

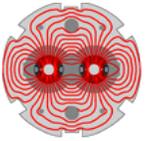
LARP

US LHC Accelerator Research Program

bnl - fnal- lbnl - slac

Accelerator Systems: Overview

Vladimir Shiltsev



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LARP Technical Scope

Letter from Joint Oversight Group (DOE and NSF, 02/05/2003):

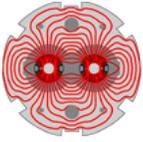
“ The research program should be planned to make optimal use of the infrastructure and expertise within participating US National Laboratories and should be worked out with CERN on the basis of mutual interest.

The planned research could be expected to include:

participation in beam commissioning and ongoing optimization of beam parameters;

beam experiments, including construction of specialized instrumentation, aimed at both improved LHC performance and fundamental beam physics questions

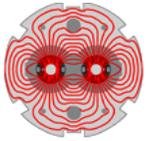
design and development of equipment for improvements to the LHC, such as 2nd generation IR quads and advanced instrumentation.”



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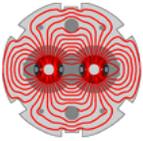
LARP AS Deliverables

- The Joint DoE/NSF Guidance (Feb'03) defines LARP as a world-class R&D and scientific research program at the frontier of accelerator science and technology.
- The deliverables of the research should improve U.S. capability and not be products or intellectual contributions that are readily available either at laboratories or in the marketplace.
- Although some fabricated deliverables are envisioned within the program, major physical deliverables will be separately funded as projects proposed and approved following standard procedures.



LHC Technical Challenges

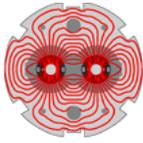
	Tevatron [March '06]	LHC ["nominal"]
Luminosity [$\text{cm}^{-2} \text{s}^{-1}$]	1.7e32	100e32
Magnet style	1-in-1	2-in-1
Beam-beam tunes shift	0.025	0.010
# of bunches	36	2,808
Beam stored energy [MJ]	1	366
B-field stored energy [MJ]	300	10,600
Chromaticity snapback dQ'	~ 40	~ 100
Tolerable loss on ramp	$\sim 2-4\%$	$\sim 0.01-0.1\%$



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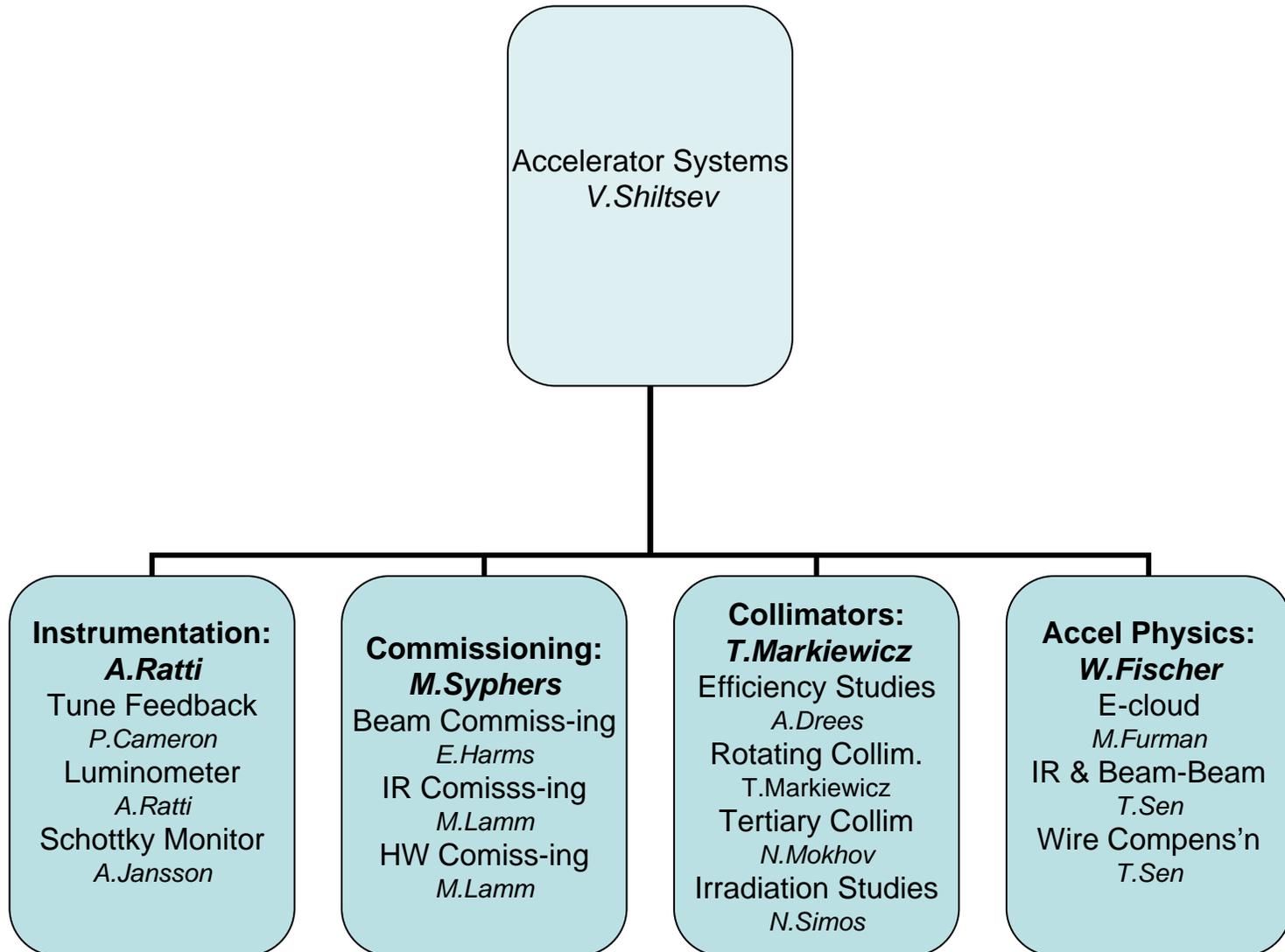
Program Components

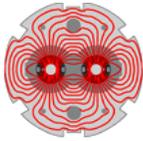
- **Collimation system R&D:**
 - avoid uncontrolled losses → Phase I system till L~0.1 Design
 - test various proposals for Phase II → Rotating Collimators?
 - LARP Collimator R&D complements the work at CERN
- **Development of beam instrumentation:**
 - build specialized diagnostics beyond the usual set
 - push the state-of-the-art, some help US machines
 - be ready in 2007 for LHC commissioning of the LHC and operation
- **Participation in LHC Commissioning:**
 - benefit to the U.S. HEP program if the LHC turns on rapidly and successfully
 - make available US (firstly, Tevatron and RHIC) expertise
 - train younger generation of accelerator scientists and engineers
- **LHC Accelerator Physics/Upgrades Studies:**
 - need of deep understanding of beam physics at the frontier hadron collider and evaluation of the upgrade paths
 - mix of calculation, simulation and experimentation
 - mix of activities at home institutions in the U.S. and at CERN



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LARP AS Organization

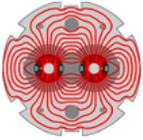




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FY06 Accelerator Systems Budget

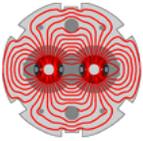
Mar 31, 2006			Total	Labor+MTSC			
WBS				BNL	FNAL	LBNL	SLAC
US LHC Accelerator Research Program			11000	3264	3300	4086	350
1	Accelerator Systems	Shiltsev	3684	875	1200	1309	300
1.1	Instrumentation	Ratti	1635	450	250	935	0
1.1.1	Phase I						
1.1.1.1	Tune feedback	Cameron	430	405	25		
1.1.1.2	Luminometer	Ratti	960	25		935	
1.1.1.4	Schottky monitor	Jansson	245	20	225		
1.2	Commissioning	Syphers	879	65	670	144	0
1.2.1	Phase I						
1.2.1.1	Beam Commissioning	Harms	335	35	300		
1.2.1.2	Interaction Region Commissioning	Lamm	501	30	335	136	
1.2.1.3	Hardware Commissioning	Lamm	43		35	8	
1.3	Collimation	Markiewicz	500	150	50	0	300
1.3.1	Phase I						
1.3.1.1	Cleaning efficiency studies	Drees	50	50			
1.3.2	Phase II						
1.3.2.1	Rotating Collimator R&D	Markiewicz	320		20		300
1.3.2.2	Tertiary collimator study	Mokhov	30		30		
1.3.2.3	Irradiation studies	Simos	100	100			
1.4	Accelerator Physics	Fischer	670	210	230	230	0
1.4.1	Studies						
1.4.1.1	Electron Cloud	Furman	200	50		150	
1.4.1.2	Interaction Regions & Beam-Beam	Sen	260	0	180	80	
1.4.1.3	Beam-Beam wires	Sen	210	160	50		



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1.1 Instrumentation

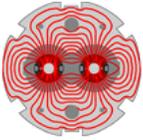
- L2 Leader: Alex Ratti (LBL)
- FY06 budget: 1635 k\$
- L3 tasks:
 - 1.1.1.2 Tune feedback
 - P.Cameron (BNL) 430k\$
 - 1.1.1.2 Luminometer
 - A.Ratti (LBL) 960k\$
 - 1.1.1.4 Schottky monitor
 - A.Jansson (FNAL) 245k\$



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1.2 Commissioning

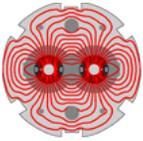
- L2 Leader: Michael Syphers (FNAL)
- FY06 budget: 879 k\$
- L3 tasks:
 - 1.2.1.1 Beam Commissioning
E.Harms (FNAL) 335k\$
 - 1.2.1.2 Interaction Region Commissioning
M.Lamm (FNAL) 501k\$
 - 1.2.1.3 Hardware Commissioning
M.Lamm (FNAL) 43k\$



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1.3 Commissioning

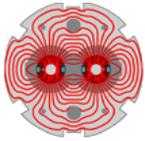
- L2 Leader: Tom Markiewicz (SLAC)
- FY06 budget: 500 k\$
- L3 tasks:
 - 1.3.1.1 Phase I cleaning efficiency studies
A.Drees (BNL) 50k\$
 - 1.3.2.1 Rotating Collimator R&D
T.Markiewicz (SLAC) 320k\$
 - 1.3.2.2 Tertiary Collimator Study
N.Mokhov (FNAL) 30k\$
 - 1.3.2.3 Colimator material irradiation study
N.Simos (BNL) 100k\$



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1.4 Accelerator Physics

- L2 Leader: **Wolfram Fischer (BNL)**
- FY06 budget: **670 k\$**
- L3 tasks:
 - 1.4.1.1 Electron cloud studies
M.Furman (BNL) 200k\$
 - 1.4.1.2 Interaction Regions and beam-beam
T.Sen (FNAL) 260k\$
 - 1.4.1.3 Beam-beam compensation with wires
T.Sen (FNAL) 210k\$



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“Hard” Deliverables

- “Hard deliverables” are defined as systems or components developed for the LHC which are:
 - crucial to LHC performance
 - “plan B” is weak or non-existent
- This tasks need special protection in the face of an unforeseen LARP budget and manpower shortfalls
- Both CERN and LARP Executive Committee endorsed following LARP Accelerator Systems tasks as “hard deliverables”:
 - **Luminosity Monitors**
 - **Tune Feedback**
 - **Beam & Instrumentation Commissioning**
 - **Rotatable Collimators**



Review Presentations

- **L2 reports:**
 - technical highlights, accomplishments
 - milestones and budget
- **Summary:**
 - program execution, scorecard
 - reviews, communication
 - new tasks and activities