Q5 gradient requirements in point 6

G. Arduini, R. De Maria, S. Fartoukh, M. Giovannozzi, Y. Papaphilippou, R. Tomas

HL-LHCv1.3

- HL-LHCv1.3 optics:
  - Contains versions for:
    - Baseline round optics (β^*=15 cm)
    - Flat optics for alternative solutions
  - Takes into account constraints on MKD-TCT phase advance (<30^0) to allow tertiary collimator settings as it is implemented in the ATS optics for LHC in operation and (to a large extent) limitations imposed by dump protection (discussions with WP14 ongoing)
  - Assumes implementation (baseline) of MS@Q10 in point 1 and 5
  - Study versions have been also developed for alternative layouts not including MSQ10 but so far no acceptable solution (i.e. with acceptable DA with beam-beam) has been found (R. De Maria @ Madrid Meeting 15/11/2017)

Q5 in point 6

- Q5 in point 6 is a MQY magnet:
  - Nominal/Ultimate gradient 160/172 T/m @4.5 K
  - HL-LHC Baseline: upgrade to 1.9 K ➔ 200 T/m

Max. gradient B1/B2	7 TeV (no OP margin)		7.5 TeV (no OP margin)	
	Round	Flat	Round	Flat
Q5.L6 [T/m]	162-163	167-175	174-175	179-188
Q5.R6 [T/m]	159-164	165-170	170-176	177-182

  - The above ranges include:
    - optics configurations with and w/o MS@Q10 (see R. De Maria – HL-LHC Annual meeting 2017)
    - optics configurations studied for LHC (see S. Fartoukh @ Chamonix 2018)

Tests

- Possibility to test the magnet at higher gradient @4.5 K mentioned during the 2nd HL-TCC on 11/02/2015
  - Abandoned so far (3rd HL-TCC on 25/2/2015)

- Reduction of the required gradients obtained (see Chamonix 2017) but need for upgrade at 1.9 K remains unless higher gradients are considered achievable at 4.5 K.

- We should re-consider the possibility of tests to approach 4 kA given also the interest for Run 3 MDs (and operation ?) @ 7 TeV (see S. Fartoukh @ Chamonix 2018).

Further potential developments

- Studies are ongoing to:
  - Evaluate the impact of a possible reduction of the aperture settings of TCTVs in collaboration with WP5
  - Refine, cross-check the compatibility with (and possibly revise) the dump protection requirements (in particular TCDQ minimum opening, tolerances and movement at high energy) in collaboration with WP14.
  - Identify solutions to avoid installation of MSQ10 (solution found so far not satisfactory)

to further define the operational range for these magnets