

(Selection of beam-data events for)

Background Mixing

Simulation Workshop

SLAC

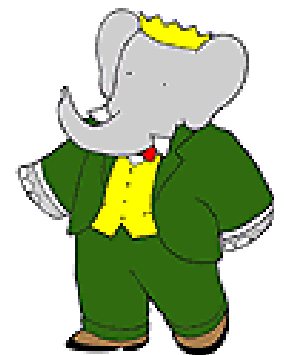
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SLAC

- **Outline**

- Online selection algorithm
- Pass through Prompt Reconstruction
- Open (and to be re-opened) Issues



TM and © Laurent de Brunhoff

Introduction

- **Purpose**

- Address the need to simulate machine-induced and other backgrounds in the Monte Carlo
 - Includes radiation, beam-gas, beam-wall events, but also detector noise and other sources
- Select “background frames” using random triggers to overlay on top of the MC signal event
 - Done at the Digi level (“Digi mixing”)
 - Happens before Trigger simulation
 - But have to bootstrap the L1 accept time

Requirements

- **Background event selection**
 - Selection has to track machine/detector conditions
 - Not from special background runs, but from continuous filtering during data taking
 - Need a random source, *i.e.*, independent of event content
 - Want sampling rate be proportional to physics output, *i.e.*, at some constant effective cross section

Selection Algorithm

- **Implemented in Level 3**
 - Using “weighted prescaler” technology
 - Counts events on one trigger line to control passing events on another, possibly prescaled
 - Logs selection B at rate of selection A modulo N
 - Taking online luminosity filter as seed
 - DCH-based two-prong selection, $\sigma_{\text{eff}} \sim 7.86 \text{ nb}$
 - Taking 1 Hz cyclic trigger as random source
 - Generated in FCPM, completely independent of PEP

History (I)

- **The manual days**
 - Originally, raw background events were selected offline, loaded into Objectivity
 - Scanned every xtc file to extract random triggers
 - Selection algorithm implemented in client application
 - Similar to what we use today, however:
 - Not synchronized with Production
 - Involved manual staging of every xtc file
 - Competing with production

History (II)

- **The less manual days**
 - Selection algorithm moved into Level 3
 - Now fully parameterized
 - Types and event rates defined in configuration database
 - Trivial offline skimming by tag bit (L3TSkimApp)
 - “L3OutBackground”
 - Still manual staging of xtc files

We all have to thank Jim Cochran to keep up with this!

History (III)

- **The CM2 Era**

- Now processing done in ER in one go with physics data
 - No extra pass through the xtc data
 - Background collections written as part of PR

Issue 1: Trickle Injection

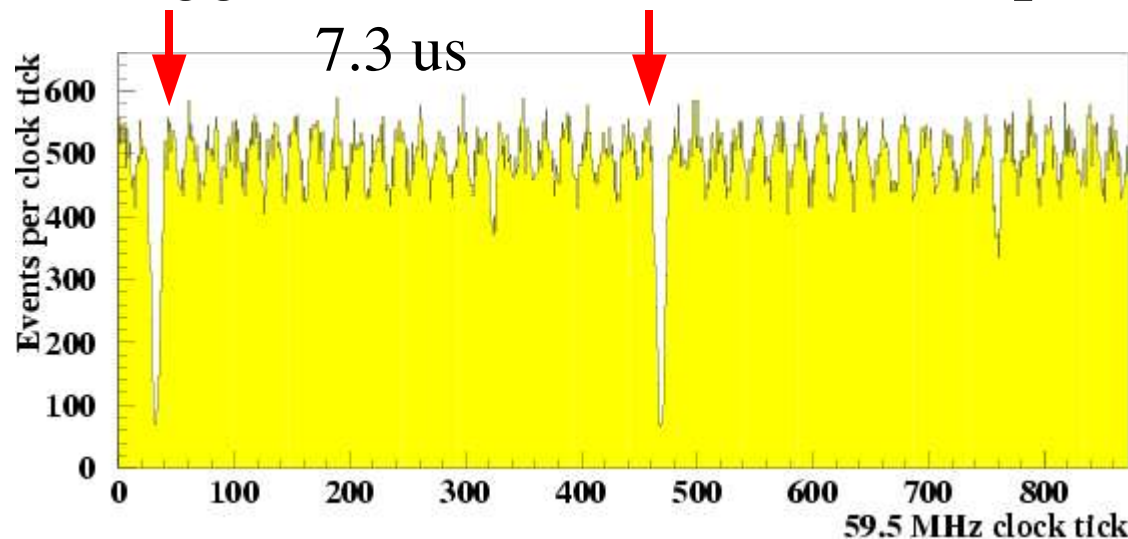
- **Physics Veto Window**
 - A major concern when extraction done outside PR
 - Physics window defined offline (not online)
 - Events near T.I. can be dramatically different
 - Must not allow T.I. background triggers into SP
 - Due to replication, a single event could do harm
 - Issue rather elegantly addressed by doing this in Elf
 - Injection veto is applied equally to physics and random triggers
 - Suggest to monitor background triggers in Weaver plane to avoid any surprises

Issue 2: The Ion Clearing Gap

- **PEP-II Revolution Phase**

- Due to the PEP-II bunch structure, collision events do not occur at all phases
 - There are no physics triggers in the Ion Clearing Gap
- Random triggers OTOH are uniform in phase

Level 3 beam
spot monitor
(two-prong)



Ion Clearing Gap (cont.)

- **Consequences for background triggers**
 - The luminosity “seed” triggers are ok, however:
 - Due to the low rate of the cyclic triggers, the luminosity trigger's phase relation is lost in the algorithm that scans forward to the next random
 - In fact, any trigger rate \ll bunch structure $O(MHz)$
 - Background frames do not exclude the ICG
 - Events that are inside the ICG, are “unphysical”
 - Is this a problem (yet)?
 - Possible remedies are complicated by L1 timing jitter

Issue 3: Rate vs Replication

- **How many frames should we save?**
 - Have to balance size of background collections versus number of times frames have to be reused
 - Current ratio of background trigger over BB cross section is:
$$7.86 \text{ nb} / 300 : 1.1 \text{ nb} = 1 : 42$$
 - Today this yields:
$$\sim 400 \text{ k events at } 15 \text{ fb}^{-1} \text{ per month}$$
 - Each frame is re-used about 40 times
 - Should we be saving more?

Rate vs Replication (cont.)

- **Logging**

- Certainly, to keep this option open, we should be logging more
 - Can always prescale events in PR (DigiFilter) until we want them in the collections
 - Negligible effect on Level 3 logging rate
 - Currently ~ 0.2 Hz at $8.5 \times 10^{33} \text{ cm}^{-1} \text{ s}^{-1}$
- Suggest to at least double the rate at which we log these events
 - Lower prescale 300 \rightarrow 150 (or less)
- Decide what to do in PR

Conclusions

- Selection/production of background collections done by Level 3 + Elf
 - Integrates this into production
 - Addresses original issue of Trickle Injection veto
- **To Do**
 - Suggest to monitor background frames in DQG
 - Time to revisit the selection rate (or relative cross section) of background events
 - Suggest to increase logging immediately
 - Evaluate if and how to address the Ion Clearing Gap