ATF2 Cavity BPMs

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ATF Operation meeting17[th] December 2009
SLAC, KNU, PAL, KEK, JAI-RHUL, UCL
KEK, ATF
https://www.pp.rhul.ac.uk/twiki/bin/view/JAI/BeamPosition

System status

- C-band excellent
    - Good phase stability
    - Amplitude stability ~few %
    - Resolution order 1
- S-band system
    - IQ rotation (phase) instability
    - Not present in calibration tone ~48 hours
    - Becomes bistable with DR-RF ramp (can we try to avoid using DR-RF ramp for dispersion)
    - Code "fixed" but still problems
- Talk focus on new results in last 2 shifts

Introduction

- Resolution studies
  - All BPMs 20 dB attenuators (apart from ...)
  - MFB2FF and MQM16FF full resolution (no attenuators)
    - Chosen because magnets nominally off, can centre beam in BPM (both x and y) without disturbing optics
- Full system analysis (one file 1000 pulses all BPMs)
  - Orbit reconstruction
  - X-Y coupling
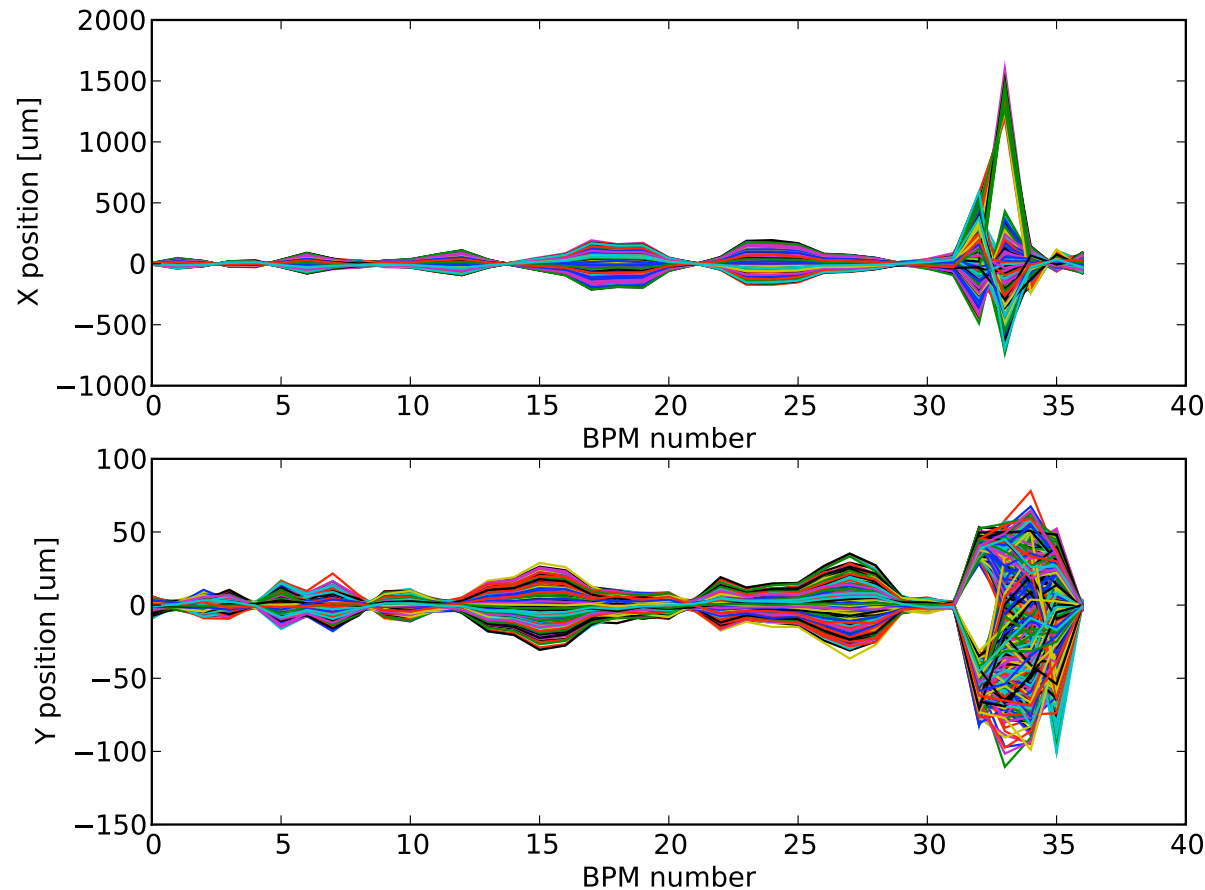 - QM16FF and MFB2FF resolution
  - Jitter correction

Reference orbit

bpmAllLog_20091217_003952.dat
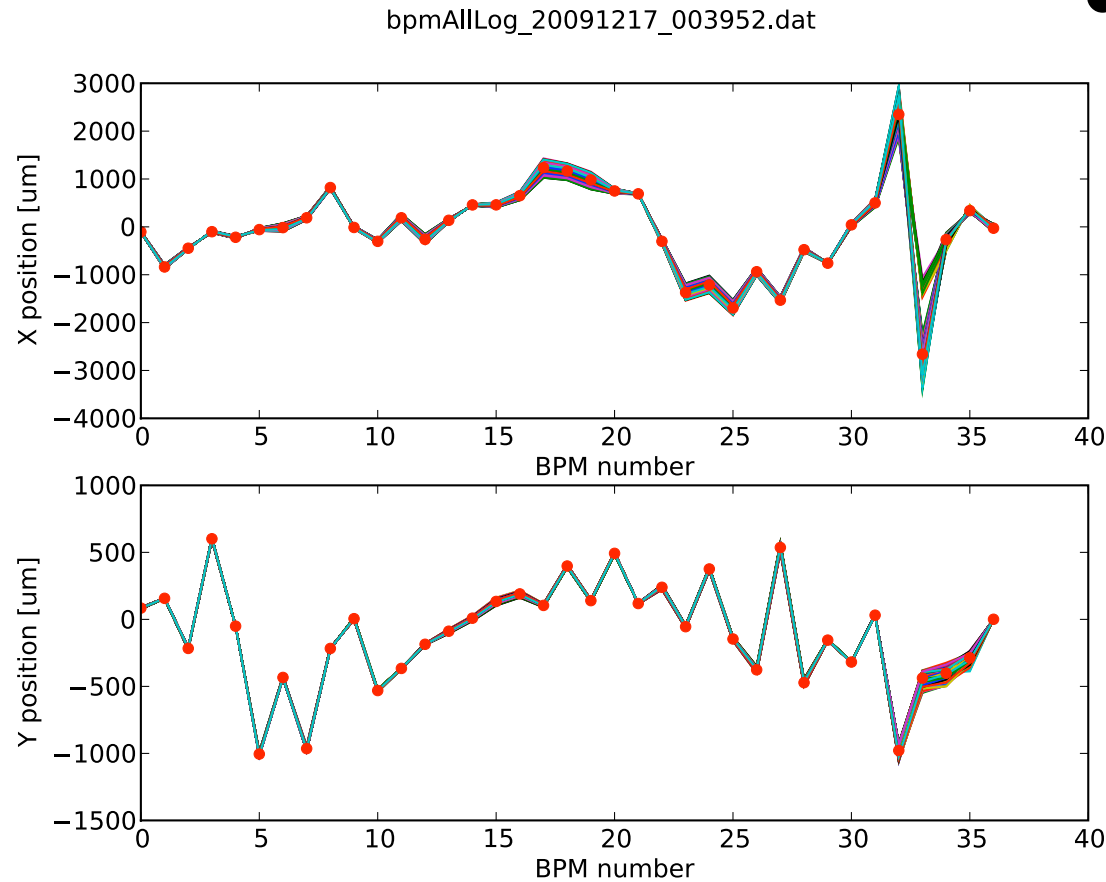
- Cut on reference amplitude and QD10Xx position
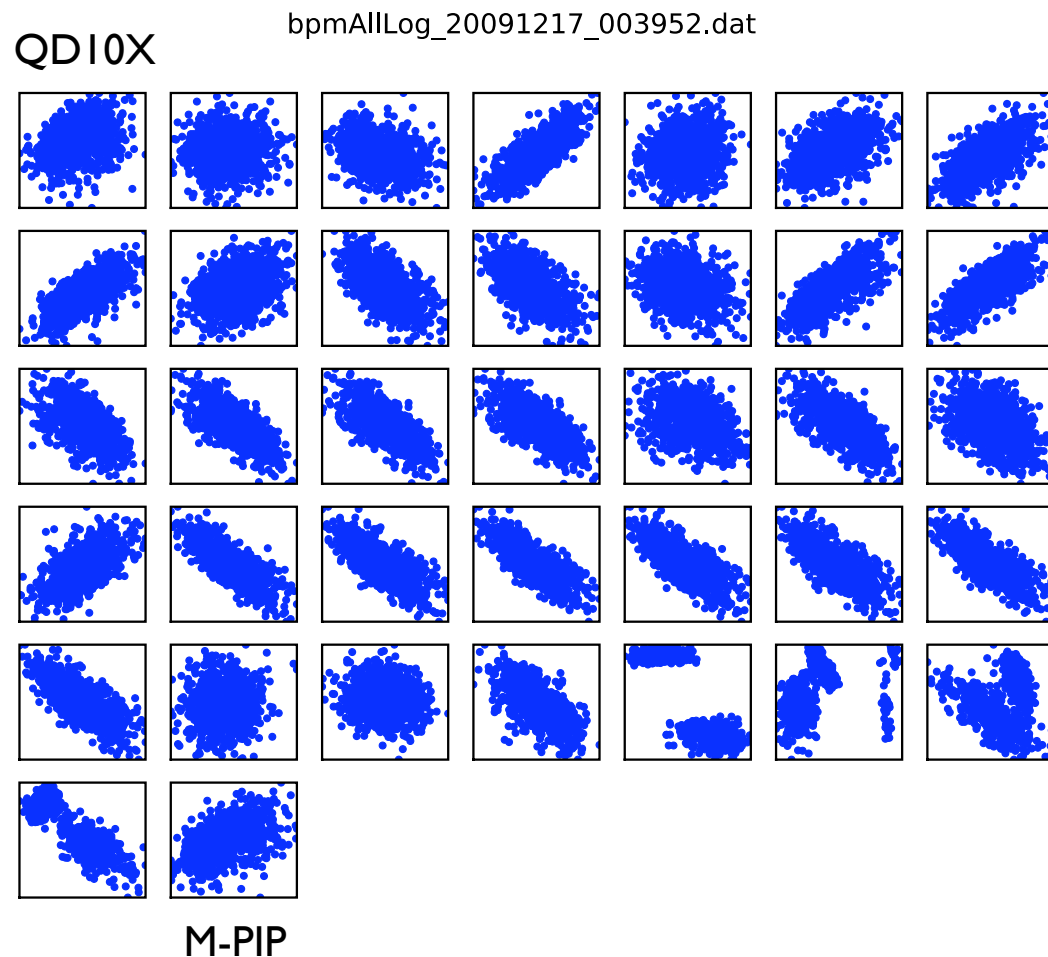
  - Bad extracts

  - Low charge

Jitter in cavity BPMs

bpmAllLog_20091217_003952.dat

- **Subtract reference orbit**
  - S-Band BPMs clearly have some problem
  - Clear beta-function dependence on jitter
  - Typically y jitter less 50 μm

X-Y correlation/coupling

QD10X

bpmAllLog_20091217_003952.dat

M-PIP

- X-Y correlation for each BPM

  - Scales suppressed but appears too large to be mechanical roll

  - X-Y Coupling

  - Need to remove to compute resolution

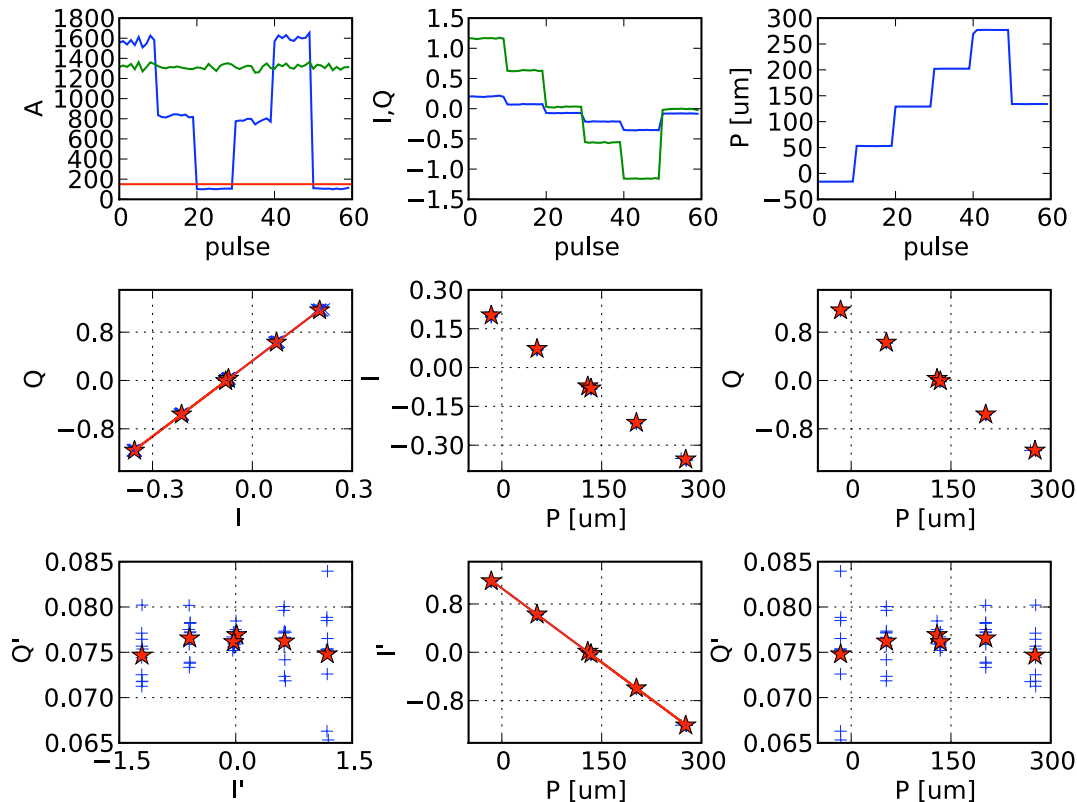 - S-band bistable although beam appears stable

X-Y coupling subtracted
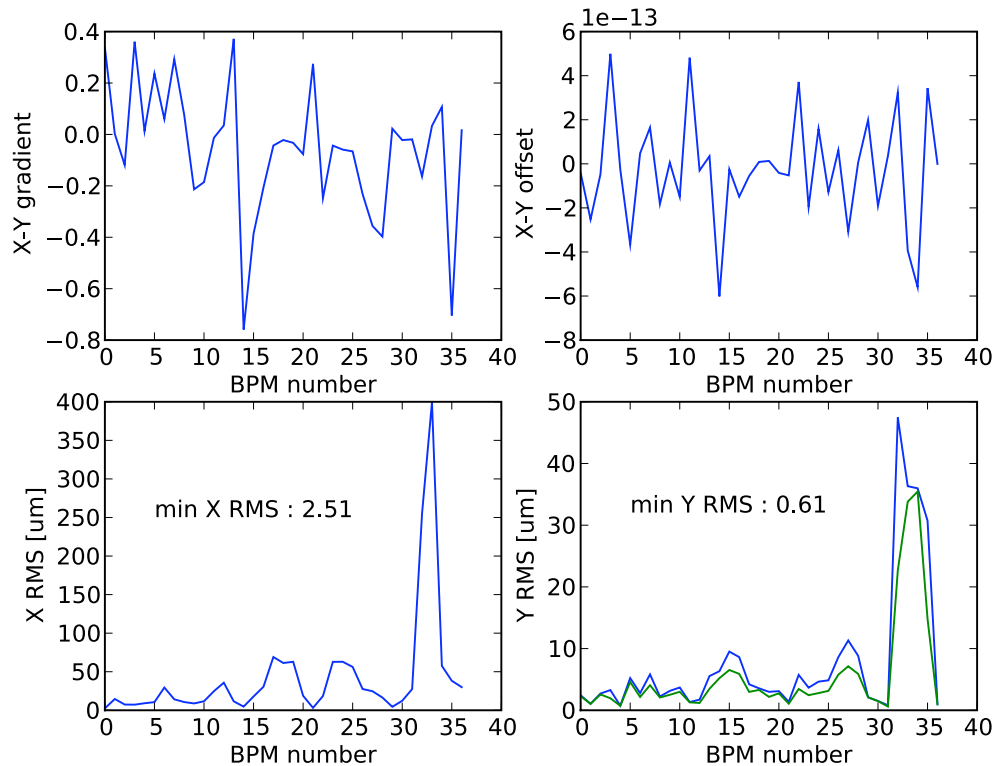
- Top plots are gradient and offset for the X-Y correlation can be large (-0.8)

- Lowest RMS vertical position jitter 0.61

FM2 & QM16 calibration

- Centre BPM on beam, don't have to worry about quad centre

- Range ±150 µm

- Quality of calibration is excellent

- Perfect for studies of BPM sensitivity

Towards high resolution

- Relationship between BPM EM centre and magnet

  - Determine signal levels for normal quadrupoles well centred on beam (BBA)

  - Can system tolerate this?

- Need to understand BBA offsets compared with high resolution dynamic range

- Require

  - Might always be difficult horizontally as beam jumps out of un-staturated dynamic range

  - Vertically probably o.k, what about the sextupoles? Large BBA offset

    - SF6FF {x,y} = {2750, 604}

    - SF5FF {x,y} = {2325, -205}

Towards high stability

- Need to inject calibration tone all the time

  - Presently signal level too low

  - D. McCormick planning upgrade to fix minor problem with SLAC electronics

- Decision to inject all pulses with calibration tone

  - Mix latter part of waveform with calibration tone frequency

  - Extract scaling per pulse

  - Apply to amplitude/phase for each digitized waveform

- Complex code upgrade will be run parallel to existing system

  - Allows maximum time to test and debug (freeze existing operational version)

Towards stable S-band

- KNU (A. Heo, Y. Kim) students to stay until end Feb 2010

  - Short shifts measurements to calibrate S-band system

  - Develop new data logger to constantly and carefully monitor S-band system

  - Experiments with calibration tone

  - Careful review of existing calibration data to determine source of problem

- Address during January operation

  - Will need short shifts combined with C-band calibration (checks say 5 BPMs)

Summary

- BPM system progress is now quite rapid

  - Gain stability measurements essential for BBA and long term and turn key operation

  - Lots of work to do on BPM system output

- Resolution dominated by beam jitter

  - Matrix inversion/SVD techniques to fix this

  - Apply to

    - Resolution studies

    - Also calibration

- Another trip required for

  - Hardware upgrades to S-band system

  - More system check out