Including the tail catcher for energy reconstruction

- Outline:
  - New geometry model including a tail catcher
  - Improved calibration method
  - Effects of the tail catcher
    - Single particles
    - Single jets

Simulating the tail catcher on a full detetor model

- New detector model: sidaug05_tcmt
  - sidaug05: projective SiW ECal, SS/RPC HCal and muon system.
    Muon layers are 5cm Fe + 0.64cm RPC + 0.86cm air
  - sidaug05_tcmt: non-projective 0.5x0.5(cm^2) Ecal, 1x1 SS/Scint Hcal and 3x3 SS/Scint TCMT
    tail catcher layers are 2cm SS + 0.5cm scint + 0.3cm air
  - Several single-particle samples simulated
    muons, photons, charged pions, neutrons, Klongs (perpendicular to beam)
    b- and c-jets : energy = 1 . . 250GeV, theta = 1 . . 179 deg

Improved(?) calibration method

A maximum likelihood approach (event-by-event)

$$f(E_{reco}) = gauss(E_{reco}; \mu, \sigma_E)$$

where $E_{reco} = \Sigma_{cal} SW_{cal} * E^{live}_{cal}$

$\mu = E_{gen}$,

$\sigma_E = x / sqrt(E_{gen})$

and $x = 20\%$ for gammas

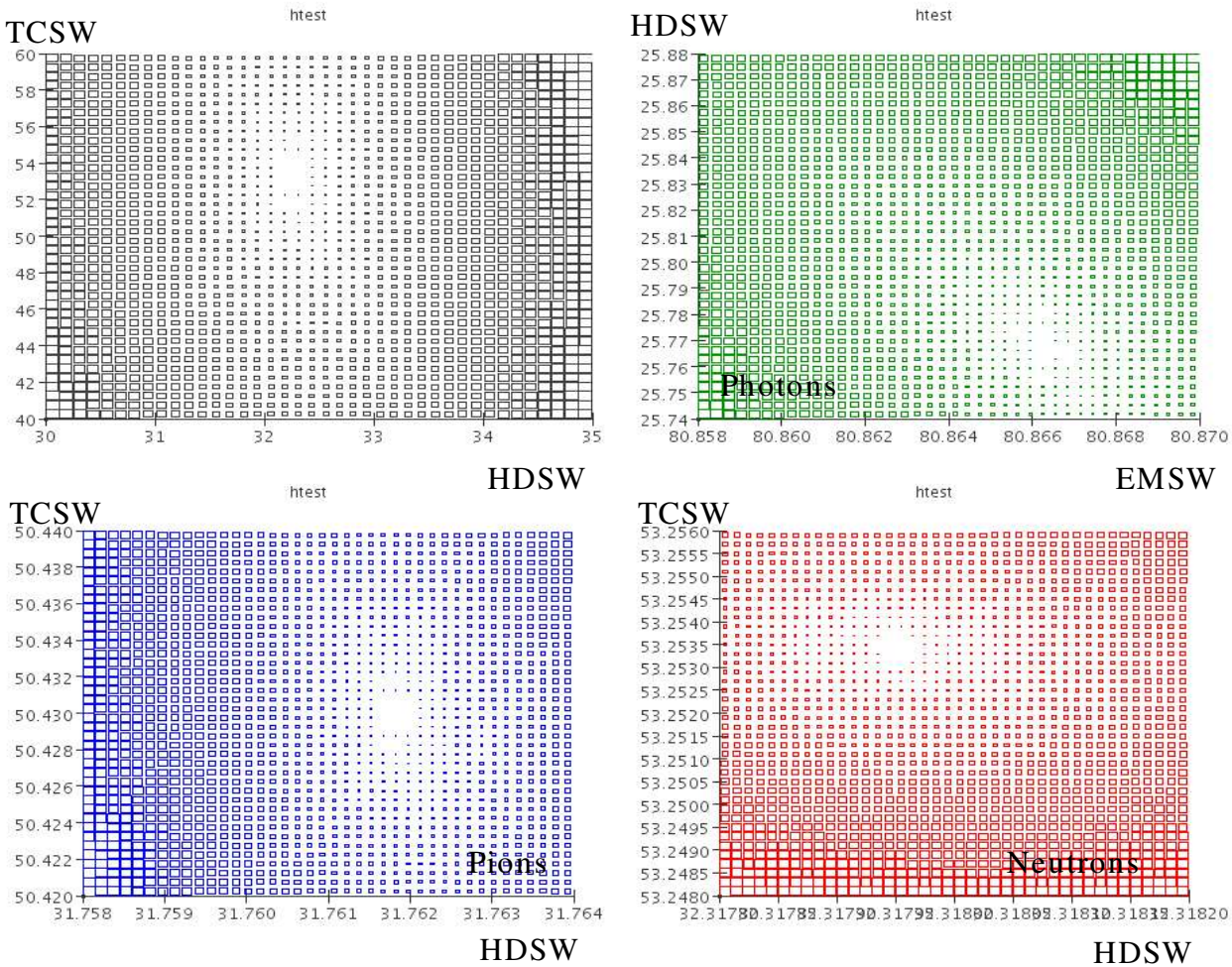
$x = 60\%$ for hadrons

The likelihood funcion:

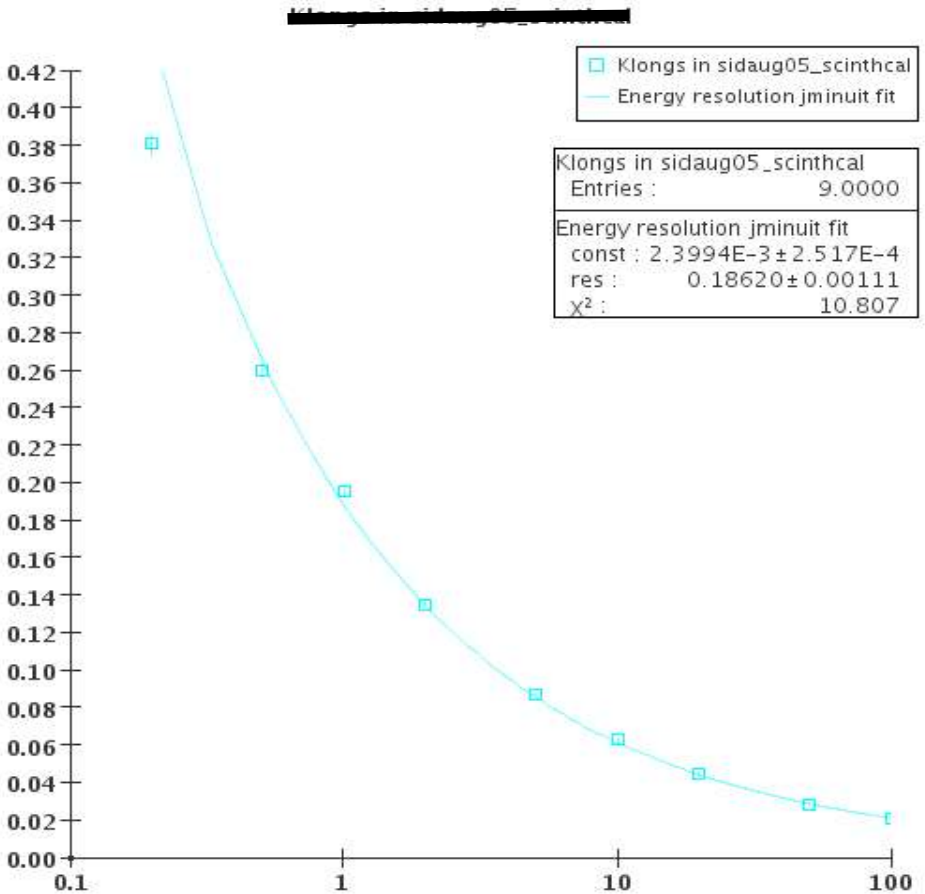
$$L = \Pi_i f(E_{reco,i})$$

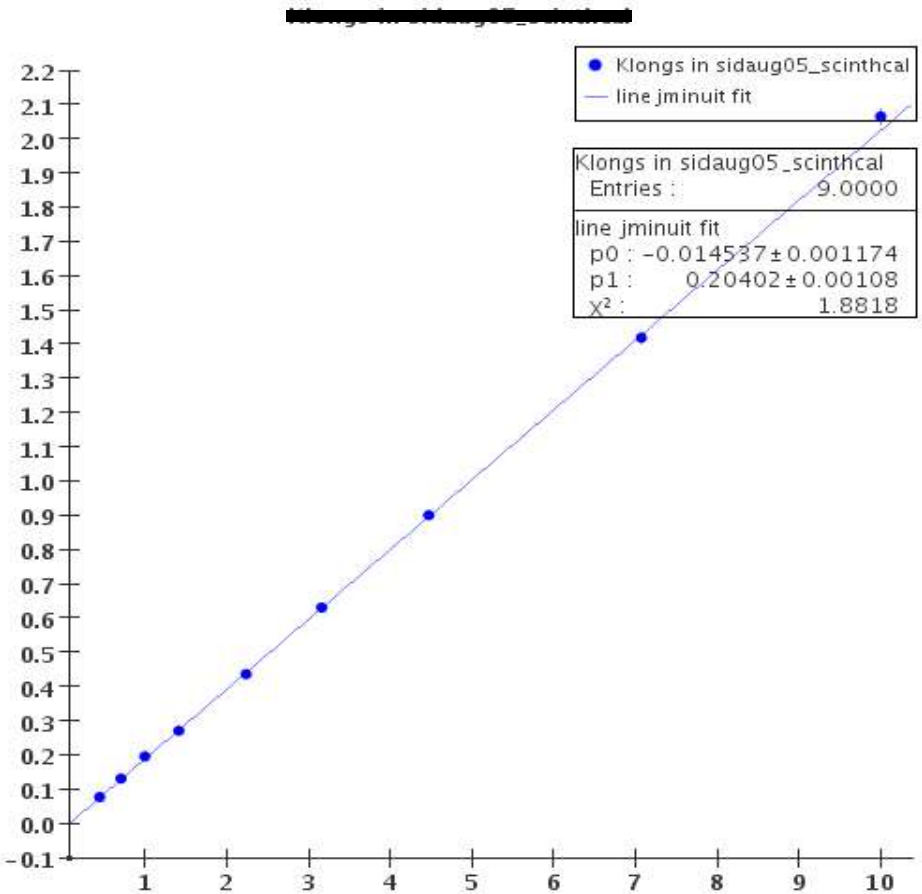
⇨ find minimum of $-log(L)$

Question: minimizing energy resolution or energy residuals?

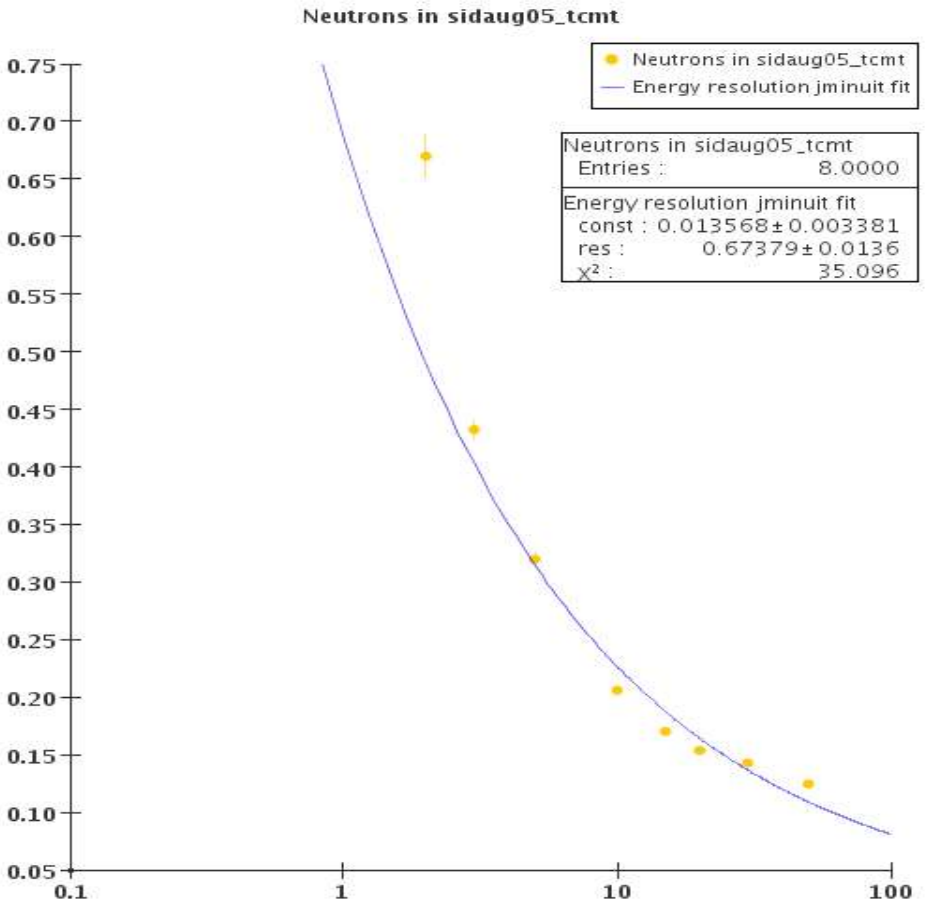


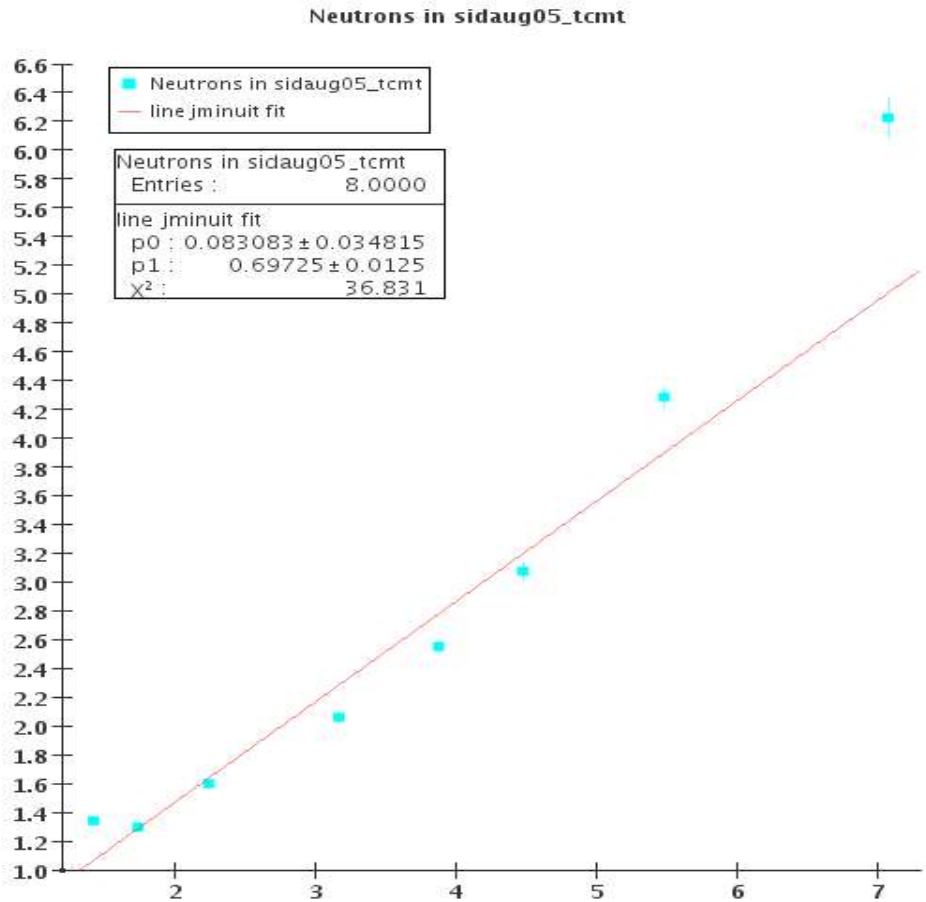
Energy resolution: photons in sidaug05_tcmt



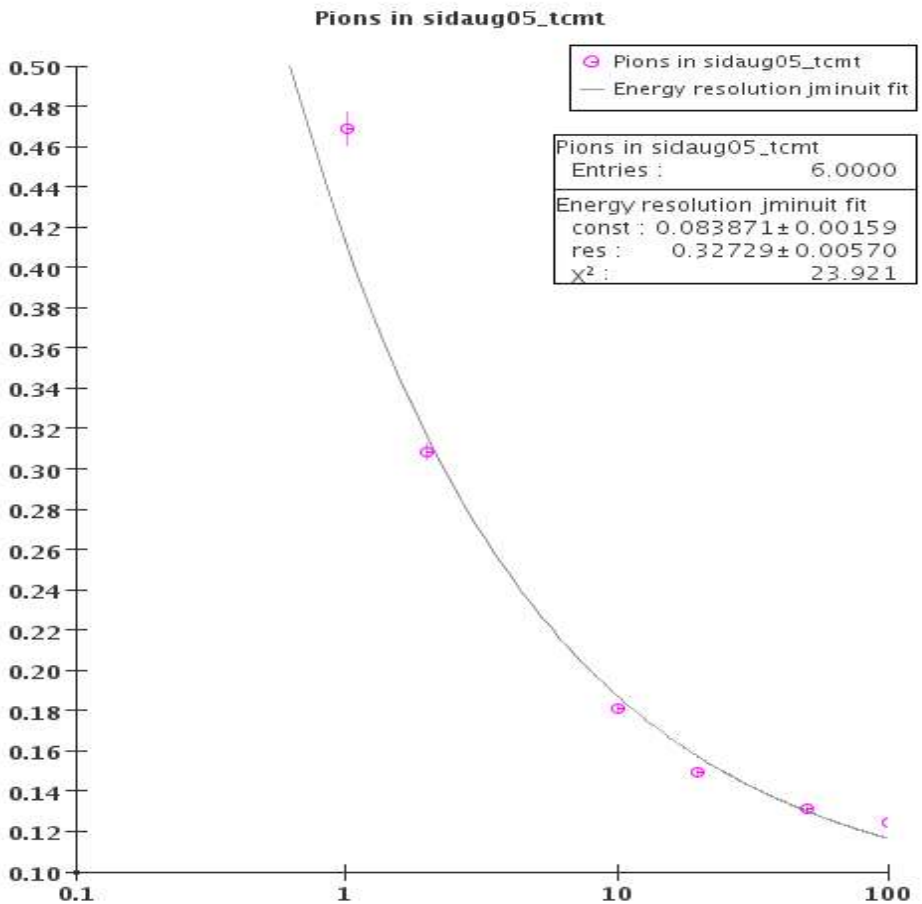


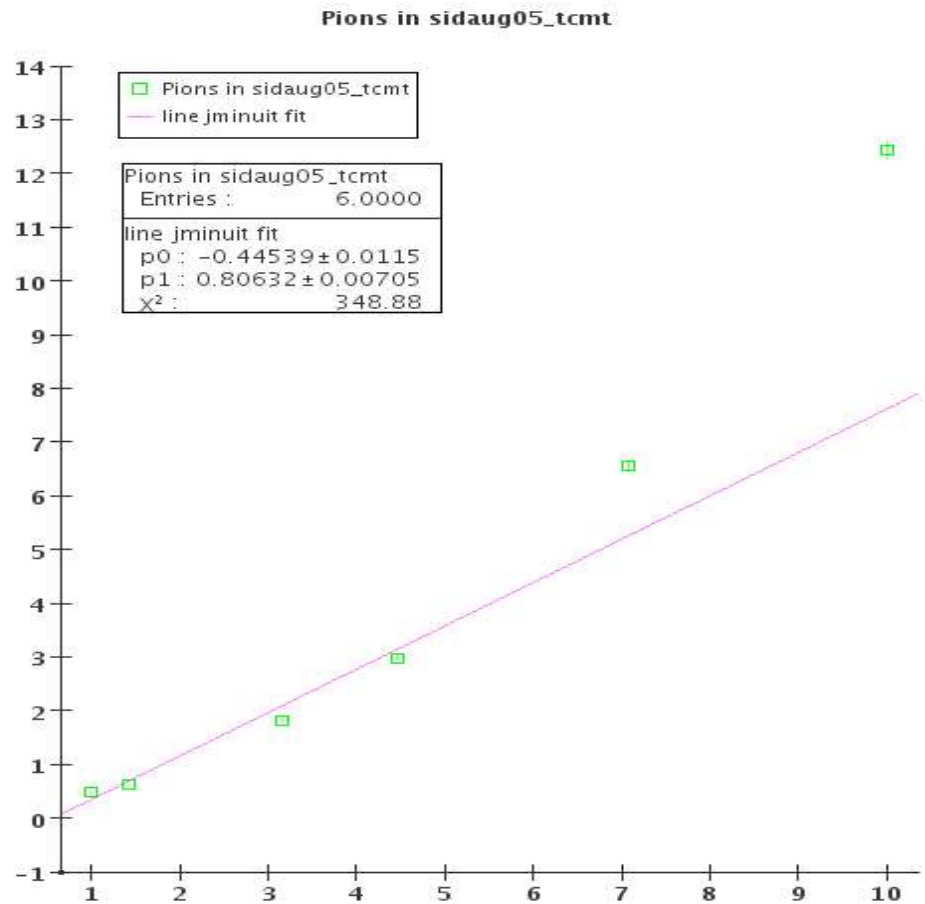
Energy resolution: neutrons in sidaug05_tcmt





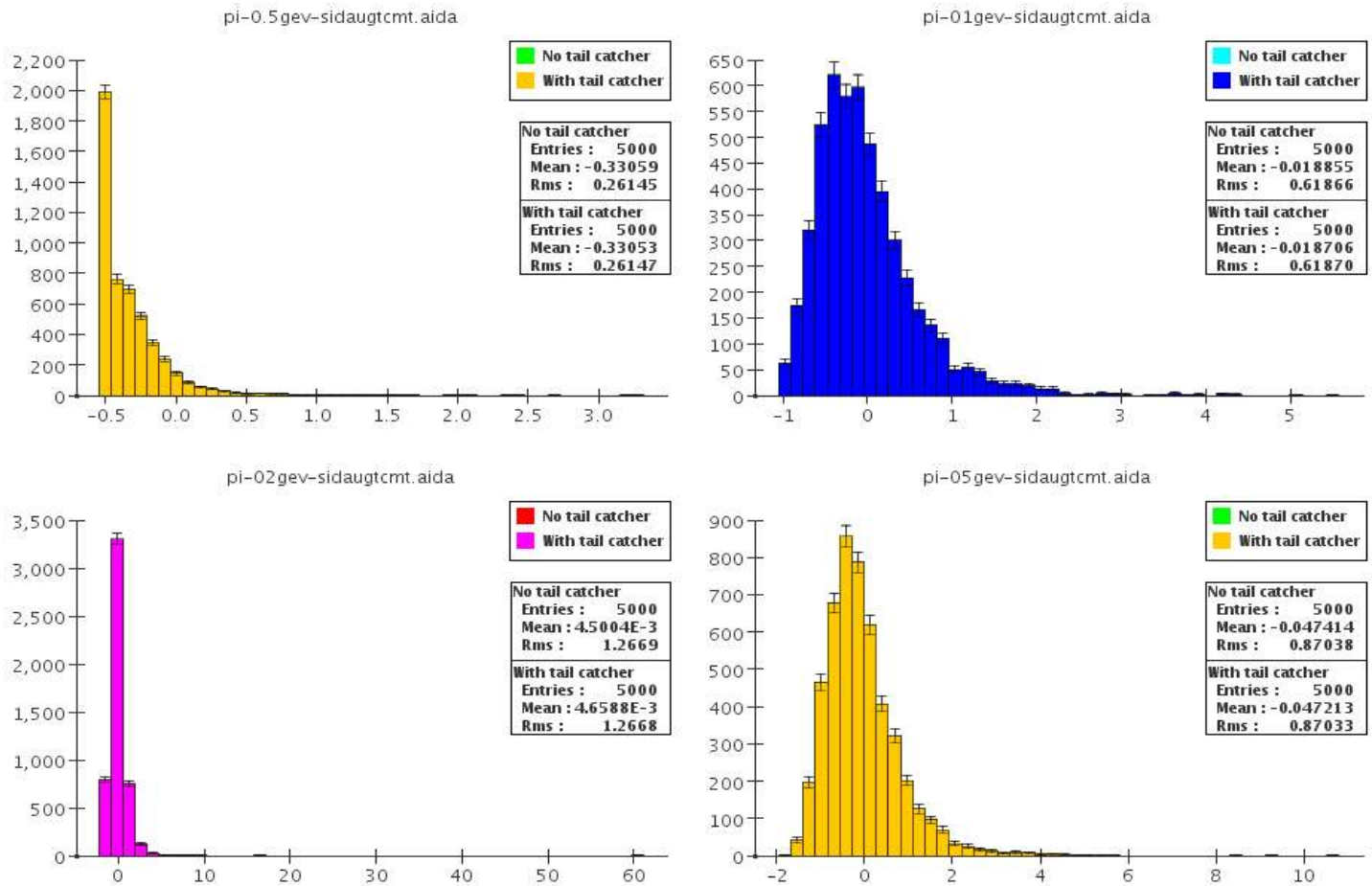
Energy resolution: pions in sidaug05_tcmt





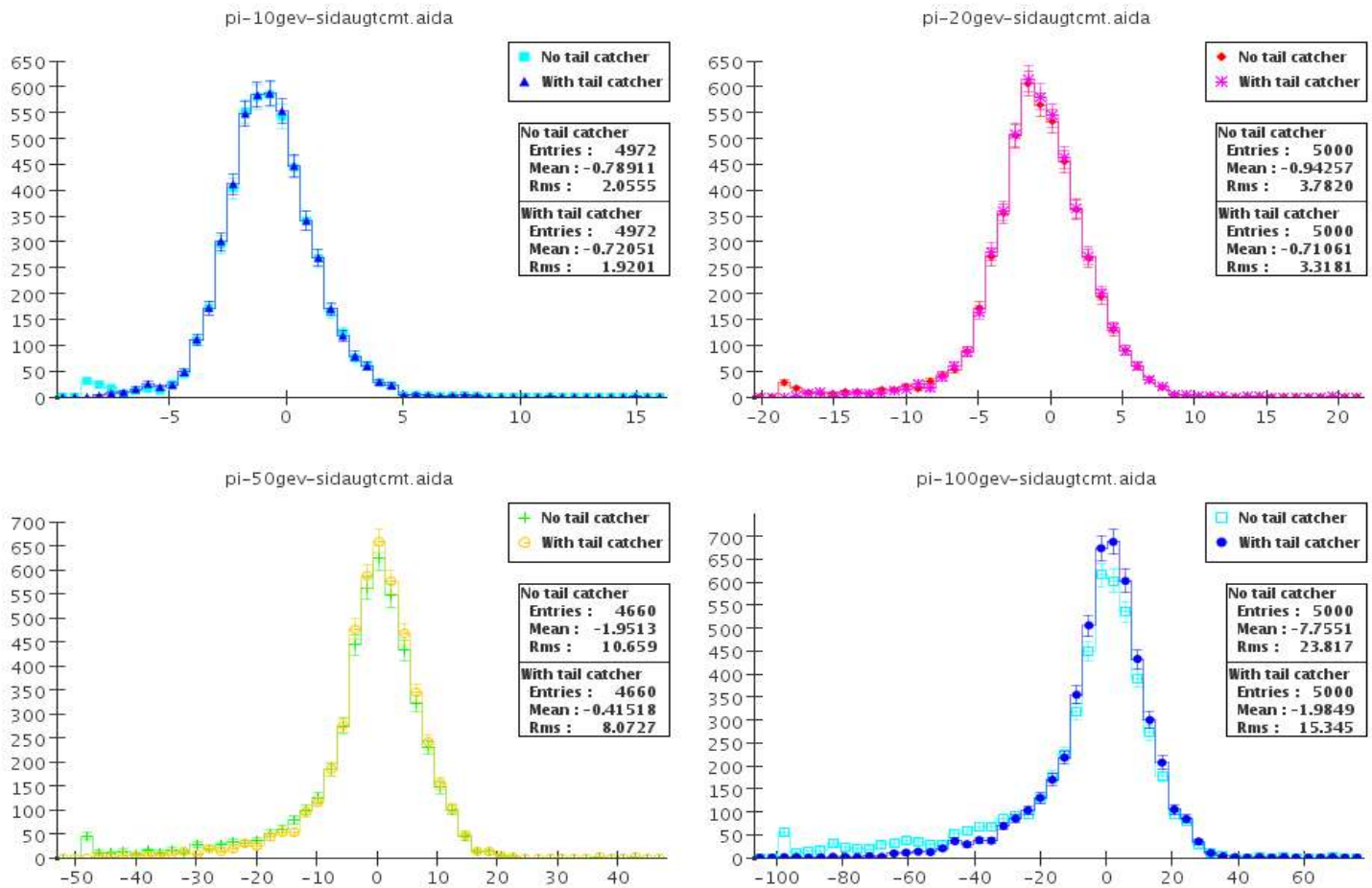
Adding TC data

Very small effect for low energy pions (up to 5 GeV)



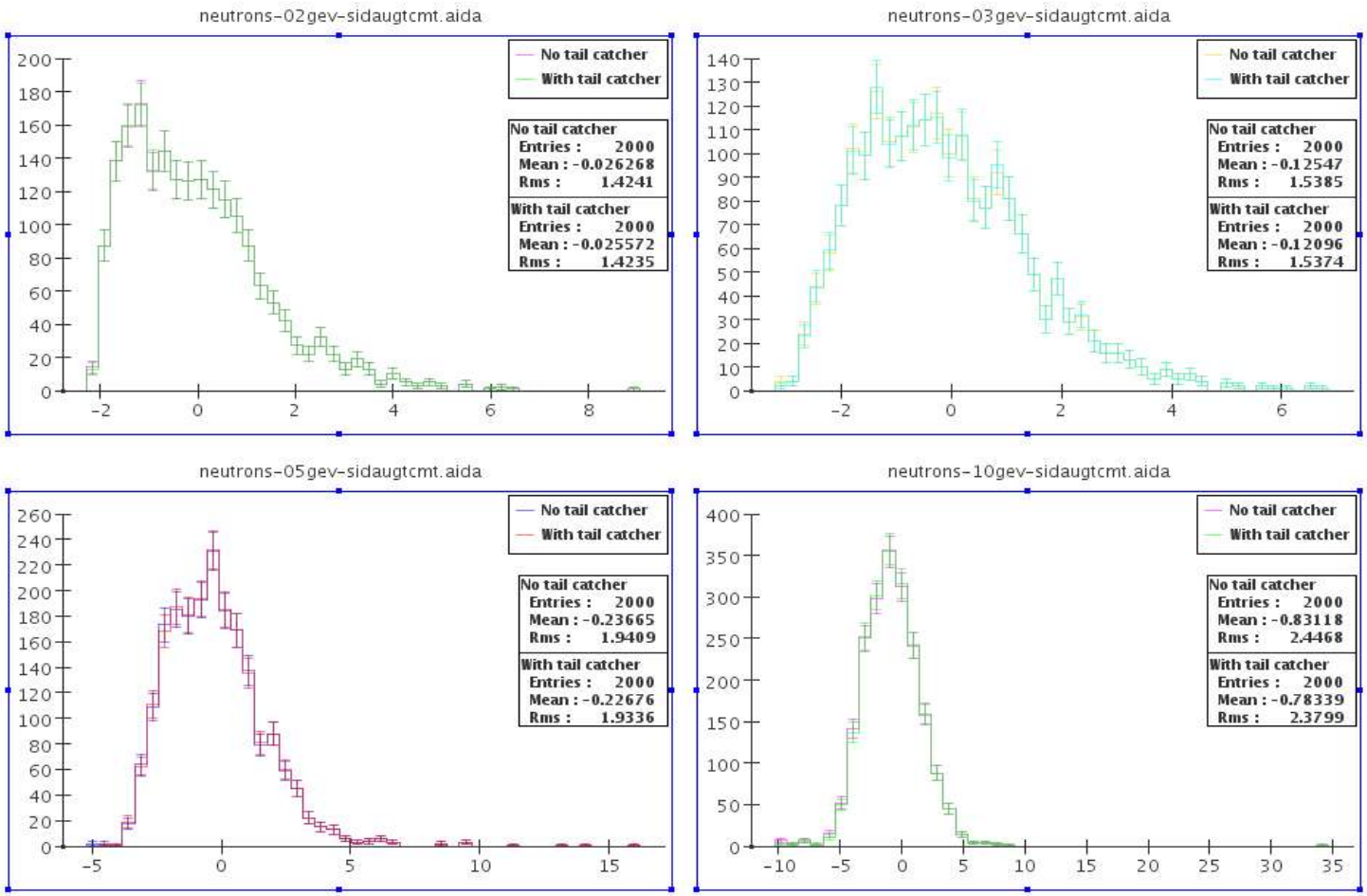
Adding TC data

Clear effects for high energy pions (10 GeV or more)



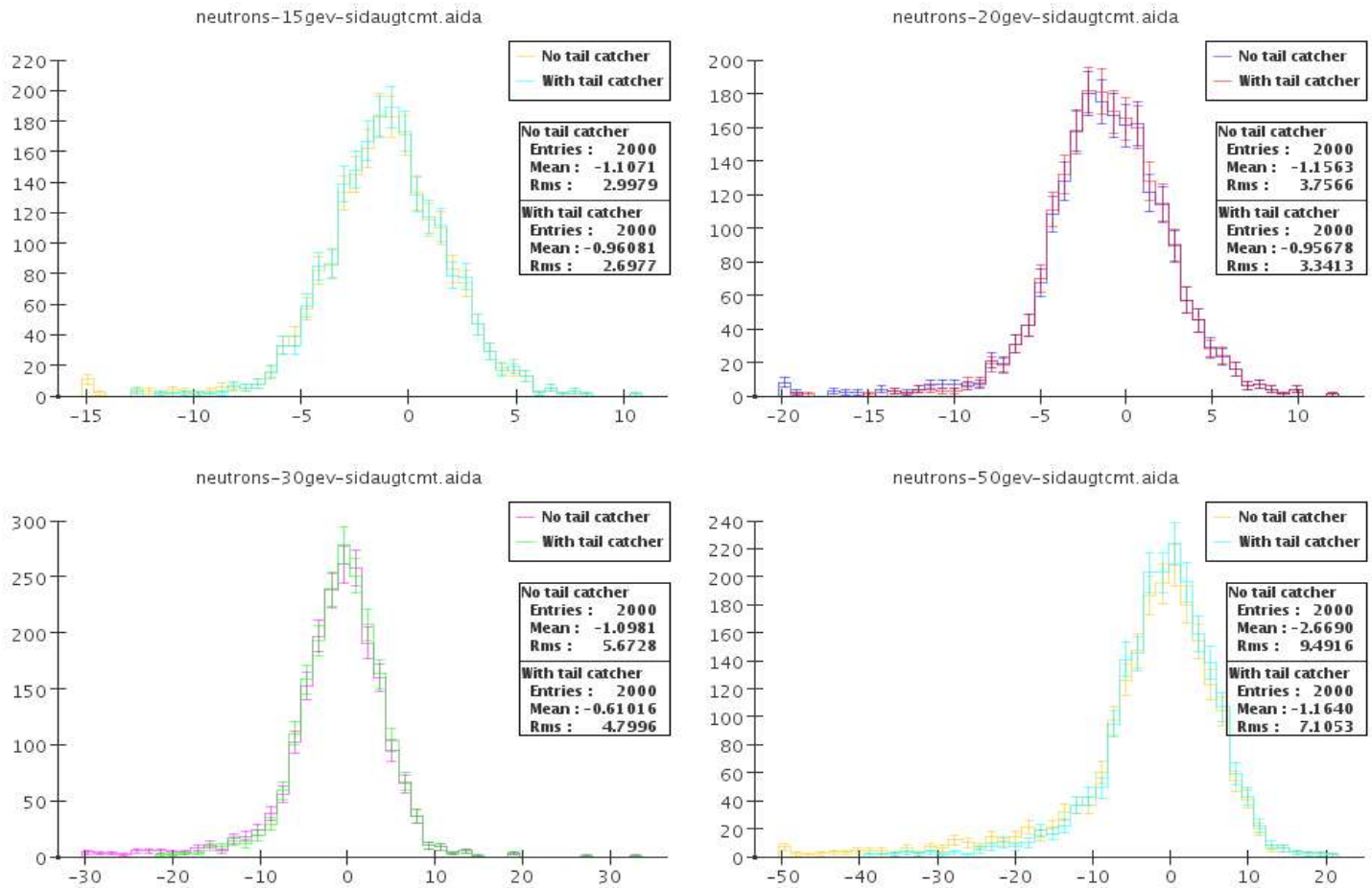
Adding TC data

Similarly for low E neutrons



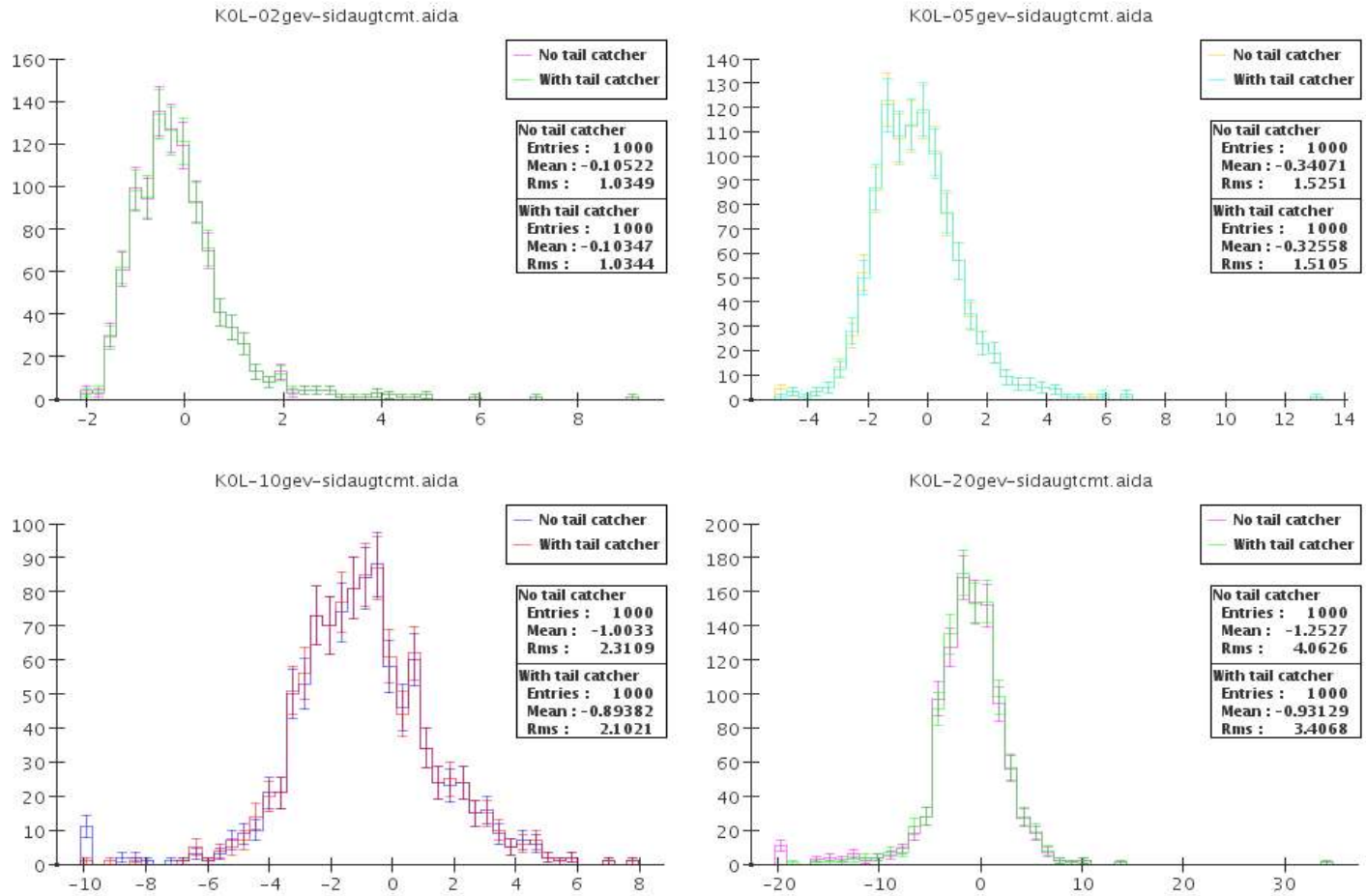
Adding TC data

Clear effects also for high energy neutrons (15 GeV or more)



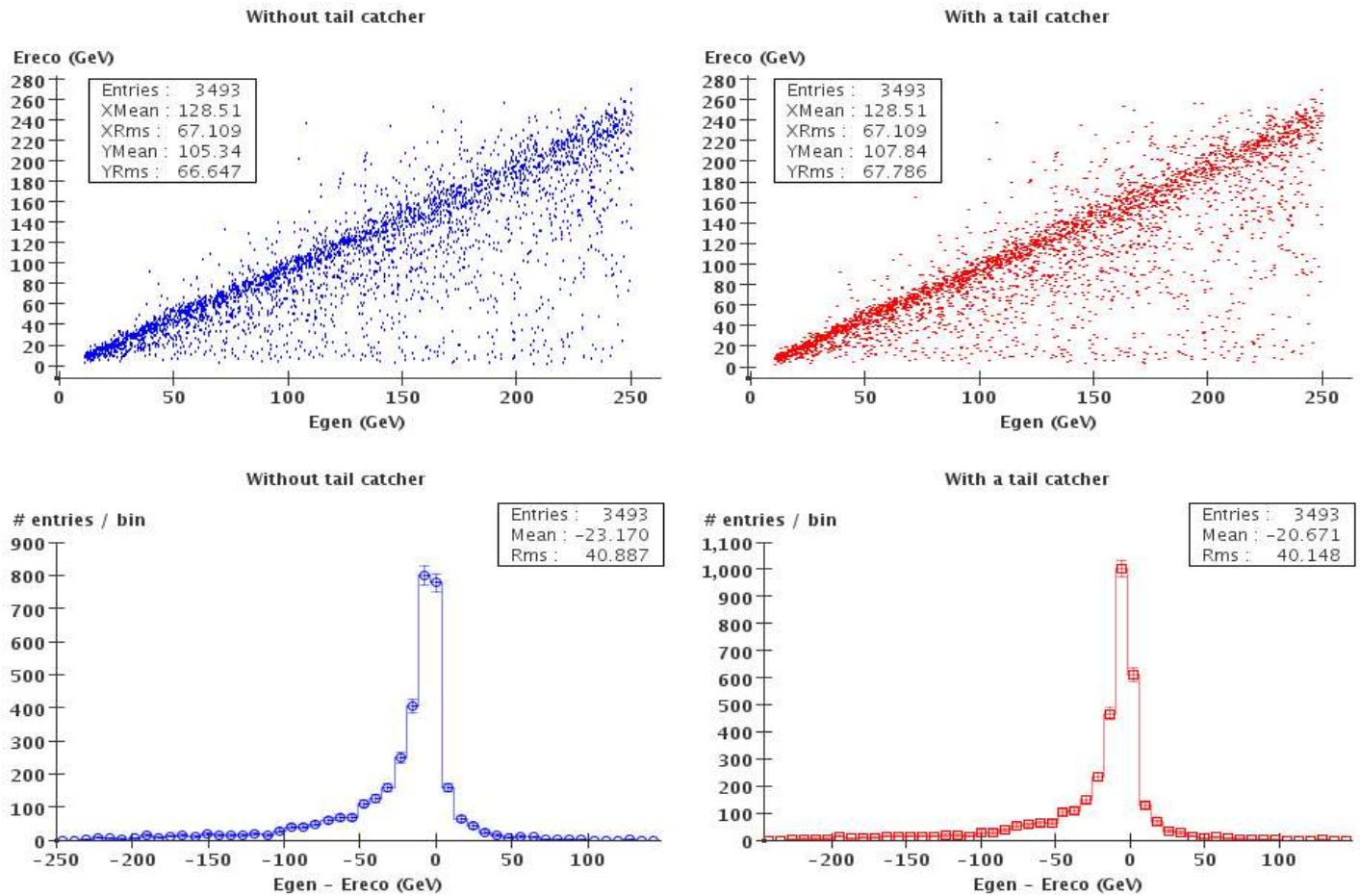
Adding TC data

For Klongs

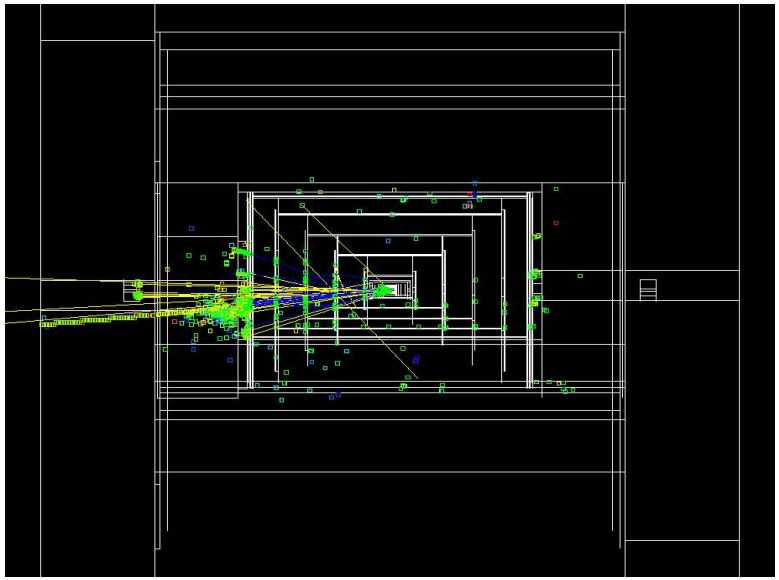


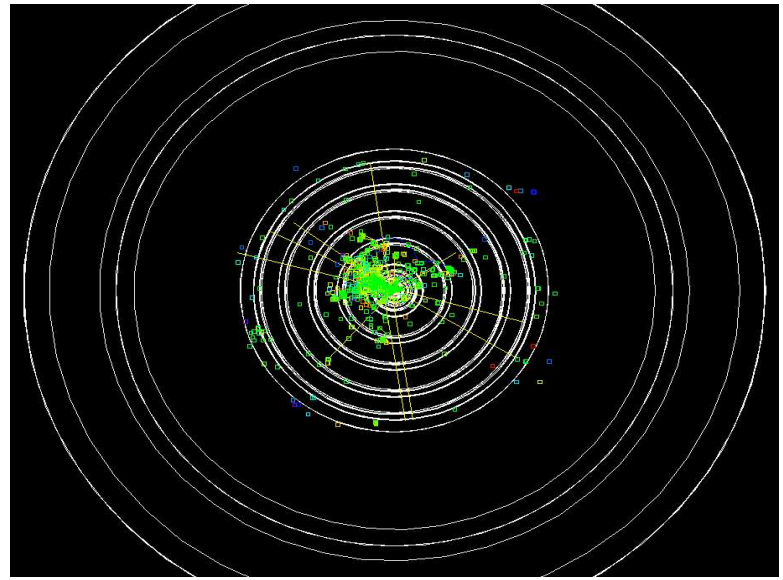
Looking at single-jet events

b-jet events:
E = 1 . . 250 GeV
theta = 1 . . 179 deg

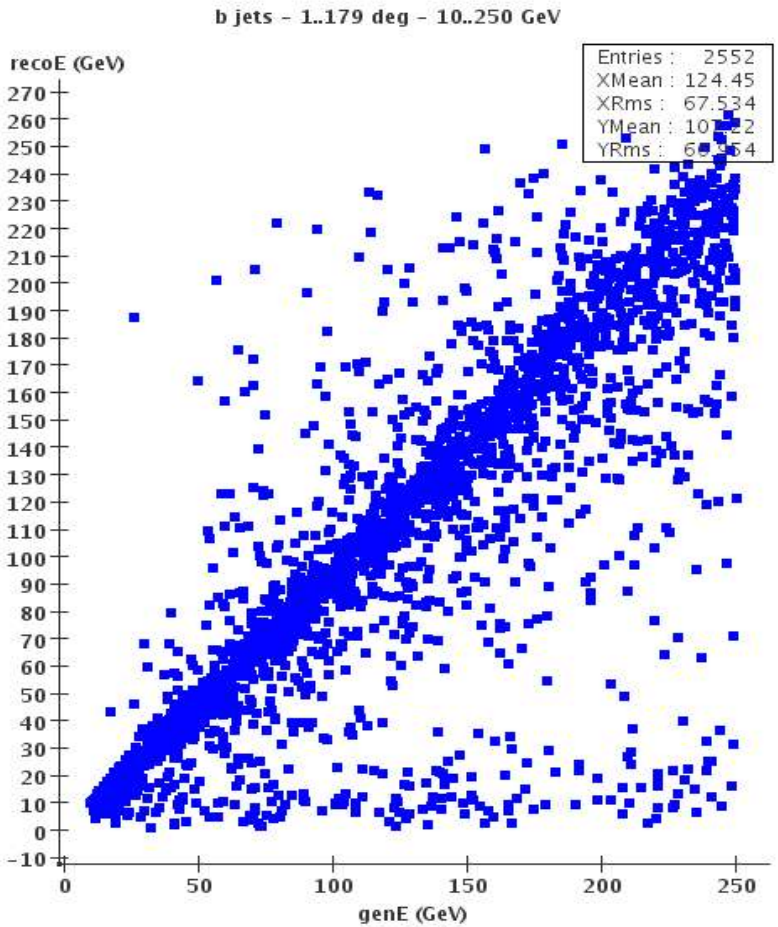


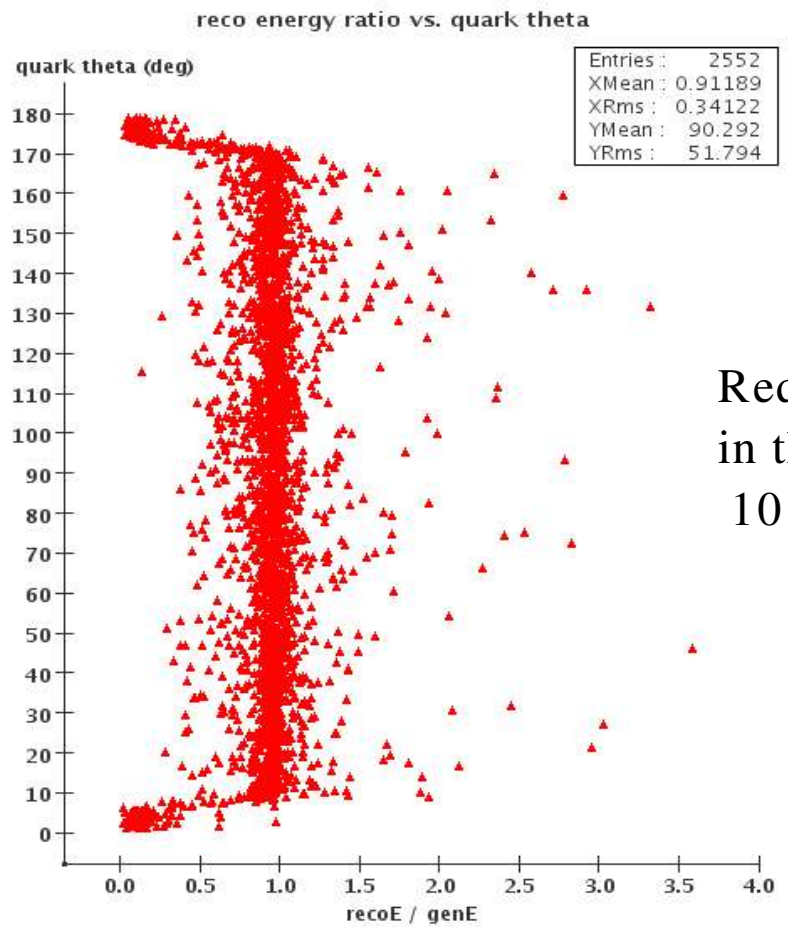
An event with large missing energy





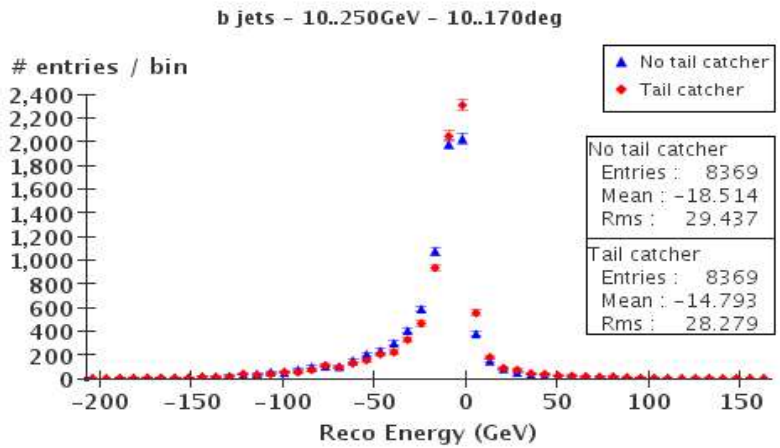
Fiducial cut in theta

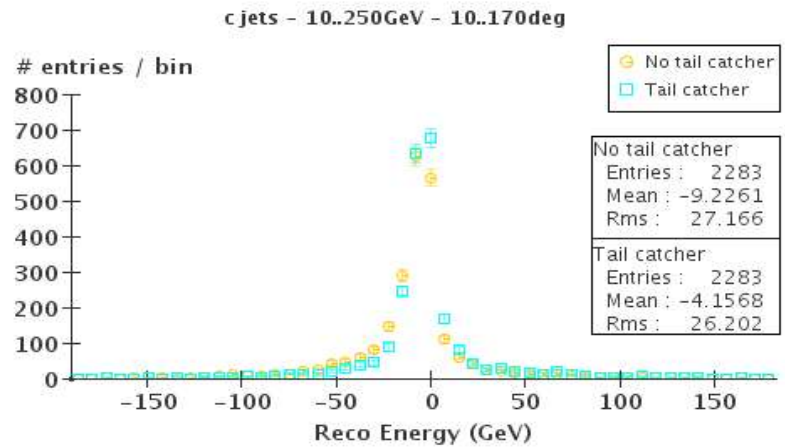


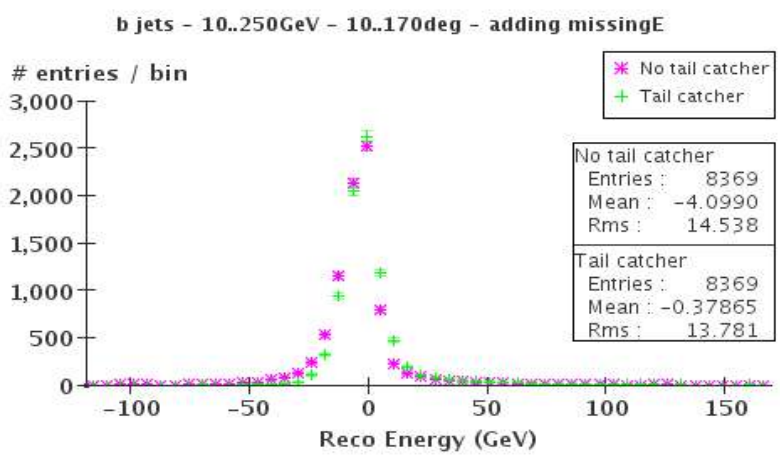


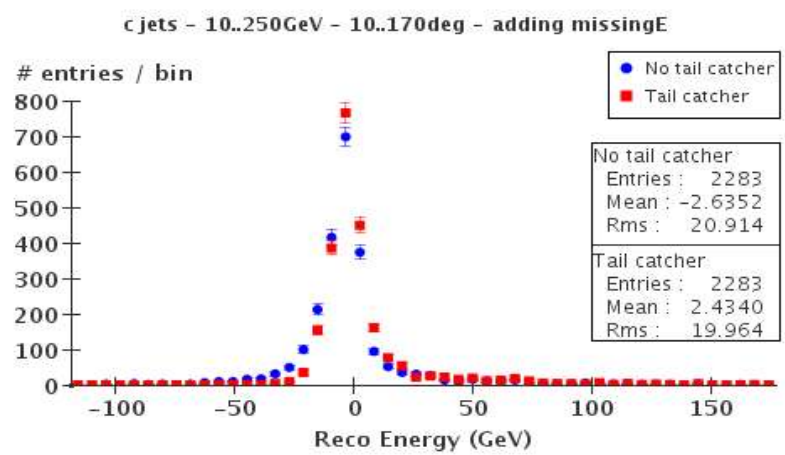
Require theta in the range 10 .. 170 deg

TC effects on single jets

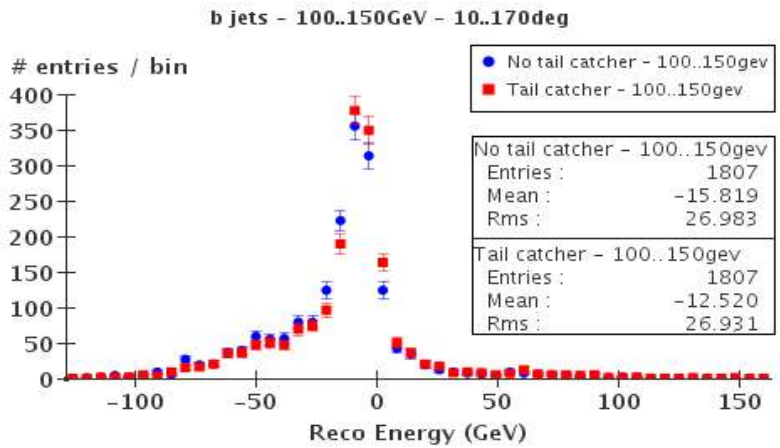


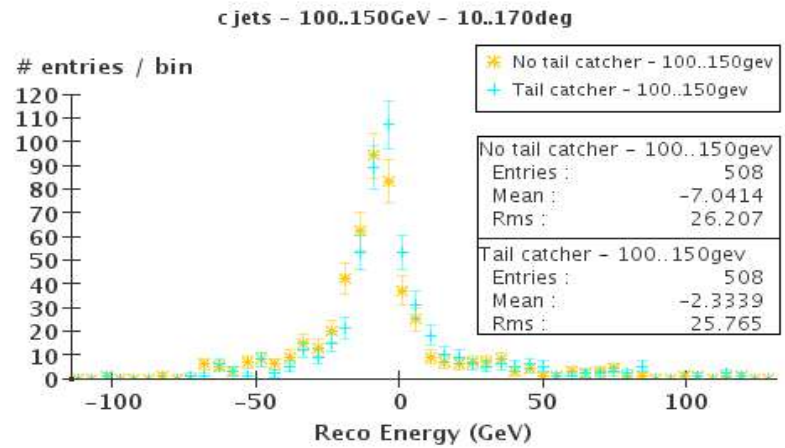


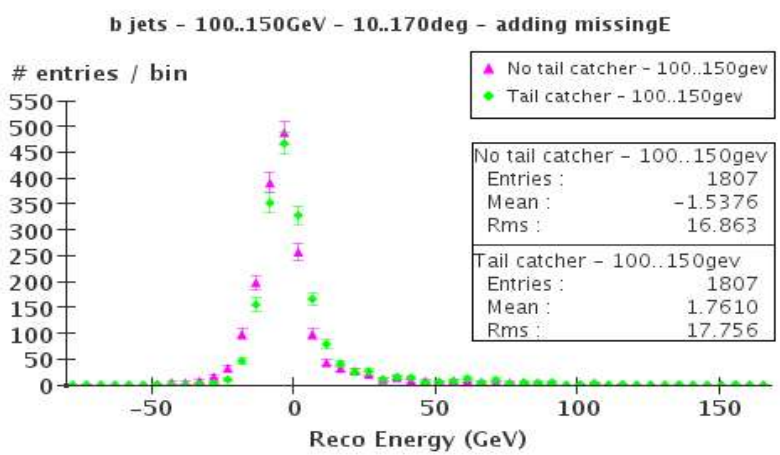


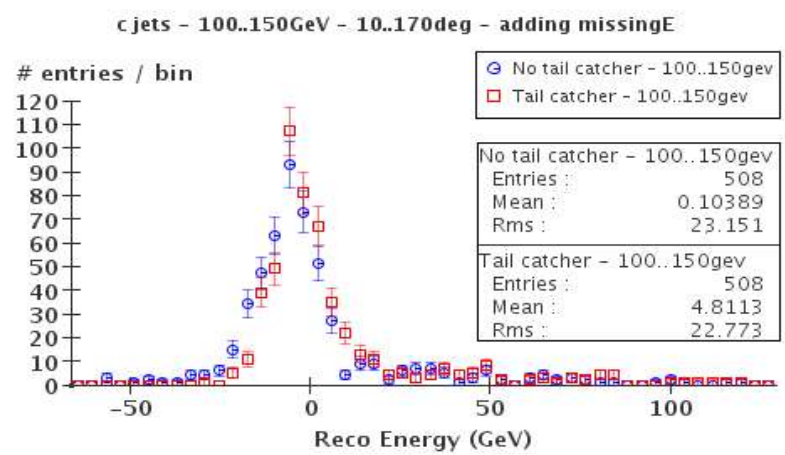


TC effects on single jets

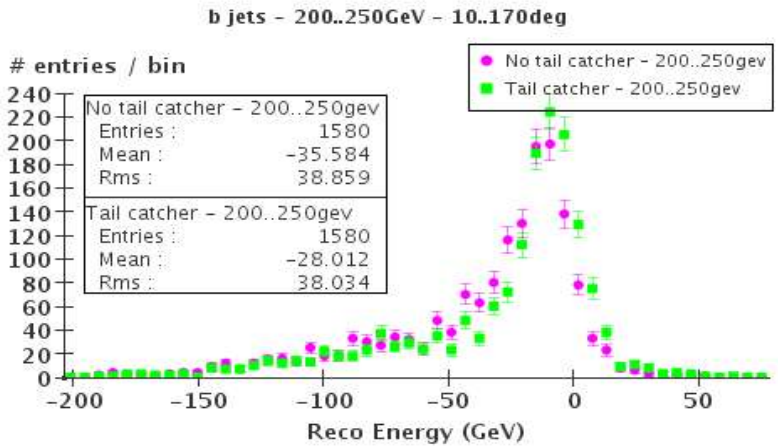


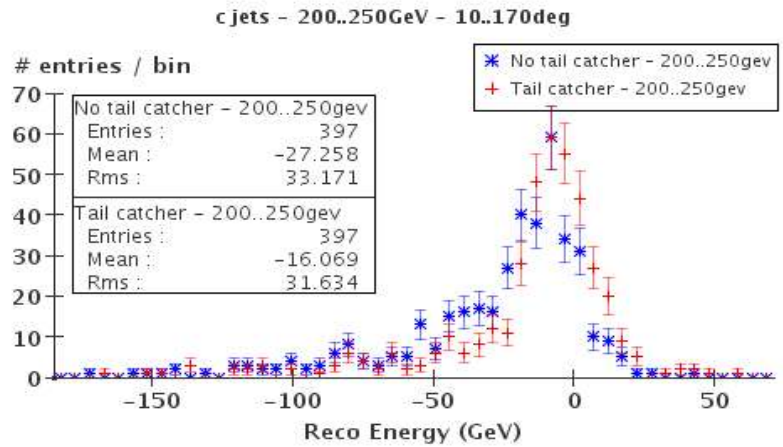


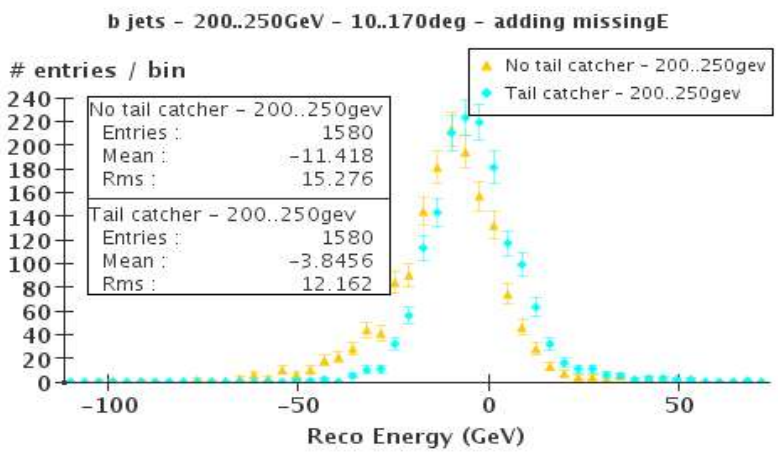


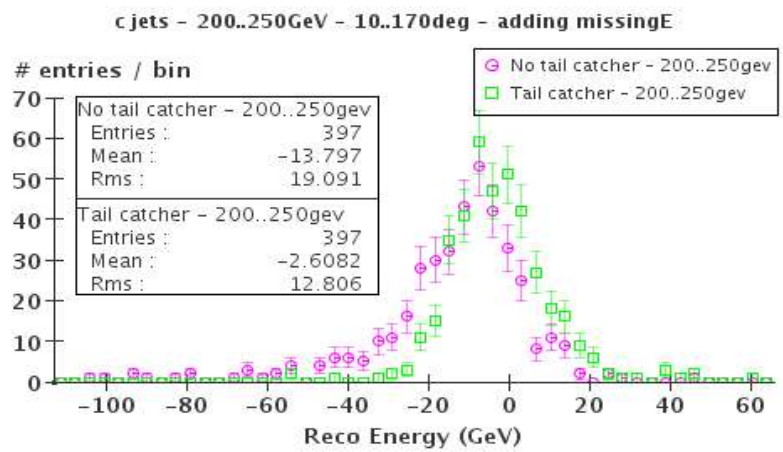


TC effects on single jets





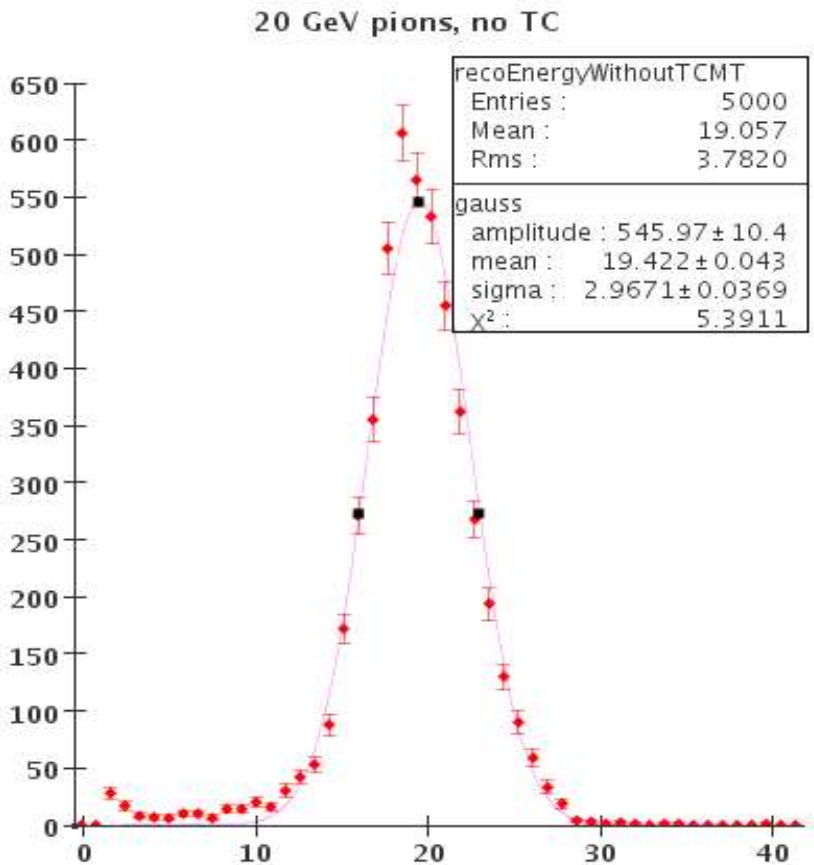


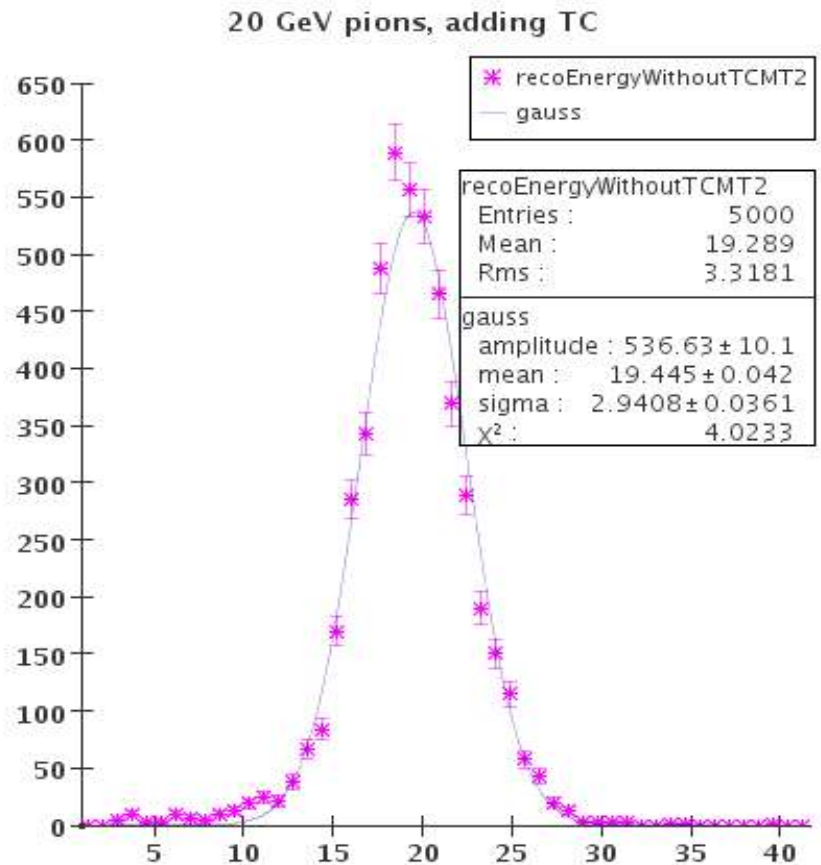


Next steps

- Found a problem: all “no TC” plots actually use the same HDSW as the “with TC” plots
  - Fix: Re-calibrate HD without the tail catcher
- Effects of the tail catcher on single particle energy resolutions
- Refine/improve calibration procedure
  - Segmented subcomponents (superlayers)
  - Different particle types
  - Use a full-fledged PFA, when available

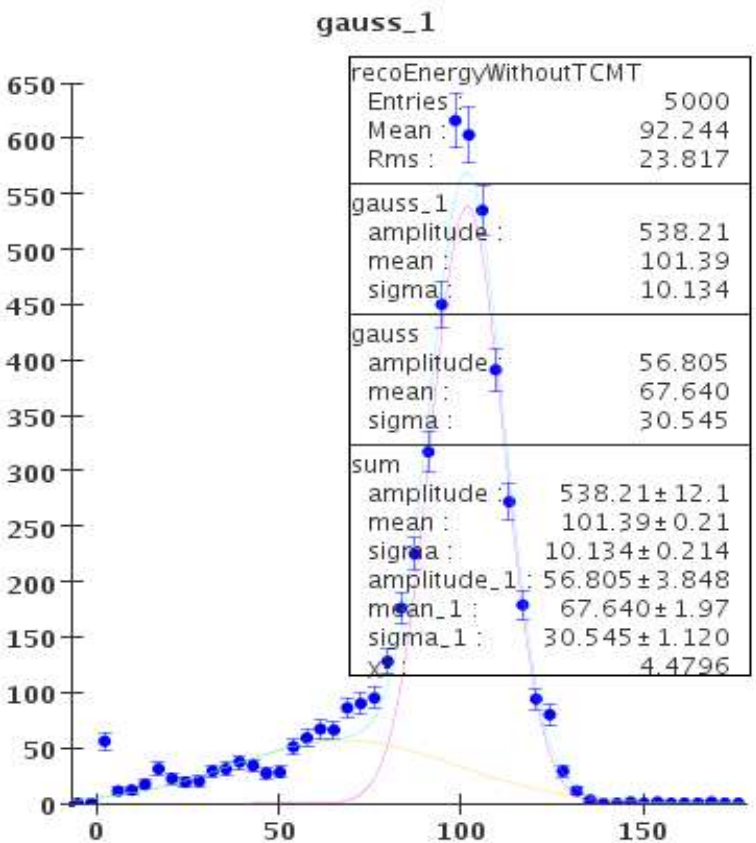
Trying gaussian fits

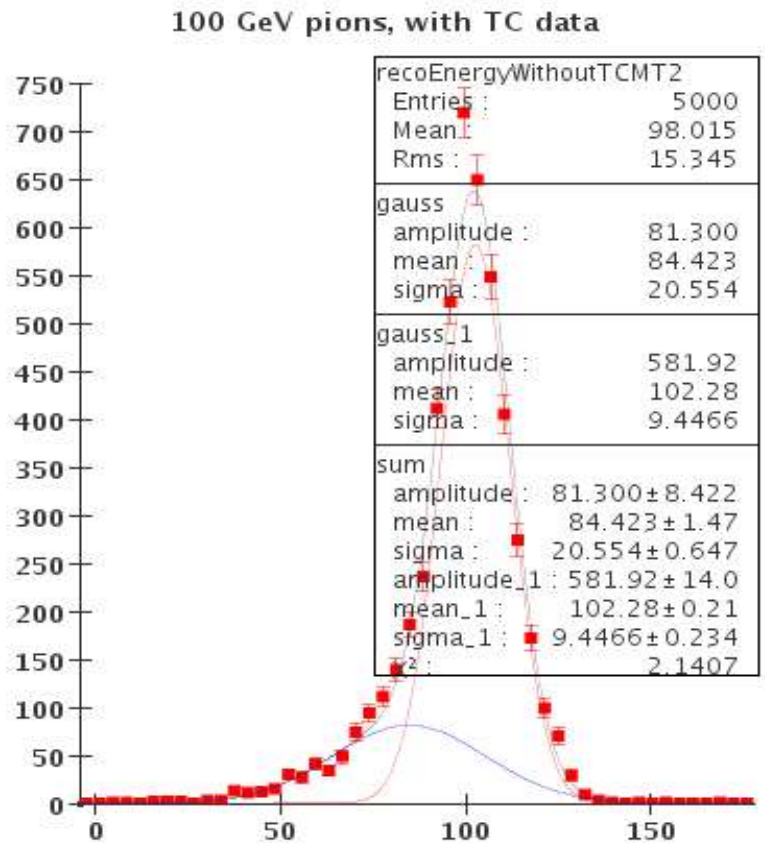




* No significant change to fit parameters, but get a better fit quality.
* Without TC data, fit results are more sensitive to initialization

Trying gaussian fits





* Missing energy gets reasonably well modeled with two gaussians
* As expected, the second gaussian improves with tail catcher data