

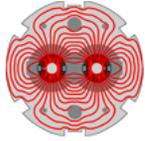
LARP

US LHC Accelerator Research Program

bnl - fnal- lbnl - slac

LARP Accelerator Systems: Summary

Vladimir Shiltsev



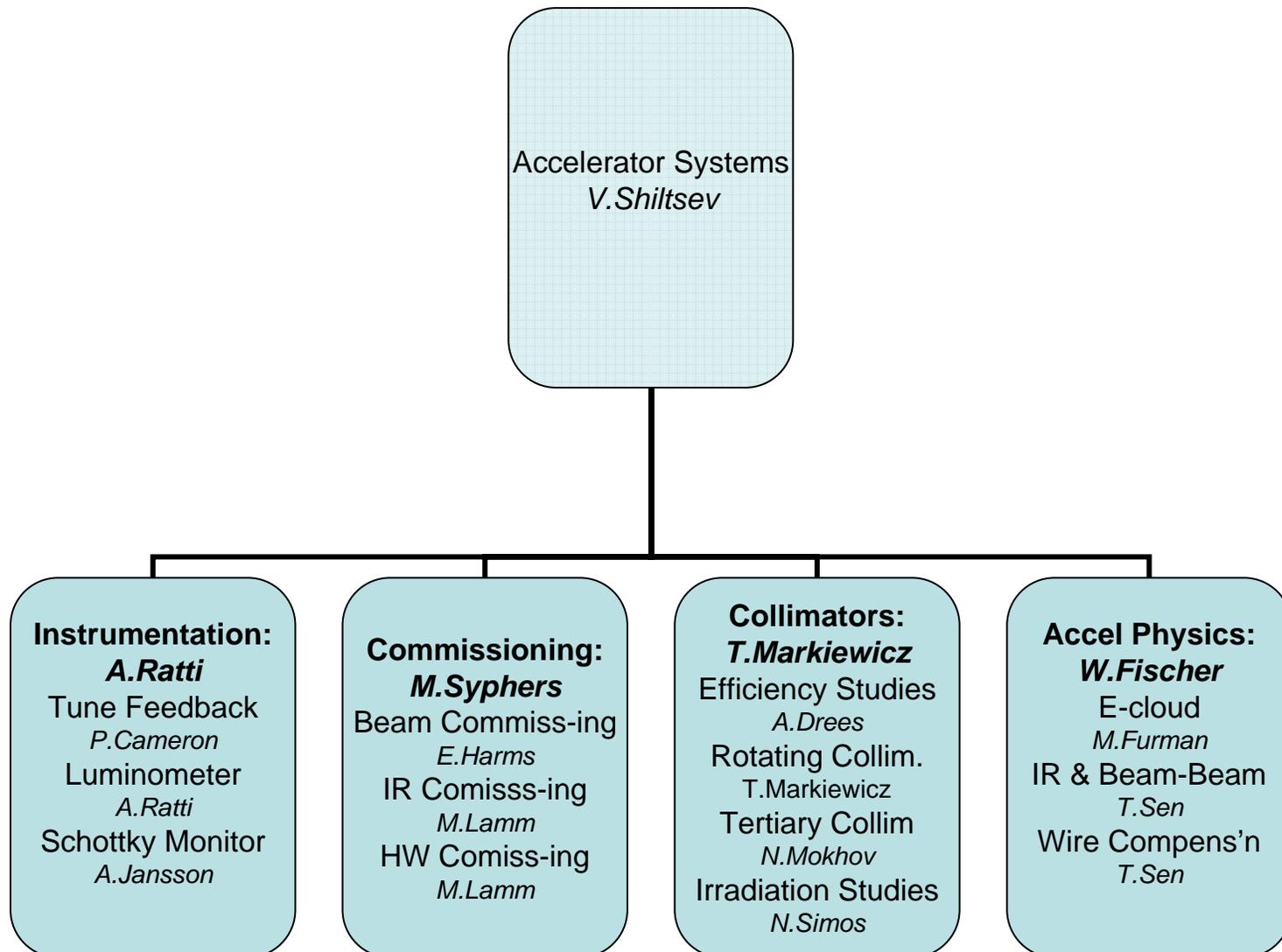
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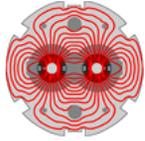
Content

- **Accelerator Systems Summary:**
 - LARP AS Organization Chart, changes
 - Last DoE Review recommendations, concerns
 - Communication within LARP AS
 - FY06 Budget and spending to date
 - Accelerator Systems Progress Highlights
 - Task Sheets, Reviews, Meetings
- **New Proposals and Tasks:**
 - New proposals
 - “Group of 5+1”
 - Status of consideration & approval process



LARP Accel. Systems Organization





LARP

Changes in Organization

- “Commissioning” and “Accelerator Physics” L2 Tasks split right before DoE Review in November 2005
- Wolfram Fischer of BNL appointed Accelerator Physics L2 task leader
 - See Scorecard:

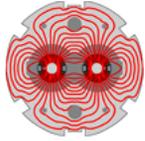
Recommendation – Beam Commissioning

BC2: One result of the change in management was the separation of accelerator physics and beam commissioning. The committee felt that that it would have been useful to provide more elucidation for this decision. Clearly, there are differences between the two sets of tasks, but many of the accelerator physics tasks (and hopefully personnel) have relevance to beam commissioning. It would be useful to understand the rationale for this change, and this should be provided at the next DOE review.

Response/Action Plan

There were two reasons behind separating BC and AP: First, the number of activities to cover had grown to some 7 (HC, BC, LHC@FNAL, e-cloud, beam-beam, wire compensation, IR design), hard to track and manage by a single L2 leader. Second, none of the AS L2s could devote 100% of their time to LARP. As a result, it was decided to separate BC and AP L2 tasks under the leaderships of Drs. M. Syphers (FNAL) and W. Fischer (BNL). To our further advantage, this also helped to balance representation between the labs at the AS L2 level

- New changes to reflect new tasks and initiatives anticipated:
 - As discussed at LARP collaboration meeting, advised by LARPAC and approved by LARP Executive Committee
 - See details below



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Communication/Coordination

- **Communication within LARP:**
 - VideoConf of all AS L2s+Steve ~once/mos (2 mos)
 - L2 tasks have their own: e.g. Collimation regular VC introduced
 - One-on-one meetings (site visits, reviews, etc) ~once/qrtr
 - Collaboration meetings ~twice/year
- **Communication with CERN**
 - First “long-termers” (P.Limon et al)
 - Visits (HC, BC, Instr, etc) >1/mos
 - Workshops (e.g. TAN) and reviews (e.g. RC) ~once/qrtr
 - LARP Collab Meetings ~twice/yr
 - US-CERN meetings ~ once/yr
- **Web:**
 - LARP Doc DB is functioning, smashing success
 - USLARP.org is functioning, e.g. this event, becoming “the one”

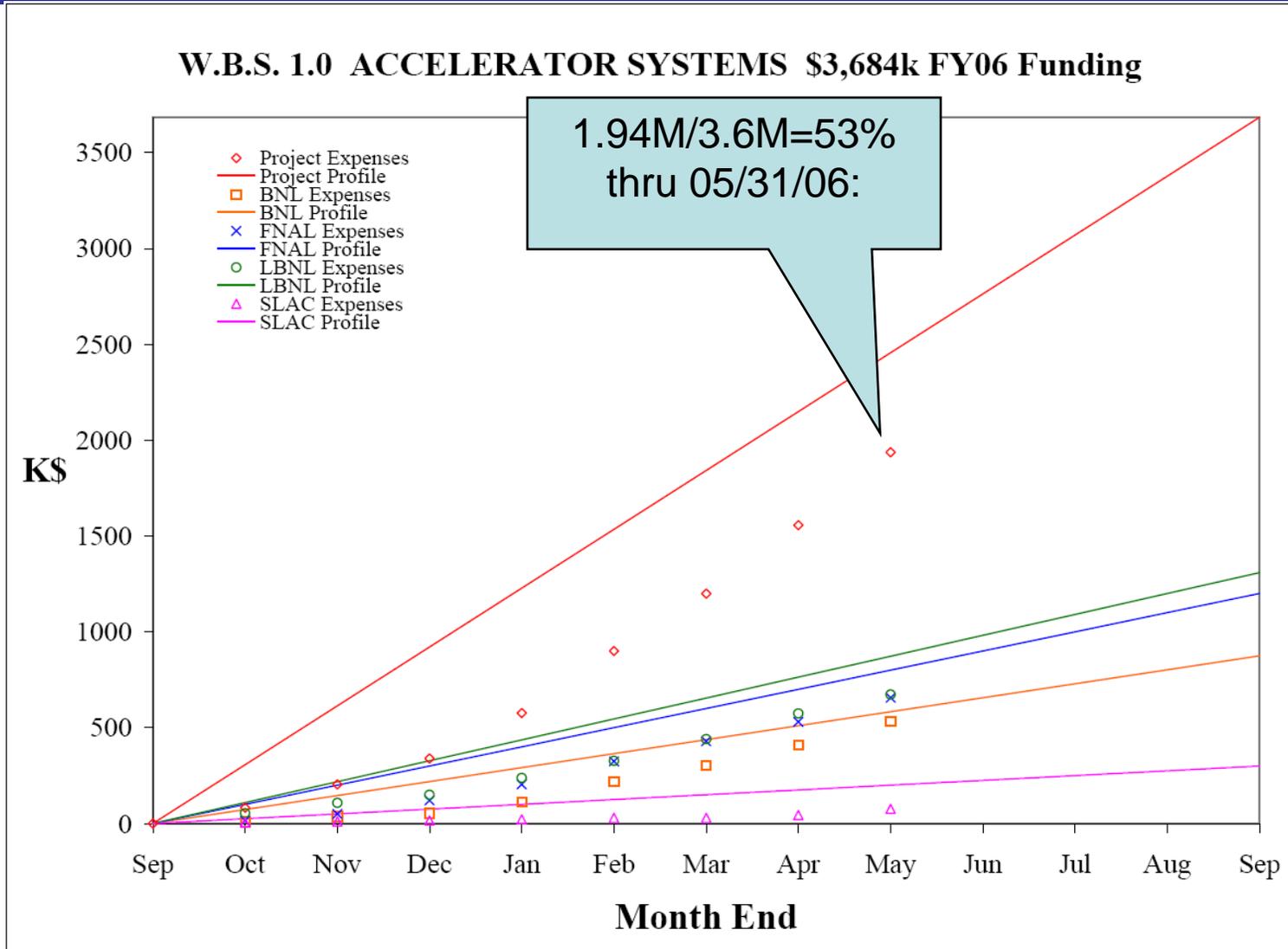


FY06 Accelerator Systems Budget

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		

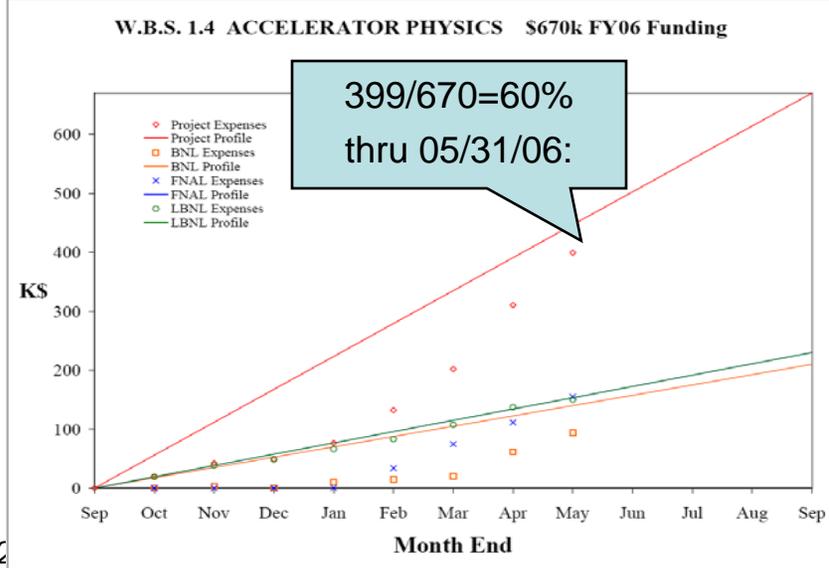
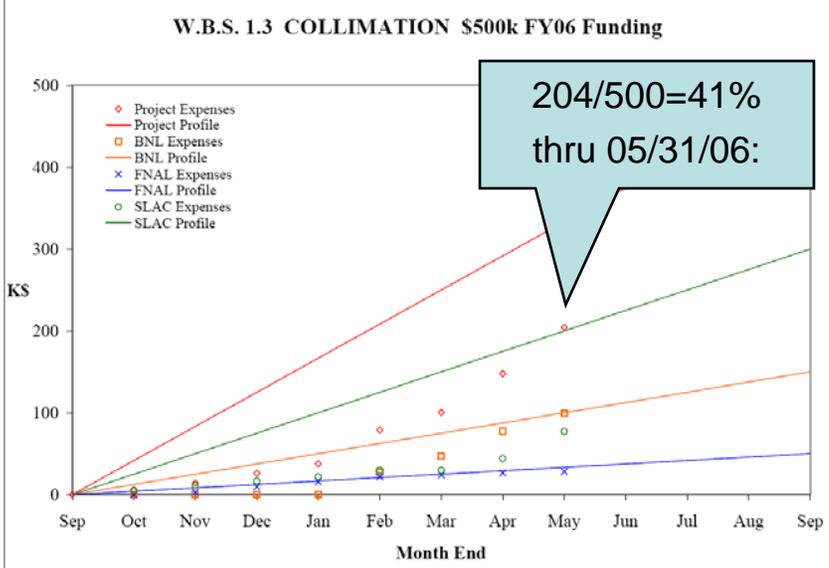
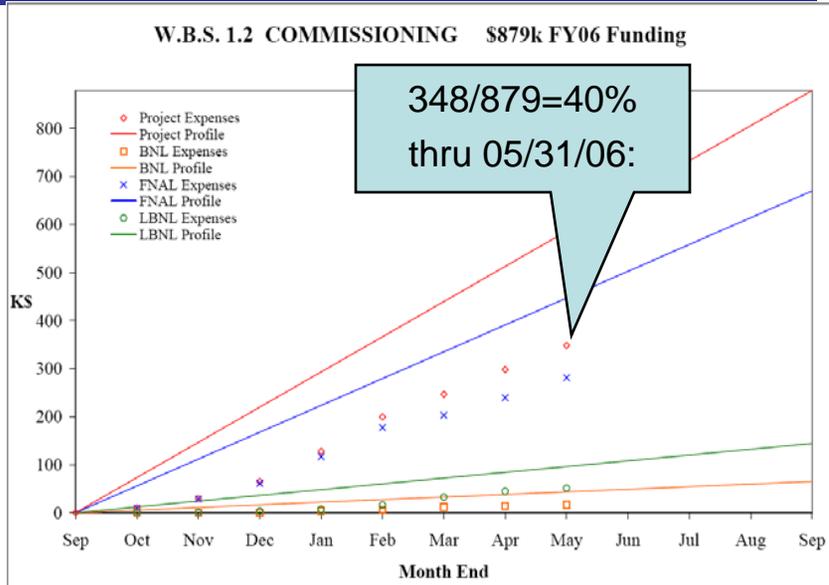
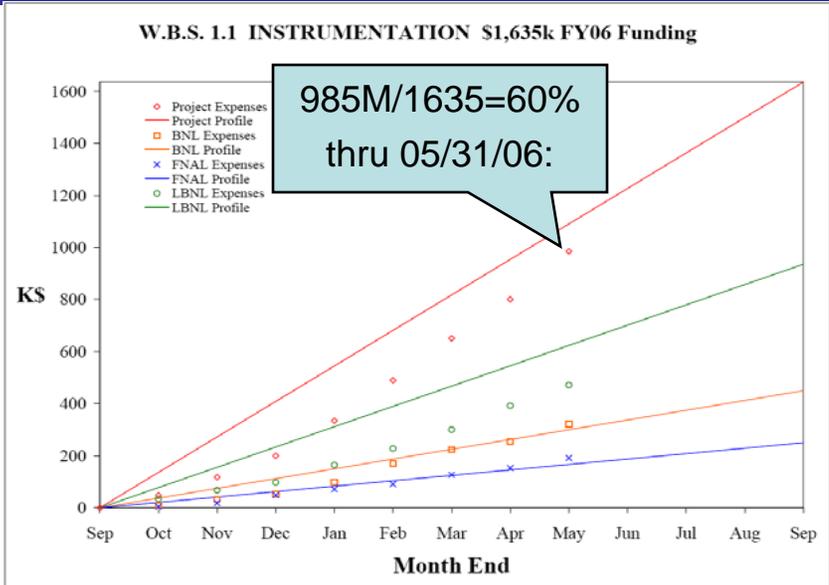


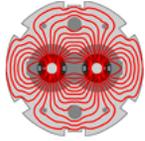
Accel.Syst. Spendings - Overall





Accel.Syst. Spendings - II



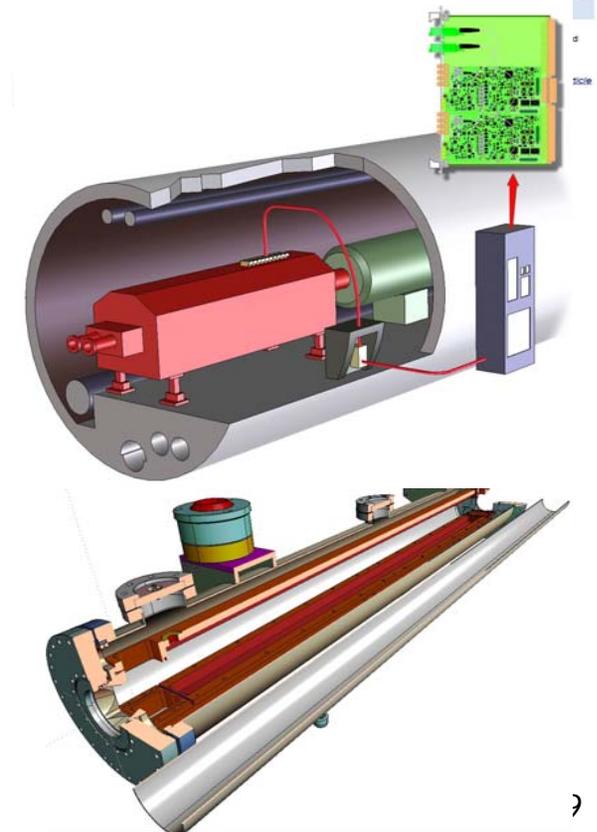
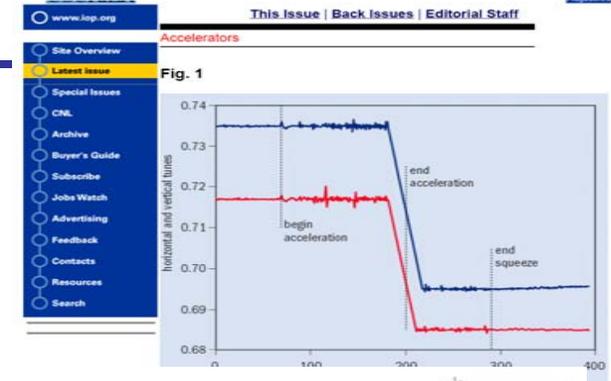


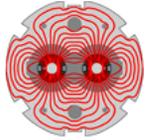
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Summary: Instrumentation



- **Tune Feedback:**
 - Breakthru with "3D" and 4-mode tracking (Q1)
 - Impressive results with TCFB in RHIC (Feb'06)
 - Yet some technical problems to resolve
 - SPS test (Summer'06)
 - Final System Design Review (Oct'06)
 - Firmware ready, support HW/Beam Commiss (FY'07)
- **Luminometer:**
 - Successful 40MHz ALS x-ray test
 - Design completed and reviewed (April'06)
 - RHIC tests and rad tests at CERN (Summer'06)
 - Four systems complete (Winter 06-07)
 - Installation and integration support (FY07)
- **4.8 GHz Schottky:**
 - Designed and sent to CERN (May'06)
 - Review June 22, 2006 at CERN
 - CERN will build & install in FY'06
 - LARP will build analog electronics (FY06)
 - FY'07 trips for commiss. (w/o, with beam)





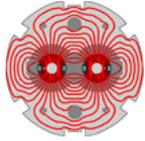
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Another Concern from Oct'05 DoE Review: **Sign-Offs**

- Alex Ratti developed an acceptable – for both US and CERN – 6-item Sign-Off Documentatation scheme
- Now – for instrumentation only, later for other tasks
- It's model for other tasks (Collimators, Wires, etc)

Planned documentation for each instrument

1. FS - Roles and Responsibilities
 1. Defines who does what, when
2. ES- Technical Specification
 1. Complete description of the device, its interfaces, its requirements....
3. ES - Functional Spec (of DAB 64x interface)
 1. Definition of what functions and features are included in the data acquisition system
4. ES - Memory Map of Firmware
 1. How the data is transferred to the control system
5. Any other document
 1. (ES) Safety, installation, HW checkout and commissioning,
6. FS - Acceptance Plan and signoff list
 1. Contains a list of deliverables from LARP to CERN
 2. Signoff list
 3. Once accepted, defines the end point of LARP's contribution to the instrument



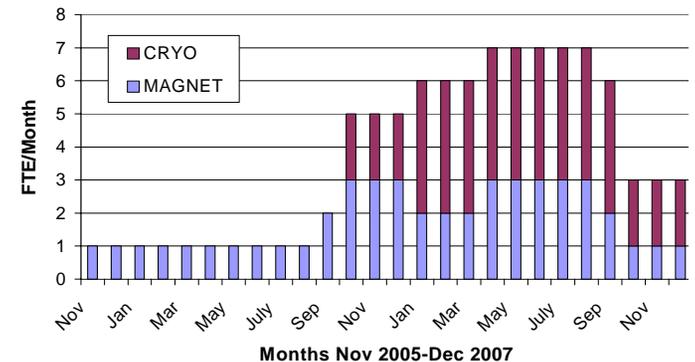
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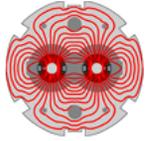
Summary: Commissioning

- IR Commissioning:
 - 1st US string in LHC tunnel (Dec'05)
 - 7 LARP'ies for USLHC oversight (Feb'06)
 - Installation of 2nd IR quad/DFBX/D1 on-going
- Hardware Commissioning:
 - Support from: FNAL 4-7 and LBL 2-3 FTEs
 - CERN's "project associate" status to LTC-ers
 - 3-4 to follow the 1st one (PJL) in the Fall 06
 - Plan to peak of 7 in Summer'07
- Beam Commissioning:
 - Coordination with CERN established (Spring'06)
 - LHC@FNAL approved (May'06)
 - BC Solicitation Letter sent (may'06)
 - 3 people scheduled for SPS run in Summer'06
 - LHC@FNAL to open in Sep'06
 - Planning to participate for Sector Test (CY'07)
 - Start-up and long-term BC-ers yet to be named and scheduled (review in FY'07)



Proposed Profile for LARP Hardware Commissioners

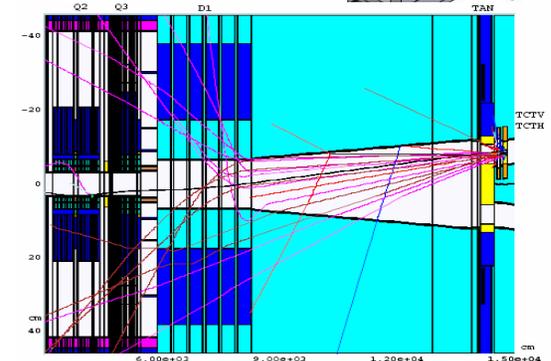
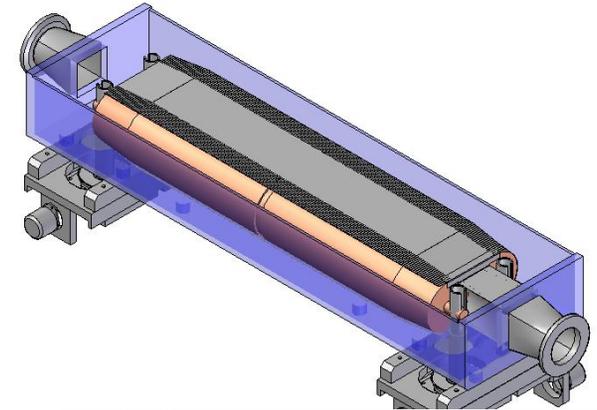


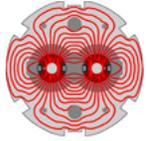


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Summary: Collimation

- Benchmark LHC Tracking codes:
 - Good agreement with RHIC ion rad maps (CY05)
 - Progress slow in FY06 due to lack of manpower
- Rotating Collimator:
 - RC1 design reviewed by CERN (Fall'05)
 - CDR reviewed, changes recommended (Dec'05)
 - Manpower issues: Engineer+Designer hired (Apr)
 - Schedule slipped by ~6 mos
 - Single jaw tests, support/stopper design (Fall'06)
 - RC1 performance report (mid-FY07)
- Tertiary Collimators:
 - IR1 modeled and studied with BEAM1 (Spring'06)
 - 3 more MARS runs for IP5 and BEAM1&2 (FY'06)
- Irradiation Studies:
 - 2D C-C irradi'd at BLIP, new findings (Q1-2 FY'06)
 - Cu, GlidCop and 3D C-C under tests (FY'06-'07)

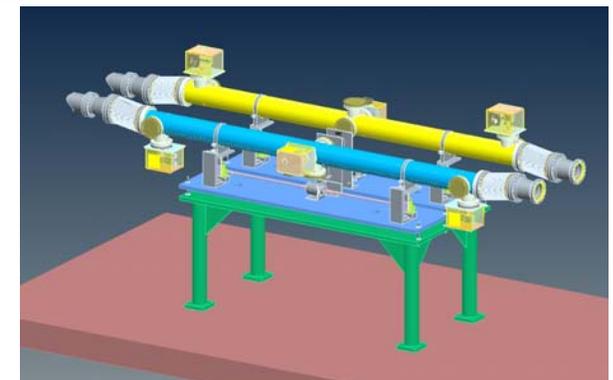
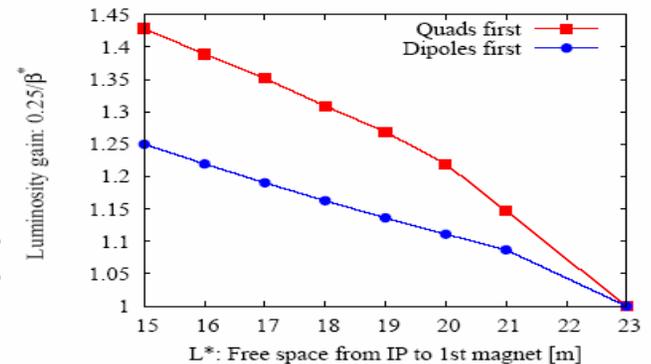
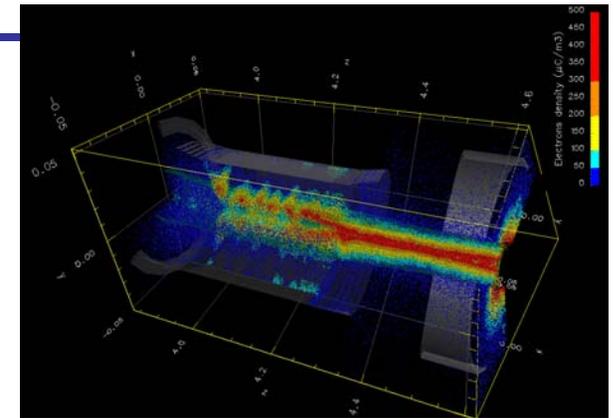


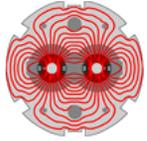


LARP

Summary: Accelerator Physics

- Electron cloud simulations:
 - LHC dipoles e-cloud simul's done (PRSTAB,03/06)
 - Successful benchmarking POISINST.vs.HCX(Apr'06)
 - RHIC detector studies ongoing
 - Long list of studies (12.5ns, ions, 3D, SPS data, etc)
- IR and Beam-Beam:
 - Concept design of three IR schemes (QF,DFr,DFe)
 - 4-lab Simulation collaboration started (Dec'05)
 - Energy Deposition in "Quad First" design (Q4 '06)
 - Nonlinear correction schemes for 3 designs (CY'06)
 - Directions set after Valencia Workshop (Oct'06)
- Long-range Wire Compensation:
 - Wire designed and under construction (Q1-2 FY'06)
 - RHIC experiments and 4 lab simulations (Q2 '06)
 - Install the wire (CY'06)
 - RHIC studies and more simulations (mid FY'07)





LARP

Special Attention: “Hard Deliverables”

- As presented by H. Schmickler at the LARP Collaboration Meeting (April'06, LBNL, see the Meeting Summary)
- Endorsed by the LARP Executive Committee (June 5, 2006)
- “Hard deliverables” are the projects which CERN needs but can not back-up itself in case of failure (thus, special attention and protection needed):
 - Lumi Monitors for 2 IPs (2007)
 - Tune Feedback (2007)
 - Beam Commissioning (2007-2009-beyond)
 - Phase II rotating collimators prototype (2009)



Planning and Tracking: TS, Reviews, NI

US LHC Accelerator Research Program
Task Sheet FY06

Task Name: Schottky Monitor (1.1.1.4)

Date: May 10, 2006

Responsible Person: Andreas Jansson

Statement of work:

The goals for Fiscal year 2006, which is the first year this task receives LARP funding, are (i) to clearly define the responsibility boundaries and hardware/software interfaces with CERN, (ii) agree on a data acquisition scheme and platform (e.g. DAB board), (iii) design the pick-up structure and associated signal processing, and (iv) review the entire proposed system towards the end of the year.

Milestones:

- Nov 05 Initial planning trip to CERN (by Ralph Pasquinelli) to discuss all relevant project details with the appropriate people.
- Jan 06 Based on information from the planning trip, complete an "integration document", signed off by both parties, and entered into CERN Electronic Document Management System (EDMS).
- Summer 06 Hold a review of proposed design, with reviewers from LARP and CERN.

Budget:

The total budget for FY06 is \$245k, divided into \$200k of labor costs and \$45k for materials, travel, contracts and services (MSTC). Of the labor budget, \$20k has been allocated to BNL for work on the DAB board, while the remainder (\$180k) is allocated to FNAL for design of pick-up structures and processing electronics. The MSTC budget, for processing electronics and task related travel, is allocated to FNAL.

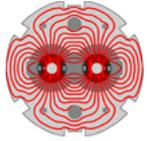
US Collaborators:

FNAL Andreas Jansson, Ralph Pasquinelli, Paul Lebrun, Ding Sun, Dave Tinsley

BNL Peter Cameron, Peter Oddo

CERN Liaison(s): Rhodri Jones, Fritz Caspers

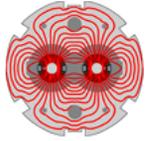
- Task Sheets are written by L2s and approved by L2s and L1s and L0
- Most useful documents
- Objective, milestones, funds and personnel resources – all can be found on one page
- Semi-annual reports are lined up along these Task Sheets



LARP

Internal Reviews

- **Rotating Collimator-1 CDR Review**
 - December 2005, chaired by W.Turner
 - OK, advised to design jaw support before “cut iron”
- **Luminosity Monitor Final Design Review**
 - April 2006, chaired by T.Shea
 - All positive, technical risks low to medium
- **Schottky Monitor Final Design Review**
 - June 22, 2006, at CERN
- **Tune FB Final Design Review**
 - Oct. 06, at BNL



LARP

LARPAC (May'06) Recommendations

- **Instrumentation:**

- Need detailed list of milestones upto 1st ramp and 1st beam (all instr)
- LumiMonitor Rad damage tests a must, more background studies!
- Provide to CERN list of spare parts, prepare written failure handling
- Use LHC@FNAL for monitoring passive instruments (Lumi, Schottky)

- **Commissioning:**

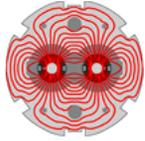
- Document details how Instrum experts will continue to be involved in BC
- Need more BC candidates → lab support → repeat CTF-like campaign
- Make sure there are people in the LHC@FNAL, VC room

- **Accel Phys:**

- recommend e-cloud collaboration with PEP-II and ILC DR

- **New Initiatives :**

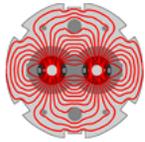
- New initiatives should be consistent with LARP goals after '08-'09
- Don't hurt current programs
- Sufficient homework must be invested for each initiative



LARP

Collab.Mtg.: 10 New Initiatives

- Recently initiated (minor) activities:
 - Flux jumps effects (T.Sen, *et al*)
 - dB/B measurements (V.Shiltsev, *et al*)
 - Head-tail chromaticity measurements (V.Ranjbar, *et al*)
- Potential new L3 tasks (need feasibility studies):
 - AC dipole (S.Kopp, *et al*)
 - Crystal collimation (N.Mokhov, *et al*)
 - Longitudinal Density Monitor (J.DeSantis, *et al*)
 - e-lenses for Head-on B-B Compensation (V.Shiltsev, *et al*)
 - Crab cavities (R.Calaga, *et al*)
- Considerations on Large Scale Improvements:
 - 1.5TeV Injector in LHC tunnel LER-LHC (H.Piekarz, *et al*)
 - Optical Stochastic Cooling (A.Zholents, *et al*)

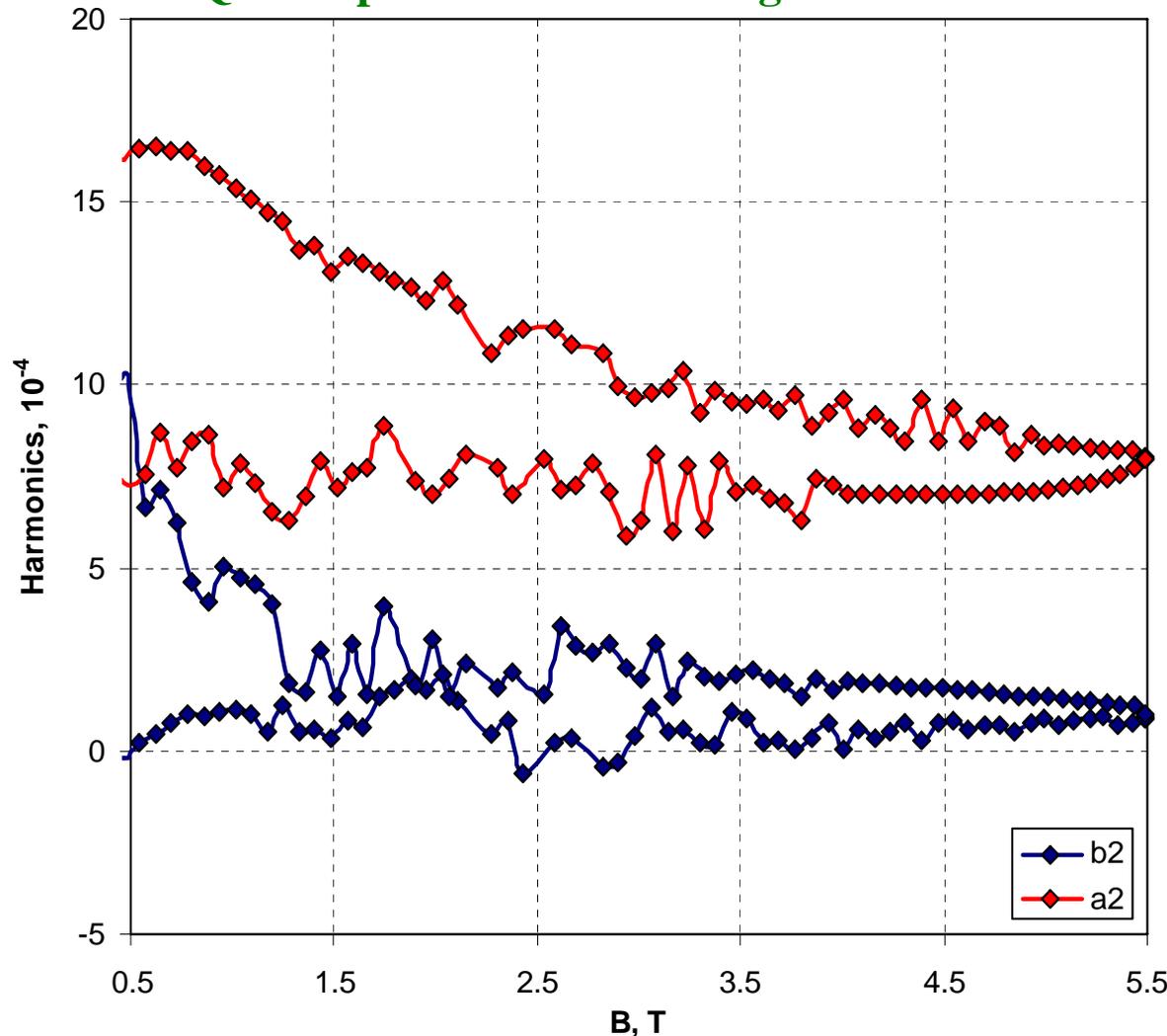


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Flux Jumps

T.Sen

Quadrupole in HFDA04 magnet



An accelerator magnet would need to demonstrate no or sufficiently small fluctuations

How small?

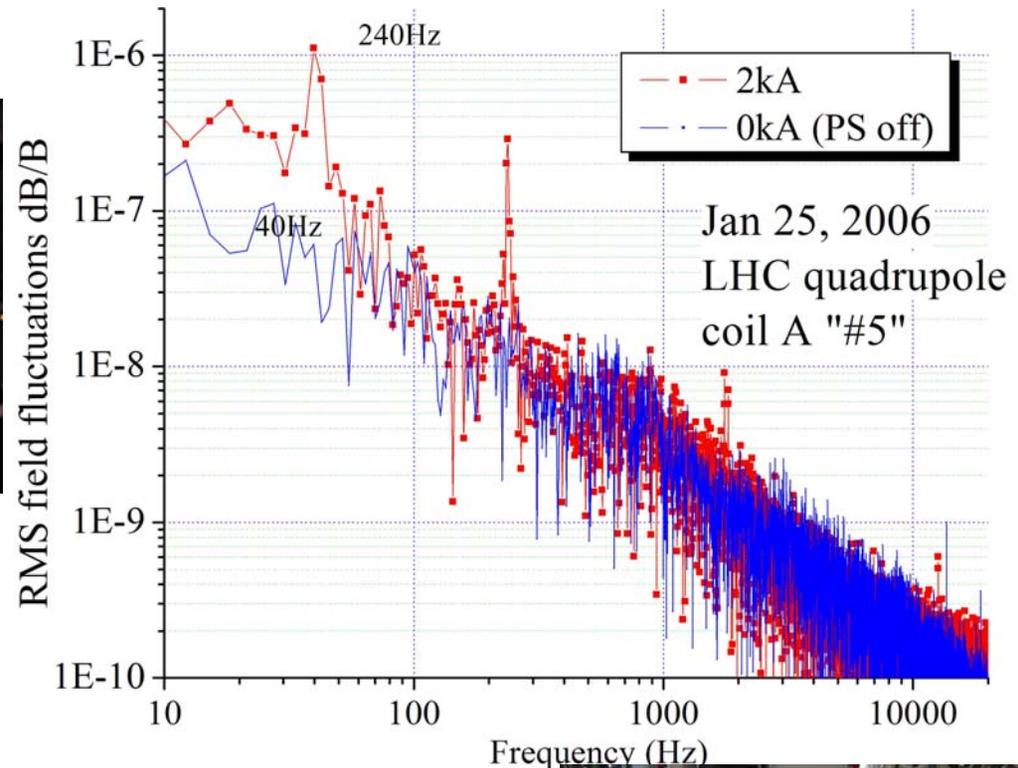
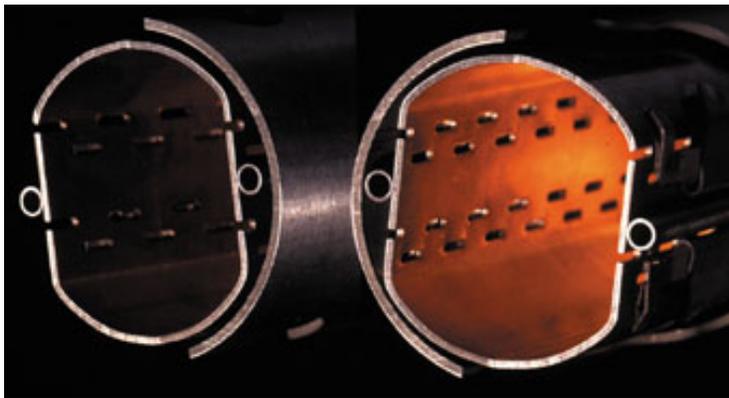
preliminary estimates show that 1 unit of $d(b3)$ will result in ~ 2 units of Q' jumps if residual dispersion controlled to better than 1 cm at I

tune jumps can be $\sim 3e-4$
all nonlinear effects need to be studied (AccelPhys)



Fast dB/B Fluctuations *v. Shiltsev*

LHC tolerance: $\text{dB/B} \sim 3 \times 10^{-10}$



LHC screen: light and feels 20 K

He flow turbulence;

B-flux is constant at 3kHz

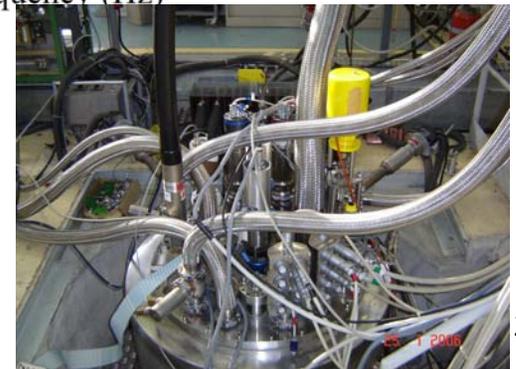
→ $\text{dB/B} \sim \text{dR/R}$ → need

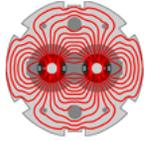
$\text{dR} < 1\text{A}$ to blow horizontal
emittance

*First attempts at CERN
(2006):*

*$\sim 1 \times 10^{-8}$ noise in quad/no
screen*

$\sim 1 \times 10^{-7}$ with air flow

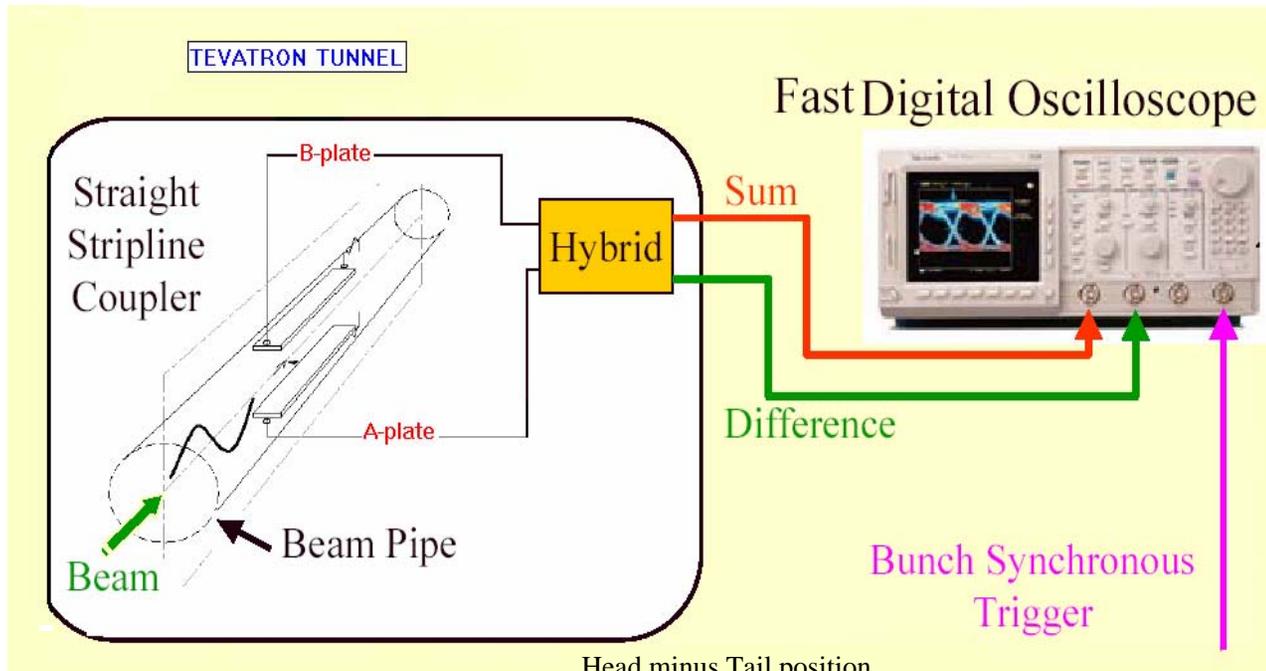




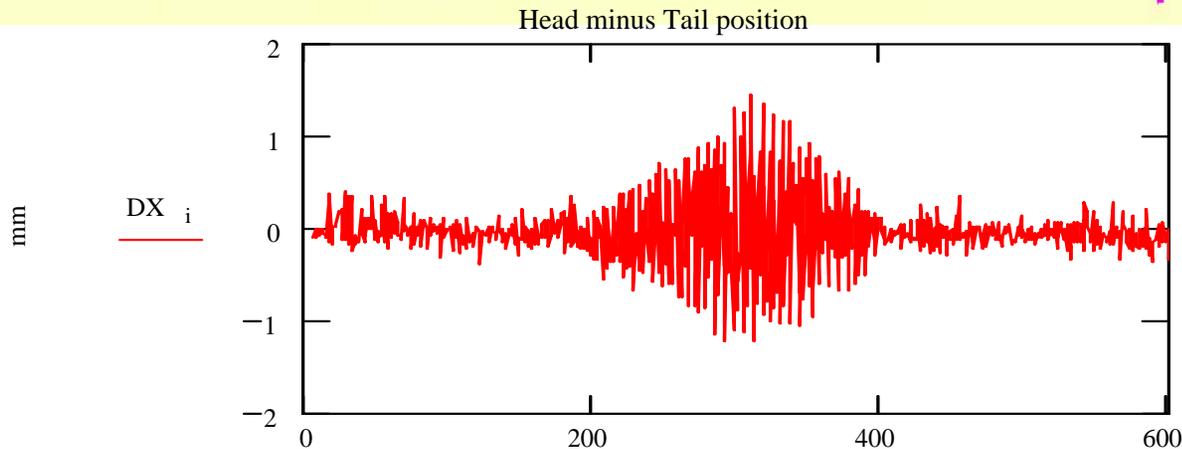
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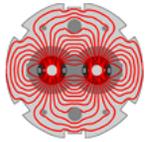
Fast Q' Head-Tail Monitor

V. Ranjbar



- Particles with different dP/P have different tunes \rightarrow head-tail phase difference $\sim Q'$
- Small $d\epsilon$ kick
- Accuracy ~ 0.5 unit
- Very fast method
- Currently used for Q' monitoring in the Tevatron
- Interest from CERN



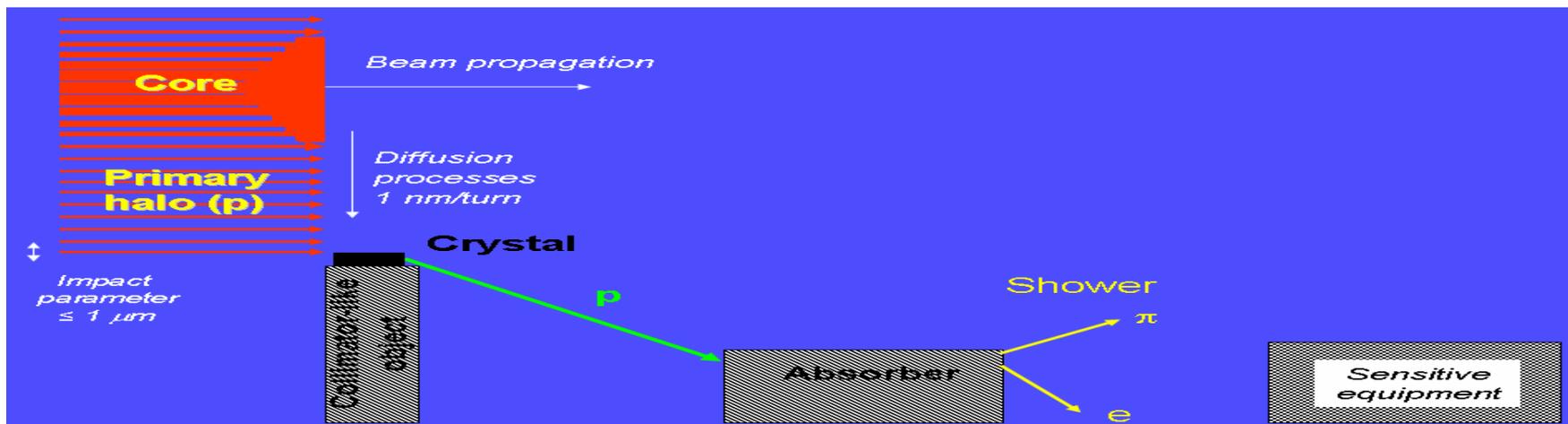
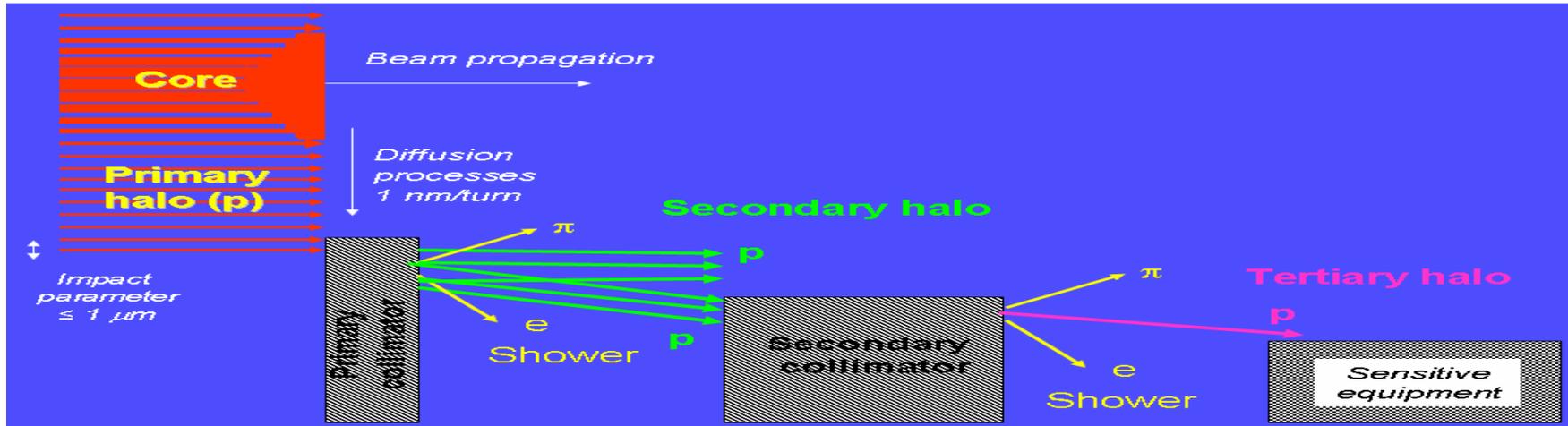


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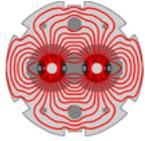
Crystal Collimation

N. Mokhov

Two-Stage "Conventional" Cleaning



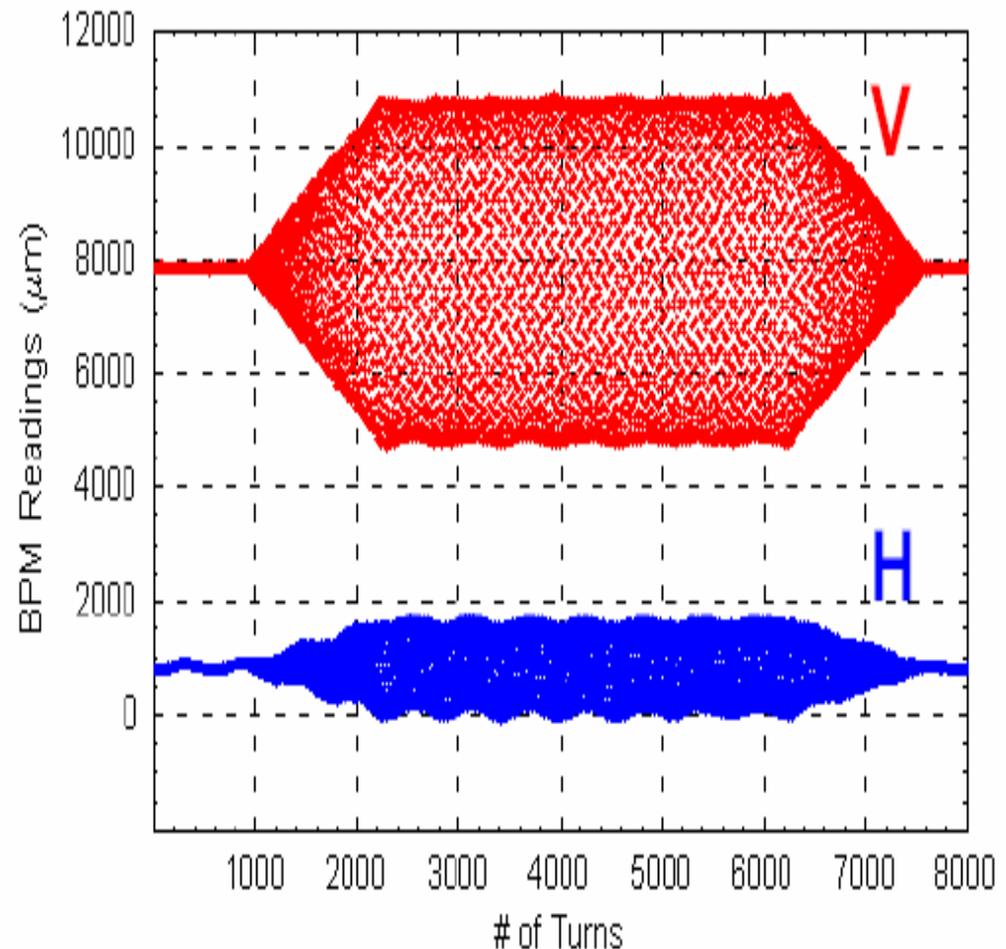
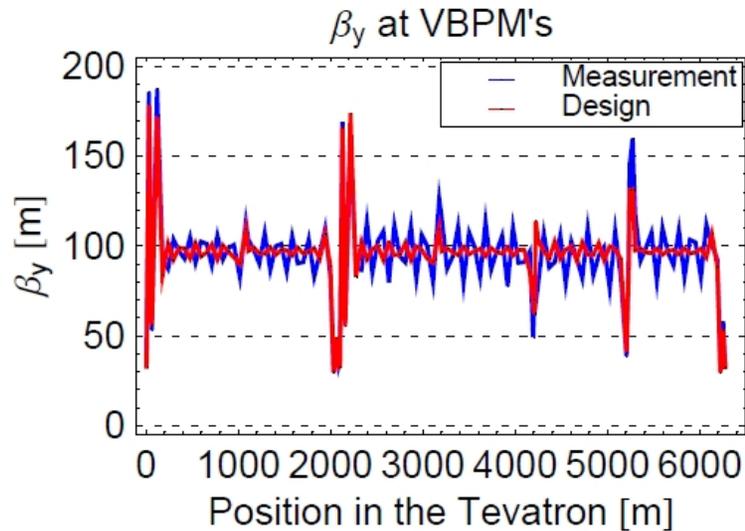
Primary halo directly extracted! No secondary and tertiary halos!?



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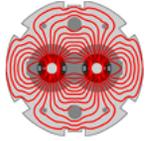
AC dipole

S. Kopp



- Recent good results from the Tevatron
- Formal proposal for LHC at Collab meeting (Apr '06)
- Collaboration formed including Fermilab (A.Jansson, M.Syphers), UT Austin (R.Miyamoto, S.Kopp), BNL (M. Bai, R. Calaga) and CERN (H.Schmickler, J.Serrano)

First AC dipole data in the Tevatron

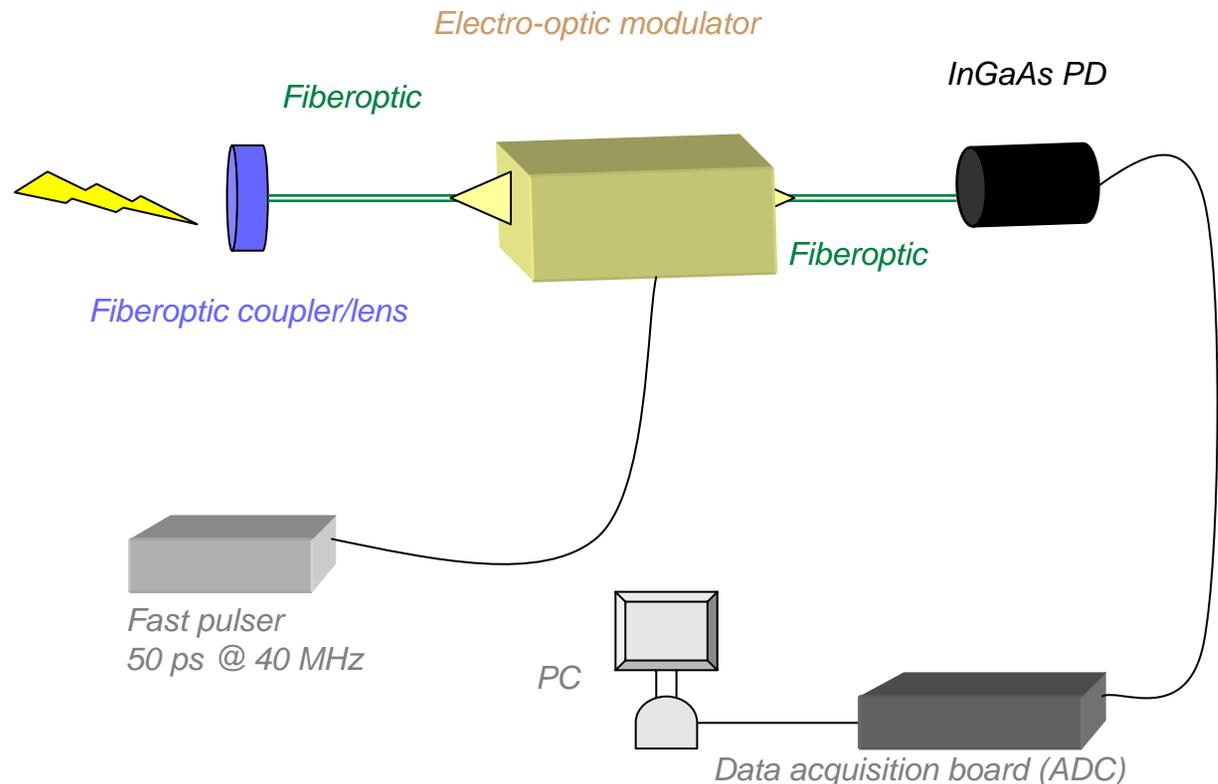


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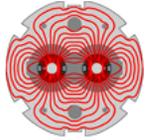
Longitudinal Density Monitor

S. DeSantis

- **Fresh Idea:** Couple SyncLite to optical fiber, deliver signal upstairs and process it there with electro-optical modulator
- 50 ps slices, 10 s integration, resolves 0.5M p (!)
- To see $\sim 1e-5$ tails of main bunches and ghost bunches



- Presented at the LARP Coll.Mtg.
- **CERN is interested, too**
- LDM can be a very useful tool for high luminosity operation

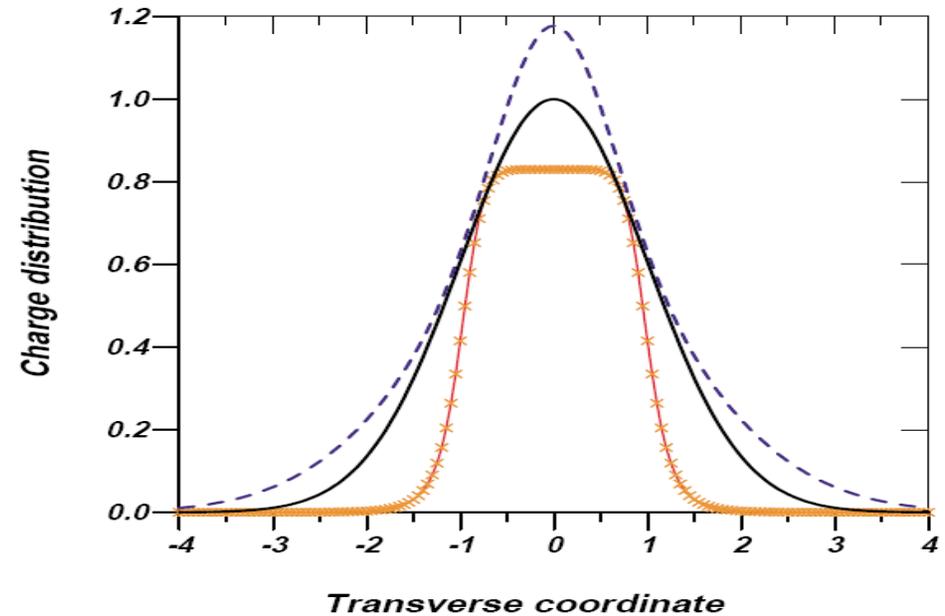
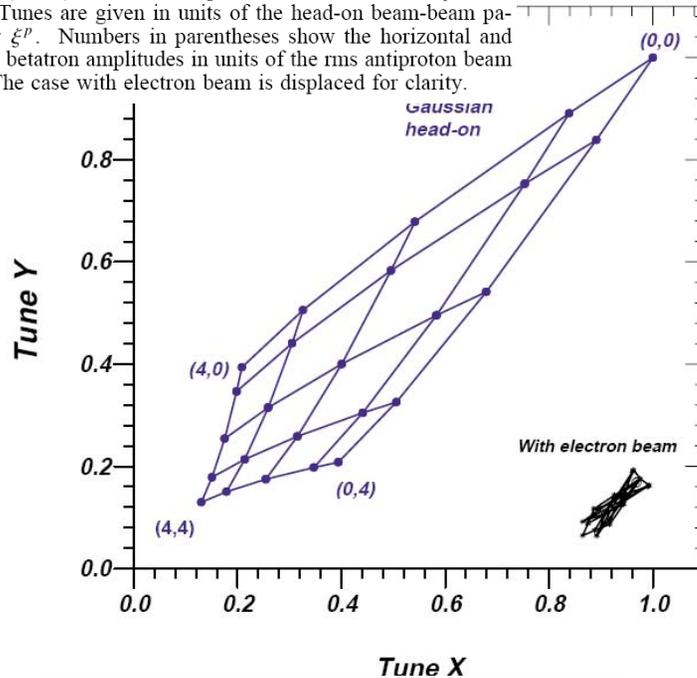


LARP

Head-on beam-beam compensation

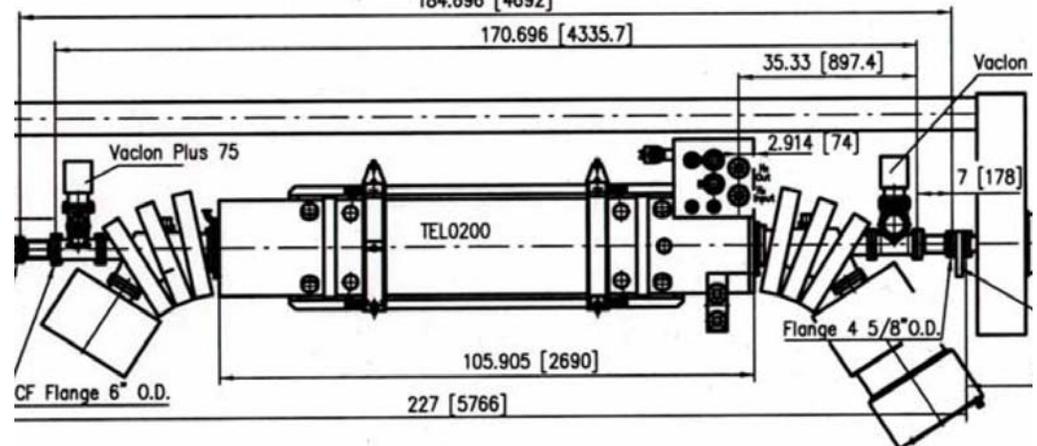
V. Shiltsev

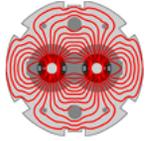
FIG. 6. (Color) Electron compression of the head-on \bar{p} footprint. Tunes are given in units of the head-on beam-beam parameter ξ^p . Numbers in parentheses show the horizontal and vertical betatron amplitudes in units of the rms antiproton beam size. The case with electron beam is displaced for clarity.



$$N_e = N_{IP}N_p/(1 + \beta_e).$$

- for LHC $N_p=1.1e11$, $N_{ip}=4$, for 10kV electrons ($\beta_e=0.2$) one needs $N_e=4.4e11$ or $J_e=1.2$ A in $L=3$ m long Gaussian rms = 0.3-0.5 mm e-beam





LARP

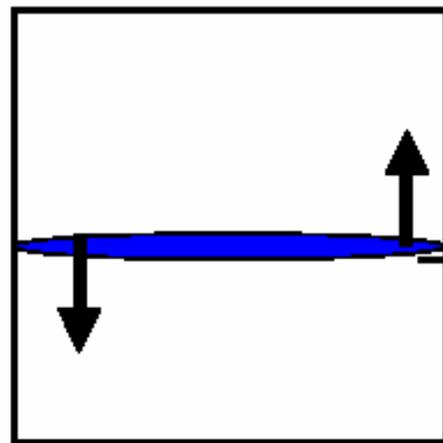
Crab Cavities

R. Calaga

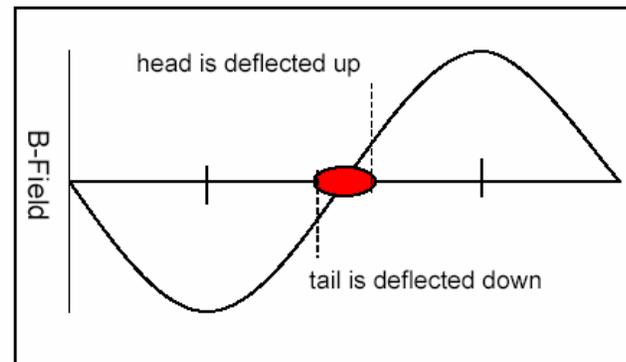
Transverse deflecting dipole mode

- The crab cavity imparts a transverse momentum to the bunch.
- The bunch continues to rotate outside the cavity.

Crab Cavity



~0.5m



~15m

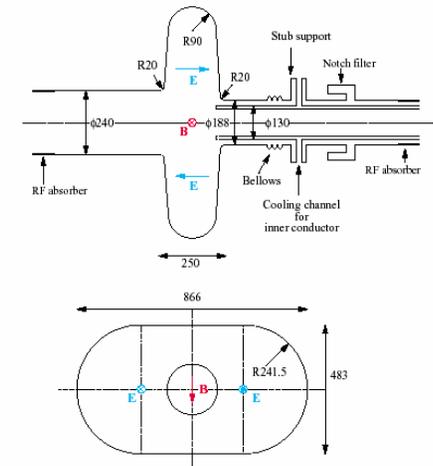
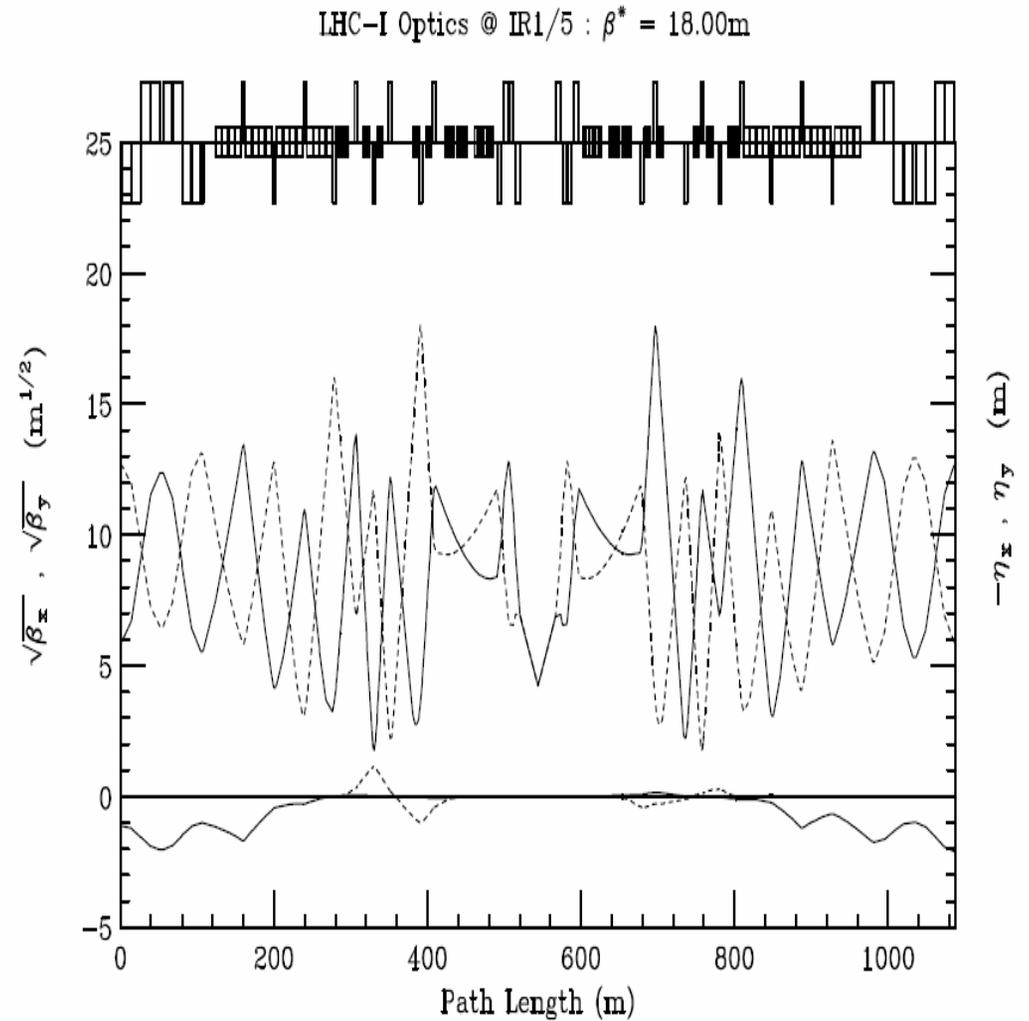
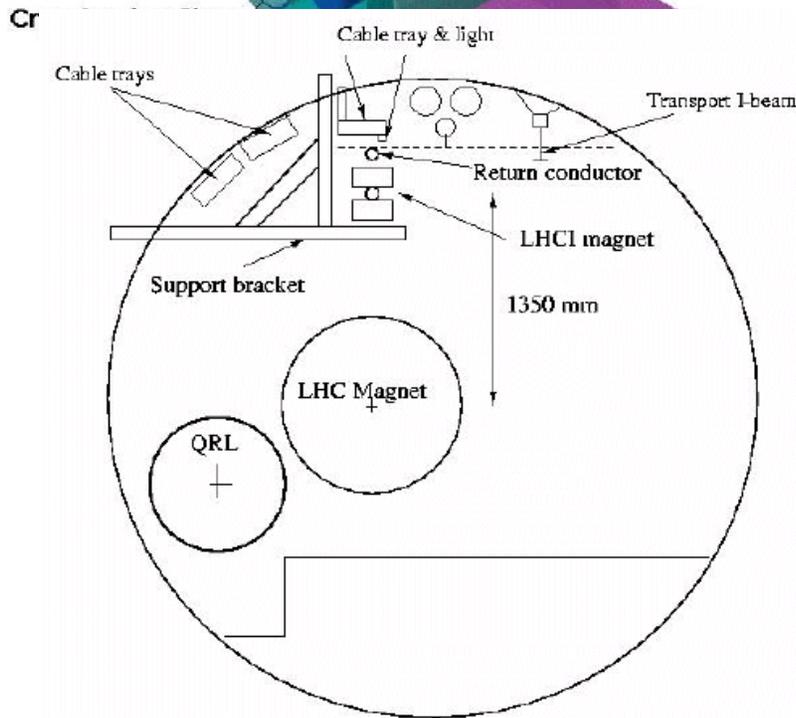
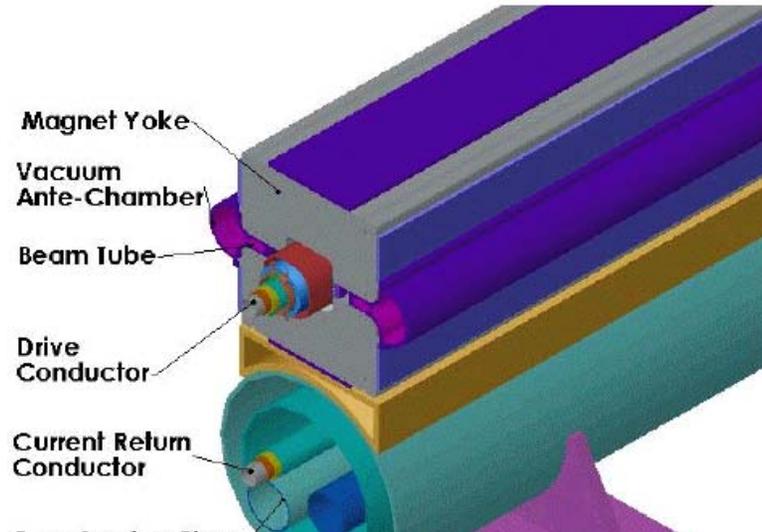


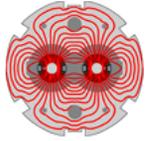
Figure 1: Squashed cell and co-axial beam pipe coupler.

IP

1.5 TeV SuperFerric Injector in LHC tunnel

H. Piekarz

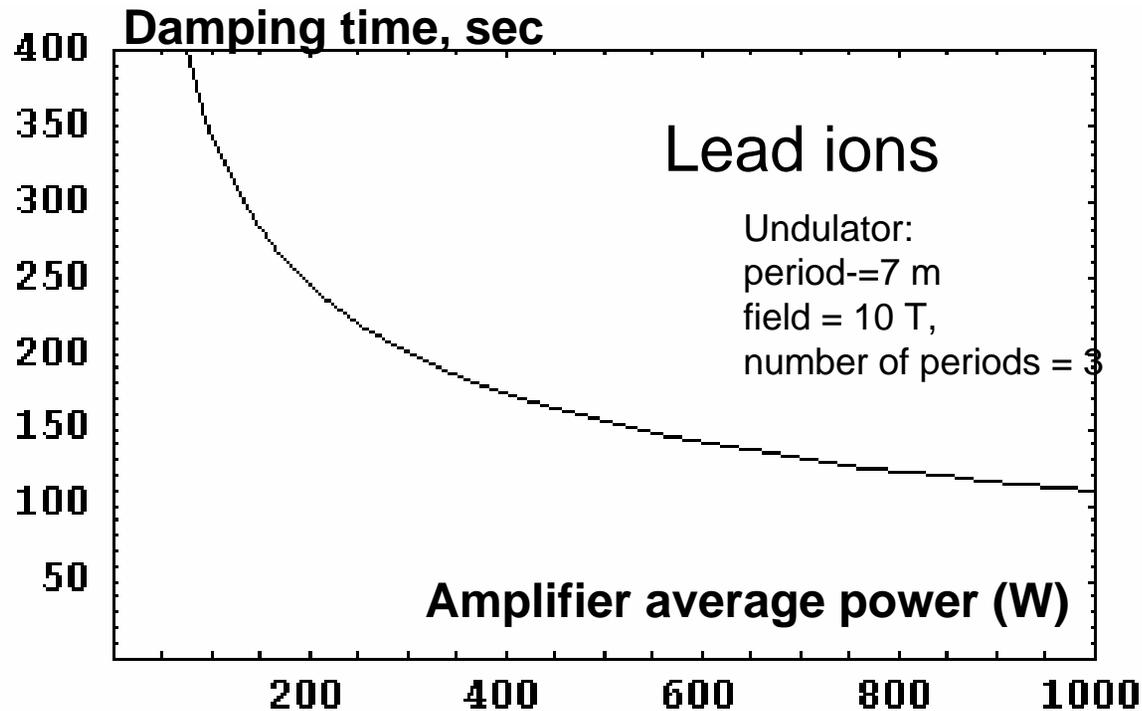




LARP

Optical Stochastic Cooling

A. Zholents



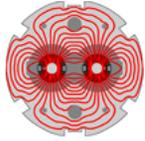
Needs for R&D:

- Bypass optics
- Optical amplifier
- Proof-of-principle with electrons

Damping time for protons ~ 5 hours at 1kW amplifier power

Plan of Action :

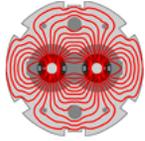
- support letter for OSC demonstration experiment (NSF)
- wait for results



LARP

Consideration Process

- All new proposals presented and discussed at the LARP Collaboration meeting at LBL (May'06)
- At the Collaboration Meeting "Group of 5+1" (L2s+VS+SP) is formed to consider all the proposals and formulate LARP's "vox populi"
- General requirements:
 - Interesting subject, development should push up the state of the accelerator physics and technology in the US
 - Of interest for LHC
 - Collaboration of >1 Lab, Universities welcome
 - Not at expense of current unfinished tasks
 - Right time and budget scale
- Consideration process:
 - OSC out of consideration due to scale and uncertainties (WF+VS+SP sent a supportive letter to NSF for MIT-Bates OSC proof-of-principal experiment)
 - CERN LTC formulated their attitude
 - The "Group of 5+1" met 05/31 and discussed all proposals



LARP

New Proposals: Summary

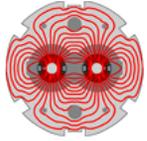
<i>Task</i>	<i>request FY07</i>	<i>Multi Lab</i>	<i>CERN LTC</i>	<i>LARP "5+1" Group and Executive Committee</i>
AC Dipole	40k\$ +	+	+	Good for new L3 task in Instr
LDM	73k\$?	-	+	Part of AS "Feasibility Studies " Task
Crab cavities	75k\$?	+	-	Part of AS "Feasibility Studies " Task
E-lenses	220k\$?	+	-?	Part of Accel.Phys B-B Task
Crystal Collim.	45k\$	+	-	Deferred by 1 yr, wait for Tevatron and SPS experiment results
LER-LHC	50k\$	-	-+	Support travel ~5k\$, no commitment after Oct.3-4 workshop
Flux jumps eff.	~0k\$	-	-	Too small, bury in AS/AP
Head-Tail Q'	~5k\$	-	+	Too small, support travel
dB/B fluct.	~10k\$	-	0	Too small, bury in AS
TOTAL:	520k\$			~ 220-300k\$

LARP DOE Review | 06/12/2006 - Shifted ~~50~~ after FY'07 budget consideration)



Accelerator Systems Summary

- LARP “Accelerator Systems” Task program improves the US accelerator physics capabilities and provides an accelerator physics and technology needed for startup, operation and improvements to LHC by:
 - Development of advanced beam instrumentation
 - Participation in hardware and beam commissioning
 - Development of innovative collimation techniques
 - Innovative accelerator physics research
- **Impressive progress since last DoE Review:**
 - Successful TCFB test at RHIC, Schottky design finished
 - Ongoing instrument tests and physics studies at the Tevatron and RHIC
 - Hardware commissioners lined up, beam commissioning more and more active
 - Development of rotating collimators and wire compensators started, on a good track
 - Simulation of beam-beam effects and e-cloud simulation and code benchmarking
- **Strong collaborative efforts in place and evolving**
 - scientists from four US Nat'l Lab and CERN actively participate
 - US colliders are essential test beds for LARP AS developments
 - Effective communication and coordination between US labs, between LARP and CERN
- **Healthy pressure of new initiatives:**
 - Many proposals explored, several are under consideration for FY'07
 - New groups attracted, including Universities



LARP

- backup slides...

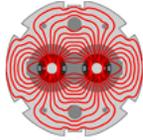


Resource Loading Schedule

LARP Schedule/Resource Data

12/22/05

ID	WBS	Task Name	Input	Point of Contact	Dur	Start	Finish	Pred	M&S	Resource Names
1	1	LARP Accelerator Systems		Shiltsev	902d	10/1/04	4/24/08		\$1,053,788	
2	1.1	Instrumentation		Ratti	707d	7/1/05	4/24/08		\$605,788	
3	1.1.1	Phase I			707d	7/1/05	4/24/08		\$605,788	
4	1.1.1.1	LARP Tune Feedback	Received	Cameron	201d	12/14/05	9/29/06		\$108,000	
5	1.1.1.1.1	Final Design Review April 2006			72d	1/10/06	4/20/06		\$0	
6	1.1.1.1.1.1	Preparations			71d	1/10/06	4/19/06		\$0	AD Electrical Engineer[25%]
7	1.1.1.1.1.2	Review			2d	4/19/06	4/20/06		\$0	AD Electrical Engineer[200%]
8	1.1.1.1.2	CERN SPS Installation - May 2006			139d	12/14/05	7/3/06		\$108,000	
9	1.1.1.1.2.1	Altera Dev Kit setup			20d	12/14/05	1/13/06		\$0	AD Electrical Engineer[50%]
10	1.1.1.1.2.2	NCO programming - DAC driver			10d	1/17/06	1/30/06	9	\$0	AD Electrical Engineer[50%]
11	1.1.1.1.2.3	I/Q programming - direct/coupled/ch			10d	1/31/06	2/13/06	10	\$0	AD Electrical Engineer[50%]
12	1.1.1.1.2.4	FIR filter programming			10d	2/14/06	2/27/06	11	\$0	AD Electrical Engineer[50%]
13	1.1.1.1.2.5	PID loop programming			10d	2/28/06	3/13/06	12	\$0	AD Electrical Engineer[50%]
14	1.1.1.1.2.6	delivery complete DAB from CERN			1d	1/31/06	1/31/06		\$0	AD Electrical Engineer
15	1.1.1.1.2.7	vXworks DAB driver			30d	1/31/06	3/13/06		\$0	Controls
16	1.1.1.1.2.8	ADO programming			19d	2/15/06	3/13/06		\$0	Controls
17	1.1.1.1.2.9	AFE control programming			10d	3/6/06	3/17/06		\$0	AD Electrical Engineer[50%]
18	1.1.1.1.2.10	integration - FPGA software onto DA			10d	3/17/06	3/30/06		\$0	AD Electrical Engineer[50%]
19	1.1.1.1.2.11	delivery of A/D library from CERN			1d	3/24/06	3/24/06		\$0	AD Electrical Engineer
20	1.1.1.1.2.12	implementation A/D library			10d	3/30/06	4/12/06		\$0	AD Electrical Engineer[50%]
21	1.1.1.1.2.13	delivery of FFT library from CERN			1d	4/12/06	4/12/06		\$0	AD Electrical Engineer
22	1.1.1.1.2.14	implementation FFT library			6d	4/12/06	4/19/06		\$0	AD Electrical Engineer[50%]
23	1.1.1.1.2.15	bench testing on resonators			13d	4/12/06	4/28/06		\$0	AD Electrical Engineer[50%]
24	1.1.1.1.2.16	LabVIEW Control Program			95d	12/19/05	5/4/06		\$0	AD Electrical Engineer[20%]
25	1.1.1.1.2.17	port vXworks system to LynxOS			30d	4/3/06	5/12/06		\$0	AD Electrical Engineer[50%]
26	1.1.1.1.2.18	delivery to CERN			1d	5/1/06	5/1/06		\$108,000	
27	1.1.1.1.2.19	pre-beam testing			11d	5/1/06	5/15/06		\$0	CERN Electrical Engineer
28	1.1.1.1.2.20	testing with beam			35d	5/15/06	7/3/06		\$0	CERN Electrical Engineer
29	1.1.1.1.3	RHIC Installation - Sept 2006			150d	3/1/06	9/29/06		\$0	
30	1.1.1.1.3.1	wiring and junction boxes design			22d	3/3/06	4/3/06		\$0	AD Electrical Engineer[25%]
31	1.1.1.1.3.2	wiring and junction boxes fab, test, i			44d	4/3/06	6/2/06		\$0	AD Electrical Tech[50%]
32	1.1.1.1.3.3	power amplifier design			24d	3/1/06	4/3/06		\$0	AD Electrical Engineer[10%]
33	1.1.1.1.3.4	power amplifiers fab, test, install			44d	4/3/06	6/2/06		\$0	AD Electrical Tech[50%]
34	1.1.1.1.3.5	delivery of 2nd DAB from CERN			1d	5/1/06	5/1/06		\$0	AD Electrical Engineer
35	1.1.1.1.3.6	vXworks DAB driver			92d	4/25/06	9/4/06		\$0	Controls[15%]
36	1.1.1.1.3.7	ADO programming			92d	5/1/06	9/8/06		\$0	Controls[15%]
37	1.1.1.1.3.8	NCO programming - DAC driver			6d	5/22/06	5/30/06		\$0	AD Electrical Engineer[50%]
38	1.1.1.1.3.9	I/Q programming - direct/coupled/ch			6d	5/30/06	6/6/06		\$0	AD Electrical Engineer[50%]
39	1.1.1.1.3.10	FIR filter programming			6d	6/5/06	6/12/06		\$0	AD Electrical Engineer[50%]
40	1.1.1.1.3.11	PID loop programming			6d	6/12/06	6/19/06		\$0	AD Electrical Engineer[50%]
41	1.1.1.1.3.12	AFE control programming			6d	6/19/06	6/26/06		\$0	AD Electrical Engineer[50%]
42	1.1.1.1.3.13	A/D programming			7d	6/26/06	7/5/06		\$0	AD Electrical Engineer[50%]
43	1.1.1.1.3.14	FFT programming			6d	7/3/06	7/11/06		\$0	AD Electrical Engineer[50%]
44	1.1.1.1.3.15	LabVIEW Control Program			111d	4/25/06	9/29/06		\$0	AD Electrical Engineer[10%]



LARP

Reporting



LARP

May 5, 2006

LARP Semi-Annual Progress Report

Editor: S. Peggs

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Executive Summary

This summary provides a snap-shot of the status of the U.S. LHC Accelerator Research Program (LARP), focusing on topics that were prominent at the Collaboration Meeting that was held April 26-28 at LBNL. The main body of this report describes in detail the progress that has been made in the first two quarters of FY06.

Some technical highlights

Subscale Quadrupole SQ02 achieved 97% of its short sample limit after extensive testing at LBNL in October 05, and at FNAL in March 06. Technical Quadrupole TQS01 has just begun testing, and has reached 87% of its short sample limit. This is a great success for the world's first large bore (90 mm) Nb₃Sn magnet. Nonetheless, the cause (or causes) of the shortfall are under investigation.

Simultaneous tune and coupling feedback was demonstrated in RHIC - a world first - thanks to work by physicists and engineers from BNL, CERN and FNAL. This paves the way towards the ultimate goal of chromaticity feedback during snap-back at the beginning of the LHC energy ramp. (See article in the May 2006 CERN Courier.)

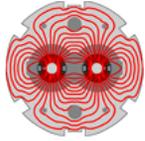
IR and Hardware Commissioning

Six people from FNAL and 2 from LBNL have been identified to take part in IR Commissioning (of U.S. built deliverables) and Hardware Commissioning (generic support of LHC installation and commissioning). Peak staffing of 7 people is foreseen in 2007. The start date for a major presence is September 1, 2006. One person, Peter Limon, is already in long term residence at CERN.

Accelerator Systems deliverables

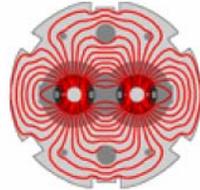
Four items have been identified by LARP and CERN as "hard deliverables", in the sense that they are crucial to LHC performance and that "plan B" is weak or non-existent. These tasks would need special protection in the face of an unforeseen LARP budget shortfall. They are:

- Luminosity Monitors. A review that was held on April 24 2006 noted good progress toward on-time completion.
- Tune Feedback. Excellent recent progress at RHIC. A "Final Design Review" will be held this summer or early fall.
- Beam and Instrumentation Commissioning. Several tentative names are already available, and more are being solicited. A vetting procedure needs to be established soon, in order to ensure excellence in commissioning.
- Rotatable Collimators. We are confident that this longer time scale item is on track, despite a slow start on the first engineering prototype.



LARP

Other Directive Documents



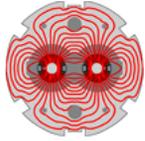
LARP

U.S. LHC Accelerator Research Program R&D Plan

Editors: S. Gourlay, S. Peggs, V. Shiltsev

October 25, 2005

Version 1.0



LARP

DoE Review of LARP November 2005

- “The review committee was very pleased with the presentations on beam instrumentation and accelerator physics. In addition, they found the idea of participation in the development of a remote control room a very interesting possibility for enhancing interactions with CERN from afar via the Fermilab project “LHC@FNAL”.
- Plans for commissioning of LHC hardware are already being implemented, with the first U.S. staff member (Peter Limon) already stationed at CERN. It was reported by management that U.S. laboratories will provide staffing for this effort, and, in fact, FNAL has committed seven persons to this task. LARP and CERN will cover costs of travel and additional living expenses in the Geneva area.
- Finally, the committee again emphasized its displeasure with the lack of formality in dealings of LARP, and strongly recommended a more effective bookkeeping system for managing expenses and progress on all active tasks, and a person who would be responsible for implementing such a system”.