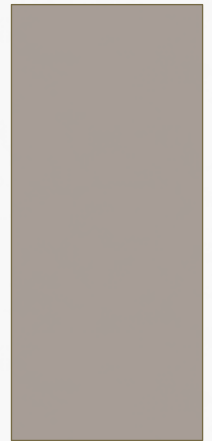


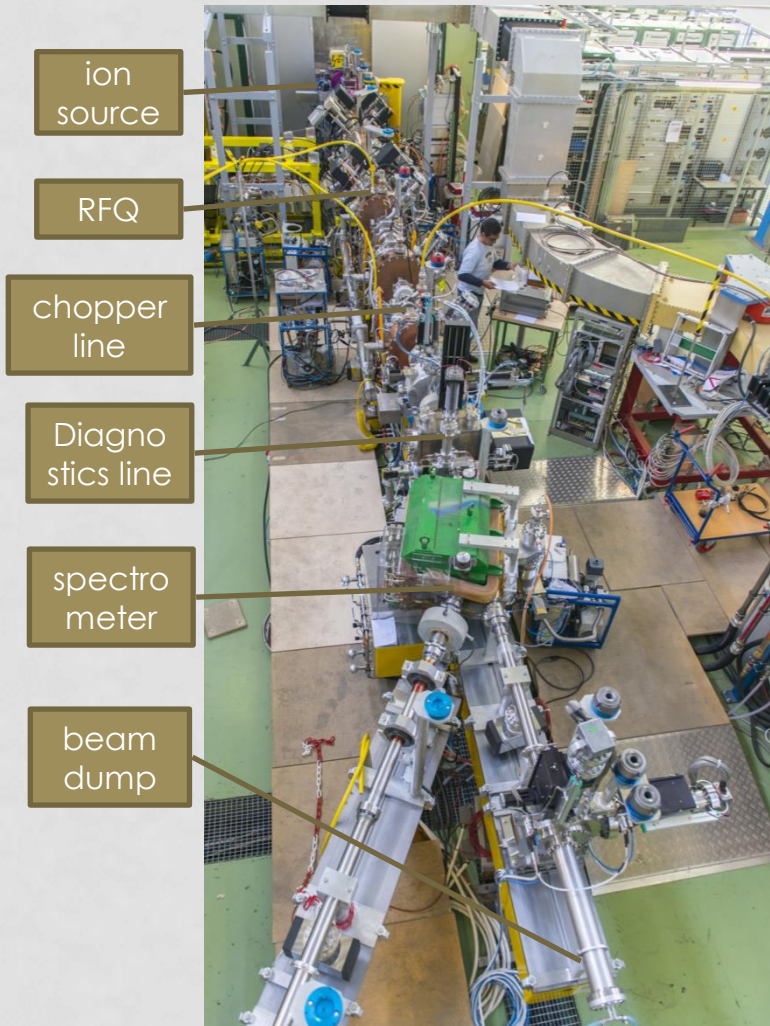


OPERATIONAL EXPERIENCE WITH INTERLOCK
SYSTEMS DURING 3MEV COMMISSIONING PHASE

COMMISSIONING AND MEASUREMENTS



45 KEV TO 3 MEV



source : 45 keV

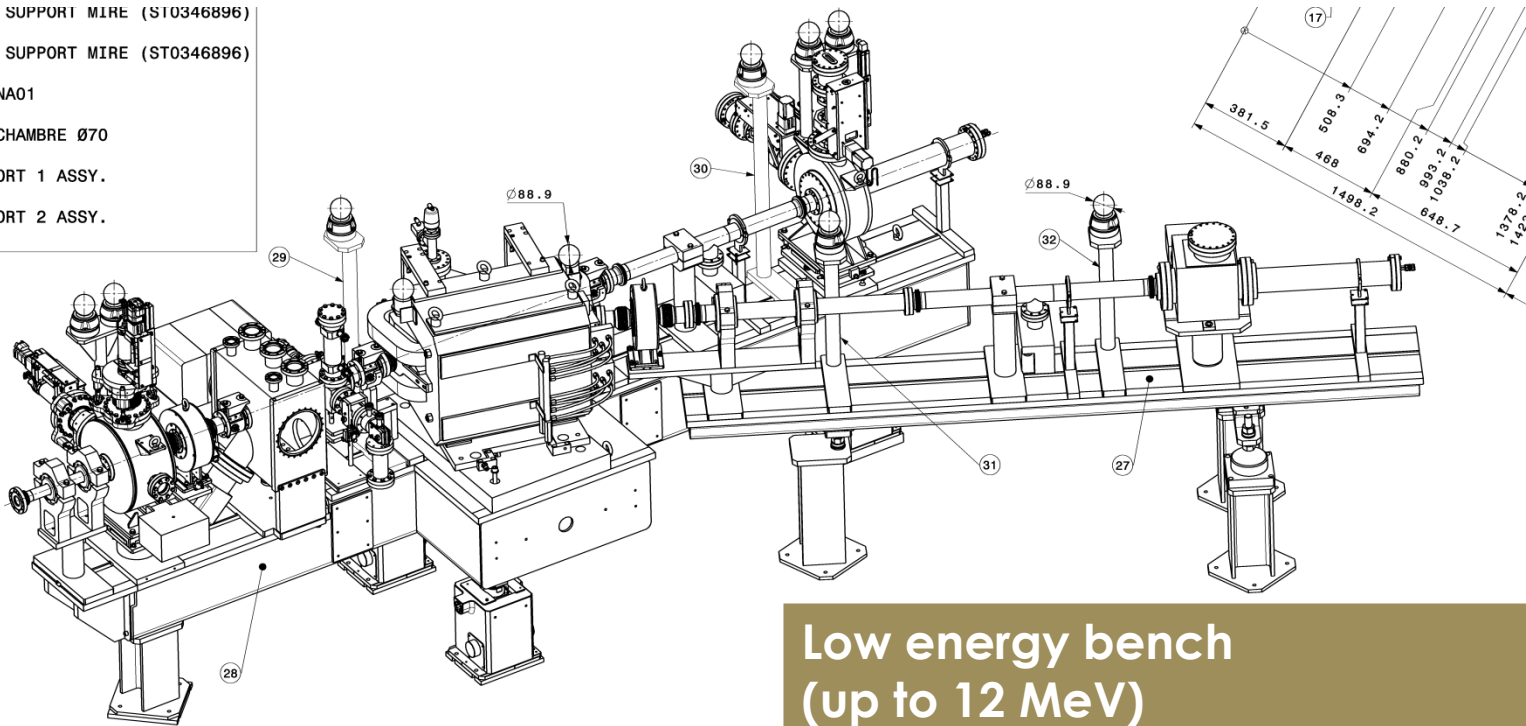
LEBT	2 solenoids, 2 steerers	Beam current Beam profile Slit and grid emitt (temporary)
------	----------------------------	--

RFQ : 3 MeV

MEBT	11 quads 3 bunchers 2 choppers	Beam current at 2 locations Wire scanners
------	--------------------------------------	---

MOVABLE DIAGNOSTIC BENCH

- 1 - ENSEMBLE SUPPORT MIRE (ST0346896)
4L.GH05031
- 2 - ENSEMBLE SUPPORT MIRE (ST0346896)
4L.GH05091
- 3 - CHAMBRE NA01
PLVCTC_0137
- 4 - SUPPORT CHAMBRE Ø70
PLTDISA0077
- 5 - BPM SUPPORT 1 ASSY.
PLBPUSA0026
- 6 - BPM SUPPORT 2 ASSY.
PLBPUSA0030



Low energy bench
(up to 12 MeV)

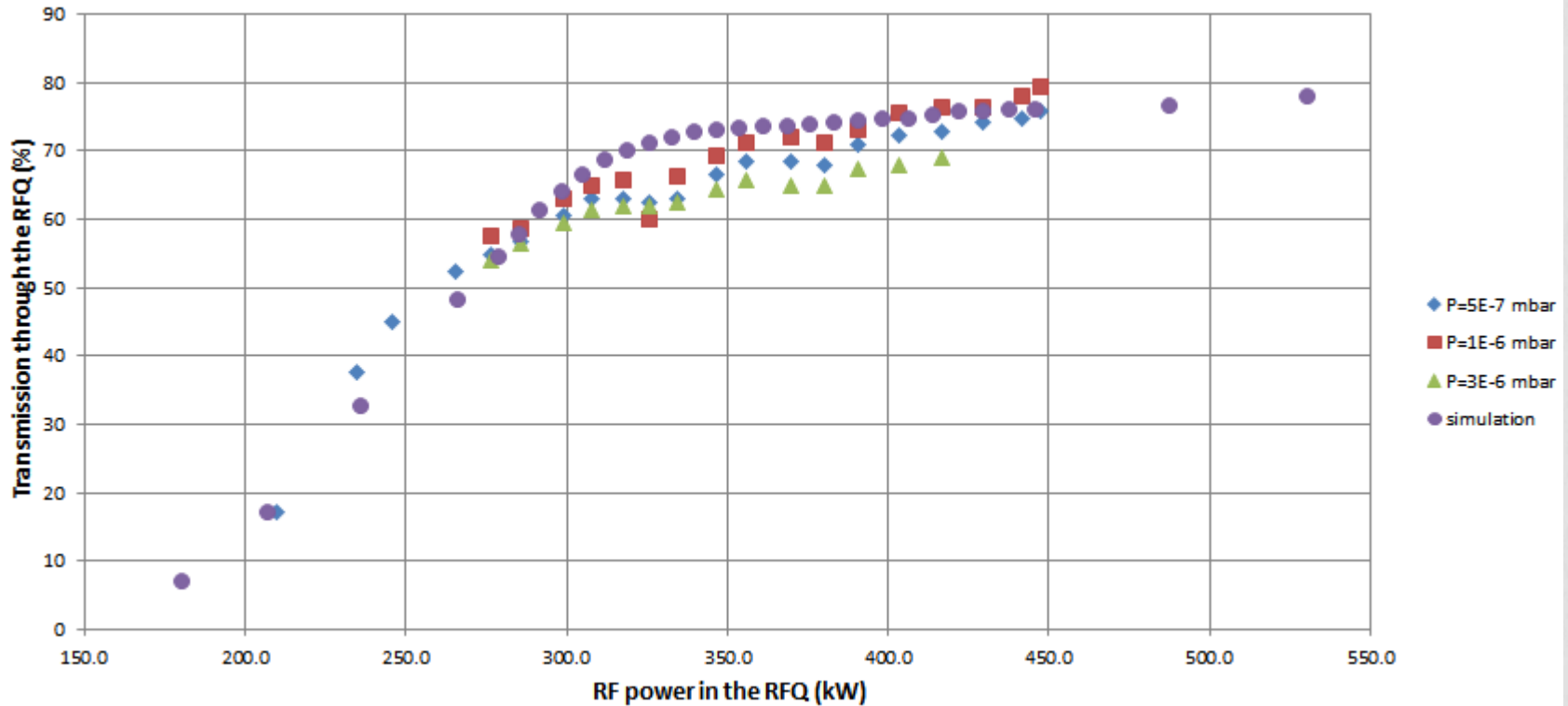
02-28-00A. DEMOUGEOT Vacuum chambers and bracket - Rep. 20-35-36
02-27-00A. DEMOUGEOT Hauteur mires: 339.843 (-4.504) --> 334.94

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

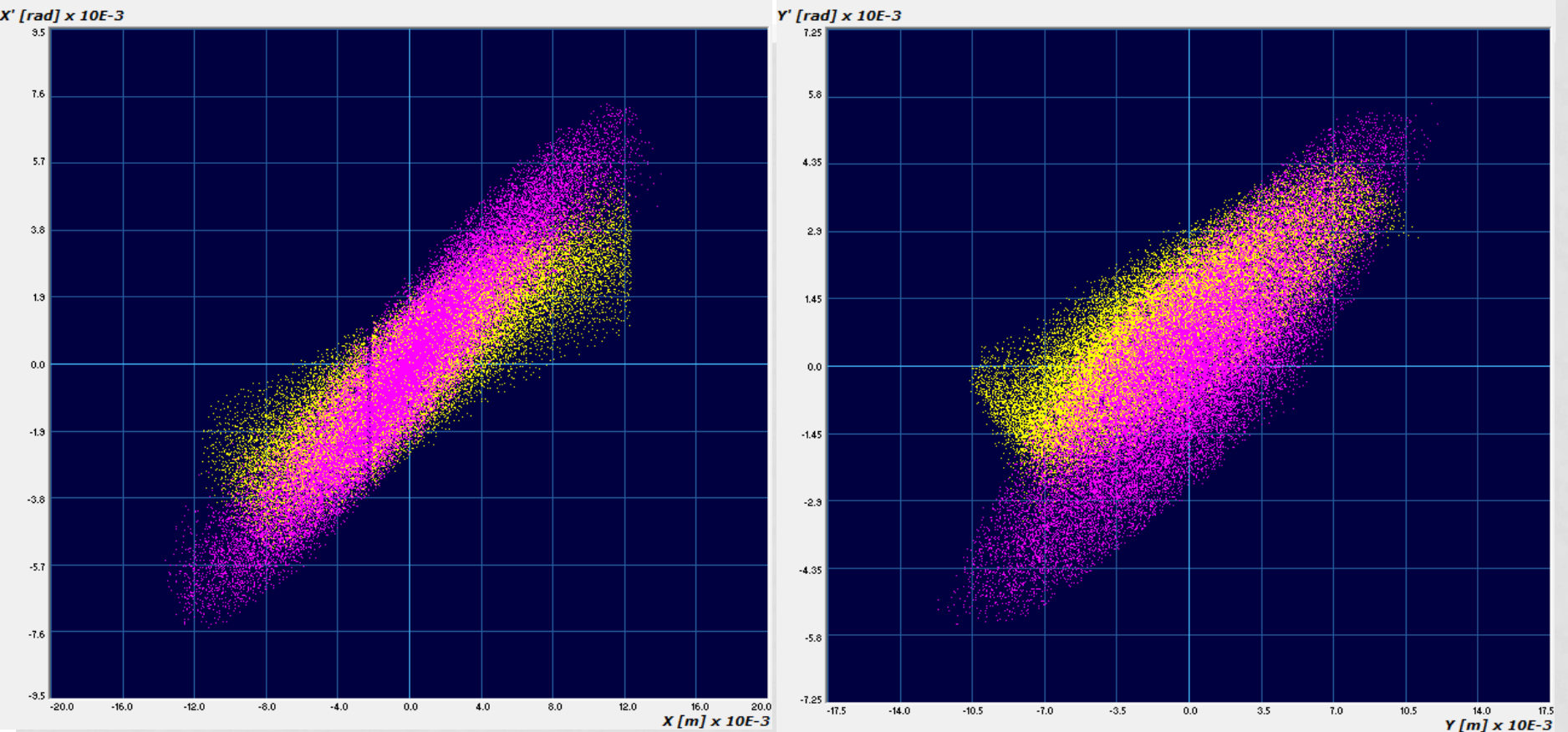


TRANSMISSION VS. RF POWER

FOR DIFFERENT PRESSURE IN THE LEBT (NEUTRALISATION)

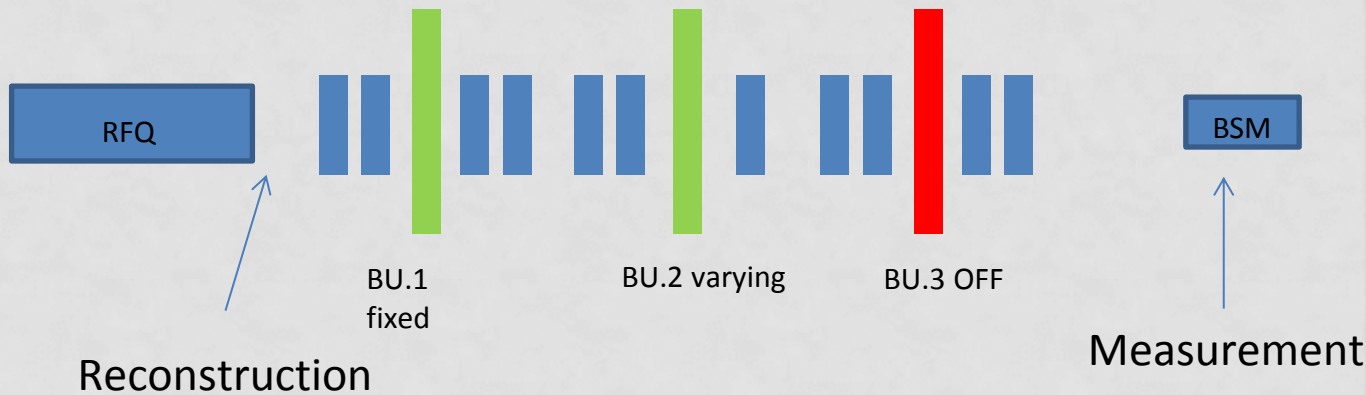


TRANSVERSE EMITTANCE-DIRECT

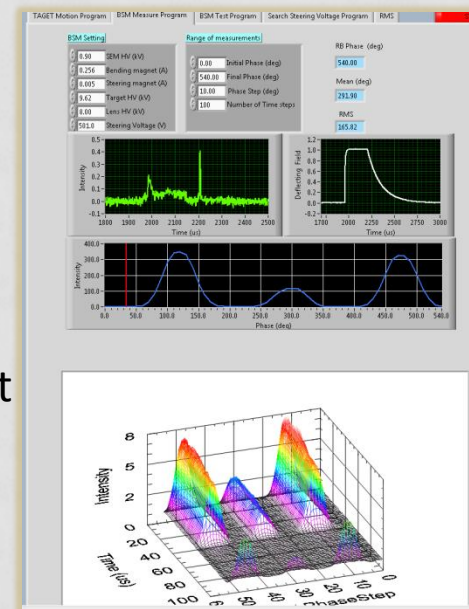
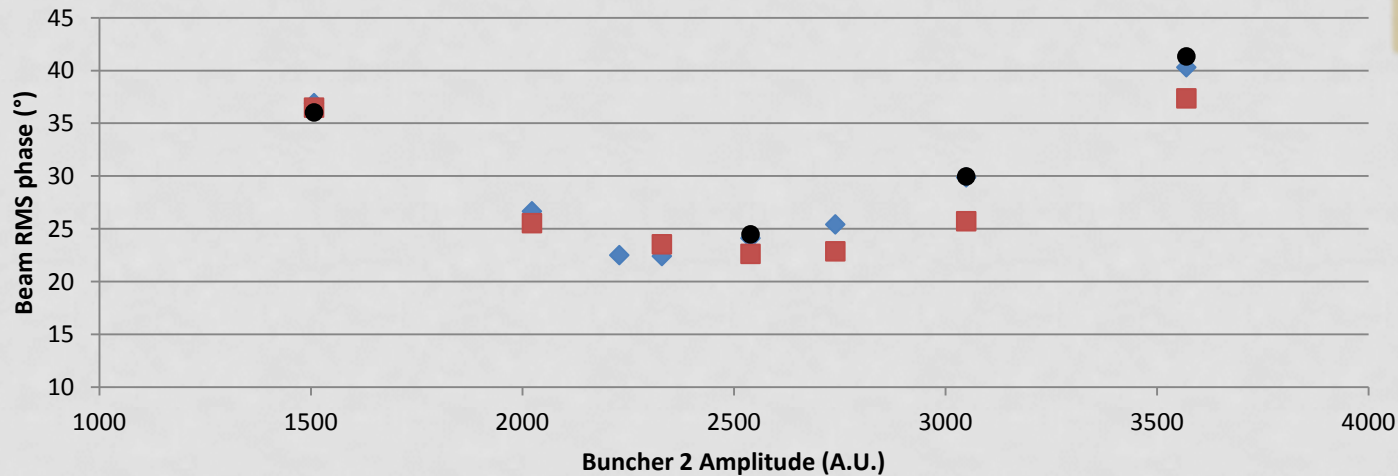


Yellow = measured, pink = simulations

LONG EMITTANCE -INDIRECT

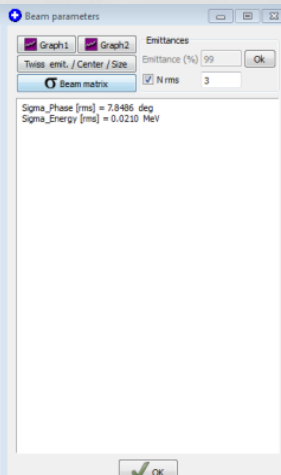
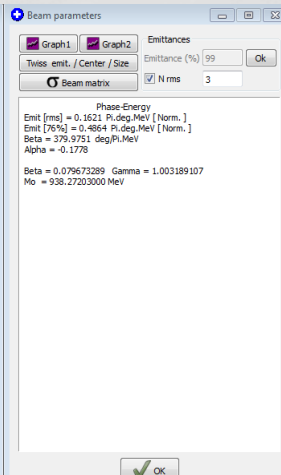
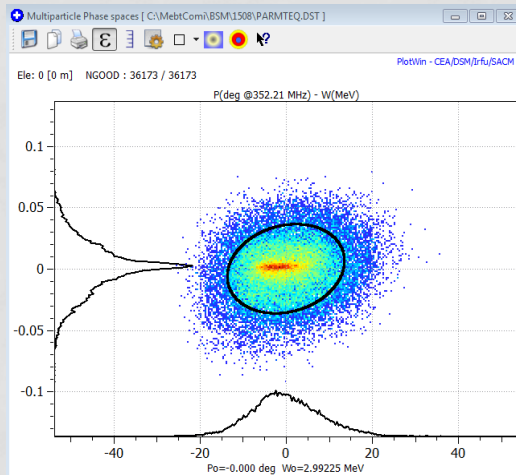


Beam RMS phase vs Cavity amplitude



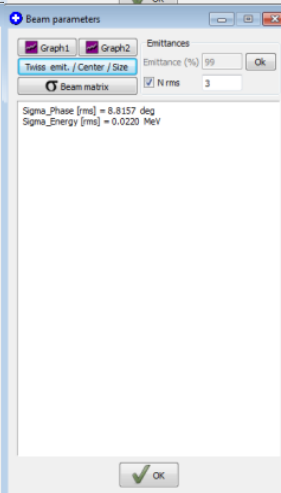
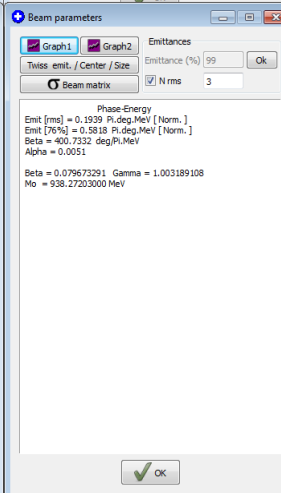
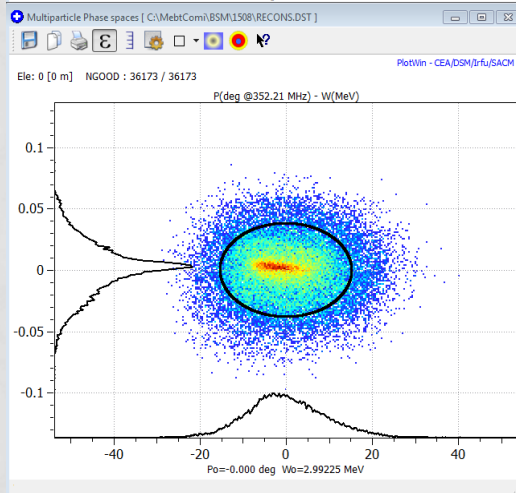
- ◆ Measurements
- Simulation
- Reconstructed

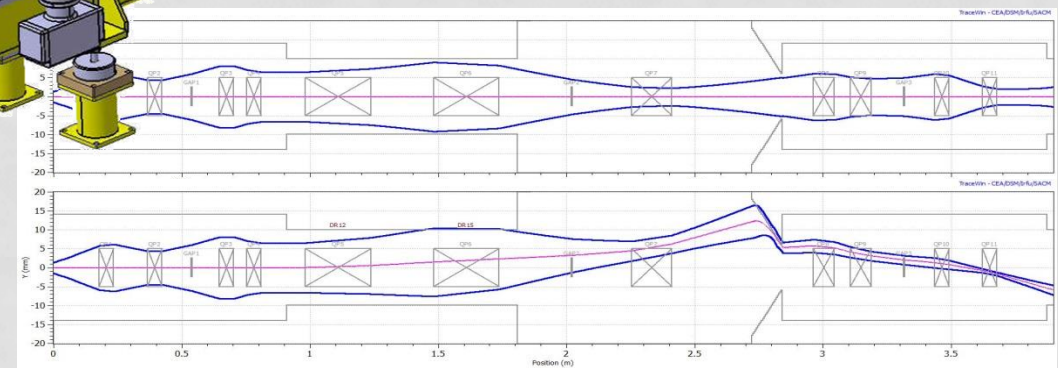
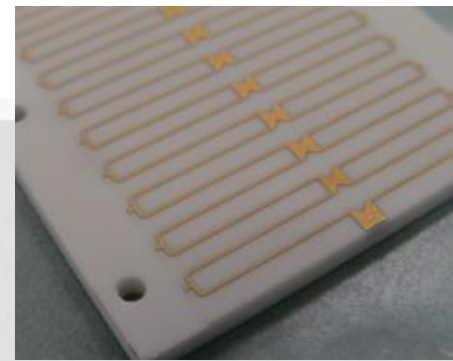
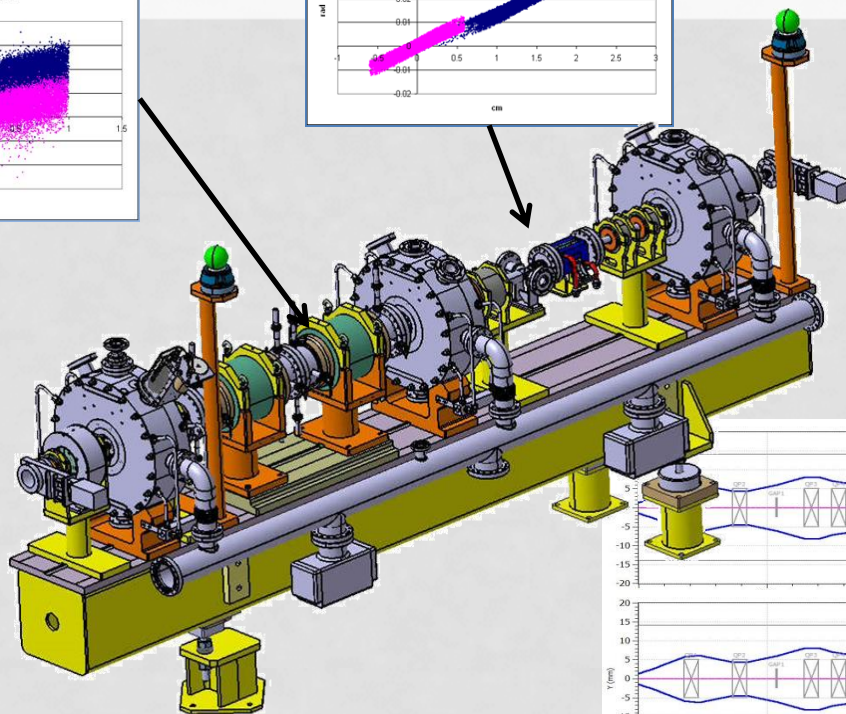
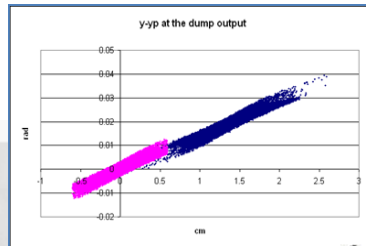
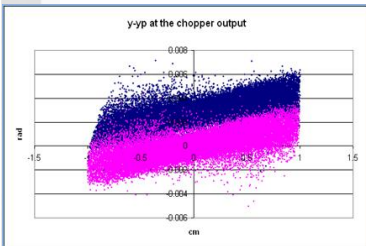
LONG EMITTANCE -INDIRECT



Expected : 21 keV
Reconstructed : 22 keV

Reconstruction technique and diagnostic performance were validated !

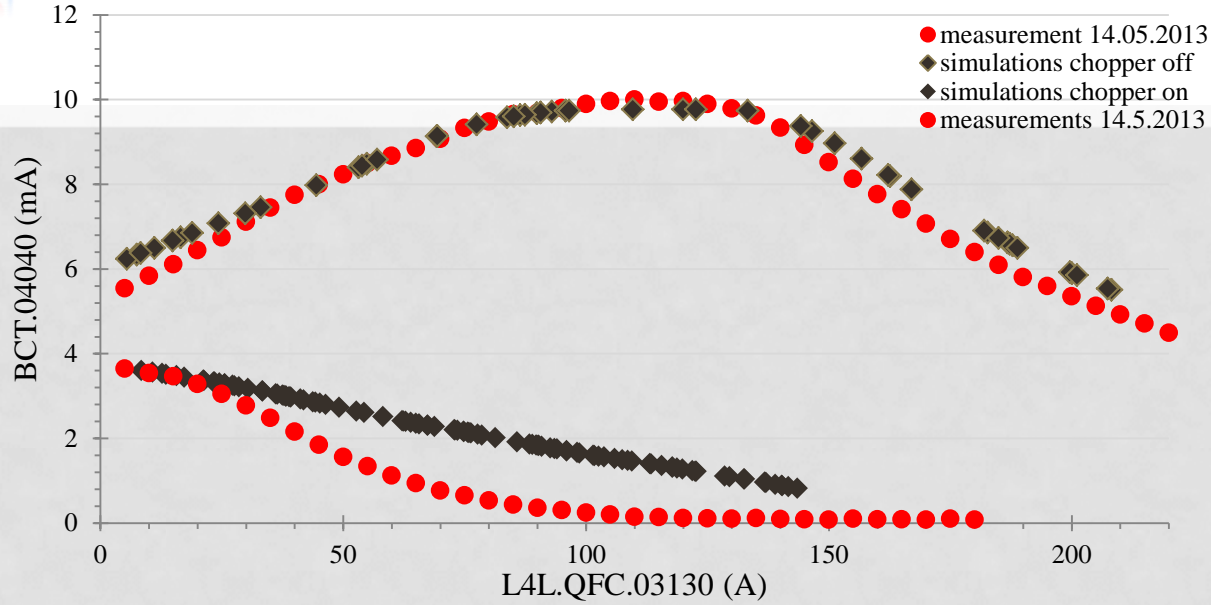




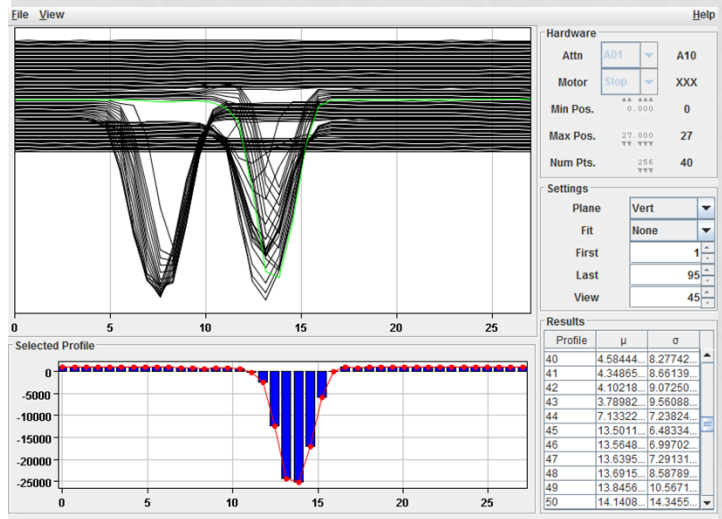
Micro-bunches are shifted in the phase space by a voltage applied between two plates.
 Relatively low voltage to allow for short rise/fall time.
 Shift transferred in the real space at the dump – Appropriate phase advance.



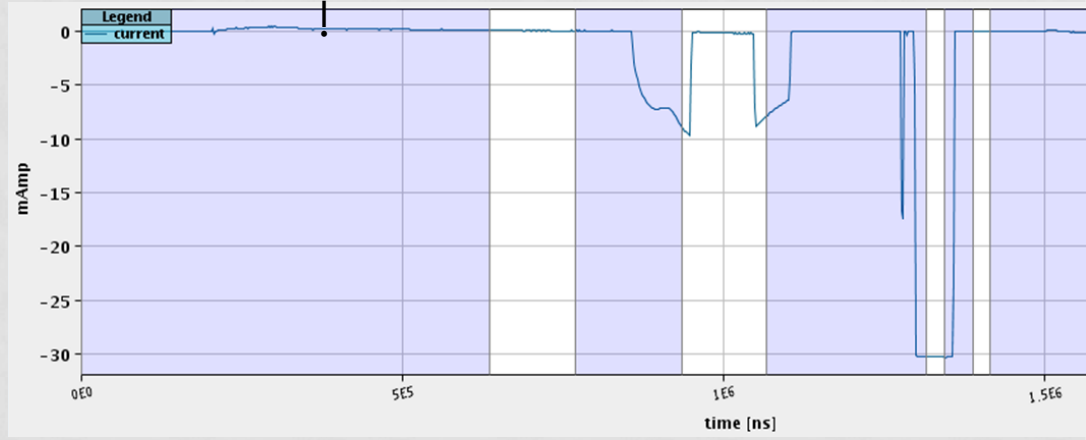
The chopper is working



The chopper line dynamics is validated !



Fall and rise time < 10 ns



THE BIS

BIS was connected only in the tunnel

It always worked when it was supposed to be

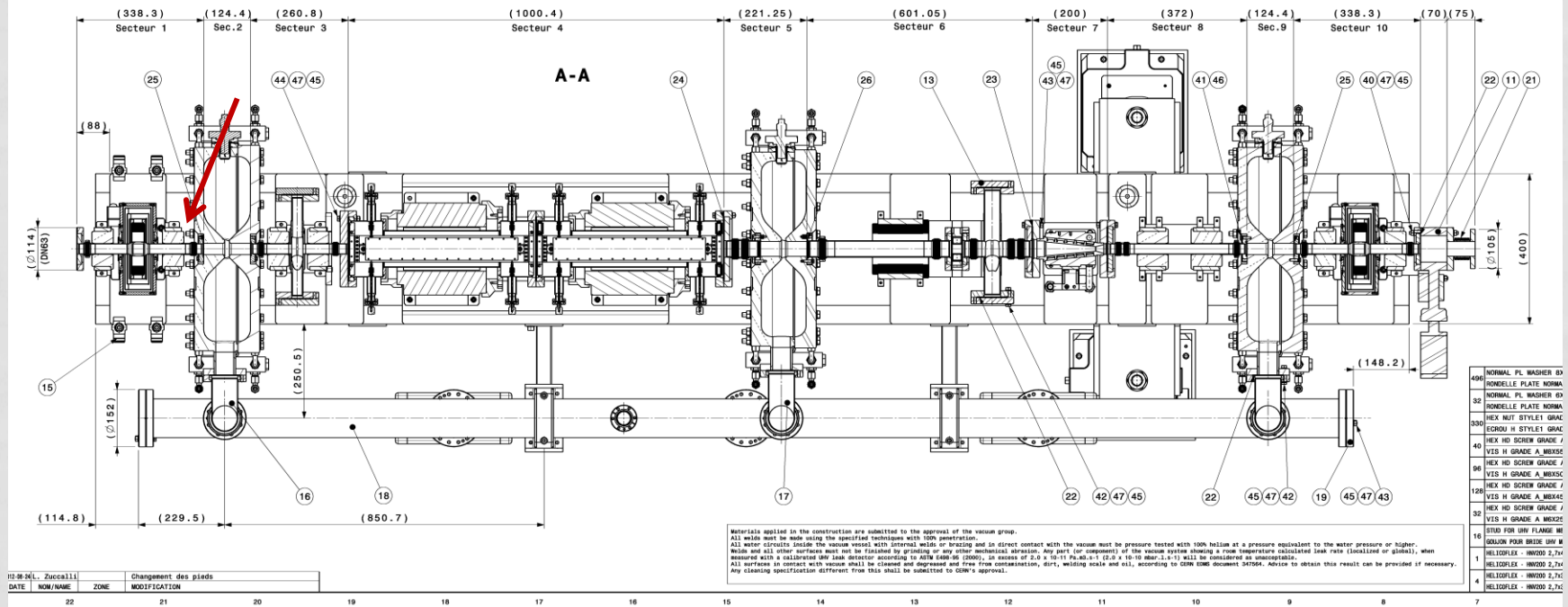
We got a demo and we understand how it works and we know how to read the tables (personally I find colour coding a bit tricky)

Most of the signals were connected to the BIS

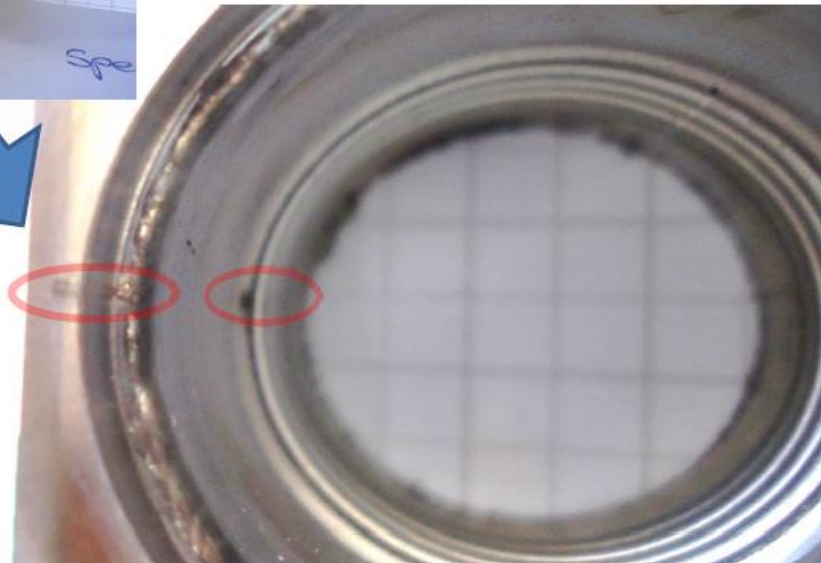
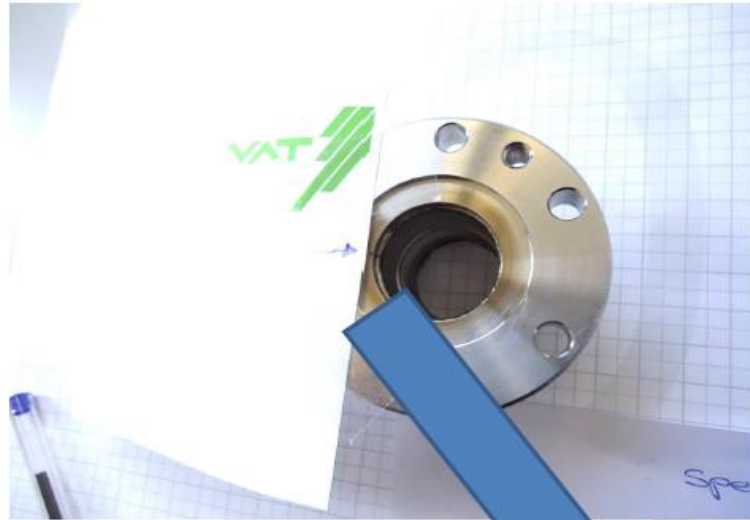
Watchdog was connected only the last day

Sometime during the commissioning phase we need to allow for losses but....

ON DECEMBER 12 AT 16:30 A SEVERE VACUUM LEAK WAS OBSERVED IN THE MEBT LINE. IT WAS LOCATED ON THE BELLOW DOWNSTREAM THE FIRST BUNCHER CAVITY, ON THE LEFT SIDE WHEN LOOKING DOWN THE BEAM LINE.



L4 damage bellows

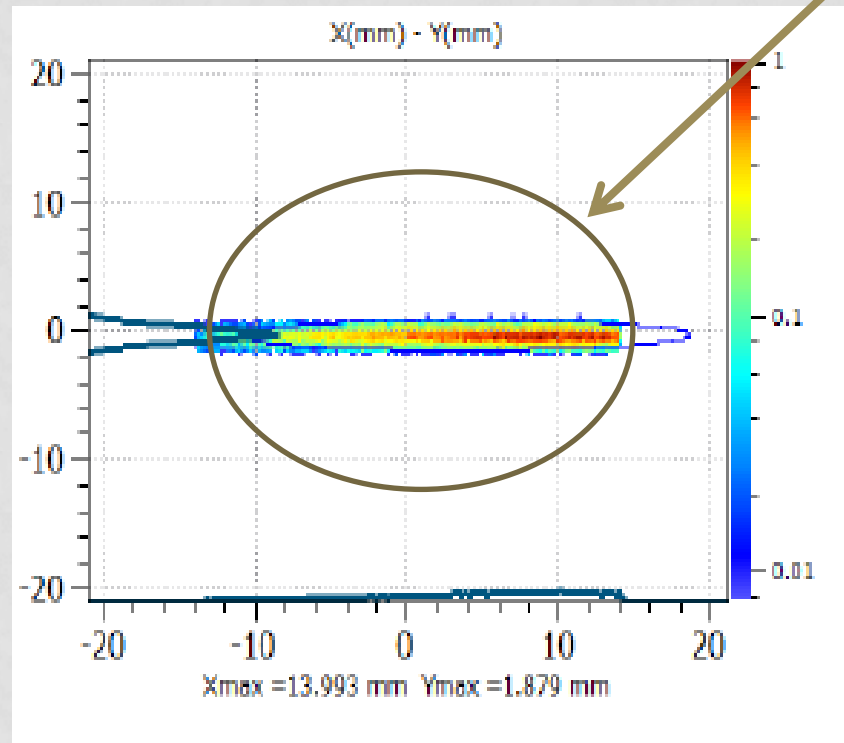


06/01/2014

BEAM IS FIRST SUSPECT

beam	
Beam current	12.5mA
Pulse length	300us, 1Hz
Misalignment at the RFQ output	Xc=0.67mm yc=-0.35mm X'c=6mrad y'c=-11mrad
LEBT solenoids	AQN to be set
L4L.SNB.01050	87.01632
L4L.SNB.01170	114.571488
MEBT quadrupoles	AQN to be set
L4L.MQD.3110 (Q1)	147.2585251
L4L.MQF.3210 (Q2)	
L4L.MQD.3310 (Q3)	
L4L.MQF.3410	-52.60076696
L4L.MQF.3510	-46.48494016
L4L.MQD.3610	176.6553191
L4L.MQF.3710	-119.998277
L4L.MQD.3810	35.875
L4L.MQF.3910	-31.47315951
L4L.MQD.4010	54.05899705
L4L.MQF.4110	-52.24188791

BEAM GOING INTO THE PAPER, SCRAPING ON THE LEFT SIDE . 16% LOST ON THE BELLOW



CONFIRMED BY CESARE !

Angle α (deg)	Scaled energy deposition E_d (J/cm ³ /pulse)		Approximate DT (°C/pulse)
1	174.52		46.76
5	871.56		233.54
10	1736.48		465.30
15	2588.19		693.52
20	3420.20		916.46
30	5000.00		1339.77
40	6427.88		1722.38
45	7071.07		1894.73
50	7660.44		2052.65
60	8660.25		2320.56
70	9396.93		2517.95
80	9848.08		2638.84
90	10000.00		2679.55

COMBINATION OF UNLIKELY BUT POSSIBLE EVENTS

- A severe misalignment between the RFQ and the MEFT that was not present at the 3 MeV test stand and was later confirmed by survey
- An optic that favoured amplification of this misalignment whilst focusing the beam to sub mm size in the other direction
- A phase advance such that the loss occurred on the “wave” (or lip) of the bellow which is only 200 microns thick and it is an aperture limitation (25.1 mm vs 28 mm of adjacent vacuum chamber).

ACTIONS

- RFQ MEBT were realigned . Add a protection on each jack in order to prevent any manipulation of the alignment screw and ask SURVEY for a smoothing before new beam for the next diagnostic line positions
- That any measurement with settings that are very far from nominal should be firstly thoroughly simulated and done over few shots if they generate losses. Settings which generate losses should be allowed only in exceptional circumstances and in presence of the supervisor.
- The bellows are a point of weakness and their bore aperture should never be smaller than the adjacent vacuum chamber. It is proposed that all the bellows that don't satisfy this criterion are progressively replaced at a convenient time. A protection of the bellow could also be put in place.

L4 lissage radiale 3MeV

