Run-8 Trigger Projections (p-p @ 200 GeV)

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Table 2: Maximum luminosities that can be reached after a sufficiently long running period. All numbers are given for operation at an energy of 100 GeV/nucleon.

Mode	No of bunches	Ions/bunch [10^9]	β^* [m]	Emittance [μm]	$\mathcal{L}_{peak}$ [$cm^{-2}s^{-1}$]	$\mathcal{L}_{store\ avg}$ [$cm^{-2}s^{-1}$]	L_{week}
Au-Au	103	1.1	0.85	17-35	30×10^{26}	12×10^{26}	350 μb^{-1}
Cu-Cu	111	6	0.9	15-30	12×10^{28}	4×10^{28}	14 nb^{-1}
Si-Si	111	12.5	0.9	15-30	50×10^{28}	17×10^{28}	60 nb^{-1}
d-Au	83	120d/1.1Au	1.0	15-30	30×10^{28}	14×10^{28}	40 nb^{-1}
p↑-p↑ *	111	175	0.9	20-25	70×10^{30}	40×10^{30}	14 pb^{-1}

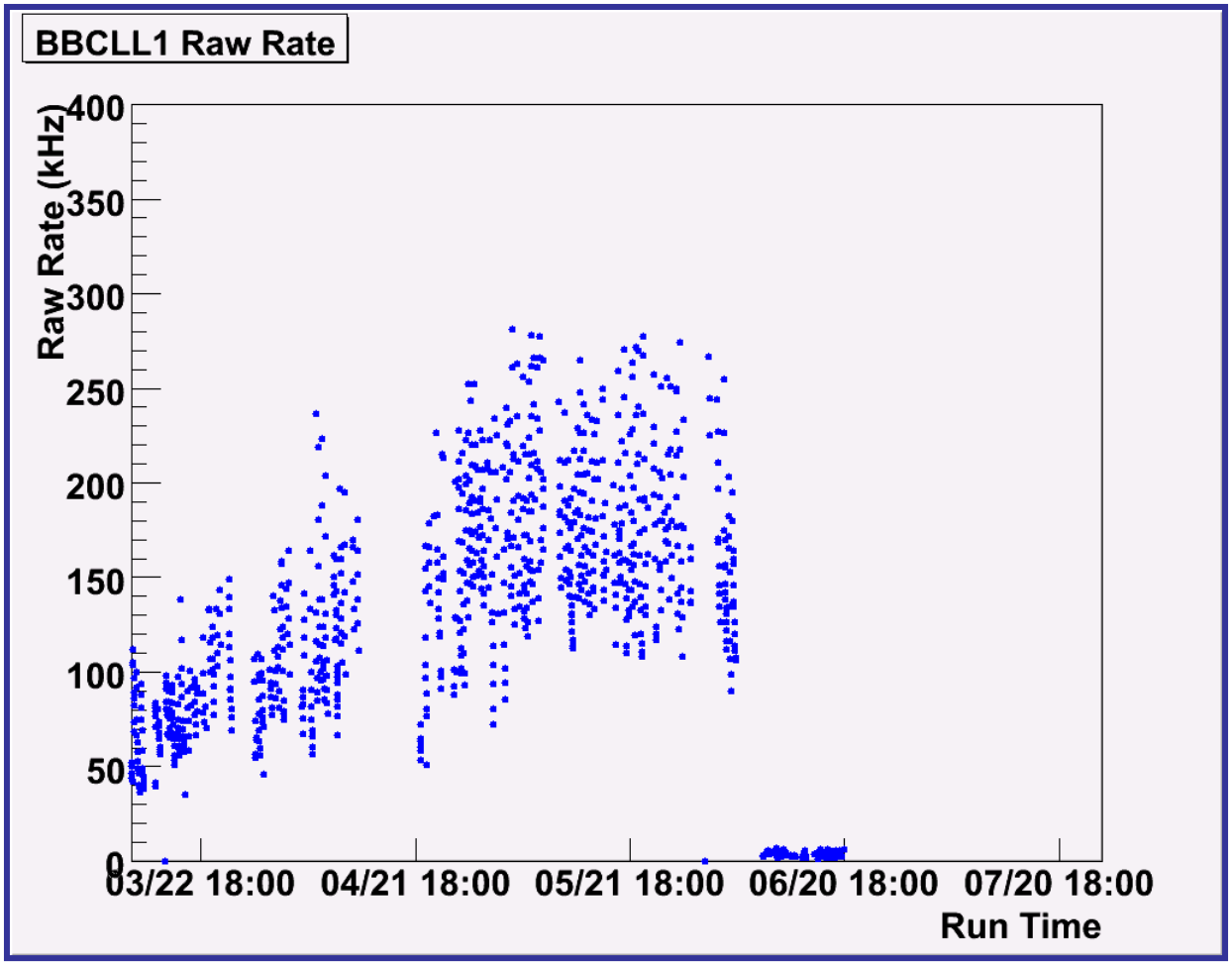
*We expect that an average store polarization of 65% can be reached. If both STAR and PHENIX elect again to have 9 non-colliding bunches, the luminosity is reduced by 9% compared to the numbers stated in the table.

Assume 43 milli-barn p-p inelastic cross section, BBCLL1 firing on 50%, and |zvtx| < 30 cm on 50%....

→ Peak = 750 kHz → Average = 430 kHz

Note that these projections were for a longer run. However, plan trigger and DAQ throughput based on maximum peak rate.

Run-6 pp results for BBCLL1 raw rate versus time.



The highest BBCLL1 rates from Run-6 were of order 250 kHz.

That was at the very limit of what we could take with no prescale on the ERT 4x4 (with threshold ~ 1.4 GeV).

List of current 32 Level-1 triggers….
No reliable beam for checking rejection factors yet !

MUIDLL1_S1D&ERTLL1_4x4c&BBCLL1
MUIDLL1_N1D&ERTLL1_4x4c&BBCLL1
BBCLL1(>0 tubes)
BBCLL1(noVertexCut)
ZDCLL1wide
ZDCLL1narrow
BBCLL1&(ZDCN|ZDCS)
Clock
ERTLL1_2x2&BBCLL1
ERTLL1_4x4a&BBCLL1
RxNP&BBCLL1
ERTLL1_4x4b&BBCLL1
ERTLL1_4x4c&BBCLL1
ERTLL1_E&BBCLL1
MUIDLL1_N1D&BBCLL1
MUIDLL1_S1D&BBCLL1

MUIDLL1_N1H&BBCLL1
MUIDLL1_S1H&BBCLL1
MUIDLL1_N1H&ERTLL1_4x4c&BBCLL1
MUIDLL1_S1H&ERTLL1_4x4c&BBCLL1
(MUIDLL1_N1D&S1D)&BBCLL1
MUIDLL1_N2D&BBCLL1
MUIDLL1_S2D&BBCLL1
ZDCN||ZDCS
ZDCNS
MPC_4x4
MPC_4x4&BBCLL1
ERTLL1_4x4b
PPG(Pedestal)
PPG(Test Pulse)
PPG(Laser)
Noise

I assume we will hear about other trigger requests at today's meeting. Some of the above triggers could be combined.

I will outline some of these new triggers in the following slides.

A. Sivers central arm (hadron) – muon arm (hadron) correlations…

MUIDLL1_N1H&ERTLL1_4x4c&BBCLL1
MUIDLL1_S1H&ERTLL1_4x4c&BBCLL1

One wants identified hadrons in the muon arms (and thus the 1H triggers – no hit in the last gap).

“Since for the Sivers central-muon correlations we are interested in hard scattering events, and the BBC sees a sizeable fraction of the cross section for such events, including the BBC doesn't hurt. The MuIDLL1 trigger is susceptible to noise in the MuID itself without the coincidence of another trigger (usually BBC) but including and ERT trigger will take care of that.

John Lajoie”

One we know the rejection factor of these triggers, we could try running without the BBCLL1 in coincidence and see if that rejection is sufficient. I would prefer to wait to do this until stable beam conditions and reasonable luminosity are achieved.

Also, note that the ERTLL1_4x4c (~ 1.4 GeV threshold) & BBCLL1 has no prescale up to rates of 250 kHz. However, we need to confirm the factor of 75 rejection of this trigger.

B. Charm via electron-muon coincidence

MUIDLL1_S1D&ERTLL1_4x4c&BBCLL1
MUIDLL1_N1D&ERTLL1_4x4c&BBCLL1

"Similar MUIDLL1 & ERTLL1 trigger is important for e-mu coincidence trigger for open-charm production data. This should be taken without prescale, and (better) without BBCLL1 request.

Yuji"

These are different from the previous triggers since the muon trigger is now for muons (1D).

One we know the rejection factor of these triggers, we could try running without the BBCLL1 in coincidence and see if that rejection is sufficient. I would prefer to wait to do this until stable beam conditions and reasonable luminosity are achieved.

C. Charm from single muons

MUIDLL1_N1D&BBCLL1
MUIDLL1_S1D&BBCLL1
MUIDLL1_N1H&BBCLL1
MUIDLL1_S1H&BBCLL1

Vince and Donny have pointed out that the single muon physics is often limited at high pT by the understanding of punch-through background. The the 1H muon triggers allow us to enhance this sample.

These triggers typically do not have enough rejection and need significant prescaling.

One rejections are confirmed, we could combine these into 4→2 triggers with the OR condition (assuming it fits/works in the GL1 logic).

D. More Minimum Bias (BBCLL1) events…

Sasha Milov requested a factor of x5 increase in minimum bias statistics for phi and other hard to trigger on particles (in certain pT ranges).

In previous pp runnning, Sasha quoted 1.5 x 10^9 minimum bias events recorded. Thus, the requst is for 7.5 x 10^9 minimum bias events.

However, for this coming run, I get that in 5 weeks there are # seconds = 5 x 7 x 24 x 60 x 60 = 3 x 10^6.

If RHIC x PHENIX uptimes are 0.5 * 0.6, that means we are taking data for approximately 1 x 10^6 seconds.

Thus, even if we allocated 1 kHz of the DAQ bandwidth to minimum bias, we would only get 1 x 10^9 minimum bias events recorded. There is no way to get 1.5 x 5 = 7.5 x 10^9 recorded minimum bias events.

We always try to have some minimum bias sample, but if the luminosities are very high >> 250 kHz, the bandwidth is very tight.

Physics Issues for PWGs to think about….

1. **Highest priority last run was ERT 4x4 with lowest threshold (~ 1.4 GeV)**
   At the highest rates in Run-6 (~250 kHz), this trigger was using ~ 3kHz of DAQ bandwidth.
   For running at higher rates, this trigger will be prescaled.

   Topic for discussion, is there an issue with masking a lot of the PbGl for this lowest threshold (not the higher ones)?

2. **Run-6 electron 2x2 threshold at 400 MeV. Clearly this has physics impact for low mass dileptons. Proposal is to raise to 600 MeV, otherwise we need a prescale at the higher luminosities (even at 200-250 kHz).**

   What do people think? No objections so far !

3. **I have defined an MPC4x4 and (MPC4x4 & BBCLL1). Do we need more defined trigger slots for different thresholds?**

4. **Other spin related polarimeter needs?**

5. **Note that triggers without BBC are a challenge. Significant issue with muon triggers due to "ringing events". Algorithm for rejecting these ringing events not yet debugged, and otherwise screws up livetime.**

Level-2 Filtering…

A list of algorithms and trigger bits should be sent to the list for review.

In particular, for the 2 Muon case, in Run-6 we did not run the muon Level-2 algorithm, but just filtered on the Level-1 2-deep trigger bits. I would prefer to do this again this run.