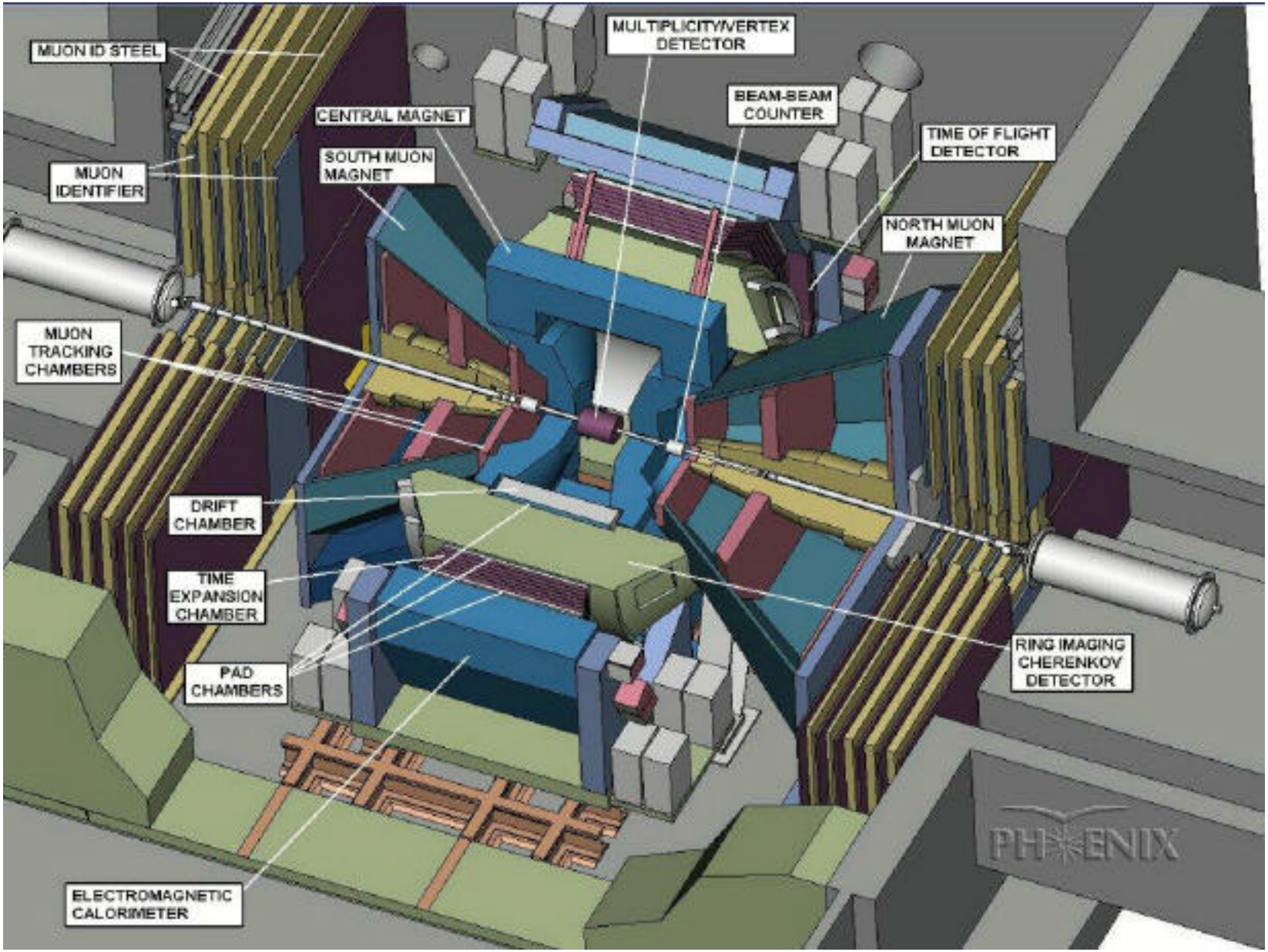
The PHENIX Multiplicity and Vertex Detector

Michael Bennett
Los Alamos National Lab

1. Overview
2. Design Challenges
3. Performance
4. Status


MUON ID STEEL
MULTIPLICITY/VERTEX DETECTOR
BEAM-BEAM COUNTER
CENTRAL MAGNET
TIME OF FLIGHT DETECTOR
SOUTH MUON MAGNET
MUON IDENTIFIER
NORTH MUON MAGNET
MUON TRACKING CHAMBERS
DRIFT CHAMBER
TIME EXPANSION CHAMBER
RING IMAGING CHERENKOV DETECTOR
PAD CHAMBERS
ELECTROMAGNETIC CALORIMETER
PHENIX

MVD Overview:

Physics goals:

Charged particle multiplicity

Centrality trigger at LVL-1

Collision vertex position ($\sigma < 2$ mm)

$dN/d\eta$ $d^2N/d\eta d\varphi$

Design Challenges:

Large acceptance ($\Delta\eta = 5$, full ϕ)

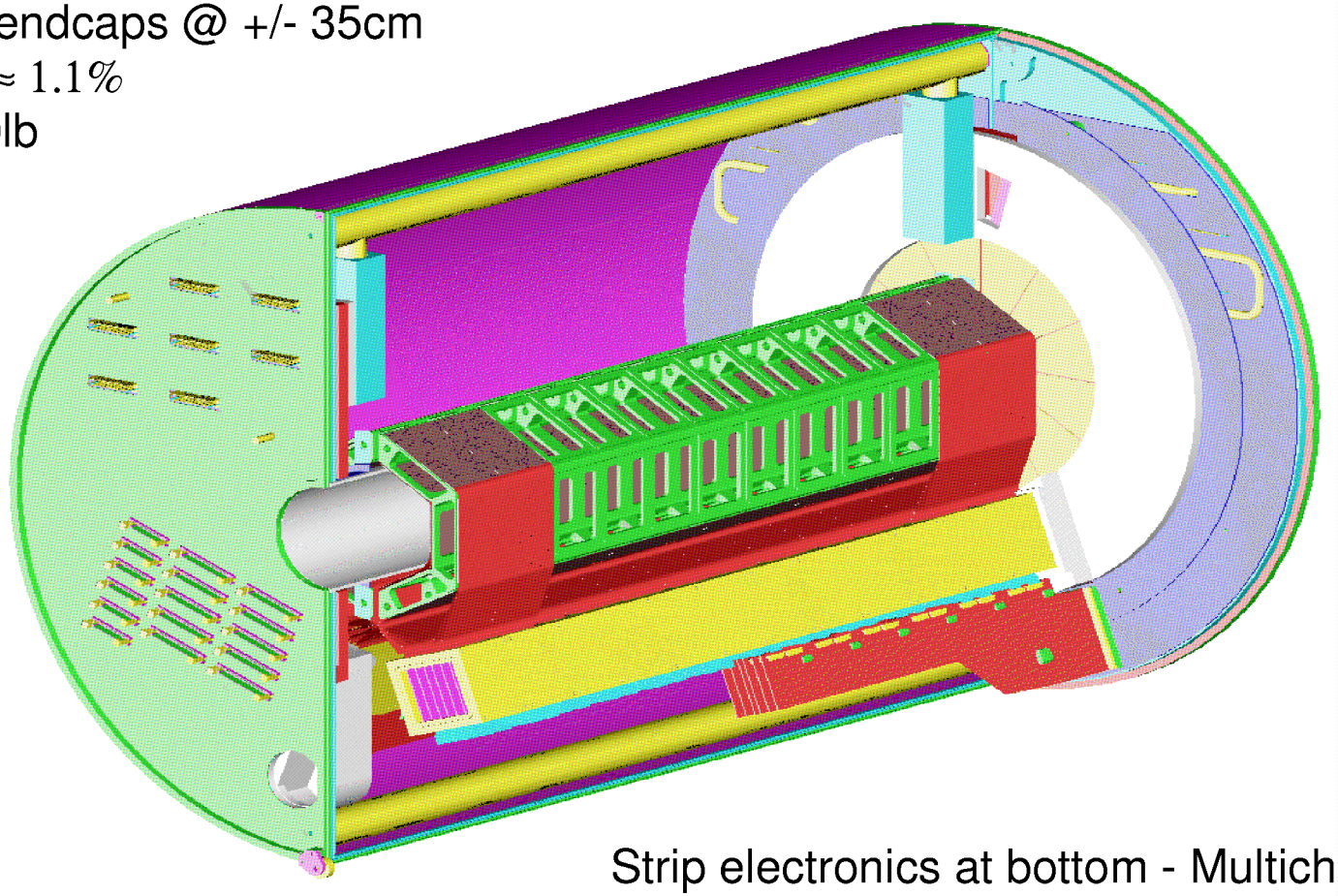
High granularity (large track density)

Minimal material in electron arm acceptance

Compact Read-out electronics

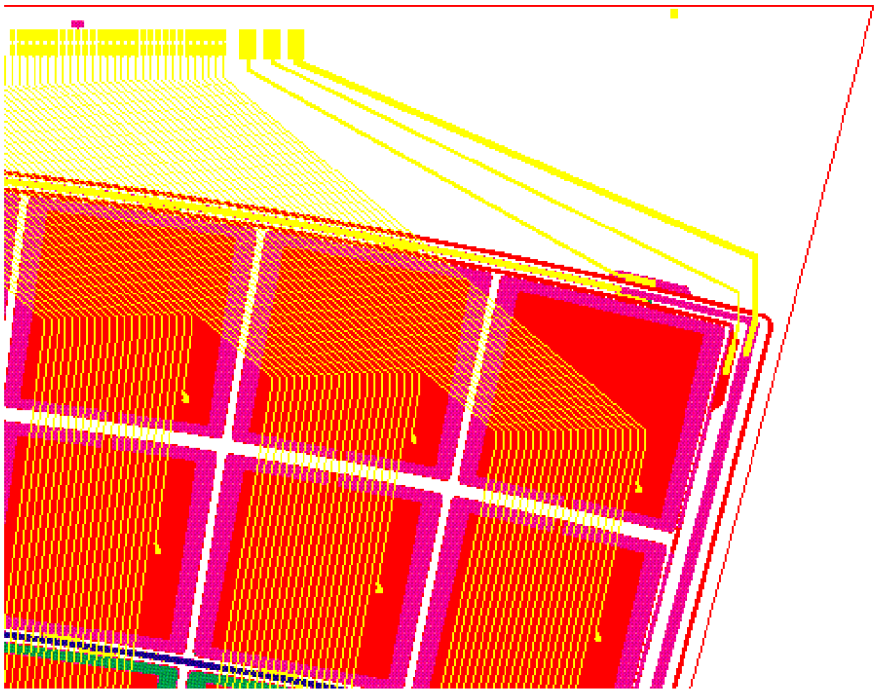
The Multiplicity Vertex Detector

Clamshell design - mounts to magnet pole faces.
Inner and outer barrels of silicon strip detectors, 200μm, 64cm length
Silicon pad endcaps @ +/- 35cm
Rad length ≈ 1.1%
Weight < 30lb



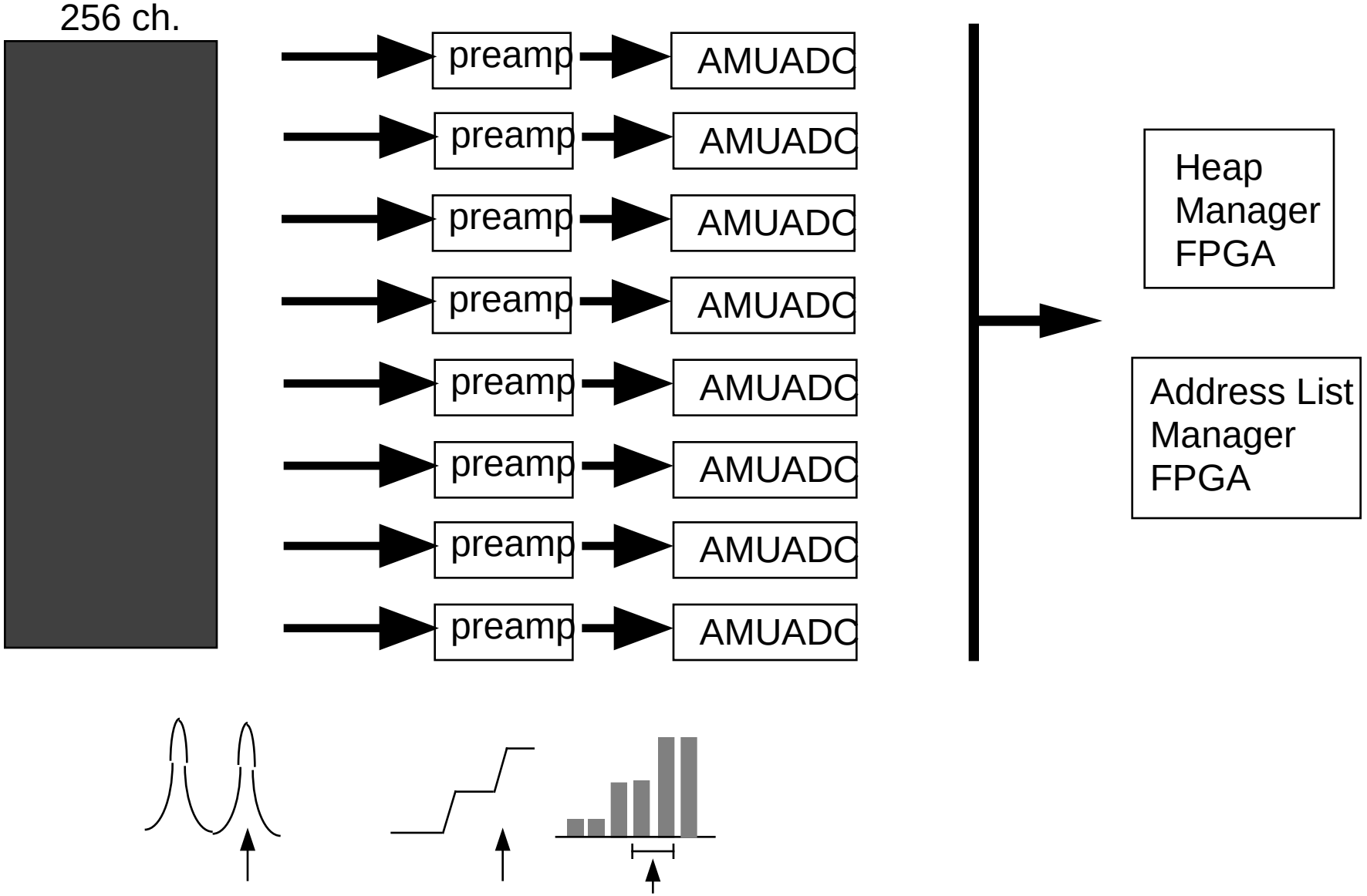
Strip electronics at bottom - Multichip Module
256 channels/detector
Channel count = 34,816

Double Metal Pad Detector



*Eliminates specialized kapton cable
*Reduces wirebonding
*Facilitates detector probing
*Facilitates assembly, handling

Front End Electronics:



Final MCM:

Design at LANL/NIS
Lead Engineer - Gary Smith
Lead Designer - Gary Richardson

1 MCM:	256 channels	2 Xilinx 4010
	8 preamps	1 opamp
	8 AMUADCs	1 Temp sensor

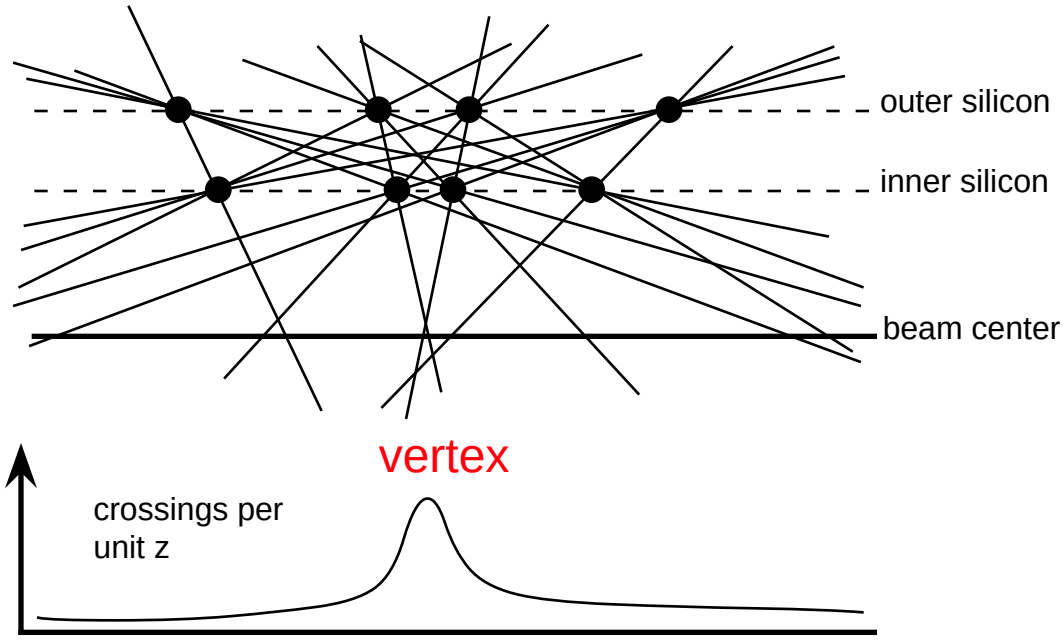
Trace pitch = 54 μm
Line width = 43 μm
I/O pad pitch = 150 μm

I/O pads gold sputtered for wire bonding

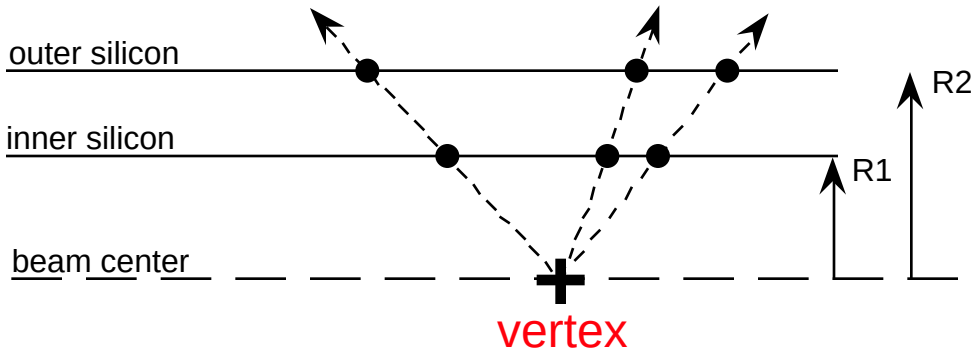
base metal + 4 trace layers = Ti - Cu - Ti

M1 = signals, all connections off IC chips
M2 = bus lines
M3 = power lines
M4 = surface mount components

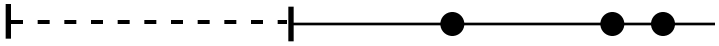
The pseudo-tracking algorithm:



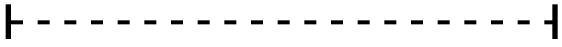
The correlation algorithm:

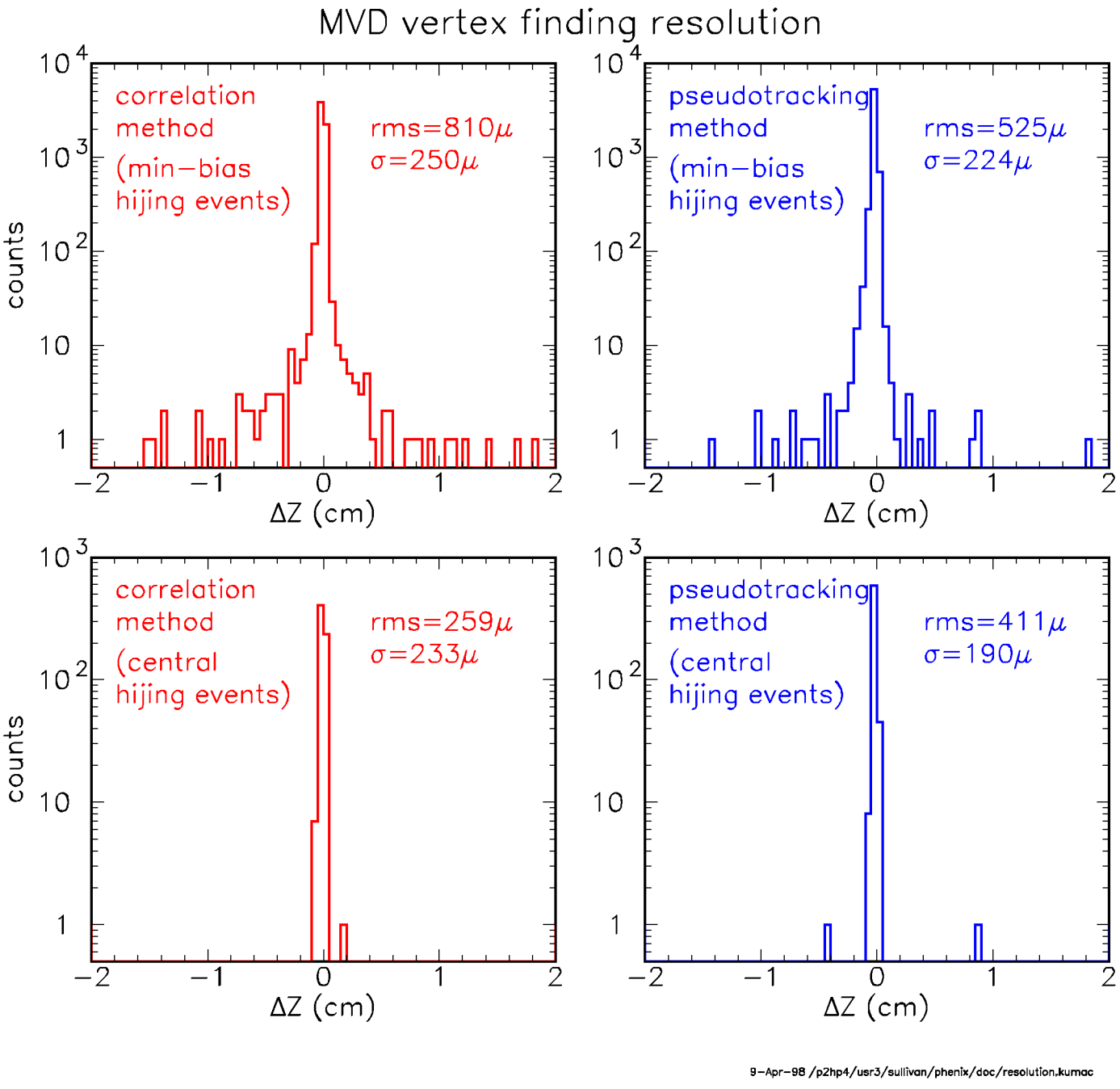


offset + outer silicon hits scaled by $\frac{R1}{R2}$



offset scaled by $\frac{R2}{R1}$ = vertex position




MVD vertex finding resolution
correlation
method
(min−bias
hijing events)
rms=810μ
σ=250μ
pseudotracking
method
(min−bias
hijing events)
rms=525μ
σ=224μ
correlation
method
(central
hijing events)
rms=259μ
σ=233μ
pseudotracking
method
(central
hijing events)
rms=411μ
σ=190μ
counts
ΔZ (cm)
9−Apr−98 /p2hp4/usr3/sullivan/phenix/doc/resolution.kumac

MVD Construction Status:

All mechanical and electrical components prototyped or in fabrication.

- Si pad detectors starting production.
- Si microstrip detectors in production.
- Rohacell C-cages in production at UCR.
- All custom die are manufactured - KGD testing.
- MCMs delivered by Lockheed-Martin in mid-summer.
- All custom electronics boards are in fabrication.
- All kapton cables are in production.
- Cooling system components being procured.

Construction Complete at LANL in spring of '99.

Installation in PHENIX in June '99.

First heavy-ion beam in Oct. '99.