PØD-Tracker CC inclusive analysis: Production 4 & 5 Update

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Productions and Matching

• Productions
  ▪ Prod-4
  ▪ Prod-5

• Matching methods
  ▪ Global tracks
  ▪ Tracker-to-PØD

• Run periods (PØD water bags are filled)
  ▪ Run 1
  ▪ Run 2

• Momentum bins: 0-2, 2-5, 5-10, 10+ [GeV]
Match methods

• ‘Global’ matching
  ▪ Use Global tracks

• Tracker-to-PØD match (T2P)
  ▪ Identify Tracker Trks that start at the first layer of TPC1 (Z < -750 mm)
  ▪ Pair each of the above with a PØD Trk when:
    o PØDTrk last node is in the last two PØDules (-1016 mm < Z)
    o Check Tracks time stamp (±100 ns)
    o $\sin \theta$ between last and first nodes directions < 0.365
    o $R^2 = \Delta X^2 + \Delta Y^2$ between last and first nodes positions < 85$^2$ mm$^2$

Note:
Trk quality cuts are apply on both Tracker and PØD Trks
# Samples and POT’s

<table>
<thead>
<tr>
<th>Production-Spin</th>
<th>Data</th>
<th>MC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run 1</td>
<td>2.95x10^{19}</td>
<td>54.5x10^{19}</td>
</tr>
<tr>
<td>Run 2</td>
<td>4.30x10^{19}</td>
<td>110x10^{19}</td>
</tr>
</tbody>
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<th>Production-Spin</th>
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<tr>
<td>Run 1</td>
<td>2.96x10^{19}</td>
<td>98.9x10^{19}</td>
</tr>
<tr>
<td>Run 2</td>
<td>4.31x10^{19}</td>
<td>130x10^{19}</td>
</tr>
</tbody>
</table>

- In both periods PØD water bags are full
- Data used passed DQ checks
- NEUT MC samples
Reminder: Analysis flow

• Beam and Data Quality information
  o Each spill (ND280 Event) should be checked that
    ▪ BeamSummaryData→GoodSpillFlag == 1
    ▪ DQ: ND280OffFlag == 0

• Individual Trk information
  o Each Trk in spill
    ▪ Start Position in the PØD Fiducial volume (Water-Targets; TN-073)
    ▪ Have a TPC1 piece
    ▪ Sort into bunches

• Bunch time window information
  o (in) Each bunch
    ▪ Select the negative Trk with the highest momentum
Global: Run 1

Prod-4

Prod-5

Point = Data
(4D) (5B)

Histo = MC
(4C) (5C)

Note:
• Normalized by POT
• Corrected by Beam flux (11by3.1)
Global: Run 2

Prod-4

Prod-5

Point = Data
(4D) (5B)

Histo = MC
(4C) (5C)

Note:
• Normalized by POT
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T2P: Run 1

Prod-4

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Point = Data
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T2P: Run 2

Prod-4

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Point = Data
(4D) (5B)

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Note:
• Normalized by POT
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# Data/MC Ratios: Global & T2P

- **‘Global’ matching**

<table>
<thead>
<tr>
<th>Prod-4*</th>
<th>0 - 2 GeV</th>
<th>2 - 5 GeV</th>
<th>5 - 10 GeV</th>
<th>0-10 GeV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run 1</td>
<td>0.937±0.020</td>
<td>0.868±0.029</td>
<td>0.770±0.052</td>
<td>0.904±0.016</td>
</tr>
<tr>
<td>Run 2</td>
<td>0.892±0.017</td>
<td>0.860±0.023</td>
<td>0.771±0.042</td>
<td>0.872±0.013</td>
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<table>
<thead>
<tr>
<th>Prod-5</th>
<th>0 - 2 GeV</th>
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<th>5 - 10 GeV</th>
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</tr>
</thead>
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<tr>
<td>Run 1</td>
<td>0.984±0.019</td>
<td>0.922±0.028</td>
<td>0.768±0.048</td>
<td>0.950±0.015</td>
</tr>
<tr>
<td>Run 2</td>
<td>0.950±0.015</td>
<td>0.871±0.022</td>
<td>0.836±0.041</td>
<td>0.919±0.012</td>
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- **Tracker-to-PØD match (T2P)**

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<td>Run 1</td>
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<tr>
<td>Run 1</td>
<td>0.918±0.019</td>
<td>0.846±0.027</td>
<td>0.752±0.045</td>
<td>0.881±0.015</td>
</tr>
<tr>
<td>Run 2</td>
<td>0.987±0.017</td>
<td>0.931±0.024</td>
<td>0.928±0.043</td>
<td>0.965±0.013</td>
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* Mass correction apply to MC
Summary

• PØD-Tracker analysis includes
  - Two different matching methods (Global, T2P)
  - Was preformed for
    o Production 4
    o Production 5
  - Where the PØD water bags are full in
    o Run 1
    o Run 2

• The ratios include flux correction (11bv3.1)
• The final ratios
  - Tracking efficiencies should be completed - ongoing effort
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# Prod-4 Data/MC Ratios

## ‘Global’ matching

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## Tracker-to-PØD match (T2P)

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*Mass correction*

## Tracker (Thanks to Federico)

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<td>0.879±0.065</td>
<td>0.760±0.120</td>
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<tr>
<td>Run 2</td>
<td>0.962±0.019</td>
<td>0.933±0.040</td>
<td>0.839±0.075</td>
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