STAR Beam Use Request for Run20

	Beam Energy (GeV/nucleon)	$\sqrt{s_{NN}}$ (GeV)	μ_B (MeV)	Run Time	Number Events (“Good”) requested / collected
	9.8	19.6	205	4.5 weeks	400M **582M**
	7.3	14.5	260	5.5 weeks	300M **324M**
Run20	5.75	11.5	315	9.5 weeks	230M
Run20	4.55	9.1	370	9.5 weeks	160M
Run20	3.85	7.7	420	12 weeks	100M
Run20	31.2	7.7 (FXT)	420	2 days	100M **51M**
Run20	19.5	6.2 (FXT)	487	2 days	100M
Run20	13.5	5.2 (FXT)	541	2 days	100M
Run20	9.8	4.5 (FXT)	589	2 days	100M
Run20	7.3	3.9 (FXT)	633	2 days	100M **53M**
Run20	5.75	3.5 (FXT)	666	2 days	100M
	4.55	3.2 (FXT)	699	2 days	100M **201M**
	3.85	3.0 (FXT)	721	2 days	100M **3.7M+300M (run18)**

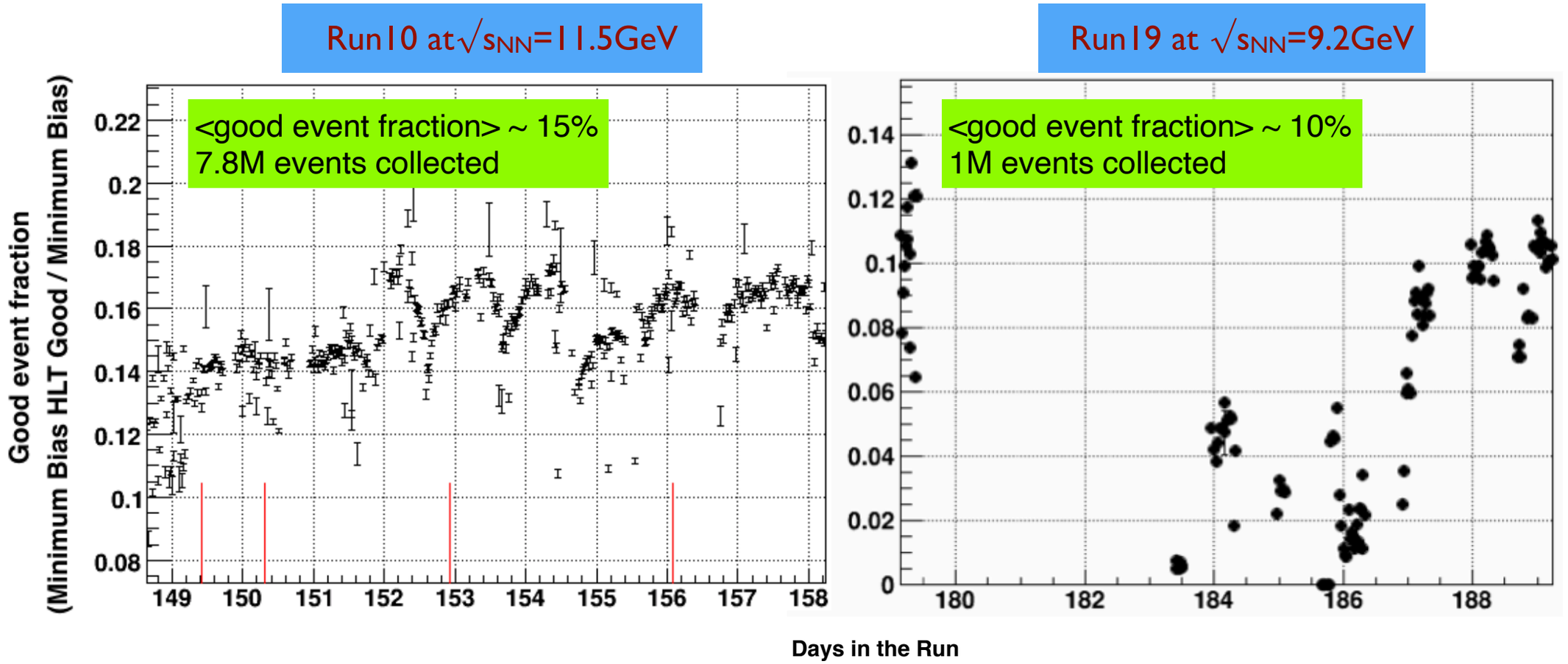
- Top priority for Run20 is measuring next two energies in BES-II at **$\sqrt{s_{NN}}$= 11.5 GeV and 9.2 GeV**
- Finishing **fixed target** measurements at $\sqrt{s_{NN}}$ = 3.5, 3.9, 4.5, 5.2, 6.2, 7.7 GeV

Run20 preparation

- On shift from 11/25, full (4-person) shift from 12/10
- Plan to take cosmic data for calibration from 11/26 and be ready for main physics program
- No new/additional detector installed for physics for Run20
- eTOF preamplifier boards (partly damaged in Run19) have been fully replaced with new boards with improved overload protection
- Fixed target runs to be scheduled ensuring the best performance of eTOF
- Physics trigger and detector configurations for Run20 are similar as in Run19
- Global timing and trigger detector calibrations expected to be done in ~0.5 day with established collisions for the first physics program at $\sqrt{s_{NN}}$=11.5GeV
- Optimizing running conditions with CAD to maximize the data collection efficiency and yield from the beginning and throughout the run

extra

Rates at 11.5 GeV in Run10 and 9.2 GeV in Run19

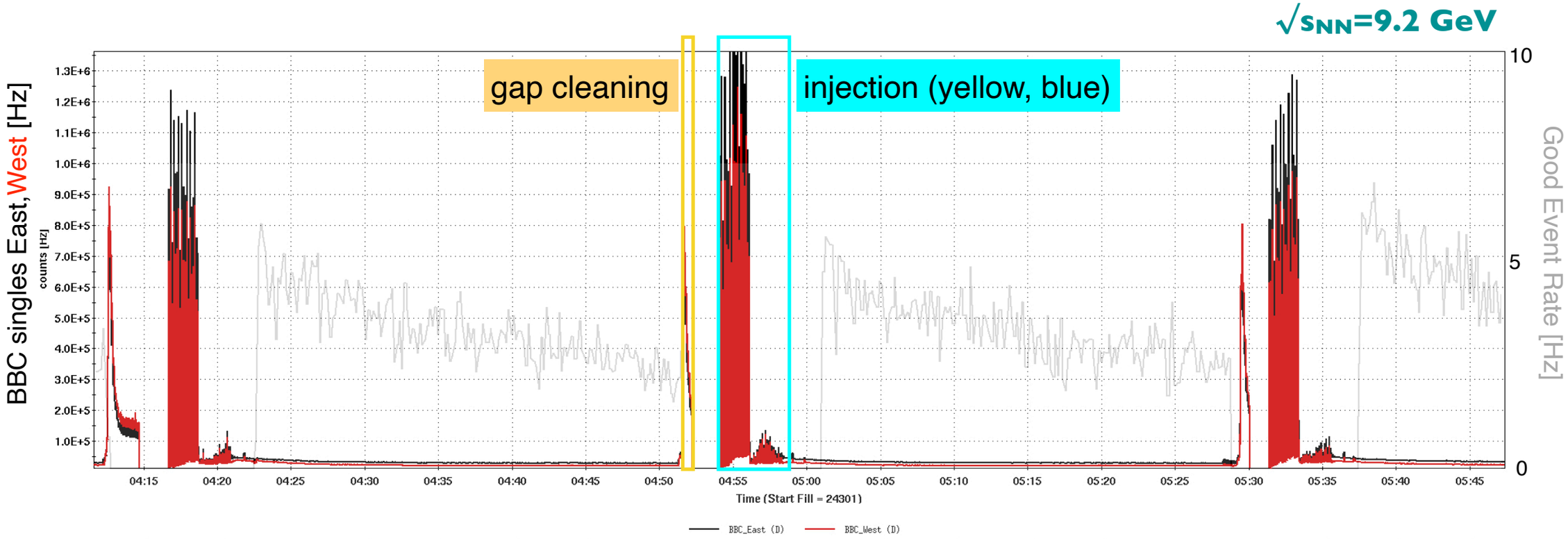


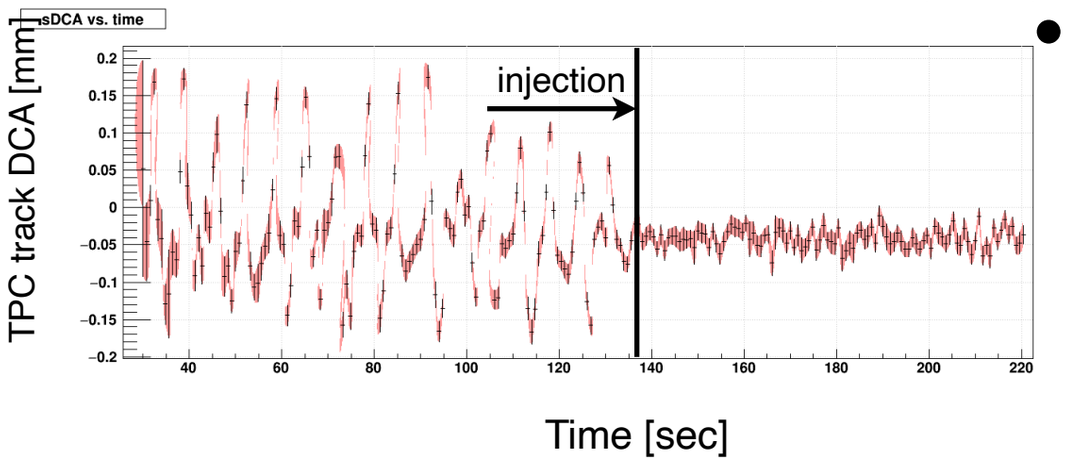
- <Good event rate>~15Hz
- <Good event rate>~8Hz

Optimizing running conditions for Run19 (and beyond)

- For maximal integrated **luminosity** with minimal **background**
- AGS bunch merging (2-1 vs 3-1)
  - filling takes longer, and beam decay fast
  - luminosity improvement for lower energies
- Beta squeeze
  - effective (L~1/β*) but background issues especially with a large beam size
- Fill length optimization
  - gain ~5-15% in integrated luminosity
- Abort gap aligning at STAR (2 abort gaps to 1 abort gap)
  - ~10% gain
- Injection ordering, half-injection scheme
  - useful if background is acceptable
- Dedicated beam scrubbing
  - no immediate improvement on background/vacuum
- Gap cleaning
  - at the end of fill (vs continuous) works well
- Considering extending useful vertex range for good events
  - extending Be beam pipe section for Run20/21?
- Continuous online offline QA of data for fast feedback

Injection and gap cleaning



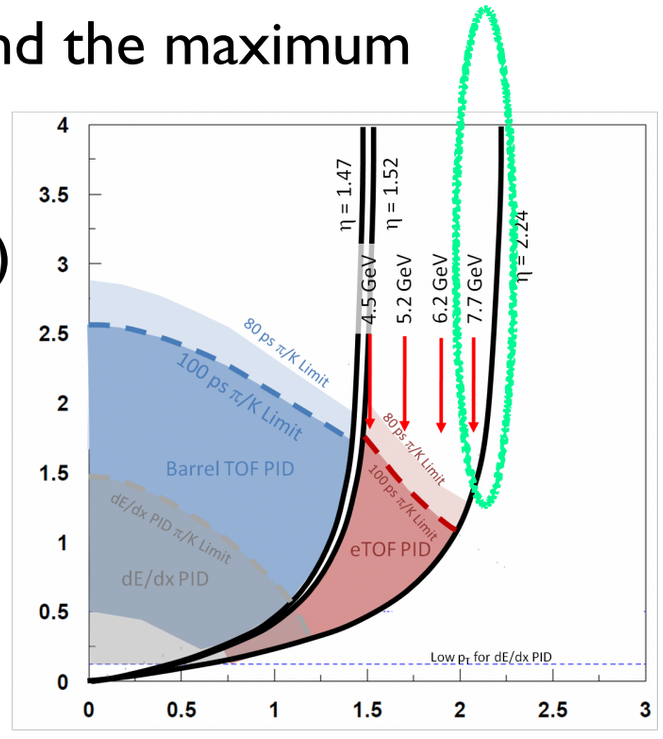


- **Injection**
  - Large charge deposition from background in TPC in every 6.6 sec during injection for all collision data: decided not to take data during the injection period

    (not seen in injection for run10 7.7 GeV)
  - If the background rate during injection is comparable or lower to the condition in the fill after injection, we can include in the physics data taking
  - ~10-15% gain in integrated luminosity if included
- **Gap cleaning**
  - Short (~1min) during the lowest luminosity at the end of fill. small loss of luminosity with isolated background.

Fixed target runs in Run19

- Sustained clean (good event rate > 70%) and high rates (~1.5 KHz)
- Needed large β* lattice to have meaningful measurement for low energy beam optics.
- Beam orbit control (vertical bump) works well to keep the rate
- STAR Event trigger rates feed back crucial for beam steering
- "good event rate" not sensitive to beam condition beyond the maximum rate. Needed saturate bandwidth and minimize pile-up
- eTOF crucial, especially for high beam energy (31.2 GeV)
  - complete FXT run in Run20 after eTOF is fixed



Event statistics needed for BES-II (in millions)

Collision Energy (GeV)	7.7	9.1	11.5	14.5	19.6
μ_B (MeV) in 0-5% central collisions	420	370	315	260	205
Observables					
R_{CP} up to $p_T = 5$ GeV/c	-	-	160	125	92
Elliptic Flow (ϕ mesons)	80	120	160	160	320
Chiral Magnetic Effect	50	50	50	50	50
Directed Flow (protons)	20	30	35	45	50
Azimuthal Femtoscopy (protons)	35	40	50	65	80
Net-Proton Kurtosis	70	85	100	170	340
Dileptons	100	160	230	300	400
$>5\sigma$ Magnetic Field Significance	50	80	110	150	200
Required Number of Events	100	160	230	300	400