

10 Hz Global Orbit Feedback System

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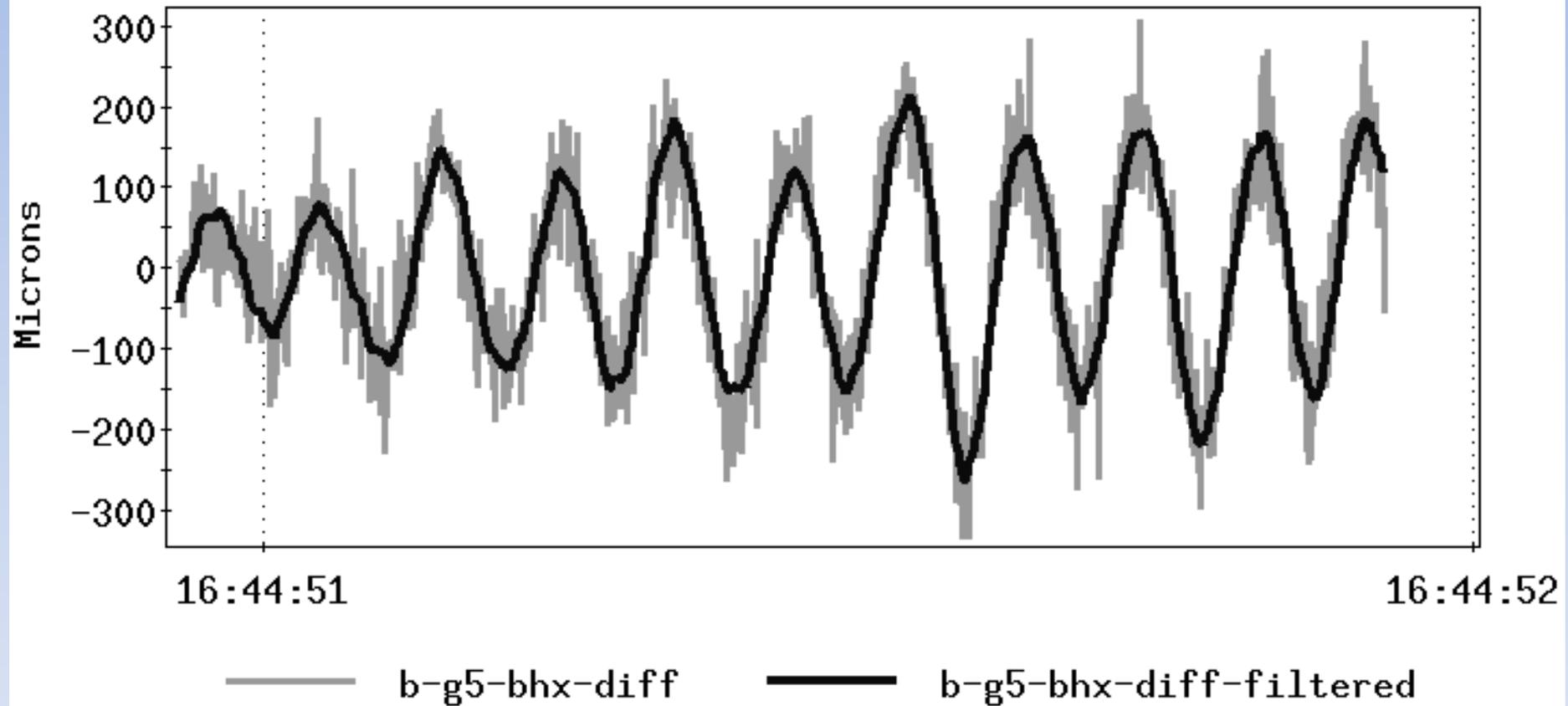
Topics

- Purpose of the system
- Overview of architecture
- BPM data distribution
- New steel laminated core magnets
- Status
- Plan for this experimental run
- Cost overview

Purpose of the System

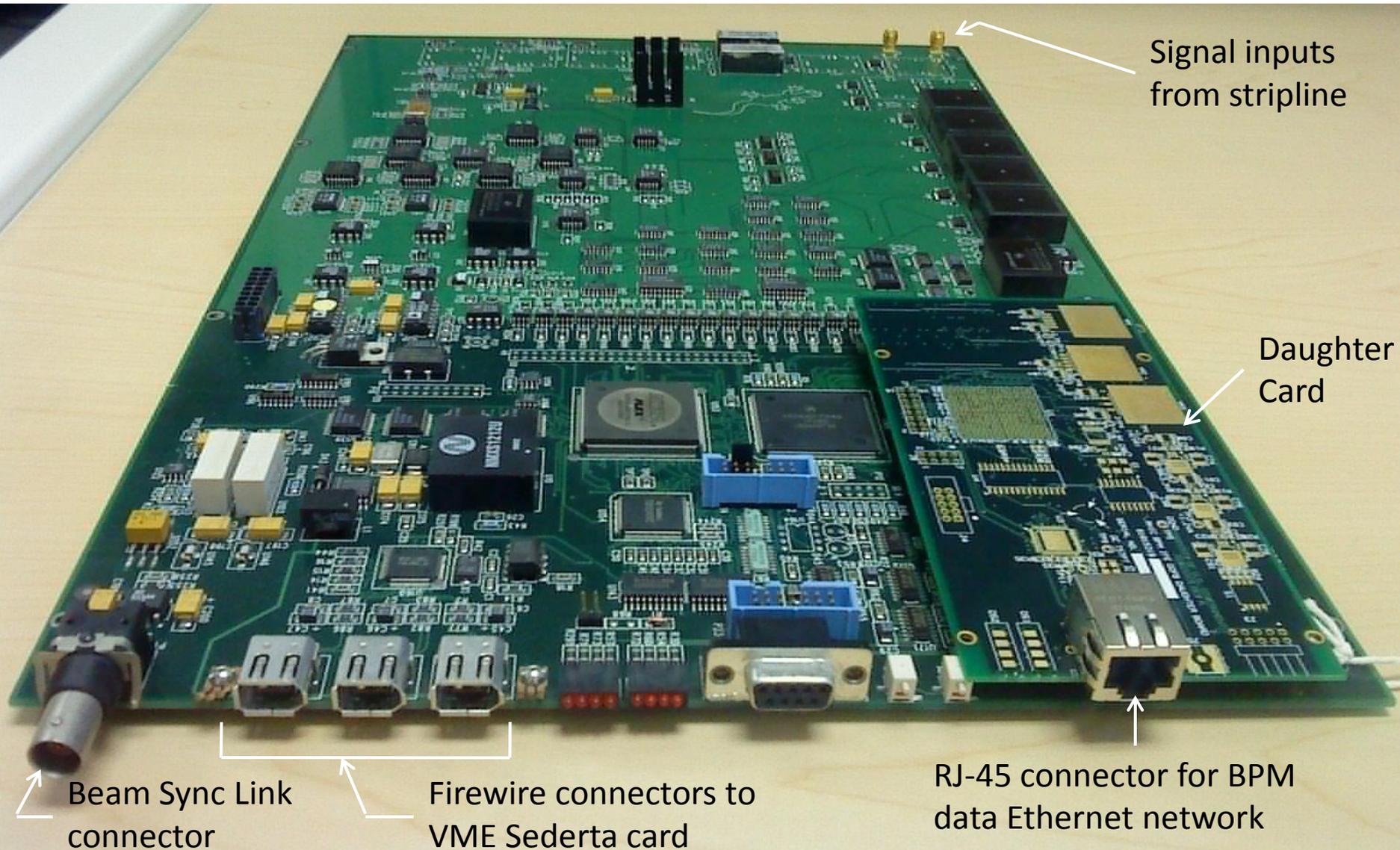
- To provide global orbit correction of the beam perturbations around 10 Hz.
- 36 BPM measurements and 12 dedicated corrector magnets will be used for each ring.

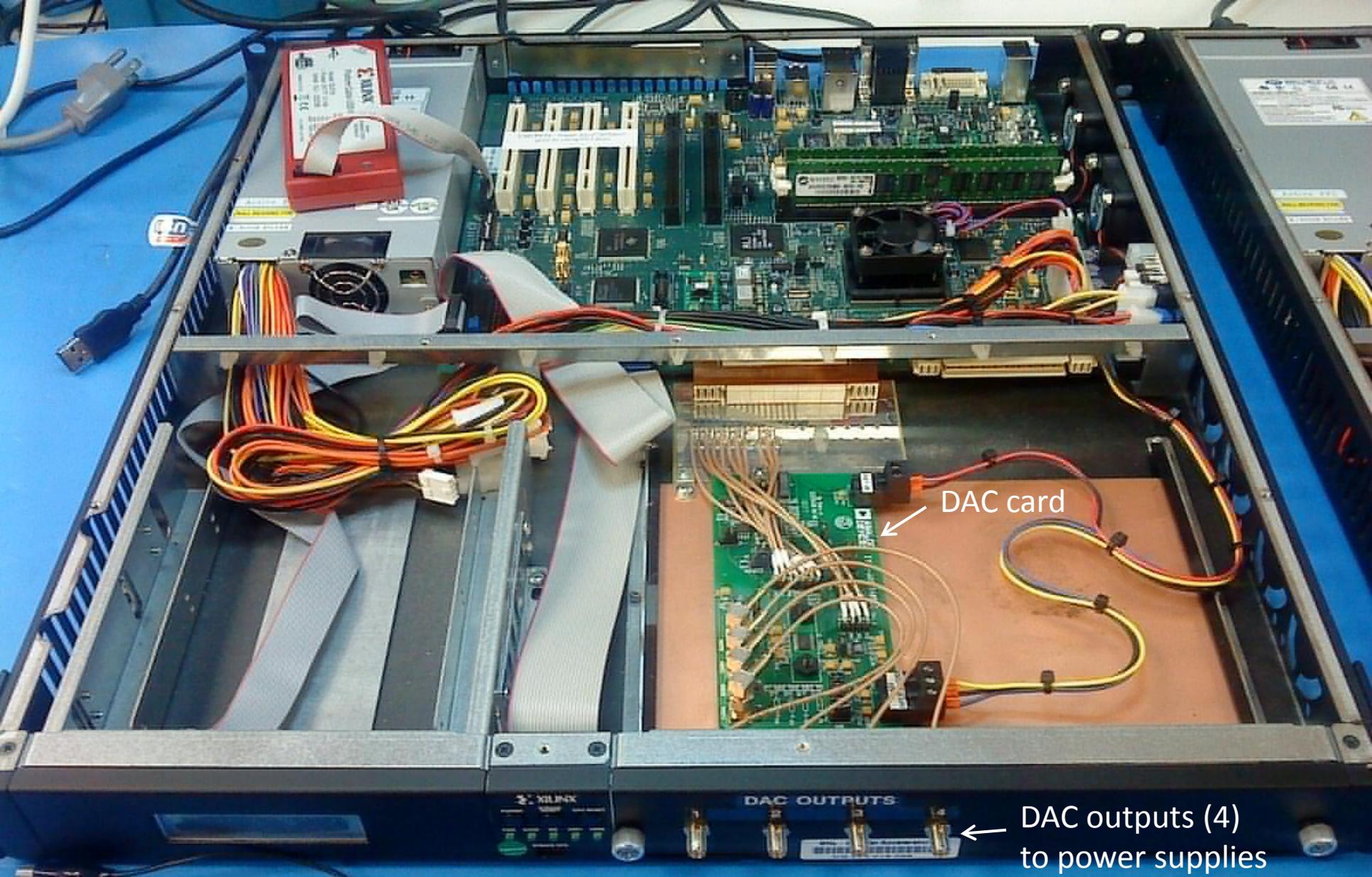
BPM Raw Difference vs. Filtered Difference



The digital filtered difference signal will be used for the orbit correction calculations.

RHIC BPM IFE board with daughter card





ML-510 with digital to analog converter card

10 Hz GOFB Hardware Block Diagram

Typical for each svc building and local alcoves



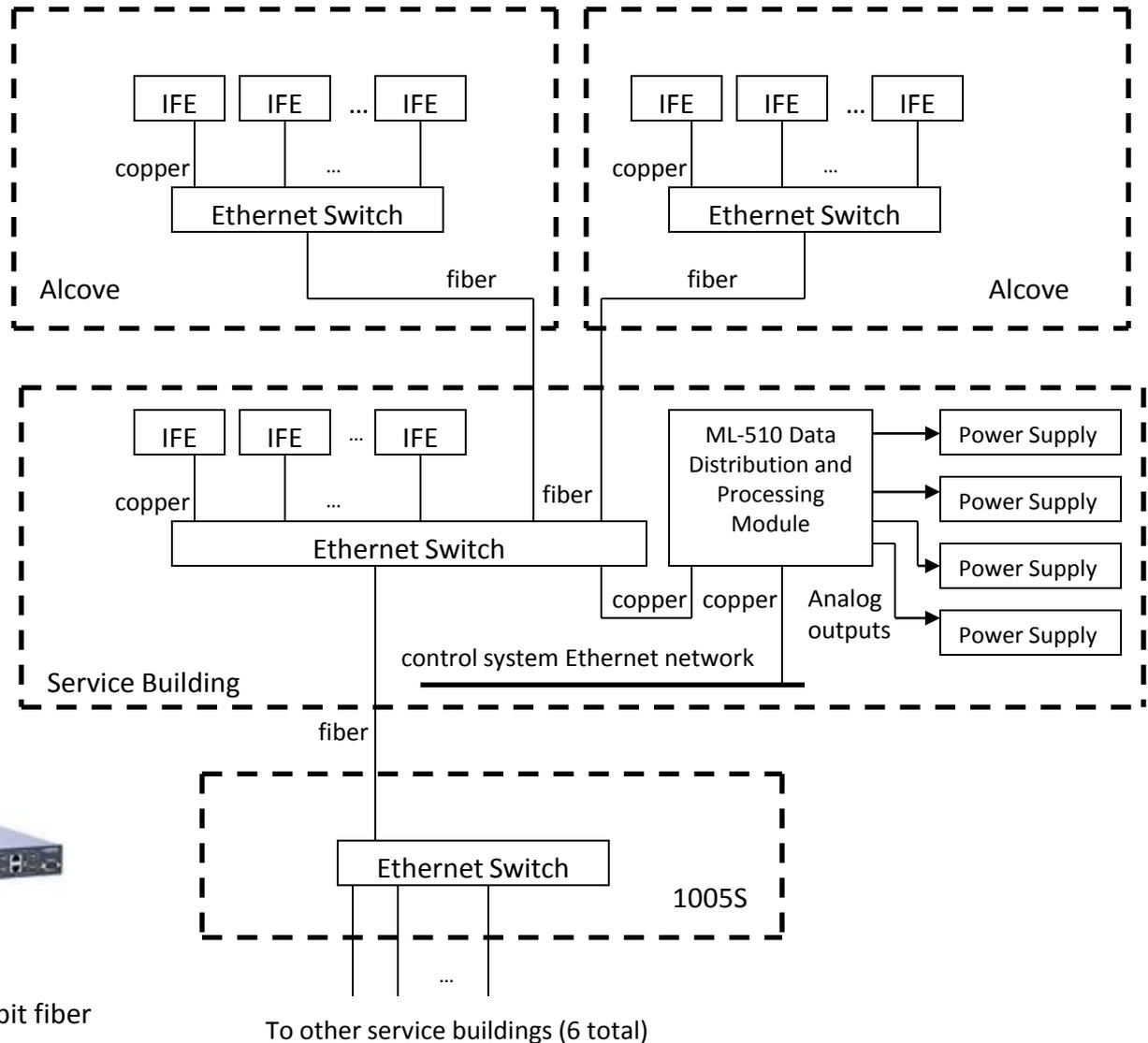
Alcove Ethernet Switch
Netgear GS724AT
24 RJ-45, w/ 4 SFP ports



Service Building Ethernet Switch
Netgear GS724AT
24 RJ-45, w/ 4 SFP ports



1005S Ethernet Switch
Netgear GSM7212
12 SFP ports for 1 gigabit fiber



BPM Data Distribution Timing

Description	Time
Maximum fiber optic cable delay (1001A to 1012A to 1005S to 1010A)	25 us
Measured maximum Netgear network switch latency time through 4 switches (alcove to service building to 1005S to service building)	18 us
Time to send 72 packets (36 BPMs per ring) on 1 Gigabit link. (72 pkts * 84 bytes/pkt * 8 bits/byte * 1 ns/bit)	49 us
Total	92 us

This timing does not include the BPM IFE data acquisition time.
(ADC processing delay is approx. 10 us.)

ML-510 and Ethernet Switch Test Setup

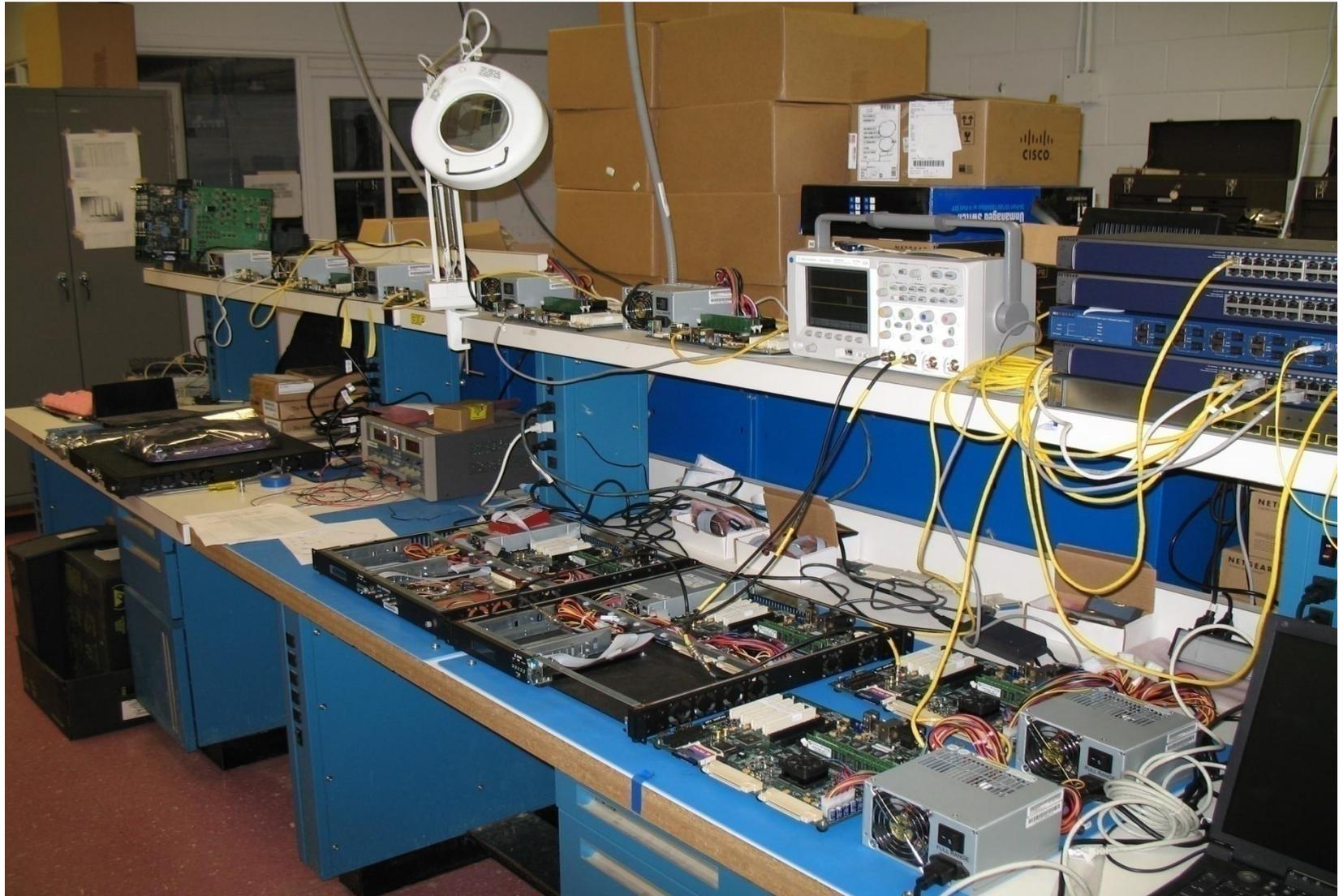
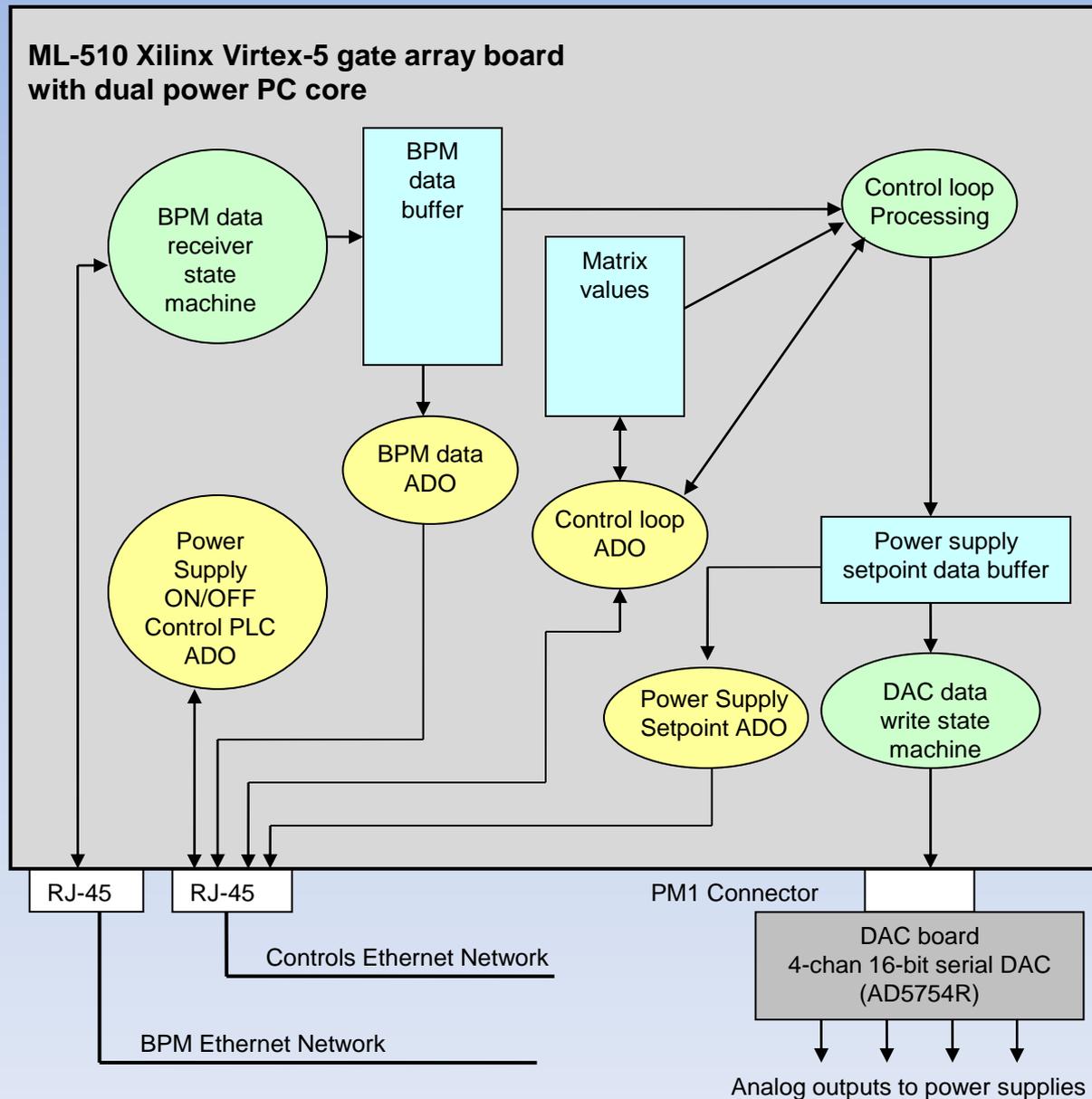
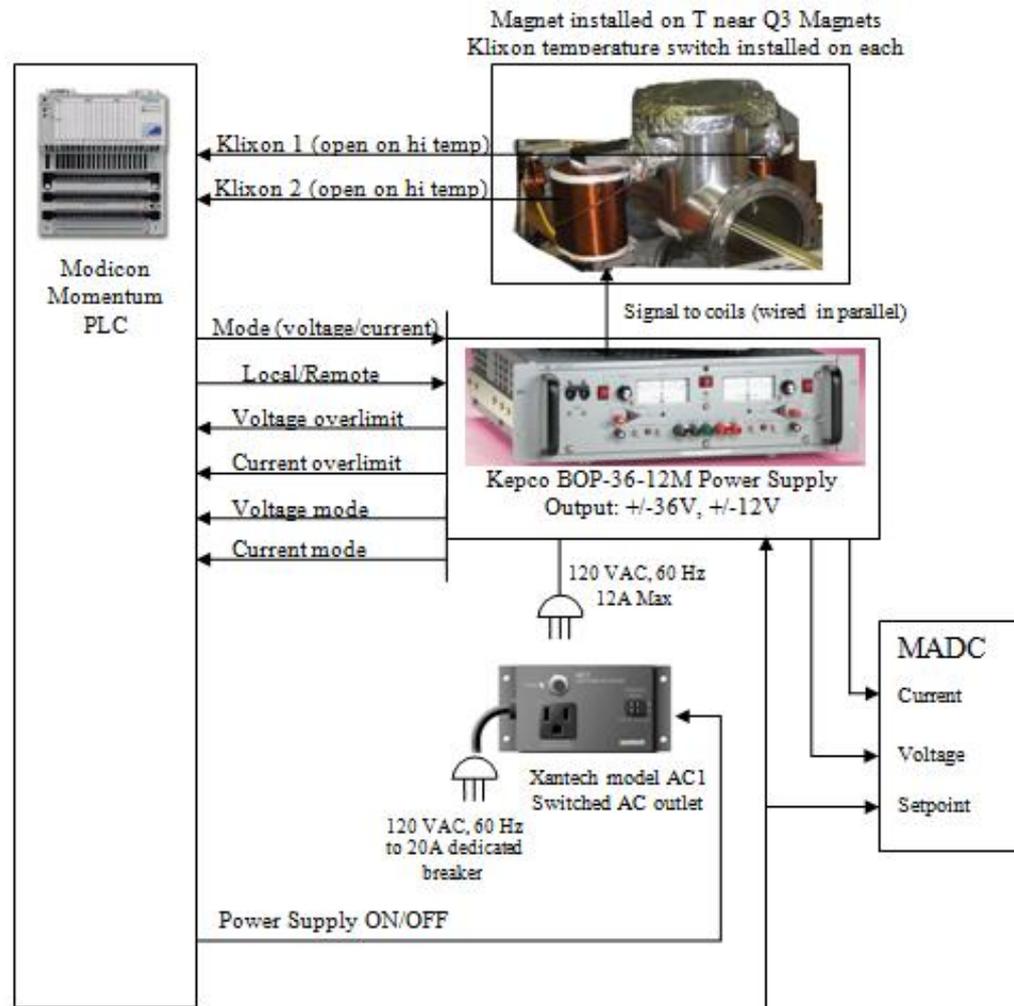


Photo by Rob Hulsart

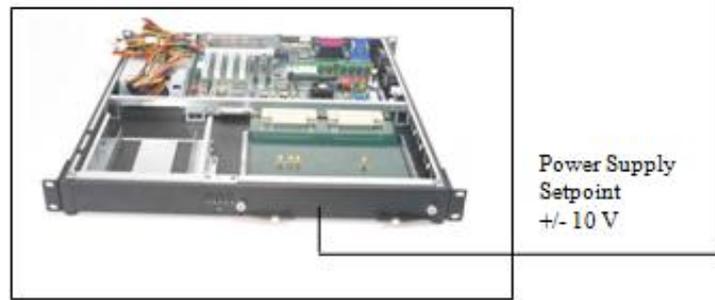
10 Hz Global Orbit Feedback System Software Block Diagram



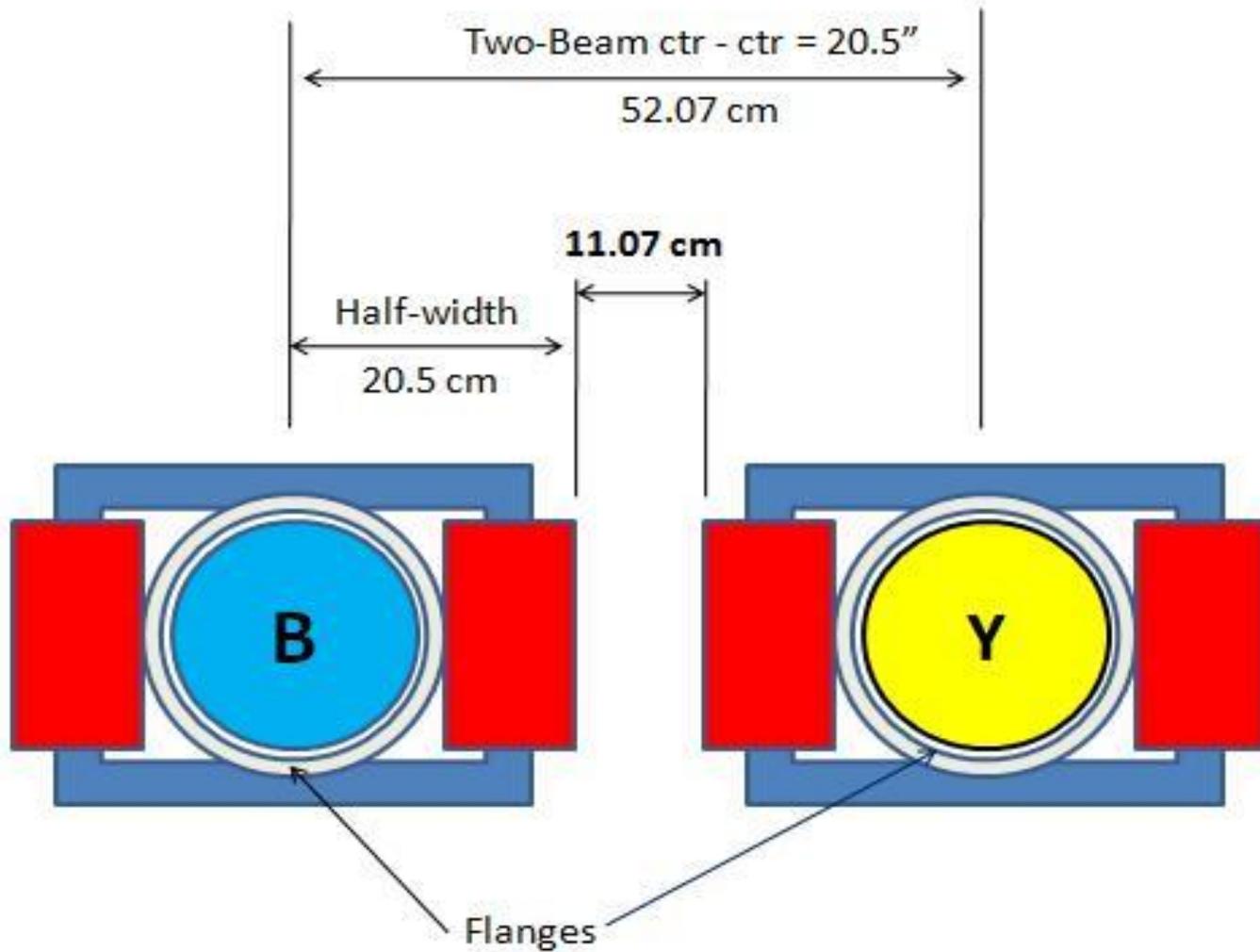
10 Hz Global Orbit Feedback System Power Supply Control (typical)



Xilinx ML-510 Processing Module
With digital to analog converter output for power supply setpoint

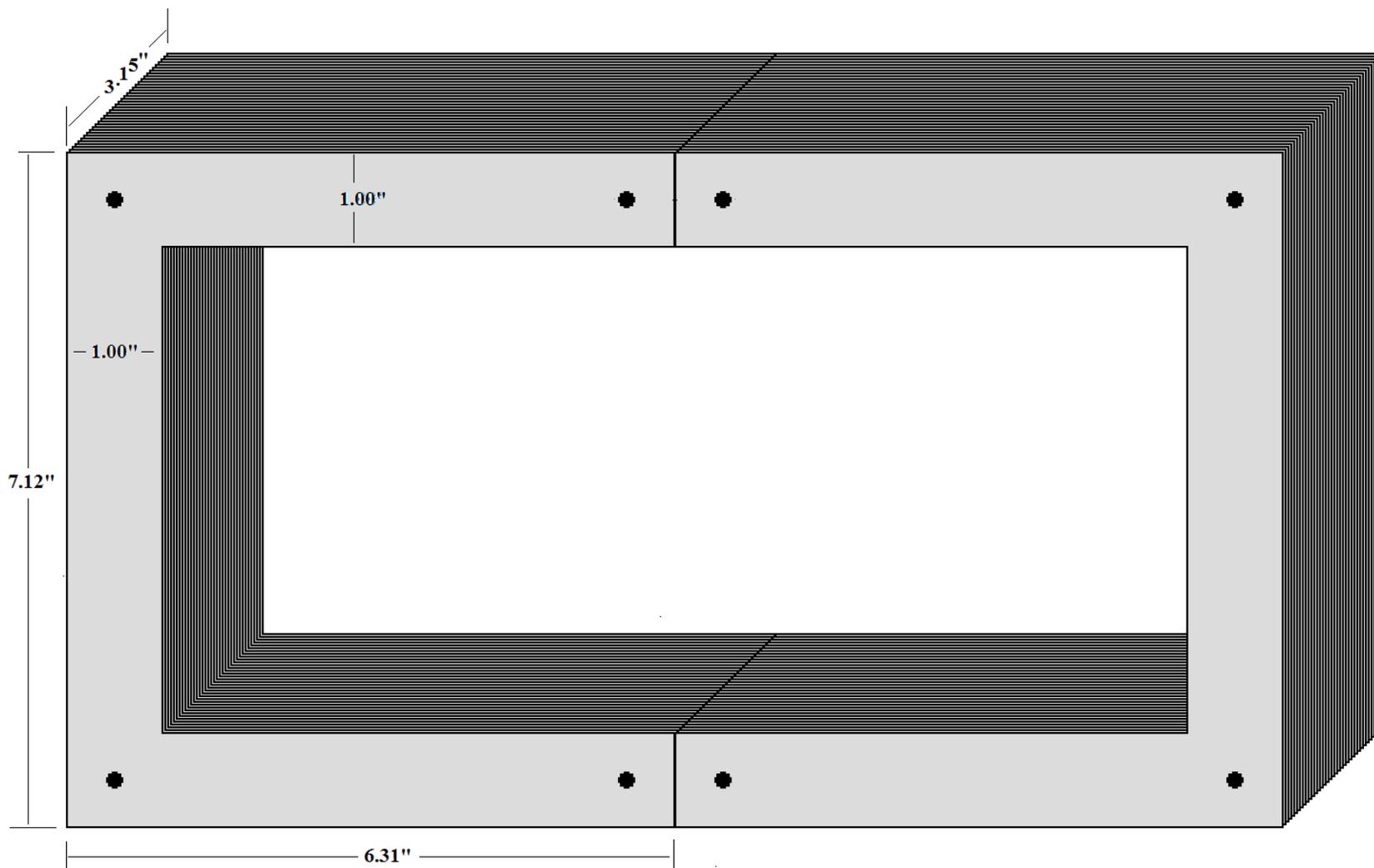


Laminated Steel Core Corrector Magnet Design (Wuzheng Meng)



Isometric view of the laminated core

(P. Thieberger)

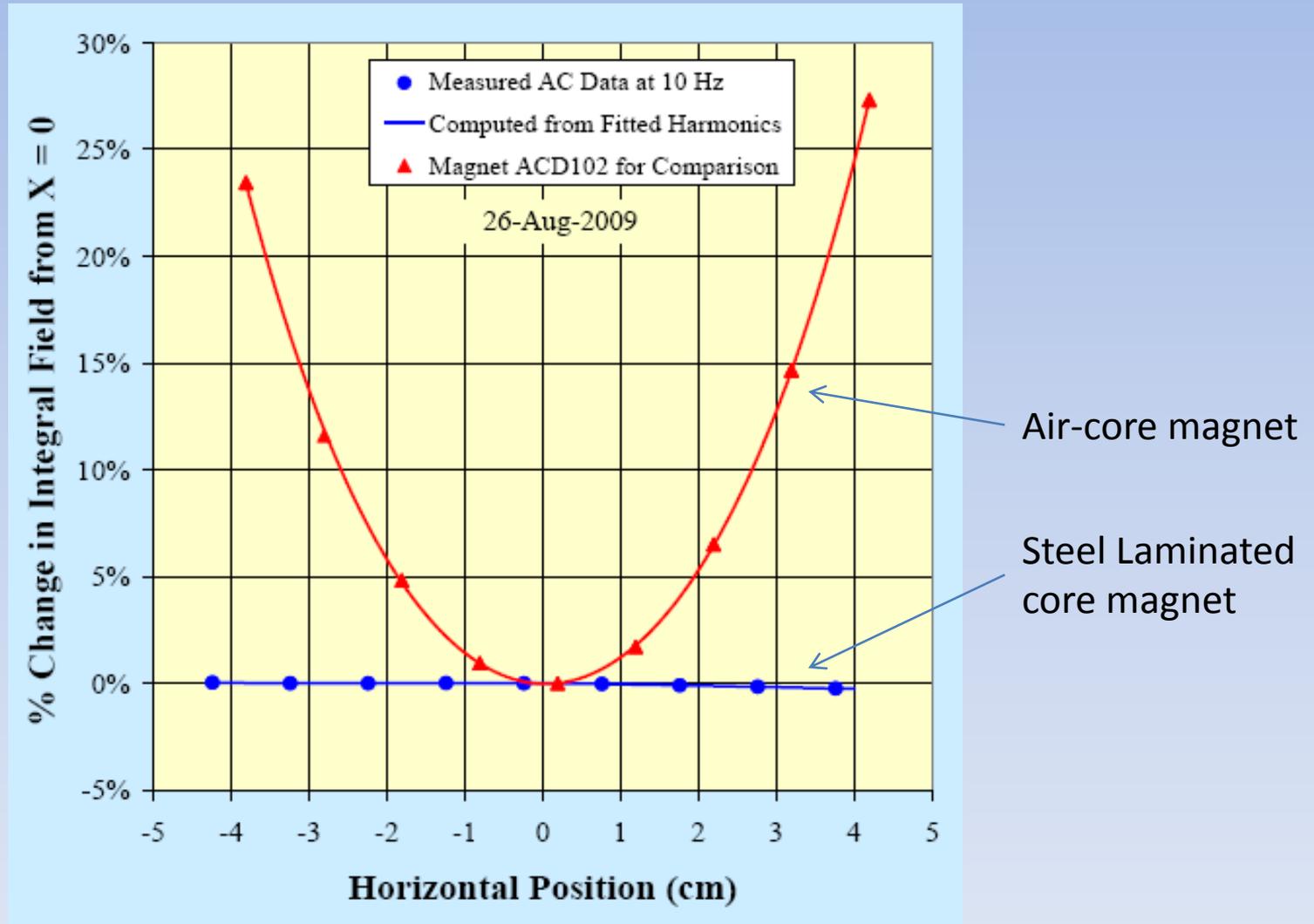


Prototype Steel Laminated Core Magnet



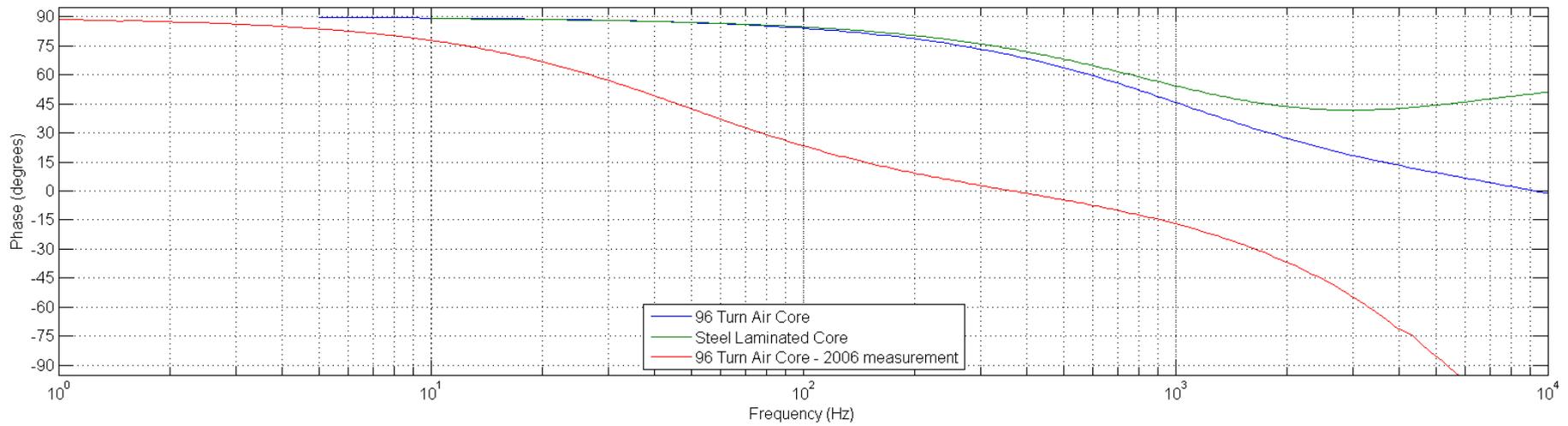
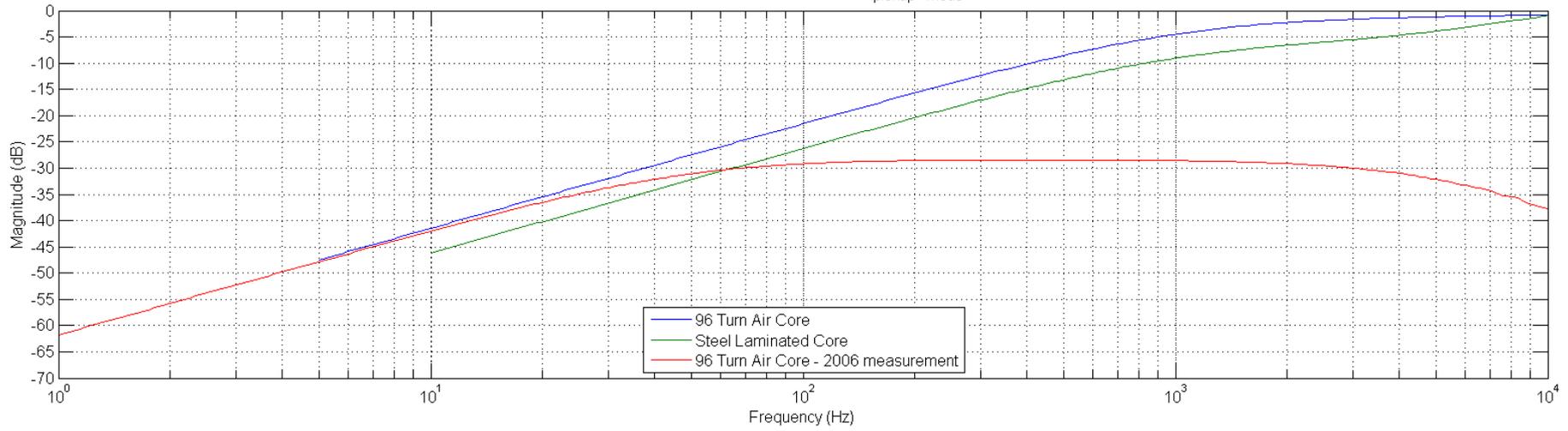
Magnet Integral Field Quality

Air-core vs. steel laminated core



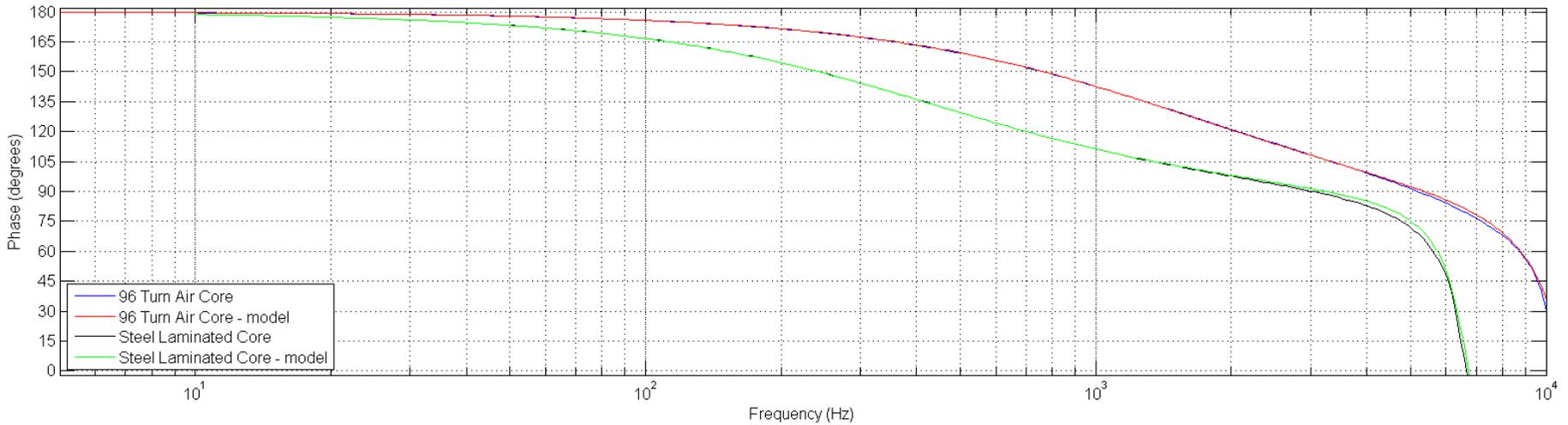
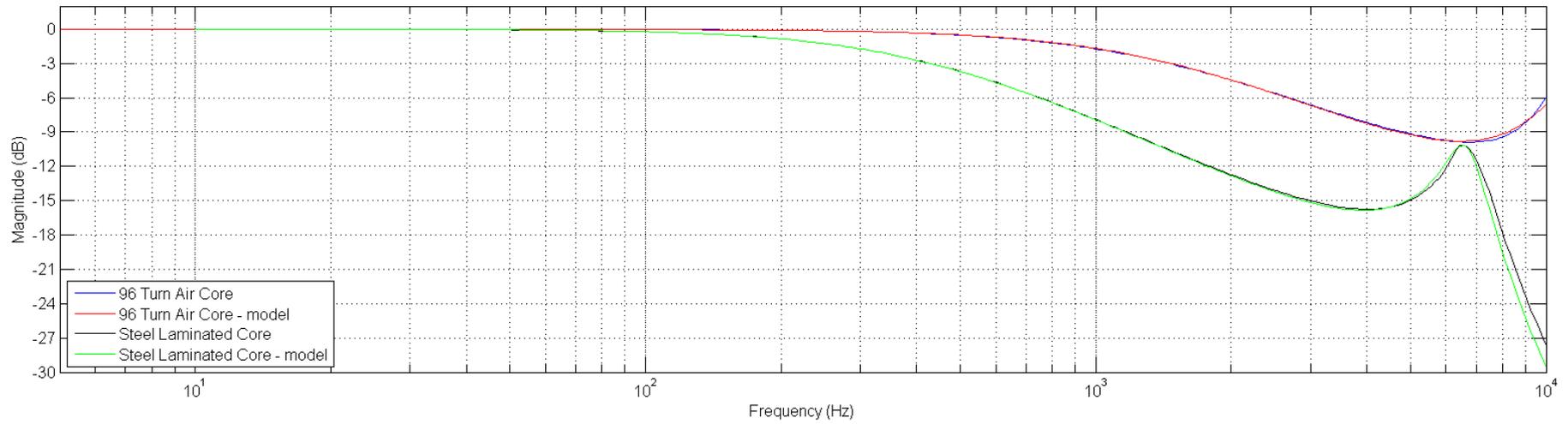
Magnet testing performed and reported by Animesh Jain & Peter Thieberger

Magnet Transfer Function (V_{pickup}/I_{meas})



(Kevin Mernick)

Kepeco 36-12M Power Supply Response (I_{meas}/I_{ref})



(Kevin Mernick)

Status

- BPM Daughter cards
 - Components for 48 boards purchased and received
 - Assembly of first 3 prototypes expected in ~2 weeks
 - Gate array programming and hardware testing required
 - Production boards to be assembled after successful prototype test
- Magnets
 - Tests of prototype were very successful
 - Materials for 8 magnets in-house
 - Resources needed to assemble (wind) 8 magnets
 - Magnet stand design is in progress

Status

- Magnet Power Supplies
 - 8 power supplies are in-house
 - Power supply PLC equip. in-house, programming in progress
 - Additional power required in 1006B & 1008B
 - Installation and wiring required
- Data processing module (ML-510 with DAC)
 - All ML-510 modules in-house
 - DAC modules for this run in-house, additional assembly required.
 - ML-510 programming in progress, but significant development work is required

Status

- Ethernet switches
 - All Netgear switches are in-house
 - Fiber optic cables and Cat-6 cables on order
 - Installation and wiring required

Plan for this Run

- BPM data distribution tests (parasitic)
- Correction tests in blue ring only using 4 air-core magnets installed in IR 6 and IR 8 (**APEX**)
- Correction tests in blue ring only using 4 new steel laminated core magnets installed in IR 6 and IR 8 (**APEX**)
- Measure effect of magnet in blue ring on the yellow beam (**APEX**)

Additional Plans

- If very successful and time permits:
 - Install magnets and power supplies in IR 6 and IR 8 for both blue and yellow rings (8 magnets/power supplies total)
 - Rearrange BPM daughter cards, providing a combination of blue and yellow measurements (total of 40 operational daughter cards expected this year)
 - Test correction in blue and yellow beams simultaneously

Cost Overview

Description	Expenditures To Date (for this run)	Approx. Cost To complete full system
Development tools	\$13,900	
BPM Daughter Cards (40 this year, 40 next year)	\$28,000	\$30,000
Processing Modules (9 ML-510s purchased, DACs and misc. required for full system)	\$35,200	\$5,000
Network Switches	\$20,000	
Power Supplies	\$22,000	\$56,000
Power Supply Controls (PLC)	\$10,000	\$20,000
Magnets (materials purchased for 8; 24 total required)	\$10,000	\$20,000
Magnet stands	?	?
Cables, connectors, etc.	\$31,000	\$5,000
Total:	\$170,100	\$136,000