LumiCal Resolutions

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CERN-EP-LCD

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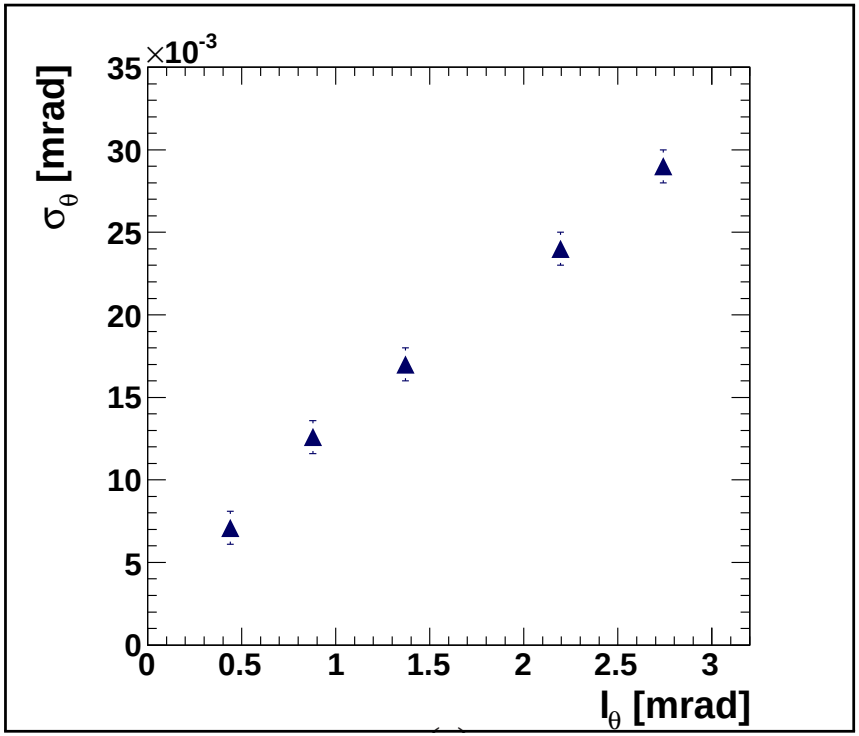
LumiCal Parameters, expected Performance

- Z: 2539 mm
- Inner Radius: 100 mm, 40 mrad
- Outer Radius: 340 mm, 134 mrad
- Radial cells: 64, 1.47 mrad



From LCD-Note-2009-002, 1.5 TeV electrons, optimized log constant

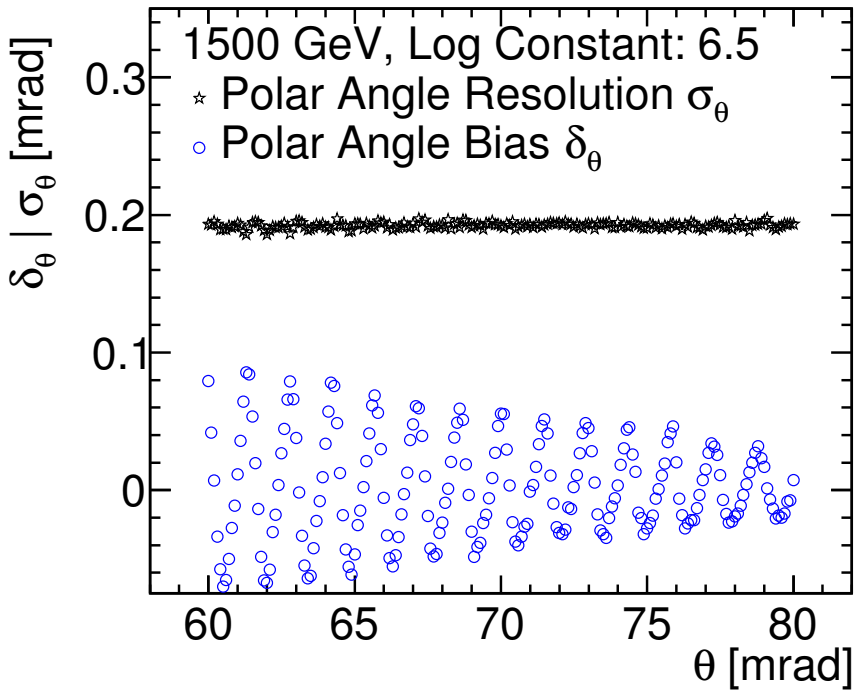
The Situation

- Polar angle resolution 10 times worse than previously estimated
- Theta calculated from x/y/z average. Energy weighted by

$$\bar{x}_i = \frac{\sum_{\text{Hits}} w_{\text{Hit}} x_{\text{Hit}}}{\sum_{\text{Hits}} w_{\text{Hit}}}$$

with

$$w_{\text{Hit}} = \max\left(0.0, \log\left(C + \frac{E_{\text{Hit}}}{E_{\text{Cluster}}}\right)\right)$$

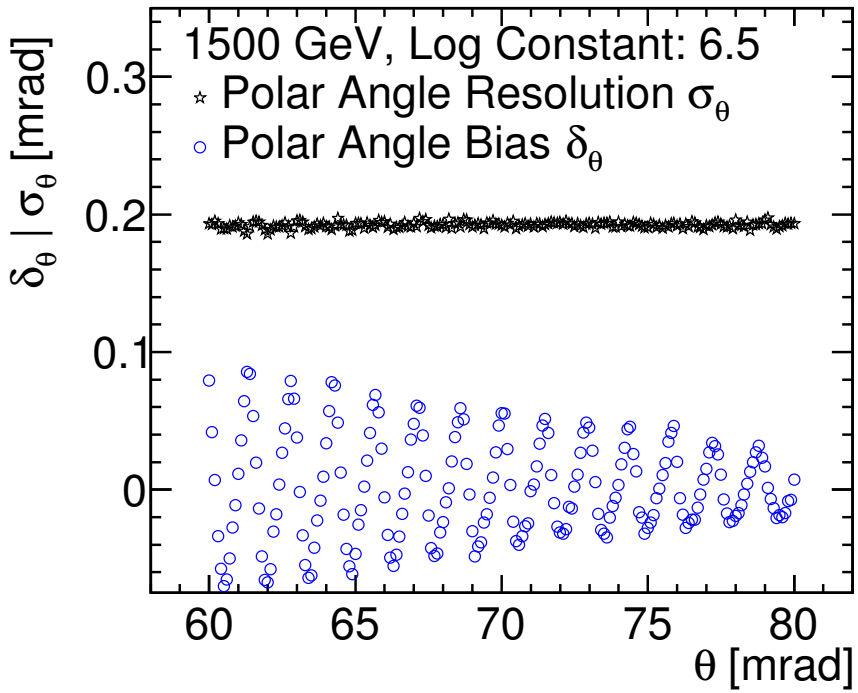


Bugs and Fixes

- Multiple places where cluster positions is calculated
  - Once for clusters for LCIO output: not averaging polar angle
  - Once for root trees written by processor: averaging polar angle, at least for *Theta* `branch`
- Re-calculating cluster position from clusters resulted in better resolutions
  - Discovered by Yorgos: wrong Z position calculated from cellID: wrong unit when reading layer thickness. Off-by-one error: starting layers at 0
  - segmentation offset off by half radial cell width

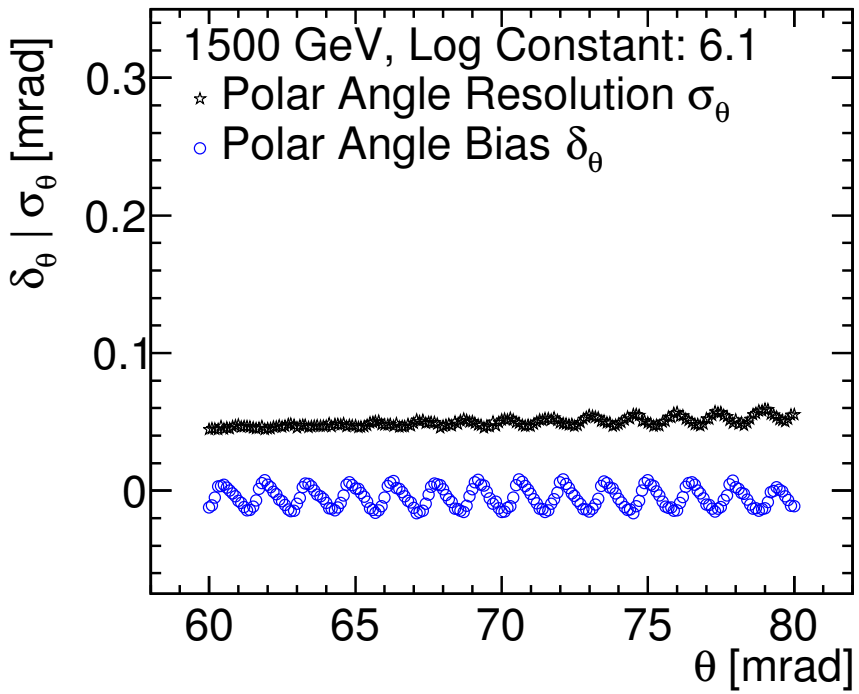
Resolutions

- Previously



Resolutions

- Previously
- Fix Z-position of layers, fix layer starting with 0, place hit in middle of sensitive
  - Mostly affecting reconstruction performance, resolutions more visible when using root file output from processor



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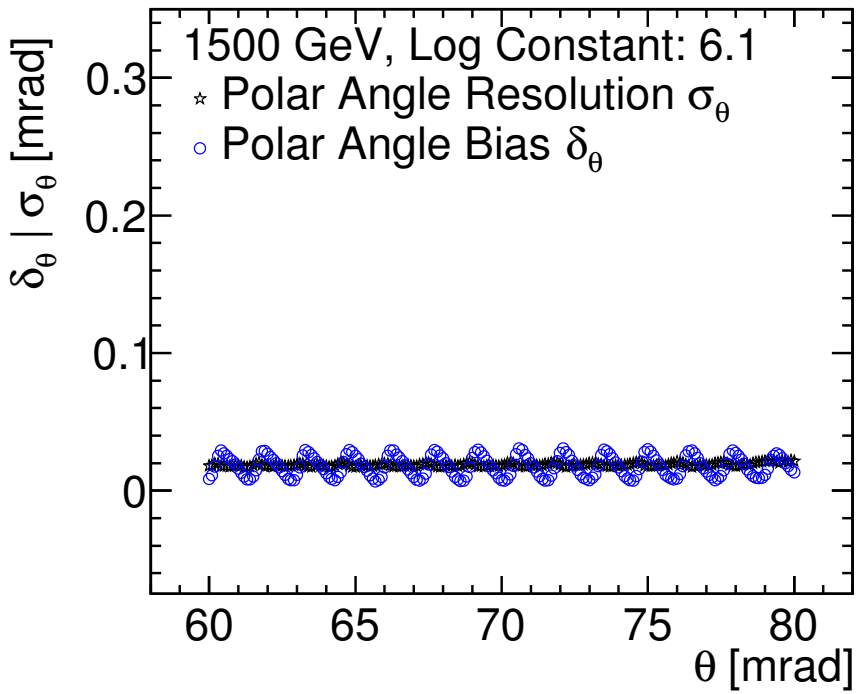
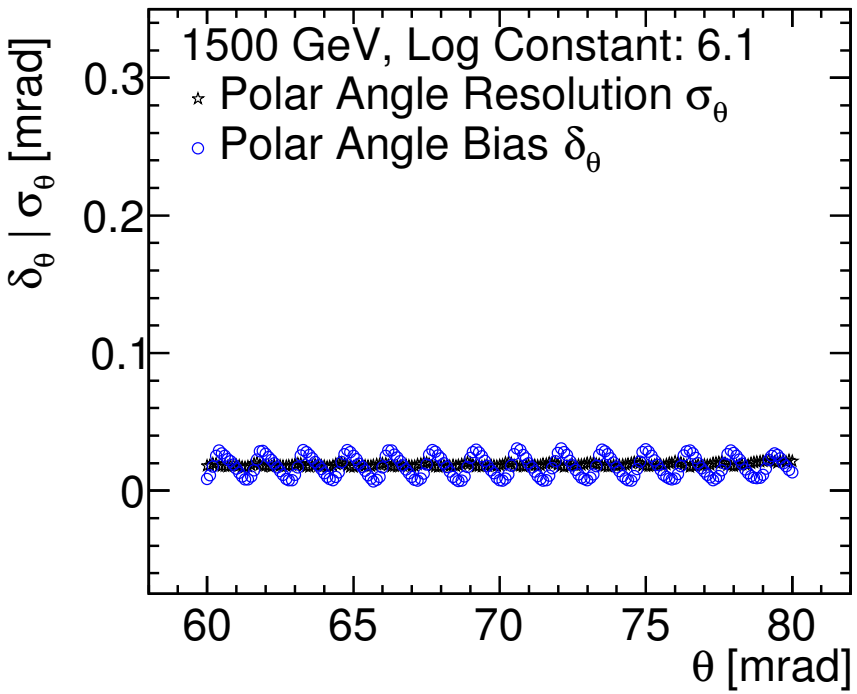


Resolutions

- Previously
- Fix Z-position of layers, fix layer starting with 0, place hit in middle of sensitive
  - Mostly affecting reconstruction performance, resolutions more visible when using root file output from processor
- Average over polar angle instead of cartesian coordinates
- Fix radial cell position
  - No change with respect to previous, only affecting root file output



Work in Progress: Weighting Cells by cell Area

- Cell area grows by radius, larger cells receive larger energy deposit

$$A = R_{\text{cell}} \Delta\phi \Delta R \qquad (1)$$

  ΔR and $\Delta\phi$ are constant, area only scales by R.

- Scale cell weights with $R_{\text{min}}/R_{\text{cell}}$

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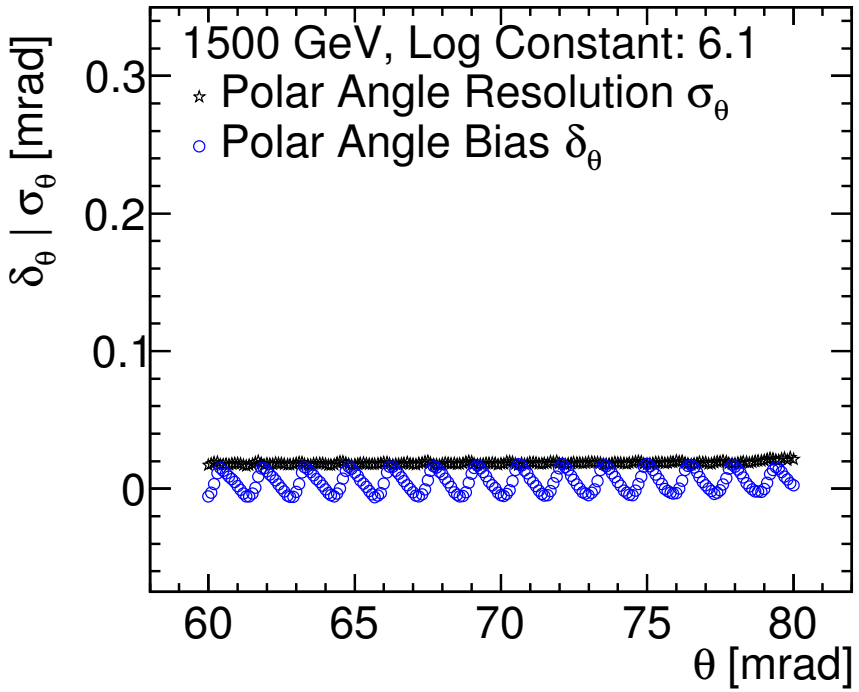

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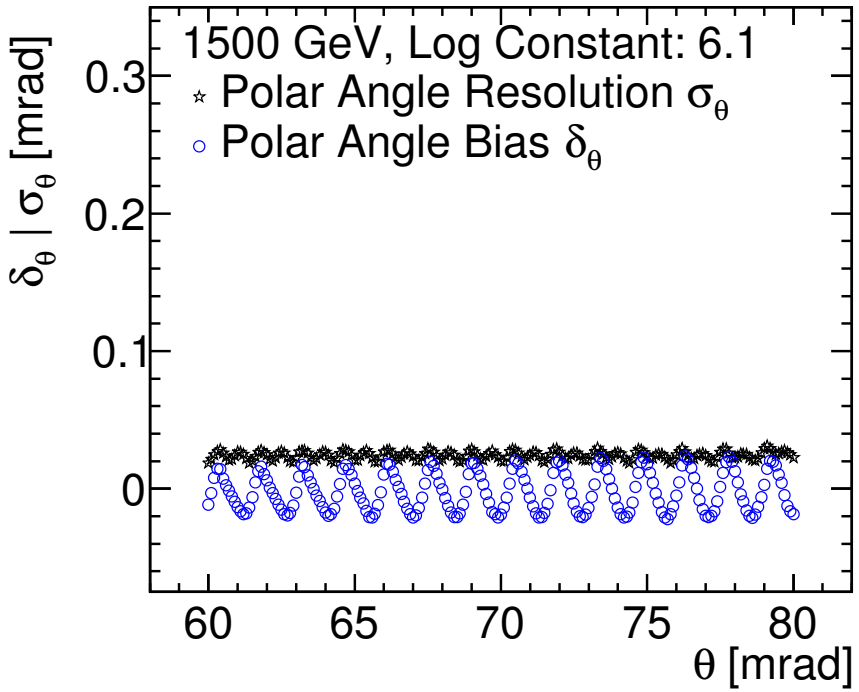

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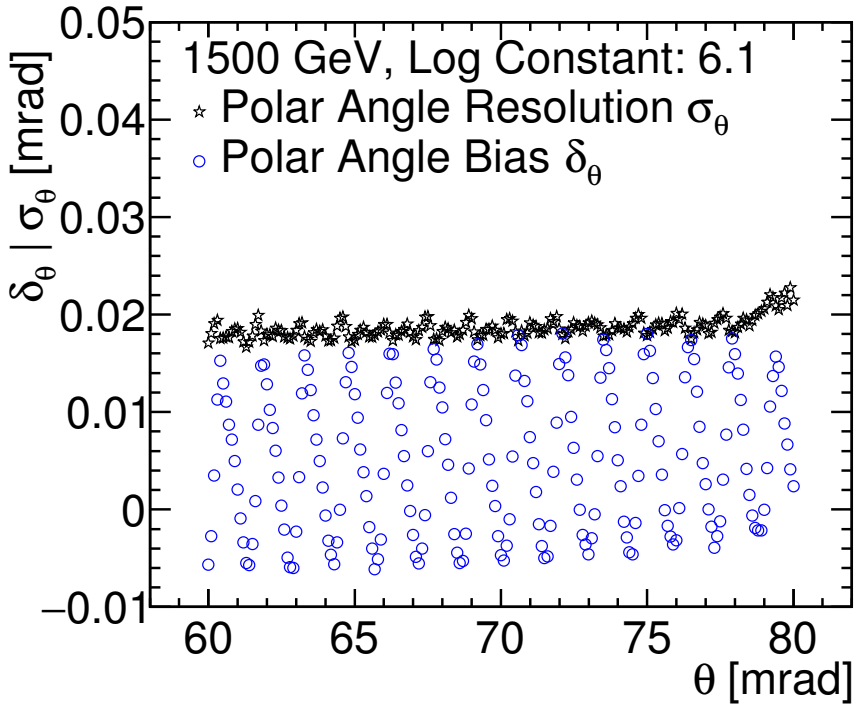

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