US LHC Accelerator Research Program

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The U.S. LHC Accelerator Research Program:

A Proposal

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Outline

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Responses to Questions in the Review Charge

A. Organization

1) Does the proposed organizational structure represent a truly national activity?

Yes:

- o *Proposal and work plan developed by intensive collaboration among representatives from all three labs.*
- o *Top LARP management includes representatives from all three labs. Work is organized by technology, not by lab.*
- o *LAPLOG made up of Directorate representatives from all three labs.*
- o *US side of US-CERN Committee includes top LARP management (3 labs) plus relevant Division Heads from all three labs.*
- o *A mechanism is provided for integrating additional institutions into the LARP.*

Responses to Questions in the Review Charge

2) Is there a process provided within the LARP organizational structure for peer reviews and selection of work packages based solely on the basis of merit and appropriate match to the LHC needs?

Yes.
The work selected to be included in the program has been reviewed (and will be reviewed as the program progresses) for scientific and technical excellence and compatibility with the LARP goals by the LAPAC. The overall content of the program has been reviewed and approved (and will be reviewed as the program progresses) by the US-CERN Committee to ensure that it matches well with LHC needs.

Responses to Questions in the Review Charge

3) Does the national organizational structure provide for adequate oversight of the U.S. work performed?

Yes.

Oversight is provided by:

- *The Fermilab Director, advised by the LAPLOG.*
- *Technical and scientific review by LAPAC, advising the Program Leader.*
- *Review of coordination with and effectiveness for LHC by US-CERN Committee advising the Project Leader*
- *Periodic written reports from the sub-programs to the Program Leader.*
- *Technical reviews reporting to the Program Leader.*

Responses to Questions in the Review Charge

4) Is there a formal process provided for coordinating the U.S. activities with the LHC management and has it been used to develop the current technical plan?

Yes.
The technical plan has been developed by intense collaboration between the US lab and their counterparts for each topic at CERN. The complete program plan has been presented to and approved by the US-CERN Committee, which was asked explicitly to comment on how well the program coordinates with the overall LHC program.

Responses to Questions in the Review Charge

5) Is there a management structure in place to successfully implement the proposed program.

Yes.
The work has been organized along the lines of technical deliverables, and leading experts in each area have been appointed to lead the effort. Where a task involve more than one laboratory, contact people have been identified at each laboratory.

Responses to Questions in the Review Charge

B. Technical Program

1) Do the proposed technical program activities keep U.S. physicists and engineers at the forefront of accelerator physics and technology?

Yes.
The work we plan to do on the LHC, which will be the forefront hadron collider, is at the forefront of accelerator physics and technology. We will be deeply involved in the commissioning of this very difficult machine, which pushes beam and accelerator system parameters to the limit. Accelerator physics experiments will exploit the extreme and unprecedented beam conditions of the LHC. Instruments to be developed by LARP will extend the state-of-the-art. We plan to develop magnets for a luminosity upgrade which have performance parameters well beyond the state-of-the-art.

Responses to Questions in the Review Charge

1) (continued) Do these activities leverage the U.S. base program in these areas?

Yes.
The work on machine commissioning, accelerator physics, and instrumentation builds on our experience constructing and operating our own superconducting accelerators and in developing instruments for these and other accelerators. This work also makes use of specific world-class expertise we have in many accelerator physics topics. The magnet R&D program is built upon the expertise developed in the high-field Nb_3Sn dipole programs at all three labs.

Responses to Questions in the Review Charge

2) Does the technical program proposed by LARP provide an appropriate match between U.S. leadership and unique capabilities in high field-high gradient superconducting magnet R&D and CERN's long and short range needs as presented in the Taylor EPAC paper and other sources?

Yes.
The US labs are clearly the world leaders in the development of high-field Nb_3Sn accelerator magnets, and through the US LHC Construction Project are leaders in the construction of the high-gradient IR quadrupoles that represent the current state-of-the-art. These are precisely the technologies required for a luminosity upgrade.

Responses to Questions in the Review Charge

3) Does the technical program proposed by LARP exploit the unique U.S. capabilities in accelerator physics and instrumentation?

Yes.
The topics chosen are ones where we have unique capabilities that allow us to have maximum impact on the potential performance of LHC. For example, the longitudinal density monitor is based on cutting edge technology spun off from the ALS "femtosecond light source" program; the first tune feedback system in a hadron collider is being commissioned in RHIC; the US AP groups are recognized world leaders in understanding electron cloud and beam-beam effects.

Responses to Questions in the Review Charge

4) Was a peer review and selection process used to select the work proposed and was it based on merit of the proposal and a match to LHC needs?

Yes.
As noted above, the proposed work was subjected to peer review for scientific quality and match to the LHC needs through the LAPAC and US-CERN Committee. (See A.2.)

Responses to Questions in the Review Charge

C. Resource Planning

1) Does the schedule proposed for the technical program match the resources, financial and manpower, available to LARP?

Yes.
The program plan makes use of manpower and infrastructure resources available at the three labs. Cost and schedule estimates have been developed, and the technical program has been adjusted to be consistent with the funding guidance.

Responses to Questions in the Review Charge

2) Is the proposed schedule realistic and does it match well with the CERN schedule?

Yes.
The schedules for the hardware and beam commissioning tasks are determined by the CERN LHC commissioning schedule. R&D on beam instrumentation will lead to working devices at the time of LHC startup or within a year or so thereafter. The magnet R&D program is planned to deliver at least one accelerator-ready design in time for the start of construction of a luminosity upgrade early in the next decade.

However, funding limitations increase the risk that not all of these goals will be met.

Responses to Questions in the Review Charge

3) Does the plan as put forward leverage off the current R&D activities of the three national laboratories and potential university partners?

Yes. See B.1. Note, that, at the moment, there are no universities that are part of LARP.

It is assumed that this current level of base support will be maintained in addition to LARP.

This is understood, subject to the continued availability of adequate funding to the labs to allow continued vigorous support of the base program in accelerator physics, instruments, and magnet R&D in areas related to the LHC-specific work of the LARP.

Conclusions

The US LHC Accelerator Research Program is an essential component of the US High Energy Physics Program.

- It helps exploit our large investment in the LHC by working to maximize the physics output for American scientists.
- It leverages our investment in the machine by providing opportunities for American accelerator scientists to pursue their research.
- It keeps the US Labs at the forefront of the science and technology of high energy hadron colliders.

We have a world-class accelerator research and development program plan, and have an organization and team capable of carrying it out.

It is time to get started.