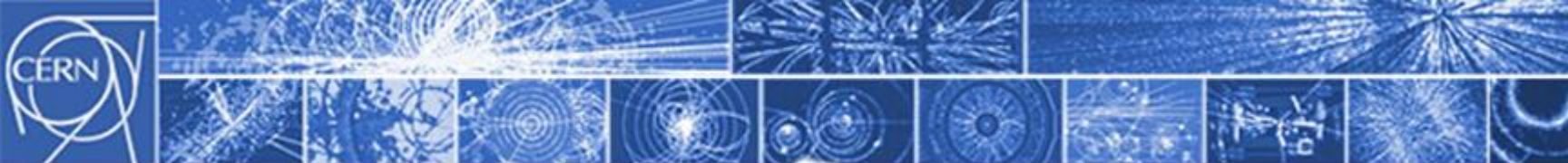


Beam Interlock System for the LINAC4 (3 MeV)

Christophe Martin
TE/MPE

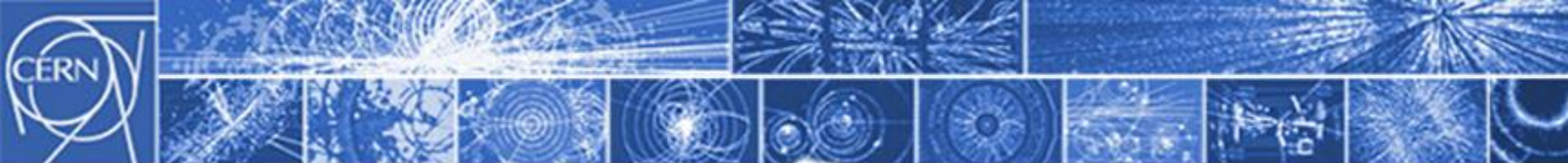
Christophe Martin TE-MPE-EP

04/04/2014



Outline:

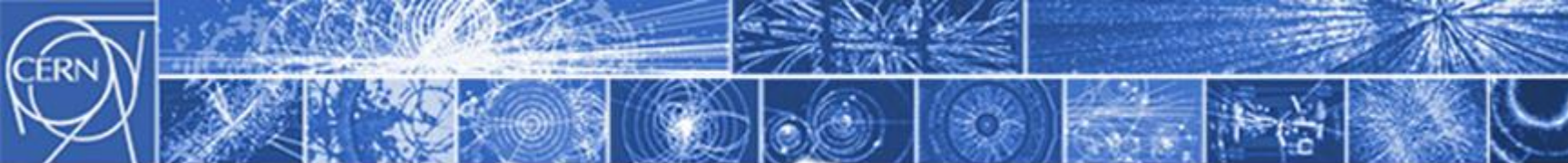
- Quick reminder on the layout
- Current system deployed for the 3MeV part
- Linac4 SIS
- BIS supervision overview
- Open issues / non-conformities



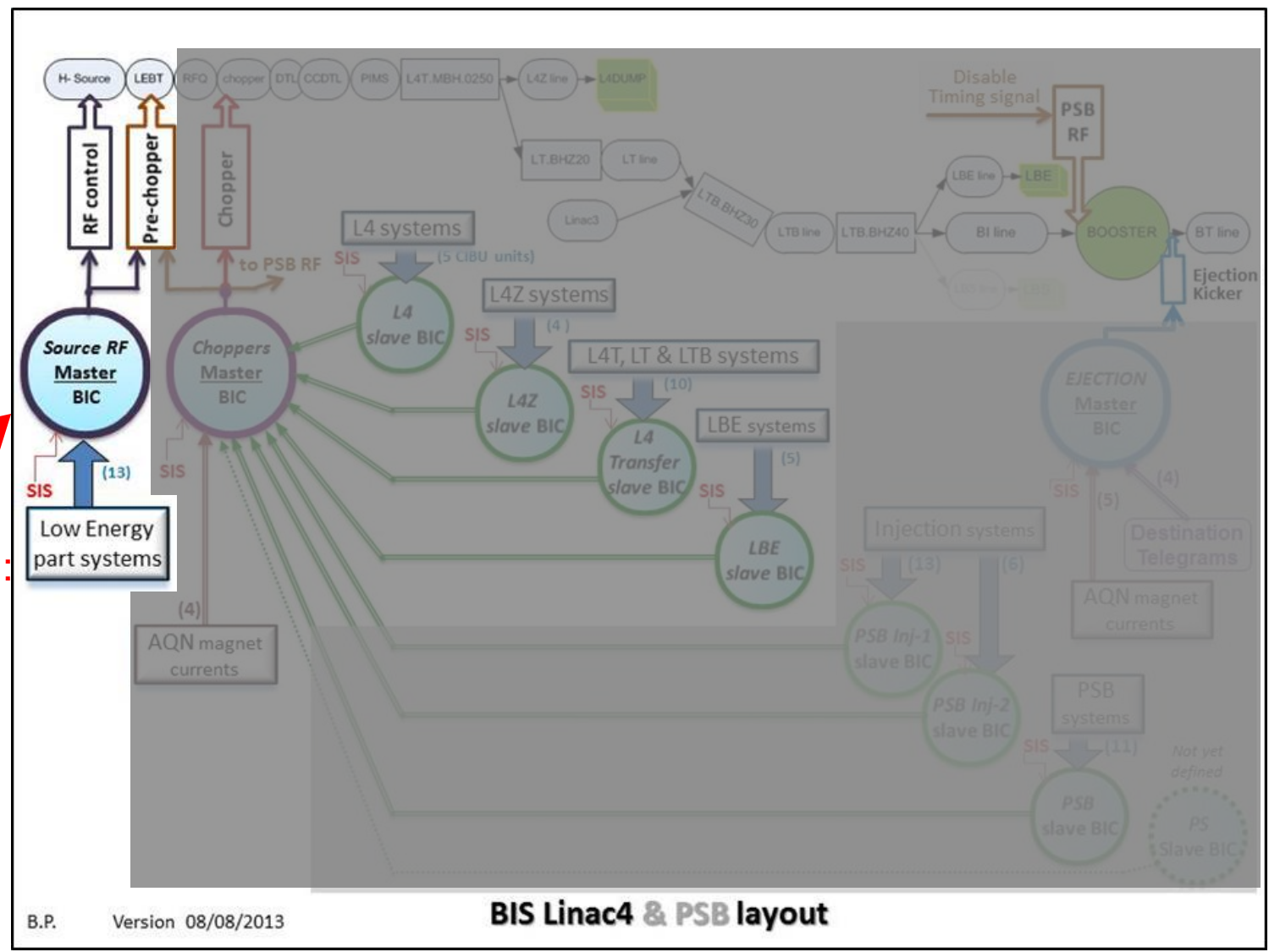
Outline:

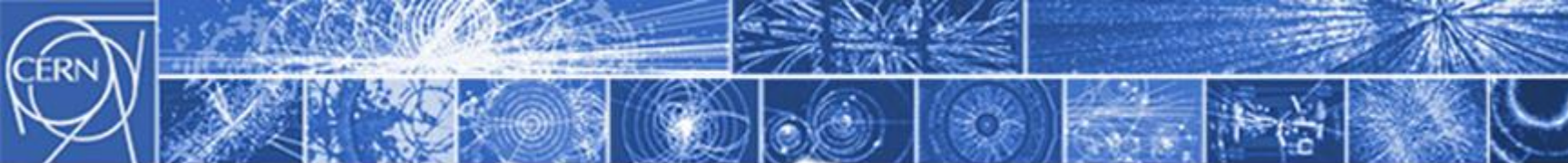


- Quick reminder on the layout
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LINAC4 BIS :
3Mev

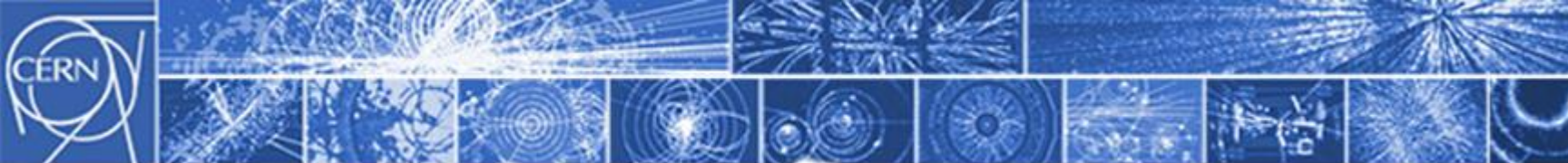




Outline:



- Quick reminder on the layout
- **Current system deployed for the 3MeV part**
- Linac4 SIS
- BIS supervision overview
- Open issues / non-conformities



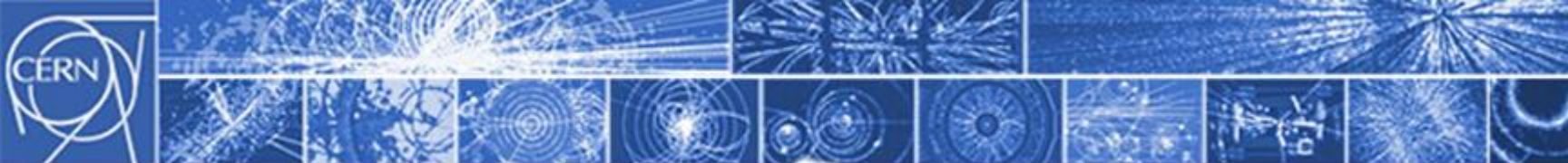
TRUTH TABLE OF THE 'SOURCE RF' MASTER BIC



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

- In the final version, 12 Users will be connected to the “Source RF” master BIC (*as described inside the engineering specification [EDMS 1016233](#)*)

- Two equations can give the “Beam Permit” to true
 - Normal operation, “Beam stopper” in “OUT” position
 - “Beam stopper” in “IN” position, the source pulses to the beam stopper (*for source stability reason*)



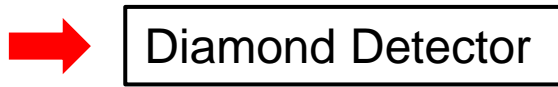
EXPECTED MODIFICATIONS OF THE 'SOURCE RF' MASTER BIC FOR THE 3MeV COMMISSIONING

Christophe Martin TE-MPE-EP

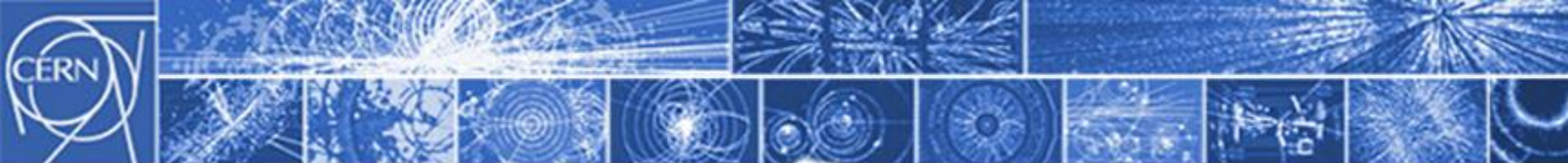
04/04/2014

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x	1	Chopper	6
x	1	L4 Low-Energy Watchdog	7
x	1	L4 Low-Energy Vacuum Valves	8
x	1	AQN L4 QUADS	9
x	1	RFQ	10
x	1	CCC Operator Veto	11
x	1	L4 Operator Veto	12
x	x	Not used	13
x	x	Not used	14
1	1	H ⁺ Source Beam_Permit	OUT

➤ Input 9 “AQN L4L.QUADS” not ready
(and not required for 3Mev operation)



➤ Input 11 “L4 Operator Veto” not required before the connection of the Linac4 to the Booster (2016 ?)



THE REAL SITUATION WITH THE DIFFERENT USERS (AT THE END OF 3MeV COMMISSIONING PERIOD)

Christophe Martin TE-MPE-EP

04/04/2014

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

✓



Not Ready (masked inside the source by ABP) *



Not Ready (masked at CIBU level)

✓

✓

✓



Not Ready (masked at CIBU level)

✓

✓

✓

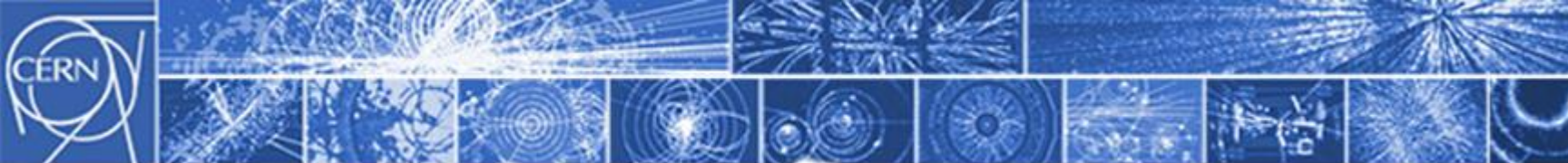
✓



Not Ready (masked at CIBU level)

✓

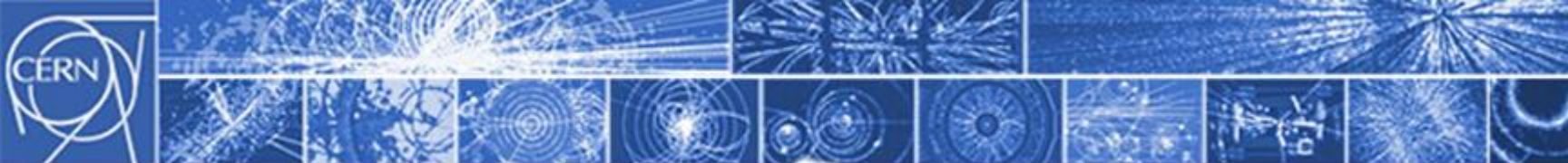
* The MPP had required that the “Source Internal” signal was mandatory



Outline:

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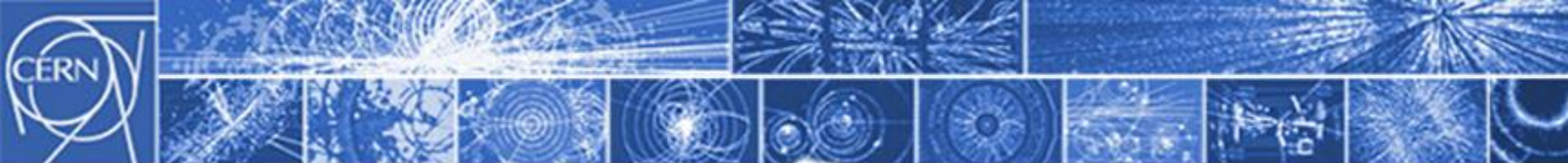


LINAC4 SIS

On today two processes run on the SIS

- Instrumentation protection
(*described in the document “Using SIS to shorten the L4 pulse [EDMS 1266936](#)*)

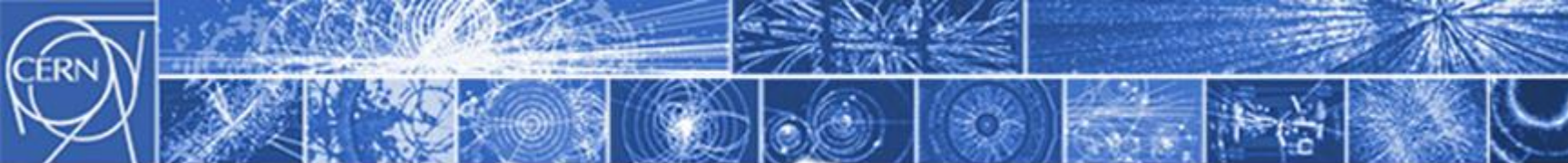
- Monitoring of the source HV



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“Standard” supervisor view

CIBX overview : CIBX.400.LN4.RF
VIEWS COMMANDS

CIBX overview : CIBX.400.LN4.RF
VIEWS COMMANDS

SAFE BEAM FLAG **FALSE**

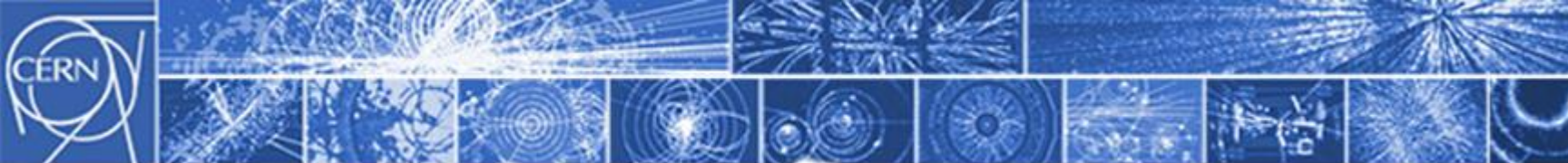
Initialized

	INPUT	DISABLED	MATRIX	PERMIT
SOFTWARE INPUT	FALSE		FALSE	FALSE
1 Source Internal	TRUE	NO	TRUE	
2 Source HV (bouchon !)	TRUE	NO	TRUE	
3 Pre-chopper	FALSE	NO	FALSE	
4 Source BeamStoppers Out/Moving	FALSE	NO	FALSE	
5 Source BeamStoppers In	TRUE	NO	TRUE	
6 Chopper (bouchon !)	TRUE	NO	TRUE	
7 L4 Watchdog	TRUE	NO	TRUE	
8 L4 Low-Energy Vacuum Valves	TRUE	NO	TRUE	
9 Diamond Detector	TRUE	NO	TRUE	
10 RFQ	TRUE	NO	TRUE	
11 Commissioning Dump (bouchon !)	TRUE	NO	TRUE	
12 L4 Operator Veto	TRUE	NO	TRUE	
13 Not used	FALSE	NO	FALSE	
14 Not used	FALSE	NO	FALSE	

Re-Armed

Switch to Detailed view

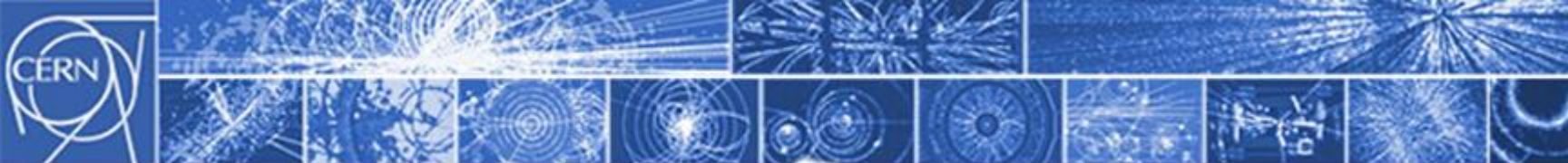
04/04/2014 Christophe Martin TE-MPE-EP



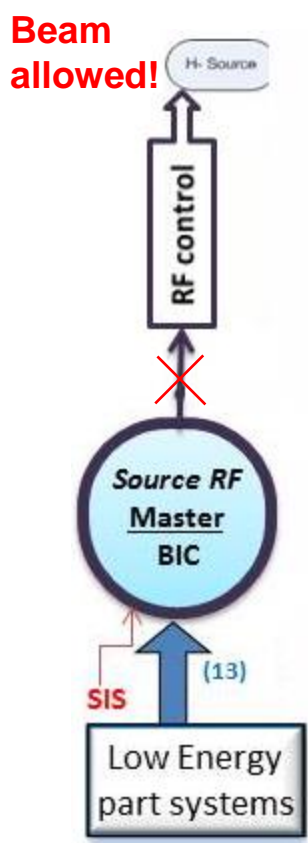
Outline:

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Beam permit to target system "RF Control"



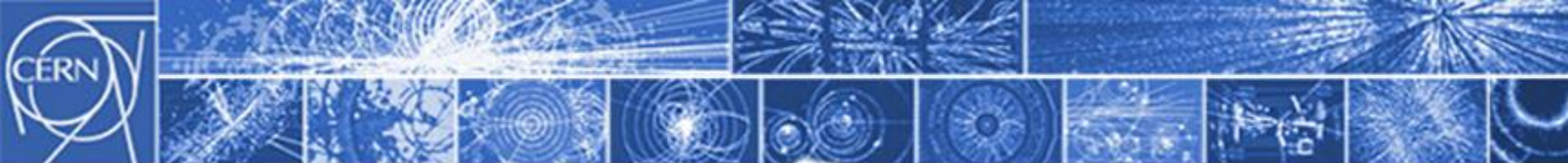
Issue:

If the cable between the BIS and the RF control system is removed, the "Beam Permit" signal is seen as TRUE by default by the RF control electronic. Consequently the source is allowed to operate.

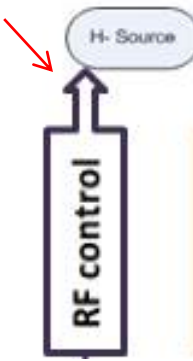
Action:

The equipment owner is going to modify its electronic. We need to recommission the RF Control interface, before the 12 MeV phase.

For any change of the electronic connected to the BIS, please advise the BIS team for a recommissioning.



Output of the target system “RF Control” connected to the source



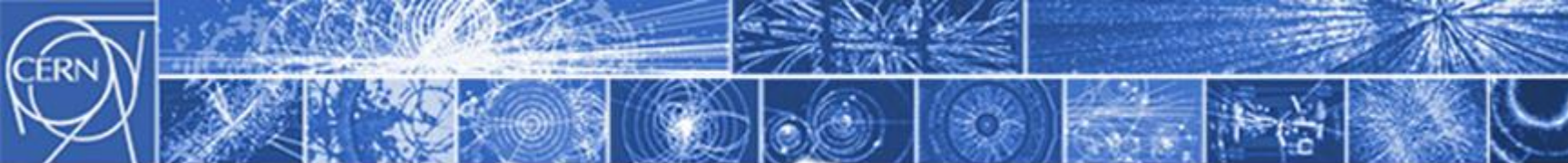
Issue:

The signal from the RF control to the source is not latched. The risk of air ionisation during uncontrolled changes of the RF amplifier is increased.

The BIC doesn't internally latch the Beam Permit signal, it means that if one User Permit input changes, the BIC output follows this change.

Action:

For the time being we will leave the situation as it is for now, the equipment owner accepts this risk. Nevertheless the IS-team may have to come back on this point before end 2016. (Email from Jacques Lettry).



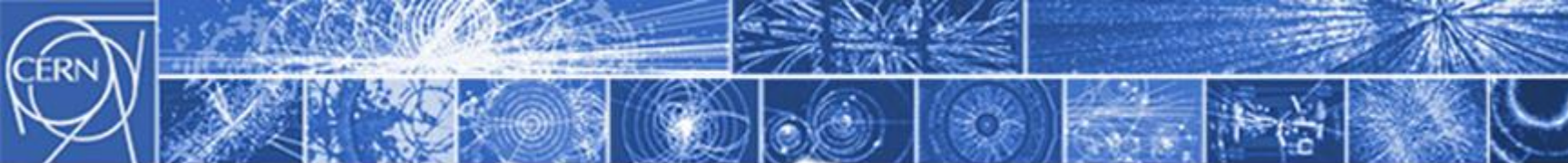
Beam Permit signal interfere with the source start

Issue:

During source start the nominal conditions are very different from those of the beam permit. No BIS signal or software interlock signals should interfere with source operation.
(Email from Jacques Lettry)

Action:

The BIS team propose to add a new equation to the BIS “Master Source RF” to allow the start-up of the source. A new CIBU would be installed near the source PLC for adding the new signal “Source Start”.

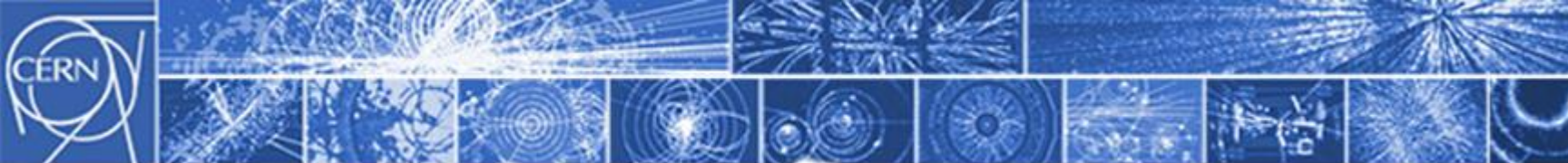


New equation

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

New CIBU

- This new “Source Start” CIBU will be controlled by the source team.
- The source team would also add some conditions on SIS. This point must be discussed in details.



Thanks for your attention