



Plans towards CC in the LHC

a US – centric perspective

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LBL





Outline

- Where we are....
 - ...and where we think we are going
- SPS test considerations
- Reaching the LHC baseline
- Organization
- US (LARP++) role and planned contribution



Global Collaboration

- Active collaboration with the UK and CERN
 - Cryomodule concepts
 - Engineering analysis
 - System integration
 - Ideas and experience exchange
- Tremendous amount of skills and knowledge among collaborators
 - Best chance to develop an excellent CC system



SPS vs. LHC



- SPS
 - 3-4 year focus
 - Downselected many objectives
 - Streamlined goals to simplify systems and provide more fundamental answers
 - I.e. Does crabbing work with proton beams?
 - We don't need active alignment to verify this
 - Not testing in the LHC
- LHC implementation will need SPS results + much more



Roles within LARP

- EM modeling of all systems – SLAC
- Cavity Design – BNL and ODU
- Cryostat design and integration – FNAL

- Close collaboration with CERN and the UK teams
 - Plan to get even closer, through weekly meetings and other integration events

Niowave built all PoP systems and is funded to build prototype hardware through the DOE SBIR program

- Proposing an industrialization plan for a team discussion tomorrow



Collaborative events

Besides dedicated breakouts at all collaboration meetings and other LARP or HL-LHC events

- Dec 12 – Planning meeting at FNAL
- May 13 – Cryomodule Integration at FNAL
<https://indico.fnal.gov/conferenceDisplay.py?confId=6859>
- Jul-Aug 13 – CM Conceptual Design at CERN
<https://indico.cern.ch/conferenceDisplay.py?confId=263565>



Upcoming events

- DoE review of LARP – Feb 14
- Design freeze – Mar. 2014
 - Release cavity models to Niowave
- Technical Advisory Panel - Apr. 14
 - Possibility to combine with CM23 LARP HL-LUMI collaboration meeting in May 7-9



Ongoing work - 2014

- LARP plans to complete one fully dressed prototype cavity of each LARP design (DQW and RFD) by the end of September
 - Deliver complete 3D model to Niowave by March
 - Niowave generates production drawings and builds cavities by September
- Testing later in the year Vertical Test Stands in the US
- Sending existing proof of principle cavities to CERN for testing in SM18



Ongoing work – Future years

- After VT measurement results prepare deliverable for SPS test
- Cyomodule and cavity integration
 - Power couplers desired by early 2016
 - And no later than summer 2016
- Test in SM18
- Installation and run in SPS



What will go in the SPS?

- Establishing selection criteria soon
 - Define what is required and what is important
- Provocative comment for cavity selection

Any cryomodule to meet requirements and pass SM18 Horizontal test in 2016 has a great chance to be installed in the SPS

- Ultimately it is a CERN decision



What we need from CERN



- Extended specifications and requirements or clarifications
- Parts and materials
 - Coated flanges, raw materials (steel, possibly Nb...)
 - Possible procurement of cavities or cryostats to overcome limits in funding
 - Survey interfaces
- Equipment
 - Power couplers
 - May need help with 400 MHz hardware for US test stand
 - Amplifiers, LLRF
- Documentation framework
 - Safety 'folder' + its management
 - Documentation repository



What we need from CERN (cont.)



- Engineering
 - Mechanical (Thermal+Stress+Sensitivity) analysis of all cavities and cryomodules
 - Pressure Vessel Safety + beyond
- SM18 tests of PoP cavities and Horizontal Tests of cryomodules
- Magnetic field measurements of SPS PT4 area
- Plus, of course, integration, RF power, Cryo, MPS, Instrumentation....



SPS plans - comments

- LARP remains committed to supporting this activity.
 - Managing yearly budget and work plan to maximize US contribution in light of ever changing funding allocations.
 - For now, “Flat is the new Up” 😞
- Revised schedule adds flexibility
 - If LS2 starts after the 2018 run testing in the SPS more than one cryomodule would be more feasible.



LARP Plans for SPS Test

- Working with CERN and UK to integrate our efforts
- LARP plans to participate in the tests by delivering hardware
 - And contribute to integration and installation
- Direct participation in MDs once the system is installed



LARP

Open questions towards the LHC



- Implement active alignment - OK
- Cryomodule configuration
 - N of cavities per CM?
 - 2x4 vs 1x8 vs....
- Cavity design (H vs V)
 - is the ability to kick in both planes a requirement for any cavity?
- What is the *final* operating gradient/kick per cavity? Final aperture?
- Impedance budget
 - > what is the acceptable n of cavities, HOM damping requirements...
- Field quality requirement?
- Crab in both planes at both IPs? (ie. kissing)
- Magnetic shielding?
-and more....

We will need to finalize all of the above (and more) before deriving a baseline design of the cryomodule for the HL-LHC....in TDR in 2016?

Mismatch with timing of SPS test results



US Scope of work - Today



- LARP R&D
 - Deliver one cryomodule for testing in the SPS
 - 2 cavities, He vessels, tuners, HOM mode dampers
 - RF power couplers, RF power, Cryogenics, local installation provided by CERN
- US Construction project
 - Deliver N cryomodules with M cavities each
 - Contain cavities, He vessels, tuners, HOM mode dampers
 - Cryogenics, RF power, local installation provided by CERN
- Until a formal baseline is established and agreed by the sponsoring agency, changes in yearly funding could impact these plans
 - Probably similar for other participants (ie. UK)
 - CERN is involved in the process



US Construction Project

- Crab cavities are included among the tasks selected in December 2012 as part of the construction project in support of the HL-LHC.
- Feedback from DOE reminds that the effort on crab cavities should be carried through construction.
 - Should not limit US contribution to the SPS test
- Working with the collaboration to define the best possible contribution.
 - Need clear deliverables by ~2016-2017 if the project baseline is defined then



Conclusions



- US remains committed to contributing to the CC project in all phases all the way through the installation and commissioning in the HL-LHC
- Working with the active, global collaboration
- LARP Crab Cavities R&D well underway
 - Starting prototype production soon
 - SPS test contributions in the plans for yearly LARP activities
- US Construction project to include a significant contribution to the Crab Cavities
 - Baseline scope and cost still in preparation



Questions?

