Operational experience with CTF3 beam position monitors

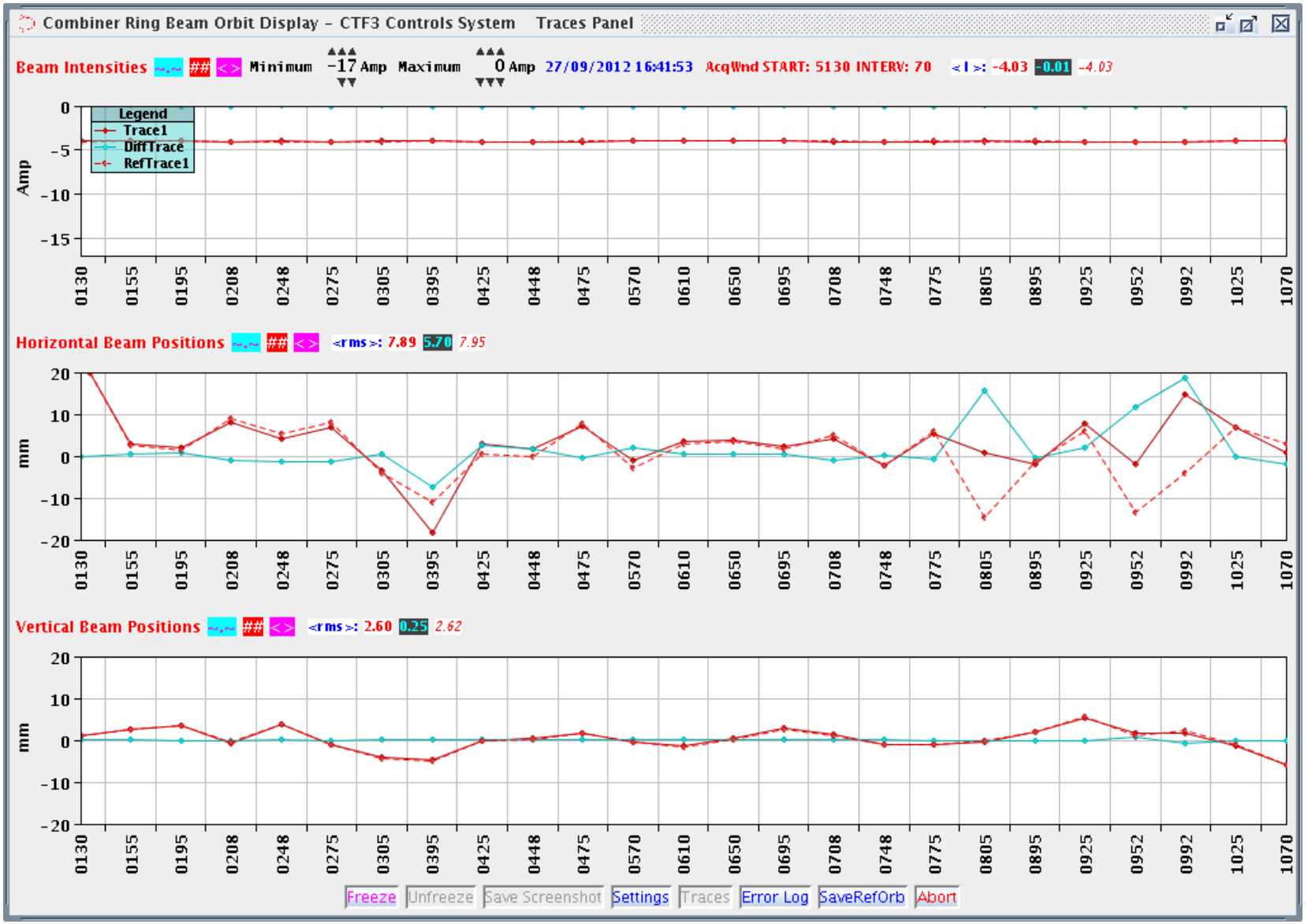
10th October 2012

Ben Constance

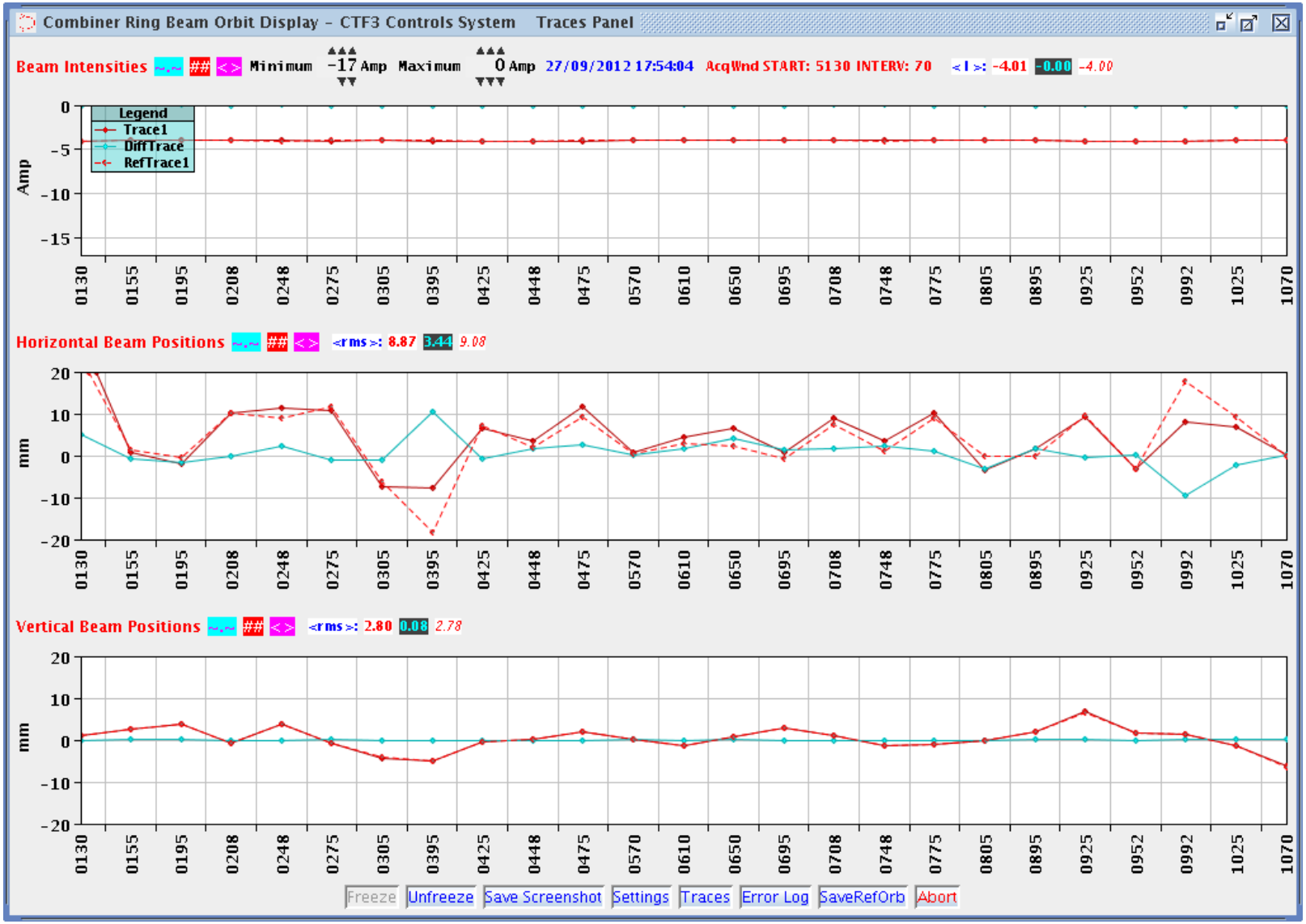
Combiner ring monitor misalignment

- Previously, large steering by quadrupole magnets to apparently centred beams
- We had a campaign during the September shutdown to measure CR BPM & BPI offsets
- Several monitors with few millimetre horizontal errors
- Still a question over the sign of the new offsets. To be confirmed with beam based measurements

Updated CR offsets

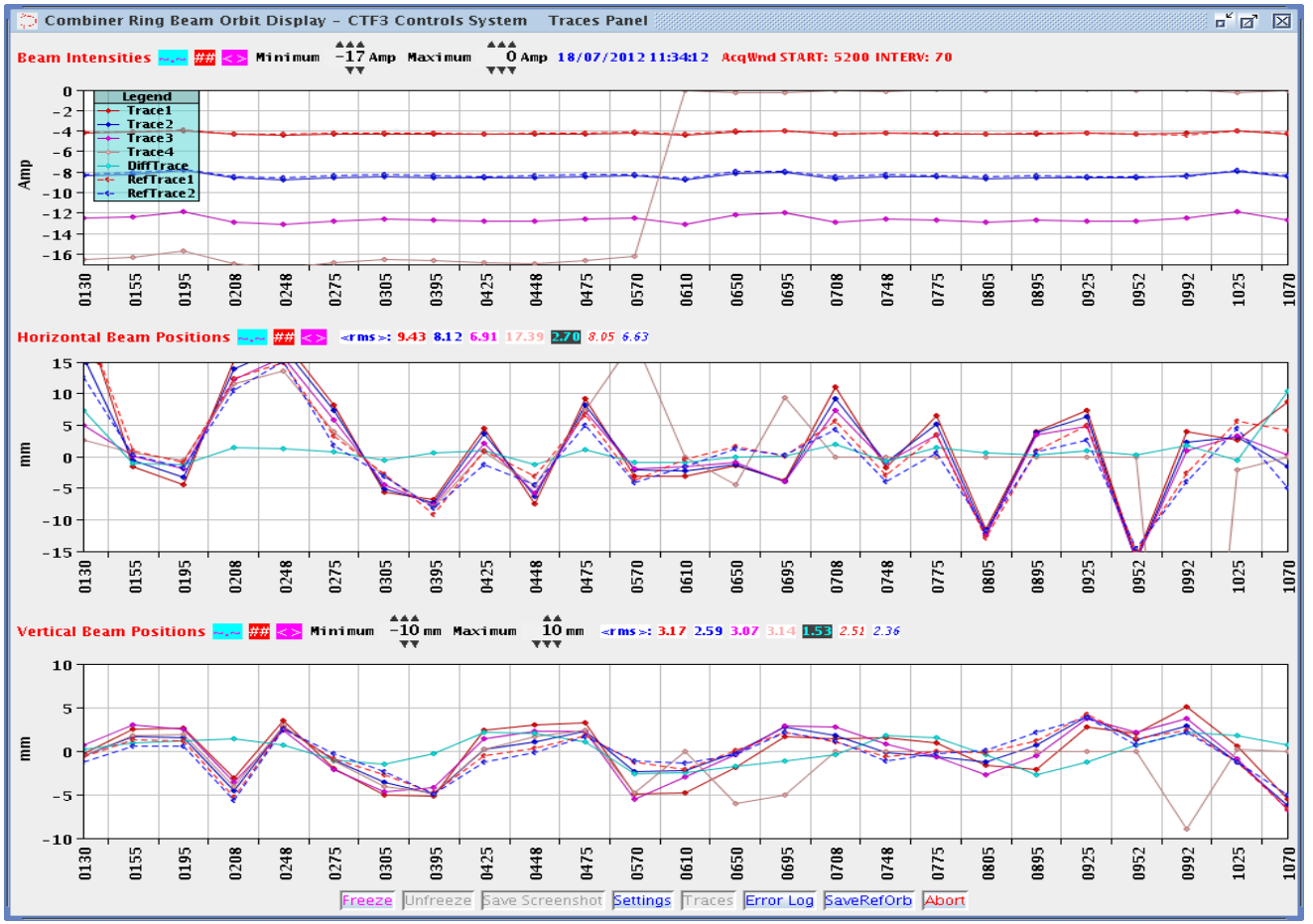


Updated CR offsets 2



Combiner ring sum signal calibration

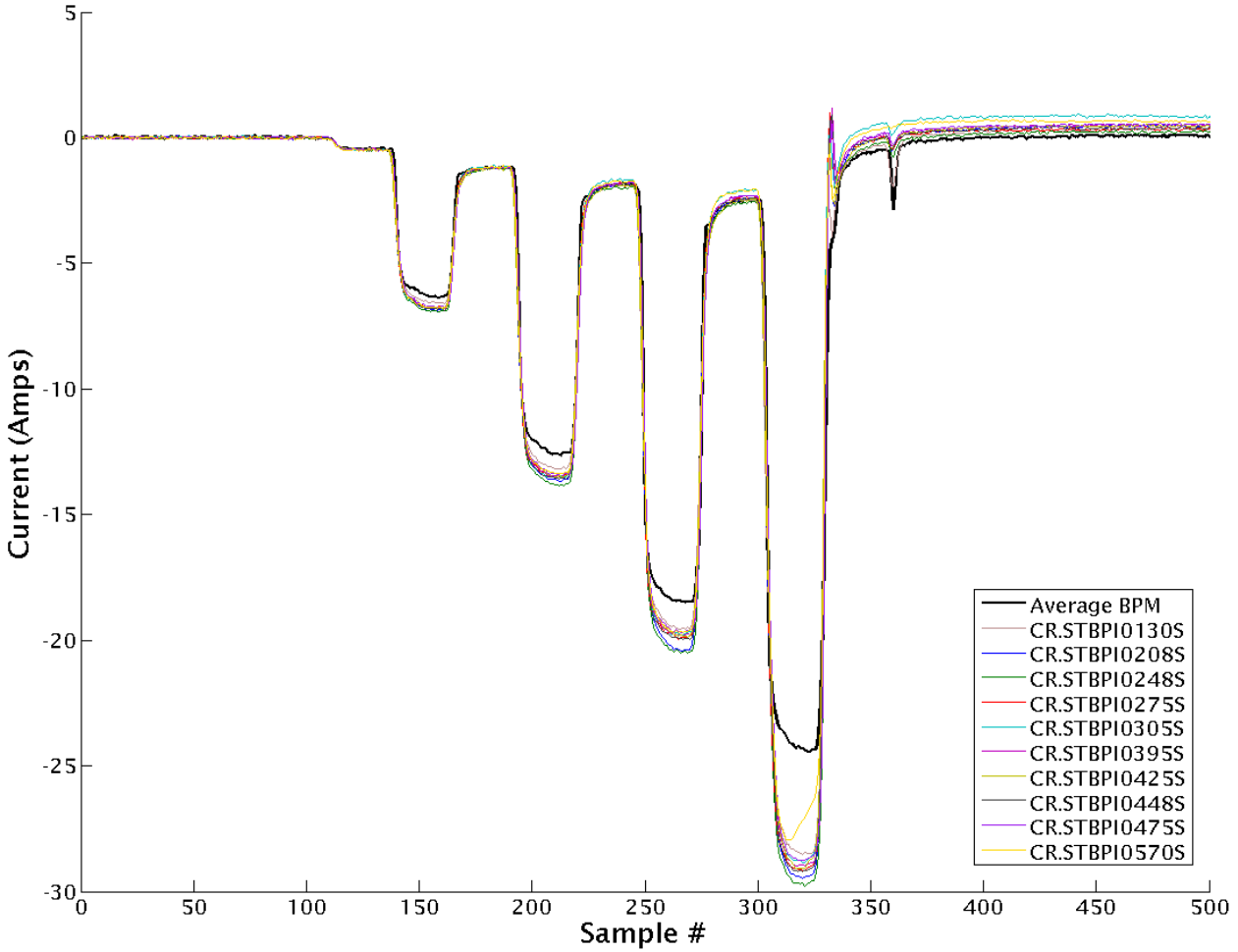
- Combiner ring BPM and BPI current measurements did not agree
- e.g. factor 4:



- In addition, large non-linearity in BPI measurements

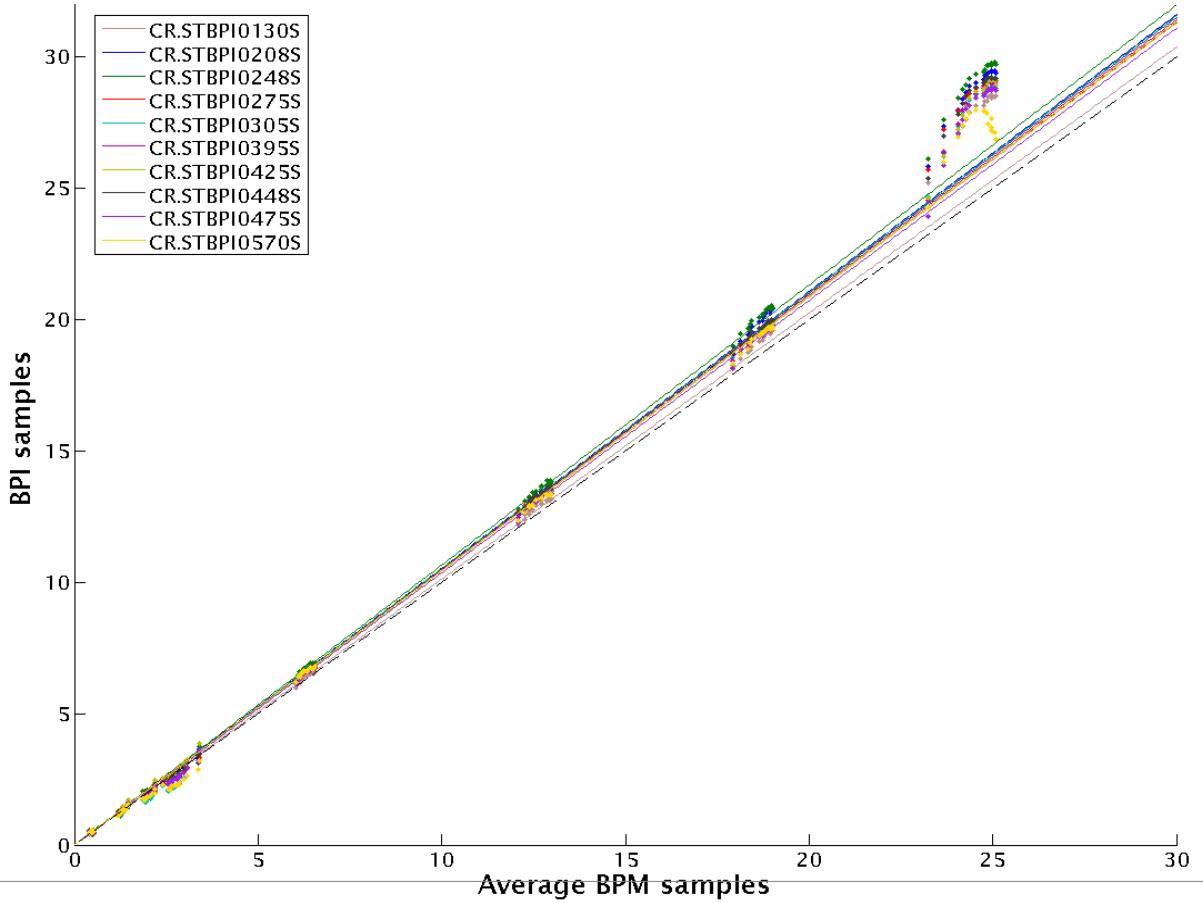
Combiner ring factor 8 data

- Non-linearity of BPIs clear on the fourth turn



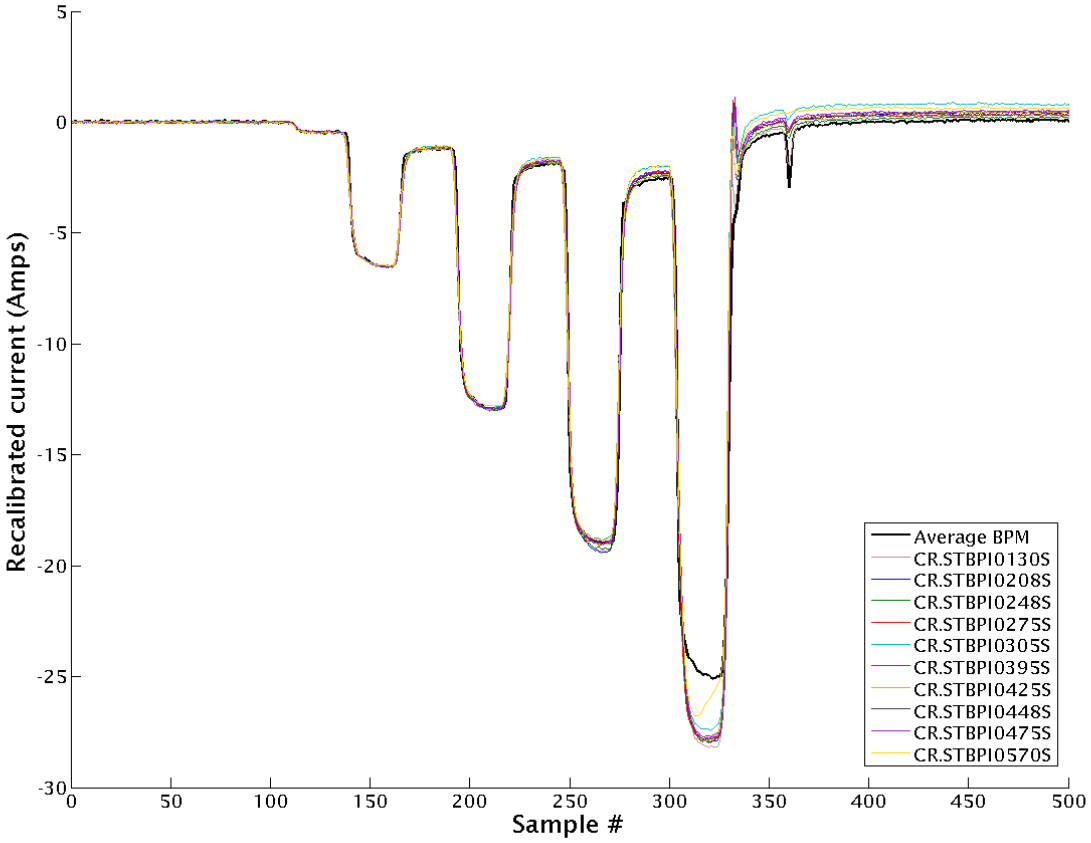
Recalibration

- Correlate sum signals from different monitors
- Linear fits to first turn only
- Fit gradients used to recalibrate with respect to 'mean BPM'



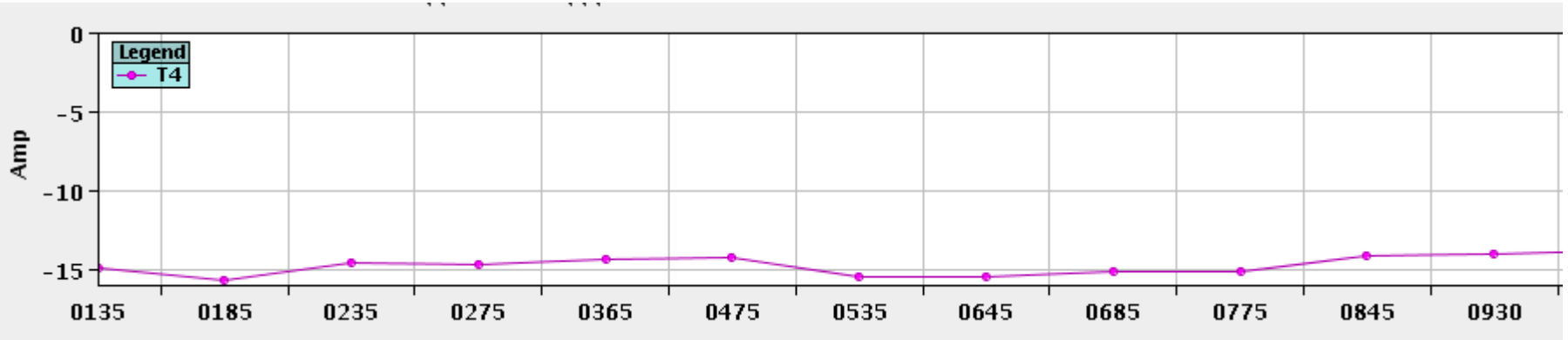
Recalibrated signals

- With calibration differences removed, non-linearity of BPIs is very clear
- Proposal to attenuate electrode signals prior to processing to determine whether source is monitor or electronics



Recalibration of TL2 monitors

- Similar situation with TL2 BPMs & BPIs



- Attempt to use same technique by extracting different turns from CR
- Perfect transmission is essential

TL2 data for factor 1-4 beams

- Orbit tuned to match 'best ever' transmission
- No losses visible, but:
  - Calibration errors
  - Current jitter
  - Signal noise

- After averaging signals offline
  - BPI signals badly calibrated
  - BPM signals decrease along the line, implying losses

BPMs

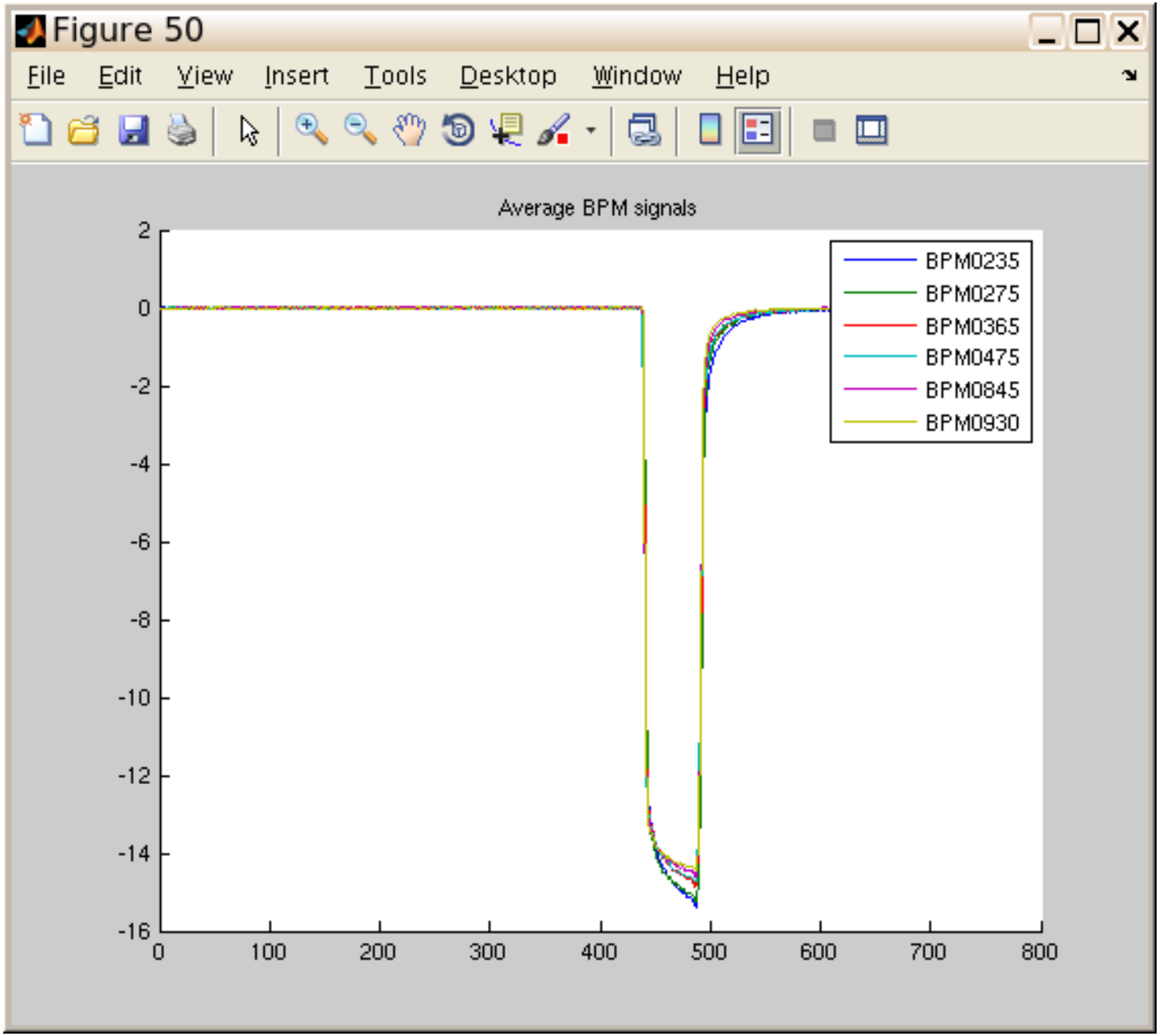


Figure 50
File Edit View Insert Tools Desktop Window Help
Average BPM signals
BPM0235
BPM0275
BPM0365
BPM0475
BPM0845
BPM0930
2
0
-2
-4
-6
-8
-10
-12
-14
-16
0
100
200
300
400
500
600
700
800

BPIs

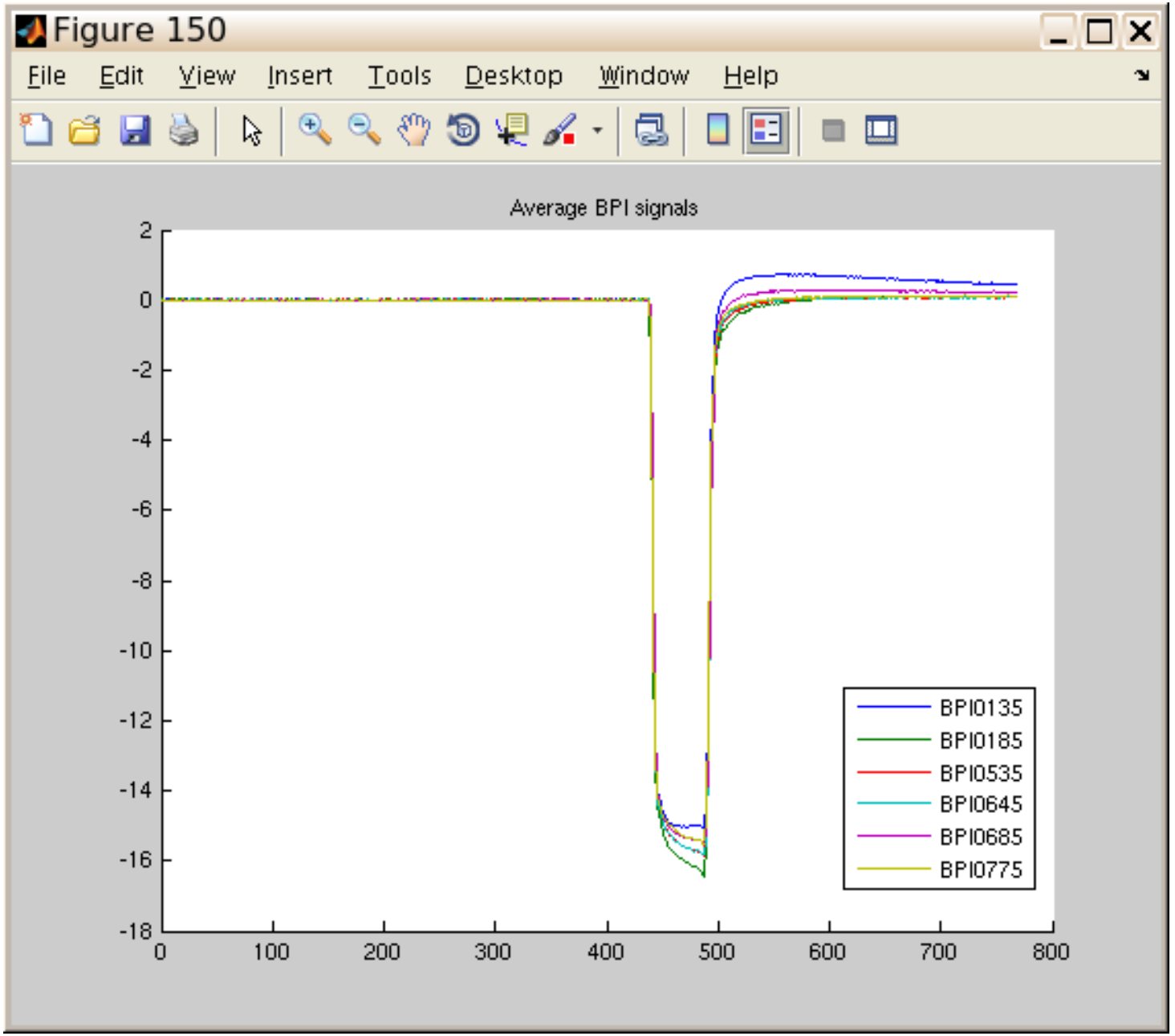
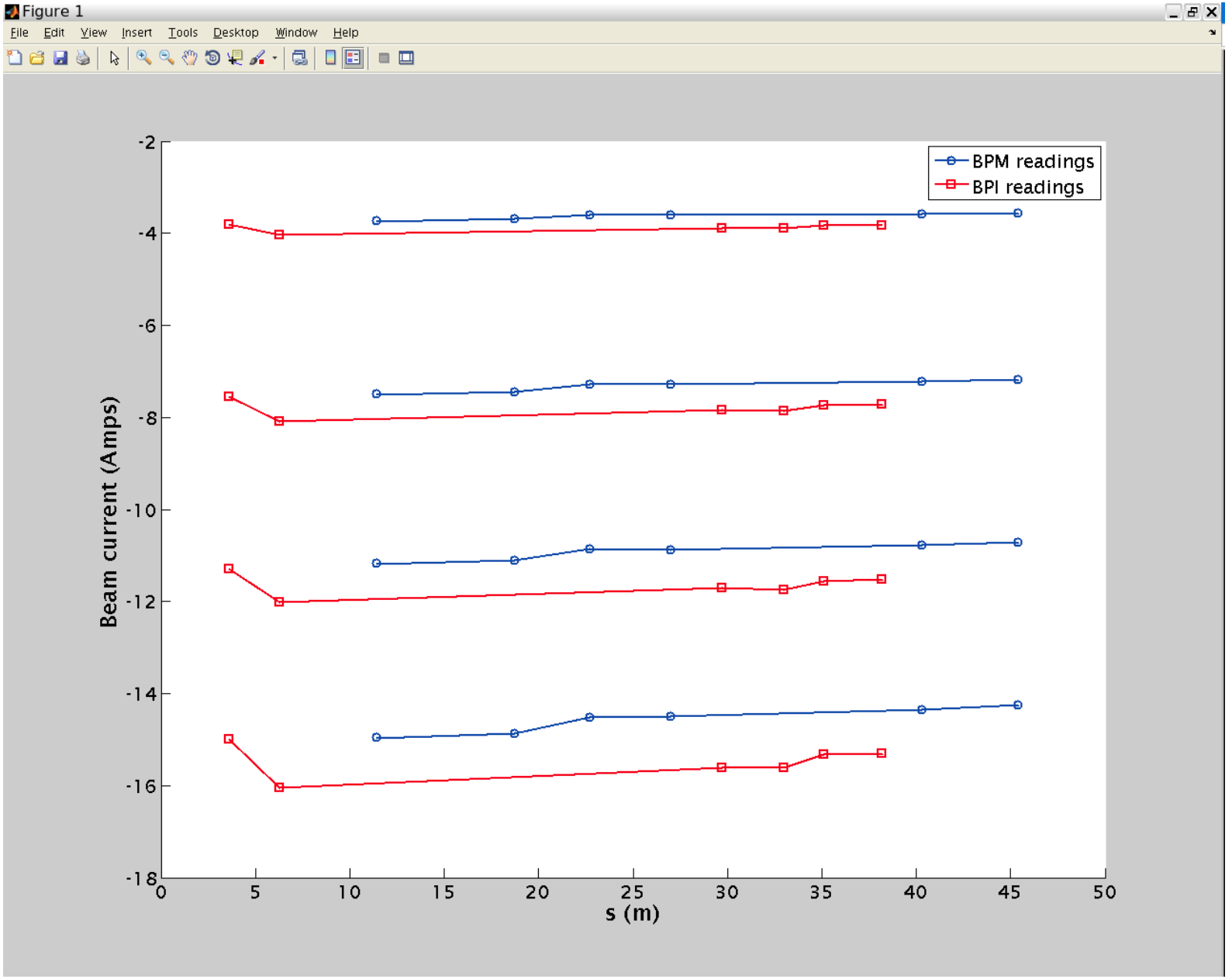


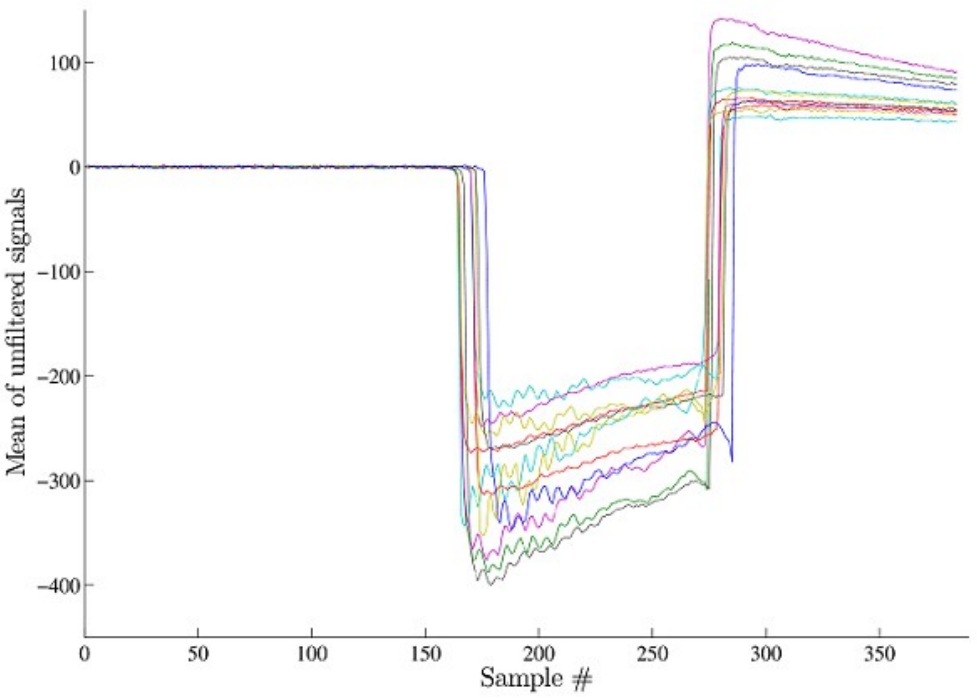
Figure 150
File Edit View Insert Tools Desktop Window Help
Average BPI signals
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300
400
500
600
700
800
BPI0135
BPI0185
BPI0535
BPI0645
BPI0685
BPI0775

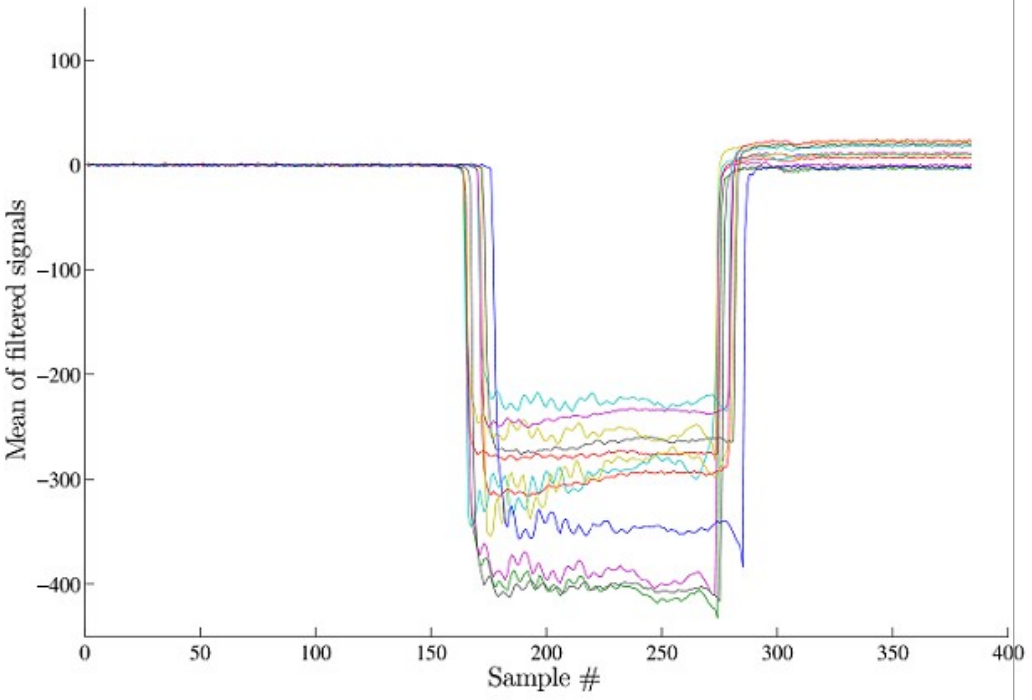
TL2 losses overview



Delay loop BPI droop correction

- Possibility of filtering to remove exponential droop discussed at the CTF3 working meeting in January 2012, e.g:





Delay loop BPI droop correction

- Droop time constants (or filter weights) vary and must be extracted from signal tail
- Unfortunately, limited digitisation window
- Large time constants mean less sampling of the tail
- Simulations show that under-sampled tails over-estimate the time constant
- Not possible to implement this algorithm without increasing the digitisation window

Summary

- Combiner ring offsets measured and accounted for in software
  - Sign to be confirmed with beam-based measurements
- Combiner ring sum signals recalibrated to ensure consistency
- TL2 monitor sum signals need recalibration
  - Not yet possible due to losses
  - Better optics control to prevent losses
  - Online signal averaging to see losses
- Delay loop BPI signals need a larger digitisation window if we want to compensate for the droop
  - To be decided whether this is worthwhile