US LHC Accelerator Research Program

Brookhaven – fermilab - berkeley - stanford

Accelerator Systems Plan & Budget

FY2005-06

Accelerator Systems budget

Accelerator Physics

Beam commissioning

Initial instrumentation

Collimation

Summary

Acc Systems Budget (FY05 & 06)

		DANFORDS		FULL		REDUCED	
		FY05	FY06	FY05	FY06	FY05	FY06
Instrumentation	$k	744	1733	745	1620	540	1740
AP+BC	$k	570	1366	400	750	360	750
Collimation	$k	0	0	430	870	300	900
HW Comm.	$k	509	525	250	700	250	700
Magnets	$k			1395	6385	1270	6235
Prog Mgmt	$k			280	675	280	675
Total	$k			3500	11000	3000	11000
AP+BC	FTE	2.7	7.0	1.9	3.8	1.7	3.8

Must protect "hard deliverables" in hard times, including collimators, but AP+BC is in danger of becoming unviable!

AP + BC budget "requests" compared to "FULL" guideline

			FY05	FY06
BNL		FTE	1.0	2.0
	Electron cloud	FTE	0.5	1.0
	Collimation	FTE	0.5	1.0
LBL		FTE	0.6	2.6
	Beam-beam	FTE	0.2	0.6
	Electron cloud	FTE	0.4	2.0
FNAL		FTE	0.9	1.7
	IR design	FTE	0.3	0.7
	Wire BBC	FTE	0.3	0.5
	Energy dep.	FTE	0.3	0.5
TOTAL (AP)		FTE	2.5	6.3
TOTAL (BC)		$k	91	241
"FULL" (AP+BC)		FTE	1.9	3.8
"FULL" (AP+BC)		$k	400	750

Instrumentation
budget "requests" compared to "FULL" guideline

		FY04	FY05	FY06
LumiMonitor	$k	204	521	1494
LDM	$k	64	123	697
Phase Lock Loop	$k	152	252	380
BNL	$k	109	115	380
FNAL	$k	43	137	0
TOTAL (Instr.)	$k	420	896	2571
"FULL" (Instr.)	$k		745	1620

Accelerator Physics

There is ample evidence of two "potential show stoppers" for the LHC are:

1) 350 MJ beam stored energy / collimation / quenching
2) Controlling beam losses at snapback

At best they are major challenges to rapid commissioning

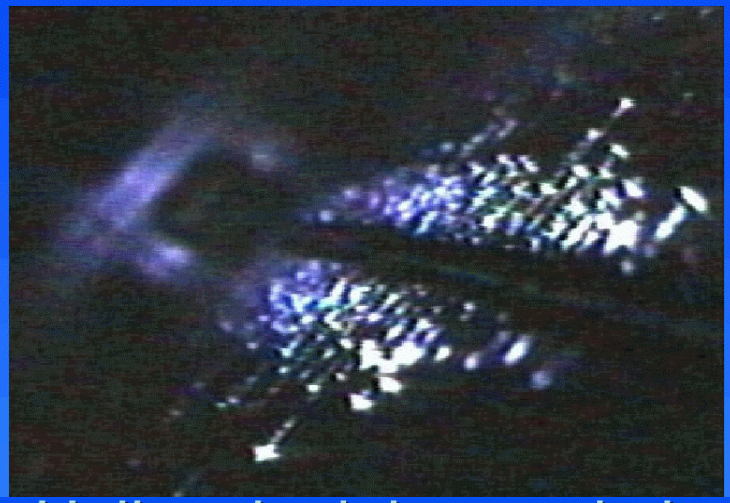
Other vital and/or critical issues include:

3) Electron cloud
4) Wire beam-beam compensators
5) Phase 2 collimators, SLAC

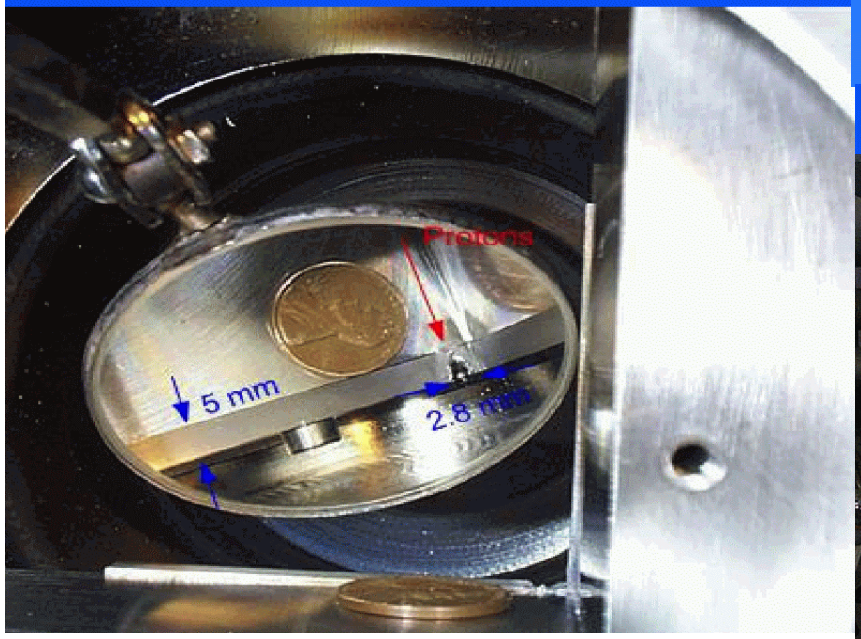
TeVatron 16 house quench

Only 1 MJ !

Secondary tungsten collimator

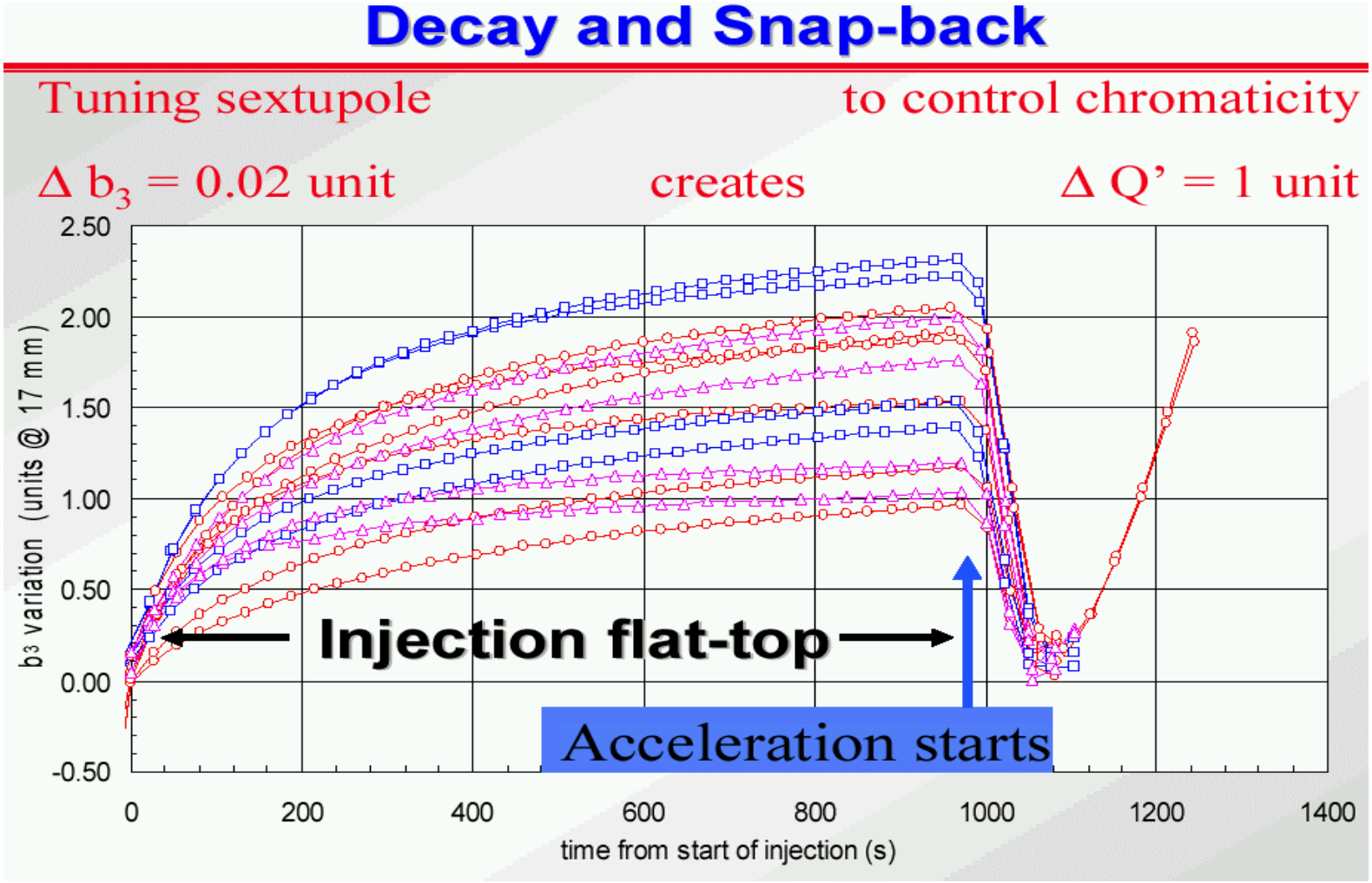


Primary tungsten collimator



Helium leak in spool piece

"No" beam loss allowed in snap back!



Accelerator Physics – 2

ALL of these topics, besides being vital to the LHC, are also vital or very important for present and/or future US accelerators.

- How should we apply LARP AP resources (FTEs) to them?

- What are the deliverables?

- How are they connected to Beam Commissioning activities? To Instrumentation and Magnet activities?

- What (software) tool development is required?

We MUST answer these questions more completely before the end of FY04, for FY05 & 06 planning

Beam Commissioning

Original intention is to put one US Accelerator Physicist on every commissioning shift. How to organize this?

Activities in Beam and Instrumentation Commissioning will mainly be organized through the AB-LHC operations team.

The LARP commitment to BC must be made real with long term individual commitments of up to 12 months.

There is a need for potential participants to visit CERN for short periods – 1 to 6 weeks.

There is no beam after 2004 until the sector test in 2006 (2007?)

Beam Commissioning – 2

WHAT	WHEN	CERN LIAISON
	2004	
TI8		
Materials testing	Sept 04	R. Schmidt, V. Kain
Optics matching	Sept 04	J. Uythoven
SPS		
Phase Lock Loop	June/Sept 04	R. Jones
Collimators (& TI8)	Sept 04	R. Assmann, R. Schmidt
Ecloud & vacuum diagnostics & studies	Sept 04	M. Jimenez, F. Zimmerman
Impedance & high current tests	?? Sept 04 ??	F. Ruggiero, E. Shapashnikova
Long range beam-beam wire compensators	Summer 04	J.P. Koutchouk
	2005	
	2006	
Sector test with beam	May 06	M. Lamont
	2007	

Beam Commissioning – 3

Collimators in SPS & TI8

1 prototype collimator will be installed in the SPS, & 1 in TT40.
Eg: will the TT40 collimator jaw survive being struck with 4 batches of 72 bunches of 1.1e11 protons at 450 GeV, delivering 2.4 MJ?

(LARP could/should take on the task of performing operational modeling and simulation of much more realistic LHC situations, in particular for the 350 MJ/collimation problem.)

Materials testing in TI8

450 GeV beam testing in a "materials test zone" in TI8. Semi-independent from the collimator tests. Eg: predict when a carbon-carbon block should suffer damage.

Beam Commissioning – 4

Optics Matching in TI8

Probable involvement by a physicist from Jlab

Phase Lock Loop

Beam tests in the SPS

Ecloud and vacuum diagnostics and studies in the SPS

Four set ups will be used in a warm straight section

- an additional cold strip detector, including a quad strip detector
- COLDEX : LHC realistic circular beam screen
- Retarding Field Detector
- NEG test bench

Beam Commissioning – 5

Impedance and high current tests in the SPS

Some say there is a need for more SPS studies to determine actual instability limits. Eg, Francesco wants to make impedance measurements with the collimator gap reduced to 3 mm.

Long range beam-beam wire compensator (LRBBWC) tests

If LRBBWC works (or not), LARP plans for LHC IR upgrades are significantly affected. It's even plausible that LARP could be involved in providing LRBBWCs for LHC.

JPK is pushing for additional SPS MDs

Initial Instrumentation

1) Tune & Chromaticity Measurement & Feedback

- crucial to minimize beam losses with intense beams during snap-back and low beta squeeze, etc

- needs integration/resolution of joint efforts at FNAL & BNL

- develop US/CERN interface definitions (hardware and people)

- related SPS beam tests in summer 2004

- simulation activity (FNAL): funded as Instrumentation activity or Accelerator Physics?

Initial Instrumentation – 2

Milestones (Cameron):

1. June/Sept 04
   single plane testing of 245MHz PLL at SPS

2. Sept 2005
   completion of evaluation tests at RHIC, to sort out the 3 options (baseband, 245MHz, 2GHz)

3. Nov 2005
   specification of preferred system configuration

4. Mar 2006
   single plane testing of preferred config at RHIC

Initial Instrumentation – 3

2) Real-Time Lumimosity Measurements

- keep the beams in exact collision.

- assume gas ionization technology

- integrate ZDCs (for LHC heavy ions?)

- test prototype at RHIC?

- a “hard deliverable”

Initial Instrumentation – 4

3) Longitudinal Density Monitoring

LDM = Abort Gap Monitor + Laser Time Slicer

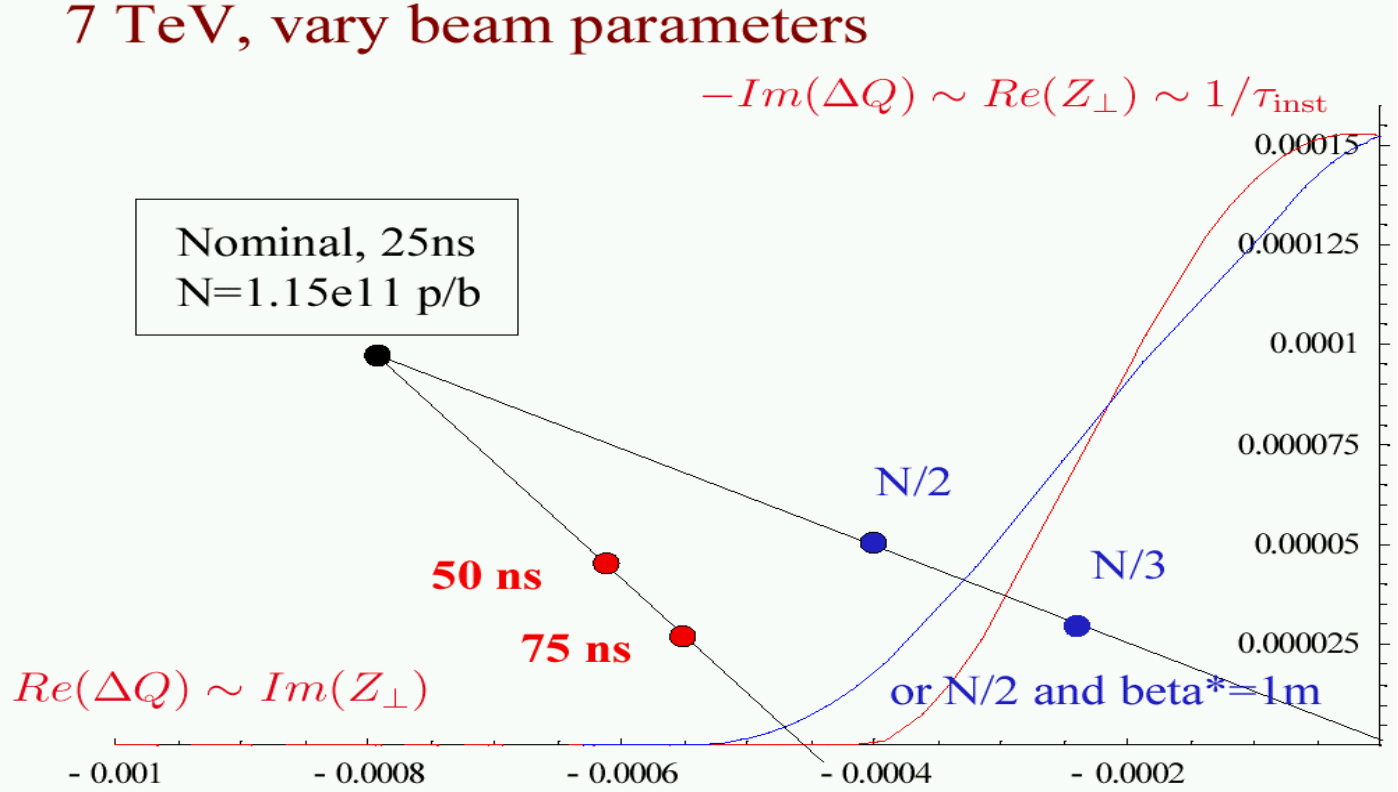
- AGM is a “hard deliverable” (critical to early operations)

- LTS is not “hard”, but fits LARP desire to push the state-of-art

- AGM and LTS share same photon source, splitter

Collimators – SLAC

Luminosity is limited by the impedance from the "Phase 1" collimators - so, build "NLC-like" low impedance collimators



Summary

1) Hard deliverables (initial instrumentation, collimators) must be – and are being – protected in hard times

2) AP + BC activities are being more tightly integrated, but still need clearer deliverables/milestones defined for FY05 & 06

3) The BC goal of one LARP Accelerator Physicist on every commissioning shift needs presence at CERN NOW (2004)!

4) How to achieve AC & BC goals in "budget squeeze play"? AP+BC is in danger of becoming unviable in FY05 & 06!

5) Initial Instrumentation activities need more definition, but are in good shape (for this stage).