Trigger & Timing Issues

Aaron Roodman
Stanford Linear Accelerator Center

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Physics Pile-Up

What is the minimum rate of collisions allowed?

assume the Maximum Bhabha pile-up acceptable is one per crossing

observable Bhabha cross-section is 40nb
and at L=10^{36} that corresponds to 40kHz

at that rate what else is in the detector with a hadronic event?

(0.1 Hadronic events per crossing)
so 10% of Hadronic events have a second $q\bar{q}$ or $B\bar{B}$
another 5% have a $\mu^+\mu^-$ or $\tau^+\tau^-$
two-photon events and radiative Bhabhas?
problem will be fragments of other interactions

$e^+e^- \rightarrow$	Cross-section (nb)
$b\bar{b}$	1.05
$c\bar{c}$	1.30
$s\bar{s}$	0.35
$u\bar{u}$	1.39
$d\bar{d}$	0.35
$\tau^+\tau^-$	0.94
$\mu^+\mu^-$	1.16
e^+e^-	~ 40

Trigger and DAQ implications

L1 Trigger - not necessary, all events are read out
DAQ - needs to read out data at 100kHz level (same in all 10^{36} scenarios)
Gregory's talk at Hawaii '04 notes that 50Gbyte/sec switches already exist

Detector Latency

Detector latency time is $\tau_{\mathrm{Detector}} \sim 2\mu sec$

Match collision frequency to detector read-out time
no idle time between collisions
implies a 500KHz collision rate
match to damping time?

Implications of 500kHz collision rate

L1 Trigger needed to reduce rate by a factor of 10-100
digital buffering needed as delay for L1 trigger and
for trigger queue
DAQ data rates are the same in all 10^{36} schemes
Bhabha pile-up at the 10% level
multiple hadronic interactions in 1% of hadronic events

Trade-offs in a LCSBF

physics pile-up $\Leftrightarrow$ beam-related backgrounds

Physics Analysis Issues

Clean-up Algorithm - remove Bhabha pile-up

Flavor Tagging

Extra leptons from radiative Bhabha or mu-pairs

Extra Kaons from two-photon events

detailed study needed

Recoil Analysis ($B^+ \to \tau^+ \nu_\tau$)

now Beam-related backgrounds cause some inefficiency

interaction related backgrounds would replace those

inefficiency again depends on fraction of physics pile-up that cannot be removed

Rare B decays

extra background from pile-up of $q\bar{q}$ and $B\bar{B}$ interactions

detailed study needed