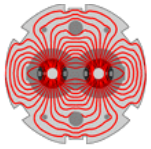
LARP

Collaboration Meeting Goals

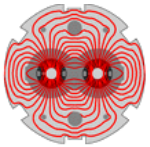
Steve Peggs

Goal: Technical, Cost, & Schedule plan for FY06 & 07

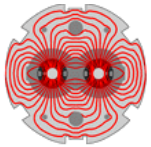
to be reviewed June 1 & 2



Strategy
Calendar & Milestones
(Hardware) Commissioning
Junior Workforce Pipeline
Magnet Program
Budget



Strategy



Challenge chronology

LHC faces 4 (identified) challenges. In rough chronology:

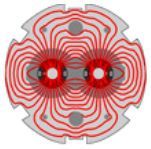
	Challenge	Luminosity	LARP
1)	Snap-back	small	TF, LM, BC, ...
2)	Stored energy	medium	RC, BC, ...
3)	Beam-beam	nominal	IRBB, RC, BC, ...
4)	Debris power	upgrade	Magnet R&D, ...

Early LARP success is tightly linked to Tune Feedback, Luminosity Monitor, and Beam Commissioning activities

Later come Rotating Collimators, and IR & Beam-Beam, etc

Magnet R&D must proceed **now,** to be ready **then.**

Early perceptions are prejudiced by the Construction Programs success – LARP does R&D, not production!



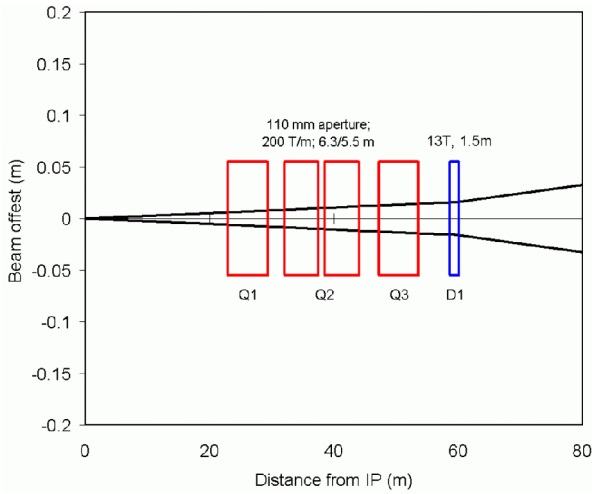
From Tevatron to LHC

		Tevatron [Mar 05]	LHC ["nominal"]
Luminosity [$\mathrm{cm}^{-2}\mathrm{s}^{-1}$]	L	1.2×10^{32}	1×10^{34}
Magnet style		1-in-1	2-in-1
Beam-Beam parameter	ξ_1	0.010	0.004
	ξ_2	0.002	0.004
Number of bunches	M	36	$\sim 3,600$
BUT unfortunately ...			
Beam stored energy [MJ]		1	350
Chromaticity snap-back	$\Delta\chi$	~ 30	~ 300
Debris power [W]		~ 1	~ 900

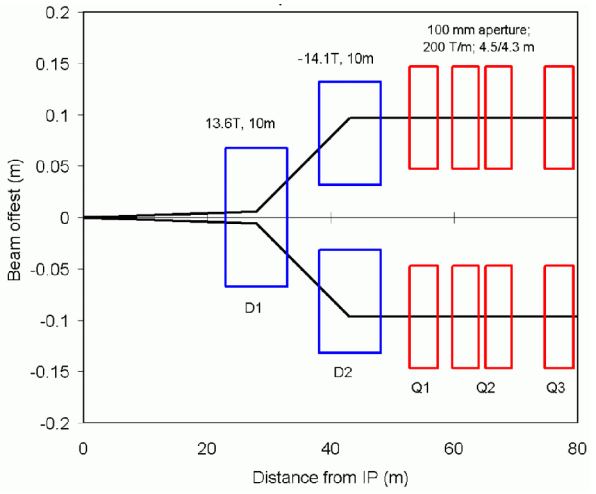
9 kW !?

IR upgrade - 2012?

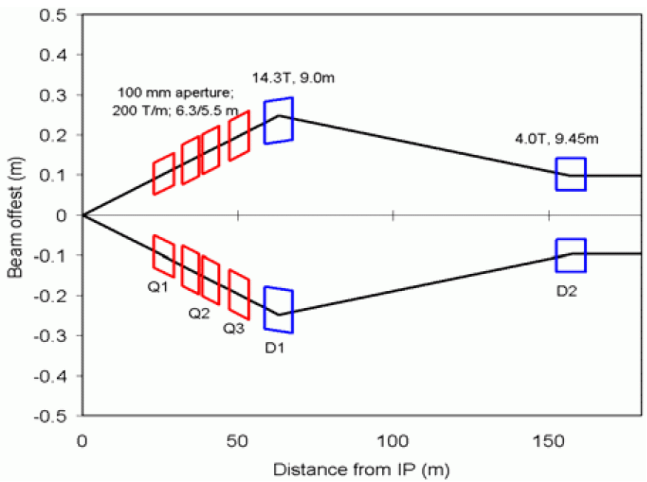
"Quad first"



"Dipole first"



"Large crossing angle"

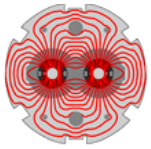


All scenarios incorporate state-of-the-art IR quads

Some also use new-concept beam separation dipoles

Other potential sub-system upgrades: beam-beam compensators, crab cavities, accelerating cavities, cryogenics, beam dumps, ...

Need real operating experience to make optimal decisions!

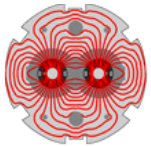


Crab cavities

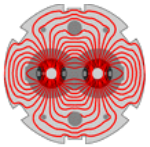
Ruggiero: "if the KEKB test with Crab cavities in 2006 is successful, we recommend the installation and test of Crab cavities in a hadron machine to validate a level of RF noise compatible with emittance preservation."

		KEK B	LHC
crossing angle	θ [mrad]	22	8
beam energy	E [TeV]	0.008	7
collision beta	β^* [m]	0.33	0.25
crab beta	β_{crab} [km]	0.1	2
RF frequency	f_{RF} [GHz]	0.51	1.3
RF voltage	V [MV]	1.4	46

Raises the possibility of additional institutional involvement:
KEK, JLAB, Cornell, [NSF], ...



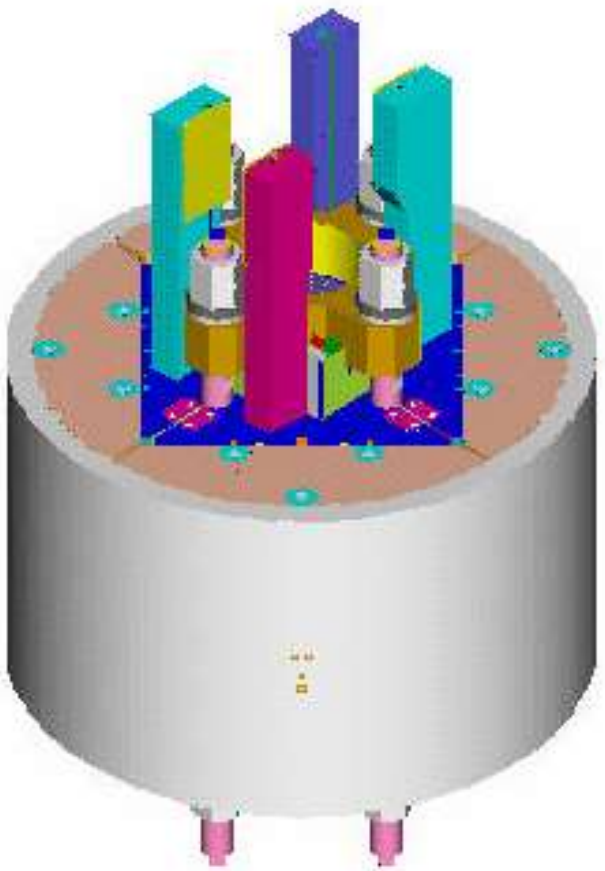
Calendar & Milestones



Calendar

Apr 4-5	Tune Feedback review, Port Jeff
Apr 6-8	Collaboration meeting 4, Port Jeff
Apr 11-12	Luminosity Monitor review, LBNL
Apr 15	Quarterly Report deadline
May 16-20	PAC05, Knoxville
May 23-27	WAO 2005, Bloomington
May ??	US executive committee meeting, FNAL
May ??	DOE Review dry run, ??
Jun 1-2	DOE Review, FNAL
Jun 6-8	DIPAC, Lyon
Jun ??	LARP Advisory Committee, LARPAC, ???
Jul ??	CERN-US Exec. comm meeting, CERN
Aug 31- 3	CARE "Upgrade scenarios", Arcidosso
Sep 19-23	Magnet Technology MT-19, Genova
Sep ??	CARE "RC Synchs. & LE injectors", ??
Oct ??	IR & Beam-Beam mini-workshop, FNAL
Oct ??	Collaboration meeting 5, near FNAL
Oct ??	CARE "SC pulsed magnets", Frascati??

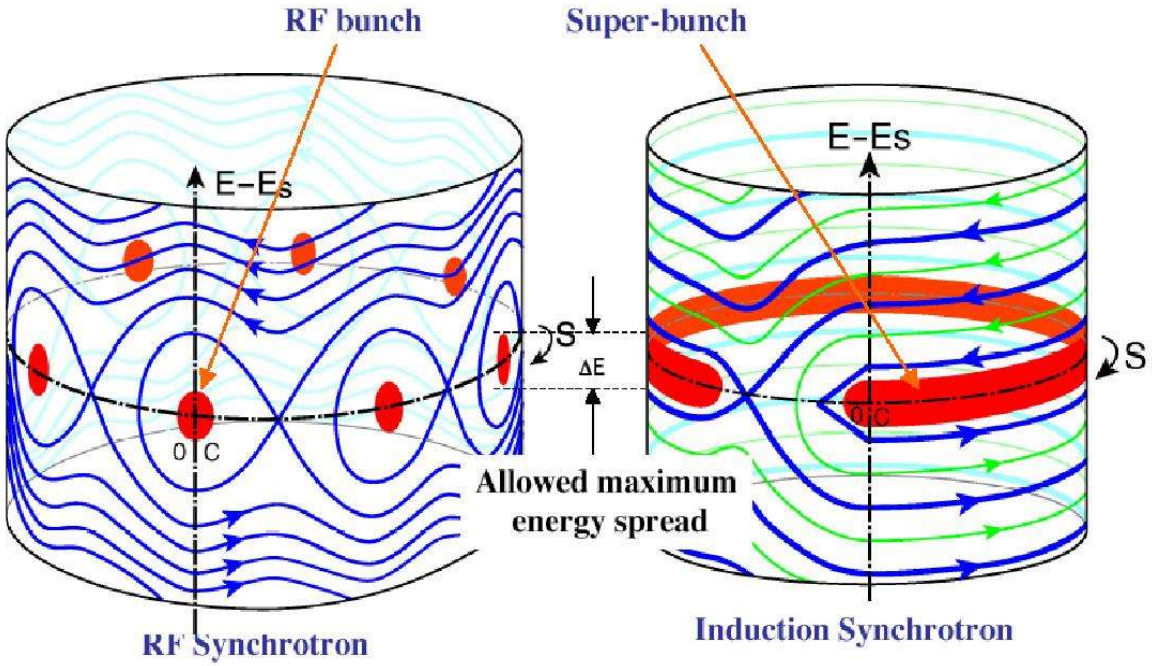
Oct 04: Collaboration Meeting 3



Short “bladder and key” construction racetrack quadrupole

LARP

Nov 04: CARE – IR Upgrades



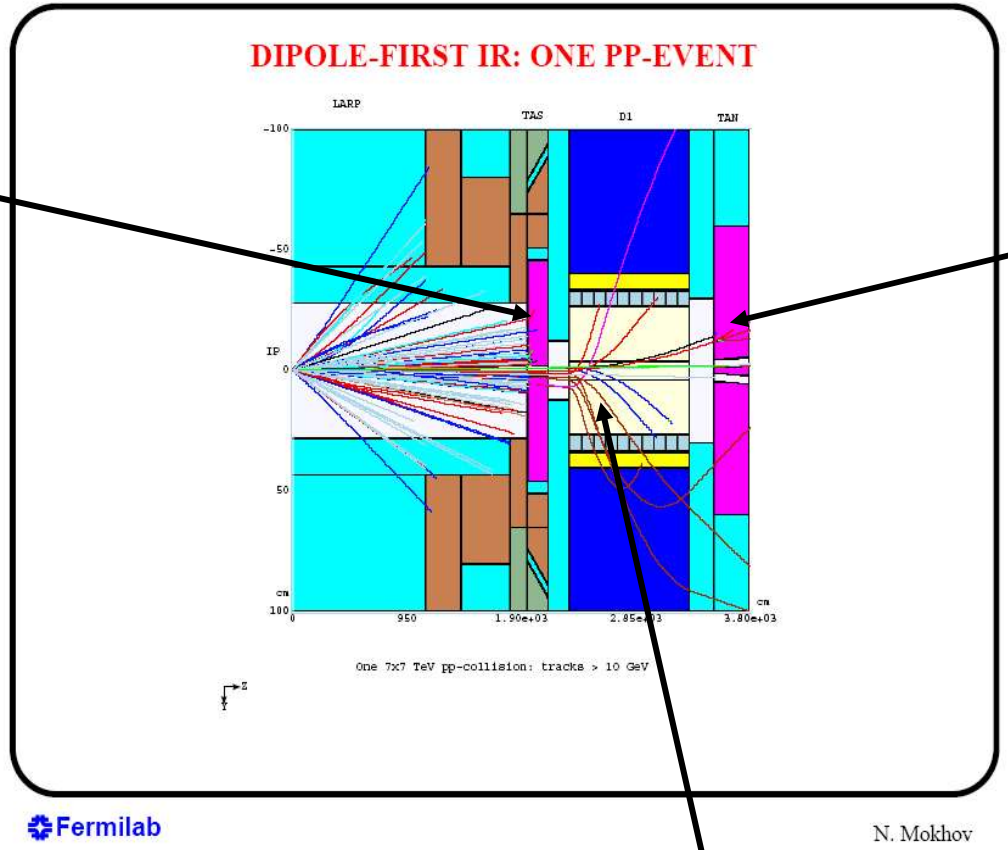
Super-bunches – very long ones – are now eliminated as delivering too many events per interaction

Intermediate length "longitudinally flat" bunches?

Dec 04: Open Midplane Dipole review

TAS

TAN

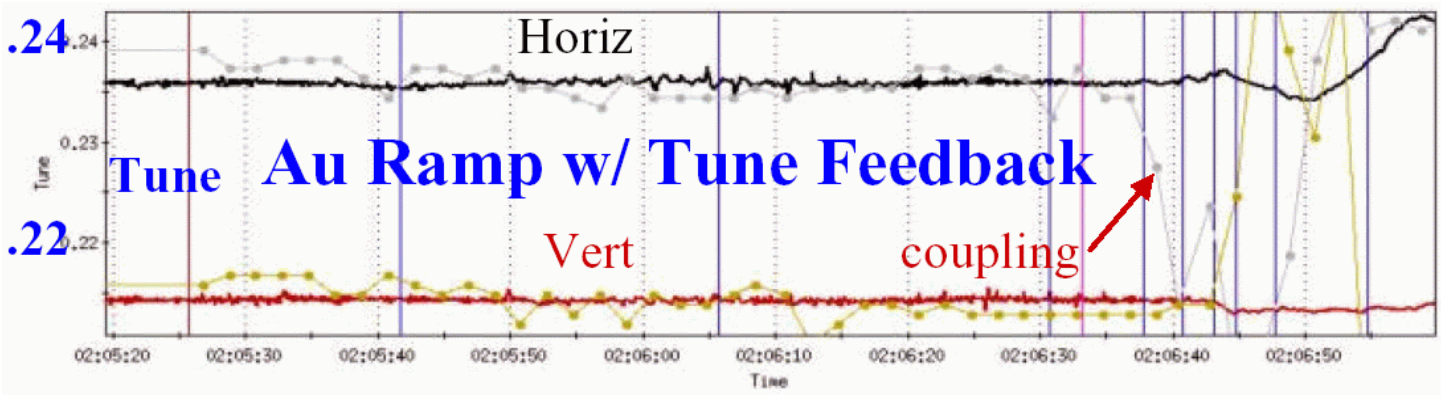


Question:

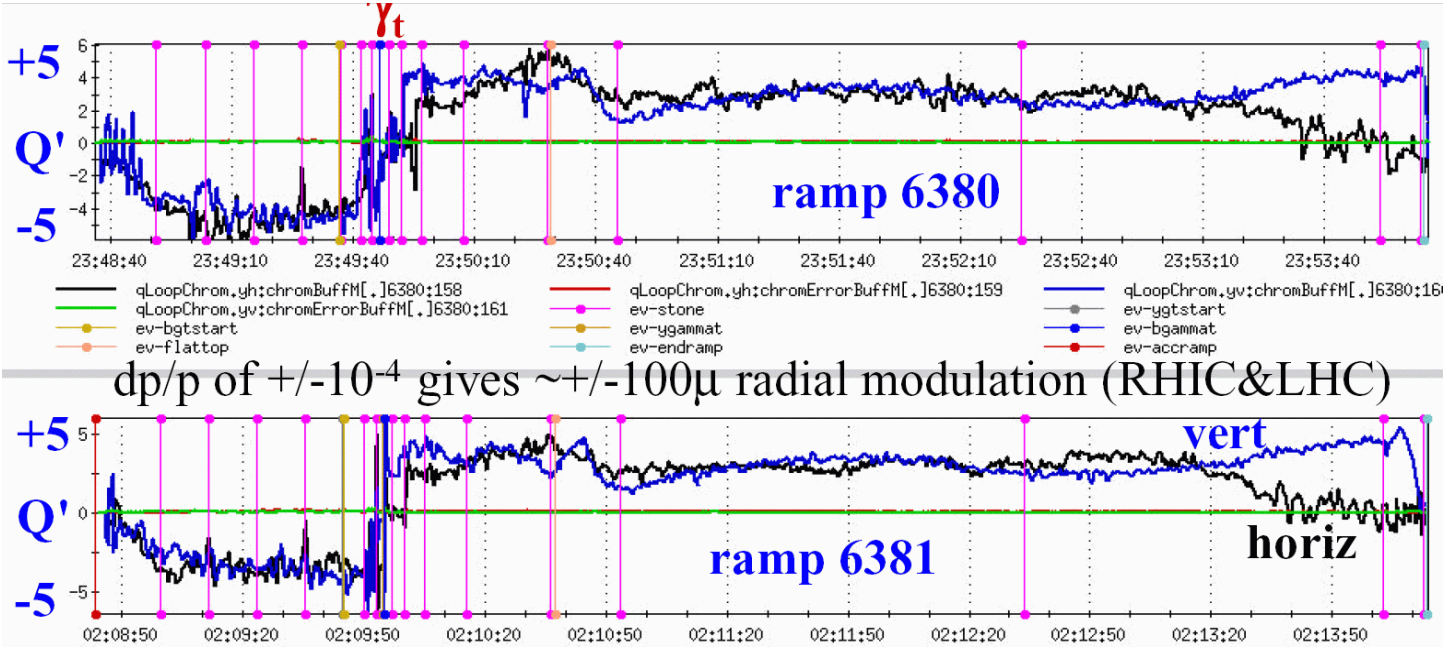
"Could a magnetic TAS help limit the flux hitting the first dipole?"

Most debris particles (many kW?) are swept into the first dipole in a "dipole first" scheme

Mar 05: Tune Feedback Workshop



Tune feedback demonstration using a similar system
(not routine)



Chromaticies tracked through two ramps
(feedback not yet attempted)

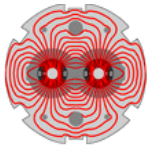
Jan 05: Chamonix XIV

APPENDIX II. : SUMMARY TABLE

Team	Number		Presence	Category	Needed Staff	Missing Staff	Missing Staff if increased parallelism	Cost of FSU or IS [kCHF]
QPPT	1	Engineer	Field	Staff, NI	5	5		
QPPT	1	Technician	Field	Staff, NI	5	5		
MIPT	1	Senior Technician	Field	Staff, NI	4	4		
MIPT	1	Senior Technician	On call	Staff, NI	1	1		
COSS	1	(Industrial Control) Software Engineer (Accelerator Systems)	Field	Staff/NI	1	1		
COSS								
					143	45		1335

Schedule slippage: some missing engineers & super-techs – 45 out of 143 – proposed to come from National Institutes

LHC seeks a "nucleus of experienced people" in magnet, cryo, & quench protection systems – 5 or 6 ? – from U.S. labs

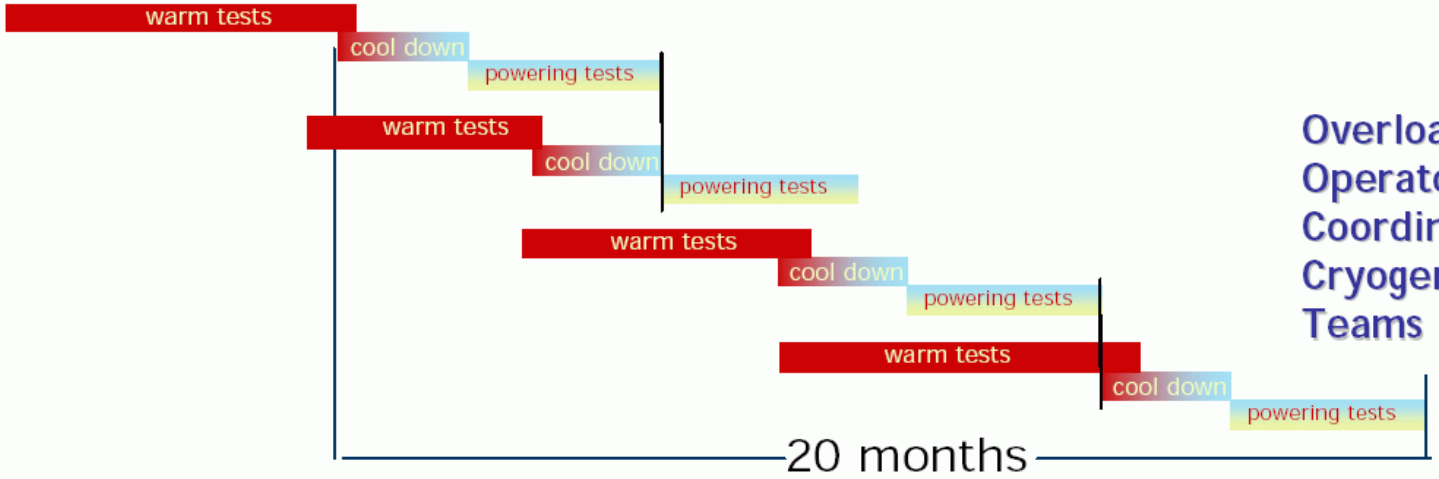


(Hardware) Commissioning

Schedule update - March 05

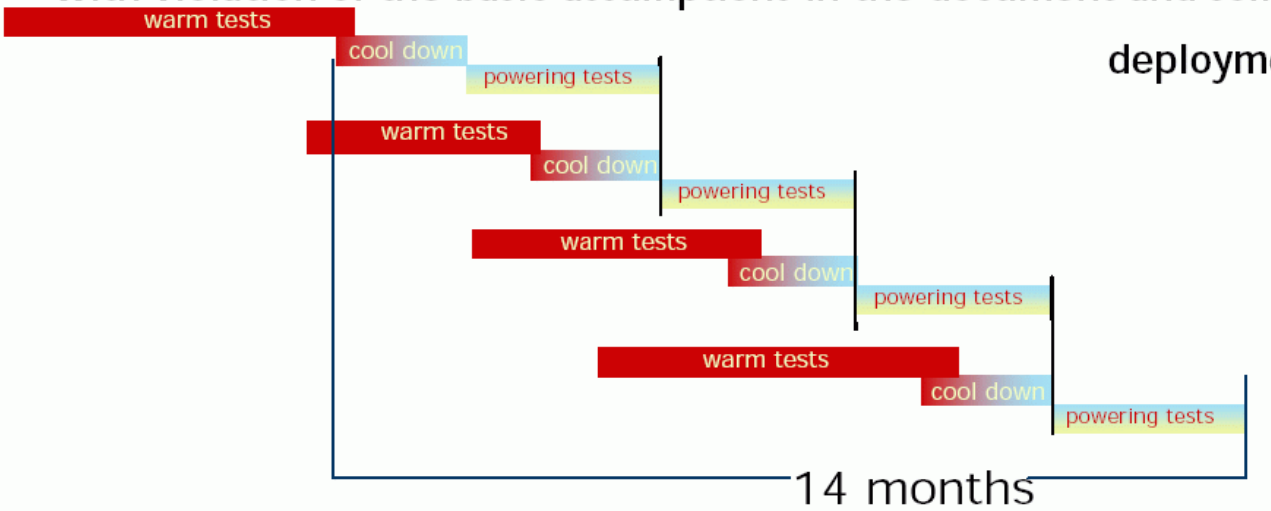
LARP

- With slight variations of the basic assumptions.



Overload of only the Operator, HC Coordination and Cryogenic Operation Teams

- With violation of the basic assumptions in the document and some conditions of deployment of the teams.



Overload of CIWSU, CIWC, CIWCS, CIWS, MI-PCIST, PCIST, ELQA CICCT,COCD, HCC, ABOP

LARP

Additional teams required

Cryogenic instrument.

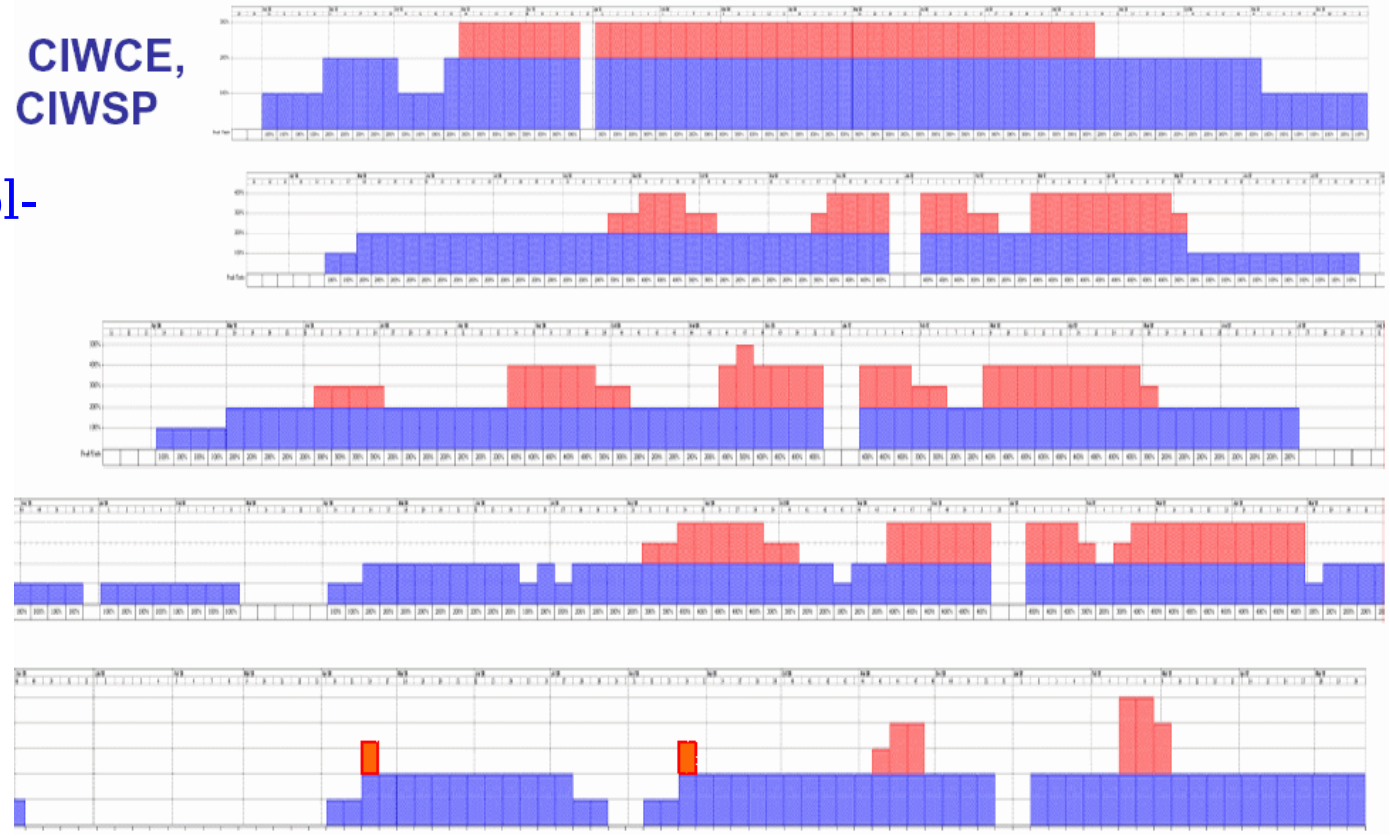
CIWCE, CIWSP

Cryo instr., cool-down & power

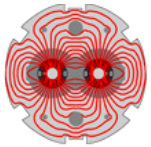
Cryogenic operation

Hardware comm. co-ord.

Electrical QA



New schedule, maintaining first beam in 2007 is more extreme - 45 staff for 20 months becomes 90 for 14 (?)



Additional U.S. support?

There is general agreement (DOE, Lab directorates, CERN) that providing additional Hardware Commissioning support

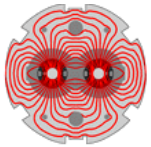
- is the right thing to do
- LARP is a potential vehicle for its organization

Current LARP scope includes only Interaction Region (U.S. built deliverables), Beam, and Instrumentation commissioning

But LARP has no mandate from DOE, CERN, or U.S. Labs.

Response: seek a formal request letter from CERN to DOE & U.S. Labs.

March 21: wordsmithing was almost complete, when ..



Commissioning Task Force

LARP has created a Commissioning Task Force, chaired by Vladimir Shiltsev (FNAL), to look at ALL potential LARP commissioning roles

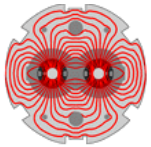
Deliverable is a white paper, ready before this summers CERN-U.S. Executive Committee meeting

This includes a head count based on a preliminary survey of potential names

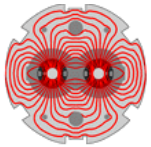
Information exchange and development at the LARP collaboration meeting (April)

Vladimir's white paper presentation to CERN-U.S. committee may be the most significant next step in the Hardware Commissioning story

Until then (basically) “wait and see” ...



Junior Workforce Pipeline



Junior workforce pipeline

The junior workforce (accelerator science & engineering) needs a national strategy on par with SRF and Superconducting Magnets

Accelerator R&D has historically been performed by HENP (not BES), with ILC participation by NSF – accept and embrace this!

LARP swims upstream against post-doc perceptions and realities:

- visas
- dollar decline ("wage cuts")
- lack of new accelerator projects

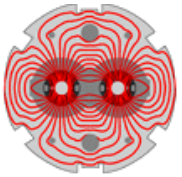
LARP junior workforce will help build the ILC – beware the pipeline bubble!

Consider potential university, Japanese, and NSF roles in LARP by analogy with ATLAS, CMS, and ILC?

- (eg crab cavities)

Toohig Fellowships

to work in LARP



Beginning in 2006, the U.S. LHC Accelerator Research Program (LARP) is looking for candidates with recent PhD's in Accelerator Physics or Accelerator Engineering to participate in:

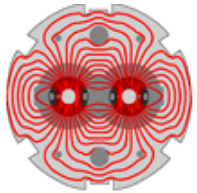
1) LHC commissioning, and/or
2) an Interaction Region upgrade.

Toohig Fellowships last 2 years, extendible by 1 year, with approximately equal time spent at a U.S. lab (BNL, FNAL, LBNL, or SLAC) and at CERN.

If you are interested, please send a resume or contact Peter Limon (pjlimon@fnal.gov) or Steve Peggs (peggs@bnl.gov)

See http://www.rhichome.bnl.gov/LARP for LARP information

Father Tim Toohig



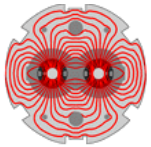
1928	Born, Lawrence Massachussetts
1962	PhD in HEP, Johns Hopkins (& LBNL)
1965	Ordained as Jesuit priest, Boston College
1966	BNL Accelerator Department
1970	Founding member of Fermilab
1978-79	Sole American resident at Dubna
	internationalist at height of the Cold War
1988	SSC Central Design Group (LBNL)
	Deputy Dir. of Conventional Facilities (SSCL)
199n	DOE Office of High Energy Physics
	helped create “LHC Construction Project”
	enabled LARP as we know it
2001	Dies, at LHC PAC meeting, SLAC

Quotes

N. Mokhov: "In the 80s, Tim was twice my guest at IHEP (Protvino). I remember our disputes on scientific, political and religious issues. He spoke Russian rather well but with a terrible Boston accent."

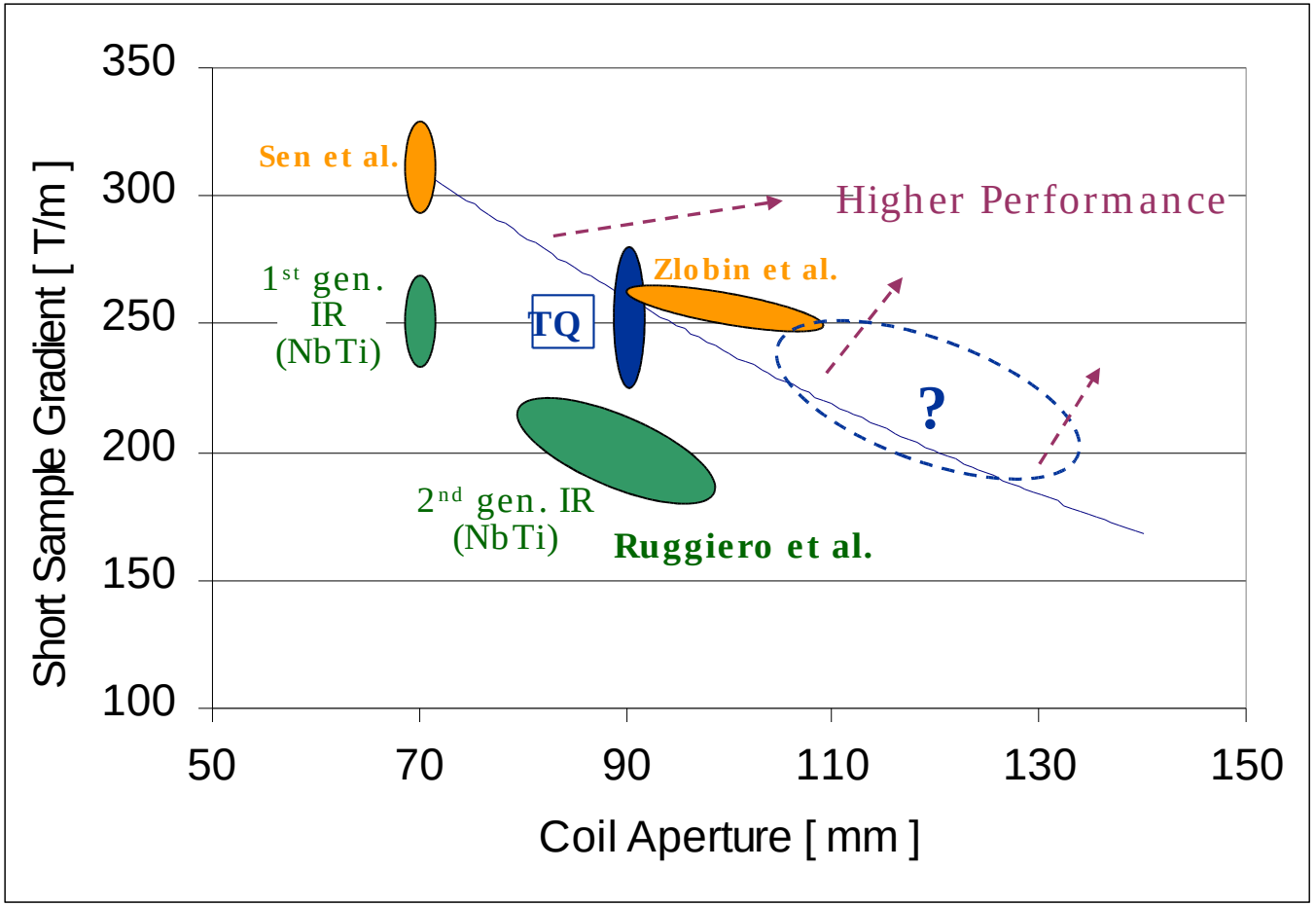
T. Toohig: “Being a Jesuit priest, if I see people playing games, I can get righteous; being Irish, I can shoot 'em in the knees.”

T. Toohig: “Scientific knowledge is incompatible with a lazy faith. If you're going to be a believer, the props are gone. You really have to come face to face with the question of God. It's more scary on one hand and richer on the other hand.”

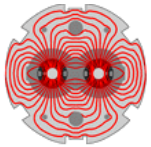


Magnet Program

Nb_3Sn quadrupole parameter space



All upgrade scenarios require state-of-the-art quads, but final parameters will only be established with beam experience



Quadrupoles

Ruggiero, Taylor, et al - EPAC 04

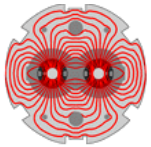
"The choice of the coil aperture is driven more by the power density limit than by the beam acceptance"

"An estimate of the radiation parameters of the magnets requires extensive simulations based on detailed knowledge"

LARP External Review - June 2004

"LAPAC suggests that the main issue is demonstration that (Nb_3Sn) quads can be made in both long and short lengths."

"... demonstration of a working long quadrupole, the first of its kind in the world, will be a key element in the decision to start ... the LHC luminosity upgrade."



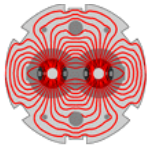
Beam separation dipoles

Open Mid-plane Dipole review – Dec 04

“While the 'dipole first' scenario may not be implemented in the first IR upgrade, it remains a viable option for later upgrades.”

"The 'open mid-plane dipole' developed at BNL is a novel concept with several features well suited to face the challenges of the separation dipole (D1) in the 'dipole first' scenario.”

“We suggest continuing and expanding this development to include the aspects not yet covered .... in order to achieve a complete conceptual design ...”



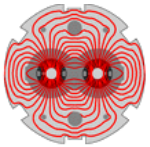
LARP

Strawman goals & timeline

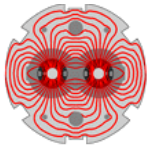
1) High gradient large aperture quad
2) Long magnet scale-up
3) Proof-of-principle open midplane dipole

	Length [m]	Aperture [mm]	FY05	FY06	FY07	FY08	FY09
Model Magnets							
Quads							
Reduced gradient cos(2θ)	1	90		X X			
Full gradient cos(2θ)	1	90		X	X	X	
Full gradient	1	~120			X	X X	X
Field quality development	2						X X
Full length, full gradient	4						X
Dipoles							
Open mid-plane PoP	1					X	X
Supporting R&D							
Sub-scale tests	1		X X	X X	X X	X X X	X X
Long coil tests	4				X	X	

06 Full gradient cos(2θ) quad
07 Wind & React full length racetrack coil
08 Proof-of-Principle open midplane dipole
09 Full length full gradient quad



Budget



LARP

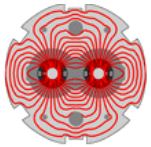
Top down exercise…

Constrained to match DOE guidance

US LHC Accelerator Research Program Mar 15, 2005 WBS		LARP level 2 top down planning FY05	FY06	FY07	FY08	FY09
	DOE guidance	3500	11000	11000	12000	12000
	Actual	3217				
1	**Accelerator Systems**	1643	3100	3100	3200	3000
1.1	**Instrumentation** (Byrd)	605	790	750	800	800
1.2	**Acc. Phys. & Comm.** (Syphers)	718	1500	1690	1800	1600
1.3	**Collimation** (Markiewicz)	320	810	660	600	600
2	**Magnet R&D**	1013	4500	4500	5400	5600
2.1	**Design Studies** (Zlobin)	153	440	440	440	440
2.2	**Model Magnet R&D** (Sabbi)	669	1880	1880	2240	2360
2.3	**Supporting R&D** (Ambrosio)	102	1230	1230	1580	1600
2.4	**Materials** (Ghosh)	89	950	950	1140	1200
3	**Program Management**	561	1400	1400	1400	1400
	Planning Contingency		2000	2000	2000	2000

Prog. Mgmt. includes 25% L2 labor, program travel, post-docs, …

Planning Contingency reduces to $0k on October 1



.. bottom up at Port Jeff

"Enable" L2 co-ordinators to resolve their plans & budget requests for FY06 & FY07 at the collaboration meeting, April 6-8.

Level 4 "Task sheet" plans are already in place for 05 -> 06 -> 07

Evaluate / prioritize /defer potential new tasks ...

Mar 15, 2005		FY2006 LARP Budget Work Sheet				
WBS		BNL	FNAL	LBNL	SLAC	Total
US LHC Accelerator Research Program						11000
1 **Accelerator Systems**						3100
1.1 **Instrumentation**	**Byrd**					790
1.1.1 Phase I						
1.1.1.1 Tune feedback	Cameron					
1.1.1.2 Luminometer	Byrd					
1.2 **Acc. Phys. & Comm.**	**Syphers**					1500
1.2.1 Commissioning						
1.2.1.1 Beam Commissioning	Harms					
1.2.1.2 Interaction Region Commissioning	Lamm					
1.2.2 Accelerator Physics						
1.2.2.1 Electron Cloud	Furman					
1.2.2.2 Interaction Regions & Beam-Beam	Sen					
1.3 **Collimation**	**Markiewicz**					810
1.3.1 Phase I						
1.3.1.1 Cleaning efficiency studies	Drees					
1.3.2 Phase II						
1.3.2.1 Rotating Collimator R&D	Markiewicz					
1.3.2.2 Tertiary collimator study	Mokhov					
2 **Magnet R&D**						4500
2.1 **Design Studies**	**Zlobin**					440
2.1.1 Quadrupole						
2.1.1.1 Shell & Block design comparison	Ferracin					
2.1.1.2 Shell mechanical design study	Ambrosio					
2.1.2 Separation dipole						
2.1.2.1 D1 design	Gupta					
2.1.2.2 D1 cooling study	Peterson					
2.2 **Model Magnet R&D**	**Sabbi**					1880
2.2.1 Quadrupole						
2.2.1.1 Technology Quad TQ1a	Caspi					
2.2.1.2 Technology Quad TQ2a	Zlobin					
2.3 **Supporting R&D**	**Ambrosio**					1230
2.3.1 Subscale models						
2.3.1.1 Small Quad SQ01b test	Feher					
2.3.1.2 Small Quad SQ02 fab & test	Ferracin					
2.3.1.3 Sub-scale dipole test	Schmalzle					
2.4 **Materials**	**Ghosh**					950
2.4.1 Conductor Support						
2.4.1.1 Strand R&D	Barzi					
2.4.1.2 Cable R&D	Dietderich					
3 **Program Management**						1400
3.1 **Administration**						
3.1.1 Systems						
3.1.1.1 Accelerator Systems	Peggs					
3.1.1.2 Magnet R&D	Gourlay					
Planning Contingency						2000
Potential new Tasks						
AC dipole (Kopp)						
Beam-Beam wires (Fischer/Sen)						
Cryogenics – conceptual design						
Energy tripler magnets (McIntyre)						
Irradiation studies (Simos)						
Long magnet scale-up						
Schottky monitor (Jansson)						
Technology Quad TQn ()						