PHENIX Run 14 Report

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FOR THE PHENIX COLLABORATION
RHIC & AGS ANNUAL USER'S MEETING
JUNE 19, 2014

Stony Brook University | The State University of New York

PHENIX

PHENIX in Run 14

- The PHENIX collaboration requested
  - Au + Au @ 200 GeV for 12 weeks

    [Physics driven goal is 1.5 nb^{-1} recorded within $|z| < 10$ cm]

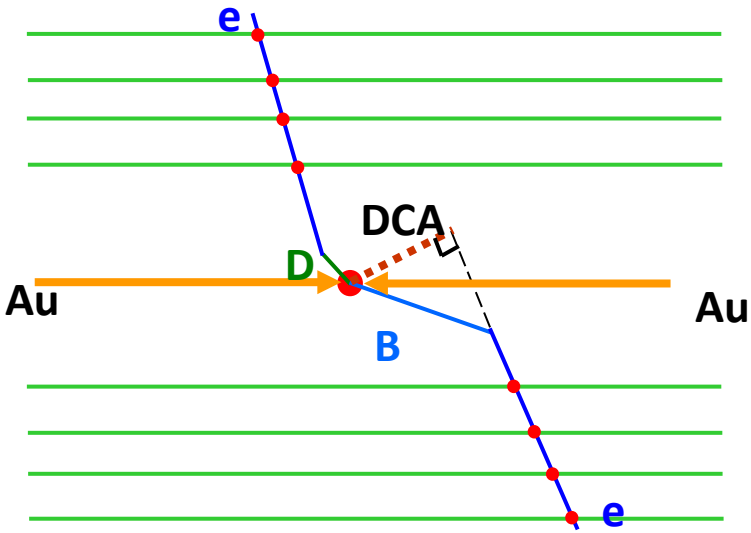
    to collect their definitive Heavy Ion Au + Au data sample

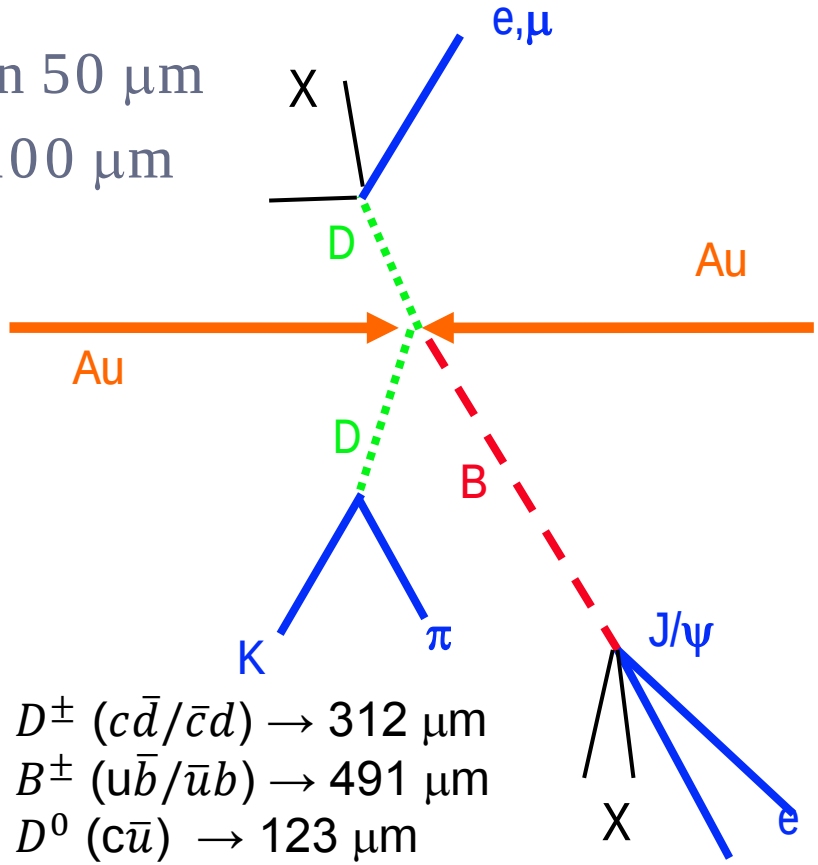
- Focus on high precision measurements of Heavy Flavor production
  - R_{AA} and v_2

    for electrons and muons separated charm and bottom decays

Heavy Quarks with PHENIX

- F/VTX detectors
  - Tracking resolution better than 50 μm
  - Vertex resolution better than 100 μm

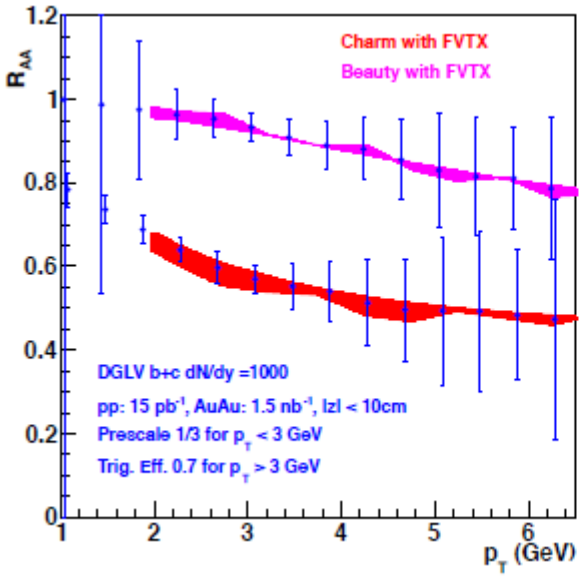




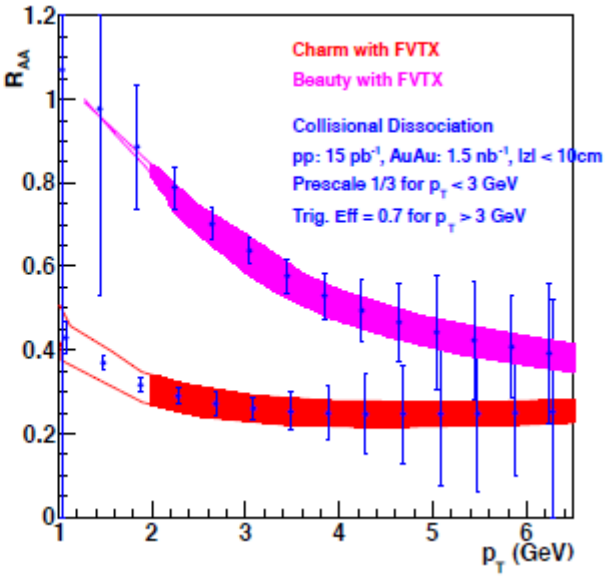
$D^{\pm}$ $(c\bar{d}/\bar{c}d) \rightarrow$ 312 μm
$B^{\pm}$ $(u\bar{b}/\bar{u}b) \rightarrow$ 491 μm
D^{0} $(c\bar{u}) \rightarrow$ 123 μm
B^{0} $(\bar{d}b) \rightarrow$ 457 μm

FVTX Data Set

- First Au+Au dataset for FVTX
- Simulation performance of nuclear modification factor R_{AA}



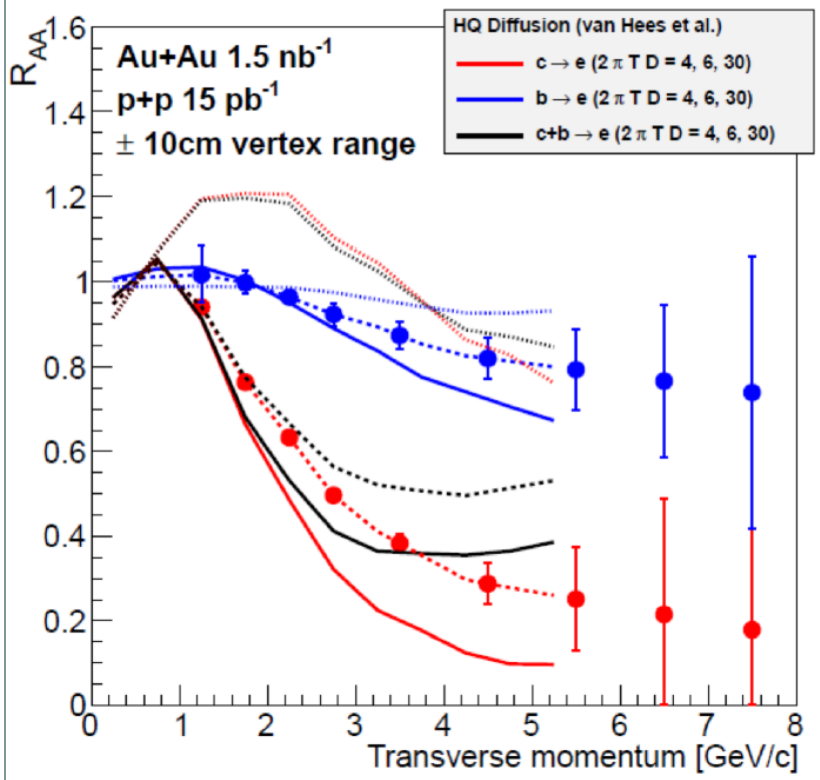
DGLV



Additional collisional dissociation processes

VTX Data Set

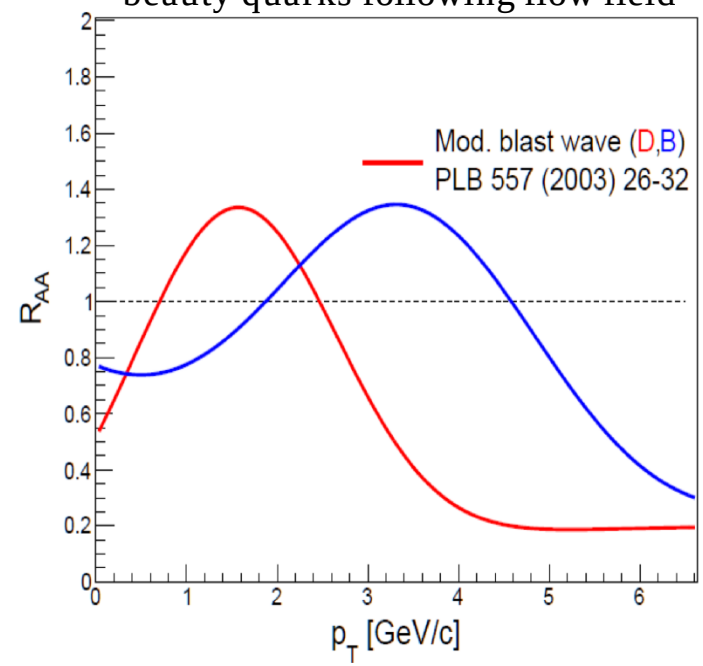
- Simulation performance of R_{AA} for VTX-system



Charm

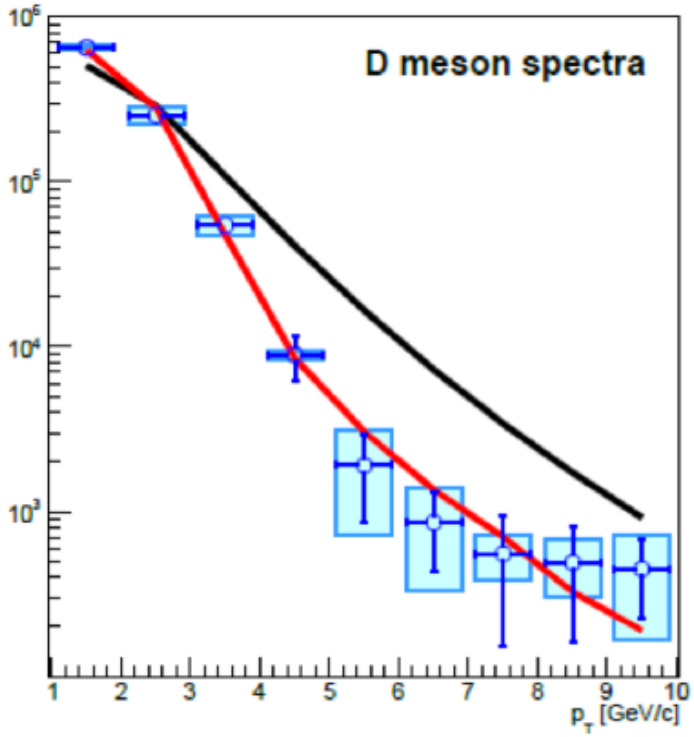
Beauty

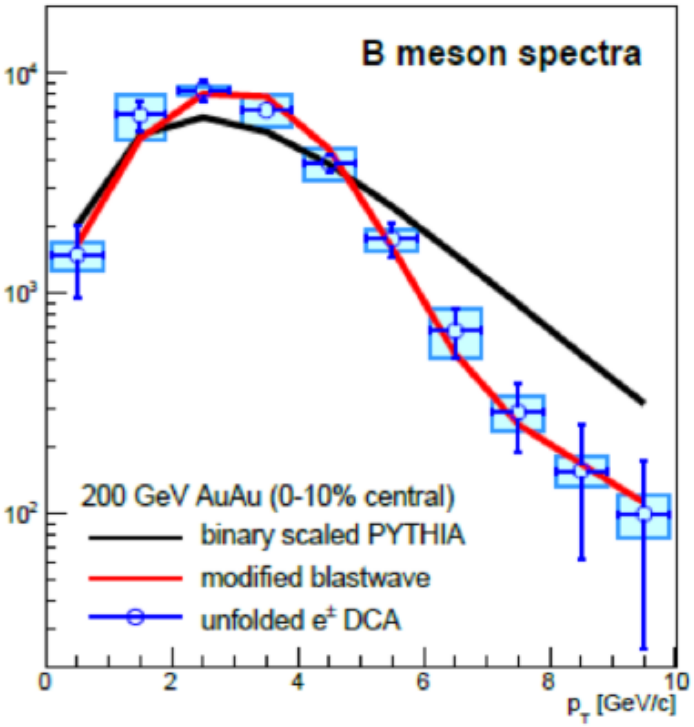
Very different prediction when considering extreme scenario of beauty quarks following flow field



VTX Data Set

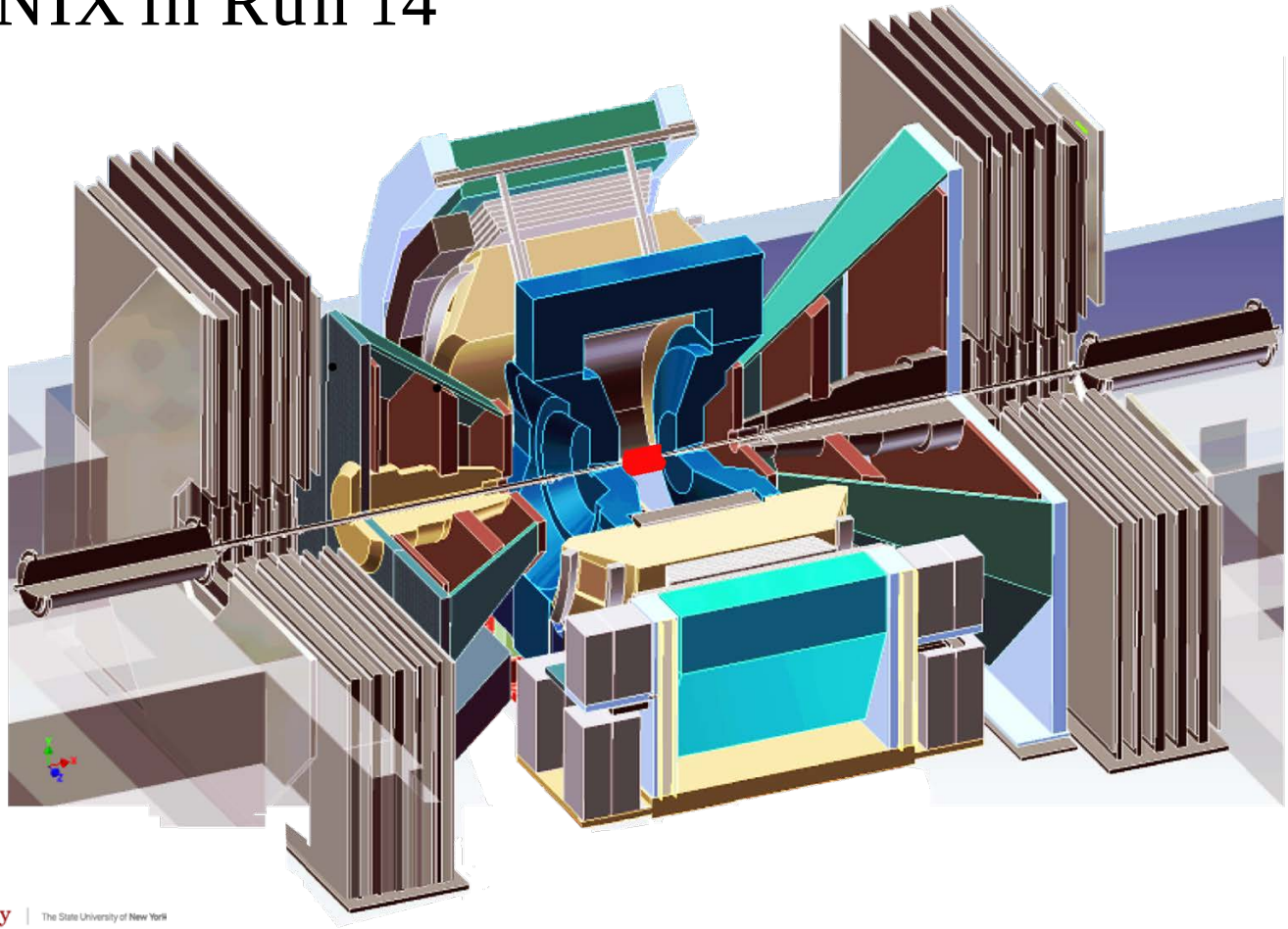
- Example full unfolding from DCA electrons to parent mesons





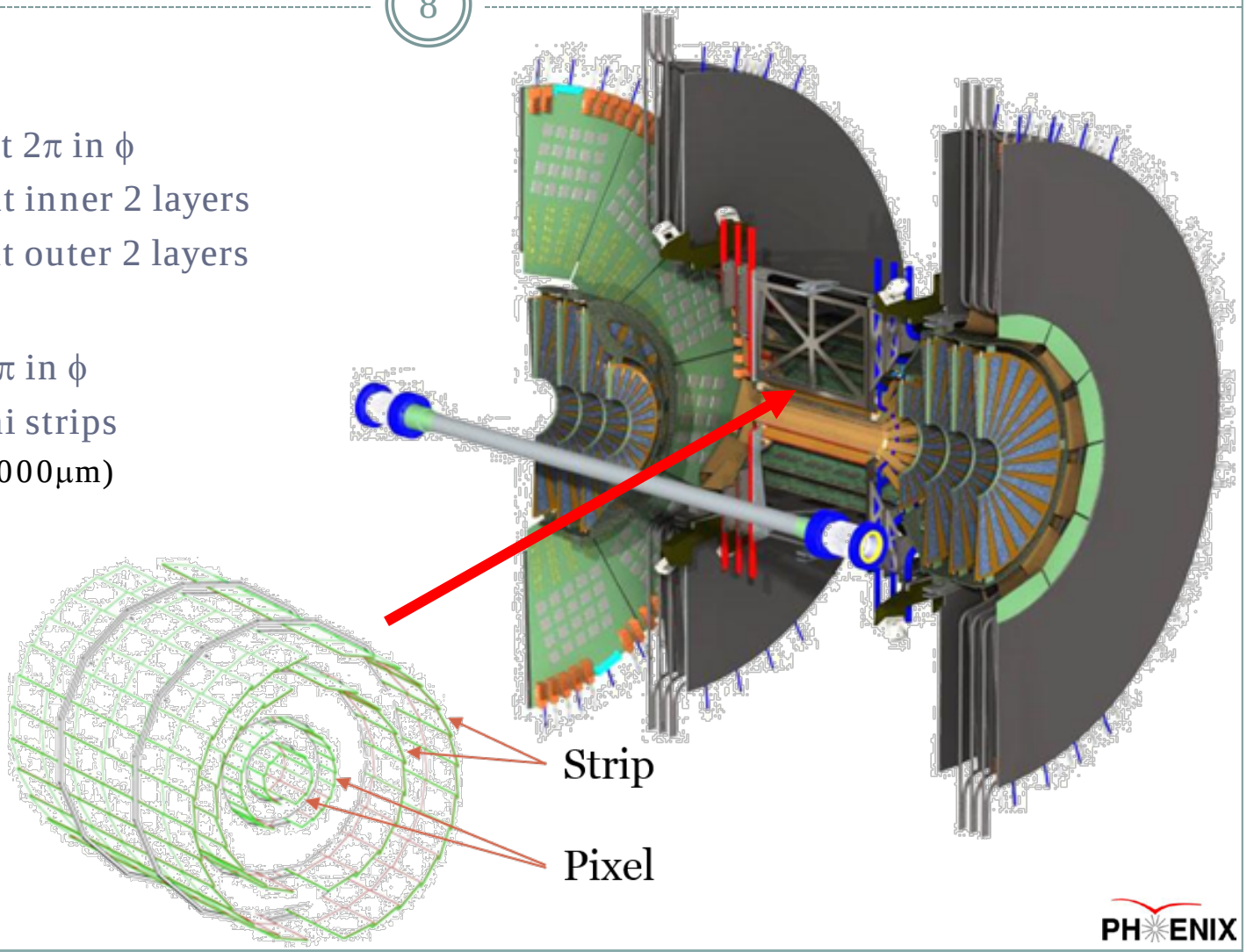
PHENIX Detectors

- PHENIX in Run 14



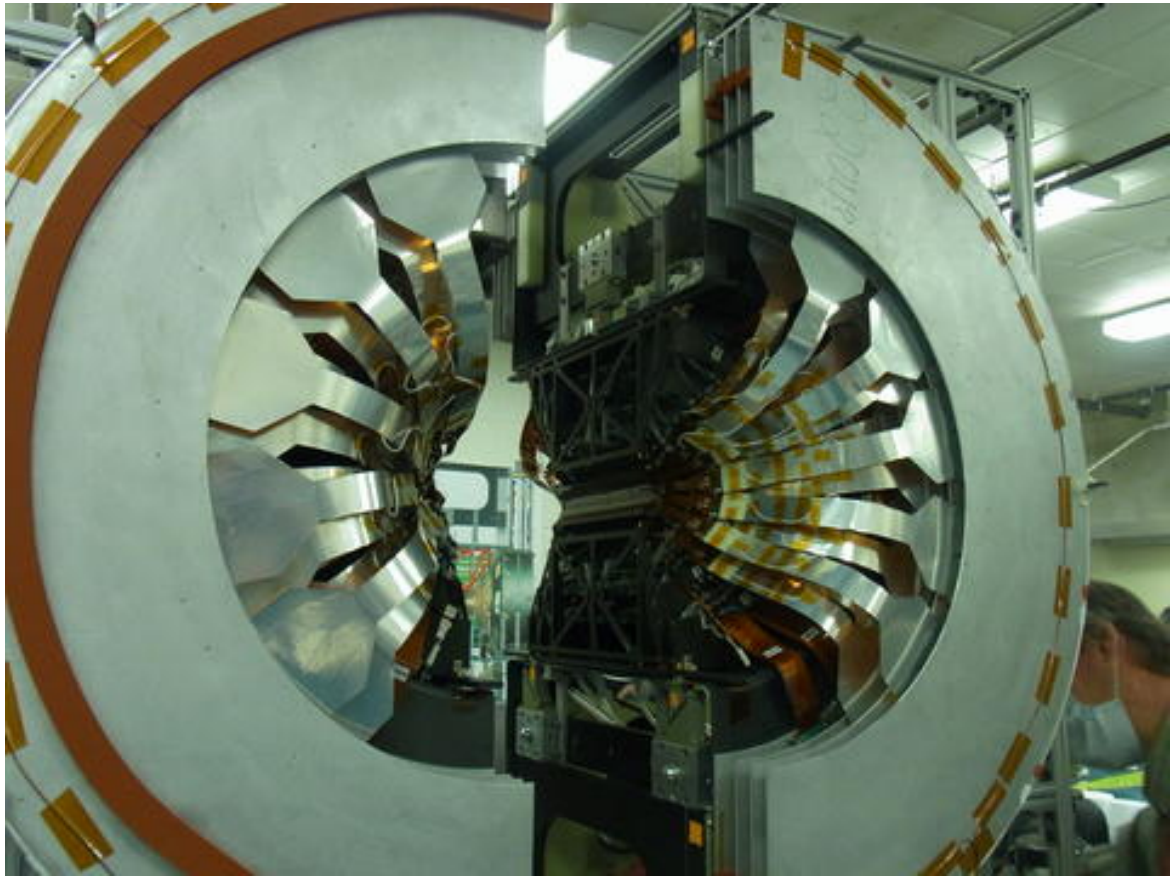
PHENIX Vertex Detector System

- Barrel region
  - $|\eta|<1.2$, almost 2π in ϕ
  - Pixel sensors at inner 2 layers
  - Strip sensors at outer 2 layers
- Forward region
  - $1.2<|\eta|<2.7$, 2π in ϕ
  - 4 layers of mini strips
    (50x 2000 to 11000μm)



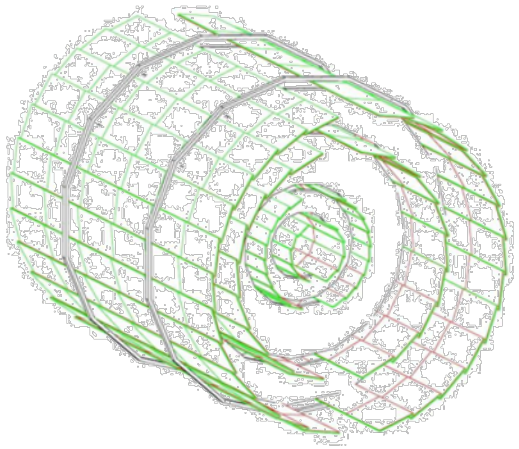
PHENIX Vertex Detector System

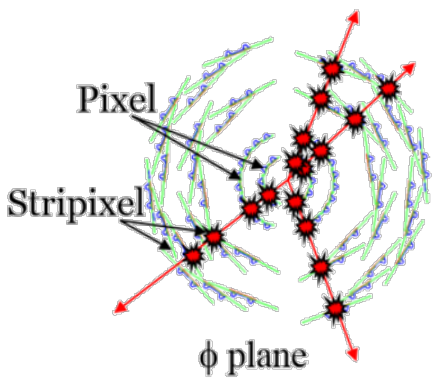
- *Refurbished* Barrel VTX system



PHENIX Vertex Detector System

- ***Refurbished*** Barrel VTX system





VTX	Layer	R1	R2	R3	R4
Geometrical dimensions	R (cm)	2.63	5.13	11.77	16.69
	Dz (cm)	21.8	21.8	31.8	38.2
	Area (cm^2)	280	560	1960	3400
Channel counts	Sensor size ϕ x z (cm^2)	1.5 x 5.67		3.43 x 6.36 (384 x 2 strips)	
	Channel size ($\Delta\phi$ x Δz)	50 x 425 μm^2		80 x 3000 μm^2	
	Sensor/Ladder	4	4	5	6
	Ladders	10	20	16	24
	Sensors	40	80	80	144
	Readout chips	160	320	960	1728
	Readout channels	1,310,720	2,621,440	115,200	221,184
Radiation length (X/X0)	Total	1.36	1.36	5.25	5.25

Layer	Radius (cm)	Detector	Occupancy in Central Au+Au	
1	2.63	Pixel	0.53 %	
2	5.13	Pixel	0.16 %	
3	11.77	Strip	4.5 % (x-strip)	4.7 % (u-strip)
4	16.69	Strip	2.5 % (x-strip)	2.7 % (u-strip)

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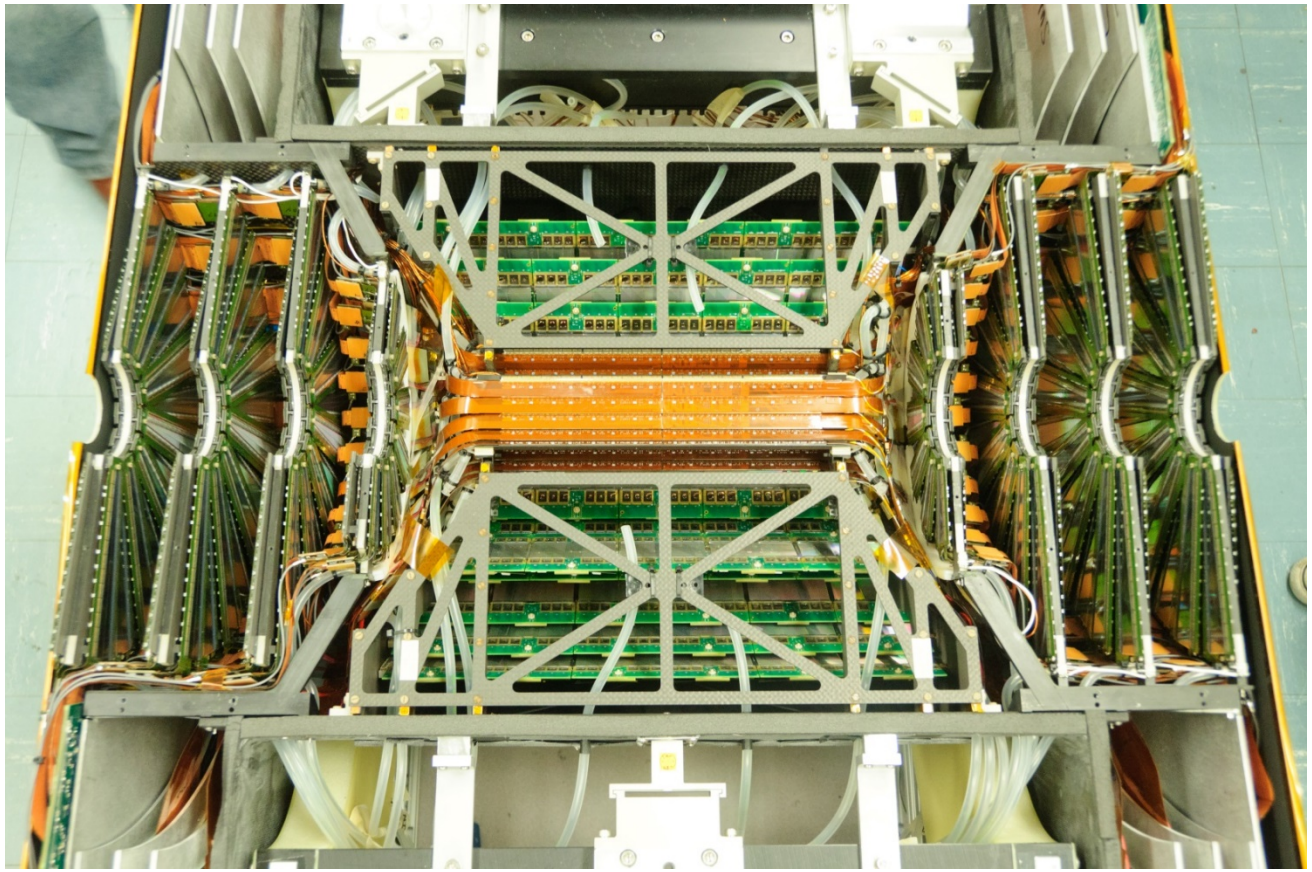
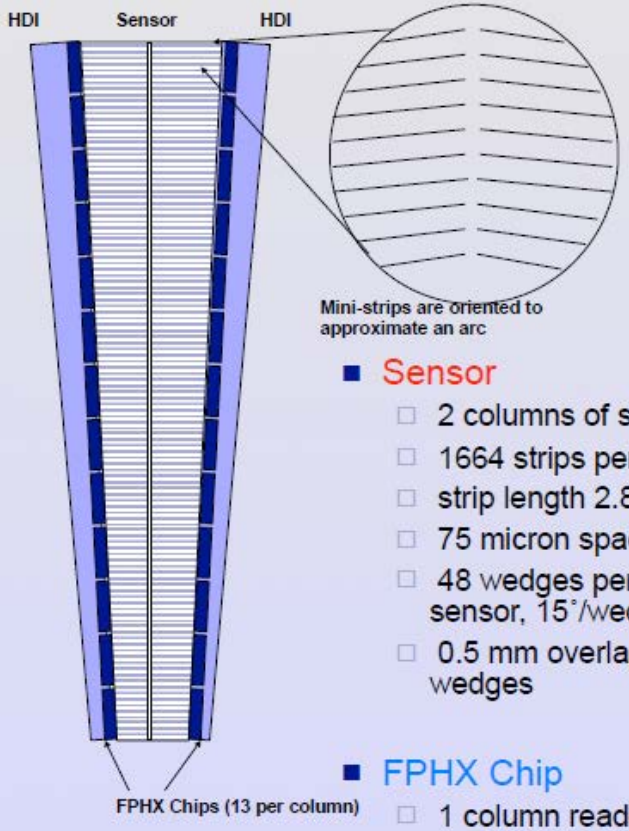
PHENIX Vertex Detector System

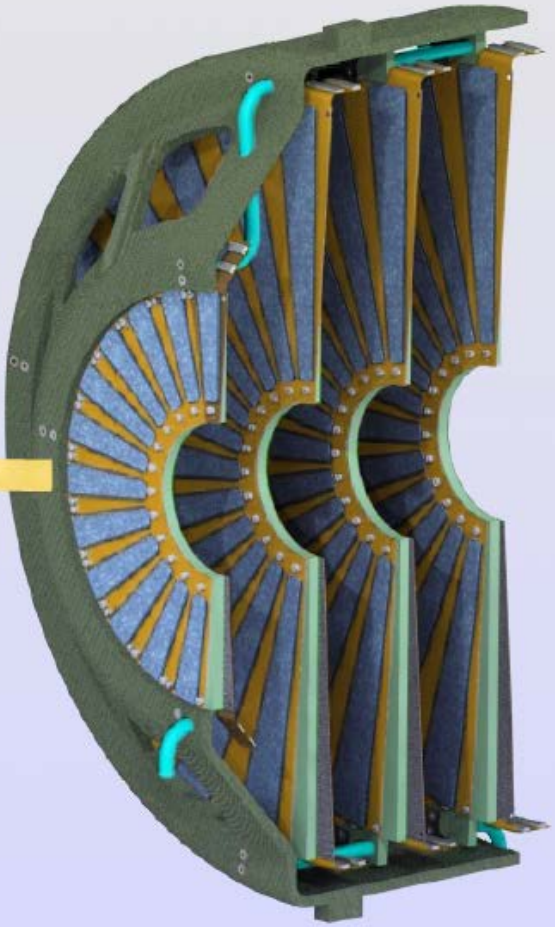
- *Refurbished* Barrel VTX system + FVTX



PHENIX Vertex Detector System



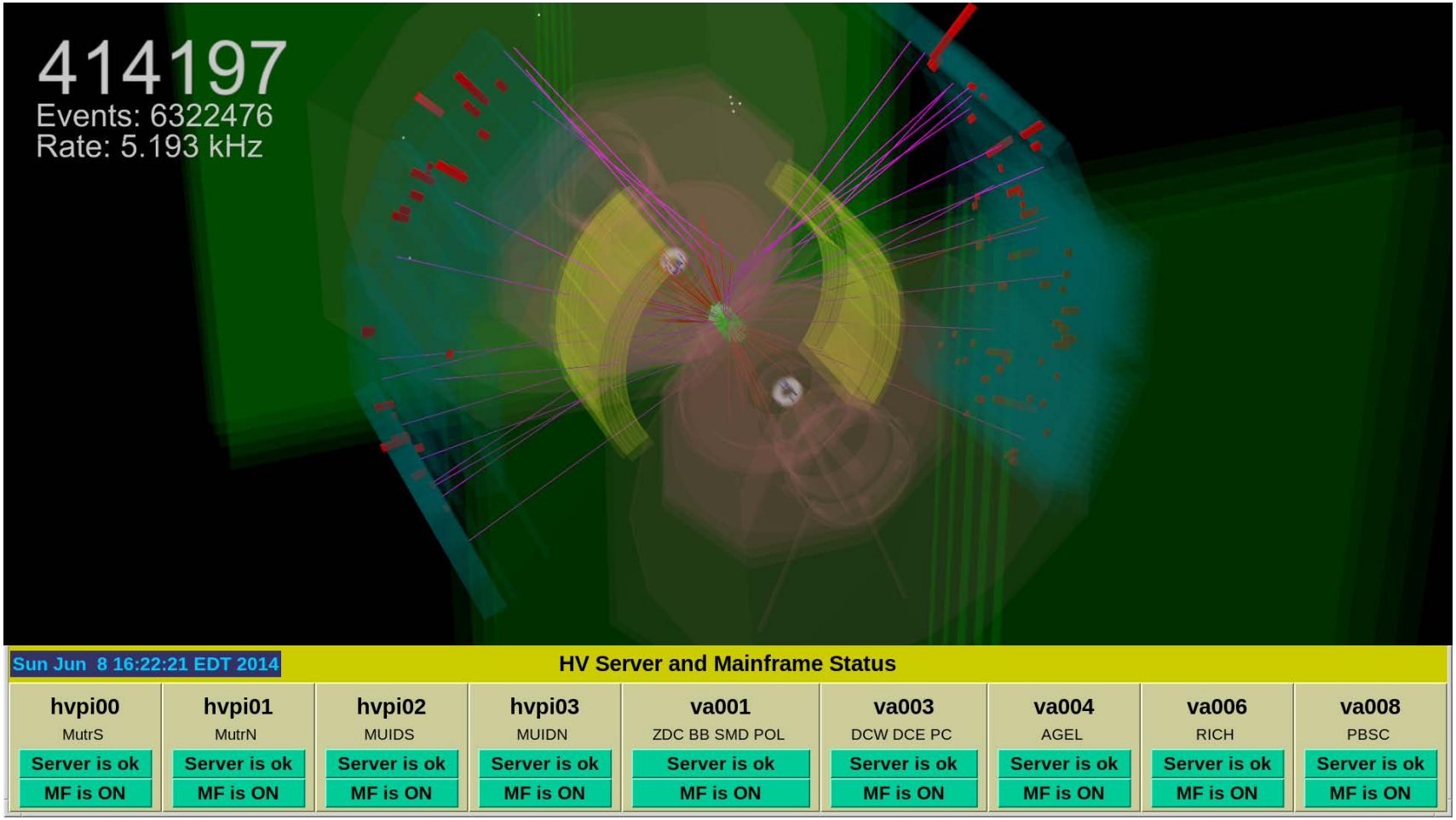
- Sensor
  - 2 columns of strips
  - 1664 strips per column
  - strip length 2.8 to 11.2 mm
  - 75 micron spacing
  - 48 wedges per disk (7.5˚/ sensor, 15˚/wedge)
  - 0.5 mm overlap with adjacent wedges
- FPHX Chip
  - 1 column readout
  - 128 channels
  - ~ 70 microns channel spacing
  - Dimensions –9mm x 1.2 mm



PHENIX IR

- F/VTX system installed in IR

PHENIX Counting House



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Run 14 The Parts

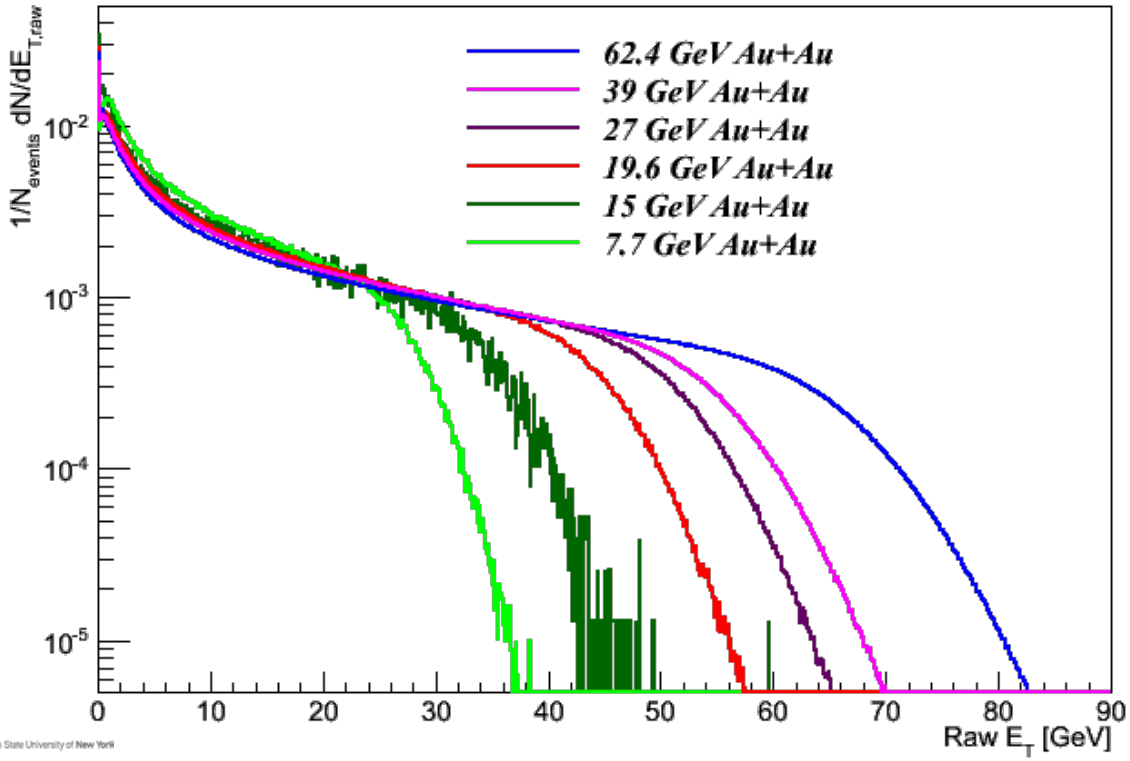
- 2014 - Run 14 subdivided in
  - Au+Au at $\sqrt{s_{NN}} = 15\ (14.6)\ GeV$
  - Au+Au at $\sqrt{s_{NN}} = 200\ GeV$

PHENIX @ 15 GeV

- Run 14 Low Energy LE @ 15 GeV
  - Physics declared for PHENIX on February 15
  - Goal for PHENIX: get detectors fully operational for physics
- We have recorded a high quality Au+Au 15 GeV data set and have tested our new detectors in preparation for the 200 GeV run
- Estimated number of (real) Au+Au @ 15 GeV events:
  - ~ 15M events in [± 30 cm] (March 10)
    $\mathcal{L} \sim 2.5/\mu b$
  - ~ 6.4M events in [± 10 cm] (March 10)
    $\mathcal{L} \sim 1.1/\mu b$

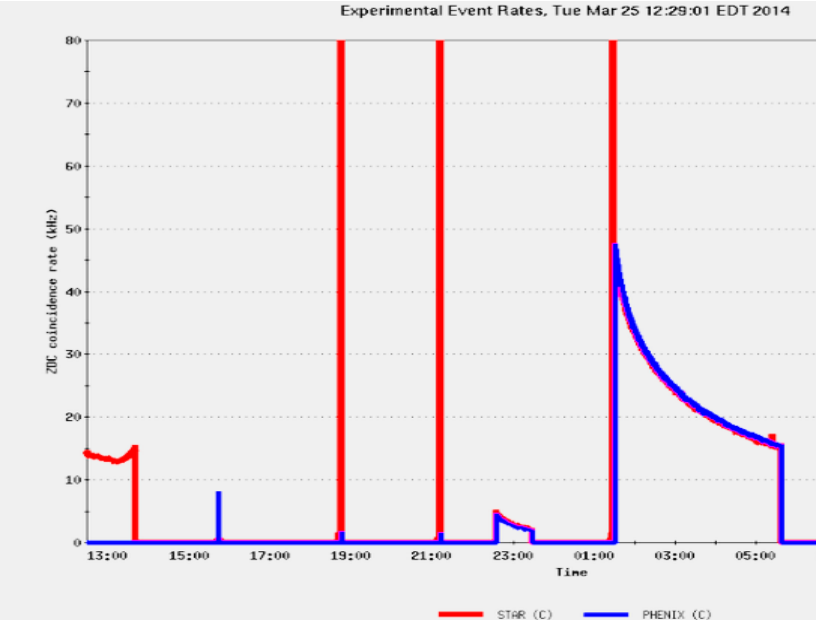
PHENIX @ 15 GeV

- *Very first* additional distribution for BES energies from a small fraction of complete dataset



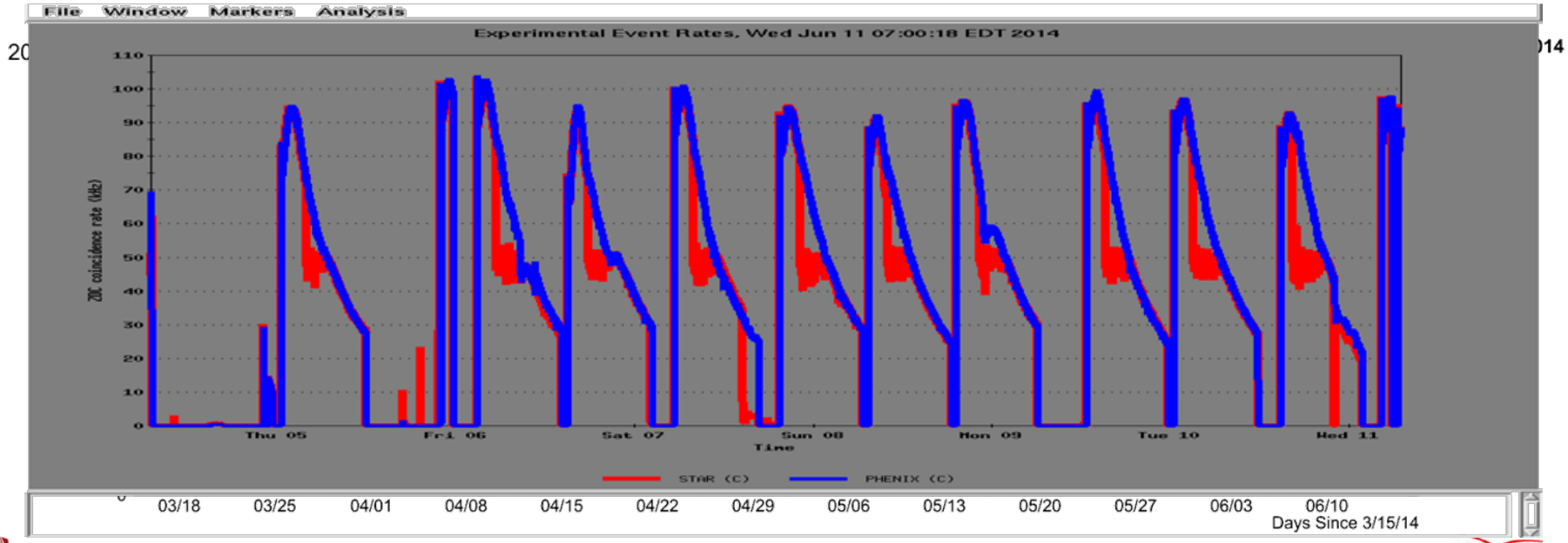
Run 14 High Energy Run

- High energy run Au+Au @ 200 GeV was declared on March 15, about five days after LE run was finished
- After 10 days set up B+Y longit. and horiz. cooling



RHIC Performance

- Excellent RHIC performance
  - Fast tune up, stochastic cooling working quickly
  - Very good lifetime, default store length 10 – 11 hours, fast turnaround



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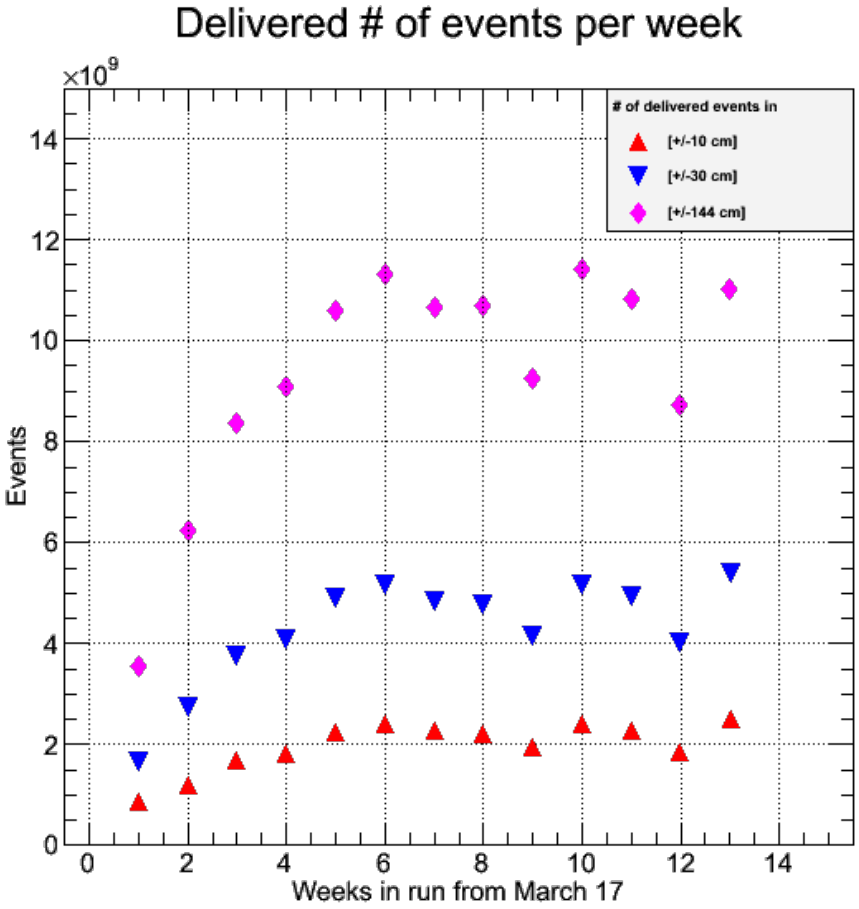
RHIC Performance

- Excellent RHIC performance

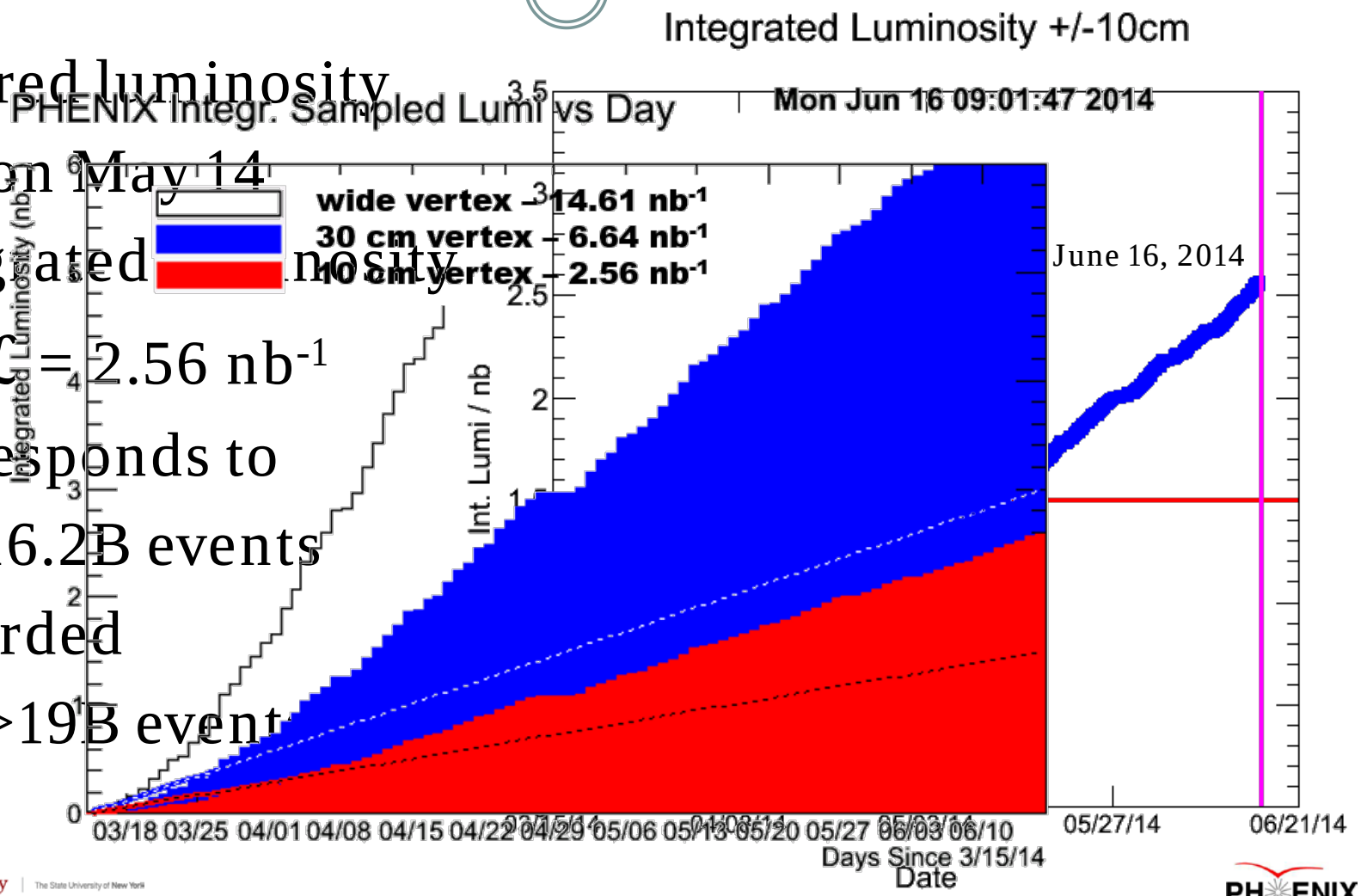


Run 14 High Energy Run

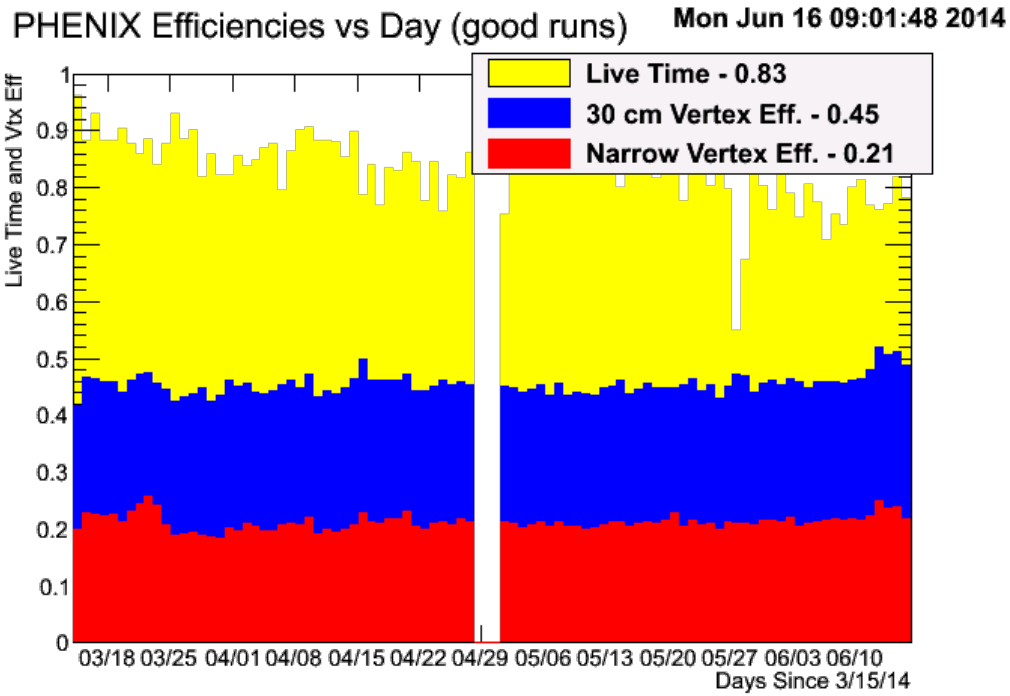
- First Physics store/run was 18046/405839, March 15
- High Energy (HE) run for 93 days → ~13 ½ weeks
- Concluded HE run with 193 fills
- Our main goal for Au+Au @ 200 GeV was to accumulate $\mathcal{L}$ = 1.5 nb^{-1} for BBC-vertex |z| < 10 cm
  - Optimal range for VTX coverage
  - Accumulated $\mathcal{L}$ = 2.56 nb^{-1}
  - 171% of our goal
  - Integrated luminosity is based on *reconstructed* events in BBC-narrow vertex range

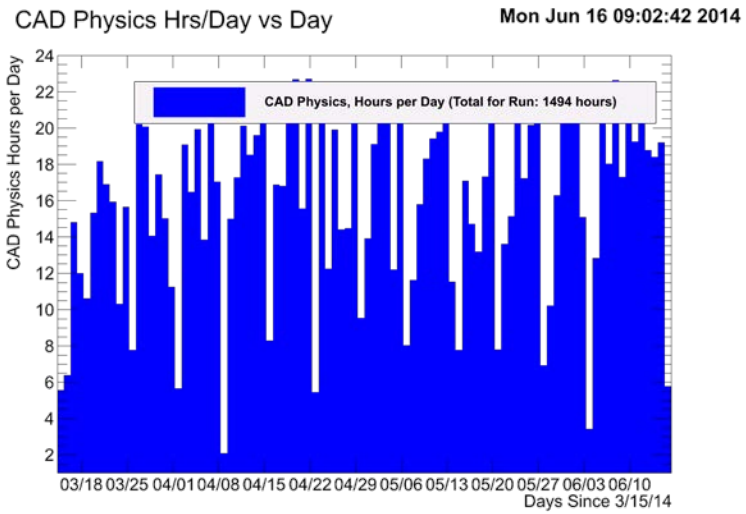
PHENIX Performance

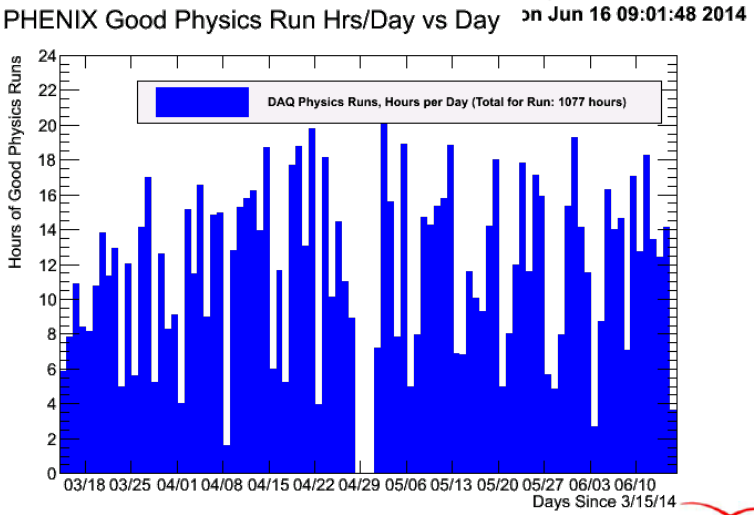
- Secured luminosity goal on May 14
- Integrated luminosity
  $\mathcal{L} = 2.56\ nb^{-1}$
- Corresponds to
  16.2B events
- Recorded
  >19B events



PHENIX Performance







- ✓ ~ 1100 hours PHENIX physics runs
- ✓ ~ 1500 hours CAD stores
- ✓ > 80% efficiency

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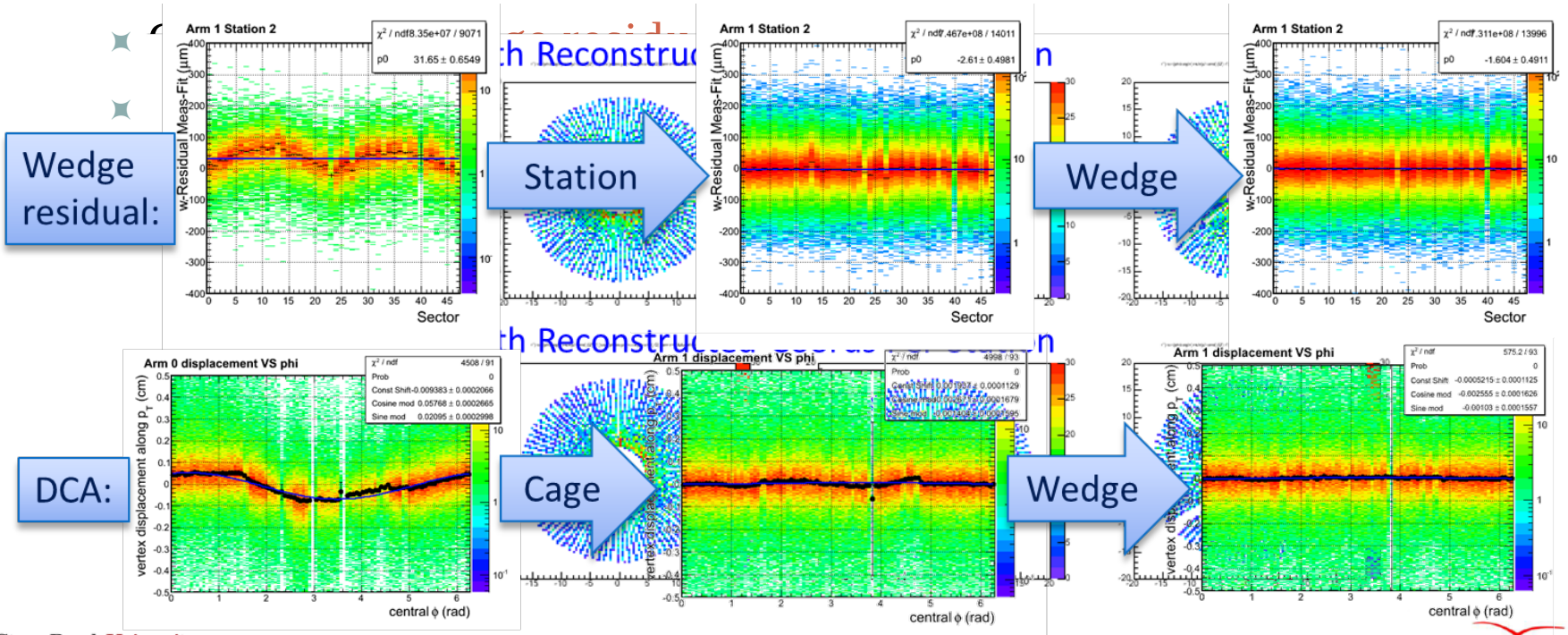
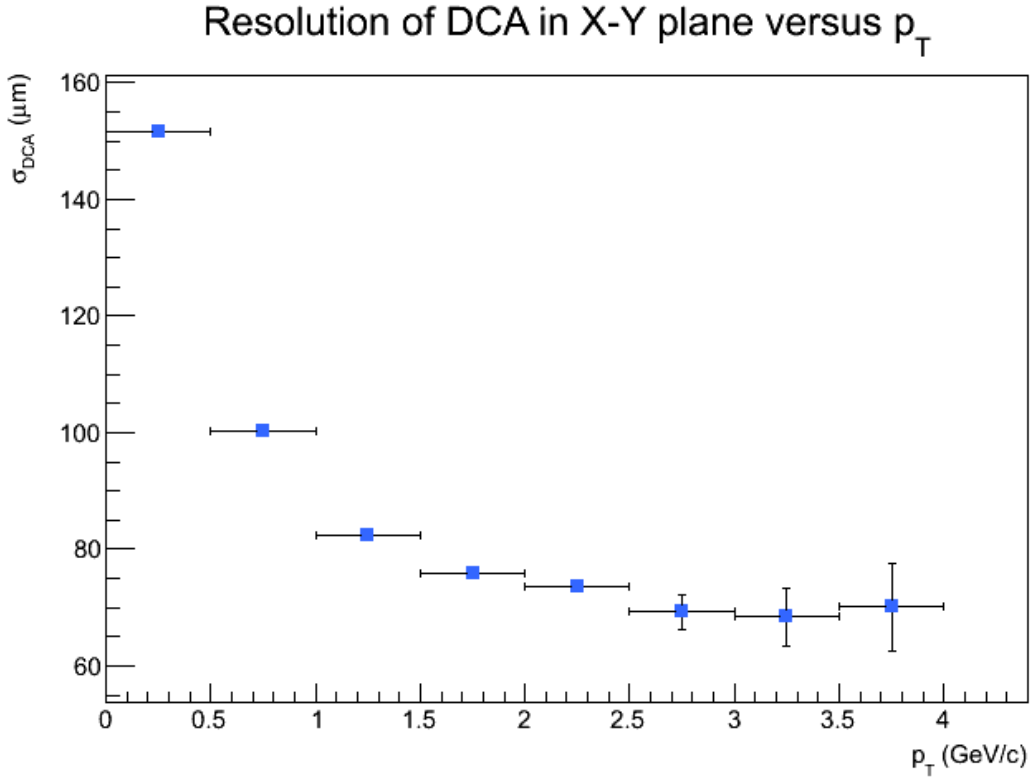
PHENIX Detector Performance

- F/VTX detectors operating well
  - Live area > 95%
  - Internal alignment



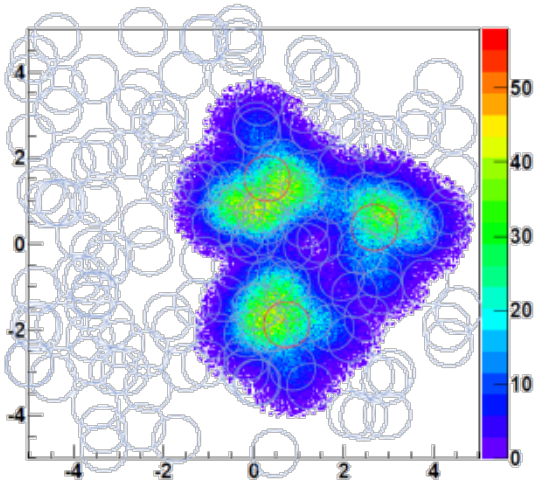
PHENIX Detector Performance

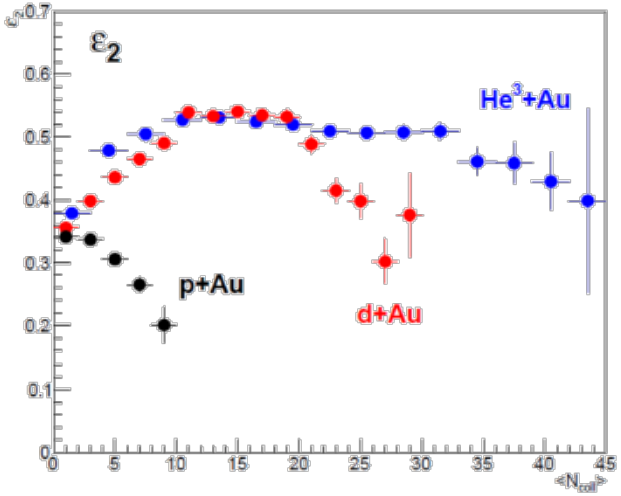
- F/VTX detectors operating well
  - Successful realignment provides better than 100 μm DCA
  - Pixel liv
  - Strip pi

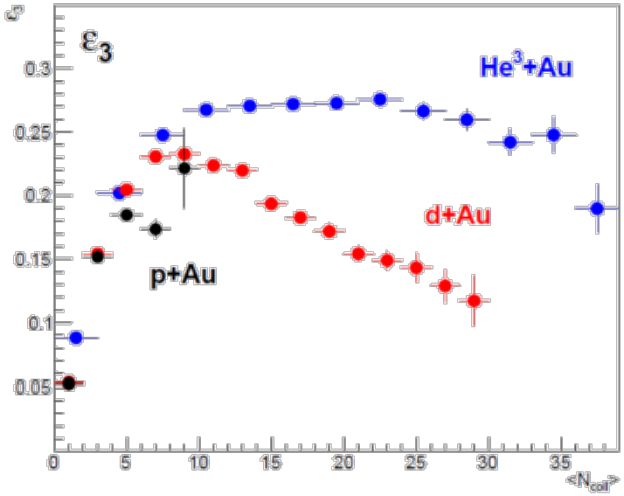


Setting Up for ^{3}He + Au

- Unique probe of geometry
- Make use of large tracking coverage of F/VTX
- Measurement if hotspots in deposited energy connect during time evolution → v_2 and v_3?

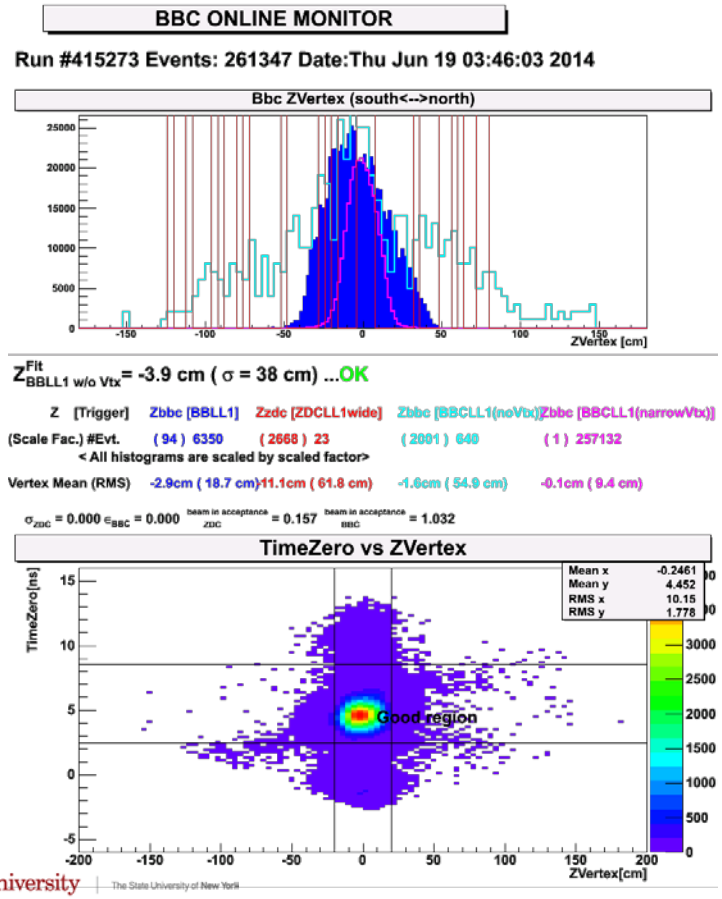


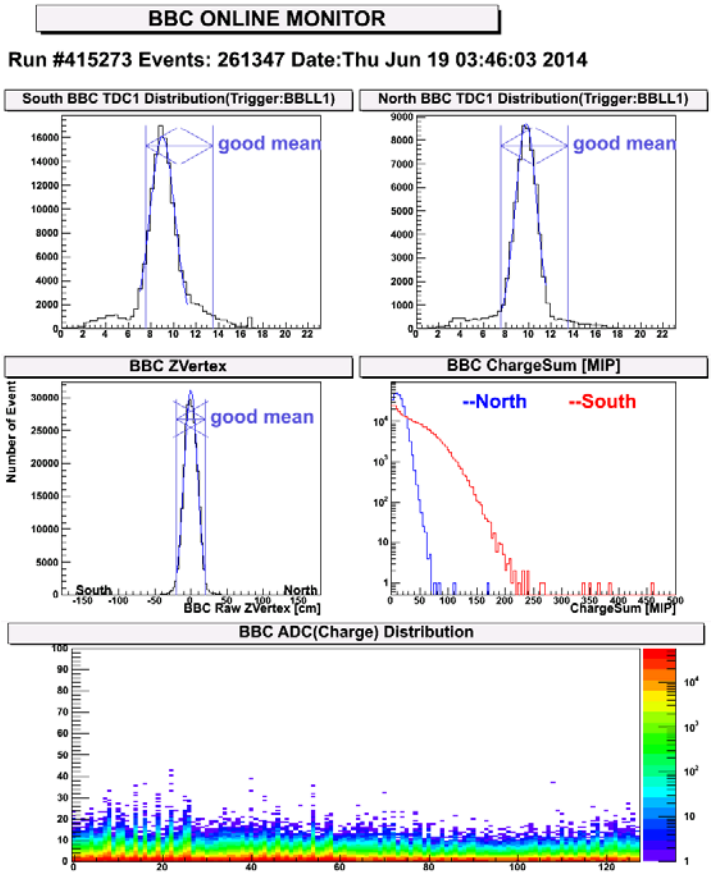




Setting Up for ^{3}He + Au

- First collisions last night (Wednesday, June 19)





Conclusion

- Run 14 Au+Au part successfully completed
- Detector is performing well
- Luminosity goal early accomplished and well exceeded
- Successful running based on fantastic - RHIC - and
  - Collaborator - performance
- Setting up for exciting final measurement with
  ^{3}He + Au @ 200 GeV
- Expecting end of run in 2014 by July 10
- Many thanks to my PHENIX fellows, C-AD members and STAR crews