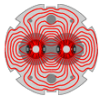
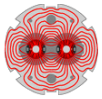


BNL -FNAL - LBNL - SLAC

Fermilab LARP involvement in LHC Beam Commissioning

Elvin Harms



Introduction

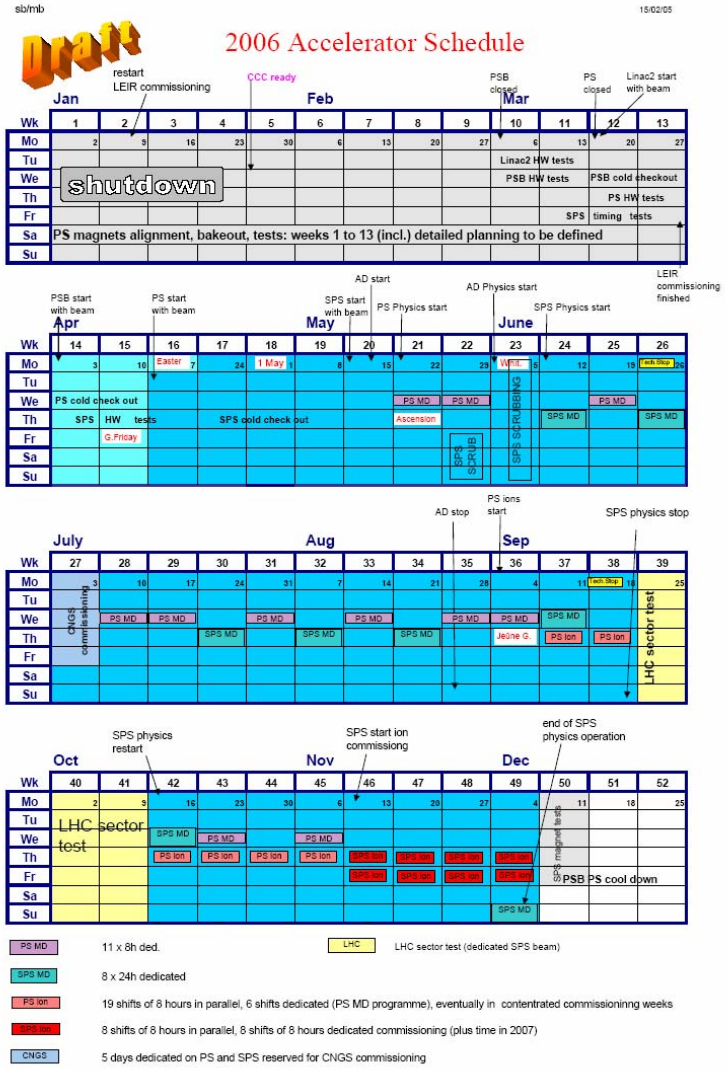
• Beam commissioning has been one of the cornerstones of LARP since its inception. U.S. involvement in LHC beam commissioning was originally envisioned to include the presence of at least one U.S. accelerator scientist on each LHC commissioning shift.

• The structure and tasks of such a presence has evolved. It is currently envisioned that US LARP participation will be as part of Commissioning teams consisting of both CERN and US scientists and engineers. The teams will focus on specific tasks as part of the entire commissioning process.

• The list of tasks/teams in currently under development at CERN. Once the prioritized list is received it will be reviewed and potential US candidates will be plugged in where vacancies and abilities lie.

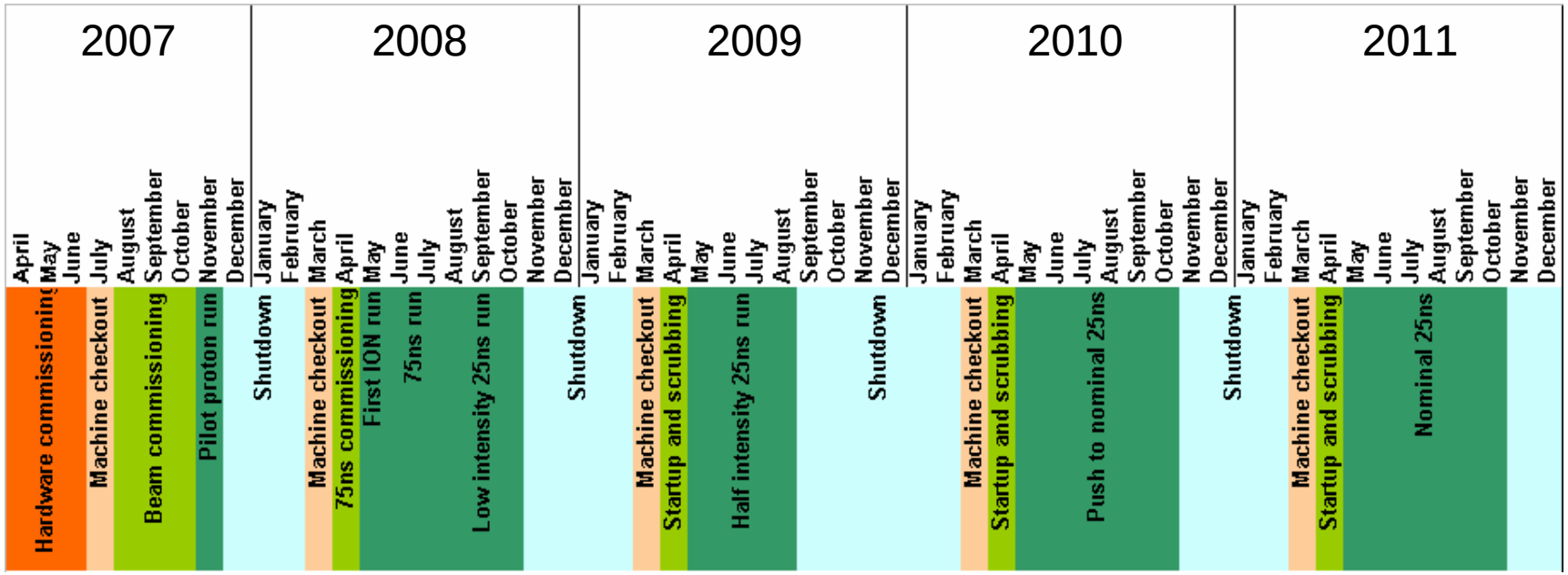
Schedule/Milestones

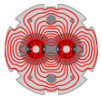
- Installation – in progress
- All machines off to focus on installation
- Hardware Commissioning until June 2007
- Injector Start up – April 2006
- Sector Test – 25 September – 15 October 2006
- First beam – summer 2007
- Collisions – summer 2007



Out Years Schedule

- 3-6 month shutdowns every year
- No significant luminosity running until 2008
- Rapid commissioning





Accelerator Systems Support

All accelerator systems have to be commissioned and will subsequently require expert support to maintain performance at the required level. For this we will obviously count on the equipment groups who are presently building the hardware systems, but we will also need a number of accelerator physicists to assume responsibility for the beam physics aspects

Three categories of accelerator systems:

- Predominately equipment systems (such as magnet circuits and power converters) requiring little accelerator physics support
- Essentially beam-based systems (such as the machine aperture) requiring a lot of accelerator physics support
- All the rest, requiring both equipment and accelerator physics expertise

For the accelerator physicists the term responsibility here means:

- Ensure beforehand that the system specification is clear and that all necessary tools, including software, are in place for first beam or when required
- Ensure that the system performs to specification as far as the beam is concerned. This will entail ensuring that all the necessary beam measurements are performed during commissioning and that any necessary corrective actions are implemented. All this should clearly be done in close collaboration with the central commissioning team described above
- ***Provide a link to the LARP personnel associated with the system***

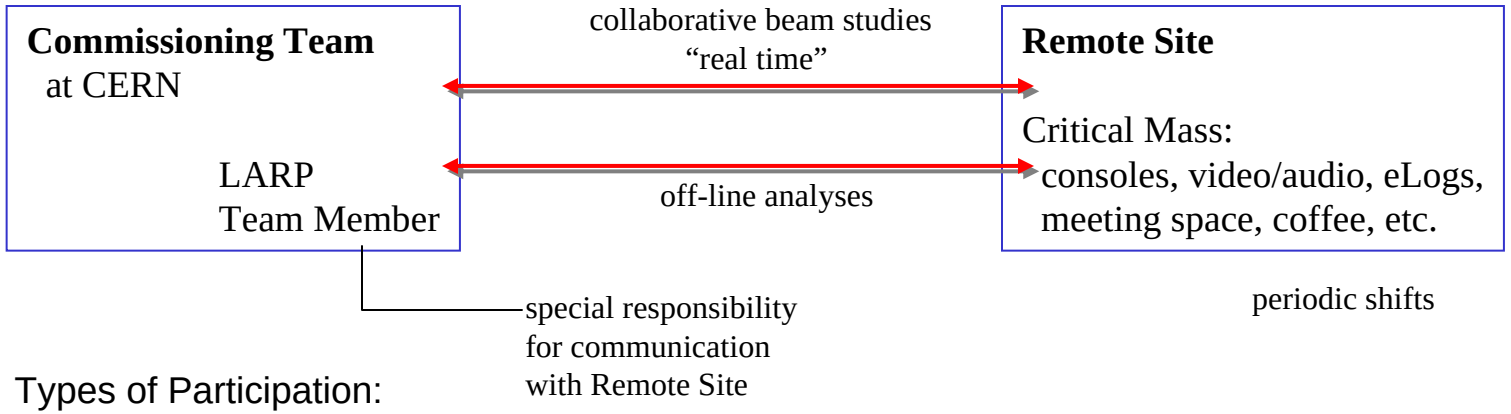
from Roger Bailey

LARP Involvement – CERN Perspective

In the present US-LARP proposal, resources are allocated for "Beam Commissioning and Accelerator Physics" activities from 2004 onwards, rising to significant numbers by 2007. In the discussions to date, we have made the point that the US-LARP commitment has to be made with long-term individual commitments of around 12 months, and that US staff should come to perform a specific role in the beam commissioning work. It has also been clearly said that CERN has to maintain sufficient expertise, particularly on shift, to ensure long-term exploitation of the machine

With this in mind, we feel that a very limited number of US-LARP resources could participate in the shift rota. Rather, they would be best suited to the accelerator physics and equipment group support activities.

Types of Participation



Four Types of Participation:

Deliverables

person builds something, visits to install, debug, etc., then leaves; may need remote access

On-site Commissioning

person has moved to CERN (for ~1 year, say) and works daily with LHC group

1-on-1 Contacts

person works with a particular person or group located at CERN, with occasional trips to CERN to participate in a study, etc.

Remote Participation

person is part of a group at Remote Site, participating daily for shorter time periods

"Training" can be performed at the Remote Site; periodic, shorter trips to CERN working with the "On-site" commissioners; people can continue to work remotely upon return

from Mike Syphers

Accelerator Systems and Responsibilities 1

	System		Equipment Group	Beam Physics or Operational aspects
Systems needed pre beam	Control system			
	Applications software		1	
	Accelerator technical services	TI operations		
		Electrical supply		
		Cooling & Ventilation		
	Vacuum			
	Cryogenics		2	
	Access			
	Cold magnets		2	
	Warm magnets			
	Magnet circuits and power converters		2	
	Power Interlock System (PIC)			
	Quench Protection and Energy Extraction (QPS)		2	

CERN knows who these are

No or very few names here

- Points to address for each system
  - What is the specification with beam
  - What measurements are needed
  - What tools are needed
  - What beam is needed
  - How much time is needed

This is the meat of Hardware Commissioning

from Roger Bailey

Accelerator Systems and Responsibilities 2

	System		Equipment Group	Beam Physics or Operational aspects
Systems needed for beam	SPS extraction, transfer, injection and first turn		2	
	Multi turn losses and BIS dependability			
	Protection devices other than collimators		2	
	Collimation system and Halo cleaning		1	
	Clean Beam Extraction			
	Radio protection		3	
	Beam Instrumentation	Screens		
		BCTs		
		BPM, trajectory & orbit correction		
		BLM		
		PLL for Q, Q', coupling	1	
		Profile monitors		
		Schottky	1	
		Luminosity monitors	1	
	Vacuum conditions during operation and electron cloud			
	Reference magnet system			
	RF systems and longitudinal beam dynamics			
	Transverse feedback		2	
	Experimental solenoids and compensations			
	Experimental equipment (Roman pots, velo)			

CERN knows who these are

CERN AP interest known here

from Roger Bailey

Accelerator Systems and Responsibilities 3

	System	Equipment Group	Beam Physics or Operational aspects
Beam based systems	Beam in the injectors	2	
	Ion beam in the injectors		
	Orbit feedback system	1	
	Filling efficiency and flat bottom conditions	1	
	Ramp and squeeze losses and overall quality	1	
	Machine protection system	1	
	Optics	2	
	Mechanical aperture		
	Machine Impedance and collective instabilities	2	
	Dynamic aperture	2	
	Lattice corrector settings	3	
	Triplet corrector settings	3	
	Lifetimes	3	
	Separation schemes	2	
	Crossing angle schemes	2	
	Collisions and luminosity steering	1	
	Experimental conditions	3	
	Ions		

No or very few names here

CERN AP interest known here

US Resources Available for LHC Commissioning

	Hardware Comms.	Beam Commissioning	
	long-term FTE	long-term FTE	short-term
Laboratory	min → max	min → max	est.visitors
Fermilab	4 → 7.5	5 → 12	12
Brookhaven	0 → 0	0 → 1*	10
Berkeley	1+1* → 2 + 2*	2* → 2 + 2*	8
SLAC	0 → 0	0 → 1	2
TOTAL	6 → 11.5	7 → 18	22

* to be hired

Sample Commissioning Allocation

Personnel Distribution Model:

	BNL	FNAL	LBNL	SLAC	*totals*		K$
FY05		0.15			0.15	FTE	*30*
		4			*4*	*bodies*	
FY06	0.75	1.25			2	FTE	*400*
	4	*8*			*12*	*bodies*	
FY07	1	3	0.25	0.25	4.5	FTE	*900*
	4	*8*	*1*	*1*	*14*	*bodies*	
FY08	1.5	3.5	0.5	0.5	6	FTE	*1200*
	4	*8*	*1*	*1*	*14*	*bodies*	

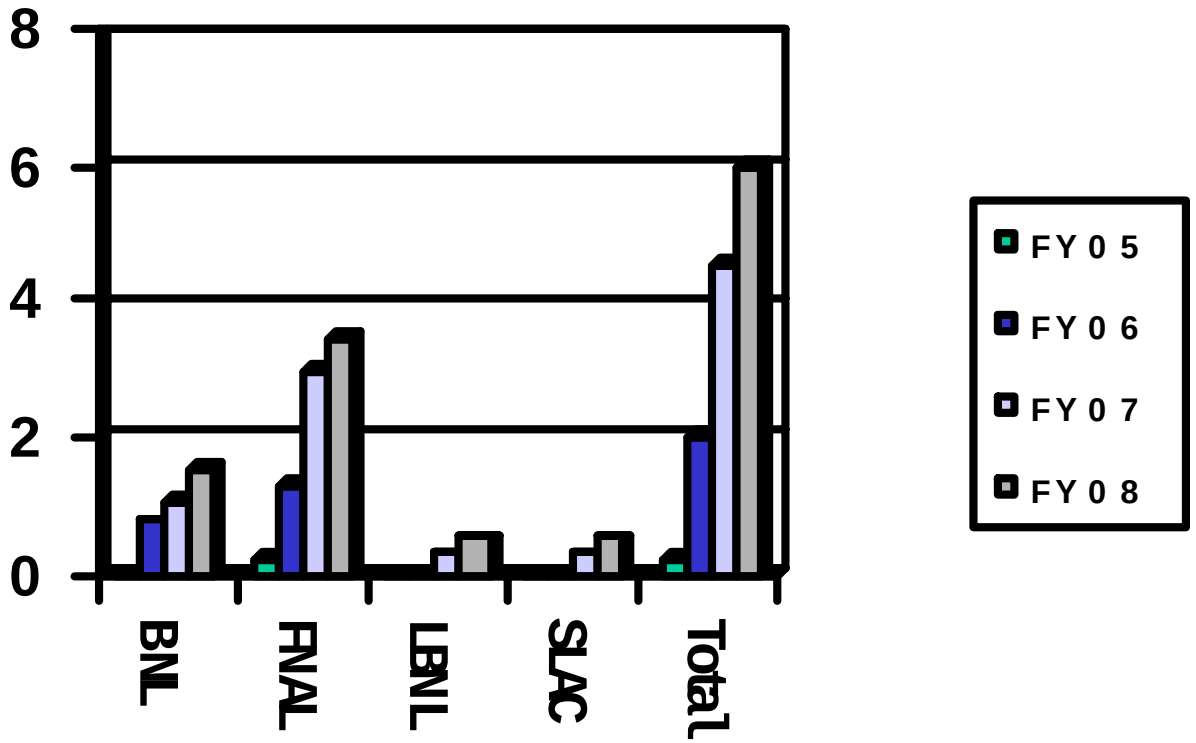
1 FTE = 200 K

Travel Distribution Model:

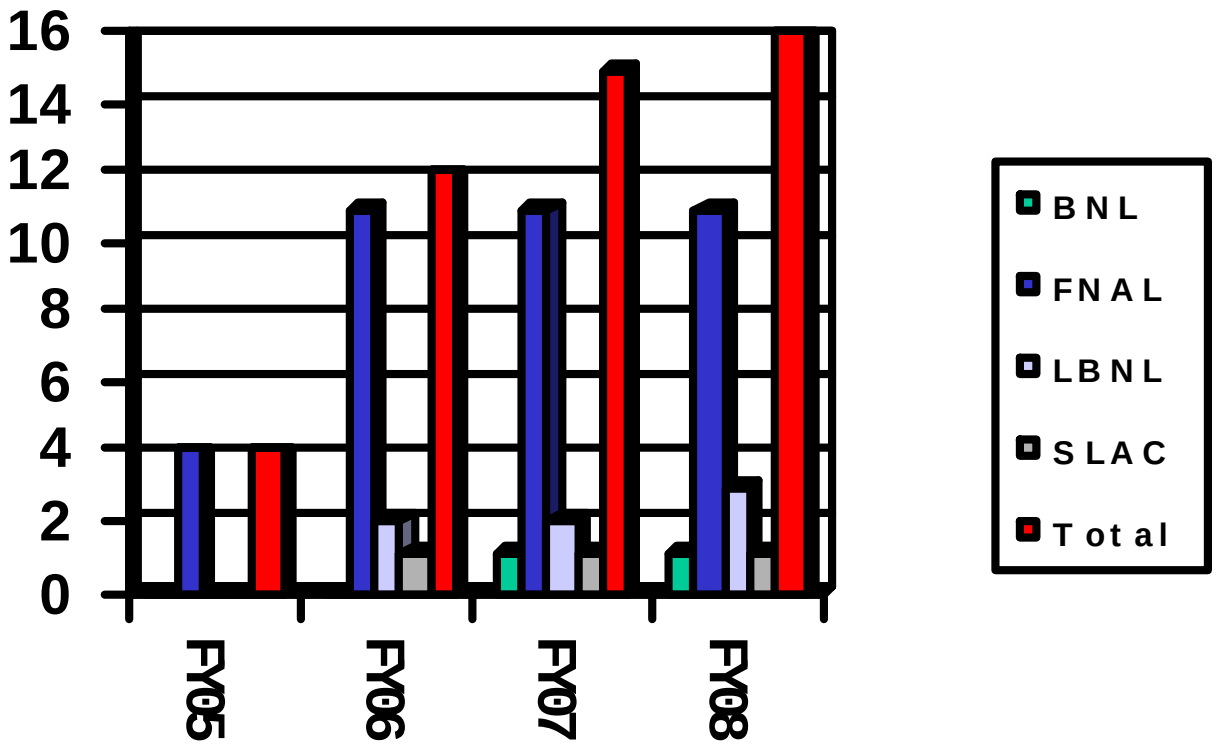
	1 wk	2 wk	4 wks	6 mos	12 mos	
FY05	5	1				0.15909 FTE
FY06	6	6	4	2		1.90909
FY07	4	2	1	4	2	4.81818
FY08	4	4		2	4	5.95455

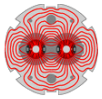
1 wk @ CERN = 0.02273 FTE = 4.54545 K$

Sample Commissioning Allocation – FTE's



Sample Commissioning Allocation - Bodies





Next Steps

- Resources
  - FY06
    - 4 persons
    - 1-week to 6-month visits
  - Remote access

- Expressions of Interest
  - Short Term
  - Long Term
  - Areas of Interest

- There should be a LARP presence during pre-beam activities (hardware commissioning, sector test, etc) to gain an understanding of LHC controls and operation before beam commissioning is initiated.