



STAR Run 16 Schedule (+1.5week extension)

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for the STAR Collaboration

Machine/Experiment Schedule Meeting 04/26/2016

Run 16 Heavy-Flavor Program

- Completion of DM12

2016	DM12 (new)	Measure production rates, high p_T spectra, and correlations in heavy-ion collisions at $\sqrt{s_{NN}} = 200$ GeV for identified hadrons with heavy flavor valence quarks to constrain the mechanism for parton energy loss in the quark-gluon plasma.
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DM12 uses the increase in RHIC luminosity that is part of the RHIC luminosity upgrade and associated detector upgrades to study rare particles with charm quarks, and possibly particles with bottom quarks, as a demanding way to learn how matter flow and energy loss are established in the partonic phase at RHIC.

Au-Au 200 GeV Highest Priority of STAR and PAC for Run-16

Run 16 proposed by STAR

Run	Energy	Duration	System	Goals	Priority	Sequence
16	$\sqrt{s_{NN}}=200$ GeV	13-wk	Au+Au	$\Lambda_c, D, v_2, R_{AA}, \Upsilon, R_{AA}$ 10nb ⁻¹ , 2billion MB	1	1
	$\sqrt{s_{NN}}=19.6$ GeV	1-wk	d+Au	100M MB	2	2
	$\sqrt{s_{NN}}=39$ GeV	1-wk	d+Au	400M MB	2	3

PAC recommendation of 10 weeks of Au+Au; additional 2 floating weeks

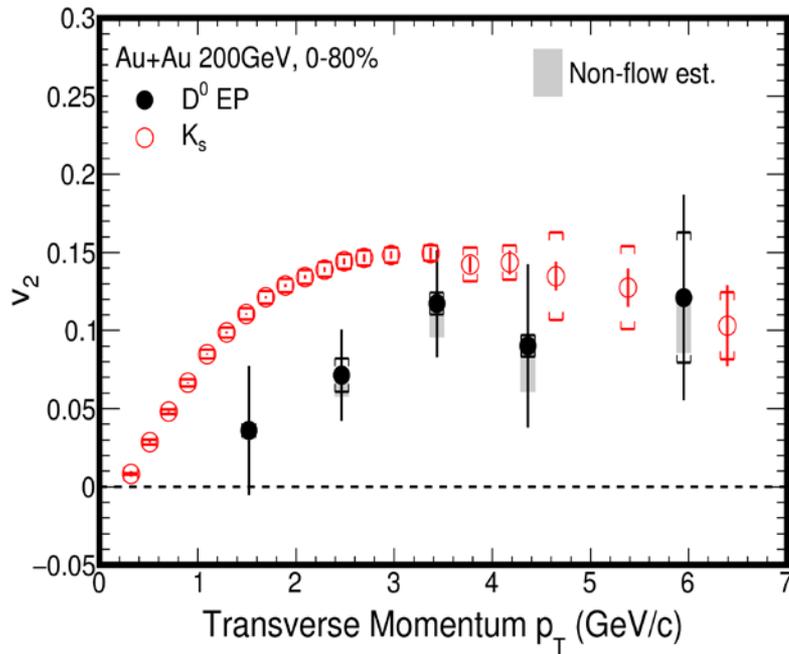
Could have reached goals: 95 hours*10wk*3600seconds*600Hz=2B

RHIC Machine Efficiency not Luminosity key

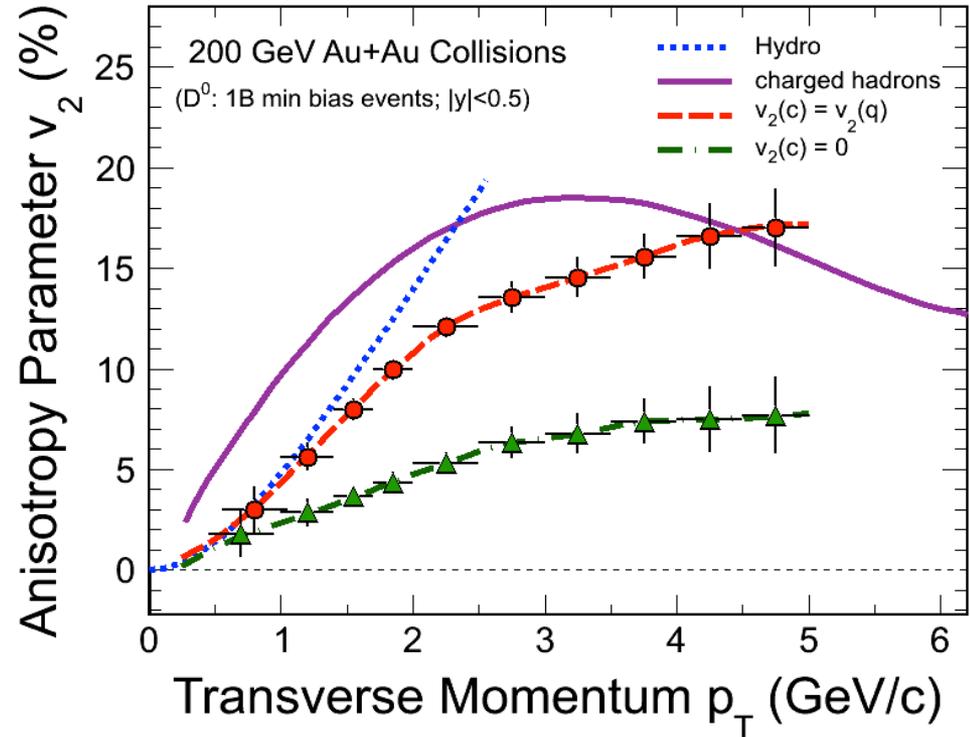
STAR Operation and Optimization - key to achieving this goal.

Goal 1: Open charm flow

Current Run-14 data – Paper in GPC
(Presented at QM2015)



HFT Projection for Au+Au **run14** + **run16**

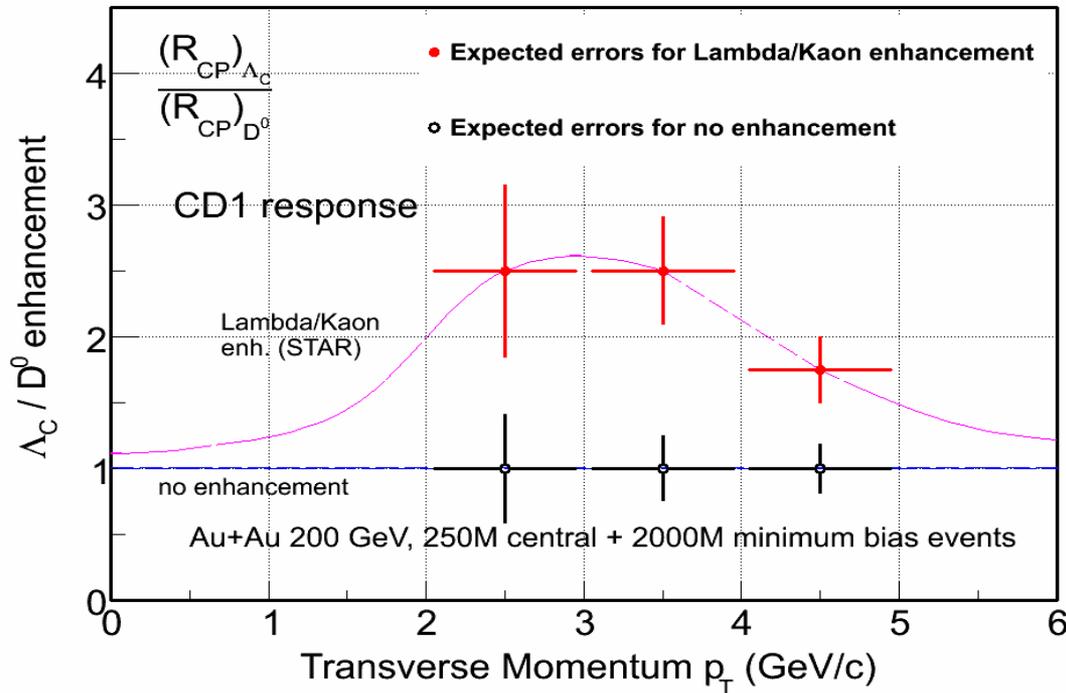


Centrality Dependence of charm v_2

Precision result from Run 16

: Needs 2 billion Minbias Au+Au events at 200GeV

Goal 2: Charm coalescence



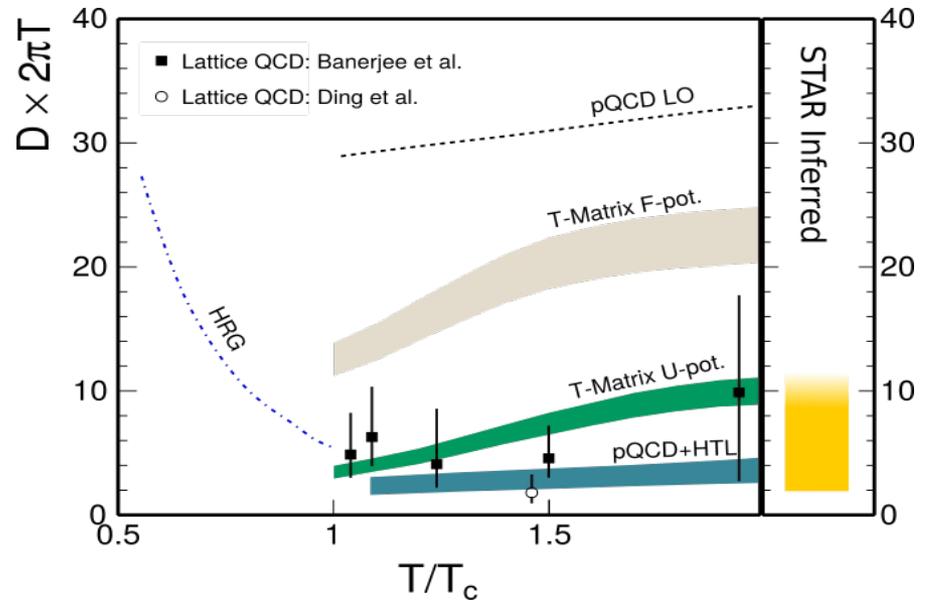
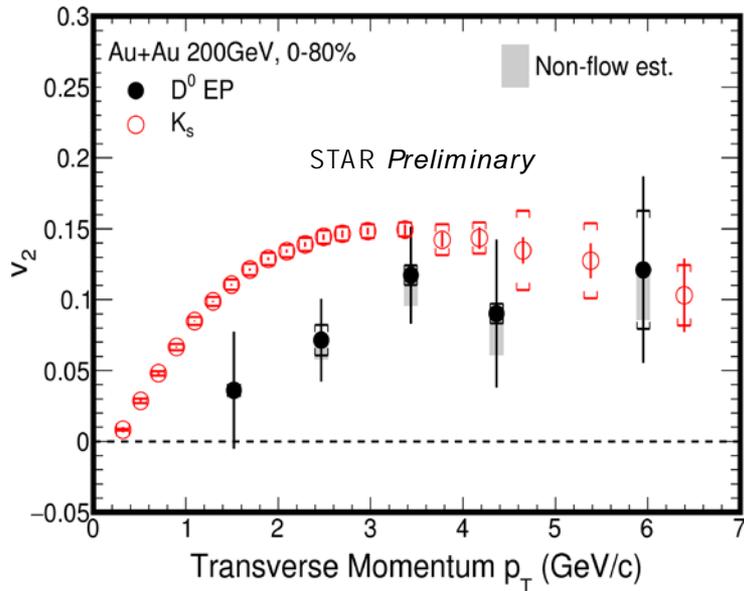
Charmed baryon enhancement?

NEW with run16 data:

Needs 2 billion Minbias Au+Au events at 200GeV

Run 14 data presented at QM15

Paper in STAR committee review



Brownian motion (diffusion) of heavy quarks

- Heavy Flavor Tracker (HFT) delivers its first results
- First result of quarkonia suppression from the Muon Telescope Detector (MTD)
- Charm flows at RHIC top energy
- Extracted diffusion coefficient compared to theory

Many improvements since Run14

Open Charm (HFT) related: (MB events)

- Cables: Cu => Al Cable for HFT readout: up to x2 better S/B low- p_T D^0
- Refurbished PXL and SSD firmware: ~18% PXL dead in Run-14
SSD improves tracking 10% (20% for D_s)

Overall factor of 3.6 improvement for D^0

- Vertex Cut quality improvement (~15%)
- Pile-up protection study w/o 30% more data volume and 10% worse efficiency
optimize protection (10%)
- Re-populate TPC ASIC and RDO, DAQ software optimization, online disk and network, +50% faster readout speed, reduced deadtime
- Bring up detector at RHIC Flattop and detector ramp down for beam dump
Run 16: 7 (5) minutes vs Run 14: 9 (11) minutes

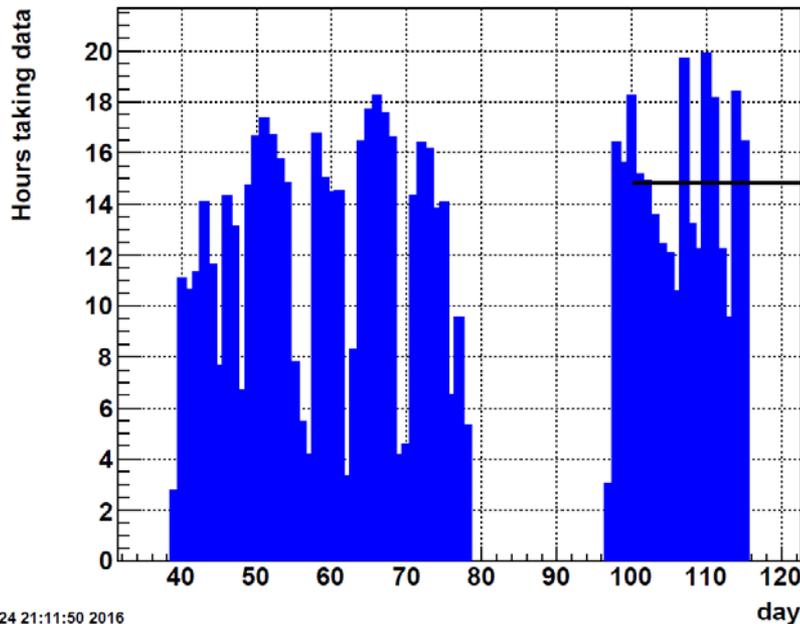
Quarkonia (MTD) related: (triggered/luminosity)

- High-Level Trigger dedicated to online dimuon selection x2 fewer events to tape
- Express stream of Upsilon candidates x10 reduction
- Reduce monitoring triggers to minimum required

Uptime (+8%)

Average Hours/day

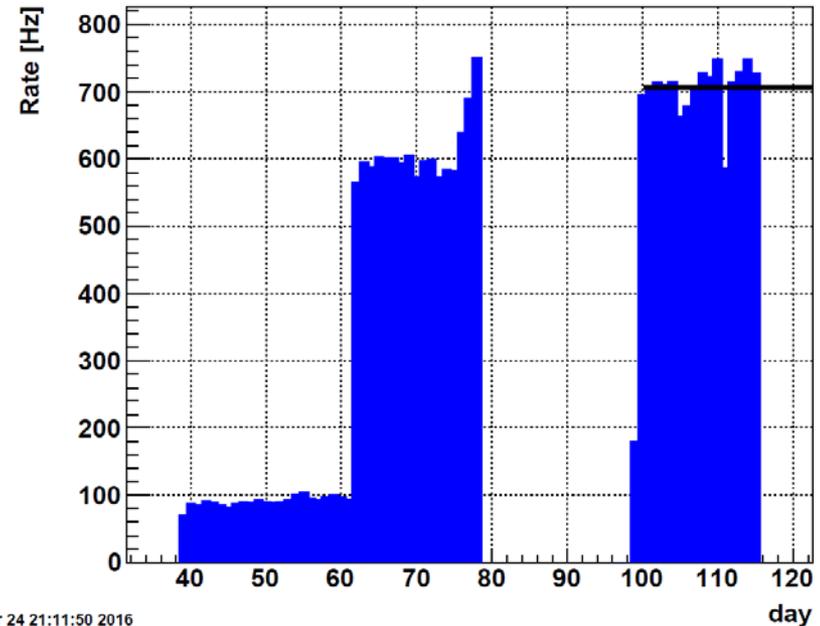
hours_perday_pxlist.txt



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Average Number Events/day

VPDME-5-p-effective Average Rate [Hz] PXL+IST



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Before the diode issue:

12 hours of actual data-taking time per day (89% efficiency of delivered beam time)
= 85 DAQ hours, 94 CAD hours/week

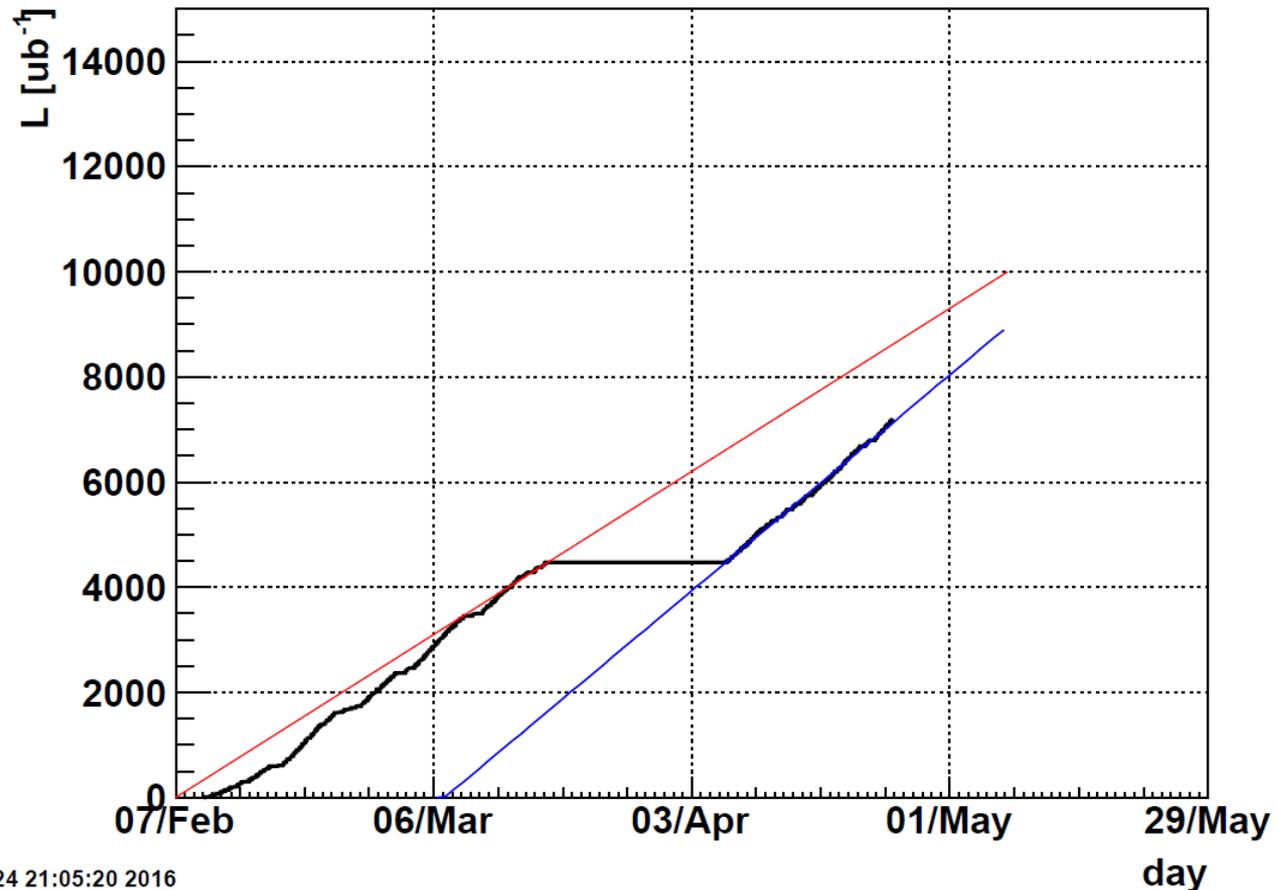
Short of projected 95-100 DAQ hours (110 CAD hours/week) needed to reach goals

SINCE April 7:

$103\text{hours} \times 710\text{Hz} \times 3600 = 260\text{M events per week (2B in 7.5 weeks)}$

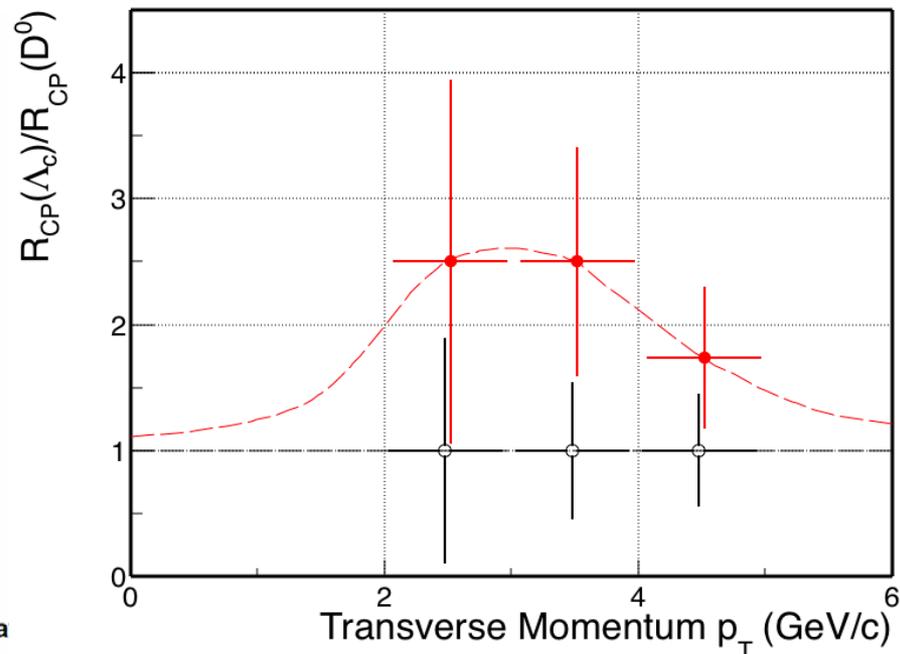
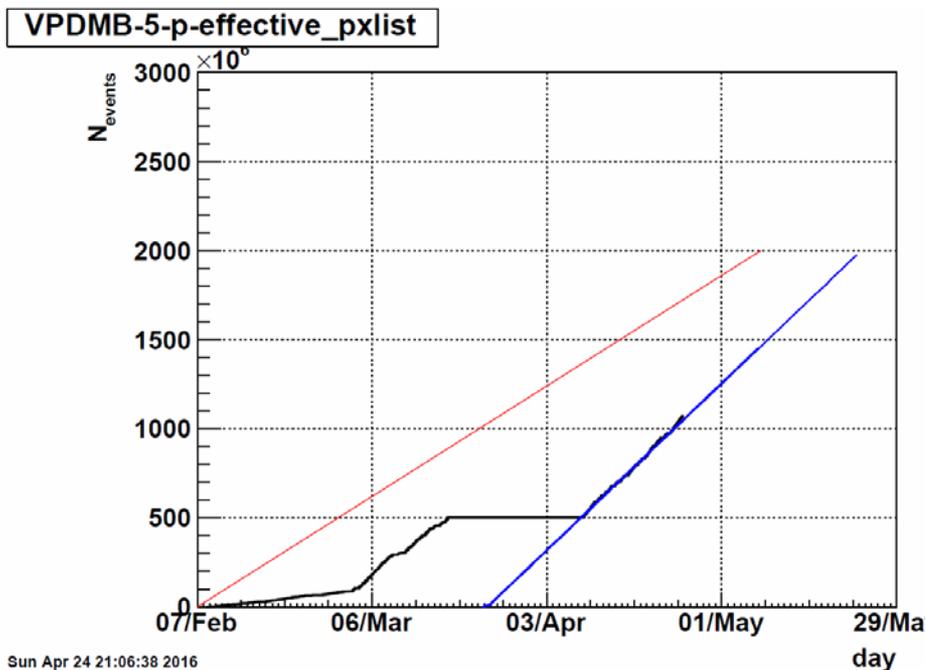
MTD Data accumulation and projection

di-muon_upsiloneff



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Projection on Λ_c for 70% of event goal



70%

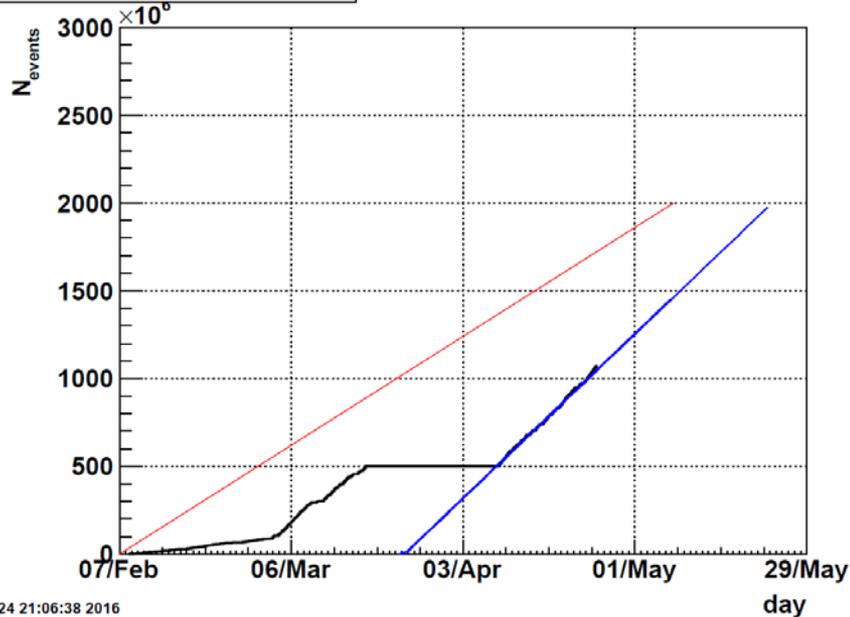
Measure	Chi2/ndf	Prob.
Red (enhancement)	5.5 / 3 (w.r.t. black)	14%
Black (no enhance.)	13.1 / 3 (w.r.t. red)	0.45%

100%

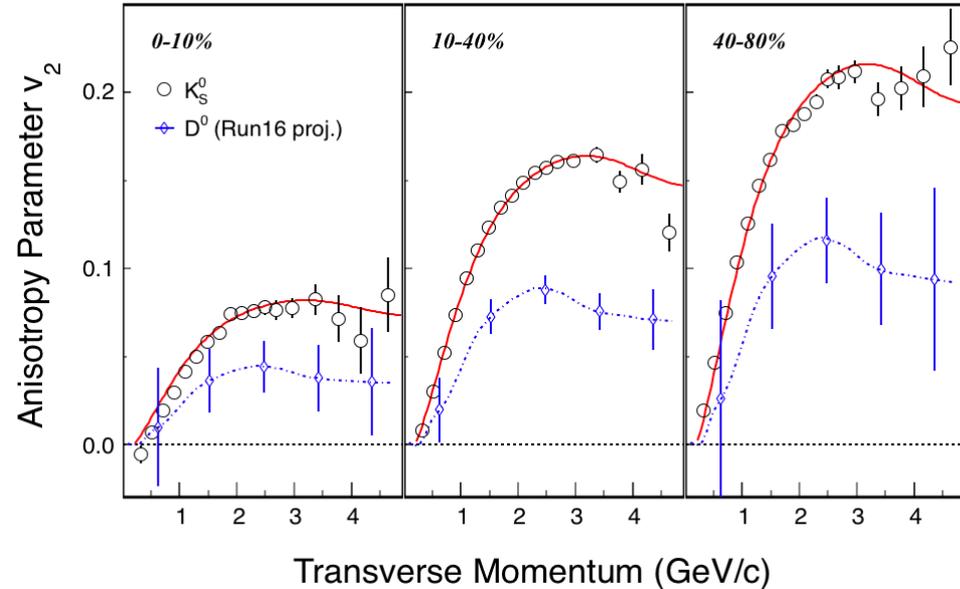
Measure	Chi2/ndf	Prob
Red (enhancement)	7.9 / 3 (w.r.t black)	4.9%
Black (no enhance.)	18.7 / 3 (w.r.t. red)	0.03%

Projection on D^0 v_2 for 70% of event goal

VPDMB-5-p-effective_pclist



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0-10% central, $p_T > 1$ GeV/c

Chi2/ndf

Prob.

100% run16 goal

12.9 / 4 (w.r.t. K_s)

1.1%

70% run16 goal

9.1 / 4 (w.r.t. K_s)

6.0%

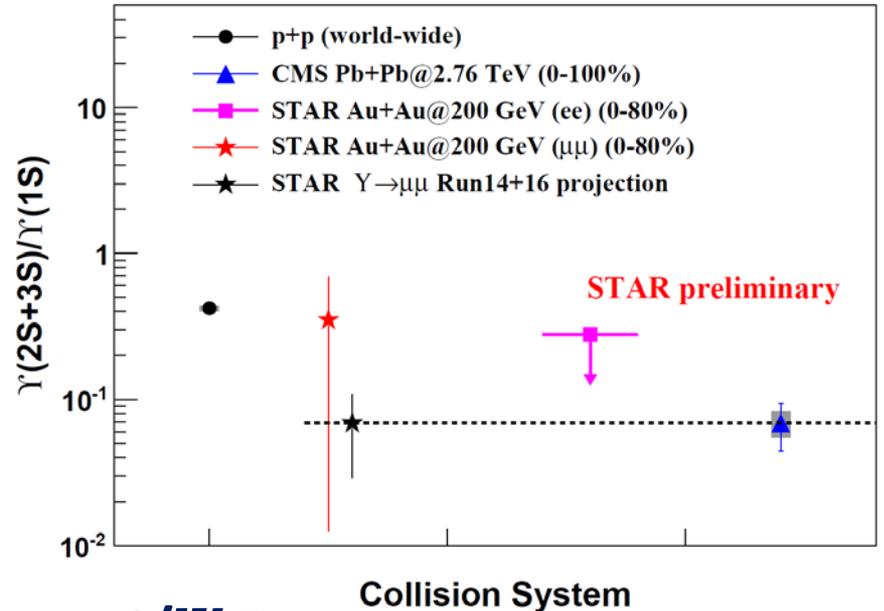
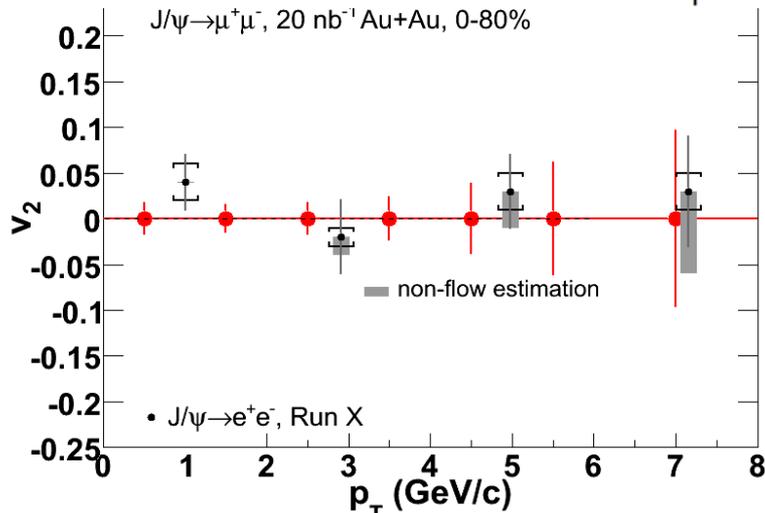
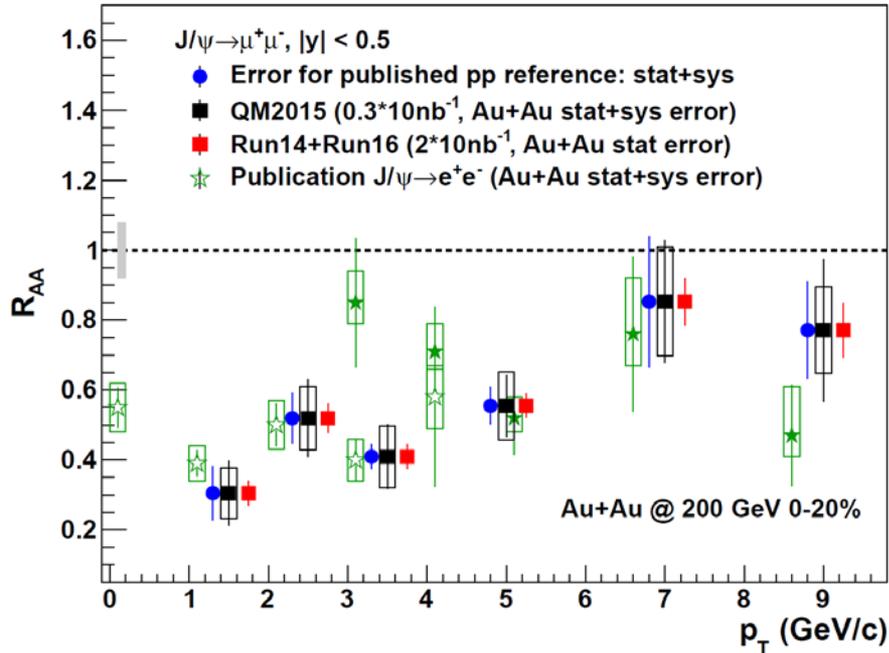
Summary and Request

- **Key Goal of Run-16 : Complete DM12**
 - High profile and high impact physics: charm thermalization, energy loss and quarkonium dissociation
- RHIC Luminosity profile is very good (flat as requested)
- Many improvements for run16 from STAR
 - Substantial investment to meet goals
- RHIC and STAR have run very well since operations were resumed past April 6; **over 100 DAQ hours/week and 700Hz HFT good events.**
 - Assuming this continues, we can reach our goals by May 18
- short of our goals for open charm (25-30%) and Quarkonium (10%)
 - linear extrapolation without extension
- **Request 1.5 weeks extension Au+Au at 200GeV (beyond May 7)**

RHIC operation resumed April 6 (Wednesday), +1.5 weeks extension to May 18 (Wednesday)

Backup slides

Goal 3: Quarkonia Suppression and v_2



J/ψ R_{AA}

J/ψ v_2

$\gamma(2S+3S)/\gamma(1S) \sim 10\text{-}20\%$ error

Results need Run14 + Run16:
Need 20nb^{-1} sampled Luminosity