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Linear Coupling Measurement and comparison with MAD8

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Contents:

- Linear Coupling through TBT Fourier analysis
- Comparison with MAD8

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Plan:

- measure linear coupling
- compensate it
- measure chromaticity
- improve chromaticity corrections

The B38 application for measuring the Booster tunes from TBT data has been improved by introducing

- *phased sum* for determining beam tunes
- *two ramps* analysis for identifying peaks.

Two sets of measurement are performed, by kicking the beam horizontally and vertically. In each plane the tune is determined by analyzing the signal in the plane of kick.

After analyzing 5 data sets taken by Meghan on October 12 and 18 (all bunches pinged), some BPMs have been excluded from the present analysis because the oscillation amplitude was 2 σ away from average on the first 12 ms (the interval of interest)

	#occurencies
B:HST13L	3.5
B:HST21L	5.5
B:VST03L	2.7
B:VST19L	3.7

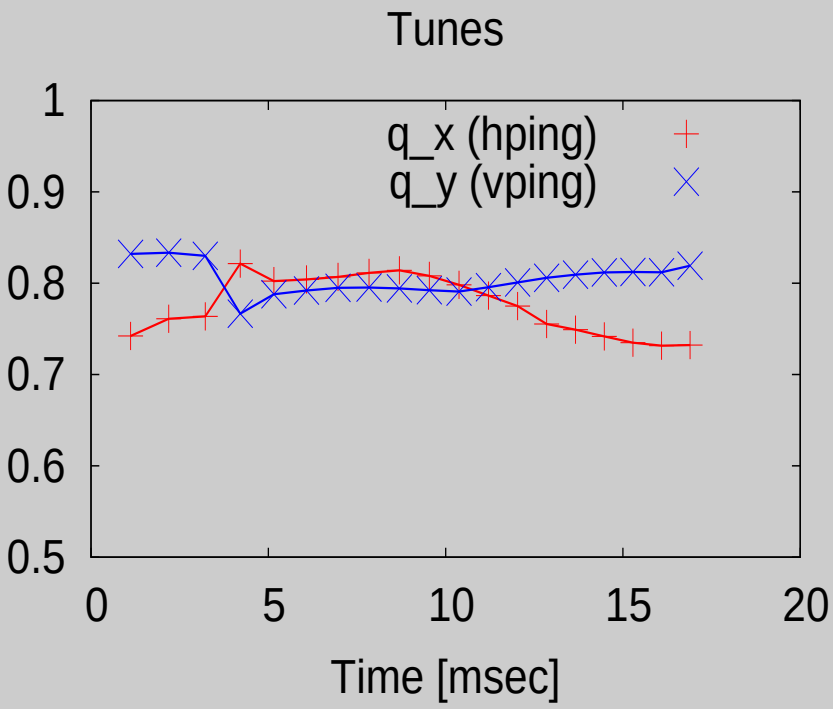
Tunes were fairly stable over the BPMs.

In some data sets there are still timing problems. For instance in the October 18 data from 17:00 BPMs from B:ST12L to B:ST23S show a timing problem starting at about 16 ms consistent with a turn shift of $+2$ units.

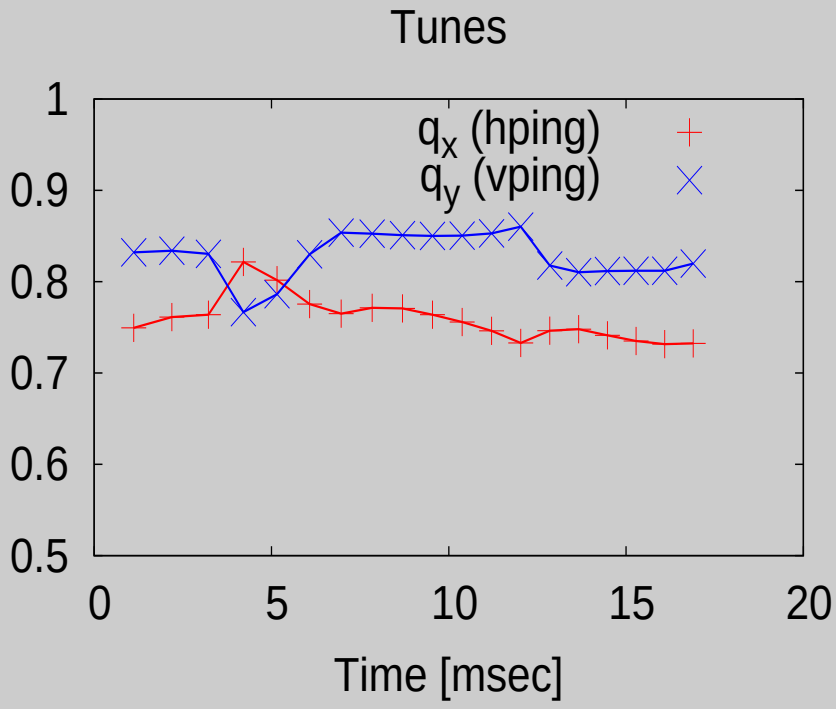
Data sets used in this (off-line) analysis (November 2, 2011)

- TBT_initialCouplingHorzTune1.txt (reference, tunes moved apart)
  TBT_initialCouplingVertTune1.txt
- TBT_initialCouplingHorzTune1SQLP1.txt (SQL: $\mathbf{\Delta}$=+1A)
  TBT_initialCouplingVertTune1SQLP1.txt
- TBT_initialCouplingHorzTune1SQSP1.txt (SQS: $\mathbf{\Delta}$=+1A)
  TBT_initialCouplingVertTune1SQSP1.txt

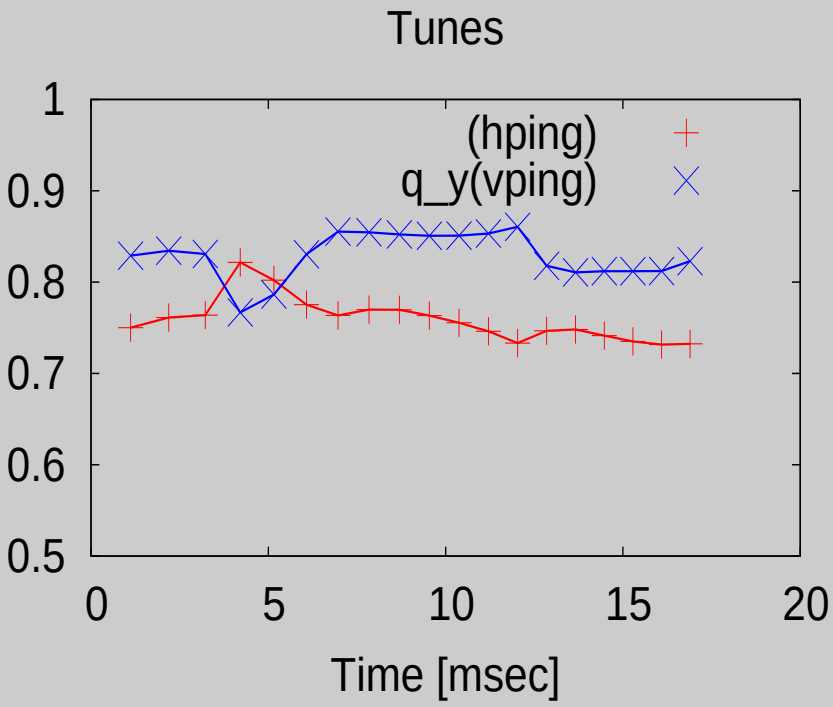
All bunches were pinged.



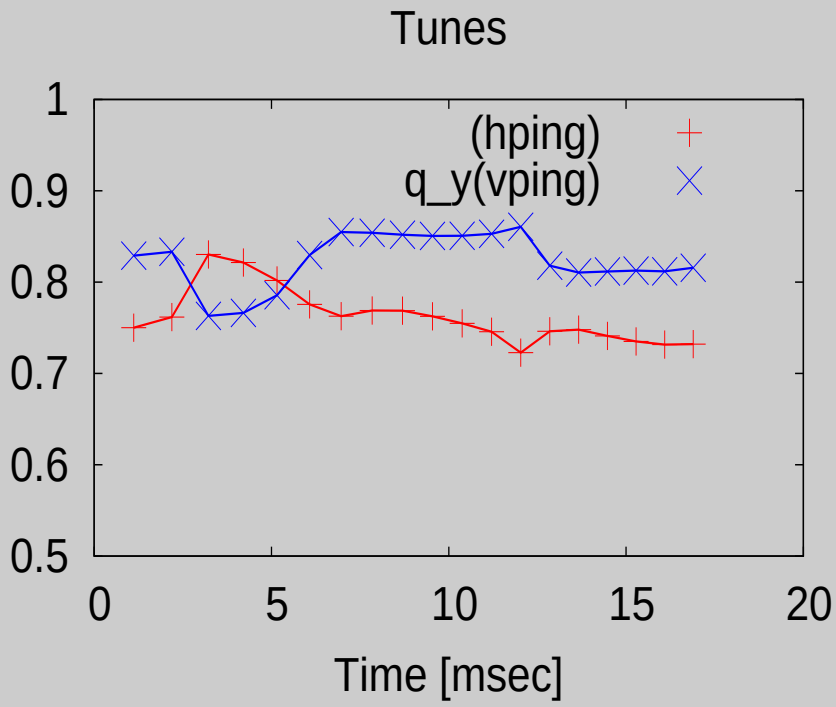
Starting tunes



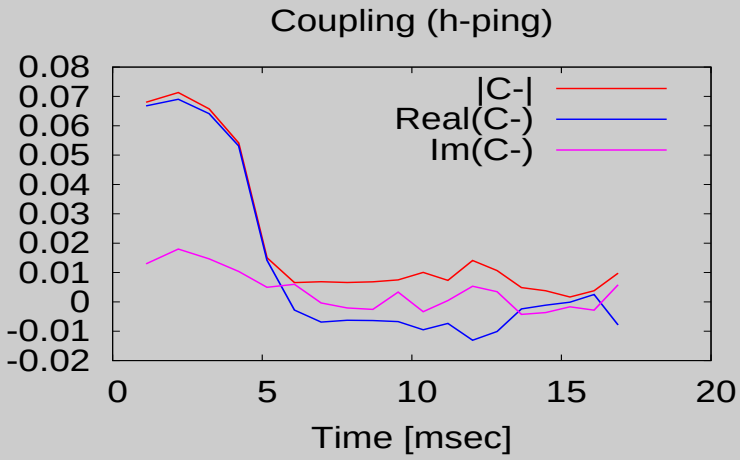
Separated tunes (from 6 ms to 12.8 ms)



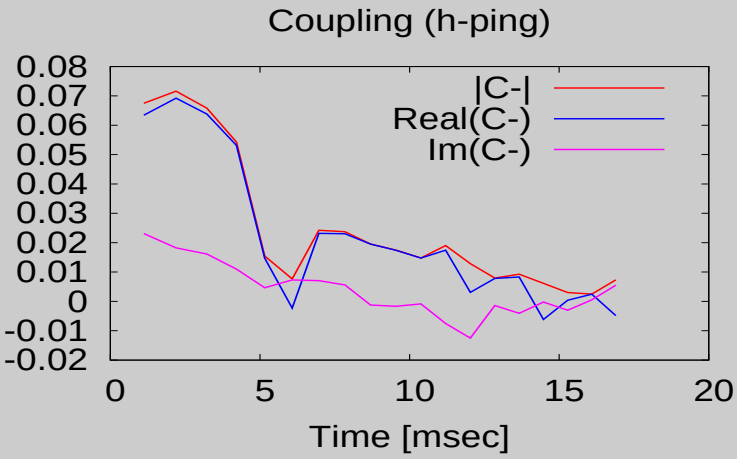
SQL: $\Delta I = +1$ A



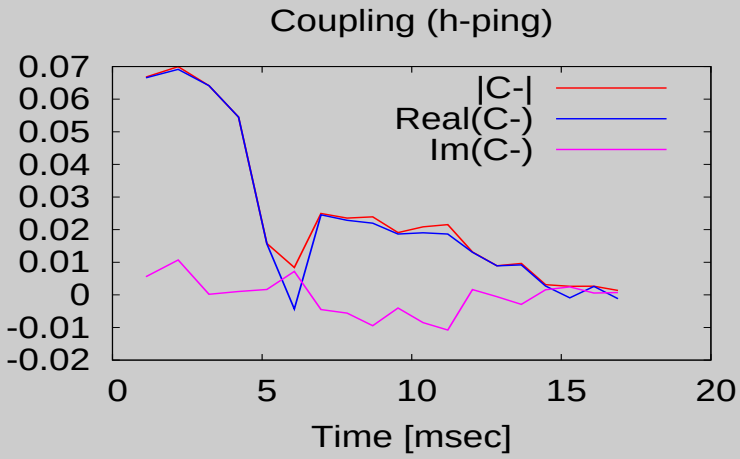
SQS: $\Delta I = +1$ A



Start



SQL: ΔI=+1 A



SQS: ΔI=+1 A

On the basis of the empirical calibration, Yuri has evaluated the circuit currents needed for decoupling the first 6 ms of the ramp

t (ms)	dISQL (A)	C- as found	C- residual
1.11255	-1.1903	0.0613084	0.00850857
2.18759	-1.40801	0.0669216	0.00859949
3.2192	-1.47273	0.0628915	0.00846603
4.20623	-1.46635	0.0554386	0.00661723
5.15437	-0.557095	0.0187812	0.00320135
6.07095	0	0.00573813	0.00573813

The MAD8 repository file booster.mad was used for generating 1024 TBT data at the BPMs for E_{kin}=1.1898 GeV ie turn #3507 or t=6.97 ms setting ΔI=+1 A for all long/short straight section skew quadrupoles. The data were analyzed by using the *same* code used for the evaluation of real measurements.

	Re(C-)	Im(C-)
meas.(ref)	-0.0069	-0.0003
meas.(SQSP1)	0.0245	-0.0045
SQSP1-ref	0.0314	-0.0041
simulation	0.0098	-0.0020

	Re(C-)	Im(C-)
meas.(ref)	-0.0069	-0.0003
meas.(SQLP1)	0.0232	0.0071
SQLP1-ref	0.0301	0.0074
simulation	0.0092	0.0008

Unlike previously stated, there a discrepancy between expected and measured effect. This is due to the fact that in the new repository file the skew quadrupole correctors calibration changed: ks=ksquad× I with ksquad=0.004/(0.0075$B\rho$) instead of ksquad=0.008889/(0.0075$B\rho$).

The actual effect is *larger* than expected from simulation...