ATF2 C and S band BPM software & control

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LAL ATF2 meeting
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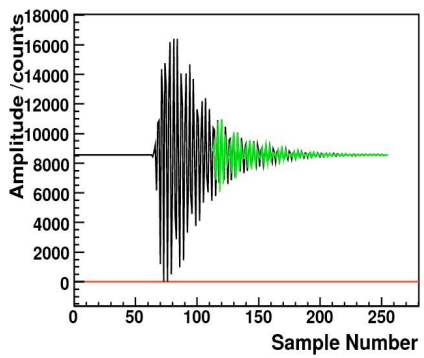
C/S-band processing software/controls

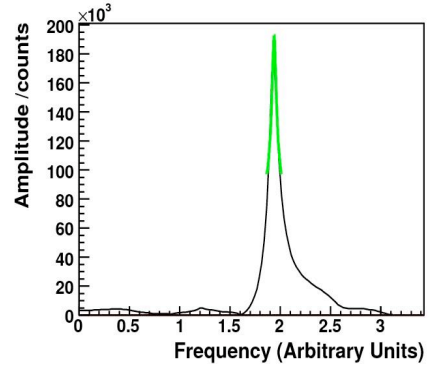
ATF Cavity BPMs

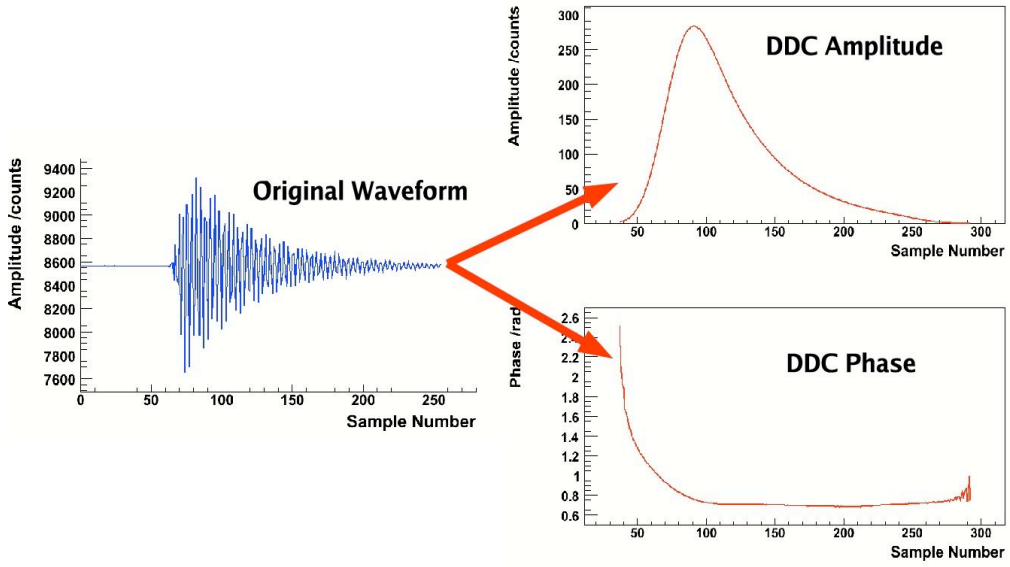
- 34 C-band cavities
- 3/4 S-Band cavities
- 3 possible test cavities (possible overhead)
- Processing for total 41 cavity BPMs
  - 20 MHz IF digitised at 100 to 120 MHz
  - Extract I-Q
  - Apply calibration constants (I-Q rotation, scale)
- Environmental monitoring
  - Tone calibration
  - Temperature etc...

Cavity BPM software system

- Same system can be used for both cavity BPMs C and S band
  - Digitally process 20 MHz IF, digitally mix to base-band
  - Robust code available based upon experience at ATF (NanoBPM and ESA-T474)
    - Either waveform fitting (slow, variable calculation latency) or digital downconversion (fast, fixed calculation latency)
    - nanoBPM and ESA results based on DDC method

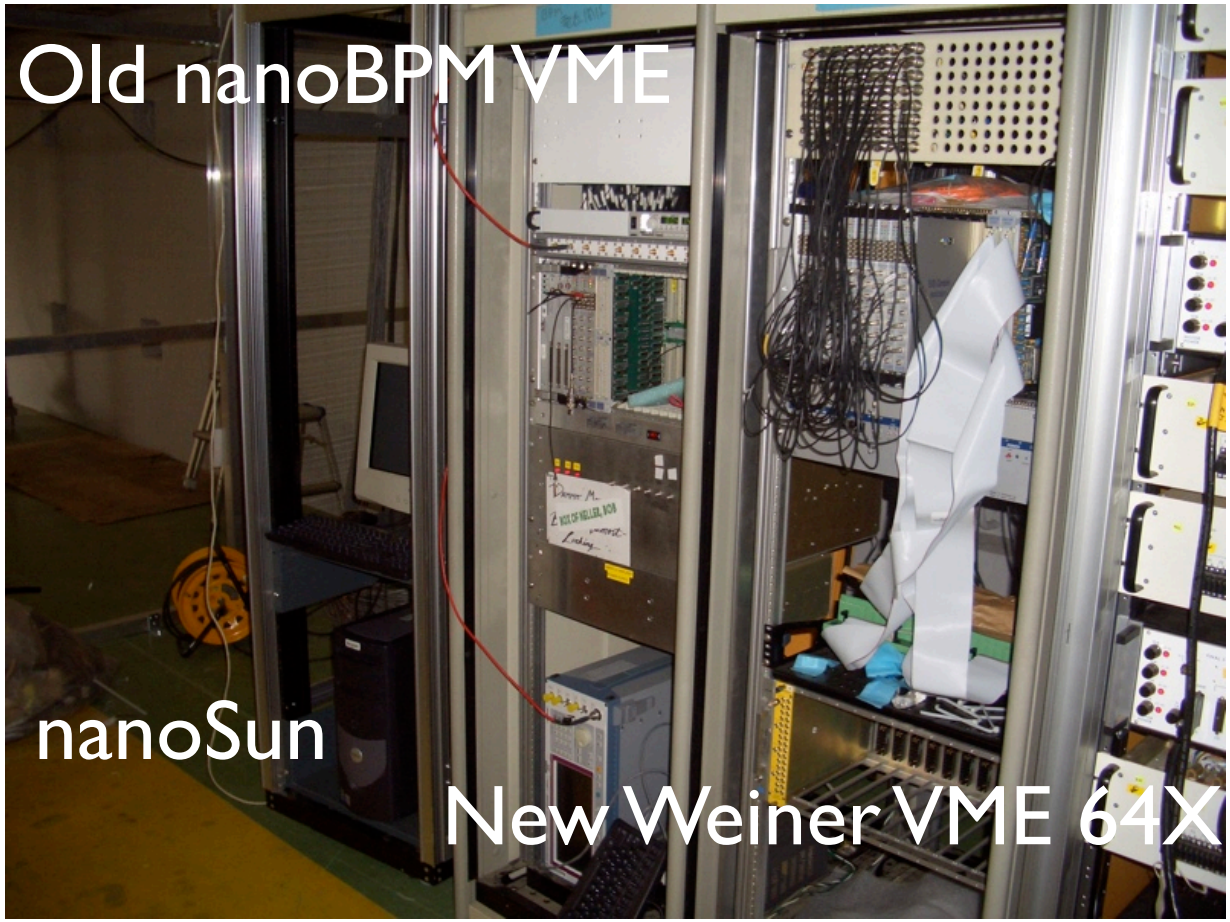






Existing physical configuration

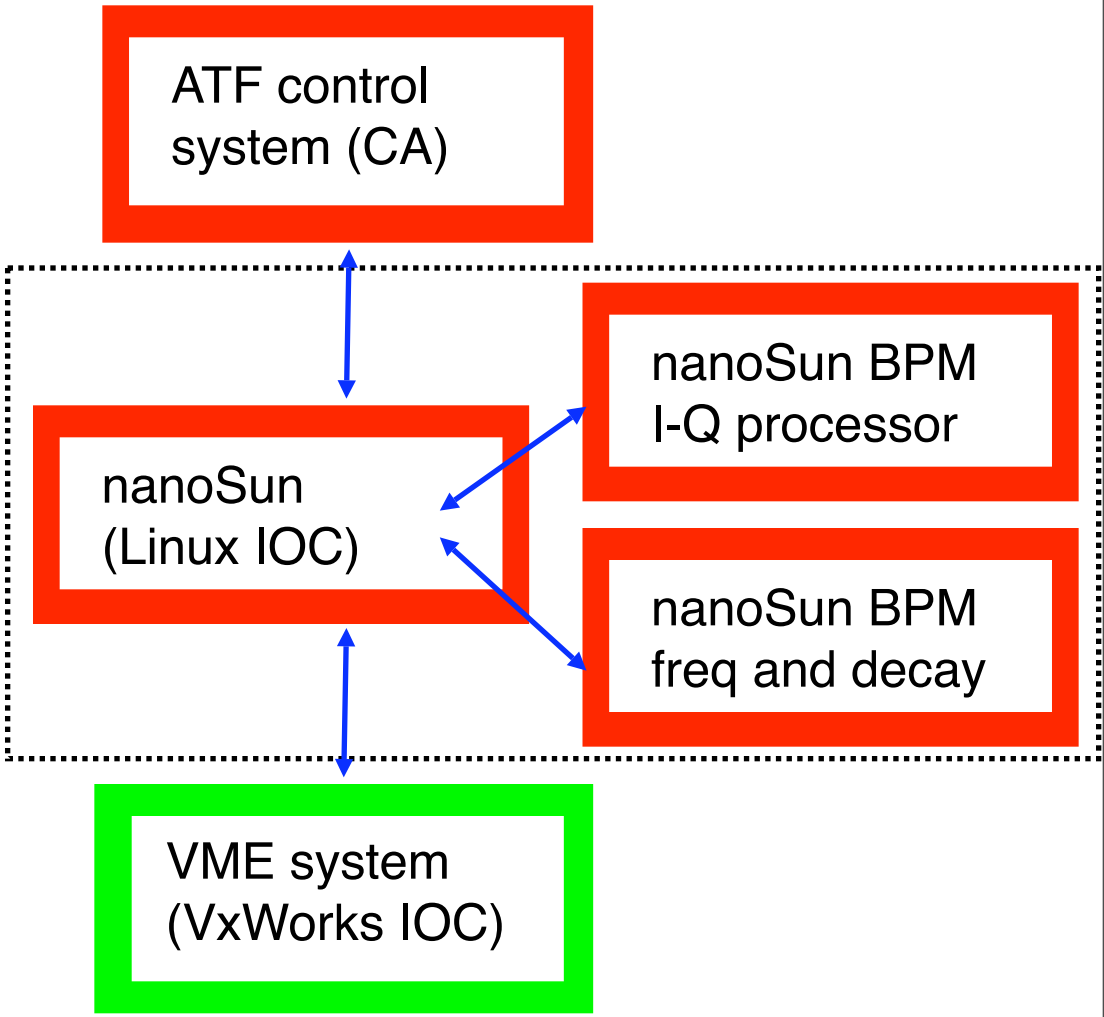
- 2 VME systems
  - 1 with MVME-167
  - 1 with no controller
- Existing system based on nanoBPM
- VxWorks IOC serving waveform data
- Last visit to KEK tested 10 SIS cards



MVME-167 will not work in 64X crate, need ethernet connector for backplane

Existing logical configuration

- MVME-167 system NFS boots from nanoSun
- nanoSun : linux RH enterprise machine
- out of date, disks nearly full etc etc
- Seriously consider updating machine
- Processed database on nanoSun or replacement

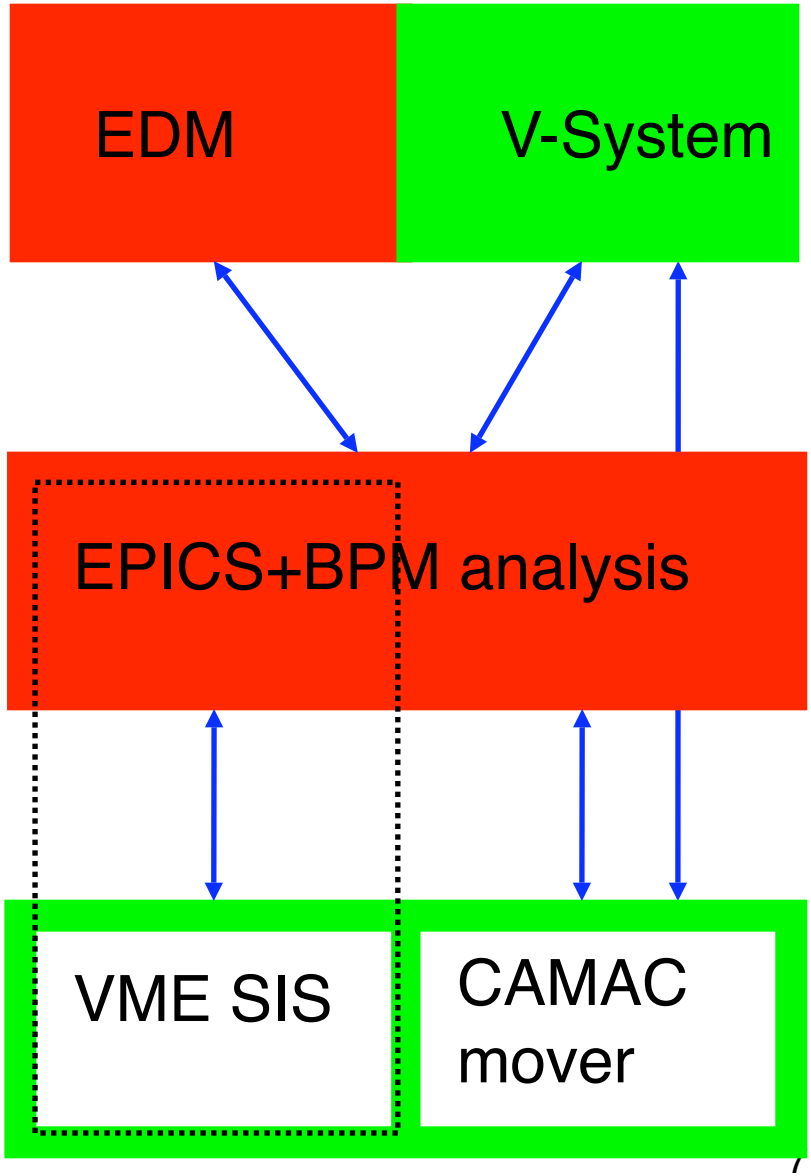


Hardware configuration

- MVME167
  - 12 SIS3301
  - 3-4 VIMC slow DC coupled digitizers
  - 2 Oregon scientific stepper controllers (might be useful for later)
- VxWorks EPICS problematic (version 3.13.10)
  - CASR/Archiver don't appear to work
  - ChannelAcess o.k
    - Simple archiver based on command line caput/get and cron job implemented for summer monitoring

Simple EPICS interface

- EPICS access to BPM waveforms
  - EPICS CA to waveform digitizers
  - EPICS process can also calculate main quantities of DDC (see database)
  - Does this process monitor mover state changes?
- Will integrate acquisition and processing in new VME processor



EPICS database

- Database well defined
  - Most of variables will be intermediate quantities for debugging
  - Database can be conceptually divided in relevant areas
    - Raw data
    - Processed data
    - Quality monitoring
    - Calibration

Hardware →

BPM raw data
- bpm1:waveform$_X$
- bpm1:waveform$_Y$

BPM processed data
- bpm1:ω_X,ω_Y
- bpm1:Γ_X,Γ_Y
- **bpm1:A_X,A_Y**
- **bpm1: ϕ_X, ϕ_Y**
- bpm1:I_X,I_Y
- bpm1:Q_X,Q_Y
- **bpm1:x,y** → ATF
- bpm1:calibrating?
- bpm1:saturation?
- bpm1:analysis?

BPM calibration
- bpm1:scale$_X$,scale$_Y$
- bpm1:Φ_{IQ},Φ_{IQ}

More complicated interface aspects

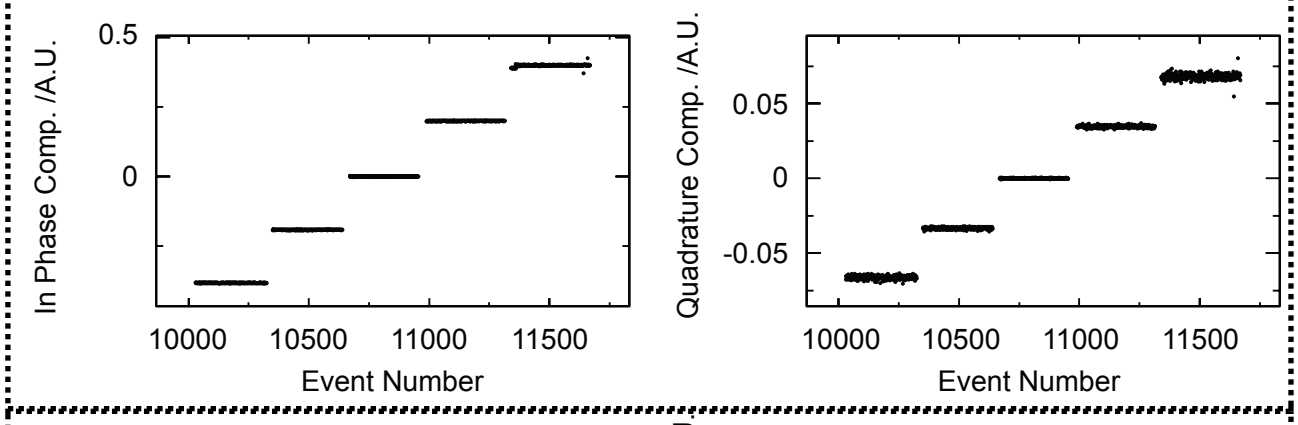
- Calibration using magnet mover system
  - Who controls this?
  - How are the constants calculated?
  - BPM system informed of magnet mover system state changes?
- Calibration tone, is stored locally on crate controller and updates main constants on a pulse by pulse basis (no problems there)
- Asynchronous full BPM buffers must also be stored for debugging (0.01 Hz, full waveforms)
- Ancillary data? Temperature monitoring/LO power

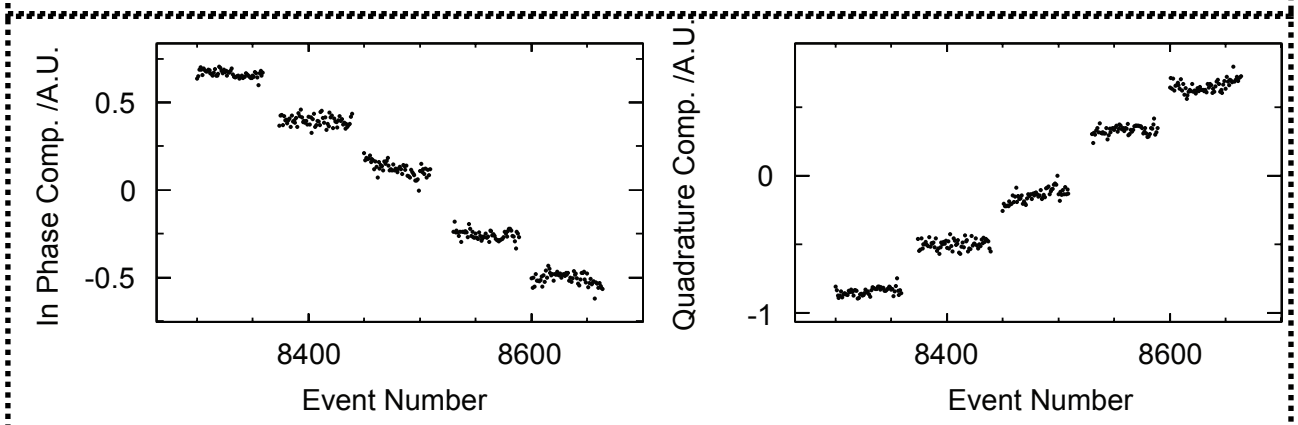
Quad mover calibration

- Possible schemes
  - BPM system informed of calibration
  - Starts monitoring mover positions
  - Once sufficient data available calculate calibration coefficients
- Should be V-system controlled
  - Could just start a sequence of actions on mover/bpm system

ESA calibration example

Beam motion removed

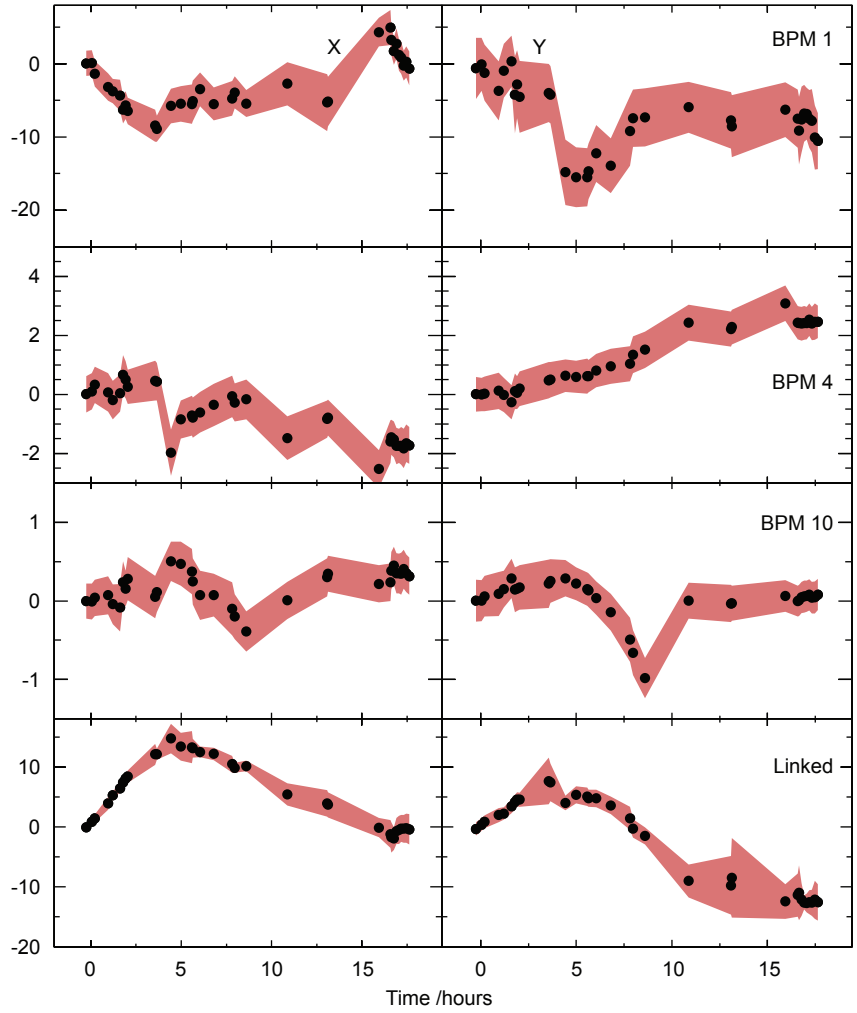




No beam drift subtraction

Environmental monitoring

- Need to have well understood calibration constants
  - nanoBPM experience not promising
    - ~few hours
  - ESA monitored calibration stability over 12 to 24 hours
  - Mainly temperature related
    - Small drifts only 2 degrees



BPM resolution ~500 nm

SBC crate controller

- VME system arrived in Royal Holloway
  - GE Fanuc V7865
    - Single slot (NFS mount primary or flash drive)
    - Intel Core 2 Duo @ 2.16 GHz
    - Dual gigabit ethernet
    - Will scale for entire ATF2 lifetime
  - Probably install linux with real time extensions
    - EPICS (complete with extensions)
  - One SIS3301 already at Royal Holloway another to come from SLAC (ESA) in a month

Summer preparation work

- IOC for processed BPM data
  - Nearly complete
  - Develop simulation mode (existing nanoBPM data and/or simulation of RF waveforms)
  - Simulation Maiheu/Lyapin (complete enough to simulate first pulse)
- Processing algorithms
  - Update to new ESA analysis (B. Maiheu is working on this) will meet in two weeks to discuss
- Linux low level driver code (just SIS3301)
  - ~1 month development and test time

Summary

- BPM processed data database and algorithms should be complete within a month
  - Linux/EPICS Driver for SIS3301 will take longer but not required for first beam, will upgrade during course of first operations year
- Calibration algorithms
  - Mover state monitoring
  - VMIC input (temperature, LO, will also take time)
- First beam system almost ready (based on MVME-167 existing infrastructure)
  - Unstable, unsupported (available expertise)
  - Good starting point

Action items /discussion points

- Overall control structure?
- Various async processes
  - Frequency and decay constant
  - Electronics gain, phase monitoring
  - Updating general calibration/control constants
- Event monitoring architecture?
  - Quad mover calibration
- Stable operations will need good archiving and save/restore functionality
  - Data available to experts remote participants