Validation of Cluster Calibration with $\Sigma \rightarrow \Lambda \gamma$ and $\gamma\gamma$ Events

Chris Schilling
University of Texas @ Austin
EMC Calibration Meeting
Outline

• Σ -> Λ γ and γγ event selection
• Methodology
• Σ -> Λ γ fits and distributions
• Σ -> Λ γ summary plots
• Link to γγ fits and summary plots
• Conclusion
Event Selection

• $\Sigma \rightarrow \Lambda \gamma$ events (Run4 only):
  - LambdaVeryVeryLoose skim
  - $\Lambda$ from $p^+ \pi^-$ ($p$ from $pLHVeryLoose$, $\pi$ from GoodTracksLoose)
  - $\gamma$ from GoodPhotonLoose

• $\gamma\gamma$ events (Run4 only):
  - require an event have 2 GoodPhotonLoose and 0 ChargedTracks
  - $\cos(\theta_{CMS})<-0.9999$ ($\approx 179<\theta_{CMS}<181$ degrees)
Methodology

- Study \((E_{raw} - E_{calc})/E_{calc}\), \((E_{meas} - E_{calc})/E_{calc}\) and \(E_{meas}/E_{raw}\) distributions from both datasets.
  - If \(r = (E_{raw} - E_{calc})/E_{calc}\) and \(f = 1/(1+r)\) then \((f*E_{raw} - E_{calc})/E_{calc}=0\), so compare \(f\) to \(E_{meas}/E_{raw}\) profiles

- \(\Sigma \rightarrow \Lambda \gamma\):
  - model the bg via event mixing/thrust rotation
  - fit modeled bg w/ quadratic.
  - fit signal pk w/ quadratic + Novosibirsk where the quadratic is fixed
  - Distribution Binning:
    - In each of 2 energy bins (50-150MeV, 150-400MeV) 5 theta bins (1endcap + 4 barrel)
    - In each of 2 theta bins (endcap and barrel) 4 energy bins

- \(\gamma\gamma\) events:
  - fit signal pk w/ Novosibirsk
  - Distribution Binning:
    - In each of 7 theta bins (end + 6 barrel) 6 1GeV energy bins
$\Sigma \rightarrow \Lambda \gamma$

Fits and Distributions
E_{raw} - E_{calc} \leq 0.15 \text{ and } E_{calc} \leq 0.4 \text{ with } 21 < \theta < 33 \text{.}

\begin{align*}
    f & = 53.92 / 16 \\
    \text{Prob} & = 5.352 \times 10^{-6} \\
p_0 & = 4946 \pm 46.4 \\
p_1 & = -0.05972 \pm 0.00073 \\
p_2 & = 0.04672 \pm 0.00048 \\
p_3 & = -0.07445 \pm 0.01740
\end{align*}
$E_{\text{meas}} - E_{\text{calc}} / E_{\text{calc}} \in 0.150000006 < E_{\text{calc}} < 0.400000006 \text{ GeV}$

$21 < \text{thidx} < 33$

$49.98 / 16$

$\text{Prob} = 2.306 \times 10^{-5}$

$p_0 = 4709 \pm 44.5$

$p_1 = -0.0001719 \pm 0.0007780$

$p_2 = 0.04874 \pm 0.00052$

$p_3 = -0.07401 \pm 0.01845$
Emas/Emaw0.150000006 < E_{calc} < 0.400000006 GeV  
21 < thidx < 33
$\Sigma \rightarrow \Lambda \gamma$

Summary Plots

http://www.slac.stanford.edu/~cschill/EMC/Calib/slg_data_newcalib_th+erg_th.ps (Summary Plots Versus Theta)

http://www.slac.stanford.edu/~cschill/EMC/Calib/slg_data_newcalib_th+erg_erg.ps (Summary Plots Versus Energy)
Theta Profile: $50 < E_{\text{calc}} < 150$ MeV

Profile Emeas/Eraw with My Calib Factor

Emeas/Eraw profile
My Calib Factor ($f$)

http://www.slac.stanford.edu/~cschill/EMC/Calib/sl_data_newcalib_th+erg_th.ps (Summary Plots Versus Theta)
50\textless E_{\text{calc}} \textless 150 \text{ MeV}

P_{k} \frac{E_{\text{meas}} - E_{\text{calc}}}{E_{\text{calc}}} \text{ vs } \theta_{\text{idx}}
Theta Profile: $150 < \text{E}_{\text{calc}} < 400$ MeV
150 < E_{calc} < 400 \text{ MeV}
Energy Profile: Endcap

Profile $E_{\text{meas}}/E_{\text{raw}}$ with My Calib Factor
Endcap

P_k E_{meas} - E_{calc}/E_{calc} vs T_{idx}
Barrel Profile: Endcap

Profile Emeas/Eraw with My Calib Factor
\( \gamma \gamma \) Fits and Summary Plots
(versus energy)

http://www.slac.stanford.edu/~cschill/EMC/Calib/2gam_data_newcalib_th+erg_erg.ps
Notes $\gamma \gamma$ for summary plots

- Distribution Binning:
  - In each of 7 theta bins (end + 6 barrel) 6 1GeV energy bins
- Strong $E, \theta$ correlation, so we see only high (>8 GeV) energy photons in the endcap and only low (<4 GeV) energy photons in the backward barrel
- Fits/distributions + summary plots are here:
  http://www.slac.stanford.edu/~cschill/EMC/Calib/2gam_data_newcalib_th+erg_erg.ps
Conclusion

• One important step is missing: MC comparisons to data
  – all jobs have been run, so I only need to produce the summary plots/fits and compare to data

• At this stage in the validation, results look promising