ECAL PID Efficiency 1
PID Efficiency Simulation

- Input flat distribution: electrons
- No radiative effects in the target
- Setup only include ECAL and sensitive detector replacing last GEM in vacuum medium.
- Use ecal cluster energy and input momentum to get energy resolution for shower only and pre-shower + shower combination
Input Flat Distribution

Last GEM Primary Track Momentum

Input Momentum

Last GEM Primary Track Theta

Input Angle

Last GEM Primary Track Hit Radius

Input Radius
ECAL Energy Calibration

Calibrated Energy on Shower = sh_edep_scint * sampling_fraction

Calibrated Energy on PreShower =
    ps_edep_scint + ps_edep_lead

Calibrated Total Energy =
    Calibrated Energy on Shower + Calibrated Energy on PreShower

Note:
- sampling_fraction obtained from simulation
- Energy deposit on lead in shower and pre-shower are recorded in the simulation
A 2.5 $\sigma$ cut applied to select $e^-$ events

Ratio of above cut selected $e^-$ over total $e^-$ events is the ECAL efficiency
e^- Efficiency

Electron Efficiency for ECAL (PS+SH) with 2.5 $\sigma$ cut
$\pi^-$ Efficiency

Pion Efficiency for ECAL (PS+SH) with 2.5 $\sigma$ cut

![Graph showing efficiency vs. $\pi^-$ momentum in MeV]
MIP Cut on the Pre-Shower

- Electron deposit energy in the PS differently compared to pions
- Due to Pions act like a MIP most of the time PS cut just above a MIP can reject pions
MIP Cut on the Pre-Shower

- Electron deposit energy in the PS differently compared to pions
- Due to Pions act like a MIP most of the time PS cut just above a MIP can reject pions
- Apply a MIP cut to select edep greater than MIP + 2.5
  - MIP cut is to 6 MeV

**Shower Scint Total Edep**

<table>
<thead>
<tr>
<th>Entries</th>
<th>54986</th>
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<tbody>
<tr>
<td>Mean</td>
<td>433.4 ± 1.701</td>
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<tr>
<td>RMS</td>
<td>399</td>
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</table>

**PreShower Scint Total Edep**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
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<td>20.81 ± 0.1711</td>
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<td>RMS</td>
<td>40.08</td>
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$e^-$ Efficiency with PS MIP Cut

Electron Efficiency for ECAL (PS+SH) with 2.5 $\sigma$ cut
$\pi^-$ Efficiency with PS MIP Cut

Pion Efficiency for ECAL (PS+SH) with 2.5 $\sigma$ cut

![Graph showing efficiency vs. momentum for $\pi^-$ particles with PS MIP cut, with data points and error bars.](image)
Additional Shower Threshold Cut

- A cut on the scintillator energy deposit in the shower
  - Set to 200 MeV
e\textsuperscript{-} Efficiency with PS MIP Cut and Sh. Cut

**Electron Efficiency for ECAL (PS+SH) with 2.5 \( \sigma \) cut**
π⁻ Efficiency with PS MIP Cut and Sh. Cut

Pion Efficiency for ECAL (PS+SH) with 2.5 σ cut
Supplementary Slides
Intrinsic ECAL Energy Resolution

Based on calibrated energy deposit in the ECAL
# Shower Energy Resolution

<table>
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<tr>
<th>Pf (GeV)</th>
<th>Res (%)</th>
<th>Error (%)</th>
<th>Pf (GeV)</th>
<th>Res (%)</th>
<th>Error (%)</th>
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<td>0.056</td>
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<td>0.004</td>
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<td>0.049</td>
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<td>3.73</td>
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<tr>
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Note:
The main difference between total energy based energy resolution and 6+1 cluster based energy resolution is the constant term is larger when 6+1 clusters are considered.
Jin's Energy Resolution (with No Phot. Elec.)

- Jin's estimation was based on ecal (ps+sh) calibrated energy deposition
  - No Photon fluctuations included
Background due to Radiative Effects

Simulation included empty target geometry, last 2 GEMs, and ECAL in air medium
Background due to Radiative Effects

Simulation only include ECAL and sensitive detector replacing last GEM in vacuum medium
Energy Deposit Distribution on ECAL: Before