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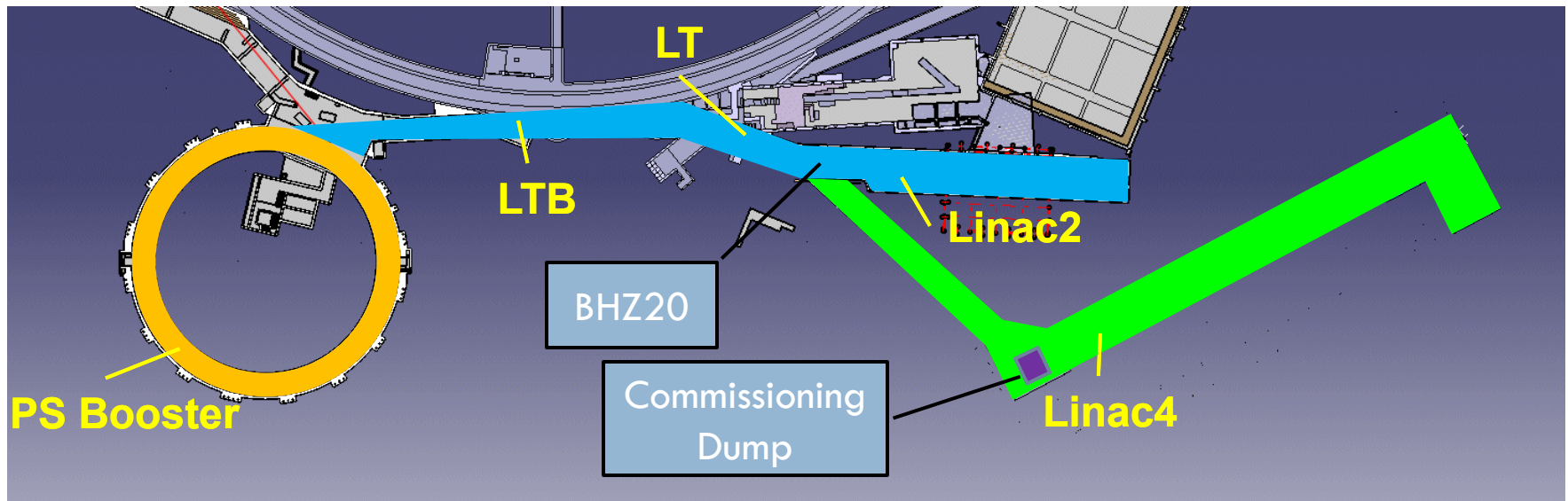
# The option of connecting Linac4 to PSB during Long Shutdown 1 (2013/14)

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IEFC Workshop,  
24.03.2011

- Linac4 can be commissioned with beam completely **independently** from the other machines, up to the 160 MeV dump.
- Since 2 years, the beam commissioning is scheduled for the period **2013/14** and has maintained constant against the floating environmental conditions, for 2 reasons:
  - a. optimization of **resources**: stretching too much the construction and commissioning increases the total number of FTEs.
  - b. have Linac4 available as early as possible as **back-up** to Linac2.



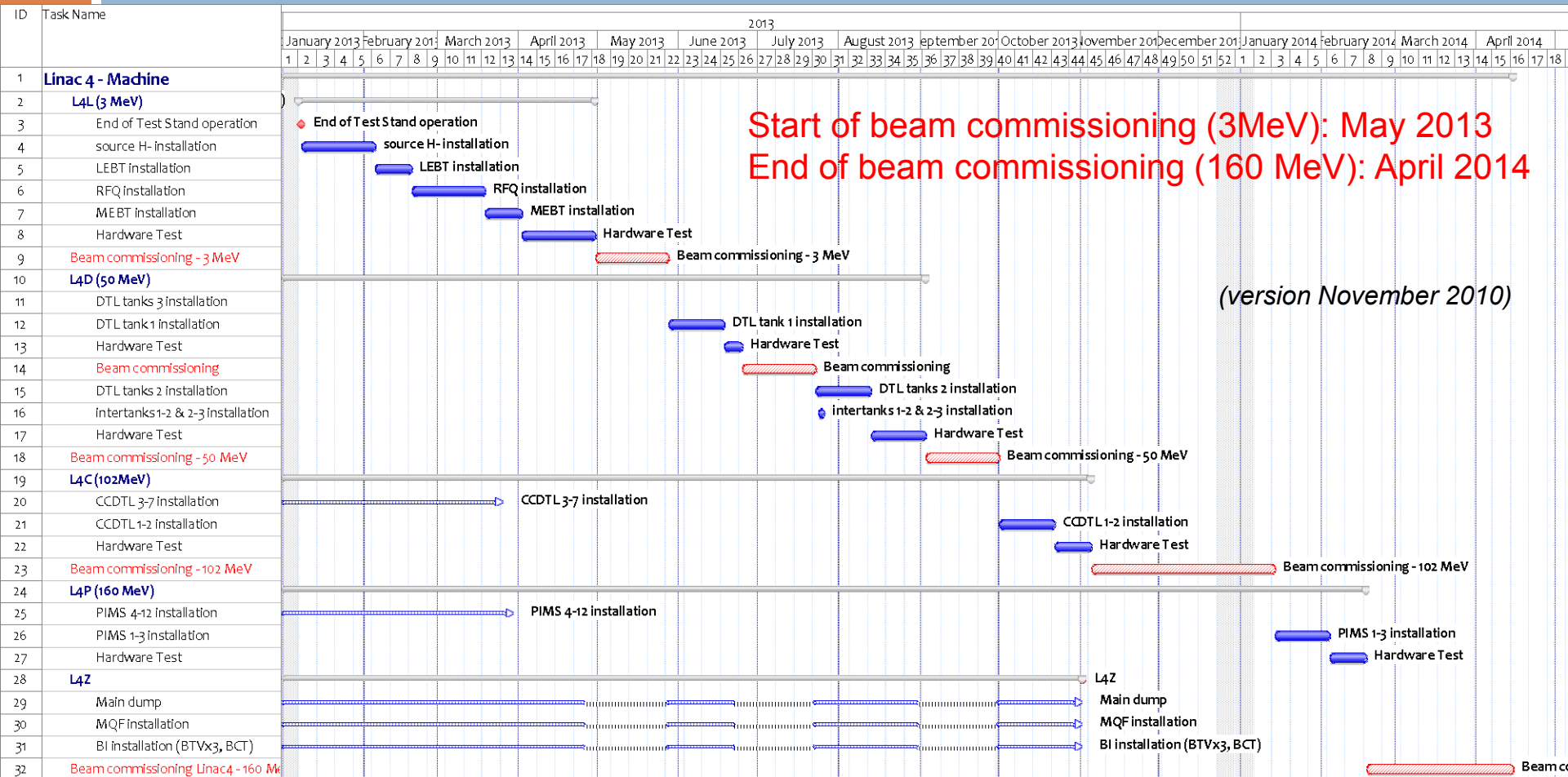




# Linac4 commissioning schedule



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5 commissioning stages:  
(on intermediate dumps)



*In 2013/14 (15 months), 6.5 months of beam commissioning, 3 months of HW tests, 5.5 months of installation*



# Connection of L4 during LS1



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- At Chamonix, it has been asked whether the connection of Linac4 to the PSB could be envisaged during LS1 (2013/14).
- The scenario would be to *maintain the linac commissioning schedule* (no much space for improvement!) and to *advance to 2014* (immediately after Linac4 commissioning):
  - a) the commissioning of the *transfer line*,
  - b) the modifications to the *PSB injection*,
  - c) the *recommissioning of the PSB* with the new beam.



# 2014 Connection Schedule



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## TENTATIVE SCHEDULE - CONNECTION LINAC4 DURING LONG SHUT-DOWN 2013/2014 - version 10.2.11

2013												2014												COMMENTS										
1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12											
				Linac4 commissioning																							L4 commissioning as in old schedule -1 month							
																									Transfer line commissioning									
																									PSB modifications	standard duration								
																									PSB commissioning	standard duration								
																									PS/SPS commissioning	standard duration								
																										decision point: start PSB modifications only of Linac4 ready								
Long LHC Shut-down (19 months)																																		
																									ion run ?	LHC shut-down can be shortened if LHC can restart with ions								

1. Normal commissioning of Linac4 up to **100 MeV energy** (December 2013).
2. In December 2013 (or earlier if possible), after 10 months of beam commissioning, there should be enough information on the Linac4 **performance** (source current, beam emittances) and **reliability** (source, chopper, RF systems) to start dismantling the present injection (“**no-way-back**” point !).
3. From January 2014, we have to count the required 3 months for PSB injection modifications, 3 months for PSB recommissioning and 1 month for PS/SPS start-up. Linac4 commissioning to 160 MeV goes on in parallel.
4. Under these assumptions, LHC could restart with beam in **August 2014**.
5. If an **ion run** is foreseen in 2014, one could envisage to restart earlier the LHC, have the ion run and then the protons from August (no interference between Linac4 work and the ion injectors – but the issue of doing a start-up of the complex with ions has to be considered).

- The answer from the teams involved is that under these assumptions connection during LS1 would be *very tight but feasible*, provided that for some groups adequate manpower resources are available (competition with other activities).
- To release the pressure on the ion source development, it is considered to start in 2014 with a “*minimum performance*”, reproducing the beams presently produced with Linac2 (required Linac4 current at *20 mA*, half the design value) with improvements implemented during the following run (if needed the source can be exchanged during a short shut-down).
- In particular, have been considered the availability of the H- source (tight, but not impossible for the minimum performance), the availability of the PSB injection equipment (tight but feasible, question of resources in the group), the RF system (question of priority with other activities), the availability of the new PSB LLRF (in principle feasible in time, temporary solutions possible in case of delays).



# H- source roadmap



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<i>H<sup>-</sup> ion source stages</i>		DESY	Linac4 Oct-2010	Linac4 May 2011	Linac4 Dec-2012	Linac4 Dec-2013	Nominal June-2015
HT	kV	35	35	45	45	45	45
RF-power	kW	30	30	50	80	80	100
RF-pulse	J	4.5	15	10	40	56	70
H- current	mA	30	20	0	30	50	60-80
p-current	mA			80			
Pulse duration	ms	0.15	0.5	0.2	0.5	0.7	0.7
Co-extracted electrons *	A		2	0	3	4	5
e-dump power *	J		35	0	68	126	158

45 kV p-beam

45 kV H<sup>-</sup> beam

(\* ) Assuming The volume source's e/H<sup>-</sup> of 50, Cs sources have e/H<sup>-</sup> of typically 2

30 November 2010

BCC, J. Lettry

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J. Lettry, 30.11.10



# Early connection - caveats



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1. Is required a long (19-month) LHC shut-down; shut-down time shorter for other machines (15 months PSB, 18 months PS).
2. There is not much safety margin left in the schedule, in case of delays we would miss the LS1.
3. We should aim for 2014 only at reproducing Linac2 beams (but space for improvement later, in particular for testing high-brightness beams in PSB and PS).
4. In case of problems, it is not possible to revert to Linac2 (additional shielding to be added in the Linac2 tunnel, more installation time (2m) required to make PSB injection modifications reversible)– options analyzed in a L4 meeting April 2010).
5. Required resources (manpower) have to be estimated; however, there are few interferences with the collimator project (design office is apparently manageable) and with the preparation of the repair of splices.
6. Interferences with the shut-down work in 2013 have to be checked. However, in 2013 most of the time at Linac4 will be devoted to beam commissioning; support groups (vacuum, transport, etc.) are needed for only 6 month integrated installation time in 2013/14.





# Conclusions



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- The connection of Linac4 during LS1 looks technically possible, if the LHC run can start in August 2014.
- Interferences with other projects/activities have to be checked, but no clear showstoppers are identified.
- However, the decision to base the MTP on a connection during LS2 is already slowing down the activity and reducing the pressure. The risk is that if a positive decision is taken in summer, it will be already too late...
- In any case, it has been agreed that Linac4 keeps the schedule for beam commissioning in 2013/14, and foresees an early (2014) installation of the transfer line, in order to be ready to serve as a backup in case of major problems with Linac2.
- The decision is more global (strategic) than purely technical: with all the modifications to the LHC during LS1, are we going to take the risk of restarting with a new linac? My answer is that a serious risk analysis for Linac4 operation is possible and will be made (but only in 2013), and mitigations exists for most of the foreseeable problems.