LINAC4 RFQ

COMMISSIONING AND MEASUREMENTS

alessandra lombardi – 18 DEC 2013 – CERN-JPARC collaboration meeting

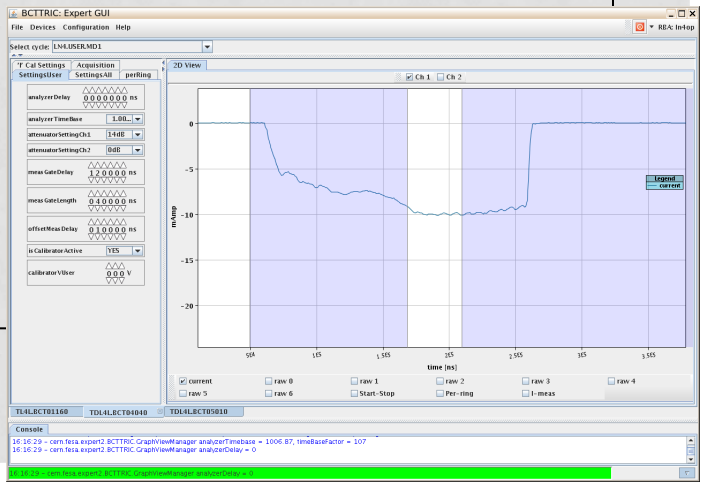
THE TIME ALLOCATED FOR THIS TALK IS LONGER THAN THE TIME IT TOOK TO COMMISSION THE RFQ …….

Talk outline

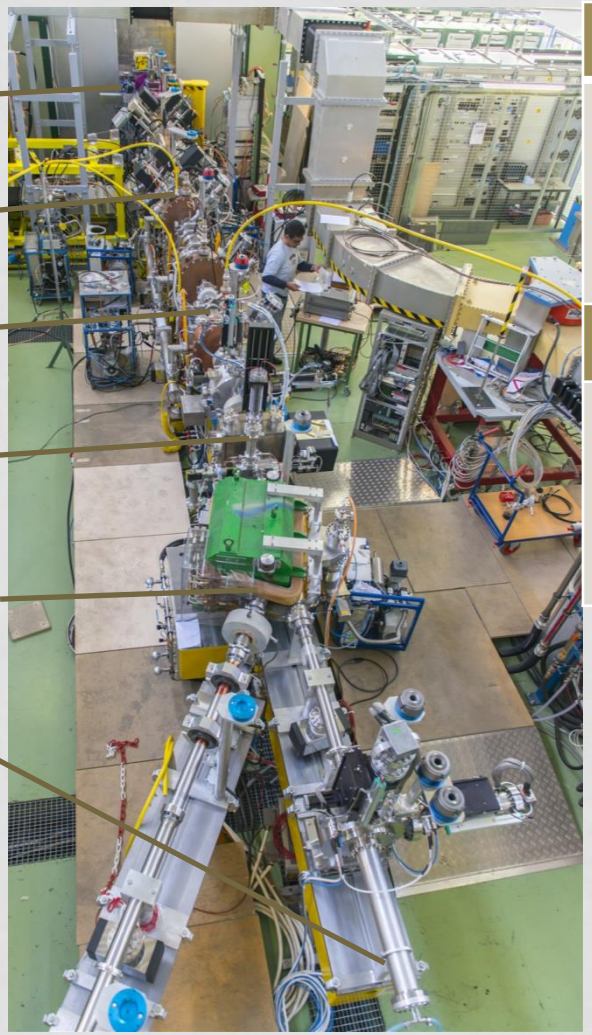
- Layout -1 min
- Source measurements-2 min
- Beam thru the RFQ-3min
- Measurements -4 min
- Conclusions and discussion -5 min

RFQ beam commissioning

- Set solenoids to nominal value-1min
- Open beam stopper and vacuum valve-30 sec
- Empirically optimise steerers - 2 min
- See beam at 3 MeV :

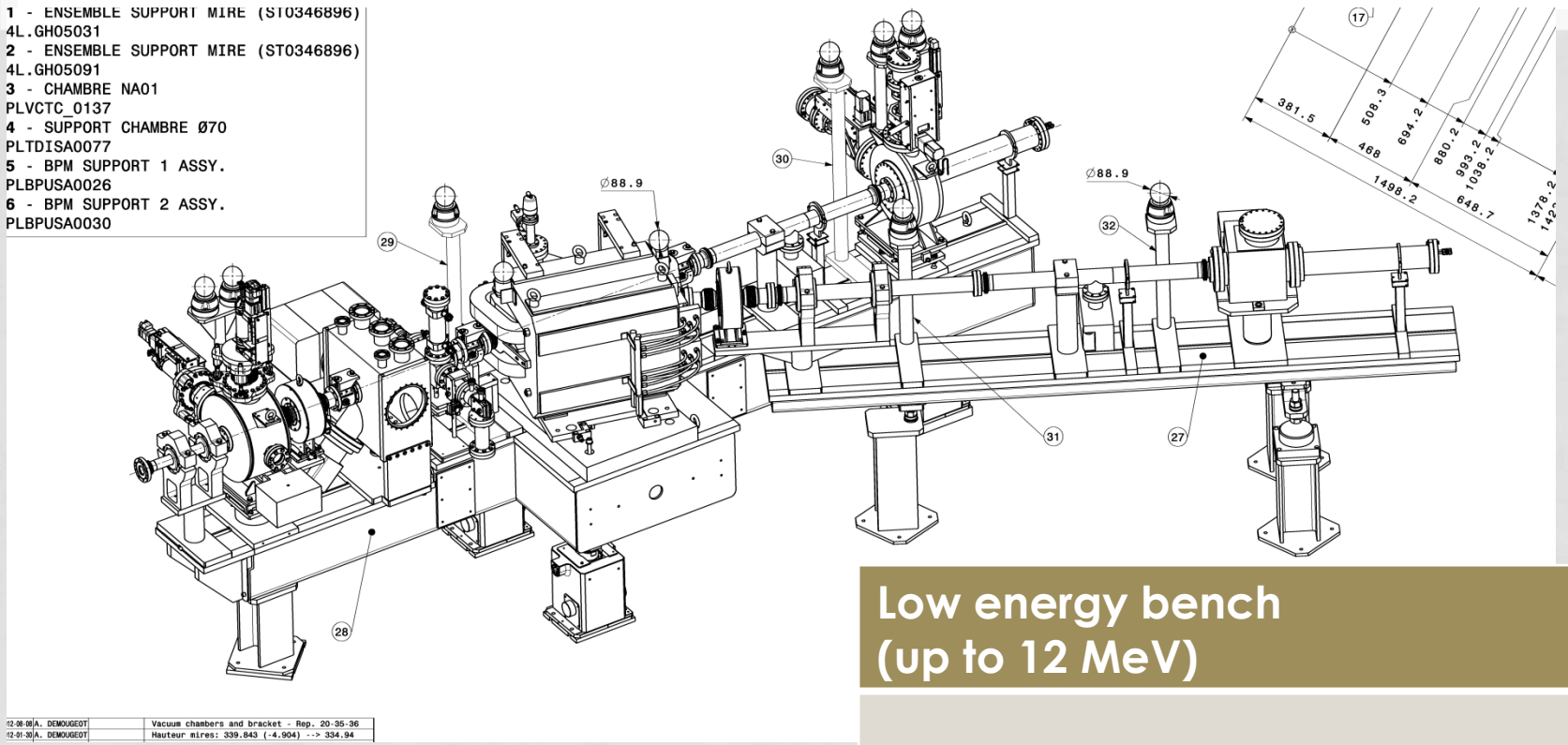


45 KEV TO 3 MEV



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

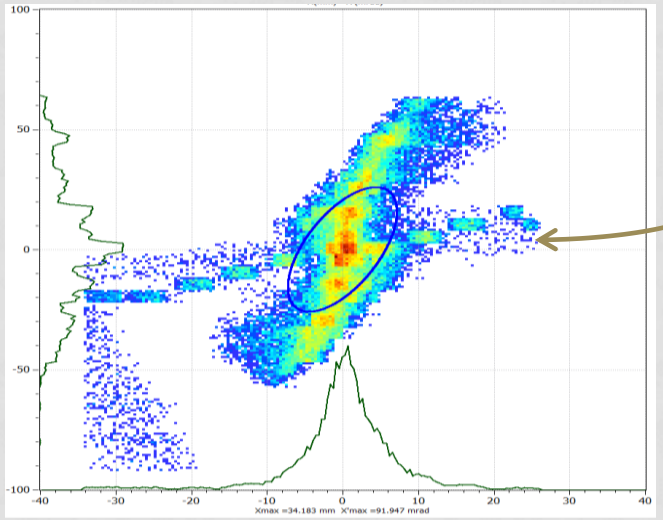
MOVABLE DIAGNOSTIC BENCH



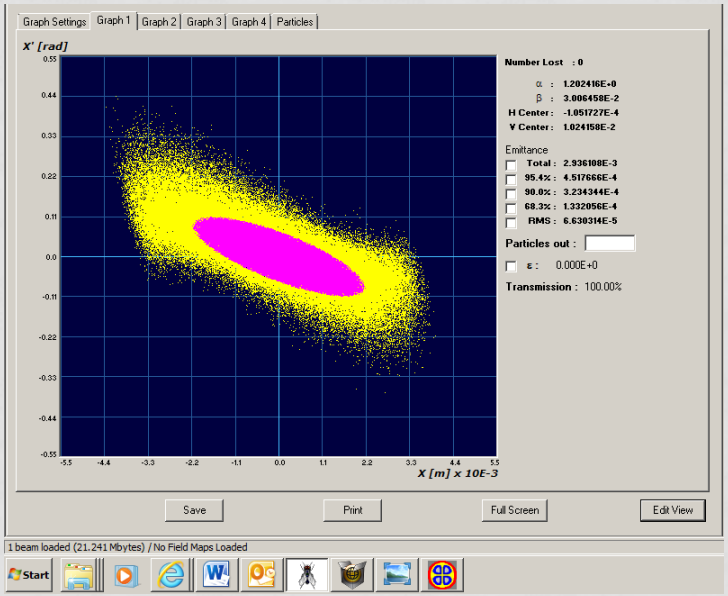
Low energy bench (up to 12 MeV)

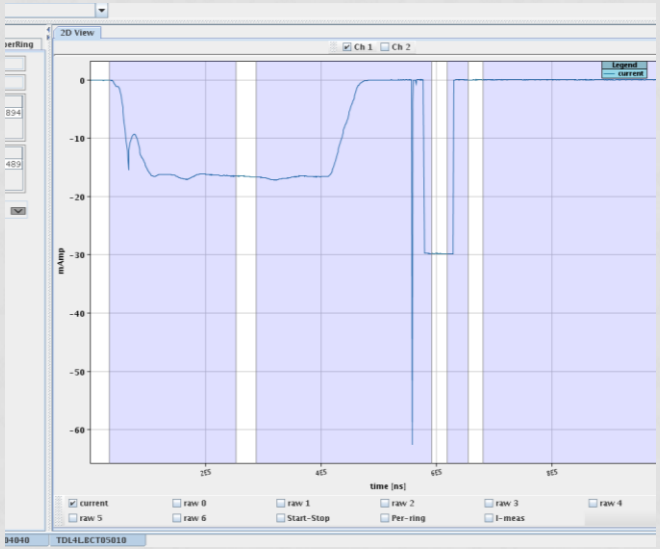
Spectrometer (0.2 %)
Slit and Grid Emittance
ToF (calibration)
Bunch Shape Monitor
Halo Monitor (chopping eff.)

BEAM AT THE SOURCE-45KEV



Measured emittance, includes H0.

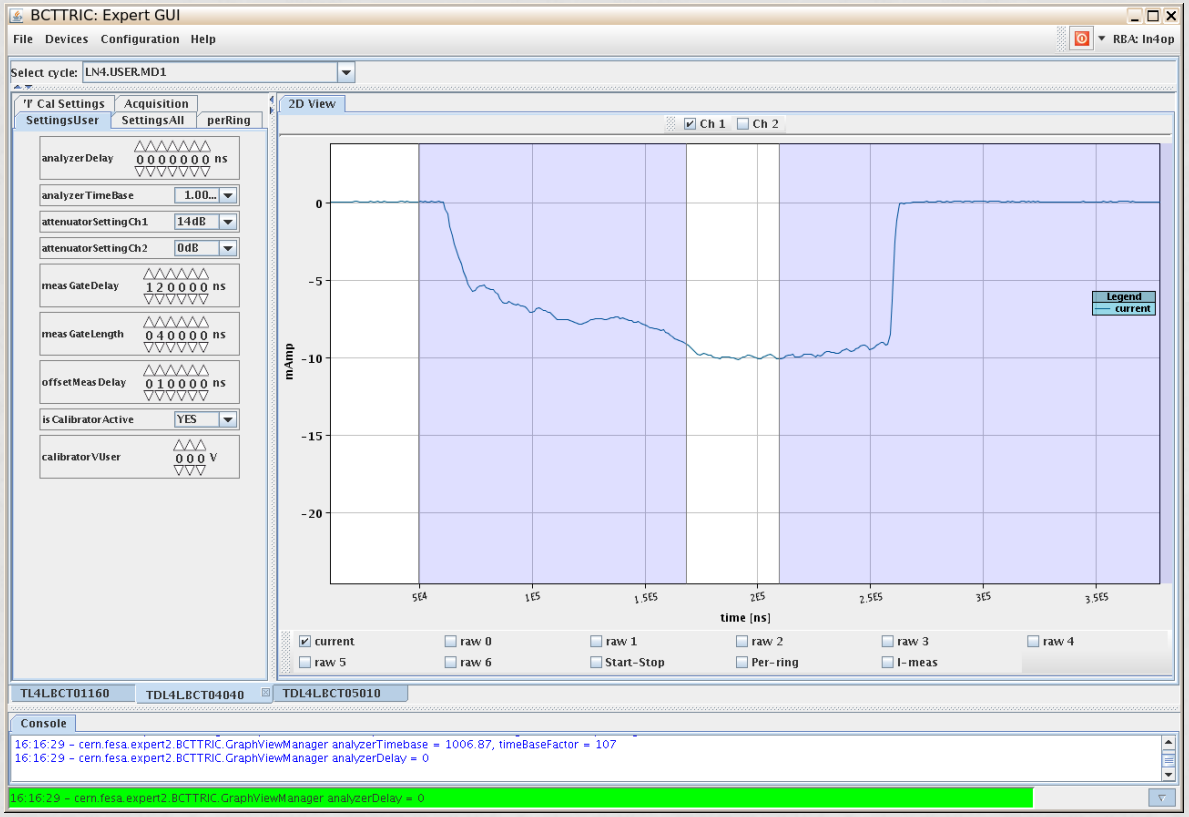




Measured current : 16mA for 200µsec.

Comparison of measured emittance (yellow) and RFQ acceptance (pink). The expected transmission (PARMTEQ + TOUTATIS) is 75%.

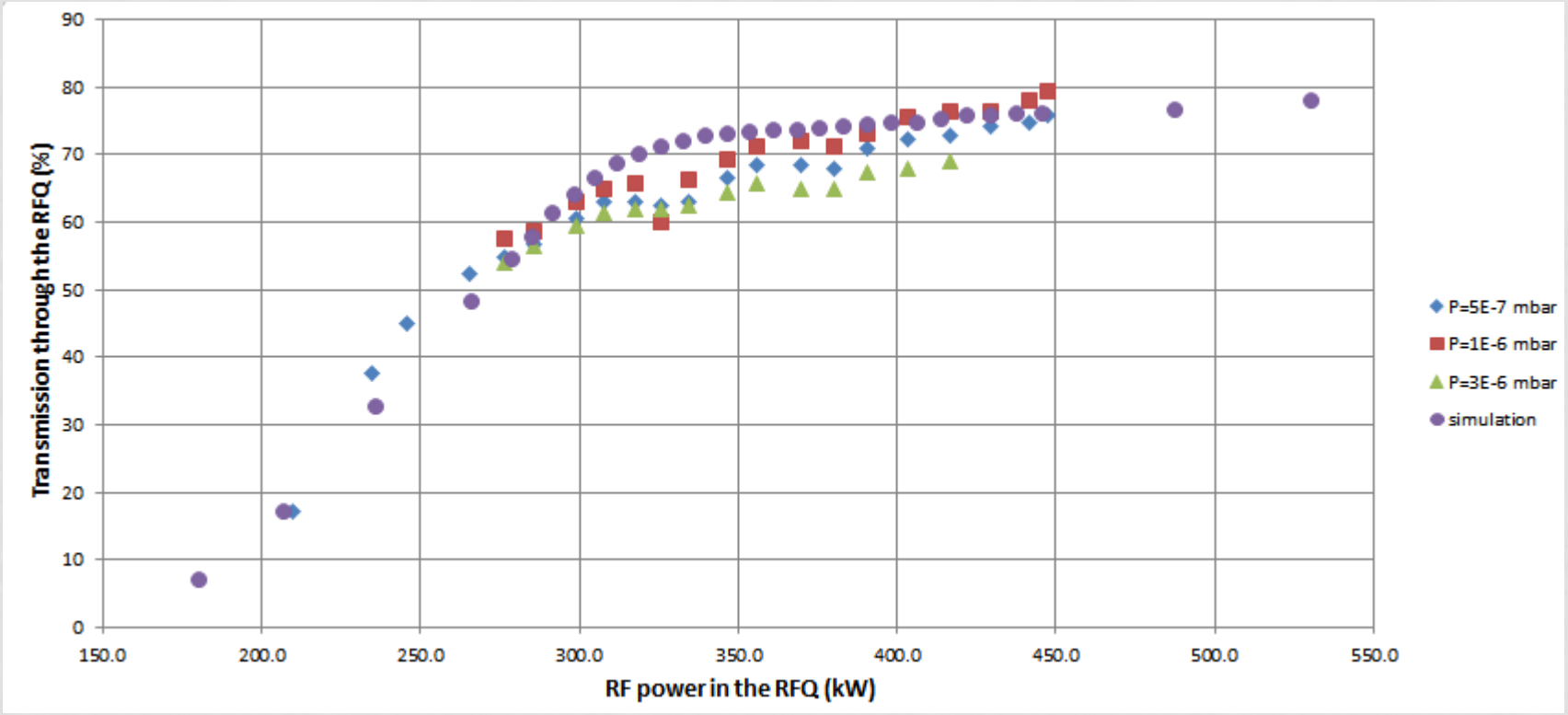
FIRST BEAM THRU THE RFQ



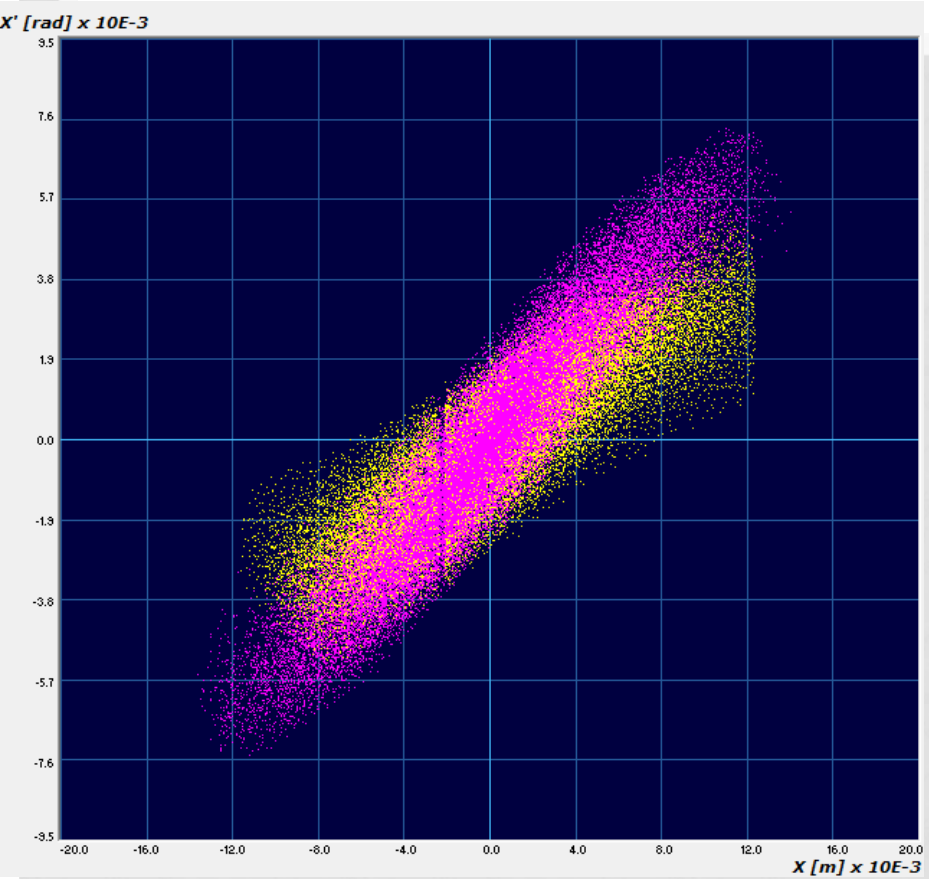
Wednesday 13/03/13 at 16h10
10mA H- accelerated to 3 MeV

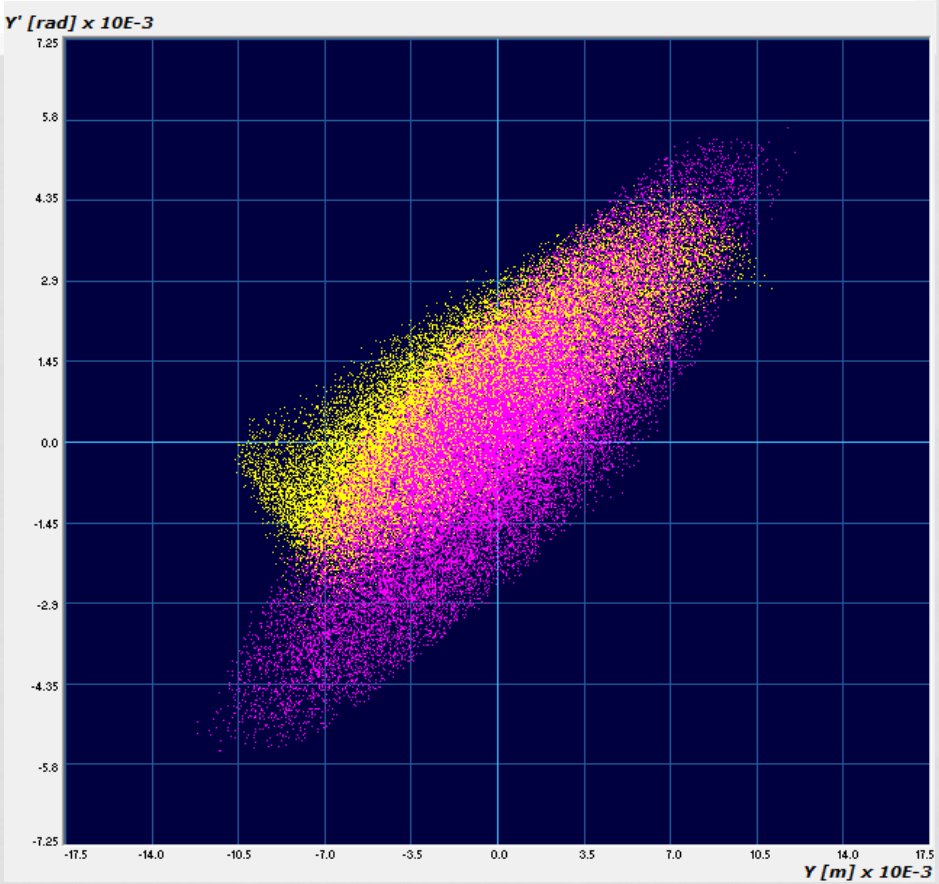
TRANSMISSION VS. RF POWER

FOR DIFFERENT PRESSURE IN THE LEBT (NEUTRALISATION)



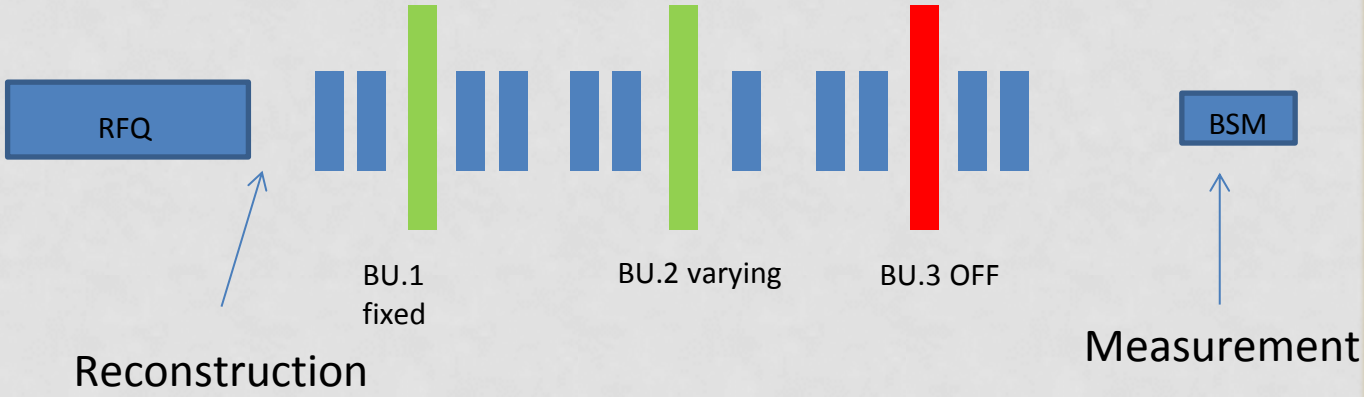
TRANSVERSE EMITTANCE-DIRECT

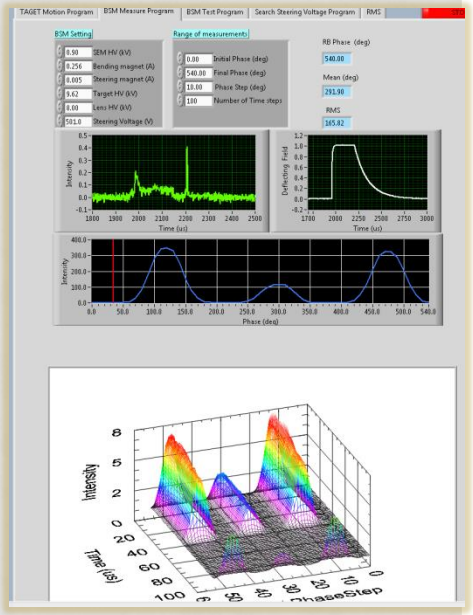


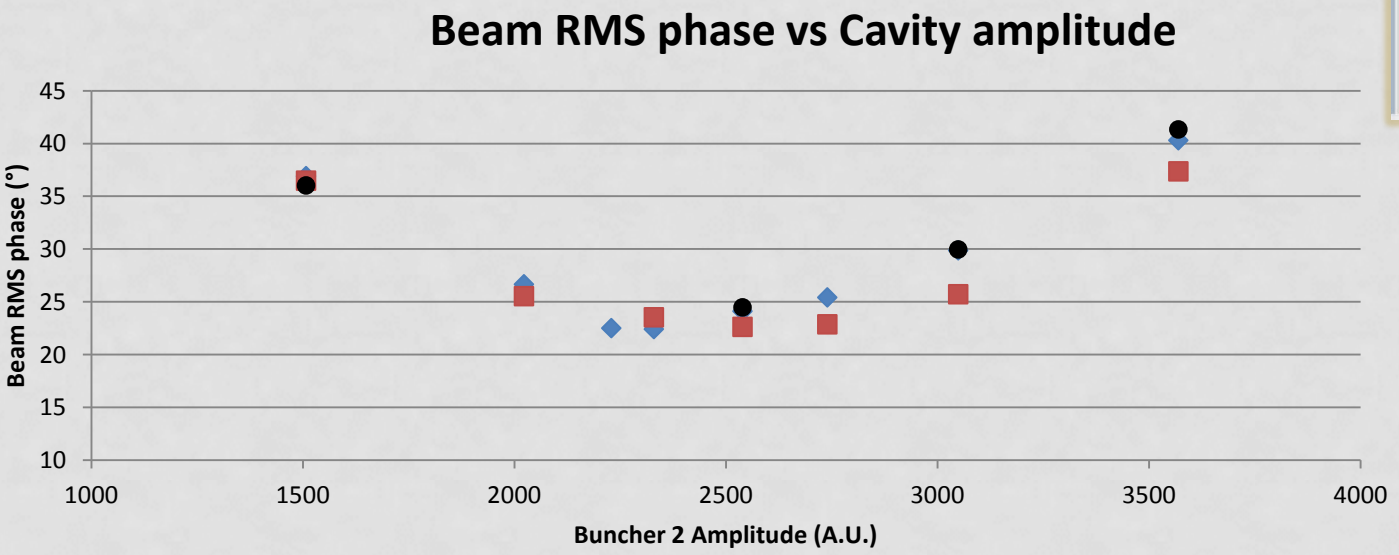


Yellow = measured, pink = simulations

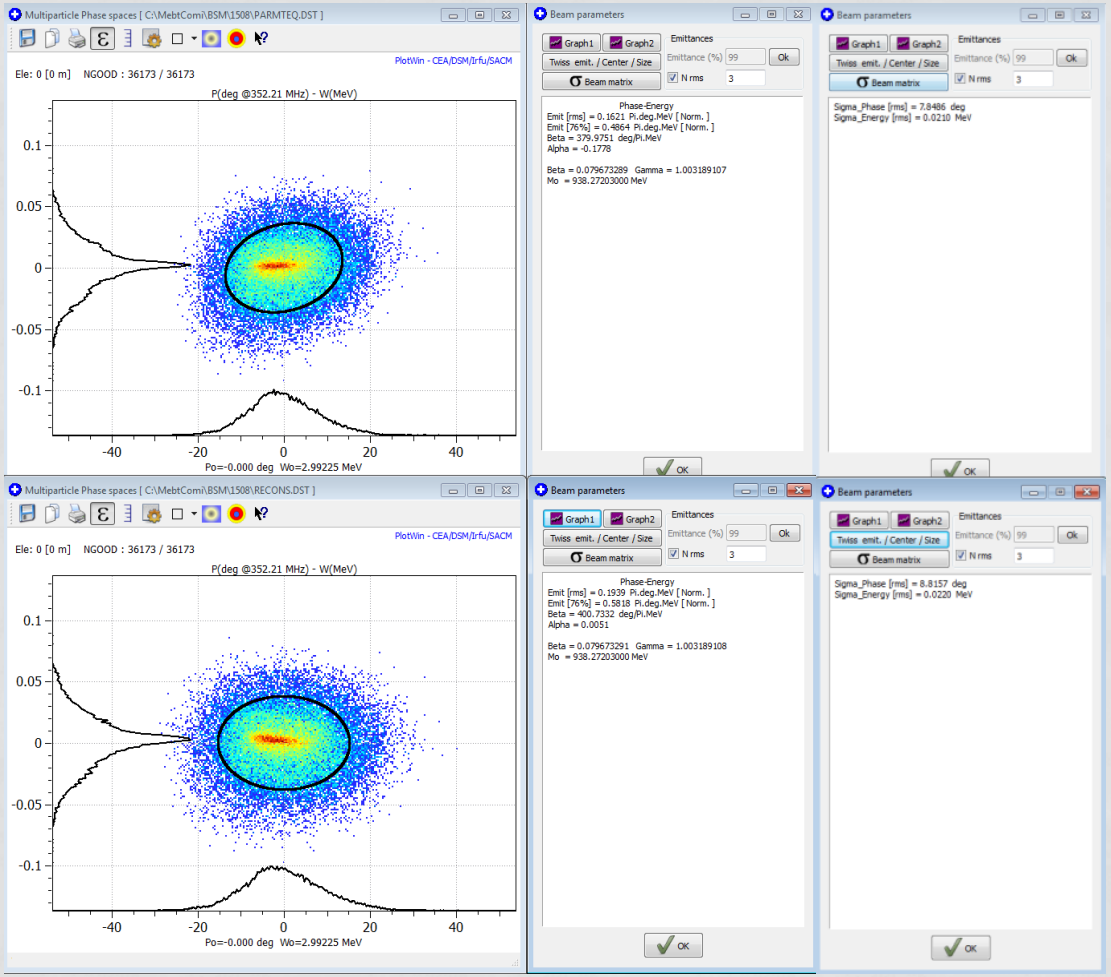
LONG EMITTANCE -INDIRECT







LONG EMITTANCE -INDIRECT

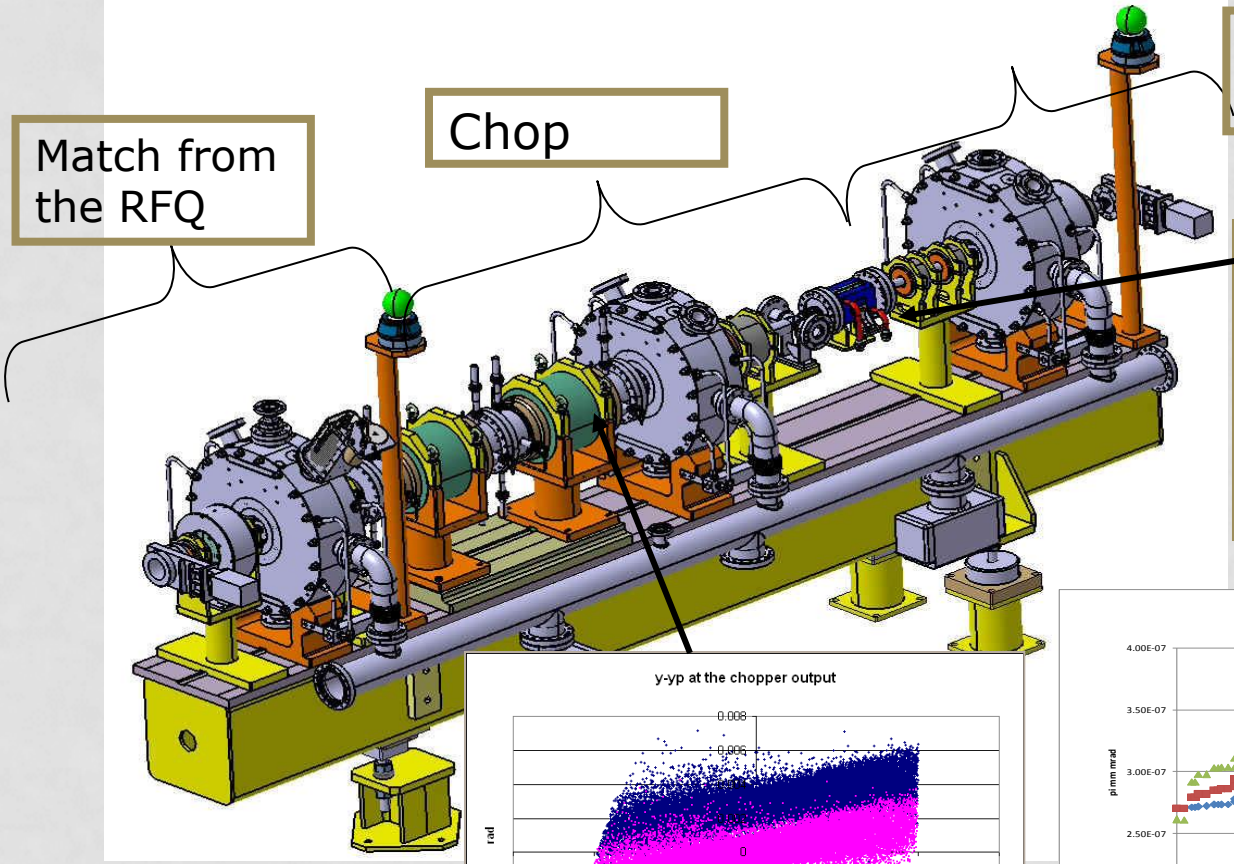


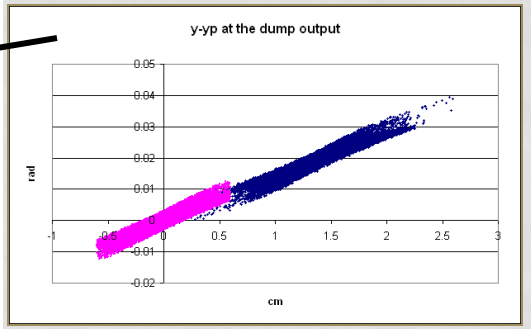
Expected : 21 keV
Reconstructed : 22 keV

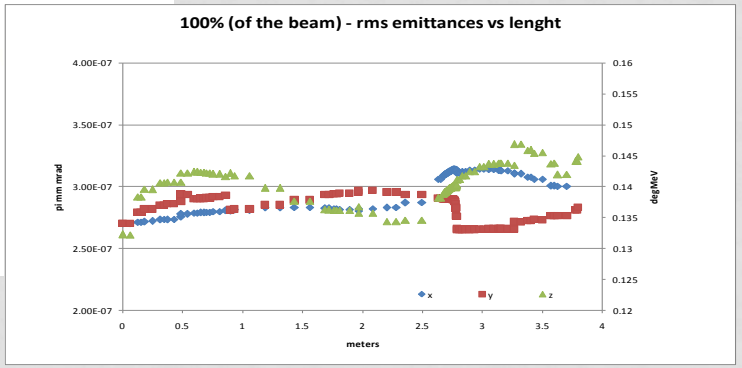
Reconstruction technique and diagnostic performance were validated !

"CHOPPING"

REMOVING MICROBUNCHES (150/352) TO ADAPT THE 352MHZ LINAC BUNCHES TO THE 1 MHZ BOOSTER FREQUENCY

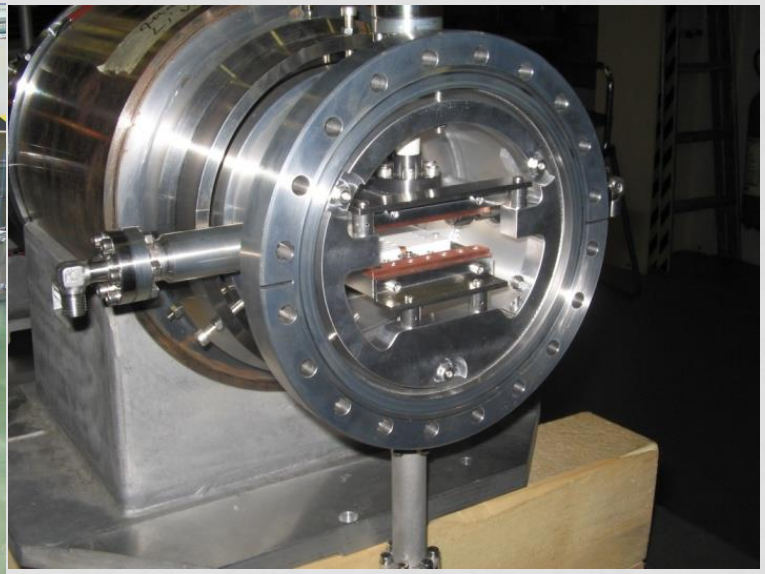


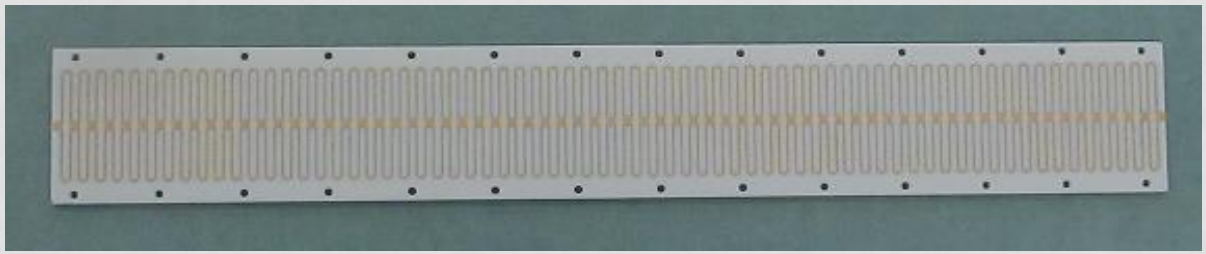


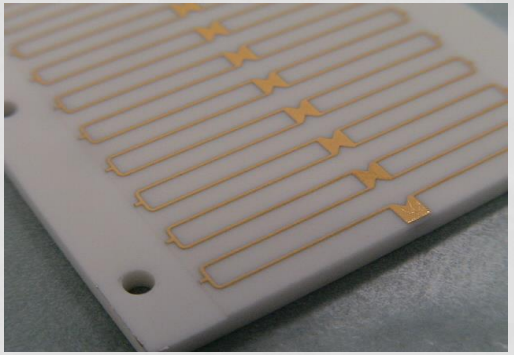


Emittance increase 20-30%

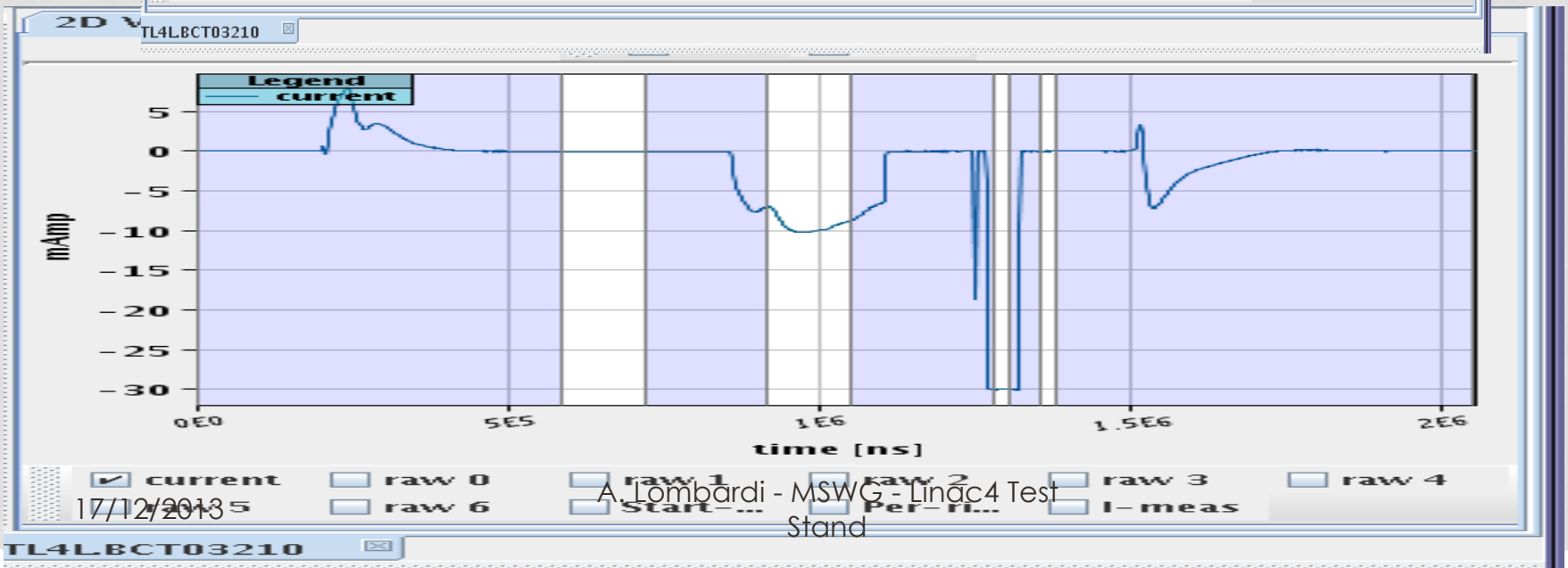
CHOPPER LINE



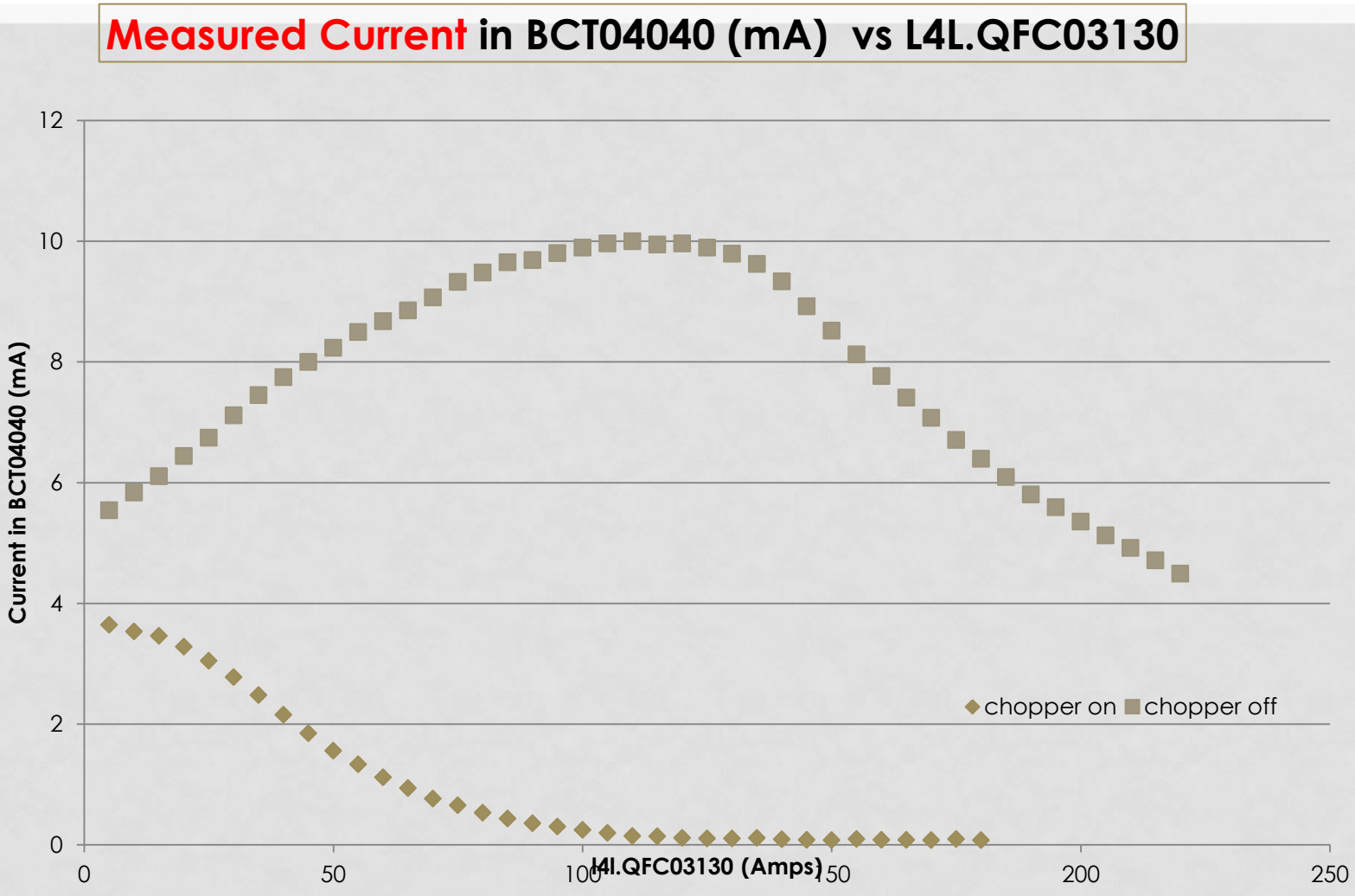




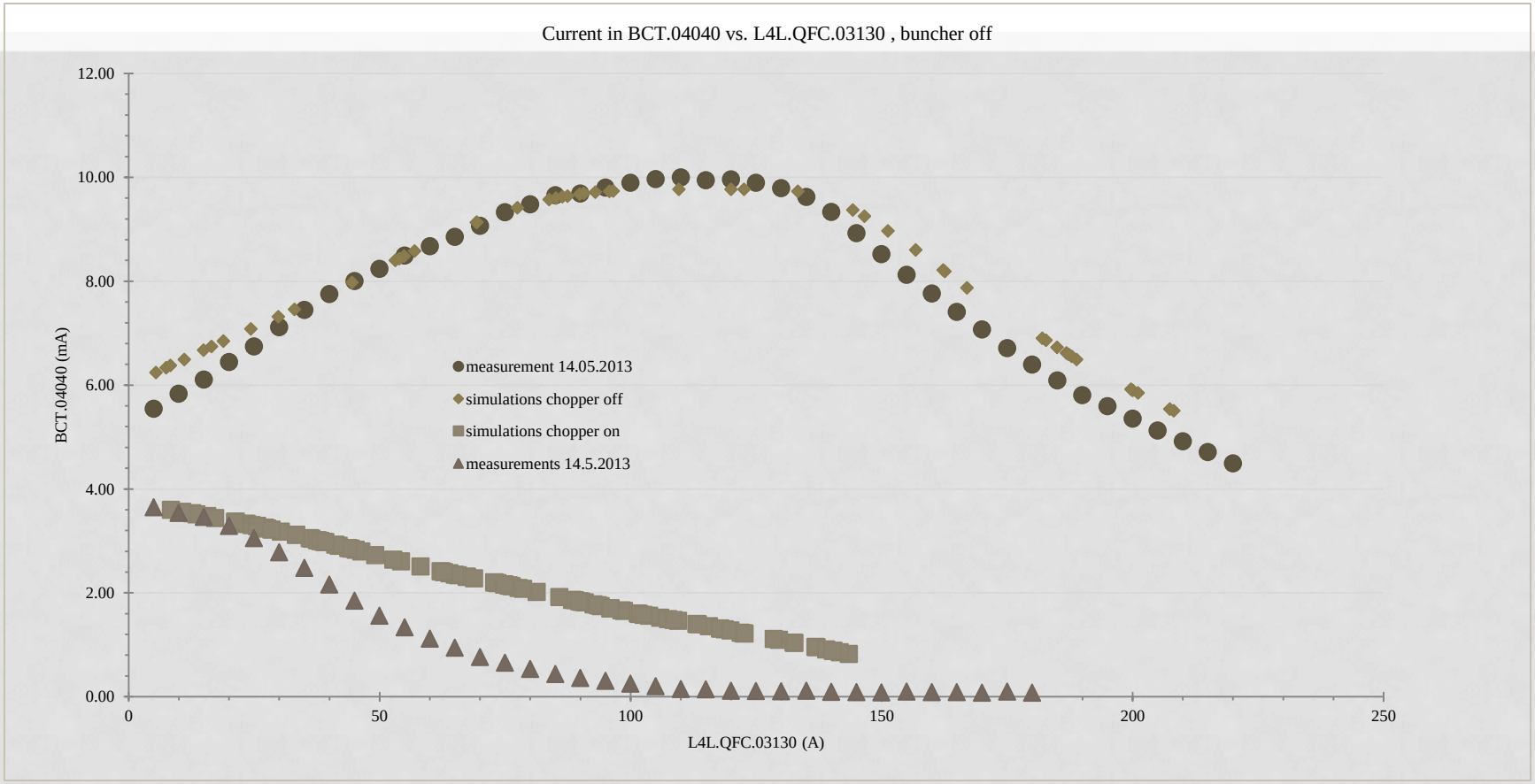
CHOPPER ON/OFF



CHOPPER ON/CHOPPER OFF



COMPARING WITH SIMULATIONS



Suspect : chopper voltage is higher than we think/beam distribution is very Gaussian

JUST LUCKY OR…?

- The beam commissioning was very swift because of a strong collaboration between mechanics, RF and beam dynamics during the manufacturing phase AND a thorough work of simulations and measurements on the LEBT

- We have developed a tool to generate a particle beam distribution FROM MEASURED data. We find that the simulations with a computer generated beam with the same rms emittance doesn't represent the measurements as well.

- Indirect measurements (transverse emittance via wire scanner; longitudinal via Bunch Shape Monitor) are sufficiently accurate, provided we use as input the measured beam at 45keV. SOMEWHERE A SLIT AND GRID EMITTANCE MEASUREMENT IS NEEDED!