ATF2 Q-BPM Electronics

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Third ATF2 Project Meeting

J. Frisch, J. May, D. McCormick,
T.Smith (SLAC)

S. Boogert (RH)

B. Meller (Cornell)

Y. Honda (KEK)

Outline

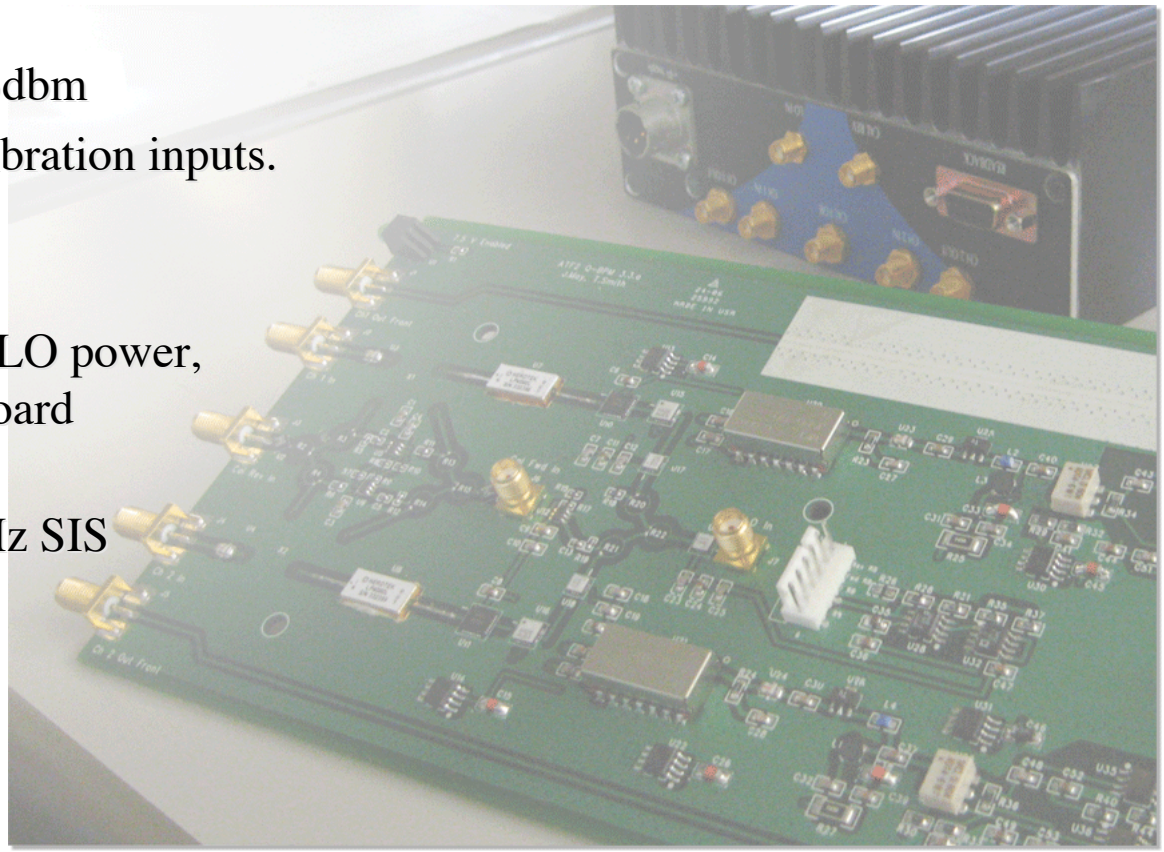
- Hardware
- Operation
- Installation

Goal

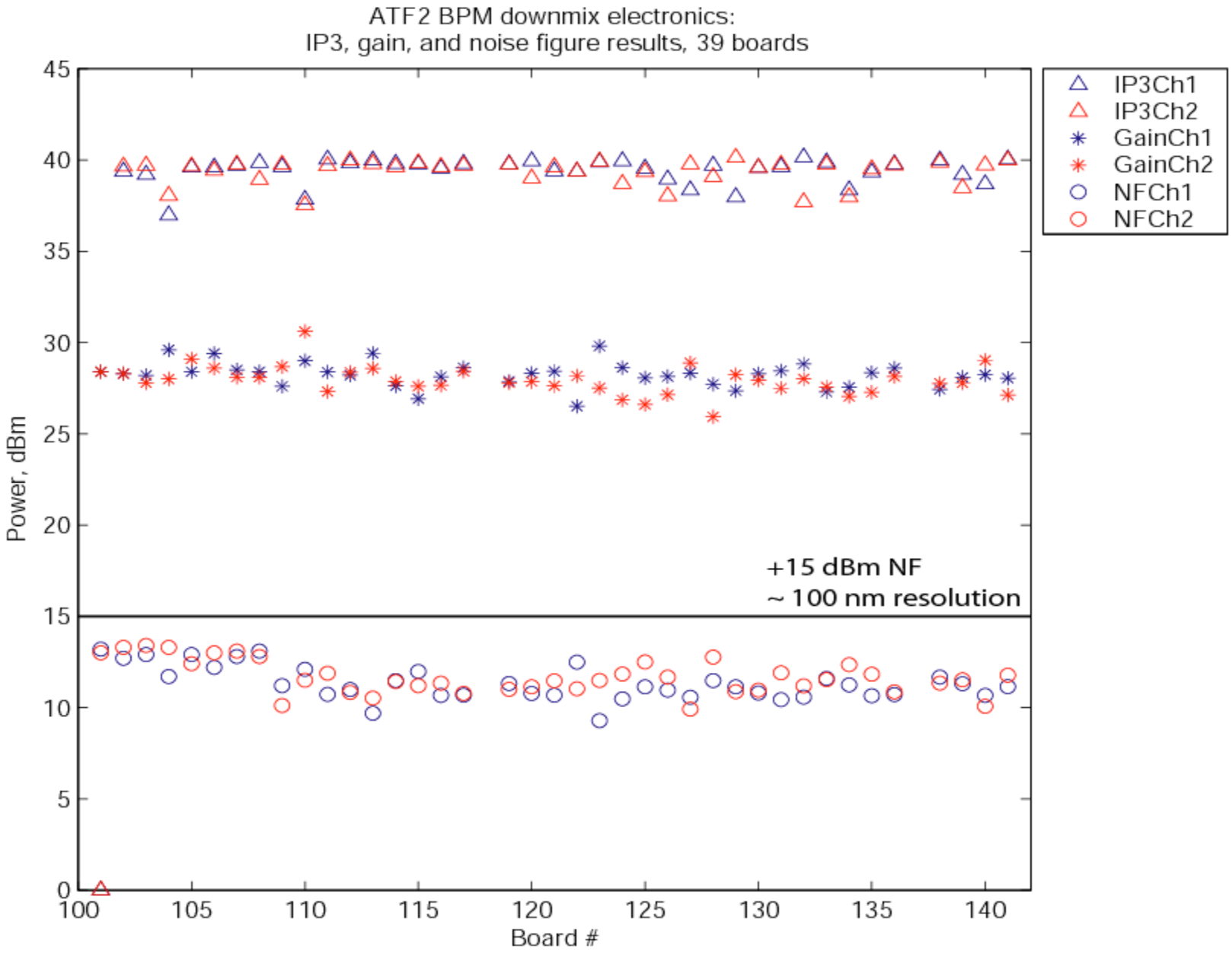
- Provide all hardware required to process the signal from the output of the QBPM hybrid up to and including the VME digitizers.
- Produce software to process the QBPM signals, extract position information and pass it to the ATF control system for display.
- Produce software for QBPM calibration and system monitoring.

Electronics Overview

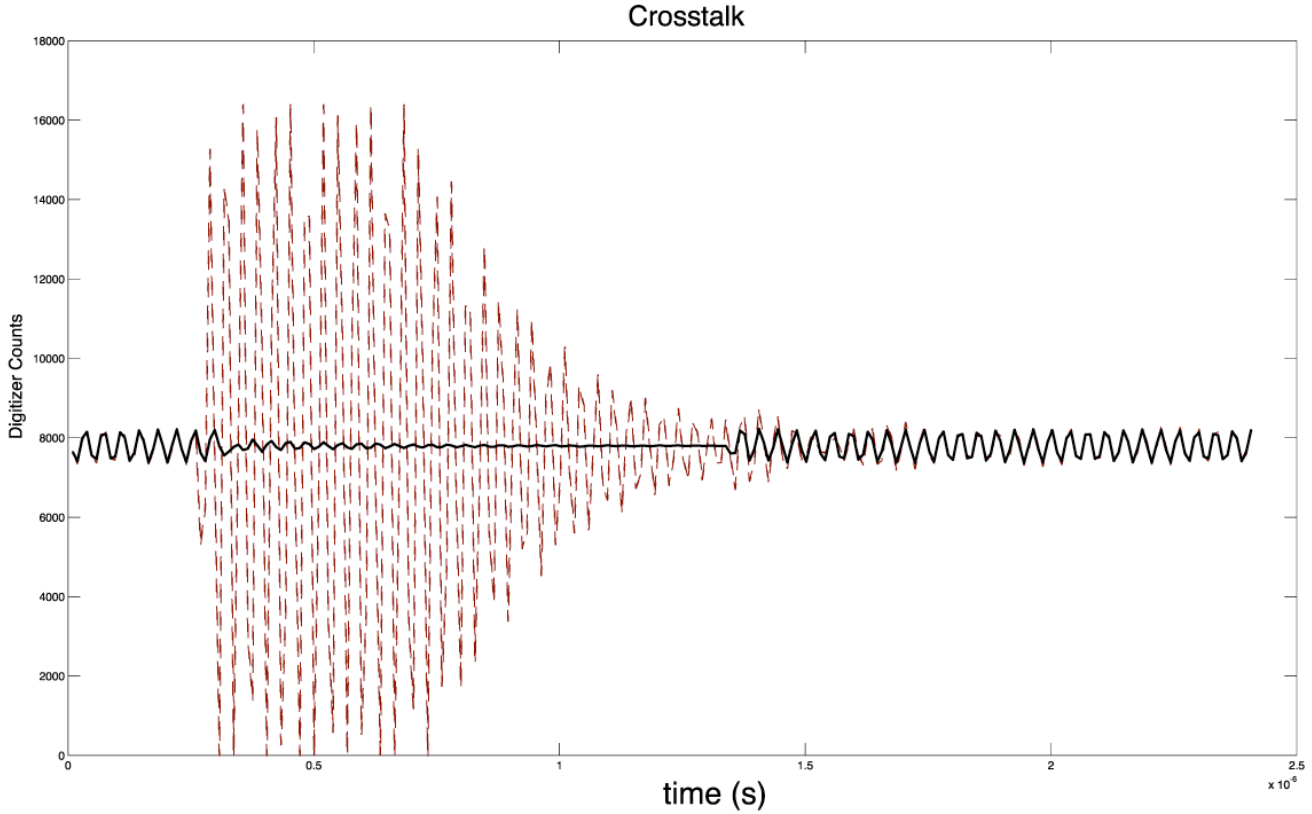
- Downmix ~6426 MHz to 26 MHz
- 2ch/box
- Single LO input. Level 3dbm
- Forward and reverse calibration inputs. Level from 0 to 20dbm
- DC input 5.8 W at 8V
- Analog outputs monitor LO power, Calibration power and board temperature.
- Output to 14-bit 100 MHz SIS digitizers



Performance Results



Crosstalk

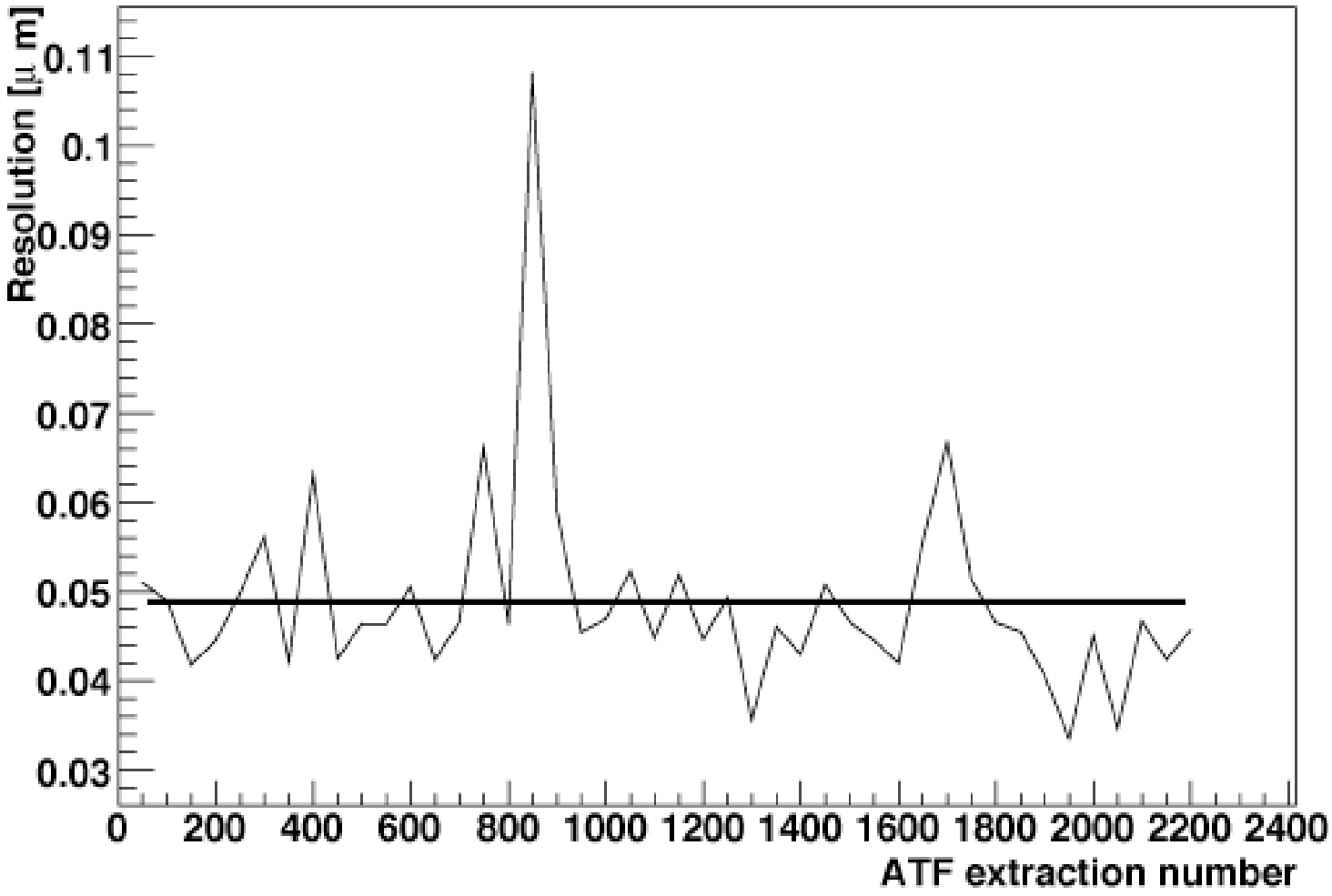


Heavily saturated BPM pulse in channel 1 of electronics

Solid line is the response in channel 2 with no input (terminated)

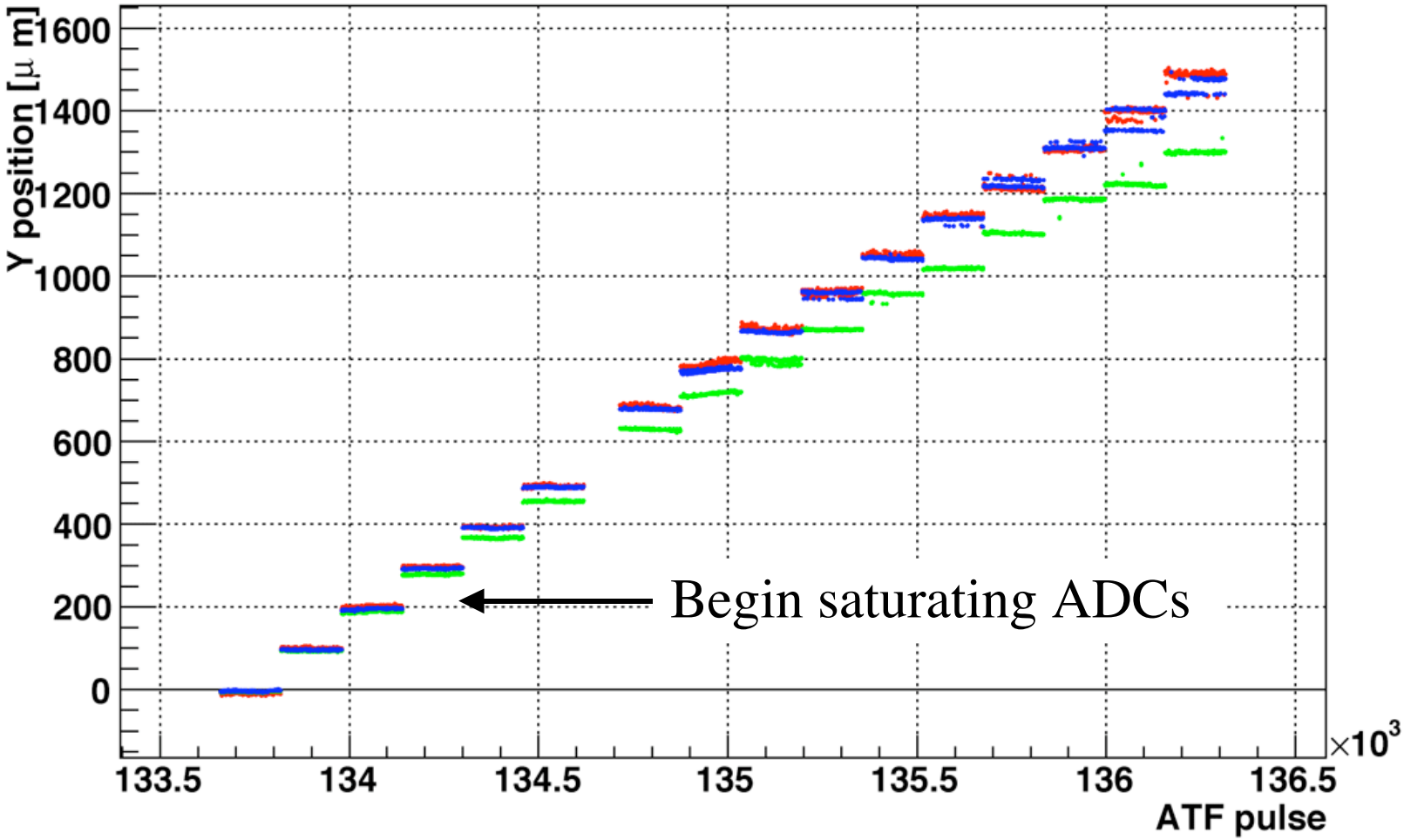
~60 dB channel-to-channel isolation on same board

Resolution

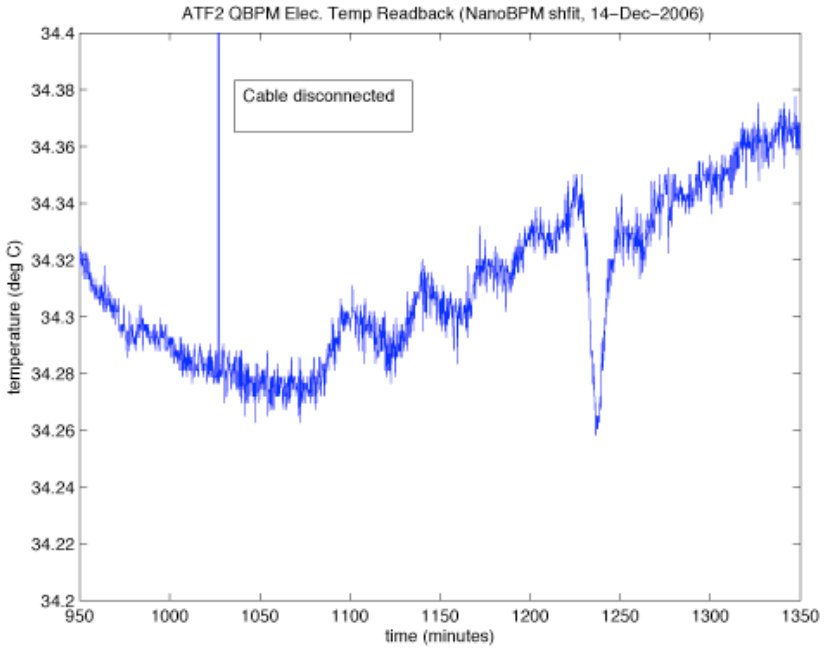

Resolution [μ m]
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
ATF extraction number

Performance in Saturation

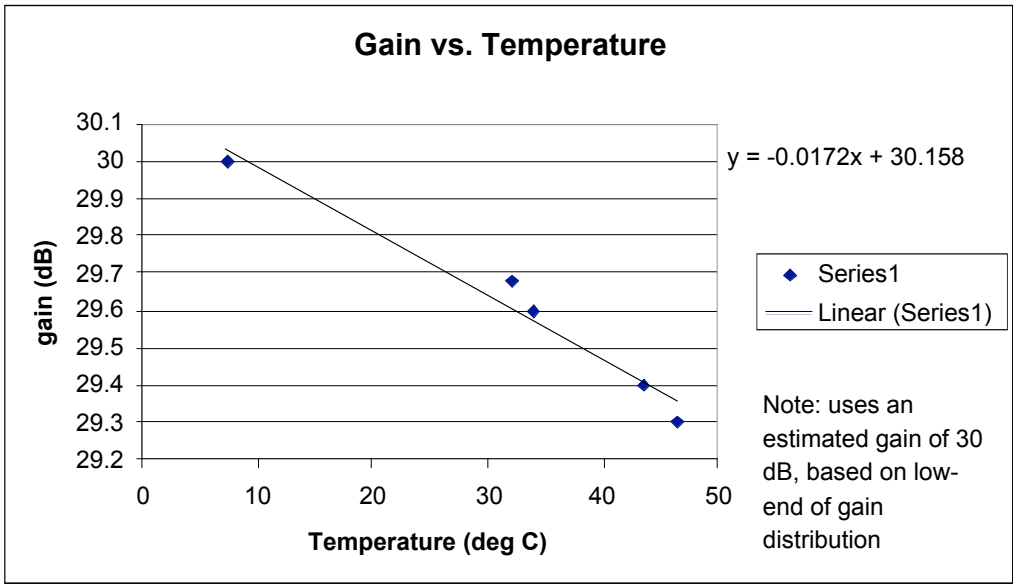
- Digitizer limits +/- 1 V



Read Back Results



Temperature data sample from 14-Dec-2006 (NanoBPM shift running ATF2 electronics)



Test ramp using temperature control enclosure at ESB

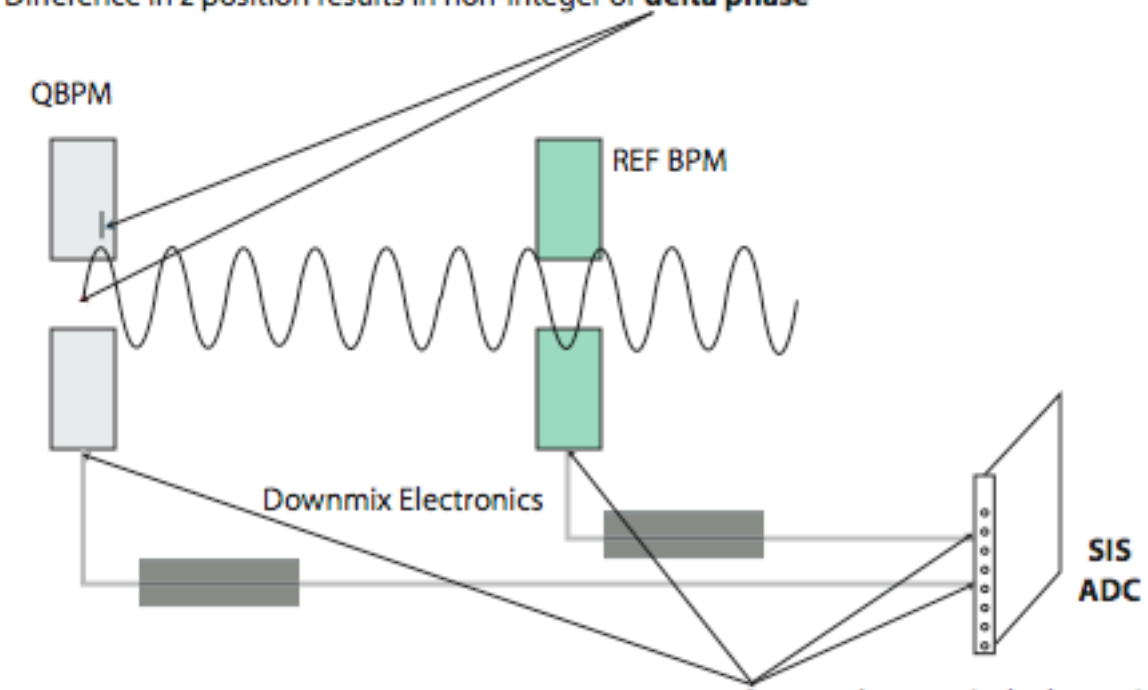
OPERATION

- First pulse calibration
  - Provide a rapid method of obtaining relative x and y positions with the correct sign from each QBPM. Beam only required to be through the first QBPM and Reference cavity.
  - Requires careful setup and measuring of Z positions of QBPMs and REF cavities. Phase advance of RF and IF cable plant must also be measured or adjusted.
  - All this is to be done before beam operation.

Operation

First Pulse Calibration

Difference in z position results in non-integer or **delta phase**



Set equal, or precisely determine the LO phase and signal path for each BPM

The distance between the reference cavity and a given BPM produces a noninteger cycle of 6426MHz.
This is the phase difference betweent he REF cavity and the BPM.signal phase (**delta phase**).

Calibrate one BPM with corrector ::
This BPM's signal minus its BPM **delta phase** is the **signal phase** for a positive (x and y) orbit through BPM
For each downstream BPM, correct its signal with its **delta phase** and compare with the **signal phase**.

A corrected BPM signal that is 0-179° from the **signal phase** indicates a positive(x and y) orbit in the BPM.

Relative amplitude of the position can be produced scaling the digitizers 14bits to +-10mm.

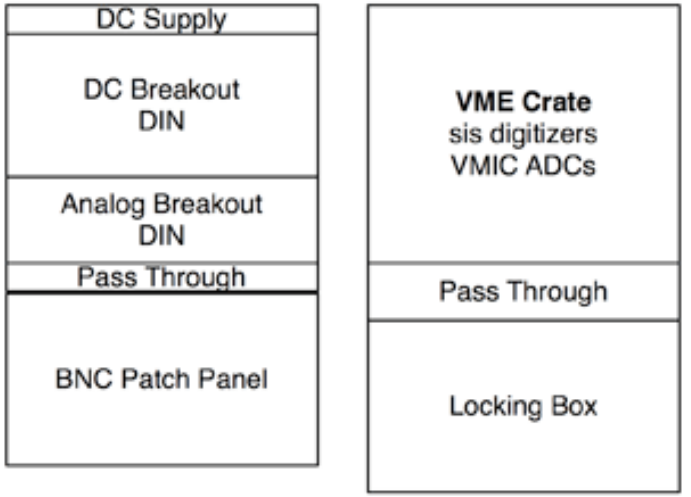
- Mover Calibration
  - Use X and Y movers to perform absolute calibration.
  - Use DDC analysis to obtain I and Q phases and produce calibrations. Corrector scans for QBPMs with no movers?
  - Need to improve program to improve response time, and handle saturated signal conditions

Installation

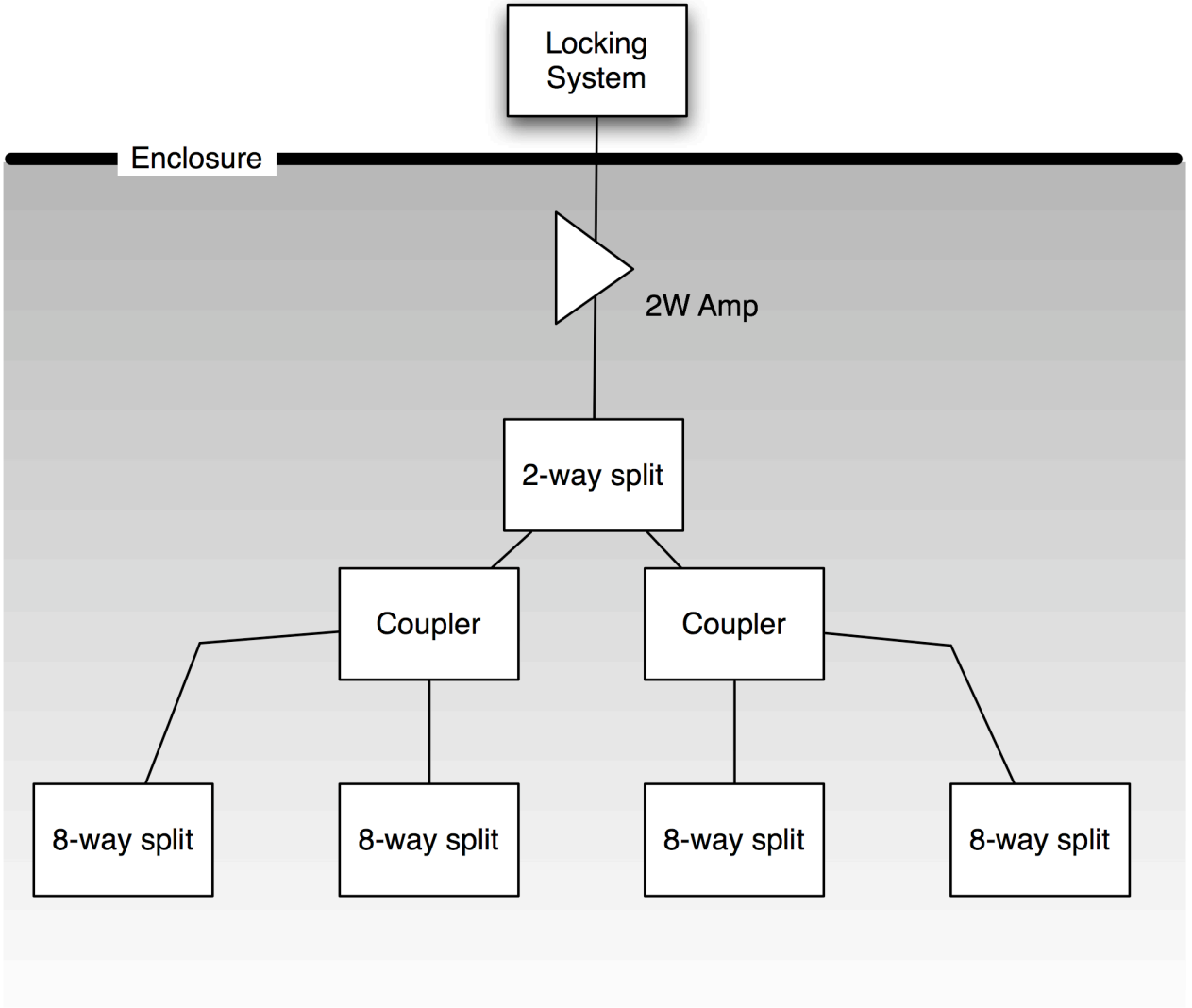
- Electronics and hardware
- Software development

Electronics and hardware

- Components
  - 38 down mix boxes
  - VME 64x crate
    - VME cpu type yet to be determined. Support vxWorks or RTEMS
    - 10 SIS digitizers (80 channels).
    - 2 analog read back digitizers (VMIC 3122)
  - DC power supply, cables and distribution chassis
  - Analog read back cables and patch panel system
  - 20 MHz signal cables patch panel and jumper cables.
  - BPM magnet mover test bed.
    - ATF2 quad with ,QBPM on magnet mover in ATF extraction line.
  - RF infrastructure (see next)
    - LO/CAL locking system
    - LO/CAL distribution system
      - 2 Watt 6444MHz distribution amp, couplers and splitters



RF Infrastructure in tunnel



Software development

- EPICS IOC for VME control.
- Single pulse readout.
- Magnet mover calibration.
- Position calculation. DDC analysis for normal and saturated BPM signals.
- Calibration tone amplifier gain monitoring.
- LO, CAL power and temperature monitoring.
- EPICS communication with ATF control system.

Delivered

- 38 Down mix boxes
- 10 SIS modules
- 2 Analog input modules
- DC power distribution
- Analog distribution
- LO locking box. (Tested during Dec. run)
  Still need to add CAL tone locking system

Still to go…

- Need detailed information on rack locations, penetrations into the housing, and cable routing in the tunnel before finalizing cable plant for LO and CAL systems
- Select VME crate controller
  - RTEMS or vxWorks
- Software development
- Test bed setup. Ready for spring ‘07 testing.
  - Test first pulse and mover calibration schemes

EXTRA: Detailed RF Dist. Path