



HiLumi-LHC/LARP Crab Cavity System External Review

BNL, May 5th - 6th 2014

Charges

The use of Crab Cavities (CC) in the high Luminosity Insertion Regions of LHC (ATLAS & CMS) is the baseline of the HL-LHC project. The cavities, originally intended mainly for the correction of the geometrical factor, i.e. to enable accumulating an integrated luminosity of 3000 fb^{-1} over a decade after HL-LHC commissioning, have recently become an important tool to reduce the pile up density, thus improving the quality of data taking by the experiment. Installation of CC is planned during Long Shutdown 3 (LS3), scheduled for beginning 2023 till half 2025.

CC developers have converged on three models of CC, commonly referred to as 4-Rods, Double Quarter Wave (DQW) and RF Dipole (RFD). In order to maximize the chances of success for the final application in LHC, testing of all three models is planned at this time.

In view of the lack of experience of CC performance in hadron machines, a beam test of CCs is planned at the SPS before LS2 (August 2018-end 2019) where one or more Cryomodules and as many different types of CC as possible will be installed in the SPS beam and tested for performance. A down-selection in the cavities considered for the LHC application is planned to happen after the SPS test based on agreed-upon criteria and relevant tests, unless experimental evidence suggests it can be advanced.

Plans call for a freeze of the CC design by April 2014, with Cryomodule design frozen by 2015, CM and CC production and assembly completed by 2016 for an initial CM test before installation in the SPS in the LHC extended year end technical stop (EYETS) of early 2017.

This review is charged to report on the maturity of the technical status for the CC system for operation on LHC beams, the reliability and expected efficiency of the management plans required for a successful SPS test by 2017-early 2018 and the maturity of the development of down-selection criteria.

The management would appreciate a presentation with the main comments and recommendations at the LARP Collaboration meeting taking place at Brookhaven National Laboratory on May 7th-9th, 2014.

Specific charges for Crab Cavities and Cryomodule systems are listed below.

Crab Cavities Review Goals

- 1) Review - for completeness - the CC Functional Specifications and assess the compliance of the various developed prototypes to the specifications.
- 2) Review the status of the three cavities including VTS test results.
- 3) Review implemented solutions for CC peripherals such as choices of materials for the He vessel, fast and slow tuning systems, power coupler, HOM couplers, etc. Review the status of the design of these cavity components. Assess these solutions and identify their risk in comparison to other systems presently in operations elsewhere in the world capable of providing useful information.
- 4) Where solutions are still under development, assess the plans and likelihood of convergence on the timescales delineated above.
- 5) Assess the proponents understanding of different operating conditions between the SPS test and the LHC application in view of beam loading, dynamic quench development, etc. highlighting the relevance of the SPS results toward the LHC application
- 6) If available, endorse or criticize appropriately the CC frozen design of April 2014.
- 7) Provide appropriate criticism and feedback to the down-selection criteria developed by the CC proponents and presented at this Review.

Cryomodule Review Goals

- 1) Review - for completeness - the CM Functional Specifications.
- 2) Review the CM design options.
- 3) Review possible limitations of the CM design caused by environmental constraints of the SPS tunnel.
- 4) Assess the feasibility for the development of a “Common Cryomodule” for the 3 types of cavities. Assess the solutions presented and identify their risk in comparison to other systems presently in operations elsewhere in the world capable of providing useful information.
- 5) Where solutions are still under development, assess the plans and likelihood of convergence on the timescales delineated above in view also of available resources.
- 6) Comment on the proposed timescale for assembled cryomodules by 2016. Based on historical experience of similar system, identify weaknesses – if any – in the proposed CM development plans.
- 7) Review the general plans and criteria for cryomodule development past the SPS application and into the HL-LHC period (post-2024) highlighting, when possible, simple and effective solutions for interfacing between the CC Cryomodule and the LHC cryogenic system.