High Luminosity LHC

US-LARP (and recent) meetings Highlights / Issues

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The HiLumi LHC Design Study is included in the High Luminosity LHC project and is partly funded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 284404.

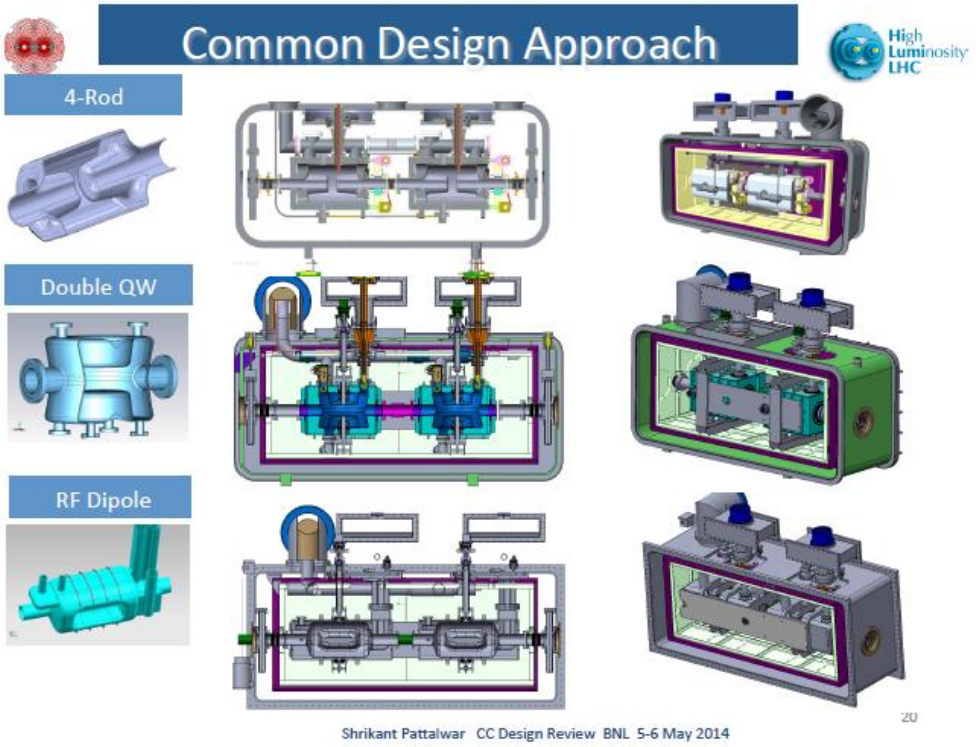
- US-LARP Collaboration meeting (7-9 May) preceded by Crab-Cavity and Magnet specific workshops
- Extended Steering committee meeting (27/5)

US-LARP: WP2

- Progress with:
  - Beam-Beam
  - Impedance
  - Layout
  - Tracking

- Many thanks for the excellent contributions and work!
- Mostly covered and reported here already

Crab cavities



- All prototypes reached the required voltage (3.4 MV/cavity)
- Main issues with ancillary equipment

A. Ratti

Crab cavities

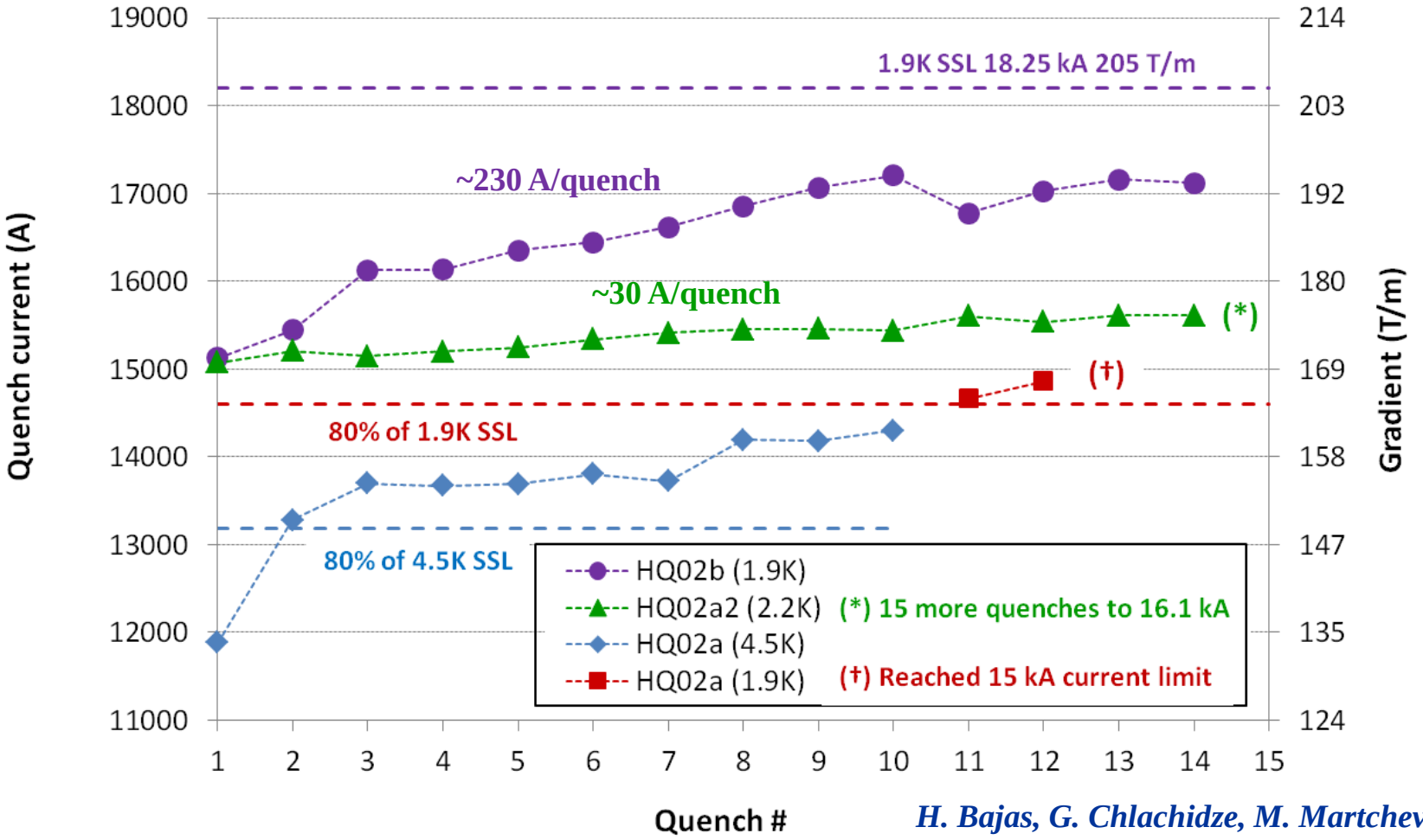
- Down-selection of the crab cavity designs:
  - Plan-A: BNL Double Quarter wave cavity design.
  - Plan B: RF Dipole resonator from Old Dominion University (ODU)
  - The 4-Rod cavity design will not be pursued.
  - More focus for the preparation of the SPS test
- Should be able to have 4 full cryostated cavities in time for the SPS test (2 BNL type and 2 ODU types) or at least get two fully dressed and cryostated cavities.
- Further safety net: BNL cavity design with coaxial HOM dampers and the ODU cavity design with wave guide damper.

Triplets

- HQ02b (short quadrupole with 120 mm diameter aperture) has reached 90% of the ultimate current with very good memory, memory that was kept from the end of the testing in the US to the continuation of the tests in CERN. The peak field reached by this quadrupole exceeded 13 T

HQ02b Quench Performance

Significant improvement of training rate above 15 kA, reaching 95% of 1.9K SSL



H. Bajas, G. Chlachidze, M. Martchevsky, F.Borgnolutti, D. Cheng, H. Felice, et al.

Halo monitoring and control

- Halo Monitoring/Control: Possible techniques for halo control by noise excitation via a quadrupole or the damper are being studied and will be tested in MDs during Run II.
- A conceptual design of an hollow electron lens for halo control has been recently completed at FNAL. The design of an halo monitor will be pursued with help from SLAC.

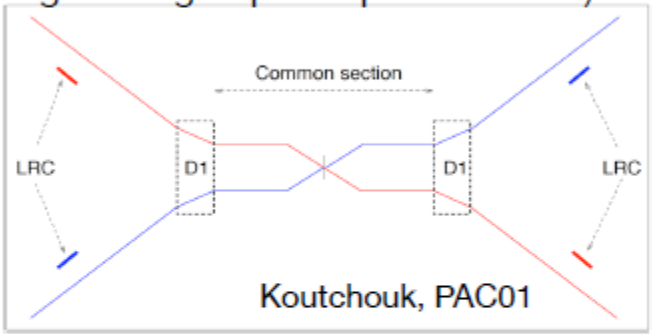
Beam-beam compensation

- Beam-Beam compensation: Beam dynamics studies for the implementation of a Beam-Beam Long Range (BBLR) compensator in LHC (as a test-bed) and HL-LHC are ongoing at FNAL and being ramped-up at CERN.
- The potential use of an electron beam for BBLR compensation is also being considered.

Beam-Beam compensation

Long-range beam-beam compensation is essential for HL-LHC Plan B

- HL-LHC Plan B:
  - flat optics at collisions: (10, 50) cm β^* ⇒ no IP1/5 compensation
  - no crab cavities required (crab crossing/kissing improve performance)
  - **a long-range beam-beam compensation scheme is needed** to achieve luminosity



- Wire compensators at 10σ to be tested after LS1: technically challenging (378 A required) and a risk for collimation and machine protection
- **Electron lenses for long-range beam-beam compensation are a safer, less demanding alternative, with pulsing option**
  - (21 A) x (3 m) required for HL-LHC, any transverse shape

[Valishev and Stancari, arXiv:1312.1660]

Points raised and for follow-up

- TAS dimension: radius of 54 mm in the baseline provided no arguments against. Need to investigate:
  - Motivations if any from the experiment protection side ➔ WP8. Not specified yet.
  - Aperture at injection and potential limit on minimum β^* (S. Fartoukh) to be addressed
  - Energy deposition impact ➔ Already discussed with ➔ WP10 (part of the review of the new layout)

Points raised and for follow-up

- Beam-beam:
  - Important now to quantify PACMAN effects and their impact
  - Influence of the magnetic errors and in particular contribution of the individual multipole to help steering magnetic field quality together with tracking studies without beam-beam
  - Develop and further benchmark luminosity/intensity evolution to provide additional criteria/checks in addition to DA
  - Strong-strong simulations to guide in the estimation of stability in the presence of damper, noise, crab cavities

Points raised and follow-up

- Interplay between beam-beam and impedance
  - This remains an open point even for LHC
  - Relying on β^* levelling: what are the implications on orbit control
  - From which value of β^* we need to be in collision?
  - Impact of crab cavities on beam stability is an issue

Points raised and follow-up

- Wire compensators:
  - LHC test set-up: number of wires and observables
  - HL-LHC scenario:
    - Can we run without alternating crossing (avoid poorly used correctors, favour energy deposition with vertical crossing)
- Indications (hope) that the experiments could stand higher pile-up and we could level at 7.5×10^{34} cm^{-2} s^{-1}. What are the implications on beam dynamics?

Steering Committee (27/5)

- Milestone reports:
  - Preliminary estimates of intensity limitations
  - Preliminary estimates of beam-beam effects
- Delivered and only minor comments received and being implemented.
- Very good and detailed snapshot of the studies
- For the moment old nominal parameters used but for the deliverable reports we should use those defined after RLIUP (Deliverable report 1.3 to be approved and published in the PLC parameters page)

Milestones and Deliverables due up to M36 (31.10.2014)

WP2 Deliverables

Report no.	Title	Due date	Status
D2.2	Magnet field quality specifications	M36	
D2.3	Corrector magnet specifications	M36	
D2.4	Beam intensity limitations	M36	
D2.5	Beam-beam effects	M36	
D2.6	Specification of machine and beam parameters	M36	

- Hi-Lumi Annual meeting (17-21/11)
- Need to advance some of the deliverable reports if ready earlier. Should we aim for DRAFTs by 15/10 or earlier if possible?

- Preliminary design report to start
  - Started to work on that by preparing templates paragraphs (ongoing)