
Crab Cavity Status & Plans

Rama Calaga, BNL/LARP

CM11, Oct 27, 2008

Session Agenda

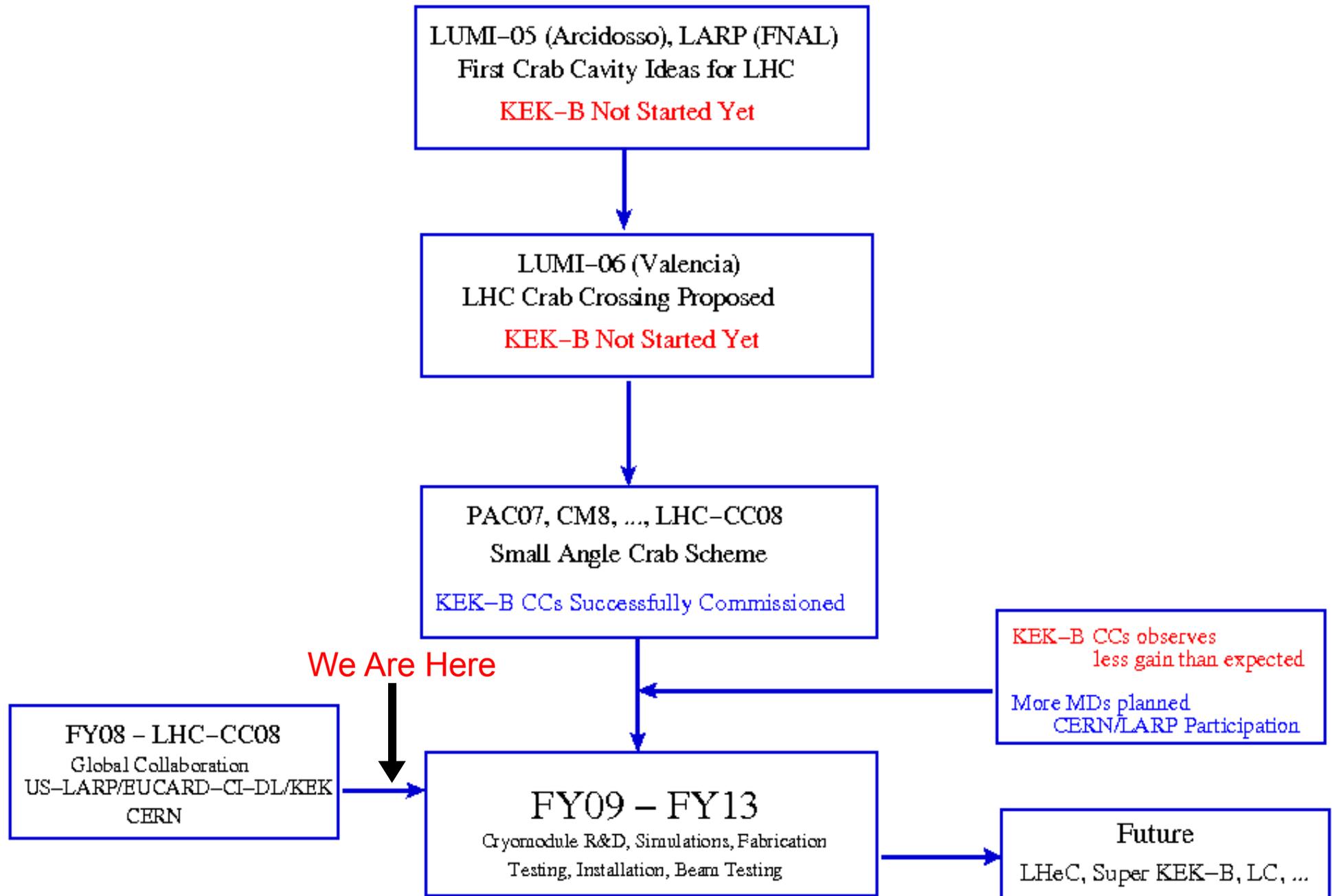
1:30 – 2:00 pm	Crab cavity status & FY09 plans – R. Calaga
2:00 – 2:30 pm	Cavity/Coupler R&D FY09 – A. Seryi (BNL / KEK / LBL / SLAC / UK)
2:30 – 3:30 pm	Discussion: Cavity/Coupler down selection
3:30 - 3:45 pm	Coffee
3:45 - 4:15 pm	Cryostat Evaluation (Flexibility for multiple designs) – N. Solyak
4:15 - 4:30 pm	Discussion: Cryostat R&D & Installation
4:30 – 4:45 pm	Coordination with KEK & UK activities – Y. Morita/P. McIntosh
4:45 - 5:15 pm	Discussion: SBIRs proposals
5:15 - 5:30 pm	Discussion: Simulations

[The session is organized to be discussion oriented](#)

Session Goals

- Outline the FY09 plan as a first step towards a comprehensive plan for a 5 yr program
- Coordination of a very large collaboration & manage various contributions w/o duplication
- Effective R&D measures to reach to a approx baseline design by Fall-2009

Some History



Critical Milestones, FY08

- 1st LHC-CC workshop – big step forward to start international collaboration
- CERN [consensus](#) & strong support for LHC-CC prototype & installation in phase I commissioning stage
- Regular meetings to focus R&D of cryomodule, significant progress in design achieved in short period ([7 months](#))
- [IR4 location](#) established by CERN-RF group for potential installation
- Preliminary beam simulations (beam-beam, collimation and impedance estimates) predict no show stopper
- Convergence to a [baseline](#) design within [1 year](#) and design review in [2 years](#)

CERN Workshop, Aug 21, 2008

Purpose

Establish CERN interest in installation, various validity requirements and a firm plan for the crab cavity installation into the LHC compatible with the phase I upgrade.

Statement of Interest

Date: 07/23/2008

To: workshop organizers

Cc: Lyn Evans

[J. P. Koutchouk](#)

After discussion with the LHC Project Manager (Lyn Evans), I will be in position in the August miniworkshop to say that CERN is indeed interested by the R&D on crab cavities, given their large potential in increasing the LHC performance. It shall be possible to install crab cavities as soon as they are available, at the condition that they cause no loss of performance, i.e. that they are properly integrated and are not seen by the beam when not used.

The interest of KEK, in addition to US-LARP and FP7-EuCARD is very much welcome.

Some Recommendations, CERN

- Hardware must be extensively tested before installation in the tunnel
- LHC performance shall **not be reduced**, even if hardware fails
- The time available to build hardware.... leaves no other possibility than **elliptical cavities** at 800 MHz
 - Moreover, the detailed layout of the insertions for Phase 2 and their integration in the tunnel is not yet known. For both of these reasons, I think unrealistic to state that the hardware developed for the validation test will be the one finally used in operation.
- A large enough **effect on luminosity** must be aimed at for the demonstration to be convincing. Setting the goal at $\sim +10\%$ implies the installation of two crab structure to provide $\sim 5\text{MV}$ kick voltage/beam

A comprehensive list of requirements for the cryomodule ↔ installation and beam testing layout will be prepared by CERN in due time.

LHC-CC Coordination

Simulation Layer

Beam-Beam
& Noise

Collimation &
Impedance

Operational
Scenarios

Design Layer

Cavity/Coupler
FY09 Focus

Cryostat/Tuner

LLRF/Controls

Power Systems
Infrastructure

Hardware Layer (Cu & Nb)

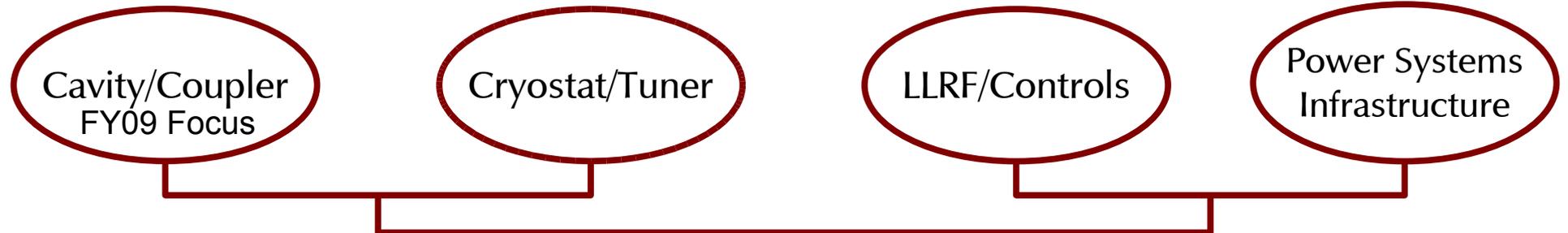
Fabrication
Assembly

Chemistry

Testing
Installation

Operations Layer

Beam
Testing



Merit Sheet, First Draft

Parameter	BNL-SLAC		DI/CL	KEK-B
	6 deg	0 deg		
Epk				
Bpk				
R/Q				
cell-to-cell coupling				
Beam pipe radius				
Transverse size (Equator Radius)				
Loss factor (longitudinal)				
Transverse loss factor				

LOM, R/Q, Qext				
SOM: R/Q, Qext				
HOMs: R/Q, Qext				
Multipacting				
Fabrication				
Chemistry complexity				
Cryostat complexity				
Assembly & associated components				

Contributions

- LARP

- FY09 is not as requested, but expected to ramp up significantly in FY10
- All proposed activities to continue, [focus on cavity/coupler](#) (CM11 discussions)

- UK/CERN

- FP7 Budget allocated sufficient for:
 - Cavity/coupler studies, LLRF, [warm model & testing](#) (UK)
 - Beam simulations, optics and installation issues (CERN)
- Perhaps an increase in the following yrs (?)

- KEK

- Waiting for funding approval, will contribute in the framework of the collaboration

- SBIRs

- [AES-BNL/FNAL/LBL/SLAC](#) (cavity, cryostat)

- Other Collaborators

- Tsinghua University: [Warm models & testing](#) (in collaboration with UK work)
- Jlab: Very interested. Some activity ongoing on rod type structures

Preliminary Schedule

LHC Crab Cavities

Rama Calaga

WBS	Task	POC	Status	Start Date	Finish Date	2008	2009	2010	2011	2012	2013
1	Beam Simulations										
1.1	Beam-beam	Sen/Calaga				█	█				
1.2	Collimation	Tomas				█	█				
1.3	Optics	Tomas				█	█				
1.4	Impedance	Zimmermann				█	█				
1.5	OP Scenarios	Calaga				█	█				
	Program Review (CM11)					█					
2	Cryomodule R&D										
2.1	Cavity Design	Calaga	In progress	01/01/06	06/01/09	█	█				
2.2	Coupler Design	Seryi	In progress	03/01/08	06/01/09		█				
2.3	Cryostat Design	Solyak	In progress	03/01/08	06/01/09		█				
2.4	Tuner	Solyak	In progress	03/01/08	06/01/09		█				
	Confirmation of Parameters								█		
3	Cryomodule Validation										
3.1	Space Constraints	Ciapala				█					
3.2	Personal & Hardware	CERN					█				
3.3	Tunnel Layout	CERN					█				
3.4	Cryogenics	CERN					█				
3.5	Survey & Alignment	CERN					█				
3.6	Radiation Issues	CERN					█				
3.7	Cavity Control	CERN					█				
3.8	Synchronization Control	CERN					█				
3.9	Slow Control	CERN					█				
3.1	RF Power	CERN					█				
	Design Review								█		
4	Fabrication										
4.1	Cavity Fabrication								█		
4.2	Main Coupler								█		
4.3	LOM/SOM/HOM Couplers								█		
4.4	Cryostat								█		
4.5	Tuner								█		
4.6	RF Power Source								█		
4.7	LLRF								█		
	Inspection Review									█	
5	Assembly										
5.1	Cavity VTA								█		
5.2	Cav/Coupler Assembly								█		
5.3	Cav/Coupler Testing								█		
5.4	Cryostat Integration								█		
5.5	Full Systems Test								█		
5.6	Tunnel Prep								█		
5.6	Installation								█		
5.7	Survey & Alignment								█		
5.8	RF Powering								█		

Conclusions

- The strong potential and interest in R&D of LHC-CCs make it one of most ideal projects for LARP, especially assuming a lead role with only partial contribution
- Budget constraints will limit the full extent of R&D but try to push for maximum effort using available resources and synergies
- FY09 will not only have very exciting developments but will also converge to baseline design