

Tune measurements through PLL excitation and I/Q Detector in FPGA (and some other TMBF stuff)

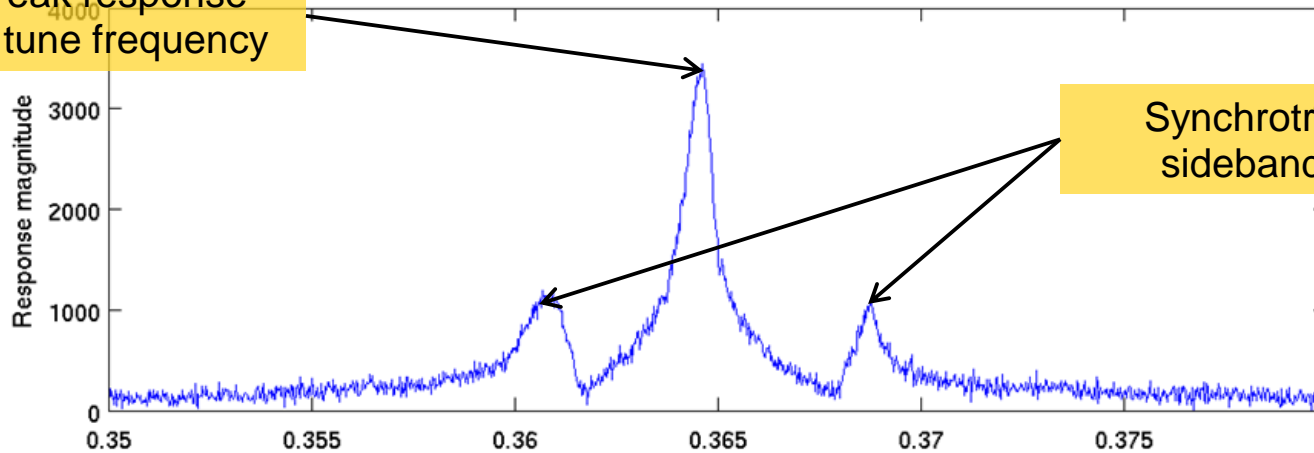
G. Rehm, M. Abbott

DEELS workshop

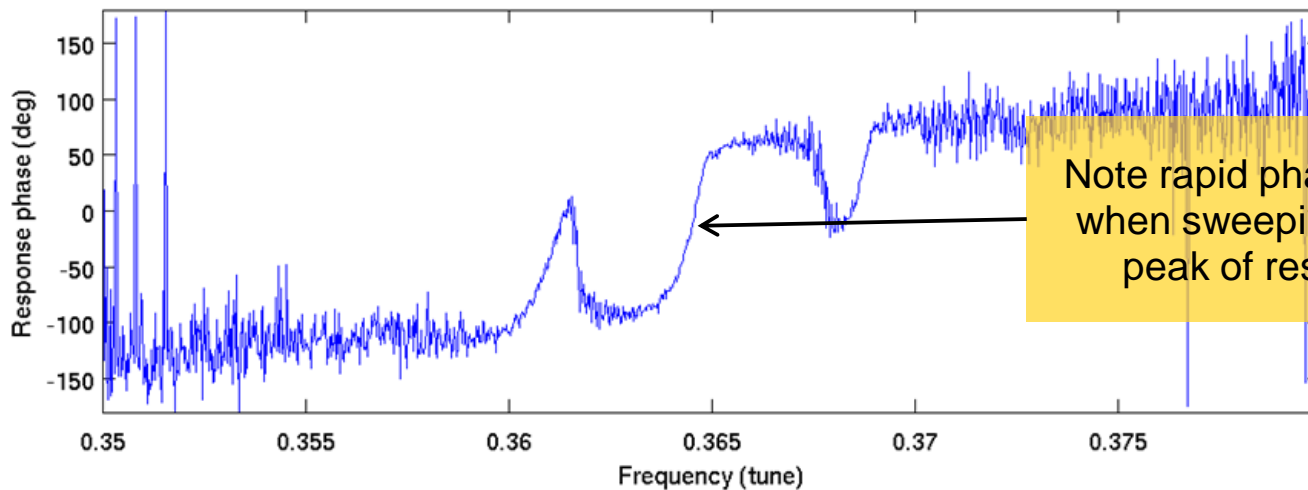
ESRF, 12-13 May 2014



Peak response
at tune frequency



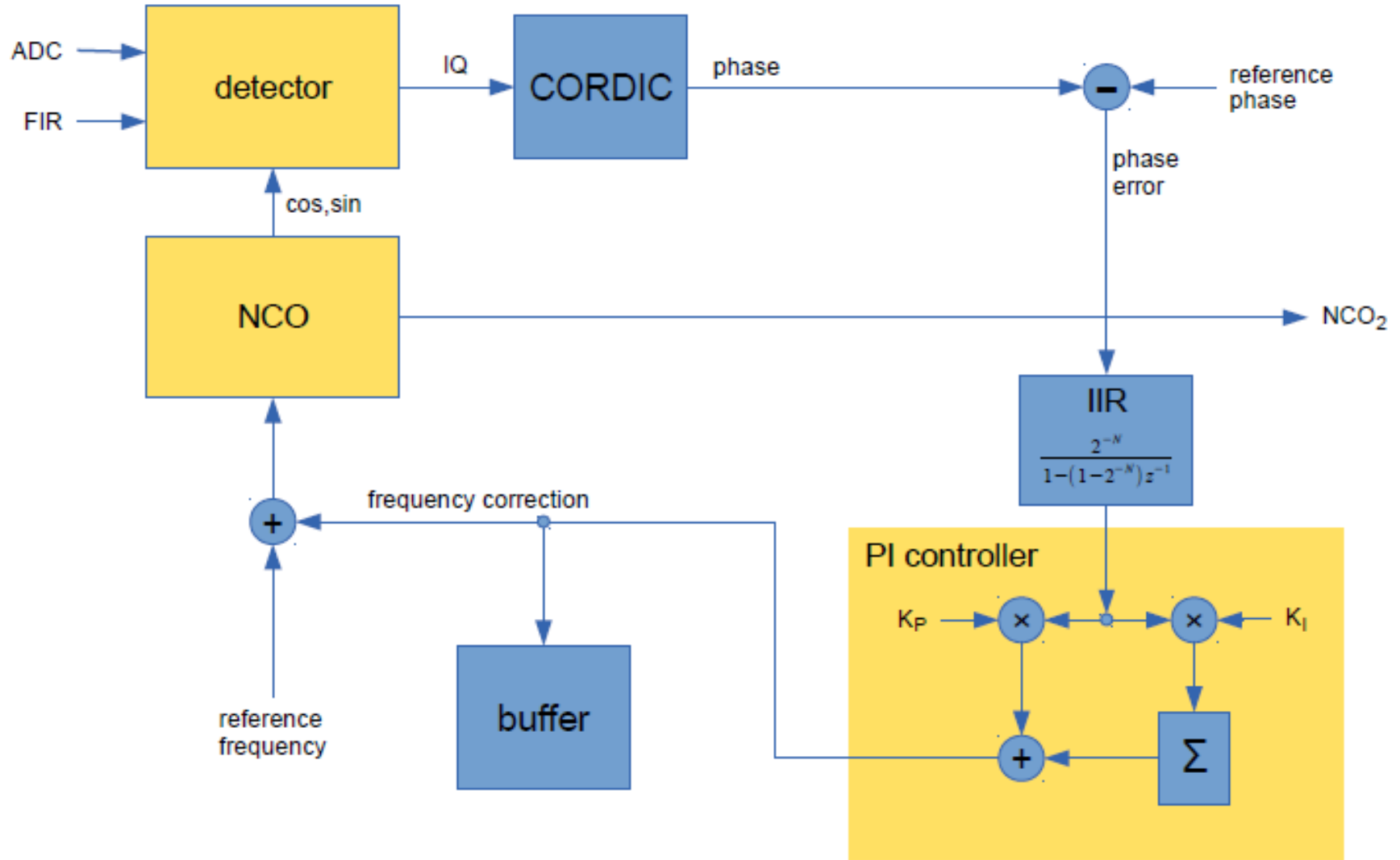
Synchrotron
sidebands



Note rapid phase change
when sweeping through
peak of resonance

- Take advantage of rapid phase change through tune frequency peak
- Measure phase at, eg, 2.6 kHz (every 200 turns)
- Run simple controller to track frequency to keep phase at target value
- Result is high update rate tune measurement
- Can quickly measure tune width by stepping phase through $\pm 45^\circ$

Tune Phase Locked Loop

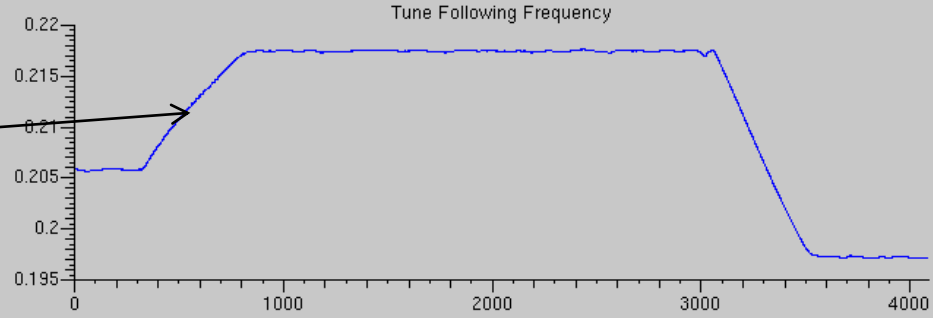


Tune PLL Screen

BBA orbit changes cause changes in tune

?
SR23C-DI-TMBF-01 Tune Following

Tune Following Frequency



Tune Select

Dwell time: <input type="text" value="200"/>	Integral: <input type="text" value="200"/>
Bunch: <input type="text" value="800"/>	Proportional: <input type="text" value="5000"/>
Bunch mode: <input type="checkbox"/> Single Bunch	Mag. limit: <input type="text" value="0"/>
Input: <input type="checkbox"/> FIR	Offset limit: <input type="text" value="0.025000"/>
Det Gain: <input type="checkbox"/> -24dB	Target: <input type="text" value="0.0"/>
Blanking: <input type="checkbox"/> Blanking	IIR decay: <input type="checkbox"/> 2 ²
Run status: Running	1.3 ms
<input type="button" value="Start"/> <input type="button" value="Stop"/>	

Status

- Data lost detection
- FIR input overflow
- Detector accumulator overflow
- Detector output overflow
- Signal magnitude too small
- Frequency shift too large
- Current status
- Reason for stopping

Readbacks

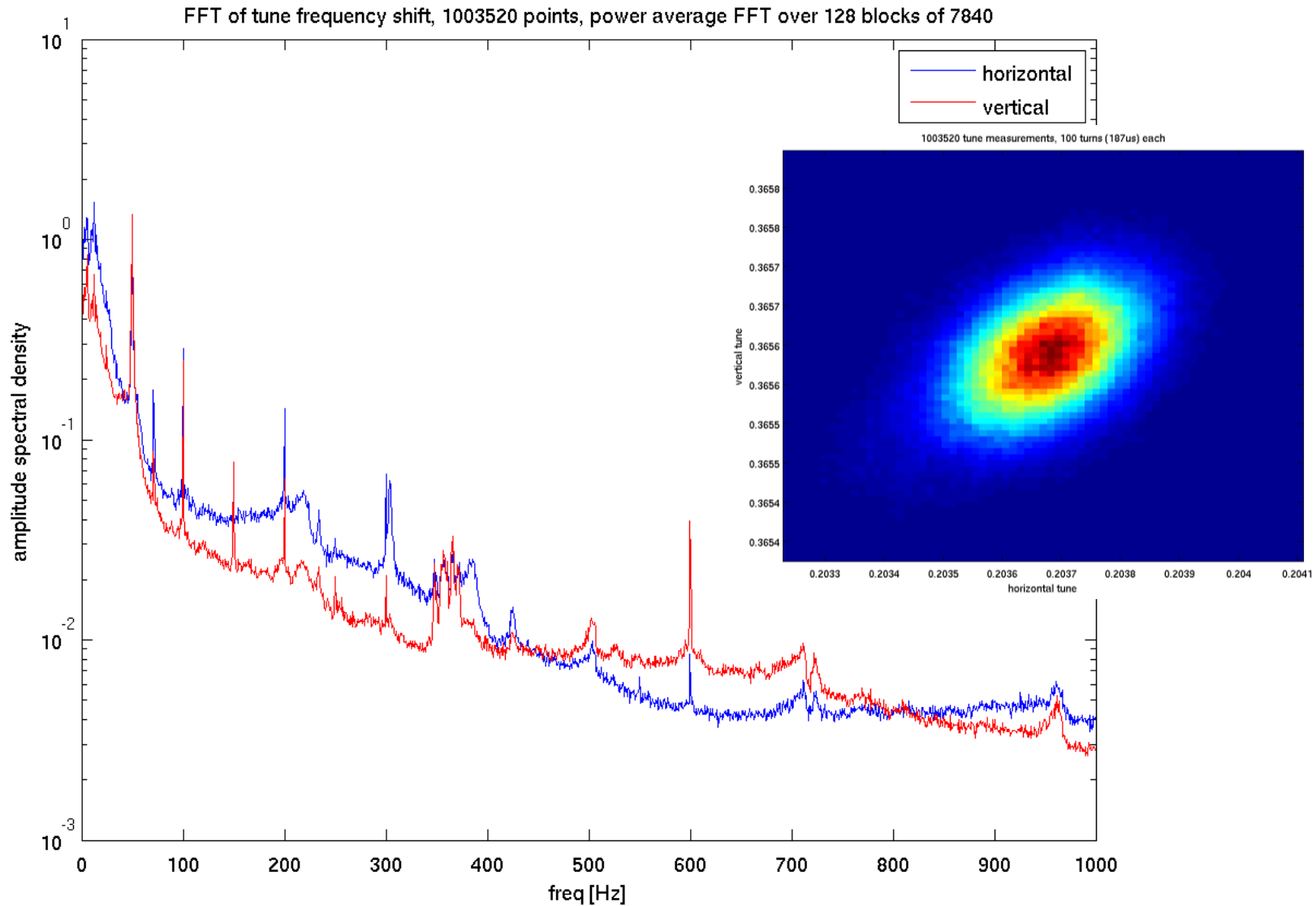
	Current	Min	Max	Variation	Filter rate
Angle:	-1.406				
Angle delta:	-1.406	I: -306	-239	-129	0.549
Magnitude:	355	Q: 181	39	200	383.5 ms

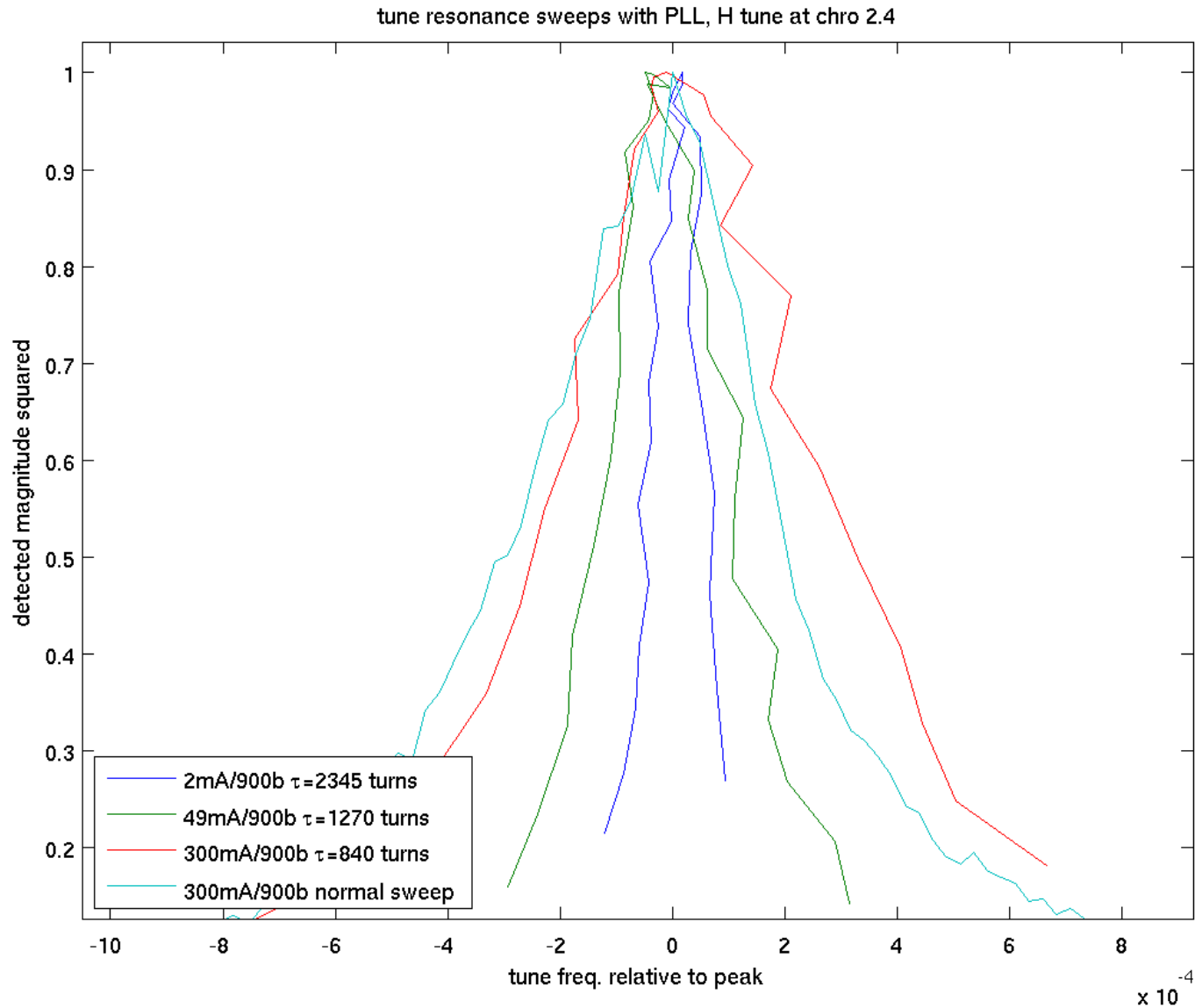
NCO

NCO freq: <input type="text" value="0.20900"/>	<input type="text" value="0.204211"/>	<input type="checkbox"/> 2 ¹⁰
NCO gain: <input type="checkbox"/> -24dB	<input type="text" value="0.21191"/>	<input type="text" value="383.5 ms"/>

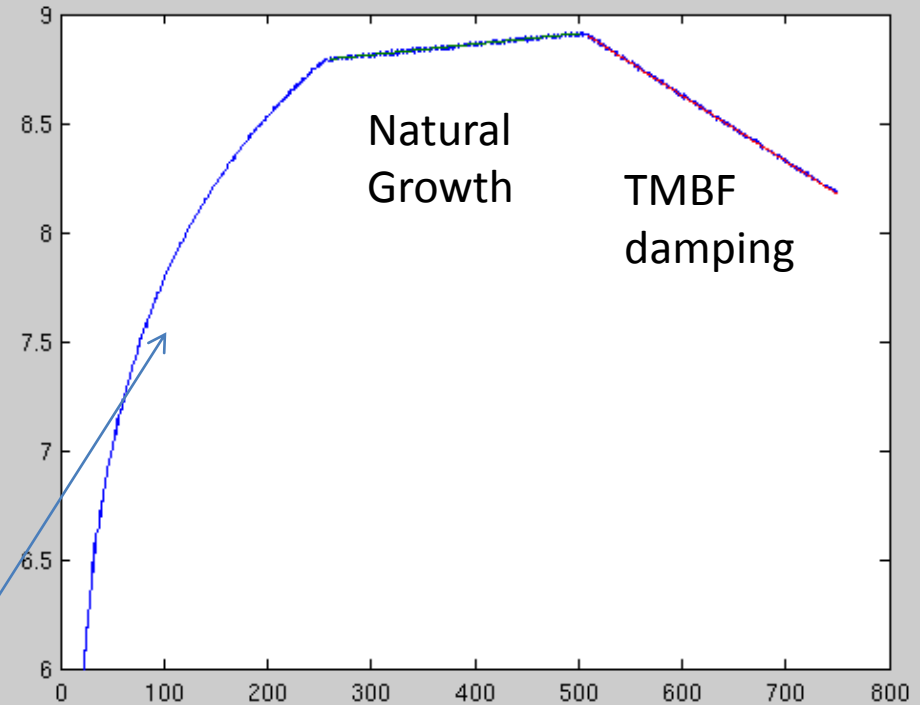
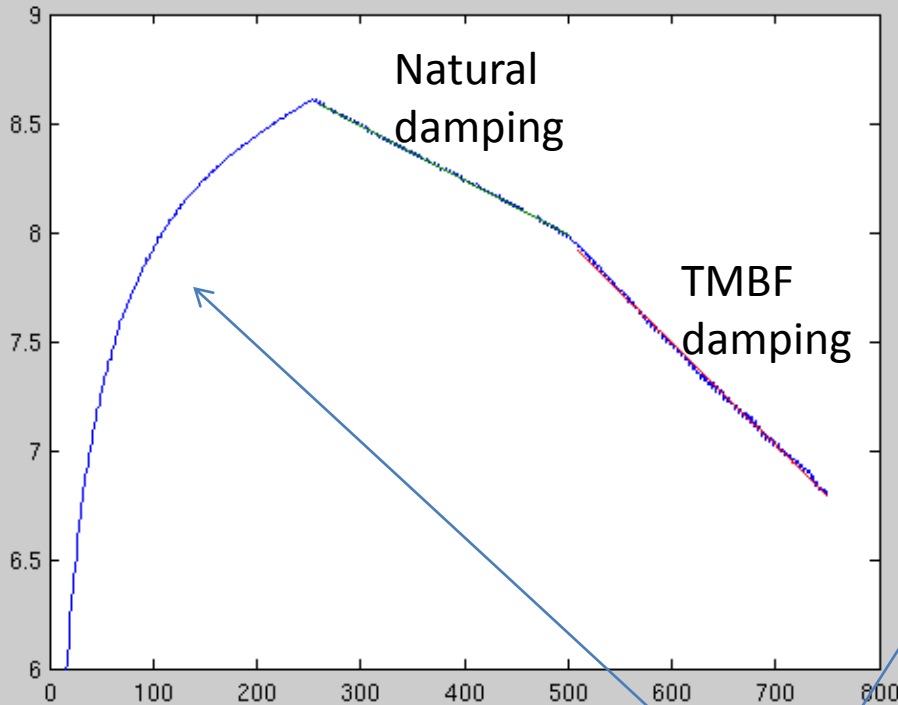
Delay Correction

Phase offset: <input type="text" value="150.80"/>
Loop delay: <input type="text" value="1.0"/>

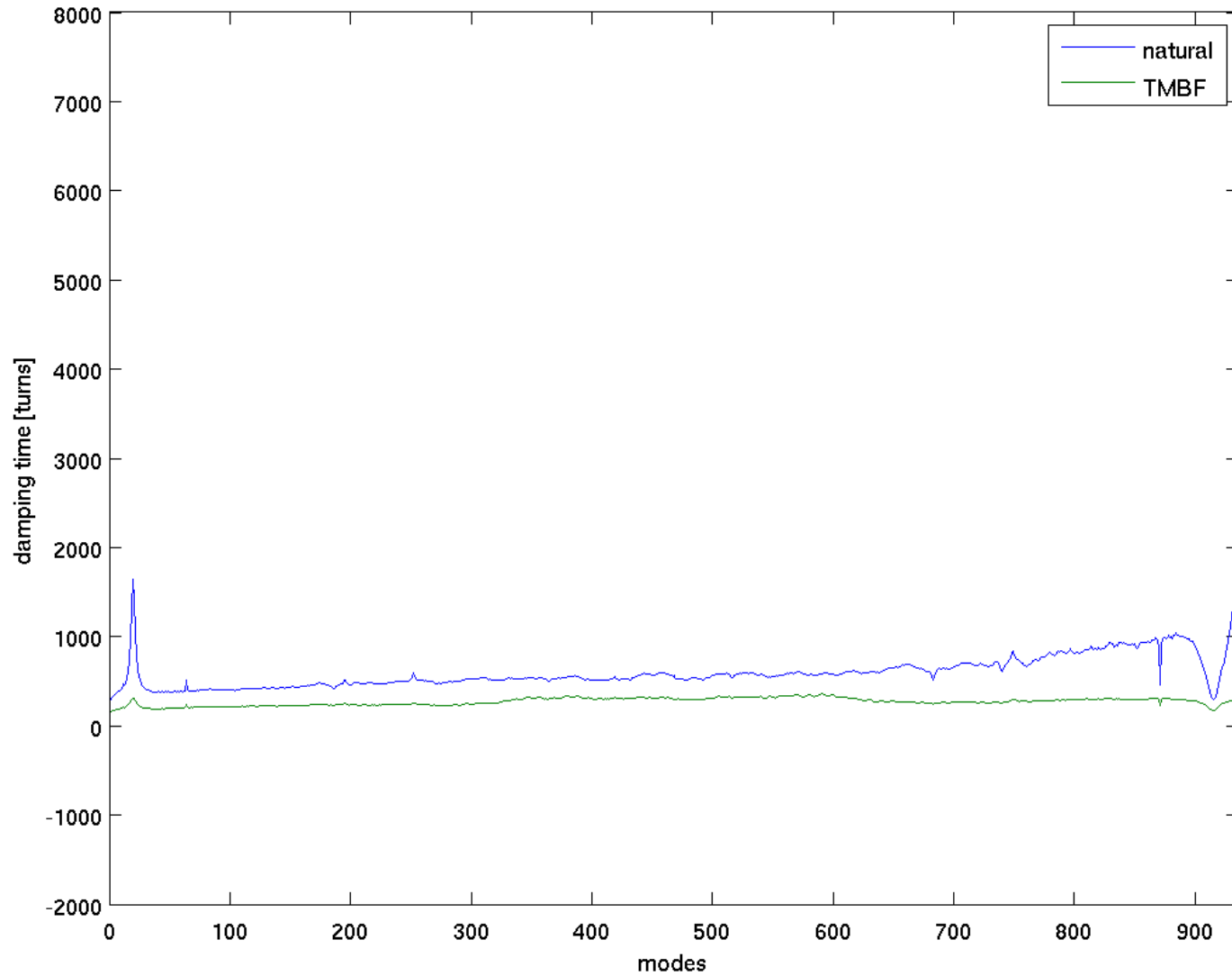


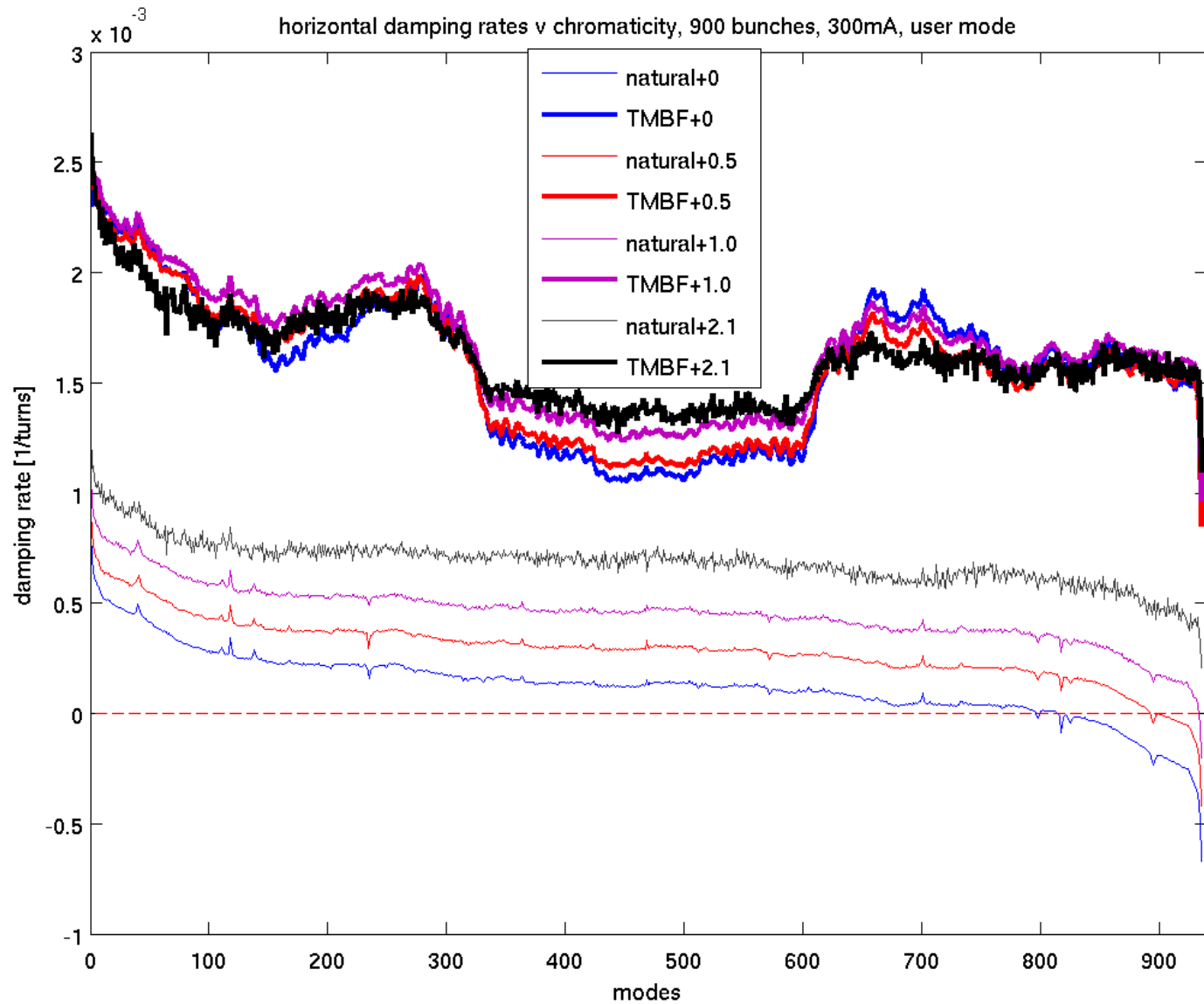


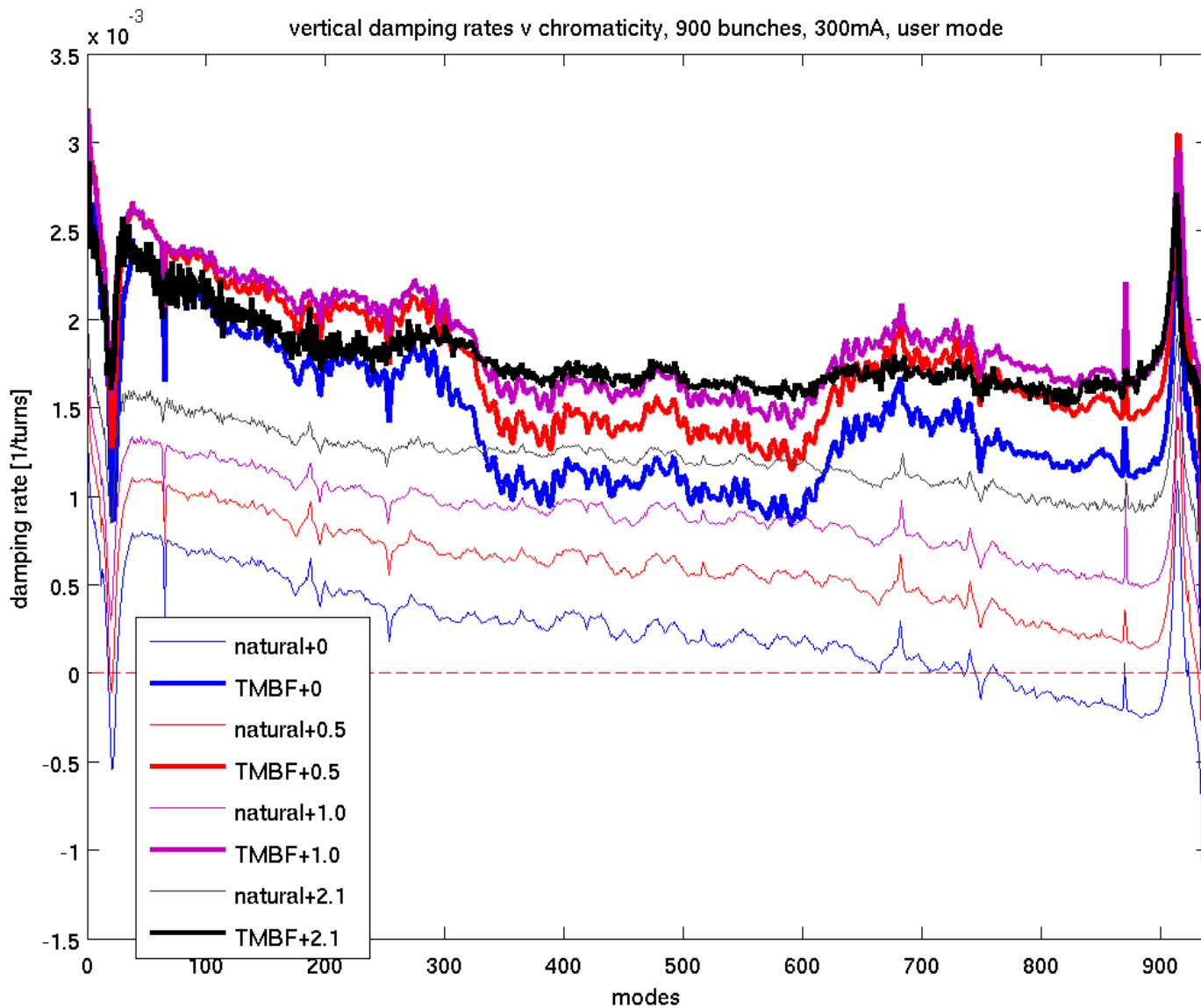
- We use the sequencer to
 - Start with damped beam (TMBF on)
 - Excite one mode at $f=f_{\text{rev}}*(n+q)$
 - Switch excitation off, but leave damping off, record mode amplitude turn by turn
 - Switch damping back on, record damping rate, record mode amplitude turn by turn
- Download short waveform of amplitudes over turns (a few 100 points), fit straight lines to $\log(\text{amplitude})$, slopes are damping rates
- Scan through all 936 modes (takes 5 minutes)

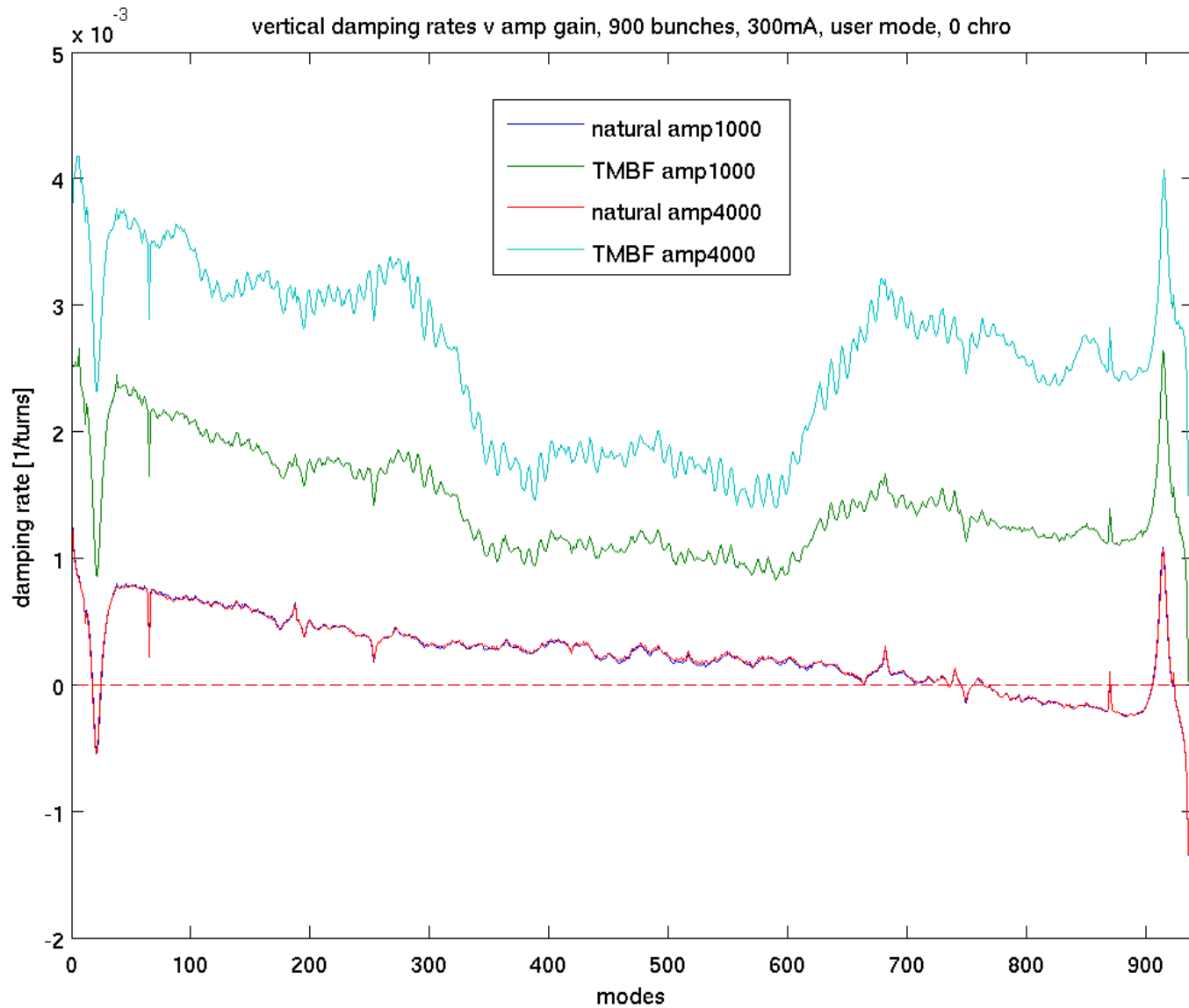


Excitation









- Where do these tune movements originate from?
How stable are tunes elsewhere?
- We can measure multi-bunch tune resonance line widths and mode decay rates, will these give the same information?
- What do all the features in the damping rate scans mean?

