LARP: Status and Prospects

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Feb 17th, 2014

Summary

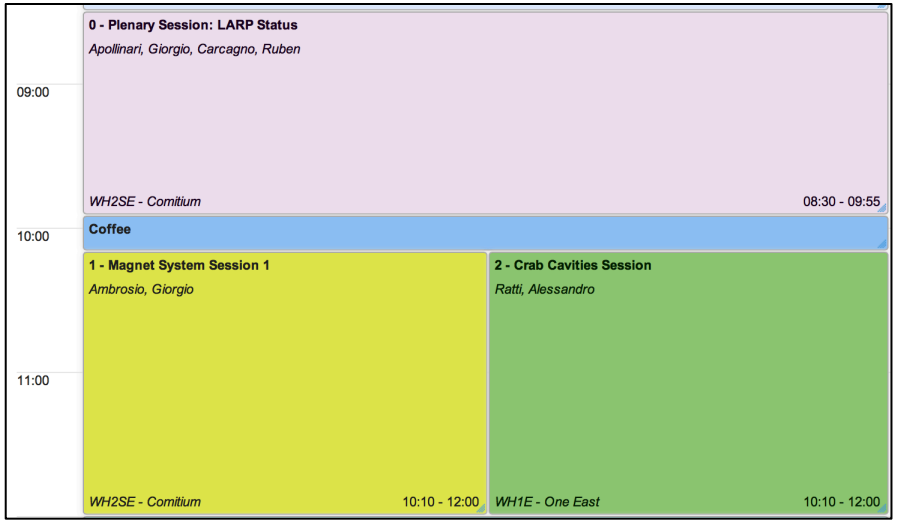
- Introduction
- From R&D to Risk Reduction Program
- LARP Achievements and 4-year Plans
- Funding
- Technical Initiatives & Toohig Fellowship Evolution
- Conclusions

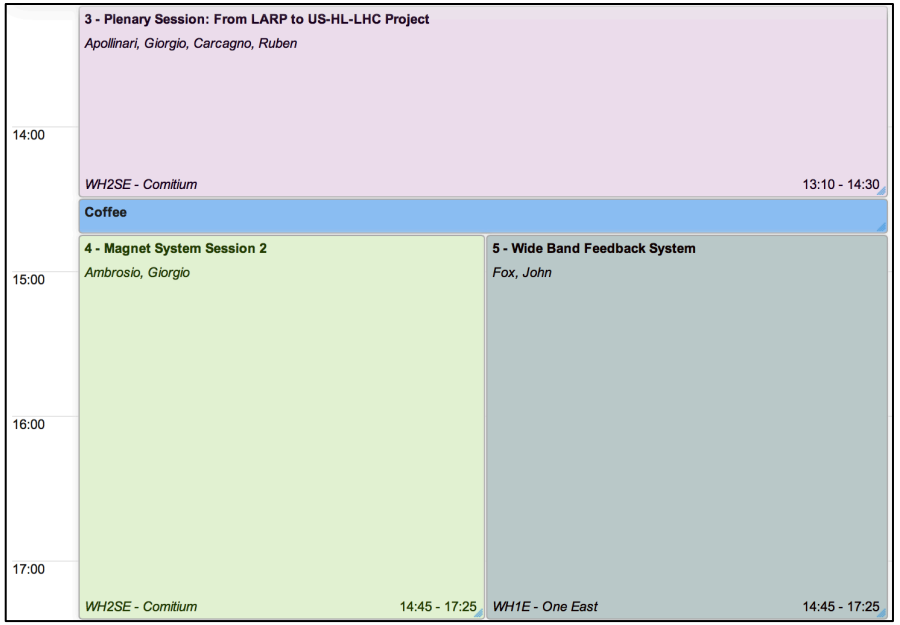
Review Organization/Charges

- Plenary sessions during early morning and early afternoon to present status/plans for LARP and plans for Project transition
- 3 parallel sessions focusing on Magnets (morning and afternoon), Crab Cavities and Wide Band Feedback System.
- Q&A (if needed) tomorrow
- Charges:

- Goals and management plans of the new LARP director;
- The effectiveness in strategic planning, development of appropriate core competencies, implementing a prioritized and optimized program for potential participating in future accelerator upgrades at the LHC at CERN; specifically, are these LARP activities well aligned with the present and anticipated LHC schedule;
- The quality and significance of the LARP scientific and technical accomplishments, and the merit, feasibility and impact of its planned development program;
- Will these accomplishments lead to mature technical readiness for the DOE CD-n sequence? What will be the demonstration of these goals? and;
- The effectiveness and appropriateness of the laboratory interactions to maximize the leveraging of existing infrastructure and expertise available at those laboratories.

Review Timeblock





LARP History and Transformation

- The US LHC Accelerator Research Program (LARP) was formed in 2003 to coordinate US R&D related to the LHC accelerator and injector chain at Fermilab, Brookhaven, and Berkeley
  - SLAC joined shortly thereafter
  - Has also had some involvement with Jefferson Lab, Old Dominion University and UT Austin
- LARP has contributed to the initial operation of the LHC, but much of the program is focused on future upgrades
  - Increase Luminosity
  - Beam Handling/Monitoring
- The program is currently funded at a level of about $12-13M/year, divided among.
  - Magnet research (~half of program)
  - Accelerator research (Crab cavities, WBFS, Collimators, e-hollow lens,..)
  - Programmatic activities, including support for personnel at CERN & Toohig Fellowship
- FY13-FY14 Evolution
  - Initial convergences on deliverables for HL-LHC
  - Program to be handled like a "project" to Reduce Risk of US Contributions to HL-LHC Project

US in-kind Contribution to HL-LHC: a preliminary look

- Various Candidates:
  - 150 mm aperture Nb_3Sn quadrupoles
  - Crab Cavities
  - High Bandwidth Feedback System
  - Collimation and hallow e-beams
  - 11 T Nb_3Sn dipoles
  - Large Aperture NbTi D2 separator magnets
- Process of convergence among CERN-DO '20
- Ini
- "Elephant-in-the-Room" effect
  - Hollow electron beams for halo removal

Possibly 75% of US Contribution to HL-LHC

1. Committed to a major stake in Nb_3Sn quads
2. Crab cavities up to the SPS test and beyond to production
3. High bandwidth feedback was seen as a high impact contribution for modest resources.

Dear Prof. Siegrist,

Following recent discussions, CERN is assuming that the total US contribution to the Hi-Lumi project is of the order of US$200 million (construction project, excluding the R&D carried out within the LARP program that is due to continue for another 3-4 years in order to finish the R&D on the hardware and to continue the support for the important activities of accelerator physics and the long term visitor program).

The principle item of this contribution would be the Nb3Sn low-beta triplet. We understand that a preliminary evaluation of the quadrupoles (with 150 mm aperture) based on a joint study by LARP and CERN amounts to about 75% of the total US contribution, or US$150 million, for half of the magnets (i.e. 10 cold mass quadrupoles, without cryostat, with no integration nor installation). This proposal (half USA and half CERN) is the preferred solution not only to stay inside budget but it also leverages the advanced US technology (LARP) and would allow CERN to fully master the technology for future maintenance and consolidation. Mutual agreement on this proposal can be discussed at a later date.

CERN proposes that the remaining 25%, or US $50 million, be used to support hardware contributions on the following items (either full or part system):

a. High bandwidth feed-back system for the SPS/Crab cavity with a cryo-module
b. 11 T dipole (cold mass no cryostat)/electron-lenses

The feed-back system is of course subject to the success of the final prototype, like the Nb3Sn quadrupoles. Its cost is rather modest compare to the other items, so this could possibly leave some margin for other significant and visible contributions. The other items are not yet fully defined and/or their actual installation in the HL-LHC machine is not yet approved pending development of a final design and validation test results. So our suggestion is to keep the above list as a prioritized list to be reviewed depending on the outcome of the tests.

CERN would also like to express its gratitude if the DoE would support the continuation of the design of the D2 magnet based on the extensive expertise of BNL.

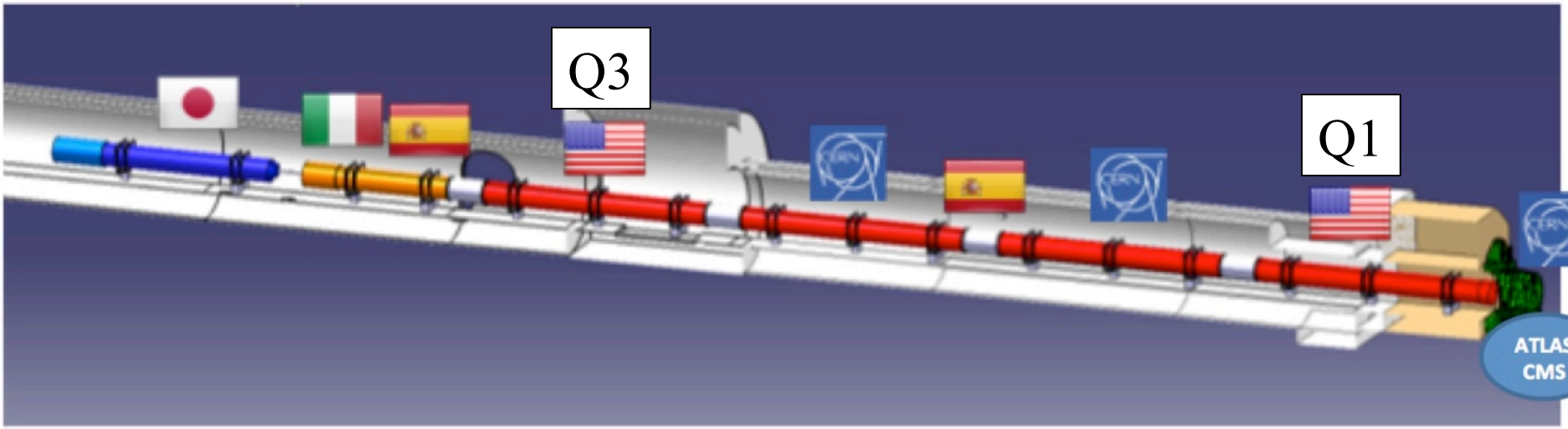
We remain at your disposal for any further information or clarifications.

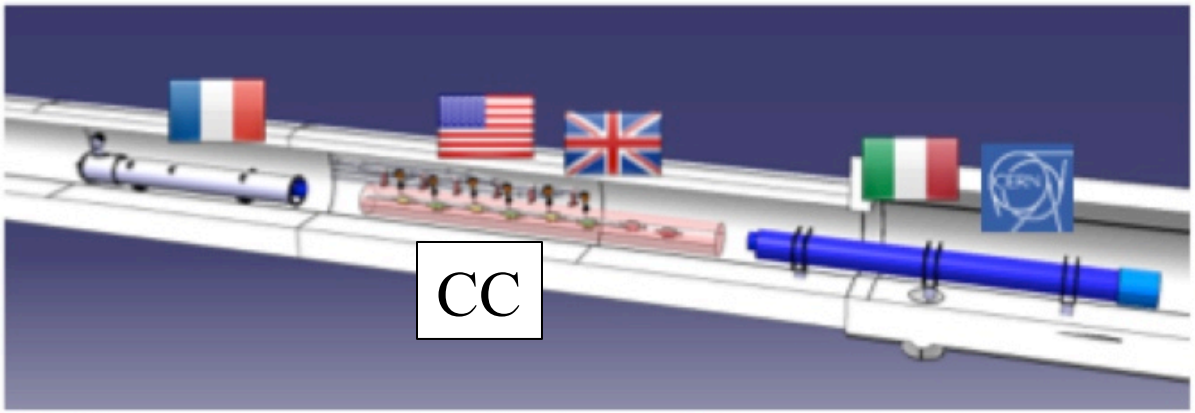
Yours sincerely,

Rolf Heuer
Director-General

Stephen Myers
Director of Accelerators and Technology

In-kind contribution and Collaboration for HW design and prototypes





CC : R&D, Design and in-kind **USA**

CC : R&D and Design **UK**

Q1-Q3 : R&D, Design, Prototypes and in-kind **USA**

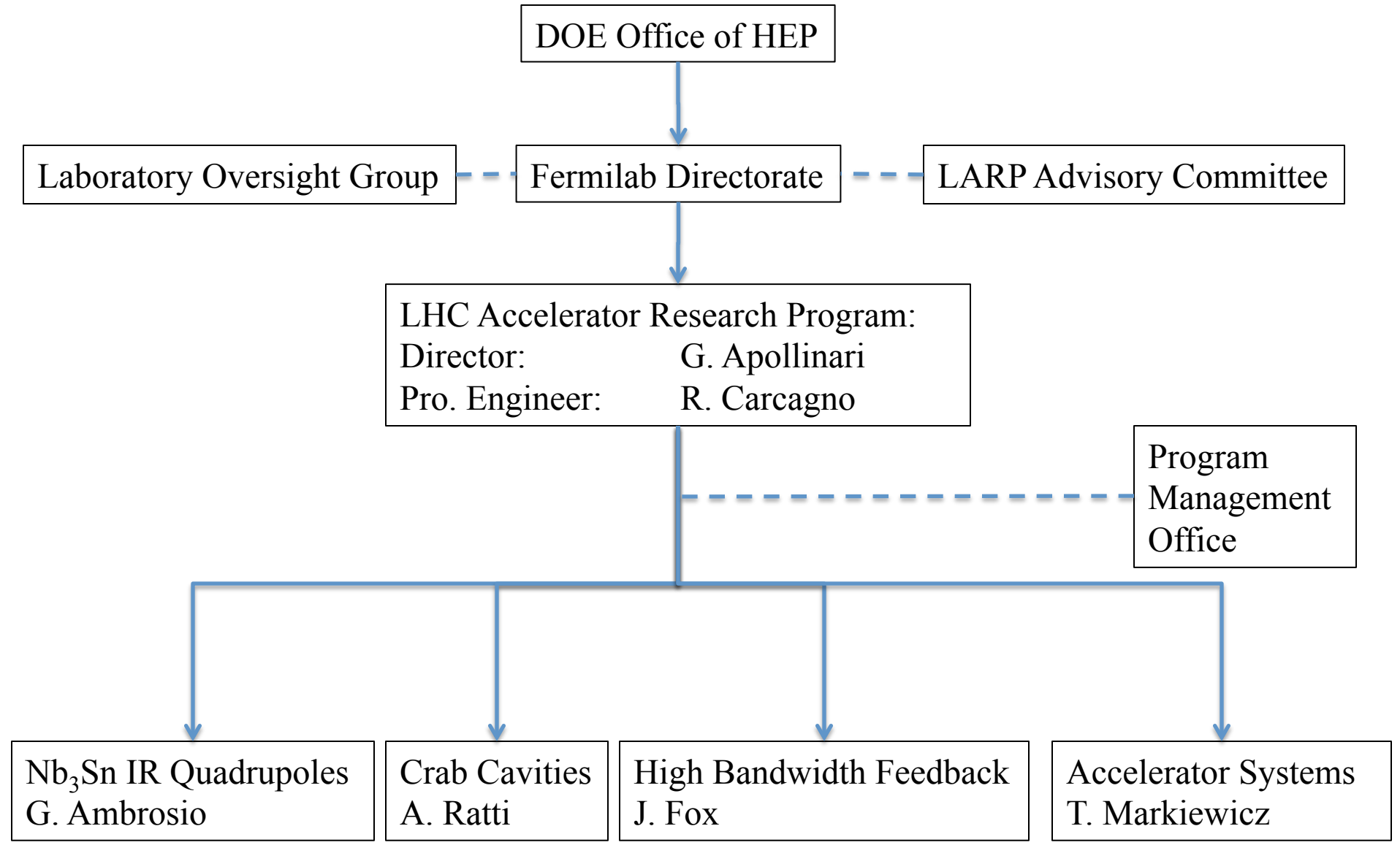
D1 : R&D, Design, Prototypes and in-kind **JP**

MCBX : Design and Prototype **ES**

HO Correctors: Design and Prototypes **IT**

Q4 : Design and Prototype **FR**

FY14-FY17 LARP Organization



Short Technical Status Report: Magnets

SQ Series: 19 coils, 11-12 T
SQ02: **54/61 MJR** J_c>1800
- 97% at 4.3/4.5 K
- 97% at 1.8 K

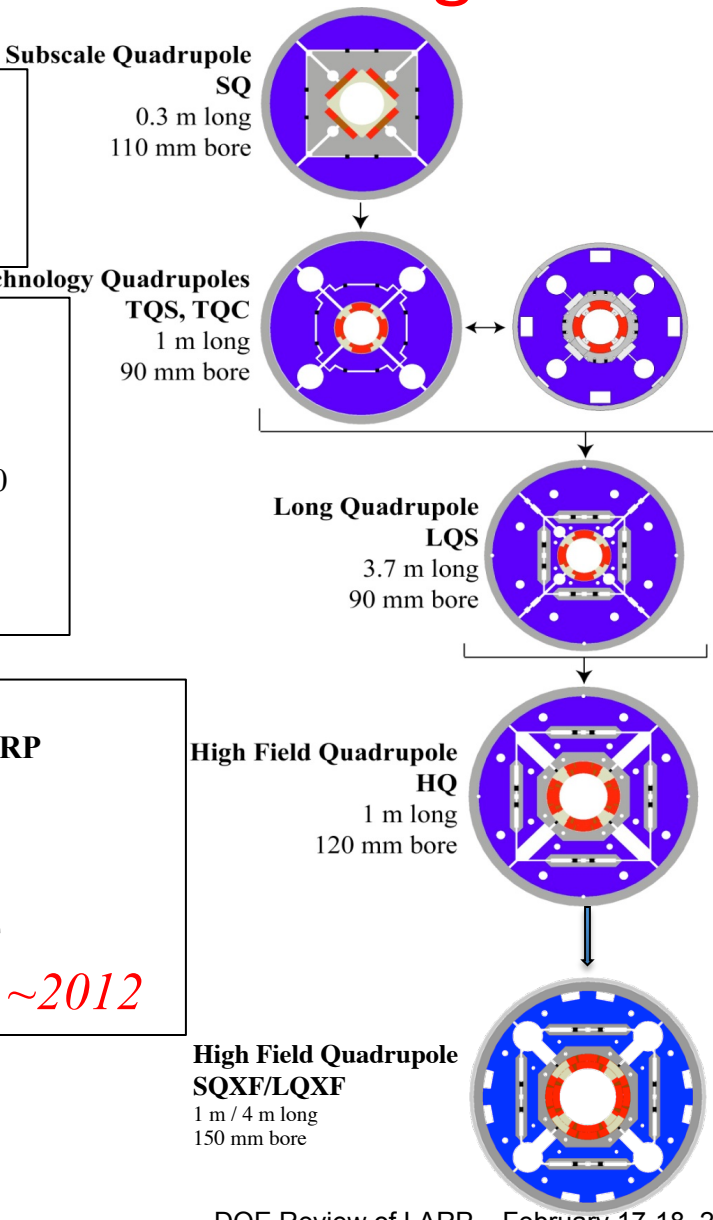
TQ Series: 33 coils, 12-13 T
TSQ02**: 54/61 RRP** J_c>2800
- 88% to 97% at 4.3
- "Erratic" @ 1.9 K

TQS03: **108/127 RRP** J_c>2800
- 93% at 4.3 K
- 93% at 1.9 K

HQ Series: 25 coils, 13-15 T
HQ01e: **54/61 and 108/127 RRP**
- 85% at 4.5 K
- No Increase at lower T

HQ02: **108/127 RRP** J_c>2800
- 98% at 4.5 K
- Not fully trained at lower T

LARP Focus until ~2012



LR Series: xx coils, ~12 T
LRS02: 54/61 RRP J_c>2700
- 96% at 4.5 K

LQ Series: 19 coils, ~12 T
LSQ01**: 54/61 RRP** J_c>2700
- 93% at 4.5 K
- Marginal Increase at lower T

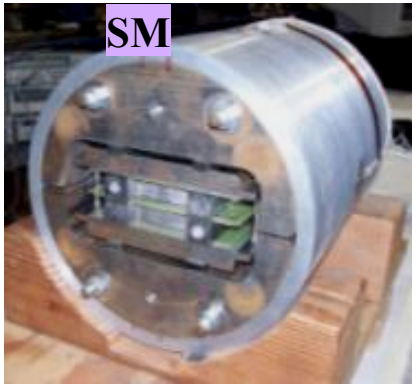
LQS03: **108/127 RRP** J_c>2800
- 91% at 4.6 K
- No increase at lower T

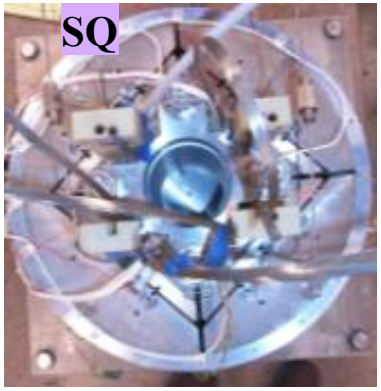
New IR quad Aperture (150 mm)

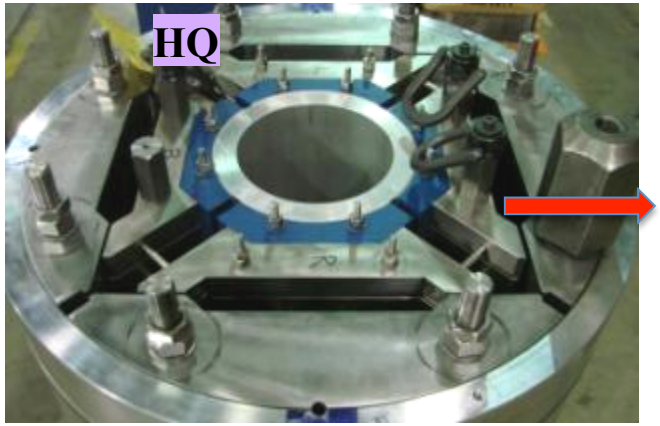
US SQXF Series: 13/18 Coils
- *2 or 3 1m long models*
- *2014-2016*

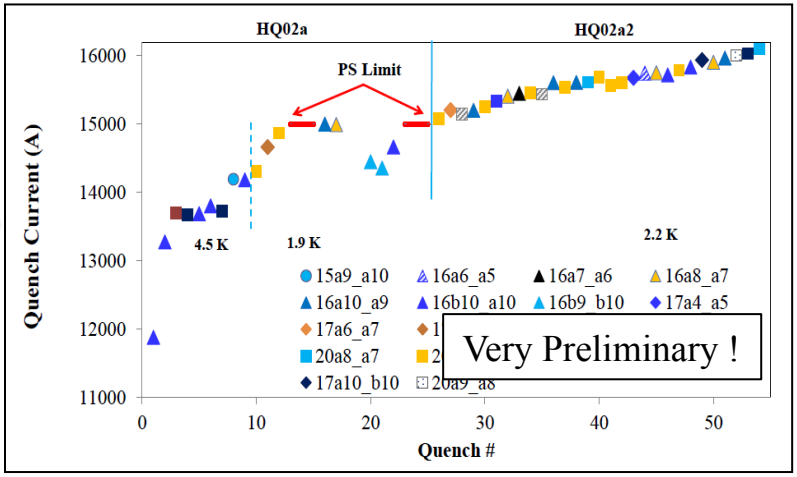
US LQXF Series: 18 Coils,
- *3 ~4.3 m Long Models*
- *2015-2017*

LARP Quadrupole Magnet Development



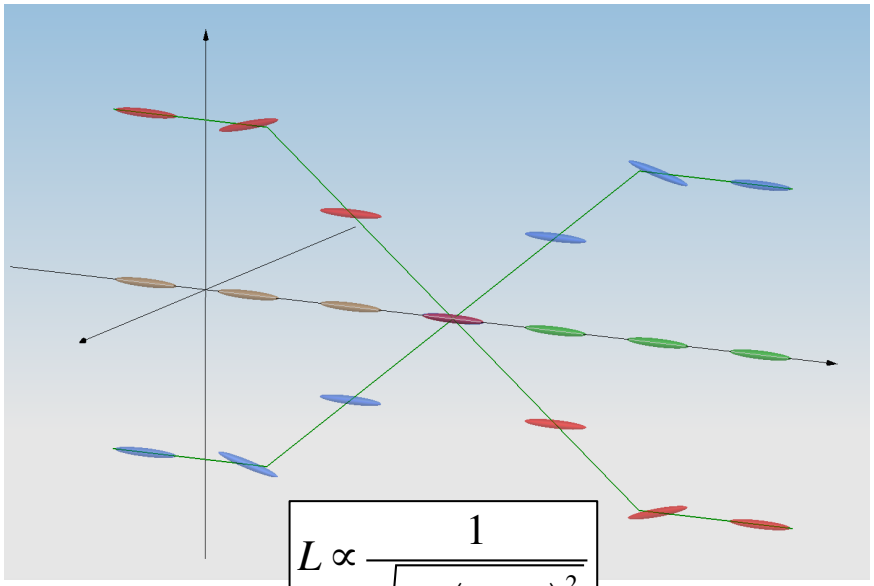






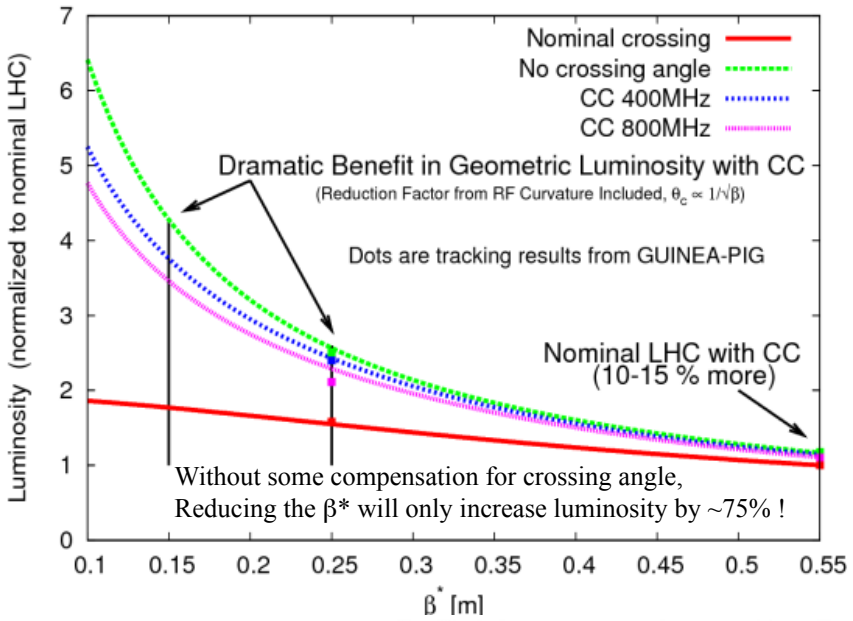
First (and only) ~4m long Nb_3Sn magnet in the world

Crab Cavities

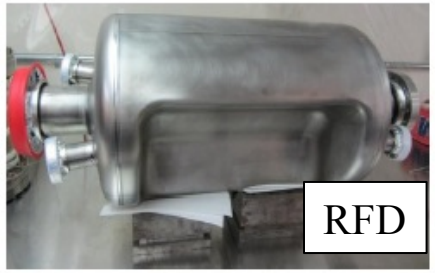


$$L \propto \frac{1}{\sqrt{1+\left(\frac{\theta_c \sigma_z}{2\sigma_x}\right)^2}}$$

"Piwinski Angle"



- Technical Challenges
  - Crab cavities have only *barely* been shown to work.
    - Never in hadron machines
  - LHC bunch length requires low frequency (400 MHz)
  - 19.4 cm beam separation needs "compact" (exotic) design
- Additional benefit
  - Crab cavities are an easy way to level luminosity!



UK LARP

Recent Developments

Conclusions & Outlooks (2/2)

- **Crab-cavities in specific configuration (CK scheme) remains the key**

- To reduce the peak PU line density at constant performance,

- Or to boost the perfo

- Or (in the worst case

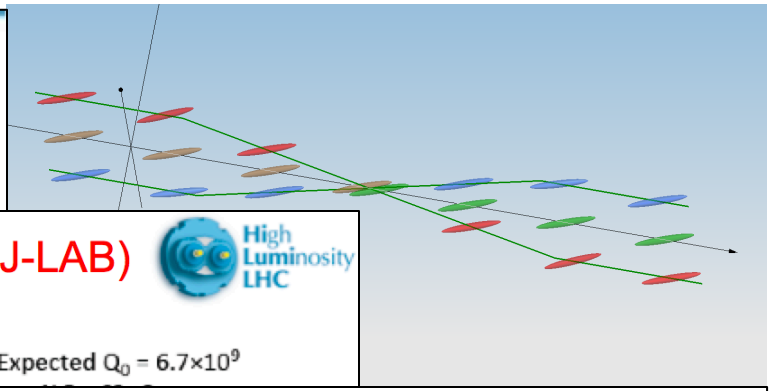
the performance loss a

HL-LHC baseline and backup (25 ns): 2
(BB wire .or. crab w/o

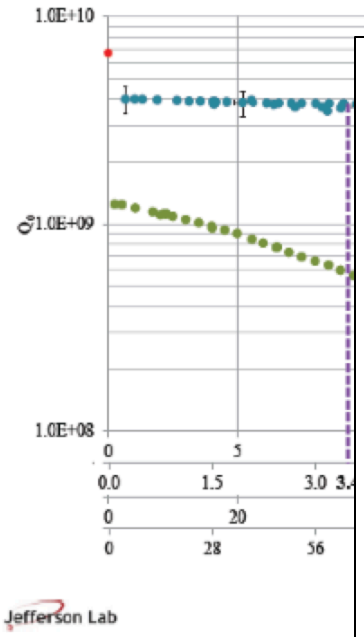
"HL-LHC+" (25ns): 250 fb^{-1}/y
(BB wire .and. crabs wit

"HL-LHC++" (25ns): 250 fb^{-1}/y
(BB wire .and. crabs with CK sc

LHC2012 (50 ns): 25 fb^{-1}/y

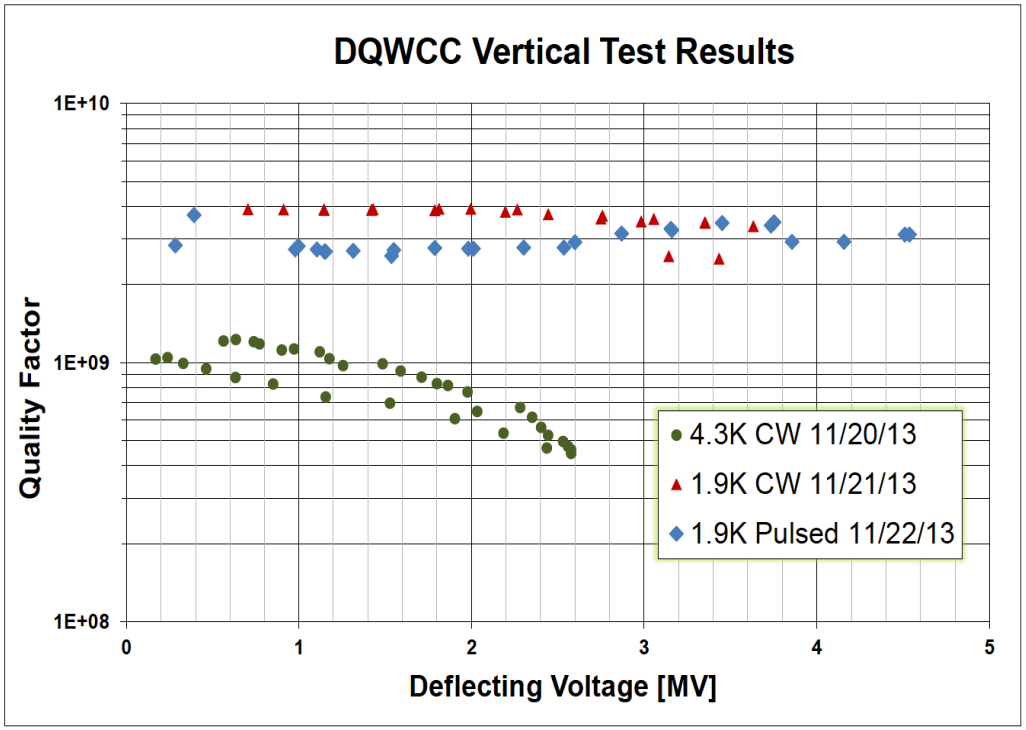


First test of RFD (ODU-SLAC at J-LAB)



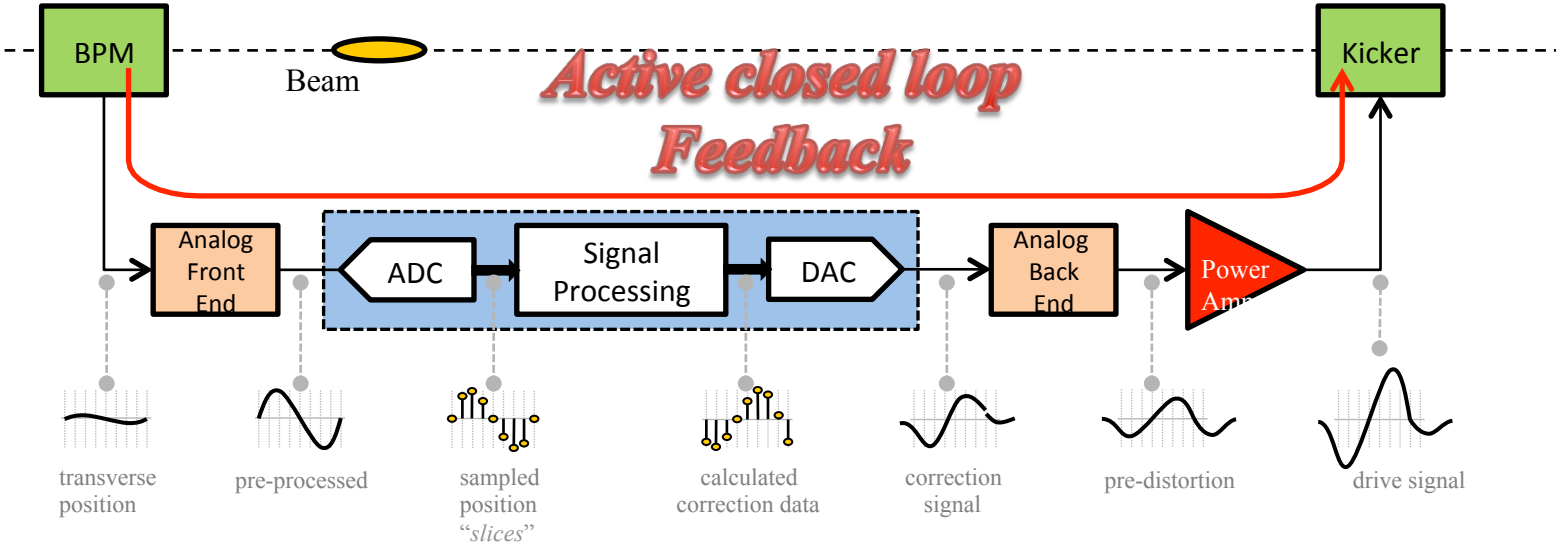
- Expected $Q_0 = 6.7\times10^9$

Jefferson Lab



High Bandwidth Feedback System

- The high bandwidth feedback system is a GHz bandwidth instability control system
  - Increases LHC luminosity via higher SPS currents
  - Improves LHC beam quality and allows SPS operational flexibility
  - Leverages US expertise
- Control of one SPS bunch demonstrated in 2013 validating basic system architecture
- Aiming for a deliverable (with LARP or pre-project funding) of an SPS full-function instability control processing system hardware, firmware and diagnostic for use at SPS post LS2.
  - CERN to contribute beam-line components (kickers, cable plant, etc.) and machine measurement program.
- Technology applicable to LHC providing beam diagnostic as part of control



From R&D to Risk Reduction: Strategic Plan for LARP

- Magnets Goals
  - US has leadership on Nb_3Sn Acc. Magnet Development
  - Maintain leadership by relying on LARP to provide complete model and prototype development for new 150 mm QXF Magnets
  - Goals:
    - 2 Short QXF Models
    - 3 Long QXF Prototype and Pre-Production Magnets
    - 2 Single Coil Tests (1 Short and 1 Long)
    - Technology Transfer to CERN
- CC Goals
  - Collaborate with HL-LHC members (CERN, UK) to install hardware and test CC System in SPS by FY17
  - Goal:
    - Provide Hardware and Manpower for CC SPS Test
- WBFS Goals
  - Collaborate with C
  - Goal:
    - Provide Hardwa

- A Program (such as LARP) can only support "Goals" and not "Deliverables"
- *Scope* Discussion & Negotiation is & will be important parts of CERN/LARP interactions

FY14 LARP Funding

- In June '13 the LARP Collaboration prepared plans for FY14 under a guidance of ~13.5 M$ *excluding GARD contributions (2 M$)*. The expected FY14 funding was ~15.5 M$.
  - GARD=General Accelerator R&D, program in US Labs and Universities covering basic Accelerator R&D, a.k.a. "Core Program".

Subject: Funding information

Feb 11th, 2013

We have a goal to increase the funding for both the LARP program and the MAP program in FY 2014 and FY 2015. We would like to grow each program with a goal of a $2 million increase per year in each year. It has become clear to us that these programs cannot achieve their goals without higher funding. LARP is now charged to carry out R&D to reduce the technical risk of an eventual U.S. contribution to the LHC accelerator upgrade, and MAP is charged to answer questions on the technical feasibility of building a muon collider. Any anticipated growth in the U.S. HEP program is currently directed towards new projects, such as LBNE, Mu2e, and LSST now, so we are looking to redirect effort out of the HEP General Accelerator R&D category by up to $4 million in FY 2014 and an additional $4 million in FY 2015 and correspondingly increase effort in LARP and MAP. As additional guidance, we do not wish to impact any efforts that support Project X at Fermilab.

- In July '13, DOE communicated that LARP IFP for FY14 would be 12.4 M$ *inclusive* of a 2M$ GARD contribution.

FY14 Funding Request (cont)

- Decisions:
  - Kept Magnet funding almost at request level
  - Reduced CC/WBFS funding by ~20%
    - *(Important)* Corollary: on CC, started to negotiate with CERN the delivery of 2 RFD and 2 DQW dressed (i.e. with He-Vessel) cavities for SPS test rather than 2 Cavities only (which would have implied a US unilateral down-selection) with a cryomodule (with possible resources conflict with LCLS-II). WBFS following on similar steps.
  - Cancelled Material Radiation tests at BNL, LTV program, etc..
- Since HEP FY14 budget allocation was above the FY14 IFP, we requests at least ~1 M$ to re-establish:
  - Material Radiation Test at BNL
  - Scope for Crab Cavities
  - Scope for WBFS
  - Anticipate Magnet Tooling Procurement
- In principle, FY15 funding should see an increase, over request, by an additional 2 M$ from the GARD Programs across the country (for a total of 4 M$).

LARP and US-HL-LHC Needs: June '13 Review

- In Jun '13, the LARP/US-HL-LHC Project underwent a LARP Internal Review that presented the following profile request for LARP continuation until 2017 and for US-HL-LHC Project
- CD-4 planned by end-FY22

LARP Funding Total ~ 62 M$

Project Funding Total ~205 M$

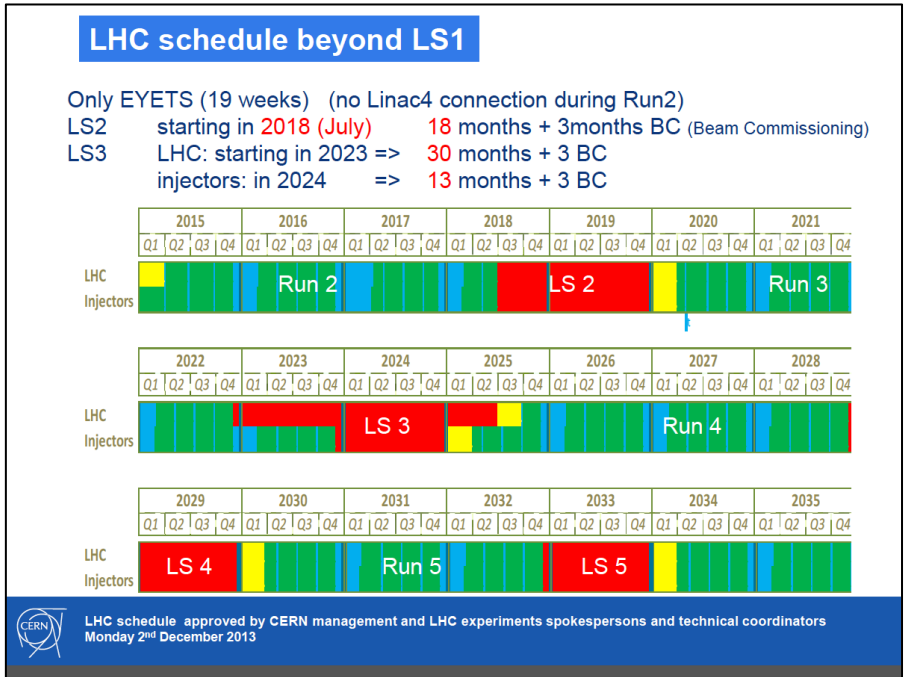
Totals w/Distributed Contingency	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	Total
Existing LARP Management	$900,000	$900,000	$900,000	$900,000	$900,000	$0	$0	$0	$0	$0	$4,500,000
IR Quad Prototypes	$5,428,000	$6,674,495	$10,787,491	$6,128,707	$2,092,806	$432,039	$0	$0	$0	$0	$31,543,537
Crab Cavity Prototype	$797,492	$1,200,000	$2,298,266	$187,697	$0	$0	$0	$0	$0	$0	$4,483,455
Feedback System Des/Dev	$1,317,124	$1,409,219	$1,772,012	$1,711,097	$0	$0	$0	$0	$0	$0	$6,209,452
Add'l Mgmt for Construction	$0	$302,287	$991,260	$1,300,231	$1,678,290	$2,075,913	$2,132,028	$2,189,578	$2,248,830	$2,152,449	$15,070,867
IR Quad Construction	$0	$0	$9,445,813	$18,642,867	$25,211,021	$29,682,904	$26,944,355	$19,340,937	$10,411,064	$1,043,069	$140,722,029
Crab Cavity Construction	$0	$0	$195,681	$3,386,538	$3,831,668	$15,353,475	$11,615,261	$8,190,661	$3,800,762	$2,342,882	$48,716,928
Feedback System Construction	$0	$0	$0	$0	$2,330,342	$2,536,272	$1,199,412	$0	$0	$0	$6,066,027
Totals	**$8,442,617**	**$10,486,001**	**$26,390,523**	**$32,257,136**	**$36,044,127**	**$50,080,604**	**$41,891,056**	**$29,721,175**	**$16,460,656**	**$5,538,400**	**$257,312,295**
US-LARP Budget											
LARP Budget for Projects	**$9,400,000**	**$9,400,000**	**$9,400,000**	**$9,400,000**	**$9,400,000**						**$47,000,000**
Other LARP Budget:											
-General Accelerator R&D											
-Toohig and Long Term Visitors											
-Programmatic Travel	**$3,000,000**	**$3,000,000**	**$3,000,000**	**$3,000,000**	**$3,000,000**						**0**
Total LARP Budget (Exist Program	**$12,400,000**	**$12,400,000**	**$12,400,000**	**$12,400,000**	**$12,400,000**						**0**
Pre-Project Funding Required	**$0**	**$1,086,001**	**$16,990,523**	**$22,857,136**	**$0**						**0**
Project Funding Required	**$0**	**$0**	**$0**	**$0**	**$26,644,127**						**9**
Total Funding Required	**$12,400,00**	**$13,486,00**	**$29,390,523**	**$35,257,136**	**$39,044,127**						**9**

- LARP request in FY14:
  - 13.5 M$ + 2 M$ (GARD) = 15.5 M$
- LARP/+ Pre-Project Request in FY15:
  - 29.4 M$ + 4 M$(GARD) = 33.4 M$

CERN Schedule Update

Since Jun '13:

- The CERN Schedule was updated, with LS2 in mid-CY18 to CY19, and the end of LS3 (QXF magnets and CC CryoM installed) by mid-CY25
- Opportunity – with CERN concurrence - to have CD-4 by end-FY23 and therefore CD-3 by FY18.
  - Not painless, negotiation with CERN not yet completed
- Timing Strategy:
  - Full LARP support in FY14-FY17
  - LLI Procurement funds in FY16 & FY17
  - US-HL-LHC CD0/CD1/CD2 (& CD3a) by late-FY17 (EVMS starts) as MIE Project
  - US-HL-LHC CD3b by early-FY18



Scenario # 1 – Funding as Requested

- Assume LARP funding in FY15-FY17 will increase to adequate (and constant) level of ~16 M$/y (or ~15.6 M/y if FY14 LARP budget can be increased by ~1 M$)
- Approach:
  - All effort are funded per-request

CC & WBFS SWF back in LARP.
No need of Pre-Project funds

REQUESTED LARP FUNDING FY15-FY17											
		FY14 Request	FY14 Actual	FY15 Request	FY15 Distribution	FY16 Request	FY16 Distribution	FY17 Request	FY17 Distribution	FY18 Request	FY18 Distribution
LARP Requests (Feb '13)	Magnets	7.5	7.3	10.1		8.3		5.9			
	CC	1.5	1.4	1.7		1.6		1.6			
	WBFS	1.5	1.2	1.9		1.9		1.9			
	Management/AS	3	2.5	3.1		3.1		3.1			
	HL-LHC Manag	0		0.3		1		1.3			
	Total	***13.5***	***12.4***	***17.1***	***16***	***15.9***	***16***	***13.8***	***16***		
					CD0		CD1		CD2		
						Total LARP Needed		**60.3**			
						Total LARP Funded		**60.4**		**SBIR (CC)**	**1.0**

All activities can deliver with healthy AS efforts.

Scenario # 2
Funding @ 90% of Request

- Assume LARP funding in FY15-FY17 will increase to level of ~14.1 M$/y (or ~13.8 M/y if FY14 LARP budget can be increased by ~1 M$) representing an overall 10% cut.
- Approach:
  - Preserve "HL-LHC Manag" effort for Project preparation
  - Preserve Magnet effort
  - Cut AS (totally in FY16-FY17) and CC/WBFS (by ~10-15%)

Magnet effort preserved

Moderate decrease of CC & WBFS funding (still above FY14 level, though)

Requested LARP Funding (FY14-FY17) - 10%

		FY14 Request	FY14 Actual	FY15 Request	FY15 Distribution	FY16 Request	FY16 Distribution	FY17 Request	FY17 Distribution	FY18 Request	FY18 Distribution
LARP Requests (Feb '13)	Magnets	7.5	7.3	10.1	8.2	8.3	8.0	5.9	6.2		
	CC	1.5	1.4	1.7	1.6	1.6	1.6	1.6	1.5		
	WBFS	1.5	1.2	1.9	1.6	1.9	1.7	1.9	1.6		
	Management/AS	3	2.5	3.1	2.3	3.1	1.4	3.1	1.4		
	HL-LHC Manag	0		0.3	0.3	1		1.3	1.3		
	Total	***13.5***	***12.4***	***17.1***	***14.0***	***15.9***	***14.0***	***13.8***	***14.0***		
					CD0		CD1		CD2		
						Total LARP Needed		60.3			
						Total LARP Funded		54.4		SBIR	1.0

HL-LHC Manag. Effort preserved.

AS effort cut substantially in FY15 and disappearing by FY16-FY17

Nightmare Scenario
Funding @ 80% of Request

- Assume LARP funding in FY15-FY17 will remain at FY14 IFP level, FLAT/FLAT
  - Extremely dangerous, inability for US to maintain capabilities to deliver on present agreement without un-avoidable transfer of risk to Project phase.
- (One Possible) Approach:
  - Preserve "HL-LHC Manag" effort for Project preparation

Magnet effort reduced by 5%

CC & WBFS efforts reduced by 30-35%

NIGHTMARE SCENARIO REQUESTED LARP FUNDING -20% (FY14 IFP FLAT/FLAT)

		FY14 Request	FY14 Actual	FY15 Request	FY15 Distribution	FY16 Request	FY16 Distribution	FY17 Request	FY17 Distribution	FY18 Request	FY18 Distribution
LARP Requests (Feb '13)	Magnets	7.5	7.3	10.1	7.4	8.3	7.8	5.9	7.6		
	CC	1.5	1.4	1.7	1.3	1.6	1.1	1.6	1		
	WBFS	1.5	1.2	1.9	1.3	1.9	1.1	1.9	1.1		
	Management/AS	3	2.5	3.1	2.1	3.1	1.4	3.1	1.4		
	HL-LHC Manag	0		0.3	0.3	1	1	1.3	1.3		
	Total	***13.5***	***12.4***	***17.1***	***12.4***	***15.9***	***12.4***	***13.8***	***12.4***		
					CD0		CD1		CD2		
						Total LARP Needed		**60.3**			
						Total LARP Funded		**49.6**		**SBIR(CC)**	**1.0**

AS eliminated in FY15-FY17

External Resources

- In addition to the direct DOE funding for LARP, the program relies on the following resources:
  - SBIR
    - An SBIR for 1 M$ was allocated by DOE to Niowave for the development and construction of hardware for the Crab Cavities activities.
    - We intend to invest this SBIR in the construction of 4 dressed cavities (two for each type of US design) in preparation for the SPS test.
  - CDP (Conductor Development Program)
    - CDP has traditionally invested part of its funds into the procurement of SC strand used by R&D programs such as LARP
    - Agreed upon 700k$ (FY14) and 500k$ (FY15). Would like to procure 500k$ of Nb_3Sn in FY16 as well.

Technical Initiatives within LARP

- Several *Management* Technical Initiatives took place in the last 6 months:
  - ✓ LIU-SPS HB Transverse Damping System Review
    - Called by CERN, provided release of engineering resources at CERN
  - ✓ Testing of QXF models in LARP
    - Technical Limitation in US to test 4 m long models
    - Internal Technical Review to entertain proposals
      - Decision leaning toward proceeding with BNL vertical stand improvement proposal for LARP phase, and FNAL horizontal cryostat setup for the Project Phase.
  - ✓ Workshop on SC Strand & Cable Specification for QXF Magnets
    - CERN-LARP Workshop resulting in first draft of Specifications usable by LARP Program.
  - CERN/LARP Review (with external reviewers) of Crab Cavities Project
    - Chair: A. Yamamoto
    - To be run as a satellite to the LARP/HL-LHC CM22 in BNL on May 5th-6th.
  - Workshops on Quench Protection and Coils Fabrication/Structure Design
    - CERN-LARP Workshop to be run as a satellite to the LARP/HL-LHC CM22 in BNL on May 5th-6th.
  - CERN/LARP Review (with external Reviewers) of QXF design
    - Later in CY2014

Technical Initiatives within LARP (cont)

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Number: **1311290 v.1.0**
EDMS Id: **1311290 v.1.0**
Released

LHC-PM-QA-517: Conceptual specification
I. BEJAR ALONSO, P. FESSIA

Note
2014-01-21

Summary | Sub-Documents | Approval & Comments | Used in | Access Rights | Versions & other info

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Description, External Reference and Keywords

Description	Template for Conceptual Specifications
External Reference	
Keywords	

Files of the Document

LHC-PM-QA-517.V04.21.01.2014 **docx** (975 Kb)

Sub-Documents

Associated URL (CDD Drawing Folder, Library...)

Context

What's next ?	Possibility to create a new version, or set document to List of Local Administrators for any questions regardin rights, lifecycle...)
Context	HL-LHC-WP: High Luminosity LHC Workpackages Conte
Release Procedure	Simple document release procedure
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EDMS Hyperlinks

This page https://edms.cern.ch/document/1311290/1.0

File(s) LHC-PM-QA-517.V04.21.01.2014.docx https://edms.cern.ch/file/1311290/1.0/LHC-PM-QA-517.V04

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.

Toohig Fellowship

- Named for Tim Toohig, one of the founders of Fermilab. Nursery of talent in Accelerator Technology.
- Open to recent PhD's in accelerator science or HEP.
- Successful candidates *used* to divide their time between CERN and one of the four host labs.
- Past
  - Helene Felice, LBNL, now staff
  - Rama Calaga, BNL, now CERN staff
  - Ricardo de Maria, BNL, now CERN Fellow
  - Themis Mastoridis, SLAC, Ass. Prof. at Cal Poly, SLOC
  - Ryoichi Miyamoto, BNL, now ESS Staff
  - Dariusz Bocian, FNAL, now Ass. Prof. at The Henryk Niewodniczański Institute of Nuclear Physics
  - V. Previtali, now Teacher in Geneva
- Present
  - Simon White, BNL
  - John Cesaratto, SLAC
  - Ian Pong, LBNL
  - Silvia Verdu Andres, BNL

Toohig Fellowship Evolution

- Commitment to maintain Fellowship directing it with the general "risk-reduction" emphasis of LARP in the next 4 years.
- Position Opening changed to reflect:
  - Focus on Magnets, Crab Cavities and Wide Band Feedback System
    - Focusing very much in line with what is being done in Universities or other Laboratory Fellowships
  - Removed from the advertisement the 50/50 subdivision of time between US Host Lab and CERN

Conclusions

- LARP Technical progress on several critical elements of "beam control" is outstanding and displays an undisputed US leadership in critical elements of Accelerator Technology
- Major focus for LARP in FY14-FY17 period is Risk Reduction for the US-HL-LHC contributions
- Funding is a serious concern to maintain progress on all elements of the *tentative deliverables* agreed upon by CERN-DOE-LARP
  - LARP Request: FY15 *16 M$* FY16 *16 M$* FY17 *16 M$*
- Negotiation with CERN on reasonable goals for LARP depending on funding level is mandatory