
STAR
STAR Run-14 Report
Flemming Videbæk
BNL
RHIC
AGS
users'center
DEPARTMENT OF ENERGY
UNITED STATES OF AMERICA
BROOKHAVEN
NATIONAL LABORATORY
The 2014 RHIC/AGS Annual Users' Meeting

Outline

- Physics motivation for Run-14
- New Detector Systems for Run-14
- Datasets and STAR performance
- Plans for Run-15
- Summary

Physics Request for Run-14

Run	*	Beam Energy	Time	System	Goals
14	2	$\sqrt{s_{NN}}$ = 15 GeV	3-week	Au + Au	1) 150M M.B. events for CP search 2) Fixed-target data taking
	1	$\sqrt{s_{NN}}$ = 200 GeV	14-week	Au + Au	HFT & MTD heavy flavor hadron measurements L=10 nb^{-1}, 1000M M.B.

Di-muon, e-muon utilizing the completed Muon Telescope Detector (MTD)

Open heavy flavor minimum bias program with the newly installed Heavy Flavor Tracker (HFT)

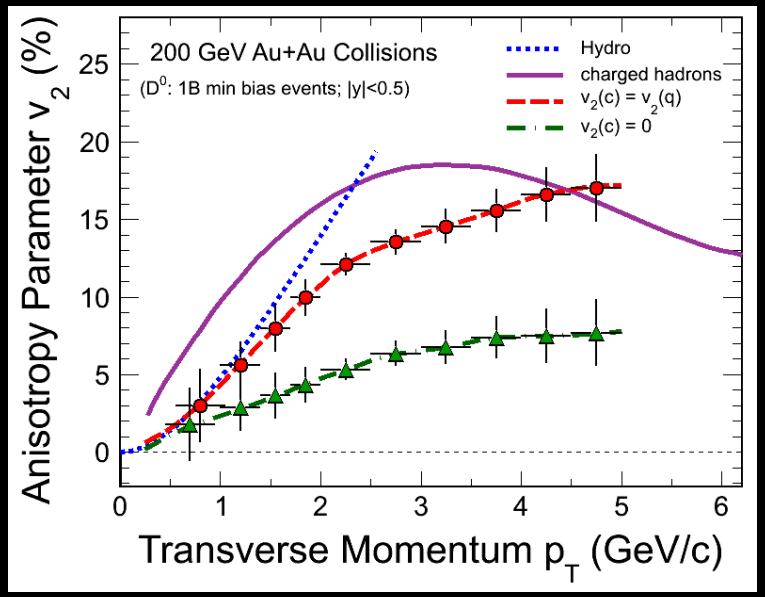
These programs are multi-year for Au+Au and p+p 200 GeV

BES-I: filling the gap in mu_B between 11.5 and 19.6 with 14.5 GeV

Run14: Physics Goals for HFT

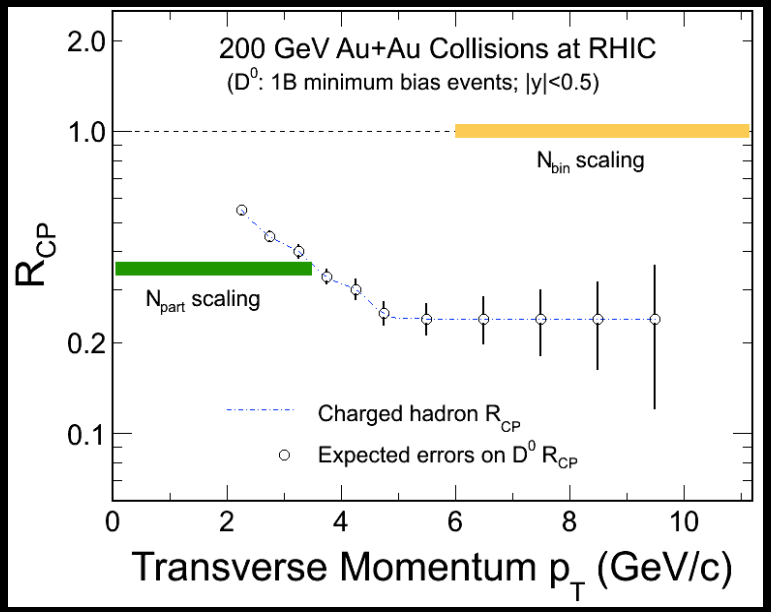
Quantify charm quark flow and coalescence

D^0 mesons

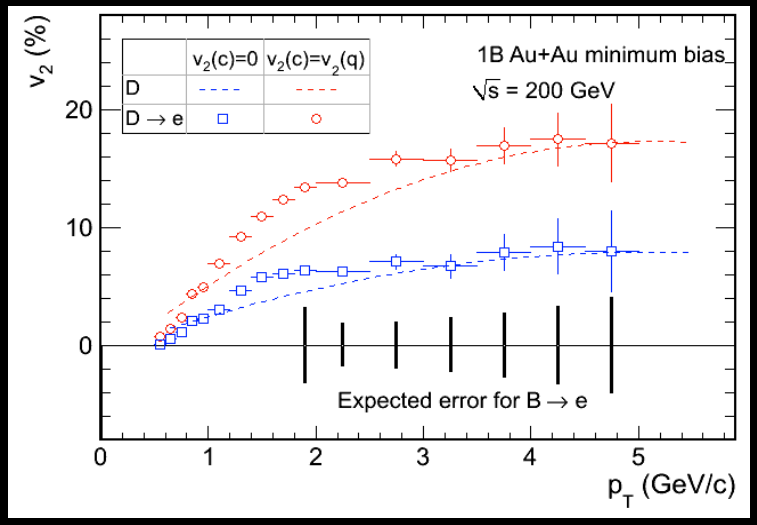


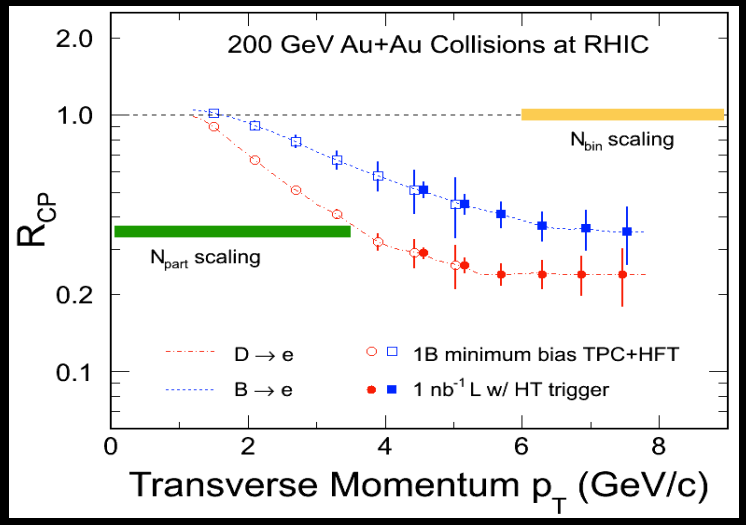
Star BUR Run-14, HFT TDR

R_{CP}



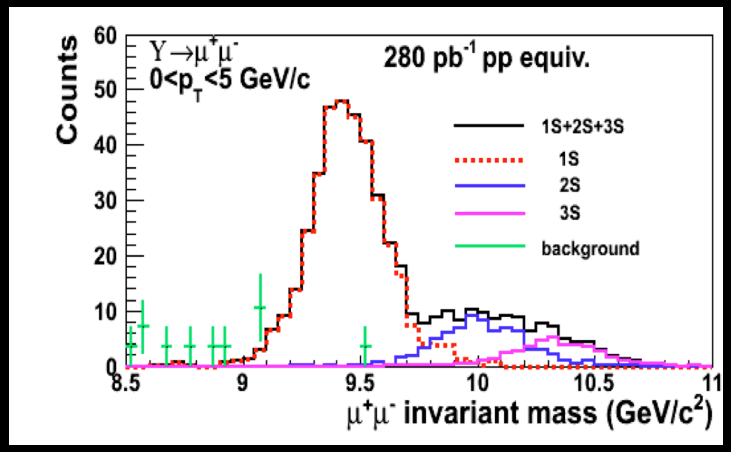
HF decayed electrons separating charm and bottom

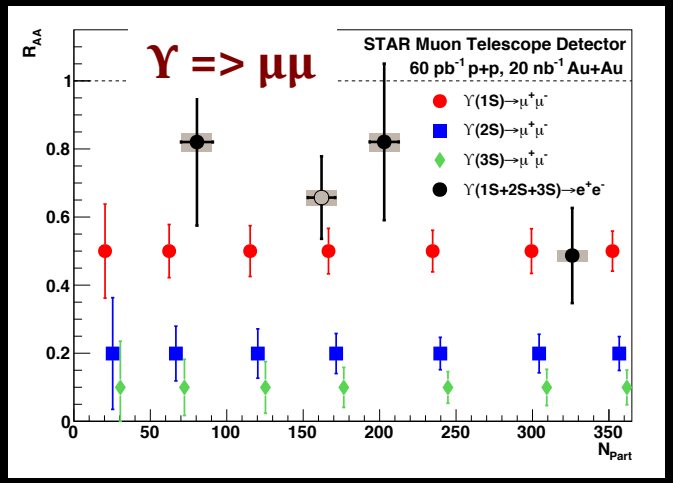




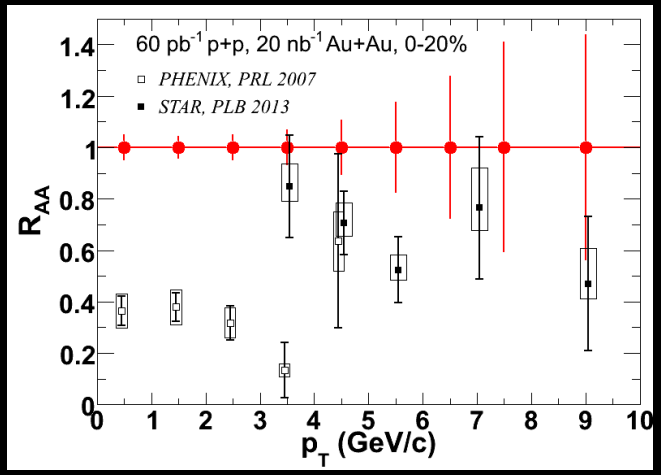
Estimated for 1B good minimum-bias events and 1 nb^{-1} HT trigger. Using impact parameter distribution we can separate charm and bottom contributions to electrons from heavy flavor decays (Y. Zhang et. al. JPG 41, 25103).

MTD: Run14 and Beyond





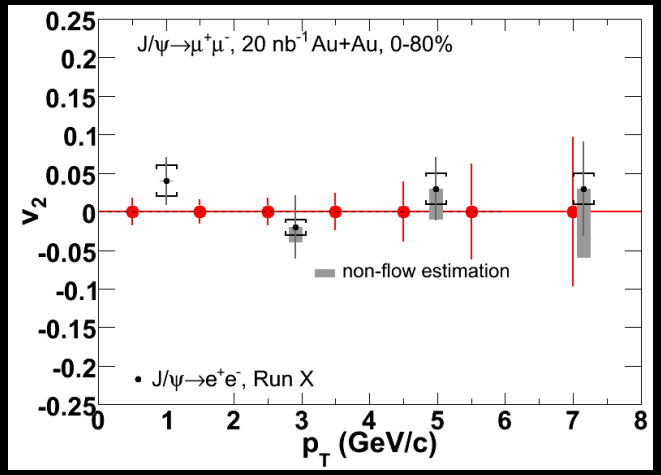
1) **Upsilon at RHIC:** unique, no regeneration, only initial production
2) **MTD at STAR:** Υ => μμ, no Bremsstrahlung tails, clean separation of the excited states



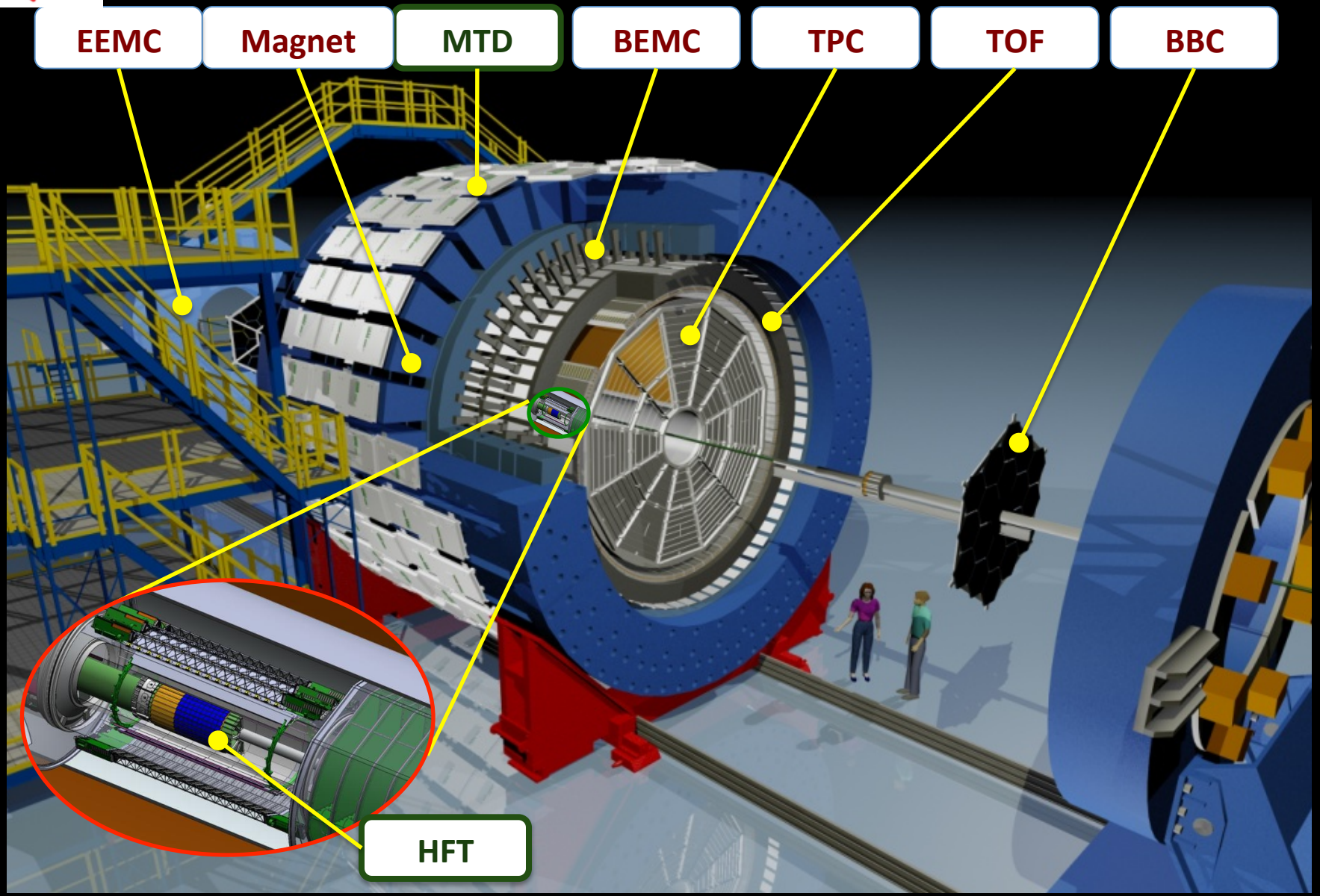
J/ψ

R_{AA} and v_2

(low p_T region)

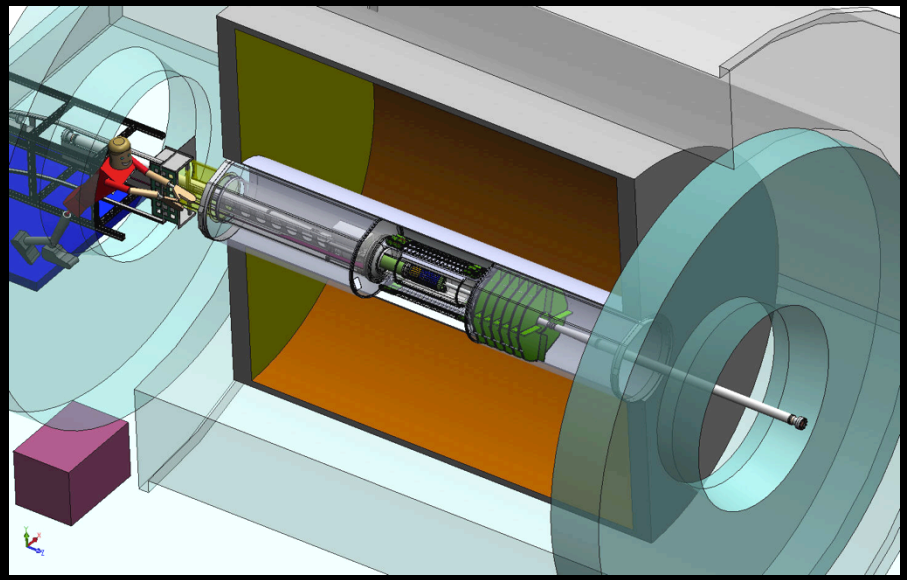


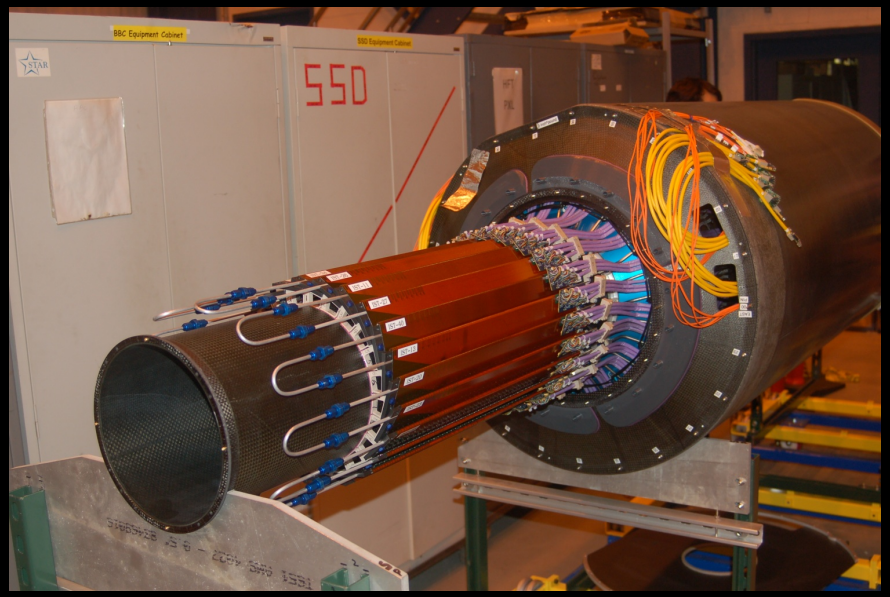
STAR Detector System

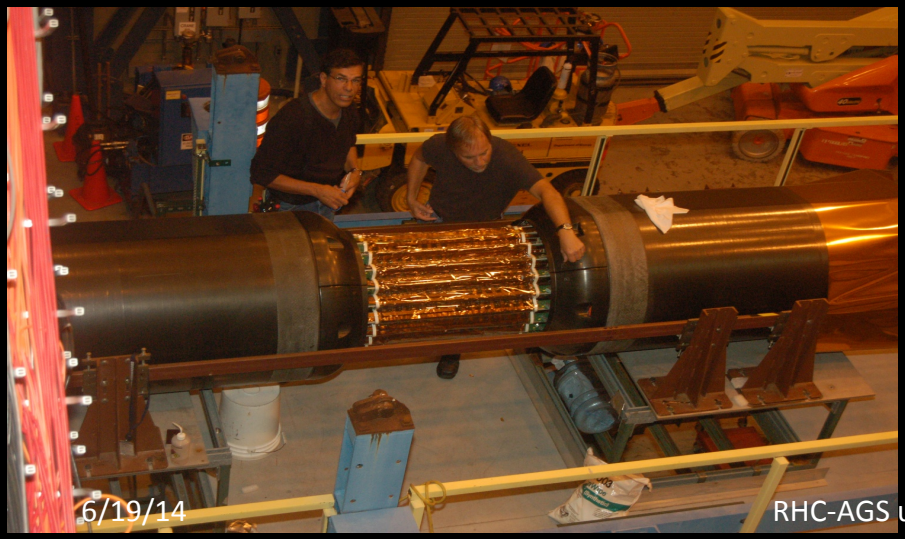


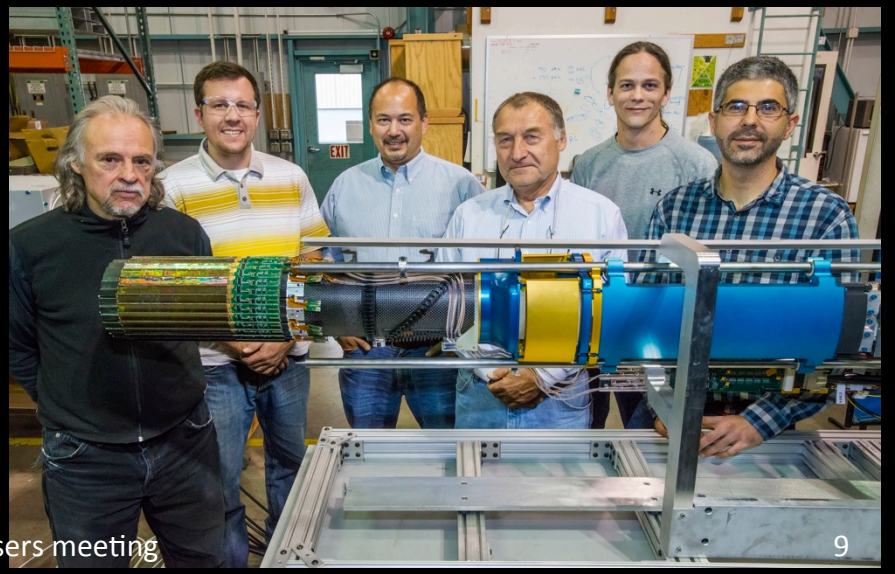
INSTALLED FOR RUN-14

Heavy Flavor Tracker

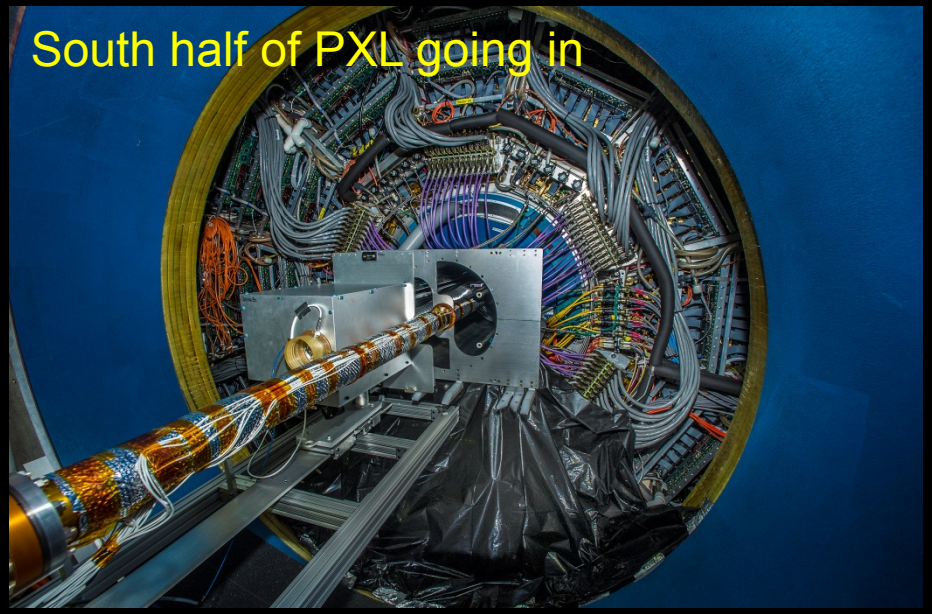


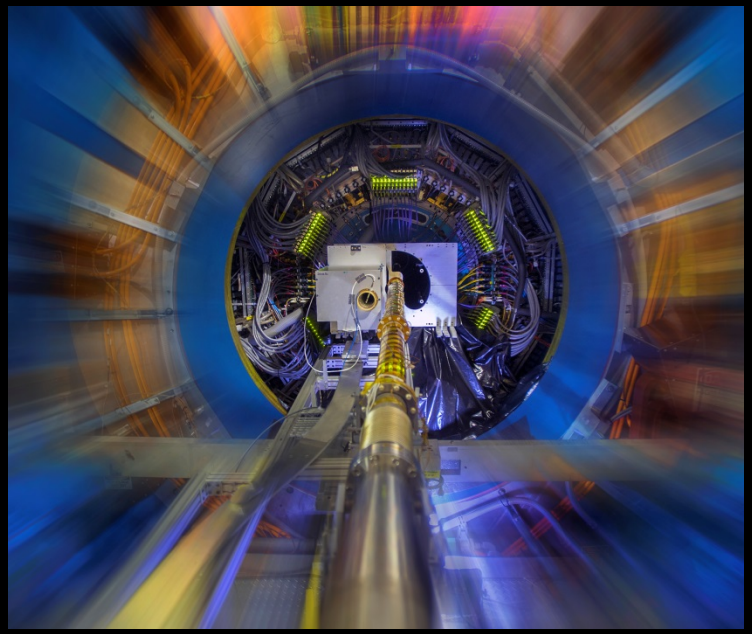






PXL Installed, plumbed for air, and cabled January 24 – 26th

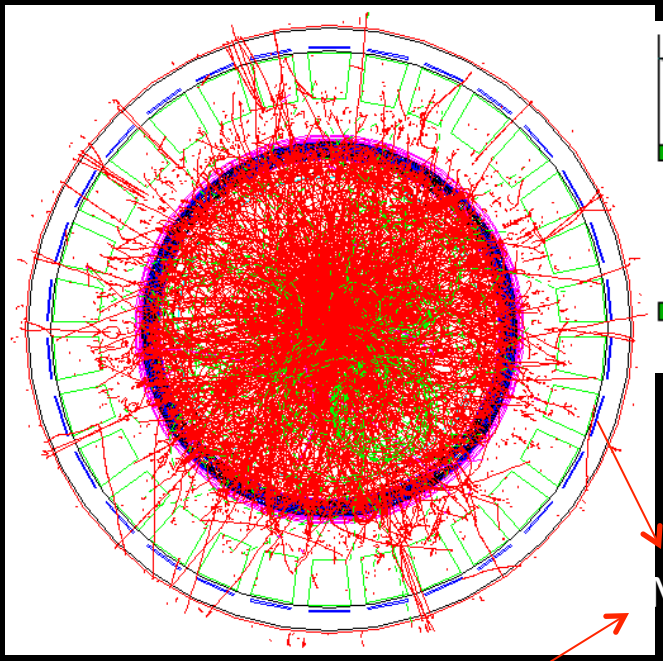




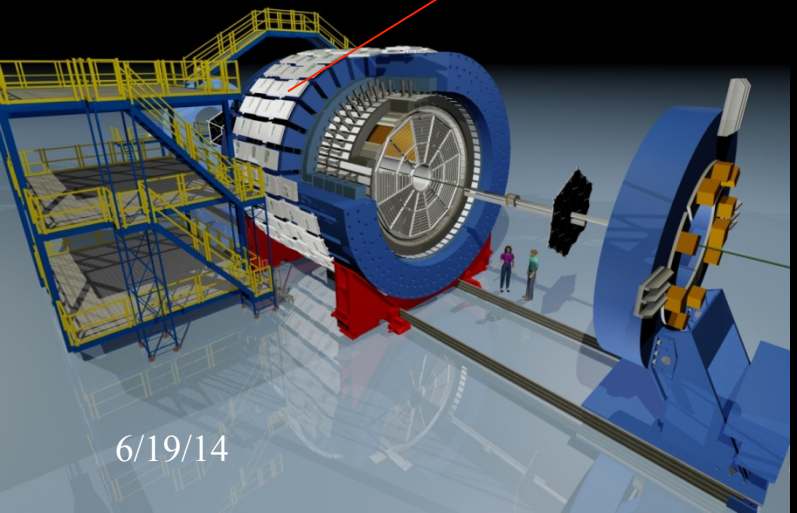
Artsy Picture courtesy of Joe Robino, BNL Photography

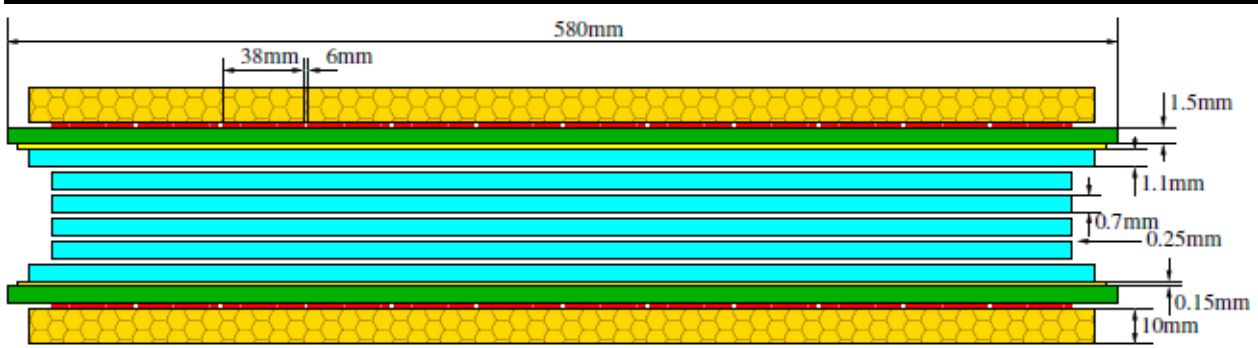
MUON TELESCOPE DETECTOR

The MTD at STAR



MTD





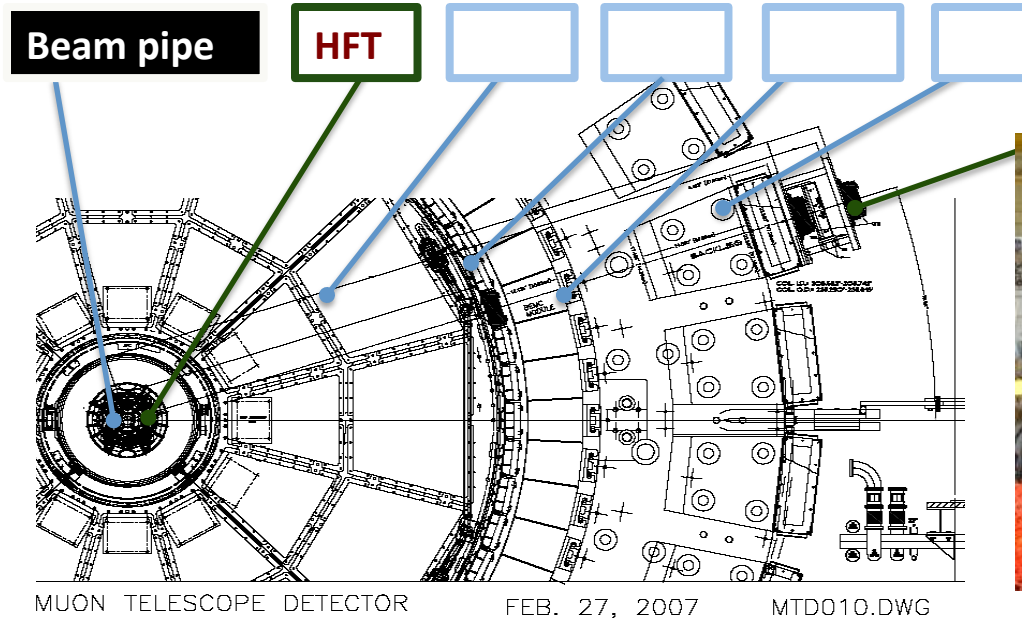
Multi-gap Resistive Plate Chamber (MRPC): gas detector, avalanche mode

A detector with long-MRPCs covers the whole iron bars and leave the gaps in-between uncovered. Acceptance: 45% at $|\eta|<0.5$

122 modules, 1464 readout strips, 2928 readout channels

Long-MRPC detector technology, electronics same as used in STAR-TOF

Status: Muon Telescope Detector

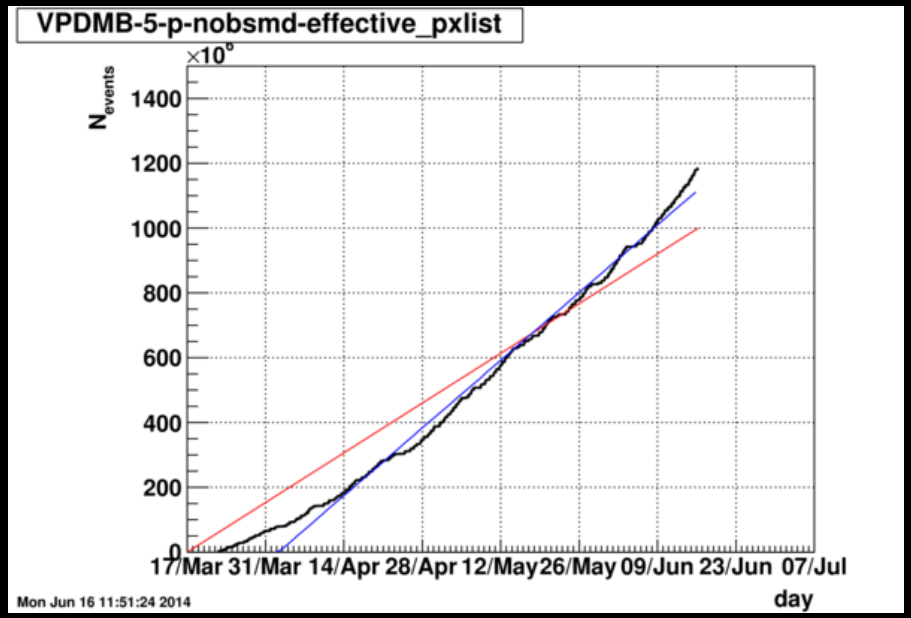


Run 14 installation
(under STAR)

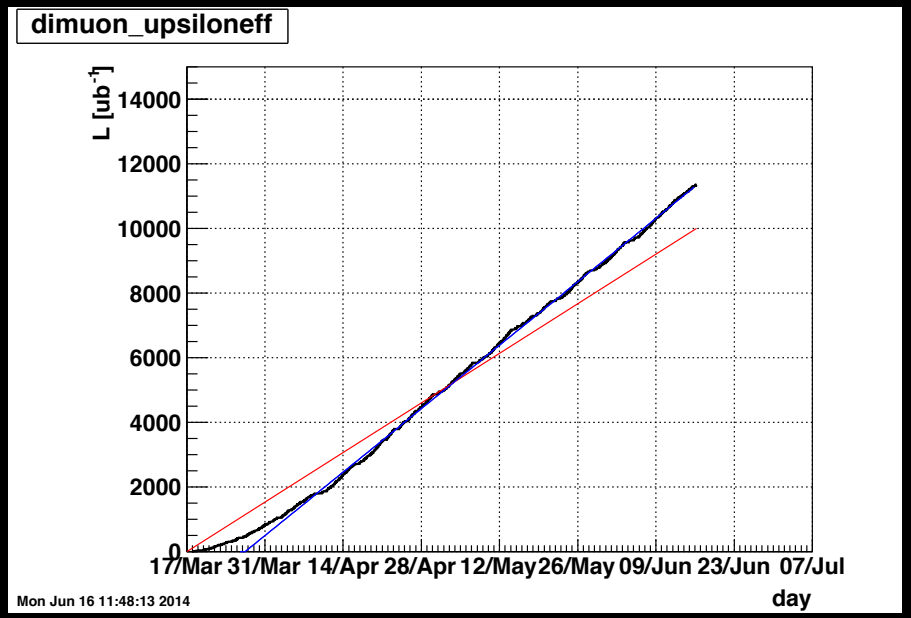
DATA SETS AND STAR PERFORMANCE

Dataset obtained

HFT minbias goal

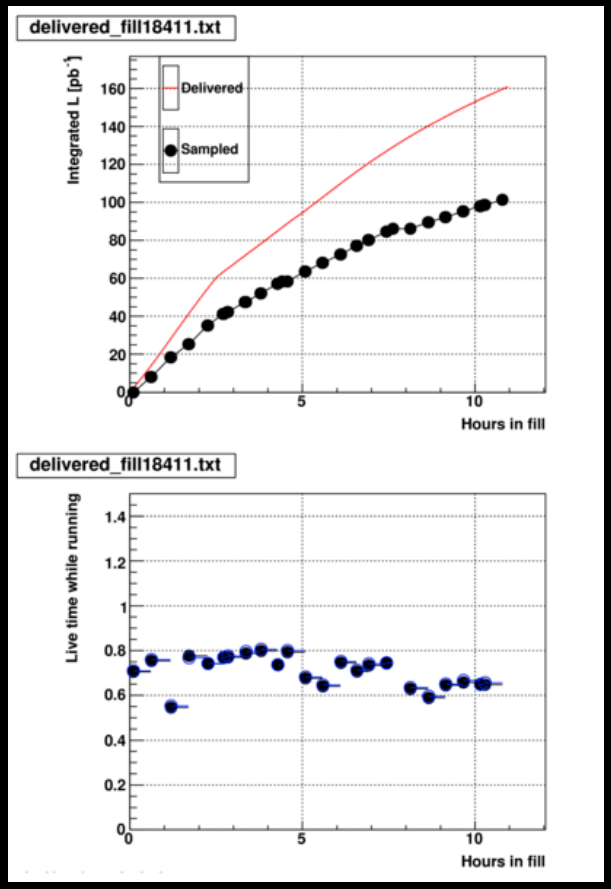


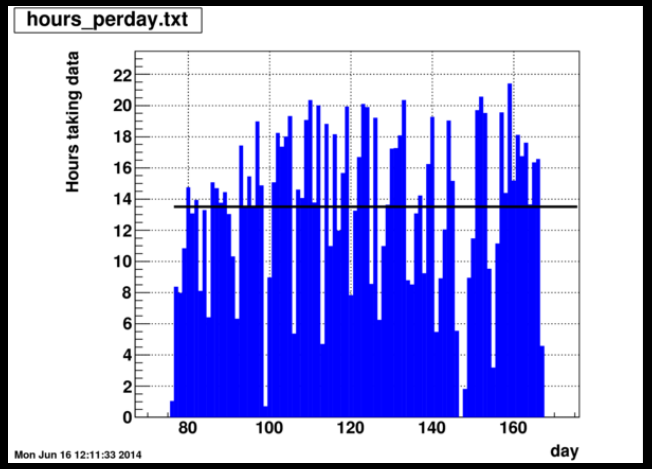
MTD dimuon goal

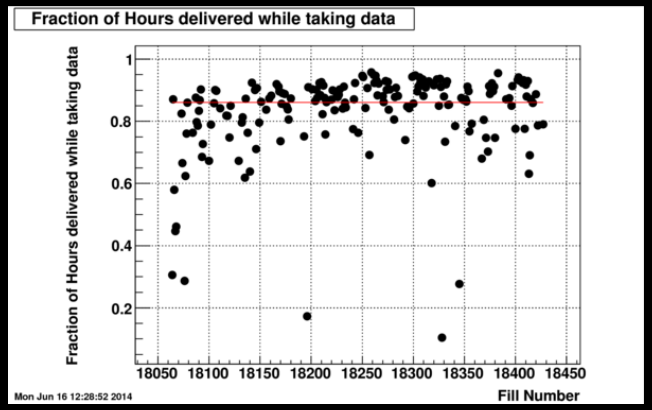


- Excellent RHIC Machine Performance
- Reach our integrated Luminosity goal for Run-14
  - $10nb^{-1}$ from Run-14
  - $20nb^{-1}$ two-year MTD goal for Upsilon
- Toward our minbias Dataset goal
  - 1 billion minbias from Run-14
  - 2 billion minbias from Run-16

STAR running efficiency

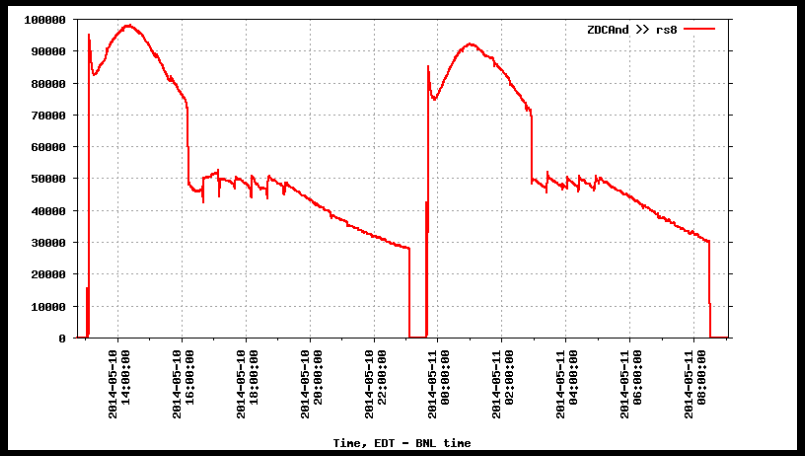


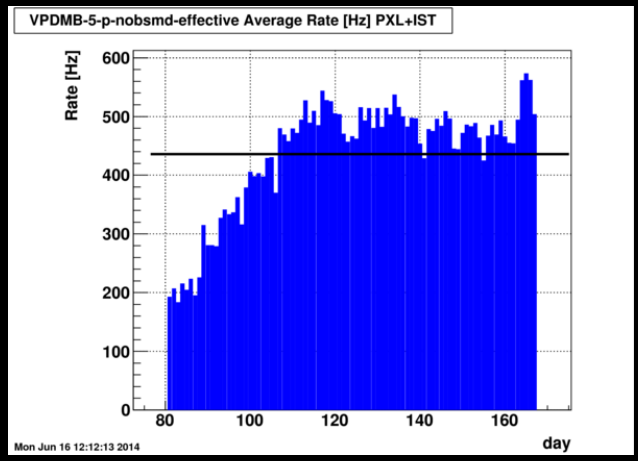




STAR run optimization

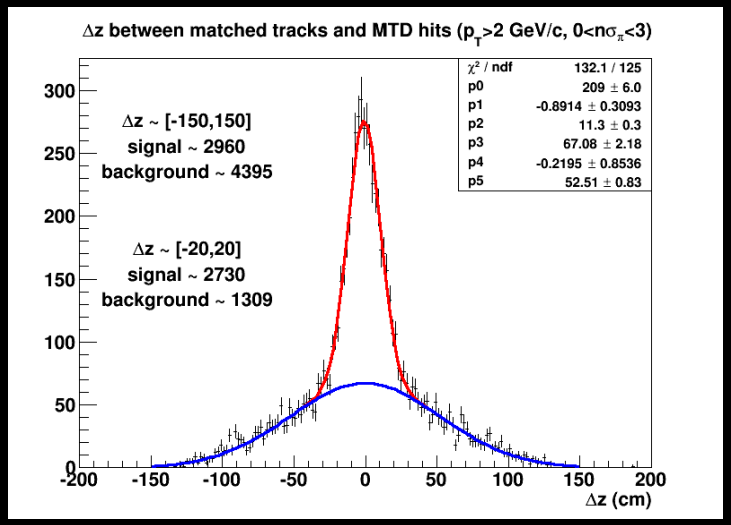
- STAR developed a strategy to optimize the data taking for the two top priorities programs in Run-14 (di-muon with MTD and and minbias with HFT)
- MTD sample all of the high luminosity part of the store
- HFT is included at interaction rates <=55 kHz to minimize latch up rates, and pileup
  - Delivered Luminosity to STAR is changed after 3 (2.5) hours
  - Record ~ 7-8h for HFT minbias program out of 10-11
  - HFT readout at ~ 1KHz; Rate to tape after protection and HLT selection ~500
  - Thanks to CA-D for implementing these procedures

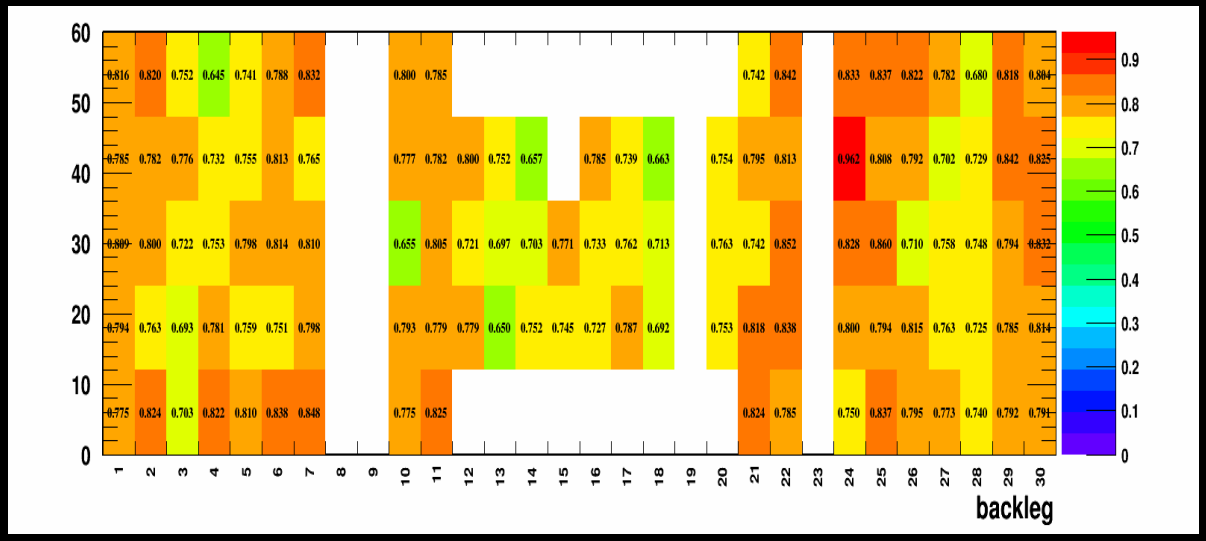




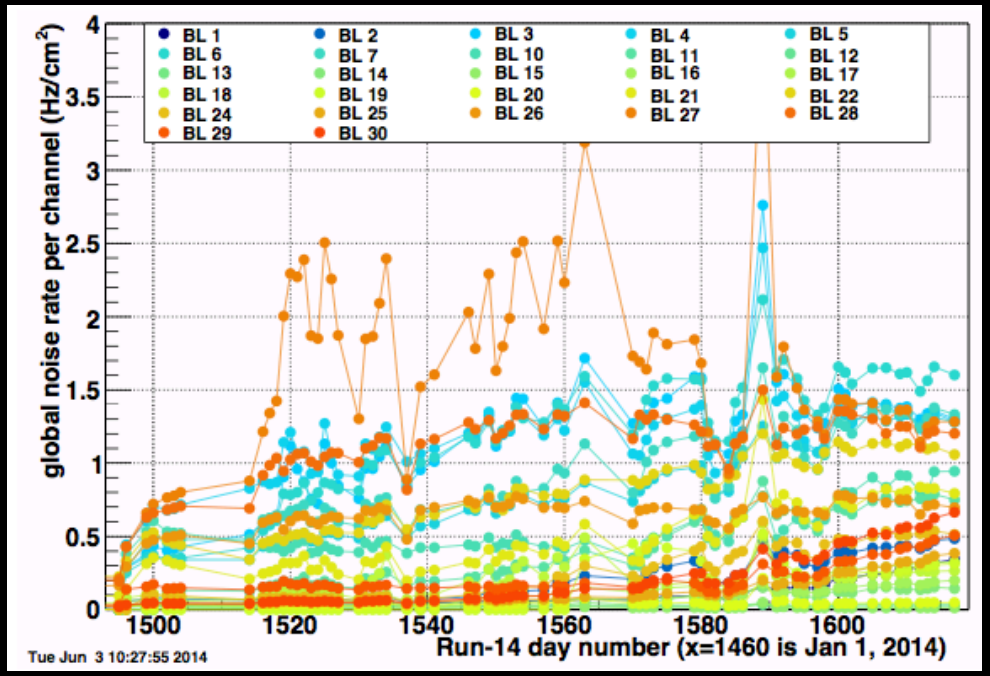
DETECTOR PERFORMANCE

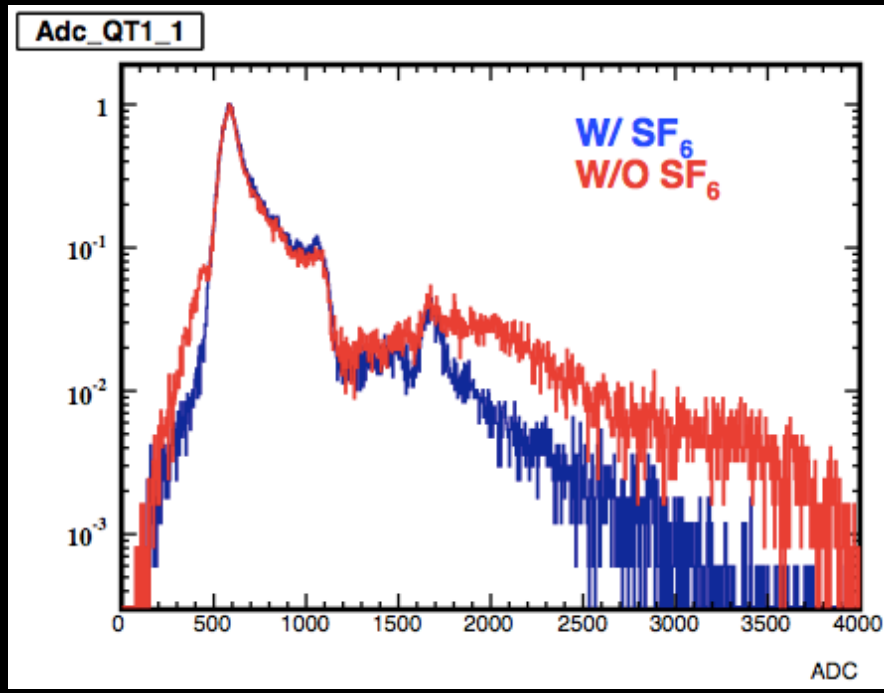
MTD in 200 GeV Au-AU





0.5% SF6 is flowing to the MTD

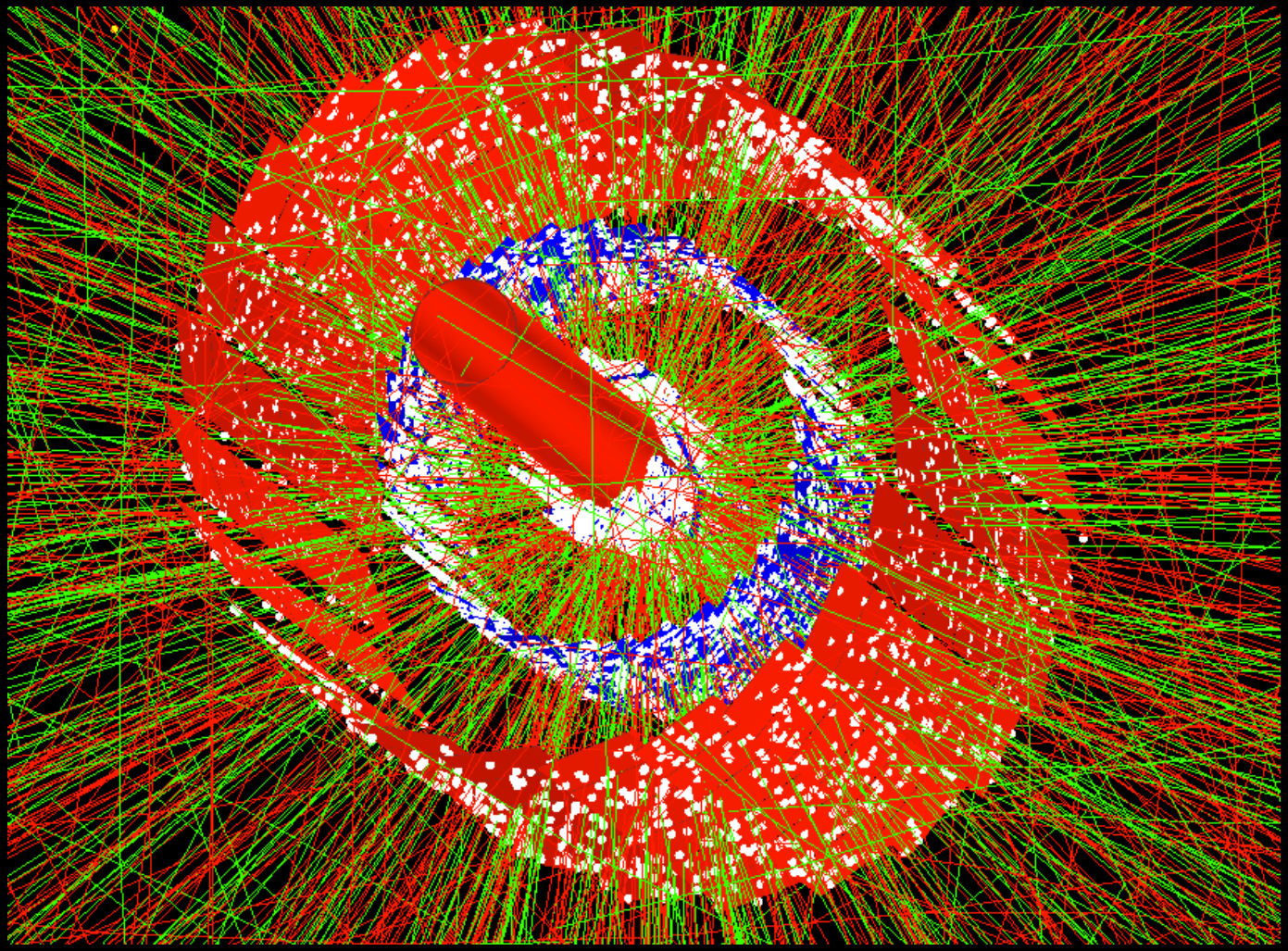




The noise rate is reduced.
Streamer signals are suppressed.

At the same time, monitor the TPC performance and SF6 concentration in the TPC gas. Thank Alexei Lebedev, Jim Thomas, Bill Christie for the efforts.

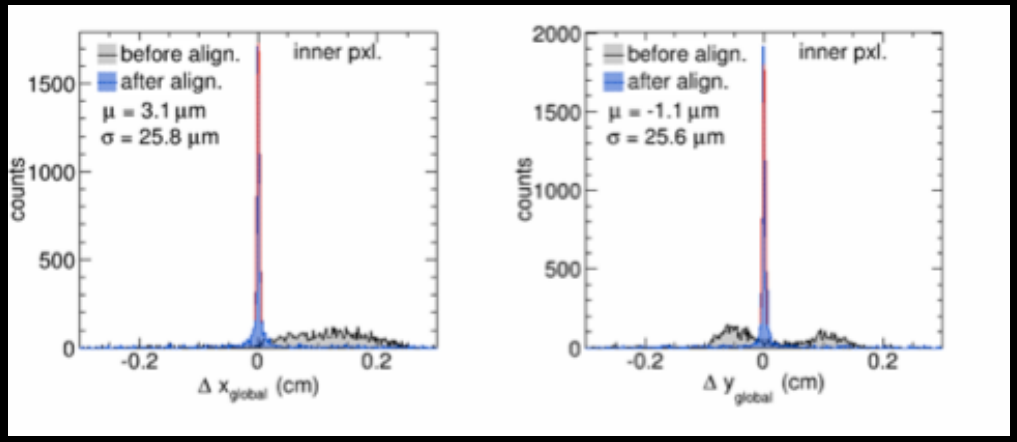
200 GeV Central Au+Au



HFT performance

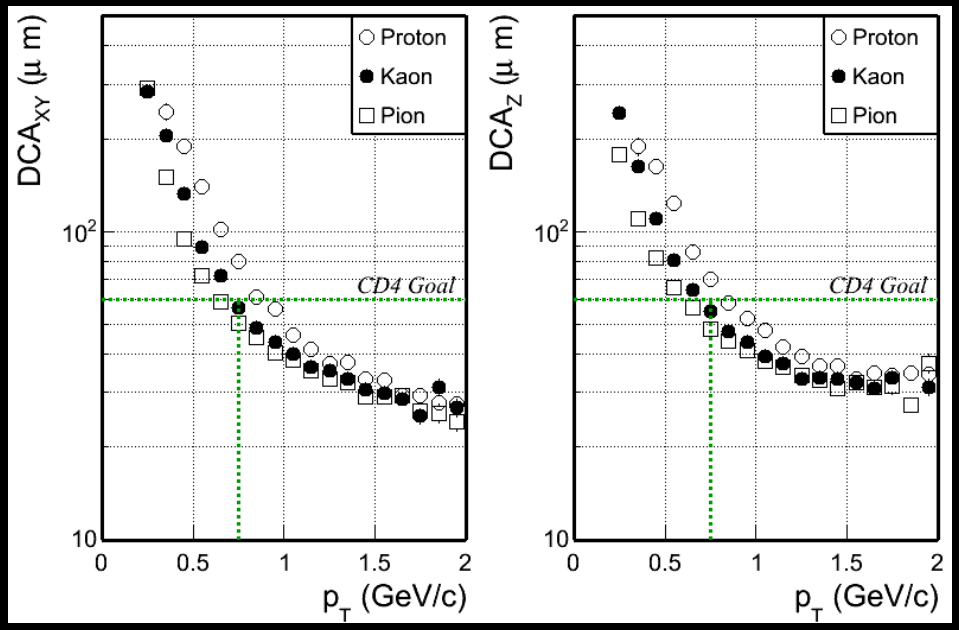
Sectors, ladders surveyed to ~20 micron reproducibility with CMM

Sector to Sector alignment from cosmic ray running in February and low-luminosity zero-field Au+Au



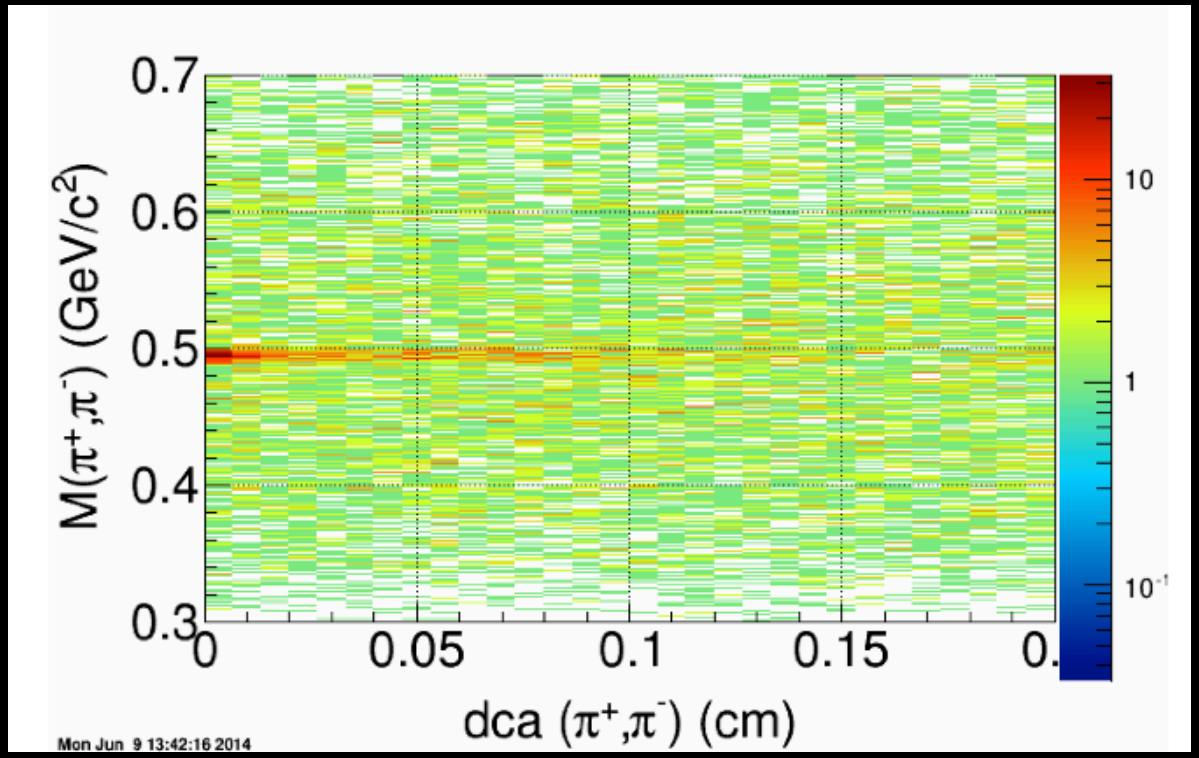
Low luminosity runs (5 kHz) were taken to confirm alignment in beam and for first test productions

DCA resolution in r-φ and z for π, K and p meets detector goals



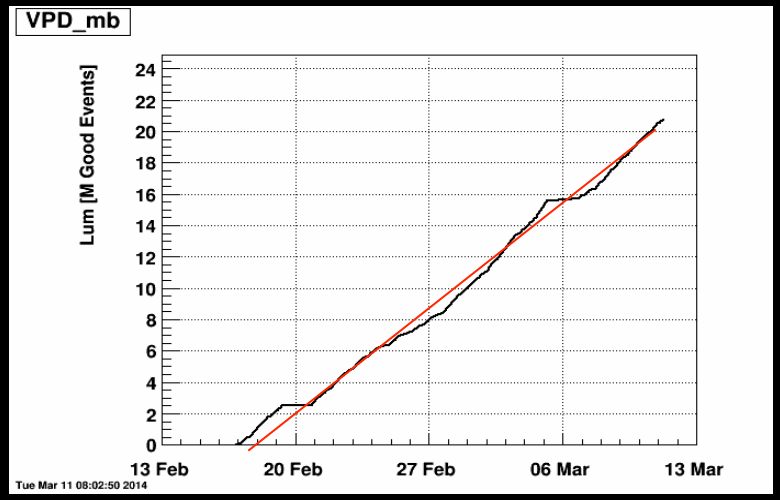
Secondary vertex reconstruction of K^0_s

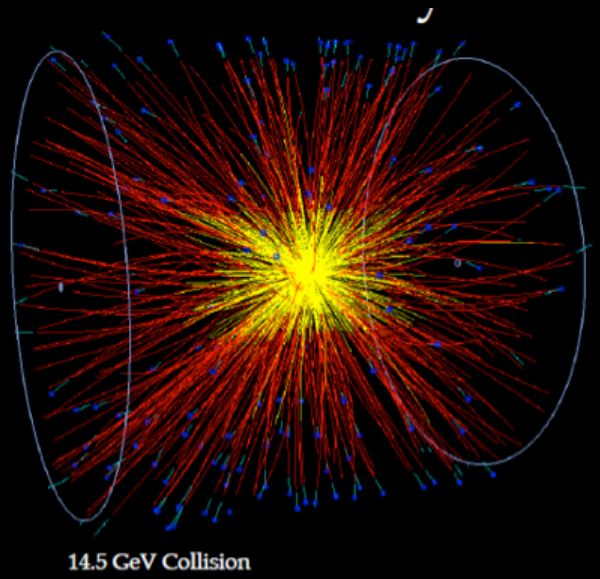
DCA ~ 100 micron
Low p_t pions
In agreement with expectations

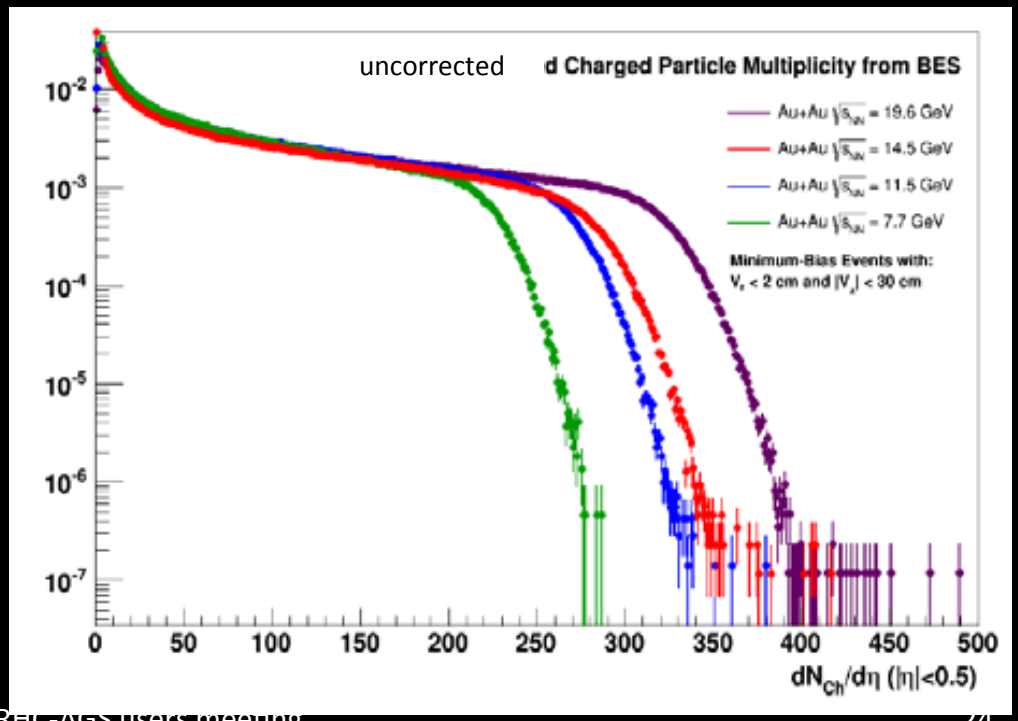


Status of run14: Au+Au@14.5GeV

Feb 13th: First Collisions
Feb 17th: Start Taking Data
Mar 11th: reach mb Goals
Mar 11th: 14.5 GeV run over
Acquired: 21 M VPD_mb

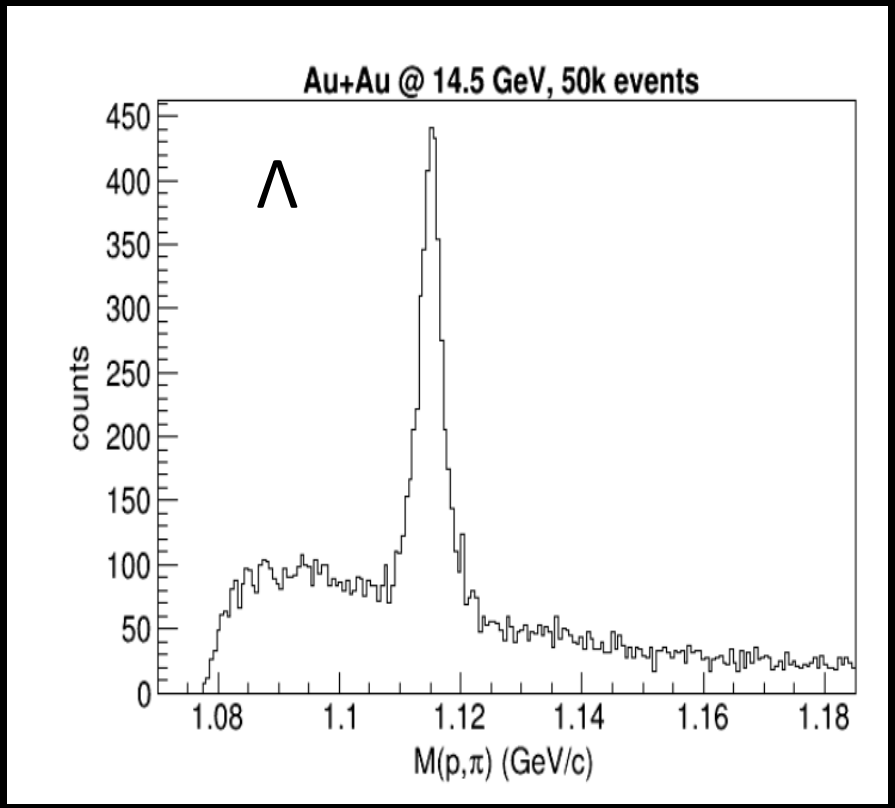


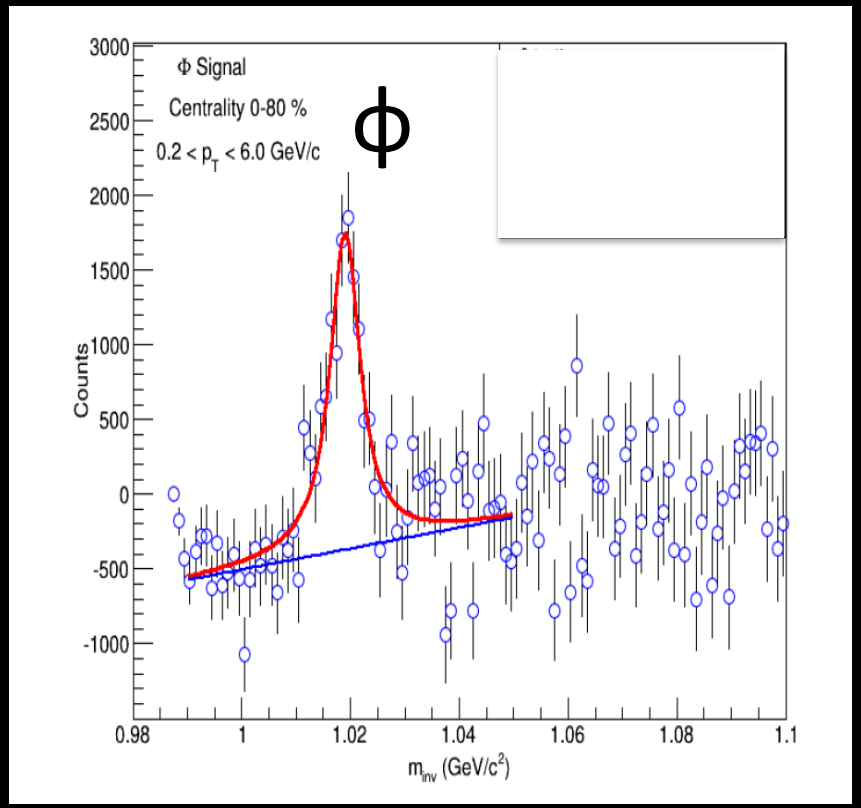




Topological PID iat 14.5 GeV

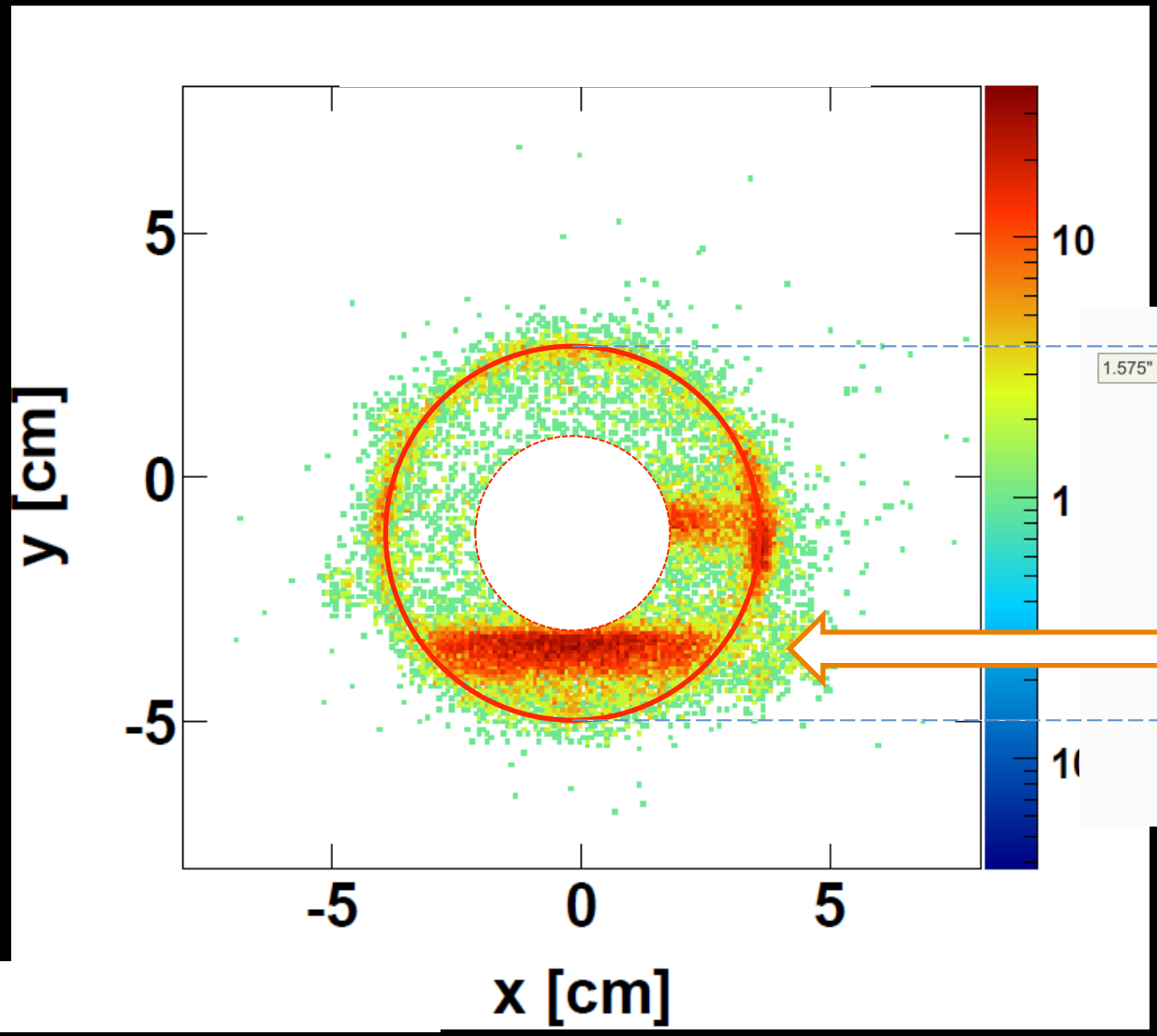
Everything has been looking great and the data have been actively analyzed

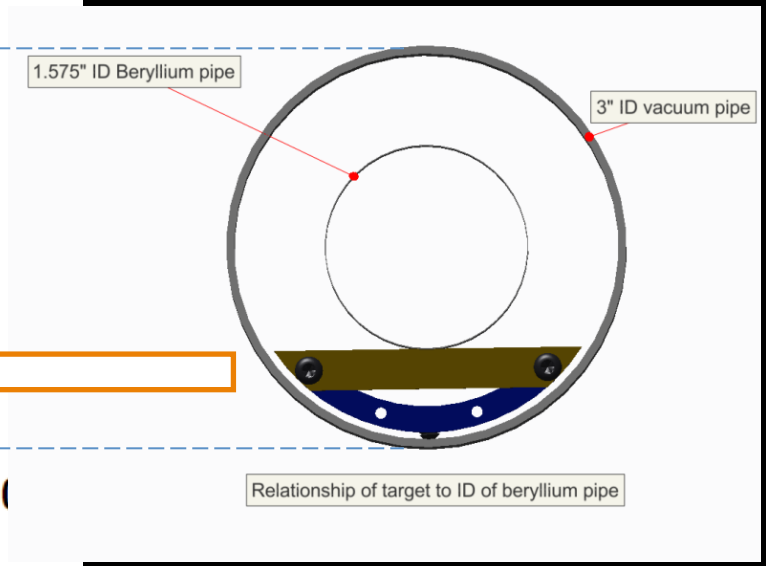




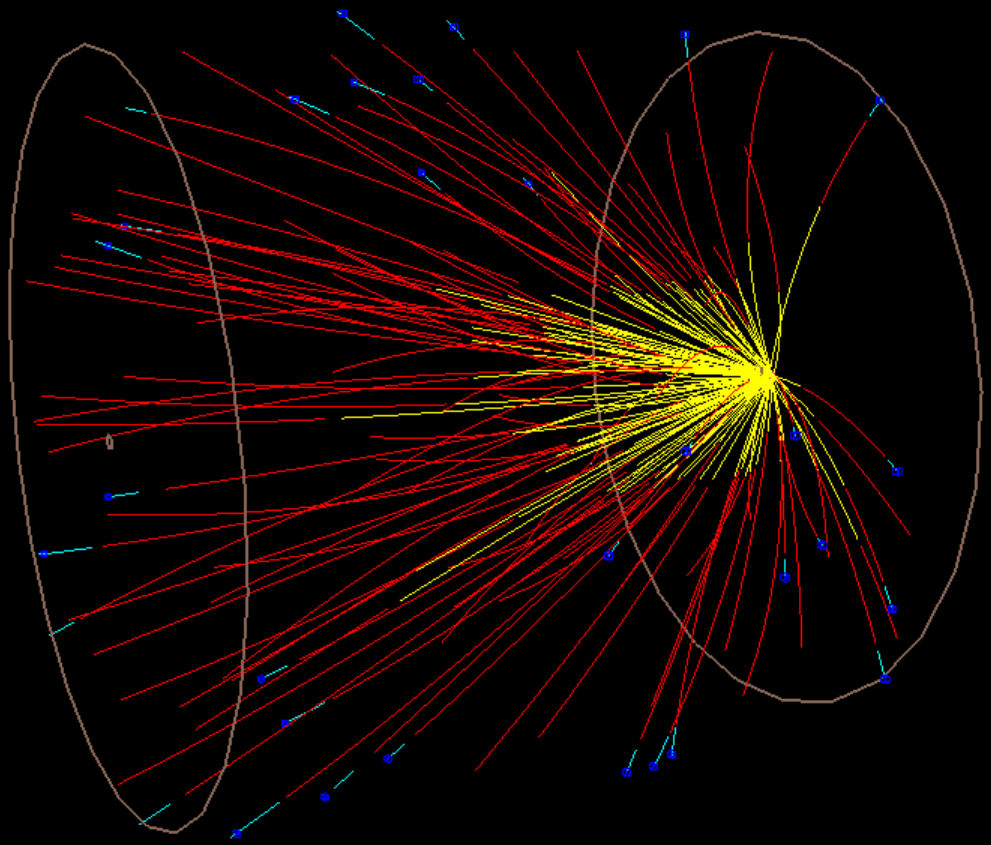
Fixed Au- target

A thin Au foil inside beam pipe at ~215 cm allows for low wnwrgy Au+Au



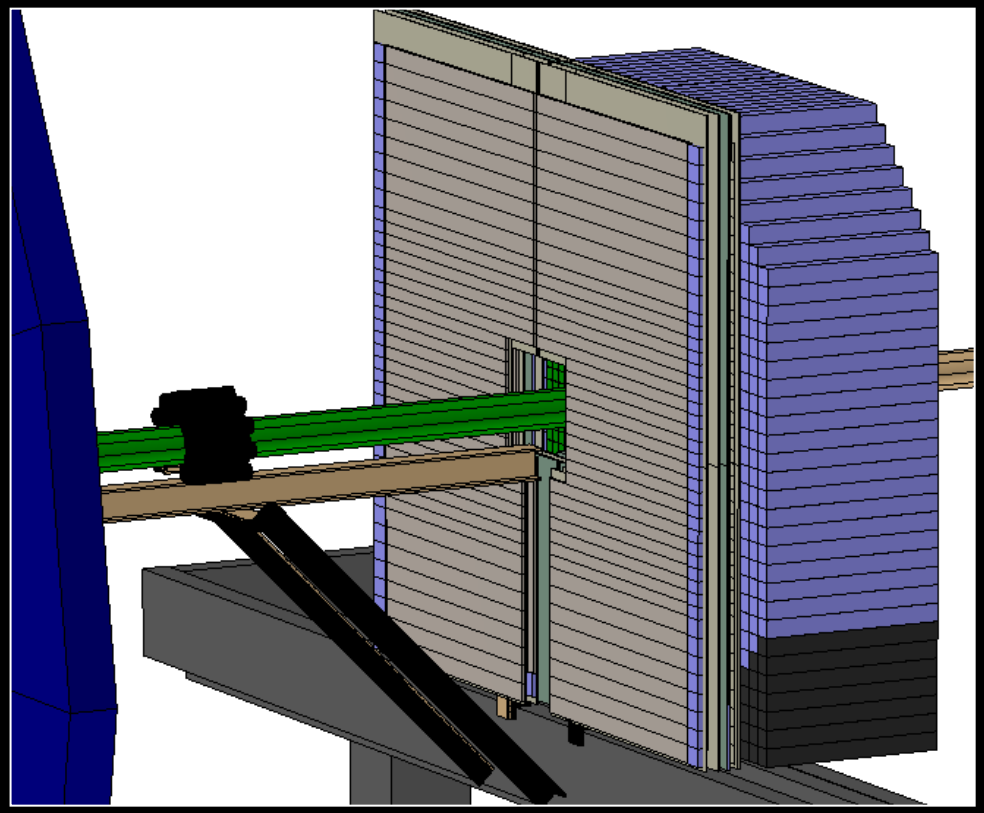


Fixed target ‘Au’+Au event



PREPARING FOR RUN-15

FMS with pre-shower for Run-15



FMS pre-shower:
scintillators with Pb convertor and SiPM readout

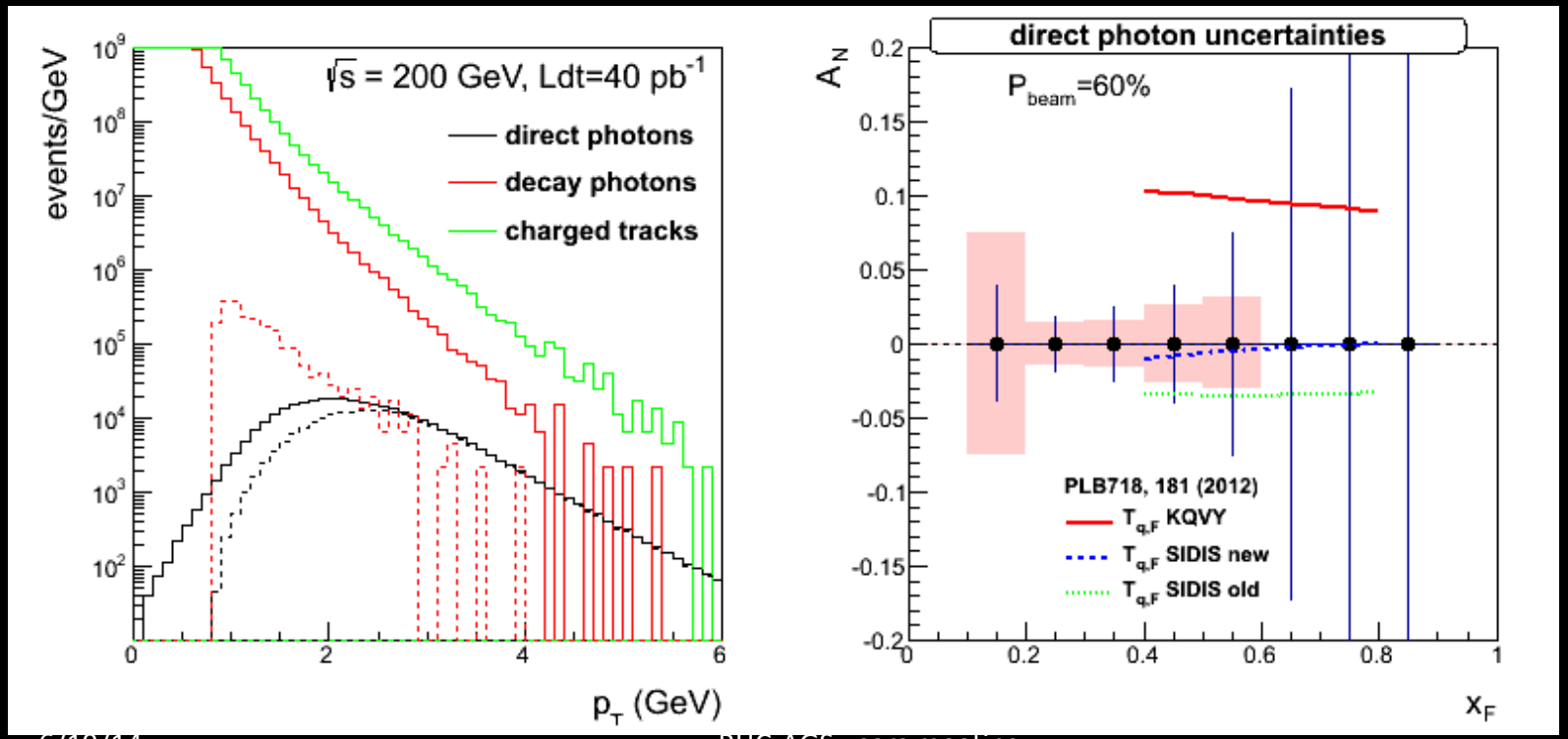
- Physics aim
  - Direct photon measurements
- Forward Meson Spectrometer is being refurbished
- Pre-shower added
- 3 layer hodoscope at $2.5 < \eta < 4.0$

Run15 Transverse Spin Goals

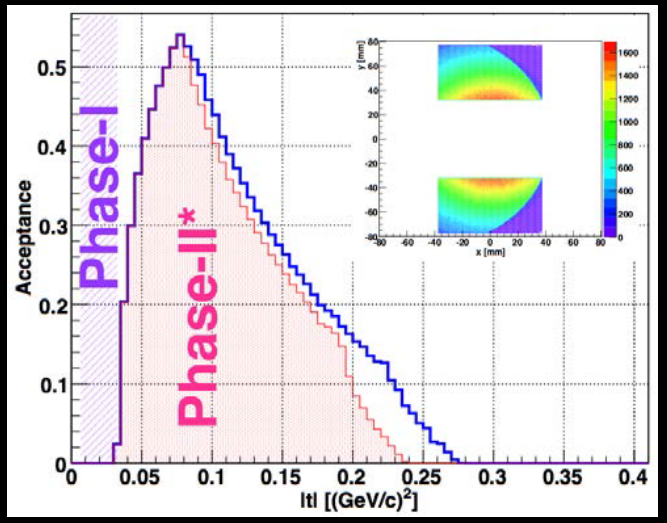
Study transversity, Sivers effects
L=40 pb^{-1}, 60% pol.

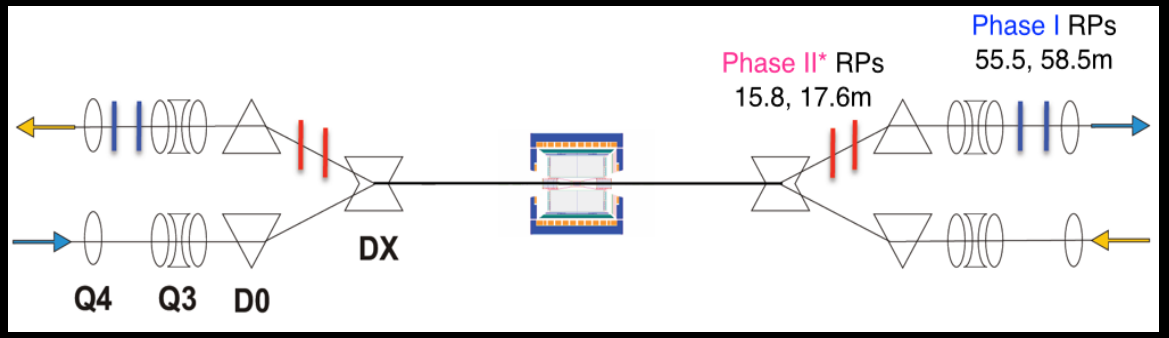
Preshower for FMS:
photon_survival ≥ 0.98
hadron_survival ≤ 0.02

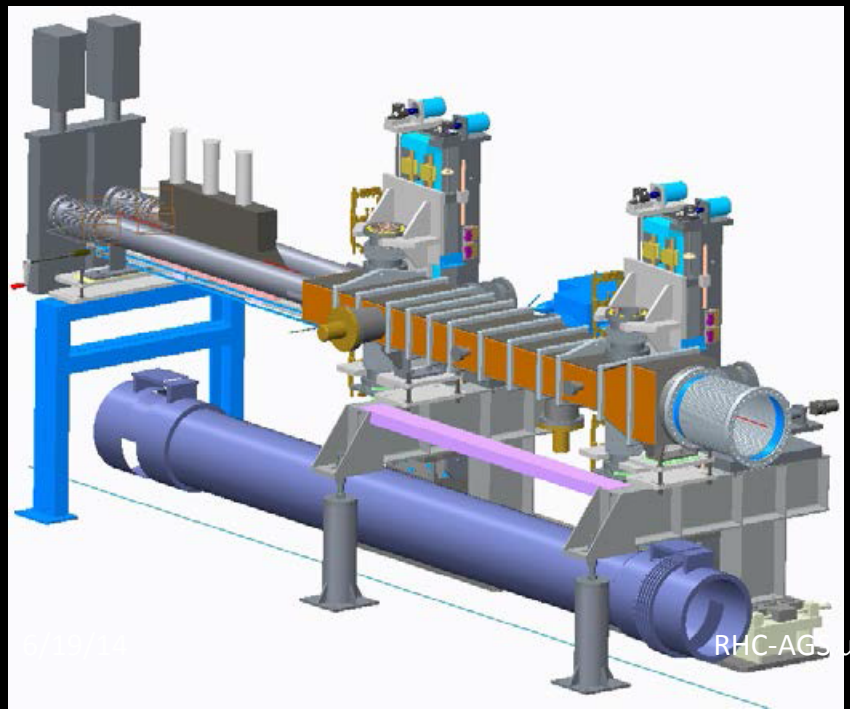
Track matching FMS/PS1,2
$n\downarrow cluster = 1$ (above 1 GeV)
$E\downarrow cl > 15.0\ GeV$
$p\downarrow T > 2.0\ GeV$
For systematic uncertainty:
$A\downarrow N\ (\pi\uparrow 0\ ,\eta) \approx \max(A\downarrow N\ (\pi\uparrow 0\ ))$



Roman Pot Phase II* (run15)







- Will allow taking data without special accelerator conditions,
- Requires new vacuum chamber in DX-D0 region
- Uses Roman Pot system and detectors of pp2pp
- Among physics goals
  - A_N for diffractive processes
  - Exotic states

Design accommodates horizontal RPs to allow spectator proton tagging for future $p^{\Uparrow}D$ and $p^{\Uparrow}He^3$ collisions.

Summary -1

- STAR completed two upgrade projects HFT and MTD on time
- Both detector system work very well
- The HFT is the first large scale implementation of MAPS pixel in a collider experiment
- Thank to DOE NP for the support for both projects
- Also thanks also to PISCEL group at IPHC, Strasbourg for participation in R&D and construction of PXL detector

Summary-2

- The high priority program of Heavy Quark Physics took very significant amount of data reaching the nominal goals in Run-14
- The 14.5 GeV run added important energy point to the BES-I
- Looking forward to the physics results
- STAR running efficiency was very good
- The accelerator performance was very good.

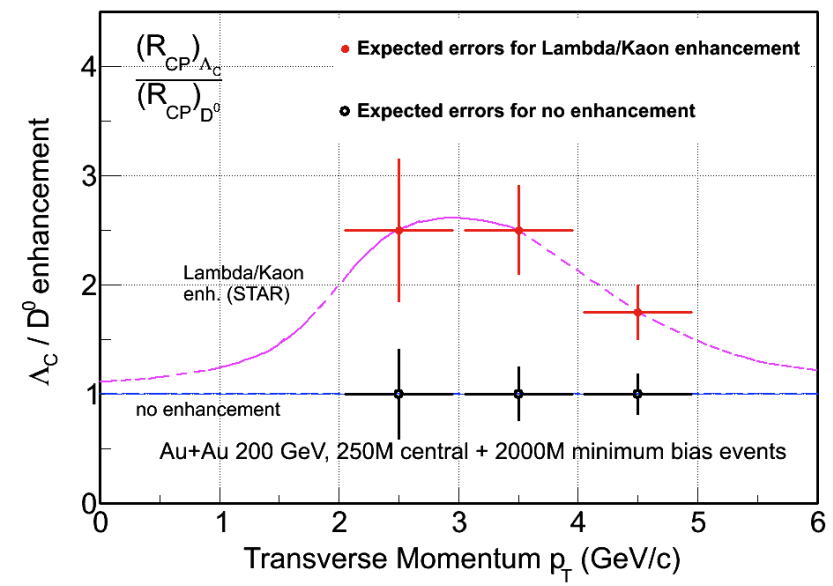
STAR talks at this users meeting

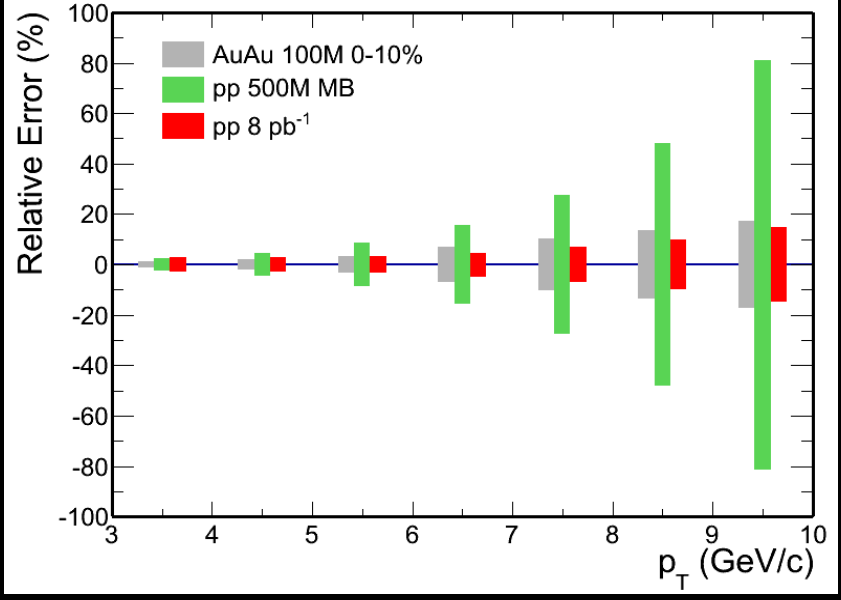
Mustafa Mustafa Recent and near future Open Heavy Flavor measurements in STAR Experiment at RHIC
STAR plans for BES II Jim Thomas, LBNL
eSTAR LOI Ernst Sichtermann, LBNL
Upsilon production in A+A and d+Au collisions at STAR Anthony Kesich, University of California at Davis
J/psi production in A+A collisions at STAR Ota Kukral, Czech Technical University
Transverse Spin Results from STAR Yuxi Pan, University of California at Los Angeles
STAR results on W production Jinlong Zhang, Shandong University
Gluon Polarization Results from STAR Brian Page, Indiana University
Plans and Prospects for STAR and eSTAR Oleg Eyser, BNL
Charge asymmetry dependence of pion/kaon anisotropic flow in top energy Heavy-Ion Collisions Aihong Tang, BNL
STAR results from BES-I and a first look at the RUN-14 14.5 GeV data Evan Sangaline, University of California at Davis
Cold Nuclear Matter in dAu from STAR Anthony Kesich, University of California @ Davis
Beam Energy Scan Alex Schmah, LBNL
Upgrade and New Physics STAR Zhenyu Ye, University of Illinois @ Chicago

Also thanks to Zhangbu Xu, Lijuan Ruan, Alex Schmah, Dan Cebra, Bill Christie and HFT group for material used in talk

Backup Slides

HF Physics: Beyond Run14





Λ_c: lowest charm baryon state, $c\tau \sim 60\mu m$

- Hadro-chemistry with charm
- Meson vs. baryon effect with charm hadrons

STAR multi-year physics program with the heavy flavor measurements requires high statistics data from ***both p+p and heavy ion*** collisions