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MIP Project

Started by Claudia as an assignment from Instrument Workshop…

• What is the purpose?
  – Find a MIP using Tracker and Calorimeter

• Why are we doing this?
  – Estimate data taking time needed to select a MIPs sample
  – Develop basic cuts to be used for the end-to-end tests for trigger and data flow

• What is in this talk?
  – We will show preliminary distributions using the MonteCarlo Ntuple generated for the Instruments Analysis Workshop
    – version (baseline): emv3r0402p09
MIP Signature

- Variables used in this analysis
  - Tracker
    - TkrThinHits
    - TkrThickHits
    - TkrBlankHits
    - Tkr1ZDir
    MIPs have to hit each Si-layer and have a vertical direction
  - Calorimeter
    - CalELayer0 … CalELayer7
    - CalTwrGap
    MIPs have to leave in each CAL-layer ~ 11 MeV and minimize path between CAL-layers
## MIP cuts – Efficiency table

Normalized to all triggers, in the future we will study the selection using TKR triggers only and CAL triggers only.

<table>
<thead>
<tr>
<th>Variable Cut</th>
<th>Cut Min</th>
<th>Cut Max</th>
<th># Events left after each cut</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>-</td>
<td>-</td>
<td>219040</td>
<td>100.00%</td>
</tr>
<tr>
<td>TkrThinHits</td>
<td>20</td>
<td>26</td>
<td>61113</td>
<td>27.90%</td>
</tr>
<tr>
<td>TkrThichHits</td>
<td>7</td>
<td>9</td>
<td>80064</td>
<td>36.55%</td>
</tr>
<tr>
<td>TkrBlankHits</td>
<td>3</td>
<td>5</td>
<td>90832</td>
<td>41.47%</td>
</tr>
<tr>
<td>Trk1ZDir</td>
<td>-1.2</td>
<td>-0.81</td>
<td>103696</td>
<td>47.34%</td>
</tr>
<tr>
<td>CalELayer0</td>
<td>5</td>
<td>25</td>
<td>68207</td>
<td>31.14%</td>
</tr>
<tr>
<td>CalELayer1</td>
<td>5</td>
<td>25</td>
<td>64318</td>
<td>29.36%</td>
</tr>
<tr>
<td>CalELayer2</td>
<td>5</td>
<td>25</td>
<td>60397</td>
<td>27.57%</td>
</tr>
<tr>
<td>CalELayer3</td>
<td>5</td>
<td>25</td>
<td>57502</td>
<td>26.25%</td>
</tr>
<tr>
<td>CalELayer4</td>
<td>5</td>
<td>25</td>
<td>54263</td>
<td>24.77%</td>
</tr>
<tr>
<td>CalELayer5</td>
<td>5</td>
<td>25</td>
<td>51682</td>
<td>23.59%</td>
</tr>
<tr>
<td>CalELayer6</td>
<td>5</td>
<td>25</td>
<td>48923</td>
<td>22.34%</td>
</tr>
<tr>
<td>CalELayer7</td>
<td>5</td>
<td>25</td>
<td>46854</td>
<td>21.39%</td>
</tr>
<tr>
<td>CalTwrGap</td>
<td>7</td>
<td>40</td>
<td>47639</td>
<td>21.75%</td>
</tr>
<tr>
<td>All cuts</td>
<td>-</td>
<td>-</td>
<td>6765</td>
<td>3.09%</td>
</tr>
</tbody>
</table>

Data from 2 towers are used. Efficiency obtained for each cut separately.

Add all cuts together we get only 3% efficiency, but this can improve as we study more the distributions.
Tracker Variables After MIP Cuts

- **TkThinHits**
  - Entries: 6738
  - Mean: 23.16
  - RMS: 1.651
  - Expect 24

- **TkThickHits**
  - Entries: 6738
  - Mean: 8.164
  - RMS: 0.5968
  - Expect 8

- **TkBlankHits**
  - Entries: 6738
  - Mean: 4.159
  - RMS: 0.4934
  - Expect 4

- **Tk1ZDir**
  - Entries: 6738
  - Mean: -0.9531
  - RMS: 0.04198
  - $\theta = 0^\circ$
  - $\theta = 36^\circ$
CAL Variables after MIP Cuts

Each crystal layer peaks around 11 MeV as expected
CalTwrGap variable

CalTwrGap = \sum_{i=0}^{6} Gap_i

- Each gap is about 1.5 mm (thanks Anders!)
- This seems to be an useful variable, need to study more

Expected value for a straight track

Entries 6738
Mean 16.91
RMS 6.115

CAL crystal layers
Crosscheck (after MIP cuts)

**CalCsIRLn**
- Entries: 6738
- Mean: 8.66
- RMS: 0.4937

**Expected value (~8.6) after cuts**

**TkrRadLength**
- Entries: 6738
- Mean: 1.476
- RMS: 0.08886

**Expected value (~1.5) after cuts**

**CalMIPDiff**
- Entries: 6738
- Mean: -1.766
- RMS: 9.678

**Expected value (~0) after cuts, need to understand it better**

**CalEnergySum**
- Entries: 6738
- Mean: 102.8
- RMS: 9.894

**Expected value (~100 MeV) after cuts**
To do list

- Understand large values in CalTwrGap
- Understand tails in radiation length variables
- Study dependence on X.Y and angles
- Learn to use Event Display to help to study

- Merit ntuple: questions
  - Why do we have 2 similar variables in MeriTuple?
    - (Tkr1ZDir) is cosine of Tkr1Theta
  - Can we add a Monte Carlo variable of the true energy deposited in the CAL so that we can compare with CALEnergySum?
Back up slides
Tracker Variables

No cuts applied, just for reference

- **TkrThinHits**
  - Entries: 219040
  - Mean: 13.16
  - RMS: 8.925

- **TkrThickHits**
  - Entries: 219040
  - Mean: 4.601
  - RMS: 3.913

- **TkrBlankHits**
  - Entries: 219040
  - Mean: -0.7506
  - RMS: 0.1832

- **Tkr1ZDir**
  - Entries: 219040
  - Mean: -0.7506
  - RMS: 0.1832

On-axis from top  Parallel to layer
Calorimeter variables

No cuts applied, just for reference