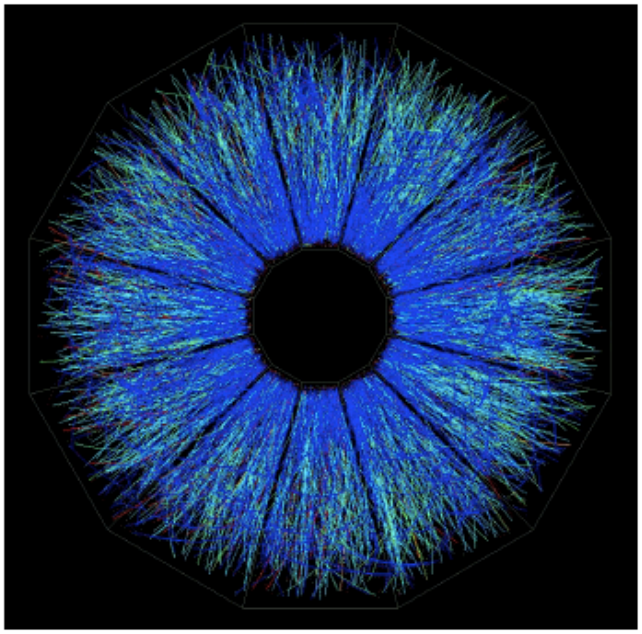
https://drupal.star.bnl.gov/STAR/starnotes/public/sn0670

RHIC Beam Use Request For Runs 18 and 19

The STAR Collaboration



May 15, 2017

Zhangbu Xu
(Brookhaven National Lab)

- BUR on Isobars (chiral effect)
- BUR on Au+Au @ 27 GeV (global Lambda polarization)
- BUR on BES-II
- BUR on FXT
- Performance in run17 Goals and Performance
- Summary

U.S. DEPARTMENT OF ENERGY | Office of Science

BUR charges from ALD/BNL

Dear RHIC Spokespersons:

I am writing to request that you submit the annual Beam Use Request for the RHIC runs in 2018 and 2019 and related material.

We currently anticipate, assuming favorable budget conditions, runs of 15 cryoweeks (including 2 weeks for the Coherent electron Cooling test) in FY2018 and 24 cryo-weeks each in FY2019 and FY2020. Less favorable, but still likely, budget conditions would only allow for a combined run of 20 cryo-weeks in FY2019/FY2020. The beam use request should consider both possibilities.

The submissions are due by May 15, 2017. Since PHENIX has ended data taking and sPHENIX has not yet started construction, I expect to receive a BUR from STAR only.

I also ask STAR and PHENIX to report on the status of analyses of data from previous RHIC runs, especially the runs in 2014-16.
In addition, I invite the STAR and sPHENIX Collaborations to present letters of intent for proposals of modest forward upgrades to their detectors for data taking after 2021 for consideration by the PAC.

Contents

Two Highest Priorities for the next two RHIC runs (run 18 and 19) focus on two compelling programs key to RHIC mission

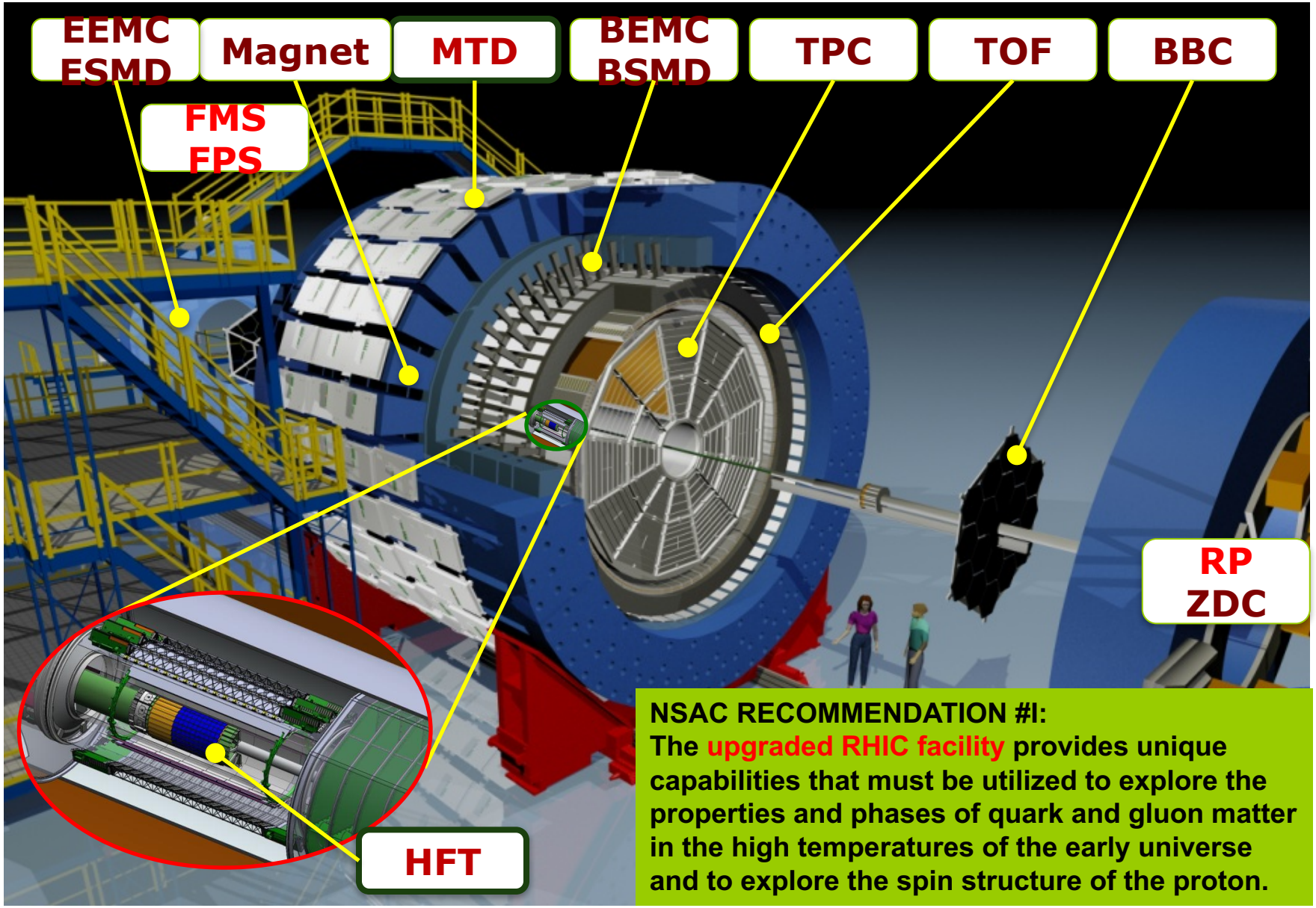
Run 18: isobar collisions at 200 GeV

Decisive test of role of magnetic field in charge separation measurements

Run 19: Initiating the BES-II

Higher BES energies +
Fixed Target (FXT) program

STAR Detector System



NSAC RECOMMENDATION #I:
The upgraded RHIC facility provides unique capabilities that must be utilized to explore the properties and phases of quark and gluon matter in the high temperatures of the early universe and to explore the spin structure of the proton.

X10^3 increases in DAQ rate since 2000, most precise Silicon Detector (HFT 2014-16)

Run 18 BUR Executive Summary

Run	Energy	Duration	System	Goals	priority	Sequence
18	$\sqrt{s_{NN}}$=200 GeV	3.5-wk	Zr+Zr	1.2B minbias	1	1
		3.5-wk	Ru+Ru	1.2B minbias	1	2
	$\sqrt{s_{NN}}$=27 GeV	3-wk	Au+Au	1B minbias	2	3
	$\sqrt{s_{NN}}$=3 GeV(FXT)	2 days	Au+Au	100M minbias	3	4

1. Isobar collisions:

study the CME contribution to charge separation

$^{96}_{44}Ru$, $^{96}_{40}Zr$:

charge different by 10% (44 vs 40), everything else the “same”

2. Au+Au @ 27 GeV:

High Statistics Λ and $\overline{\Lambda}$ Global Polarization Measurement

Event-Plane Detector (EPD) presence important

3. Au+Au @ 3 GeV:

Fluctuation measurement at energies between HADES and BES-I

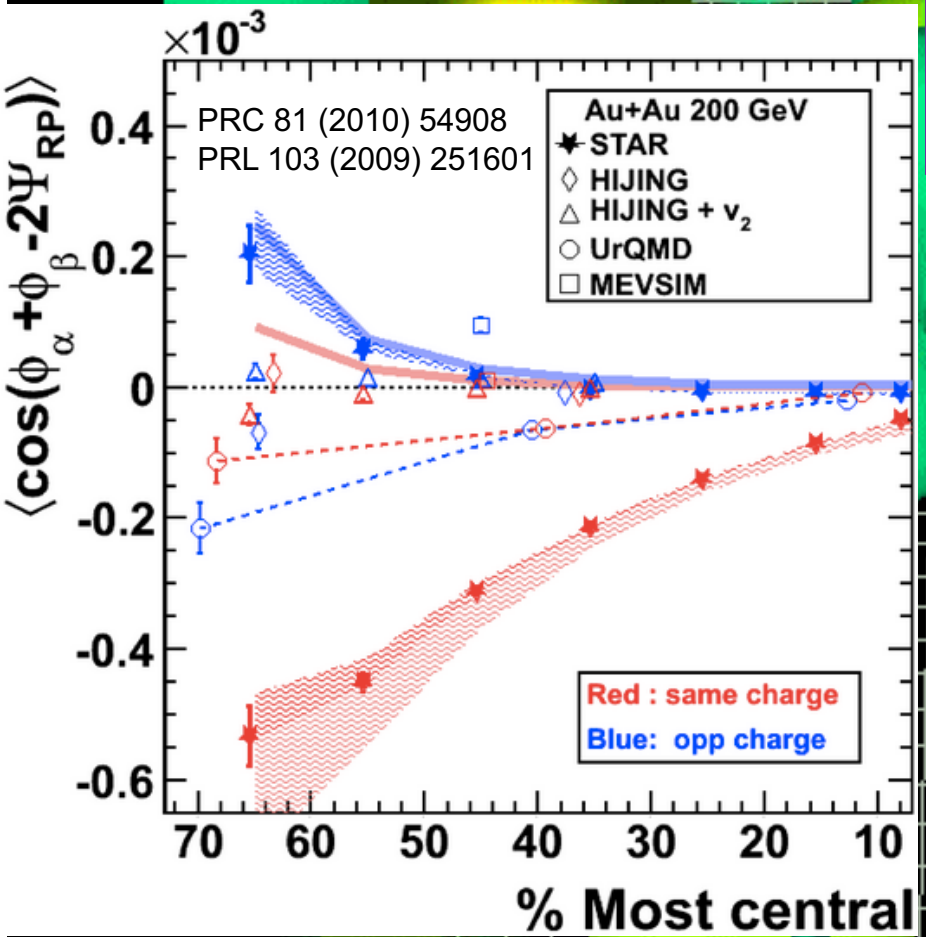
Significant statistics in FXT mode with large acceptance

Competition with BM@N (NICA) scheduled for 2019

Observing Topological Charge Transitions

To observe in the lab
- add massless fermions
- apply a magnetic field

Paul Sorensen: QM2017
CME task force report: arXiv: 1608.00982
Talk by Yuji Hirono (afternoon)



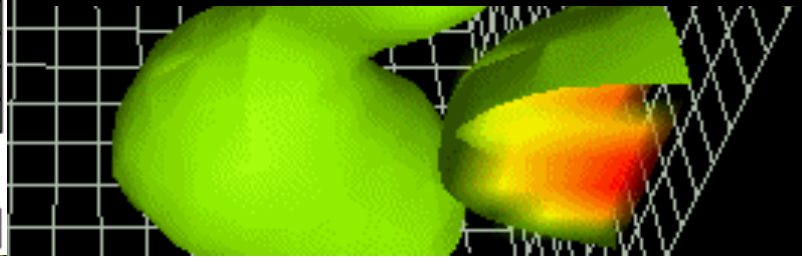
A required set of Extraordinary Phenomena:

QCD Topological Charge
+ Chiral Symmetry Restoration
+ Strong Magnetic Field

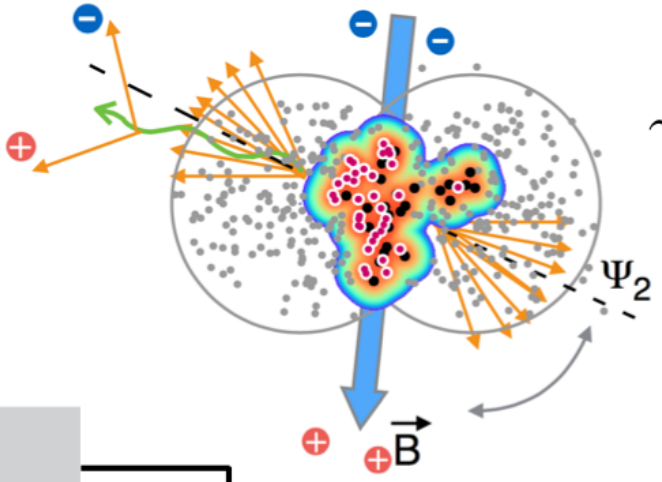
Observable:
Chirally restored quarks separated along magnetic field

Experimental strategy:
Measure 2 particle correlations (++,--,+-)
WRT reaction plane;
1/3 observed values
reproduced by conventional models

A decade of disentanglement



Signal & Backgrounds of charge separation



$$\gamma^{a,b} = \langle \cos(\phi_1^a + \phi_2^b - 2\Psi_2) \rangle$$

Charge separation (central-events)

Background

- HBT, Coulomb
- Flowing resonance
- Charge conservation
- Momentum conservation

$\approx \frac{v_2\{2\}}{N}$

v_2

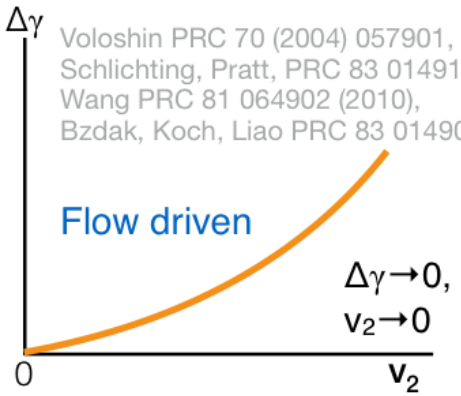
Signal

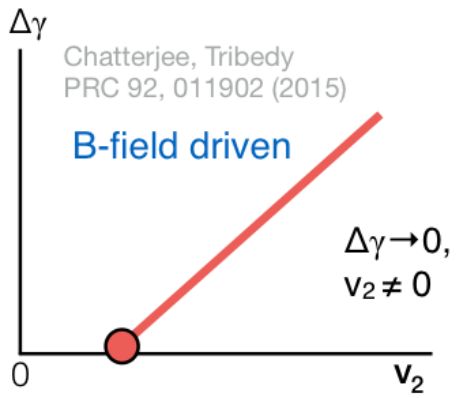
- Magnetic field

Ψ_2

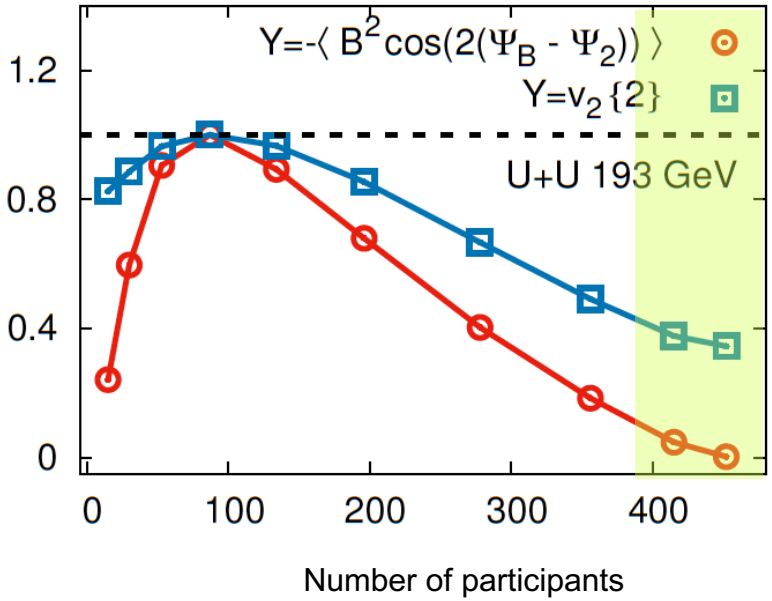
$\approx \langle B^2 \cos(2(\Psi_B - \Psi_2)) \rangle$

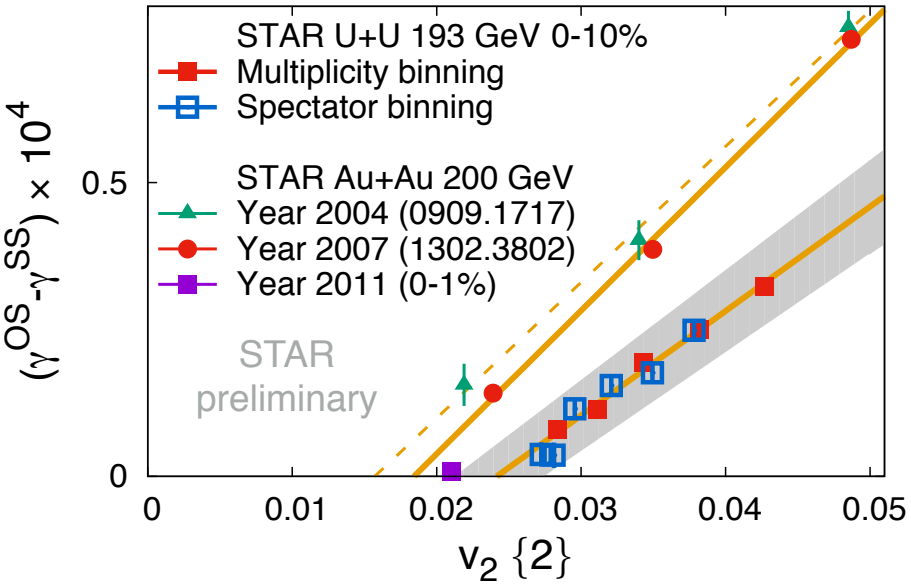
P. Tribedy, QM2017





Charge separation depends on final-stage shape v_2





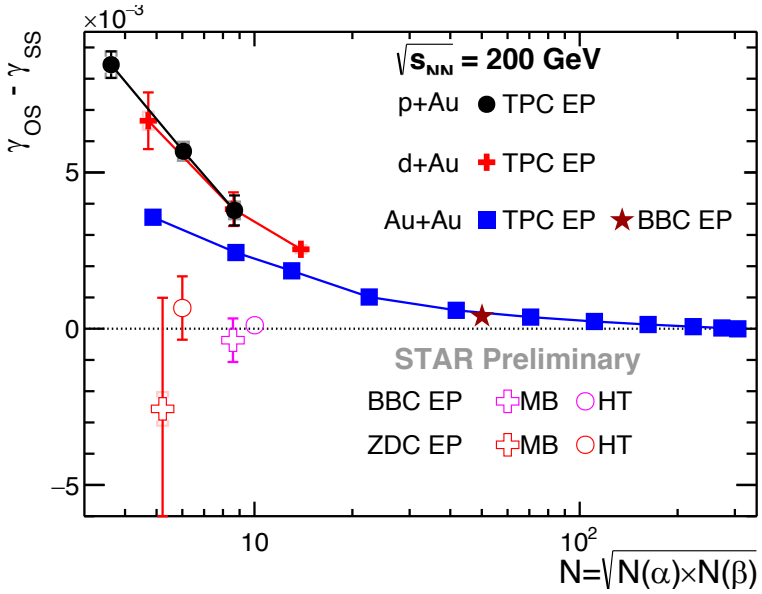
- Azimuthal anisotropy (v_2) contributes to background (could be very large); PRC89(2014)
- magnetic field which drives the signal, Qualitatively have similar centrality dependence.

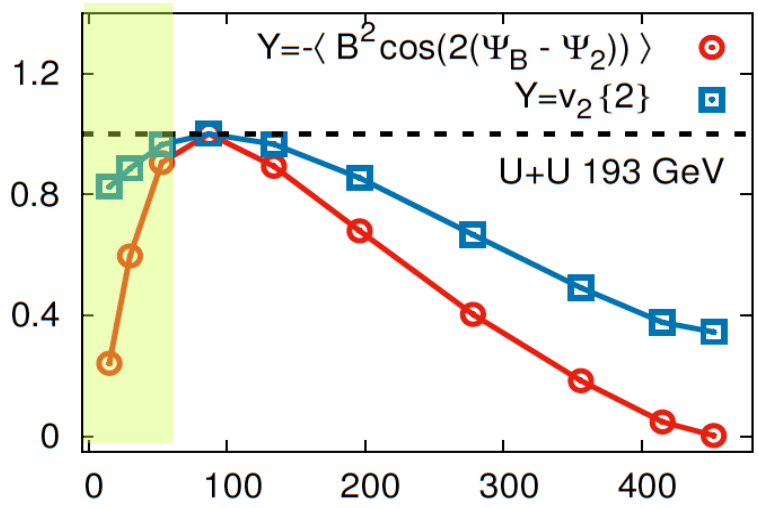
U+U and Au+Au central data: different dependence on v_2; Intercept at non-zero v_2

Not just driven by final-stage background correlations?

Qualitative assessment is not likely to disentangle the two effects; STAR seeks to provide precision test

Charge Separation depends on initial systems

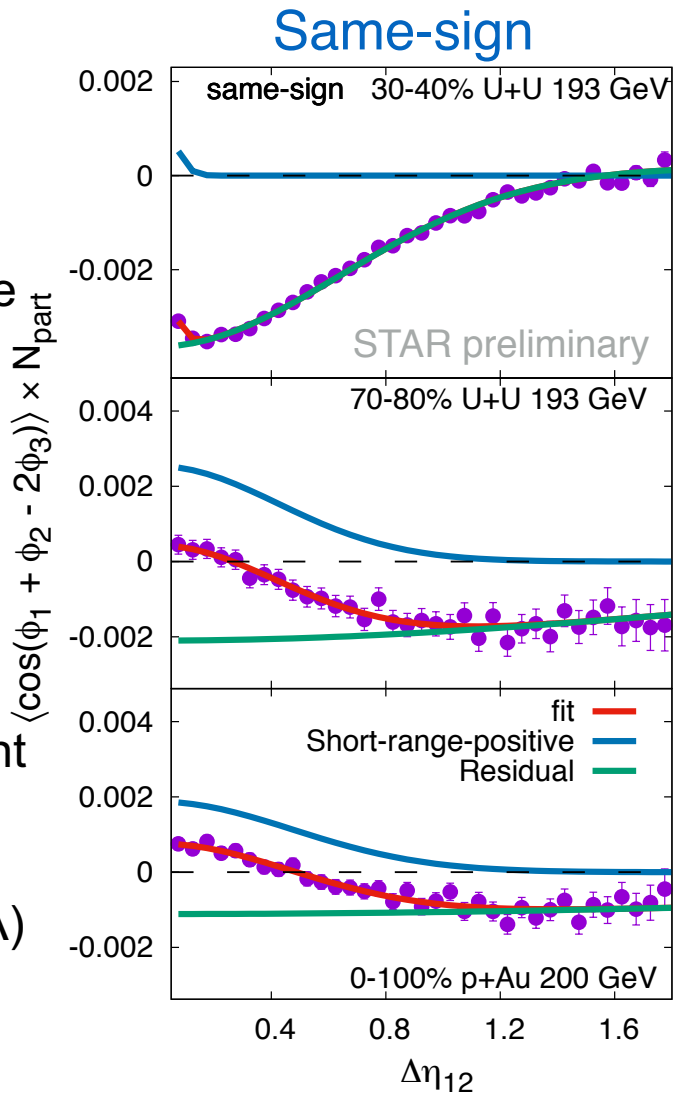




Peripheral A+A p+Au and d+Au qualitatively similar

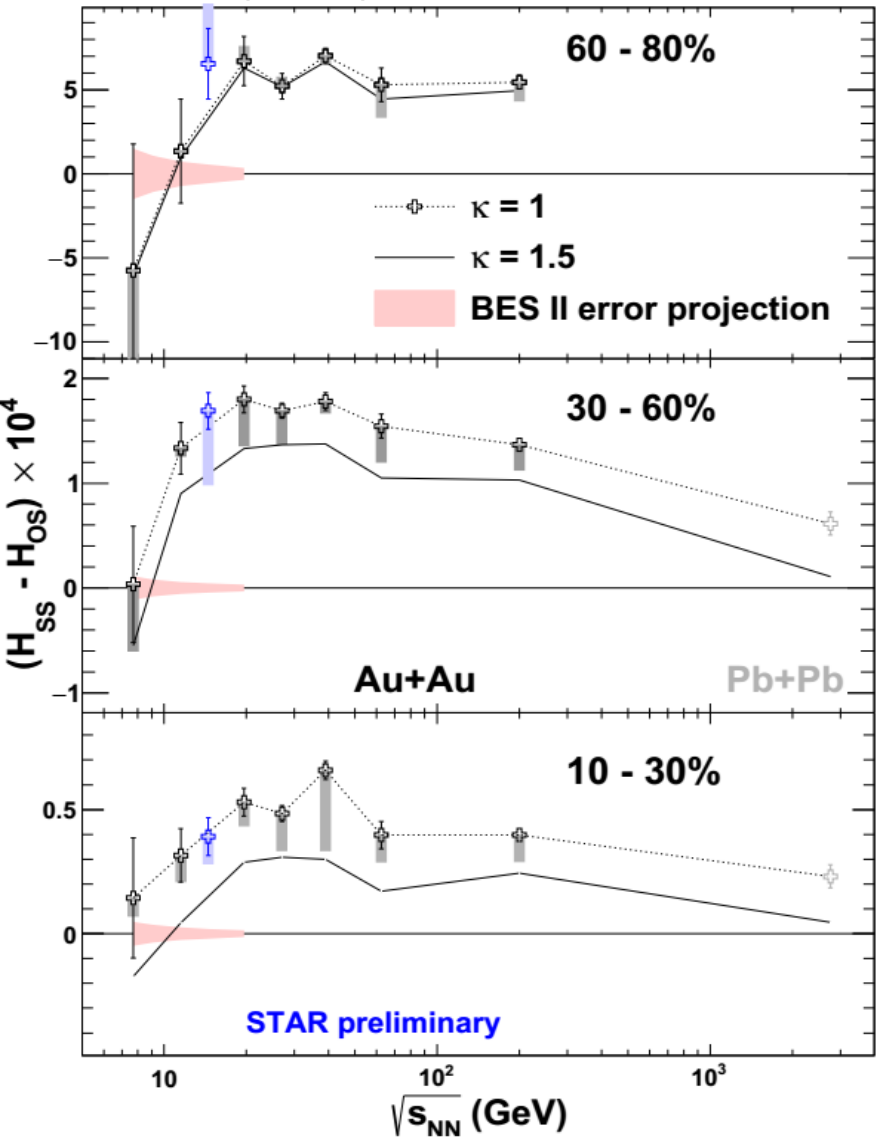
magnitude of charge separation dependence on correlation conditions (rapidity gaps)

Qualitatively different rapidity distribution from central to peripheral A+A (p+A)



Separation appears in many forms

PRL113(2014)



peak between 10-200GeV

Has a predicted dependence on Global charge asymmetry: Chiral Magnetic Wave

Editors' Suggestion

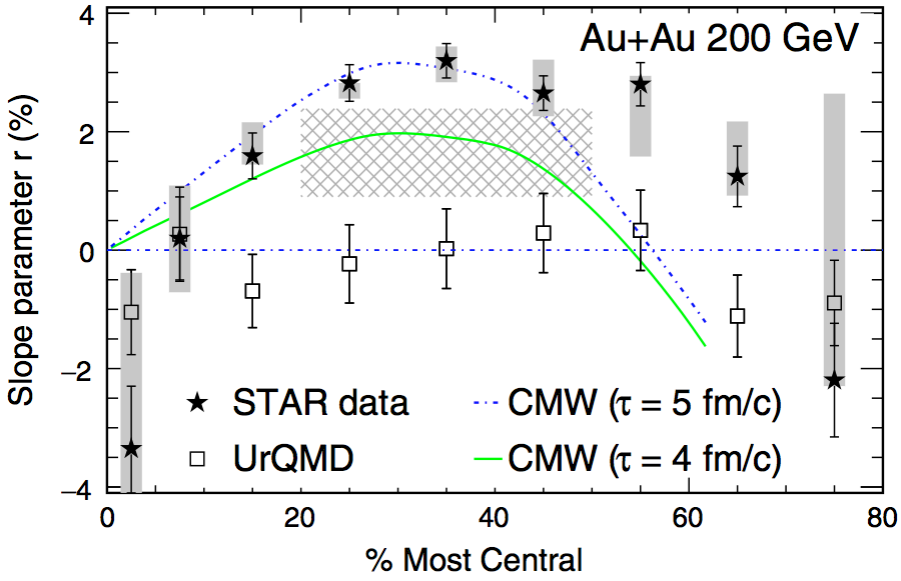
Observation of Charge Asymmetry Dependence of Pion Elliptic Flow and the Possible Chiral Magnetic Wave in Heavy-Ion Collisions

L. Adamczyk *et al.* (STAR Collaboration)

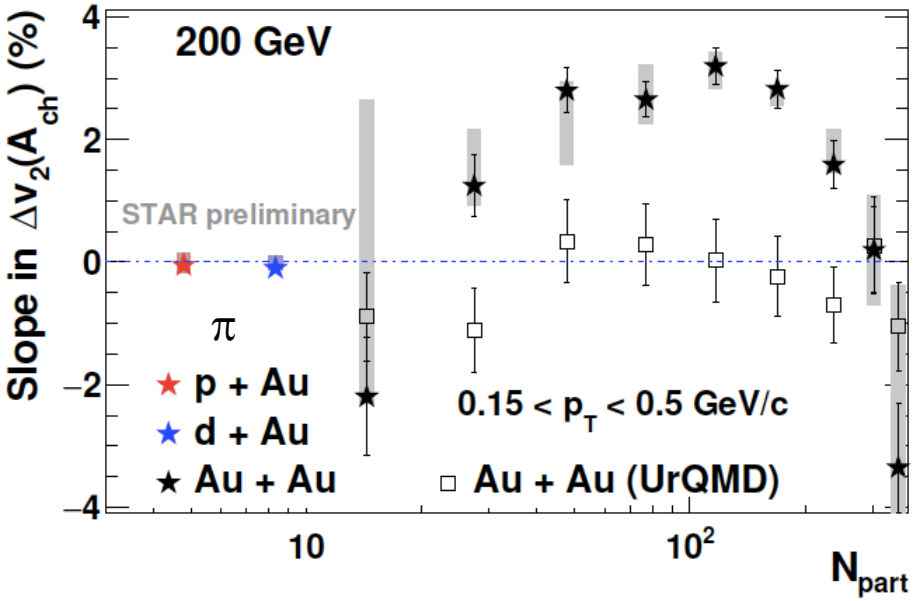
Phys. Rev. Lett. **114**, 252302 (2015) – Published 26 June 2015

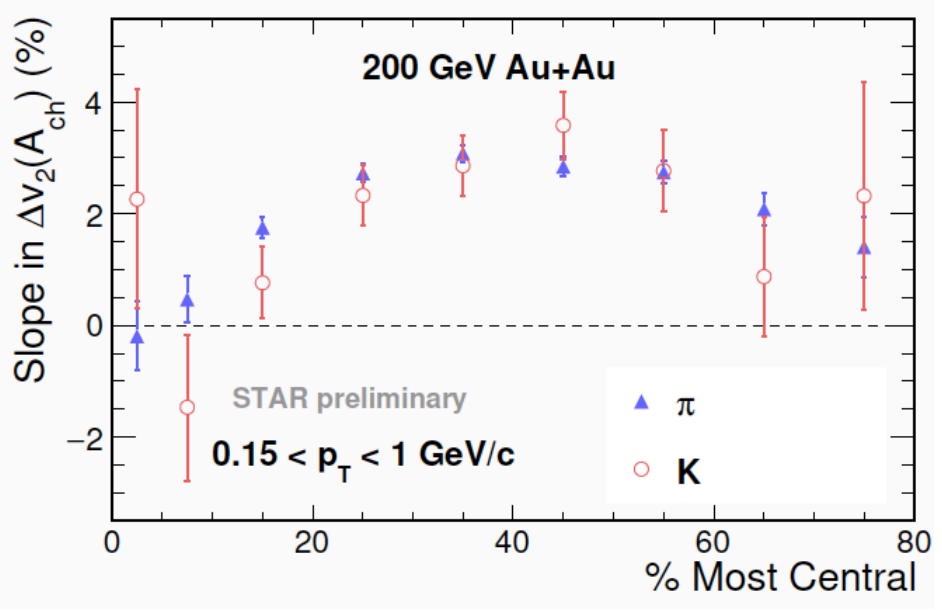
A possible signature of chiral symmetry restoration, in the form of a chiral magnetic wave in the quark-gluon plasma, has been observed in heavy-ion collisions at RHIC.

Show Abstract +



Strangeness (PID) distinguish models

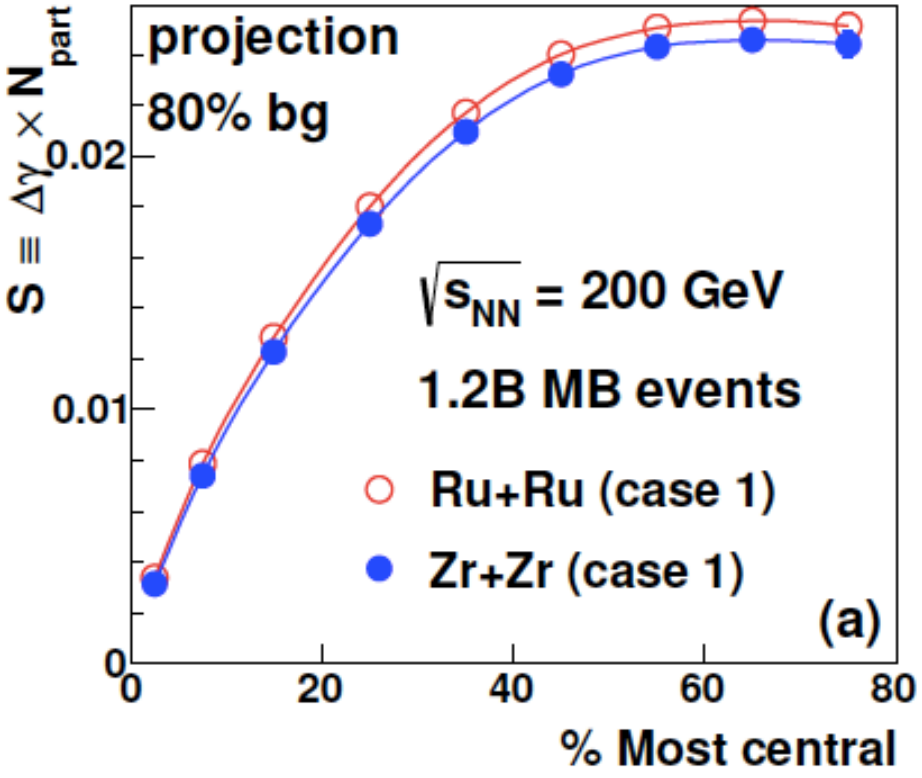


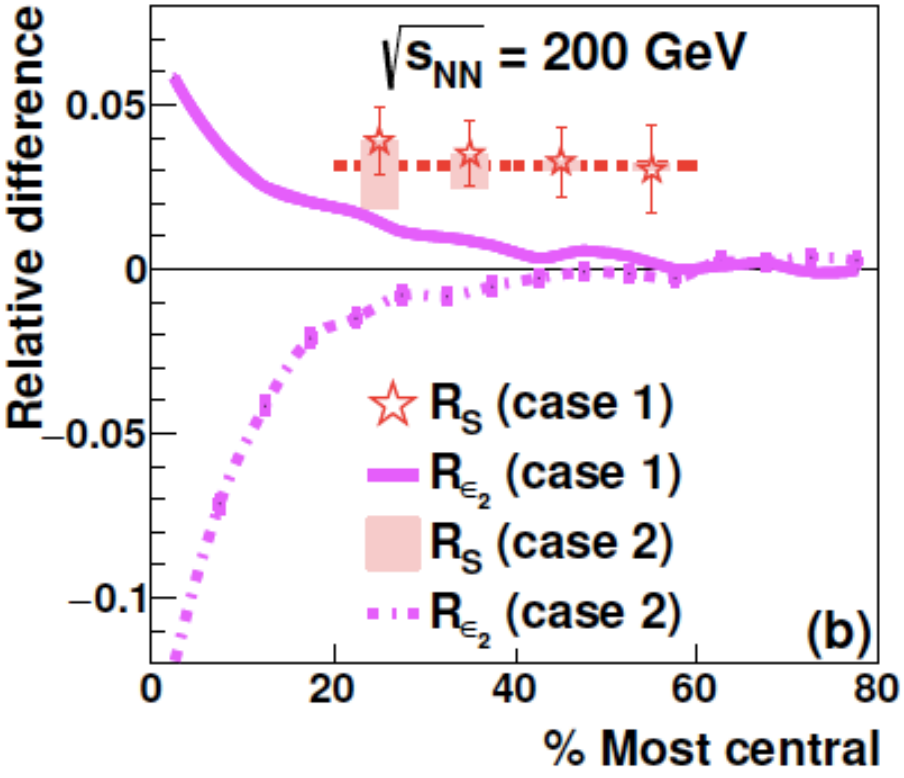


"… We demonstrate that the STAR results can be understood within the **standard viscous hydrodynamics** without invoking the **CMW**…"
"… **the slope r for the kaons should be negative**, in contrast to the pion case, and the magnitude is expected to be larger… Note that in these predictions are integrated over $0 < pT < \infty$. In order to properly test them, a wider pT coverage is necessary…"
— Y. Hatta et al. Nuclear Physics A 947 (2016) 155

Measured kaon slope is positive: contradicts the conventional model prediction without CMW

A decisive test with Isobars



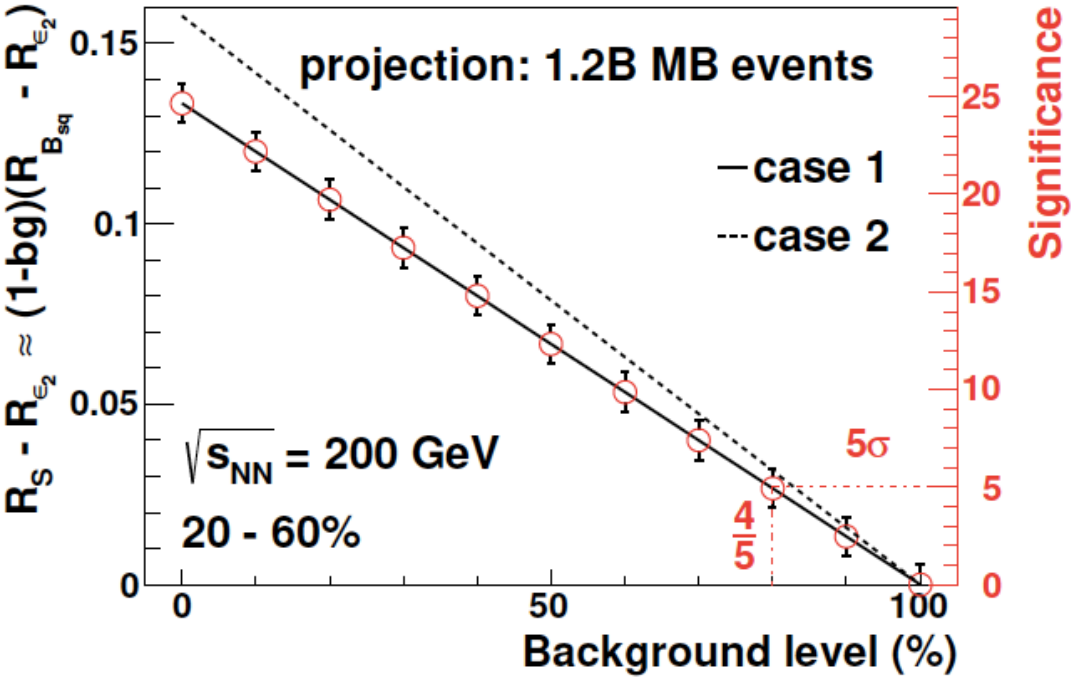


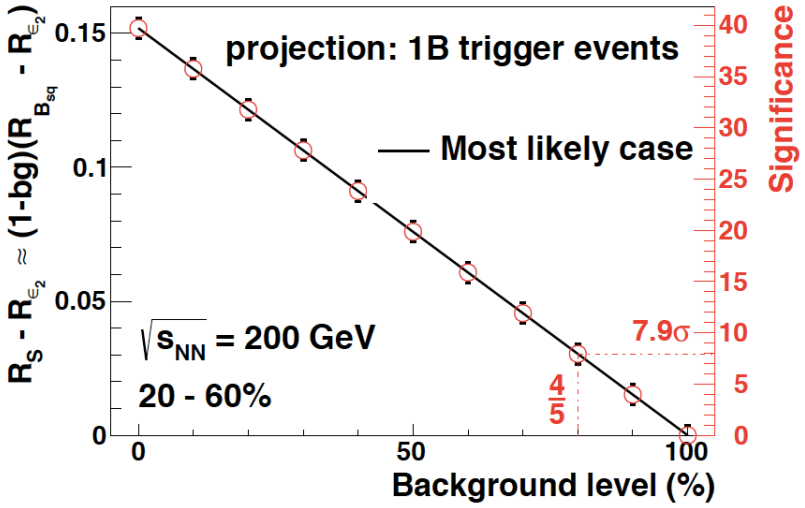
CAD attempts to locate enriched Ruthenium-96 source
Possible with the refurbished Oak Ridge Isotope Facility,
Run with natural abundance reduces luminosity by x5
Can reach 1.2 Billion events within 3.5 weeks of operation

PRC 94(2016)041901

Projections for Isobar

With 1.2B minbias events each species
5σ significance
if 80% observed correlation is background





With most likely β_2 value,
and possible trigger events

Chiral Symmetry & Magnetic Field

Two other Extraordinary phenomena to make this possible (QCD topology reflects in charge separation)

Disentangle and assess necessary conditions

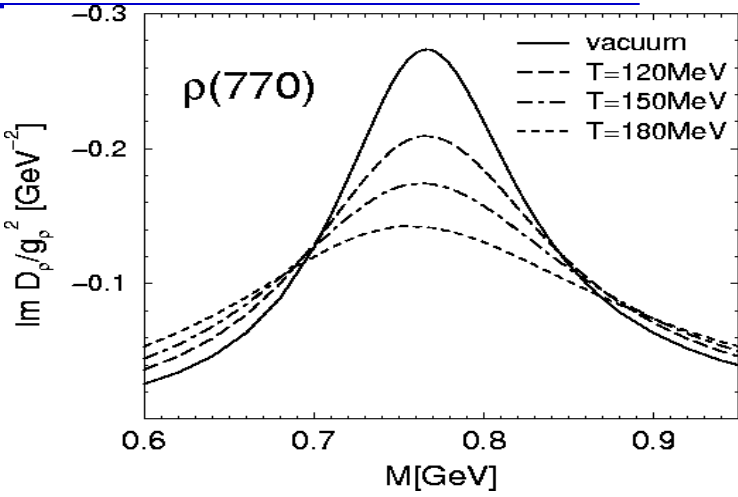
- Chiral Symmetry Restoration
  - low-mass dilepton excess (change of vector meson ρ spectral function)
- Strong Magnetic Field
  - Coherent photo-production of J/Ψ and low-mass dilepton in non-central A+A collisions
  - Global Hyperon Polarization

QCD phase transition is a chiral phase transition

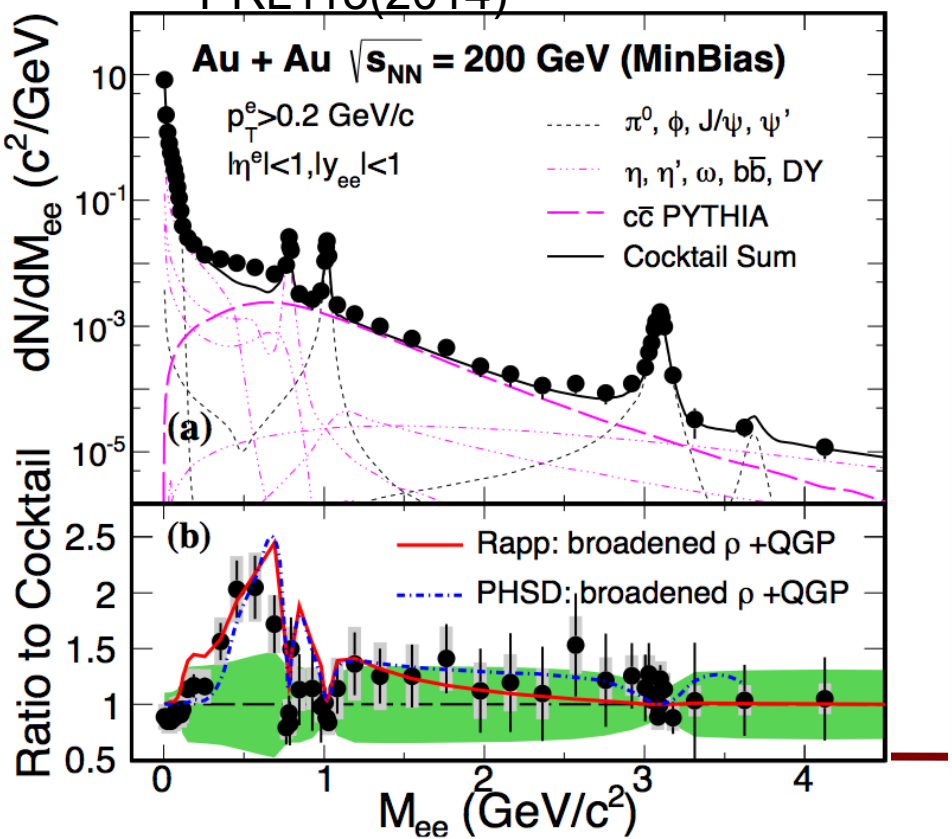
Golden probe of chiral symmetry restoration:
change vector meson ($\rho \rightarrow e^+e^-$) spectral function

RHIC+SPS data:

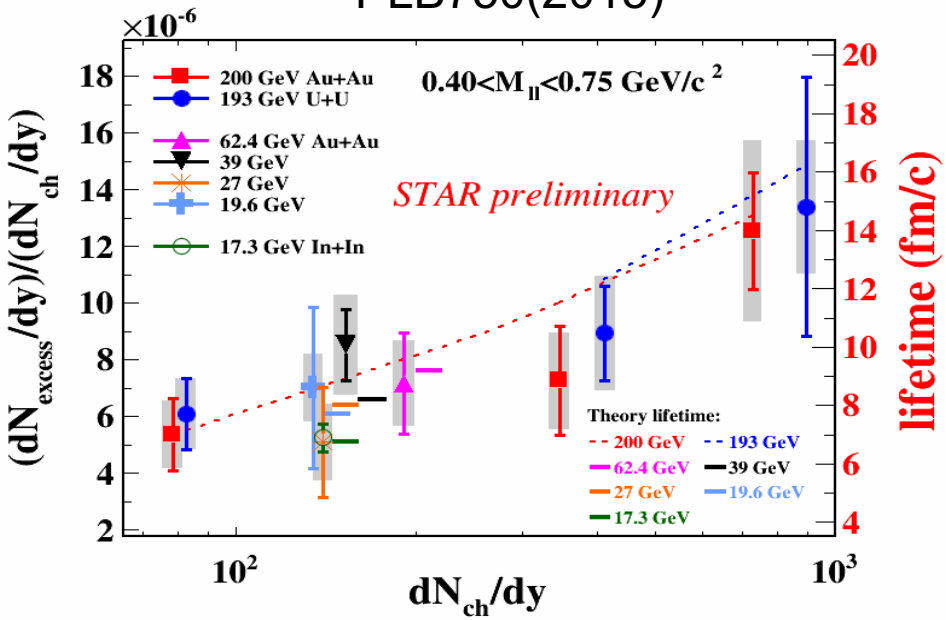
Consistent with continuous QGP radiation and broadening of vector meson in-medium



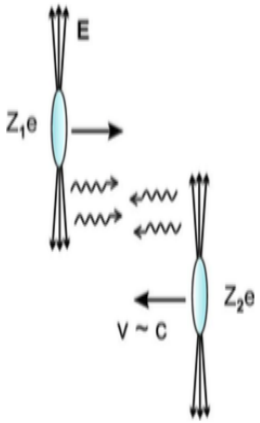
PRL113(2014)

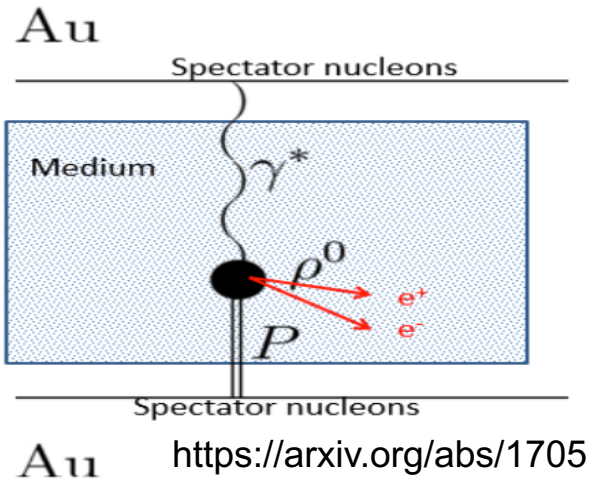


PLB750(2015)

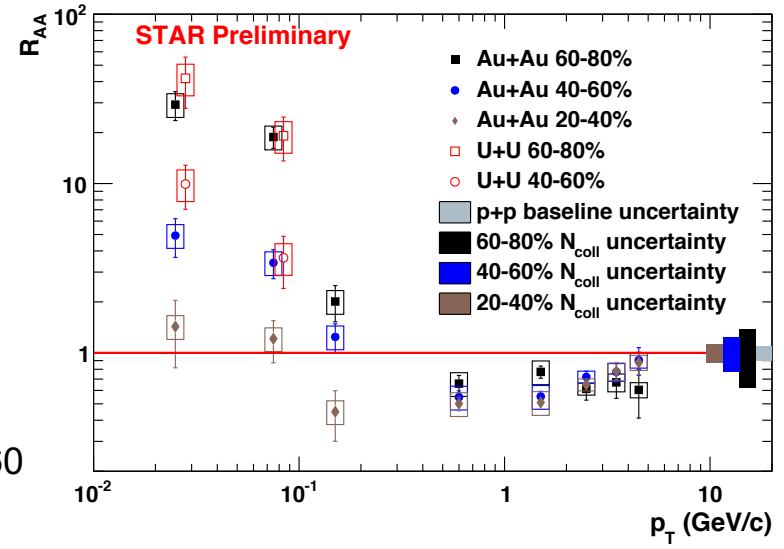


Coherent photoproduction in violent non-central A+A collisions?



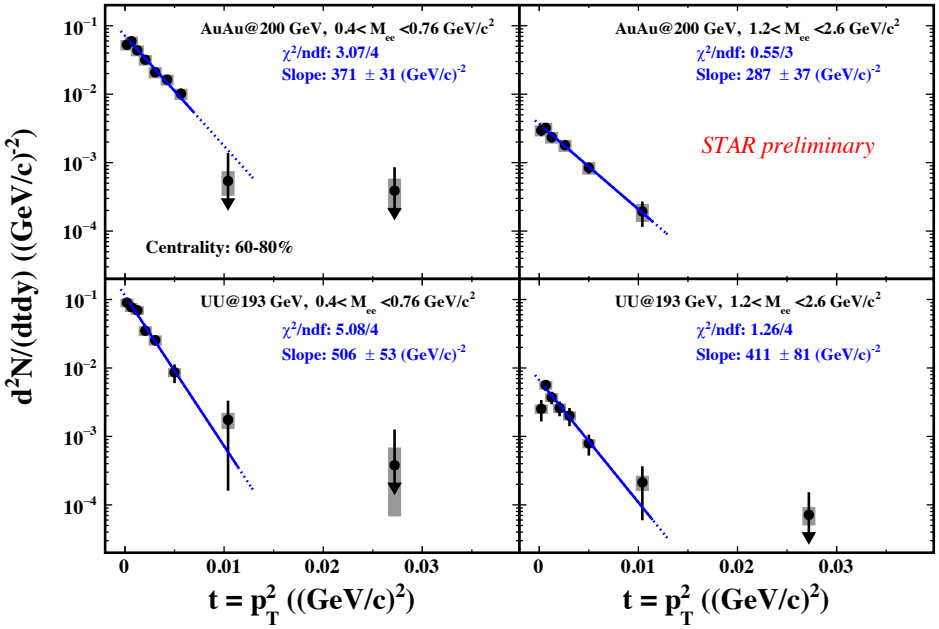


https://arxiv.org/abs/1705.01460



Shower the nucleus with electromagnetic field and test the effect with isobar collisions:

- Non-central but not UPC photoproduction
- Large enhancement of dilepton and J/Ψ production at very low p_T (<150MeV)
- Consistent with strong electromagnetic field interacting with nucleus target collectively
- Test with Isobar collisions (dilepton at LMR)
  Photon-photon (Z^4)
  Photon-Pomeron (Z^2)
  Hadron-Hadron (Z^0)
  LMR excess B-field driven (Z^2)



Au+Au at 27GeV

Run	Energy	Duration	System	Goals	priority	Sequence
18	$\sqrt{s_{NN}}$=200 GeV	3.5-wk	Zr+Zr	1.2B minbias	1	1
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	$\sqrt{s_{NN}}$=3 GeV(FXT)	2 days	Au+Au	100M minbias	3	4

1. Isobar collisions:

study the CME contribution to charge separation

$^{96}_{44}Ru$, $^{96}_{40}Zr$:

charge different by 10% (44 vs 40), everything else the “same”

2. Au+Au @ 27 GeV:

High Statistics Λ and $\overline{\Lambda}$ Global Polarization Measurement

Event-Plane Detector (EPD) presence important

3. Au+Au @ 3 GeV:

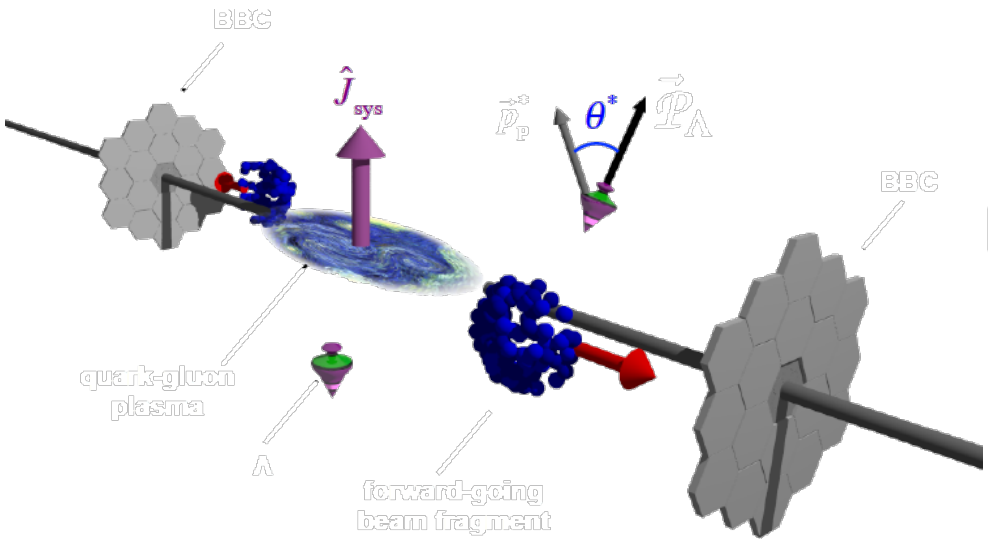
Fluctuation measurement at energies between HADES and BES-I

Significant statistics in FXT mode with large acceptance

Competition with BM@N (NICA) scheduled for 2019

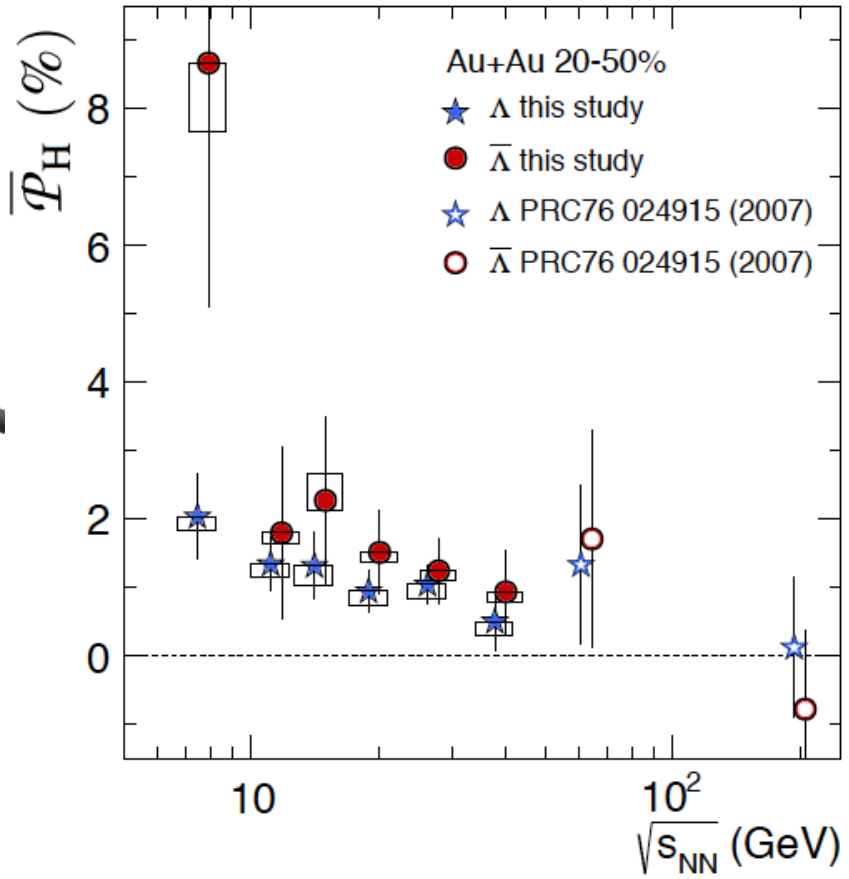
Global Hyperon Polarization

new tool to study QGP and relativistic Quantum fluid Vorticity in general



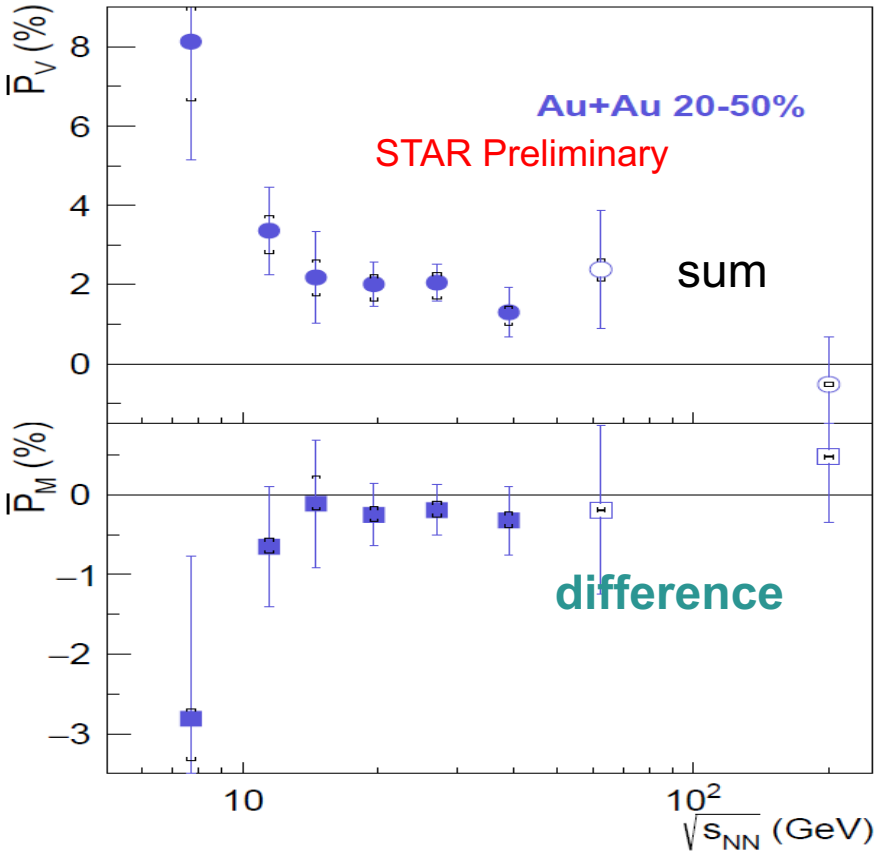
Non-zero global angular momentum transfer to hyperon polarization

arXiv:1701.06657
Accepted by Nature (news embargo)



QCD fluid responds to external field

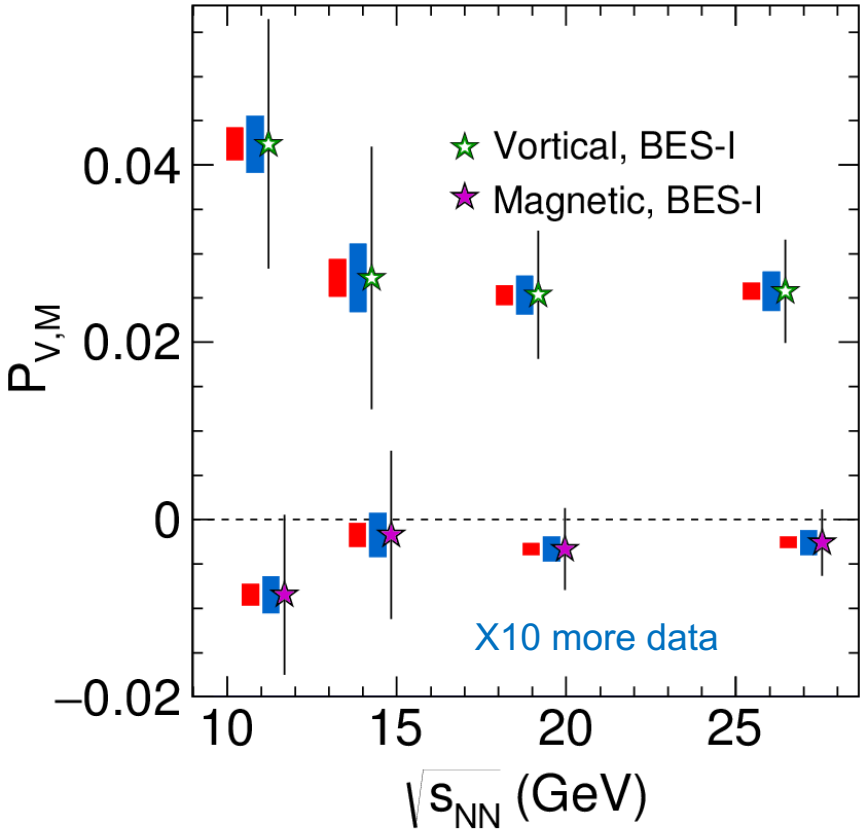
- Positive Global Hyperon Polarization indicating a spin-orbit (Vortical) coupling
- Current data not able to distinguish Lambda/AntiLambda polarization difference,
- (potentially) Direct measure of Magnetic Field effect
- **Need >x10 more data (3σ at current central value)**

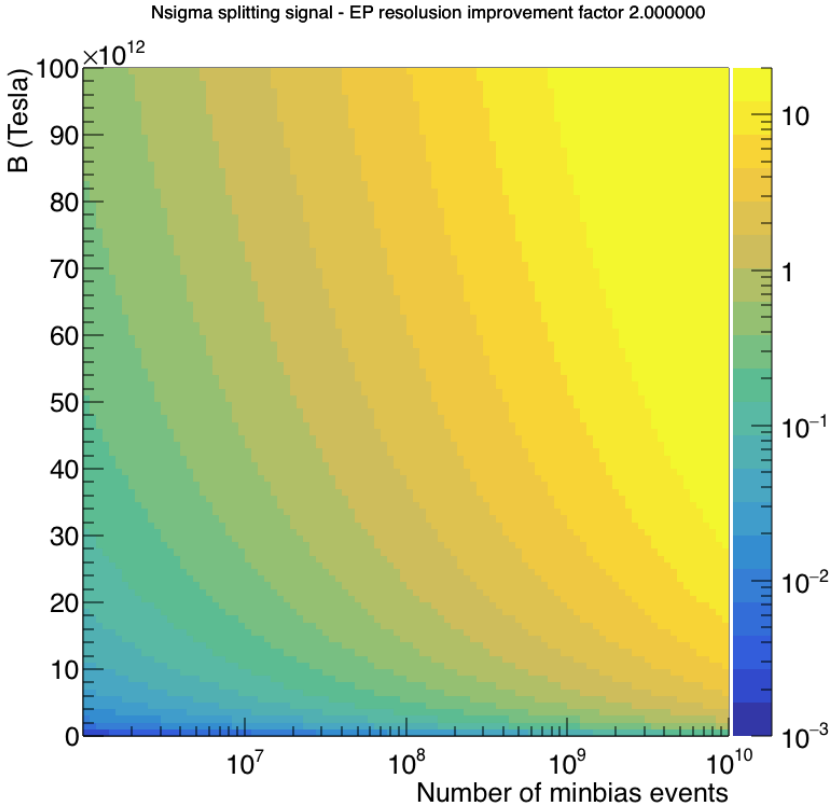


Global Lambda Polarization Projection

https://drupal.star.bnl.gov/STAR/system/files/EPD_Construction_Proposal.pdf

- Clearly, very exciting development
- Signal and BES dependence need more data
- Request Au+Au 27GeV in run 18 with EPD
  To establish whether there is a difference
- Result will guide further studies in BES-II





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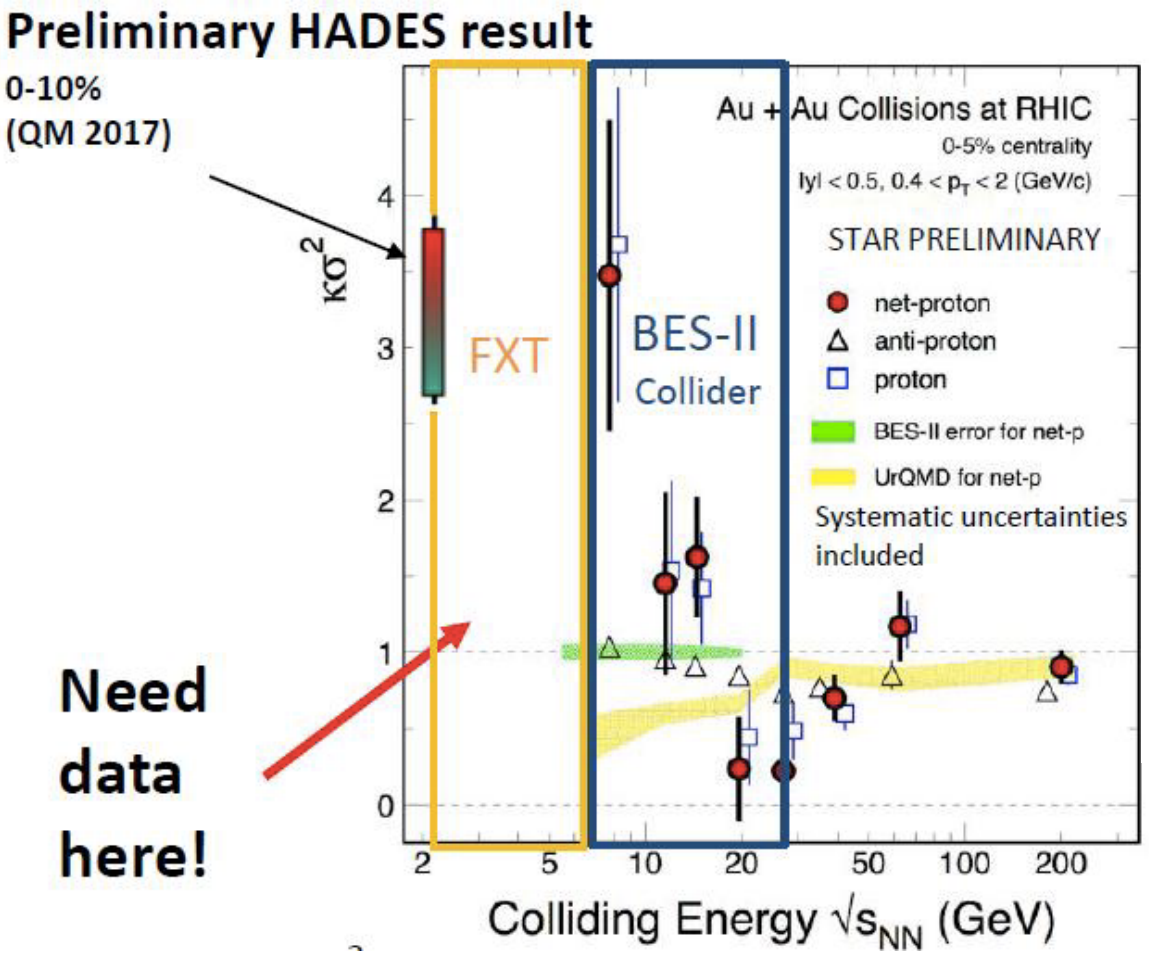
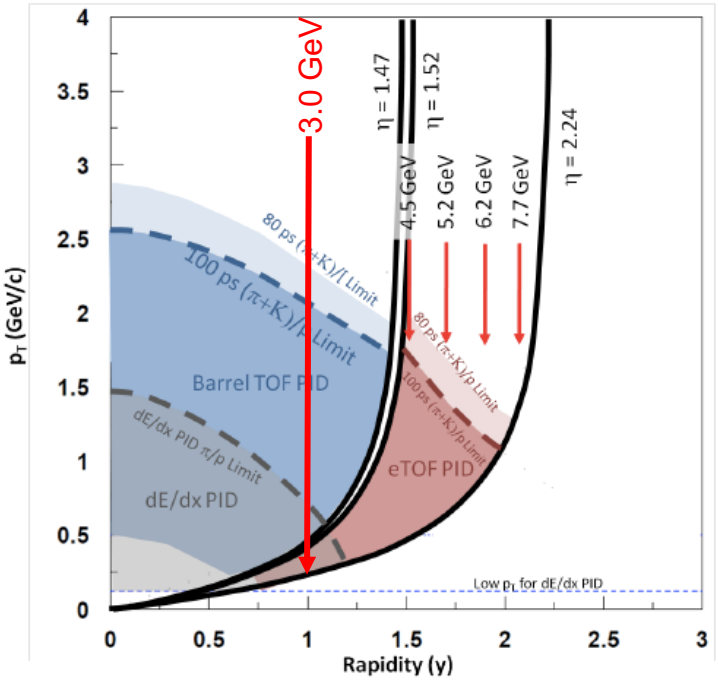
Net-proton Fluctuation at low energies



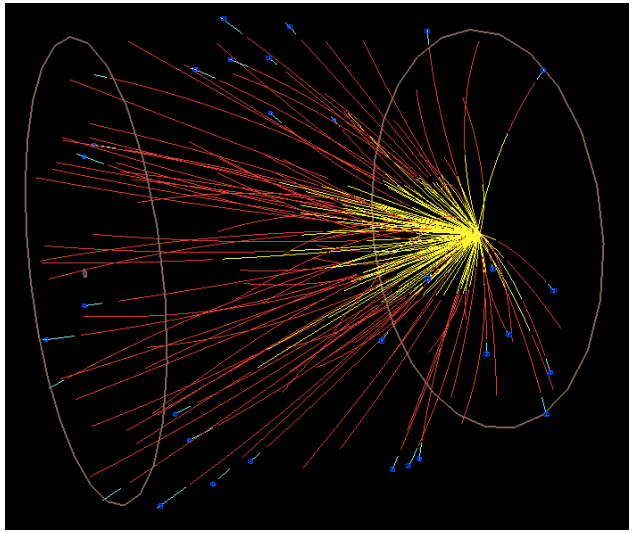


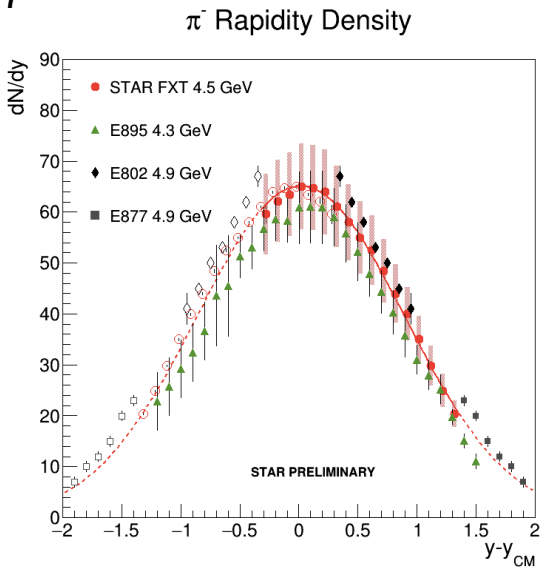
Au+Au at 3 GeV:
mid-rapidity well within current TPC

With high statistics, establish a bridge between BES and world program at fixed target (HADES/CBM/NICA/JPARC)

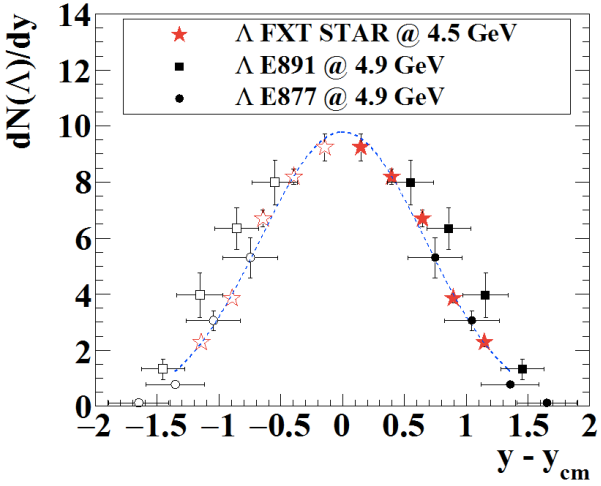
FXT Pilot Runs were Successful

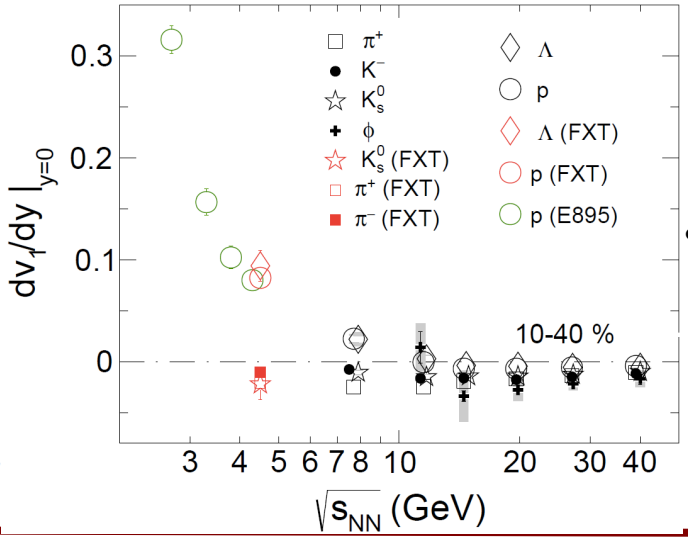
Preliminary results release at QM2017





STAR Preliminary





- Pilot Run in run 14-15
- A couple of hours beam; 1.3 Million 0-30% events
- Results consistent with AGS results:
  - Spectra,
  - HBT,
  - v_1 slopes,
  - v_2,
  - fluctuations
- Ready to make it part of a BES program

Run 19 BUR Executive Summary

Beam Energy (GeV/nucleon)	$\sqrt{s_{NN}}$ (GeV)	Run Time	Species	Number Events	Priority	Sequence
9.8	19.6	4.5 weeks	Au+Au	400M MB	1	1
7.3	14.5	5.5 weeks	Au+Au	300M MB	1	3
5.75	11.5	5 weeks	Au+Au	230M MB	1	5
4.6	9.1 [1]	4 weeks	Au+Au	160M MB	1	7
9.8	4.5 (FXT)	2 days	Au+Au	100M MB	2	2
7.3	3.9 (FXT)	2 days	Au+Au	100M MB	2	4
5.75	3.5 (FXT)	2 days	Au+Au	100M MB	2	6
31.2	7.7 (FXT)	2 days	Au+Au	100M MB	2	8
19.5	6.2 (FXT)	2 days	Au+Au	100M MB	2	9
13.5	5.2 (FXT)	2 days	Au+Au	100M MB	2	10

1. **Au+Au @ 11.5 – 19.6 GeV:**
   Commencement of the RHIC BES-II at high-end of BES-II energies;
   The goal of BES-II is to turn BES-I observed trends and features into definitive conclusions and new understanding.

2. **Au+Au FXT:**
   Multiple measurements at energies between
   World FXT programs and BES-II
   Significant statistics in FXT mode with large acceptance

Highlights of BES-II and Upgrades in LRP 2015

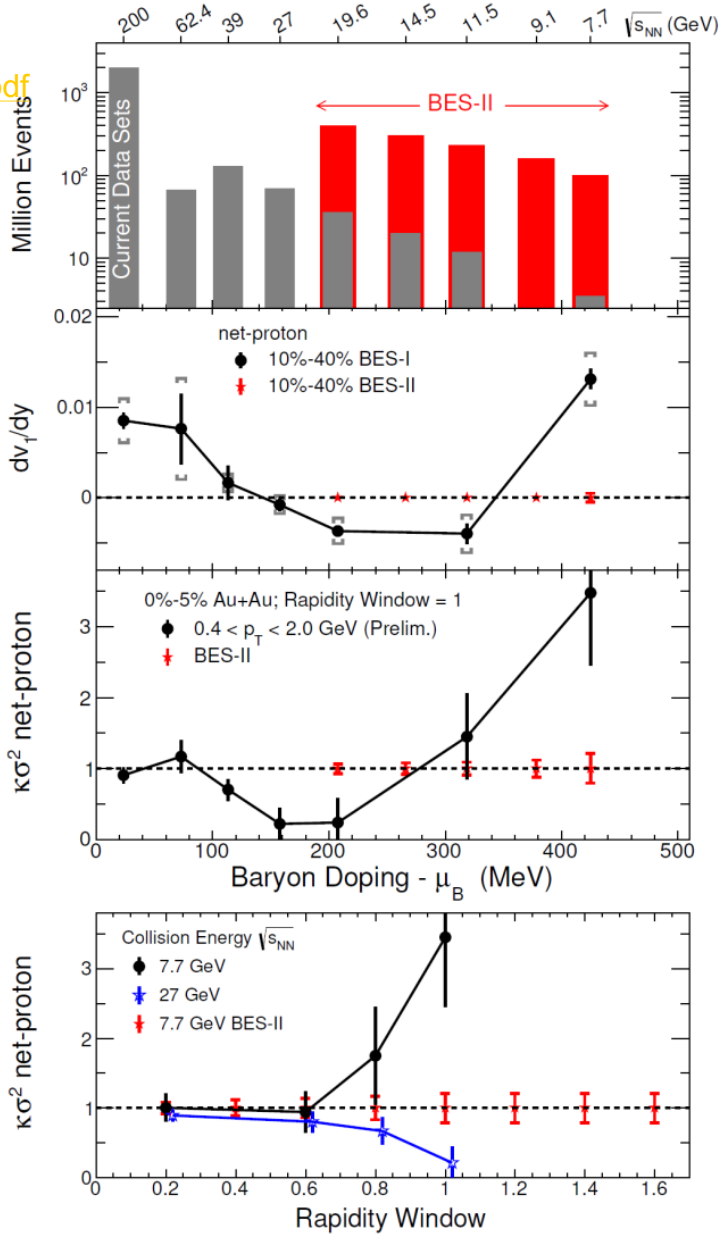
Strong Endorsement by the NSAC 2015

http://science.energy.gov/~/media/np/nsac/pdf/2015LRP/2015_LRPNS_091815.pdf

Data from BES-I provide qualitative evidence for a reduction in the QGP pressure, with consequences for flow patterns and droplet lifetimes that have long been anticipated in collisions that form QGP not far above the crossover region. (See second panel of Figure 2.10.)

The detector upgrades planned for BES-II focus on maximizing the fraction of the particles in each collision that are measured, which is particularly important for fluctuation observables.

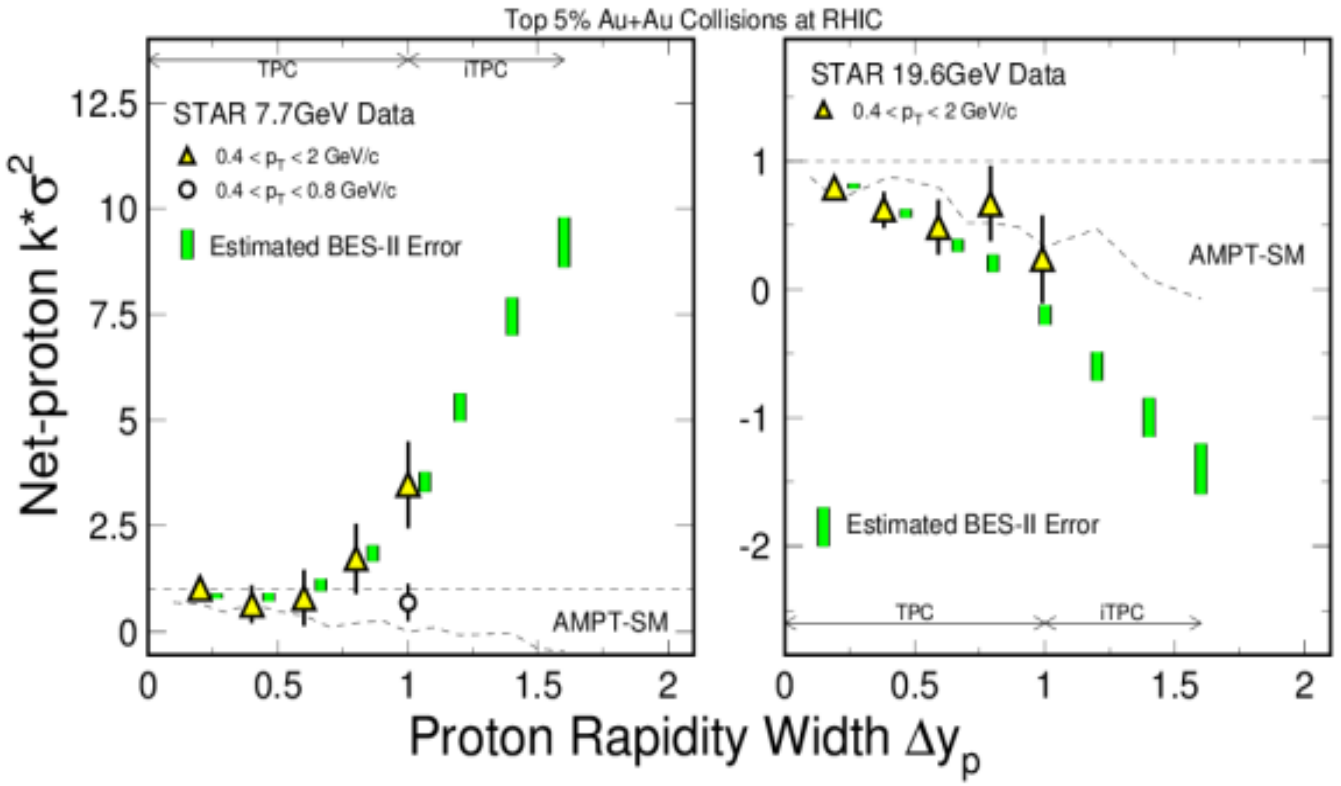
The trends and features in BES-I data provide compelling motivation for a strong and concerted theoretical response, as well as for the experimental measurements with higher statistical precision from BES-II. The goal of BES-II is to turn trends and features into definitive conclusions and new understanding.



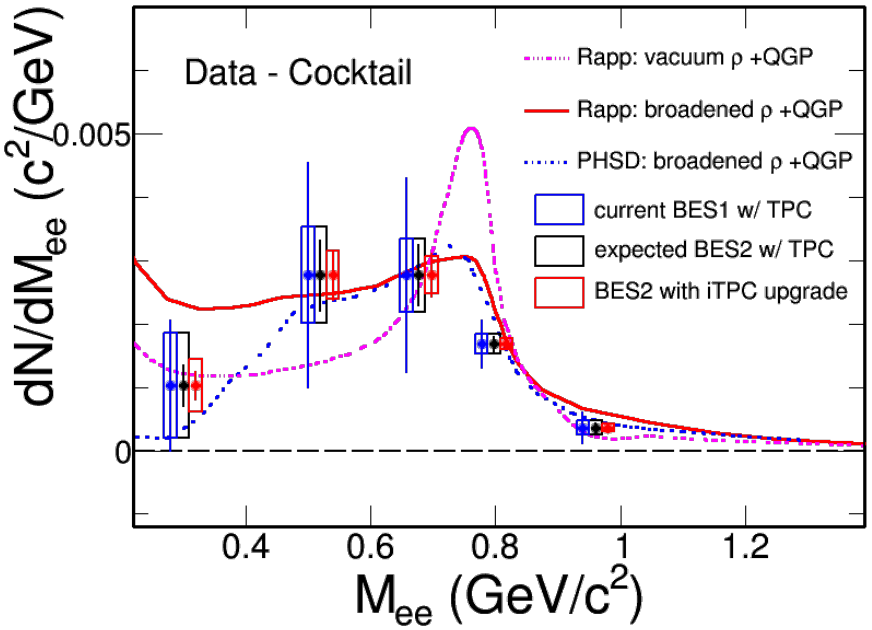
BES-II Physics highlights (I): net-proton Kurtosis

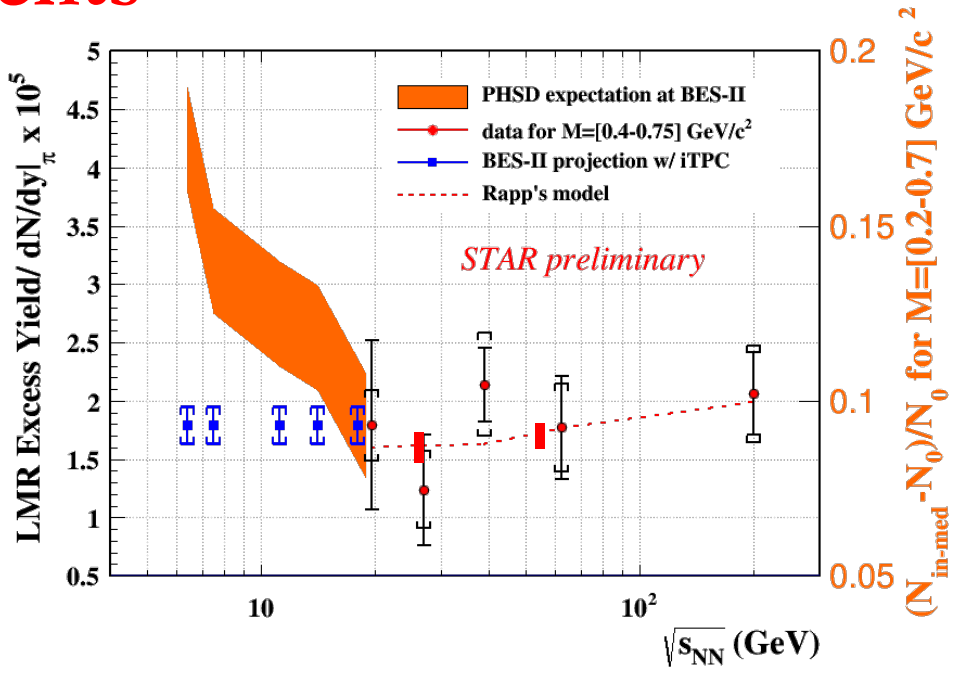
Reach the necessary rapidity width of the correlation/fluctuation (~1-2 unit)

B. Ling and M. Stephanov, Phys.Rev. C93 (2016) 034915



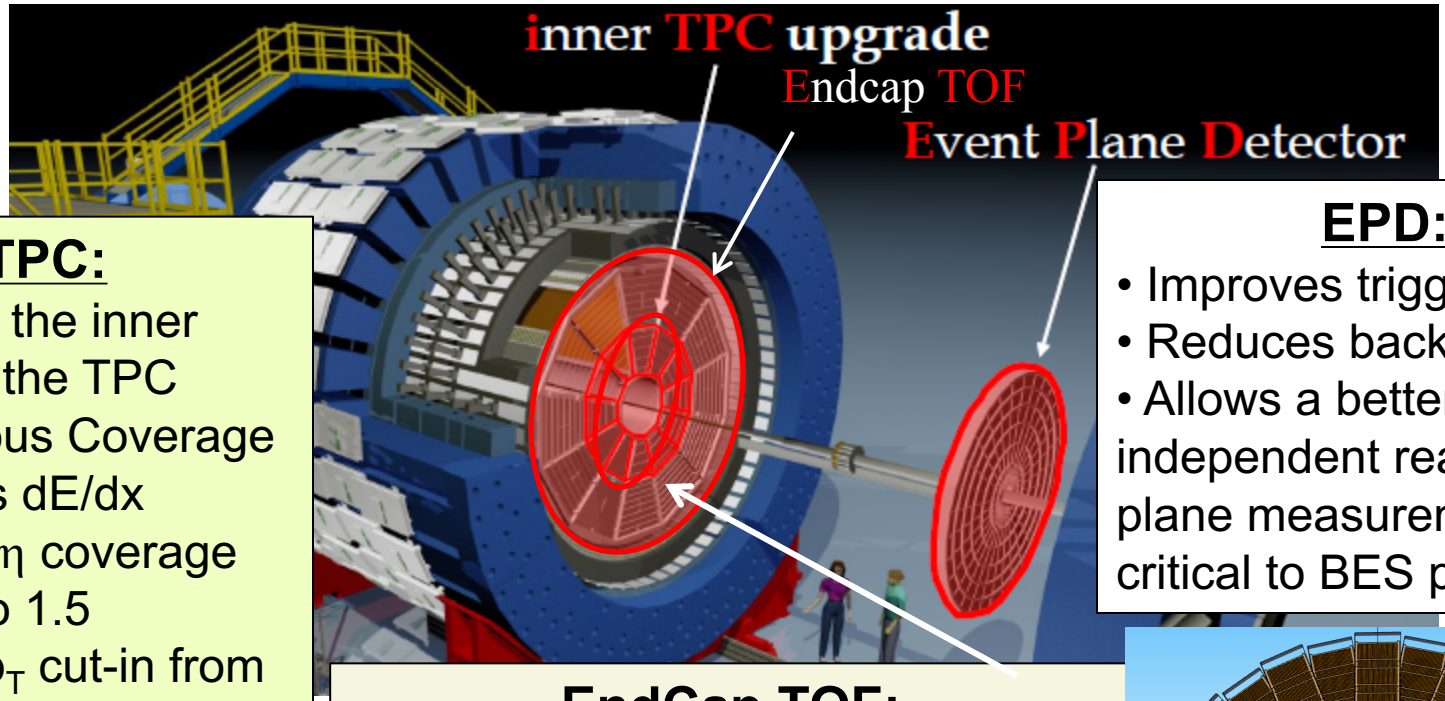
BES-II Physics highlights (II): Di-electron measurements





- Systematically study di-electron continuum from $\sqrt{S_{NN}}$ = 7.7 – 19.6 GeV
- Inner Time Projection Chamber (iTPC) upgrade: reduce systematic and statistical uncertainties
- Distinguish models with different ρ-meson broadening mechanisms (Rapp's method vs. PHSD)
- Study the total baryon density effect on LMR excess yield in BESII

Major Upgrades for BES-II



iTPC:

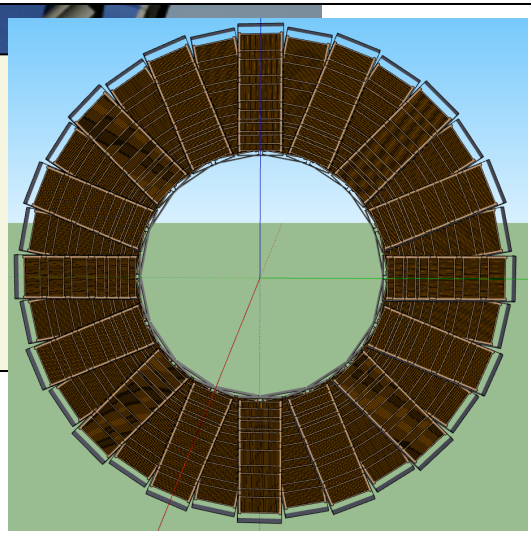
- Rebuilds the inner sectors of the TPC
- Continuous Coverage
- Improves dE/dx
- Extends η coverage from 1.0 to 1.5
- Lowers p_T cut-in from 125 MeV/c to 60 MeV/c

EPD:

- Improves trigger
- Reduces background
- Allows a better and independent reaction plane measurement critical to BES physics

EndCap TOF:

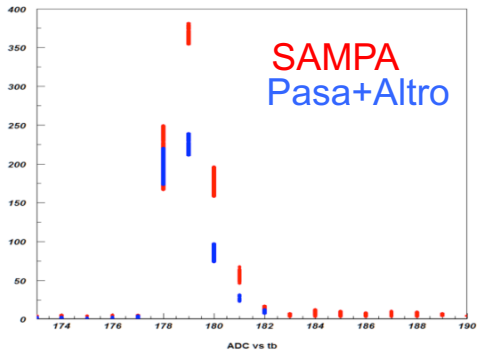
- Rapidity coverage is critical
- PID at η = 0.9 to 1.5
- Improves the fixed target program
- Provided by CBM-FAIR



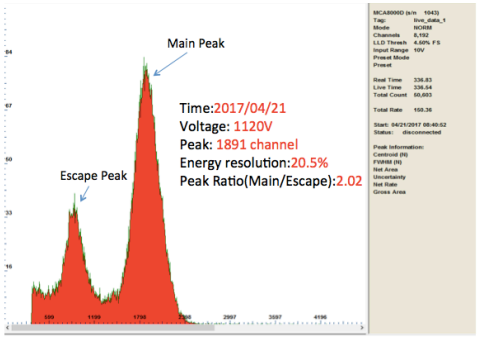
Funding sources:
iTPC: DOE+MoST+NSFC
eTOF: CBM
EPD: MoST fund + NSF Universities

iTPC Project Status

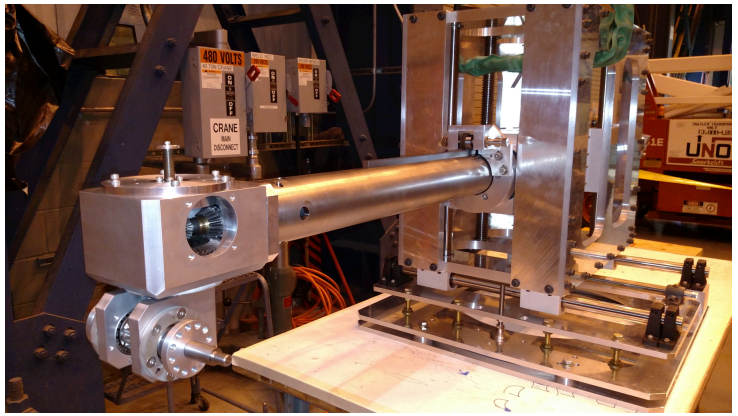
- SAMPA FEE (WMP2)
  - 2FEEs and RDO installed on one inner most row of TPC
  - Running through USB port with beam
  - 200 chips for a sector this summer
  - ALICE MWP3 pre-production ~September 2017;
    4000 chips afterward
- Sectors (strongback+padplane+WMPC)
  - First two sectors completed at LBL and arrived at SDU in June 5
  - Complete in July and back to BNL
- Insertion tool
  - Completed at UIC and arrived at BNL in May 12
- Reviews and Reports
  - DOE TCSM review 09/12/2017
  - MWPC readiness review at SDU 12/05/2017
  - LBL and SDU conducted local multiple reviews
  - Monthly Phone calls with DOE since 01/2017
  - Quarterly reports to DOE



SAMPA is well behaved

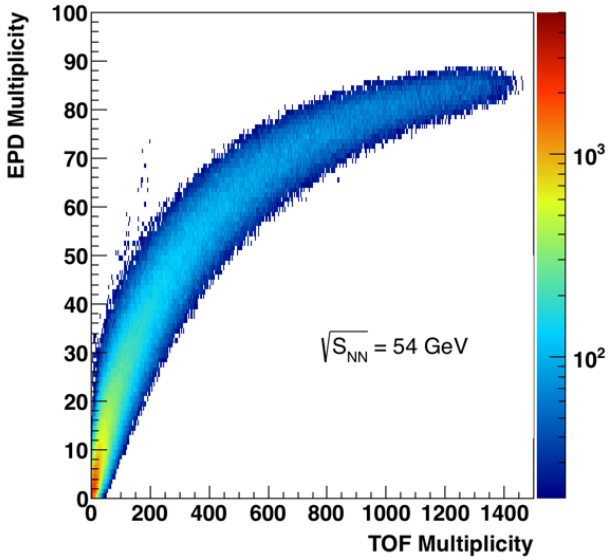


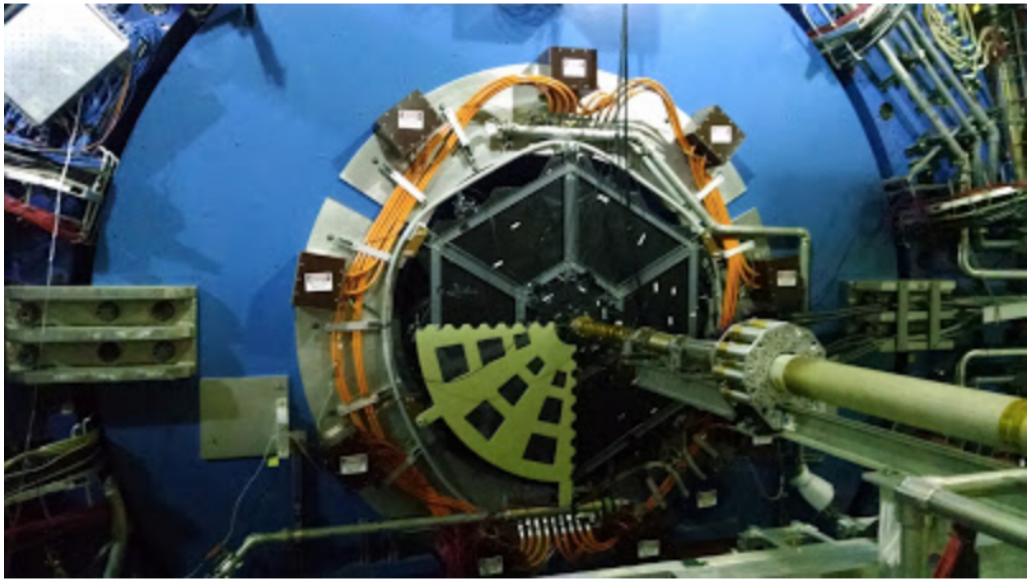
FWHM 20%



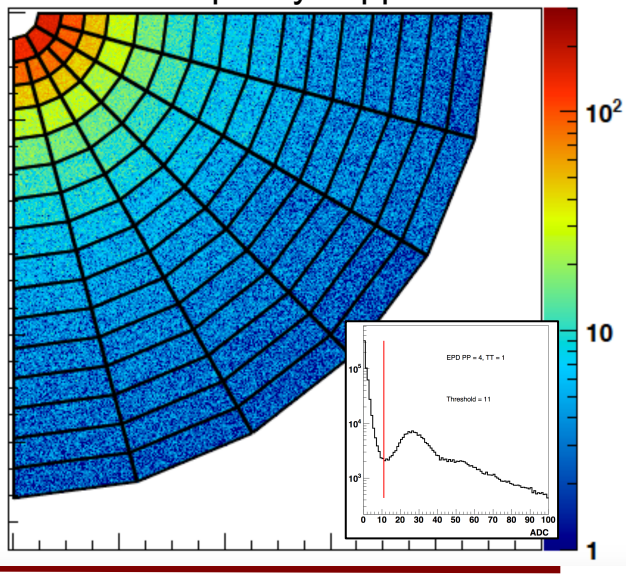
Event Plane Detector (EPD)

- 3 final sectors (1/8) in run 17
- Completed for run 18
- Lehigh+OSU (NSF fund)
- Project funded by MoST (USTC)



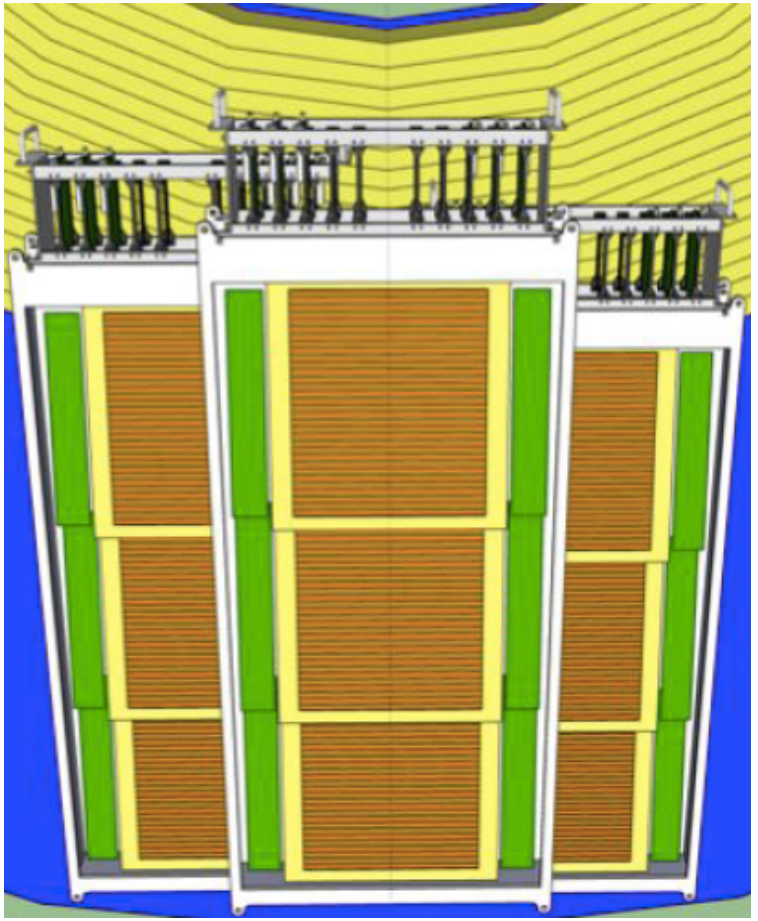


Occupancy in pp500



Endcap TOF Status

- Two prototype modules with readout installed in run 17
  - CBM Triggerless Electronics interface with STAR DAQ/TRG systems
  - Collected 64M events with eTOF
  - Provides performance for final design choices
- Run 18 plans on one full Sector
  - 3x32-strip MRPC with final readout electonics
  - Installation: 10-11/2017
- Complete installation in 11/2018
- Complete BES-II program with full eTOF coverage



Additional NSFC fund for eTOF modules and physics: proposal review in 07/07/2017

2016 BUR ➔ Run 17

Run	Energy	Duration	System	Goals	priority	Sequence
17	$\sqrt{s_{NN}}$=500 GeV	13-wk	Transverse p+p	A_N of $W^{\pm}$, γ, Drell-Yan, L=400 pb^{-1}, 55% pol	1	**1**
		1-wk	p+p	RHICf		**2**
		2-wk	CeC			
	$\sqrt{s_{NN}}$=62.4 GeV	4-wk	Au+Au	Jets, dileptons, NPE 1.5B MB	3	**3**
18	**$\sqrt{s_{NN}}$ =200 GeV**	**3.5-wk**	**Ru+Ru**	**1.2B MB**	**2**	**4**
	$\sqrt{s_{NN}}$=200 GeV	**3.5-wk**	**Zr+Zr**	**1.2B MB**	**2**	**5**
	$\sqrt{s_{NN}}$=27 GeV	**2-wk**	**Au+Au**	**>500M MB**	**3**	**6**

Options from guidance:

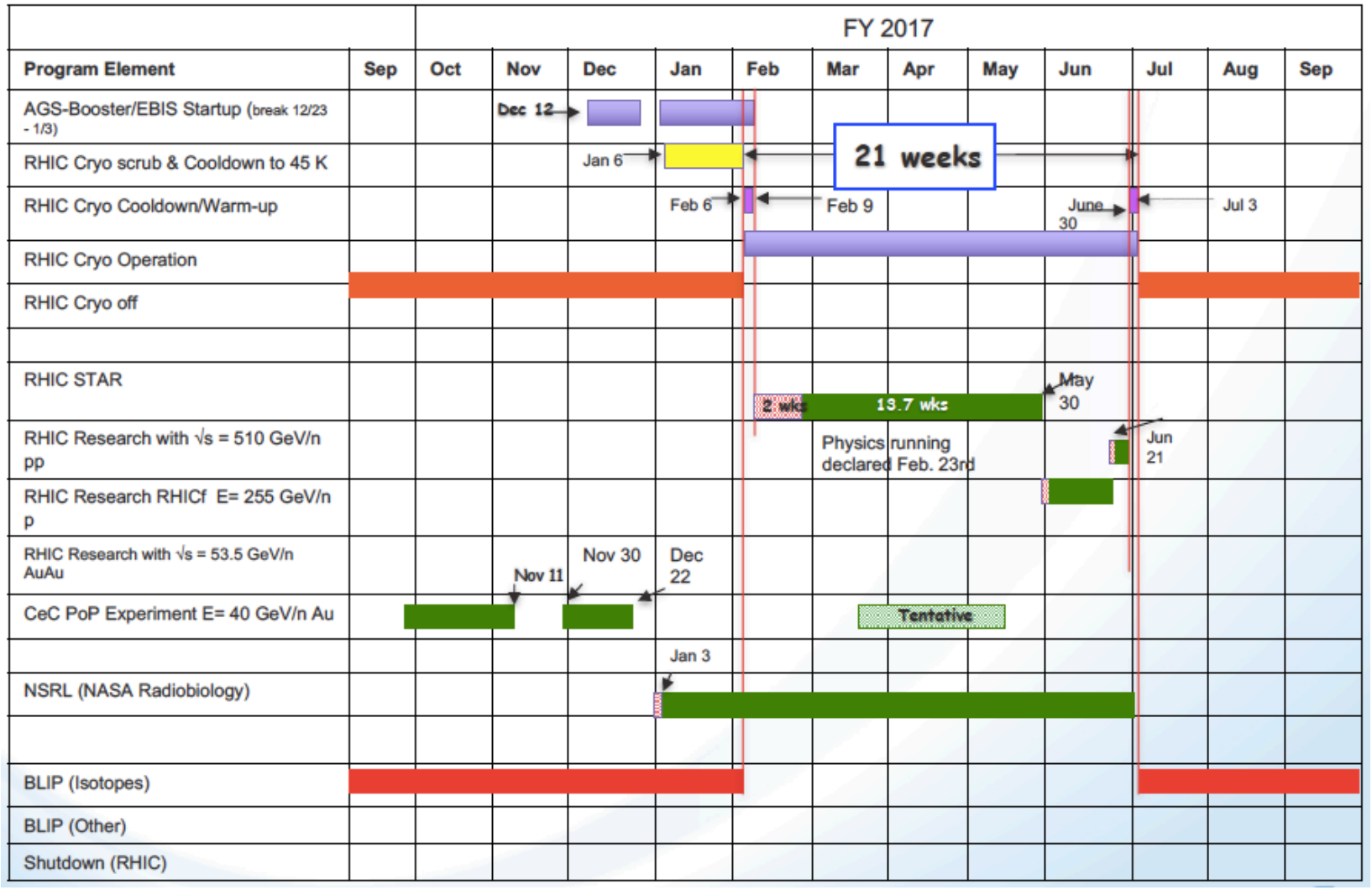
1) 24 cryo-weeks in run 17, 13 weeks in run 18
2) 19 cryo-weeks in run 17, 13 weeks in run 18
3) If only 15 weeks in run 17, all for pp500

https://drupal.star.bnl.gov/STAR/starnotes/public/sn0657

C-A Operations FY17

May 8, 2017

Bill Christie



To allow for timely LINAC repair, plan is to switch fro pp running to AuAu running on May 30th, and then come back to pp running on June 21st.

Run 17 Spin Program BUR and Projections

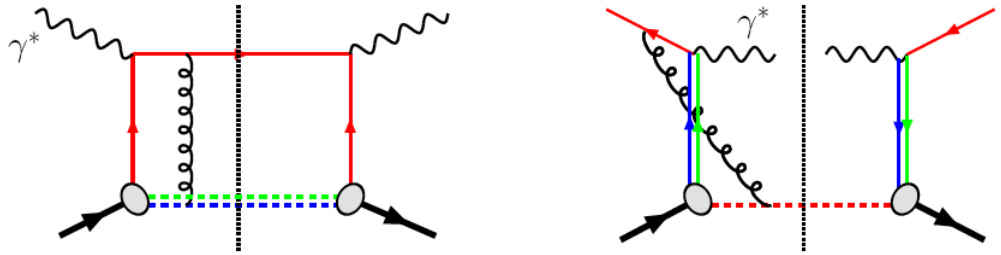
In this Beam Use Request the STAR Collaboration presents four compelling and prioritized scientific programs for the 2017 and 2018 RHIC runs.

STAR's **highest scientific priority** is the first significant measurement of the sign change of the Sivers function, as compared to the value measured in semi-inclusive deep inelastic scattering experiments, through measurements of single spin asymmetries in $W^{+/-}$, Z, direct photon and Drell-Yan production in transversely polarized $\sqrt{s}$ = 500 GeV p+p collisions. This measurement will also shed light on the size and nature of the evolution of these transverse momentum dependent distributions. The sign change measurement is a fundamental test of QCD and is being pursued by other experiments, making a timely measurement imperative. We therefore request **13 weeks of 500 GeV p+p running in Run17.**

Year	#	Milestone
2015	HP13 (new)	Test unique QCD predictions for relations between single-transverse spin phenomena in p-p scattering and those observed in deep-inelastic lepton scattering.

NSAC Milestone (HP13)

Year	#	Milestone
2013 ✓	HP8	Measure flavor-identified q and $\overline{q}$ contributions to the spin of the proton via the longitudinal-spin asymmetry of W production.
2013 ✓	HP12 (update of HP1, met in 2008)	Utilize polarized proton collisions at center of mass energies of 200 and 500 GeV, in combination with global QCD analyses, to determine if gluons have appreciable polarization over any range of momentum fraction between 1 and 30% of the momentum of a polarized proton.
2015	HP13 (new)	Test unique QCD predictions for relations between single-transverse spin phenomena in p-p scattering and those observed in deep-inelastic lepton scattering.

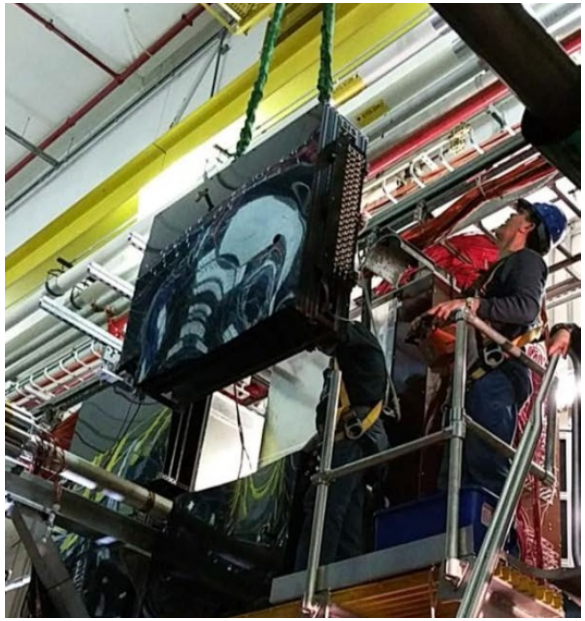


A_N of $W^{\pm}$,γ, DY in pp 500 are all sensitive to the Sivers sign-change. STAR can access all three world-class measurements in the proposed 2017 Run – **Significant discovery potential before 2020!**

Forward Detector preparation for run 17

Forward Meson Spectrometer (FMS) + FMS Pre-shower + FMS Poster-Shower

Installation of pre-shower for run 15

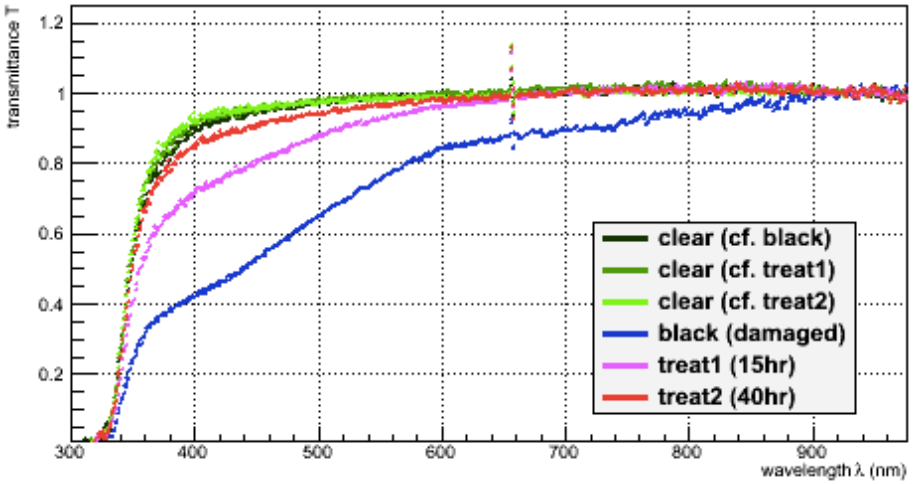


1. All three detector subsystems:
   existing FMS, Pre-shower
   Add new post-shower
2. Add UV lights to cure FMS radiation

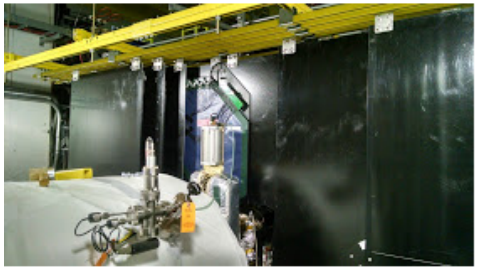
https://drupal.star.bnl.gov/STAR/system/files/STAR.FMS_.Postshower.v2.pdf

FMS radiation damage cured by UV lights

PbGl transparency after UV curing

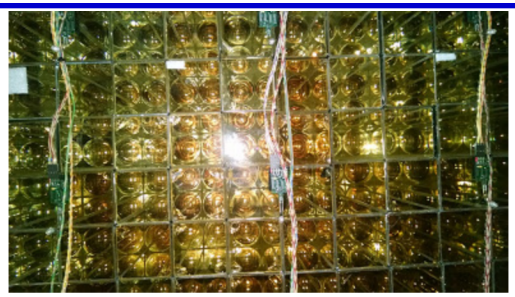


Hardware Additions for Run 17

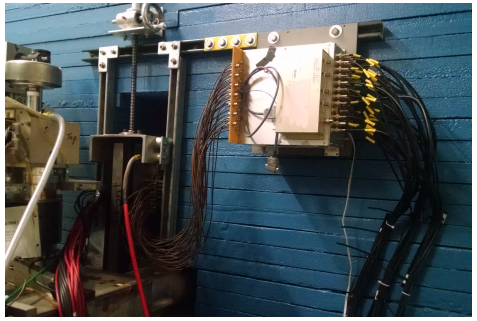


FMS Post Shower

* EIC Calorimeter R&D setup

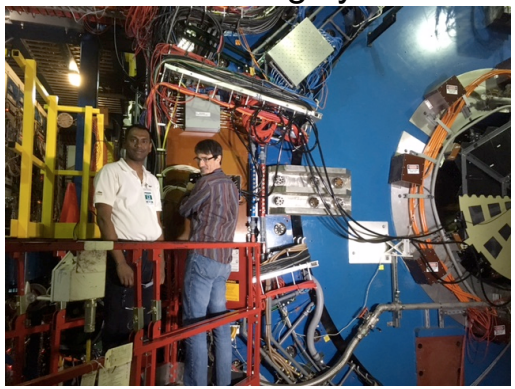


FMS UV Curing system

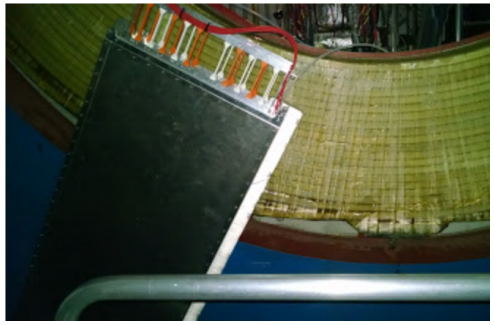


RHICf

1. FMS UV curing system
2. FMS post Shower
3. RHICf
4. EPD quadrant
5. eTOF prototype (2 modules)
6. Original (low mass) beam pipe
7. iTPC prototype RDO and FEE
8. Prototype Digital Electronics Platform (DEP)
9. Forward/EIC calorimeter R&D
10. New QT with TAC built in EPD, MTD
11. Selectable trig crate readout
12. TPC HV PS



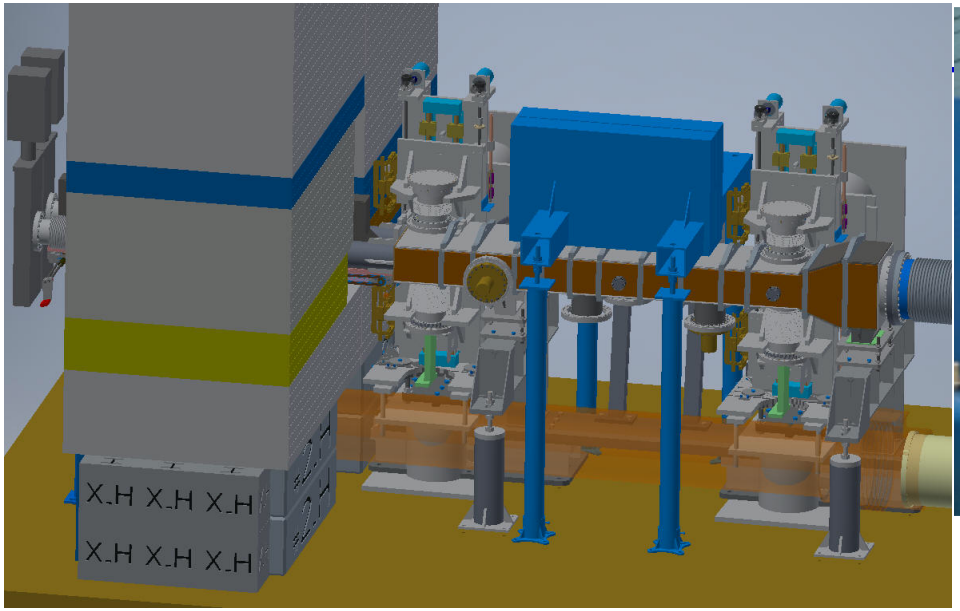
Event Plane Detector (EPD) quadrant

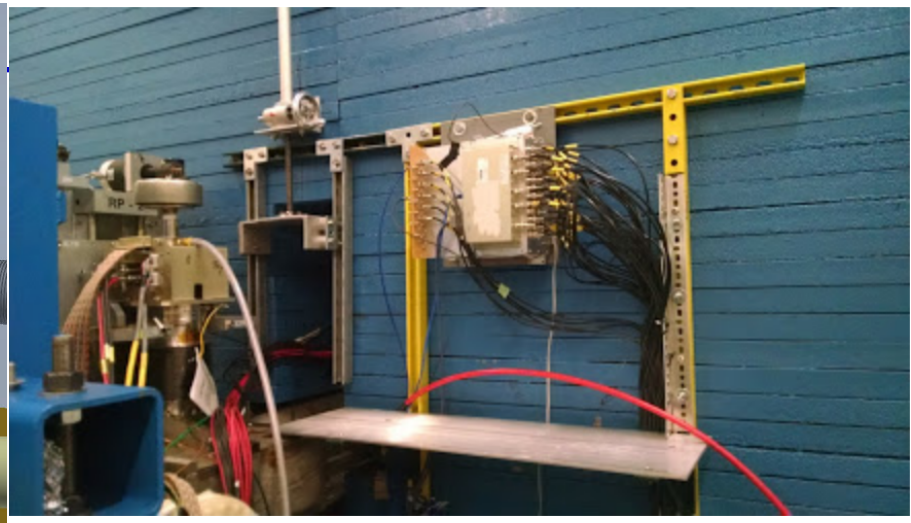


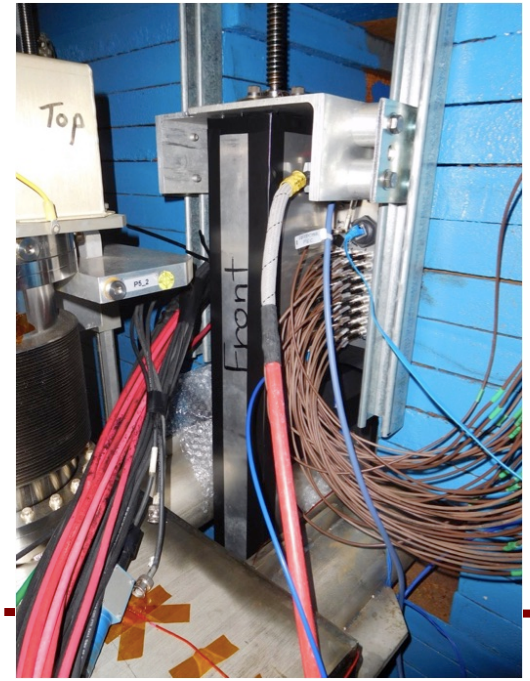
eTOF Prototype

Original (low mass) center cone

RHICf Installation on the West side of STAR







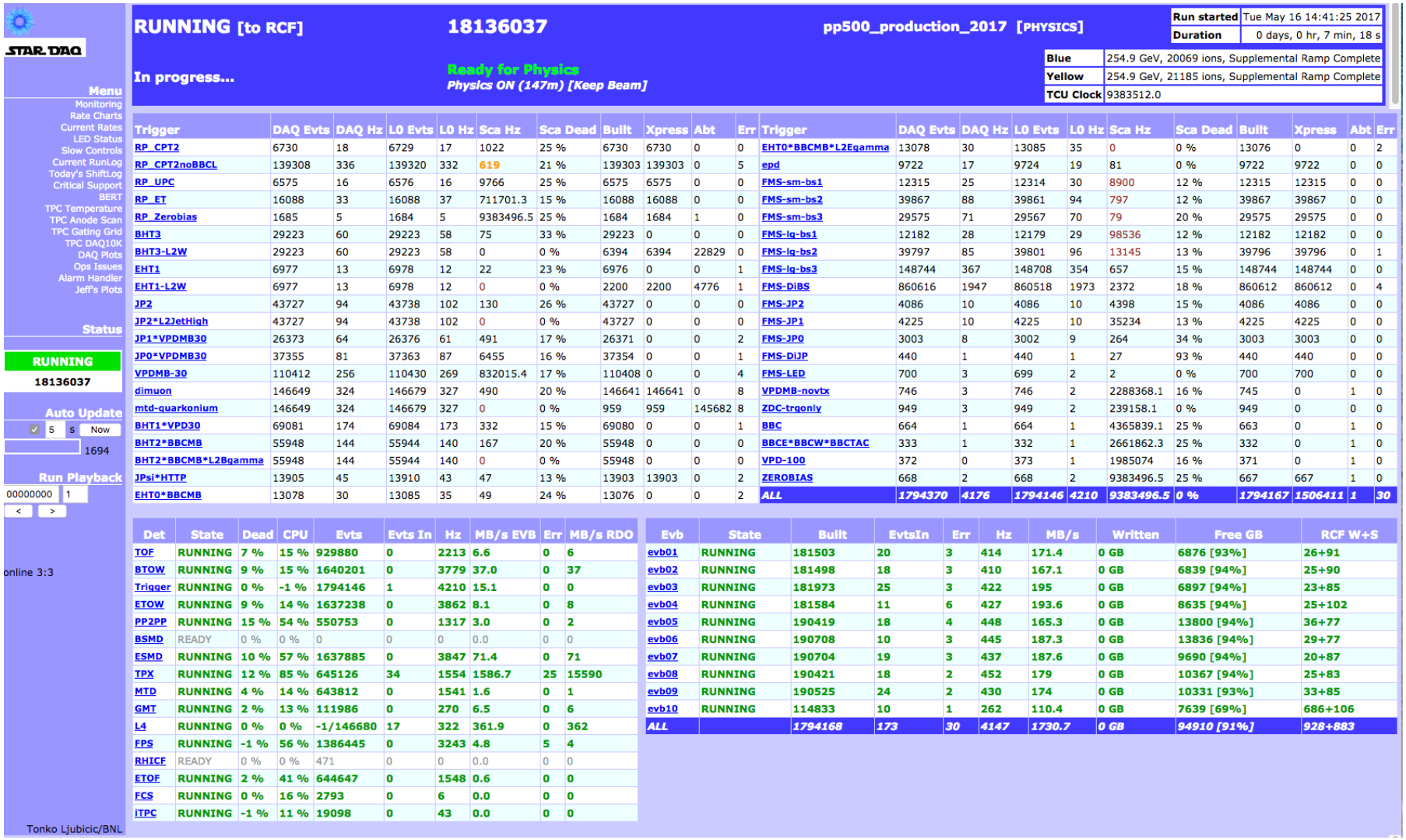
The RHICf setup is a position sensitive calorimeter system to be positioned just in front of the ZDCs on the West side of STAR.

It will measure cross sections for particles traveling in the Blue beam direction. Integration and radial polarization test went well.

RHICf beam time 06/22-25/2017

RHICf BUR (2016)
https://indico.bnl.gov/materialDisplay.py?materialId=4&confId=1761

Run 17 pp510 GeV Trigger Distributions



STAR DAQ

Menu
Monitoring
Rate Charts
Current Rates
LED Status
Slow Controls
Current RunLog
Today's ShiftLog
Critical Support
BERT
TPC Temperature
TPC Anode Scan
TPC Gating Grid
TPC DAQ10K
DAQ Plots
Ops Issues
Alarm Handler
Jeff's Plots

Status

RUNNING
18136037

Auto Update
5 s Now
1694

Run Playback
00000000 1
< >

online 3:3

Tonko Ljubicic/BNL

RUNNING [to RCF] **18136037** **pp500_production_2017 [PHYSICS]**

In progress...

Ready for Physics
Physics ON (147m) [Keep Beam]

Run started	Tue May 16 14:41:25 2017
Duration	0 days, 0 hr, 7 min, 18 s
Blue	254.9 GeV, 20069 ions, Supplemental Ramp Complete
Yellow	254.9 GeV, 21185 ions, Supplemental Ramp Complete
TCU Clock	9383512.0

Trigger	DAQ Evts	DAQ Hz	L0 Evts	L0 Hz	Sca Hz	Sca Dead	Built	Xpress	Abt	Err
RP_CPT2	6730	18	6729	17	1022	25 %	6730	6730	0	0
RP_CPT2noBBCL	139308	336	139320	332	619	21 %	139303	139303	0	5
RP_UPC	6575	16	6576	16	9766	25 %	6575	6575	0	0
RP_ET	16088	33	16088	37	711701.3	15 %	16088	16088	0	0
RP_Zerobias	1685	5	1684	5	9383496.5	25 %	1684	1684	1	0
BHT3	29223	60	29223	58	75	33 %	29223	0	0	0
BHT3-L2W	29223	60	29223	58	0	0 %	6394	6394	22829	0
EHT1	6977	13	6978	12	22	23 %	6976	0	0	1
EHT1-L2W	6977	13	6978	12	0	0 %	2200	2200	4776	1
JP2	43727	94	43738	102	130	26 %	43727	0	0	0
JP2*L2JetHigh	43727	94	43738	102	0	0 %	43727	0	0	0
JP1*VPDMB30	26373	64	26376	61	491	17 %	26371	0	0	2
JP0*VPDMB30	37355	81	37363	87	6455	16 %	37354	0	0	1
VPDMB-30	110412	256	110430	269	832015.4	17 %	110408	0	0	4
dimuon	146649	324	146679	327	490	20 %	146641	146641	0	8
mtd-quarkonium	146649	324	146679	327	0	0 %	959	959	145682	8
BHT1*VPD30	69081	174	69084	173	332	15 %	69080	0	0	1
BHT2*BBCMB	55948	144	55944	140	167	20 %	55948	0	0	0
BHT2*BBCMB*L2Bgamma	55948	144	55944	140	0	0 %	55948	0	0	0
JPsi*HTTP	13905	45	13910	43	47	13 %	13903	13903	0	2
EHT0*BBCMB	13078	30	13085	35	49	24 %	13076	0	0	2

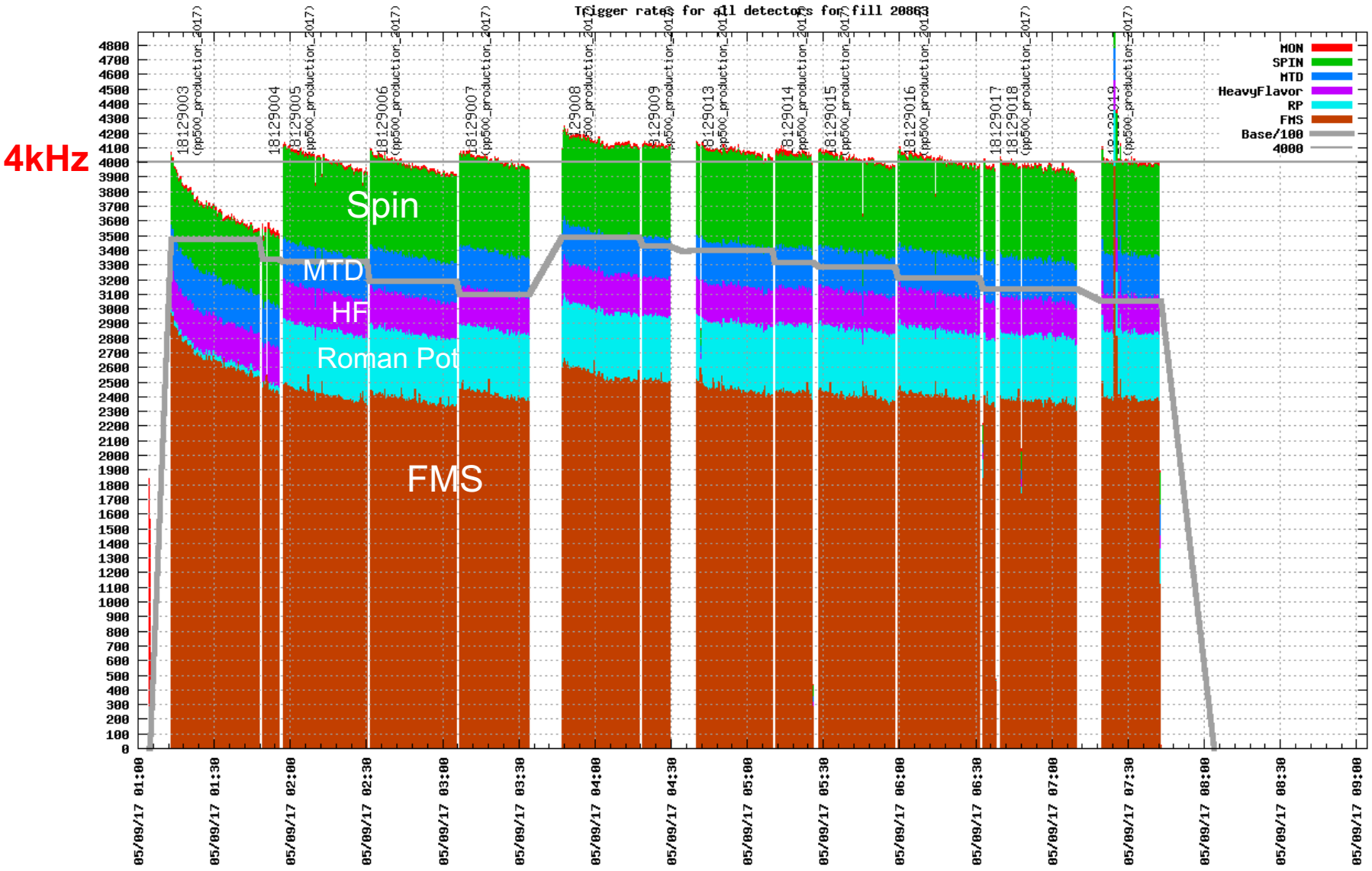
Trigger	DAQ Evts	DAQ Hz	L0 Evts	L0 Hz	Sca Hz	Sca Dead	Built	Xpress	Abt	Err
EHT0*BBCMB*L2Egamma	13078	30	13085	35	0	0 %	13076	0	0	2
epd	9722	17	9724	19	81	0 %	9722	9722	0	0
FMS-sm-bs1	12315	25	12314	30	8900	12 %	12315	12315	0	0
FMS-sm-bs2	39867	88	39861	94	797	12 %	39867	39867	0	0
FMS-sm-bs3	29575	71	29567	70	79	20 %	29575	29575	0	0
FMS-lg-bs1	12182	28	12179	29	98536	12 %	12182	12182	0	0
FMS-lg-bs2	39797	85	39801	96	13145	13 %	39796	39796	0	1
FMS-lg-bs3	148744	367	148708	354	657	15 %	148744	148744	0	0
FMS-DiBS	860616	1947	860518	1973	2372	18 %	860612	860612	0	4
FMS-JP2	4086	10	4086	10	4398	15 %	4086	4086	0	0
FMS-JP1	4225	10	4225	10	35234	13 %	4225	4225	0	0
FMS-JP0	3003	8	3002	9	264	34 %	3003	3003	0	0
FMS-DiJP	440	1	440	1	27	93 %	440	440	0	0
FMS-LED	700	3	699	2	2	0 %	700	700	0	0
VPDMB-novtx	746	3	746	2	2288368.1	16 %	745	0	1	0
ZDC-trgonly	949	3	949	2	239158.1	0 %	949	0	0	0
BBC	664	1	664	1	4365839.1	25 %	663	0	1	0
BBCE*BBCW*BBCTAC	333	1	332	1	2661862.3	25 %	332	0	1	0
VPD-100	372	0	373	1	1985074	16 %	371	0	1	0
ZEROBIAS	668	2	668	2	9383496.5	25 %	667	667	1	0
ALL	*1794370*	*4176*	*1794146*	*4210*	*9383496.5*	*0 %*	*1794167*	*1506411*	*1*	*30*

Det	State	Dead	CPU	Evts	Evts In	Hz	MB/s EVB	Err	MB/s RDO
TOF	RUNNING	7 %	15 %	929880	0	2213	6.6	0	6
BTOW	RUNNING	9 %	15 %	1640201	0	3779	37.0	0	37
Trigger	RUNNING	0 %	-1 %	1794146	1	4210	15.1	0	0
ETOW	RUNNING	9 %	14 %	1637238	0	3862	8.1	0	8
PP2PP	RUNNING	15 %	54 %	550753	0	1317	3.0	0	2
BSMD	READY	0 %	0 %	0	0	0	0.0	0	0
ESMD	RUNNING	10 %	57 %	1637885	0	3847	71.4	0	71
TPX	RUNNING	12 %	85 %	645126	34	1554	1586.7	25	15590
MTD	RUNNING	4 %	14 %	643812	0	1541	1.6	0	1
GMT	RUNNING	2 %	13 %	111986	0	270	6.5	0	6
L4	RUNNING	0 %	0 %	-1/146680	17	322	361.9	0	362
FPS	RUNNING	-1 %	56 %	1386445	0	3243	4.8	5	4
RHICF	READY	0 %	0 %	471	0	0	0.0	0	0
ETOF	RUNNING	2 %	41 %	644647	0	1548	0.6	0	0
FCS	RUNNING	0 %	16 %	2793	0	6	0.0	0	0
iTPC	RUNNING	-1 %	11 %	19098	0	43	0.0	0	0

Evb	State	Built	EvtsIn	Err	Hz	MB/s	Written	Free GB	RCF W+S
evb01	RUNNING	181503	20	3	414	171.4	0 GB	6876 [93%]	26+91
evb02	RUNNING	181498	18	3	410	167.1	0 GB	6839 [94%]	25+90
evb03	RUNNING	181973	25	3	422	195	0 GB	6897 [94%]	23+85
evb04	RUNNING	181584	11	6	427	193.6	0 GB	8635 [94%]	25+102
evb05	RUNNING	190419	18	4	448	165.3	0 GB	13800 [94%]	36+77
evb06	RUNNING	190708	10	3	445	187.3	0 GB	13836 [94%]	29+77
evb07	RUNNING	190704	19	3	437	187.6	0 GB	9690 [94%]	20+87
evb08	RUNNING	190421	18	2	452	179	0 GB	10367 [94%]	25+83
evb09	RUNNING	190525	24	2	430	174	0 GB	10331 [93%]	33+85
evb10	RUNNING	114833	10	1	262	110.4	0 GB	7639 [69%]	686+106
ALL		*1794168*	*173*	*30*	*4147*	*1730.7*	*0 GB*	*94910 [91%]*	*928+883*

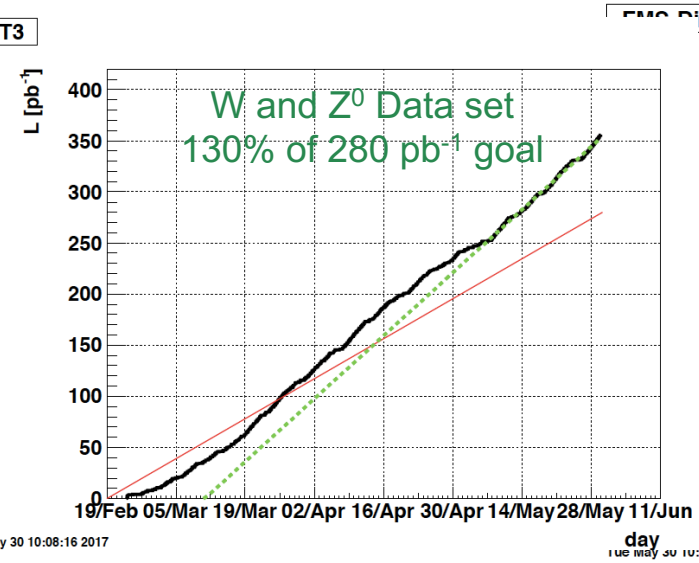
41 Triggers Running at a total of about 4200 Hz, accumulating ~ 1.7 GB/sec!

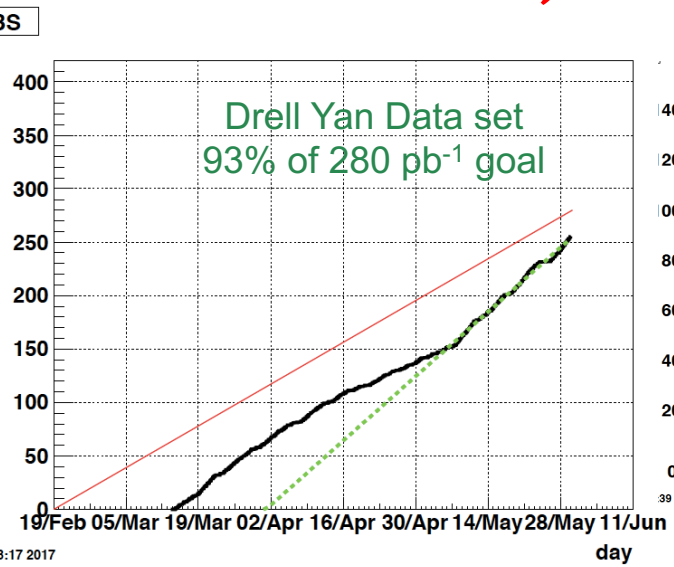
Bandwidth Allocation at 4000Hz

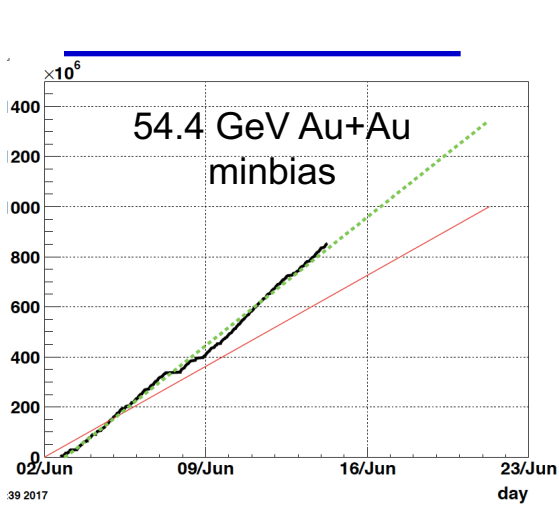


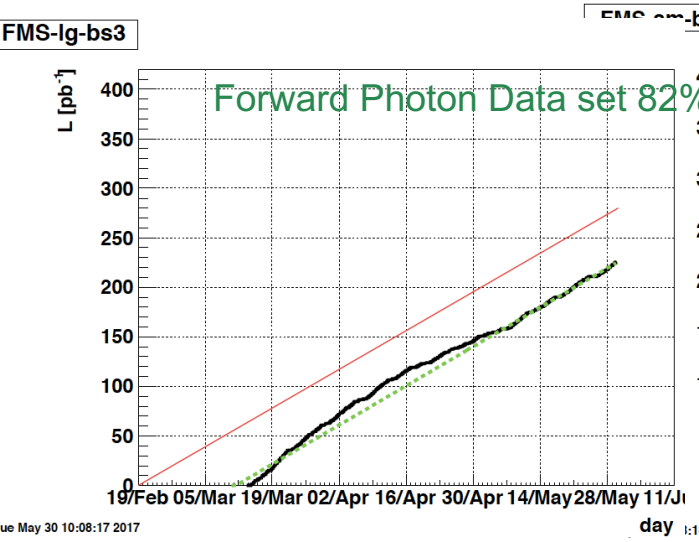
Store from May 9th; https://online.star.bnl.gov/RTS/plotdata/storedPlots2017.php

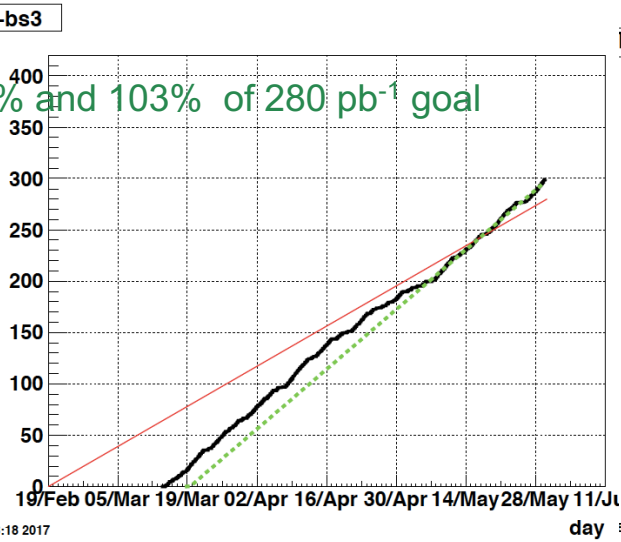
Run 17 Datasets and Projections

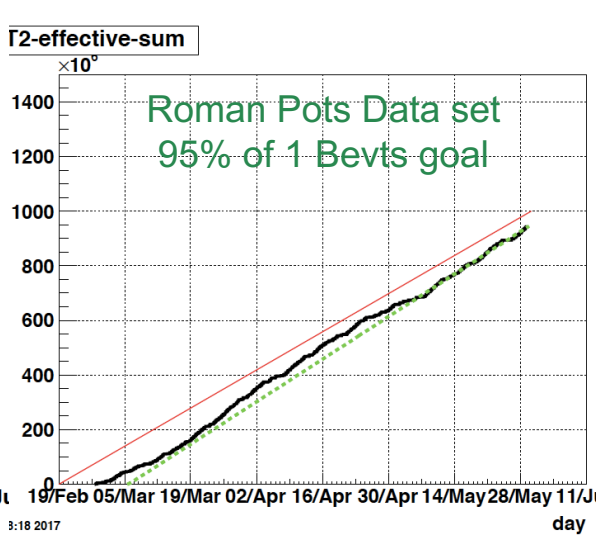












Key: ——— = Goal ——— = Data to date ——— = Projection

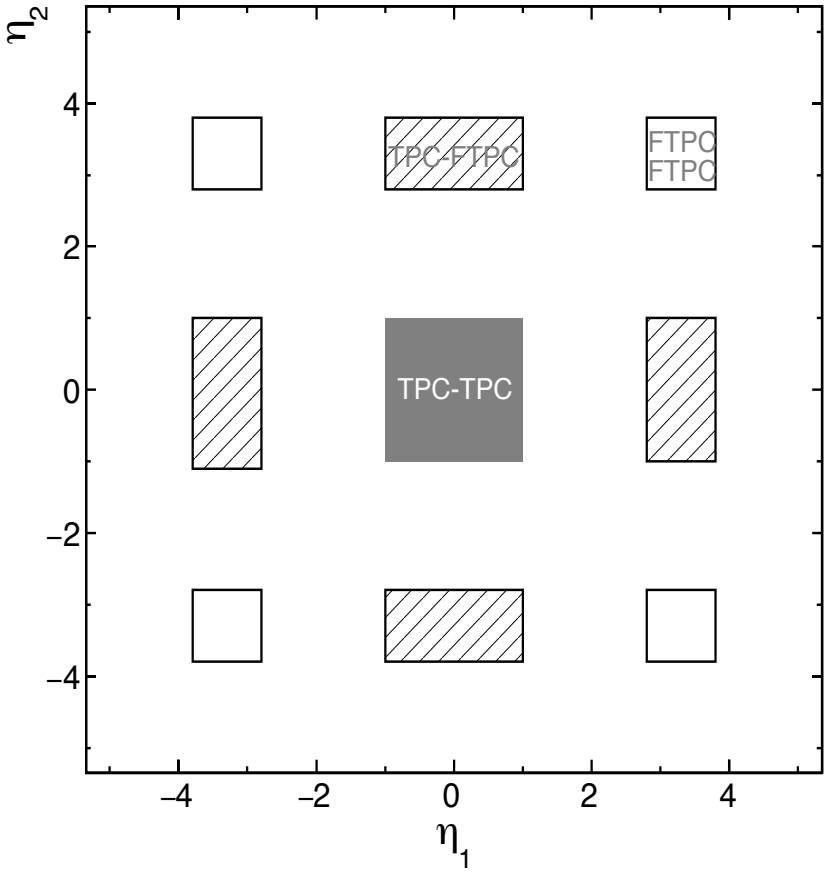
Summary

- Successful run17 (thanks CAD)
- Compelling Spin Program in run17
  Three measurements related to TMD evolution and sign change
  (A_N $W^{+/-}$, γ, DY)
- Compelling Heavy-Ion Programs for run 18
  - Decisive test of Chiral Magnetic Effect
  - Quantifying the role of external field in Global Hyperon Polarization
  - Bridge the BES-II and world programs (HADES/CBM/NICA/JPARC) with competitive FXT program
- Preparation for BES-II
  - Science cases
  - Detector upgrades
  - New compelling and complimentary measurements (FXT)
- and beyond
  (3+1D hydro and Cold QCD)
- Maintain track record in Results and Publications
  - Productivities in paper publication and PhD graduations
  - Continue to find external resources (computing), funding (hardware) and attract new members
- Concerns and work in progress
  - Run 17, more than 30 shifts signed up by experienced Russian colleagues (denied entry to BNL)
  - Several (university) detector experts retired; potential single point failures (BNL) persist
  - Maintenance and replacements of aging components (EMC/TRG)
  - Support and guidance for beyond BES-II
  - Budget: potential disastrous funding for Spin (Cold QCD) and HI incapacirate RHIC/STAR program

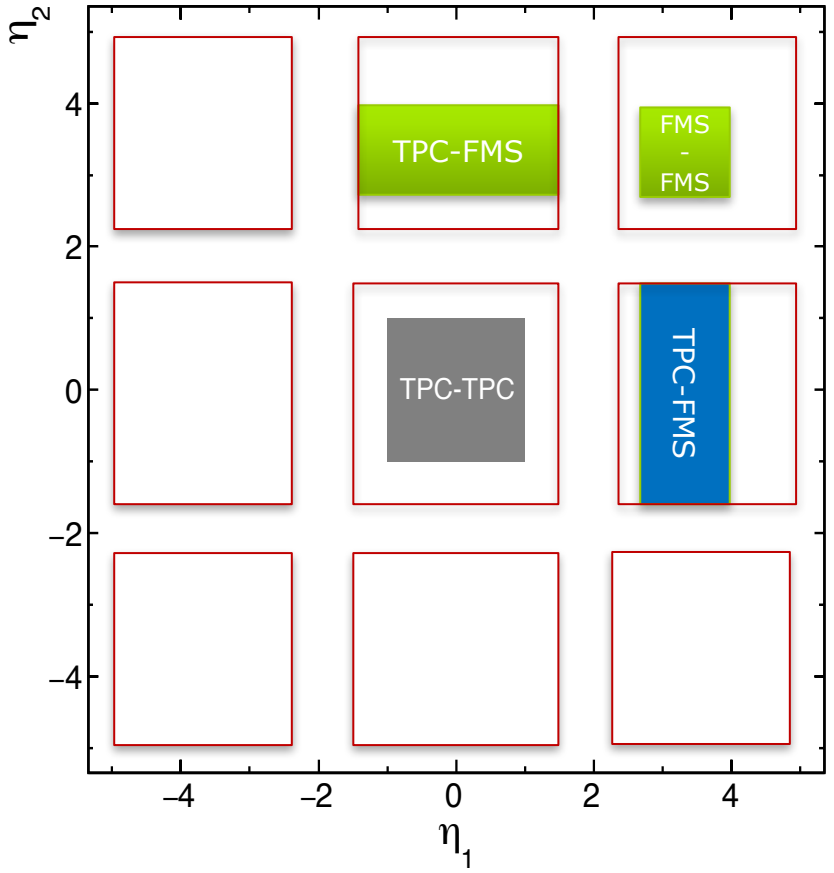
Backup slides

Rapidity Coverage (BES-II)

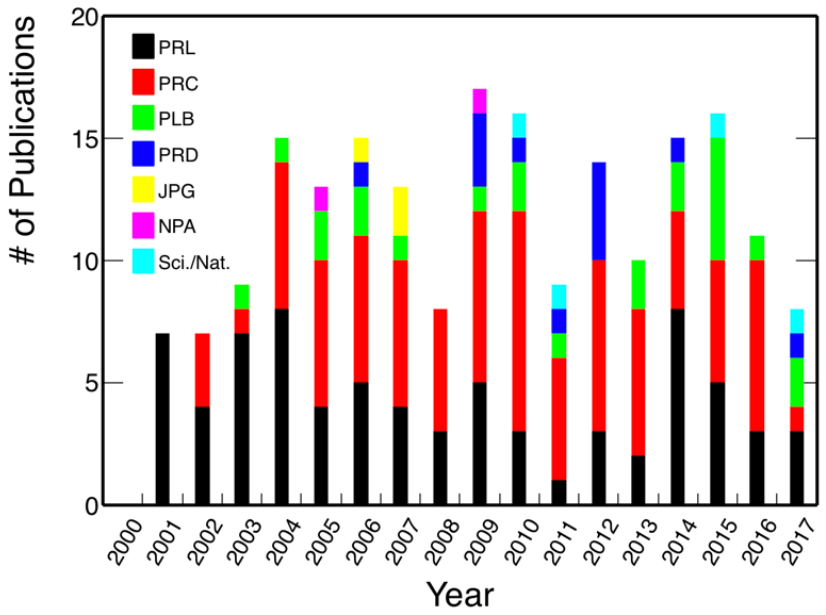
TPC+fTPC (2001-2012)



TPC+iTPC+eTOF+EPD+FMS (2019--)



STAR Collaboration Status



Total refereed publications: 200

Total PHD Graduations: 248

Total Citations: 25111

April 2014 – May 2017

- 45 refereed publications
- 50 PhD graduation;
  18 PhD since June 2016

In progress:

- 6 in journal review
- 12 in collaboration (GPC) review process

Helen Caines and Zhangbu Xu were elected as co-spokespersons by the STAR Institution Council; New management in July 1, 2017

Data Analyses and publications:
Helen Caines' talk

12 Institutions joined since 2014:
SBU, SCSU, Lamar, NCKU, WLCAPP, Lehigh, UCR, TDU, Tsukuba, Heidelberg, Rutgers, Fudan
RHICf*, CBM*

Data production and priorities

Year	Species	Total #of events (M)	%tage events completed	Estimate time to delivery (months)	%tage time to completion
16	[summary]	**9126.46**	**49.44**	**3.74**	**60.45**
	Au+Au 200GeV	6543.26	63.25	3.22	
	d+Au 200GeV	1181.10	31.58	0.44	
	d+Au 62GeV	357.91	0.00	0.08	
	d+Au 39GeV	642.12	0.00	0.08	
	d+Au 20GeV	402.08	0.00	$<$ 0.08	
15	[summary]	**10997.37**	**84.31**	**0.75**	**86.89**
	p+p 200GeV	6329.66	93.70	*0.19*	
	p+Au 200GeV	3647.70	78.76	0.33	
	p+Al 200GeV	1015.11	45.61	0.24	
	fixed Target	4.76	100.00	0.00	
14	[summary]	**6718.09**	**84.66**	**0.39**	**90.85**
	Au+Au 200GeV	5045.59	96.79	*0.22*	
	He3+Au 200GeV	1260.30	31.29	0.18	
	Au+Au 14.6GeV	412.20	99.38	*0.00*	

RCF time

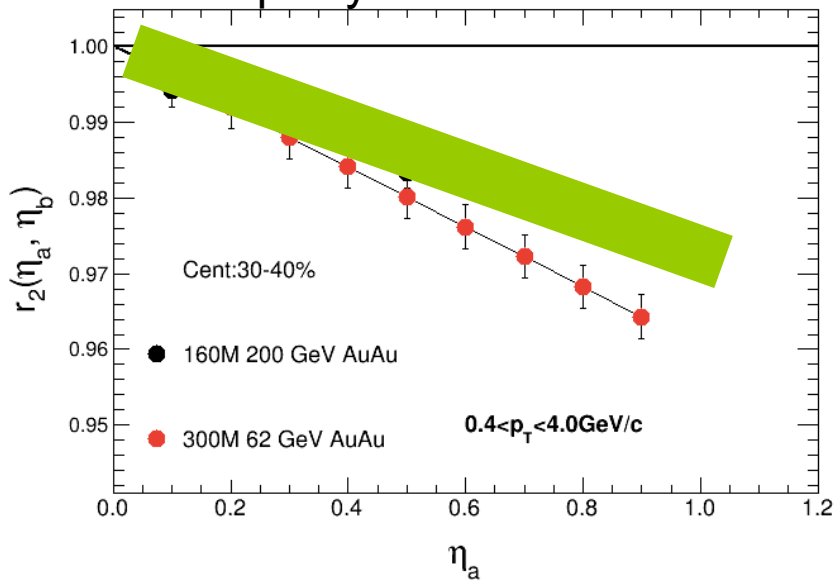
Year	Species	RAW space [PB]	MuDST space [PB]	picoDST [PB]	MuDST total space [PB]	picoDST total space [PB]	Total reco time, 1.5 passes [m]	Required (+calib time) [m]
					8.5	***1.31***		
16	200 GeV Au+Au	6.96	4.88	0.70	**9.28**	**2.09**	14.04	**15.20**
	200 GeV d+Au	0.43	0.53	0.08			1.04	
	Low energy d+Au	0.14	0.06	0.01			0.12	
17	500 GeV p+p	4.85	2.65	0.41	**12.53**	**2.59**	11.4	**15.34**
	Low energy Au+Au (27 GeV or 1/2 time 62 GeV)	1.2	0.6	0.09			1.45	
18	27 GeV Au+Au	0.32	0.22	0.03	**12.76**	**2.82**	0.42	**6.48**
	200 GeV Ru+Ru	0.88	0.65	0.10			1.53	
	200 GeV Zr+Zr	0.88	0.65	0.10			1.53	
19/20	Various Au+Au BES-II	0.35	0.25	0.04	**13.01**	**2.86**	1.45	**2.95**

Production computing resources:
RCF, NERSC/Cori, Dubna

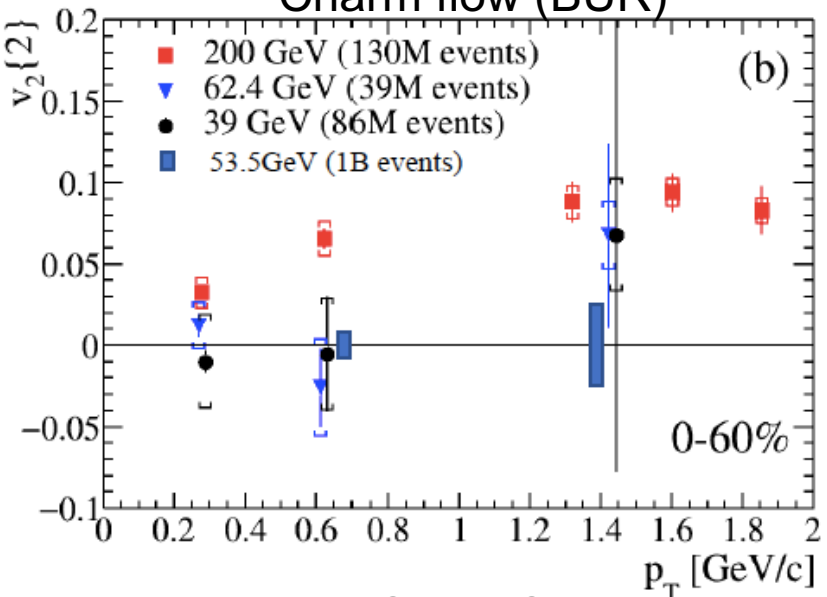
Utilize picoDST for run 16 (and on) production;
Migration of other datasets to picoDST on disk

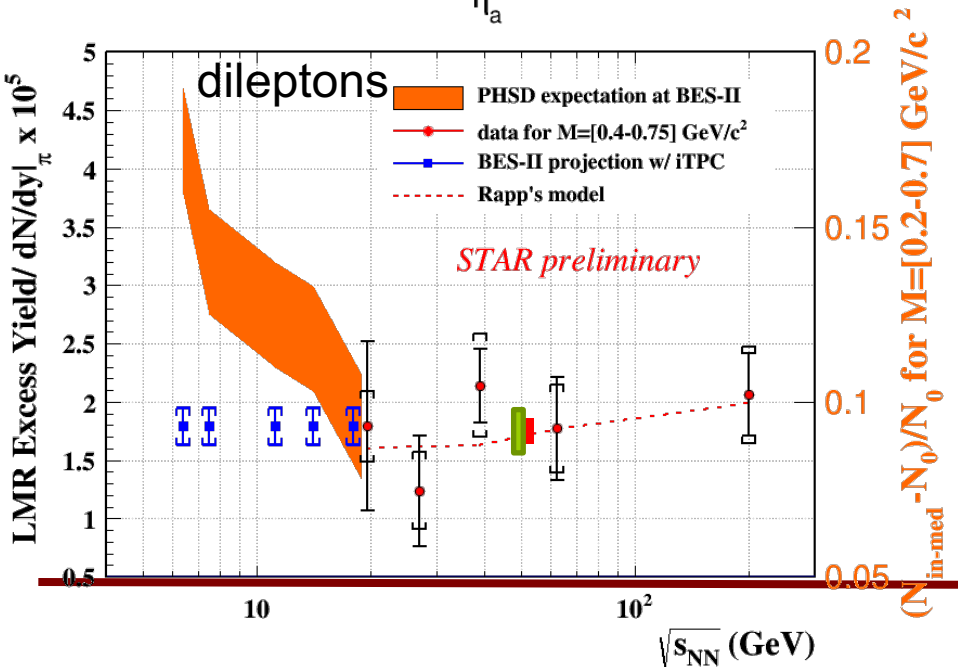
3 weeks Au+Au at 54.4GeV

Rapidity decorrelation



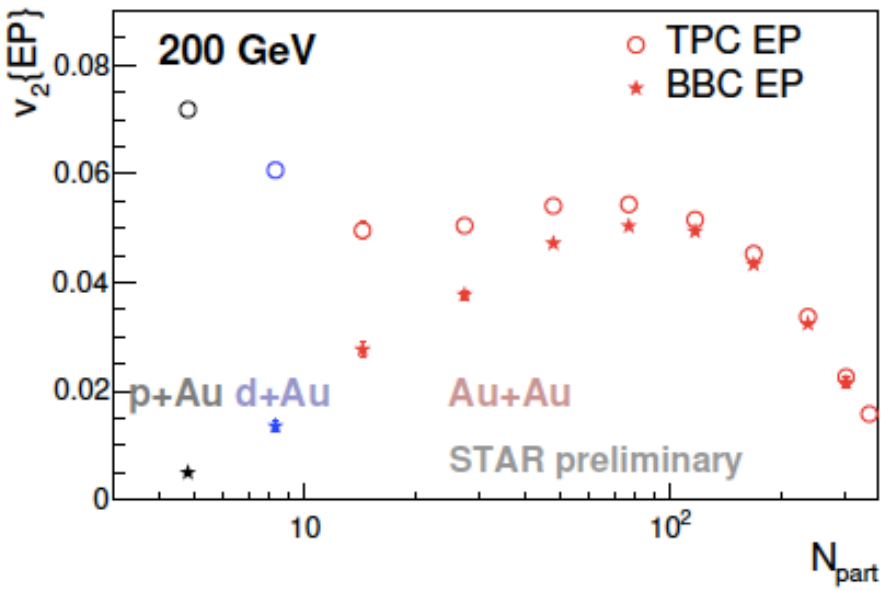
Charm flow (BUR)





In summary, RHIC and STAR are progressing well toward reaching the highest priority goals for RHIC run 17 by May 30. The proposed continued beam operation between June 1 and July 3 will provide unique opportunities for RHICf, CeC, and a dataset crucial for studying the 3-dimension structure of QGP hydrodynamics as well as providing potentially valuable insights to the rare probes at low beam energies.

Dependence of v2 and g on EP



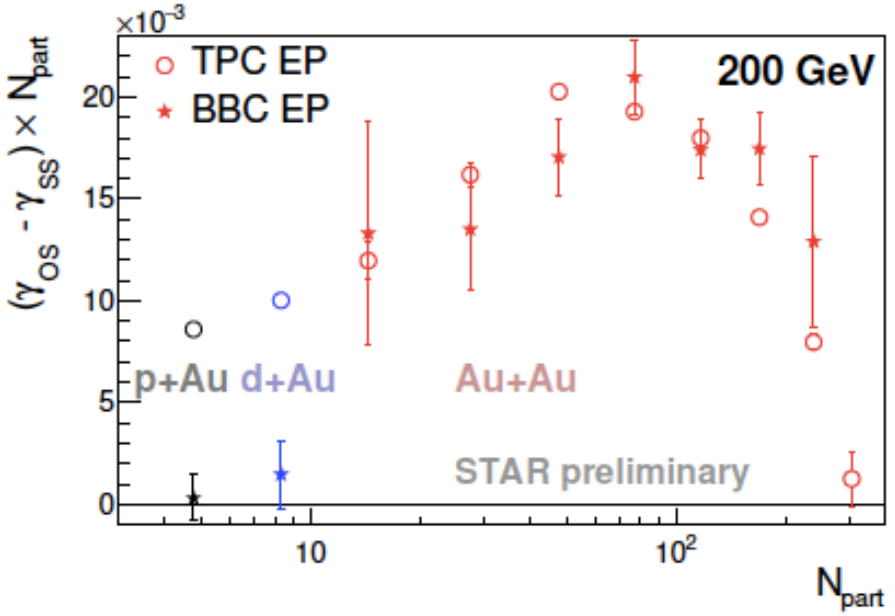


Figure 23: v_2 (left) and $(\gamma_{OS} - \gamma_{SS}) \times N_{part}$ (right) for p+Au, d+Au and Au+Au collisions at 200 GeV, measured with event planes from both TPC and BBC.

κ for all energies

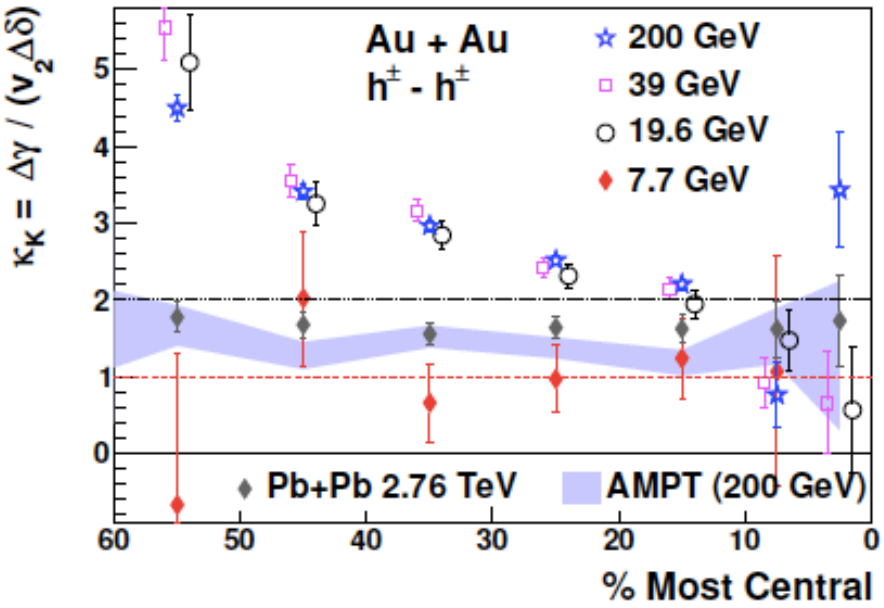


Figure 24: κ_K vs centrality for Au+Au collisions at 200, 39, 19.6 and 7.7 GeV [80], and for Pb+Pb collisions at 2.76 TeV [81]. The AMPT calculations are also plotted for Au+Au at 200 GeV in comparison.

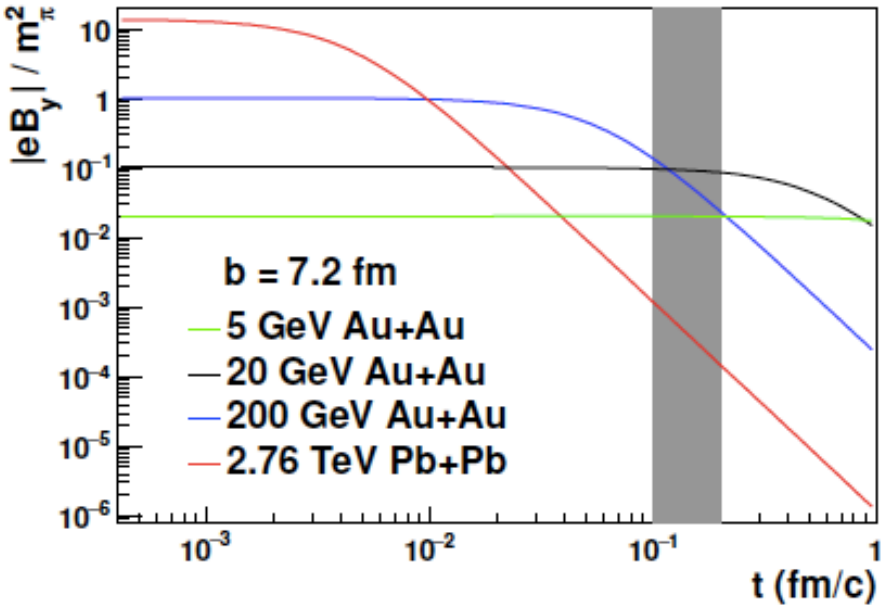
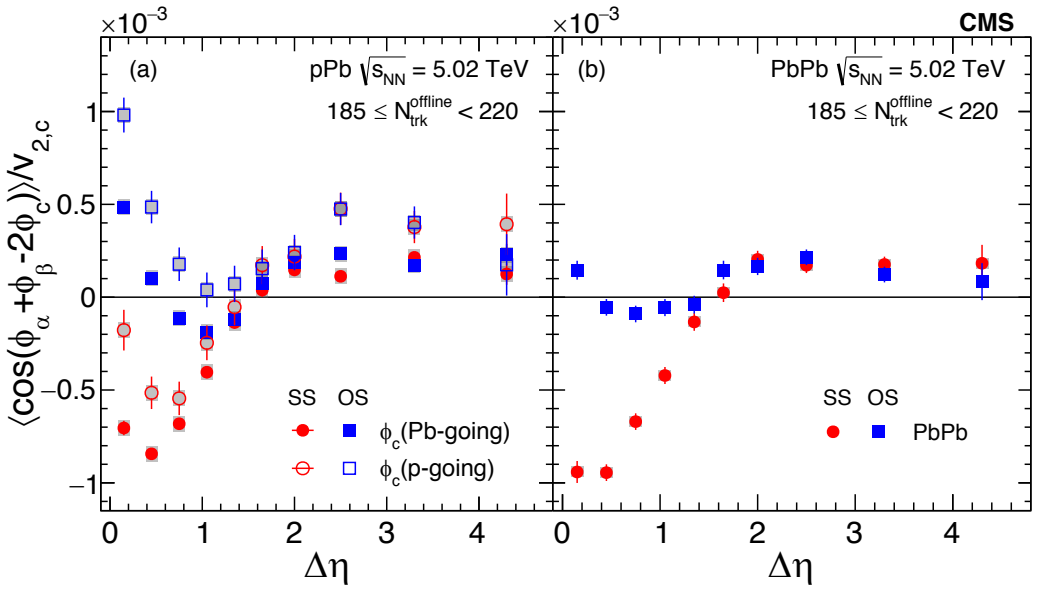
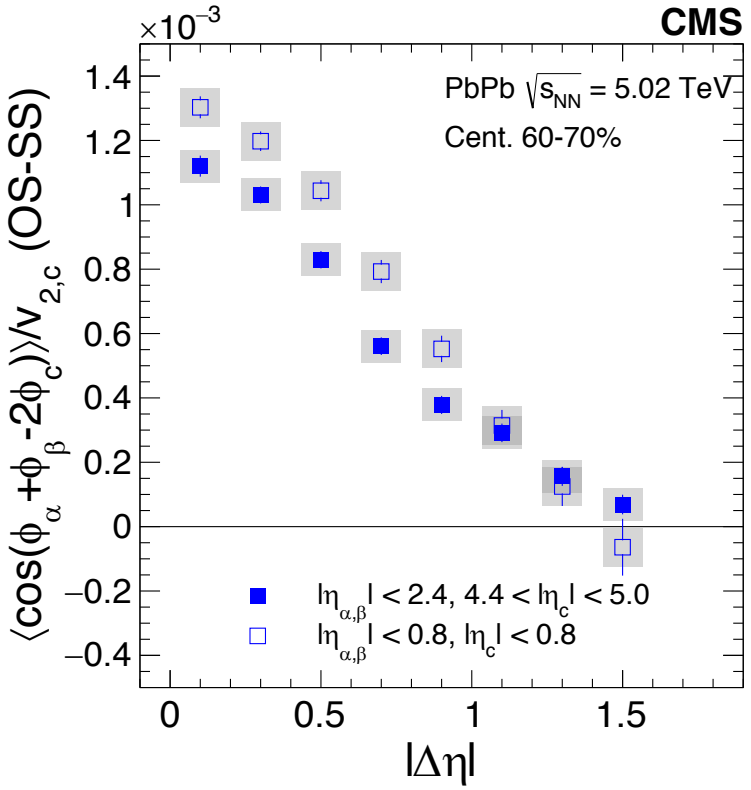


Figure 25: Magnetic field in a vacuum as a function of the evolution time for Au+Au at 5, 20 and 200 GeV and Pb+Pb at 2.76 TeV [82]. The gray band indicates the presumable initial quark production.


CMS
(a)
pPb $\sqrt{s_{NN}}$ = 5.02 TeV
185 ≤ $N_{trk}^{offline}$ < 220
(b)
PbPb $\sqrt{s_{NN}}$ = 5.02 TeV
185 ≤ $N_{trk}^{offline}$ < 220
SS OS
ϕ_c(Pb-going)
ϕ_c(p-going)
PbPb
$\times 10^{-3}$
$\langle\cos(\phi_\alpha+\phi_\beta-2\phi_c)\rangle/v_{2,c}$
$\Delta\eta$


CMS
PbPb $\sqrt{s_{NN}}$ = 5.02 TeV
Cent. 60-70%
$|\eta_{\alpha,\beta}| < 2.4$, $4.4 < |\eta_c| < 5.0$
$|\eta_{\alpha,\beta}| < 0.8$, $|\eta_c| < 0.8$
$\times 10^{-3}$
$\langle\cos(\phi_\alpha+\phi_\beta-2\phi_c)\rangle/v_{2,c}$ (OS-SS)
$|\Delta\eta|$