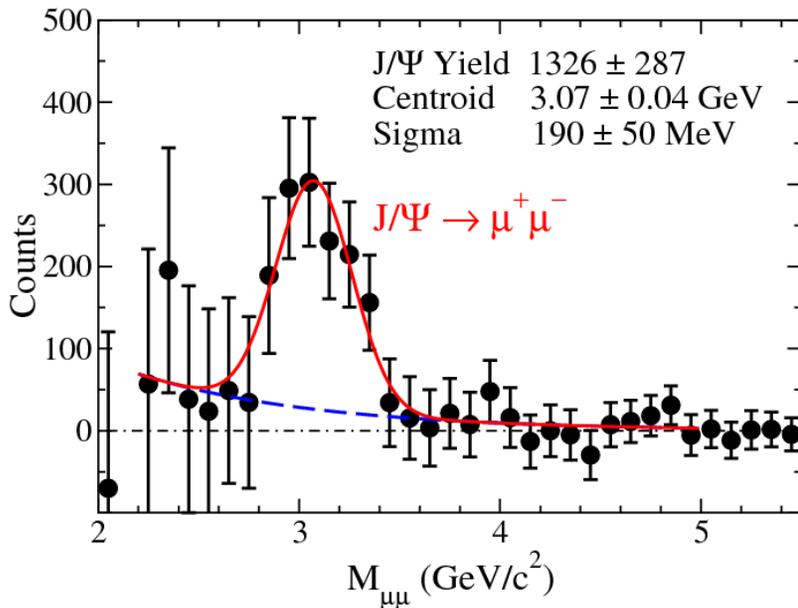
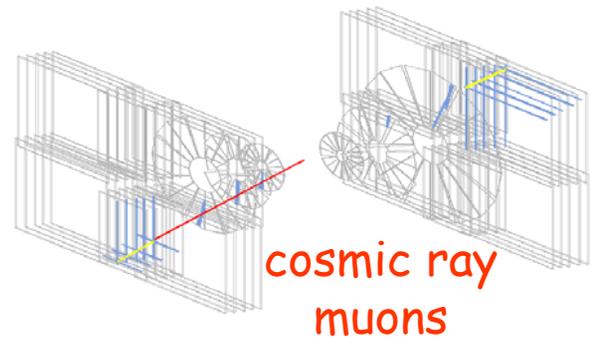
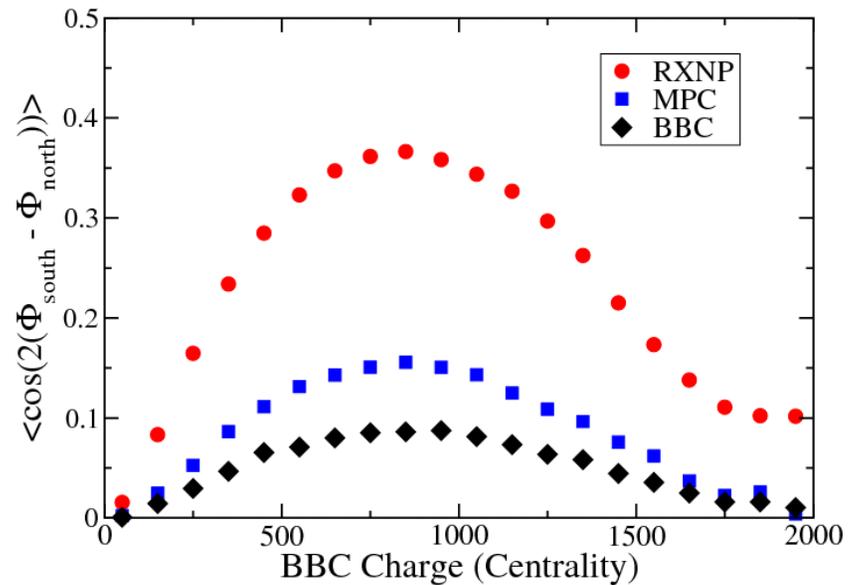


Mike Leitch, LANL  
 PHENIX Run Coordinator  
 RHIC Run7 Closeout Retreat  
 July 2007

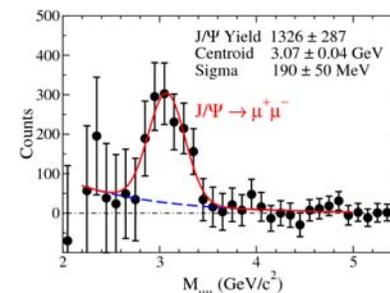
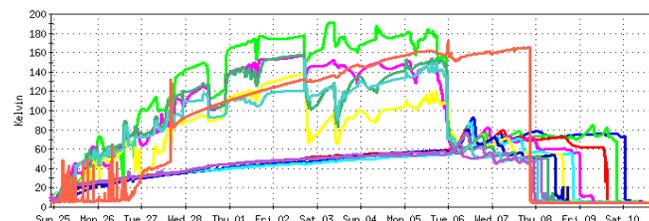
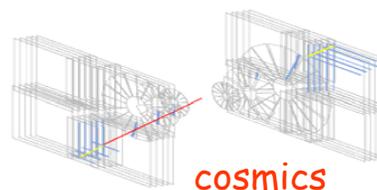


reaction plane



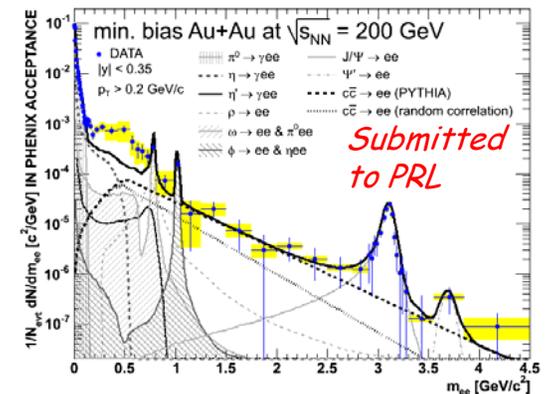
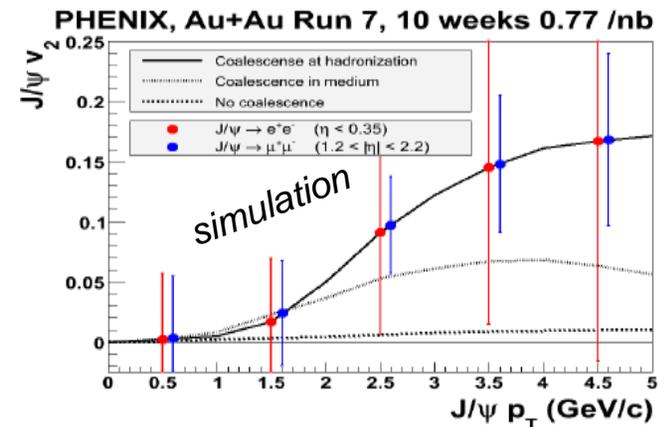
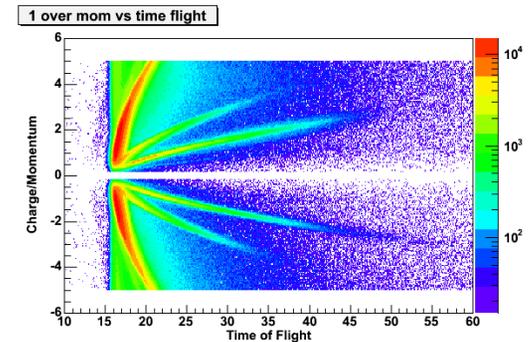
# Run7 Chronology

- Originally hoped to start with Nov 1<sup>st</sup> cool-down and PHENIX planned for:
  - AuAu - 15 wks (1.1 nb<sup>-1</sup>), pp - 10 wks (32 pb<sup>-1</sup>)
- Delayed by continuing resolution & meager FY06 level to match
- But PHENIX started anyhow:
  - Cosmic rays starting Jan 9<sup>th</sup>
  - "Run7 is on" Feb 1<sup>st</sup>
  - Start of cool-down Feb 8<sup>th</sup>
  - Cryo problems Feb 24<sup>th</sup>
  - Rings cold & with beam Mar 13<sup>th</sup>
  - Start of Physics Mar 27<sup>th</sup>
- End of Run7 Jun 26<sup>th</sup>
- 13 wks of physics (Mar 27<sup>th</sup> - Jun 26<sup>th</sup>)

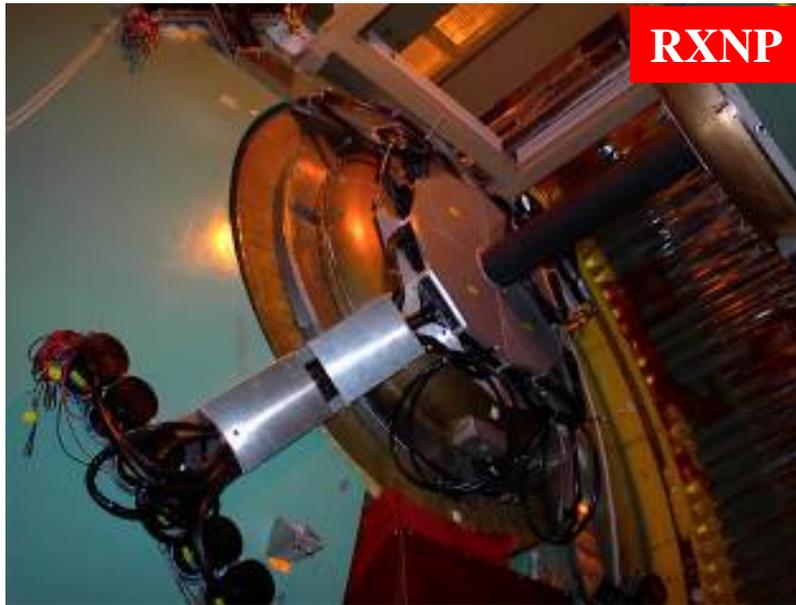


# PHENIX Physics Goals for Run7

- Increase statistical & systematic precision of rare signals in AuAu, e.g.  $J/\psi$ , jet correlations, etc
- Increase reach in  $p_T$ , especially with PID from new TOF-West detector ( $p_T > 8 \text{ GeV}/c$ )
  - Identified particle spectra
  - Identified leading particles in jets
- Factor of two or more improvement in Reaction Plane resolution - valuable to many signals
  - $v_2$  for  $J/\psi$ ,  $\gamma$  - new
  - electrons, hadrons - extended
- Low-mass lepton pairs with the HBD



# Four New Detector Subsystems for Run7



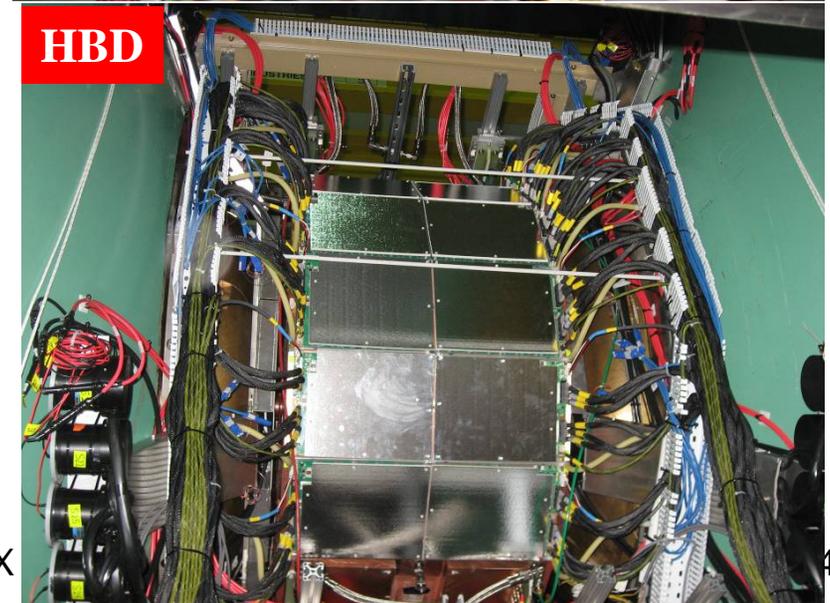
**RXNP**



**MPC-N**



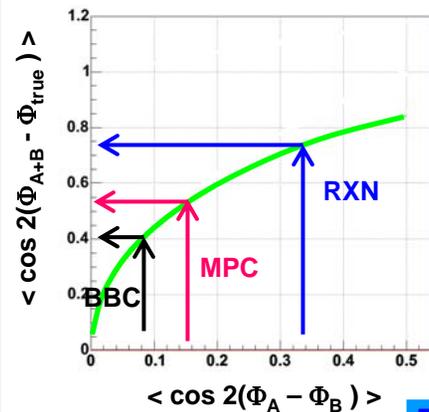
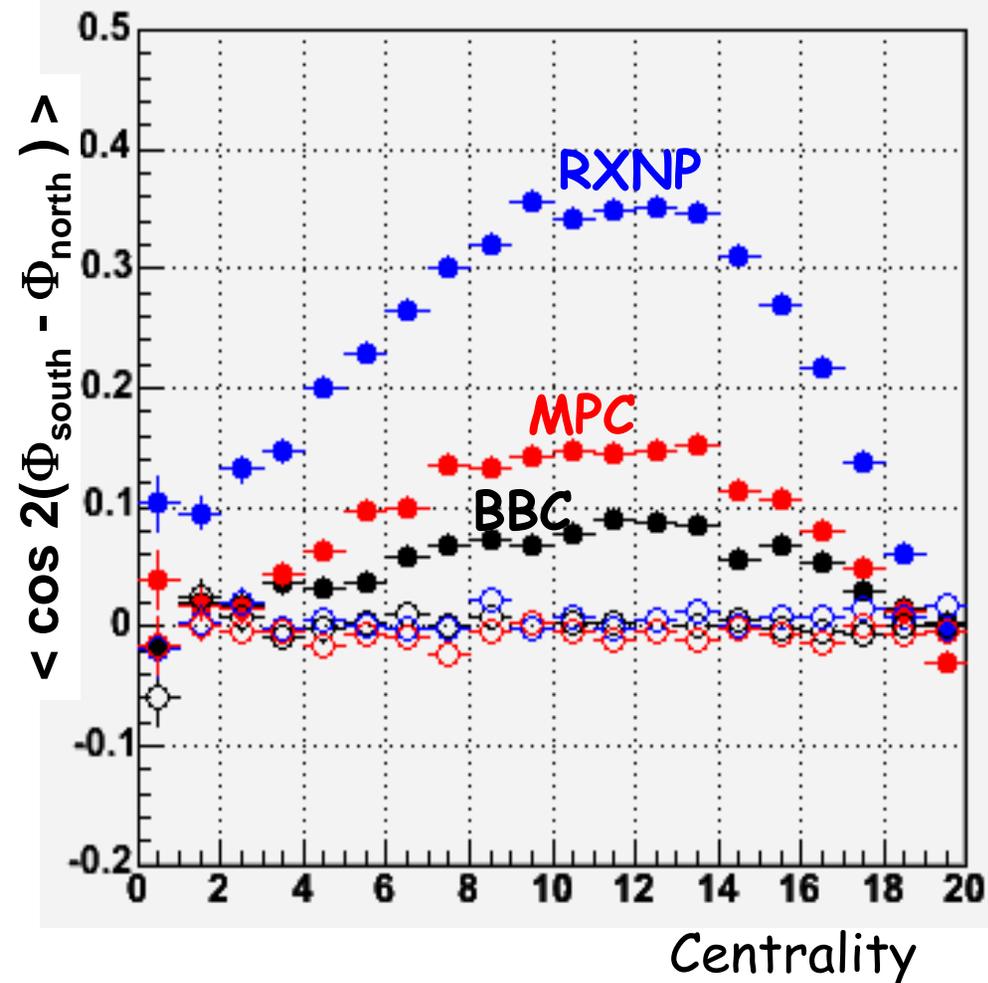
**TOF-W**



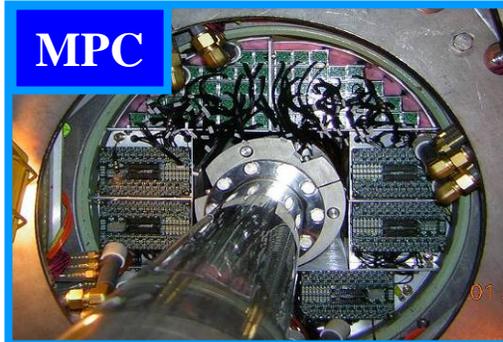
**HBD**

# PHENIX Reaction Plane Measurements Now from MPC, RXNP & BBC

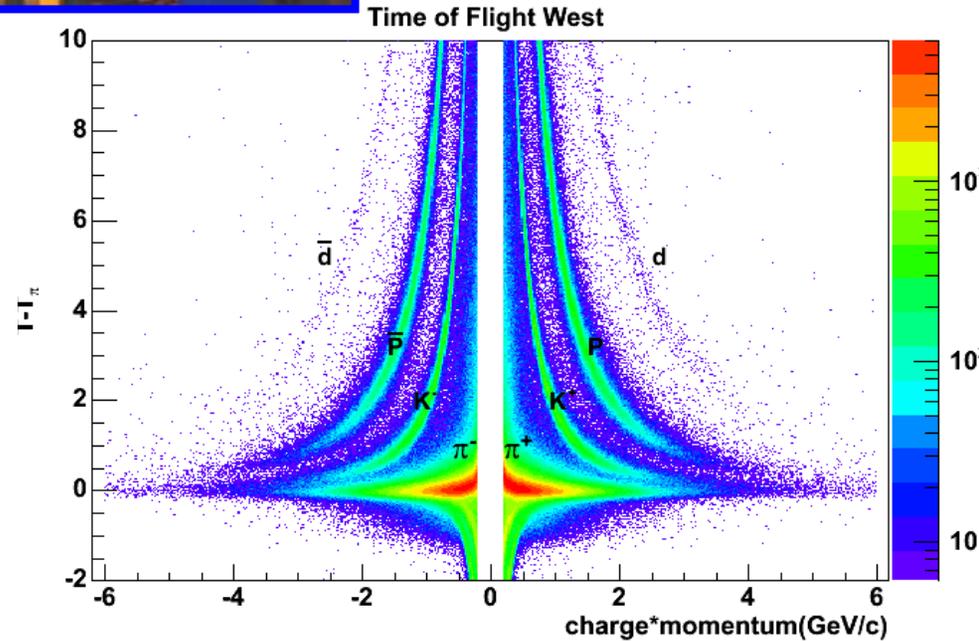
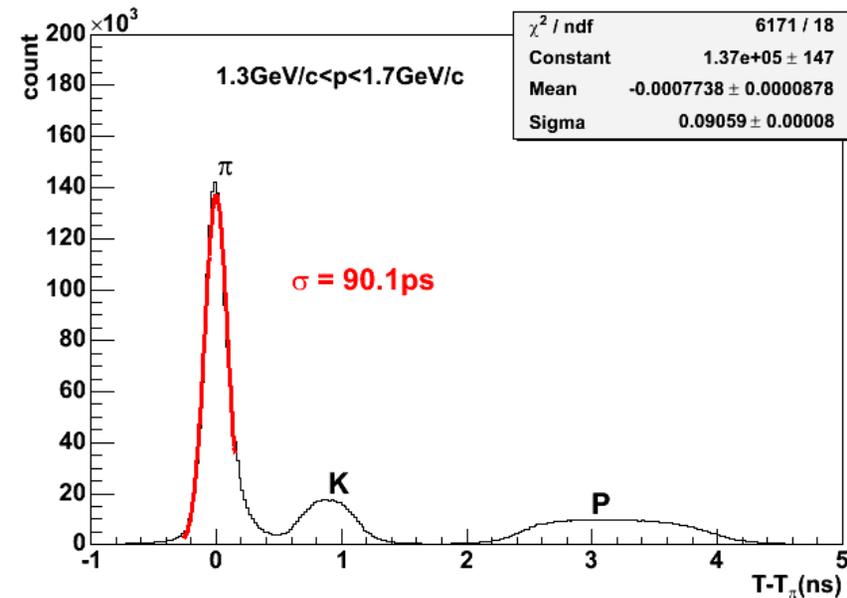
Reaction Plane Detector



$$\delta(v_2^{\text{true}}) = \frac{\delta(v_2^{\text{expt}})}{\sigma_{RP}}$$



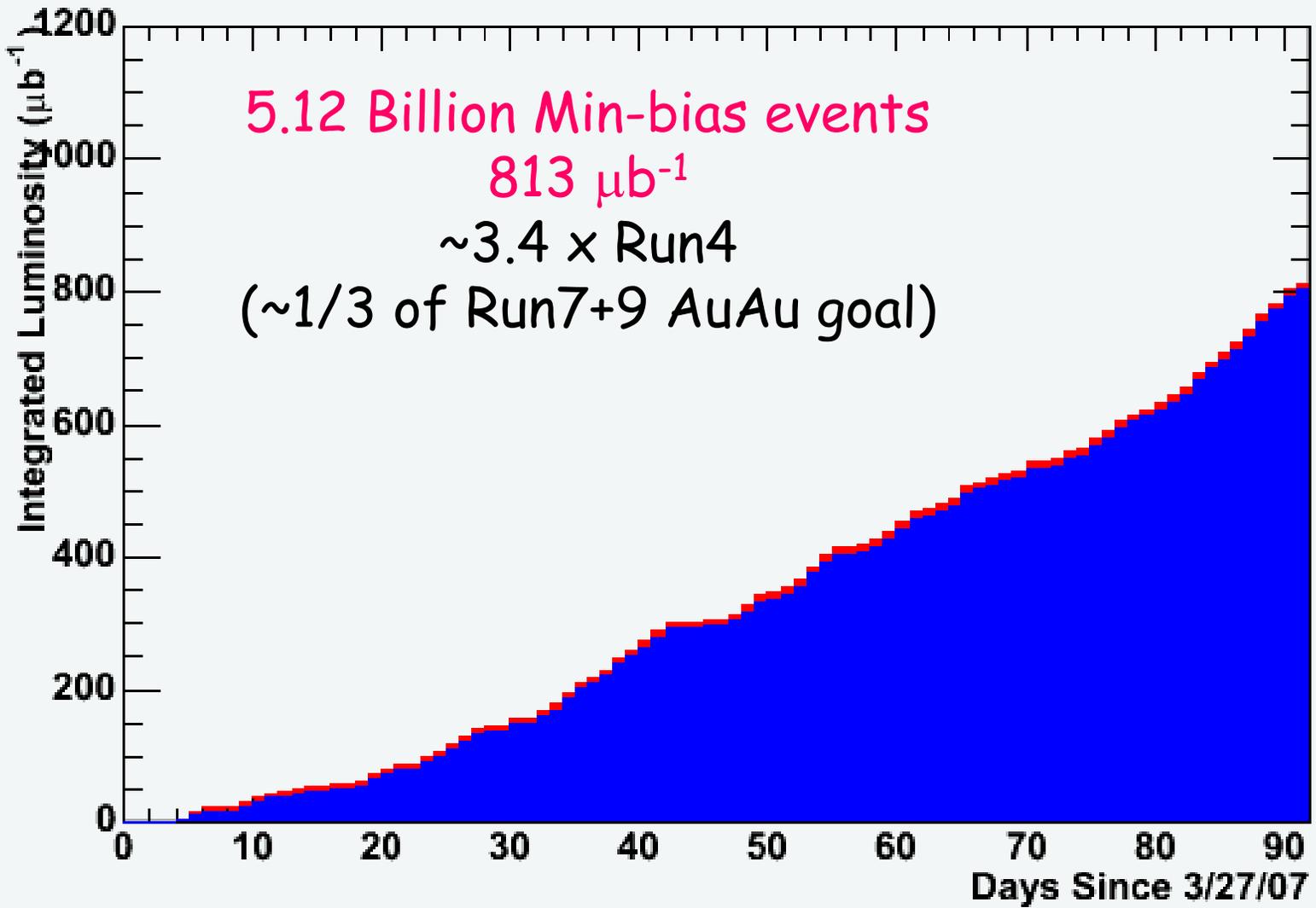
# TOF-West Particle Identification



6/21/2007

PHENIX - MJL

6



# The PHENIX Luminosity Story

	All Run7	%	Last week (6/19-26)	%	PHENIX BUP
CA-D luminosity	3260 $\mu\text{b}^{-1}$		482 $\mu\text{b}^{-1}$		
PHENIX ZDC luminosity Uptime	20.46B ZDC/9.8b = 2088 $\mu\text{b}^{-1}$	64.4%	3.41B ZDC/9.8b = 348 $\mu\text{b}^{-1}$	72.2%	
PHENIX BBC luminosity Vtx cut*	6.27B BBCLL1 /(0.92*6.847b) = 995 $\mu\text{b}^{-1}$	47.7%	960M BBCLL1 /(0.92*6.847b) = 152 $\mu\text{b}^{-1}$	43.7%	70%
PHENIX live luminosity Live time	5.12B BBCLL1 /(0.92*6.847b) =813 $\mu\text{b}^{-1}$	81.7%	854M BBCLL1 /(0.92*6.847b) =136 $\mu\text{b}^{-1}$	89.5%	
PHENIX up*live time	59.5%*81.7%	48.6%	72.2%*89.5%	64.6%	60%
Overall		24.9%		28.2%	

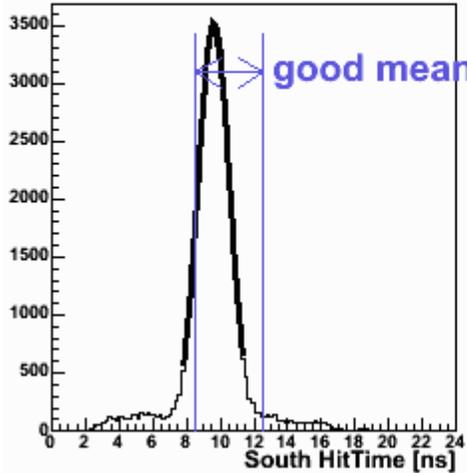
Time DAQ  
Not on for  
physics

\*Vertex eff slightly worse after "+-" → "-+" magnetic field change  
(cause of lower vtx eff for last week than whole run)

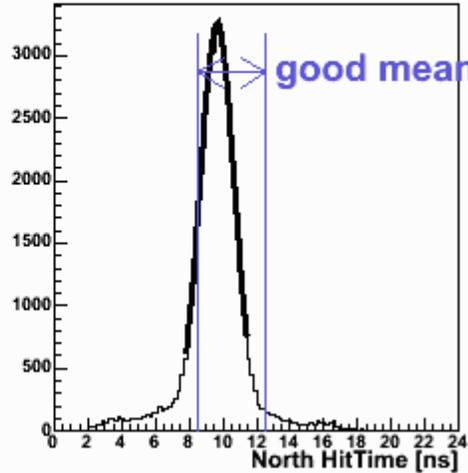
# Effects of Stochastic Cooling at PHENIX

Run #235227 Events: 50172 Date:Wed May 16 22:42:19 2007

BBC South Hittime



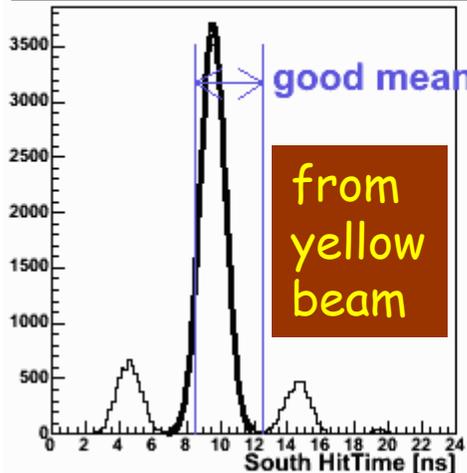
BBC North Hittime



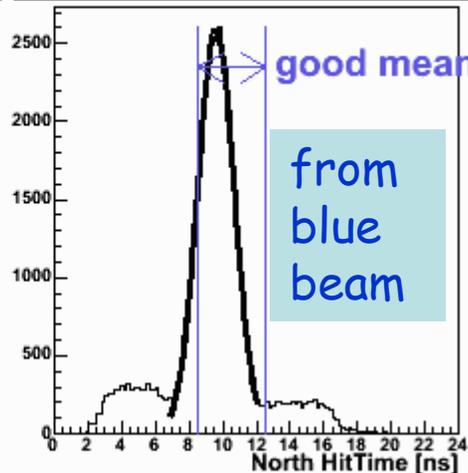
beginning  
of store

Run #235235 Events: 50136 Date:Thu May 17 02:42:52 2007

BBC South Hittime



BBC North Hittime

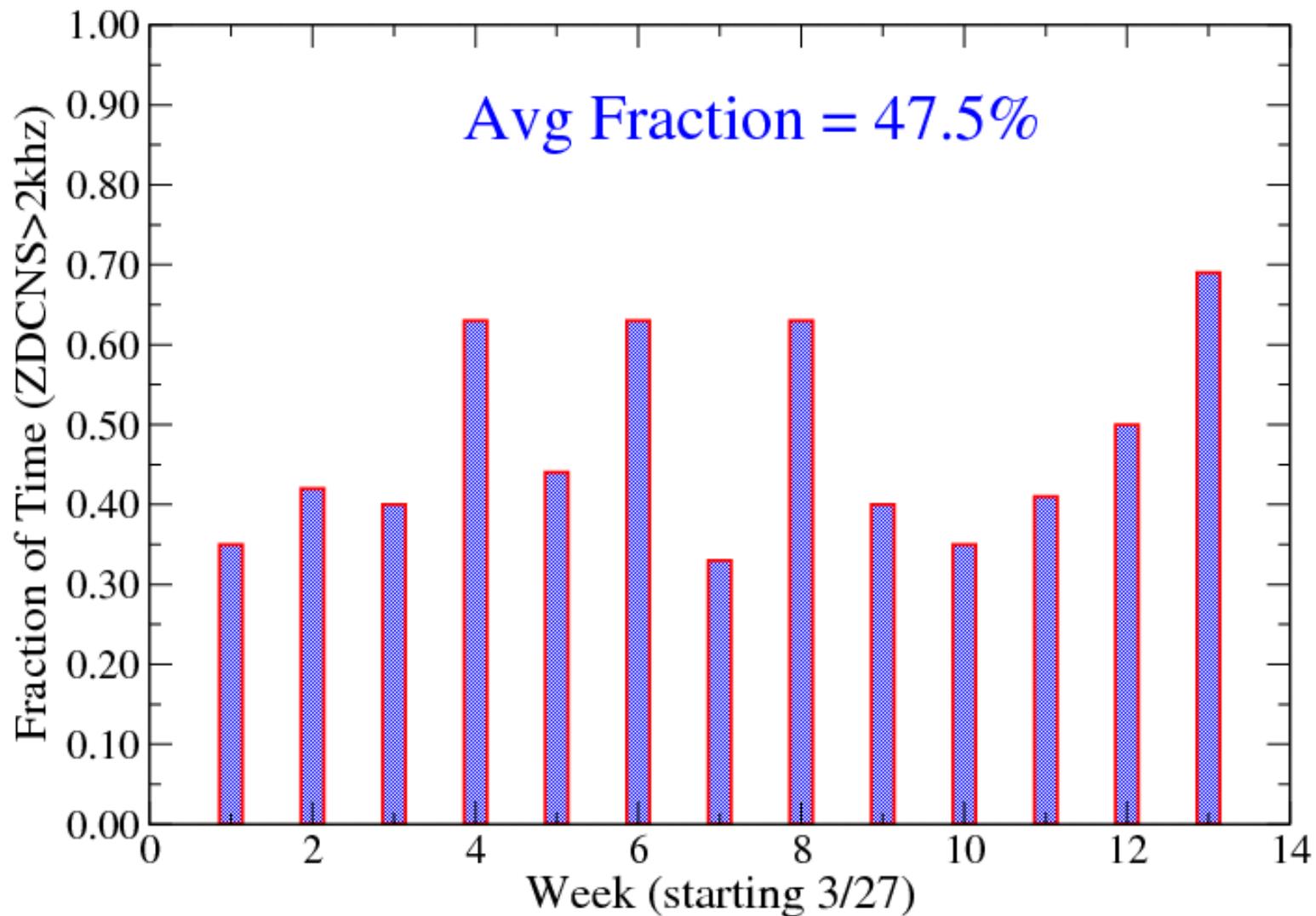


end  
of store

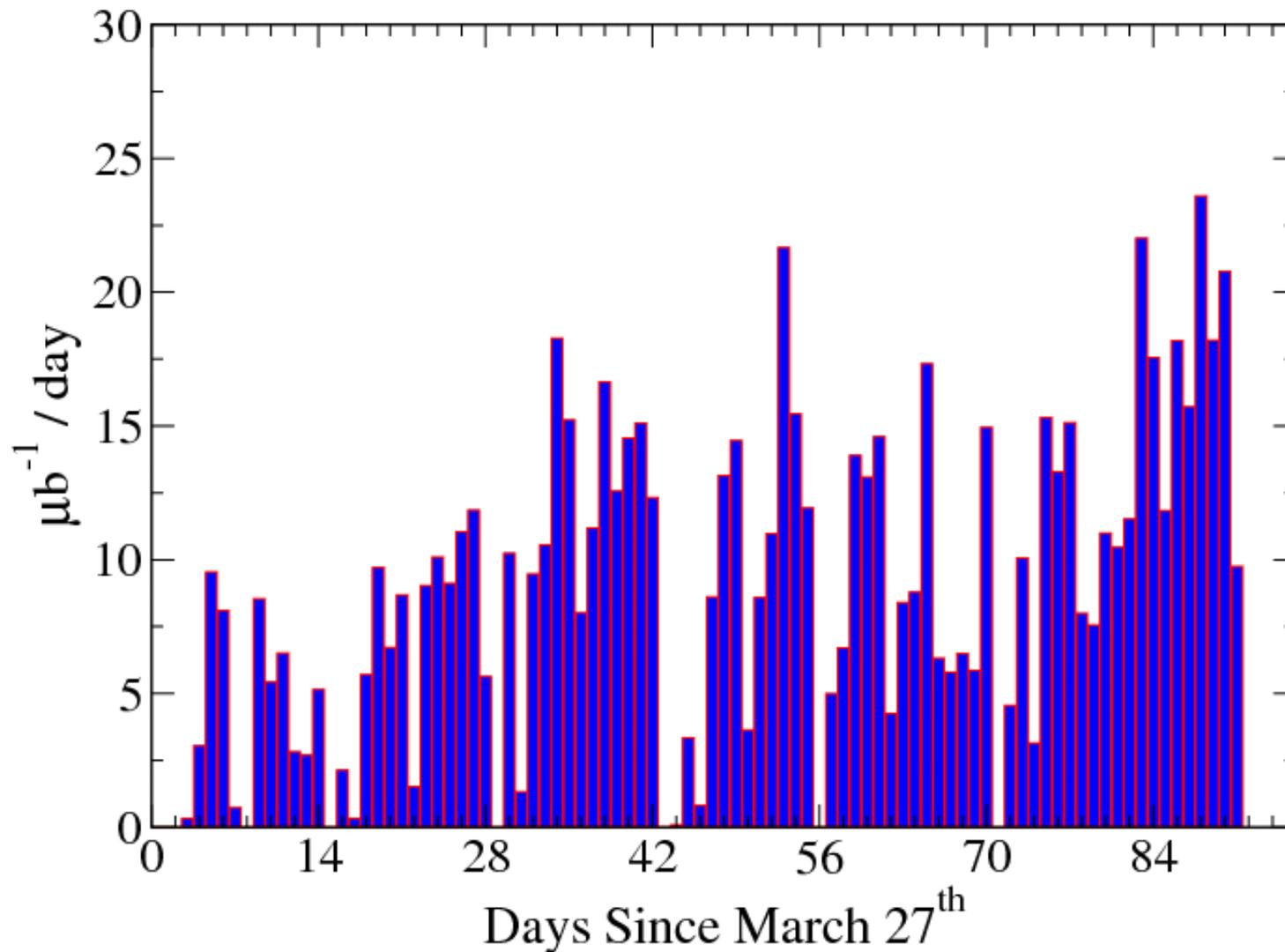
Improvement in  
integrated  
luminosity for  
PHENIX with  
Stochastic  
Cooling (SC)

$$1.16 \pm 0.03$$

# Fraction of Time at Collision



# Luminosity/Day vs Day



# PHENIX Triggering & fast analysis for Run7

## Level-1 Triggering just Minimum-Bias (+UPC)

- 5 kHz event rate through DAQ
- only small fraction of integrated luminosity missed due to rates above the DAQ limit in the 1<sup>st</sup>  $\frac{1}{2}$  hour or so of stores

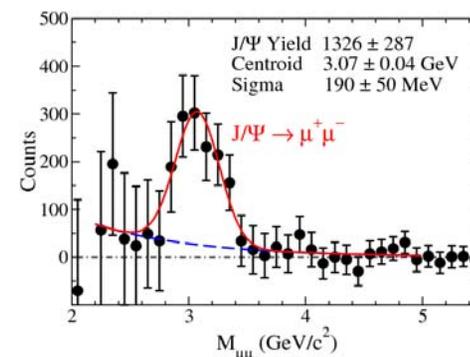
## Level-2 filtering in ATP's producing selected, parallel sample of enriched events for fast processing

- $J/\psi \rightarrow \mu\mu$ ;  $J/\psi \rightarrow ee$ ; high- $p_T$  level-2 triggers
  - 10% of raw data size
  - sent to CCF in France via GRIDFTP
  - analyzed in France for fast results

## 10% of min-bias events sent to Vanderbilt for fast analysis

- check analysis/calibrations, prepare for full analysis pass
- provide events needed for mixing in level-2 analysis

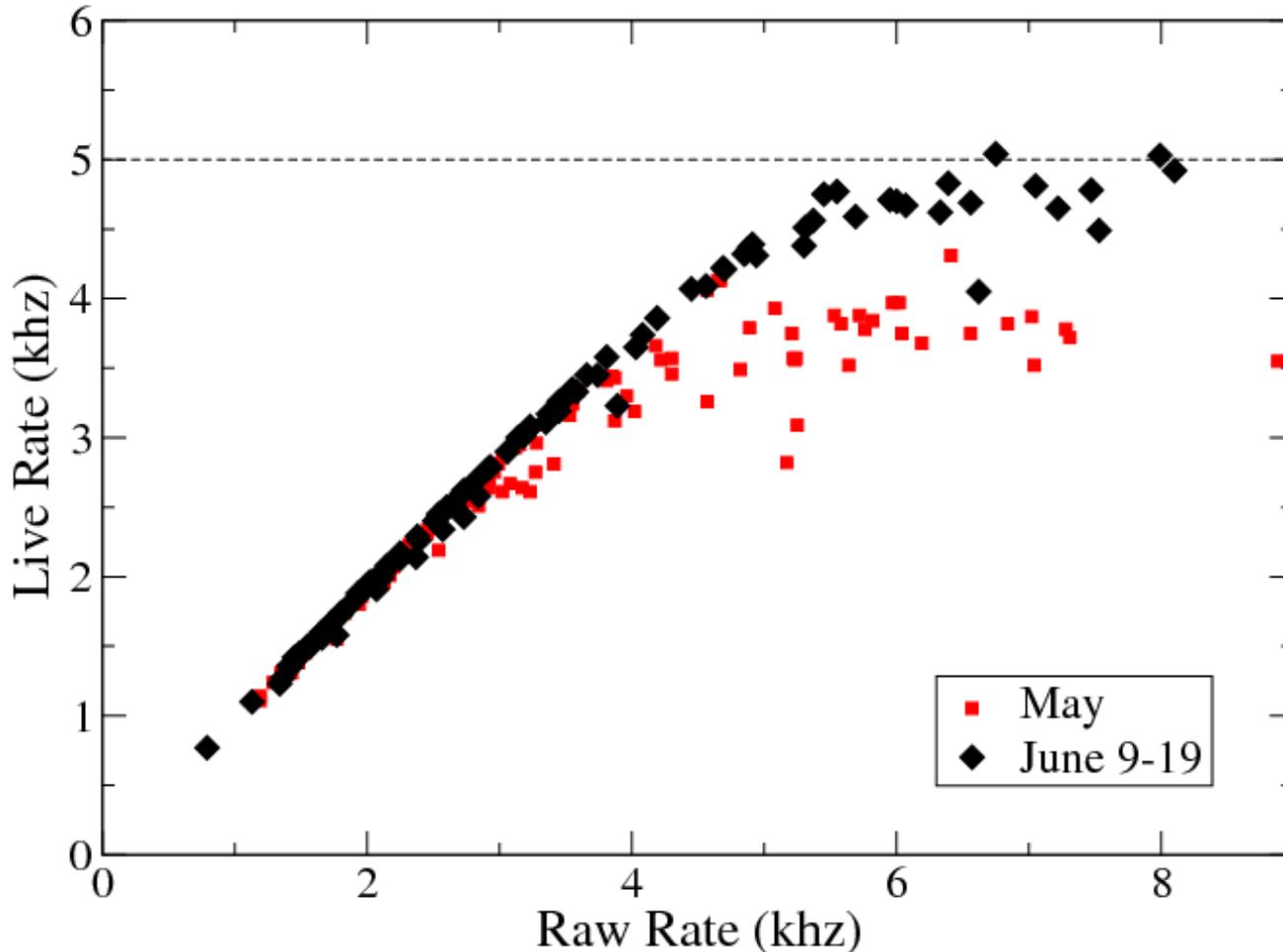
## Counting house machines for fast HBD analysis



# PHENIX Data Acquisition (DAQ)

Present DAQ performance:

- up to 5 khz event rate & 700 Mb/sec throughput

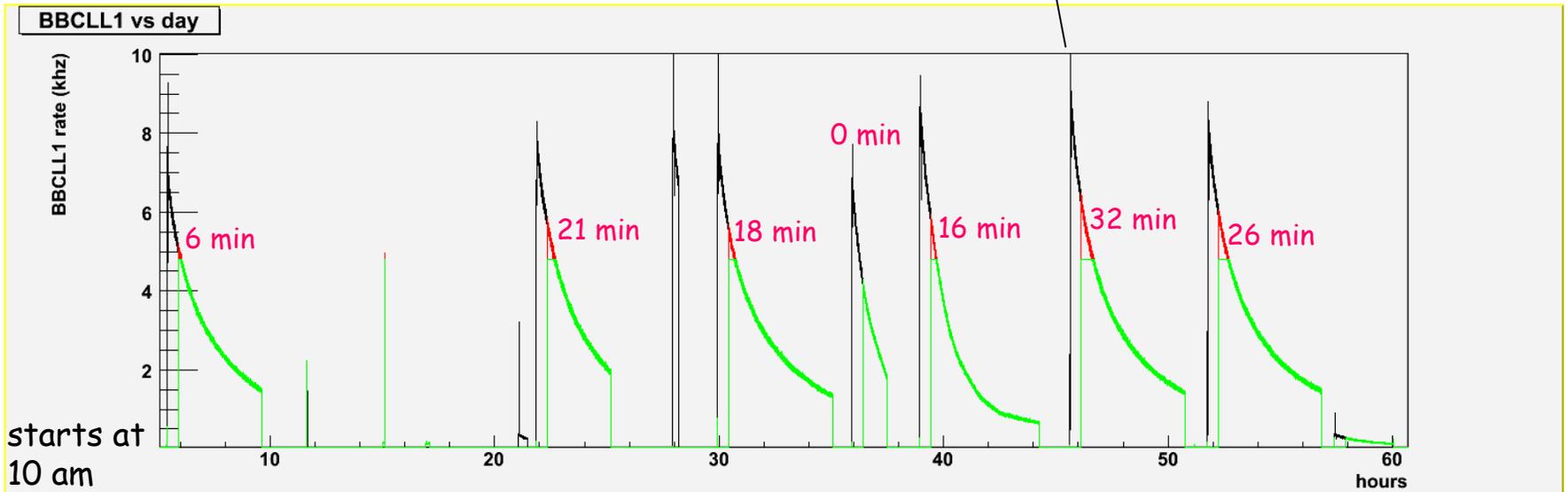
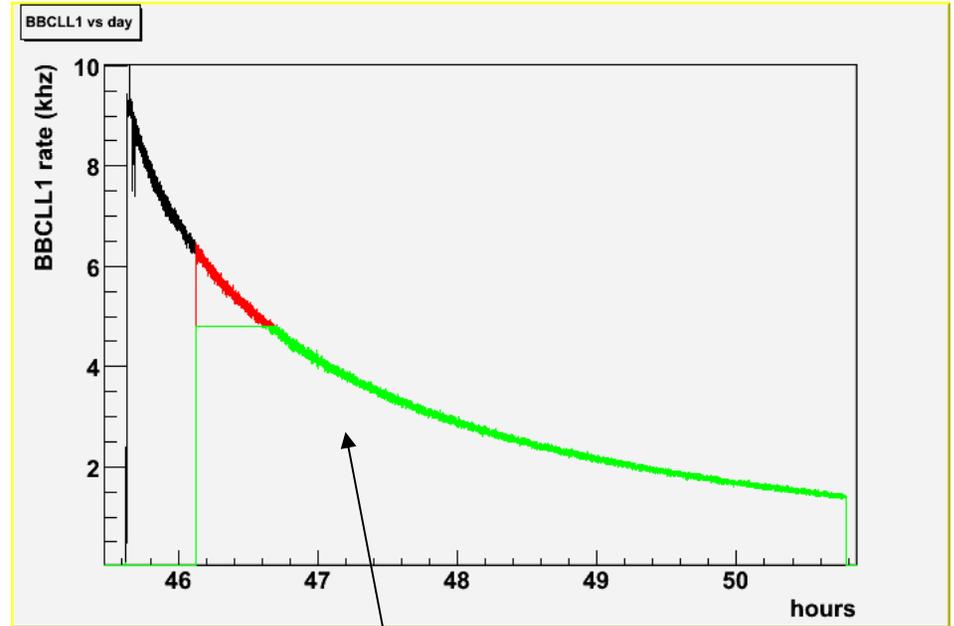


- DAQ Advances:
- level-2 code speedup
  - additional buffer box
  - fix SEB memory leaks
  - more compact HBD data format
  - etc

Luminosity fraction captured by PHENIX DAQ saturation in red

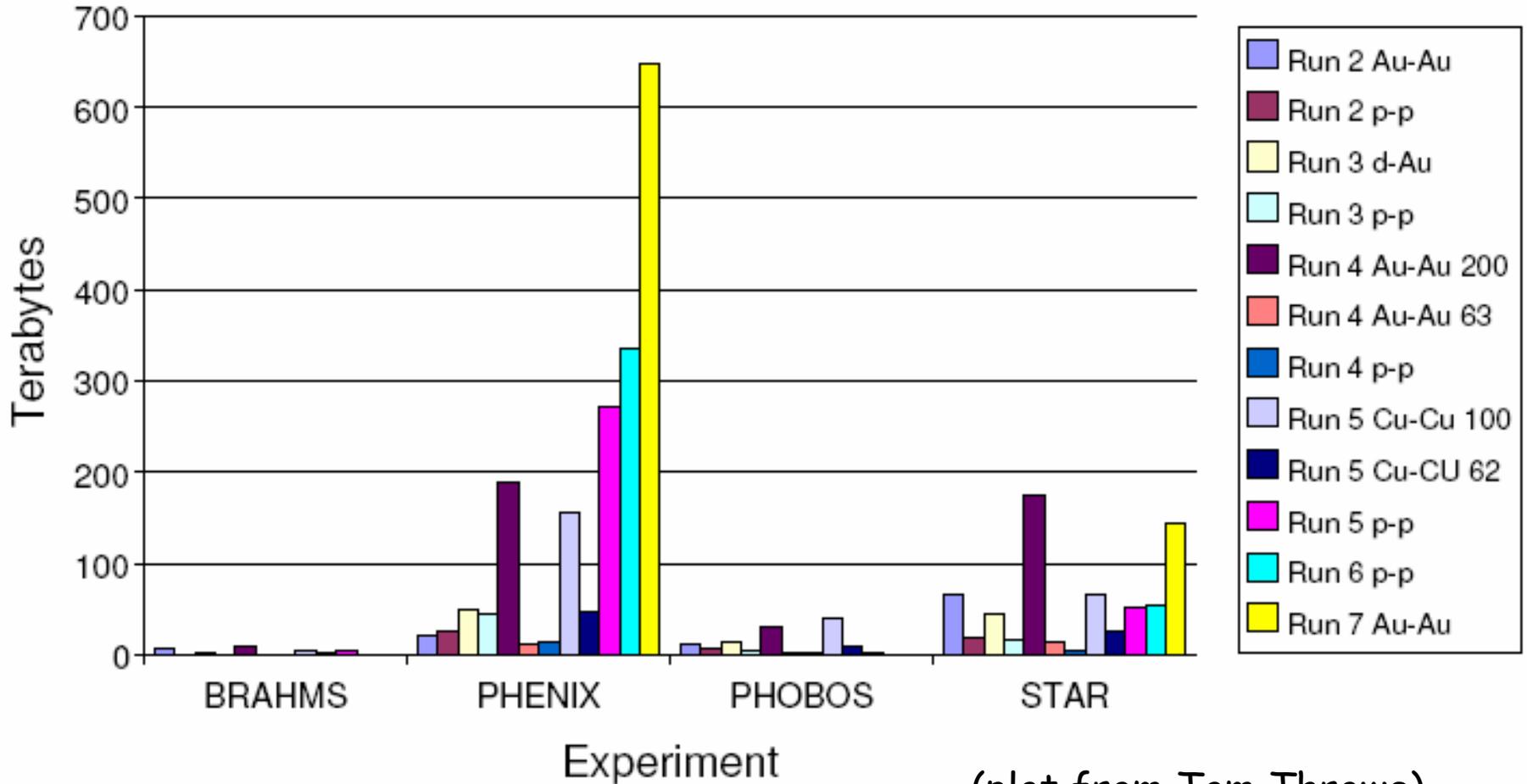
Fraction of luminosity for late April stores (at bottom) 97.8% for 4.8 khz DAQ rate

- for  $\frac{1}{2}$  hr turn-on time



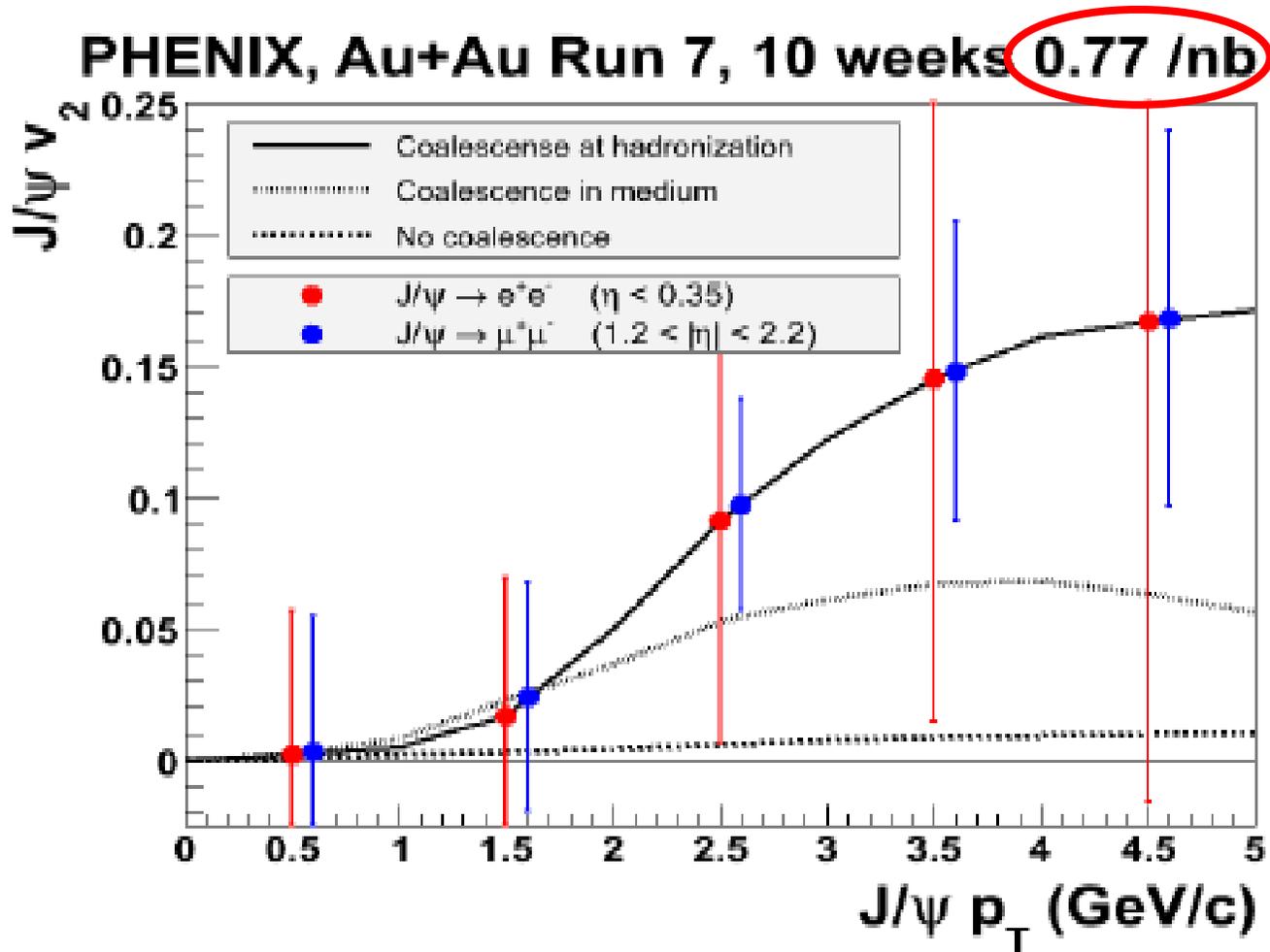
Fri Apr 27th  
6/21/2007

# Raw Data Collected in RHIC Runs



(plot from Tom Throwe)

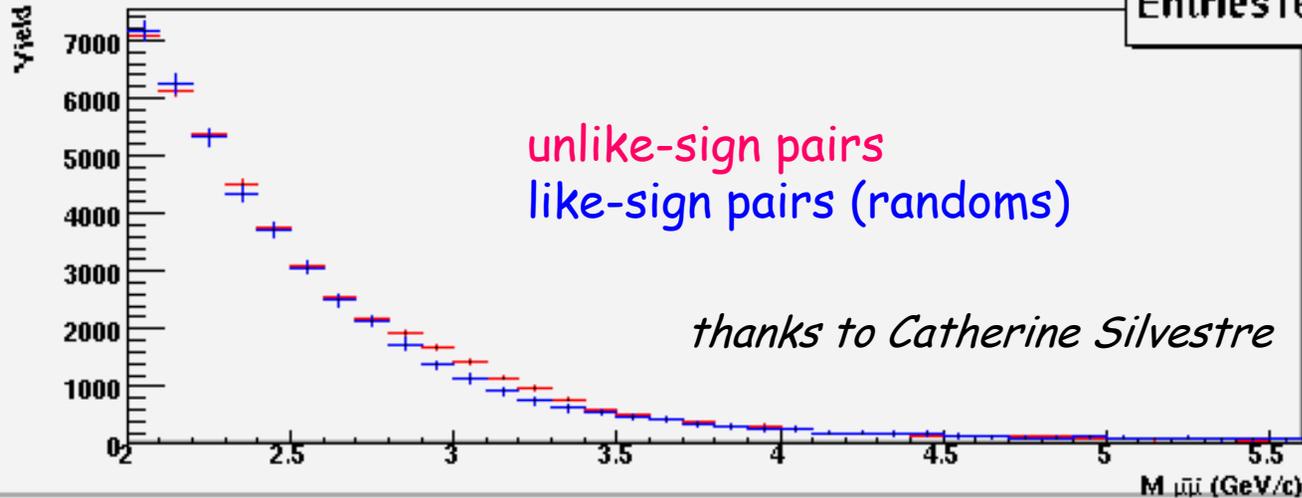
# Expected Results for $J/\psi$ flow from Run7



From Tony Frawley, heavy PWG, Jan 4<sup>th</sup>

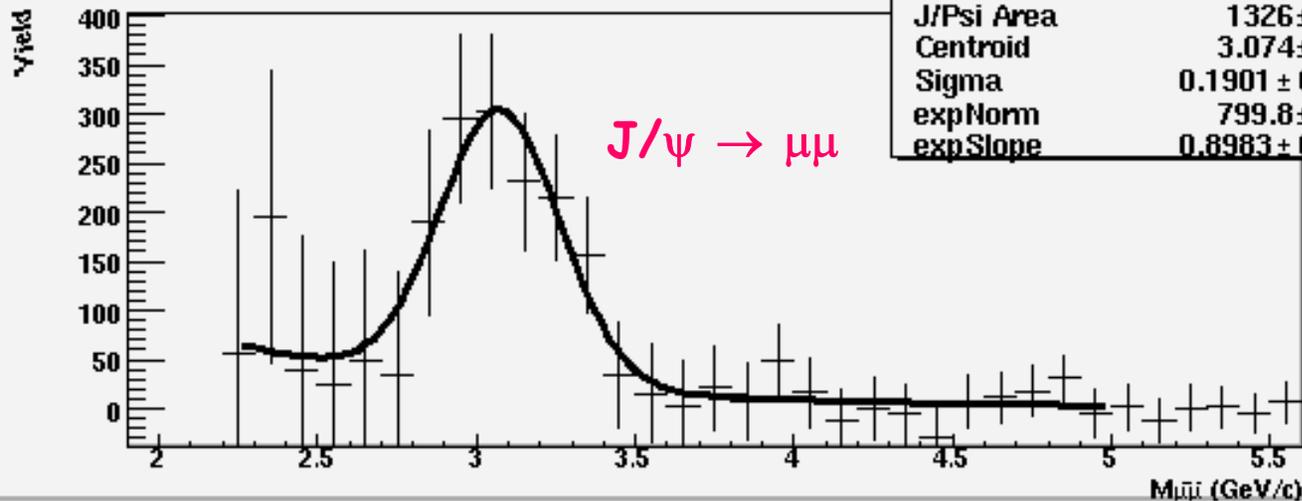
dimuon mass (+)

Entries 163306



dimuon mass (signal)

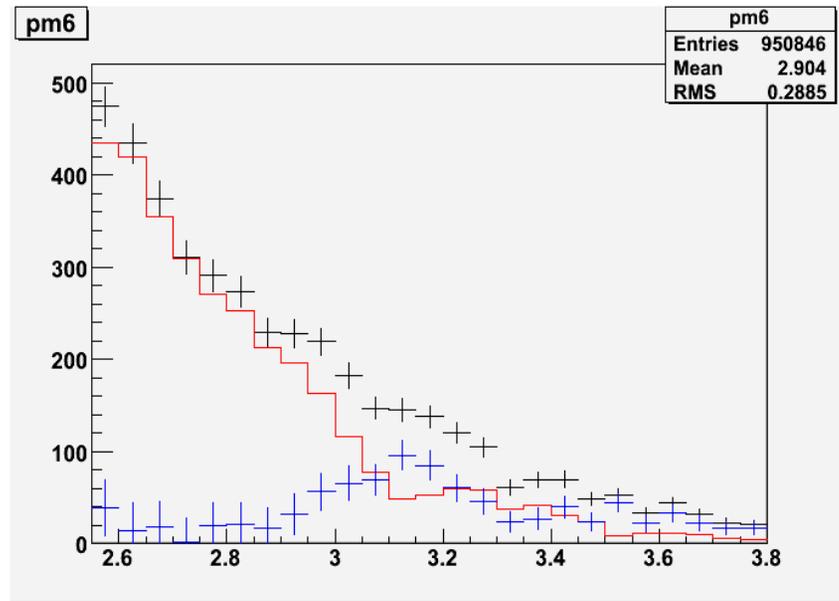
Entries	163256
J/Psi Area	$1326 \pm 287.0$
Centroid	$3.074 \pm 0.036$
Sigma	$0.1901 \pm 0.0500$
expNorm	$799.8 \pm 796.2$
expSlope	$0.8983 \pm 0.2087$



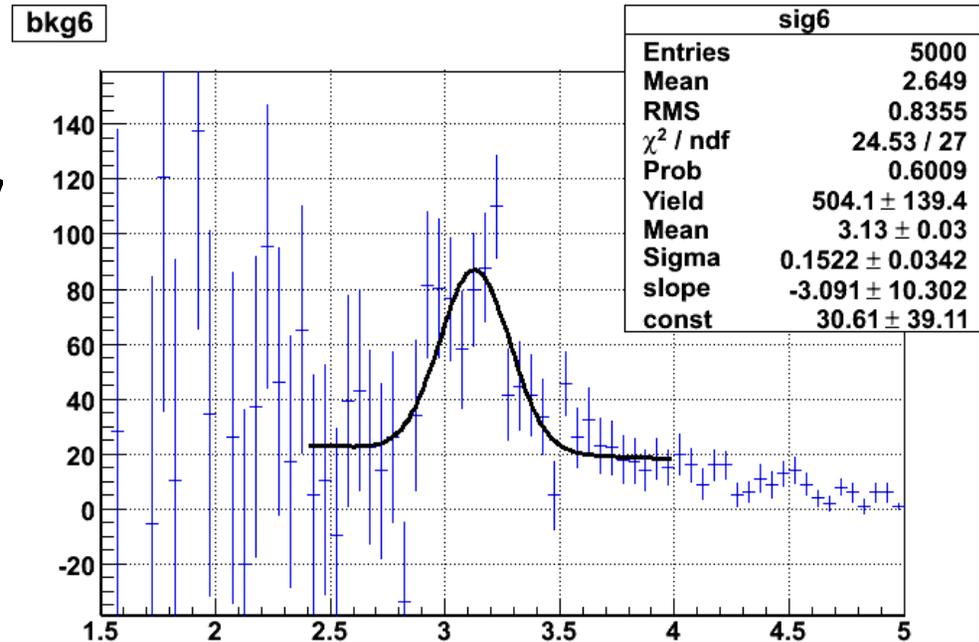
for ~8% of present Run7 integrated luminosity  
 (~16,000  $J/\psi \rightarrow \mu\mu$  for present luminosity sum)

$$J/\psi \rightarrow e^+e^-$$

about 15% of level-2 data



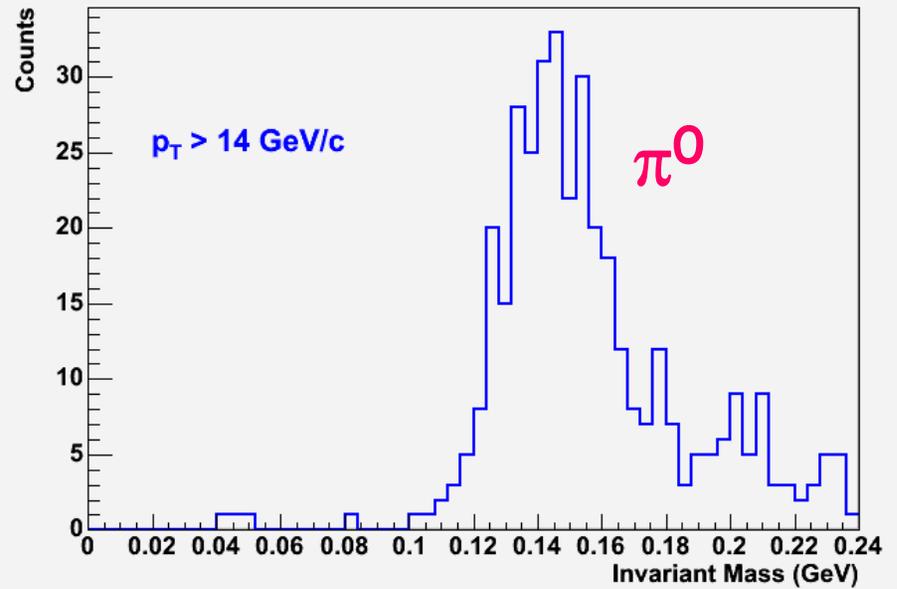
*thanks to Ermiyas Atomssa  
& Raphael Granier de  
Cassagnac*



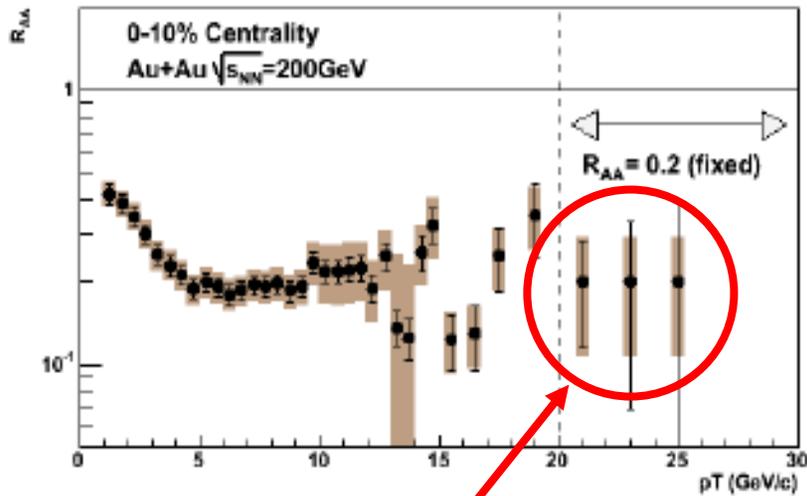
# $\pi^0$ 's & $\eta$ 's

thanks to Justin Franz

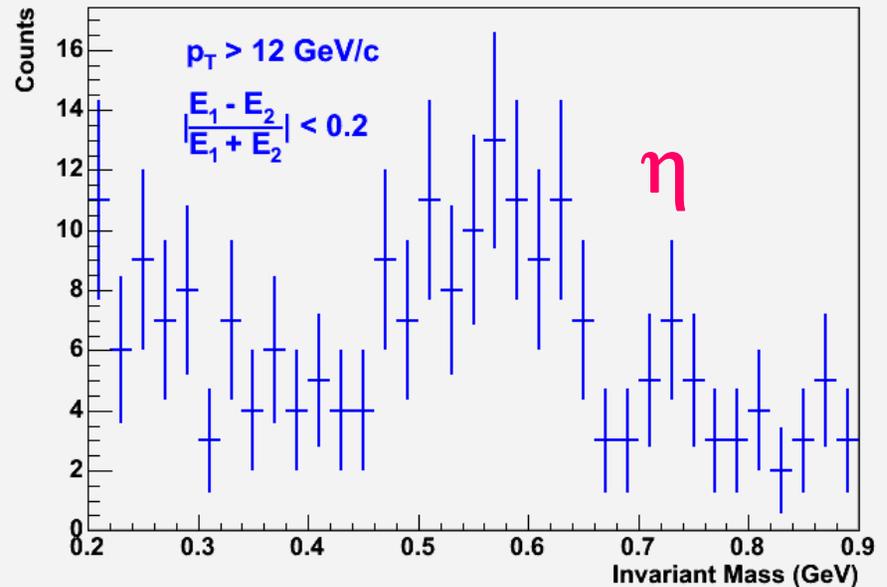
from about 16% of present data



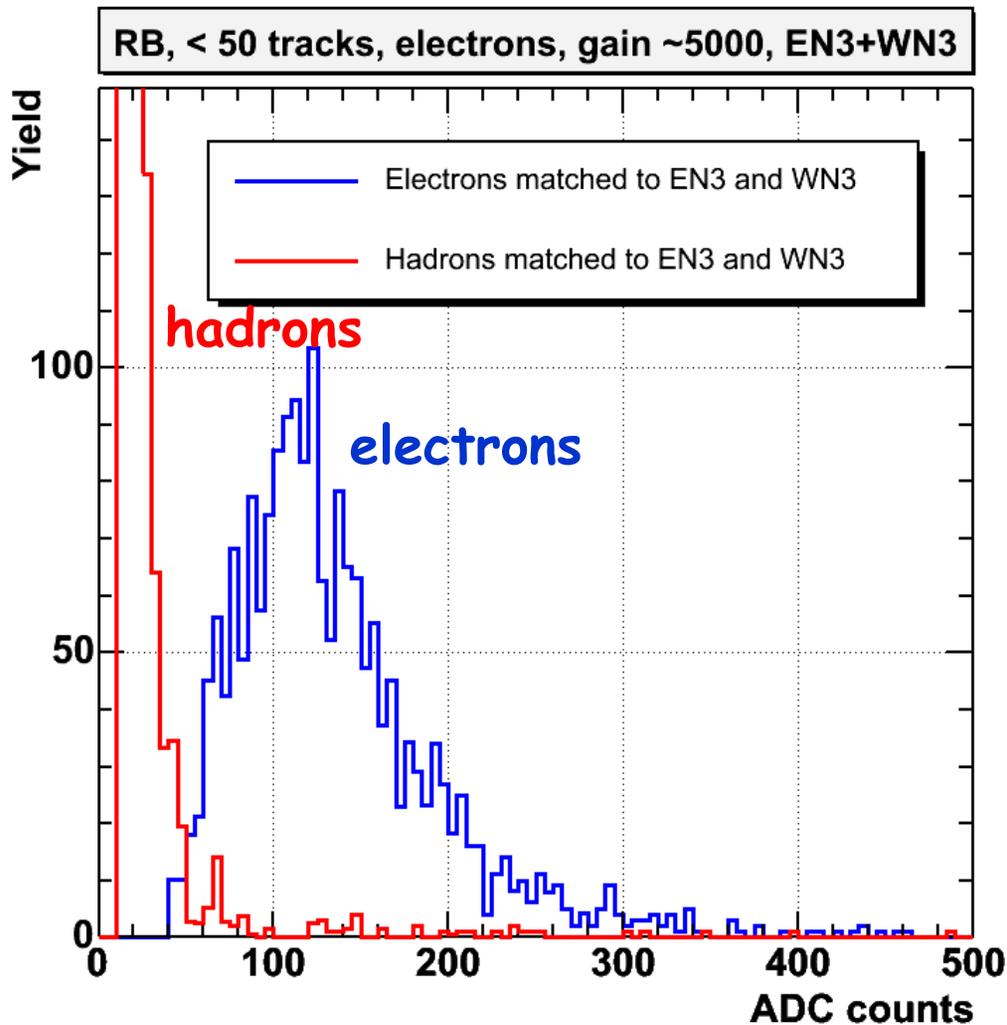
$\pi^0 R_{AA}$  with 4x statistics



extended range in  $p_T$



# Hadron Blind Detector (HBD)



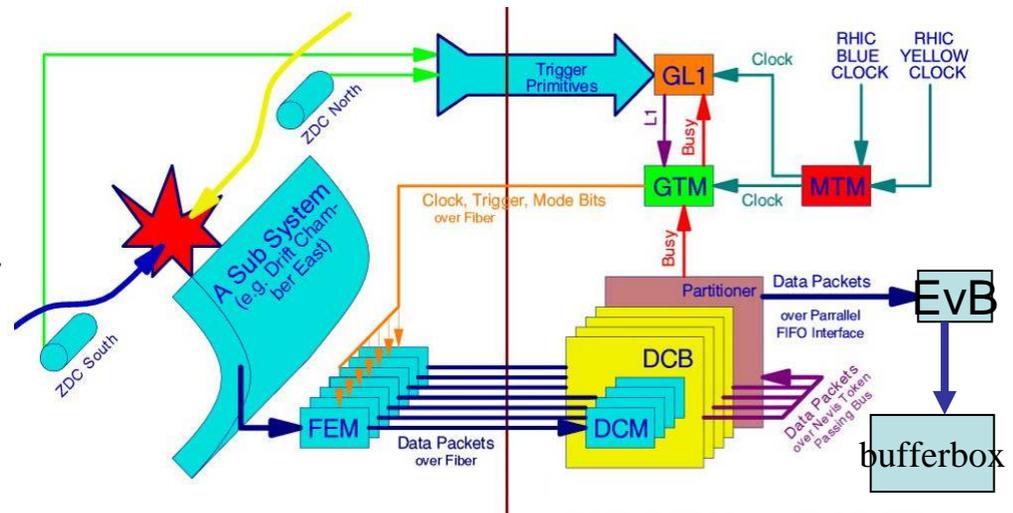
West side of HBD taken out  
Apr 25<sup>th</sup> for repairs

- HV trips with large stored energy damaged detector
- Now being refurbished with new GEM's & fixed HV
- $\frac{1}{2}$  of the East side of HBD still in



# Low Energy Running at PHENIX

- 9.19 GeV/nucleon
- PHENIX RXNP trigger
  - timed in at full energy
  - expect ~96% efficiency (compared to ~15% for BBC)
  - ZDC trigger should be very inefficient due to large Fermi motion wrt longitudinal momentum
- Wednesday afternoon could run our DAQ with the "blue low-energy clock"
- But Thursday morning, when beam was in the rings, we could not
- Presumably due to glitches in the clock (associated with other clock events that were not there on Wednesday??)



# Other Issues

- **Water cooling**
  - Availability of chiller & evaporator status to shift crews so they diagnose cooling problems quickly & call for help
  - Coupling of magnet and electronics cooling
- **Air conditioning**
  - Humidity swings in IR, can they be minimized to alleviate HV problems?
  - Get all four air conditioners to run (most of the time)
- **Flammable gas detectors**
  - Many recalibrations or head replacements
  - New technology that is stable at levels being monitored?
- **Fire Alarms & power shutdowns**
  - HSSD smoke detectors?
  - Fix light bulb coupling to PHENIX power shutoff system
- **Magnet trips - CMI mostly**
- **Access to MCR logbooks (readonly) for PHENIX shift crews**
  - New xterm for acnlinxx access?
- **Communications between workers in IR and PHENIX control room for debugging problems quickly and efficiently (old radios not allowed)?**
  - POTS with long cords or wireless phones?

# Concluding Remarks

- Over 3 times Run4 luminosity ( $\sim 813\mu\text{b}/241\mu\text{b}$ ) PLUS new capabilities from new detectors
  - E.g. 3-4 times better Reaction plane resolution
  - Full  $\pi/K/p$  PID up to 9 GeV/c
  - major advances in our physics should result
- Analysis in progress already thanks to level-2 filtering & mature analysis model
- HBD a very state-of-the-art detector, but lessons learned in Run7 should allow full operation in Run8 & beyond
- Excellent stores when they could be delivered, but too many breakdowns
  - Stochastic cooling - a step towards the future
  - Low energy (9.2 GeV) running feasible
- Thanks to our CA-D colleagues for all their unending work to keep us & the machine working!

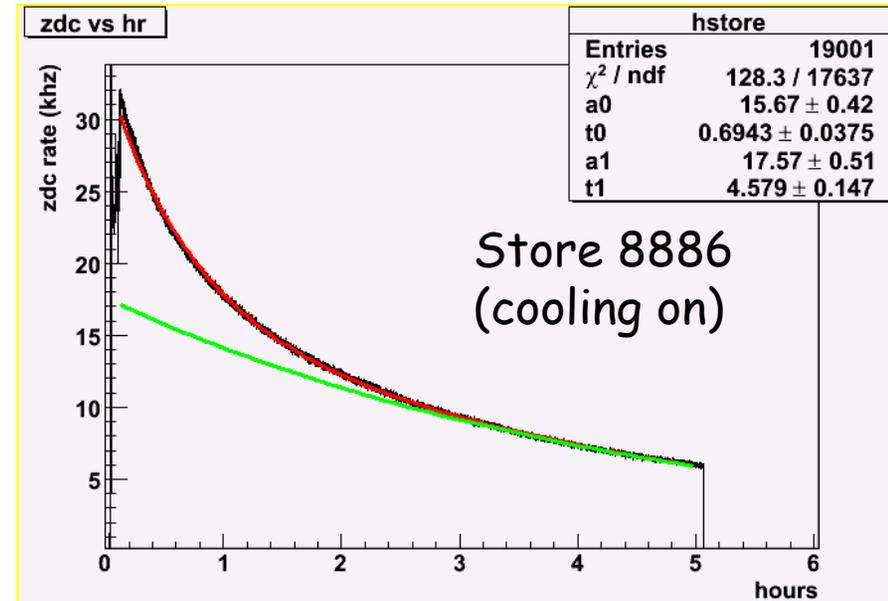
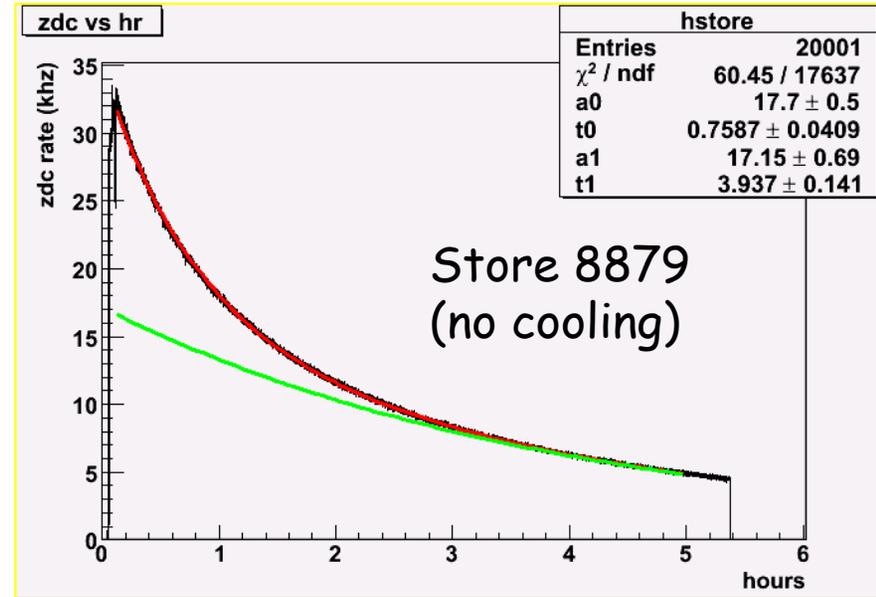
# Backup

# Improvement in integrated luminosity for PHENIX with Stochastic Cooling (SC)

date	time	store	cooled	$\mu\text{b}^{-1}/\text{hr}$	Zdc (pk)	FM ( $\times 10^{-3}$ )
5/15	2:10	8776	no	0.9804	34.97	28.04
5/30	2:10	8875	no	0.8789	32.07	27.41
5/30	23:50	8879	no	0.9746	34.85	27.97
5/19	14:47	8805	yes	1.1524	35.19	32.75
5/25	16:30	8849	yes	0.9874	30.34	32.54
6/1	8:00	8886	yes	1.0530	33.24	31.68

Average Improvement with SC:

$$\frac{32.32 \pm 0.57}{27.81 \pm 0.35} = 1.16 \pm 0.03$$

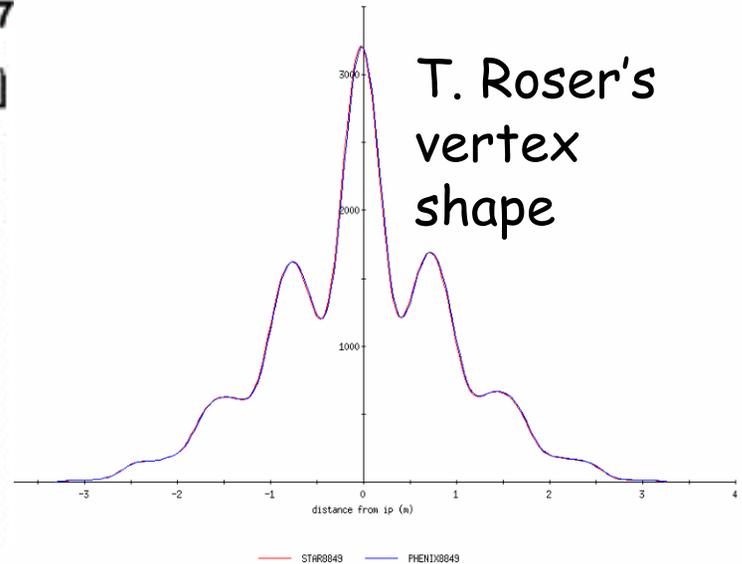
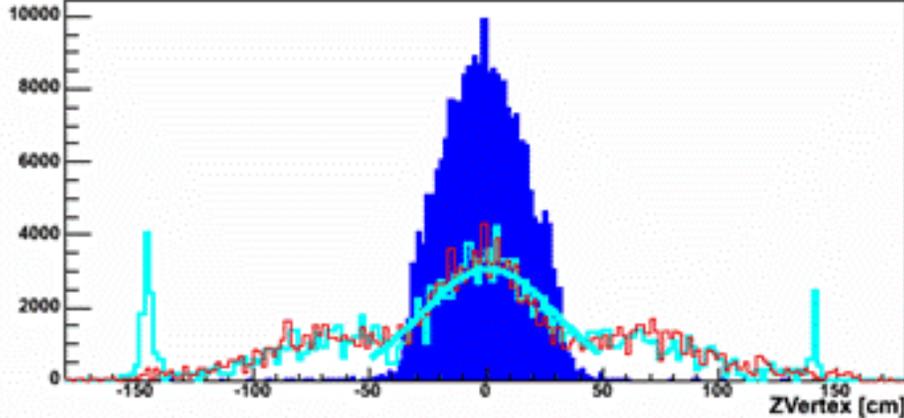


# Differentiation of vertex into distinct peaks due to Stochastic Cooling

BBC ONLINE MONITOR

Run #238332 Events: 94473 Date:Sun Jun 10 05:20:08 2007

Bbc ZVertex (south<-->north)

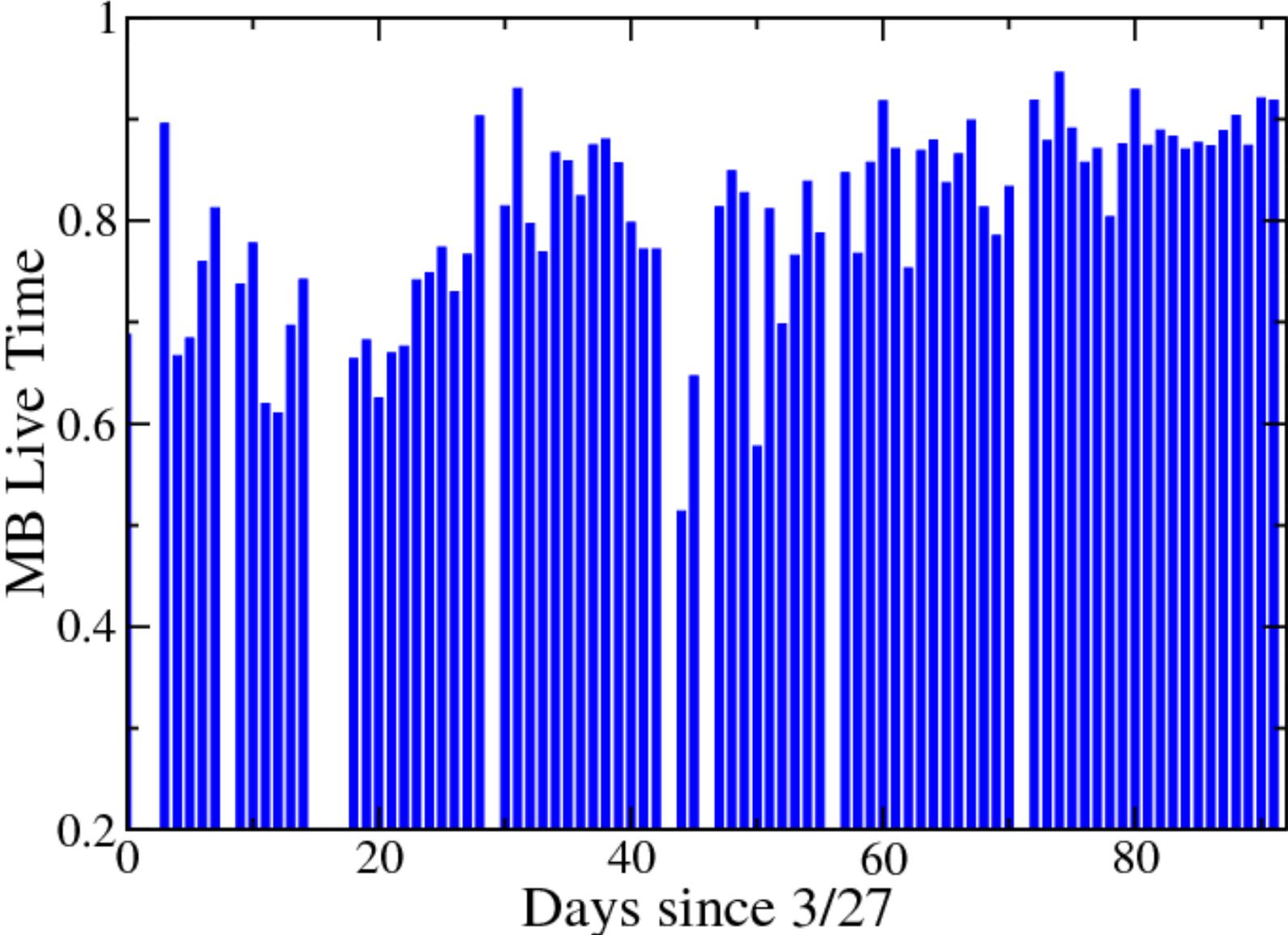


ZDC vertex (ZDC Wide)

BBC vertex (BBC no vertex cut)

BBC vertex (BBC  $\pm 30$  cm vertex cut)

# Live Time vs Day

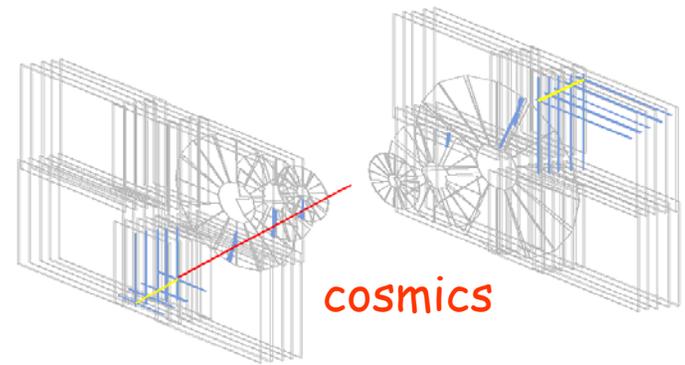
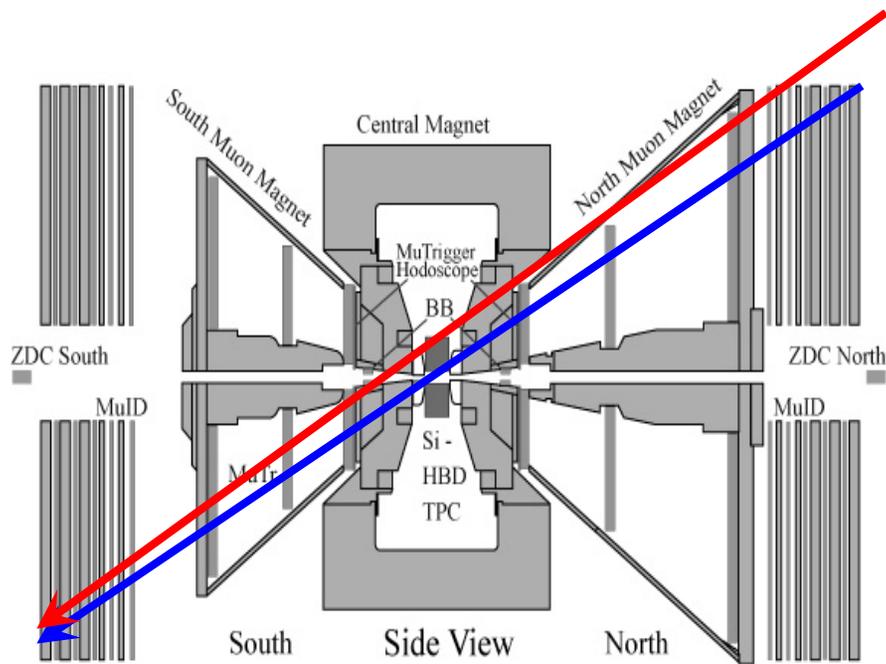


# PHENIX Shakedown/Cosmic Ray Running (Jan & Feb)

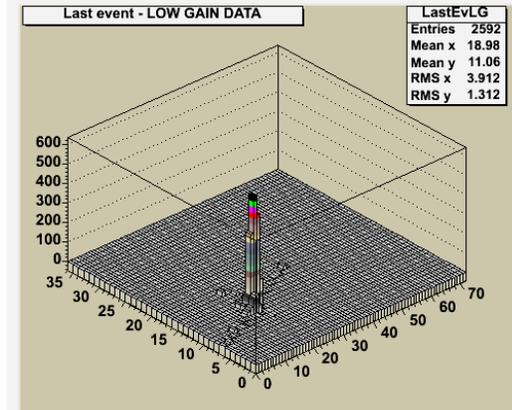
Need Cosmic Ray background measurement for  $W$  physics

• Cosmic/ $W$  estimated to be 1/1 for  $p >= 10$  GeV, but estimate is unreliable - need measurement!

Also Cosmic ray in EMCal looks much like high- $p_T$  photon



Event in EMCal Sector  $W^0$



# Hadron Blind Detector (HBD)

- A "hadron-blind" detector to detect and track electrons near the vertex."
- Dalitz rejection via opening angle
  - Identify electrons in field free region
  - Veto signal electrons with partner
- HBD: a novel detector concept:
  - windowless  $\text{CF}_4$  Cherenkov detector
  - 50 cm radiator length
  - CsI reflective photocathode
  - Triple GEM with pad readout
- *The HBD will improve our S/B by a factor of ~100*

