Belle Starr Status Update

Robert Bormuth
Leiden University and Nikhef
August 26, 2016

Scan results: Finding the minimum

Improved estimation of likelihood “bkg” estimation. Used now the output of TSpectrum for background fit (based on Markhov Chain approach)

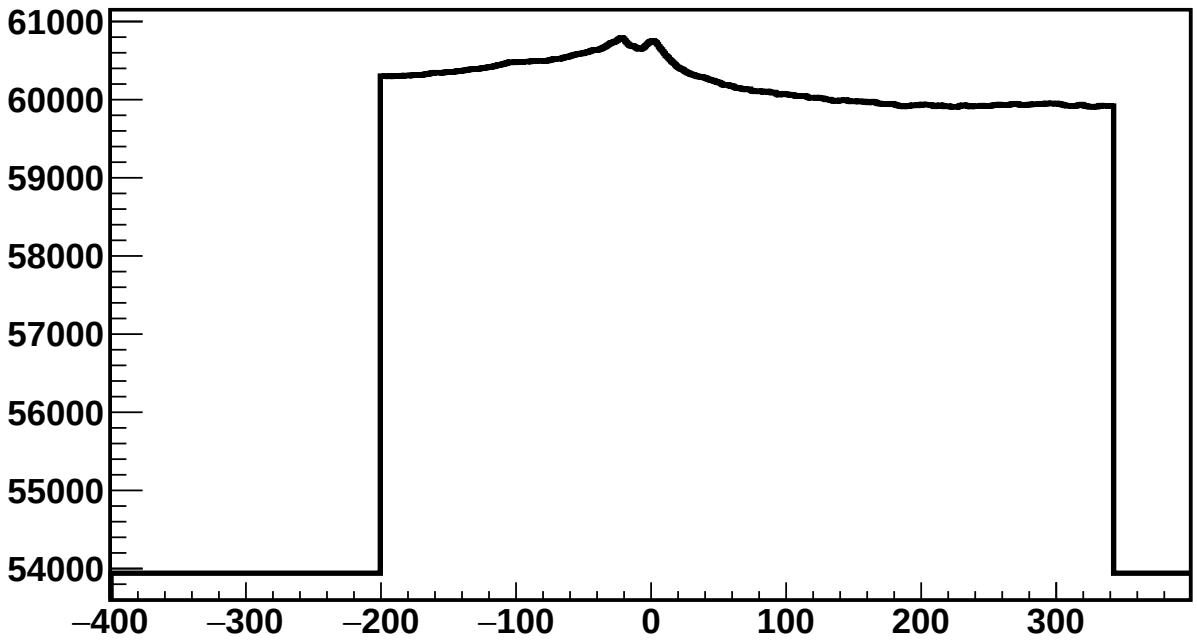

Figure : X: distance along scan direction in meter; Y: neg. log likelihood

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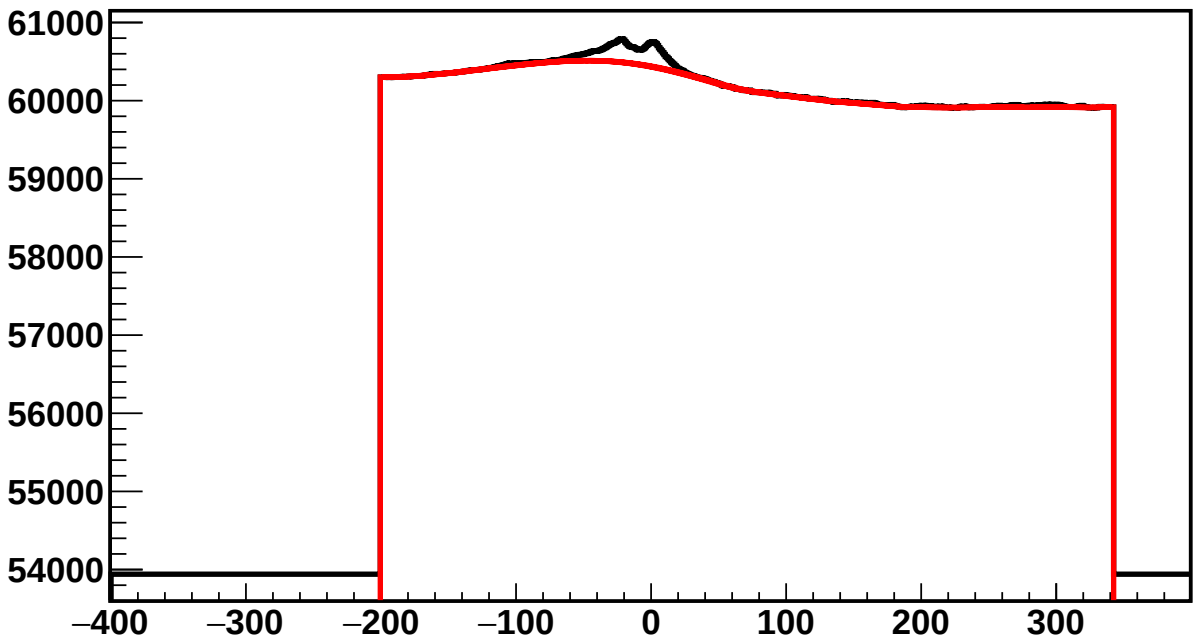

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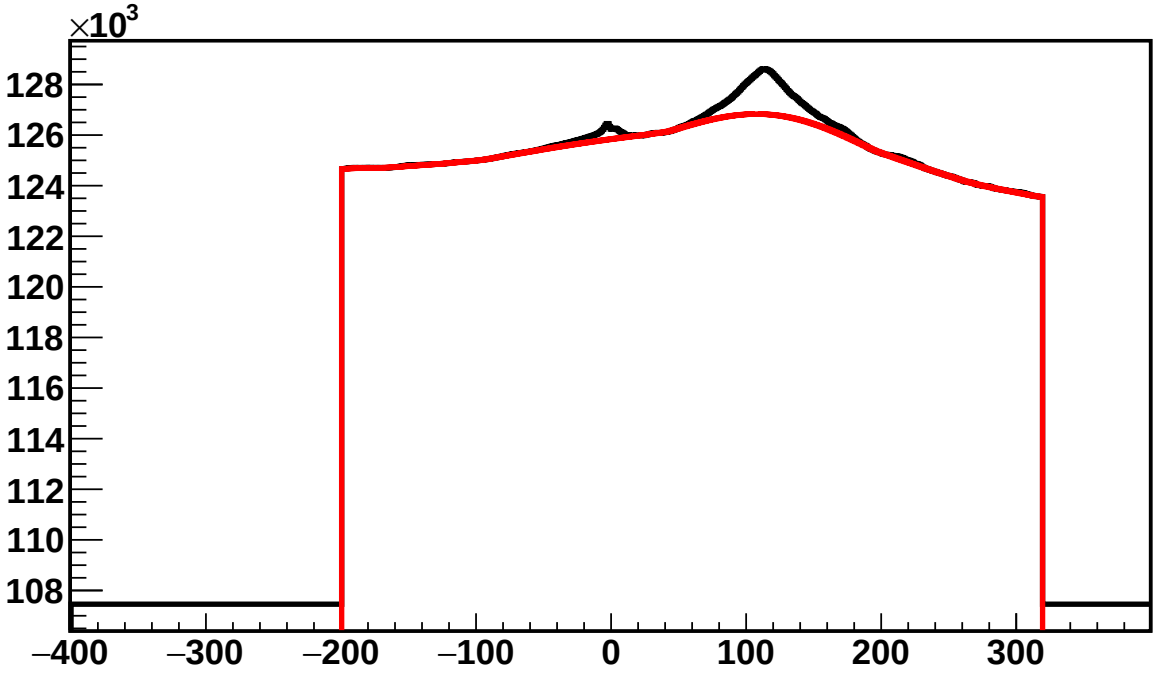

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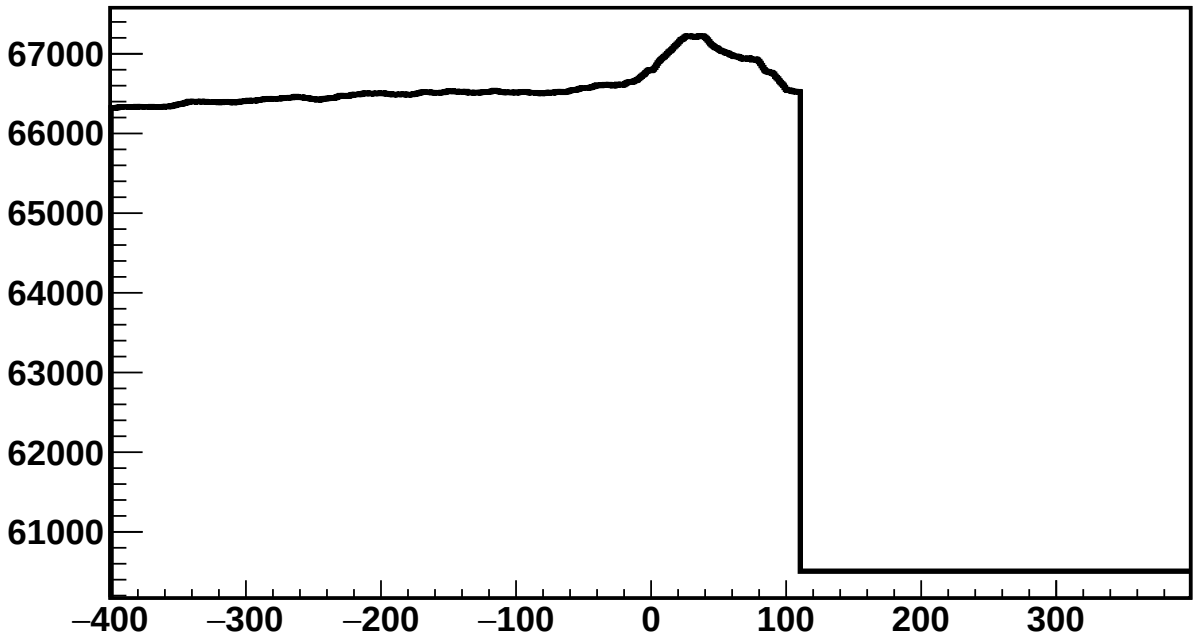
Scan results - peak estimation

Peak significance

TSpectrum finds peaks based on width, need to establish if these peaks are significant, found discrimiantor

$$\text{peak}_L \geq \text{bkg}_L + 300 \tag{1}$$

Scan results - peak estimation



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Scan results - peak estimation

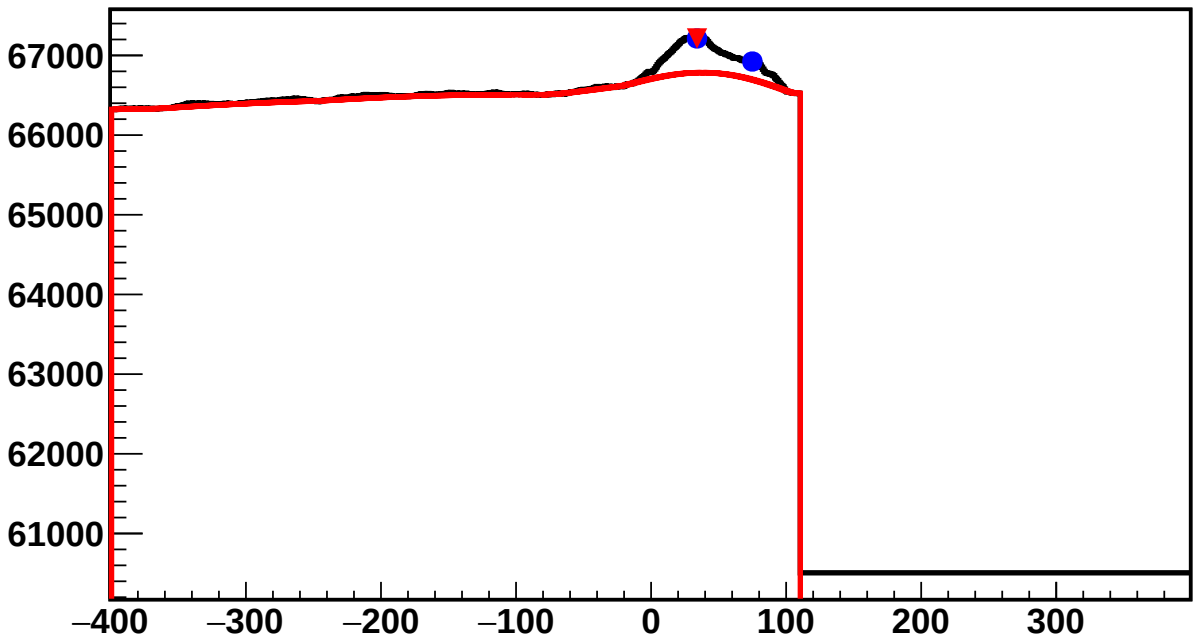

Figure : X: distance along scan direction in meter; Y: neg. log likelihood, blue all peaks found, red significant peaks

Further improving shower position reco

Belle Starr reco so far, can be found at
http :// svn.km3net.de/reconstruction/Belle_Starr/trunk/ :

1. Single shower position, direction and energy fit (Belle Starr Prefit)
2. Scan two shower likelihood from rec position in ± 400 m along rec direction (Belle Starr Scan)
3. Analyze likelihood landscape using TSpectrum (Belle Starr Peak)

$\hookrightarrow$ further improve reco by running full two shower position fit on good output of Belle Starr Peak

Refitting the output

Since we only refit the two positions, expect improvement in vertex reco and direction reco:

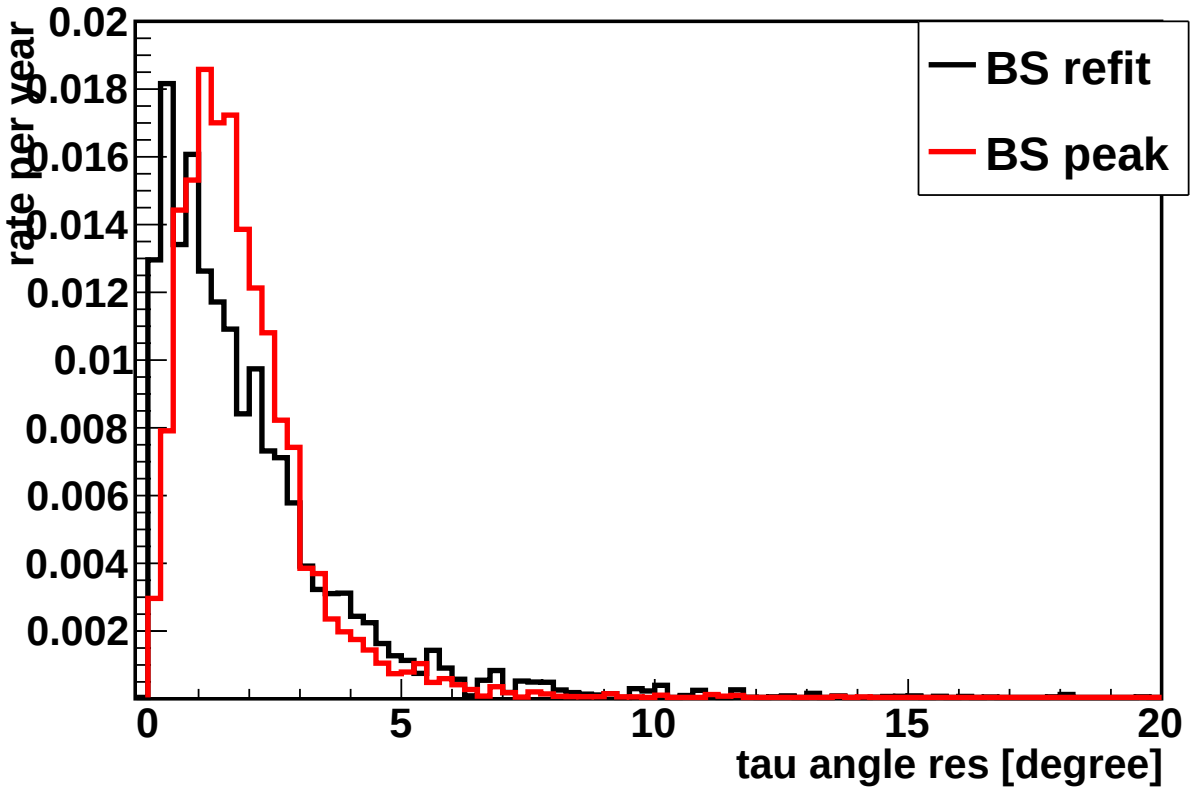

Figure : Angular resolution of tau events before and after refitting

Refitting the output

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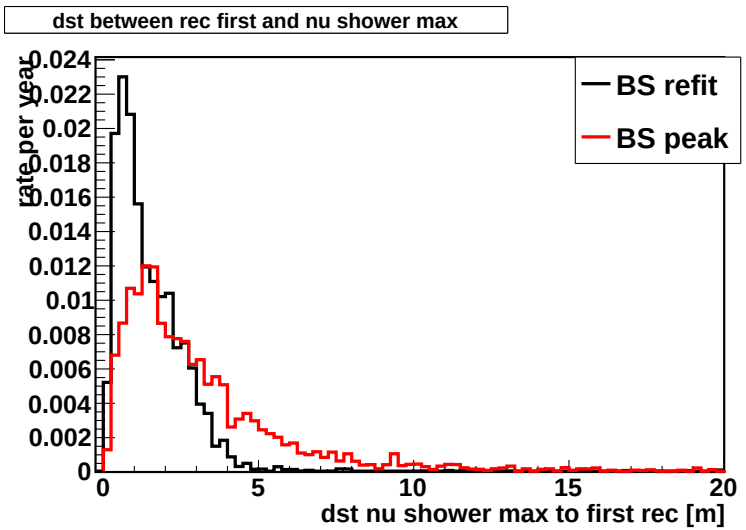
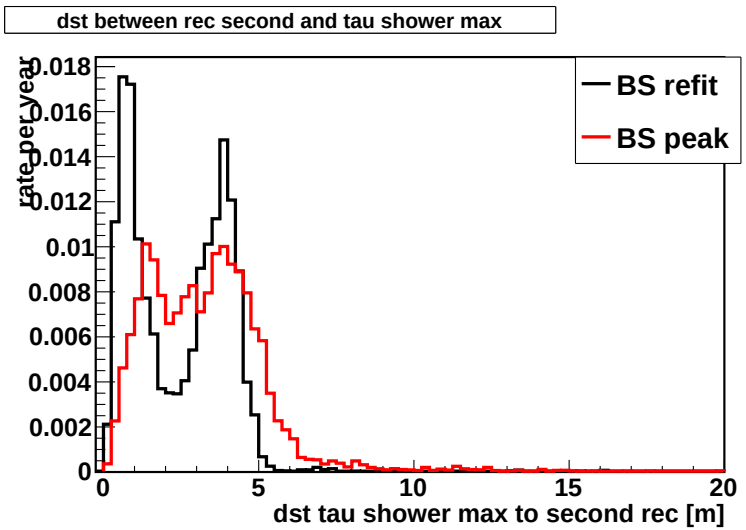


(a) Distance between neutrino shower maximum and first (in time) rec position before and after refitting



(b) Distance between tau shower maximum and second (in time) rec position before and after refitting

2nd vertex position resolution

Double peak structure for second peak currently under investigation (not caused by hadronic vs em shower!)

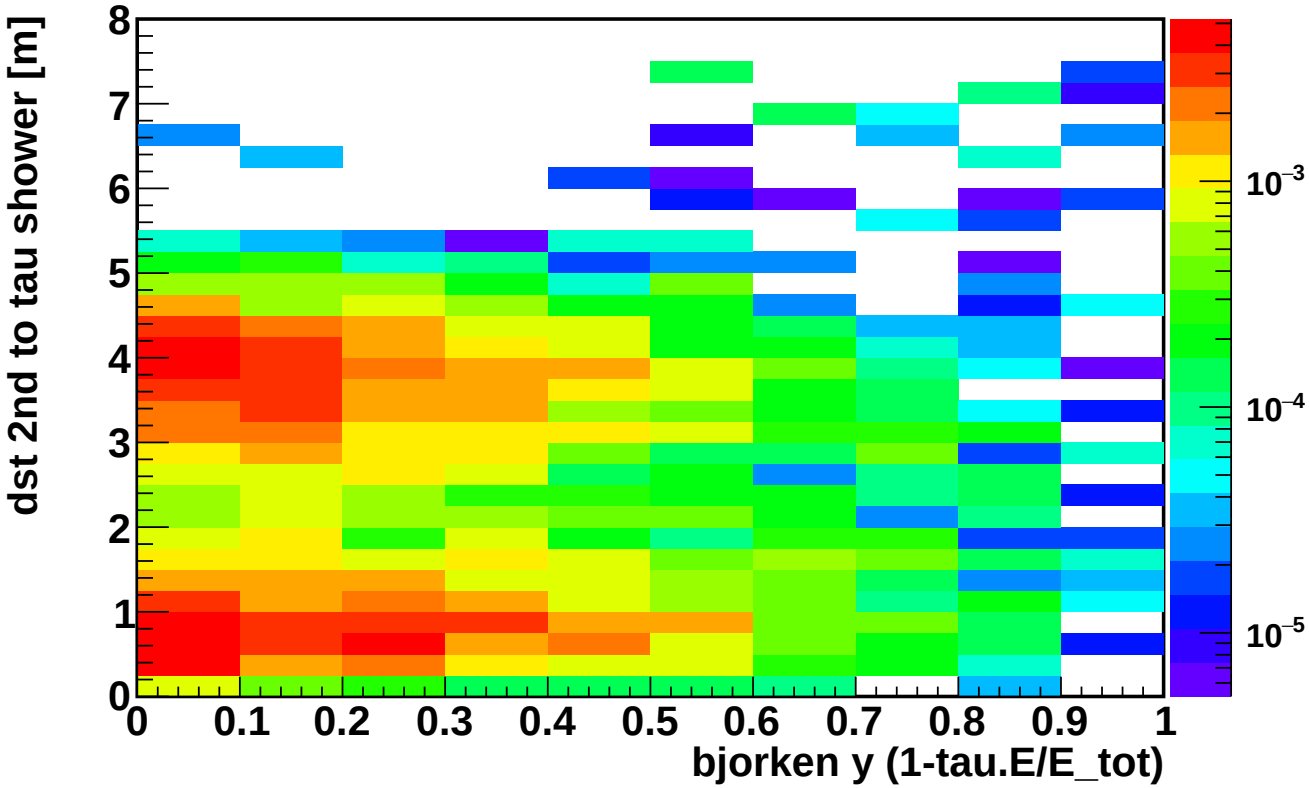


Figure : Distance 2nd rec vertex to tau shower maximum vs bjorken y

2nd vertex position resolution

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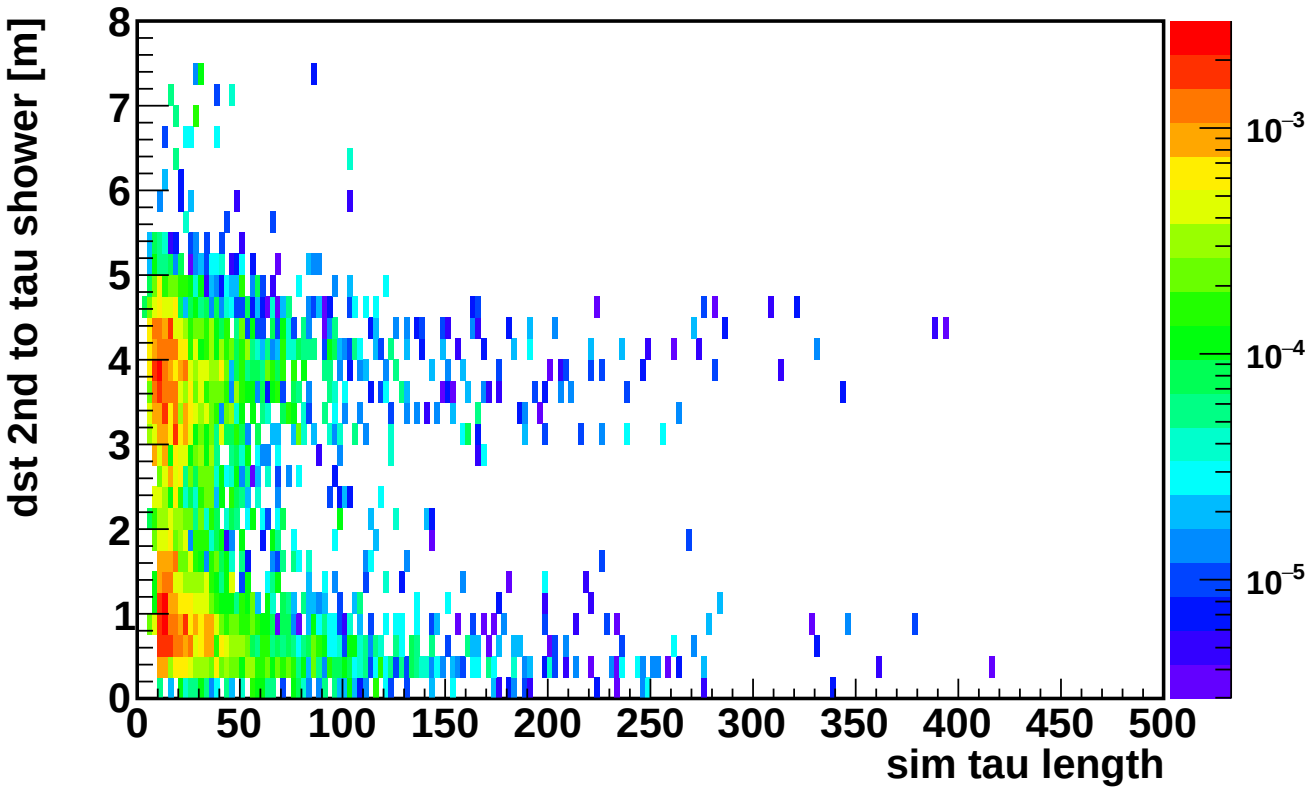

Figure : Distance 2nd rec vertex to tau shower maximum vs sim tau flight length

2nd vertex position resolution

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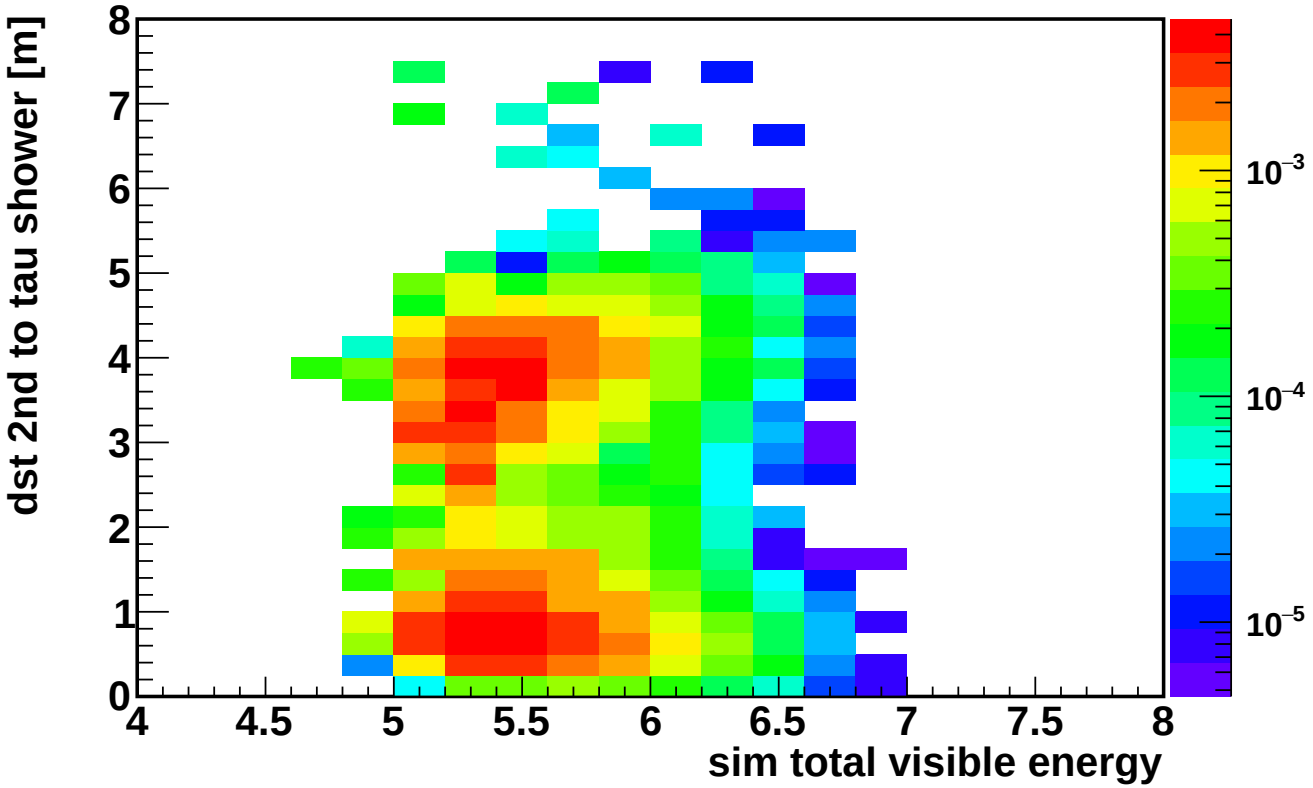


Figure : Distance 2nd rec vertex to tau shower maximum vs sim total visible energy

Atmospheric Muons

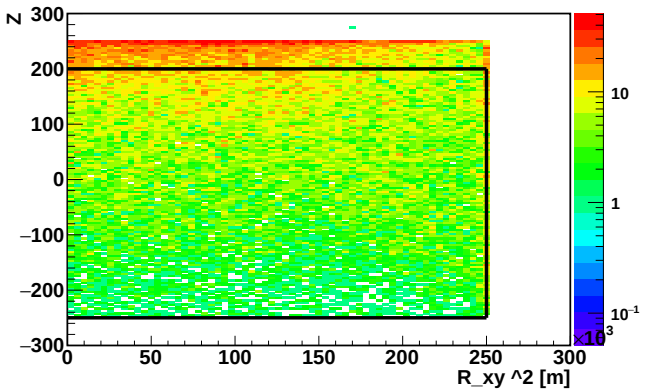
Started looking at atmospheric muon rejection, for diffuse HE IceCube the LoI quotes 6 μ_{atm} surviving the BDT

Used MC

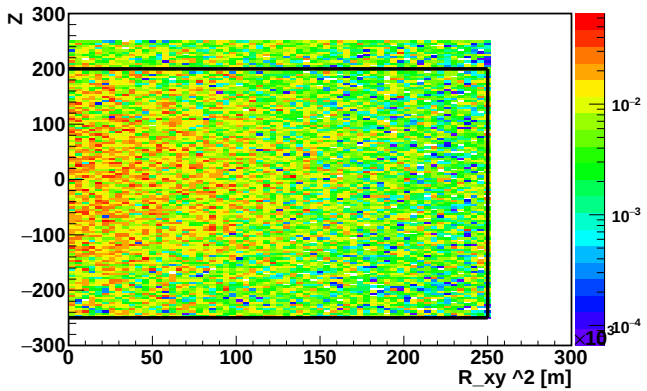
Used the atmospheric muon production with threshold 50 TeV

Containment Cut

Since atmospheric muons come from “above” we expect the first rec vertex to be in the top of the detector



(a) Position of first rec vertex in detector, black lines indicate containment cut, atmospheric muon events



(b) Position of first rec vertex in detector, black lines indicate containment cut, “Double Bang” events

Cut on likelihood value

To further reduce the atmospheric muon background the reduced two shower position likelihood (of the scan) is used:

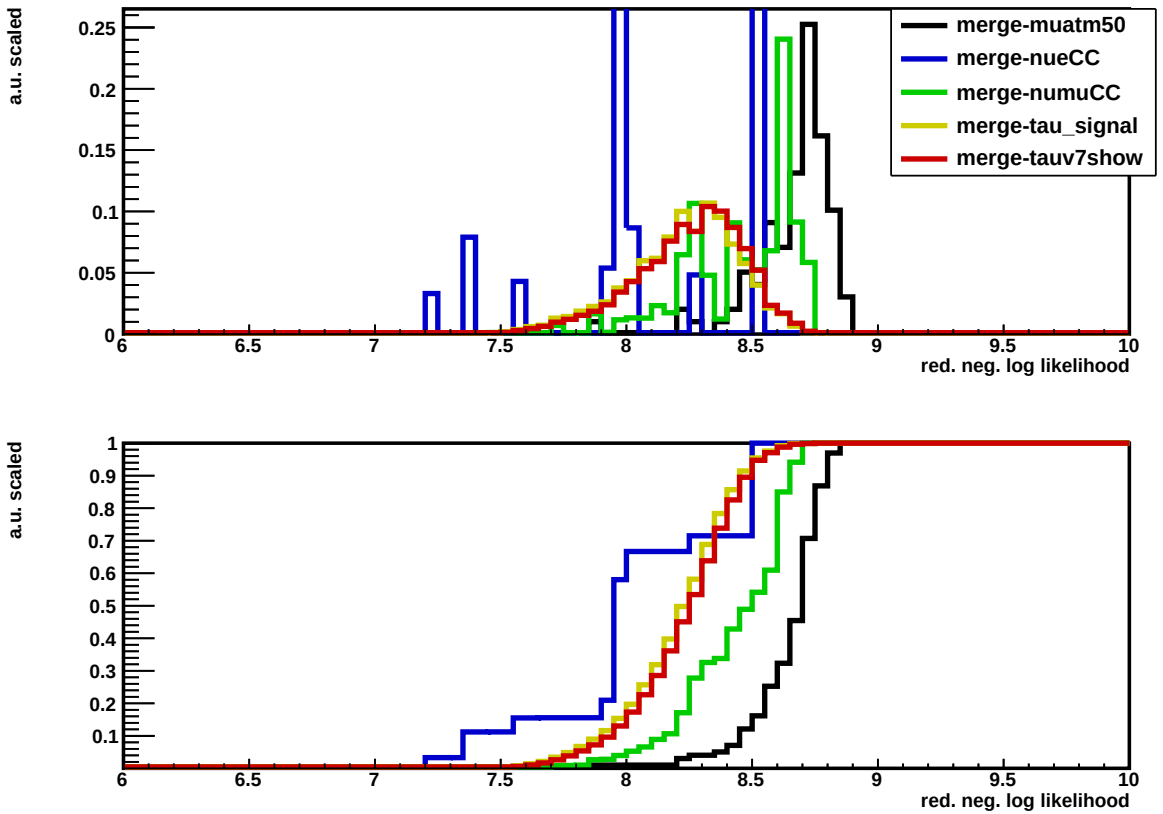


Figure : Likelihood of selected events top, bottom cumulative distribution

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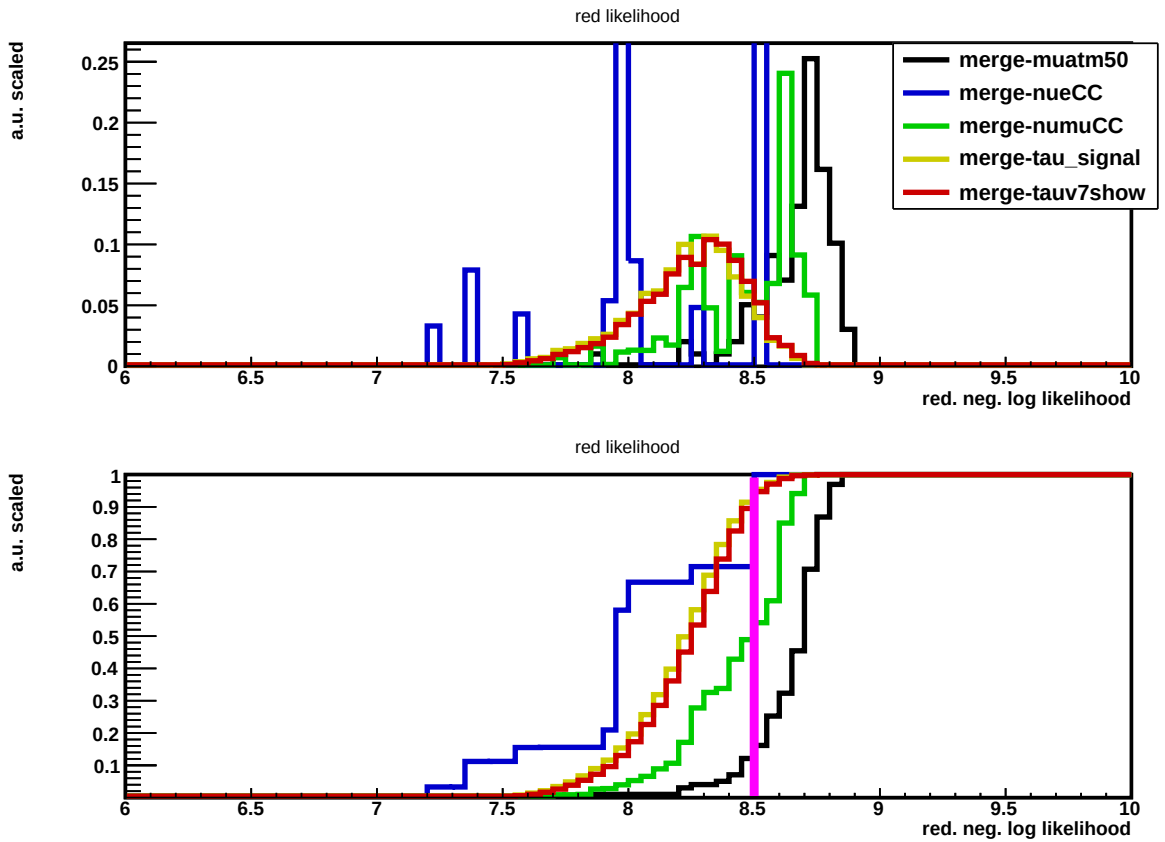

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Selection Cuts

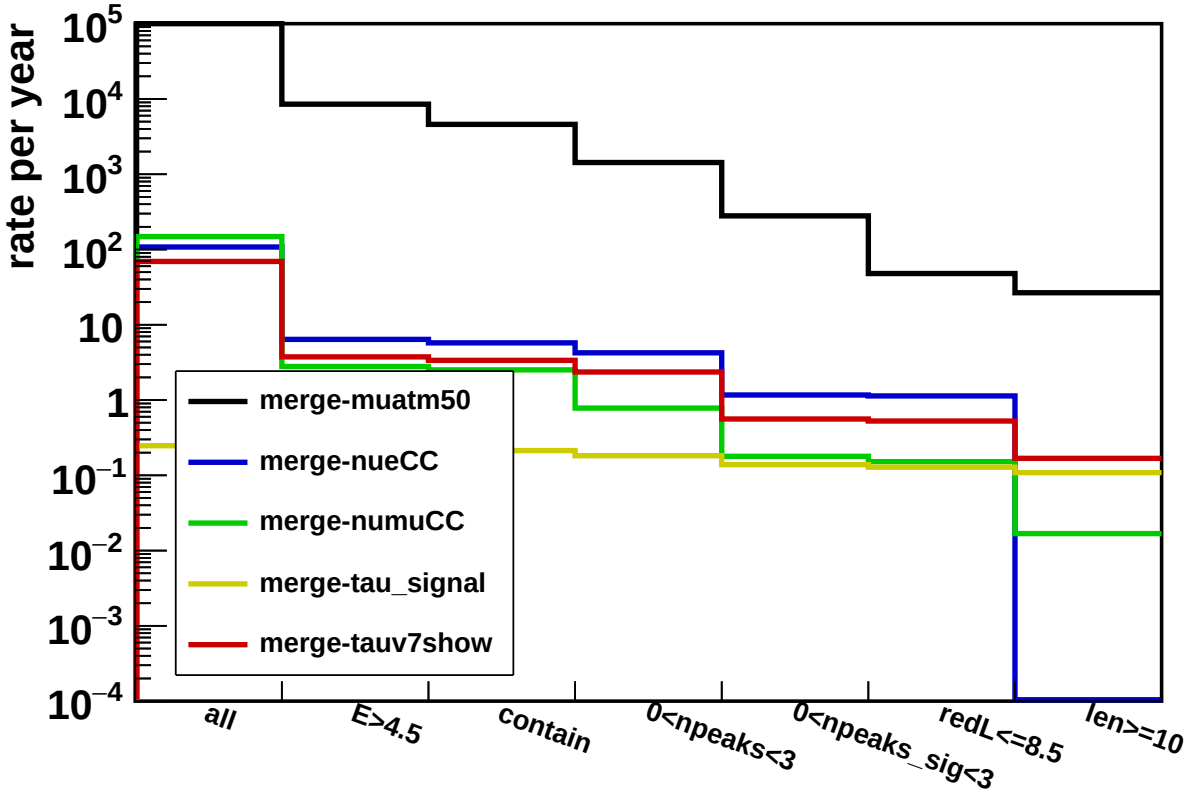

Figure : Selected events for cut flow

Adjust length cut?

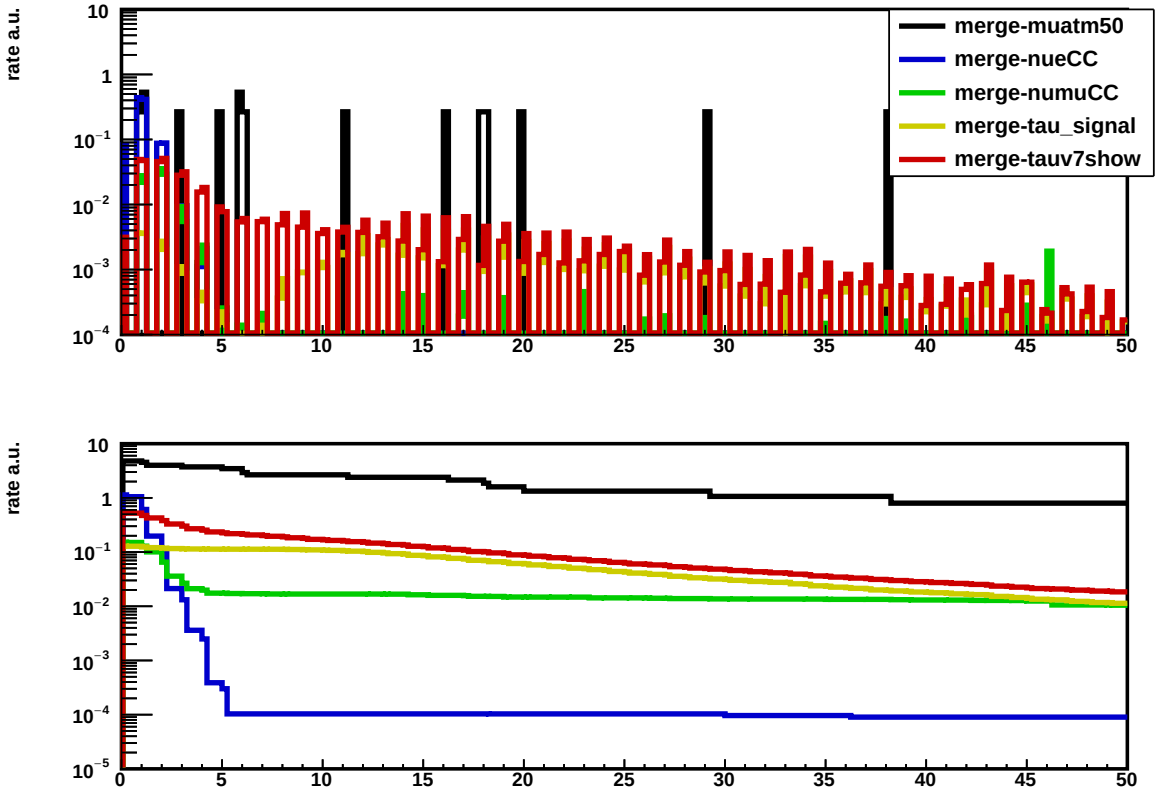

Figure : Reconstructed length [on x axis in meter] after OTHER cuts, maybe reduce below 10 m?