Potential B trigger improvements

- Executive summary:
  - **Because the B physics program is "bandwidth limited," trigger improvements can be as valuable as luminosity improvements**
    - Obvious example: we did charm physics measurements with 5-10/pb of run 2 data that weren't possible with 110/pb of run 1 data
  - **It is likely that L1/L2/L3 bandwidth can be increased**
  - **It is likely that we can make better use of existing bandwidth**
  - **You can make a difference even if you are not already a trigger expert. If more people from the B group gain the knowledge needed to make trigger improvements, CDF will be a better B physics experiment**
  - **We have an opportunity to improve our experiment so that it is better suited to meet our B physics goals**
- Disclaimers:
  - **This is more of a discussion than a presentation**
    - (I didn't prepare very much.)
  - **I have expert knowledge of only a fraction of this material**

Making better use of L1 bandwidth

- Improving SVT efficiency
  - **"4/5" logic improves track pair efficiency by ~ 50% !!**
  - **"3/3" logic recovers 2 or 3 wedges**
  - **Can more efficient clustering eliminate the need for 4/5?**
  - **Better handling of tracks that cross barrel/bulkhead boundaries**
  - **Should we track down to 1.5 GeV?**
  - **Should we upgrade SVT to handle tracks that cross wedges?**
  - **How many offline tracks (3-layer OI, |d|>80um, pt>1.5) does SVT fail to identify? Which ones are worth trying to recover?**

- Making L1 smarter
  - **How will we use the 3-track board?**
    - 2 tracks down to 1.5 GeV?
    - Track pair plus opposite-side muon?
    - Other great ideas?

Increasing L1 bandwidth

- Improving SVT timing
  - **Skipping redundant track fits in "4/5" mode**
  - **Better S/B in clustering (has never really been optimized!!)**
  - **Smarter handling of wide clusters (4 or more strips)**
    - Suppress them? Split them? De-weight them?
  - **Short-circuit SVT for the 25% of L1A that don't need SVT info**

- Improving SVX timing
  - **Finish two-SRC implementation**
  - **Return to (baseline) 7-bit SVXII digitization**
  - **"Presend digitize" for SVXII => 72 wedges work independently**

- Ultra-dynamic prescaling
  - **See David Saltzberg's CDF note 6434**
  - **Claim: gain ~ 15kHz L1A rate with little or no added deadtime**

L2 bandwidth

- Making better use of it:
  - **Improving SVT purity**
    - Where do SVT fakes come from?
  - **Finishing L2 muon implementation (in progress)**
    - Gain 50-75 Hz (out of 300-350 Hz bandwidth) L2A rate at 5E31

- Getting more of it:
  - **Speeding up TDC processing / readout**
    - Maybe reach 500 Hz L2A rate (vs current ~350)?

L3 bandwidth

- Making better use of it:
  - **Data compression**
    - Still need people to help validate it?
  - **Cutting on offline SVX impact parameter at L3**
    - Ready to go! Hooray!!
  - **Writing out micro-events?**
    - Could write out 500Hz of 20KB/event with half of current CSL bandwidth
    - Run 1 BPADs were about 10KB/event; were fine for most analyses
    - Remember: you can't re-run production on events we never wrote out

- Getting more of it:
  - **Christoph knows of an easy way to write out 60MB/s instead of the current 20MB/s**

Bottom line

- We should re-think our trigger strategies at all levels
  - **Want to optimize N * εD^2 to tape, per unit delivered luminosity, where N is e.g. N($B_S \rightarrow D_S \pi$)**
  - **There are potential improvements at every level**
  - **We could have BTeV-like datasets (except for the photons and the Cerenkov), by writing out 500Hz of BPADs**

- There are many ways in which "improving the trigger" means making the system work better, not just adjusting the cuts
  - **The potential benefits to the B physics program can be large**
  - **For each idea, need rough estimate of gain and of difficulty**

- Improving the trigger <u>is</u> "physics." Want to join the fun?
  - **As important as improving flavor tagging, vertexing, analysis cuts, …**
  - **We only get <u>one</u> chance to record the events. Once we get the events we want (with detector performance we want), we can analyze for years.**