Follow-up on CSC Data Rates

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CSC Rates for Pure Min Bias

What I showed last week on CSC data rates for pure minimum bias events based on studies by Ohio State:

Low Lumi ($2 \times 10^{33}$):
- 50 kHz DAQ, ME4 staged, 16 time samples, CLCT selection
- 200 MB/s (300 MB/s with 3× safety factor on neutrons)

High Lumi ($10^{34}$):
- 100 kHz DAQ, ME4, 8 time samples, ALCT*CLCT selection
- 700 MB/s (1000 MB/s with 3× safety factor on neutrons)
Muon Enrichment of L1 Triggers

Average CSC occupancy in min bias BX:
- 0.9 LCT segments for high-lumi  
  (0.7 with ALCT*CLCT)
- 0.9/17.3 = 0.052 per min-bias collision

L1 Trigger content:
- 1/4 $\mu$ + 2 $\mu$
- 1/4 e + 2e
- 1/4 jets + Etmiss
- 1/4 e $\mu$, e-jet, $\mu$-jet, ...

Estimate that half of L1 triggers have a single muon
- Of those, half are in endcap and half in barrel
- Single muon has ~4 segments in endcap region
- CSC occupancy for $\mu$ triggers is 0.5*4 + pile-up (0.052*N_{p/u})

Other half of L1 triggers come from calorimeter triggers
- Muon occupancy in calorimeter triggers will be higher than pure min-bias because of harder Pt scale of signal event
**CSC Occupancy per MB Collision vs. \( p_T \)**

Single min bias collisions from BigMB production

\[ \langle N_{\text{CSC}} \rangle \]

These are actually L2 segments, but approximately same as LCTs

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\[ p_{\text{NSegPthat}} \]
\[ N_{\text{ent}} = 8521763 \]
\[ \text{Mean} = 5.642 \]
\[ \text{RMS} = 4.881 \]

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\( 0.05 \) → \( 0.5 \) → \( p_T \)
CSC Occupancy per L1A

CSC readout includes pile-up LCT segments over 3 BX

Pure Min Bias pile-up:
- High Lumi: \( <N_{LCT}> = 3 \times 0.7 = 2.1 \) (ALCT*CLCT)
- Low Lumi: \( <N_{LCT}> = 3 \times 0.9/5 = 0.54 \) (CLCT only)

Signal + pile-up:

Single Muon triggers:
- High Lumi: \( 0.5 \times 4 + 2.1 = 4.1 \)
- Low Lumi: \( 0.5 \times 4 + 0.54 = 2.54 \)

Calorimeter triggers
- High Lumi: \( 0.5 + 2.1 = 2.6 \)
- Low Lumi: \( 0.5 + 0.54 = 1.04 \)

Average CSC occupancy for L1 triggers:
- High Lumi: \( 3.4 \) (1.6X larger than pure min bias)
- Low Lumi: \( 1.8 \) (3.3X larger than pure min bias)
Corrected CSC Data Rates

Low Lumi ($2 \times 10^{33}$):
- 50 kHz DAQ, ME4 staged, 16 time samples, CLCT selection
- 500 MB/s (600 MB/s with 3× safety factor on neutrons)
- Average occupancy is 1.8 segments $\Rightarrow$ 10kB/event

High Lumi ($10^{34}$):
- 100 kHz DAQ, ME4, 8 time samples, ALCT*CLCT selection
- 1100 MB/s (1300 MB/s with 3× safety factor on neutrons)
- Average occupancy is 3.4 segments $\Rightarrow$ 10kB/event (8 time samples)
Fluctuations in Data Size

- In principle, need to sample from one of the following distributions of the number of CSC segments for the appropriate amount of pile-up.
- In practice, with a 10 kB average event size, probably not a worry.

![Graphs showing fluctuations in data size](image)

# CSC segments per collision