Isand algorithm update

Simon Taylor / JLab

- Algorithm based on Lednev, IHEP 93-153
- Shower profile modeled by function:
  - Lead tungstate: *b*=0.31 cm, *d*=2.05 cm
  - Lead glass: *b*=0.72 cm, *d*=4.0 cm

$$f(r) = \frac{ab}{2\pi}(r^2 + b^2)^{-3/2}$$

- Energy within a single block:

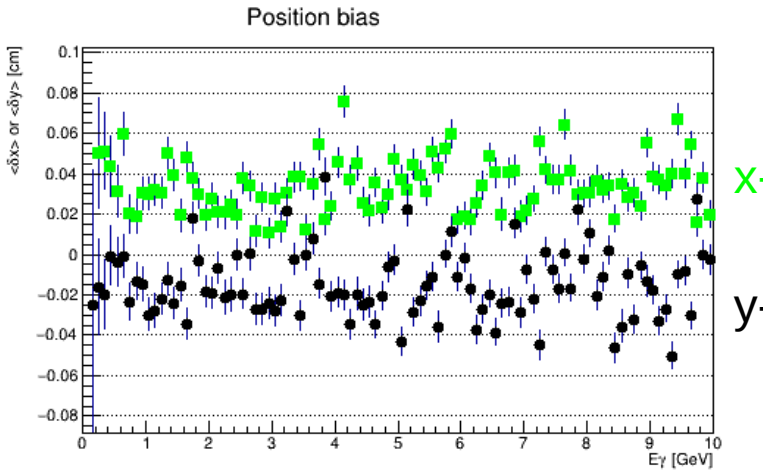
$$F(x,y) = \frac{a}{2\pi}\arctan\left(\frac{xy}{b\sqrt{b^2+x^2+y^2}}\right)$$

$$G(x,y) = F\left(x+\frac{d}{2}, y+\frac{d}{2}\right) - F\left(x-\frac{d}{2}, y+\frac{d}{2}\right) - F\left(x+\frac{d}{2}, y-\frac{d}{2}\right) + F\left(x-\frac{d}{2}, y-\frac{d}{2}\right)$$

- Look for peaks within cluster of adjacent FCAL hits
- Fit with G(x,y) to find (x_c, y_c) for each peak ⇒ photon shower
- Try to separate each peak into 2 photon candidates
  - Based on second moments of energy distribution in x and y
  - Split if χ^2/ndf improves by some margin (configurable parameter)
- Control merging with cut on mass squared for pairs of photons

Island update and Island/Default algorithm comparisons

- Island algorithm updates
  - Minimum number of iterations for χ^2 minimization = 10
  - S-curve position correction: $\delta y_{corr}=p_1\delta y(d^2/4-\delta y^2)+p_2$ where $\delta y=y_{block}-y_c$

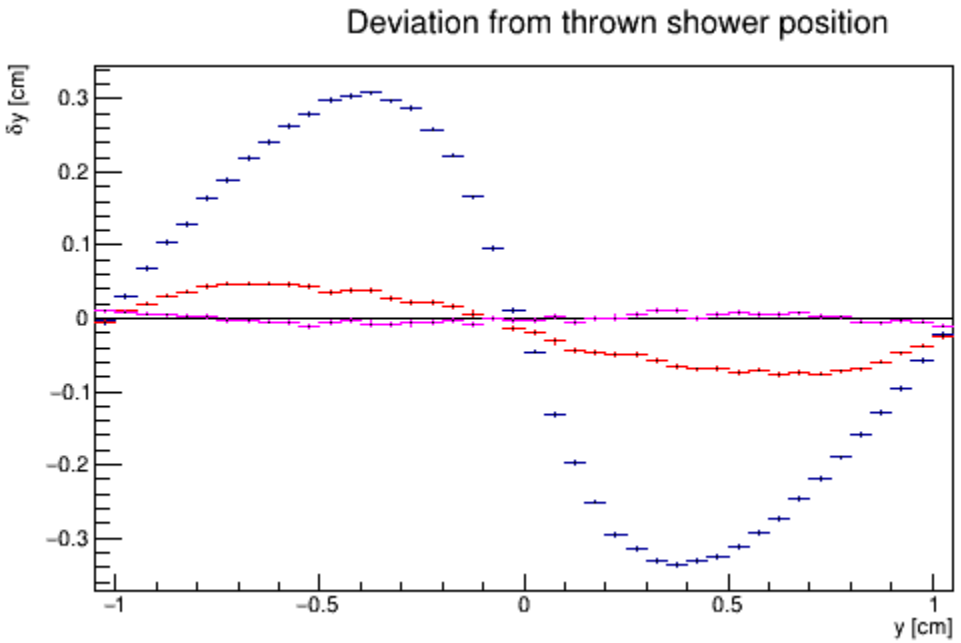


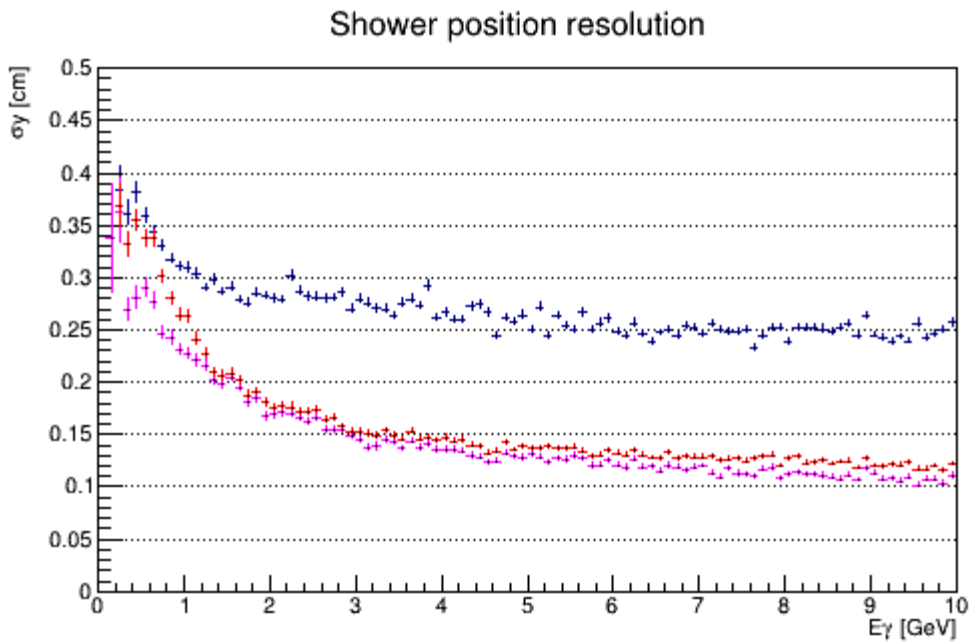
x-bias

y-bias

Single photon Insert study: ***θ=3°***
(r=30 cm)

χ^2 margin=5
Mass cut=5x10^{-5} GeV^2





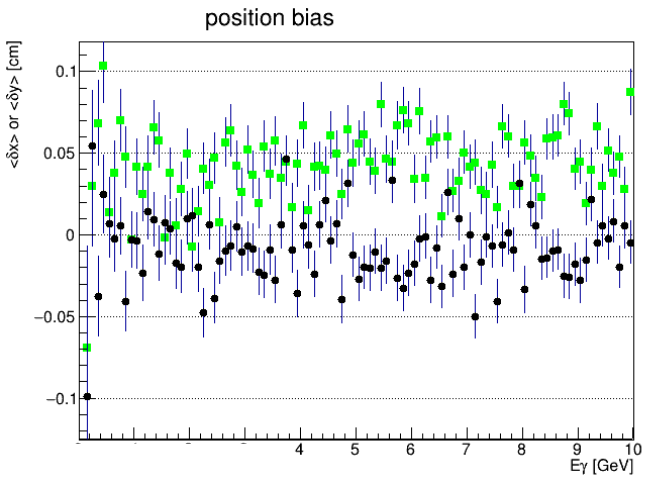
Default algorithm
Island algorithm
IA with S-curve correction

Jefferson Lab

Island/Default algorithm comparisons

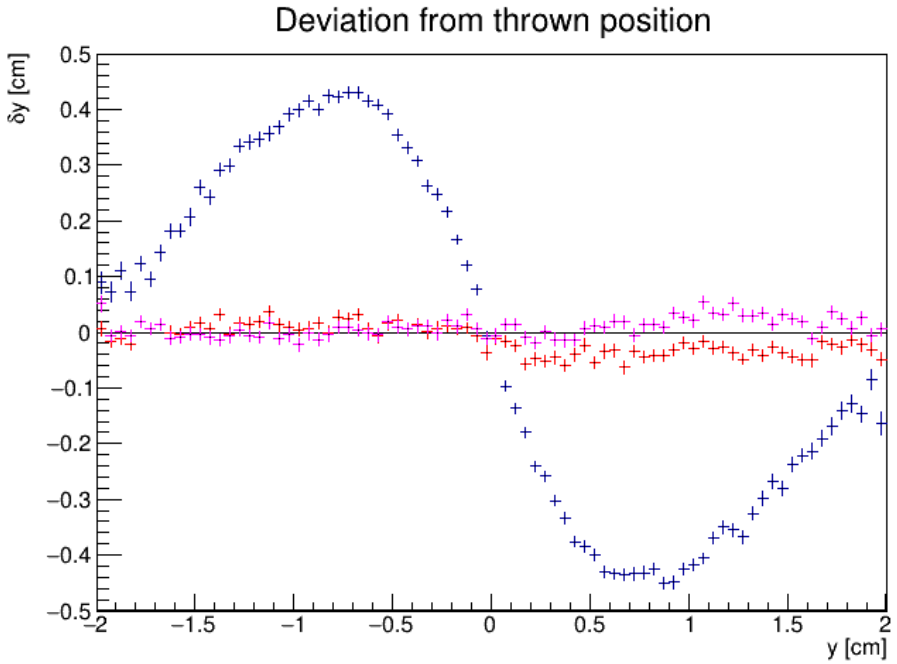
Single photon Lead glass study:
θ=6˚ (r=60 cm)

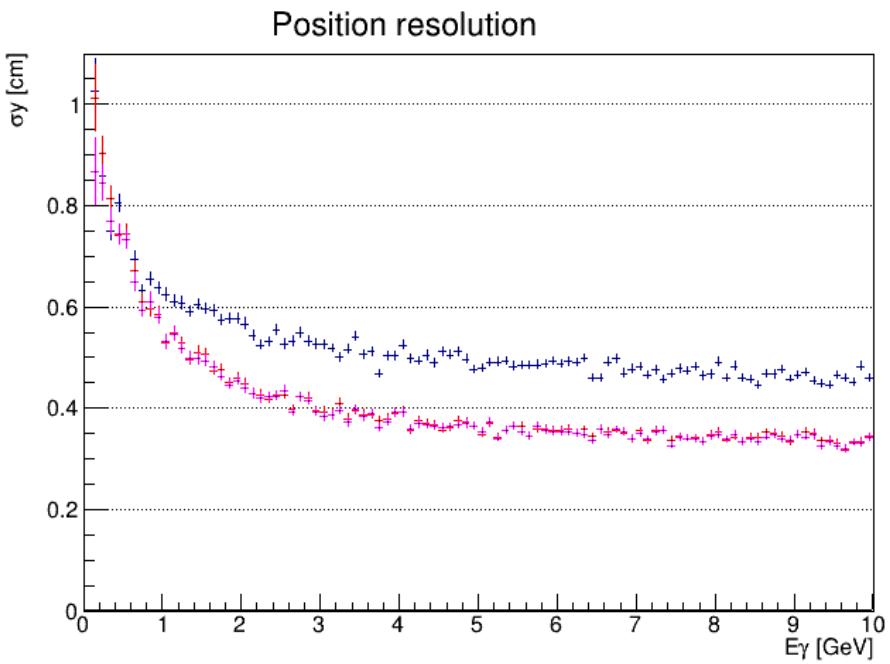
χ^2 margin=5
Mass cut=5x10^{-5} GeV^2



x-bias

y-bias





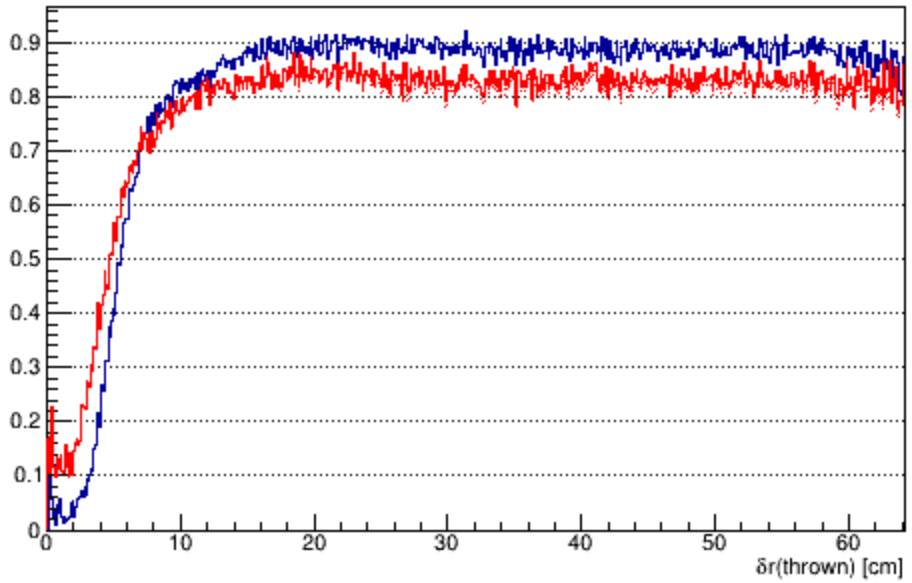
Default algorithm
Island algorithm
IA with S-curve correction

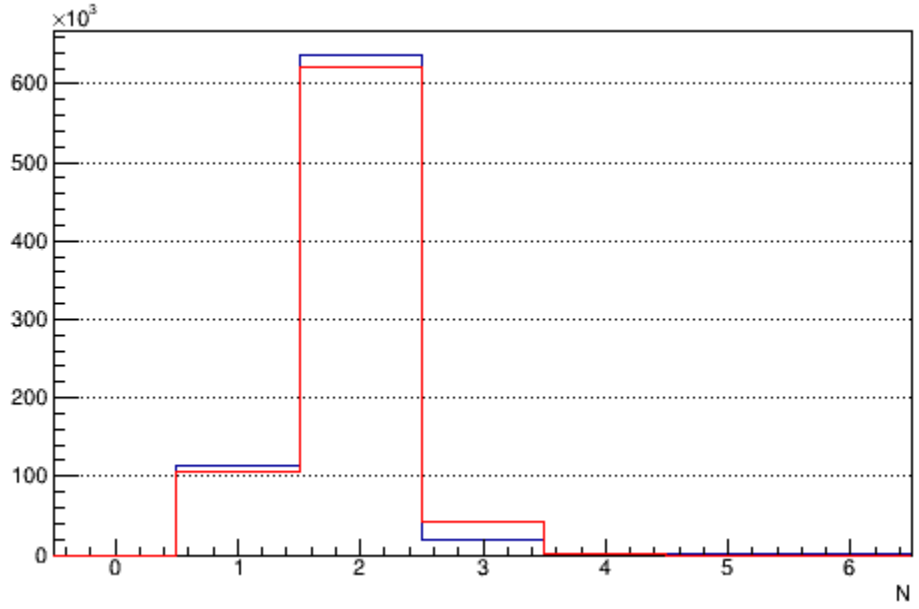
Jefferson Lab

Two-cluster separation efficiency

- Throw 2 photons at ~7˚ with variable separations
  - Energies 1-9 GeV with Δθ=-1.5˚...+1.5˚
- Require 2 reconstructed showers

DA
IA: (χ^2 margin=5, mass cut=5x10^{-5} GeV^2)





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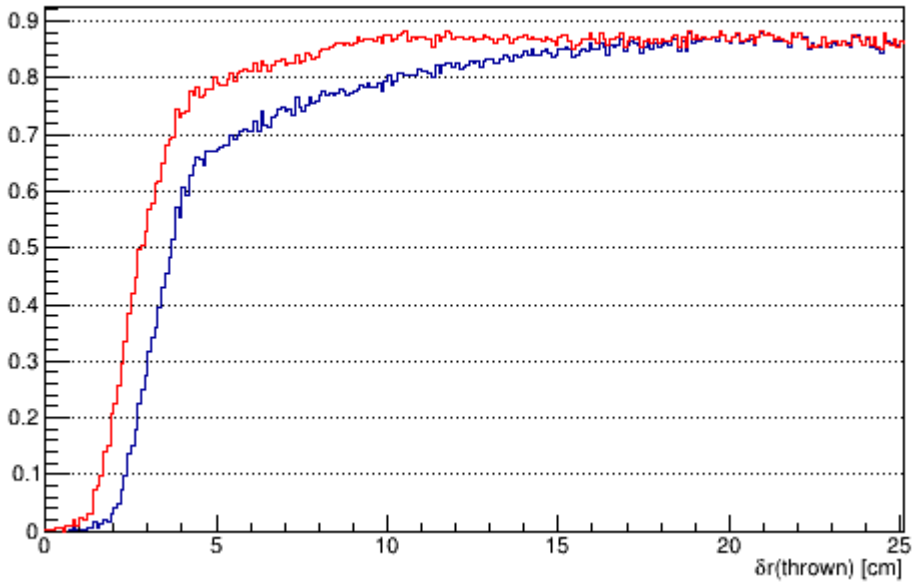

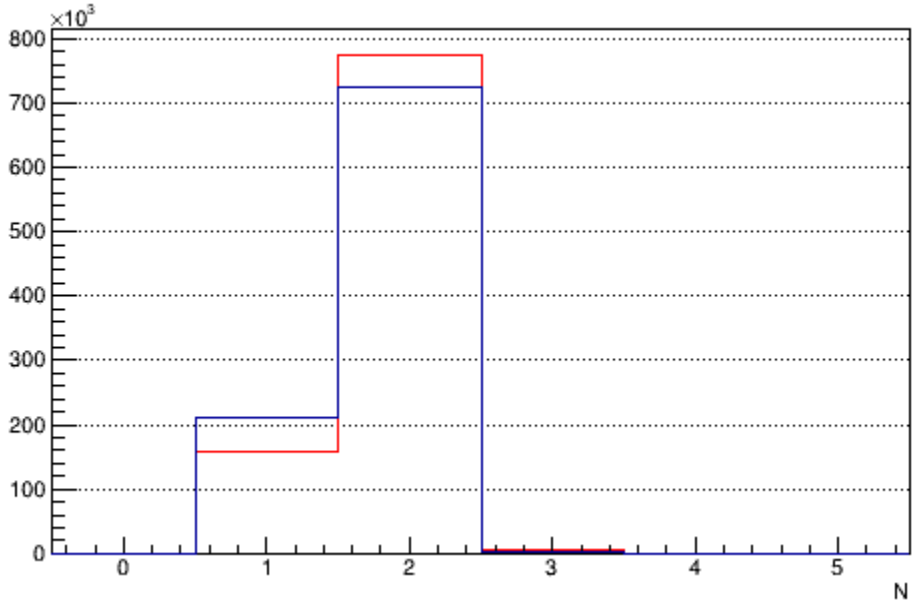

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Things to do

- Understand apparent (small) position bias
- Study and improve S-curve correction
- Try to understand 2-photon separation/split probability for LG region for IA

- Implement realistic staggered geometry