Studies of Generator-level Selection

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Proposal

- **Present Monte Carlo generation in LHCb:**
  - (pre-)selection cut @ Pythia level for B-signal events:
    - 400 mrad cut on true direction of B-meson of interest
      -> geometrical acceptance $\varepsilon_{400\text{mrad}} \sim 35\%$

- **Proposal investigated:**
  - Can we do better in a more adequate/efficient way by rejecting as early as possible events that will not pass the selection though the whole reconstruction and analysis chain?
  - apply to all event generation some (e.g. multiplicity, $P$, $P_T$) cuts
    @ Pythia level and in offline analyses ...
    -> how could it be implemented?
    -> what and where can we then gain?
### Procedure

- **B-signal (offline selected) events:**
  - apply Pythia cuts → small loss on offline selected events (a few - 10% acceptable?)
  - apply cuts on offline tracks → small loss on offline selected events
  - requirement: loss when applying Pythia after track cuts = 0%

- **Minimum bias events:**
  - $\sigma_{tot} = 102.4$ mb, $\sigma_{b-bbar} = 500$ µb
  - $\sigma_{tot} / (\sigma_{b-bbar} \times \varepsilon_{400mrad}) \approx 600$
  - if reduction in M.B. acceptance by $\approx 600$
  - amount of events to simulate less than what we would now get for the $b$-background
  - gain in CPU time + storage space
  - gain in knowledge ↔ possibility to study non-$b$ background & improvement in B/S?

- **$b\ bbar$-inclusive events:**
  - need to cross-check that loss when applying Pythia after track cuts = 0%
  - all analyses would have to apply theses cuts ...

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Limited at present by statistics
Example Distributions (I)

Distributions for MC particles in the LHCb acceptance
(1.8 < η < 4.9)
Example Distributions (II)

Distributions for MC particles in the LHCb acceptance ($1.8 < \eta < 4.9$)

- $B_d - \pi\pi$ offline selected events
  - Sum $P_T$ tracks in acceptance
  - 1 highest $P_T$ track in acceptance $- P_T$

- Minimum bias events
  - $\Sigma P_T$
  - $P_T$ of highest-$P_T$ track
Example Distributions (III)

Distributions for MC particles in the LHCb acceptance \((1.8 < \eta < 4.9)\)

- Graph 1: \(\text{sumPt trks in acc}\)
- Graph 2: \(1-\text{highest Pt trk in acc} - \text{Pt}\)
Acceptance curves (I)

Correlations in acceptance for a given selection cut

Example for $B_d \rightarrow \pi\pi$

offline selected events
Acceptance curves (II)

Correlations in acceptance for a given selection cut

Example for $B_d \rightarrow \pi\pi$

offline selected events
Conclusions and Final Remarks

- main idea exposed and several cuts studied
  - needs further investigation
  - need to cross-check feasibility with other B-signal decays
    (large multiplicity decays, decays with mainly neutrals)
  - need to investigate influence on bb-inclusive events

- distributions were shown for the MC information
  -> similar for the distributions of offline tracks (those with momentum info & hits in VELO)

- comments / suggestions welcome ...