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ALCWS, 14 July 2003

Luminosity Spectrum Studies

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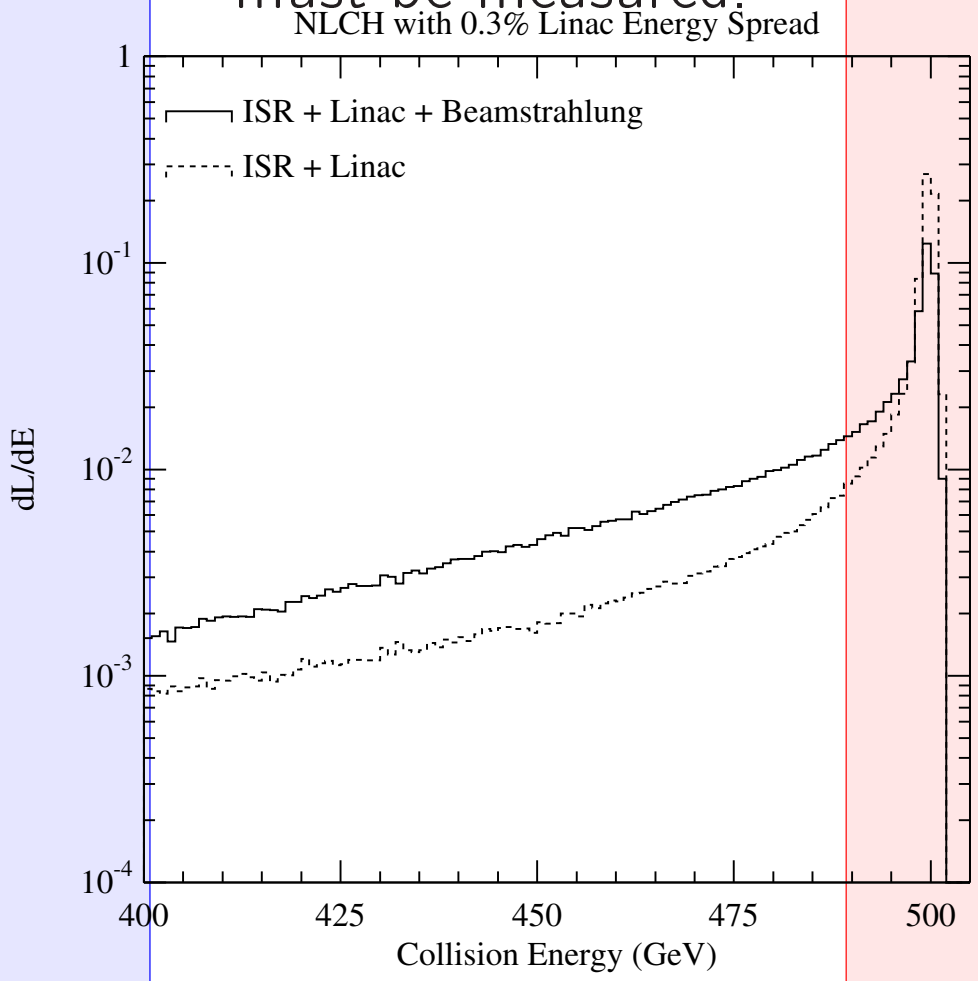
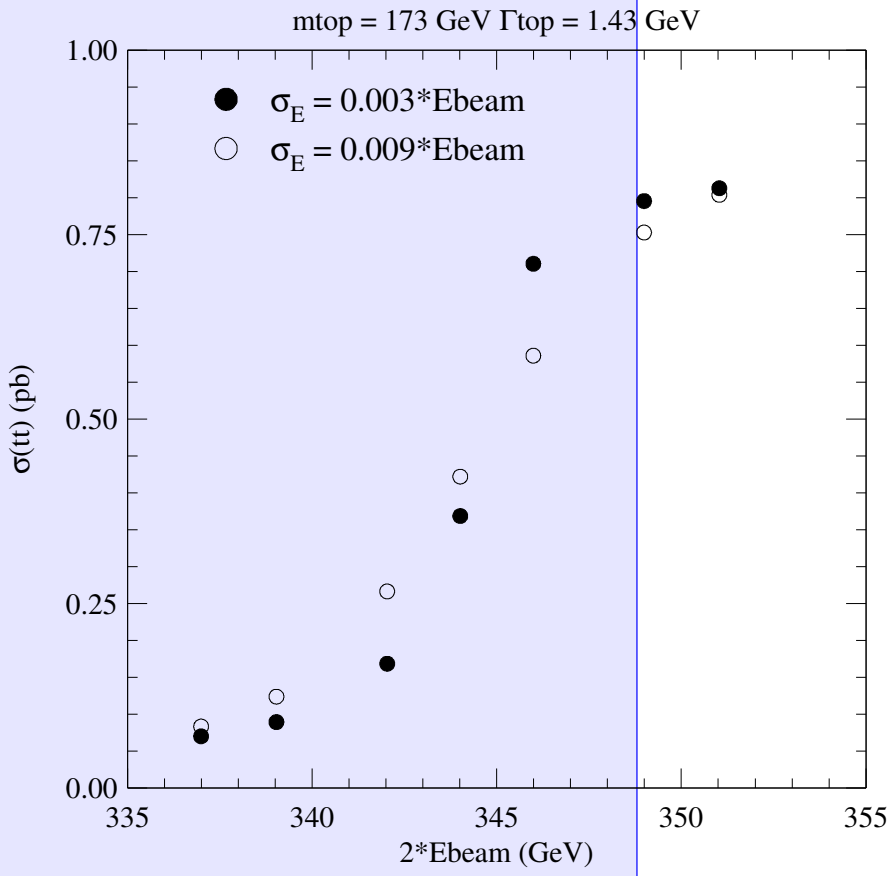
Luminosity Spectrum

Key headache is that much luminosity is lost in the tails. Effects of Beamstrahlung are similar in size to ISR. Beamstrahlung depends on the details of the collision (beam sizes, charge, angles, . . .) and thus $d\mathcal{L}/dE$ must be measured.



Measurement Requirements

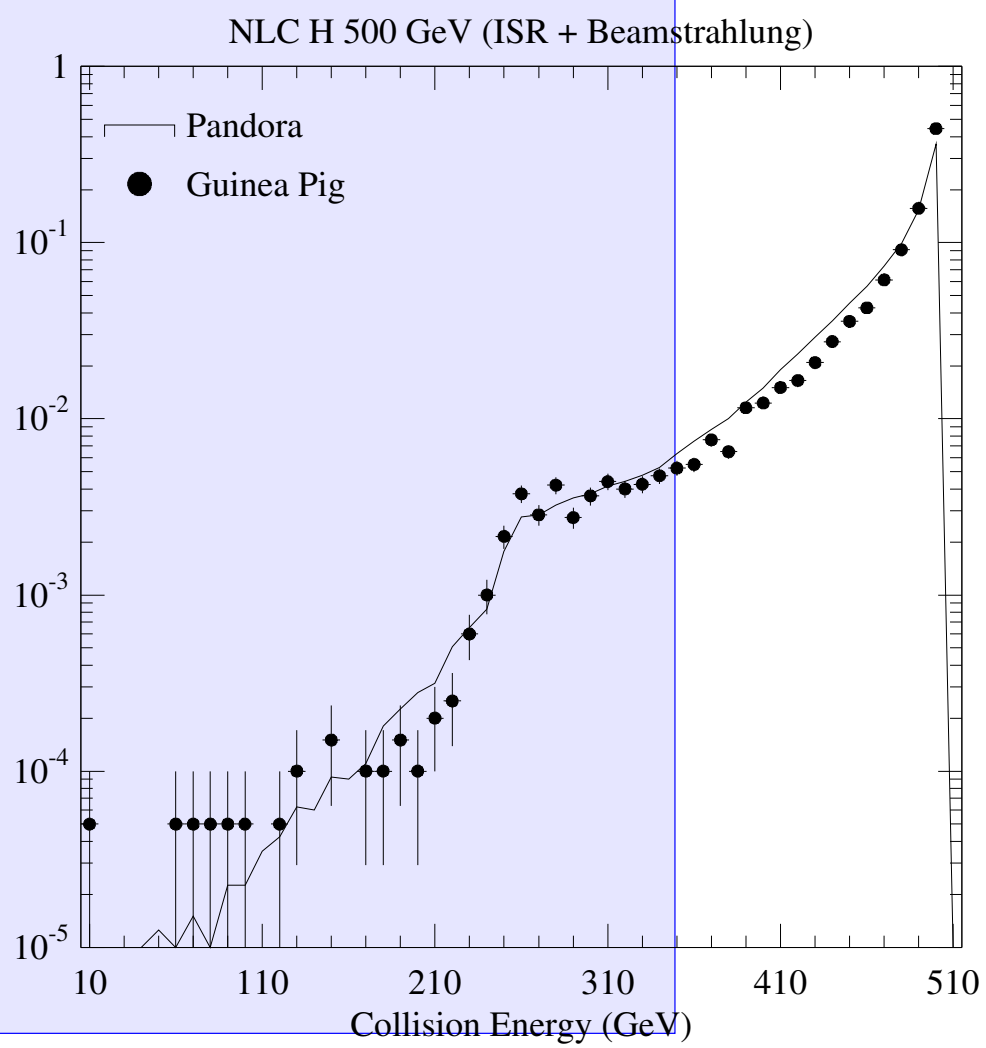


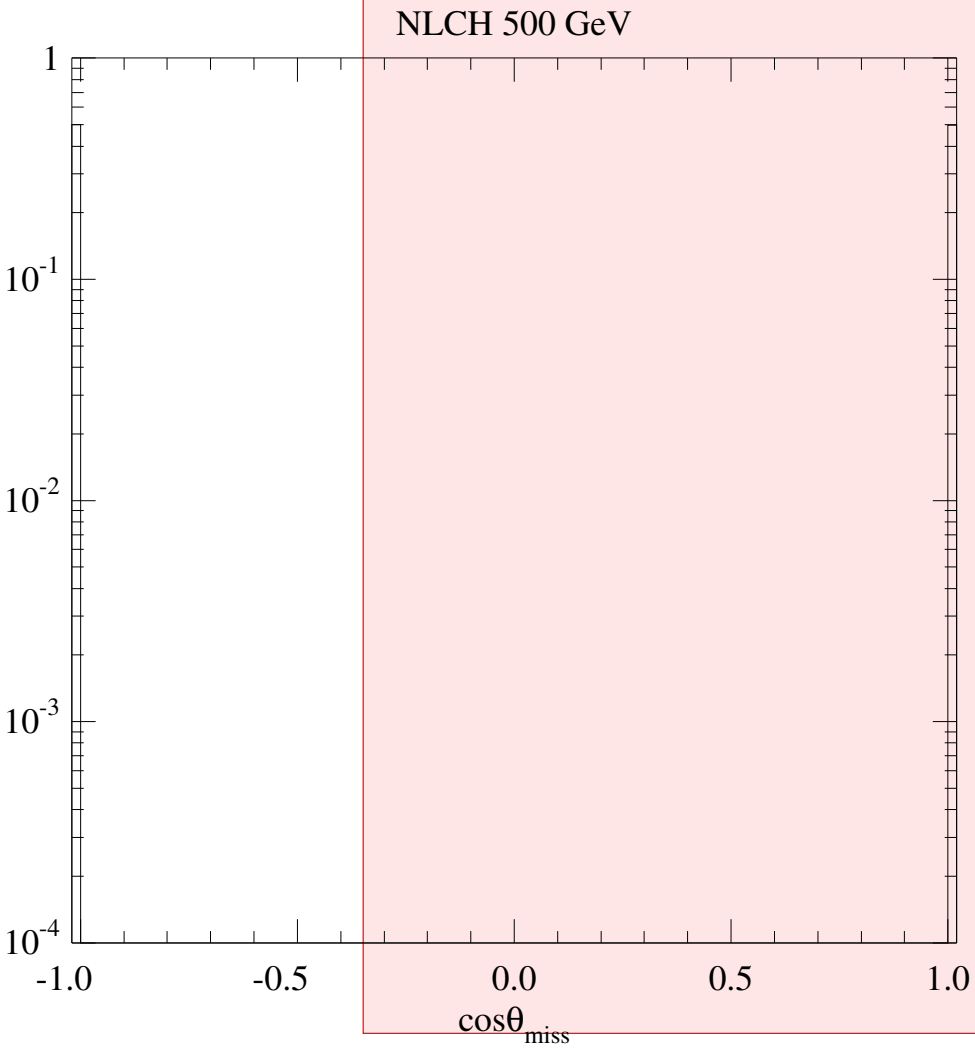
$\delta\sigma_E/E = 0.1\% \Rightarrow \delta\Gamma_t = 170$ MeV
$\delta\sigma_E/E = 0.1\% \Rightarrow \delta m_t = 160$ MeV
$\delta A_{\text{tail}}/A_{\text{total}} = 1\% \Rightarrow \delta\Gamma_t = 56$ MeV
$\delta A_{\text{tail}}/A_{\text{total}} = 1\% \Rightarrow \delta m_t = 30$ MeV
$\delta\text{Shap}/\text{Shap} = 1\% \Rightarrow \delta\Gamma_t = 0.3$ MeV
$\delta\text{Shap}/\text{Shap} = 1\% \Rightarrow \delta m_t = 0$ MeV

Other studies (Martinez *et al.*, Cinabro) show $\delta m_t = 30$ MeV $\delta\Gamma_t = 50$ MeV from other experimental effects. Similar conclusions as Fujii, Matsui, and Sumino; Battaglia for SUSY at CLIC.

Towards Analysis: Methods

Using Pandora (Peskin) to simulate NLCH machine at 500 GeV. Pandora parametrizes Beamstrahlung. Compares well with Guinea Pig but does not include correlations and assumes all photon radiation is exactly collinear:



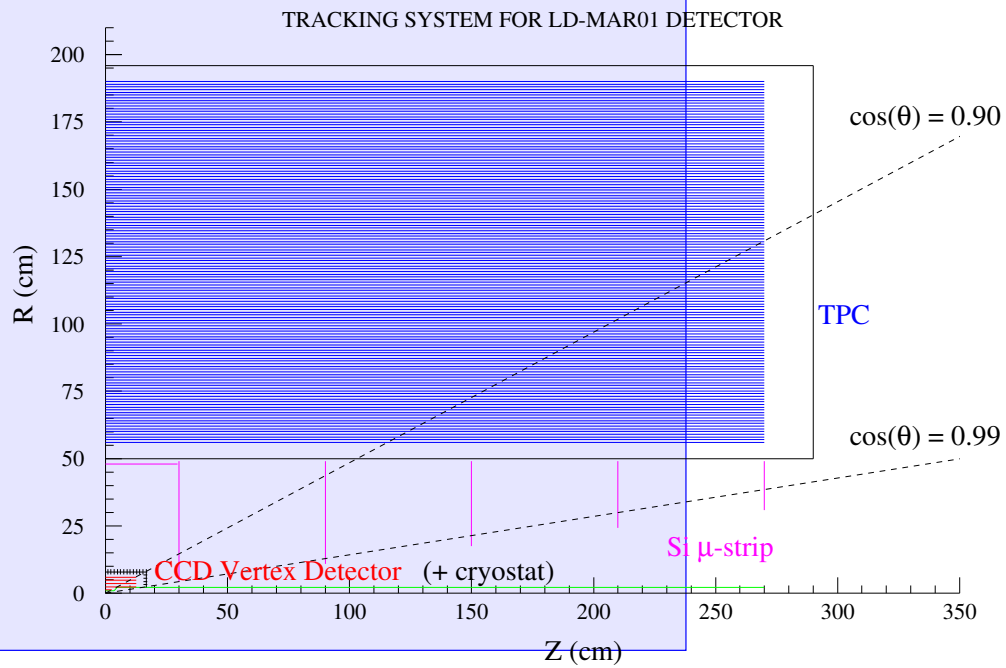


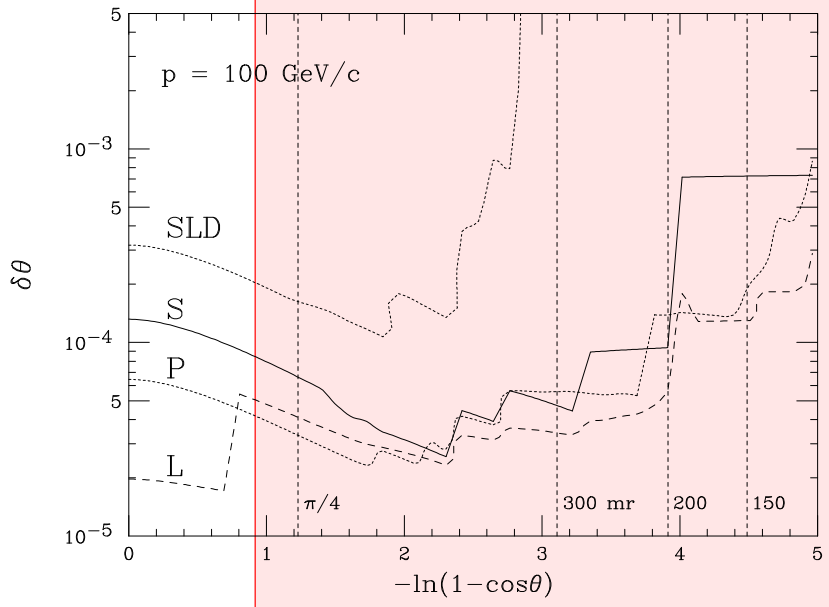
Towards Analysis: Methods and Detector Effects

Use $e^+e^- \to e^+e^-$ into the detector and measure the acollinearity ($\Delta\theta$) noting:

$$E'/E = 1 - \frac{\Delta\theta}{2\sin\theta} \tag{1}$$

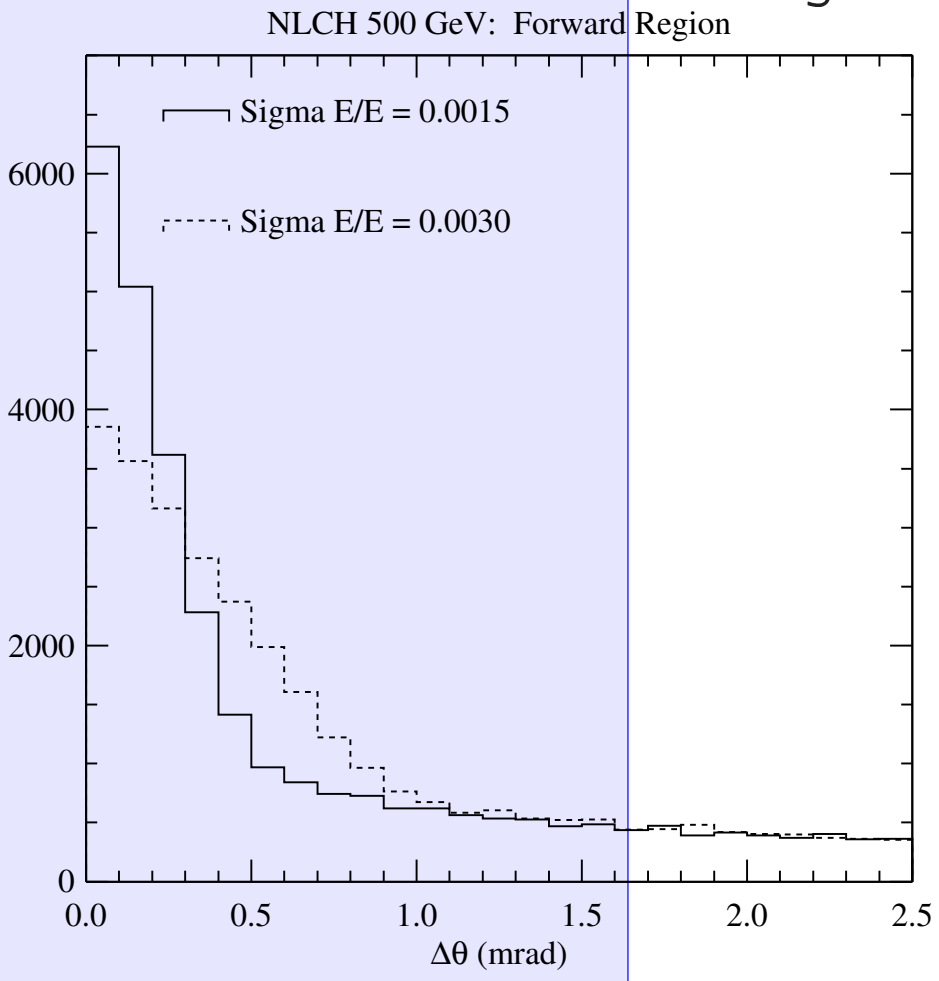
Concentrate on how to measure the width of the beam energy spread. Detector naturally divides into three regions: forward (θ 300-150mrad, $\Delta\theta$ resolution 1 mrad; end cap (800-300mrad, 0.1 mrad) barrel (rest, 0.1 mrad).

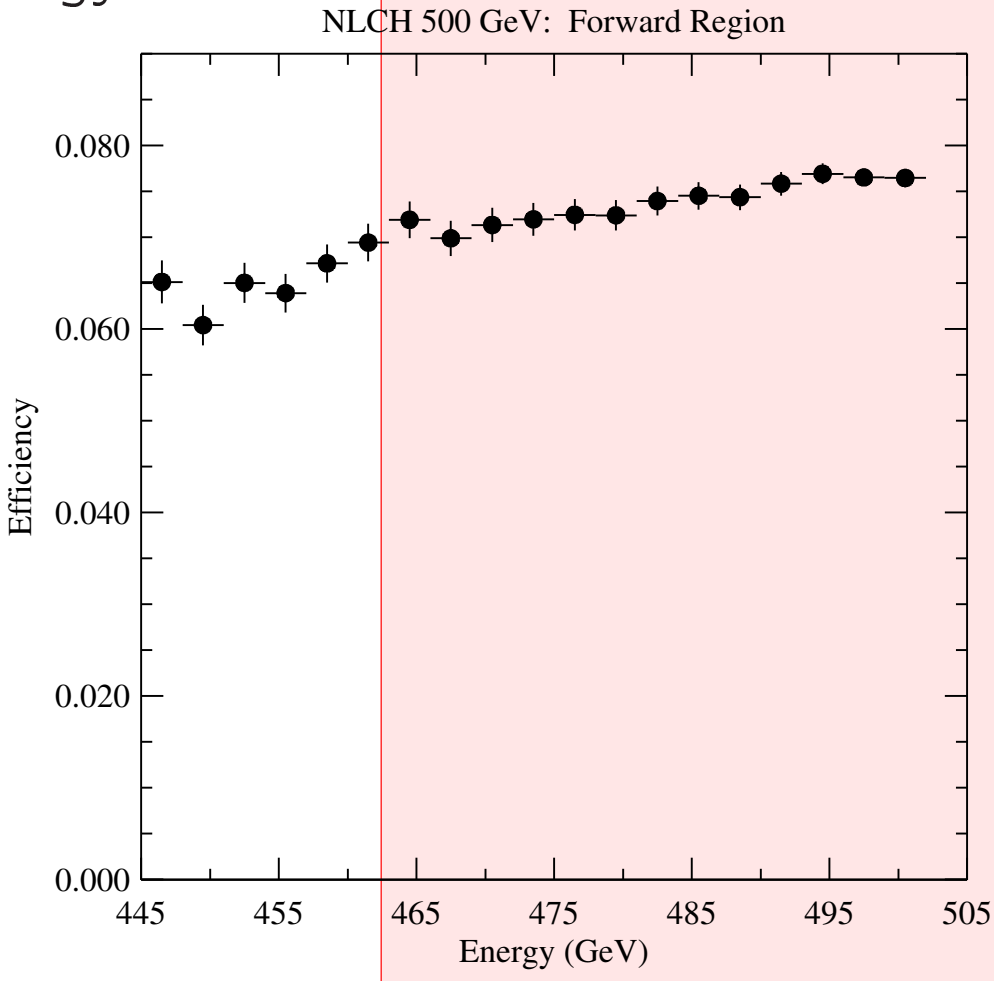




Forward Region

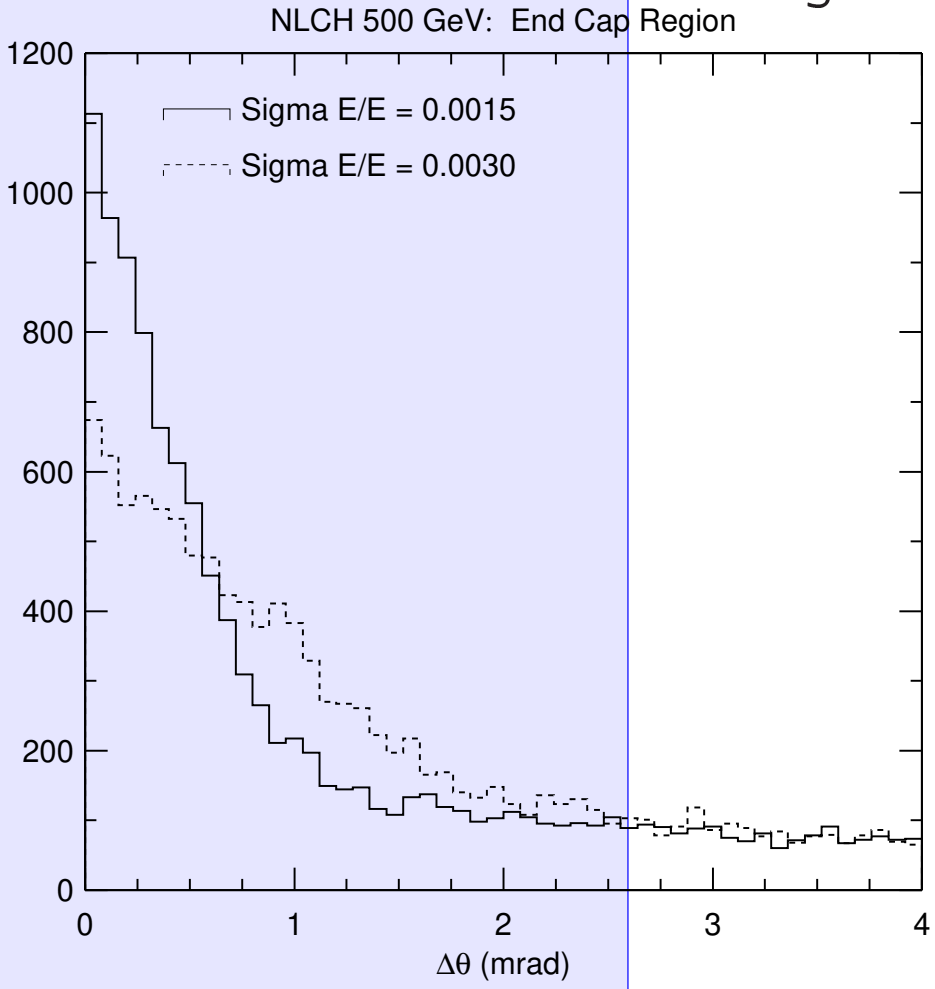
Just looking at generator level this region does not look promising. Resolution overwhelms effect we need to measure and efficiency falls for large energy loss.

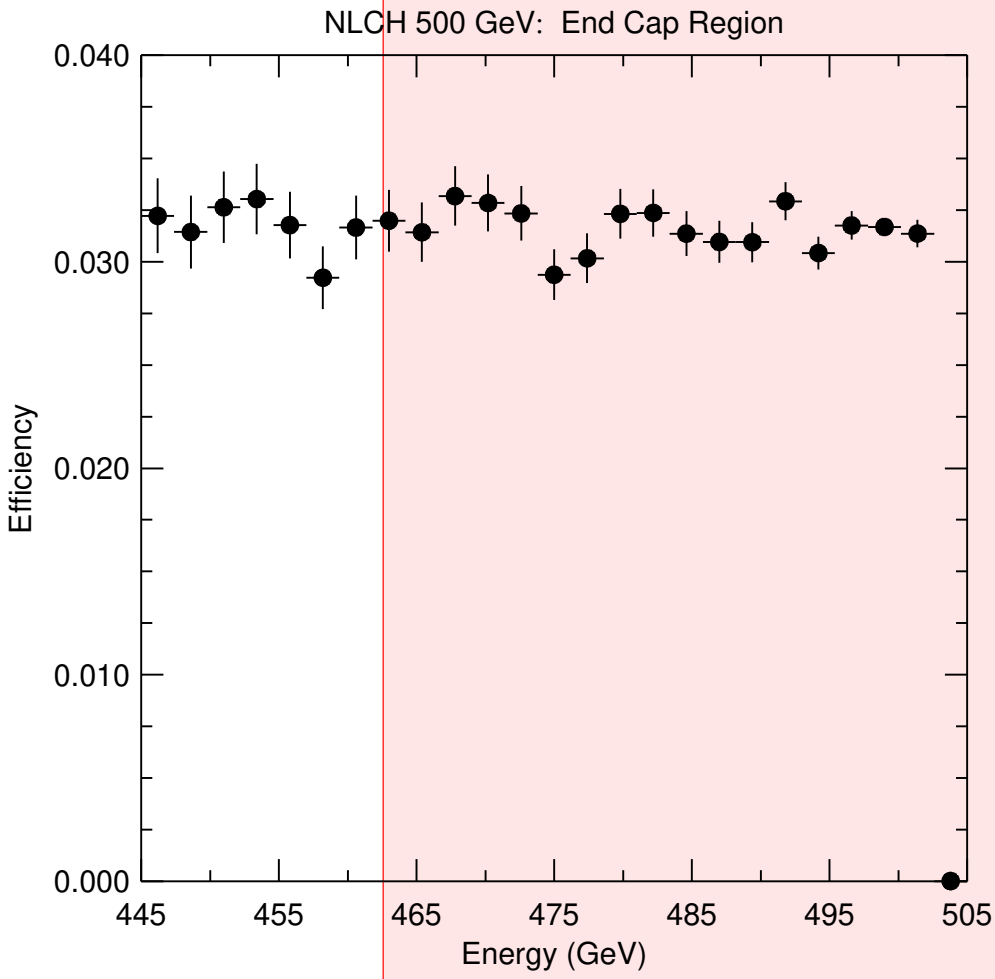




End Cap Region

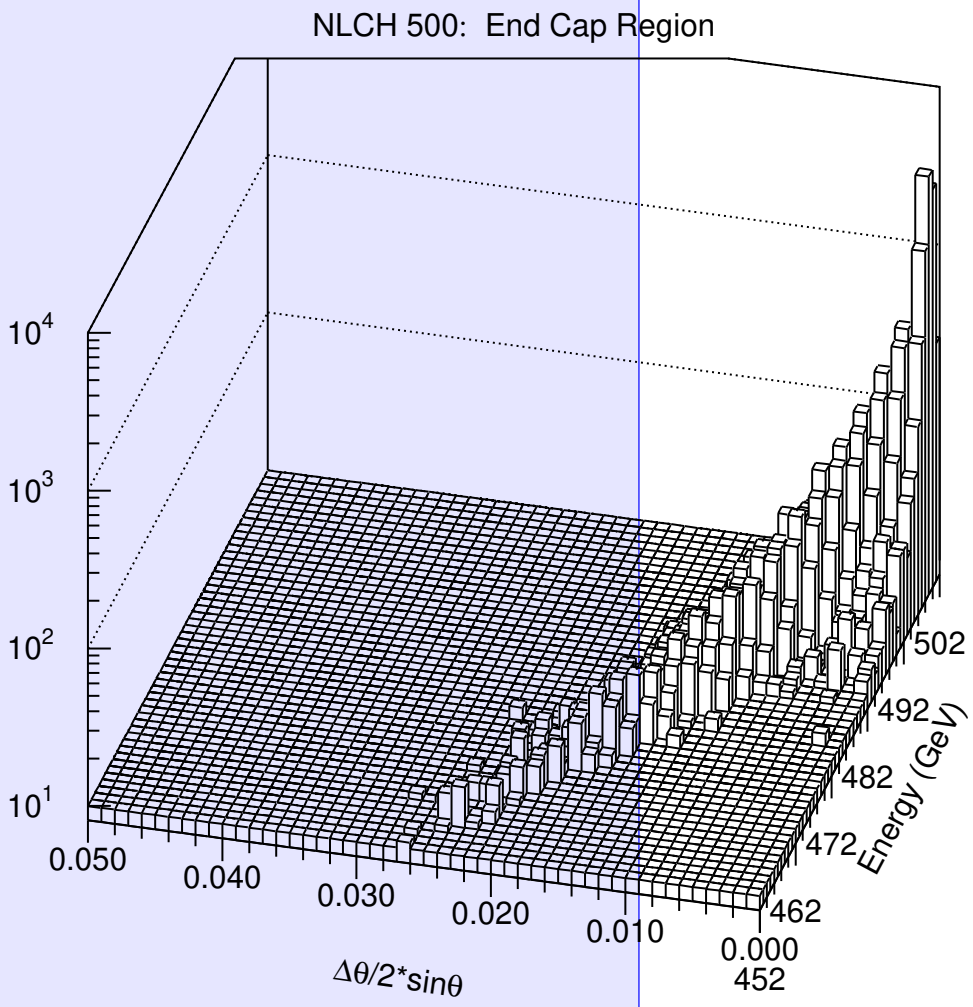
At the generator level this region does look promising. Resolution is small compared to the effect we need to measure and efficiency stable for large energy loss.

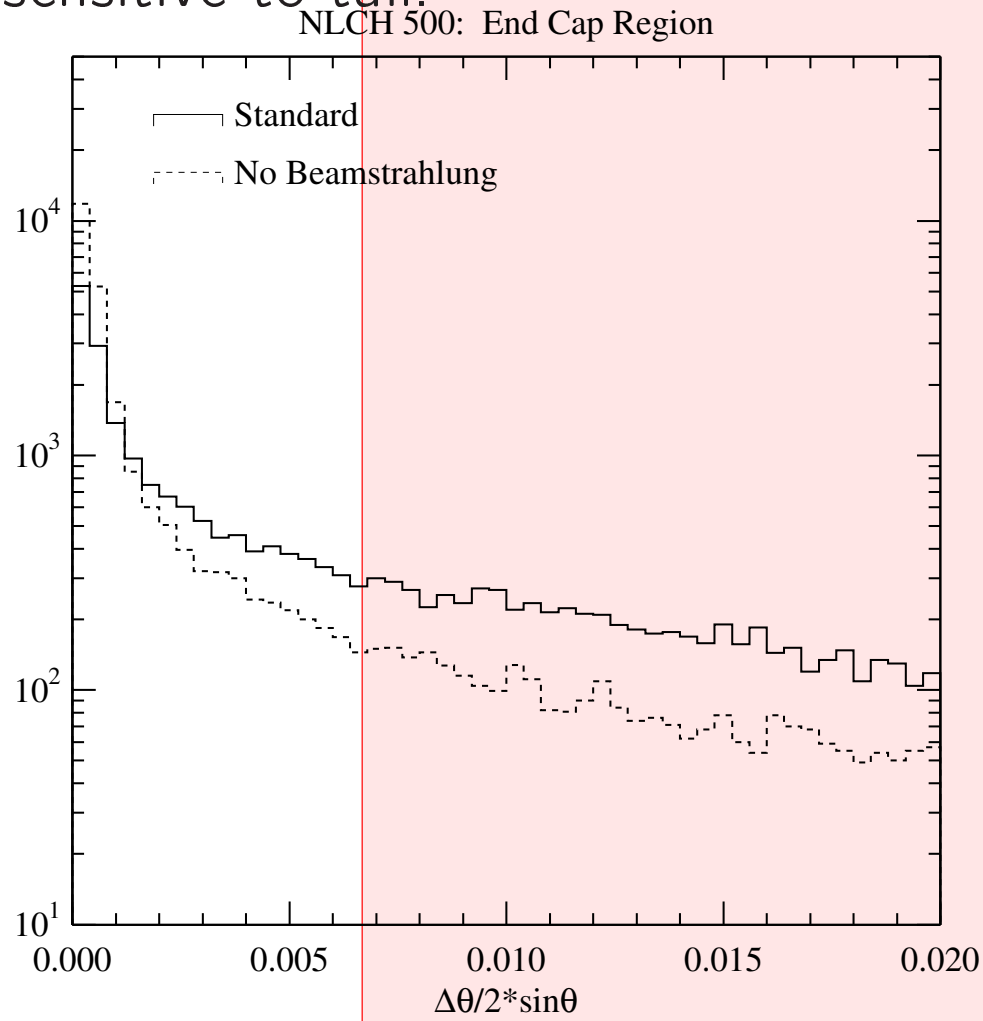




End Cap Region

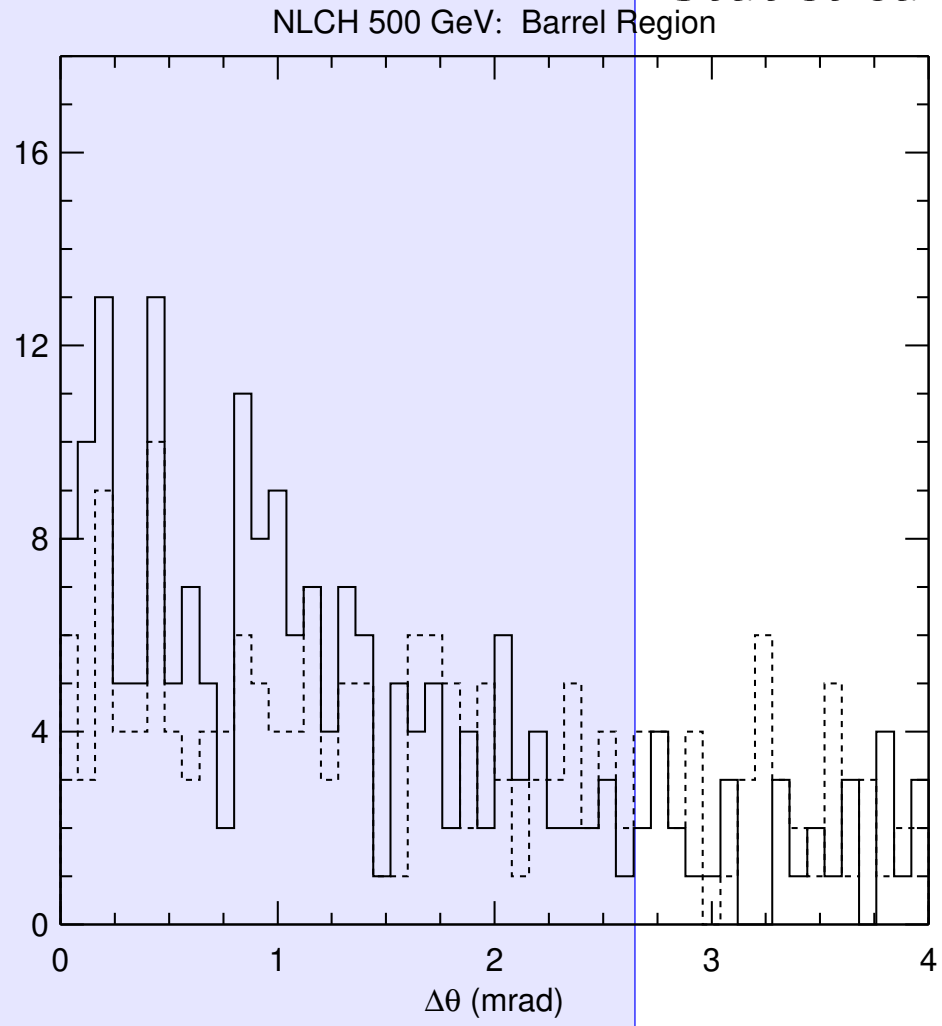
Should also be sensitive to tail.

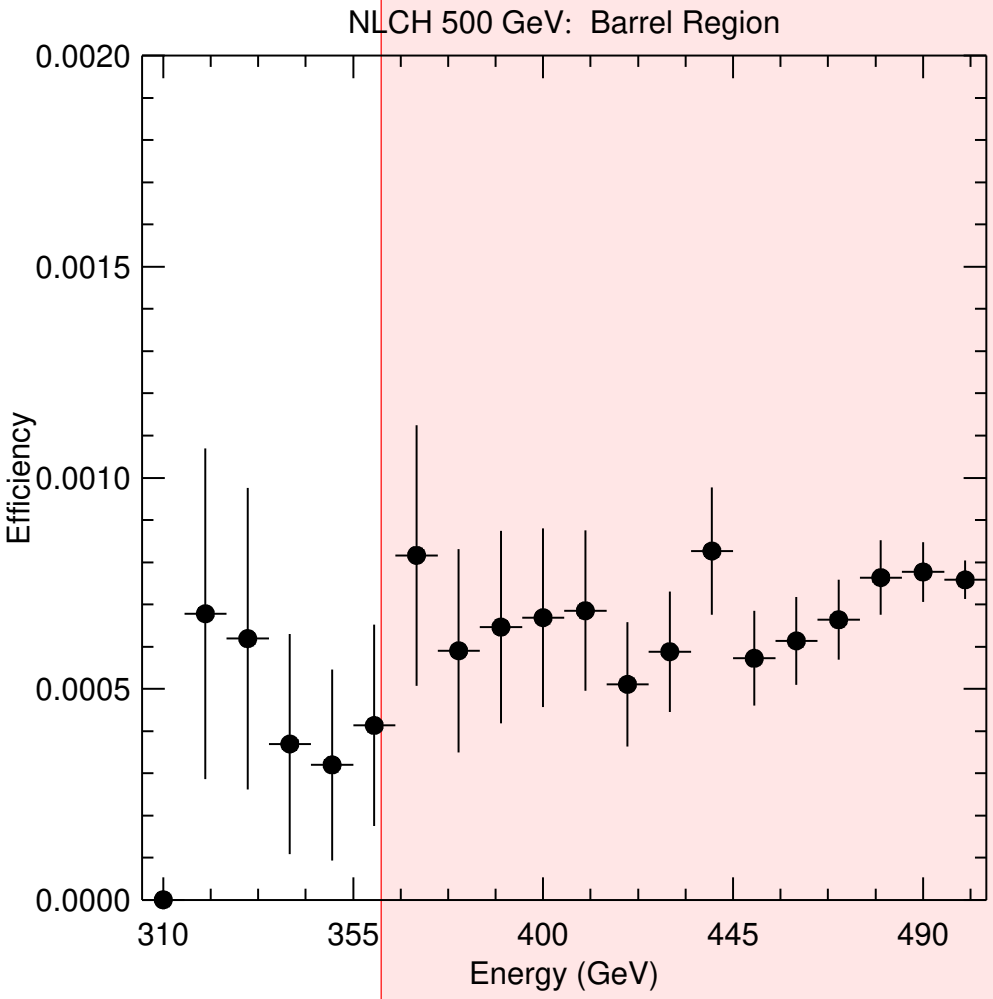




Barrel Region

Statistically not useful.





Conclusions and Plans

- End Cap region looks good to extract $d\mathcal{L}/dE$.
- Move to full simulation, just got simulation running in Detroit on 1 July. Needed expert intervention.
- Check parametrized resolution in full simulation. Extract $d\mathcal{L}/dE$.
- Add backgrounds and correlation with Guinea Pig effects. See how $d\mathcal{L}/dE$ degrades.
- Propagate $d\mathcal{L}/dE$ effects to physics extractions.