ATF2 Cavity BPM

A. Aryshev, S. T. Boogert (JAI@RHUL), G. Boorman, Y. Honda, J.Y. Huang, S.J. Hwang, J.Y. Kim, A. Lyapin, D. McCormick, S. Molloy, J. Nelson, Y.J. Park, S.J. Park, C. Swinson, T. Tauchi, N. Terunuma, G. White.

SLAC, KNU, PAL, KEK, JAI, UCL

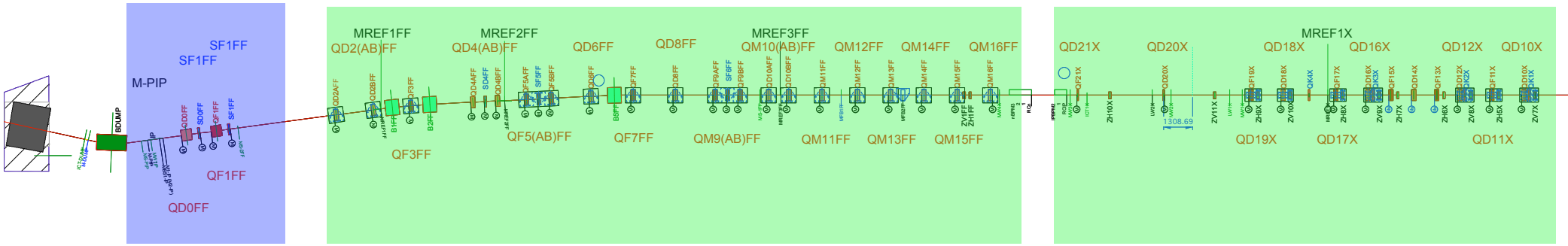
ATF2 Project/commissioning meeting,
WebEx , 8th June 2009

Introduction

- Progress since last report (15 Dec 2008)
  - Completed software system
    - Still many more improvements required
  - S-band system completed (S-band reference + RF-elec)
- Calibration scheme
  - Mover
  - Corrector
- Slow control and monitoring
  - Calibration tone injection
  - Temperature/LO

ATF layout

S-Band BPMs C-Band BPMs



Mover Corrector

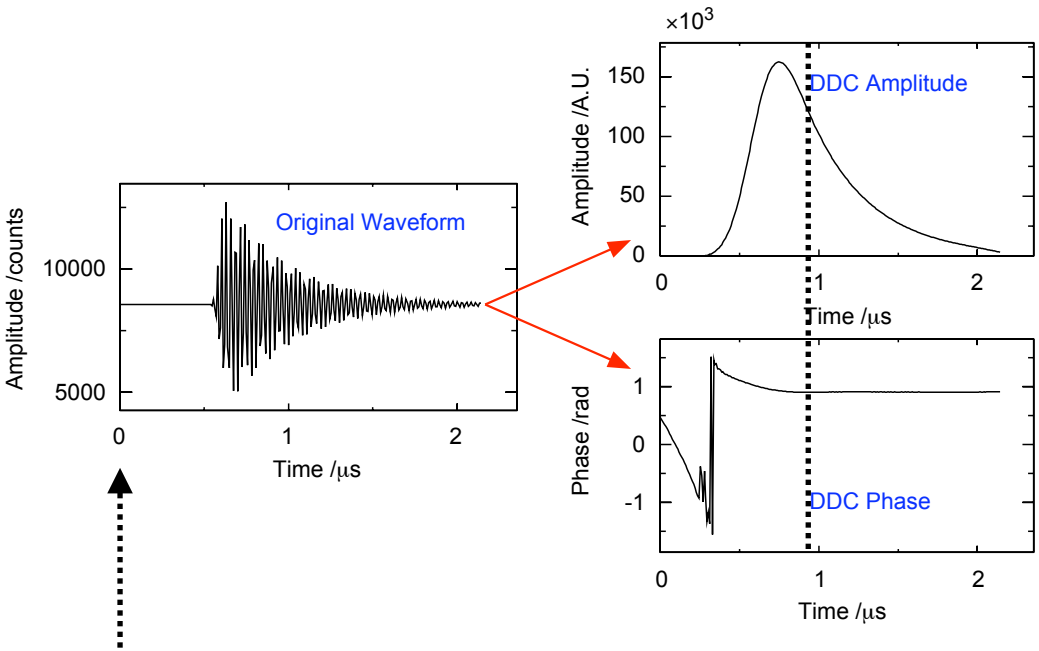
- 4 (dipole) +1 (ref) S-band
  - Variable attenuation
- 31 (dipole) + 4 (ref) C-band
  - Attenuation : 10 db in all channels (1 removed for tests)
  - 9 corrector calibrated
  - 22 mover calibrated
- 1 MPIP (readout via VME system)

Operations in 2009

Run period	BPMs calibrated	Notes
26/01/09-06/02/09	All mover BPMs	Problems with
16/02/09-13/03/09	All BPMs (Molloy)	with trigger
06/04/09-24/04/09	All BPMs (Boogert)	race condition
11/05/09-29/05/09	All BPMs (Aryshev)	trigger change

- 4 main run periods
  - Problems with trigger system developed, unstable BPM readout for 2 run periods
  - Trigger change during final period for S-band commissioning

Digital processing algorithm (DDC)



Trigger start

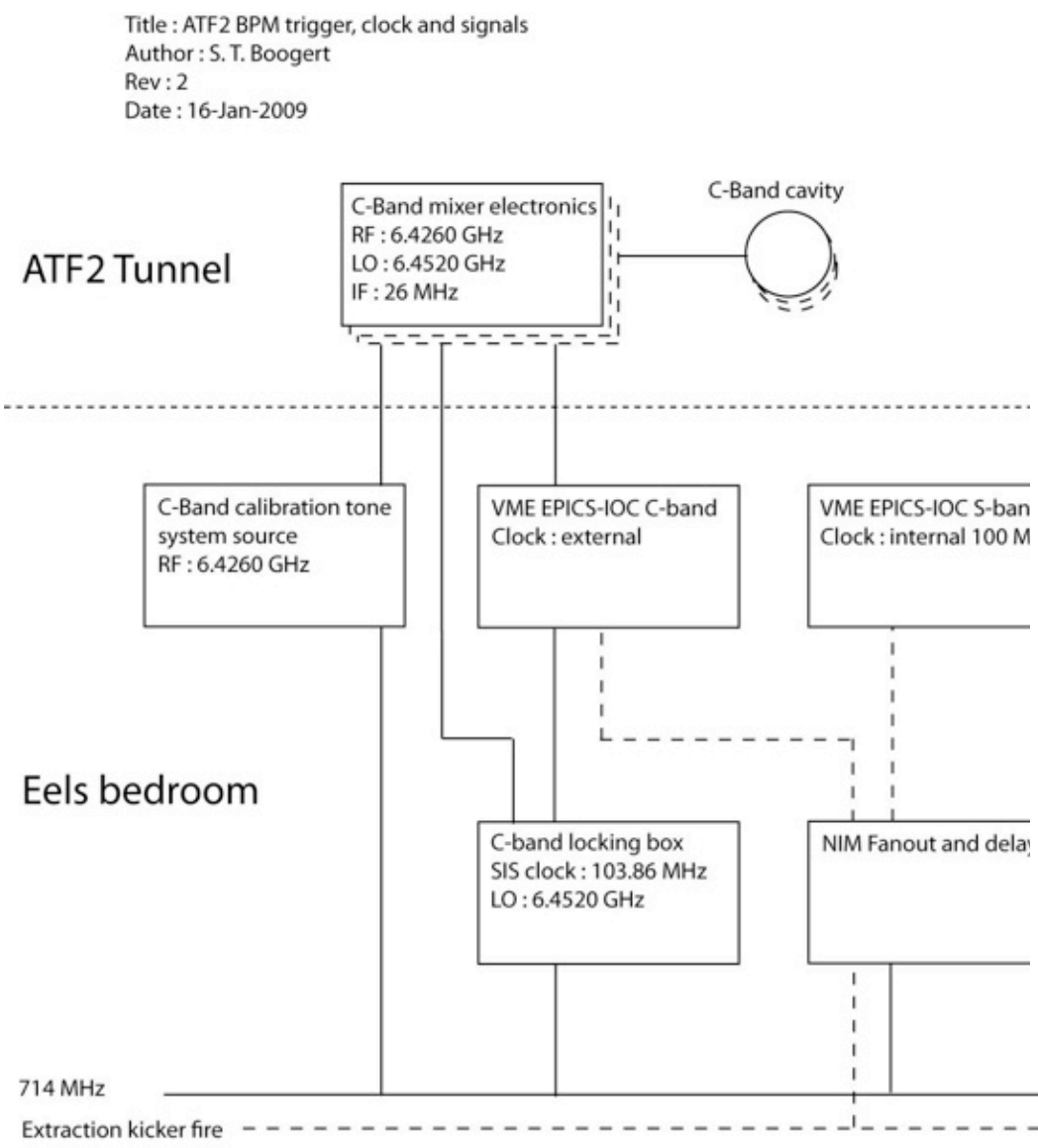
Extract phase and amplitude at some specific time

$$I = \frac{A_d}{A_r}\cos\left(\phi_d - \phi_r\right)$$

$$Q = \frac{A_d}{A_r}\sin\left(\phi_d - \phi_r\right)$$

- I and Q depend on
  - start trigger
  - beam arrival
  - DDC sample point
- E.g. change in trigger start, beam arrival or saturation levels causes will change I and Q and hence calibration
  - Compensate for changes in code

Trigger race condition

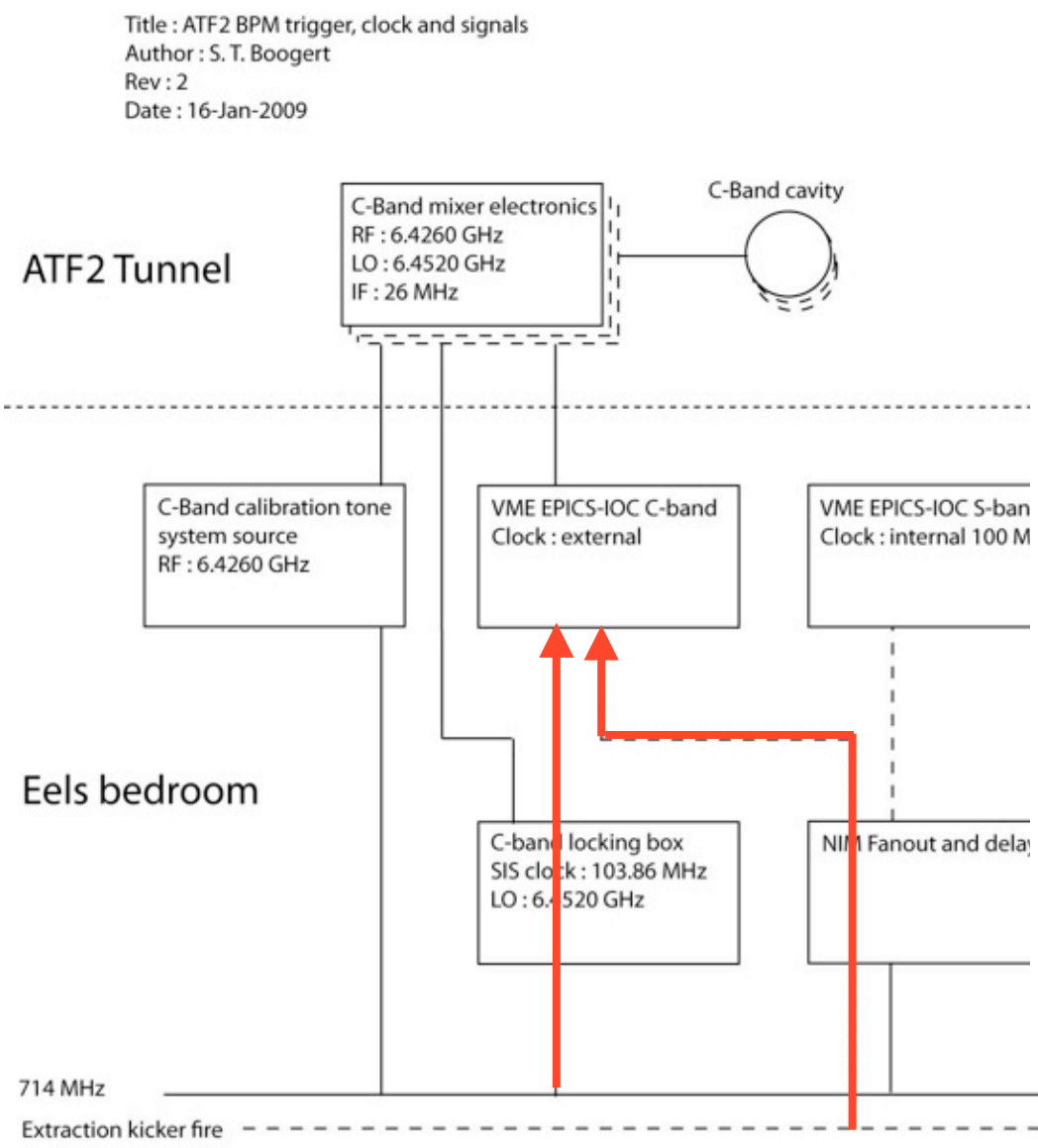


- Instability observed in BPM system
  - Depends on individual VME cards
  - NIM clock/trigger problems
  - Reference and dipole in different cards

$$I = \frac{A_d}{A_r}\cos\left(\phi_d - \phi_r\right)$$

$$Q = \frac{A_d}{A_r}\sin\left(\phi_d - \phi_r\right)$$

Trigger race condition

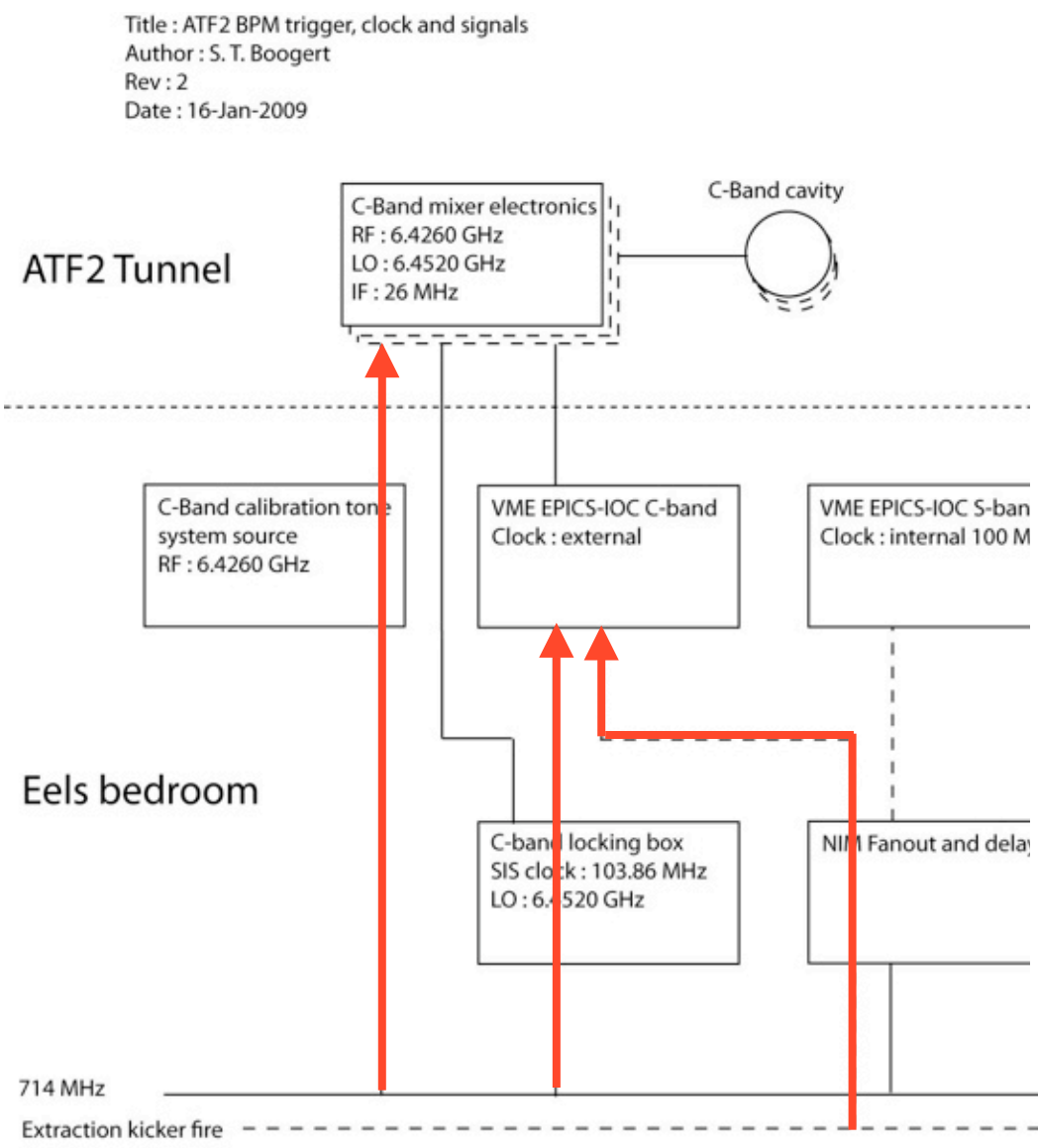


- Instability observed in BPM system
  - Depends on individual VME cards
  - NIM clock/trigger problems
  - Reference and dipole in different cards

$$I = \frac{A_d}{A_r}\cos\left(\phi_d - \phi_r\right)$$

$$Q = \frac{A_d}{A_r}\sin\left(\phi_d - \phi_r\right)$$

Trigger race condition

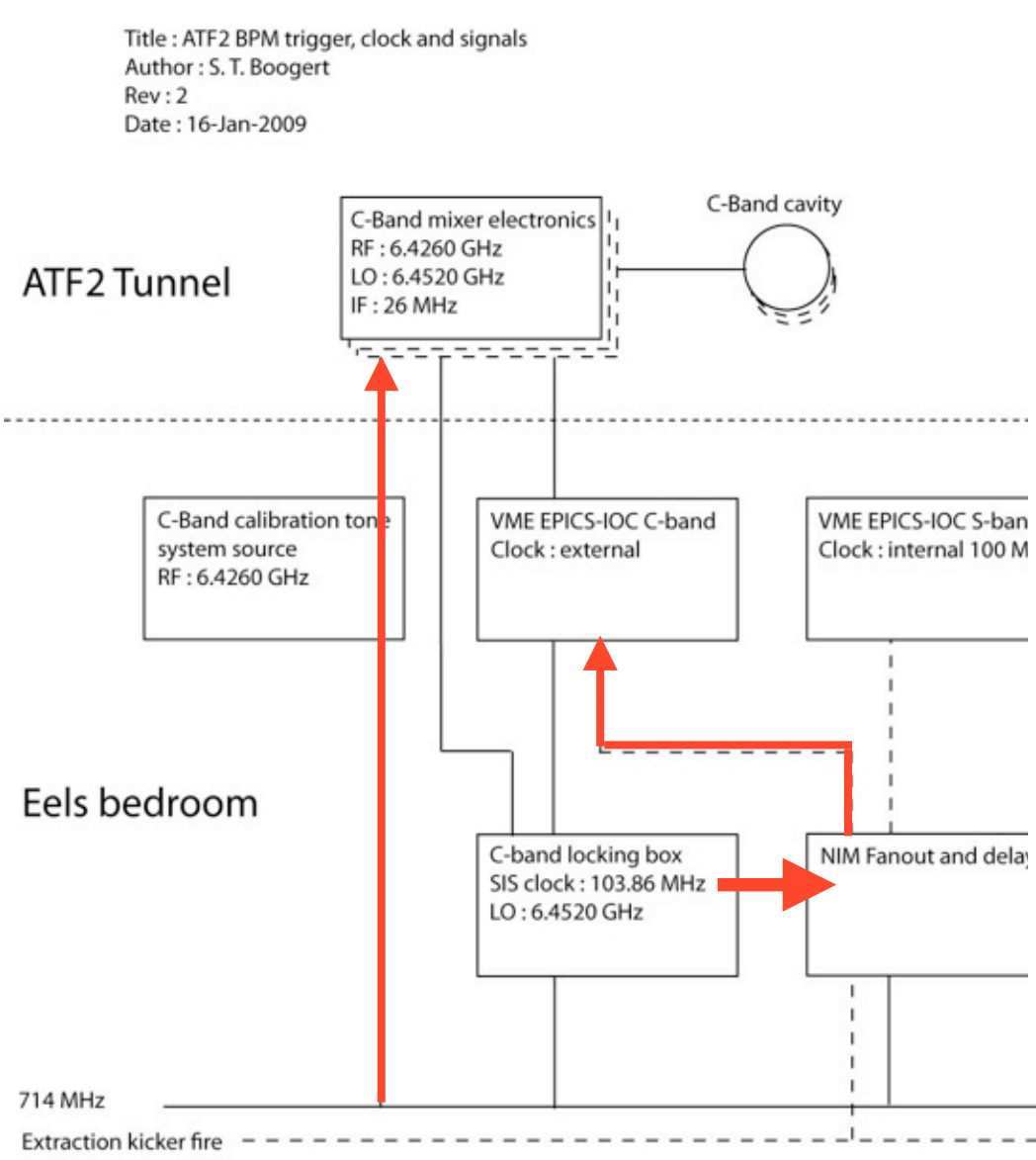


- Instability observed in BPM system
  - Depends on individual VME cards
  - NIM clock/trigger problems
  - Reference and dipole in different cards

$$I = \frac{A_d}{A_r}\cos\left(\phi_d - \phi_r\right)$$

$$Q = \frac{A_d}{A_r}\sin\left(\phi_d - \phi_r\right)$$

Trigger race condition



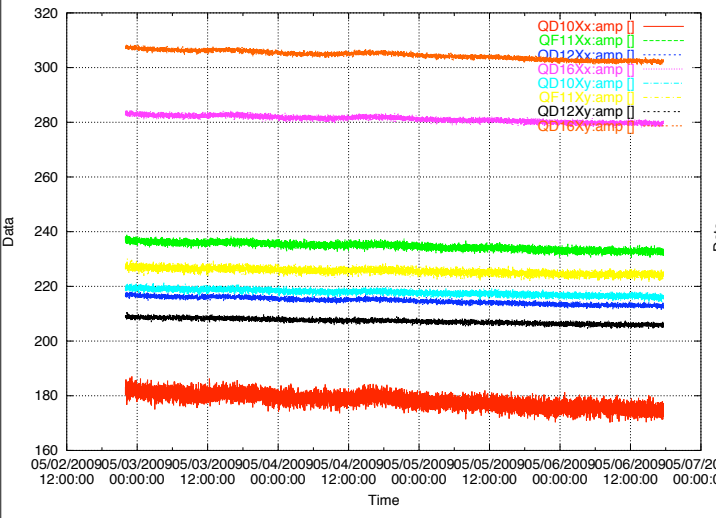
- Instability observed in BPM system
  - Depends on individual VME cards
  - NIM clock/trigger problems
  - Reference and dipole in different cards

$$I = \frac{A_d}{A_r}\cos\left(\phi_d - \phi_r\right)$$

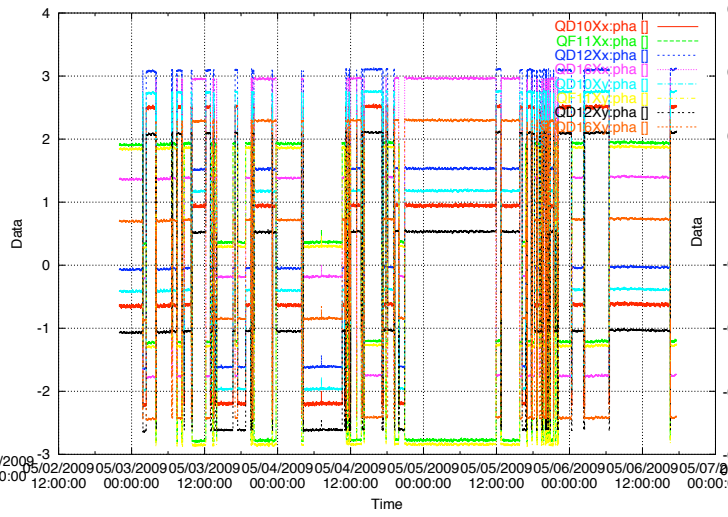
$$Q = \frac{A_d}{A_r}\sin\left(\phi_d - \phi_r\right)$$

Before trigger fix

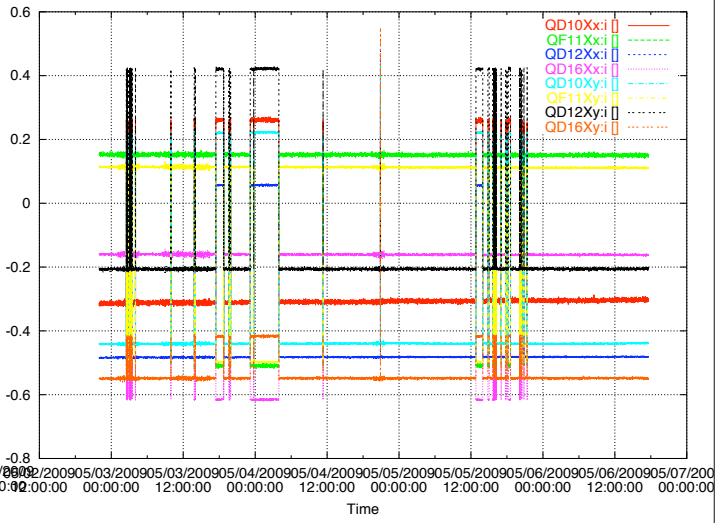
Amplitude



Phase



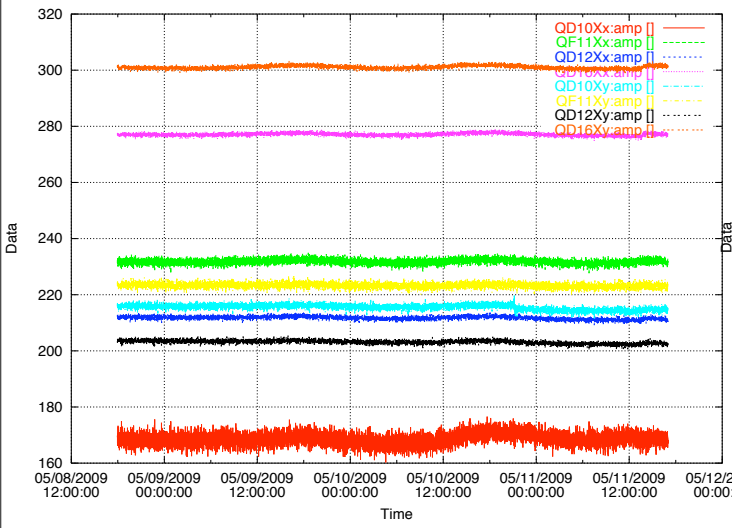
In-phase



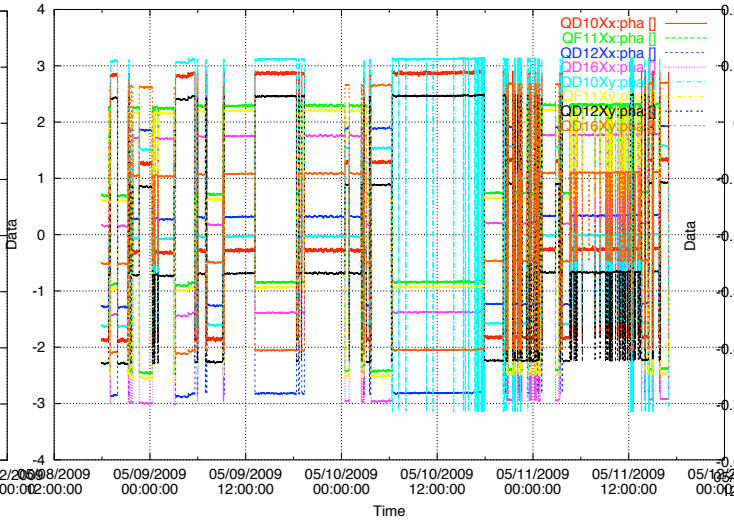
- Calibration tone essential for diagnostics
  - Signal for each of 8 card
  - Long periods of stability
  - Bistable I and Q

After trigger fix

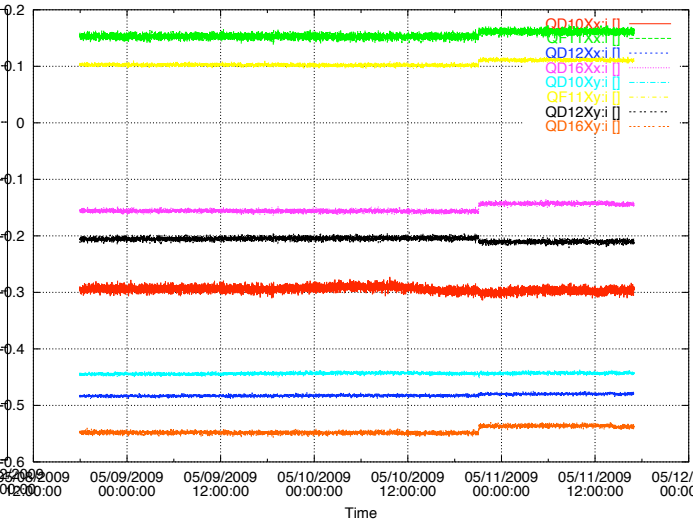
Amplitude



Phase

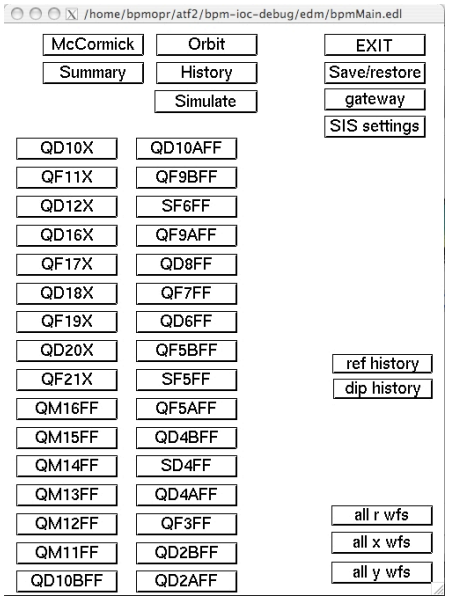


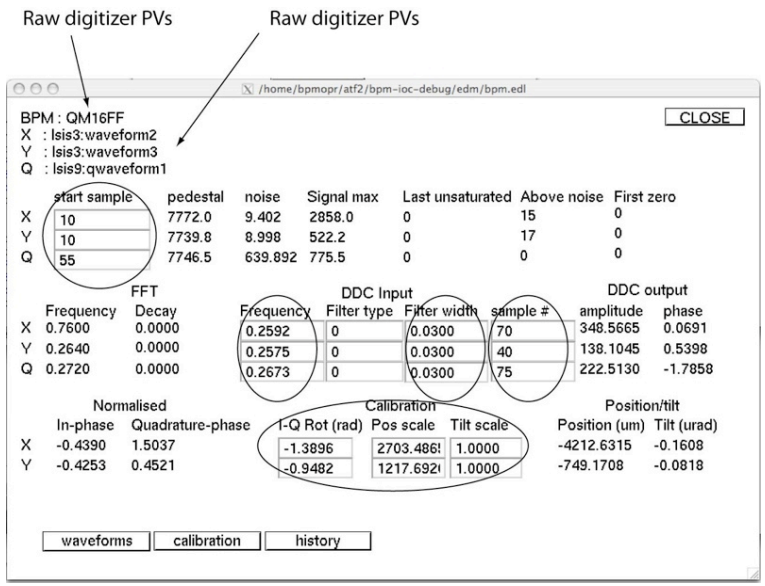
In-phase

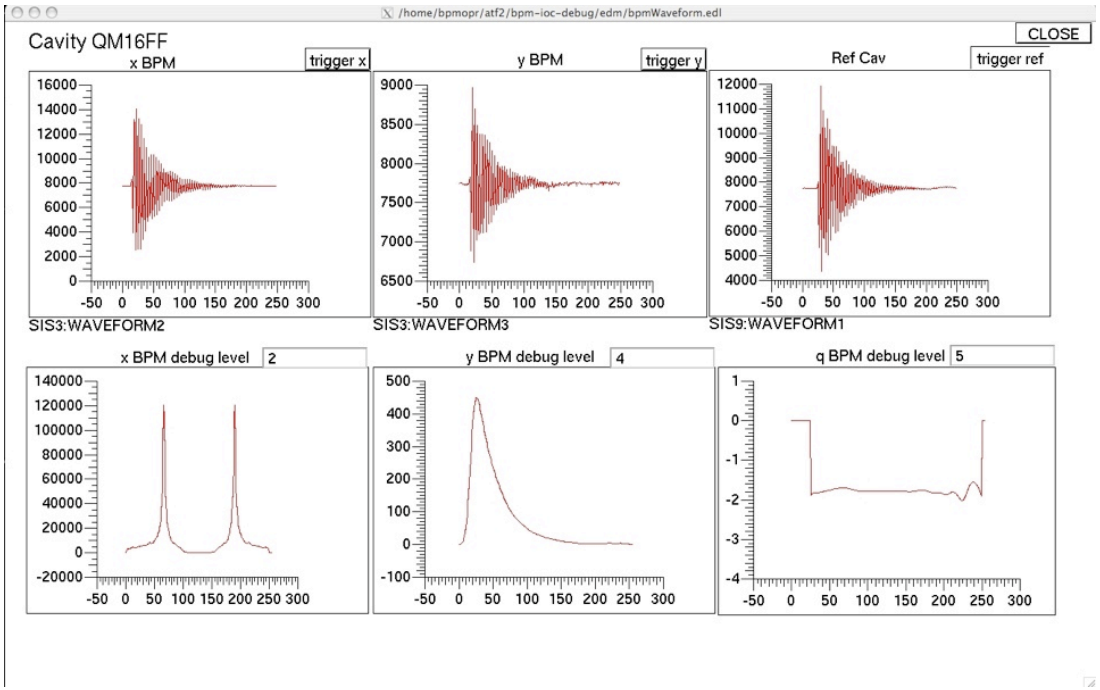


- System trigger via locking box 100 MHz signal
  - Stable even large 714 MHz phase variation
  - Amplitude is stable through out <5%
    - Must correlate with temperature
  - Tracks RF changes, including DR-RF ramp

EPICS control system



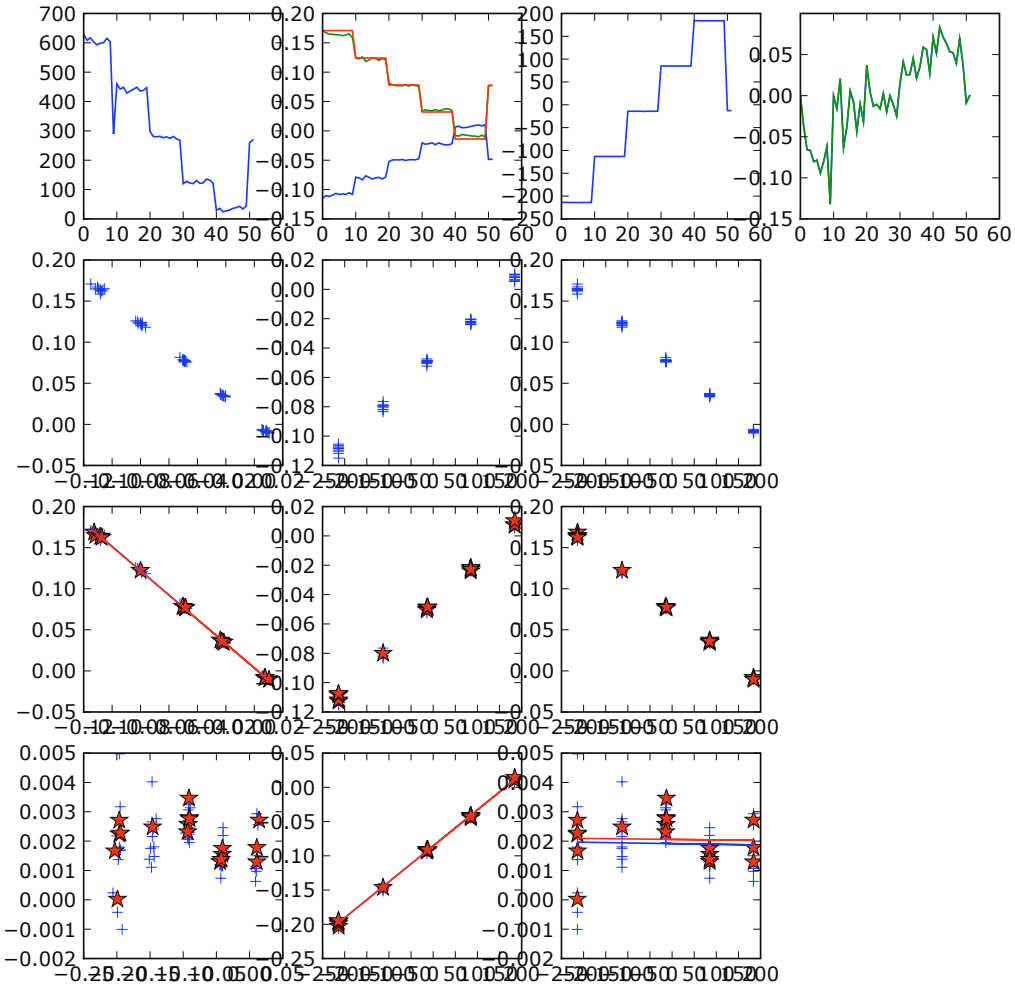




- EPICS based control
  - Aim to control digital system in a similar fashion to RF hardware
  - Change algorithm parameters
    - Filters, sample points, frequency
- Hardware implementation preferable

C-band system performance

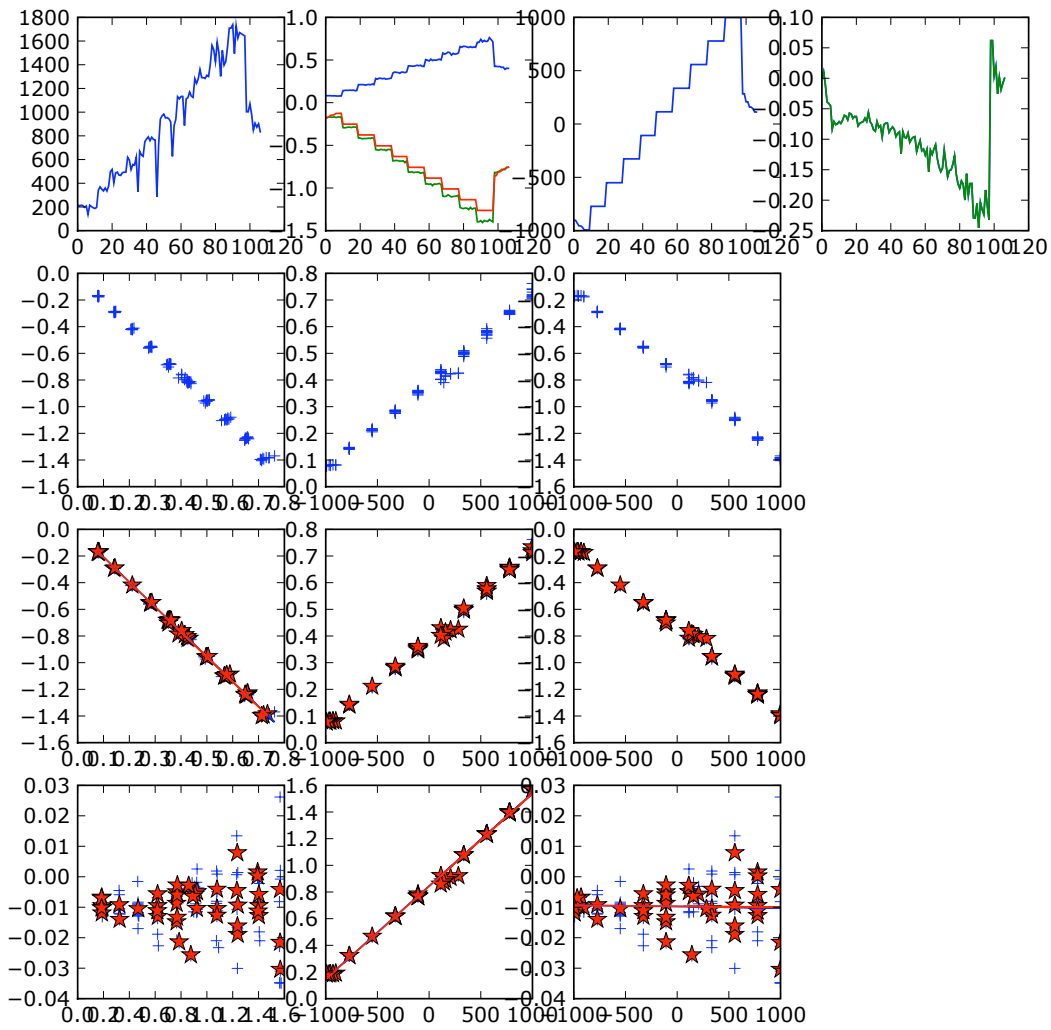
- Example of C-band system mover calibration
  - 400 um movement
  - 5 steps
- Performed for each of 22 BPMs on quad mover system
- Measured resolution 5 um
  - Mainly beam jitter need to subtract (SVD)



I-Q I-M Q-M

Long range calibration

- Test dynamic range in current state
  - +- 1 mm, 10 steps
  - Linear BPM response
- Movers have difficulty occasionally
  - residual roll after x or y move

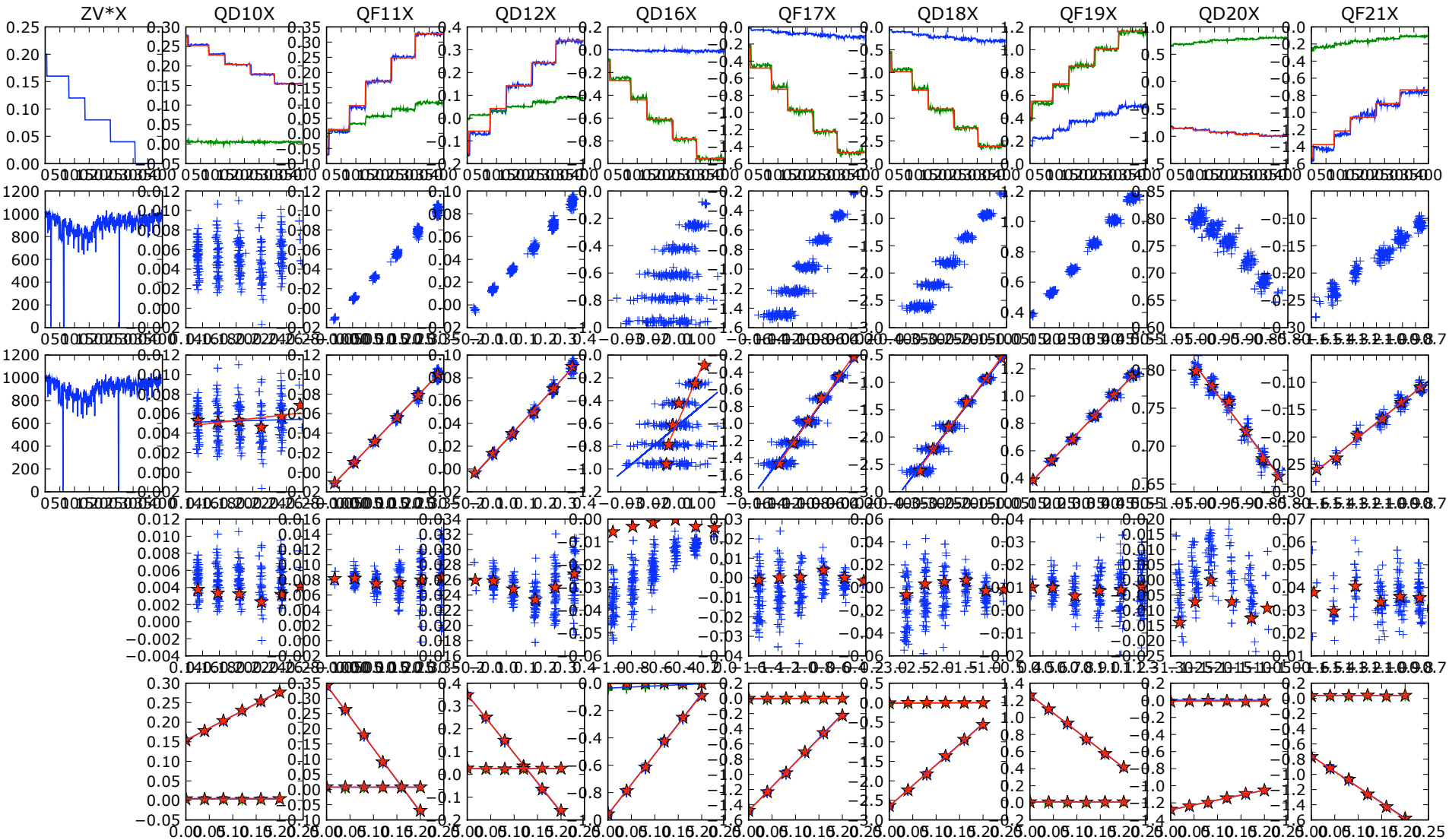


I-Q I-M Q-M

C-band corrector calibration

Static BPM calibration, ballistic orbit kick, ZV7X

../../data/20090513_fontBallisticCal/bpmAllLog_20090513_224930.dat



To do

- Before operations in October
  - Diode commissioning (t_0 determination)
  - Deal with saturation extrapolation properly
  - Complete scripts (data logging)
  - S-band system
    - Still few problems with data taking
  - Optics (for corrector calibrations and SVD methods)
    - 2 (4) magnet open (closed) bump preferred
  - Complete integration into ATF2 control system
  - Commission new computer (atf-lxs5 to replace nanosun)

Summary

- Progress since last ATF2 meeting
  - Locked calibration tone system commissioned
  - Archiving system tested
  - All BPMs calibrated
    - Analysis still being performed due to saturation, trigger and beam arrival changes
  - Offline code almost finished
    - python code (made all plots in talk, can be executed on shift by operators)
  - Need two/three weeks pre beam work to compete task list (SB & SM to visit Oct 09)