibility - New X-scheme a priori OK - VdM should be OK, but not checked yet for new IR8 phases	Post-LS1	New X-scheme, and (at least) collision optics and squeeze
IR1/5	- VdM to $\beta^* = 19$ cm - small $\beta^*$ till 40 cm or even less for flat optics (20 cm) to preserve the perf. with longer bunches	- VdM OK (easy) - 40 cm reachable with nominal squeeze sequence, but very close to the limit (small Q6 current, even smaller at 6 or 6.5 TeV) - 20 cm not reachable, but with ATS $\rightarrow$ slightly different IR phase needed	Post-LS1	<b>NONE or brand new OVERALL LHC optics (all IRs and arc optics) both for ATS and fulfilling all the above requests</b>

# Non-easy answers

- When and how should we switch to the ATS? What are the options?

## *a) Change to the ATS directly for the restart*

- **Unknowns:** possible new collective effect with the ATS: can be better (w/o chromatic aberrations if this plays a role??) or worst (e.g. with new IP15 phase advances, but we can always freely change it)
- **Risk:** restart from (almost) scratch ... is it really a risk?.. A full reset is sometimes good, even if not justified by obvious reasons.
- **Beyond the risks (or the conservatism) .. the true eventual showstoppers:**
  - What is the situation for the MKD-TCT.R5B2 phase advance. LCU should be informed of the conclusions?
  - Any other eventual show-stopper??

## *b) Develop and get the official stamp for a 1 year operational development program, both as investment for HL-LHC, but also optics back-up, e.g. for collective effects (if any correlation ?) or performance consolidation/improvement with flat optics*

- **Aim:** Fully validate the injection/ramp/pre-squeeze(/telescopic) ATS optics with several trains of nominal bunches