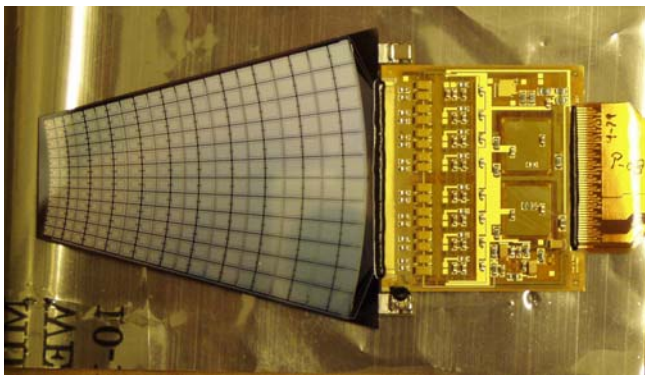
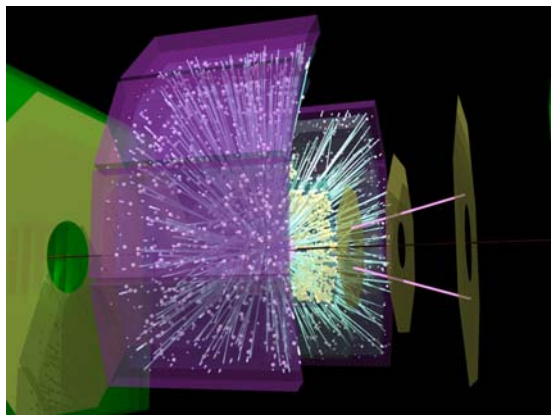
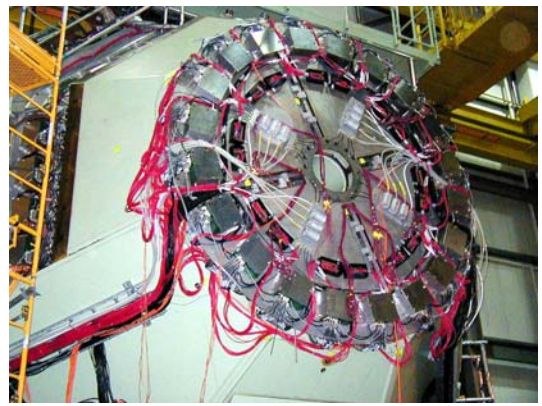
Los Alamos National Laboratory
Heavy Ion Program

1. Dave Lee – Heavy Ion Program – 15 min
2. Mike Leitch – pp, dAu – 30 min
3. Pat McGaughey – AuAu – 30 min
4. Dave Lee – Silicon Upgrade – 15 min





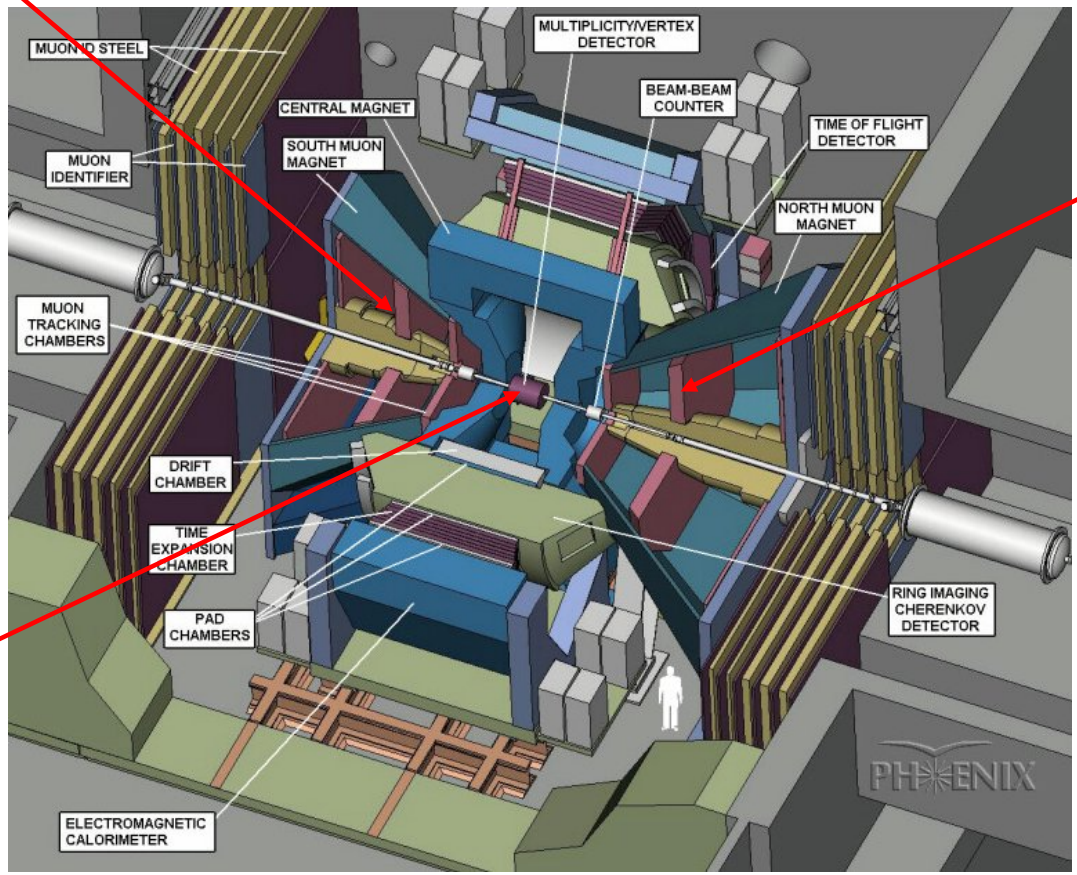


PHENIX

South Muon Arm - 2001

North Muon Arm - 2002

MVD 2002



Phenix Muon and MVD Program
Major Institutions

<u>Muon</u>
Los Alamos National Laboratory
Oak Ridge National Laboratory
PHENIX France
Riken, Kyoto
Korean Universities
University of Colorado, UNM, NMSU

<u>MVD</u>
Los Alamos National Laboratory
Yonsei University

Los Alamos Heavy Ion Program
Current Personnel

Muon Spectrometers

Barnes, Brooks, Burward-Hoy, Kunde, Lee, Leitch, Liu, McGaughey, Moss, Norman(New Postdoc), Sondheim, Sato(New postdoc)

MVD

Sullivan, van Hecke, Boissevain

Magnet Design and Simulation

Sondheim

Silicon Upgrade

Kunde, Lee, McGaughey, Moss, Sullivan,van Hecke

Total staff support = 5.5 FTE , 1.7 Postdoc

Los Alamos Heavy Ion Program
Past Accomplishments

- Muon Arm Construction – installed South 2001, North 2002
- MVD construction – installation complete 2002
- Run 2 data taking (2002), pp muon analysis, paper submitted to PRL
- Run 3 data taking (2003), dAu muon analysis

  2 QM04 invited talks, Brooks(plenary),Liu(parallel)
- Analysis tools and software developed
- Silicon vertex upgrade initiated, LOI written, proposal started
- Routine Maintenance of detector systems
- Host of Muon Workshop – very successful, 50 people

PHENIX

The Muon Spectrometers

South Muon Arm

South Muon Arm prior to run 3 in retracted position. Visible is station 1 in the front of the magnet and the MuID panels to the left.

North Muon Arm

North Muon Arm prior to run 3 during the installation process. The scaffolding used to install the electronics is visible.

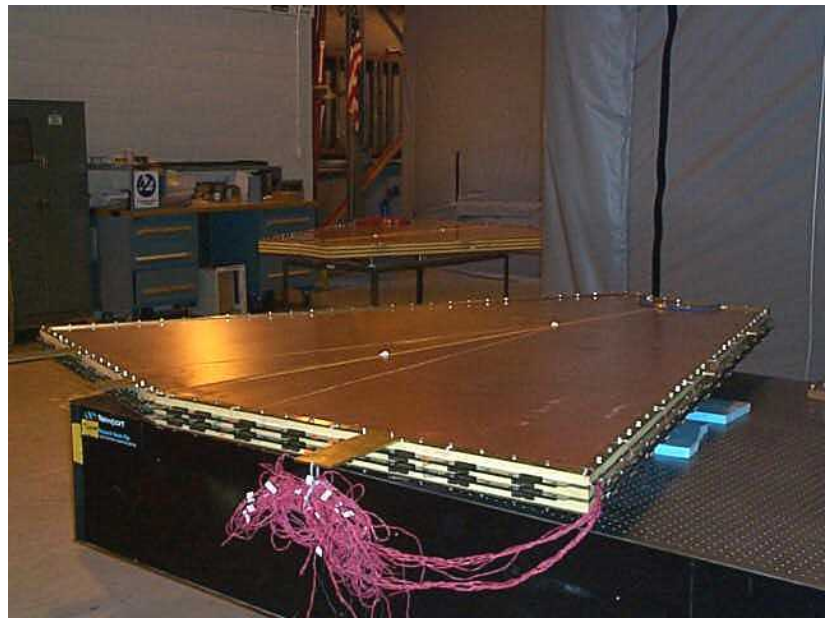
PHENIX

The Muon Cathode Strip Detectors

Largest etched foil CSC in operation. 3 gaps for total radiation length ~ 8.8 x 10^{-4}

Station 2

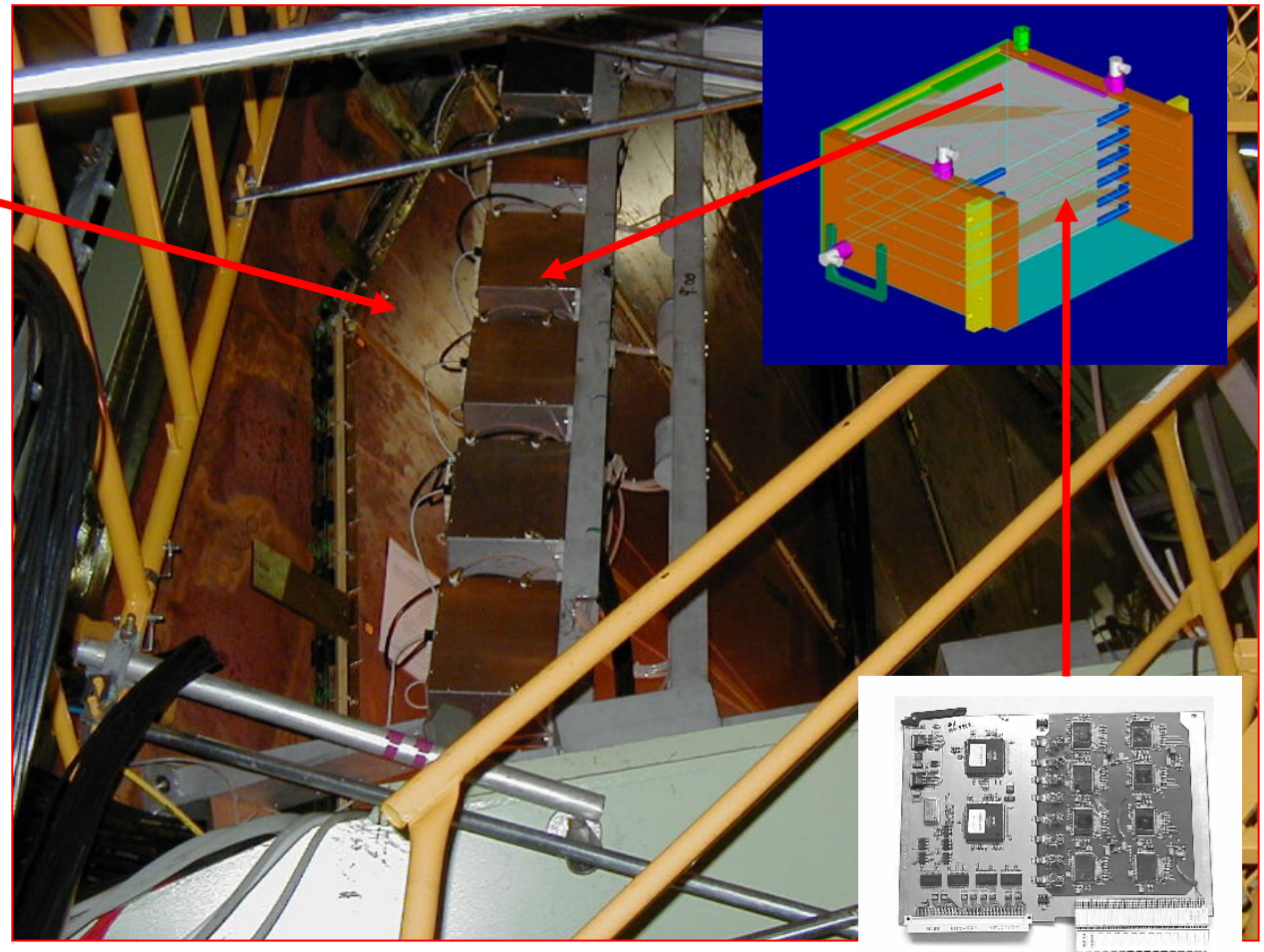
Largest CSC chambers in operation, 3.3m x 3.3m. 2 gaps using honeycomb technology



Station 3

South FEE Electronics

Station-3



~ 45,000 channels total in North and South

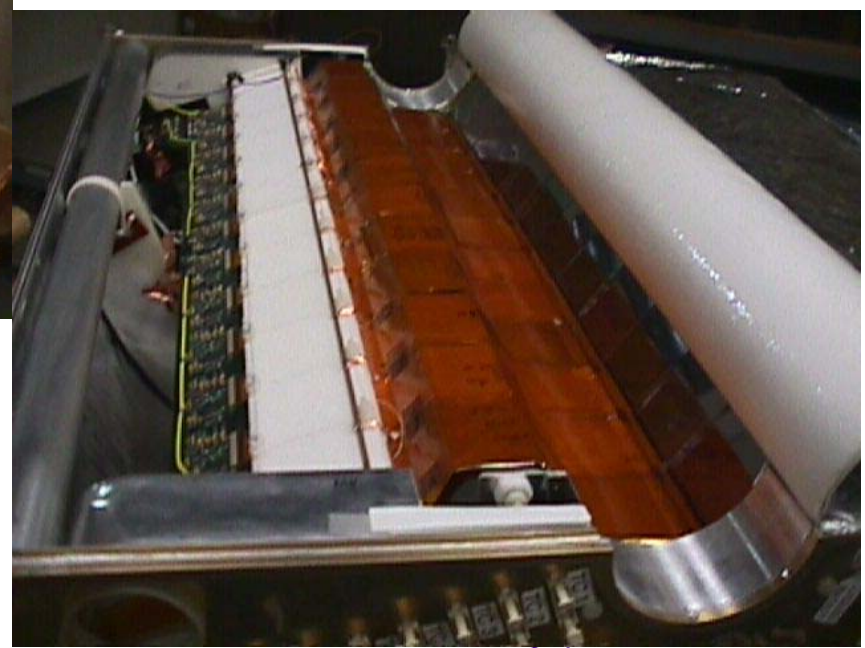
< 3000 electrons noise level

Fully pipelined

Fiber optic output

PHENIX
MVD half cylinder before run 3

Complete MVD prior to installation for run 3. Visible are the strip detectors and kapton cables (red), the cooling plenum (white), and the power and control boards (green). The pad detectors are mounted in the end plates.



Los Alamos Heavy Ion Program
PHENIX activities

Detector Council Members: Sullivan(MVD), Brooks(past muon), Leitch(past muon), McGaughey(past muon)

Subsystem managers: Lee(muon mechanical), Mischke(Electronics)

Executive Committee: Leitch, Moss(past)

Institutional Board: Barnes

Physics working groups: all, Brooks(heavy convenor),Sullivan(past hadron convenor)

Paper writing: Brooks(ppg017),Burward-Hoy(ppg009,ppg021), Leitch(ppg011), Silvermyr(ppg001,ppg019), Sullivan(ppg021,ppg026), van Hecke(ppg009)

Internal paper review: Lee(IRC014,IRC024),Silvermyr(IRC028), van Hecke(IRC021)

Data Production Manager: Silvermyr(run03)

Period coordinator: Leitch(run03,04)

PHENIX Online Documentation: van Hecke

Upgrades proposal: Kunde, Lee, McGaughey, Sullivan, van Hecke

Integration Engineer: Sondheim(muon), Boissevain(MVD)

Los Alamos Heavy Ion Program
Future Research Goals, FY05 and beyond

•Examine the suppression/enhancement of J/ψ production in Au-Au collisions from PHENIX Run-4 data relative to scaled yields from p-p and d-Au. Study the rapidity and p_T dependence to determine whether or not a quark gluon plasma is formed.

•Extract open charm production in Au-Au collisions via single muon, dimuon, and possibly electron-muon channels to help disentangle J/ψ suppression due to the QGP from nuclear medium effects.

•Study gluon shadowing, parton energy loss and the Cronin effect in d-A and p-p collisions.

•Measure π, K and heavy flavor production at forward rapidity via their decays to muons.

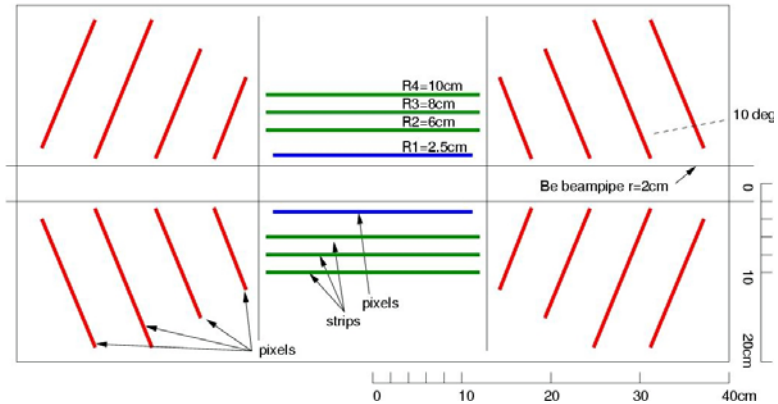
•Determine the particle multiplicity and reaction plane in Au-Au collisions at forward rapidities using the endcaps of the MVD.

•Perform R+D for a silicon vertex detector upgrade. Begin design and construction of the detector mechanical structure and a silicon Endcap detector.

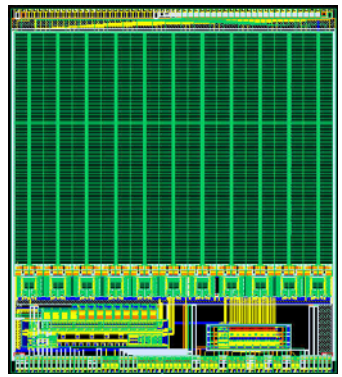
•Calculate theoretical open charm production cross sections using the color-octet and color- singlet models.

Silicon Tracker Upgrade

Mechanical Concept



Conceptual layout



Modify FPIX2

Physics extension of the present Muon Arms by clearly identifying the heavy quarks

Enhance the single muon effort by identifying decay hadrons on event by event basis

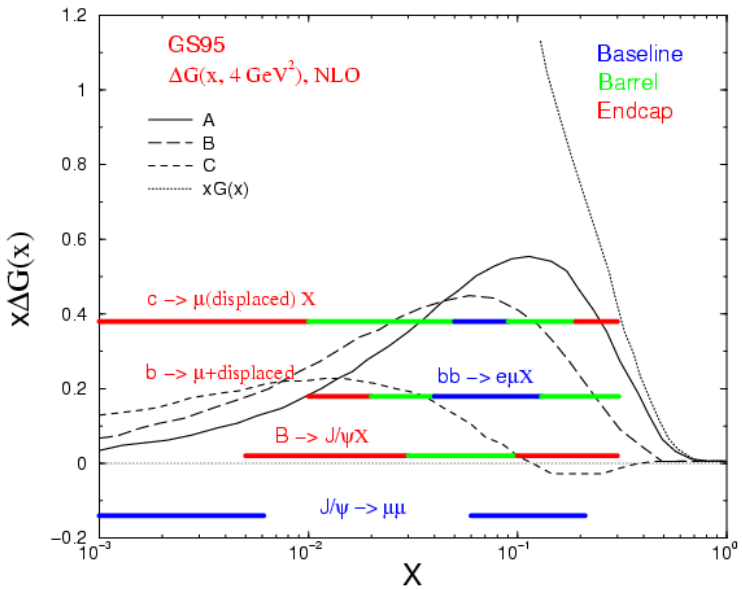
Silicon Tracker Upgrade
Physics Topics

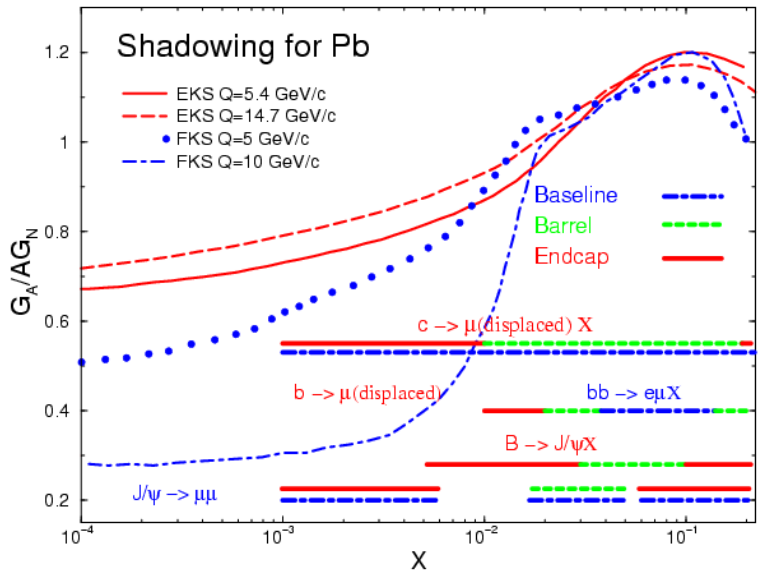
1. Gluon Structure function in protons over large x by measurements of open c and b in polarized pp reactions
2. Measurements of shadowing in nuclei by heavy quark studies in pAu reactions
3. Advanced studies of the QGP formed in AuAu reactions
   - Wide range in pt
   - Determine yields in open charm and beauty to establish any enhancement in pre-equilibrium phase
   - Measure J/psi/open charm ratio to clearly observe any J/psi suppression
   - Improved mass resolution of vector mesons

Silicon Tracker Upgrade
Endcap Extension

- Compliments the barrel section
- Larger Bjorken x coverage
- Higher total count rates
- Larger reach in transverse momentum
- Full proposal soon

Silicon Tracker Upgrade
Gluon Structure in Nuclei



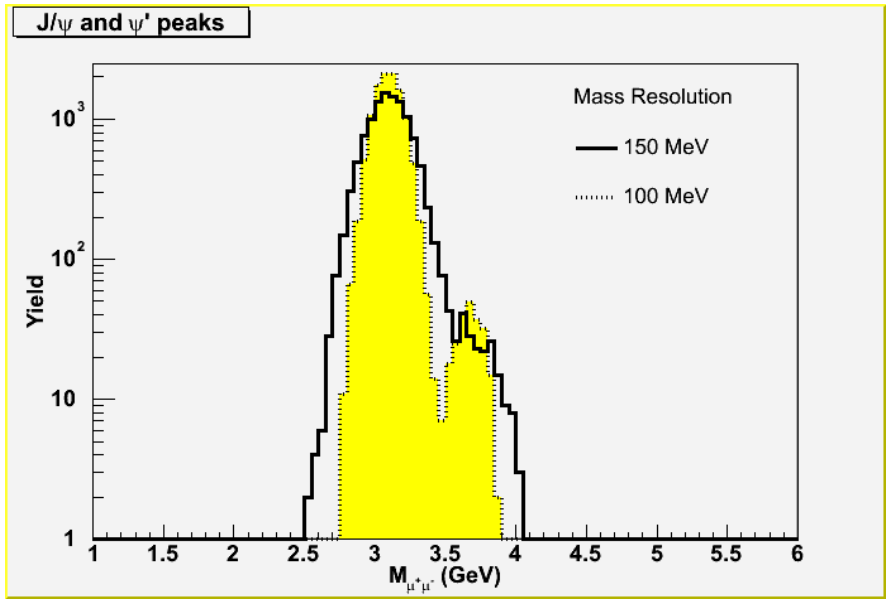


Barrel alone covers a limited range
Endcap covers lower x range and fills the gaps in the barrel coverage

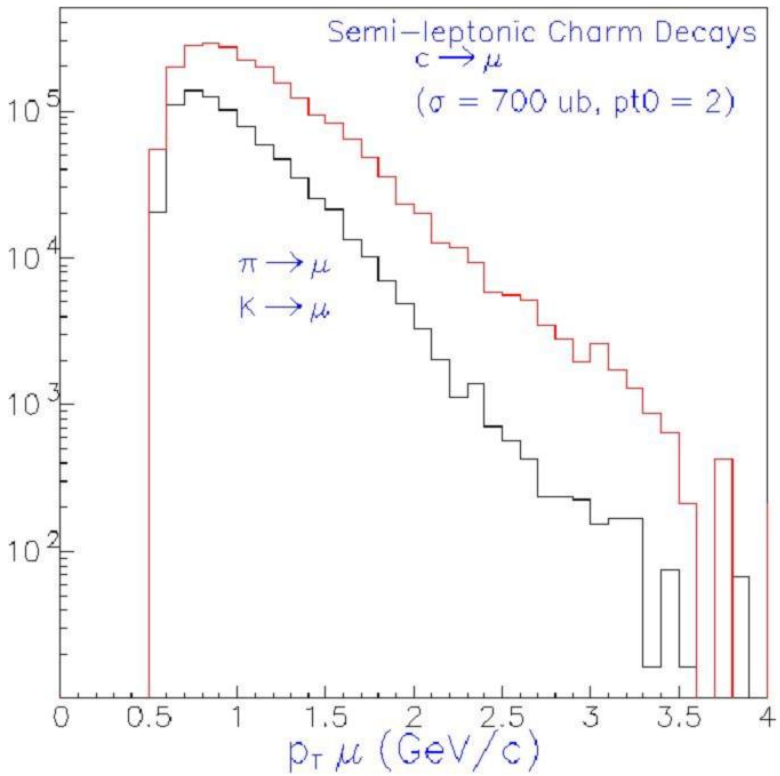
Endcap covers large range x from anti shadowing to the shadowing region
Wider pt coverage

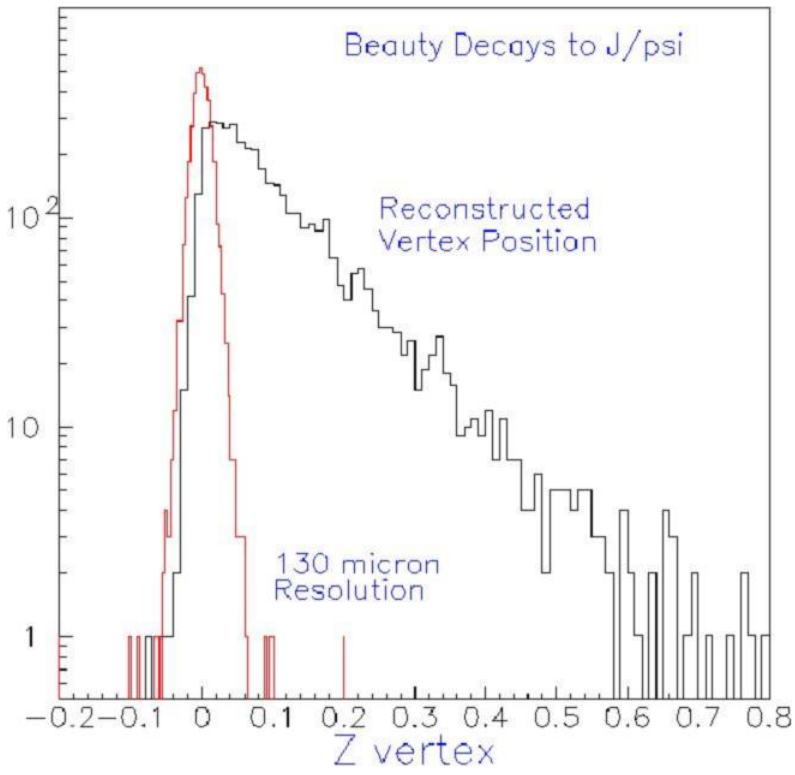
Clean charm and beauty

Silicon Tracker Upgrade
Improvement in mass resolution



Silicon Tracker Upgrade
Simulations

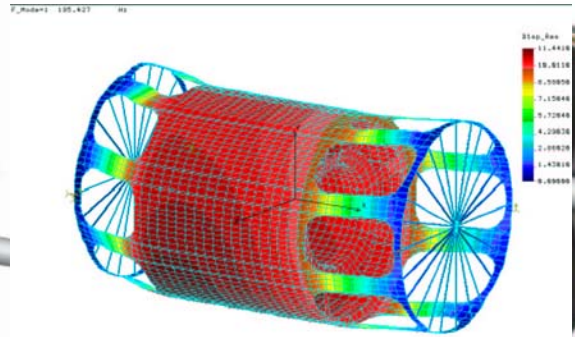


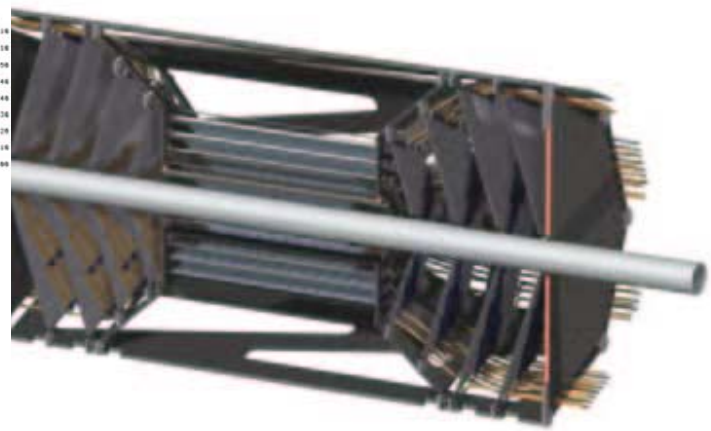


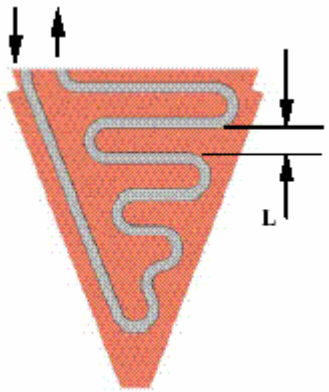
Silicon Tracker Upgrade
Proposed responsibilities

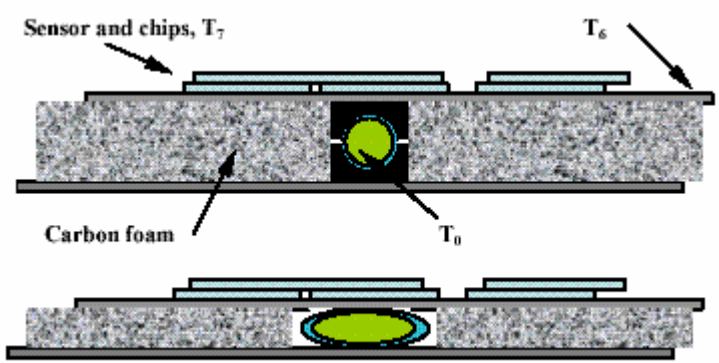
- Mechanical Structure Coordination – Barrel and Endcap
  - •Integrated approach extremely important
  - •LANL has experience, E789, L3, SSC/GEM, MVD
  - •Past relationship with experienced engineering team
- PHX chip coordination – Barrel(?) and Endcap
  - •Collaboration with FNAL (Ray Yarema) to modify existing FPIX2 chip
- Possible mechanical subsystem management

Silicon Tracker Upgrade
Mechanical Conceptual Design Studies

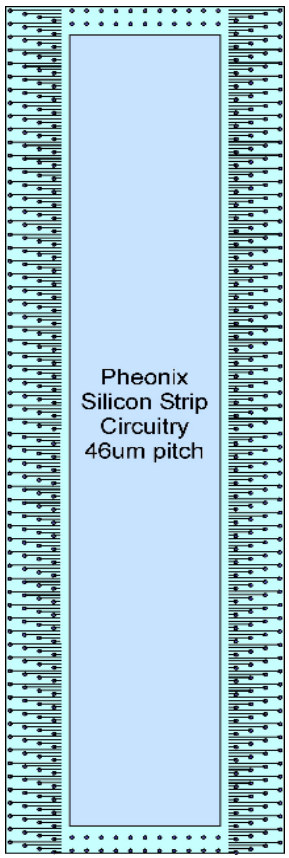








Silicon Tracker Upgrade
Proposed PHX chip by Ray Yarema



Phenix Chip Layout:

2 columns

256 channels/column

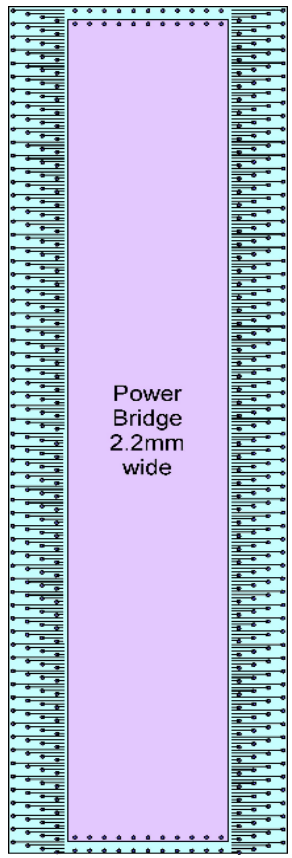
3.8 mm x 13 mm = 49.4 mm^2

Bump bonds on 200 um pitch

50 µm diameter bumps

512 bumps plus inter-chip bumps

Simulated noise performance is < 250 electrons



Silicon Tracker Upgrade

Benefits of using the Modified FPIX2 chip in the Endcap ministrips

Allows us to tailor strips to keep occupancy low

Low noise

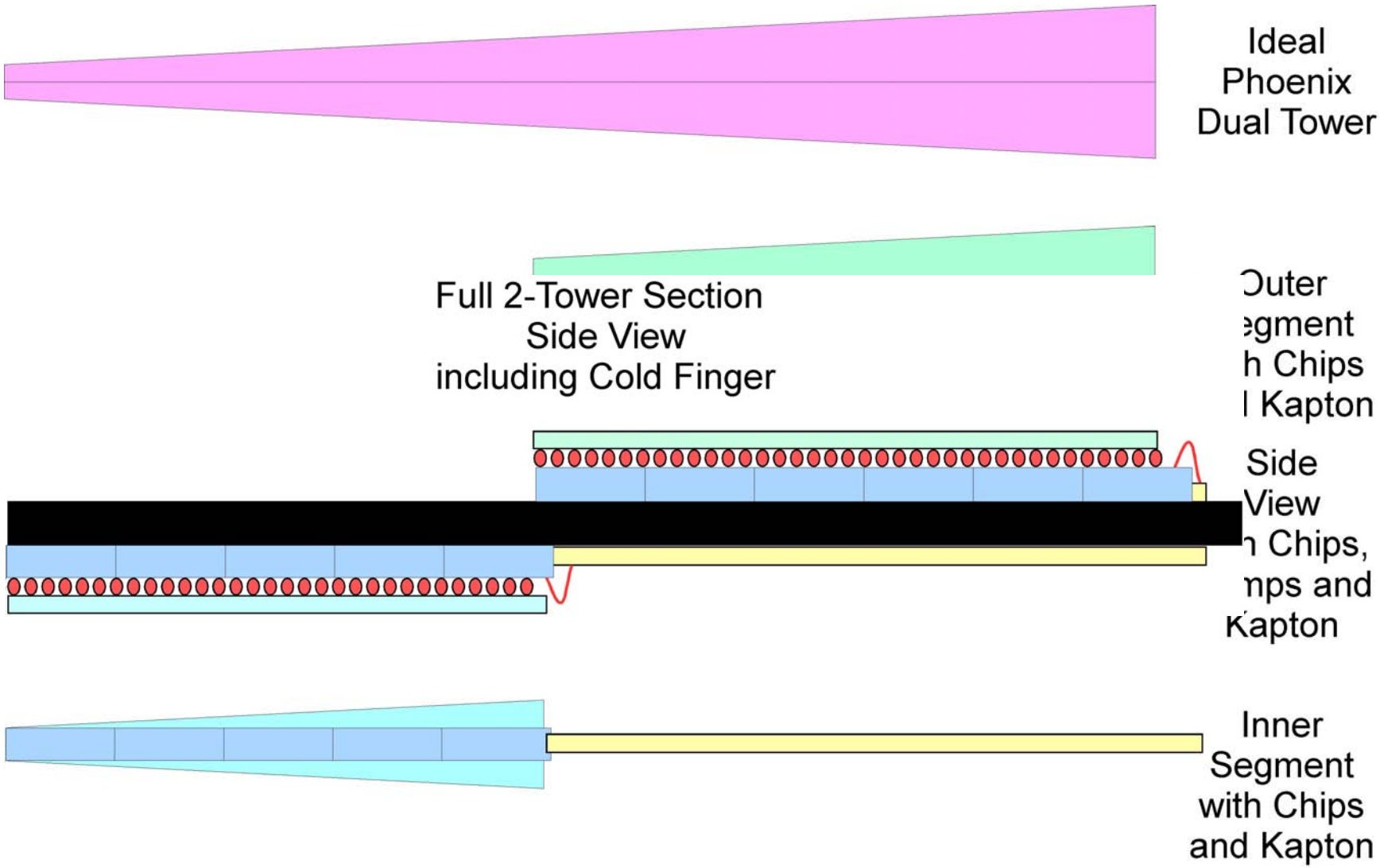
Low power – simplifies mechanics

Can provide trigger, if desired

Room temperature operation - simplifies mechanic

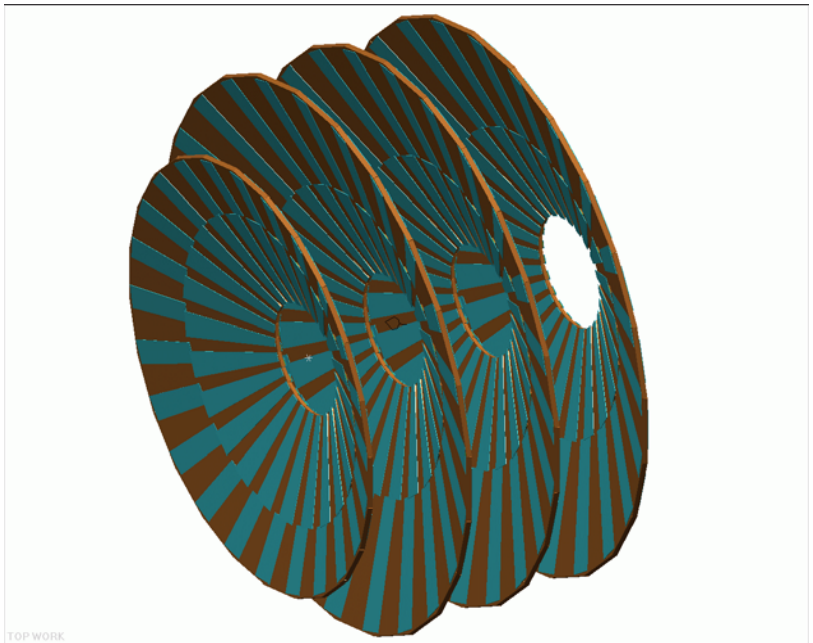
Integrated bus is very attractive

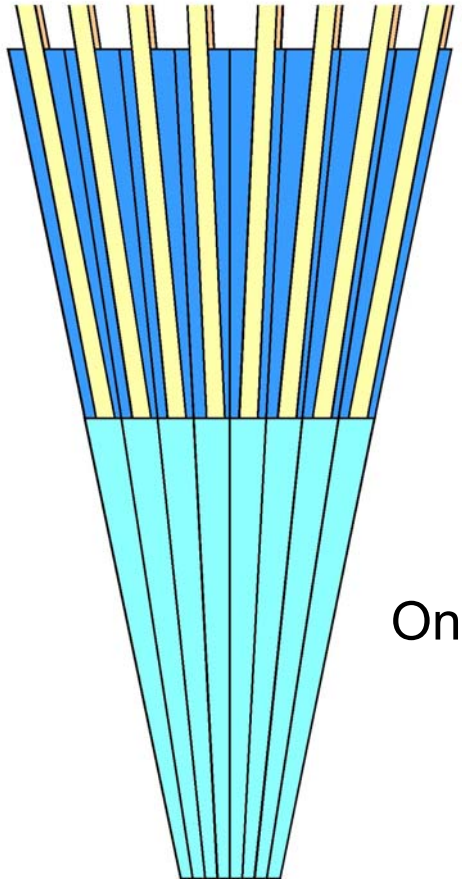
Possible Tower Section from Ray Yarema



Wedge Assembly Idea

Go to 16 wedges/lampshade to reduce the size of silicon detector pieces and sub assembly size for better yields





One wedge

Silicon Tracker Upgrade
Statement of LANL Responsibilities
from Silicon Vertex Tracker Proposal

Los Alamos National Laboratory (LANL)

The Los Alamos group has established three major initiatives for the VTX upgrade in conjunction with our interest in pursuing new physics with the muon arms. (A) We have worked with the mechanical design group of the ATLAS silicon tracker, HYTEC, Inc, to develop a concept for the mechanical structures for the integrated (barrel and endcap) design of the fully completed vertex tracker. Dave Lee, Walt Sondheim, and other LANL members will continue to lead the effort to bring the concept to a fully engineered mechanical design and to work closely with other members of the VTX upgrade group and BNL to ensure effective integration of the detector into PHENIX. (B) LANL group has also established collaboration with the FNAL electronics group headed by Ray Yarema to modify an existing chip design to read out mini-strips of the endcap extension. Gerd Kunde will continue that coordination responsibility since it is vital to the endcap effort. (C) An ongoing simulation effort will be very important to these efforts and Pat McGaughey, Hubert van Hecke, and other members of the LANL team will pursue these activities.

The LANL group has extensive experience with silicon detectors including, 1) a measurement of the of the *B* production cross section and charm production nuclear dependence with a silicon vertex detector, E789, at FNAL using electronics developed by Ray Yarema, 2) implementing the SVXH readout chip for the L3 micro-vertex detector at CERN, 3) extensive prototyping and testing in conjunction with the mechanical and electronic designs for the GEM/SSC silicon micro-vertex detector, and management responsibility for GEM; and 4) similar responsibilities for the MVD. Over the next 3 years the LANL group will gradually reach a level of effort equivalent to 3 FTE's per year to be devoted to the VTX upgrade.