

LARP



LARP CM15: Introduction

Eric Prebys
Fermilab APC
Program Director, LARP



Outline



- ◉ Highlights since last meeting
- ◉ DOE Review
- ◉ The high luminosity LHC (HL-LHC) project



Major Highlights



◉ LHC Performance

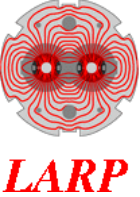
- CM14:
 - Established 3.5x3.5 collision
 - Peak luminosity: $\sim 1 \times 10^{28} \text{ cm}^{-2}\text{s}^{-1}$
- CM15:
 - Peak luminosity: $> 2 \times 10^{32}$ (~enough to reach 1 fb⁻¹ goal in 2011!)
 - Integrated luminosity $\sim 50 \text{ pb}^{-1}$

◉ LARP Instrumentation

- CM14:
 - All LARP instrumentation installed and operational
 - AC Dipole and sync. light mon already part of standard operation.
- CM15:
 - Lumi (BRANA) now the default tool for luminosity scans
 - Schottky being handed off to CERN



Highlights (cont'd)



◉ Magnet Systems

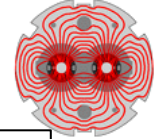
- CM14:
 - LQ had met its 200 T/m design goal
- CM15:
 - LQ eventually reached 220 T/m
 - HQ completed and undergoing tests
 - LARP now identified as responsible for R&D to establish Nb₃Sn as viable for LHC high luminosity upgrade

◉ Long Term Planning

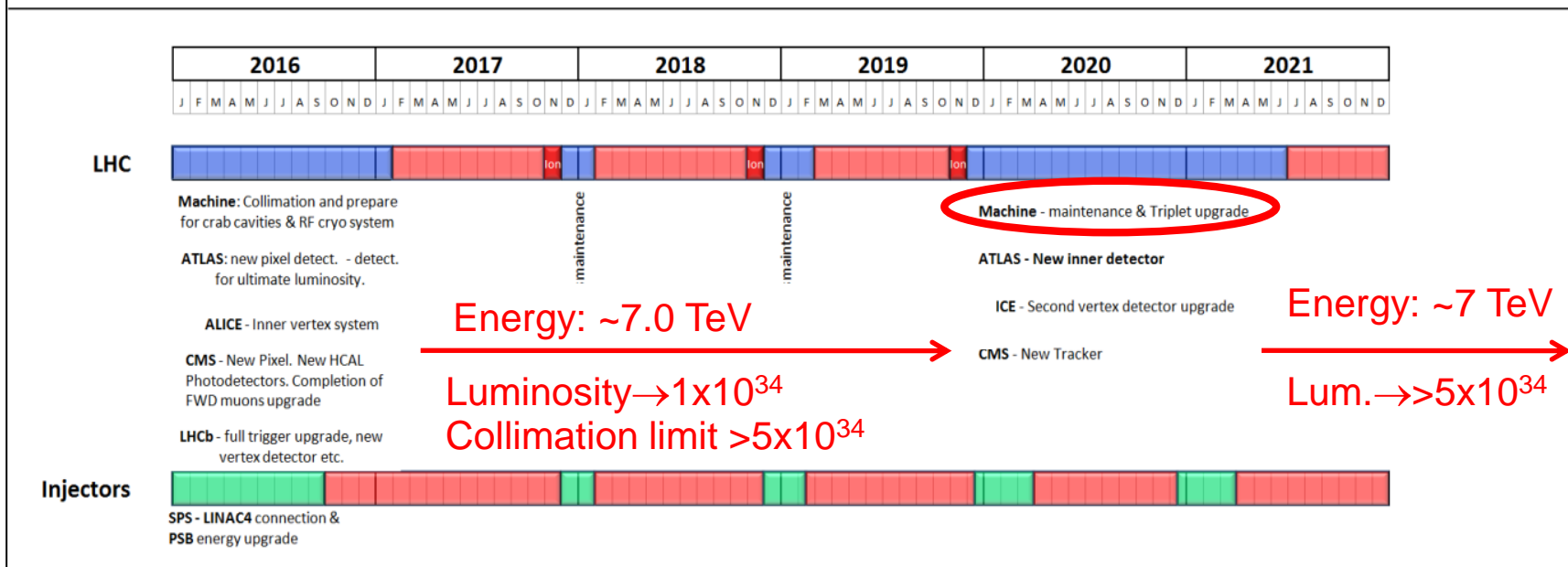
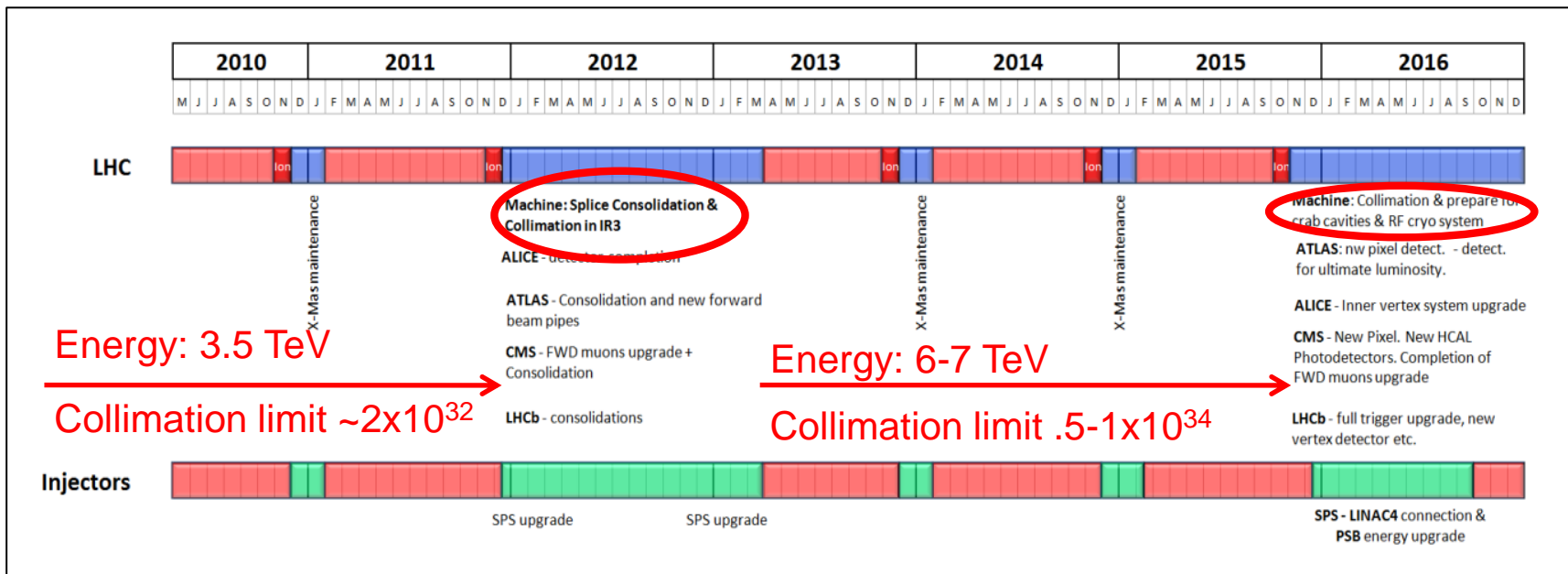
- CERN has now released an official plan through the high luminosity upgrade (formerly “Phase II”) in ~2010
 - Base line includes both Nb₃Sn and crab cavities
- Upgrade planning will be organized through EuCARD, and managed from CERN
 - LARP will integrate itself with this activity
 - Much more about this later



Tentative LHC Timeline

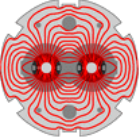


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2010 DOE Review of LARP Program



LARP

- July 15-16, 2010, at Fermilab. Reviewers:

- Accelerator Systems:

- Ali Nassiri, ANL
 - Marion White, ANL
 - Rod Gerig, ANL

- Magnet Systems:

- Peter McIntyre, Texas A&M
 - George Biallas, Jlab
 - Steve St. Lorant, SLAC

- Management

- Rod Gerig, ANL
 - Marion White, ANL
 - George Biallas, JLab

- Context

- LHC startup
 - Recent cancelation of PS2

- Overall, very positive...



1. Accelerator Systems



1.1.2 Comments: Collimator

- Detailed technical and safety requirements for installation in the SPS and for evaluating performance of the device need to be clear and formally agreed upon by LARP and CERN.
- Pass/fail criteria in the Hi-Rad-Mat test need to be very clear before the test.
- The first prototype appears to be extremely complex. Possible alternatives that are less complicated with, presumably, potentially greater reliability should be pursued in parallel.

1.1.3 Recommendations: Collimator

1. None

1.2.2 Comments: Accelerator Physics - Electron Cloud

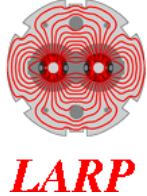
- Development of the fast kicker technology is interesting and potentially useful in many other applications.

1.2.3 Recommendations: Accelerator Physics - Electron Cloud

1. None



1. Accelerator Systems



1.3.1 Findings: Crab Cavities

- ◉ Crab cavities, championed by LARP, are now part of CERN's baseline planning for the Phase-II luminosity upgrade. CERN now considers crab cavities essential in the luminosity upgrade foreseen for 2018-2020.
- ◉ Novel cavity concepts have been supported by LARP. SBIR Phase-I work was successful and Phase-II follow-on funding applied for by two companies.

1.3.2 Comments: Crab Cavities

- ◉ The main goal of the prototyping activity is to validate the crab cavity design.

1.3.3 Recommendations: Crab Cavities

1. Work with the CERN-RF Group to develop clear specifications and a realistic R&D plan with goals for the crab cavities.
2. Prepare a technical design report with clearly-defined roles, responsibilities, schedules, and costs.
3. Subject the R&D plan and goals to a peer-review in 2011.



1. Accelerator Systems



1.4.1 Findings: Accelerator Physics

- Accelerator physics simulations have been performed in support of LARP activities
- RHIC and Tevatron have been used to advantage to perform beam studies.

1.4.2 Comments:

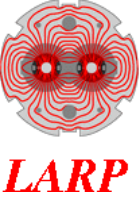
- None

1.4.3 Recommendations:

1. Perform simulations in the coming year to help guide CERN's choice of quadrupole aperture.



1. Accelerator Systems



1.5.1 Findings: Instrumentation

- ◉ All instrumentation was delivered as promised and has worked well.
- ◉ CERN is interested for LARP to pursue instrumentation in support of the LHC injector chain, as expressed in Chamonix.

1.5.2 Comments: Instrumentation

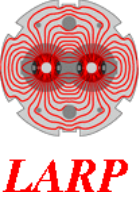
- ◉ Great job!

1.5.3 Recommendations: Instrumentation

- ◉ None



2. Magnet Systems



(... lots of very specific findings and comments about magnet program...)

2.3 Recommendations:

1. The panel strongly recommends that, during the coming year, in close consultation and cooperation with CERN, LARP undertake a substantial role for modeling energy deposition and radiation damage from beam losses and other collider issues related to the IR quad aperture decision.
2. LARP/APUL magnet program should initiate an aggressive request for funding to respond to the pre-project stages of the LHC Upgrade Project recently defined Chamonix.
3. LARP should request a letter from CERN to DOE stating that Nb3Sn Technology is the primary candidate for Interaction Region Quadrupoles of LHC Upgrade Project.
4. DOE should develop a protocol such that requests for collaboration, that are out of the existing list of LARP projects, such as the DS and D1 magnets as outlined by Gijs de Rijk at this review, can be responded to.
5. CERN is establishing a comprehensive facility for the testing of the radiation resistance of materials, insulations and superconductors in particular. Input into and adoption of the recommendations by the MS group is essential for the magnet development program.



3. Management Activities



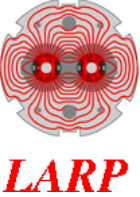
Subcommittee members: Rod Gerig, George Biallas, Marion White

3.1 Findings:

- ◉ LARP has made significant contributions to the achieved successes of LHC
- ◉ Many of the LARP activities have significant application to present and future accelerator R&D confronting US accelerators
- ◉ CERN has expressed their appreciation for these contributions, and notes that the LARP team is an integral part of the LHC accelerator program
- ◉ The Long Term Visitor and Toohig Fellows programs are viewed by CERN as very attractive and successful and benefits the US program
- ◉ The Chamonix meeting has redirected the course of accelerator upgrades and improvements for at least the next ten years resulting in a course for accelerator R&D that is now more strategic (five new task forces) **and is dependent on LARP activities**
- ◉ The above plan has moved a number of the milestones for specifications and deliverables related to LARP R&D



3. Management Activities

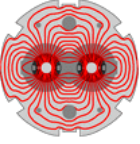


Findings: continued

- ◉ A complimentary program called Accelerator Projects for the Upgrade of the LHC (APUL) is intended to pick up where the R&D leaves off, to deliver components to the LHC
- ◉ The first APUL project has been put on hold and the FY10 allocated funds (\$7M) are in “hibernation mode”.
- ◉ The LARP team is the world’s leading effort in Nb₃Sn SC magnets for accelerators.



3. Management Activities - Charge

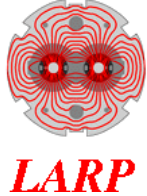


LARP

- ◉ *The quality and significance of the LARP scientific and technical accomplishments, and the merit, feasibility and impact of its planned research program: Quality, merit, significance and impact (in light of Chamonix) are high. Feasibility (i.e., the ability to deliver technology decisions by needed dates) may be constrained by funding and definition of specifications. The funding issue must be evaluated by LARP management with DOE.*



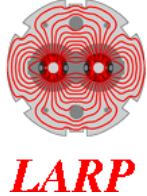
3. Management Activities - Charge



- ◉ *The effectiveness of management in strategic planning, developing appropriate core competencies, implementing a prioritized and optimized program for potential participation in future accelerator upgrades at the LHC at CERN; specifically, are these LARP activities well aligned with present LHC schedule: LARP is in the process of responding to Chamonix. Plans have not yet come into full alignment. When the FY11 budget is defined, this needs to be the highest priority for LARP management.*
- ◉ *The effectiveness and appropriateness of the laboratory interactions to maximize the leveraging of existing infrastructure and expertise available at those laboratories. This has improved over the past few years, and laboratory interactions are appropriate and effective.*



3. Management Activities



3.3 Recommendations:

1. Develop a strategic plan for LARP R&D that supports the LHC schedule, and meets the FY11 budget. Present to DOE by November 1.
2. Work with DOE and CERN to establish a formalism for the dialog and protocol which will provide the needed specifications in time to meet agreed upon milestones.



Long Term Planning...



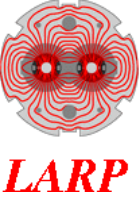
- ◉ Upgrade planning will be organized through EuCARD*,
 - Centrally managed from CERN (Lucio Rossi)
 - Non-CERN funds provided by EU
 - Non-EU partners (KEK, LARP, etc) will be coordinated by EuCARD, but receive no money.
- ◉ Work Packages:
 - WP1: Management
 - WP2: Beam Physics and Layout
 - WP3: Magnet Design
 - WP4: Crab Cavity Design
 - WP5: Collimation and Beam Losses
 - WP6: Machine Protection
 - WP7: Machine/Experiment Interface
 - WP8: Environment & Safety

Significant LARP and
other US Involvement

*European Coordination for Accelerator R&D



Relevance of LARP to CERN Upgrade



Letter to Dennis Kovar, Head Office of DOE
Office of High Energy Physics, 17-August-2010

Dear Dennis,

We are writing to express our support for the US LHC Accelerator Research Program (LARP) and to clarify the relevance and priority of some of the activities within this program with respect to the current CERN upgrade plans.

First and foremost, we are relying primarily on LARP to establish Nb₃Sn as a viable technology for use in the high luminosity upgrade of the LHC (HL-LHC), currently scheduled to be implemented in 2020 or 2021. LARP's Nb₃Sn program has had some impressive achievements over the last few years, but there are still several key demonstrations which are needed to provide the confidence necessary to proceed with the design and production of the focusing quadrupoles to be used in the LHC. LARP is working closely with CERN to establish a set of milestones which must be met, and it is vital that LARP have sufficient resources to meet these milestones.

In addition to the magnet program, two LARP activities which are closely linked to the CERN schedule are the crab cavity effort and the rotatable collimator development. Following the 9th crab cavity workshop in the fall

(...)

Prof. Rolf Heuer
Director-General

Dr. Steve Myers
Director for Accelerators



MISSION STATEMENT ON CRAB CAVITIES FOR THE LHC LUMINOSITY UPGRADE

The LHC has made an excellent start to its physics program. It will be the energy frontier machine in high energy particle physics for the foreseeable future. Maximum effort is now being put into ensuring that machine and experiments operate optimally at their design performance in order to allow full exploitation of the present physics potential.

(...)

CERN is heavily dependent on outside support for the HL-LHC project. This is particularly true for crab cavity development where practically all of the work so far has been done through collaborations. The US is already a prime contributor, via US-LARP; other contributors are KEK in Japan, STFC and the Cockcroft Institute in the UK and the CEA in France.

Due to the excellent progress in US-LARP on compact cavities and the tight schedule, the US collaboration is at a distinct advantage to carry out the R&D towards validation of the compact cavities. CERN would be very grateful if the DoE made a significant contribution to the R&D and the construction phases of this project.

Consequently we strongly invite US support for these important future objectives and look forward to discussing the detailed planning.



Edmond Ciapala



Erk Jensen



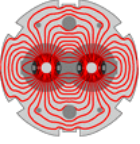
Steve Myers



Lucio Rossi

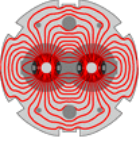


Marching Toward 2020



LARP

- ◉ The EuCARD HL-LHC collaboration will submit a study proposal in November of this year
 - Conceptual Design Report: ~2013
 - Technical Design Report: ~2015
- ◉ LARP is a ~\$12M/year R&D organization
 - Major activities will need to “spin off” as independent projects
 - Nb₃Sn quadupole project should be in place by 2014-2015 to be ready for 2020
 - Crab cavities are a ~\$50M international effort that will need to be centrally coordinated from CERN



Theme for this meeting

- ◉ We need to discuss how to move forward in the context of the new HL-LHC EuCARD project
 - How does it align with ongoing LARP activities?
 - Will it result in other opportunities for money outside of LARP to go directly to labs (Bruce?).