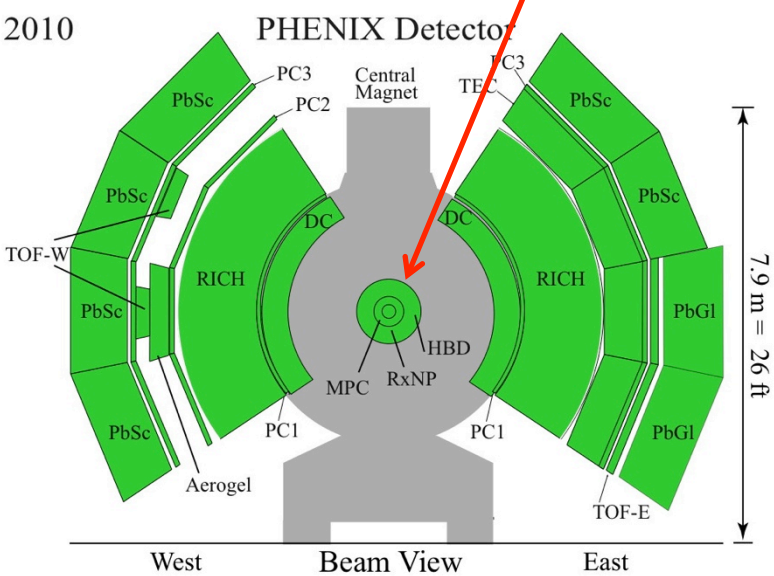
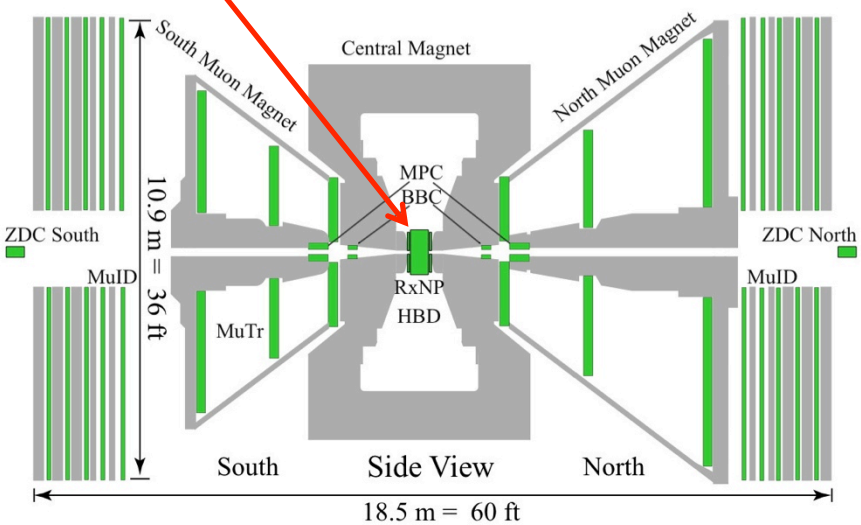
PHENIX Data Release Plan: 2013-2014 Runs

Stefan Bathe
PHENIX Analysis Coordinator
Baruch College, CUNY

Key Deliverables from Upgrades

- 2009--2010: Hadron Blind Detector (HBD)





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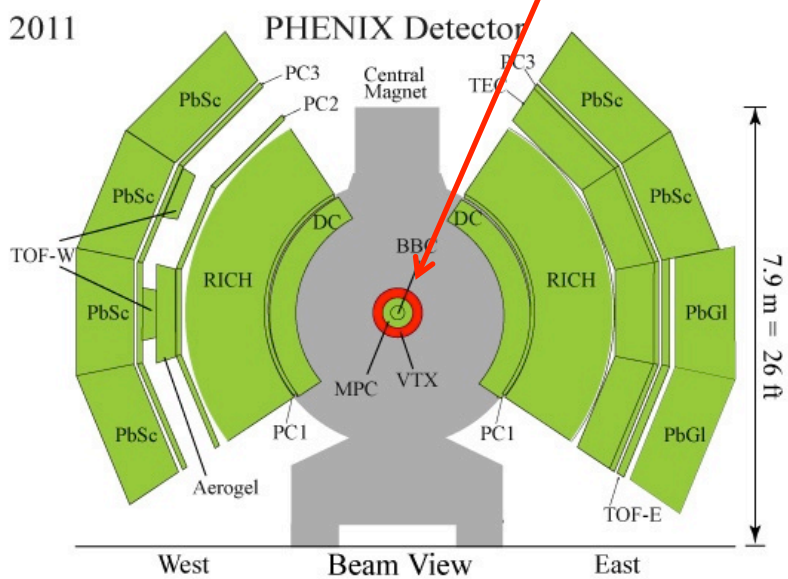
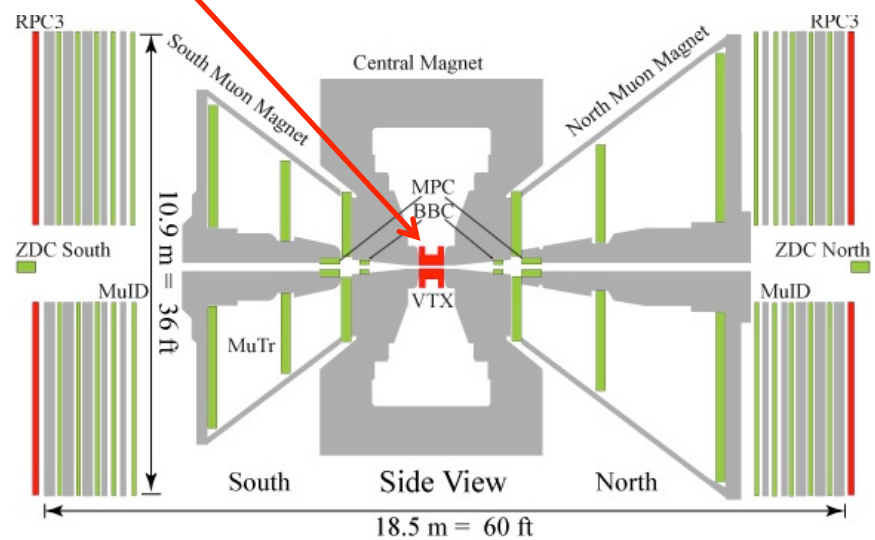
- 2011--present: Silicon Vertex Detector (VTX)





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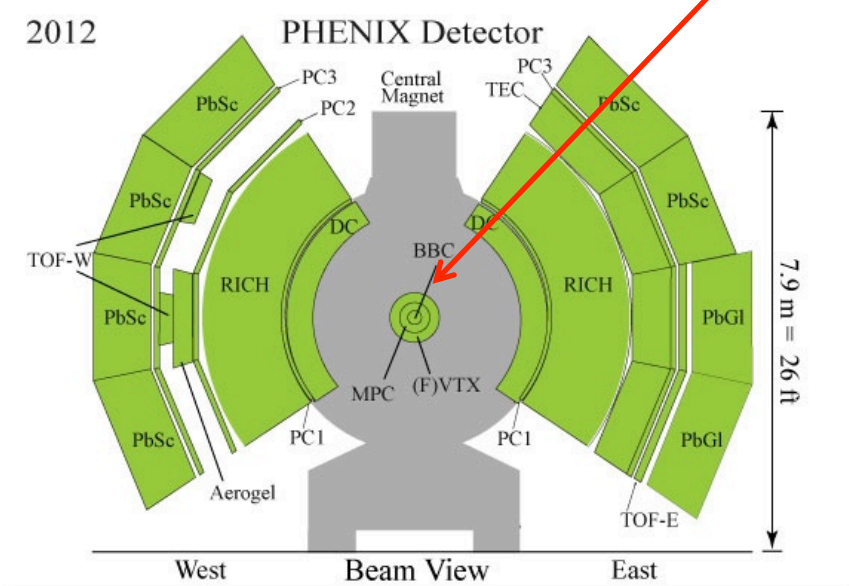

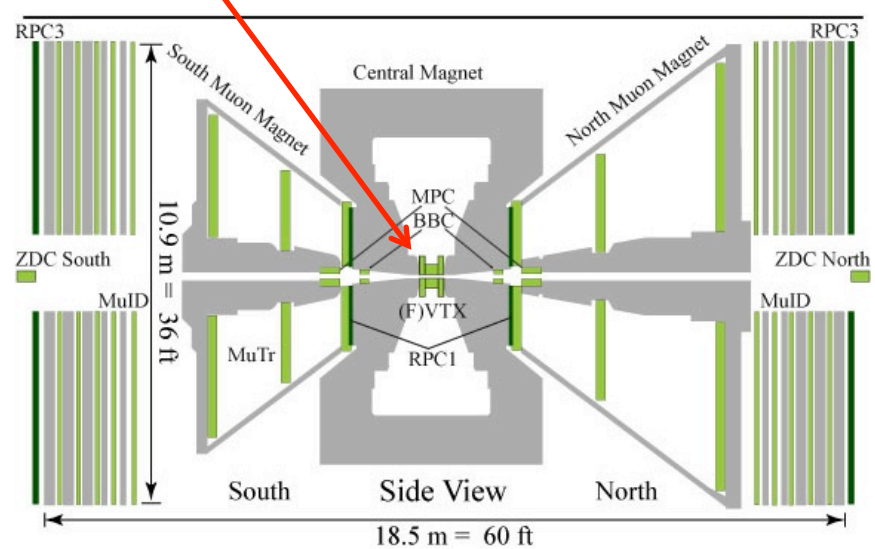

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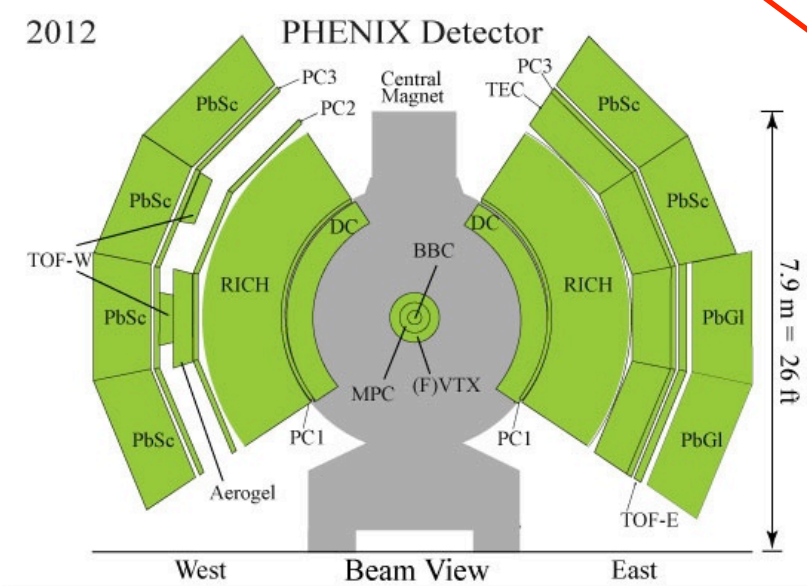
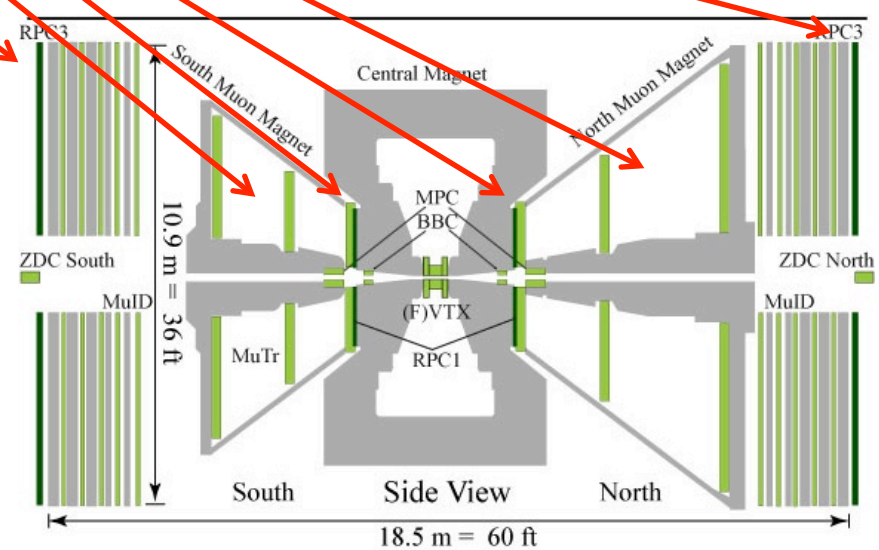
  - W trigger





Data Sets

year	E (GeV), species	Lumi*	upgrade	physics	reco status
2010	200, 62, 39, 7 AuAu	1.1	HBD	low-mass dileptons	

*Lumi: sampled integrated luminosity in pb^{-1} (nb^{-1}) in pp (highest energy HI); vertex range is narrow/wide/30 cm for heavy flavor, dileptons/W/others

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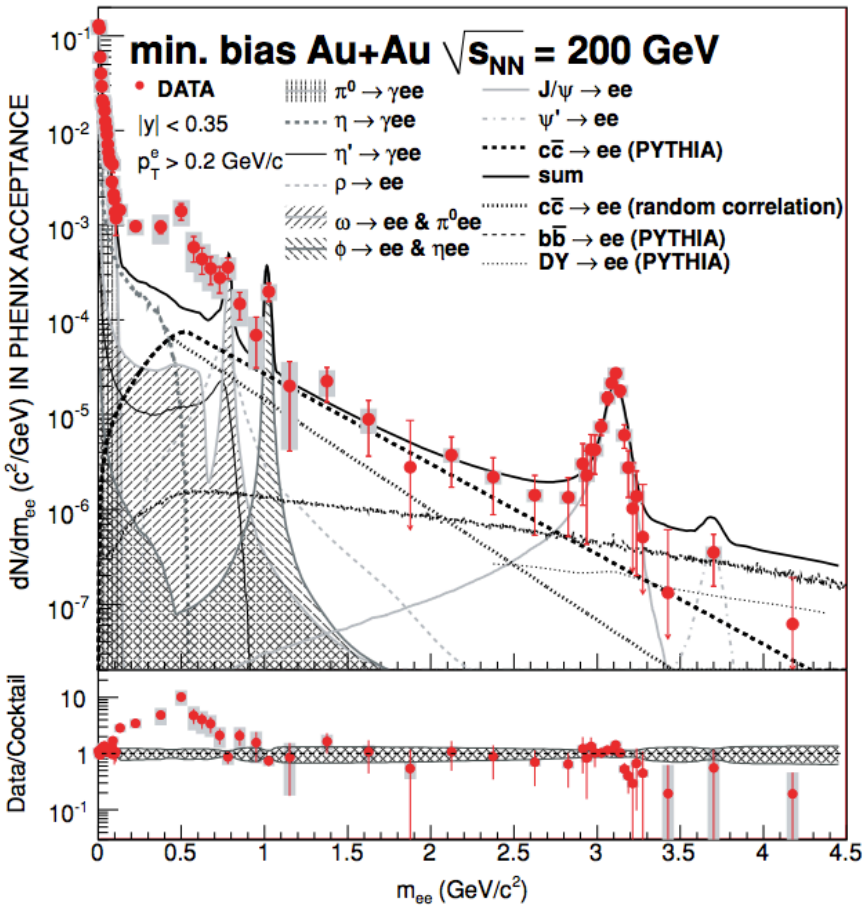
LOW-MASS DILEPTONS

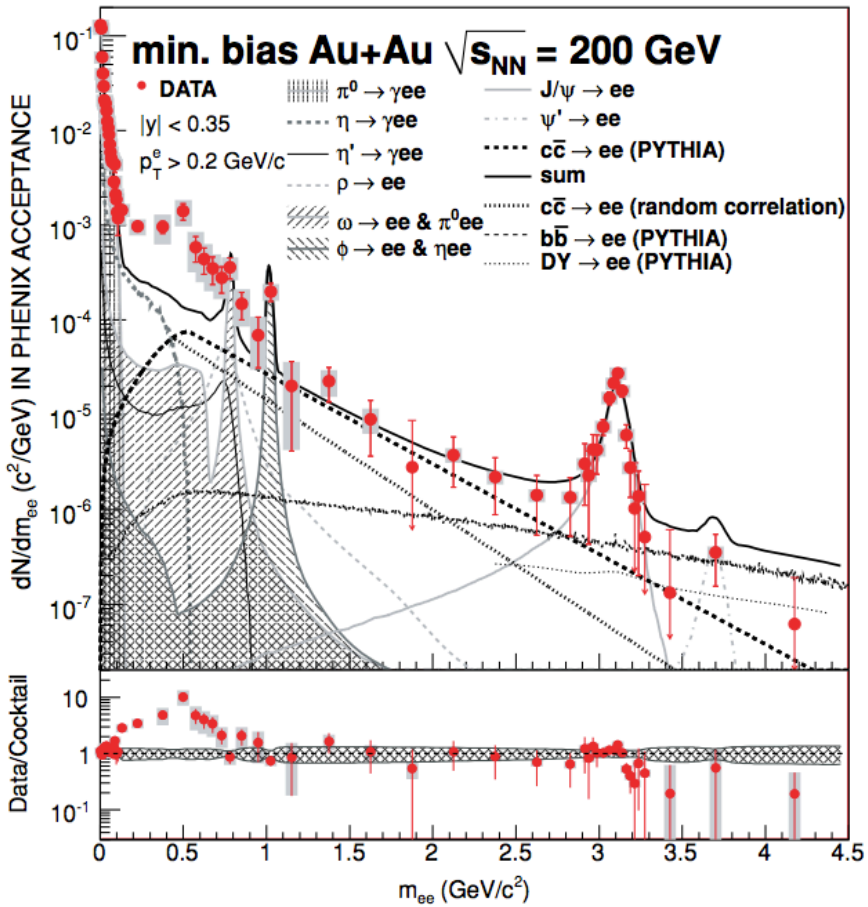
Low-Mass Dileptons

PHENIX Run04 PRC **81**, 034911 (2010)

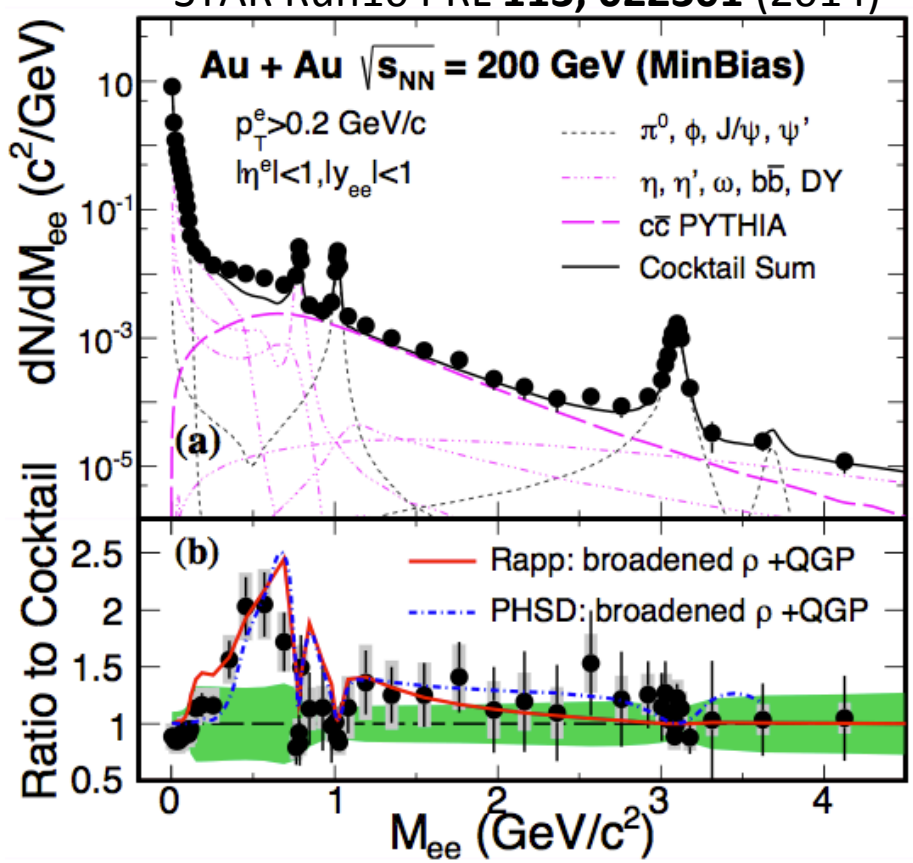


Low-Mass Dileptons

PHENIX Run04 PRC **81**, 034911 (2010)

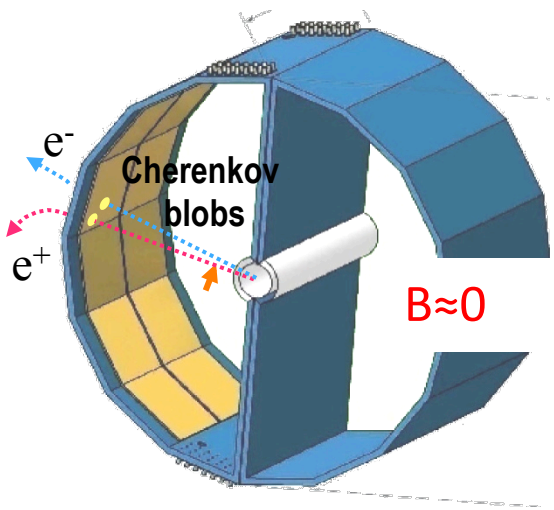


STAR Run10 PRL **113, 022301** (2014)



Discrepancy between PHENIX and STAR

Hadron Blind Detector (HBD)

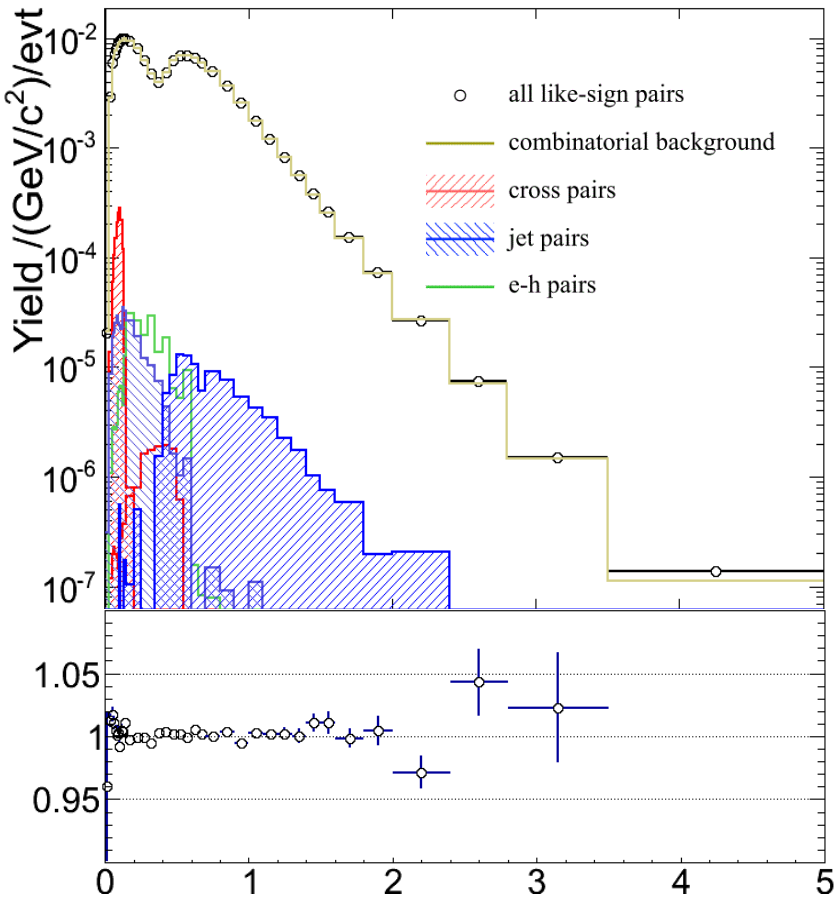


- Čerenkov detector with CF_4 gas
- CsI photocathode
- Triple GEMs for signal multiplication
- Pad readout
- 2.4 % X_0
- Background from scintillation light from charged particles in CF_4

Rejects conversion and Dalitz pairs

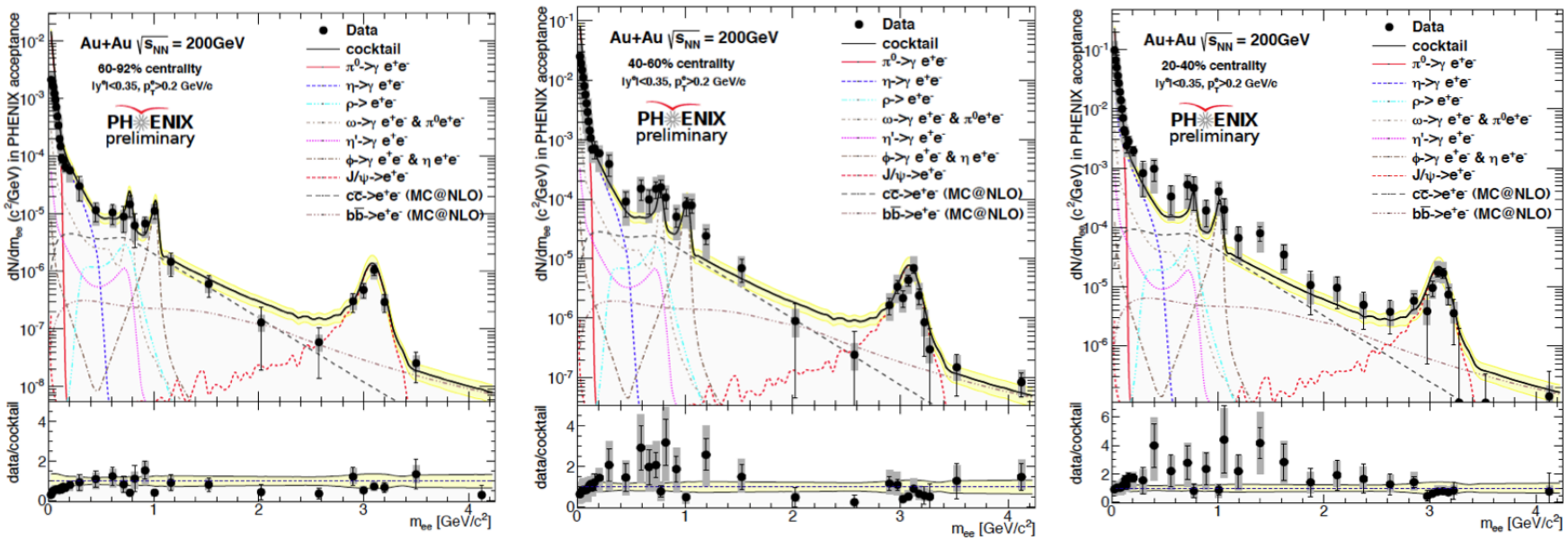
HBD Analysis

M. Makek, WTPD, BNL, 08/2014



- Challenging analysis
- Requires understanding of bckgrnd at 0.1 % level in central collisions
- Improved hadron rejection
- Improved background subtraction

HBD Data Release Plan



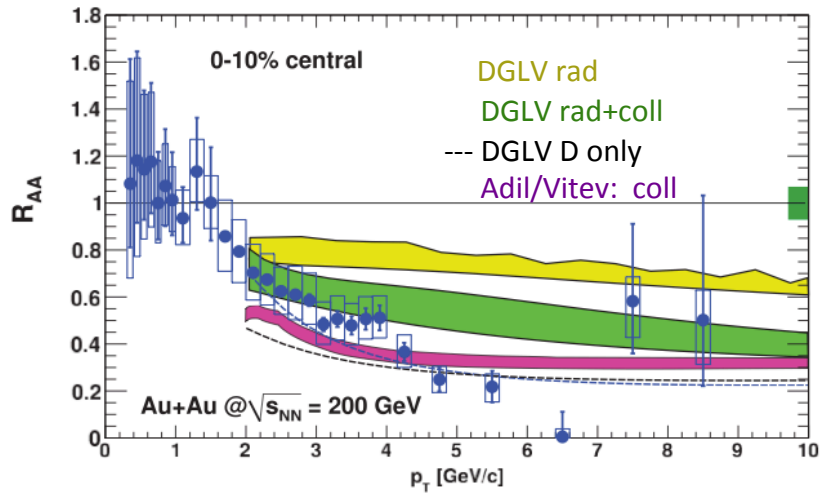
Quark Matter 2012, arXiv:1211.6002

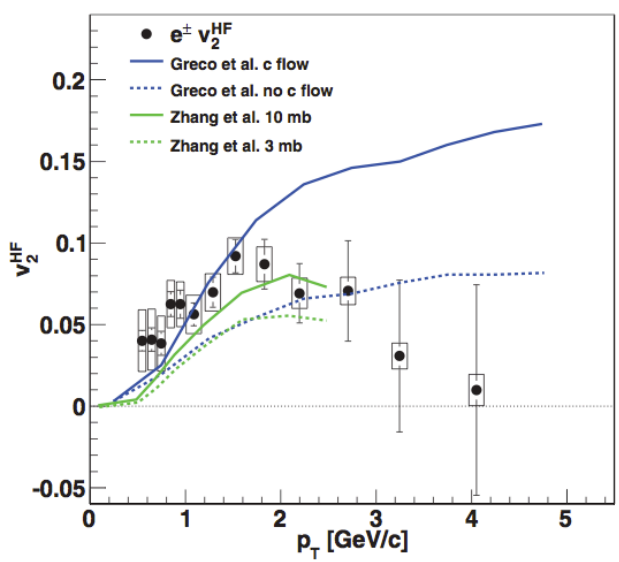
- Preliminary result for peripheral and semi-central
- Final analysis completed
- Paper Preparation Group formed December 2014
- Complete paper draft exists
- Plan: journal submission by September 2015

HEAVY FLAVOR ELECTRONS

Heavy flavor electrons

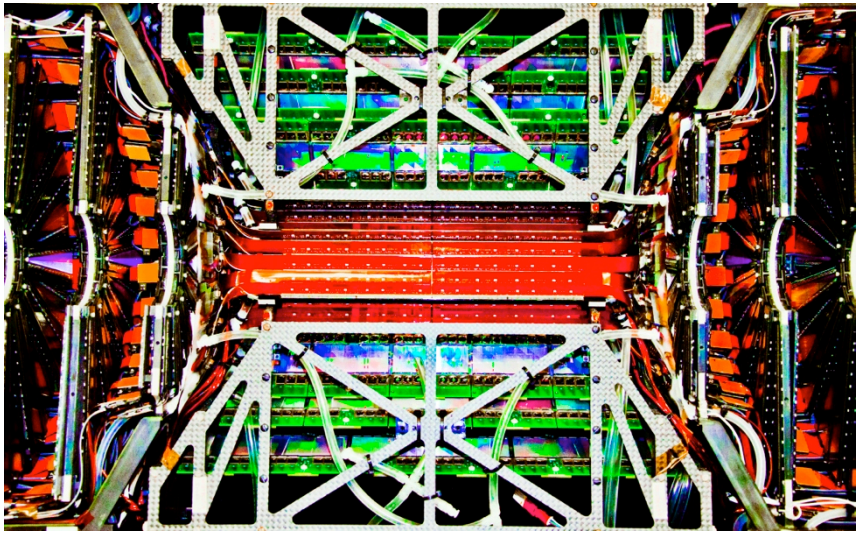
PHENIX Run04 PRC **84**, 044905 (2011)



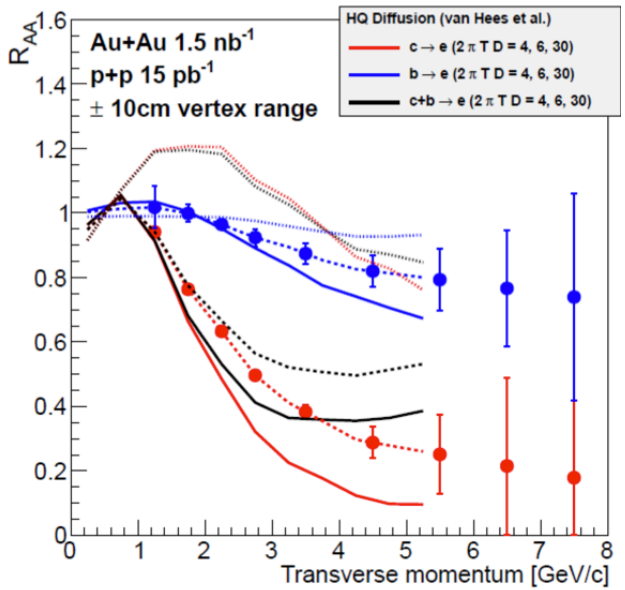


- Large suppression of heavy flavor electrons (despite of predicted dead-cone effect)
- Large flow (despite of large mass)
- Depends on quark mass?
- Separate electrons from c and b quarks!

VTX Detector

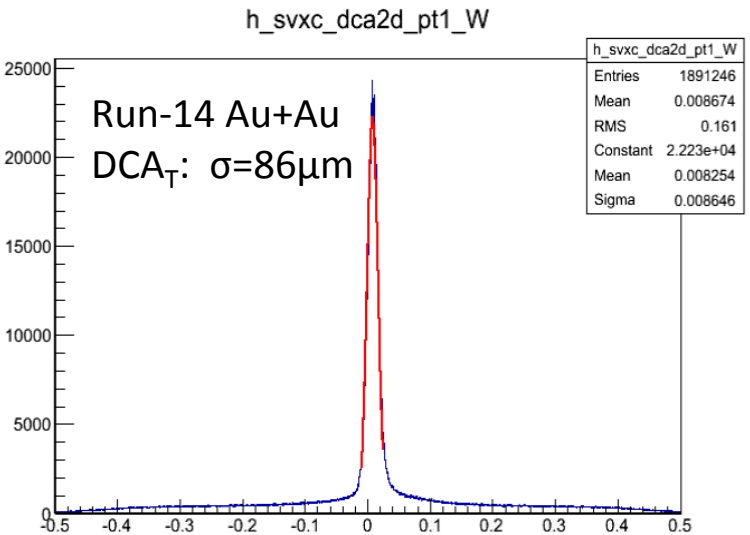


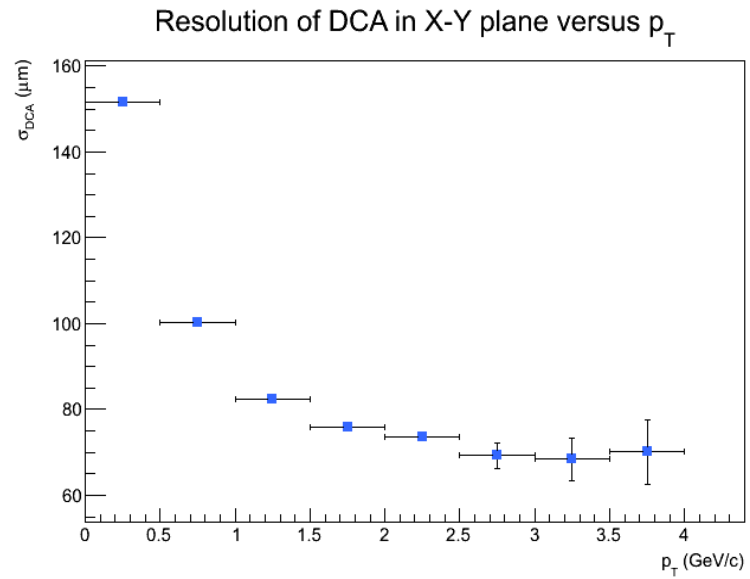
Separate electrons from c, b via displaced vertex



- Run14 projections
- Au+Au
  - Goal: 1.5 nb^{-1} (10 B mbias events)
  - Recorded: 2.3 nb^{-1}
- p+p
  - Goal: 15 pb^{-1}
  - Sampled (Run15): 23 pb^{-1}

Analysis Challenge: Alignment

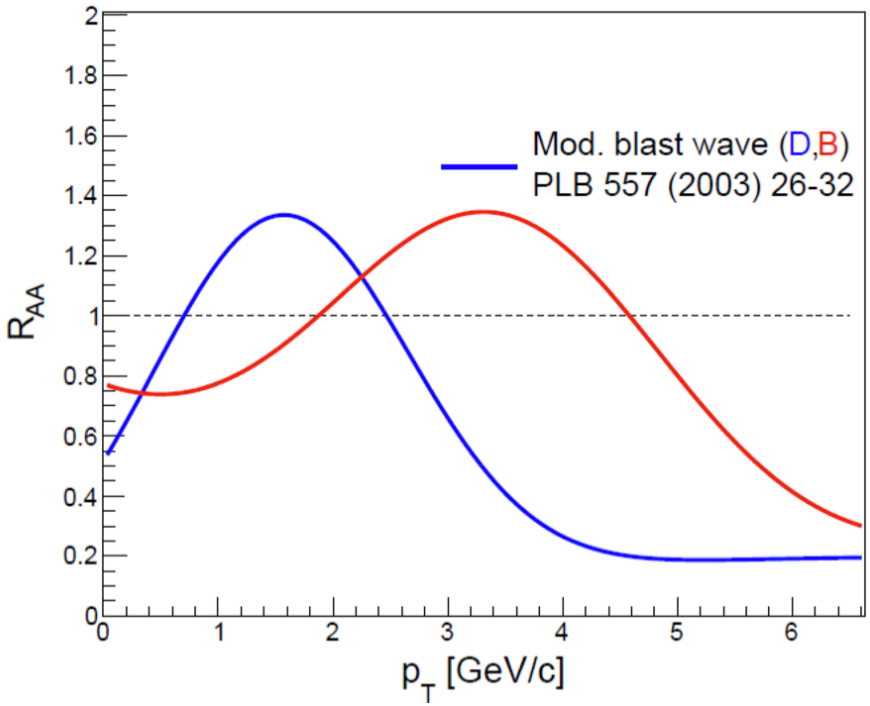




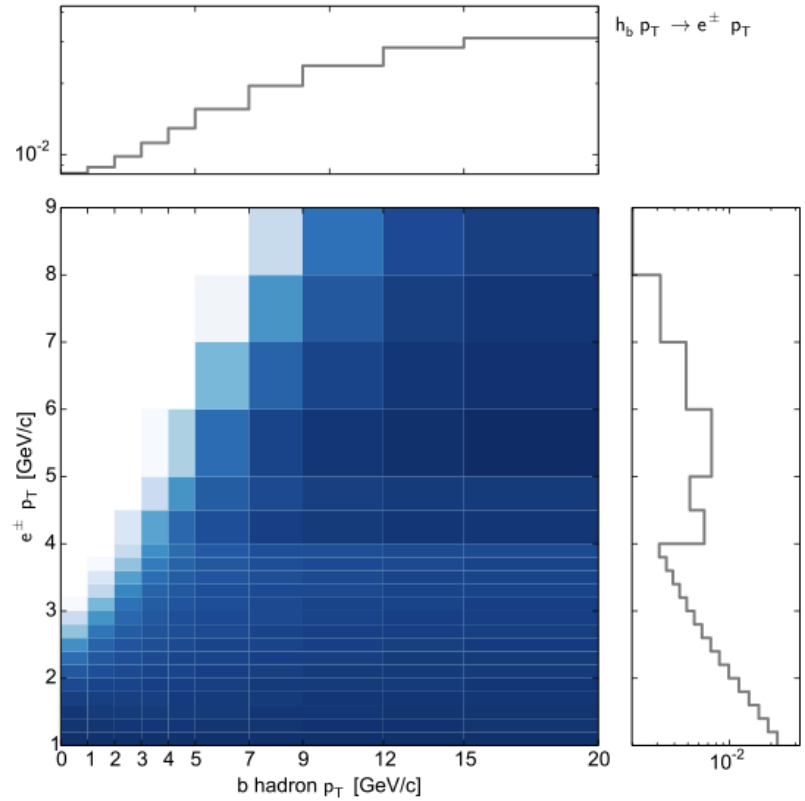
DCA Resolution from Run-14 alignment exceeds 100 μm specification

Full VTX / FVTX alignment with MILLEPEDE complete

Analysis Challenge: Unfolding

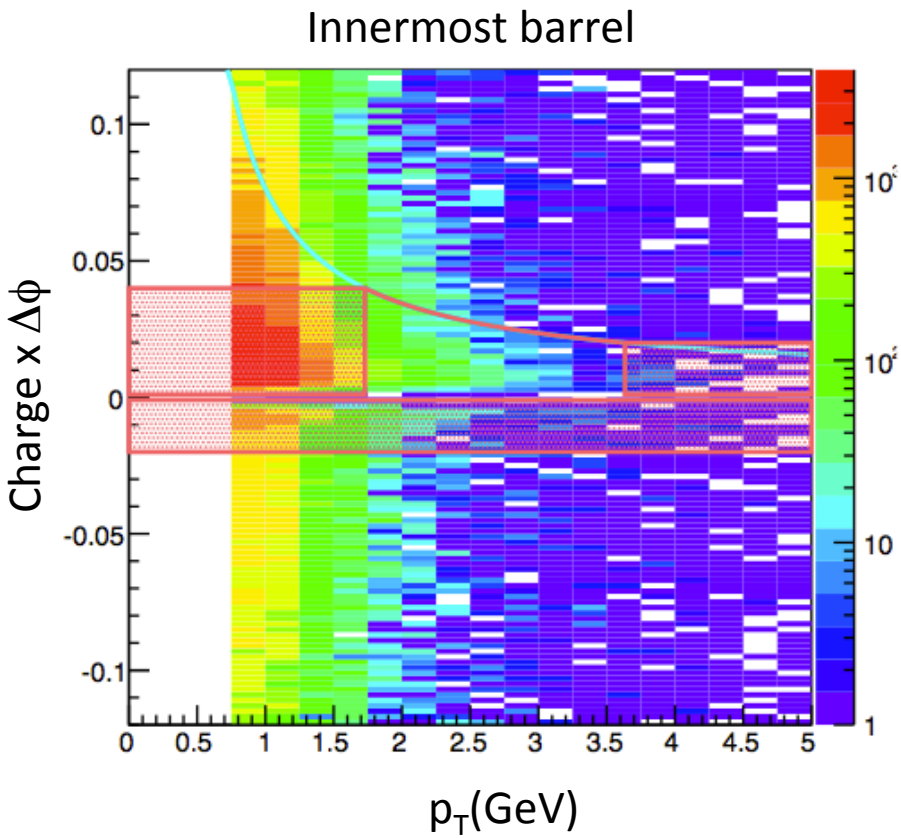


Decay matrix for B



- Hadron spectra expected to be significantly modified in AuAu (w.r.t. pp)
- Requires unfolding of electron spectra (back to hadron spectra)
- Unfolding procedure fully developed and working

Analysis Challenge: Conversions

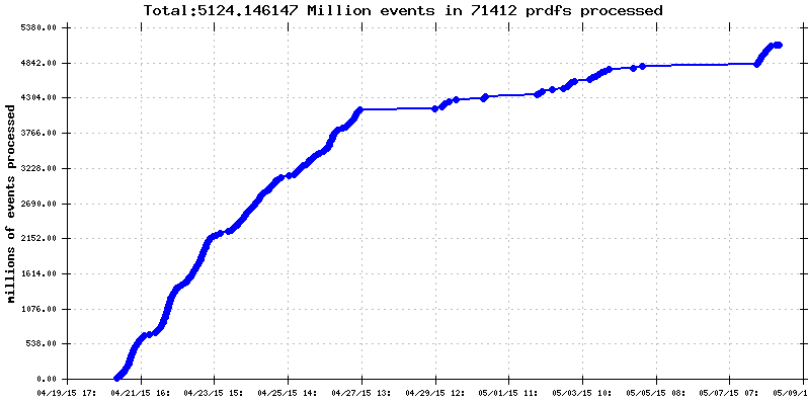


Conversion Veto:
Reject electron tracks that have close partner

- Largest electron background comes from photon conversions
- VTX: 13 % X_0
- Able to reject its own conversions

VTX Reconstruction Status

- Run11 Au+Au 200 GeV: complete
- Run14 Au+Au 200 GeV: ¼ complete
  - 1 month to 50 % completion (July 2015)
  - 6.5 months to 100 % completion (end of 2015)
  - This assumes Run15 production and Run13 re-production are completed in parallel
- Run15 p+p 200 GeV: 50 % complete
  - 2 weeks to completion (July 2015)



5 billion Au+Au events in 3 weeks

VTX Data Release Plan

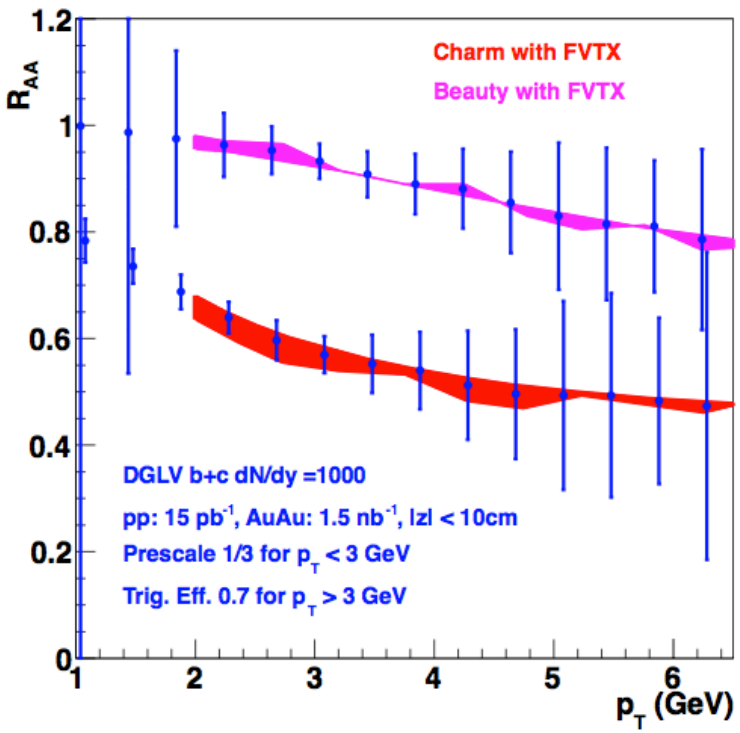
- Run11 Au+Au
  - Final analysis essentially done
  - Paper Preparation Group formed May 2015
  - Complete paper draft exists
  - Journal submission by September 2015
- Run14 Au+Au, Run 15 p+p
  - Analysis procedure established
  - analysis of Run14 Au+Au and Run15 p+p will be faster
  - preliminary result (50 % of data) by September 2015
  - followed up by publication

HEAVY FLAVOR MUONS

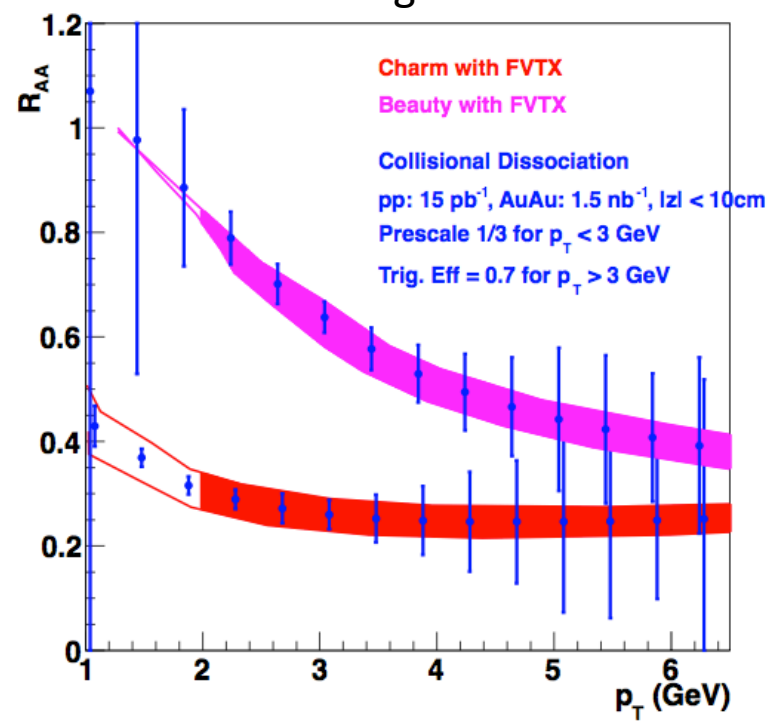
Heavy Flavor Muons with FVTX

Run14 projections

Only Bremsstrahlung



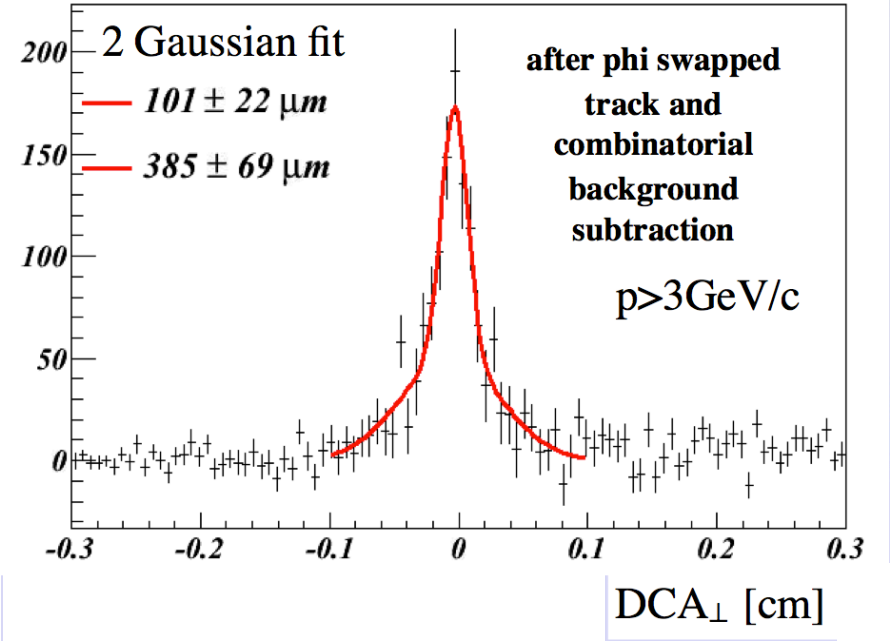
Bremsstrahlung and collisional

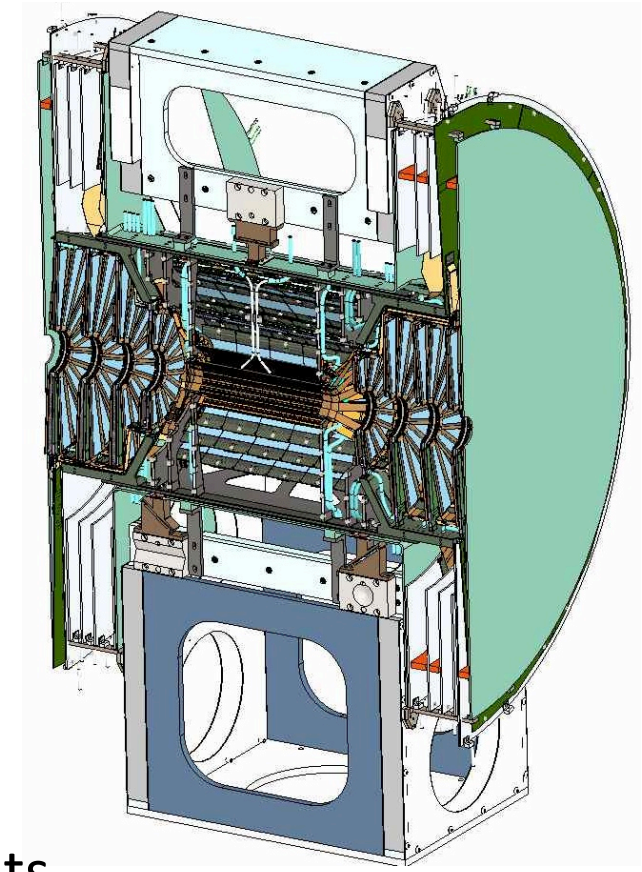


Enables clear distinction between energy loss scenarios

FVTX

Run12 CuAu 200 GeV
Prompt muons from J/ψ decays





Detector meets resolution requirements
arXiv:1311.3594 (accepted NIM)

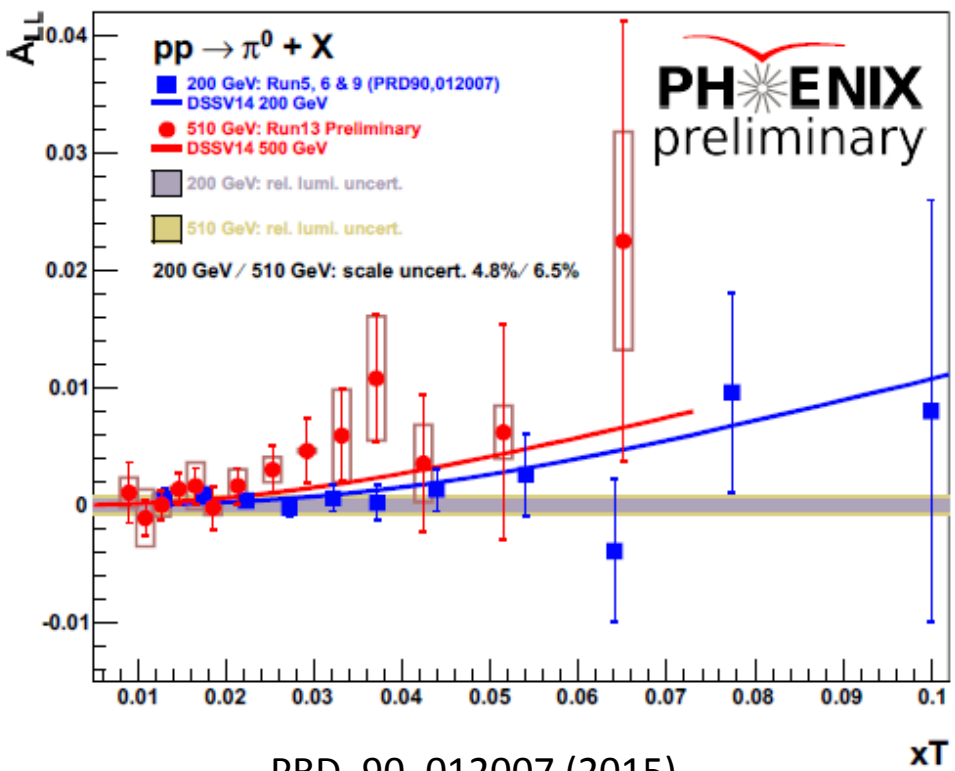
FVTX Data Release Plan

- Reconstruction status
  - Run12 Cu+Au, p+p: done
  - Run14:
    - Starting in July
    - 5 months to 50 % completion (November 2015)
    - 9 month to 100 % completion (March 2016)
  - Run15:
    - starting this week,
    - two weeks to completion (July 2015)

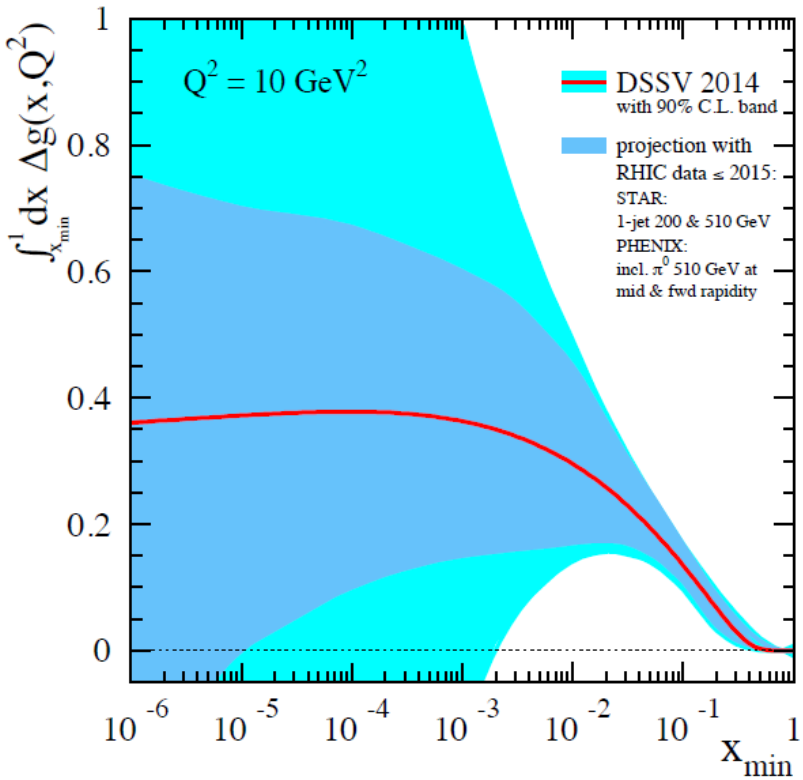
Goal: preliminary result from Cu+Au in September 2015

GLUON & ANTI-QUARK POLARIZATION

Gluon Spin Results



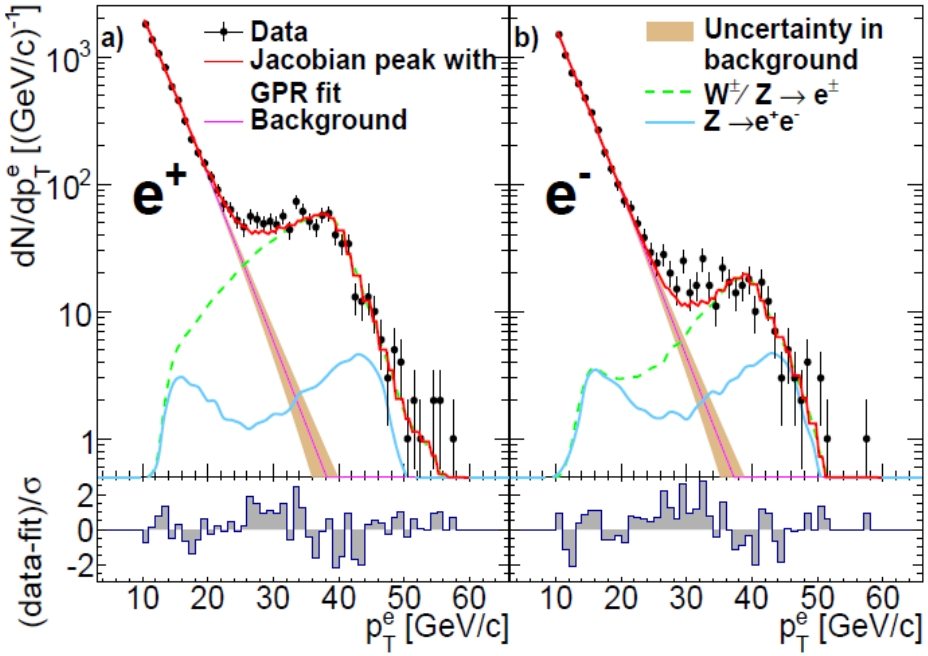
PRD, 90, 012007 (2015)
PRD, 91, 032001 (2014)

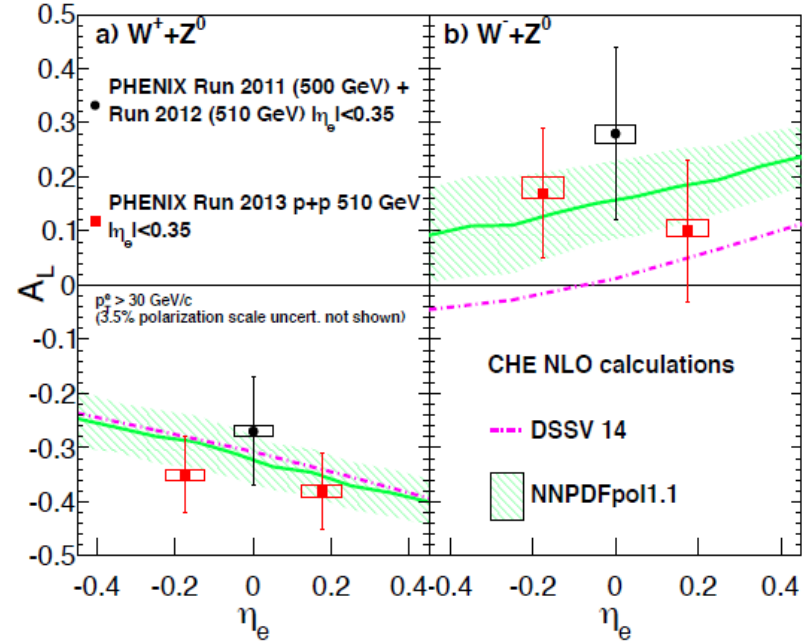


RHIC Spin White Paper
1501.01220

Finalizing Run-13 510 GeV p+p results

Mid-Rapidity W results

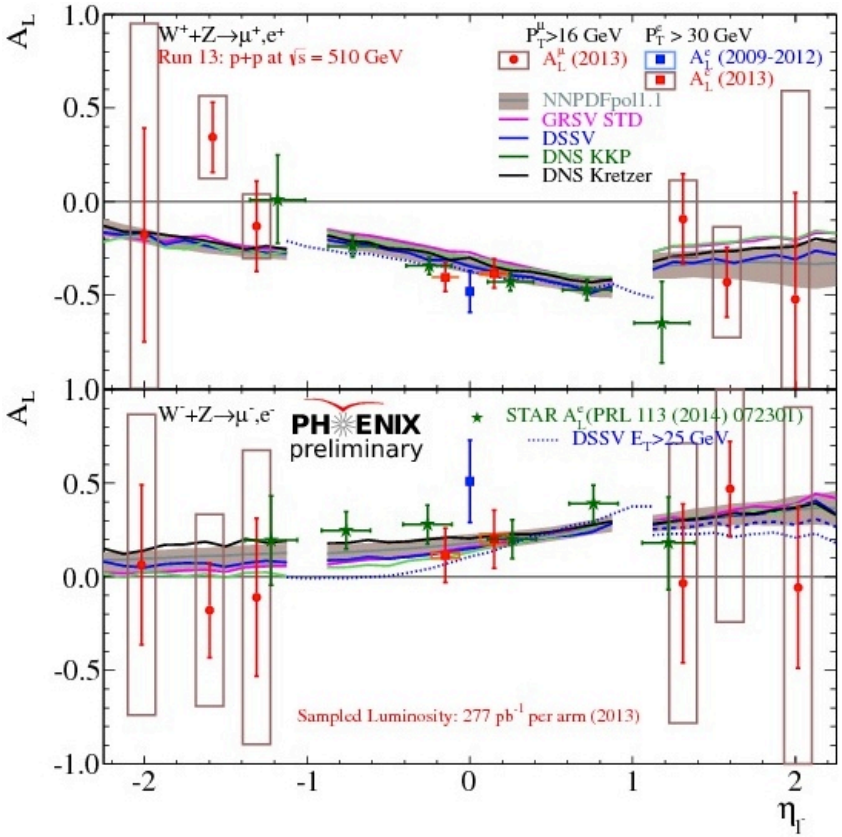




W→e results from Runs 11, 12, 13 submitted for publication arXiv:1504.07451

Forward W trigger

W→μ: preliminary result DIS 2014



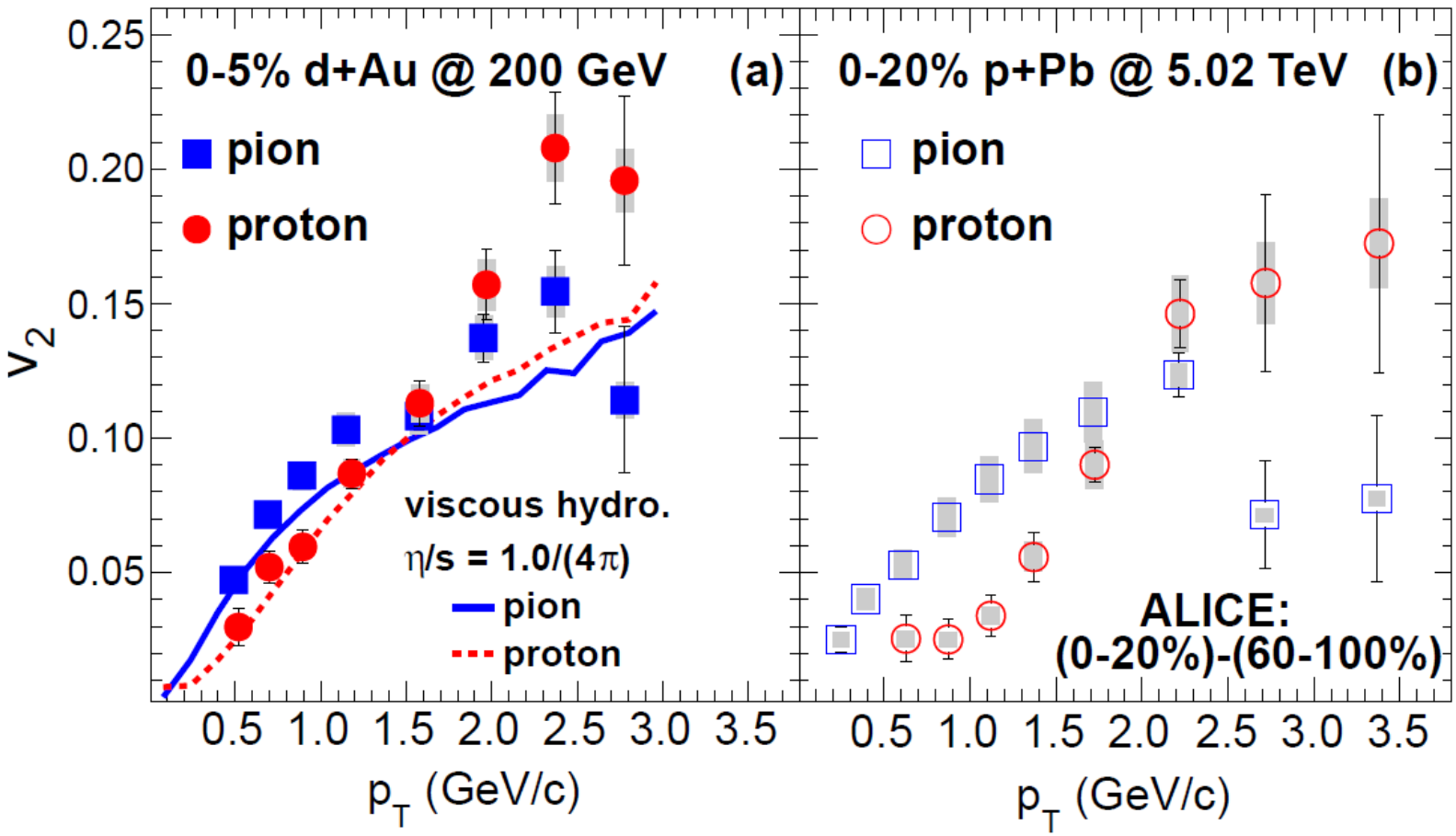
W trigger upgrade enabled full sampling of luminosity delivered in Run13
Rejection > 9,000

- Working on finalizing the result
- Upcoming new Run13 reconstruction with improved FVTX-MuTr alignment to improve hadron rejection

SMALL SYSTEMS

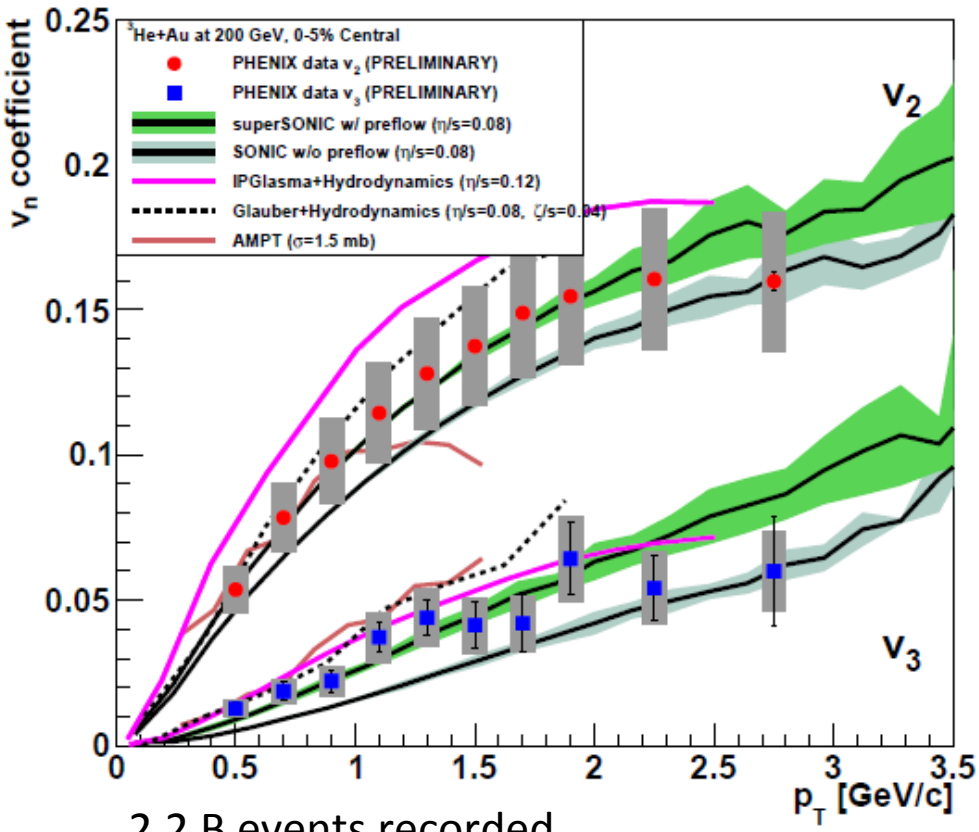
d+Au

PHENIX PRL 114, 192301 (2015) ALICE PLB 726, 164 (2013)



Mass ordering for identified hadron is observed in both d+Au and p+Pb ---- consistent with hydrodynamic flow

Run14 ^{3}He+Au



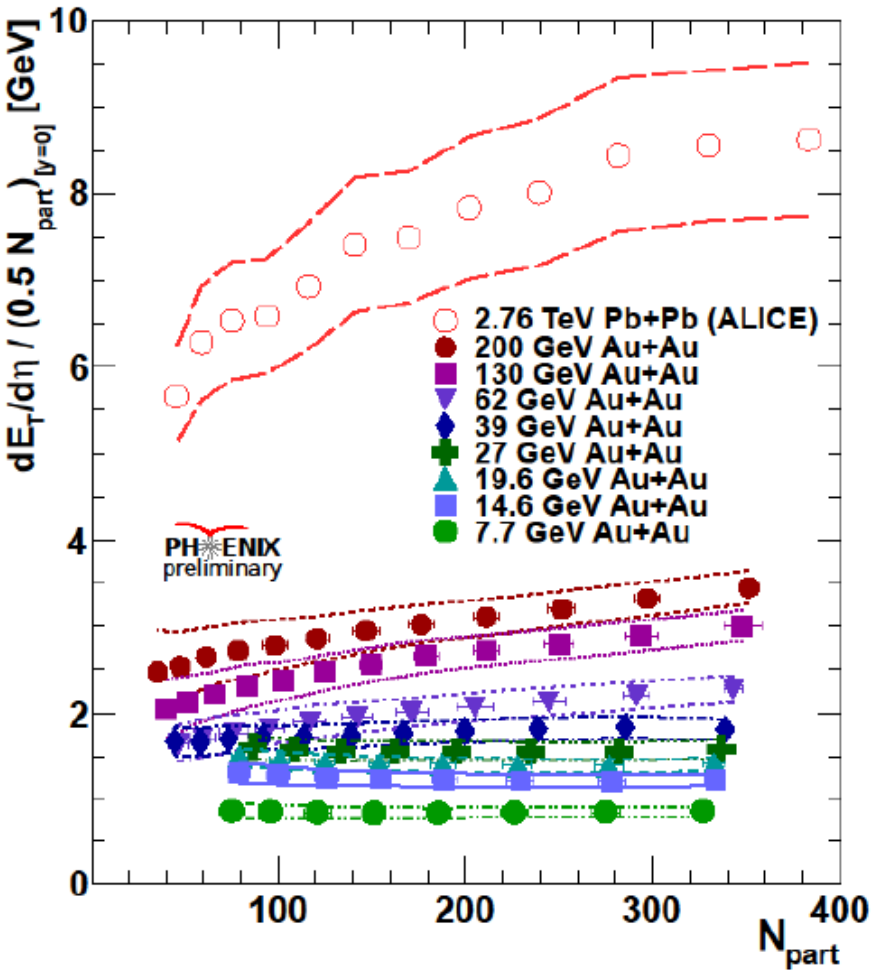
- Preliminary result shown at Initial Stages 2014
- v_2 similar in ^{3}He+Au and d+Au
- Significant v_3 in ^{3}He+Au

- Publication Plan
- Paper Preparation Group formed February 2015
- Journal submission in July 2015

2.2 B events recorded
Centrality trigger
Enhanced 0-5% most central by nearly factor 10
Recorded almost all central events

RUN14 15 GEV AU+AU

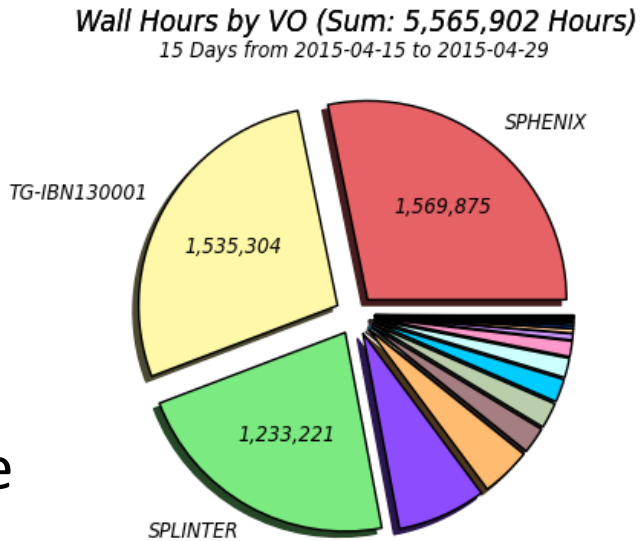
Beam Energy Scan Results



- All data sets fully reconstructed
- Including Run14 Au+Au at 15 GeV
- Preliminary result exists
- Paper Preparation Group formed December 2014

Summary

- RHIC Computing Facility (RCF):
  - 15,000 batch computing slots, 8 PB storage for raw data and DSTs



- Open Science Grid:
  - large-scale simulations w/o impacting closer-to-the-data RCF resources
- Keeping pace with increase of data size
  - Added VTX, FVTX, W trigger, MPC-EX
  - Still recording data with > 5 kHz
  - Can essentially reconstruct data from each year within that year
- Upgrades are pushing challenging analyses
- Releasing key new results in timely manner