

Libera Integration into Operations and Accelerator Physics at Diamond

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Outline

- The BPM Concentrator
- Beam current and lifetime measurement with Libera
- Phase advance measurement from T-b-T data and CW excitation

The BPM Concentrator

- Manage configuration of 168 BPMs together
- Collect individual data into waveforms, e.g. beam position into orbit
- Determine and set attenuator level
- Keep track of BPM status :
enabled/disabled/unreachable
- Stop FOFB if status changes
- Calculate and distribute beam current calibration factors

Configuration of one / many BPMs

Configure Libera
SR01C-DI-EBPM-01 Configuration

Geometry
 KX: 10.2600 KY: 10.6600
 QD: -0.0297 Diagonal

Origins
 BBA: X: 0.0645 Y: -0.4547
 BCD: 0.0000 0.0000
 Golden: 0.0000 0.0000

FT Channel Gains
 G0: 1.0000 G1: 1.0000
 G2: 1.0000 G3: 1.0000

Mode Enables
 First Turn: Disabled
 Free Run: Enabled
 TT / 64: Disabled
 Mean Sums: Enabled

Current Scale
 Current at 0dBm: 412.7

Interlock
 Enabled adc Y X
 X: -1.0000 1.0000
 Y: -1.0000 1.0000
 Auto on/off: 12.0 8.0
 Ovl detect: Disabled
 Max ADC: 85.0 % = 27853
 ADC Time/IIR: 500 / 0
 Test mode: Normal

Signal Configuration
 Switches: Automatic
 Trigger src: Internal
 DSC: Automatic
 Manual Switch: 3
 Switch delay: 120
 Attenuation: 46 +0
 Trigger delay: 0
 Atten Offset SC Detail

Notch filters: Enabled FA Spikes Clocks EXIT

BPM Configuration
Global EBPM Configuration

Status
 Enabled: 166 Disabled: 2 Unreachable: 0

Unreachable
Disabled
Enabled

Mode Enables
 First Turn: Read Disabled Inconsistent
 Free Run: Read Enabled Ok
 TT / 64: Read Disabled Ok

Origins
Golden Orbit
 X Read Set Point Ok
 Y Read Set Point Inconsistent

Beam Current Dependent
 X Read Set Point Ok
 Y Read Set Point Ok

Expert
 Attenuation: Read 46 Ok
 Switches: Read Automatic Ok
 DSC: Read Automatic Ok
 Detune: Read 400 Ok
 Auto attenuation Down at: 10 % Up at: 75 %

FR Waveforms Beam Current EXIT

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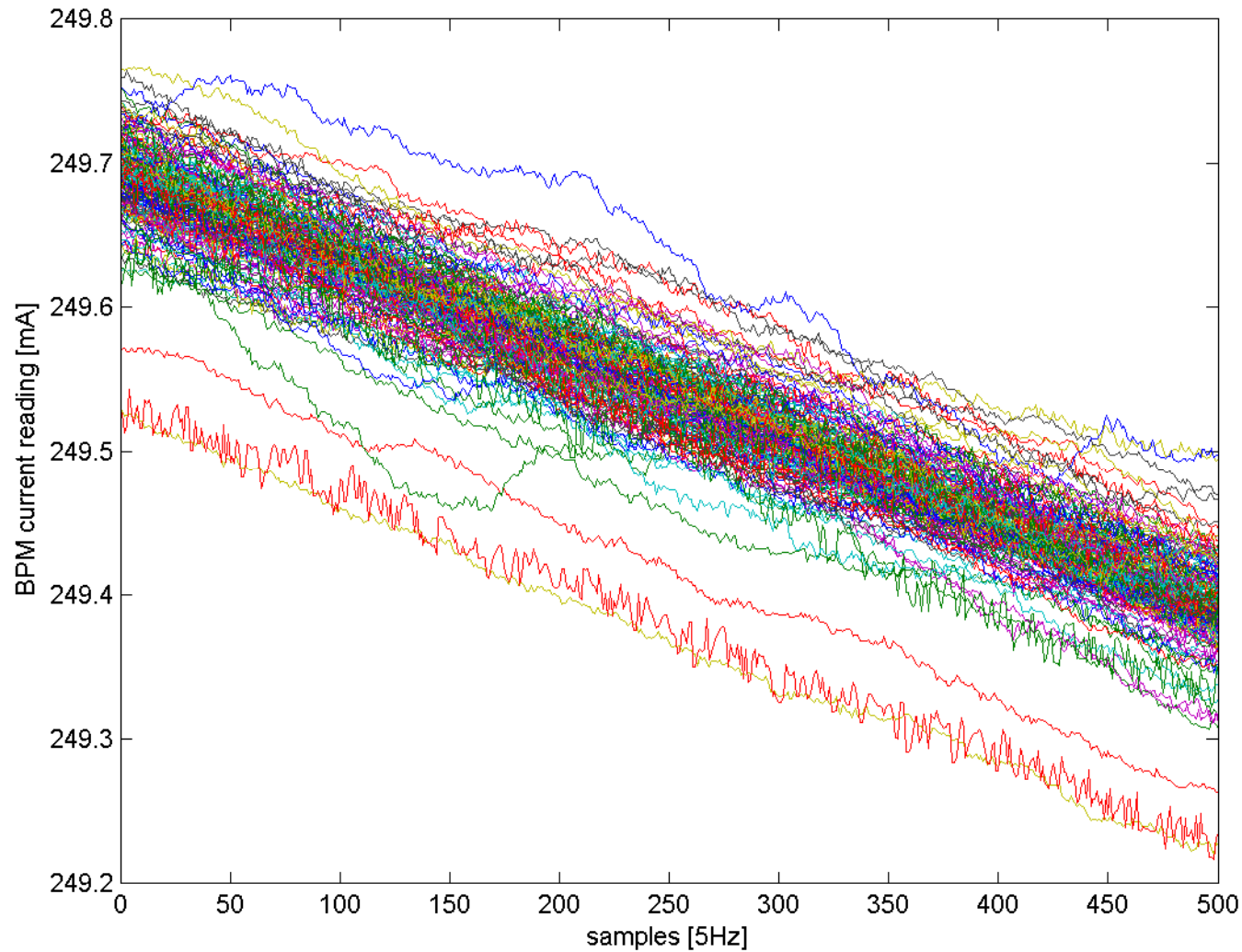
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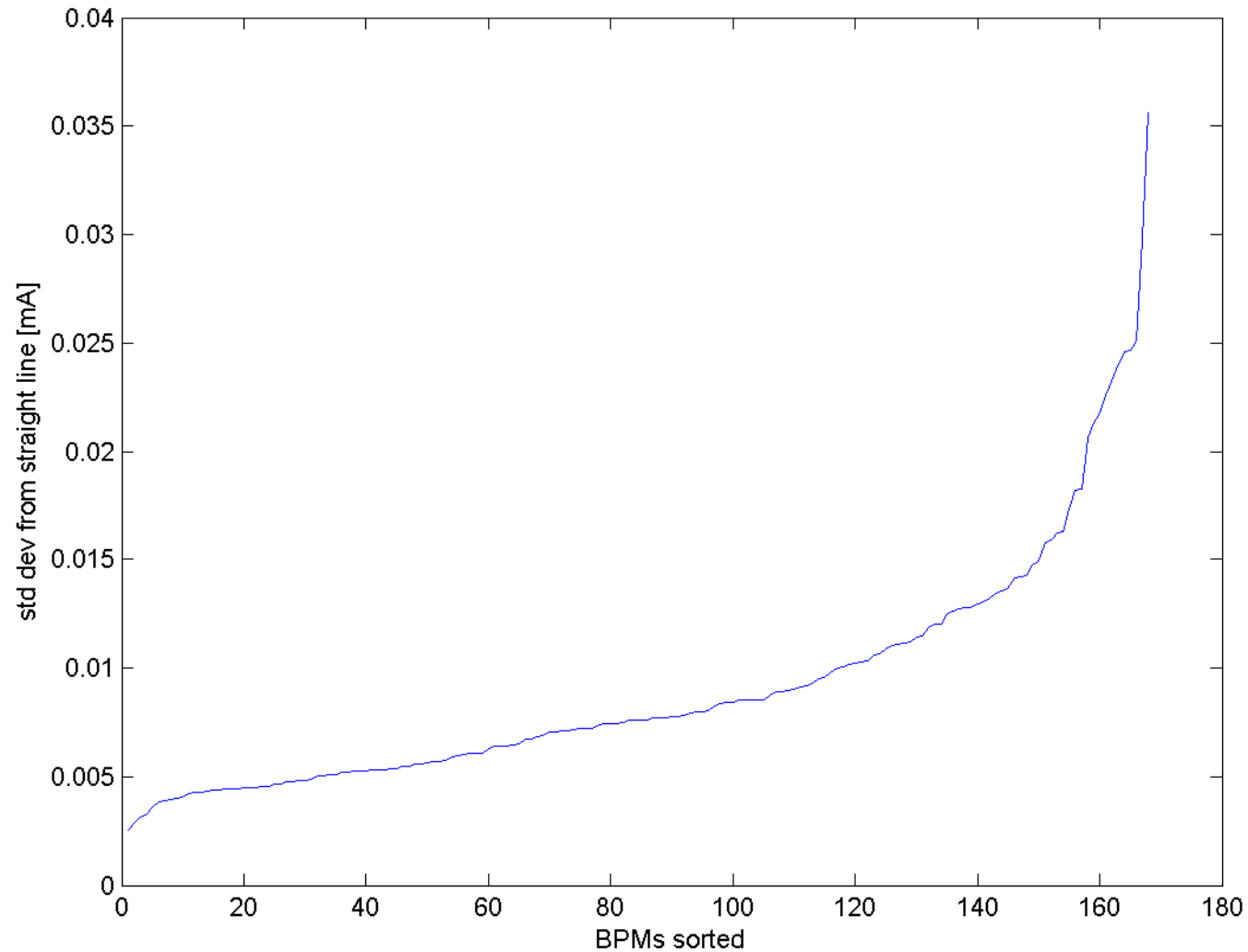
Beam Current from Libera

- Calculate input power from SA sum signal and attenuator setting
- Take into account systematic errors on attenuators
- Then single calibration factor will convert from input power to beam current, needs to be determined from know beam current (DCCT) once.
- All is fine, but then the total gain drifts and a recalibration is required.
- This is now done frequently (every 10s)

Beam Current from 168 BPMs



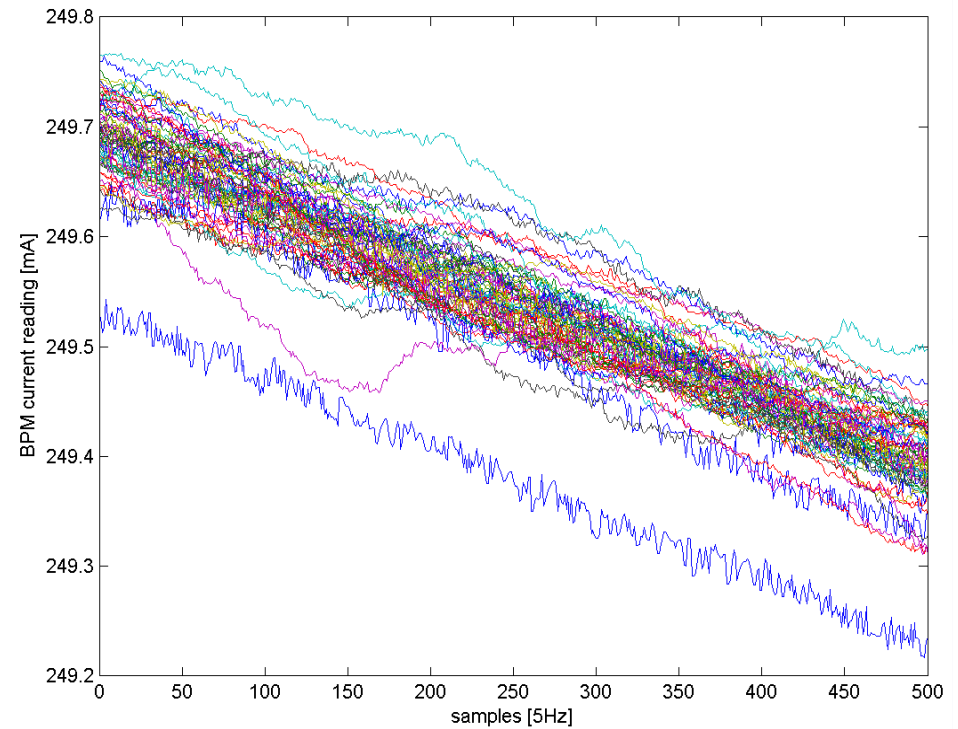
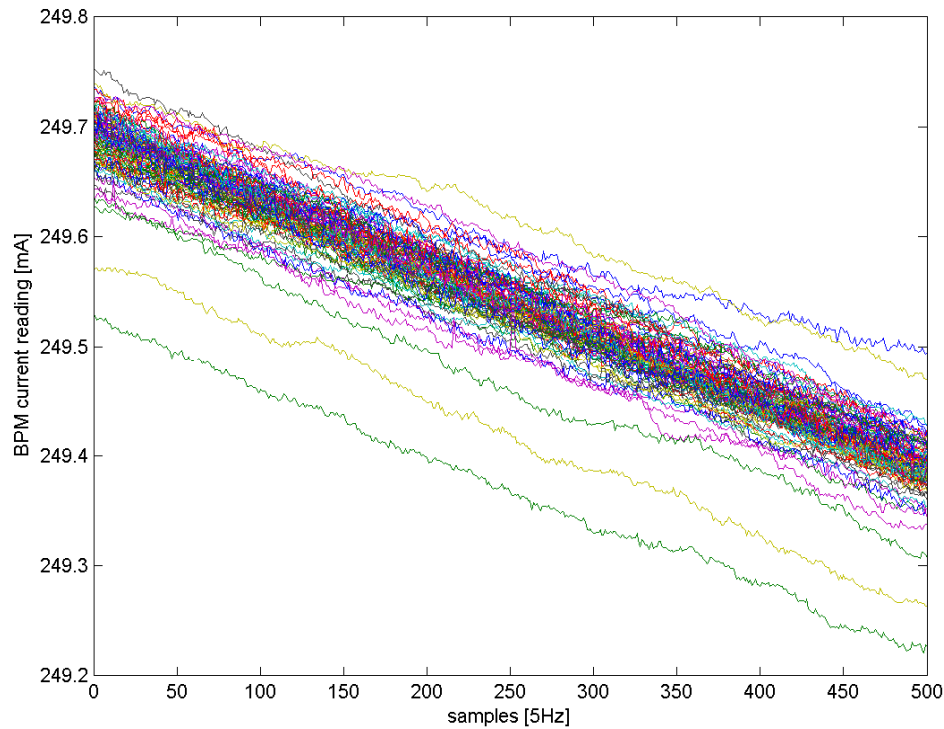
Noise Variations from BPM to BPM



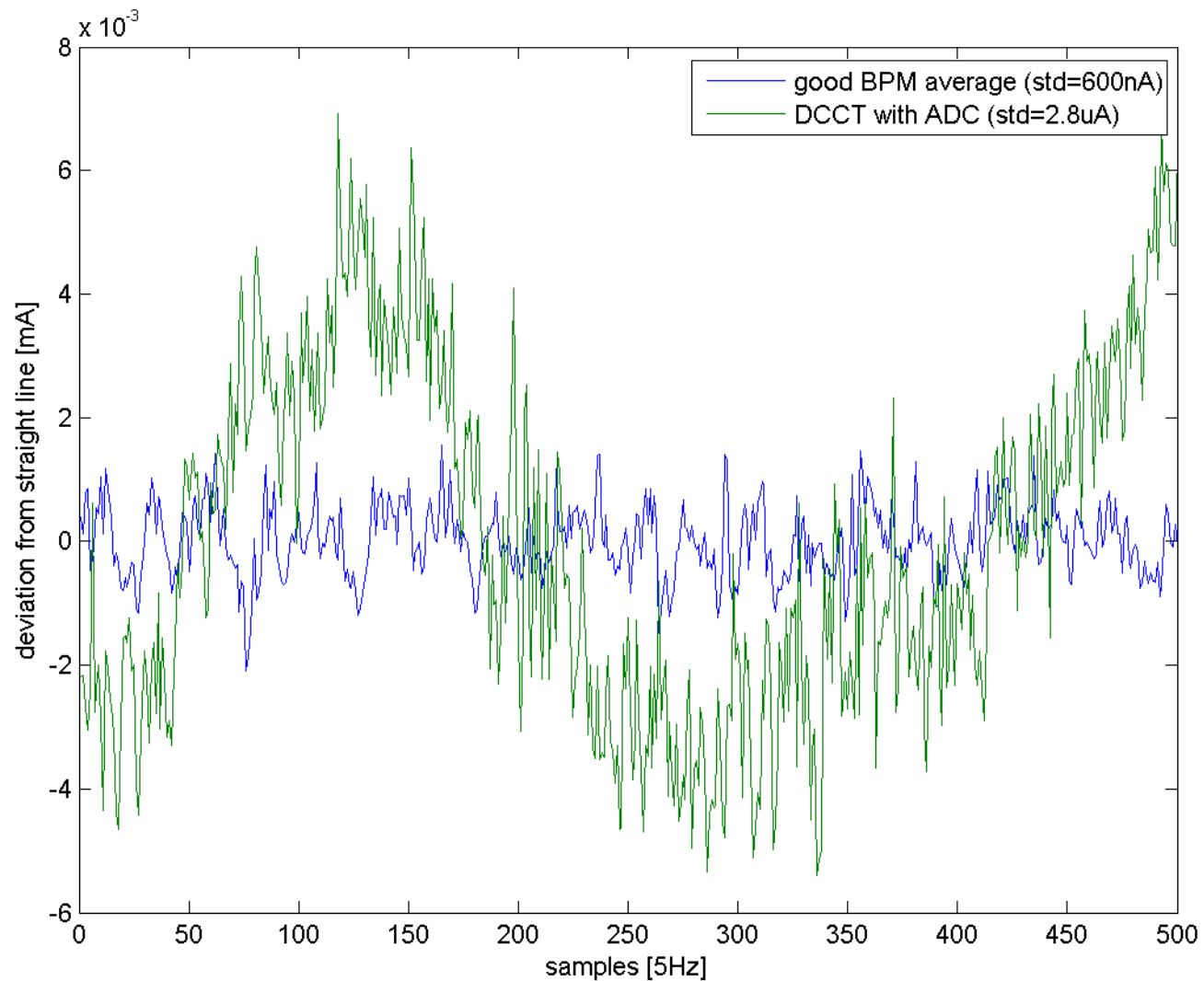
The good ones and the bad ones

100 best

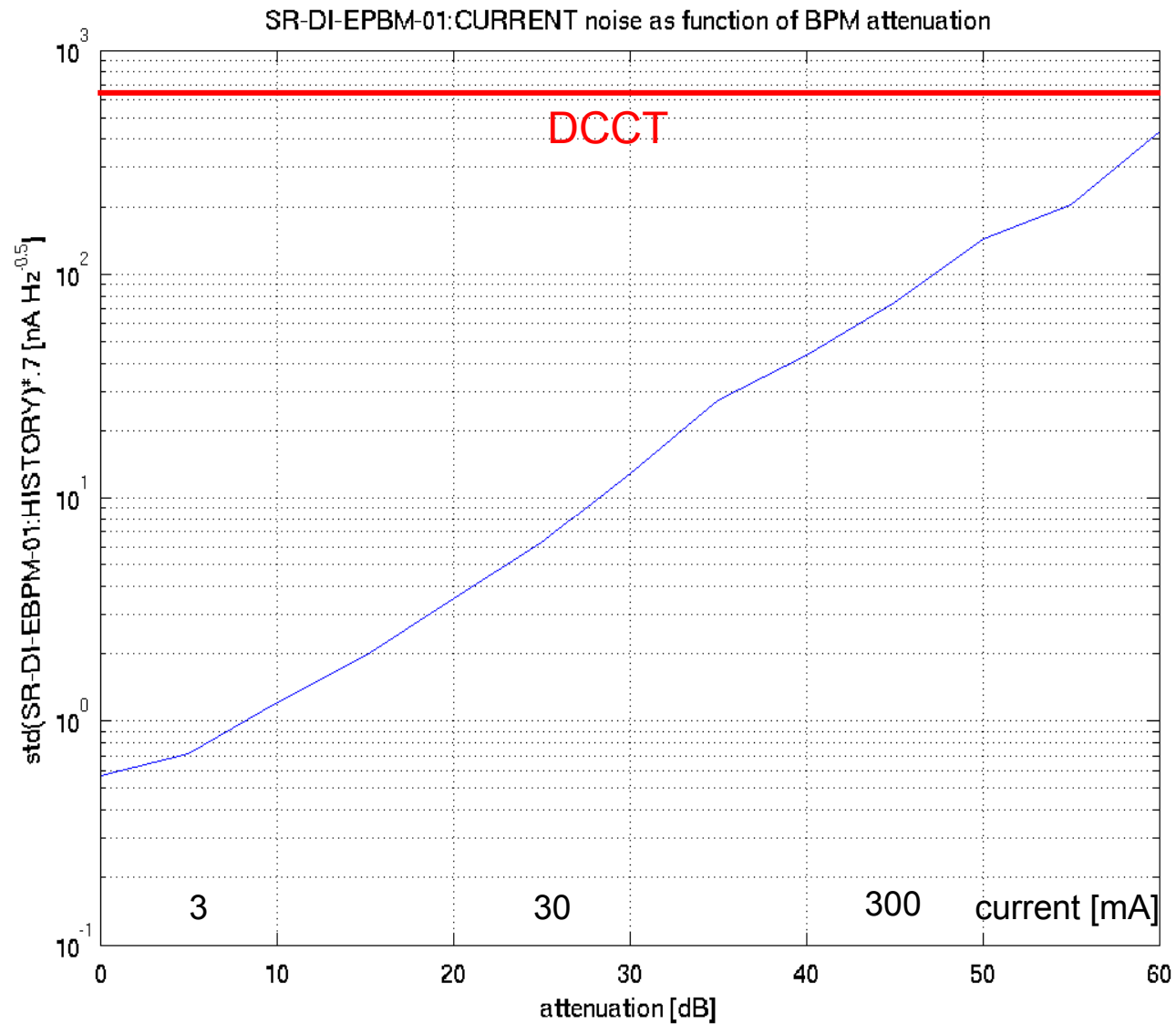
68 worst



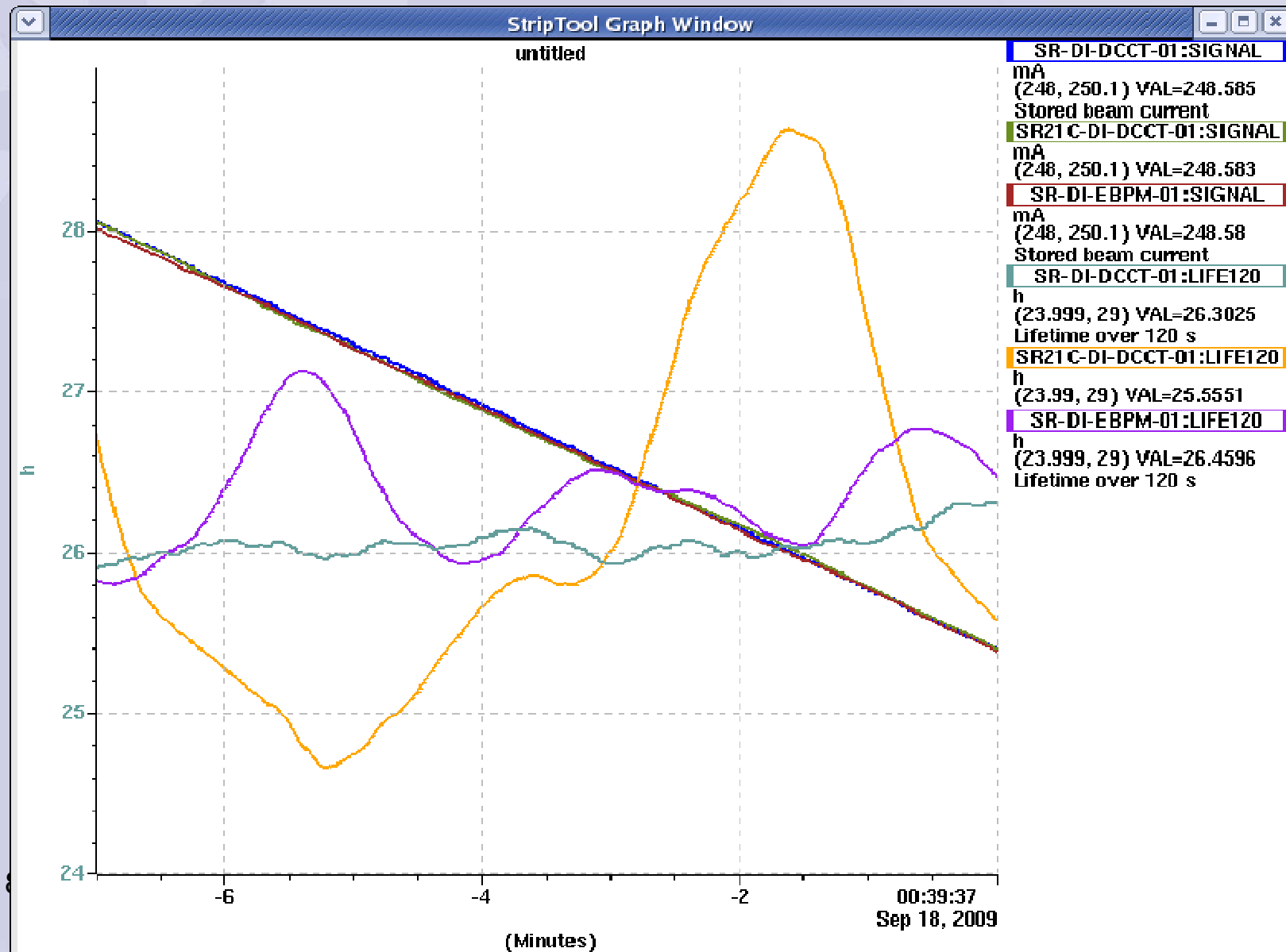
Good BPM average and DCCT



Noise on DCCT and BPM average



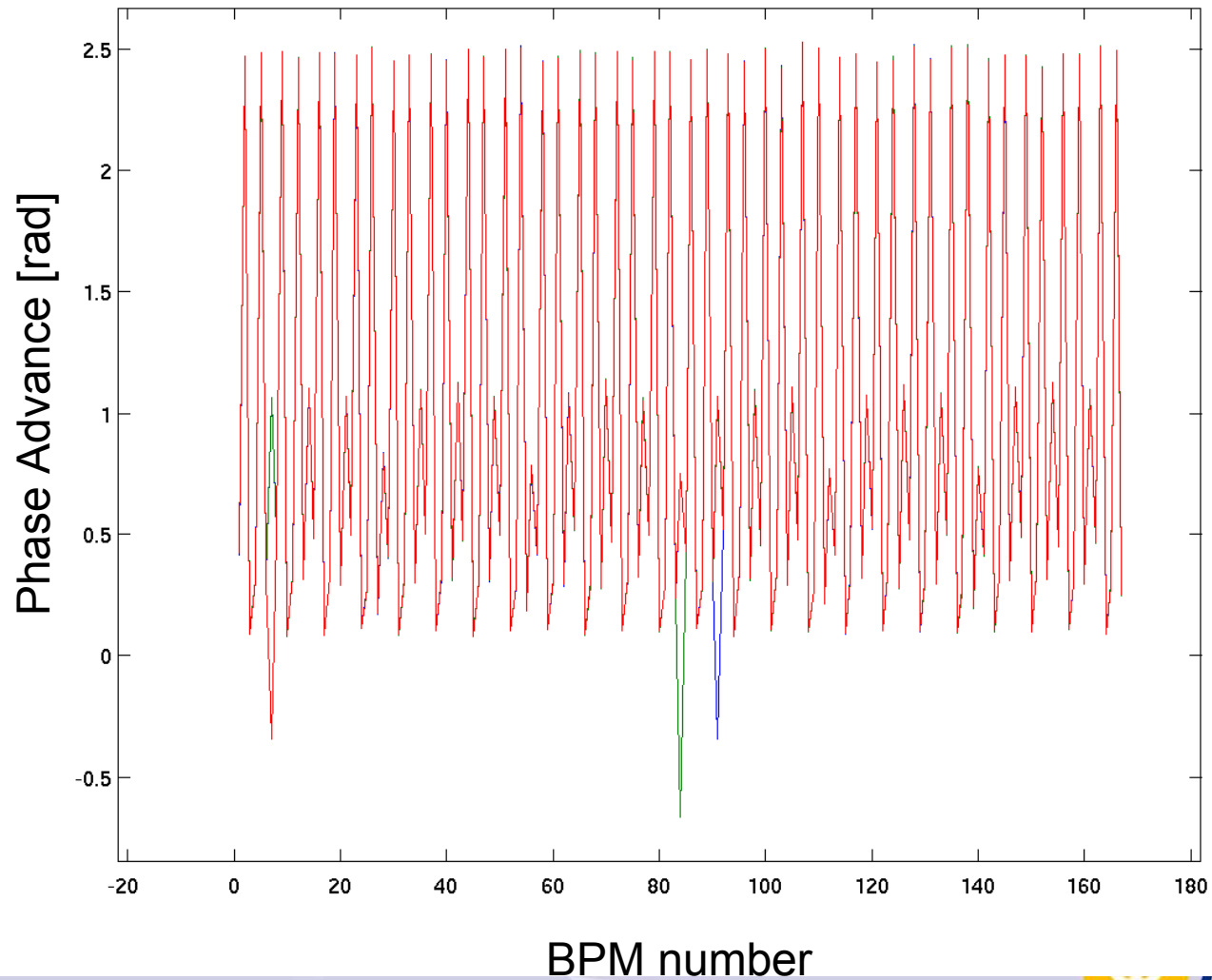
Lifetime from Average Current



Betatron Phase Advance Measurement

- Excite oscillation with CW on tune in one plane using stripline (only a few um amplitude required)
- Trigger T-b-T acquisition on all BPMs at once
- Read T-b-T data and analyse (using FFT or I/Q detector) for tune line, look at phase angle of tune line, then unwrap and calculate difference (phase advance between BPMs)
- Repeat three times to get unique result (one BPM will always be wrong in any one measurement)

Three Measurements

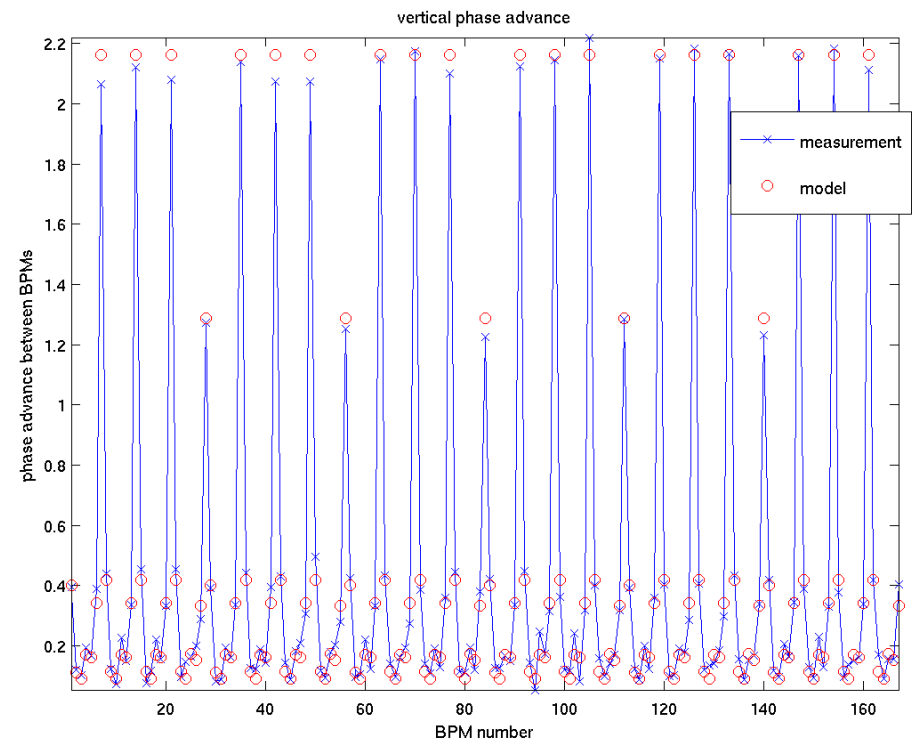
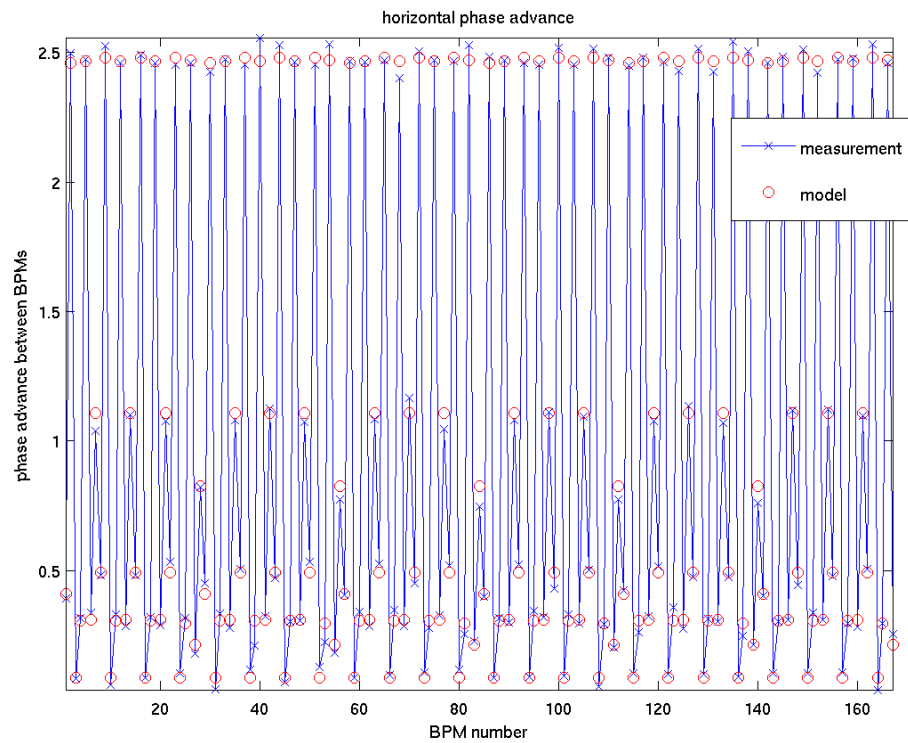


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Measurement and Model



An Idea:

- Analysis of T-b-T data is often searching for magnitude and phase at a single frequency (e.g. excitation or harmonic of)
- This could be done inside Libera
 - Reduce amount of data to transfer by 10^6
 - Distribute computation to 168 processors
- First simple implementation in software
- Then build detector into FPGA, allow averaging for long periods to further improve sensitivity

Acknowledgements

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Thank you for your attention!



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