Selected $\pi^0$ truth, and TPC vetoing

Philip Rodrigues

University of Rochester

March 16, 2011
Introduction

- Are remaining $\pi^0$s irreducible?
- Look at truth information
- Two classes of irreducible $\pi^0$:
  1. One $\gamma$ lost
  2. $\gamma$s overlap
Take contained events selected by all cuts (inc. width), \( \pi^0 \) category
  (Multi-\( \pi \) more complicated)

Left: energy deposited in P0D hits (before cleaning) of \( \gamma \) with lower value
  units are pe. See backups for evt disp. \( \lesssim 200 \) probably “invisible”

Right: angle in degrees between two \( \gamma \)s
Joint distribution of variables on previous slide

Anticorrelation, as expected
Conclusions: $\pi^0$

- Majority of single $\pi^0$ irreducible
- Possible extensions: multi-$\pi$, consider angle in each view, use cleaned hits
TPC vetoing

- Compare veto on just TPC1 with veto on all TPCs.
  - Wouldn’t expect better purity, but maybe better efficiency
- For back exiting tracks, pre-TPC cuts already applied

<table>
<thead>
<tr>
<th></th>
<th>Sig</th>
<th>BG</th>
<th>Eff</th>
<th>Pur</th>
</tr>
</thead>
<tbody>
<tr>
<td>All contained cuts</td>
<td>94</td>
<td>257</td>
<td>0.11</td>
<td>0.27</td>
</tr>
<tr>
<td>No TPC $\mu$</td>
<td>88</td>
<td>157</td>
<td>0.10</td>
<td>0.36</td>
</tr>
<tr>
<td>No TPC $\pi$</td>
<td>86</td>
<td>130</td>
<td>0.10</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Veto on all TPCs

<table>
<thead>
<tr>
<th></th>
<th>Sig</th>
<th>BG</th>
<th>Eff</th>
<th>Pur</th>
</tr>
</thead>
<tbody>
<tr>
<td>All contained cuts</td>
<td>94</td>
<td>257</td>
<td>0.11</td>
<td>0.27</td>
</tr>
<tr>
<td>No TPC1 $\mu$</td>
<td>89</td>
<td>190</td>
<td>0.10</td>
<td>0.32</td>
</tr>
<tr>
<td>No TPC1 $\pi$</td>
<td>87</td>
<td>158</td>
<td>0.10</td>
<td>0.36</td>
</tr>
</tbody>
</table>

Veto on TPC 1 only
Selected signal events with full selection

$E_{\text{reco}}$ is just energy of P0D EM track

Surprisingly exiting resolution not (much) wider, but offset
  - Adding in TPC electron track energy might help
  - Could equally well just add a constant to exiting track energies
Backup slides
Event 0

- Deposited $E_1 = 0$ pe
- Deposited $E_2 = 659$ pe
- $\theta = 18^\circ$
Event 42

- Deposited $E_1 = 1448$ pe
- Deposited $E_2 = 1330$ pe
- $\theta = 18^\circ$
Event 45

- Deposited $E_1 = 0$ pe
- Deposited $E_2 = 738$ pe
- $\theta = 90^\circ$
Event 68

- Deposited $E_1 = 0$ pe
- Deposited $E_2 = 2665$ pe
- $\theta = 119^\circ$
Event 184

- Deposited $E_1 = 12879$ pe
- Deposited $E_2 = 2674$ pe
- $\theta = 7^\circ$
Event 206

- Deposited $E_1 = 734$ pe
- Deposited $E_2 = 4$ pe
- $\theta = 50^\circ$
Event 255

- Deposited $E_1 = 442$ pe
- Deposited $E_2 = 1997$ pe
- $\theta = 30^\circ$
Event 285

- Deposited $E_1 = 0$ pe
- Deposited $E_2 = 618$ pe
- $\theta = 74^\circ$
γ true energies, 1 and 2

“1” and “2” are just whatever order comes out of the trajectory list
\( \gamma \) true energies, min and max

![Graph](image)

- Lower true \( \gamma \) energy
- Higher true \( \gamma \) energy
\( \gamma \) true energy deposits, 1 and 2

- “1” and “2” are just whatever order comes out of the trajectory list
γ true energy deposits, min and max

- Lower energy deposited by γ
  - 0 1 2 3 4 5 6 7 8 9 10
  - ×10^3

- Higher energy deposited by γ
  - 0 1 2 3 4 5 6 7 8 9 10
  - ×10^3
Number of $\pi^0$ decay products

- $n = 3$ for $\pi^0 \rightarrow e^+ e^- \gamma$ (BR=1%)