



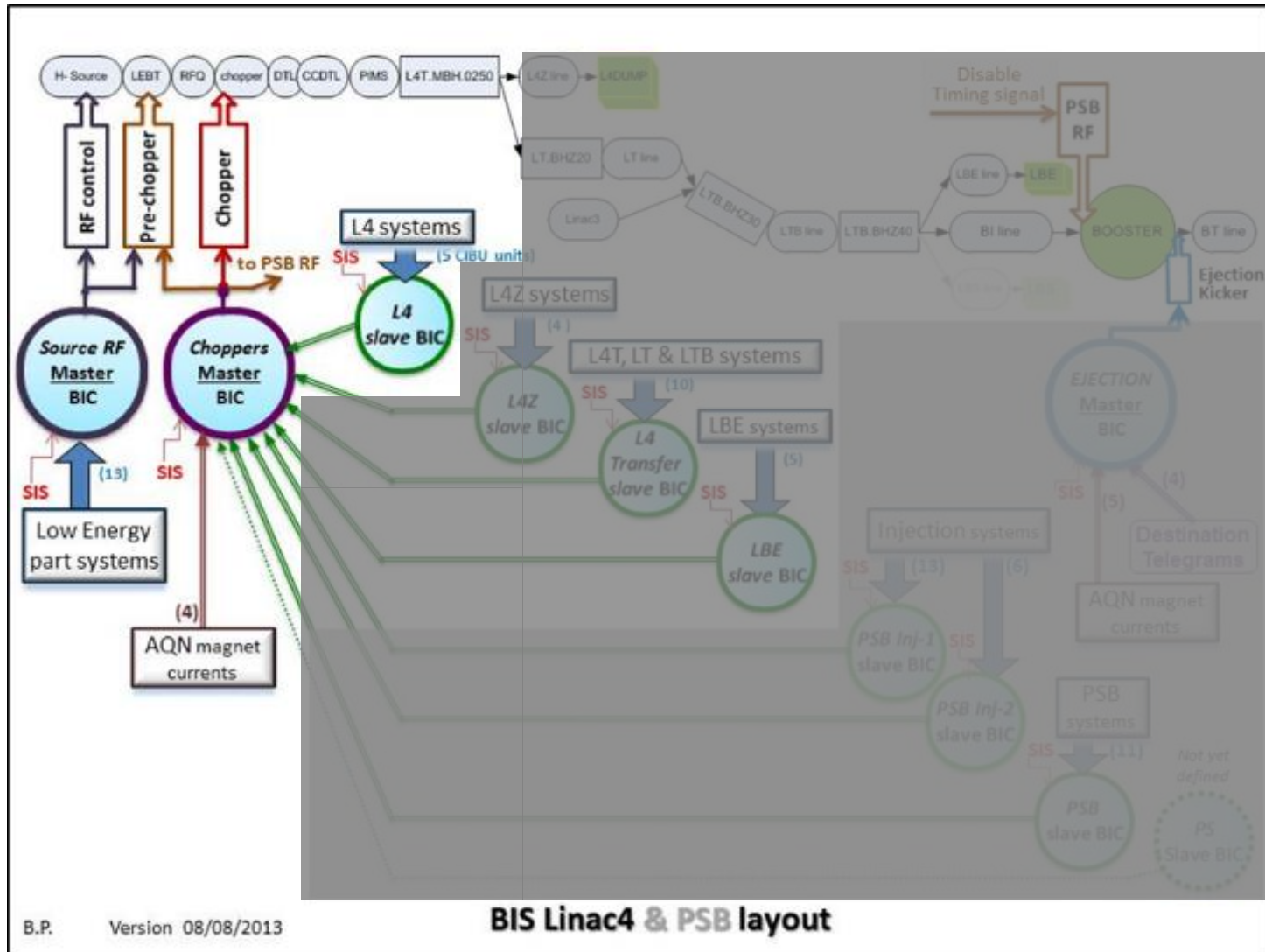
# Linac4 MP commissioning

## 100MeV Phase

David Nisbet  
L4 BCC, 17 March 2016

Acknowledgements to Christophe Martin, Stephane Gabourin,  
Andrea Apollonio , Markus Zerlauth, Daniel Wollmann

# LINAC4 BIS : 100 MeV



The Linac4 BIS architecture for the 100 MeV is the same as for the 50 MeV

# Master BIC RF for 100 MeV : the real situation

			Interlock Element	Ch.
1	1	1	SIS	0
0	0	1	Source Start	1
1	1	x	<del>Source Internal</del>	2
1	1	x	<del>Source HV</del>	3
1	x	x	Pre-chopper	4
1	0	0	Source Beam Stoppers Out/Moving	5
0	1	1	Source Beam Stoppers In	6
1	x	x	Chopper	7
1	x	x	L4 Low-Energy Watchdog	8
1	x	x	L4 Low-Energy Vacuum Valves	9
1	x	x	L4L.ChopperQuads	10
1	x	x	RFQ	11
1	x	x	<del>CCC Operator Veto</del>	12
1	x	x	L4 Operator Veto	13
x	x	x	Not used	14
1	1	1	H- Source Beam_Permit	OUT



Not Ready (mask inside the user's PLC)



Not Ready before FGC3 available



Fixed window; Chopper voltage not yet monitored;



Wide thresholds (I\_magnet in range [20A, 200A] )



Does not include LLRF



Commissioning Dump ✓



- RF control ✓
- Pre-chopper ✓

# Master BIC Chopper : the real situation

				Interlock Element	Ch
1	1	1	1	SIS	0
1	1	1	0	Source Beam Stoppers Out / Moving	1
0	0	0	1	Source Beam Stoppers In	2
1	1	1	x	Linac4 OK	3
0	0	1	x	AQN L4T.MBH_DUMP	4
x	x	1	x	L4Z OK	5
1	1	0	x	AQN L4T.MBH_LT	6
1	1	x	x	Linac4 Transfer OK	7
0	1	x	x	AQN LTB.BHZ40_LBE	8
x	1	x	x	LBE OK	9
1	0	x	x	AQN LTB.BHZ40_PSB	10
1	x	x	x	PSB Injection 1 OK	11
1	x	x	x	PSB Injection 2 OK	12
1	x	x	x	PS OK	13
x	x	x	x	Not used	14
1	1	1	1	Choppers Beam_Permit	OUT



Only the 2 first out of the 4 destinations are required for the 100 MeV phase:

- Beam to stopper
- Beam to Dump



Forced to "TRUE"  
 Forced to "TRUE"  
 Forced to "FALSE"

Inputs not required for the 100 MeV phase; permits are forced to the required level in order to allow decoding the second destination "Beam to Dump"

not considered (destination LBE & PSB)



- RF control ✓
- Pre-chopper ✓
- PSB RF X

# Slave BIC L4 : the real situation

	Interlock Element	Ch.
1	SIS	0
1	<del>External Conditions</del>	1
1	L4 Vacuum Valves + L4T.WGS.0101	2
1	<del>BLMs L4+L4Z</del>	3
x	Not used	4
1	WIC L4	5
x	Not used	6
x	Not used	7
1	L4 RF	8
x	Not used	9
x	Not used	10
x	Not used	11
x	Not used	12
x	Not used	13
x	Not used	14
1	H- Source Beam_Permit	OUT



Forced to "TRUE", not required for the 100 MeV

Functional check for all 100MeV valves

Forced to "TRUE", BLMs not yet present

Functional check for all 100MeV circuits

L4 RF moved on "Maskable" input for 100MeV commissioning phase ( as for previous phases)

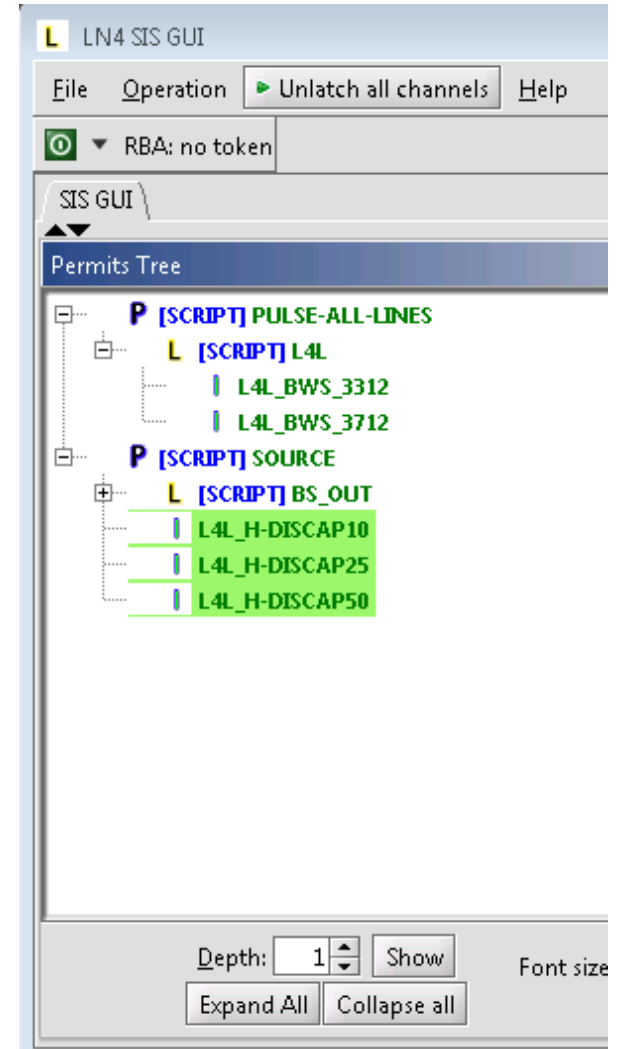
Functional check for all 100MeV cavities

Does not include LLRF

- Master RF Chopper

# SIS for LINAC4

- Operational
  - Source often masked
- BI requirements: comprehensive list received from F. Roncarlo
  - All SEM grids and Wire Scanners shall limit max beam pulse
  - SIS will limit beam pulse length to 100us if in beam
  - Devices to be included and tested in SIS
- New requirements?
  - LLRF monitoring?



# BIS Commissioning

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**Engineering Specification**

## **THE COMMISSIONING STEPS OF THE LINAC4 BEAM INTERLOCK SYSTEM**

*ABSTRACT:*

The Beam Interlock System for Linac4 and its transfer lines to the PSB will be deployed in accordance with the global Linac4 schedule which includes five commission phases: 3MeV, 12MeV, 50MeV, 100MeV and 160MeV.

This document describes the steps to deploy the different Beam Interlock Controllers and to identify the connected systems which will be required for each phase of the commissioning.

## **BEAM INTERLOCK LINAC4, BOC**

The beam interlock system is a mixed system comprising hardware (Beam Interlock System), software interlock (External Control System) and the concept of External Control System. This document summarises the beam interlock system for the PSB transfer lines and the

**Prepared by:**



# Phased energy upgrade precautions

- To follow the phased energy increase of the machine, new equipment is gradually being added to the Linac4
- Some users are required to take care of validating the new elements in their electronics:
  - Vacuum (new valves added)
  - L4 RF (new cavity added)
  - L4 WIC (new magnet circuits to be included)
- The implementation of the new elements is under the responsibility of each group.
  - Users are requested to inform D Nisbet of the tests made to validate the additional elements.
  - The commissioning of the different systems with the BIS can be made on request.
  - See Christophe Martin or Stephane Gabourin.
- **REMINDER : if the user system electronics has been modified, the interlock team should be informed in order to take the relevant actions**

# Machine protection issues

- MPP is recommending that a mitigation strategy is implemented for running without BLMs at 100MeV
  - The proposal is to operate a watchdog BCT for the LINAC part.
  - Thresholds to be defined. Implementation under discussion.
- Is the absence of LLRF from the BIS faults a problem?
  - Consider adding additional monitoring to the SIS
- 100MeV operation
  - Vacuum, RF and WIC shall demonstrate all systems are connected and operational
- H- Source connections to the BIS and SIS are either masked or constant 'Beam Permit'
  - Review of the BIS and SIS functionality required from the source

# Conclusion

- The 'Dry Run' week will be the opportunity to verify all users are interfacing correctly to the BIS and SIS
- Care required with the phased energy increase (beam dump moved, additional systems)
- Requirements for 100MeV still to be finalized
  - Watchdog and LLRF monitoring
  - H- Source conditions

