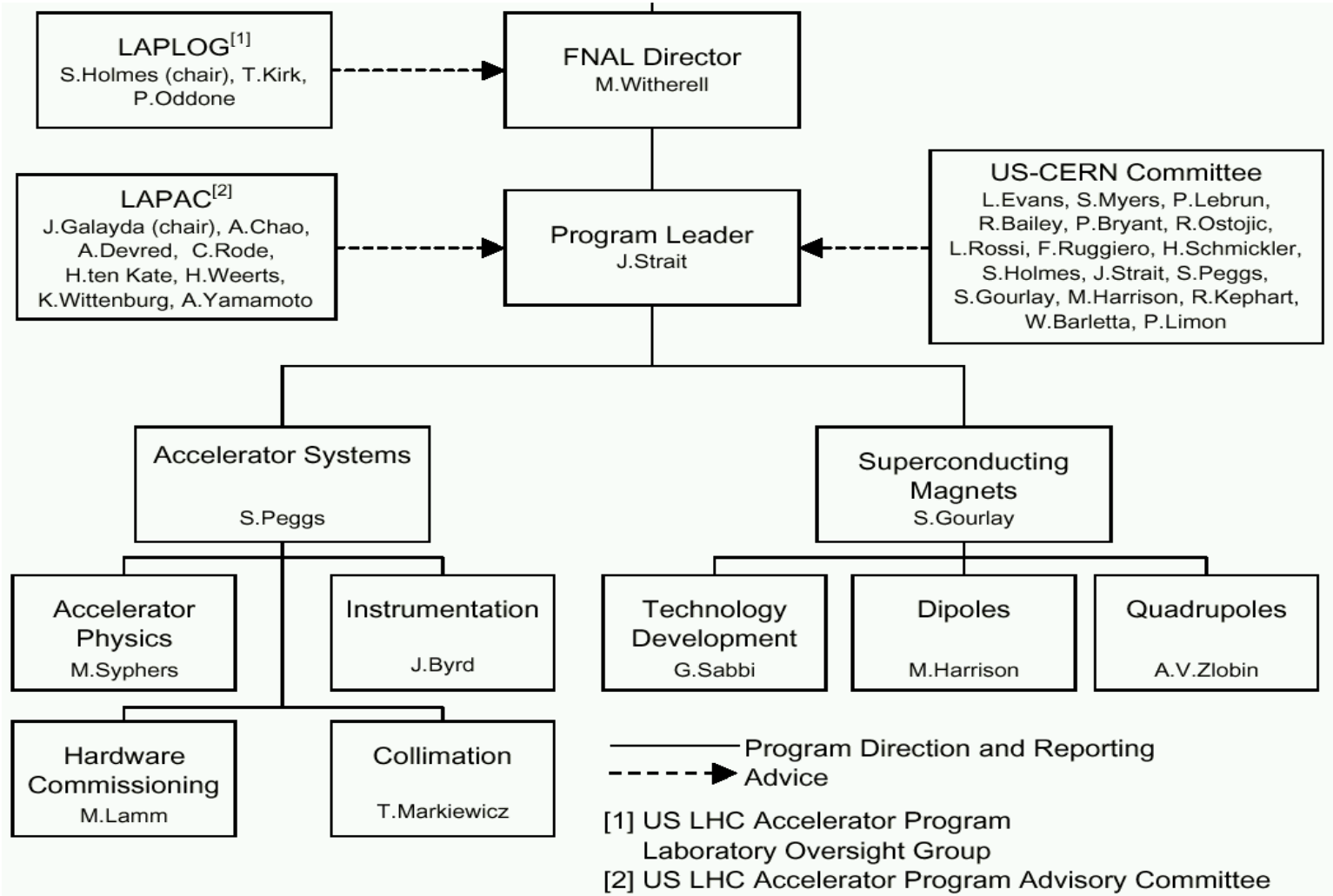
Accelerator Systems Plan

S. Peggs, BNL
for LARP Accelerator Systems

US-CERN Committee,
July 1, 2004

Organization Chart



Accelerator System Tasks

Task	LEAD	Support
INSTRUMENTATION		
Tune Feedback	Cameron (BNL)	-
Luminometer	Byrd (LBNL)	-
Abort Gap Monitor/LDM	De Santis (LBNL)	-
ACCELERATOR PHYSICS		-
Beam Commissioning	Harms (FNAL)	Drees, Furman
Electron Cloud	Furman (LBNL)	Drees
IR and Beam-Beam	Sen (FNAL)	Furman
Phase 1 Collimation Studies	Drees (BNL)	Sen
Phase 2 Collimator R&D	Markiewicz (SLAC)	Mokhov
Hardware Commissioning	Lamm (FNAL)	Wanderer, Rasson

Accelerator Systems Summary Budget

FY05 TASK	BNL $k	FNAL $k	LBNL $k	SLAC $k	Total $k
Tune Feedback	195				195
Luminometer			395		395
Abort Gap Monitor/LDM			≈ 0		0
Beam Commissioning		80			80
Electron Cloud	55		55		110
IR and Beam-Beam	40	230	40		310
Phase 1 Collimation Studies	75				75
Phase 2 Collimator R&D		50		190	240
Hardware Commissioning	75	210	100		385

Task Milestones (1)

Accelerator Systems Milestones **June 25, 2004**

	FY04			FY05										FY06					
	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1
Tune Feedback				**1**				**2**				**3**				**4**				
Luminometer				**1**		**2**														
Abort Gap Monitor/LDM							**1**													
Beam Commissioning				**1**	**2**			**3,4**												
Electron Cloud	**1**			**2**							**3**		**4**			**5**	**6,7**			
IR and Beam-Beam			**1**						**2**		**3**				**4**					
Phase 1 Collimation Studies				**1**					**2**			**3**		**4**						
Phase 2 Collimator R&D	**1**							**2**			**3**					**4**				
Hardware Commissioning				**1**		**2**					**3**	**4**								
	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1

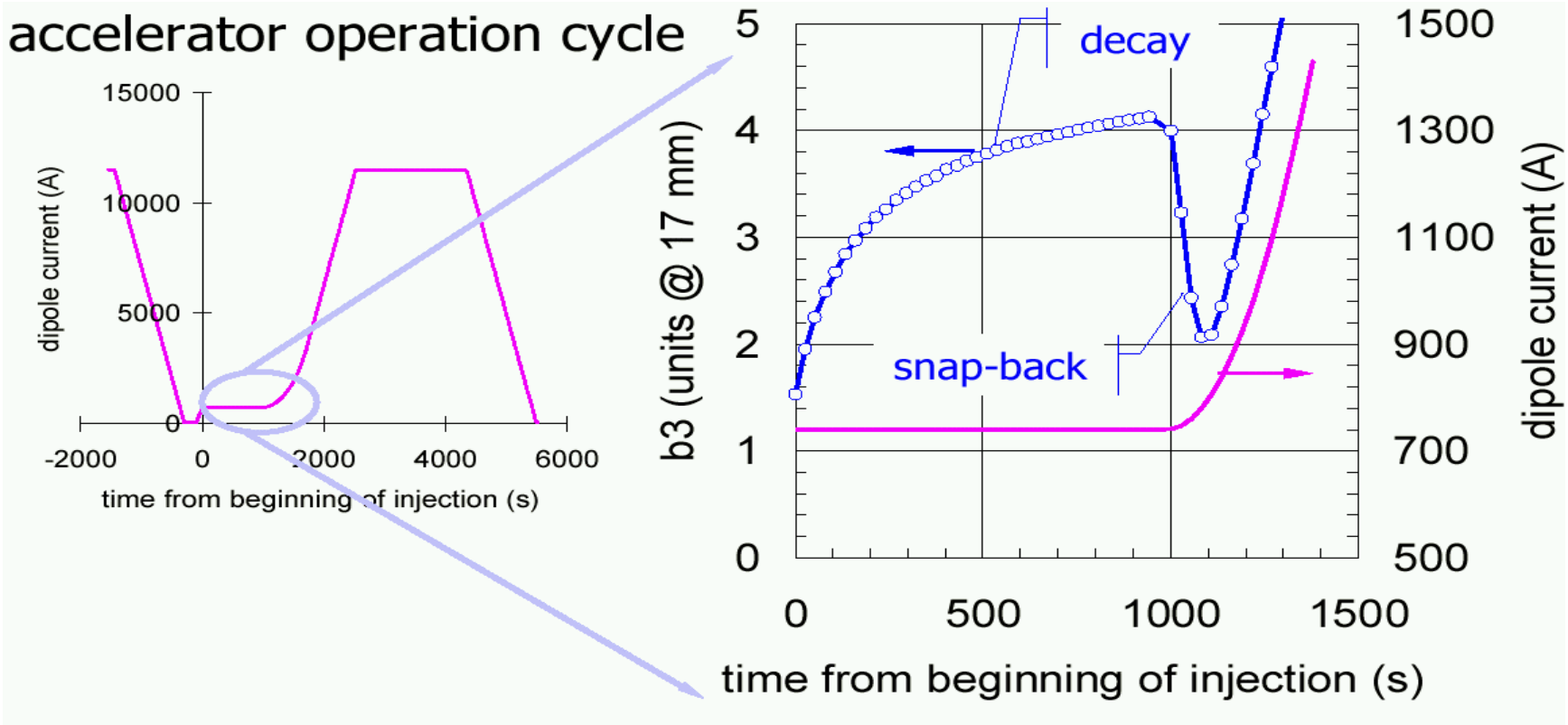
KEY:

Tune Feedback	1) Evaluate data from PLL protoype studies in SPS 2) Cost and Technical review in early CY05 3) Conclude coupling study, write coupling correction report 4) Design, fabricate, test, & operate prototype baseband PLL electronics & software in RHIC 2006) Construction of digitizer boards for LHC PLL
Luminometer	1) 40 MHz performance demonstrated, with required accuracy & sensitivity 2) Technical and Cost review: go/no go decision for continued prototype construction 2005) Design & Fab of final prototype 2005) Deliver engineering design of integration into TAN; Conceptual design for IP2 & 8 2005) Evaluate options for performing a radiation hardness test 2005) Begin interface to CERN DAQ 2007) Commission luminometering in the LHC control room
Abort Gap Monitor/LDM	1) Deliver AGM engineering feasibility study white paper

Task Milestones (2)

Beam Commissioning	1) TI-8 tests begin
	2) Reduced level of activity in FY05
	3) LHCOP group commissioning plan presented at Chamonix '05
	4) Start defining LARP jobs and names, as participants in CERN planning exercise
	2006) Participate in LHC Injection Test, 2 weeks in 2006 with beam
	2007) Several long-term postings to CERN for machine commissioning
Electron Cloud	1) Participate in SPS EC experiments and studies
	2) Go/no go agreement (CERN/LARP/RHIC) to install cold EC detector in RHIC
	3) Report on simulated reproduction of measured spectrum & spatial distribution of SPS ECs
	4) Report first cut at defining optimal LHC conditioning scenario
	5) Report on applicability of map simulation technique to LHC
	6) First beam with cold EC detector in RHIC
	7) Report on simulated EC at IR4 diagnostic bench
IR and Beam-Beam	1) Participate in beam studies of wire-based BBC at SPS
	2) Report on BEAMBEAM3D strong-strong simulations (sweeping beam, emittance growth rates)
	3) Report on dipole & quad first layouts (field quality, beta star limits, energy deposition)
	4) Report on impact of beam-beam on IR design (quad/dipole first, performance limits, BBC)
Phase 1 Collimation Studies	1) Define code bench marking tests
	2) Report on bench-marking of collimation codes with RHIC beam data loss
	3) Test LHC collimator set-up procedures with RHIC collimation system
	4) Report on accuracy of “cleaning efficiency” simulations, and lessons for LHC
Phase 2 Collimator R&D	1) Phase II collimator meeting, CERN
	2) Present status report at Chamonix '05
	3) Phase II collimator review, go/no go decision
	4) Hire ME, set up lab & test RC0 (existing prototype)
	2006) Design and build more LHC specific RC1 prototype
Hardware Commissioniong	1) Deliver a hardware commissioning report for FY05 and beyond
	2) Warm fit-up of inner triplet (D1/DFBX/Q3/Q2/Q1)
	3) Participate in installation of 3 IRs, and TAS/TAN in IR1
	4) Begin hardware commissioning efforts (room temp, vac, alignment, initial cool-down)
	2006) Installation support & commissioning of US provided sytems; injection/sector test

Tune Feedback (1)



"Snap-back" is not so fast, but the chromaticity jump is huge ~ 300 units!

Tune Feedback (2)

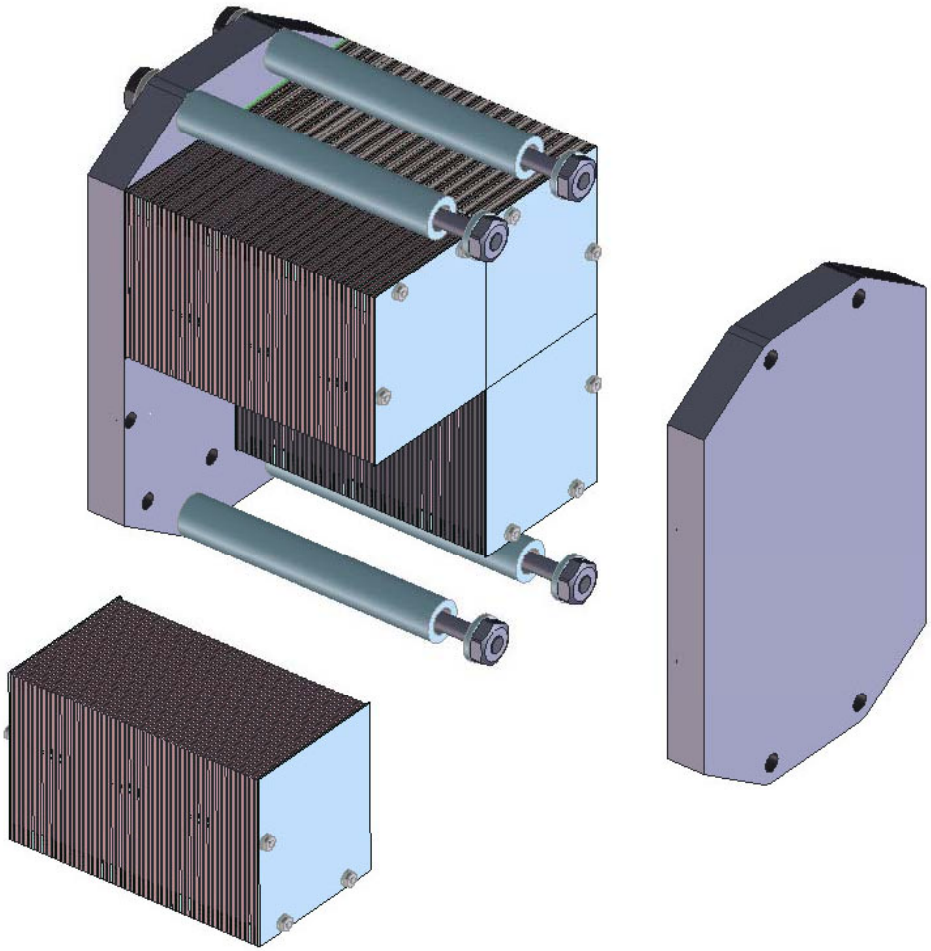
Comments:

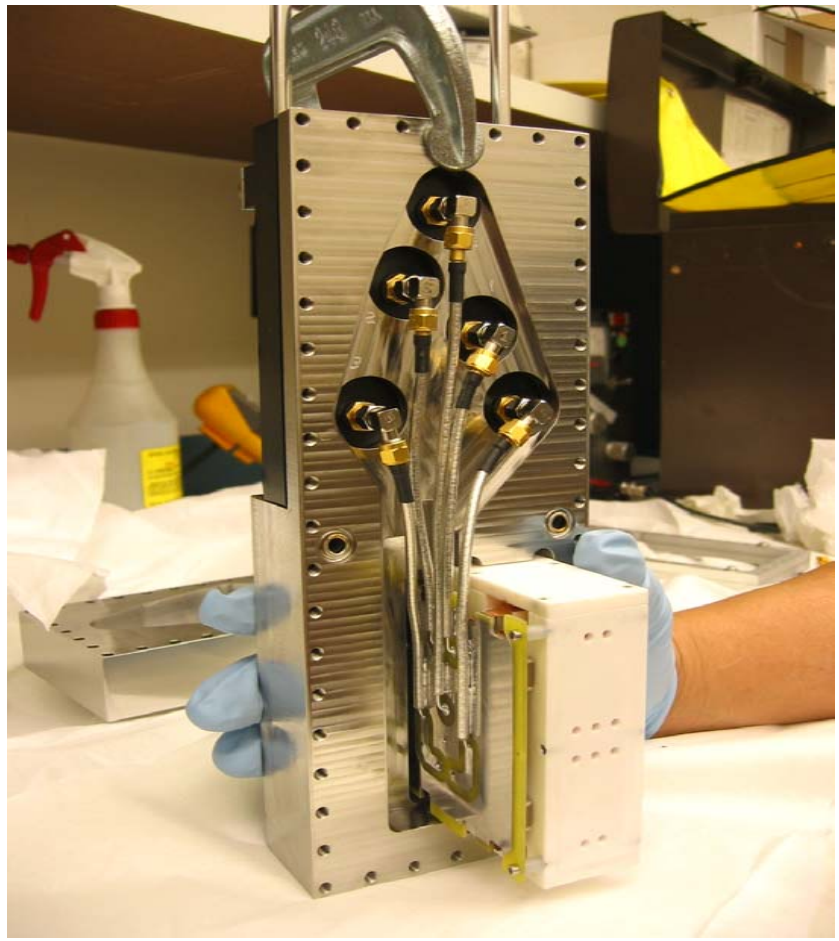
1) Both tunes and linear coupling must be under control to get a good handle on the (snap-back) chromaticities
2) Modeling & experimental efforts essential

FY05 milestones:

Oct 04	Evaluate data from PLL prototype studies in SPS
Jan 05	Cost and Technical review in early CY05
May 05	Conclude coupling study, write coupling correction report
Sept 05	Design, fabricate, test, & operate prototype baseband PLL electronics & software in RHIC

Luminometer (1)





Luminometer (2)

Comments:

1) How many gas Luminometers? Which IPs?
2) LAPAC: "Background rejection?"
3) Exception that proves the rule - production?

FY05 milestones:

Sep 04	40 MHz performance demonstrated
Nov 04	Tech. & Cost review: go/no go decision for continued prototype construction
2005	Design & Fab of final prototype
2005	Deliver engineering design of integration into TAN
2005	Evaluate options for performing a radiation hardness test
2005	Begin interface to CERN DAQ

Abort Gap Monitor/LDM (1)

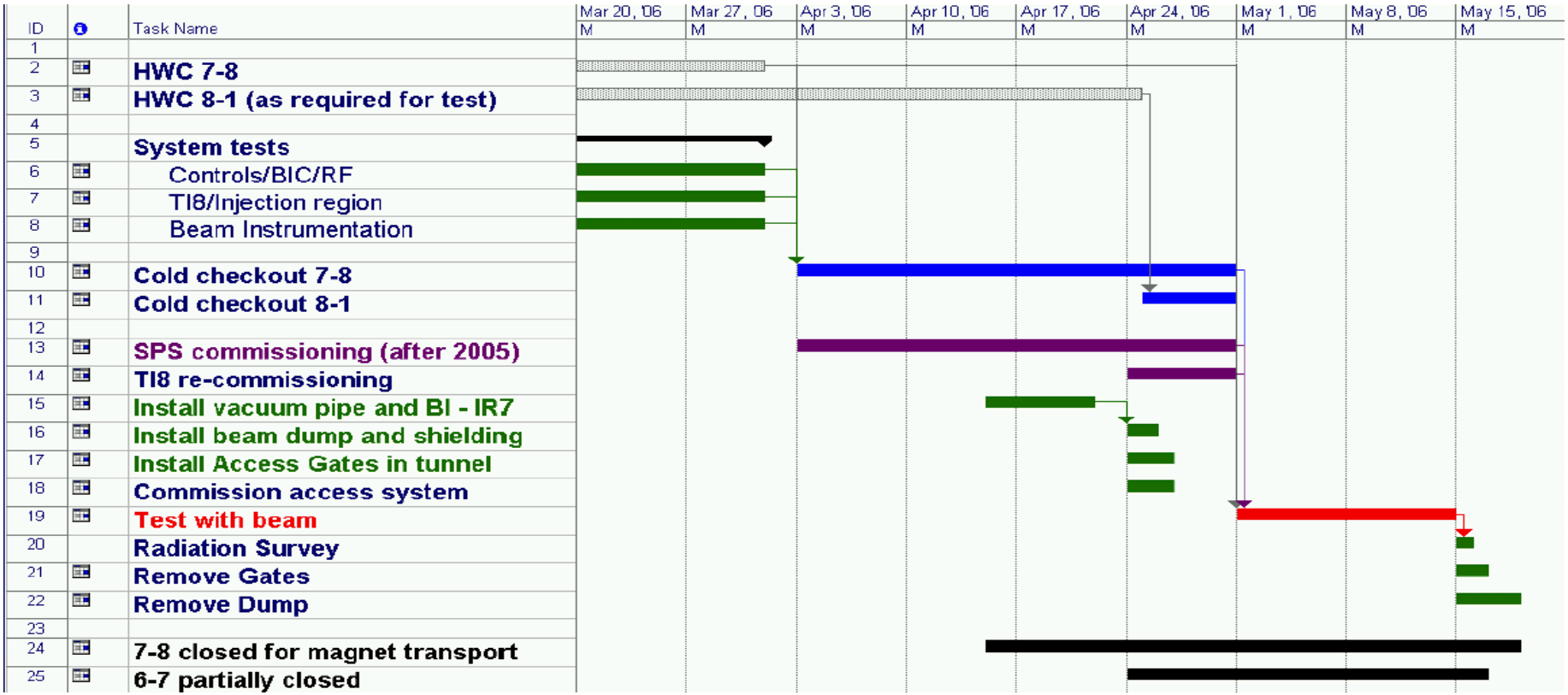
Comments:

1) Abort Gap Monitoring
   - Required on day "1"
   - Independent of beam dynamics functionality (LDM)
2) "LARP should avoid ownership of a critical device"
3) No additional funding after FY04
4) LARP shifts LDM to a potential future task, if "customer" enthusiasm from LHC and/or US builds ...

FY05 milestones:

Dec 04 Deliver AGM engineering feasibility study white paper

Beam Commissioning (1)



Beam Commissioning (2)

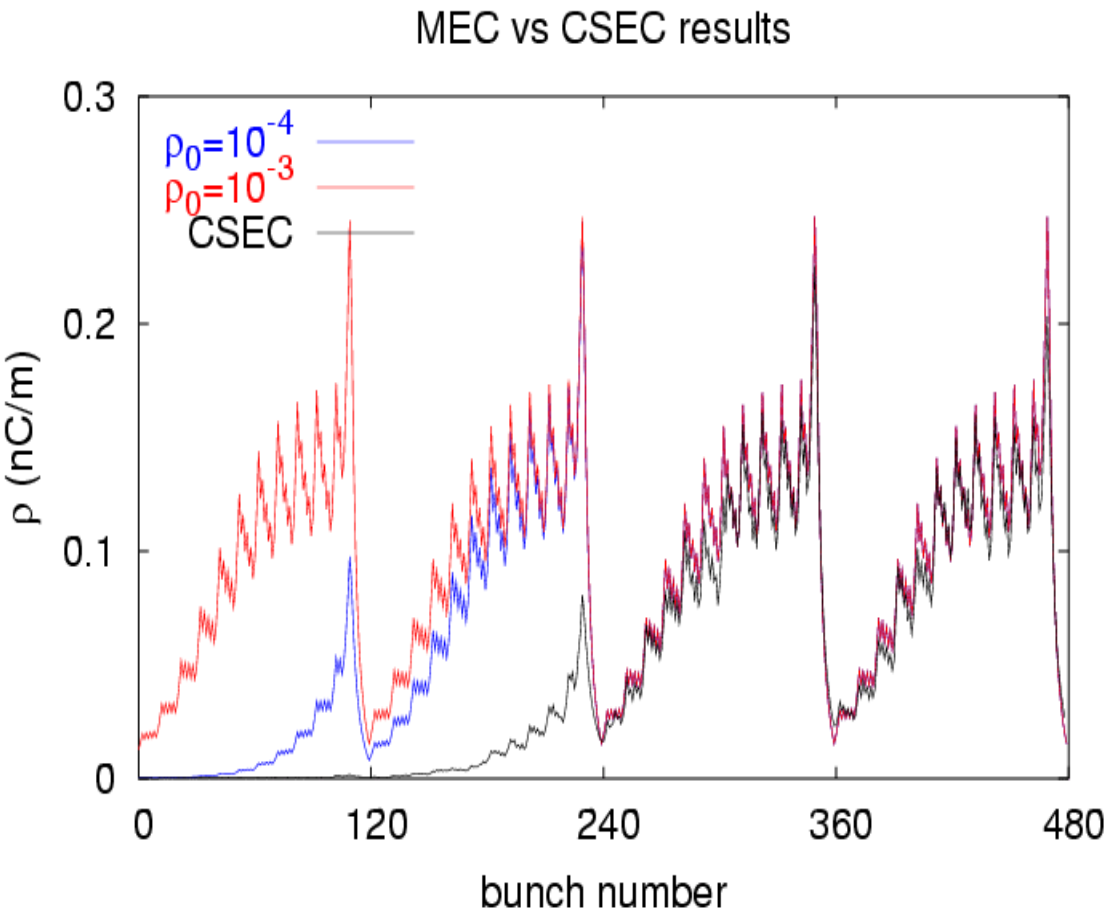
Comments:

1) No tourists – extended visits fully integrated
2) LAPAC: "Close connection to CERN staff is vital"
3) LAPAC: "What is the connection between BC and other Accelerator Systems tasks?"
4) Little activity in 05, some in 06, lots in 07

FY05 milestones:

Sep 04	TI-8 tests begin
Jan 05	LHCOP commissioning plan presented at Chamonix '05
Jan 05	Start defining LARP jobs and names, as participants in CERN planning

Electron Cloud (1)



One of several areas of activity: Maps

LEFT: A map based simulation (MEC) mimics a conventional simulation (CSEC)

6 orders of magnitude speed up

Applicable to LHC?

Electron Cloud (2)

Comments:

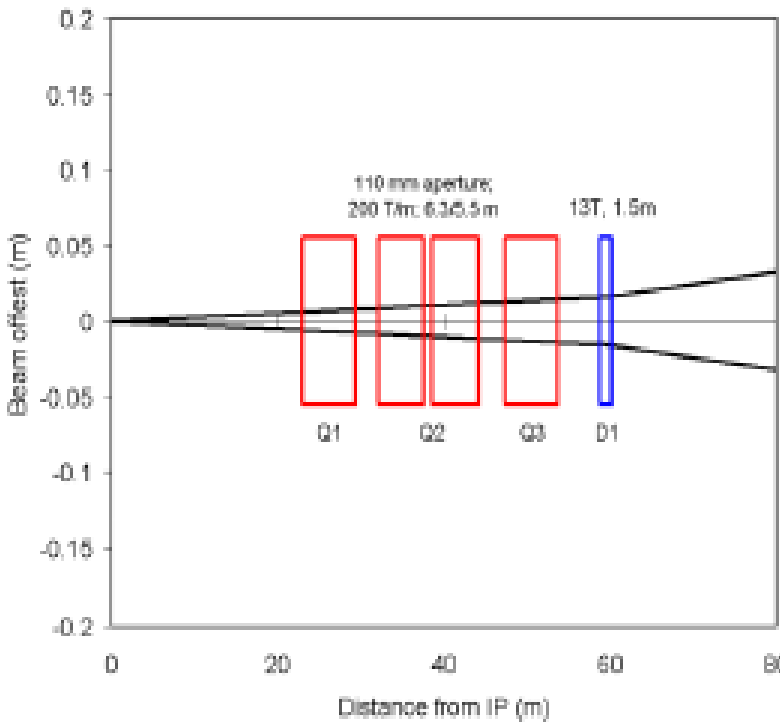
1) RHIC performance limited by pressure rise from WARM electron cloud in field free regions
2) LHC cares about heat load from COLD EC, in field
3) LAPAC: "Very attractive, but too many dimensions – specialize on experiments ..."

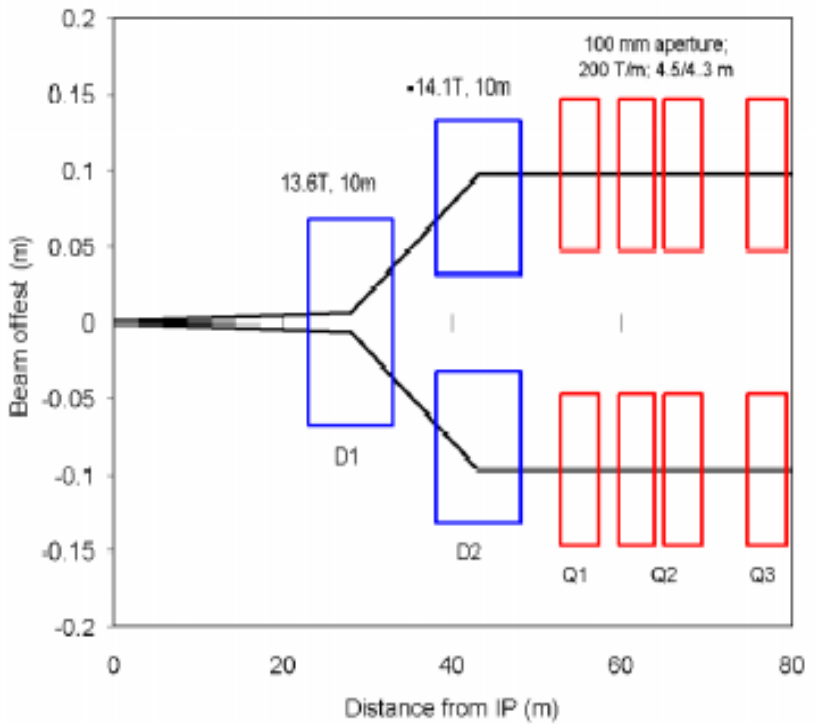
FY05 milestones:

Jun 04	Participate in SPS EC experiments and studies
Sep 04	Go/no go to install cold EC detector in RHIC
Apr 05	Report on simulated reproduction of SPS ECs
Jun 05	Report first cut at optimal conditioning scenario
Sep 05	Report on applicability of map simulation technique
Oct 05	First beam with cold EC detector in RHIC
Oct 05	Report on simulated EC at IR4 diagnostic bench

Interaction Region & Beam-Beam (1)

QUAD first or DIPOLE first? LARP & CERN continue to consider both ...





Interaction Region & Beam-Beam (2)

Comments:

1) This task supports Superconducting Magnets tasks
2) LAPAC: "Wire Beam-Beam Compensation should be actively pursued"
3) Energy deposition component interacts with both magnets and with collimation tasks

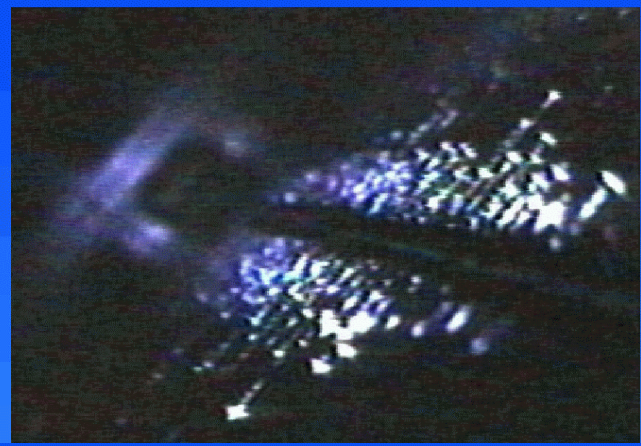
FY05 milestones:

Sep 04	Participate in beam studies of wire BBC at SPS
Feb 05	Report on BEAMBEAM3D strong-strong simulations
Apr 05	Report on dipole & quad first layouts
Aug 05	Report on impact of beam-beam on IR design

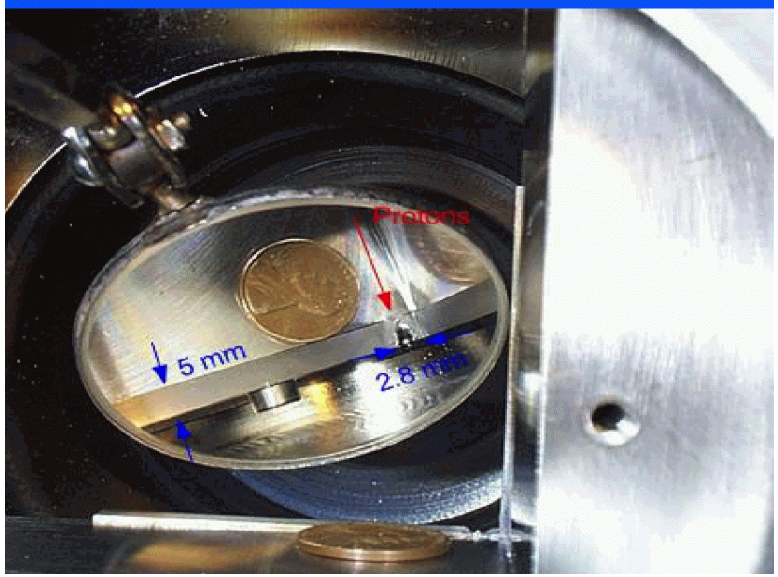
Phase I Collimation Studies (1)

1 MJ does a lot less damage than 350 MJ !

Secondary tungsten collimator



Primary tungsten collimator



Helium leak in spool piece

Phase I Collimation Studies (2)

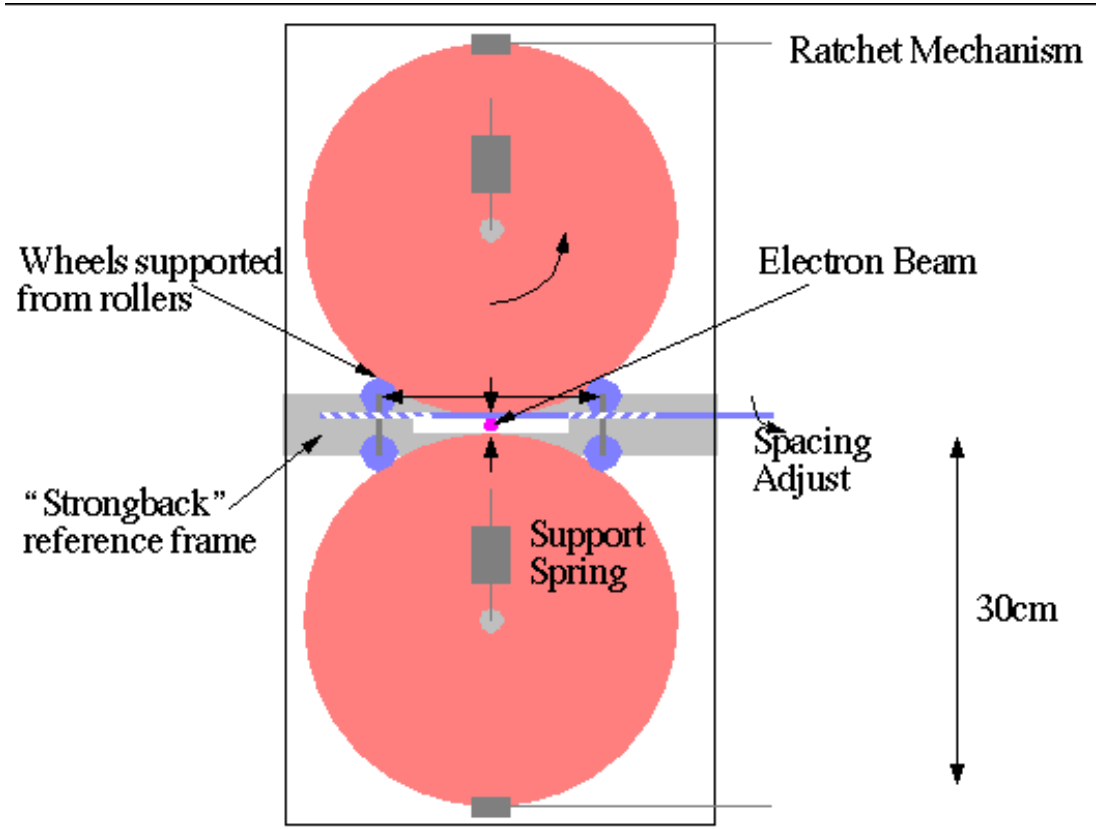
Comments:

1) Chamonix 04: "(The) complexity of the system is also worrying for (the) operations (group)"
2) Strong support and integration from/with R. Assmann & R. Schmidt
3) Code validation!

FY05 milestones:

Sep 04	Define code bench marking tests
Feb 05	Report on bench-marking of collimation codes with RHIC beam data loss
May 05	Test LHC collimator set-up procedures with RHIC collimation system
July 05	Report on accuracy of "cleaning efficiency" simulations

Phase II Collimators (1)



Phase II Collimators (2)

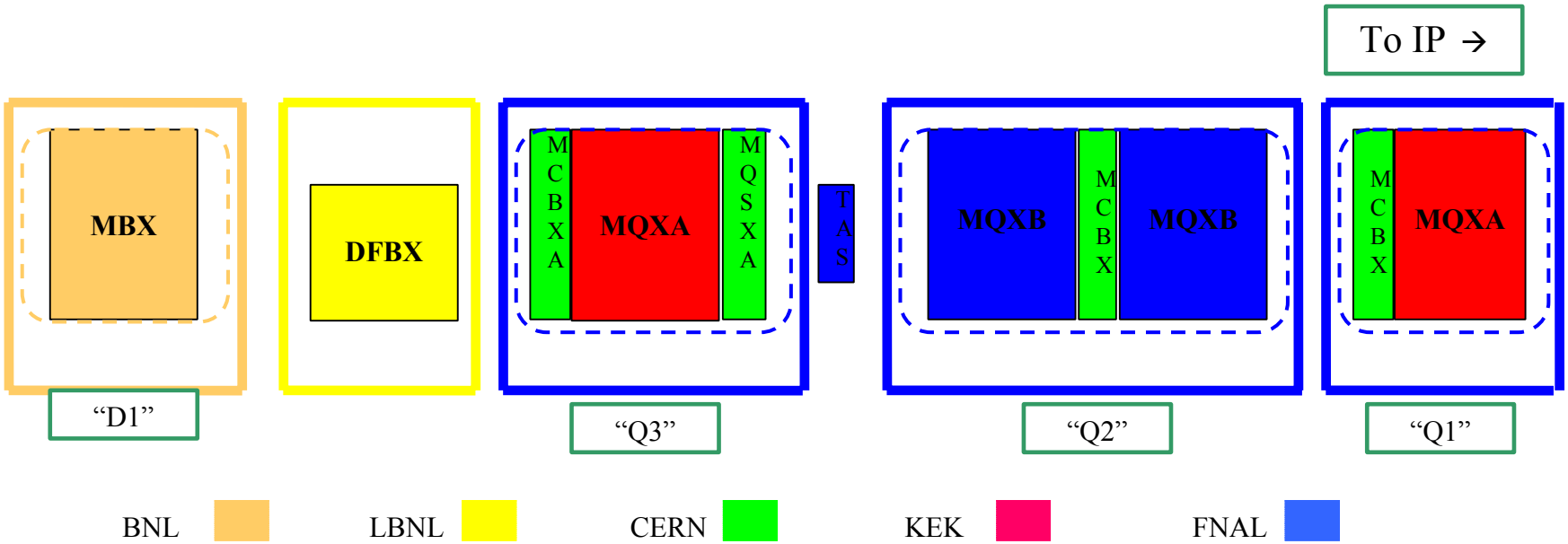
Comments:

1) Dimensions, mass, & DC heat load of Phase II Colls. are VERY DIFFERENT from those of NLC design
   - "Just design/test the best performance one can"??
2) Synergy with IR&BB, & Phase 1 Collimator Studies tasks
3) Mutual trust under construction (eg collaboration data flow)

FY05 milestones:

Jul 04	Phase II collimator meeting
Jan 05	Present status report at Chamonix '05
Apr 05	Phase II collimator review, go/no go decision
Sep 05	Hire ME, set up lab & test RC0 (existing prototype)
2006	Design and build more LHC specific RC1 prototype

Hardware Commissioning (1)



Hardware Commissioning (2)

Comments:

1) Triplet quadrupoles, separation dipoles, absorbers, ..
2) LAPAC: "LARP personnel should be put into LHC line structure"

FY05 milestones:

Sep 04	Deliver a hardware comm. report plan for FY05++
Nov 04	Warm fit-up of inner triplet (D1/DFBX/Q3/Q2/Q1)
Apr 05	Participate in installation of 3 IRs, & IP1 TAS/TAN
May 05	Begin hardware commissioning efforts (room temp, vacuum, alignment, initial cool-down)
2005	Installation support & commissioning of US provided systems; injection/sector test

Concluding comments

0) Accelerator Systems fully support Superconducting Magnets in the "long row to hoe" to the IR upgrade

1) LARP's mission is R&D (but exceptions prove rules)

2) "Collaborating means giving something up" (so that everyone wins)

3) Challenge is to integrate Accelerator Systems tasks into:

- LHC, with "min pain, max gain"
- Beam Commissioning

4) FY05 is stable. FY06 ($10 million?) & FY07 (turn on) look exciting!

5) Receptive to possible future tasks - Schottky, Beam-Beam compensation, Long. Density Monitoring, tertiary collimators, ...

- but current (fixed) resources are already spread thin