WP 4: Crab Cavity

Ed Ciapala, Erk Jensen

BE-RF, CERN

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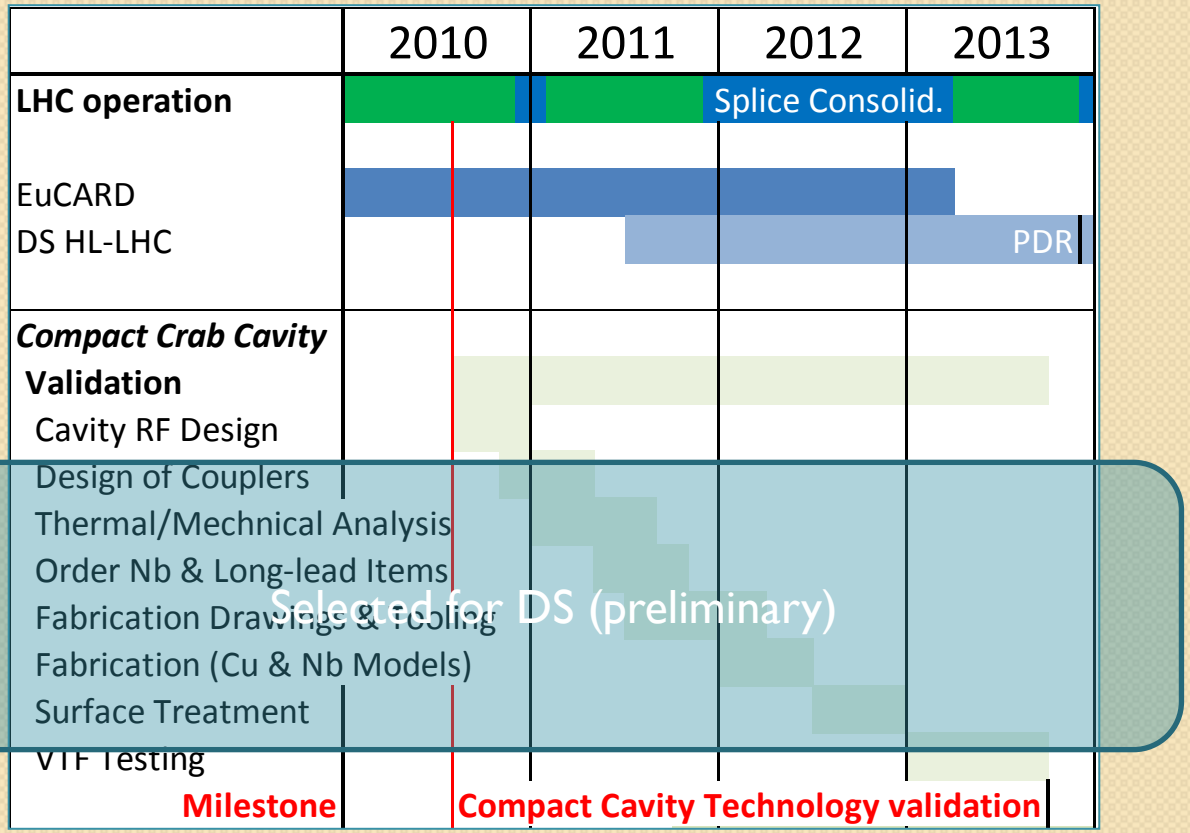
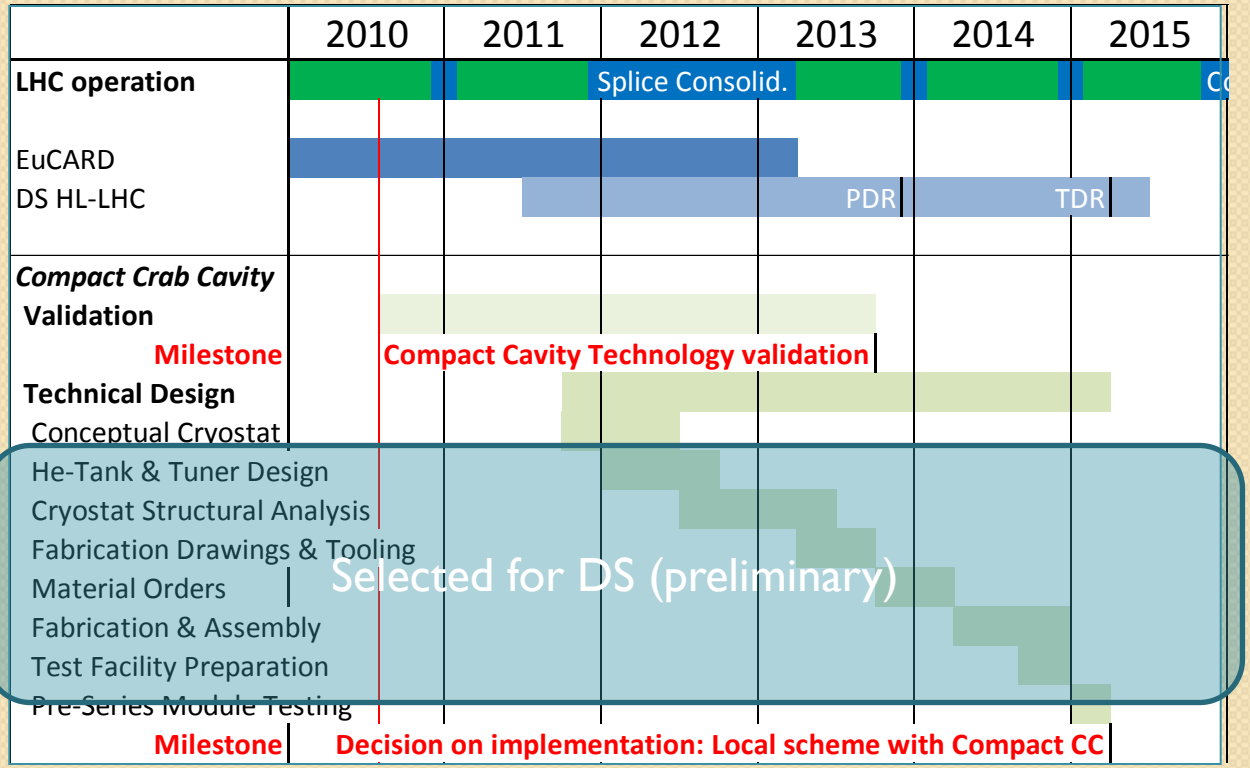
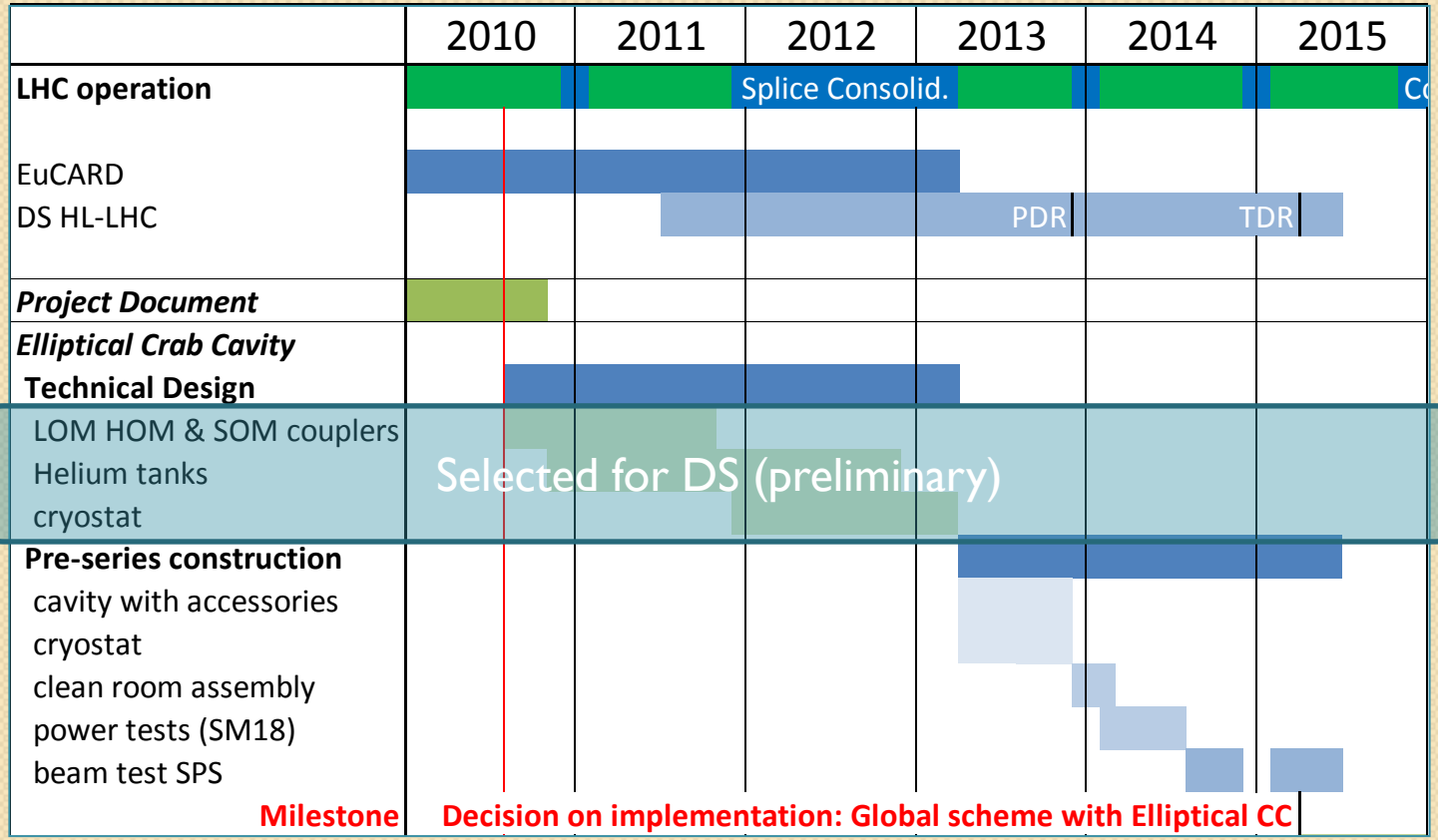
Compact CC validation phase



Compact CC Technical Design



Elliptical CC Technical Design



CC related studies in other WP's:

- WP2 (Accelerator Physics):
  - Impedance and growth rate estimates for specific HOMs to specify exact damping needs and feedback measures,
  - Effect of non-zero dispersion and stable working points,
  - Crab consistent optics,
  - Local doglegs & feedback to control beam transverse position @ CC.
- WP3 (Magnets) Task 3:
  - Dog-leg dipoles for Elliptical Crab Cavities.
- WP5 (Collimation & Beam losses):
  - Tracking simulations for loss maps for fast failure modes,
  - Beam-beam simulations to investigate instabilities, noise issues and DA.

WP4: Possible Tasks (2nd draft)

Task 4.1: Coordination and Communication • Coordination and scheduling of the WP tasks • Monitoring the work, informing the project management and participants within the JRA • WP budget follow-up	CERN, LARP, ULANC
Task 4.2: Support studies • Tunnel preparation SPS and LHC • Local IR layout and spatial integration • Effect of phase noise , LLRF system conceptual design • RF power system specification • Operational aspects (how to commission/make invisible) • Interlocks and fast Feedback	CERN, KEK, LARP
Task 4.3: Compact Crab Cavity design • Complete cavity and cryomodule specifications • Design optimisation for novel schemes • Conceptual design of SOM, HOM and LOM couplers • Conceptual design of helium tank and cryostat • Multipacting simulations on cavity & couplers • FEM simulations: mechanical & thermal aspects • Initial down-selection of the CC options • Completion of a full technical design on the initial down-selected options, with mechanical drawings and specification. • Design of tooling, dies and cavity fabrication equipment	ULANC, LARP, CERN, JLAB

WP4: Possible Tasks (2nd draft)

Task 4.4: Elliptical Crab Cavity Technical design • Coupler development and testing • Tuner design and mock up on copper models • Study of mechanical effects: resonances, microphonics. • Cavity performance with couplers and horizontal cryostat • Performance difference between 2 K & 4 K • Cryostat and He Tank Design • Complete the full technical design	CERN, CEA, CNRS, KEK
Task 4.5: Compact Crab Cavity Prototyping and Test • Procurement /fabrication of tooling, dies and equipment. • Construction of models to refine manufacturing techniques and tooling. • Fabrication of prototype niobium cavity • Cleaning and electro-polishing on the bare niobium cavity. (i.e. no couplers, antennas or other accessories), including cavity surface inspection. • Development and procurement of all test equipment and instrumentation. • Low power tests and measurements on the bare cavity in a test cryostat to test for compliance with design gradient and cavity performance specs. • Make the final CC design down-selection	CERN, CEA, CNRS, ULANC, STFC, LARP

First estimate on man-power:

... will have to be revised!

Work package number	WP4		**Start date or starting event:**			M1	
Work Package title	Crab Cavity Design						
Activity type	RTD						
Participant id	**CERN**	**ULANC**	CEA	CNRS	STFC	BNL	FNAL	JLAB
Person-months per beneficiary:	153	91.8	25.2	60	28.8	30.6	43.8	76.2
Participant id	LBNL	SLAC	KEK					
Person-months per beneficiary:	10.8	78.6	82.2					

Show Excel: "Crab Cavities for LHC spending profile DS_Oct20.xlsx".

Deliverables and Milestones

... will have to be revised! Here a first draft (too many! Too strict!)

Deliverables of tasks	Description/title	Nature	Delivery month
1	Valid proposal on handling machine protection issues		6
2	Valid proposal on ensuring an acceptable minimum of perturbation to normal LHC operation		18
3	Specification documents on conceptual design of High Power and Low Level RF systems.		24
4	Integration drawings for SPS and LHC CC installations		
5	Results on expected performance of the different CC cavity options to allow initial down-selection		28
6	Conceptual design of SOM, HOM and LOM couplers		28
7	Conceptual design of He tank and cryostat for CCs		
8	Technical design of a complete elliptical cavity in its cryostat with ancillaries		36
9	Initial down-selected bare cavities built and tested with RF		48

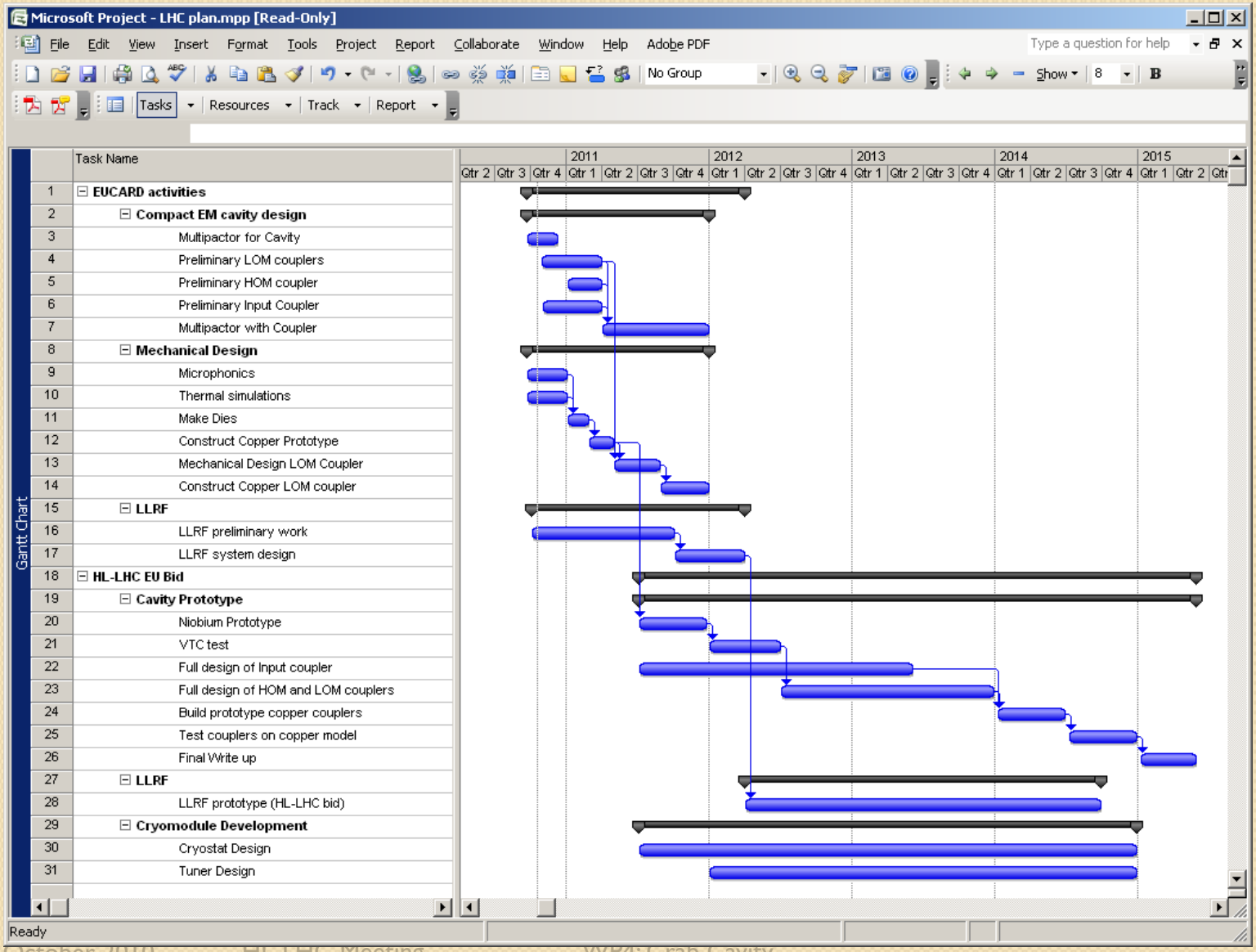
Mile-stone	Description/title	Nature	Delivery month	Comment
1	Machine protection concerns satisfied		6	
2	Operating scenario during LHC ramping specified		12	
3	Initial CC cavity designs down-selection, leaving at least two CC options for prototyping		28	
4	Completion of technical design of elliptical cavity in its cryostat		36	
5	Final CC design(s) down-selected for series production		48	

ULANC+STFC

- Lancaster and STFC planned activities:

1. Finalise cavity and coupler designs,
2. Test a Prototype Nb Cavity without couplers,
3. Prototype couplers in copper,
4. Design a Cryostat and tuner,
5. LLRF modelling (sketchy).

ULANC+STFC initial planning



CNRS (LPSC)+CEA (SBT)

Info from JM De Conto:

"We have made a demand, via the French "Grand Emprunt", for the development of Elliptical Crab Cavities. This demand is relative to:

- equipement (RF instrumentation, clean rooms etc) for about 250 k€,
- running costs, maintenance (~6 k € /year over 10 years)
- people: lab installation (1 FTEy) and cavity develpment (0.5 FTE over 10 years, like high level engineer or post doc),

in addition to the LPSC people. The demand is shared between two applications: "EQUIPEX" (Equipements d'Excellence) and LABEX (Laboratoire d'Excellence)."

This is complementary to the Design Study in which we will put the accent on the design of the Elliptical Crab Cavity and the Cryostat as well as the prototypes and their tests.

LARP + JLAB

- US Partners:
  - existing LARP: BNL, FNAL, LBNL, SLAC
  - JLAB
- LBNL (John Byrd writes):

  "I wanted to express our strong interest to be involved in the LLRF for this program. Our group has a lot to offer to this program. We are presently designing the LLRF controls for the crab cavity program at the Advanced Photon Source. This is a so-called "local" crabbing scheme with the goal of producing picosecond x-ray pulses. We are very interested in helping the LHC. We will be requesting funding from US-LARP to get involved in this effort. "
- JLAB (Jean Delayen) have sent their

KEK

- Sorry – I haven't progressed here ...