Run 18 summary and run 19 BUR

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- Overview of STAR run 18
- Run 19 STAR BUR Request
- Run 18 operation lessons and run 19 BUR updates
- Summary

RHIC Retreat meeting, July 13, 2018

Run 18 Beam Use Request

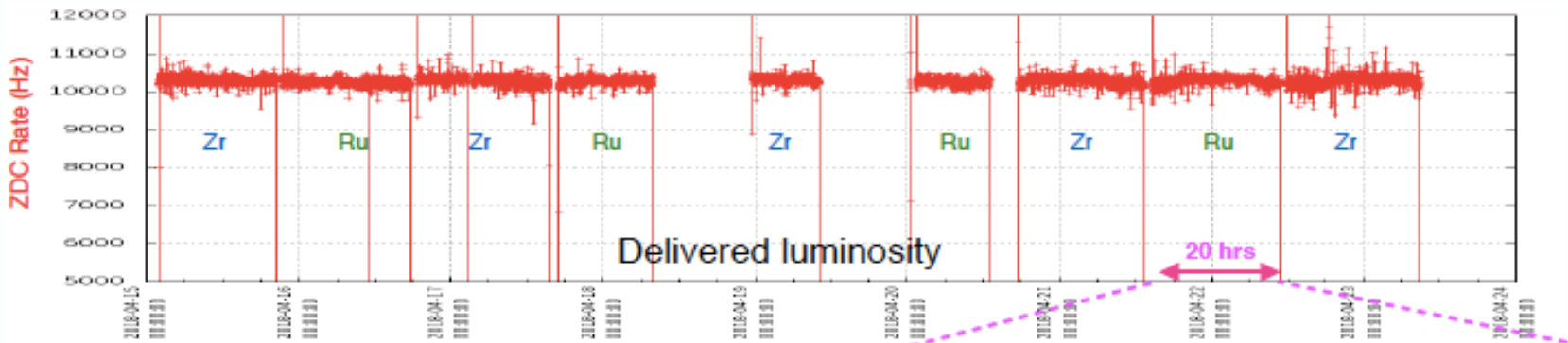
Energy	Duration	System	Goals	priority	Sequence
$\sqrt{s_{NN}}$=200 GeV	3.5-wk	Zr+Zr	1.2B min-bias	1	1
	3.5-wk	Ru+Ru	1.2B min-bias	1	2
$\sqrt{s_{NN}}$=27 GeV	3-wk	Au+Au	1B min-bias	2	3
$\sqrt{s_{NN}}$=3 GeV(FXT)	2 days	Au+Au	100M min-bias	3	4

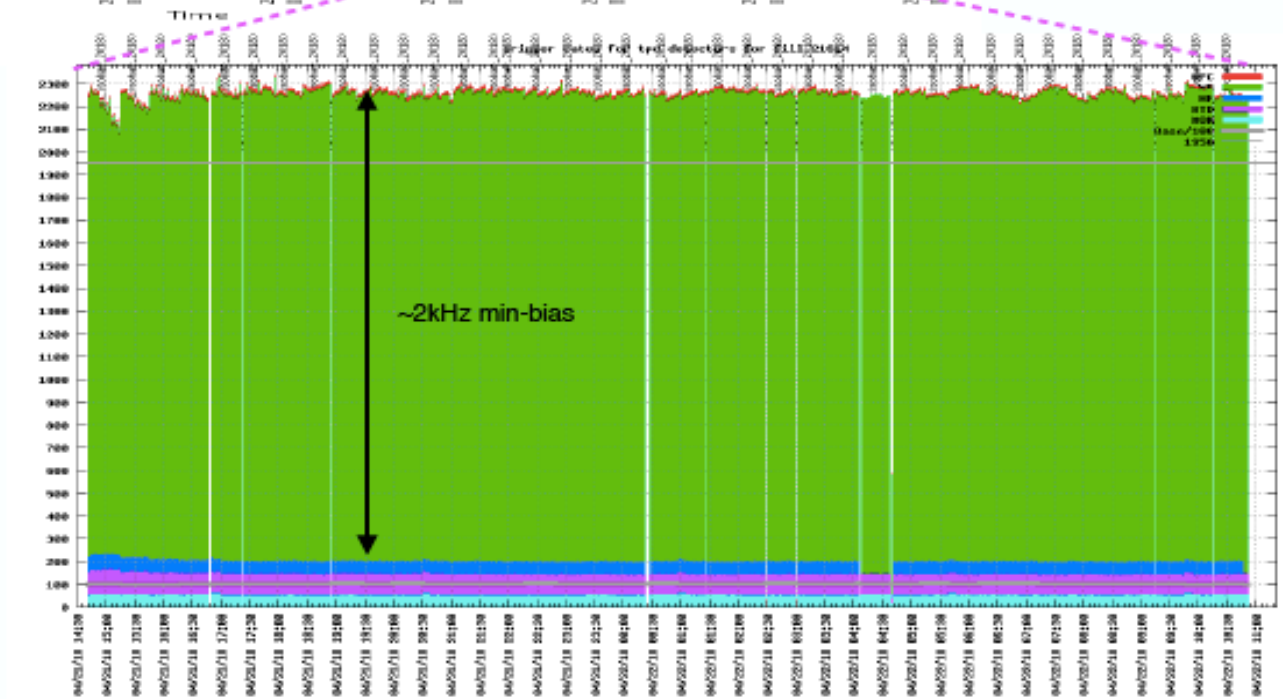
Assuming 15 cryo-weeks of running (including CeC test)

PAC recommendations consistent with STAR requests

Did not know we could switch fill-by-fill between Zr and Ru before the same retreat last year

Data taking for isobar collisions: ZrZr, RuRu at $\sqrt{s_{NN}}$=200 GeV



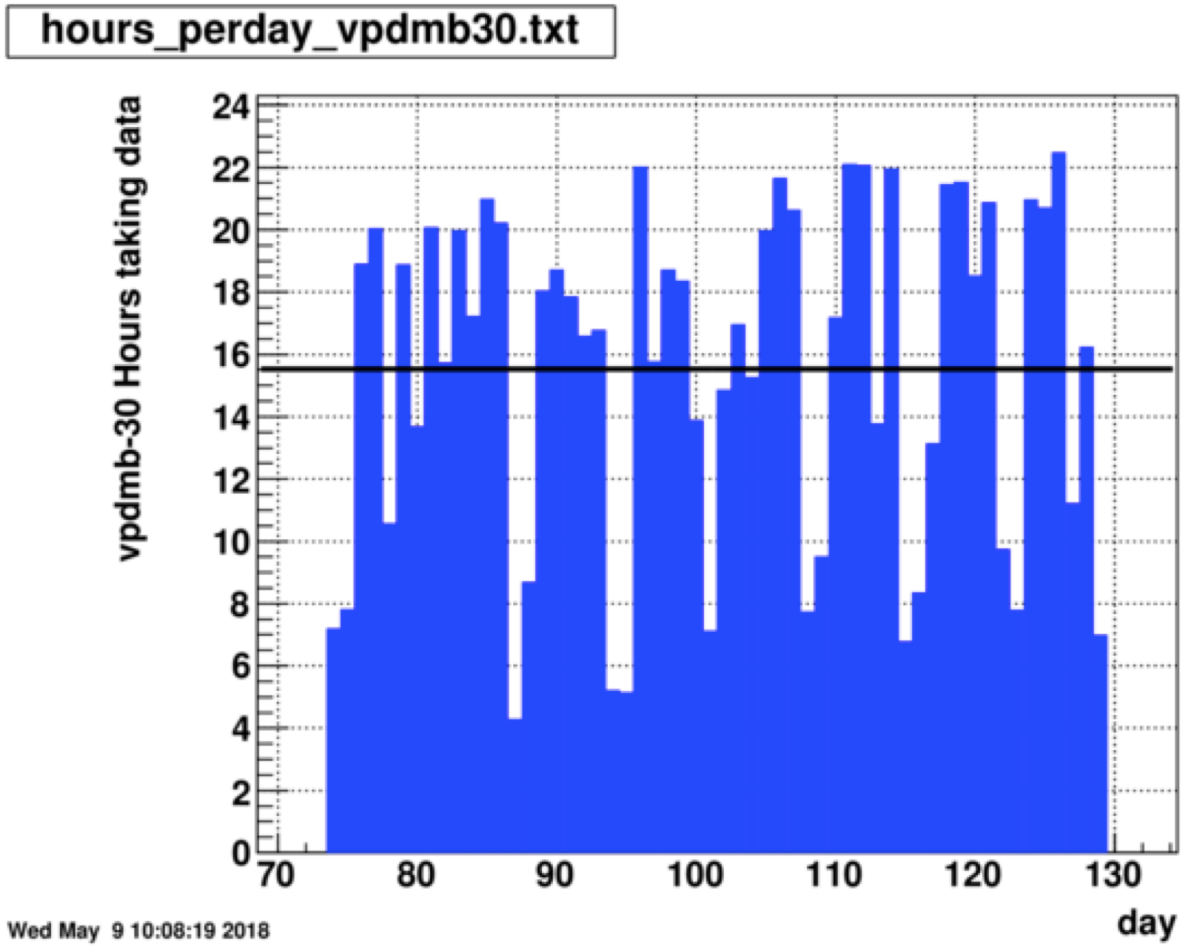


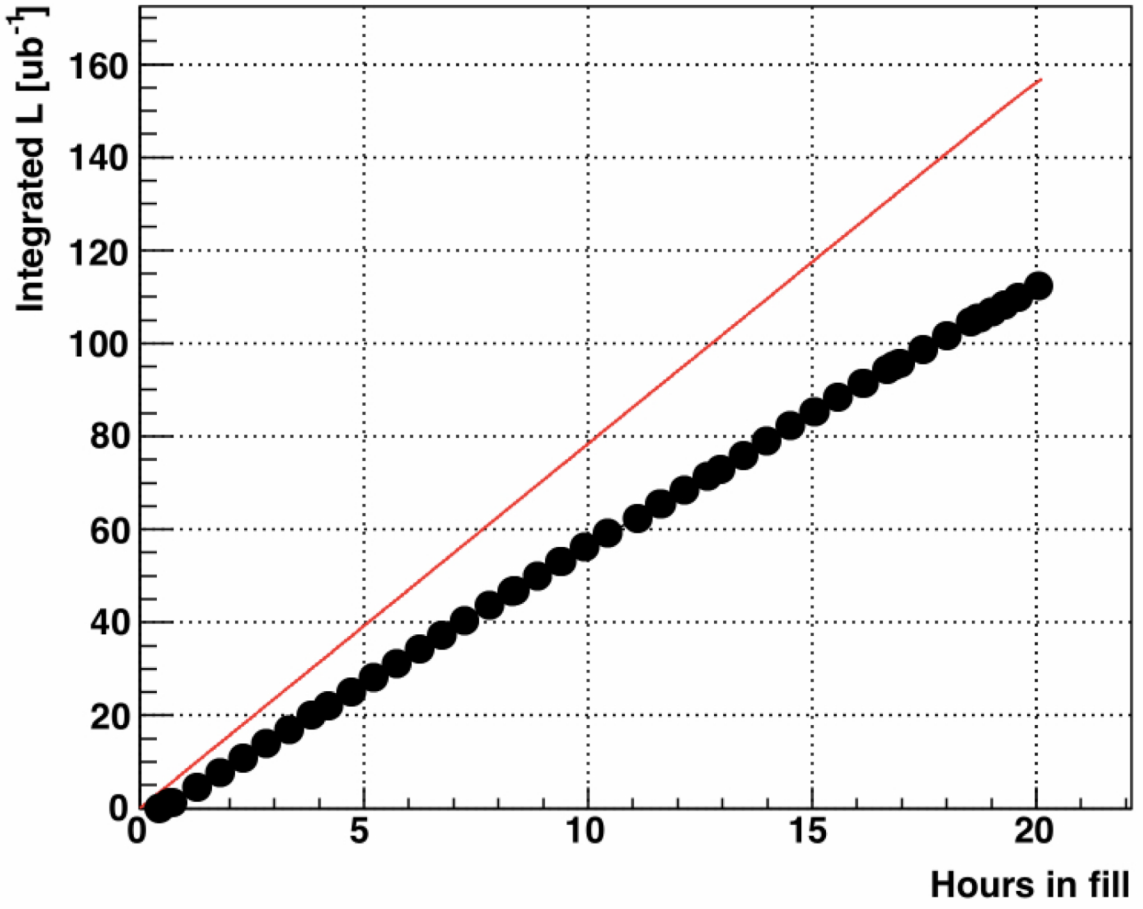
STAR Data Acquisition Rates

- Consistently stable luminosity with long (~20 hr) store length
- Min-bias data taking rates ~2k Hz (initial estimate 1.5k Hz)
- "Blind" offline data analysis (Zr vs Ru) will be performed

JH Lee, RHIC/AGS Users Meeting
June 2018

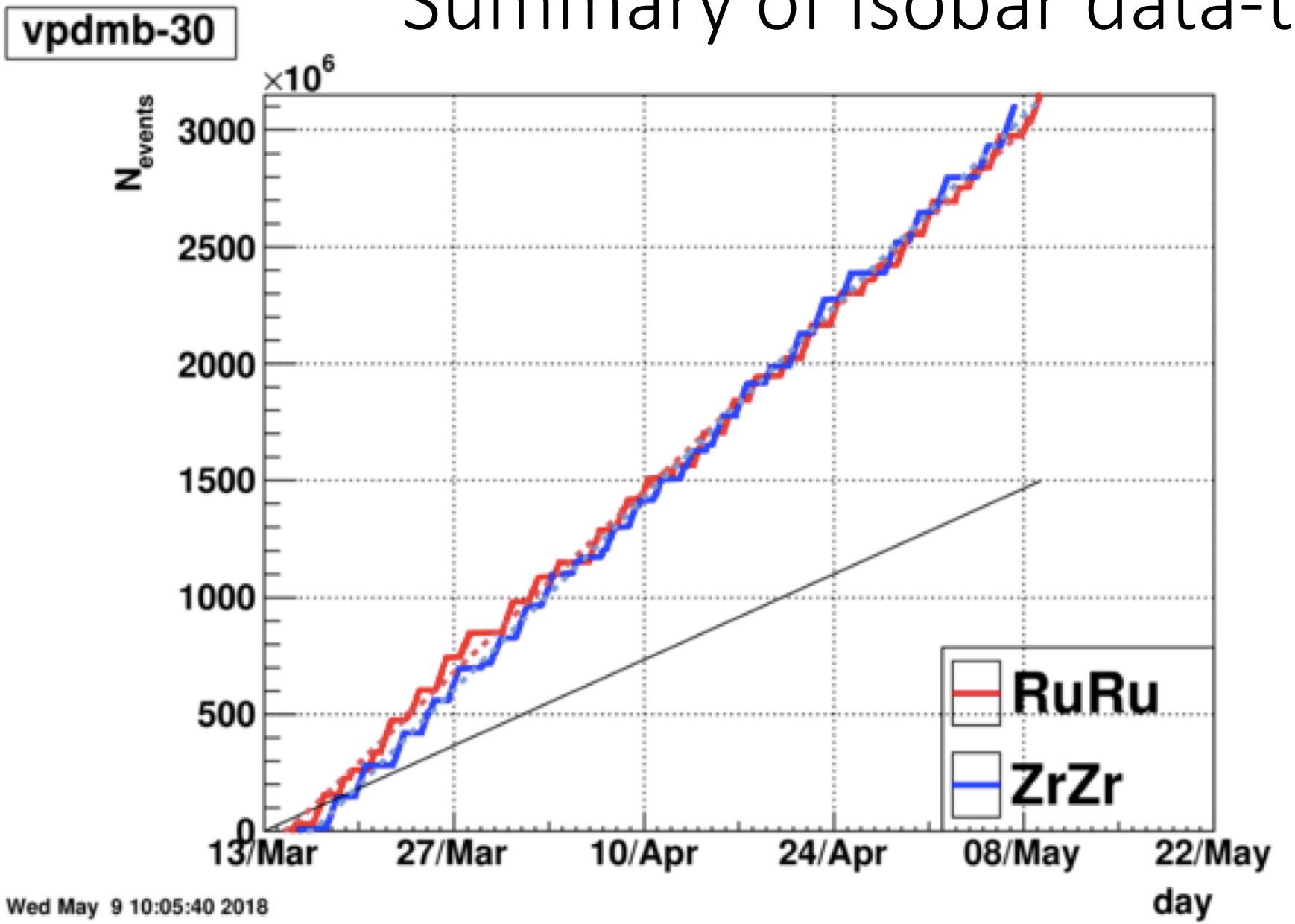
Data-taking performance





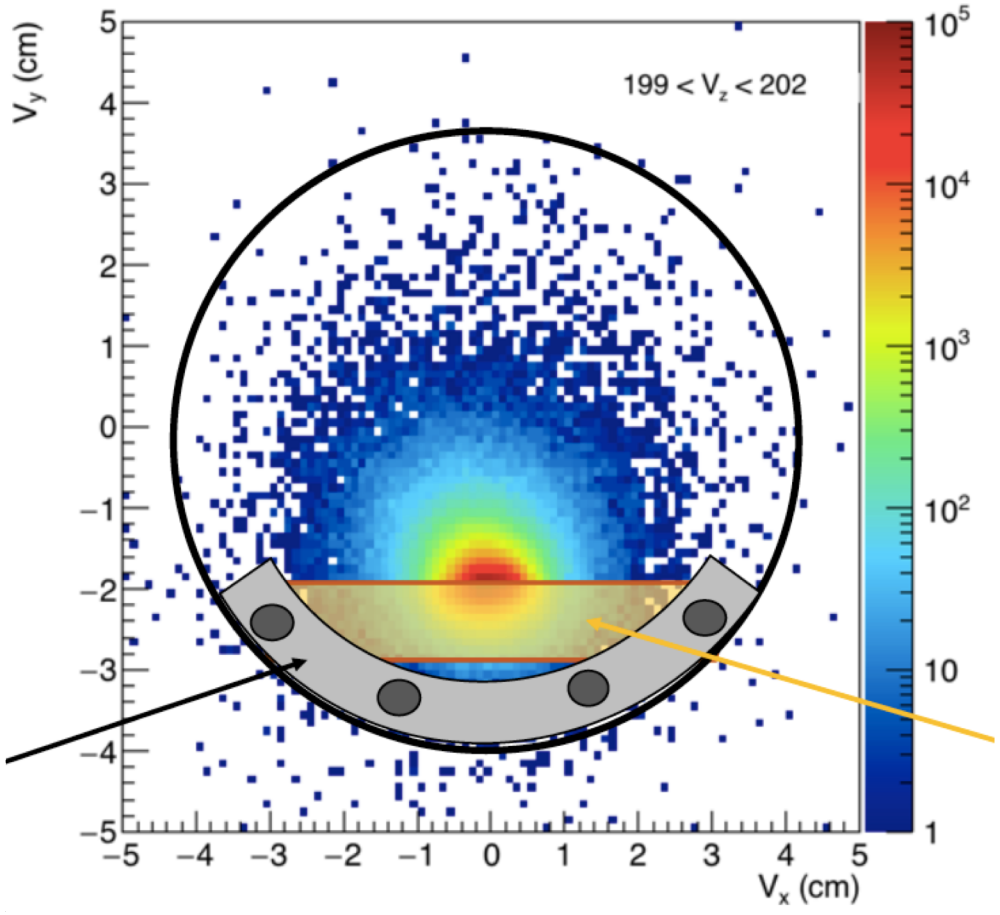
Stable and repetitive

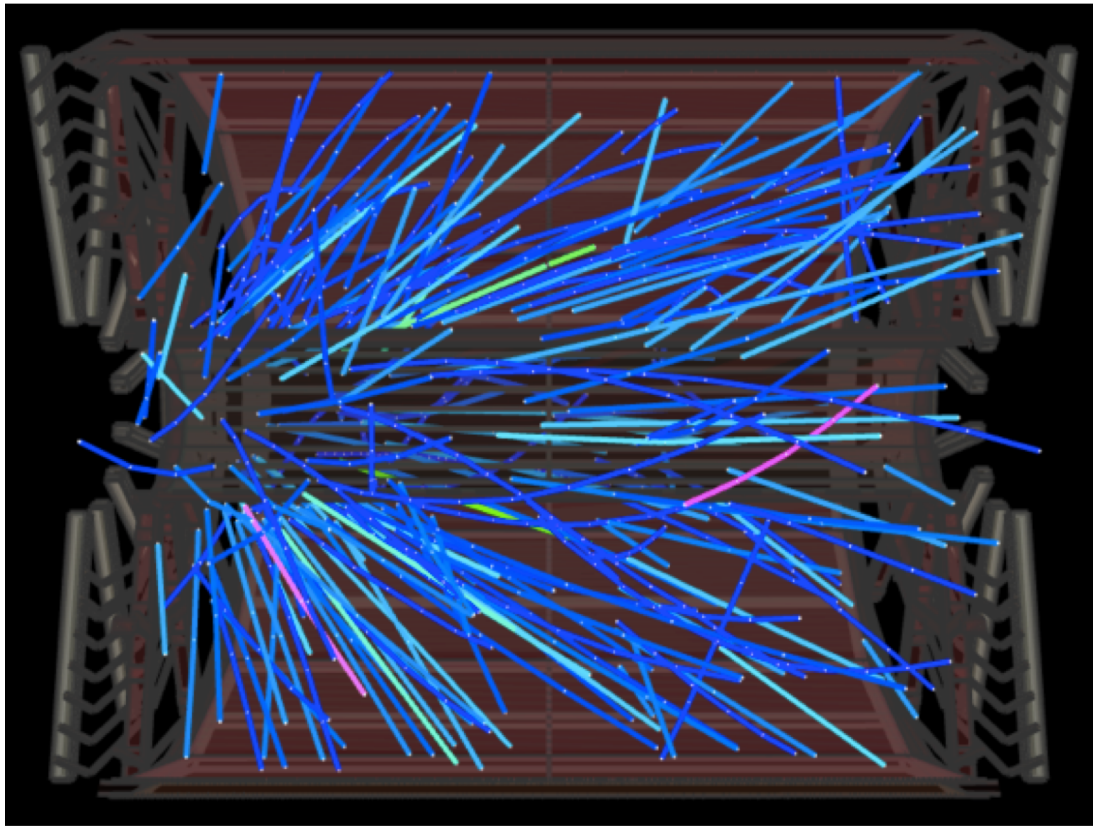
Summary of Isobar data-taking



Great run,
Stable beam condition
stable detector systems
Stable DAQ

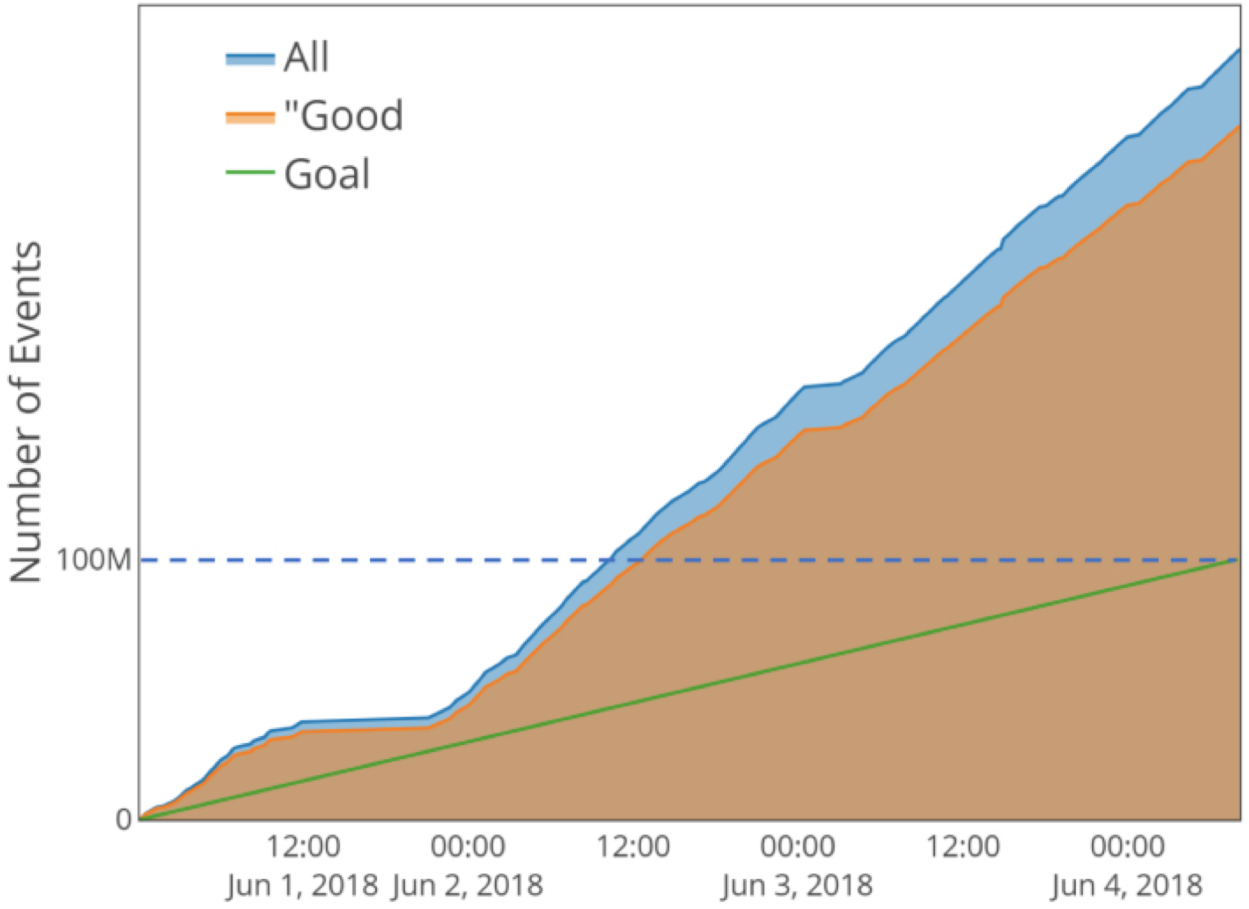
Fixed Target data-taking





Clean (<10%background)
HLT feedthrough to MCR for tuning

Summary of Fixed target data-taking



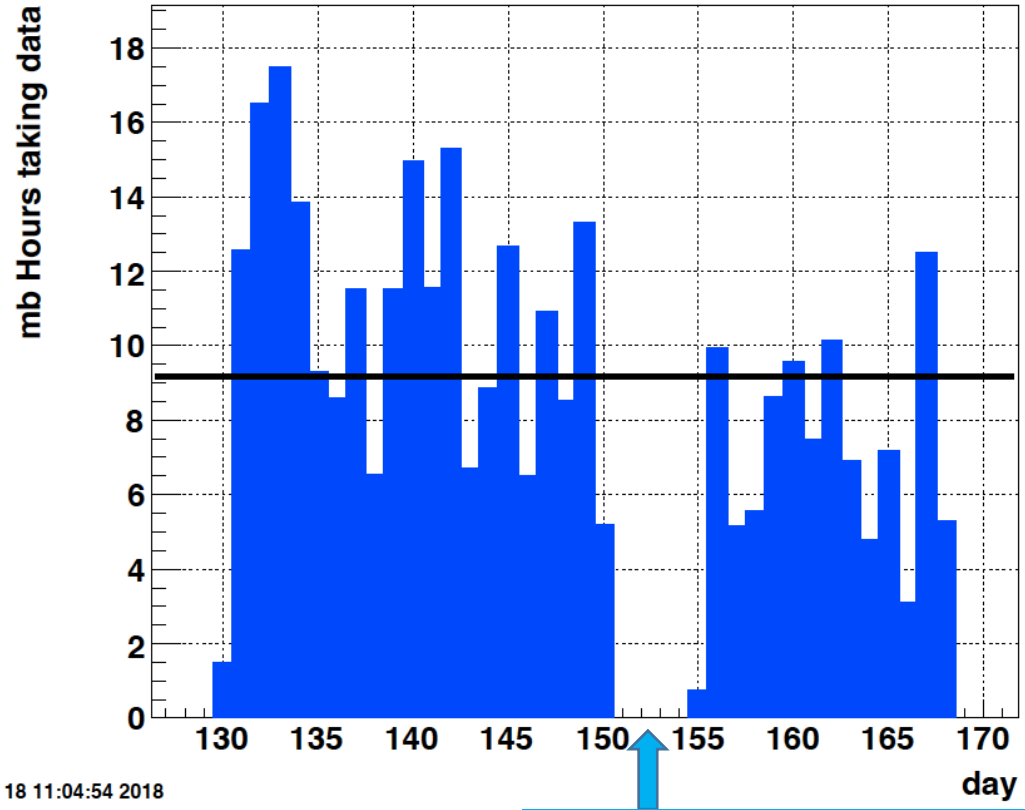
First significant dataset for FXT program
250M good events

Good trigger efficiency,
Stable beam condition

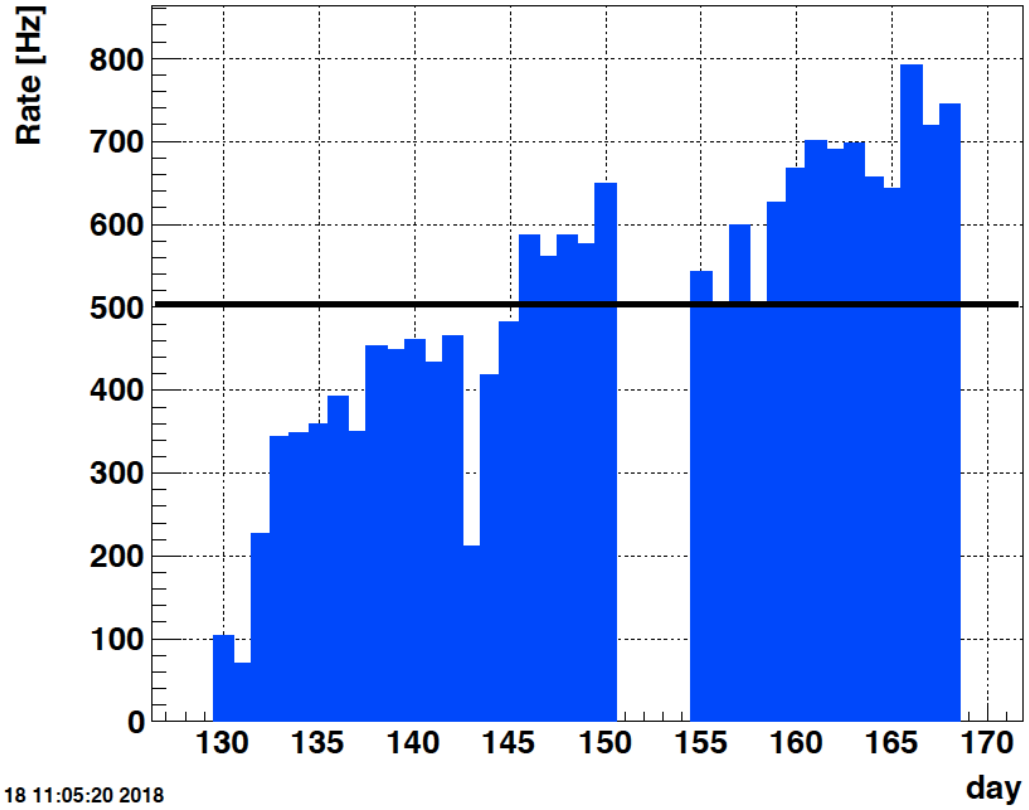
Au+Au@27GeV run statistics

Hours and "Good" event rate per day

hours_perday_mb.txt

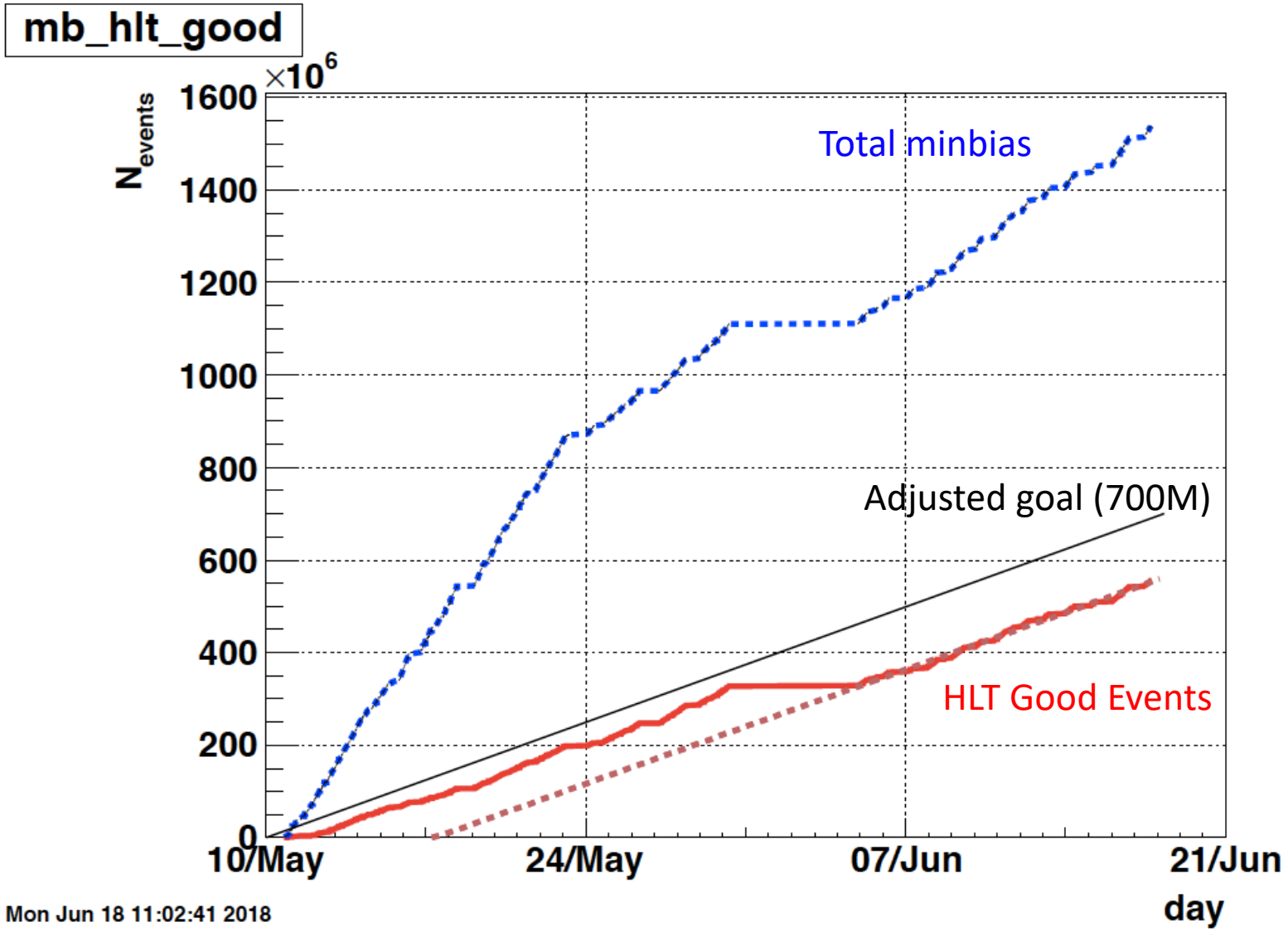


mb_hlt_good Average Rate [Hz]



FXT data-taking and
low-energy beam commissioning

Summary of 27GeV data-taking

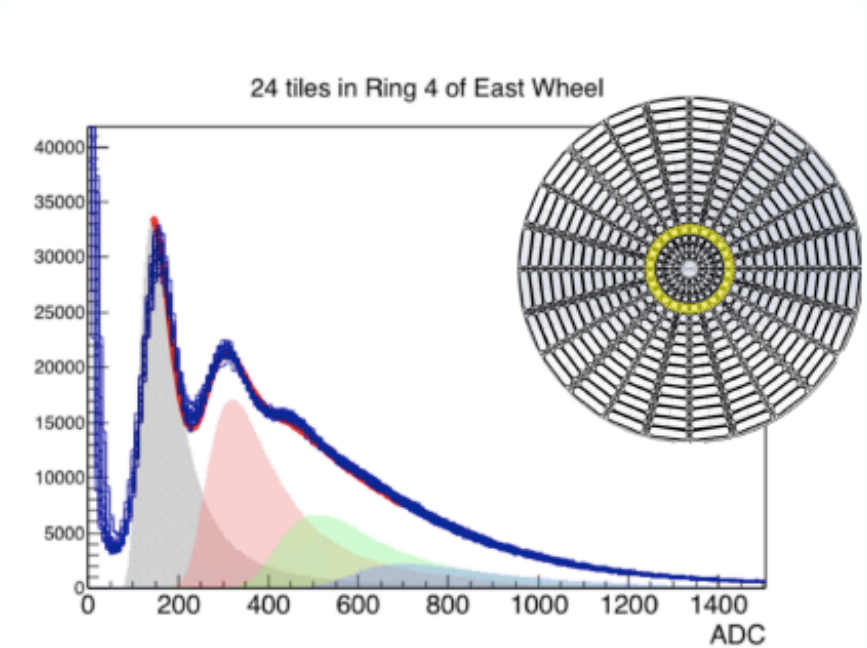


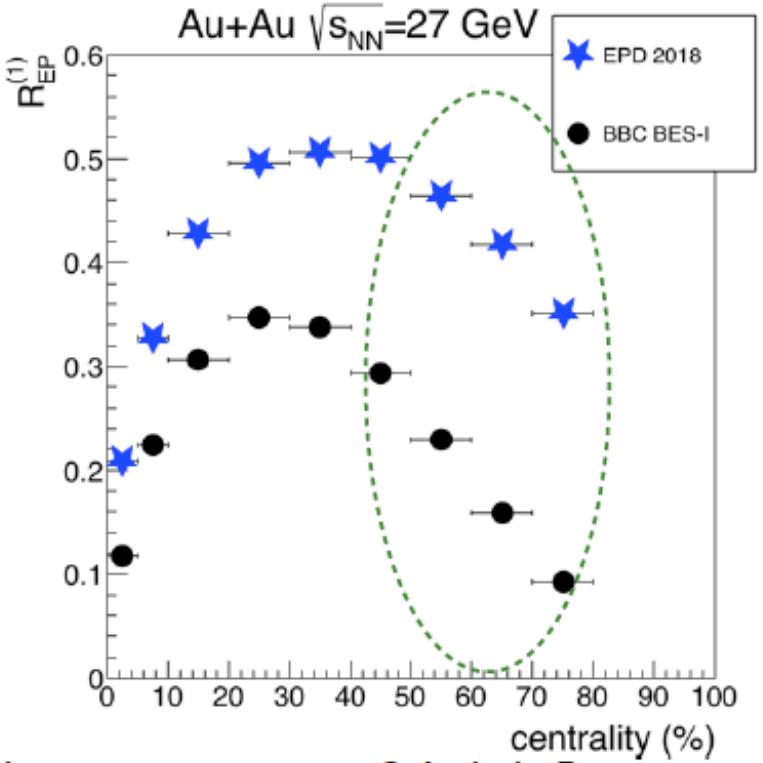
Total minbias dominated by background (~40%) and events outside the vertex cuts of 50cm or 70cm (25%);

Short of our targeted goal of 700M—1000M “good” events

Offline useable events better than our projection

EPD performance: enhanced event plane resolution



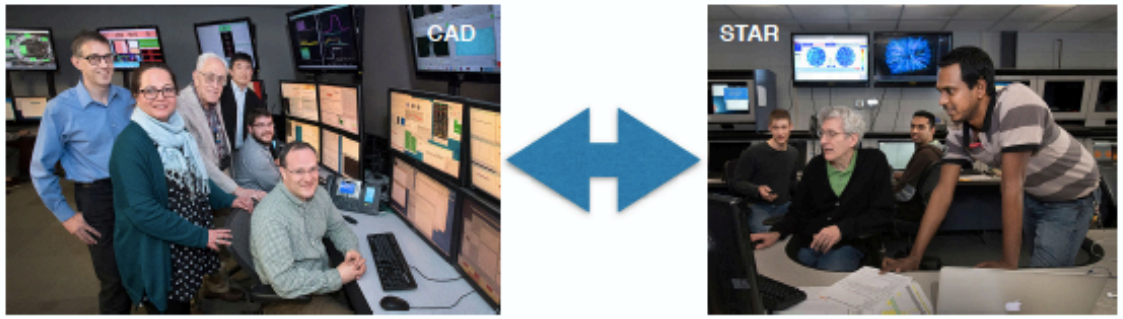


- Fully installed 16 radial and 24 azimuthal sections covering $2.1<|\eta|<5$
- Integrated and operational from the first day of the run
- Extremely uniform response
- Event plane resolution greatly improved especially for peripheral collisions
  - Lambda polarization uncertainty $\delta\mathcal{P} \sim \frac{1}{R_{EP}^{(1)} \times \sqrt{N}}$

Lessons learned from 27GeV data-taking

- Goal was very aggressive, but driven by the physics need
  From CAD projection => 1B without deadtime, vertex and trigger efficiency;
  Delivered Luminosity > CAD projection
- Background is always an issue at low energy:
  random coincidence from background hits in our trigger detectors
  much higher than actual collissions
- ways to reduce background:
  multiplicity threshold (EPD, TOF, BBC),
  detector components used (EPD, BBC, VPD, ZDC)
  Vertex (<50cm, 70cm, 100cm, 150cm)
- Trade off between potential trigger bias and efficiency:
  First week, STAR took data at more inclusive mode and high deadtime;
  Rest of the two weeks, when RHIC started CeC,APEX and LeReC commissioning (and FXT), STAR switched to low deadtime, less background, less inclusive mode
- For BES-II, necessary to decide early on the trade-off:
  continue to have effective communication with CAD through HLT;
  reduce deadtime and background on the main trigger;
  monitor and adjust the trigger condition if necessary

Data taking with effective feedbacks



- Luminosity optimization
  - Collision rates, stability
- Minimizing background at STAR
  - ex: Resolving issues with unexpected background from gap cleaning
- Fast switching between species, beam energies
  - RuRu, ZrZr balancing
  - CeC (Au 26.5 GeV) / AuAu 13.5+13.5GeV
- Beam tuning on fixed target collisions
  - Using "good" event rates (from HLT/online tracking)

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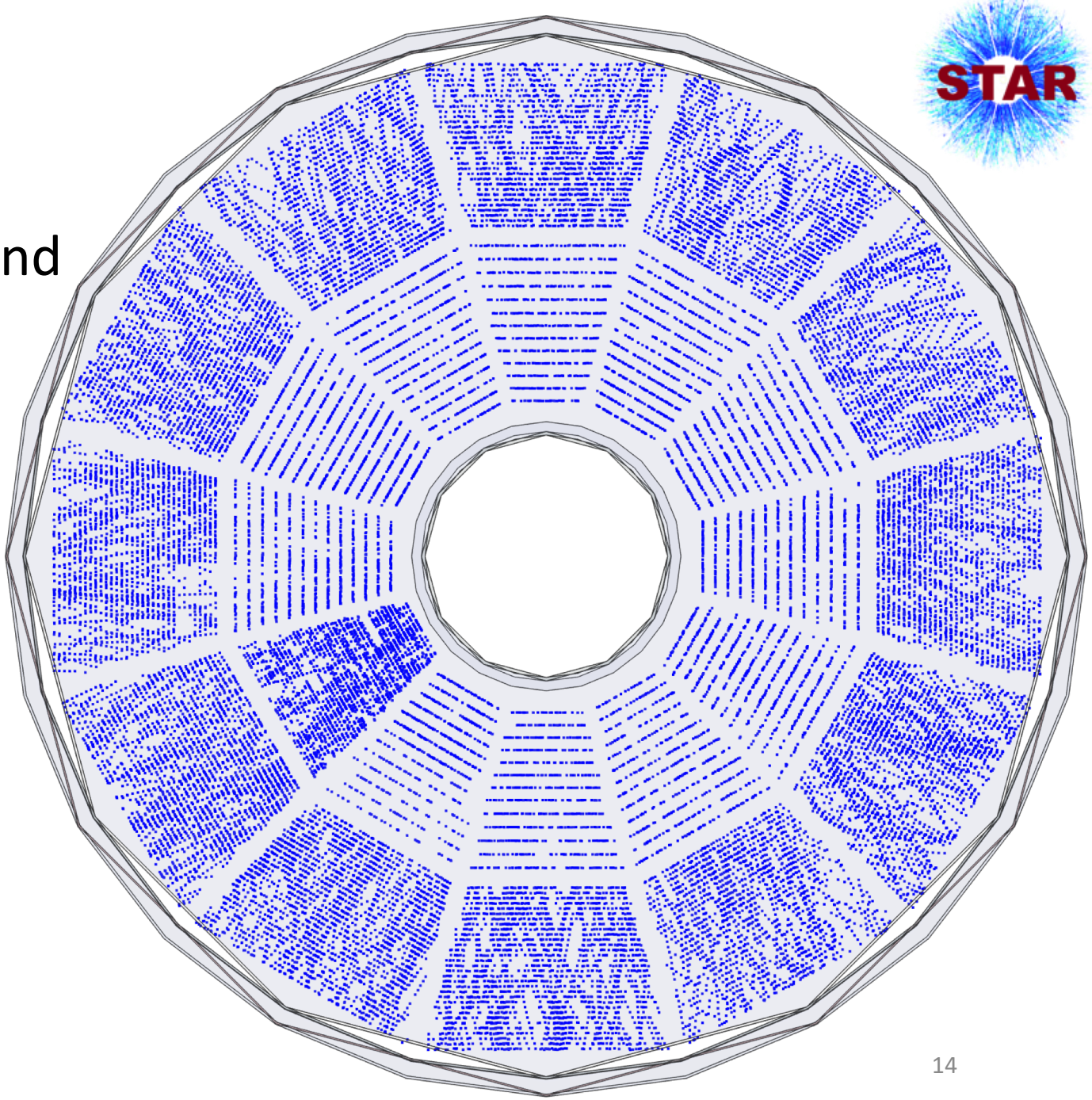
Summary of run 18 datasets

beam	minbias (Millions)	HLT “Good” events (Millions)	comments
Zr+Zr and Ru+Ru	6270 (50/50)	N/A	First 1B with IFC current spike
Au+Au @ 27 GeV	1550	557	More usable events than in previous dataset
FXT @ 3.85 GeV	337	258	60 hours of data-taking
FXT @ 26.5 GeV	237	155	Parasitical to CeC, 72 hours

iTPC for BES-II

- Successfully installed one sector and commissioned, performed well
- Installation schedule presented and being closely followed
- Need priority on resources necessary for the completion before run starts
- Clearly the team also needs to be ready for the detector to take data on day ONE



BES-II BUR (run 19-21)

Beam Energy (GeV/nucleon)	$\sqrt{s_{NN}}$ (GeV)	μ_B (MeV)	Run Time	Number Events
9.8	19.6	205	4.5 weeks	400M
7.3	14.5	260	5.5 weeks	300M
5.75	11.5	315	5 weeks	230M
4.55	9.1	370	9.5 weeks	160M
3.85	7.7	420	12 weeks	100M
31.2	7.7 (FXT)	420	2 days	100M
19.5	6.2 (FXT)	487	2 days	100M
13.5	5.2 (FXT)	541	2 days	100M
9.8	4.5 (FXT)	589	2 days	100M
7.3	3.9 (FXT)	633	2 days	100M
5.75	3.5 (FXT)	666	2 days	100M
4.55	3.2 (FXT)	699	2 days	100M
3.85	3.0 (FXT)	721	2 days	100M

Scenario I: highest energy first

Single-Beam Energy (GeV/n)	$\sqrt{s_{NN}}$ (GeV)	Run Time	Species	Events	Priority	Sequence
9.8	19.6	4.5 weeks	Au+Au	400M	1	1
9.8	4.5 (FXT)	2 days	Au+Au	100M	2	2
7.3	14.5	5.5 weeks	Au+Au	300M	1	3
7.3	3.9 (FXT)	2 days	Au+Au	100M	2	4
31.2	7.7 (FXT)	2 days	Au+Au	100M	3	5

- Commissioning of LEReC for beams that yield Au+Au collisions with $\sqrt{s_{NN}} = 7.7$ GeV and, if possible, also for beams that yield Au+Au collisions with $\sqrt{s_{NN}} = 9.1$ GeV.

PAC recommendation

- The highest priority for data acquisition in Run 19 is Au+Au collider runs at $\sqrt{s_{NN}} =$ 19.6 and 14.5 GeV accumulating at least 400M and 300M minimum bias events respectively. This will begin the BES II program by acquiring the full data sets needed for all analyses proposed at these two highest BES energies, where LEReC is not needed.

PAC recommendation for run 20-21

- LEReC commissioning.
- The first priority for data acquisition in Run 20 and 21 is Au+Au collider runs with $\sqrt{s_{NN}}$ = 7.7, 9.1 and 11.5 GeV with a goal of accumulating at least 100M, 160M and 230M minimum bias events at these three energies, respectively. This program requires LEReC. Together with the data sets from Run 19, these data will enable analyses that will address the principal scientific goals of the BES II program.
- The second priority for Run 20 and 21 is acquiring at least 100M events in fixed-target Au+Au collisions at $\sqrt{s_{NN}}$ = 3.0, 3.2, 3.5, 5.2 and 6.2 GeV, completing the fixed-target component of the BES II program and extending its reach to lower collision energies and higher baryon densities.

Run 18 lesson list

- Decision on trade-off among trigger bias, deadtime and background rejection for BES-II
- New detector subsystem checklist before physics data-taking:
  - one sector with bad gating grid connection,
  - air blower to the TPC inner field cage NOT functioning properly,
  - unexpected TPC response to humidity,
  - DAQ room air conditioner malfunctioned occasionally,
- Cold weather and icy condition around control room and counting house
- Continue to have issues with visa (Russia, India and China) for shifts

Run 19 tasks, priority and decision points

- Priority among LeREC commissioning, STAR iTPC/eTOF commissioning, and high-efficiency data-taking for physics
- Background, trigger bias and luminosity
- Readiness of new detectors (iTPC and eTOF)
- Assess quality of data (“good” events)
  run 19 and previous runs at low energies provided us tools, but every run is unique
- Decision on whether LeReC is ready for 7.7 GeV
- Decision on switching among beam energies and FXT

Summary

- Tight schedule before run 19 for installation and readiness
- Commissioning of many detector components ready on day ONE
- Several beam energies (2 + 3 FXT) + LeREC commissioning
- Run 18 provided us with a good path for such a challenge
- The collaboration highly anticipates this run

Thank you!