Run 20 RHIC Machine/Experiments Meeting

January 21, 2020

Agenda:

- General discussion of Run 20 & Scenario for discussion - W. Christie
- Collider Update - C. Liu
- LEReC Update - A. Fedotov
- STAR Status/update - J.H. Lee
- All Other Business (AOB)

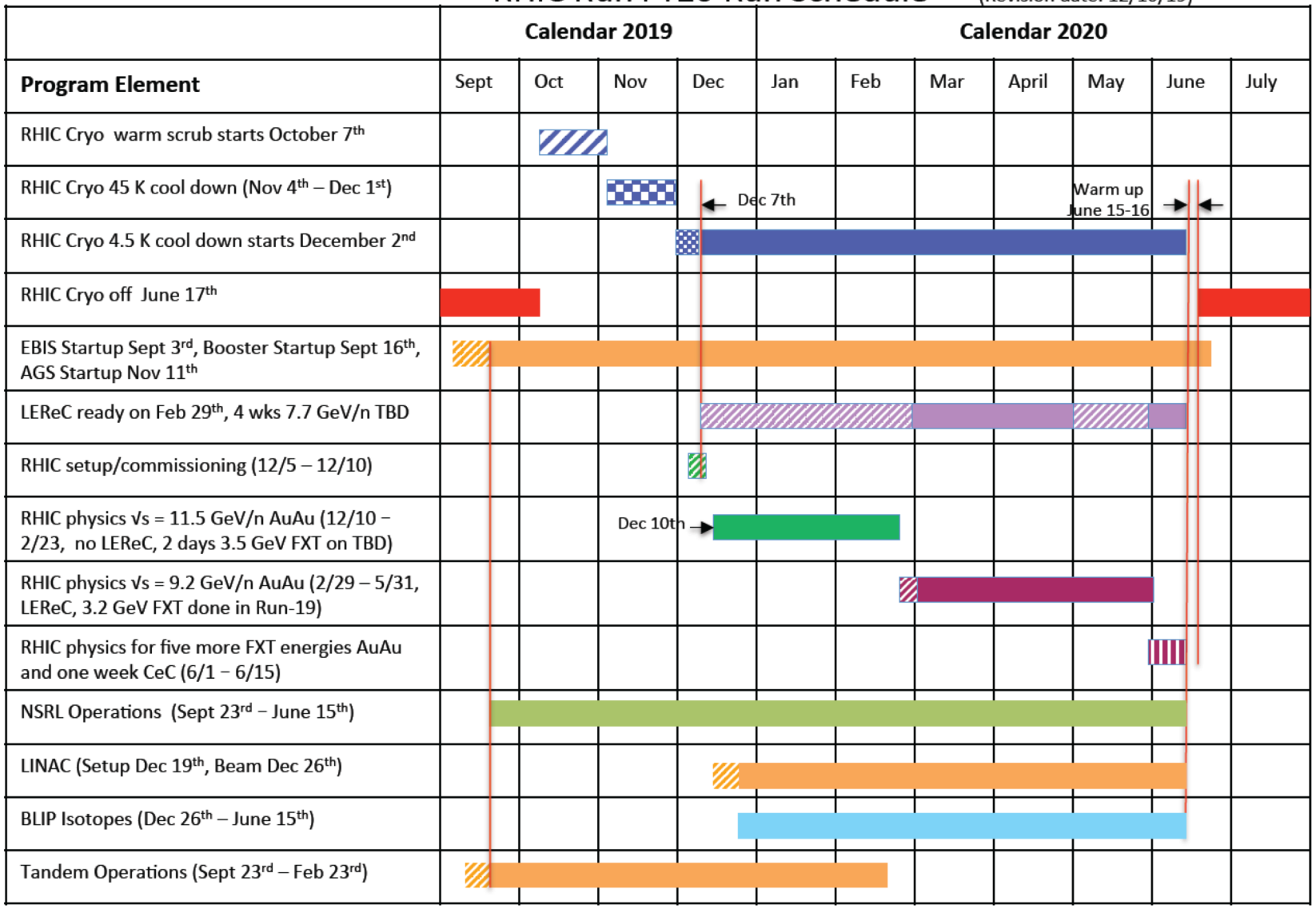
BLUEJEANS CONNECTION INFO:
To join the meeting on a computer or mobile phone: https://bluejeans.com/273705843/1875?src=calendarLink

Phone Dial-in +1.408.740.7256 (US (San Jose))
+1.866.226.4650 (US Toll Free)
+1.408.317.9253 (US (Primary, San Jose))

Global Numbers: http://bluejeans.com/numbers
Meeting ID: 273 705 843

RHIC Run FY20 Run Schedule

(Revision date: 12/10/19)



N.B. With the FY2020 budget final, RHIC Run 2020 will be 28 Cryo weeks long, as presented above.

The actual transition date between 11.5 and 9.2 GeV Physics running will be a matter of discussion as the run progresses.

It is likely that STAR will request to start/run the Fixed target sometime in mid to late January.

RHIC Schedule for the week starting Monday 1/20/20

Monday (January 20th):

- Physics running all day

Tuesday:

- Physics running all day.

Wednesday:

- Midnight to 8:45 am, Physics running.
- 9:00 am to 10:00 am, Selected Controlled Access
- 10 am to 10 pm LEReC Commissioning
- 10 pm to midnight, Physics running

Thursday:

- 0:00 to 8:45, Physics running
- 9 am to 8:45 pm, LEReC Commissioning
- 9 pm to midnight, Physics running

Friday:

- 0:00 to 7:45 am, Physics running
- 8 am to 4 pm, LEReC Commissioning
- Physics running the rest of the day.

Saturday, Sunday

- Physics running all day

Monday (January 27th):

- 0:00 to 7:45 am, Physics running (11.5 GeV/nucleon cm)
- 8 am to 2 pm, Access/maintenance
- 2 pm till finished (8 to 16 hrs) Collider commissioning for 31.2 GeV (7.7 GeV Fxt) beam in Yellow
- Fixed target physics running with 31.2 GeV/nucleon (7.7 GeV/nucleon cm), likely through Tuesday

Summary of interleaving LEReC Commissioning with the STAR Physics running

Meeting held on December 17, 2018 to discuss Strategy/plan:

- Once collisions available, Spend the first about week getting STAR tuned up and the Physics running going.
- After this first week of running, start interleaving LEReC commissioning
  - Idea discussed to schedule for 12 hours every other day (e.g. M, W, F)
  - Keep schedule "flexible" so that if for any reason LEReC can't effective use the time it switched back to Physics running.
  - Also so that if LEReC is making good progress, and more time is desirable, the allotted time can be extended.

This is a Strategy/plan to get started on this sharing of the Collider time. Expectation is that once we see how this works we'll discuss if we need any modifications.

Rough accounting of LEReC hours per week (Run 20) and planned for this week:

12/10 - 12/16:	~20 hrs LEReC
12/17 - 12/23:	28 hrs LEReC
12/24 - 12/30:	0 hrs LEReC
12/31 – 1/6:	~24 hrs LEReC
1/7 - 1/13:	~ 31 hrs LEReC
1/14 – 1/20:	~ 33 hrs LEReC
1/21 – 1/27:	*~ 32 hrs LEReC*

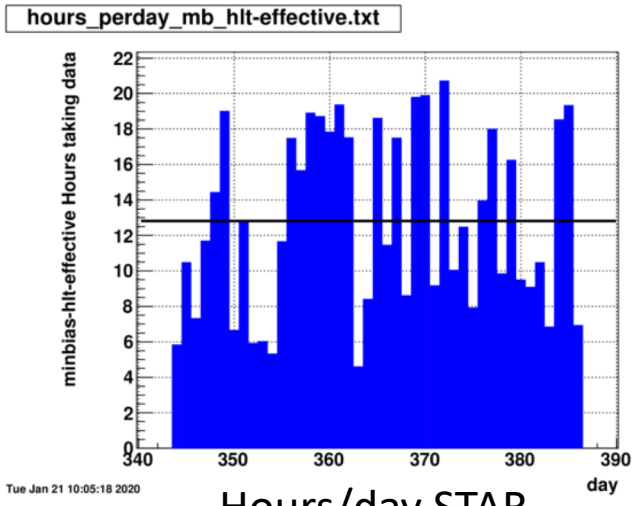
Total LEReC ~ 168 hrs (~ 7 days)

Key:

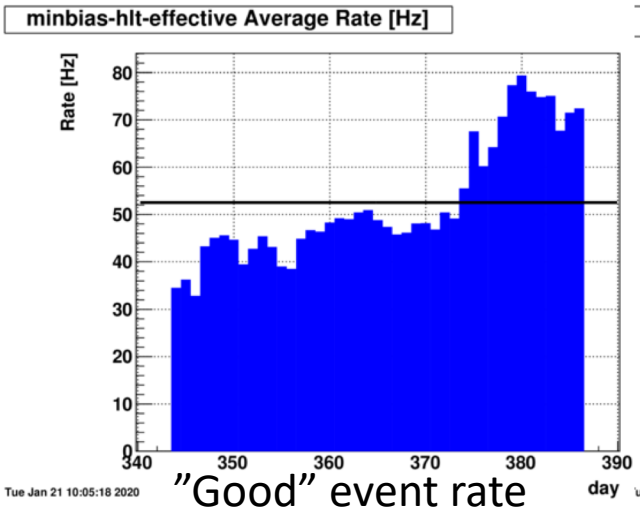
Blue = as run

Red = planned

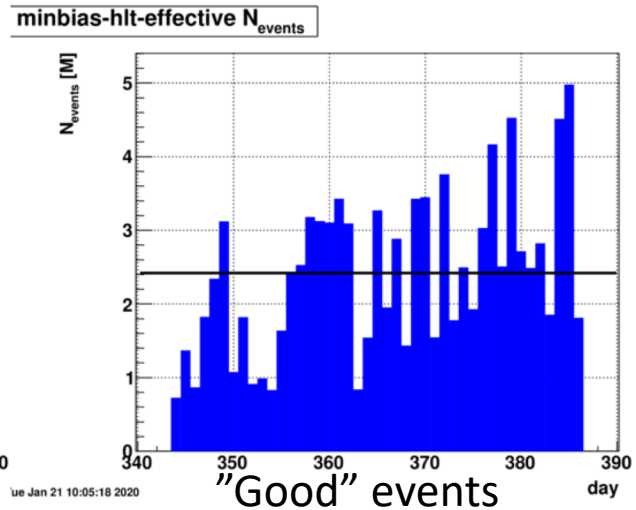
Some STAR Plots that illustrate the components involved in Event Accumulation



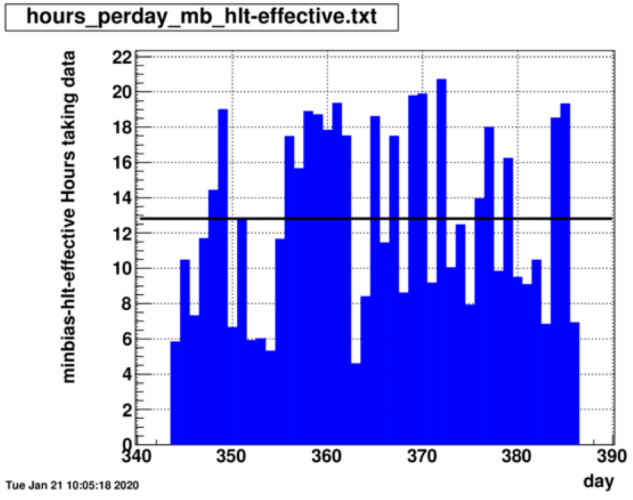
Hours/day STAR DAQ is running



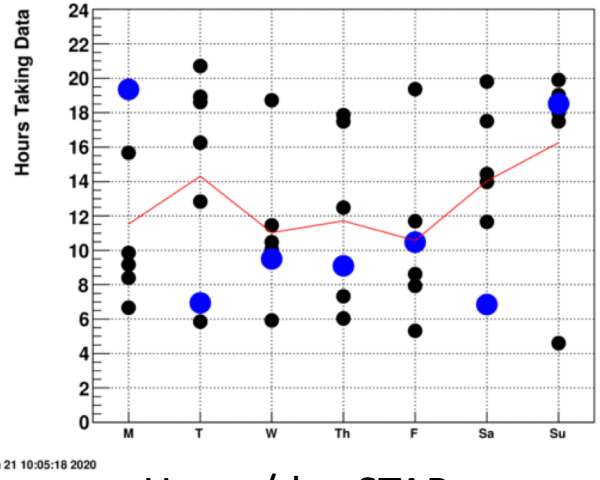
”Good” event rate averaged over a Store



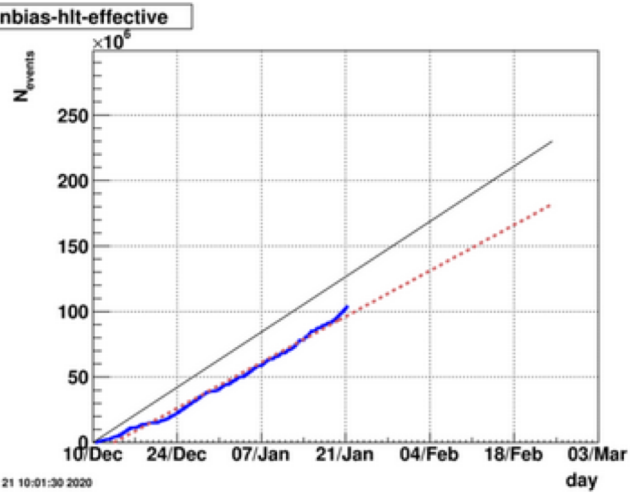
”Good” events accumulated per day



STAR DAQ running hours/day



Hours/day STAR DAQ is running



Accumulated “Good” events to date and Projection

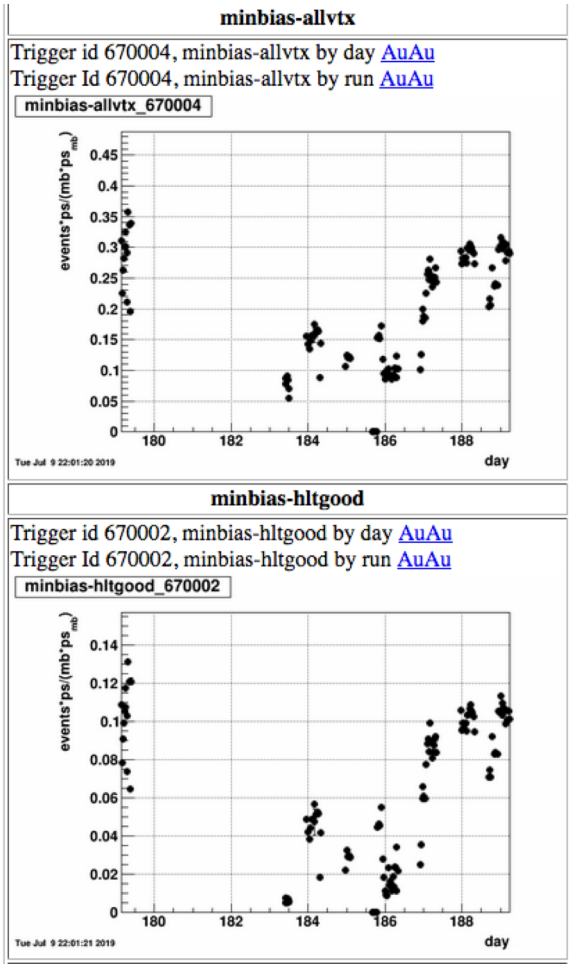
Colliding mode projections for Run-20

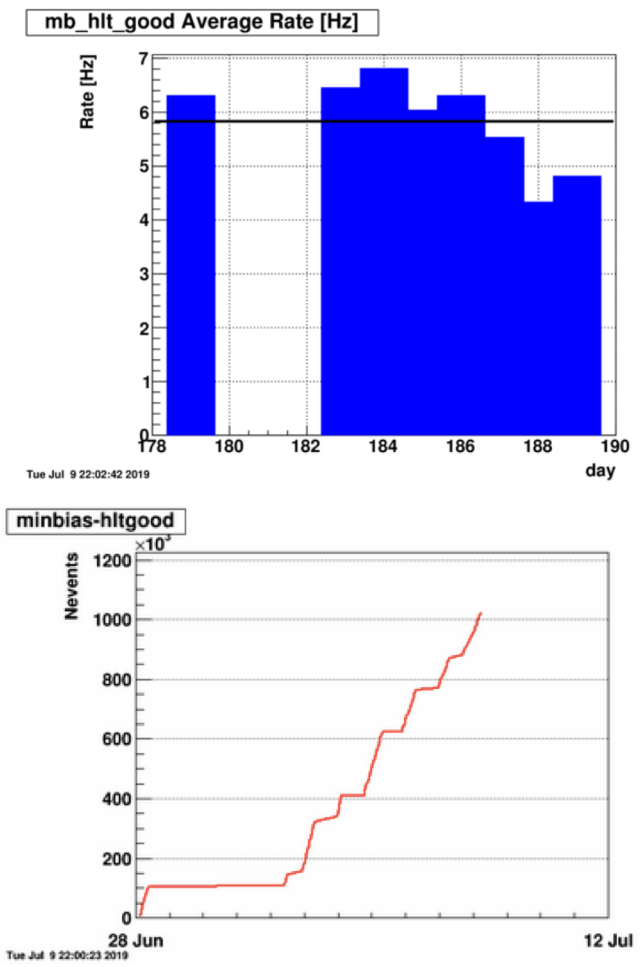
- **5.75 x 5.75 GeV/nucleon**
- L_{avg} improvement factor, total = 2.4 x Run-10
- L_{avg} improvement factor, +- 70 cm = 2.3 x Run-10
- bunch intensity N_b : 1.1 → 1.35e9
- rms emittance ε_n : 2.5 → 2.5 μm
- bunch length σ_s : 1.4 → 1.4 m
- envelope function β^* : 6.0 → 4.0 m
- electron cooling : OFF

- **4.59 x 4.59 GeV/nucleon**
- L_{avg} improvement factor, total = 1.5 x Run-19
- L_{avg} improvement factor, +- 70 cm = 2.4 x Run-19
- bunch intensity N_b : 0.8 → 0.9e9
- rms emittance ε_n : 1.5 → 1.6 μm
- bunch length σ_s : 3.8 → 2.3 m (note: σ_s = 3.8 m for AGS 3→1 merge, 2.3 m for AGS 2→1 merge)
- envelope function β^* : 4.5 → 4.5 m
- electron cooling : ON

Summary of 9.2 GeV Collision running in Run 19

RHIC, along with LeREC spent about 8 days on running with 9.2 GeV AuAu collisions, splitting between Physics running and LeREC commissioning.





We ended up accumulating just over 1 M “Hlt_good” evts.

Hlt_good:
- V_r < 1.5 cm
- |V_z| < 70 cm

Average Hlt_good event rates ~ 6 Hz, averaged over 30 minute stores.

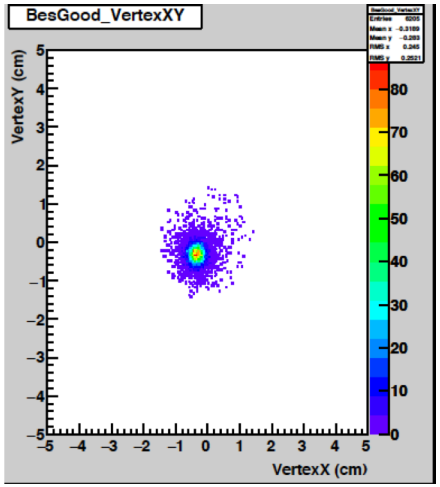
Observed LeREC Improvement on 9.2 GeV Rates in Run 19

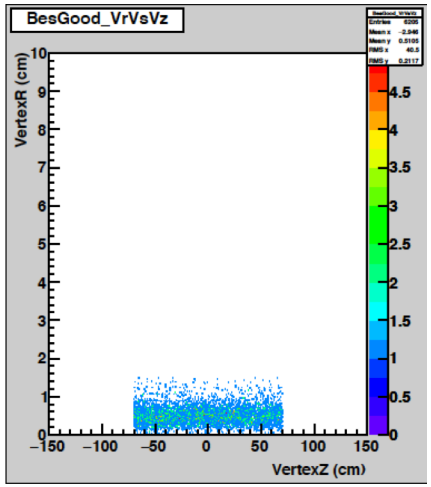
There were four stores put up early on July 4th. Fill #'s 24322, ..24, ..25, and ..26. The corresponding STAR run #'s are 20185001, …9, ..10, and ..11. The mean HLT good rate for these 30 minute stores was ~ 11.5 Hz. Plots below are from store 20185001.

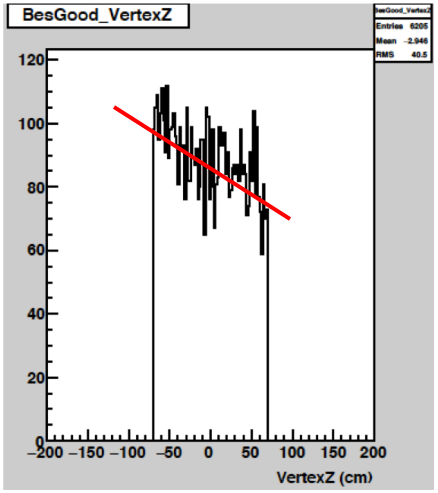
Hlt_good

→

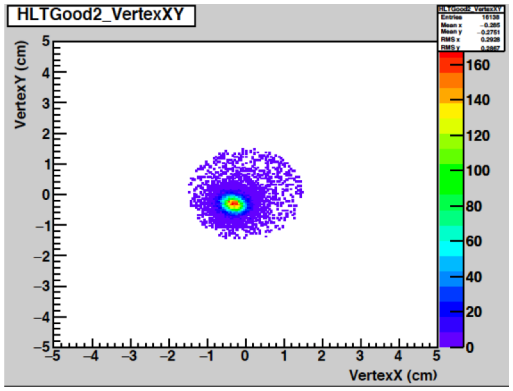
V_z < 70 cm

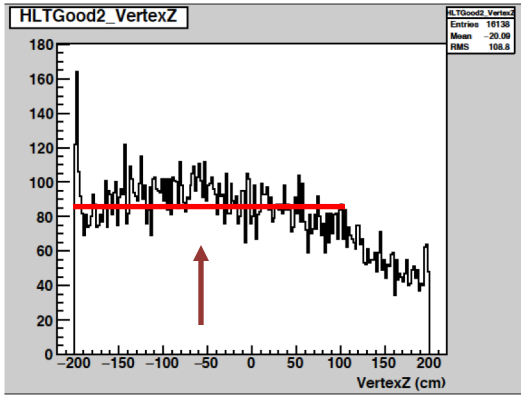






V_z < 200 cm





All four of the "LeREC" stores had similar off centered vertex distributions.

If the vertex was centered, ~ 10 to 15% higher rate would have been observed.

Conclusion - ~ 13 Hz Hlt_good rate "Observed".
~ Factor of 2 improvement (use factor 1.13 for centered vertex).

Estimation of rates for 9.2 GeV Collision data in Run 20, given the RHIC luminosity projections

The projection document estimates that we'll see an increase in the Hlt_good rate which is ~ 2.4 times the LeREC improved rates from 2019. This means rates averaged over 30 minute stores of about 2.4 x 13 Hz = 31 Hz.

IF WE RUN PHYSICS 24 hours/day, 7 days a week, one could expect (Vz < 70 cm):
(13 Daq hrs/day) x (7 days/week) x (3600 seconds/hour) x 31 Hz **~ 10.2 Mevts/wk**

IF WE RUN 24/7, AND Accept all events with 70 < V_z < 150 cm:
If we use the same devaluing factor (0.3) and assume the same Vz distribution, extending to include the events out to +- 150 cm increases the events/wk by a factor of 1.22 => **12.4 Mevts/wk**

I'd take this 12.4 Mevts/wk to be likely overly optimistic. I suggest what a more realistic number of HLT good effective per week of something like 11 Mevts.

So, to reach a "minimum" goal of 100 Mevts will take about:

100 Mevts HLT good effective/(12.4 Mevts/week) = 8.06 weeks = 8 weeks

100 Mevts HLT good effective/(11 Mevts/week) = 9.09 weeks = 9 weeks

Interleaving in 2 weeks of 7.7 GeV LeREC commissioning and 8 days of CeC would extend these estimates to to about **11.5 to 12.5 calendar weeks.**

I'd judge the above estimates to be moderately optimistic.
Factors TBD/estimated are "Good" event rates (31 Hz used here), Average DAQ Hrs/day (13 hrs used here). Also store length (estimates above are for 30 minute stores).

A possible Scenario for Run 20

Cool down and Setup for Physics - 12/2 – 12/10 8 days

11.5 GeV Physics running (including 7 days for all Fxt target data sets and 14 days for LEReC (9.2 GeV) commissioning) - 12/10 – 2/24 76 days

Estimate/projection is that 11.5 GeV data set would be ~ 170 - 180 Mevts. Depends on use of time after coming back to 11.5 until 2/24 (All Physics running or mixed with LEReC)).

9.2 GeV Physics running (inc. 8 days for CeC and 14 days for LEReC comm (7.7 GeV))

- 2/25 – 6/15 111 days (15.9 ->16 weeks)

2 Days for Warm up - 2/15 – 2/16 2 days

Total 198 days (28.3 weeks)

January

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

February

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

March

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

April

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

May

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

June

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Estimates (based on previous few slides) for the 9.2 GeV data set:

111 days – 22 days = 89 days = 12.7 wks

- 12.7 wks x 12.4 Mevts/wk ~ 157 Mevts
- 12.7 wks x 11 Mevts/wk ~ 140 Mevts

Some anticipated Issues that we'll be discussing through out RHIC Run 20

- Going into the run, it looks like a significant challenge, that we may not be able to overcome, to fully meet the stated STAR data set (statistics) goals.
- A key decision will be deciding when to switch from the 11.5 to the 9.2 GeV Physics running. The timescale for this decision is likely sometime in February.
- When to run the STAR Fixed target program, as well as whether to run it all in the same time period. Likely timescale for this decision is mid January or so.
- We need to accommodate collider time for the 9.2 and 7.7 LEReC commissioning, as well as the CeC program.
- What is clear now is that we have to be very careful and deliberate in scheduling and efficiently utilizing every day of RHIC Run 2020.

These are what I anticipate as being the key issues we'll be dealing with during the run. Any additional issues that people would like to add to the list?

All Other Business (AOB)

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	
	3.85	7.7	420	12 weeks	100M	
	31.2	7.7 (FXT)	420	2 days	100M	51M
	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	53M
	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

STAR's plan is to accumulate 100 Mevts this year for each of the 6 FXT energies.
Rough estimate of STAR running time needed per Energy is ~ 16.5 hrs.

- assumes average HLT good rate of 1700 Hz

Slide from the 12/3/19 STAR Time mtg presentation