Impedance measurements at SLS

E. Koukovini-Platia
CERN, EPFL

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M. Dehler, N. Milas, A. Streun

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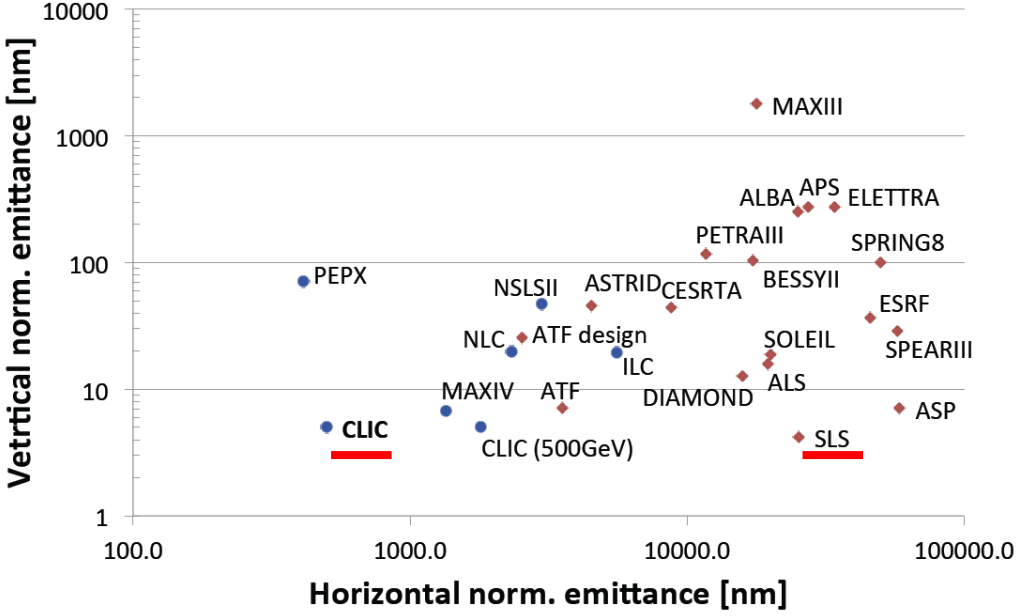
Y. Papaphilippou

CLIC DR/ SLS parameters

Parameters	CLIC@3TeV
Energy [GeV]	2.86
Circumference [m]	427.5
Energy loss/turn [MeV]	4.0
RF voltage [MV]	5.1
Stationary phase [°]	51
Momentum compaction factor	1.3e-4
Damping time x/s [ms]	2/1
Number of dipoles/wigglers	100/52
Dipole/wiggler field [T]	1.0/2.5
Bend gradient [1/m^2]	-1.1
Bunch population [10^9]	4.1
Horizontal normalized emittance [nm.rad]	456
Vertical normalized emittance [nm.rad]	4.8
Bunch length [mm]	1.8



SLS Parameter	Value
Energy [GeV]	2.411
Circumference [m]	288
Energy loss/turn [MeV]	0.54
RF voltage [MV]	2.1
Mom. Comp. factor	$6.05e^{-4}$
Damping times h/v/l [ms]	8.59/8.55/4.26
Hor. emittance [nm rad]	5.6
Vert. emittance [pm rad]	0.9
Bunch length [mm]	3.8
Energy spread [%]	0.086

- CLIC damping rings target ultra-low emittance in all 3 dimensions for relatively high bunch charge
- SLS: Vertical emittance reduced to a minimum value of **0.9±0.4pm** (CLIC damping rings target vertical emittance) which is a **new world record**
- **SLS ideal for beam dynamics measurements**

Collaboration and Measurements at SLS

- 30 of April → 1st visit at SLS, discussion on possible measurements and shifts

Measurements that were suggested:

- Beam transfer function measurement (in all planes)

- 1st shift: 15th of May

1st shift: Beam Transfer Function Measurement (I)

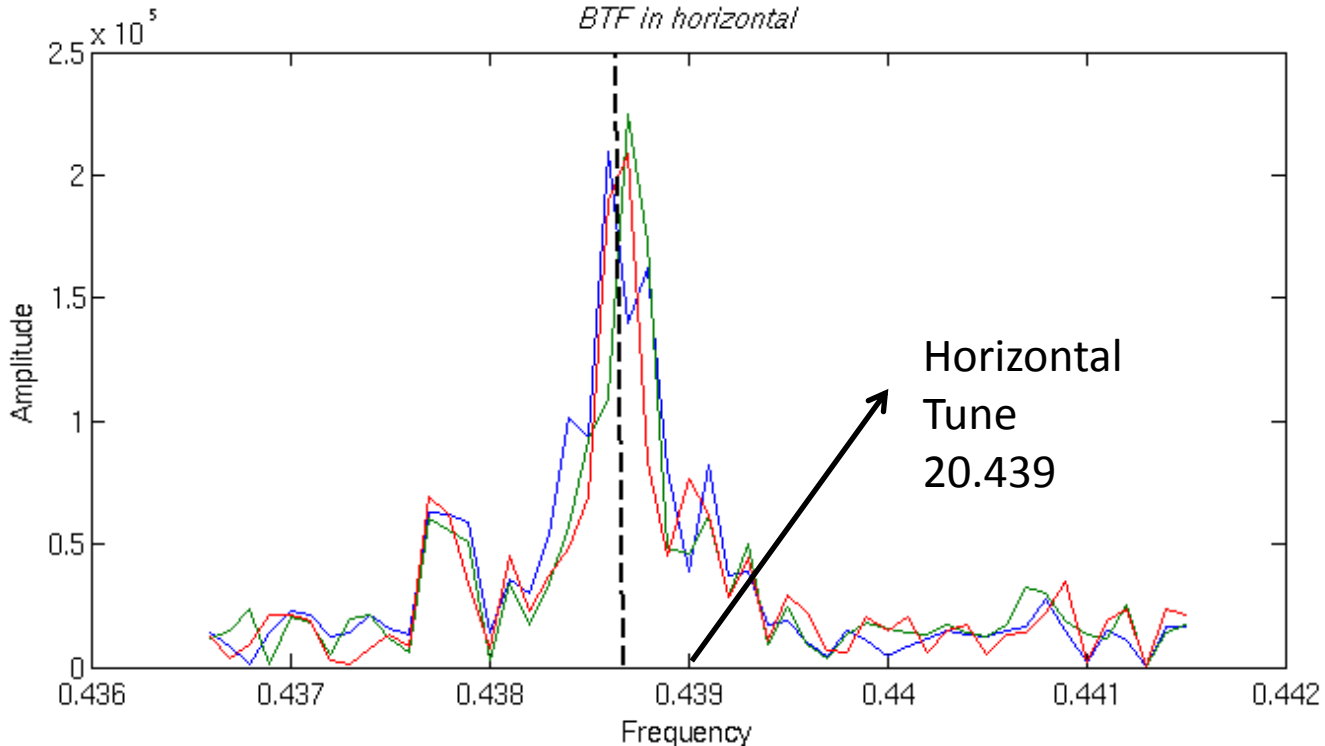
- **15/5/12→ 1st shift**
- Beam of 480 bunches with a current of 50 mA
- Tunes Qx, Qy, Qs : 20.439, 8.737, 0.00545
- High positive chromaticity: 5
- Excite the beam with a sinusoidal signal generated (signal generator whose parameters can be varied remotely)
- The signal generator is connected to an amplifier and a read-out device
- Observe the response of the beam
- Post process analysis

- Over certain number of turns, do a FFT and obtain the amplitude vs frequency/ mode number (of the Coupled Bunch Mode (CBM))
- Horizontal, vertical & longitudinal plane measurements
- **Goal → Test the diagnostics, scripts to collect the data, noise level etc**

1st shift: Beam Transfer Function Measurement (II)

Horizontal plane

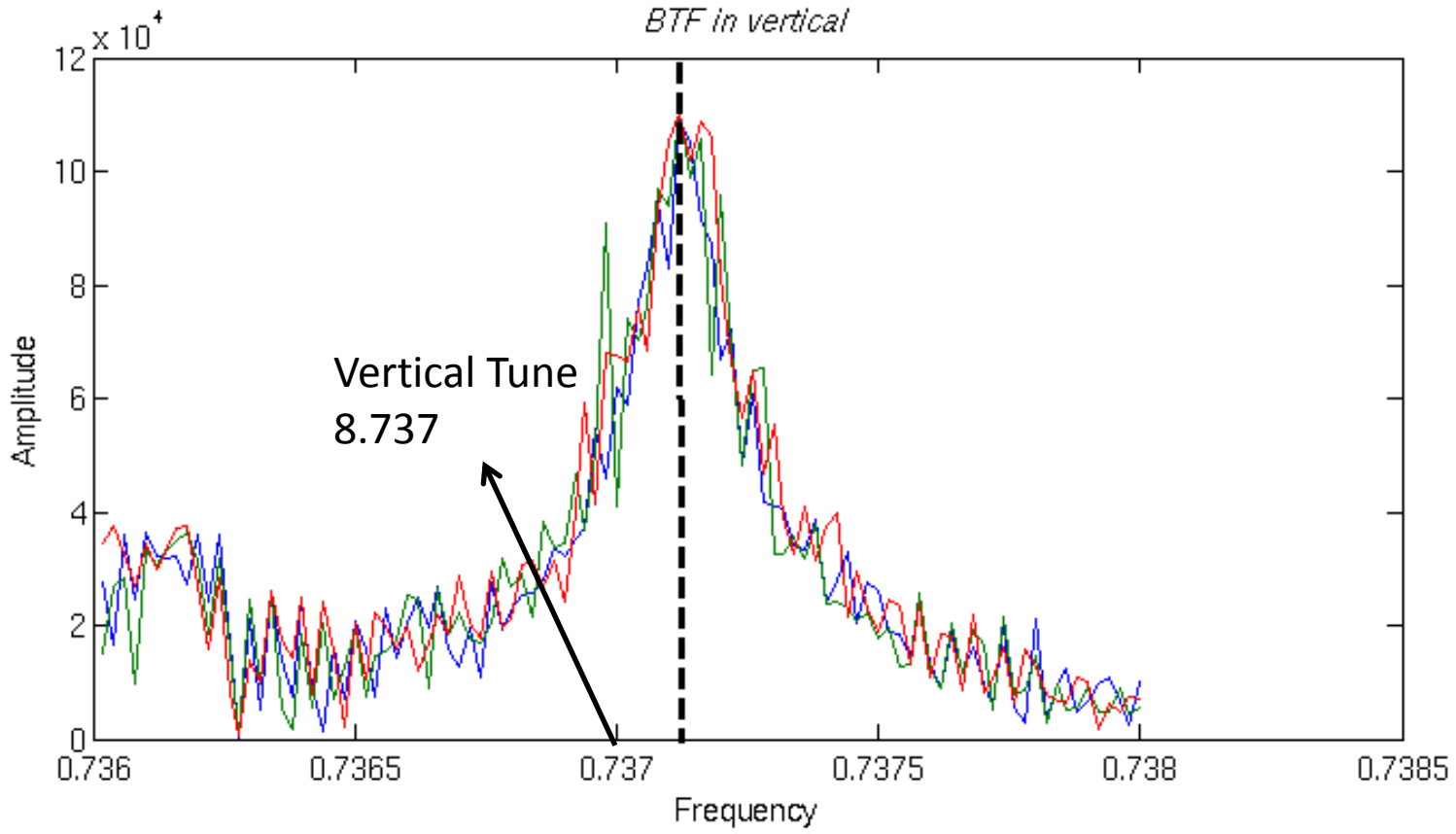
- Excite the beam (with a horizontal kicker) with a signal from the generator
- Scan over the tune resonance (.439)
- 500 turns data→ FFT → amplitude vs frequency
- 500 turns data→ FFT → amplitude vs mode number of the CBM → invalid measurements (?accuracy of the frequency set)



1st shift: Beam Transfer Function Measurement (III)

Vertical plane

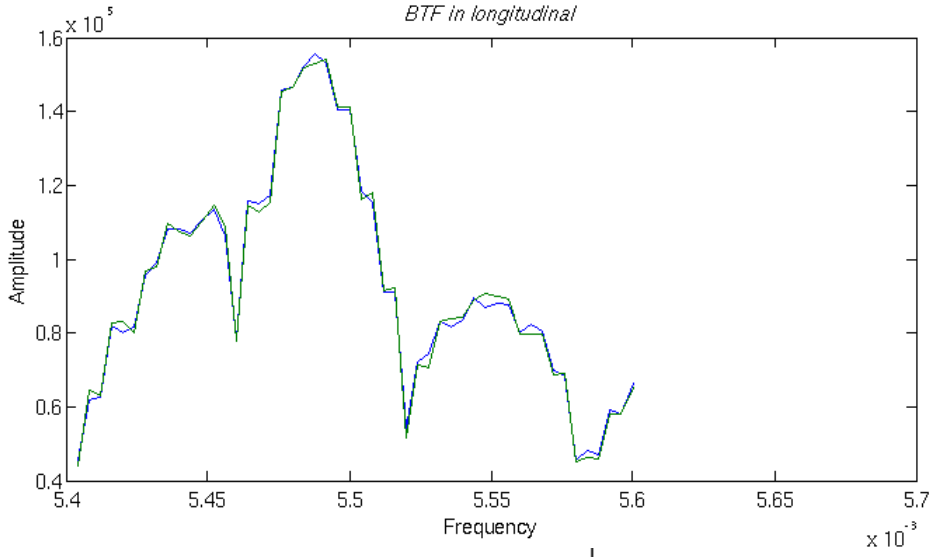
- Open the scraper (3mm radius) → 9mm
- Excite the beam (with a vertical kicker)
- Scan over the tune resonance (.737)
- 500 turns data→ FFT → amplitude vs frequency

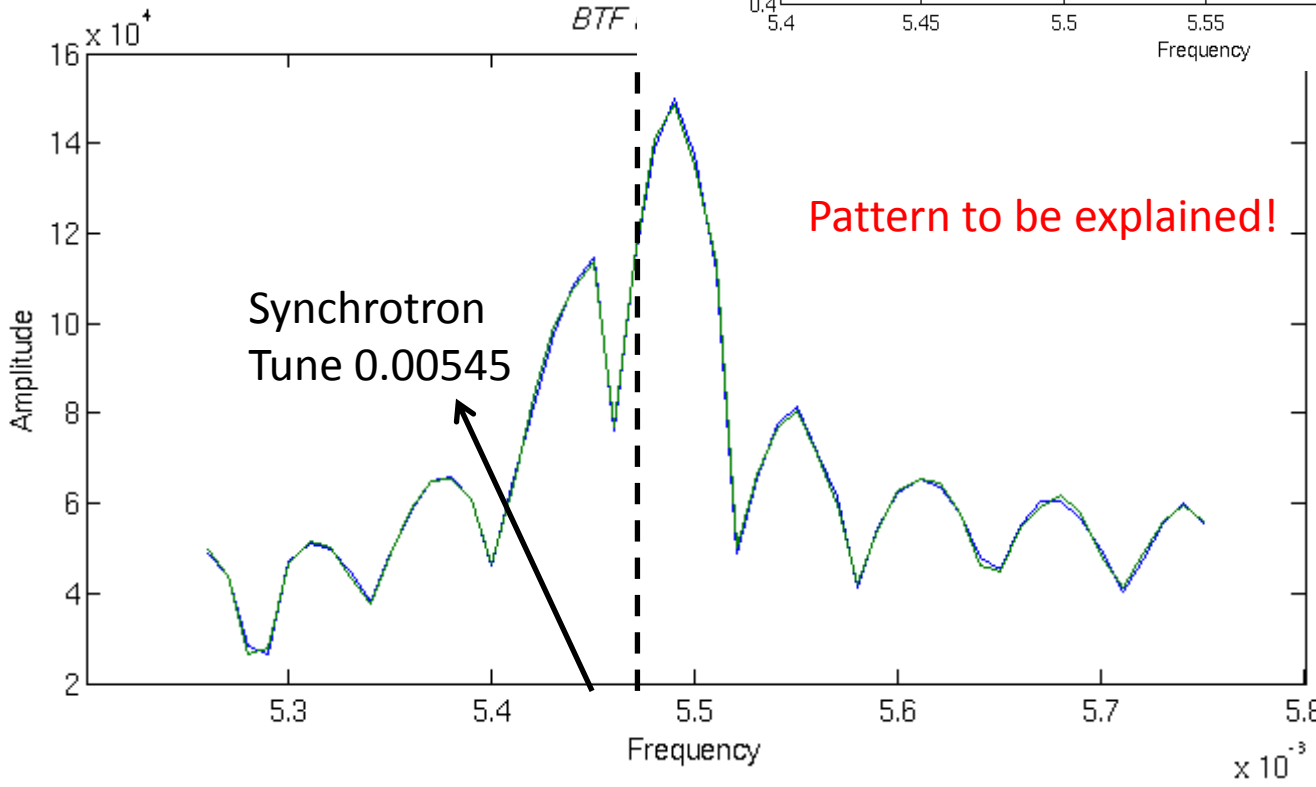


1st shift: Beam Transfer Function Measurement (IV)

Longitudinal plane

- Excite the beam (with a longituc
- Scan over the tune resonance (
- 500 turns data→ FFT → amplitu
- 500 turns data→ FFT → amplitu measurements (?accuracy of the





1st shift: Beam Transfer Function Measurement (V)

First conclusions

- Measure the resonances
- Data to be further analyzed and explain the features in the plots obtained by the measurements
- To be solved → signal generator and the frequency setting in order to do correct CBM measurements!

➢ Next shift → resolve these matters & RF cavity tuning

Future planning

Measurements suggested:

- BTF for each bunch (longitudinal) →effects of 3rd harmonic, BB impedance
- Tune shift over intensity for single bunch in the transverse plane (vertical) (to begin with). Max current 400mA (Natalia Milas has done this in the past but the desired results were not obtained)
- Movable scraper, tapered, which could be used to see the effect in the impedance → need to calculate the impedance of the scraper
- Measure tune shift with intensity of a bunch placed after a long train, changing also the distance of this bunch from the train (and or the length of the train), and compare that with the results from single bunch
- Impedance- IBS measurements (F.Antoniou, N. Milas, A. Streun)

➢Later shifts beginning of July (to be confirmed)

➢Plan several shifts till September

Thank you for your attention!