



US LHC Accelerator Research Program

bnl – fnal - lbnl - slac

US LHC Accelerator Research Program

J. Strait, Fermilab

For the BNL-FNAL-LBNL-SLAC collaboration

LAPAC Meeting

17-18 June 2004, Fermilab



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The US LHC Accelerator Research Program (US LARP) is a collaboration of four US National Laboratories, which in turn is working with CERN to advance performance of the LHC.

- **Help commission the LHC:**
 - Hardware systems that the US Labs are building now for LHC,
 - Beam commissioning of the entire complex.
- Develop **beam instrumentation** and **2nd generation collimators** to help commission LHC and bring it to design performance.
- Use the LHC as a vehicle for **fundamental accelerator physics** research.
- Perform **accelerator physics studies** and **advanced magnet R&D** directed towards **timely LHC luminosity upgrade**.

For more info, see <http://www-td.fnal.gov/LHC/USLARP.html>



Goals of the US LARP

Advance High Energy Physics

- Help bring the LHC on and up to design performance quickly.
- Improve LHC performance by advances in understanding and instrumentation.
- Use LHC as a tool to gain deeper knowledge of accelerator science and technology.
- Extend LHC as a frontier HEP instrument with a timely luminosity upgrade.

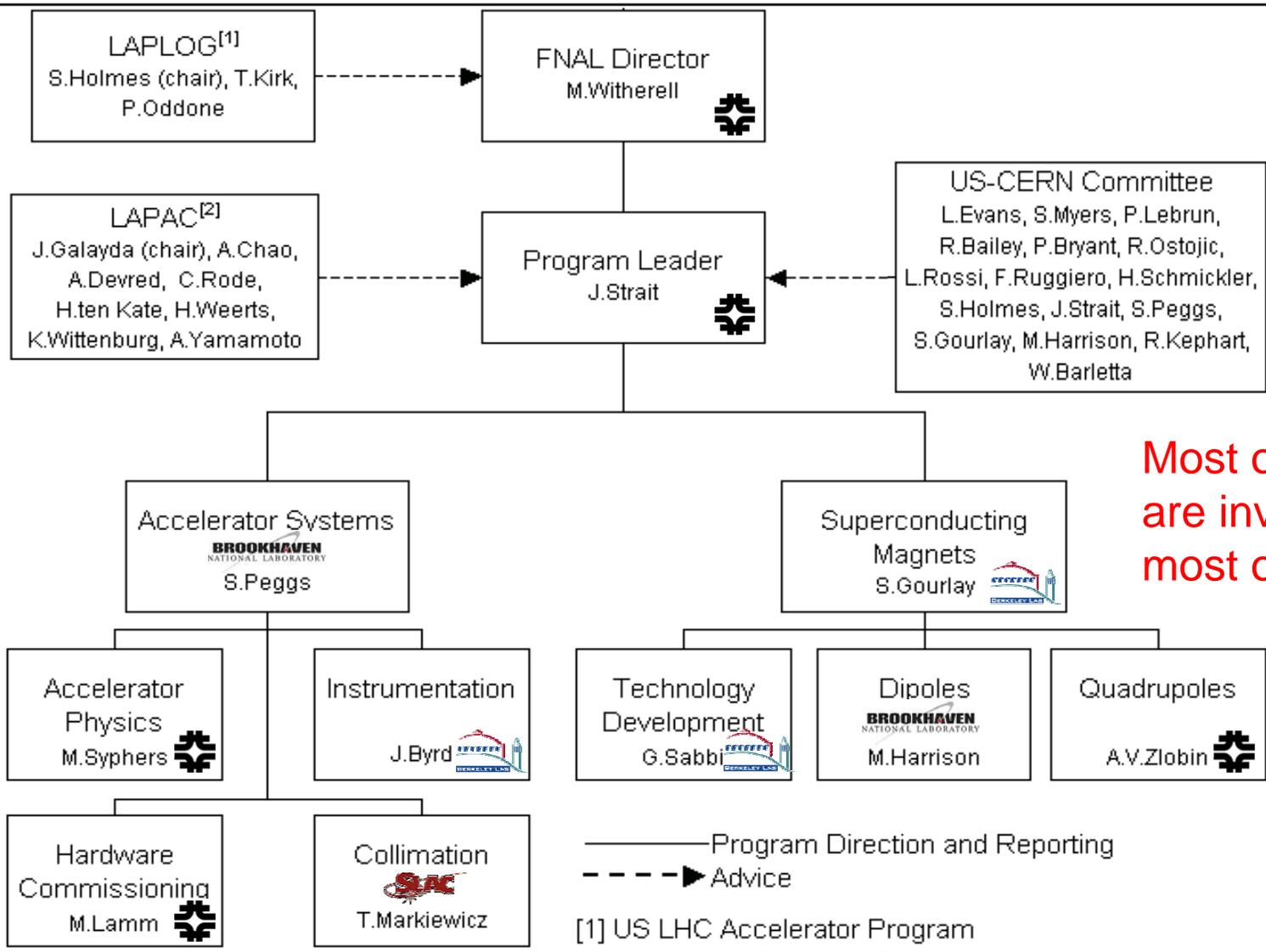
Advance U.S. Accelerator Science and Technology

- Keep skills sharp by helping commission the LHC.
- Conduct forefront AP research and development.
- Advance U.S. capabilities to improve the performance of our own machines.
- Prepare U.S. scientists to design the next generation hadron collider.
- Develop technologies necessary for the next generation of hadron colliders.

Advance International Cooperation in the High Energy Accelerators



Organization



Most of the labs are involved in most of the tasks!

————— Program Direction and Reporting
 - - - - - Advice
 [1] US LHC Accelerator Program Laboratory Oversight Group
 [2] US LHC Accelerator Program Advisory Committee



Leadership and Management Structure

Fermilab Director

- DOE has assigned Fermilab to serve as Host Lab.
- Provides management oversight for LARP.
- Advised by LAPLOG.

Program Leader

- Sets overall program direction.
- Responsible for successful execution of the LARP.
- Reports to the Fermilab Director and the JOG.
- Advised by LAPAC, US-CERN Committee, Executive Committee.

Subprogram Leaders

- Represent the *national* program... all labs are involved in all areas.
- Develop annual program plan and budget, under direction of Program Leader.



Advisory Groups and Peer Review

LHC Accelerator Program Laboratory Oversight Group (LAPLOG).

- Relevant Deputy/Associate Directors of the participating labs.
- Advises FNAL Director in his oversight duties with respect to LARP.
- Addresses high-level inter-laboratory issues.
- Reviewed and approved the LARP proposal on May 14, 2003.

US-CERN Committee for the LARP.

- Combines leaders of US LARP with relevant CERN leaders.
- Jointly chaired by CERN LHC Project Leader and LARP Leader.
- Provides top-level coordination of on-going collaborative work.
 - Reviews changes to the program as it develops.
 - Reviewed and approved the LARP proposal on April 10, 2003.
 - Next meeting – 1 July 2004.



Advisory Groups and Peer Review

Executive Committee.

- Made up of the US members of the US-CERN Committee.
- Advises Program Leader on programmatic issues within the US Labs:
 - Division of LARP technical work.
 - Resource allocation.
 - Proposed program changes prior to submission to US-CERN Committee.

US LHC Accelerator Program Advisory Committee (LAPAC).

- Distinguished accelerator scientists and technologists, and high energy physicists who are not involved in LARP.
- Provides independent advice on scientific, technical and management performance of LARP.
- Conducts reviews of the program as a whole and of individual elements as needed, but at least once per year.
- Reviewed early version of LARP program June 17-18, 2002.



LARP History

- First serious consideration of continuing US collaboration on the LHC accelerator beyond the construction project began in 1999, following a strong push from Tim Toohig.
- First presentation to DOE at June 2001 meeting of the DOE-NSF Joint Oversight Group.
 - Included all major elements of current program.
 - Requested budget starting in FY2003 (\$2.9M), growing to ~\$10M/year by FY2006.
- CERN-US-KEK Meeting on LHC IR upgrades, March 2002.
- LAPAC review of preliminary program in June 2002.
- Half-day briefing of DOE in September 2002.
 - Sent back to drawing board with respect to breadth of magnet R&D, motivation for instrumentation, and management.



More LARP History

- Proposal writing – Spring 2003.
- Current management structure established at collaboration in March 2003.
- LARP technical program endorsed at 1st meeting of US-CERN Committee in April 2003.
- Proposal submitted in May 2003.
- LARP approved by Lehman Review in June 2003.

**The U.S. LHC Accelerator Research Program:
A Proposal**

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May 2003



Program as of June 2003

Accelerator Systems

Instrumentation

Tune feedback, Luminometer, Fast longitudinal density monitor (LDM).

Accelerator Physics

Beam-beam, E-cloud, other vacuum effects, remote ops and maint., IR upgrade design, energy deposition.

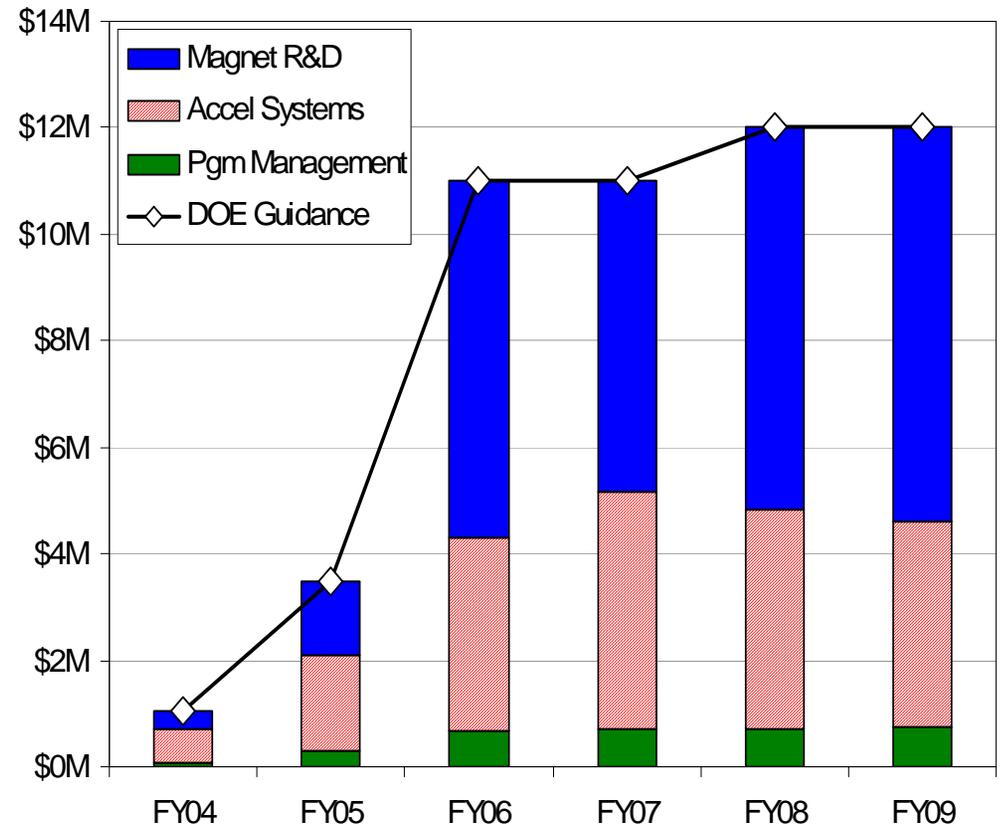
Beam Commissioning

Hardware Commissioning

IR Upgrade Magnet R&D

Large-aperture Nb_3Sn quads,
Specialized Nb_3Sn dipoles for dipole-first IR,

Nb_3Sn technology development.





Program Evolution Since the Proposal

September 2003 Collaboration Meeting

- SLAC proposal to join LARP and develop phase II collimators.
- CERN request to increase priority and advance schedule for abort gap monitor (AGM) as part of LDM development.

DOE funding profile changes:

- FY2004: \$1.05M -> \$1.25M to accommodate above changes.
- FY2005: \$3.5M -> \$3.25M based on President's budget.
- FY2006 and beyond – plan for similar reductions.

February 2004 Collaboration Meeting

- CERN request to drop fast LDM, but retain AGM.
- Add collimation and e-cloud studies using RHIC to AP menu.
- Modest reduction in FY05 magnet R&D budget to accommodate other program elements.



Current Issues

- Budget pressures.
 - Actual FY05 budget reductions and potential out-year reductions.
 - Balancing priorities among sub-programs within budget constraints.
- How to accommodate phase II collimation R&D proposal from SLAC.
 - Still working to understand the technical requirements and “ground rules” for working with CERN collimation groups.
- CERN requests for changes in the instrumentation program.
 - Drop LGM and limit AGM.
 - Add Schottky monitors (no formal proposal from within LARP yet).
 - We have not concluded yet how to respond to these requests.
- Magnet R&D priorities.
 - Priority of dipole R&D vs. quadrupole R&D.
 - Real collaboration among US labs to make best use of limited funds.



FY05 Budget

WBS	Task	k\$
	US LHC Accelerator Research Program	3363
1	Accelerator Systems	1861
1.1	Instrumentation	680
1.1.1	Tune feedback	200
1.1.2	Luminometer	400
1.1.3	LDM / AGM	80
1.2	Accelerator Physics	540
1.2.1	Beam Commissioning	20
1.2.2	Collimation	80
1.2.3	Electron Cloud	120
1.2.4	Interaction Regions and Beam-Beam	320
1.3	Phase II Collimator R&D	251
1.4	Hardware Commissioning	390
2	Magnet R&D	1302
2.1	Dipole R&D	162
2.2	Quad R&D	144
2.3	Technology Development	996
3	Program Management	200

The program we present today is out of balance with the DOE funding guidance by \$113k (3.5%).

We do not explicitly ask your advice on how to fit it into the budget box, but we will consider your technical advice as we make our decisions.



Phase II Collimation R&D Proposal

This is potentially a significant addition to LARP:

- Important to bringing the LHC to design performance.
- Challenging R&D to be led by SLAC within the US LARP, but with collaboration of other US labs.
- Potential cost is several M\$ over 4-5 years.

Program is not fully defined yet.

- Conceptual design study is necessary:
 - For us to learn LHC collimation system requirements.
 - To determine if SLAC proposal (based on NLC design) is suitable for LHC application.
- Plan a review, followed by go/no go decision in Spring 2005.

Need to exercise our procedures for vetting proposed program changes.

(See next slide.)

- LAPAC review is a crucial part of this process.



Changes to the LARP Work Scope

Proposals for new program elements or major changes to existing ones may be submitted from **within** or **outside** the current LARP collaboration.

Written proposal must be submitted to Program Leader, who will **decide** if it is to be accepted based on **advisory committee reviews**.

- Program Leader will **consult with CERN** about match to overall LHC program, **and with DOE**, if additional funding is needed.
- **LAPAC** will provide independent advice on the **scientific and technical merit**, and the **proposed budget and schedule**.
- **Executive Committee** review will include.
 - Match of proposed work to LARP goals.
 - Feasibility of fitting proposed work within available funding.
- **US-CERN Committee** will provide final review, including
 - Technical and scientific merit.
 - Match to the needs of the overall LHC program.



Charge to LAPAC

The US LARP has two complementary goals:

- To advance high energy physics by helping to make the LHC the strongest possible tool for HEP research.
- To advance US accelerator physics and technology.

The LAPAC is asked to evaluate the planned program with regard to:

- The balance between the breadth of the technical program and the available resources.
- How well the program as a whole and its specific elements address and balance between the two program objectives.



Charge to LAPAC

Specific questions regarding the program components are:

- Evaluate the plans for participating in machine commissioning, both hardware commissioning and beam commissioning.
- Evaluate the priorities and schedules for beam instrumentation development and implementation.
- Evaluate the plans for accelerator physics, and how they complement the commissioning and instrumentation work.
- Evaluate the proposed collimation R&D program with regard to scientific and technical merit, and the match to the LARP goals. *LAPAC's advice is a key element in the process for approving program additions to the LARP.*
- Evaluate the balance between dipole and quadrupole R&D, and between technology development and focused model magnet development.



Agenda

Thursday 17 June 2004

Plenary Session - Hermitage					
08:00 am	Executive Session				
08:20 am	Introduction, Overview, Charge to the LAPAC				J. Strait
08:50 am	Accelerator Systems				S. Peggs
09:20 am	Magnet R&D				S. Gourlay
09:50 am	Hardware Commissioning				M. Lamm
10:15 am	Break				Refreshments
Magnet R&D - HQ Conference Room			Accelerator Systems - Hermitage Conference Room		
10:30 am	IR QUAD Status and Plans	A. Zlobin	10:30 am	Electron Cloud	M. Furman
11:00 am	IR Quad Design Studies	V. Kashikhin	10:50 am	Interaction Region & Beam-Beam	T. Sen
11:30 am	Studies of Single Aperture IR Quad Mechanics	G. Ambrosio	11:10 am	Collimation	A. Drees
			11:30 am	Beam Commissioning	E. Harms
			11:50 am	Discussion	
12:00 pm	Lunch/Discussion		12:00 pm	Lunch/Discussion	
1:00 pm	Dipole R&D Status & Plans	M. Harrison	1:00 pm	Beam Instrumentation-Lumimonitor	J. Byrd
1:30 pm	Dipole Design Status	R. Gupta	1:25 pm	Beam Instrumentation-Tune Feedback	A. Drees
2:00 pm	Technology Development Status & Plans	G.L. Sabbi	1:50 pm	Beam Instrumentation-Abort Gap Monitor/ Longitudinal Density Monitor	S. DeSantis
2:30 pm	Technology Quadrupole 1 (TQ1)	S. Caspi	2:15 pm	Discussion	
3:00 pm	Conductor R&D Status	D. Dietderich	2:30 pm	Break/Discussion	
			2:45 pm	Collimation R&D	T. Markiewicz
3:30 pm	Break/Discussion		3:30 pm	Break/Discussion	



Agenda

Thursday 17 June 2004

Plenary Session - Hermitage

03:45 pm	Committee Executive Session	
04:30 pm	Q&A - LAPAC with LARP Principals	
05:30 pm	Committee Executive Session	
06:30 pm	Adjourn for the day	

7:00 pm

Dinner - Chez Leon (Fermilab Users' Center)

Friday 19 June 2004

Plenary Session - Hermitage

08:30 am 8:00	Committee Executive Session Follow-up Q&A Presentation requested by LAPAC Report Writing	
11:15 am 10:15	Closeout Presentation by LAPAC	
12:00 pm 11:00	Adjourn	



Dinner

The following people have signed up for dinner at Chez Leon (7:00 pm):

Alex Chao

Alexander Zlobin

Arnaud Devred

Claus Rode

GianLuca Sabbi

Herman ten Kate

Jim Strait

John Byrd

John Galayda

Kay Wittenburg

Ken-ichi Sasaki

Miguel Furman

Mike Lamm

Peter Limon

Stefano de Santis

Steve Gourlay

Steve Peggs

Tanaji Sen

Tom Markiewicz

Toru Ogitsu

If you are not on the list, see Margie Bruce immediately.
(No guarantees, however...)