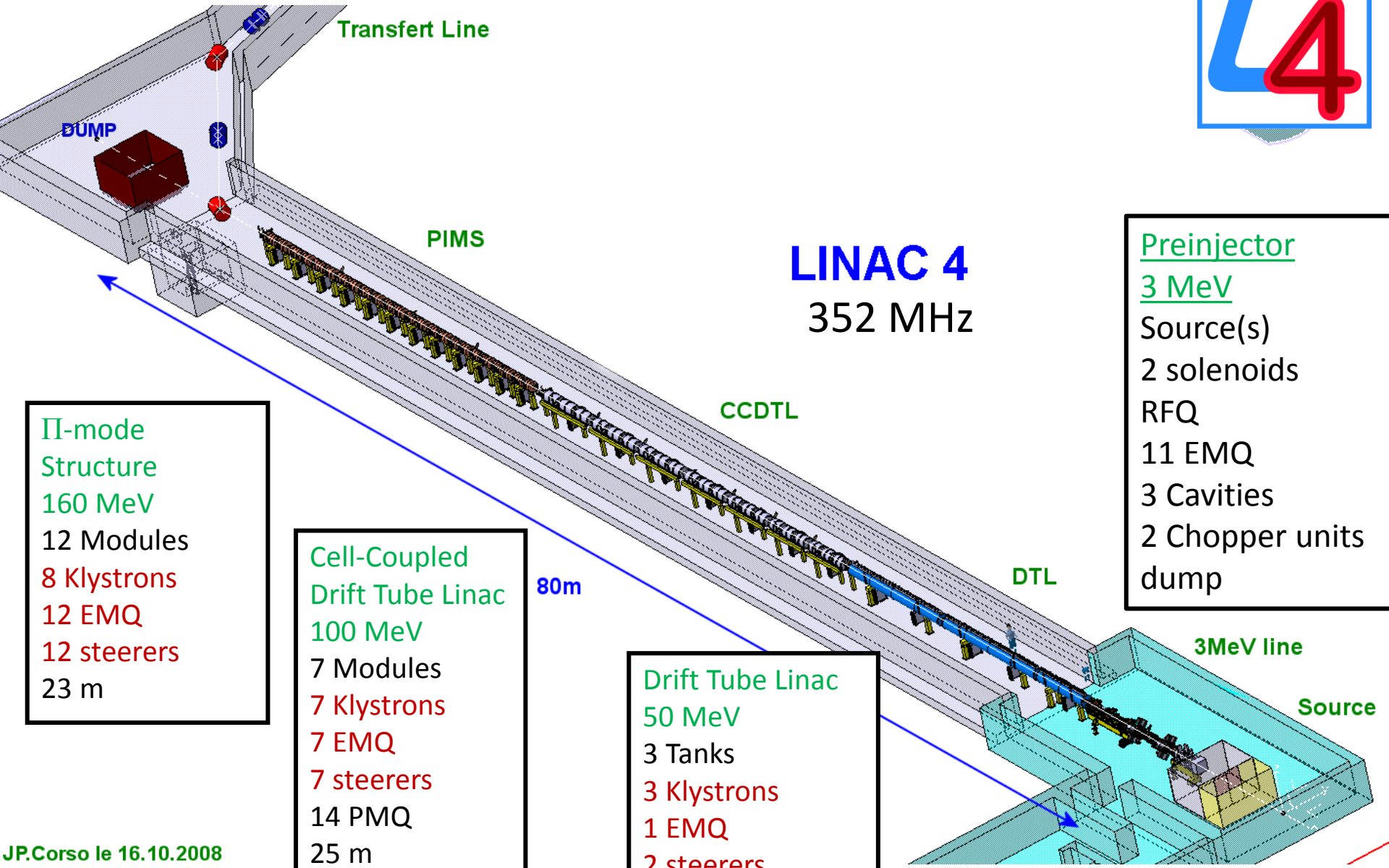
LINAC4 commissioning plans etc.

Alessandra Lombardi

on behalf of the LINAC4 team



LINAC 4

352 MHz

Preinjector
3 MeV
Source(s)
2 solenoids
RFQ
11 EMQ
3 Cavities
2 Chopper units
dump

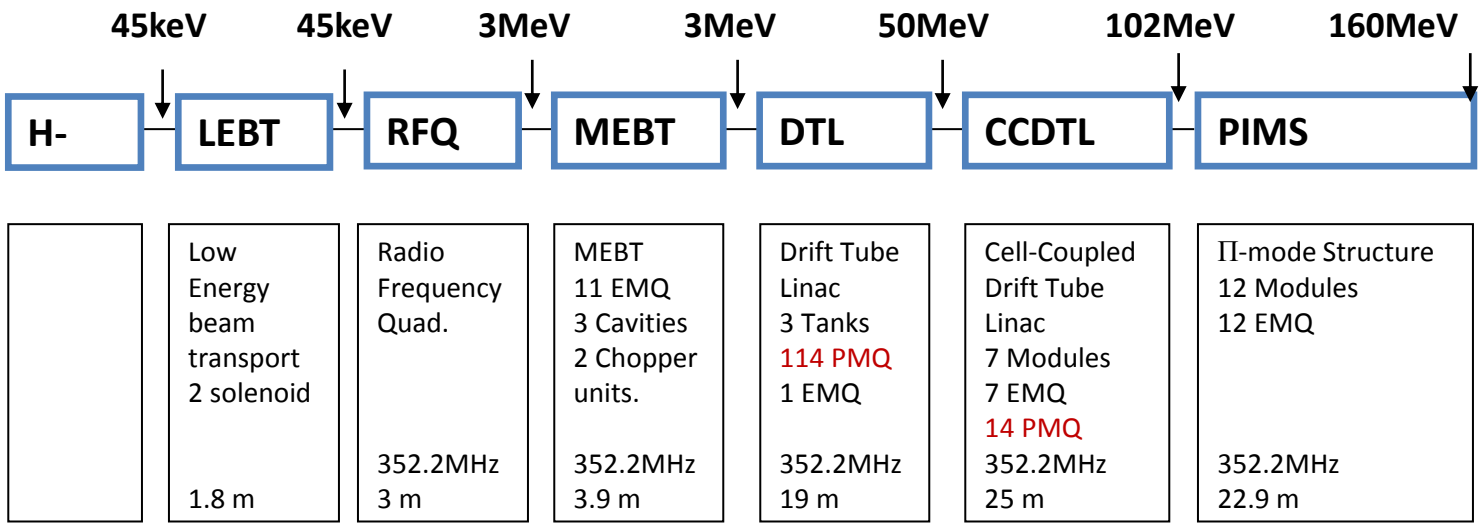
Π-mode
Structure
160 MeV
12 Modules
8 Klystrons
12 EMQ
12 steerers
23 m

Cell-Coupled
Drift Tube Linac
100 MeV
7 Modules
7 Klystrons
7 EMQ
7 steerers
14 PMQ
25 m

Drift Tube Linac
50 MeV
3 Tanks
3 Klystrons
1 EMQ
2 steerers
114 PMQ
19 m

JP.Corso le 16.10.2008

Layout of LINAC4

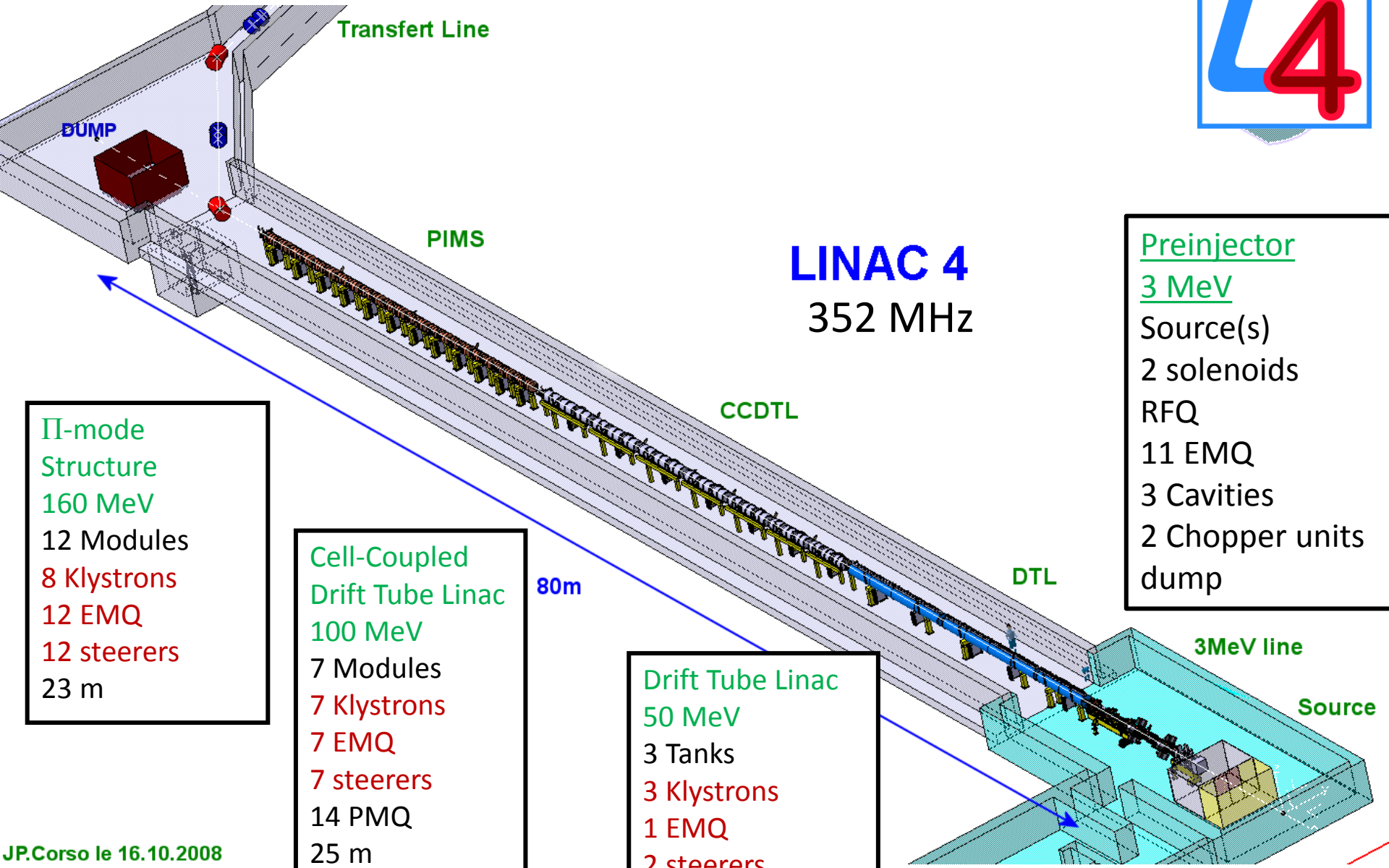


- Up to 3 MeV “charge insensitive”
- In the MEBT line we have to respect the chopping dynamics
- We need to match to a permanent focusing channel in the DTL and CCDTL

“The source(s)”

WPIS H^- Ion source: staged approach, 2 units each *+ spare*

	#1 Volume source	#2 Surface source	#3 Magnetron
Operational experience H^- current	DESY 30 mA	SNS 50 mA	BNL 80 mA
Plasma Heating process	2 MHz RF Ext. antenna	2 MHz RF Int. & Ext. antenna	Arc discharge
Cesiation		Cs-chromate Single deposition:	Cs metal Constant flow
Cs-Oven test stand		Nov. 2011	Nov. 2011
Electron / H^- ratio	10-100	10	0.5 - 1
45 keV beam available	**aug 2012**	**mid 2013**	**after 2015**



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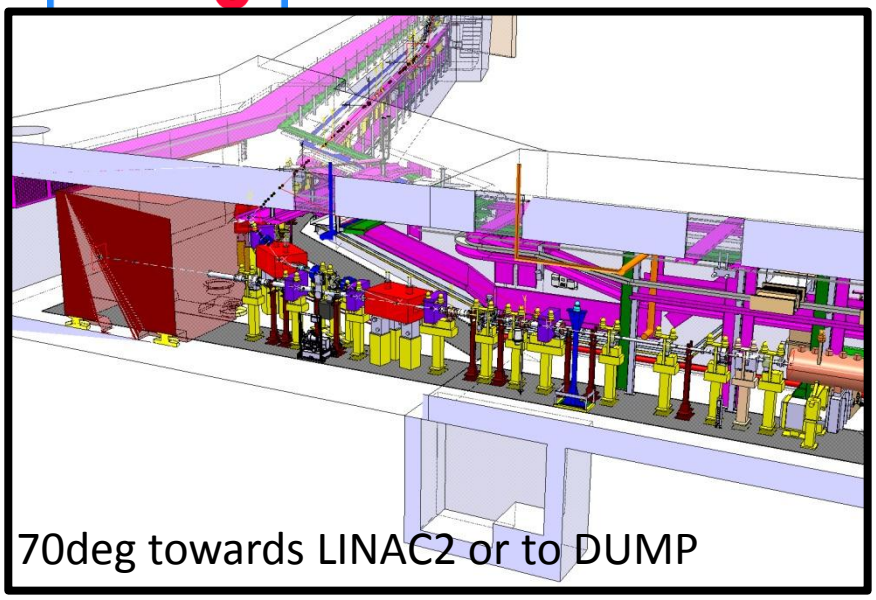
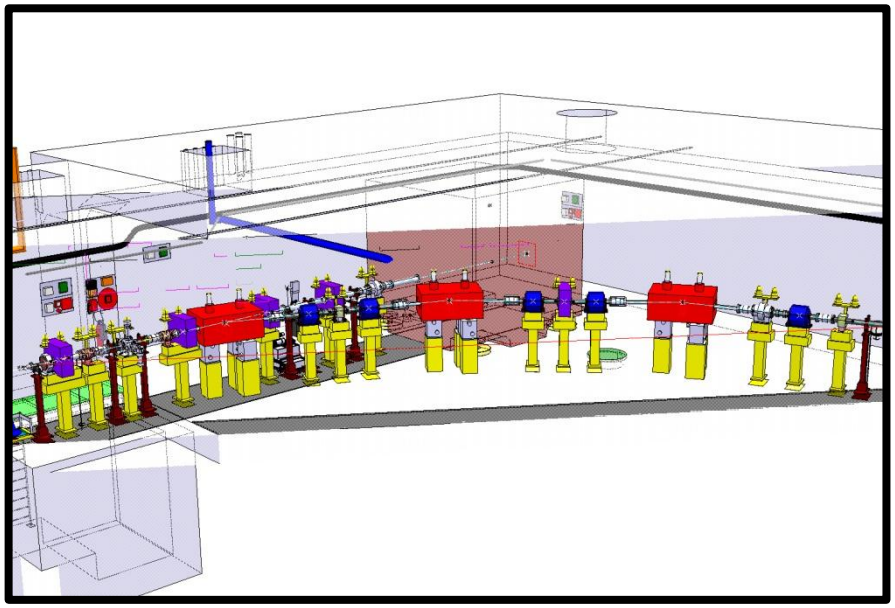
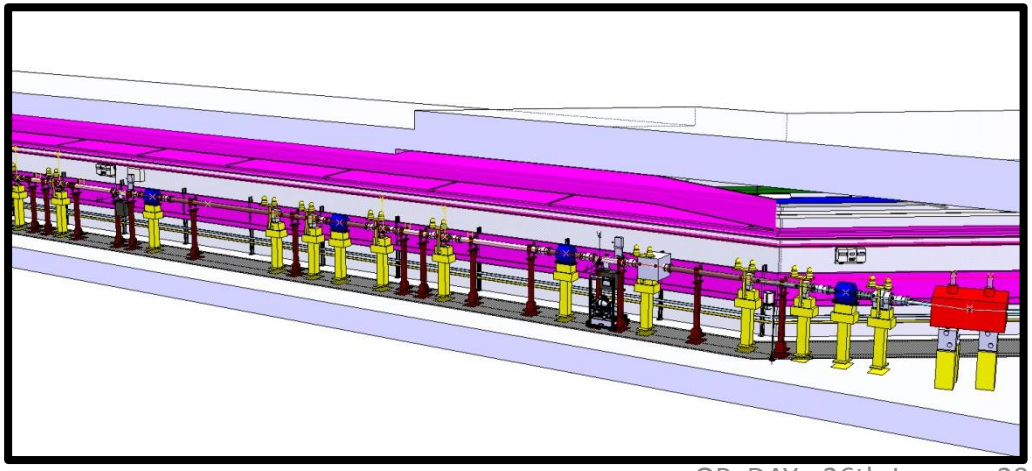
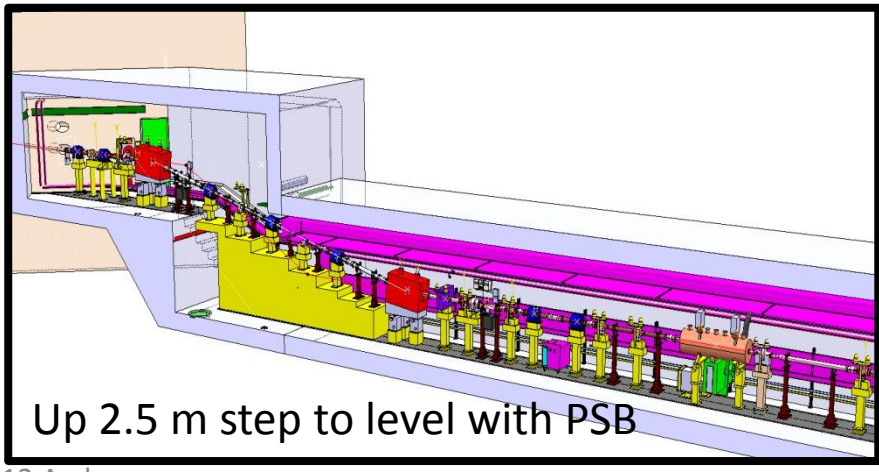
Transfer Line









Nominal Beam at PSB

Intensity	40 mA
Transverse	E= 0.3-0.4 pi mm mrad norm rms Alpha= 0 Beta x = 5,2.5,10 m Beta y = 4,2,8 m Dispersion = 0 or 1.2 m
Longitudinal	±100 keV rms energy spread (100-800 KeV possible) 160 MeV ± 1.2 MeV (dynamically over 20 µsec)
Chopped	1 µsec for the distributor rise time 1 MHz frequency of the PSB as low as just letting few µbunches (50 nsec)

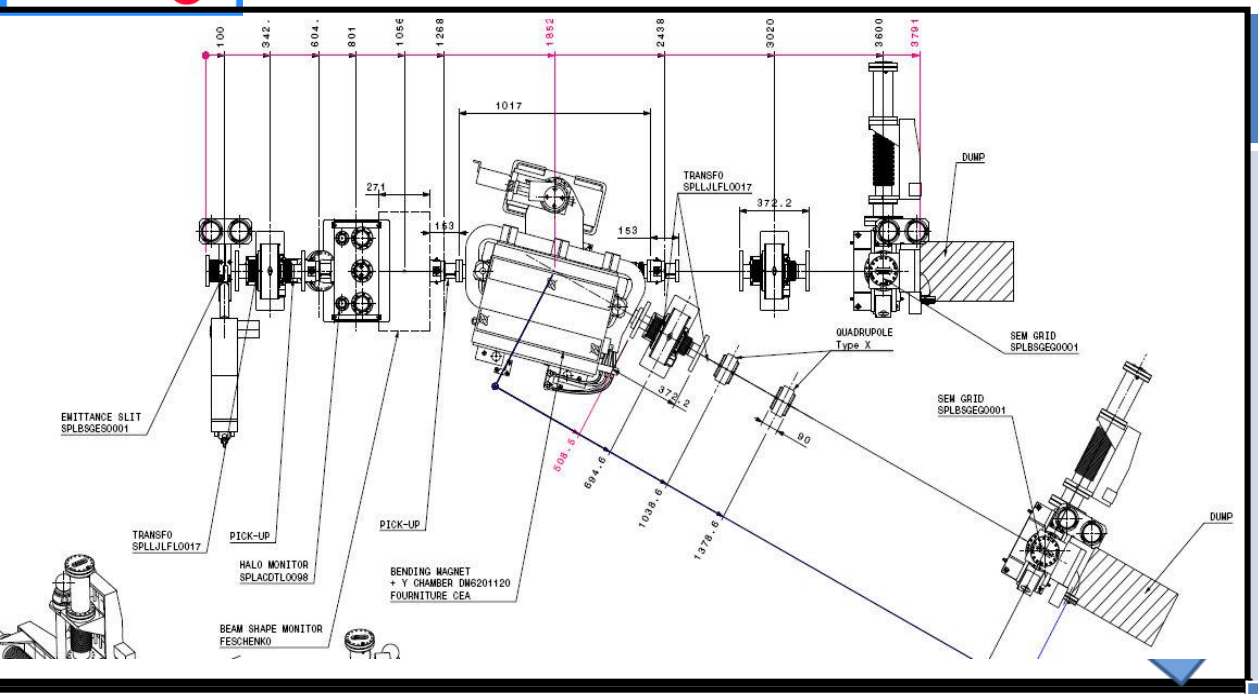
What needs to be set

		EFFECT ON
Focusing	LEBT solenoids (2)	Intensity and Transverse Emittance
	MEBT quadrupoles (11)	Chopping efficiency
	DTL CCDTL PIMS quads (22)	Intensity
	Transfer Line quadrupoles (15+18)	Intensity , Matching and Dispersion
Steering	Steerers hor and vert (36)	Intensity
RF	Phase and Amplitudes (22)	Energy, energy spread

Stages

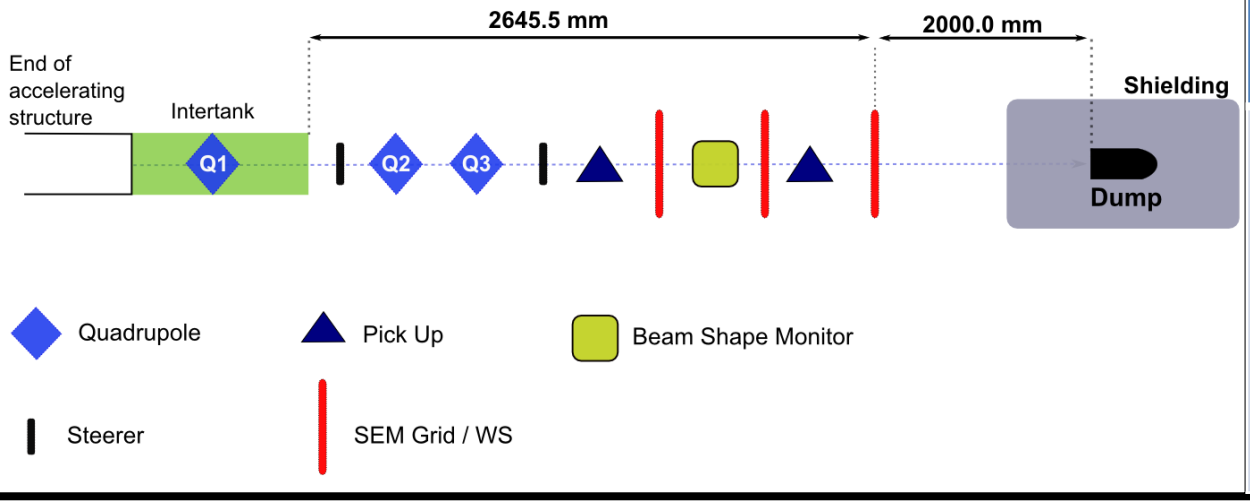
	Energy	Key issue		Completed in the tunnel by
LINAC4 stand alone	3MeV	RFQ transmission Chopping		May 2013
	12 MeV	Matching to DTL		Sep 2013
	30-50 MeV	Transporting in PMQ channel		Dec 2013
	100 MeV	Setting the RF phases		Mar 2014
	160 MeV - DUMP	Reliability		End 2014
Connection to PSB	160 MeV –LBE LBS			T0+8months

Movable Temporary Benches



Low energy bench (up to 12 MeV)

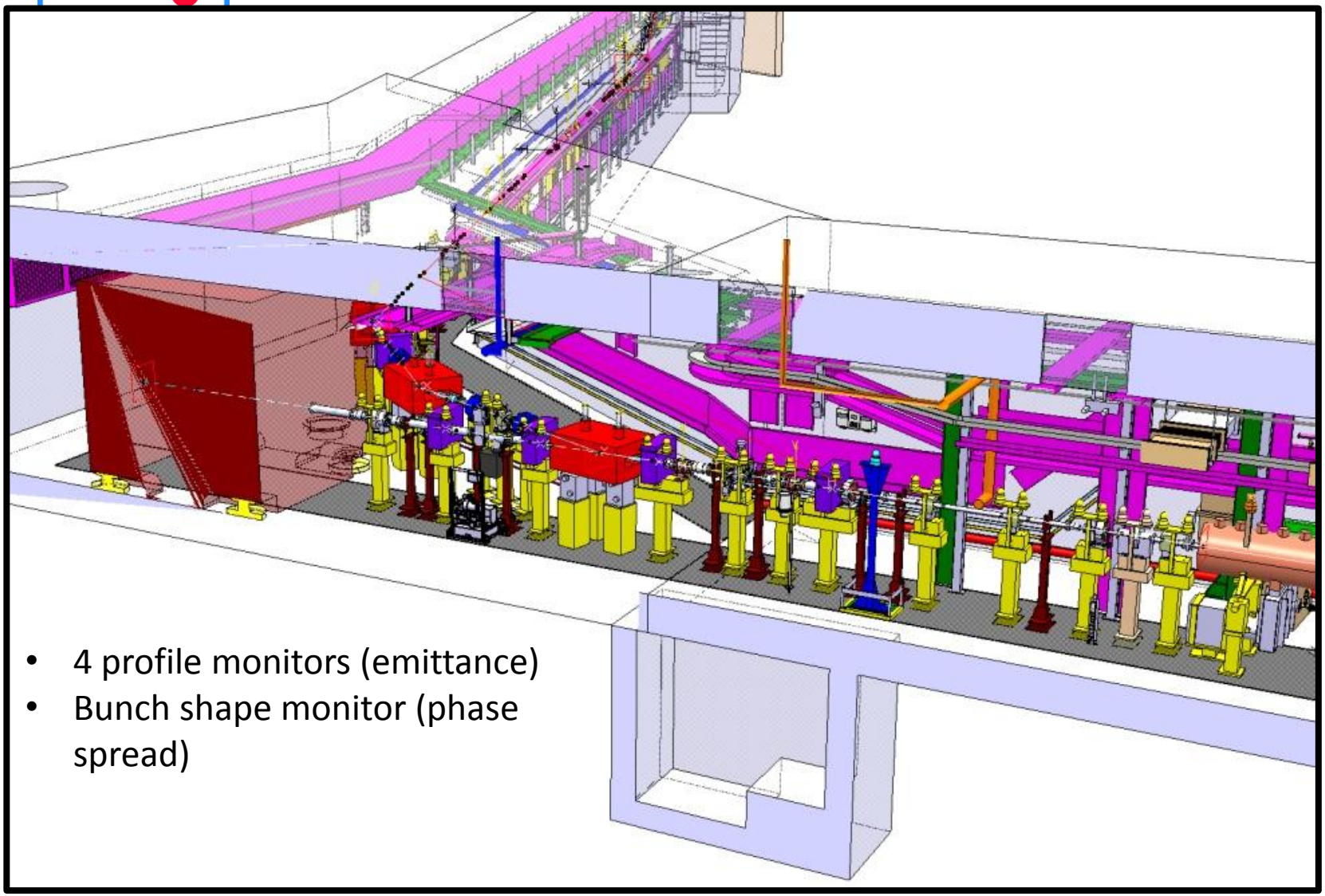
Spectrometer (0.2 %)
Slit and Grid Emittance
ToF (calibration)
Bunch Shape Monitor
Halo Monitor (chopping eff.)



Medium energy bench (up to 100 MeV)

ToF (0.1 %)
Emittance via Profiles
Bunch Shape Monitor

Permanent Measurement Line

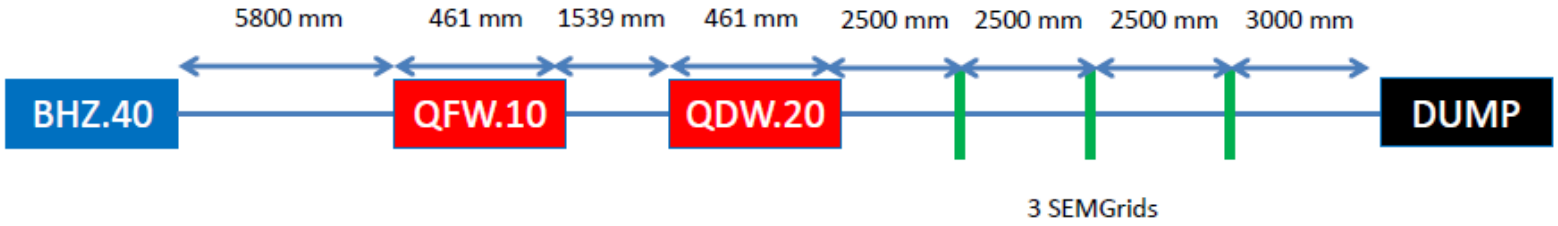


- 4 profile monitors (emittance)
- Bunch shape monitor (phase spread)

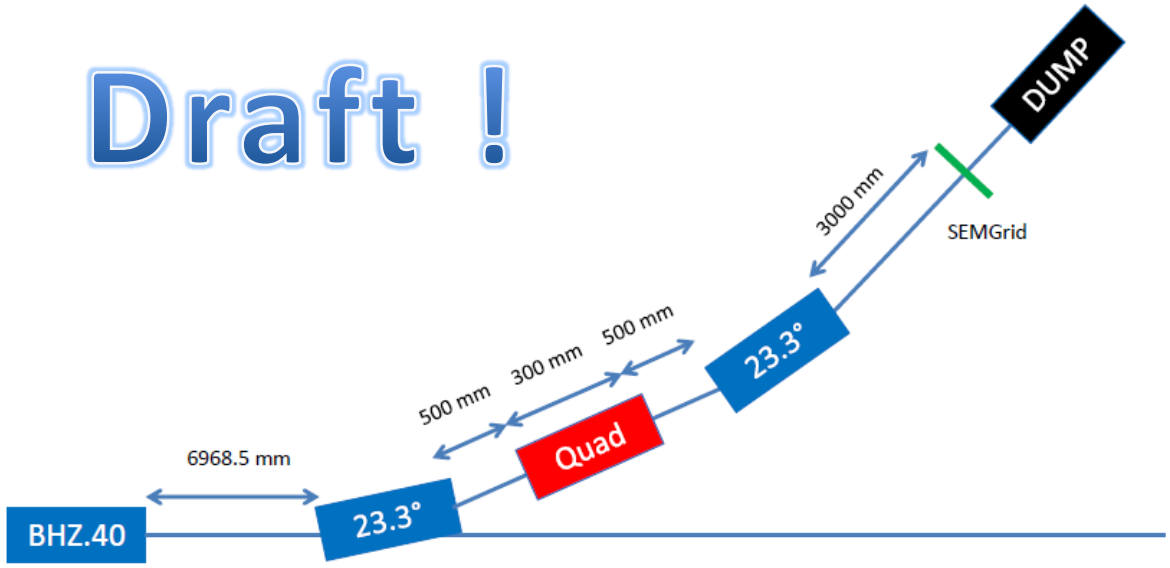
At 160 MeV on the DUMP

- Fine tuning of the whole LINAC
- Operational beam parameters at the end of the LINAC to be used as an input to rematch the line and prepare a fast commissioning of the lines.
- Reliability run

Refurbished LBE LBS



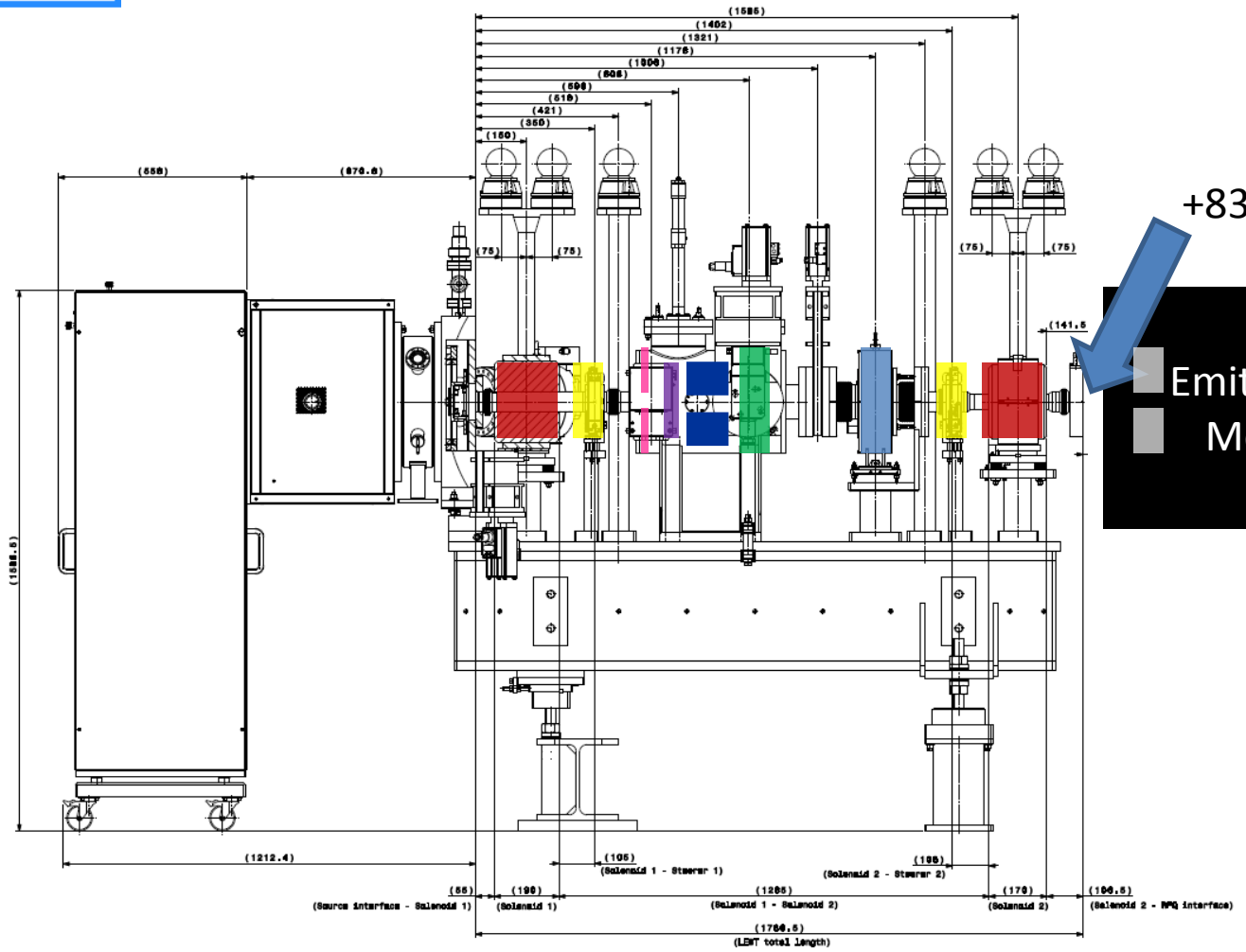
Draft !



Emittance via Q-scan

Energy spread and energy swing

What have done so far

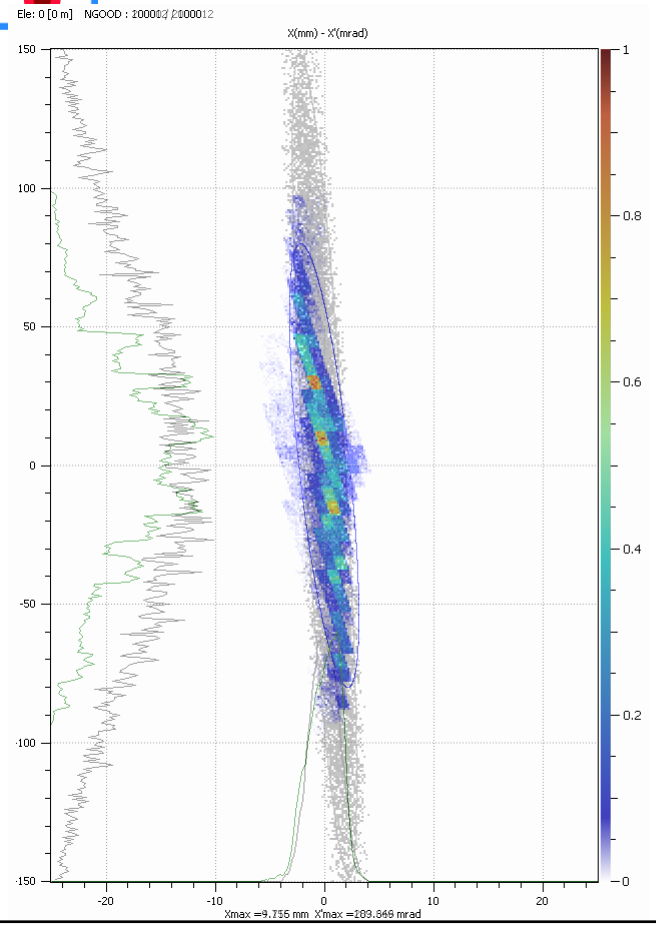


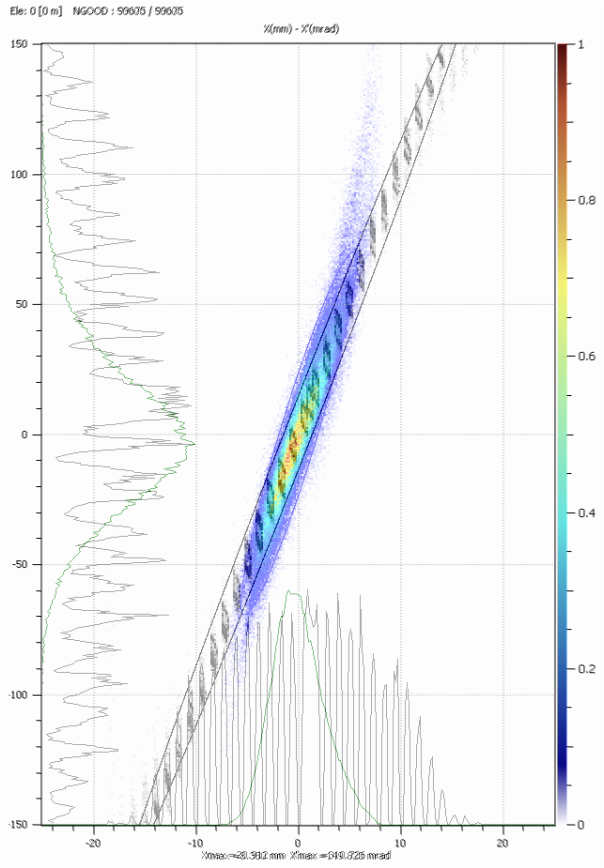
+83mm Drift

Emittance Meter

Solenoid
Steerer
Iris
Faraday Cup
Pre Chopper
SEM-Grid
BCT
Slit

What have done so far



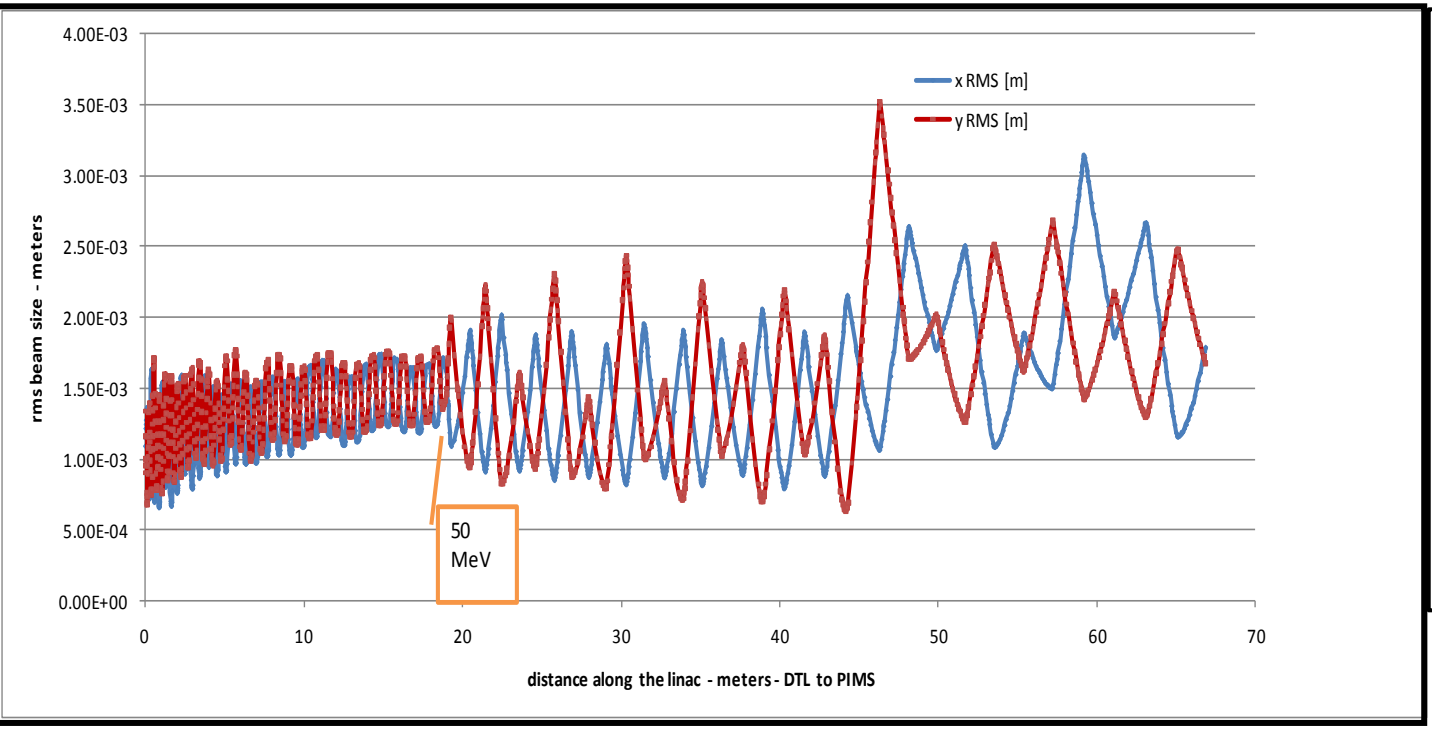


RFQ acceptance vs. **Measured emittance**

Measured after source vs. **Measured at the RFQ input plane and backtracked to the source**

What if…we need 50MeV p

- Need DTL + CCDTL module 4 + all the quadrupoles – not before end 2014
- Switch the source to P mode and complete installation new transfer line
- Reposition BHZ20



E = 0.28 pi rms norm

DW=100 keV (1rms)

40 mA

50MeV

400 µsec

Support from OP

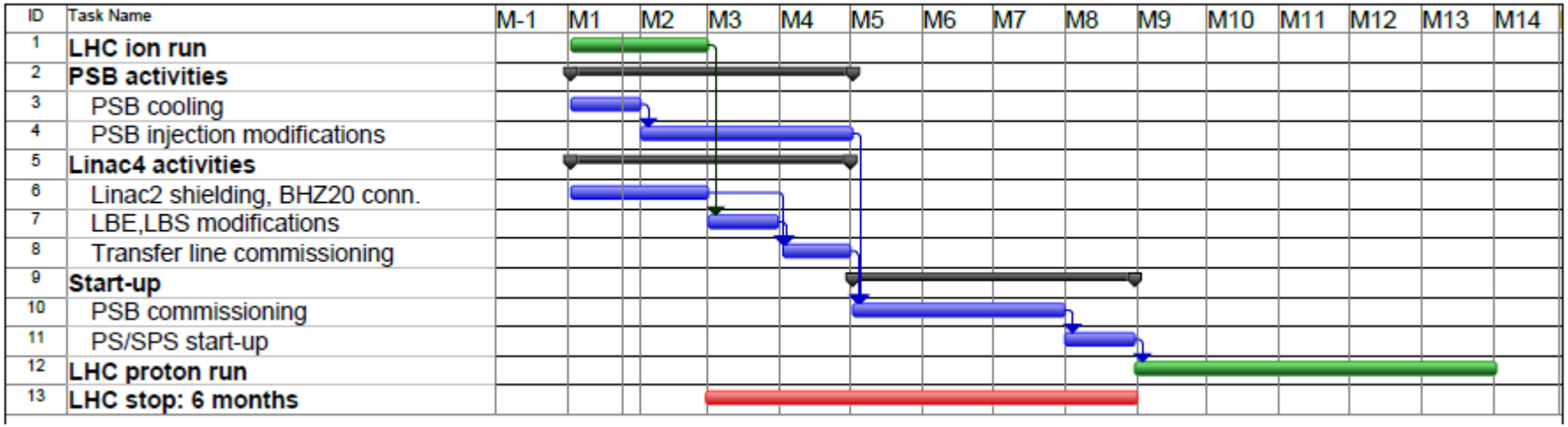
Software – for diagnostics applications – coordinated by Giulia Bellodi

Participation to commissioning of the LINAC (3 teams of 3 people with 1 LINAC expert, 1 RF expert , 1 operator) , work on the basis of 2 shifts/day during 2013/2014.

18 man.month of experienced operators (=6 months * 3 operators) in 2013/14 available for Linac4 commissioning. To be aligned with commissioning schedule.

Who is going to operate LINAC4 and from where?

Connection to PSB



Need 8 months / LHC stop of 6 months
Ready from 2015 (Linac4 must be already commissioned)

Summary

- Plan for commissioning LINAC4 in 5 stages with two temporary measurement benches. We believe that we have sufficient diagnostics to set all the linac parameters (about 130) . Energy spread can be measured properly only at 12 MeV and in the LBS.
- The present schedule foresees end of commissioning + reliability run at the end of 2014
- From 2015 LINAC4 can be connected to the PBS
- Need a shutdown of 8 months for the connection