The PHENIX Multiplicity Vertex Detector

Jehanne Simon-Gillo
Los Alamos National Laboratory

PHENIX Collaboration Meeting
Santa Fe, NM
July 26, 1996
Physics Goals

Design Criteria

MVDSchematic

Silicon Detector Design

Prototype electronics & Beamtest

Mechanical Progress

Prototyping

Milestones
Physics Goals

* Charged particle multiplicity

* $d^2N/d\eta d\phi$

* Centrality trigger at LVL-1

* Collision vertex position ($\sigma < 2\text{mm}$)

Design Goals

* Large rapidity coverage ($\Delta \eta = 5$)

* Good azimuthal coverage & granularity

* Minimum material in electron arm acceptance

* Minimize cost
MVD Collaboration


Los Alamos National Laboratory

E. Bosze, J. Chang, D. Jaffe, S.Y. Fung, R. Seto

U.C. Riverside

M. Allen, C. Britton, N. Ericson, M. Simpson, R. Smith, J. Walker

Oak Ridge National Laboratory

Y. Takahashi

University of Alabama, Huntsville
Clamshell design - mounts to magnet pole faces
Inner and Outer barrels of silicon strip detectors
  200um, 64cm long
Silicon pad endcaps +/- 35cm

Strip electronics at bottom
256 ch/ Si detector
Channel count = 34,816
"C" shaped detector assemblies
Support Structure - Rohacell foam
50μm kapton cables: Si to MCM

6 MCM per Air-cooling plenum section
Rohacell plenum
Power & Communication Bus exit base of plenum
Silicon Strip Detector

* Designed & prototyped-MicronSemiconductor
  200µm pitch, 300µm thick
* Evaluated in lab- probe, laser station
* Tested in beam

Jehanne Simon-Gillo, LANL
PHENIX Collaboration Meeting, July 26, 1996
Single Metal Pad Detector

Jehanne Simon-Gillo, LANL
PHENIX Collaboration Meeting, July 26, 1996
Double Metal Pad Detector

* Eliminates specialized kapton cable
* Reduces wirebonding
* Facilitates detector probing
* Facilitates assembly, handling
* Increases yield
* Sequential readout

Jehanne Simon-Gillo, LANL
PHENIX Collaboration Meeting, July 26, 1996
Front-end Electronics

Basic components:
- 8ch preamp, AMU, ADC,
- Heap Manager (1/4 Phenix clock)

ADC - Nonlinearity of response - worsening of resolution in low range

3-Board set used in Beam test

Jehanne Simon-Gillo, LANL
PHENIX Collaboration Meeting, July 26, 1996
MCM Pre-Prototype Development

32 channel MCM
8 channel die
Preamp, AMU, ADC, FPGA
AGS Beam Test

Prototype electronics, DAQ
Prototype Si strip detectors, kapton cables
Prototype RF enclosure

Jehanne Simon-Gillo, LANL
PHENIX Collaboration Meeting, July 26, 1996
Beam Test Data

![Graph showing track candidates vs. LYL-1 trigger delay (µs)]
Beam Test Data

Presample:
ADC values before event
Includes high & low freq noise

Post-sample:
ADC values after event
Includes high & low freq noise

Post-pre:
Subtract ped and low freq noise
High freq noise remains

<Chip> subtraction:
Removes high freq noise
Remaining width due to ADC resolution
Mechanical Progress

All mechanical components designed
(Pre Mechanical Design Review July 30)
Mounting, Truss, Detector supports, Enclosure, Cables, Motherboard, Connector ID, Cooling systems....

Engineering analysis - MCM Cooling, Detector Support Deflection, Foam Environmental

Truss Structure Deflection studies
Detector Support Deflection studies
Rohacell Cage Environmental
Rohacell Cage Mechanical Stability
Thermal and Electrical Studies of Enclosure
Enclosure formation and assembly procedure
MCM Air Cooling Studies
Air-induced Vibrational Studies
Motherboard water cooling system

Extensive prototyping

Jehanne Simon-Gillo, LANL
PHENIX Collaboration Meeting, July 26, 1996
MCM Cooling System:

Air Cooling (10°C min)
10mW/chan
2x safety margin

Motherboard Cooling System

Water: 10-25°C

Silicon Detector Cooling System

Air: 10-25°C

Jehanne Simon-Gillo, LANL
PHENIX Collaboration Meeting, July 26, 1996
Prototyping

Fullscale! Represent all mechanical components
Mechanical studies
Assembly issues, jigs
Cables, connectors
Integration
Assembly procedure

Jehanne Simon-Gillo, LANL
PHENIX Collaboration Meeting, July 26, 1996
Milestones

**Mechanical:**

- Vertex detector design complete: Mar-96
- Pad detector design complete: May-96
- MVD Chain Test: Apr-96
- Mechanical design -prelim: Jul-96
- Cooling design -prelim: Jul-96
- All detectors received: Apr-97
- Final Mech design review: Dec-96
- Subassemblies complete: Mar-98
- Assembly complete: Oct-98

**Front-end Electronics:**

- Review TGV R2: Nov-95
- Review AMU/ADC R1: Mar-96
- FEE Prelim design review: Aug-96
- Review AMU/ADC R2: Oct-96
- Review TGV R3: Oct-96
- Review Prot MCM w/vendor: Nov-96
- MCM Design Complete: Jun-97
- Chip Fab Complete: Jun-97
- MCMs complete: Feb 98

Jehanne Simon-Gillo, LANL
PHENIX Collaboration Meeting, July 26, 1996