
CERN

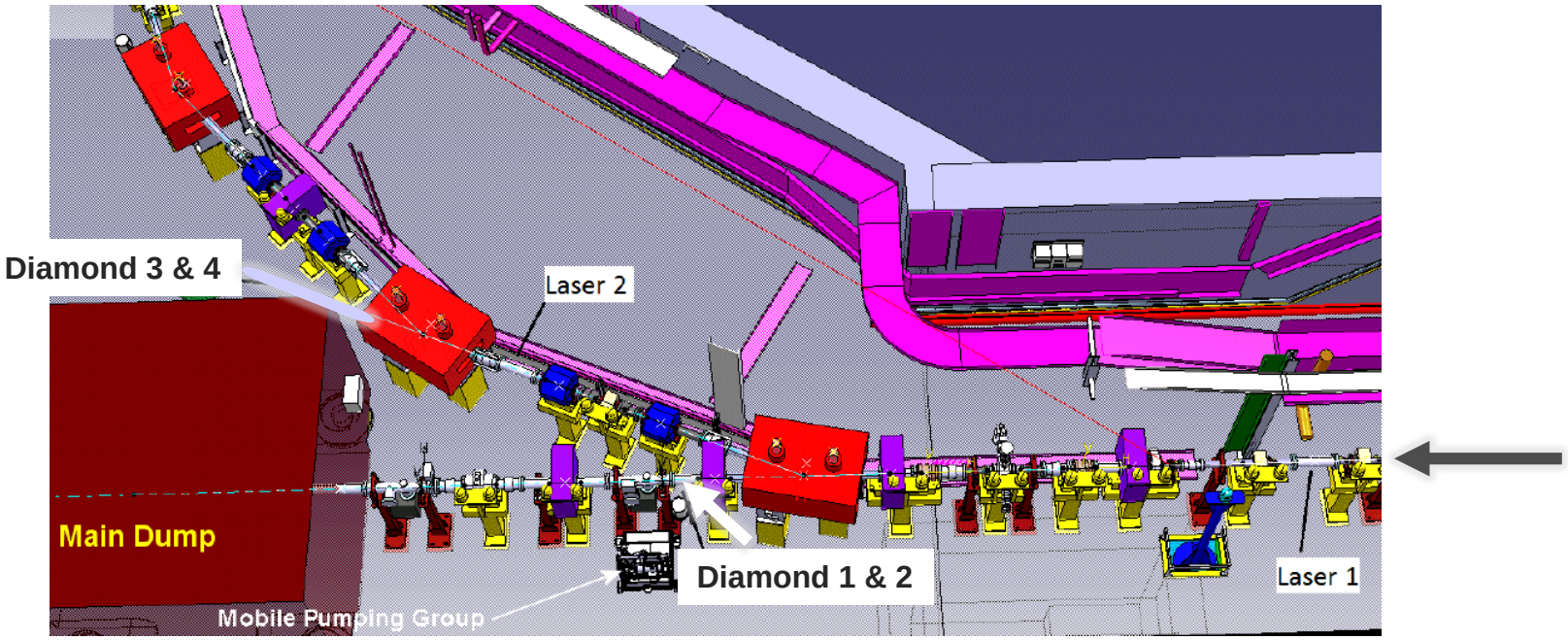
Laser Emittance Meter & Beam Loss Monitoring:
Configuration and interlock logic

MPP on LINAC4 Machine Protection

Laser Emittance Meter

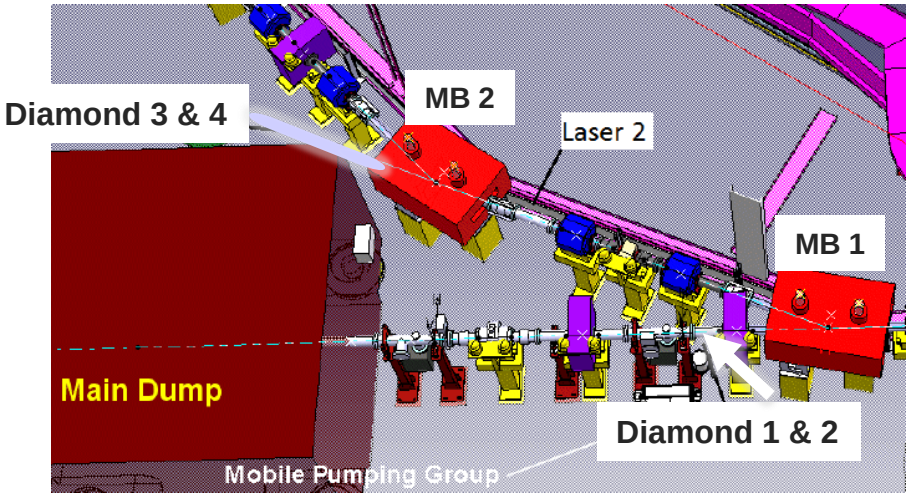
2 Laser Emittance systems, each of them consisting of

- Laser station
- 2 Diamond detectors on actuators
  (downstream few meters, after bending dipole)



Interlock functionality for Diamonds

- Diamond 3 & 4:
  - **No interlock needed**,
    secured by interlock of main bend



- Diamond 1 & 2:
  - **Hardware** interlock needed
  - Logic:

Diamond 1 or 2 **IN** beampipe

Main bend **OFF** (Current < threshold)

Cut Beam

  - Continuous monitoring of main bend 1 current & position of diamond 1 & 2

- Similar interlock system used already for 3 MeV beam tests

Status

- Laser Emittance Meter will be installed in first half of 2017

- To be done for interlock system:
  - Half sector test – nothing, diamonds not installed yet

  - Final configuration
    - Acquisition electronics in development by S. Burger (similar to 3 MeV interlock card)
    - Validation planned after installation (4/2017)

BLM – Detector Layout

Location	Layout Name	Status	Notes
L4L	L4L.BLM.4114	to not install	
L4D	L4D.BLM.0208	Stand-by	Maybe Diamond
	L4D.BLM.0304	OK	
L4C	L4C.BLM.0114	OK	
	L4C.BLM.0214	OK	
	L4C.BLM.0414	OK	
	L4C.BLM.0614	OK	
L4P	L4P.BLM.0114	OK	
	L4P.BLM.0404	OK	
	L4P.BLM.1004	OK	
L4T	L4T.BLM.0449	waiting for connectors	Support installed
	L4T.BLM.0709	waiting for connectors	Support installed
	L4T.BLM.1074	waiting for connectors	Missing drilling for support
	L4T.BLM.1084		Missing drilling for support
	L4T.BLM.1249		Missing drilling for support
	L4T.BLM.1409		Missing drilling for support
	L4T.BLM.1634		Missing drilling for support
	L4T.BLM.1709		Missing drilling for support
L4Z	L4Z.BLM.0294	waiting for connectors	Support installed

LINAC

1 IC BLM
1 Diamond BLM

HST

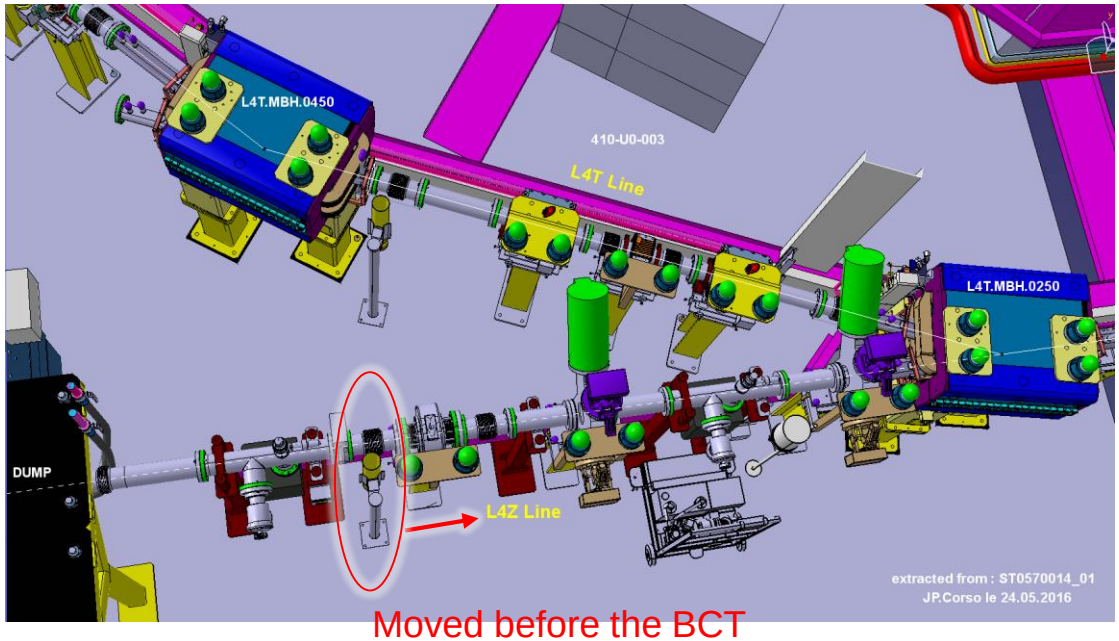
Transfer Line (after first H bend)

Dump Line

BLM – Detectors Installation

160 MeV run

- All LINAC detectors installed (last is at the end of L4P, L4P.BLM.1004)
- L4Z waiting for connectors assembly (will be ready for September)

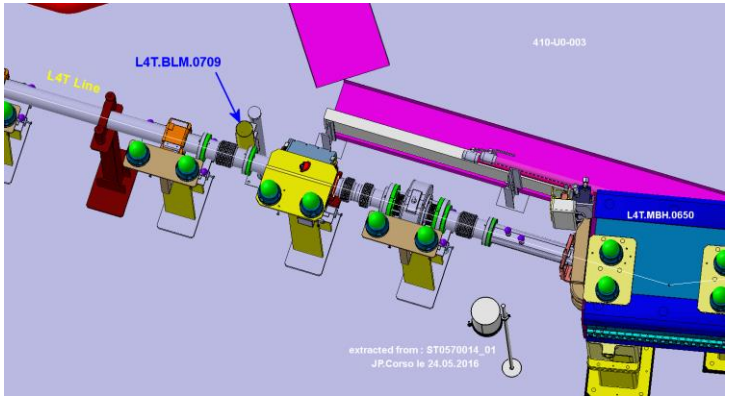


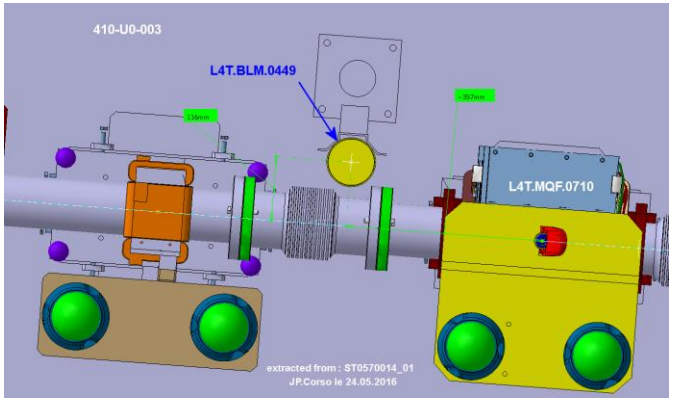
Moved before the BCT

BLM – Detectors Installation

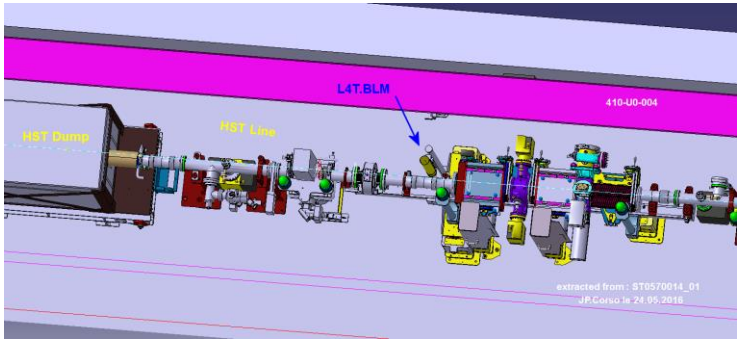
HST

- 2 detectors between L4T.MBH.0250 (1st bend) and HST girder:
  - Waiting for connectors assembly (will be ready for September)

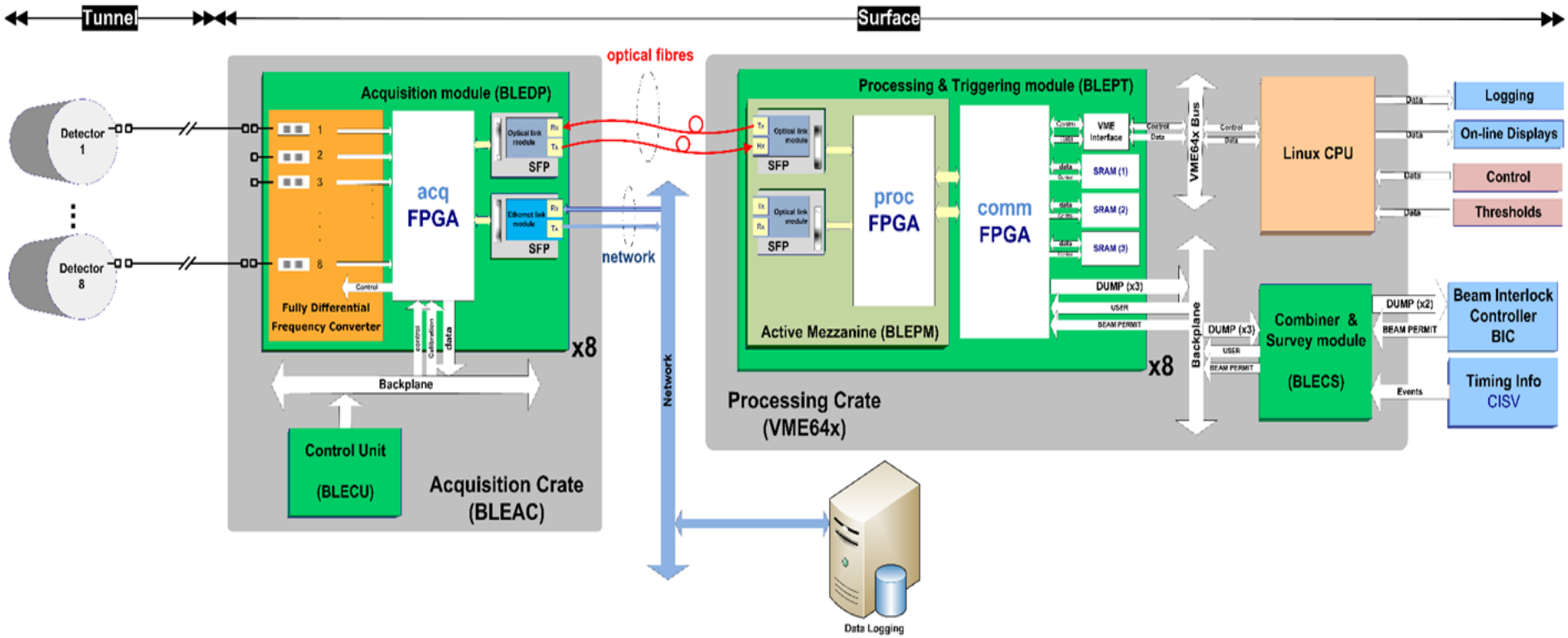




- 1 Diamond + 1 IC after BSW4, around H0/H- dump – Expected to be ready for September
  Waiting for:
  - Diamond cables & Connectors assembly for IC
  - Need to install supports and detectors on HST girder → after girder installation in the tunnel



BLM – Electronics Installation



- Electronics ready and installed
  - HW commissioning on-going (last channels to be configured next week)
  - Requested to EN-EL better grounding of supports
- General remark - So far it took long time and resources to get to the installation: many iterations on installation, integration, holes drilling etc…

BLMs – Interlock Functionalities

HW interlock (Machine Protection)

- Continuous (500kHz refresh rate) comparison between losses over 5 integration periods (between 2us to 1.2s) and 5 threshold values.
- Each time one of the integrated values exceeds the relevant threshold → Beam Permit removed for all users.
- Beam Permit latched → need operator reset.

SW interlock (Machine Optimization)

- Look at maximum of each integration period for each user at the end of the cycle
- Measured values compared to a second set of thresholds (1 per channel and per USER)
- If a channel value is for 1 USER above the relevant threshold for *n* times → block (and latch) the USER injections
- *n* : settable (per channel and per user) from 1 to 16

For both HW and SW interlocks

- Thresholds will be driven remotely from DB to the FPGA via an INCA interface

BLMs – Interlock implementation status

- Electronics ready and being tested (on the field verification of processing and interlock FPGAs)
- Beam measurements at 100 MeV compromised by bad grounding of the supports

- Missing:
  1. Thresholds remote driving to FPGA, will not be available this year
     - Temporary solution
       - Implemented manual thresholds driving to electronics
       - Presently under test, will be ready for September
  2. Thresholds values

- To be done:
  - Commissioning of interlock functionalities without beam,
    - On site electrical tests with TE-MPE
    - Send test signals manually, generate beam interlock and check BIC response.

- Open questions:
    - Will start without thresholds or with some max threshold?
    - Second CIBU needed? At the moment there is only the one.

- Thank you