CC Inclusive Cross Section

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CC Inclusive Cross Section

- Motivation and challenges,
- CC inclusive sample,
- Event reconstruction,
- Systematics,
- Conclusions.

CC Inclusive Cross Section Motivation

Why bother? Can't we just add CCQE, CCPip and CCPi0?

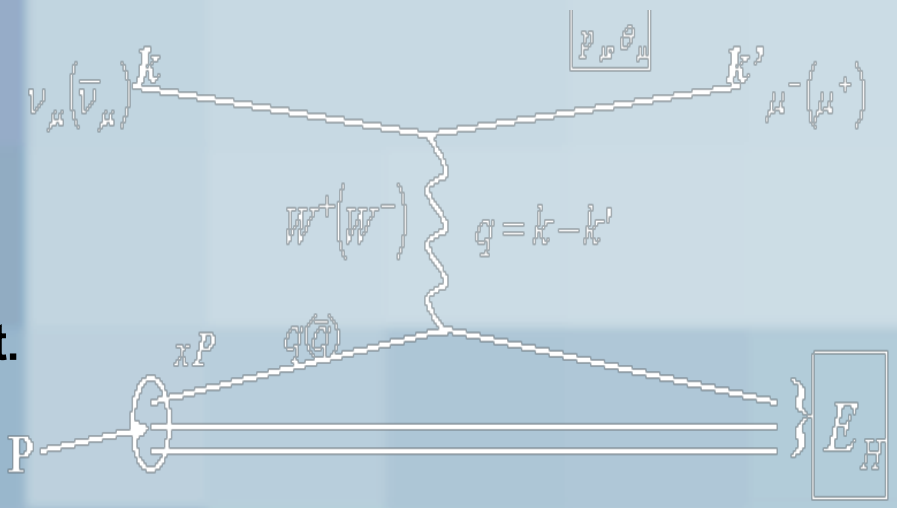
- Yes, we can add the cross sections, but we'll be adding the systematics as well.

- Complicated model dependent correlations - each of the exclusive channels is a background for the others through FSI model.

It's important to have a full suite of cross section measurements from one experiment – same flux systematics.

- very useful for MC model tuning.

CC Inclusive Cross Section Challenges



We can reconstruct muon kinematics.

Conventionally E_{HAD} is reconstructed - allows reconstruction of the whole event.

However:

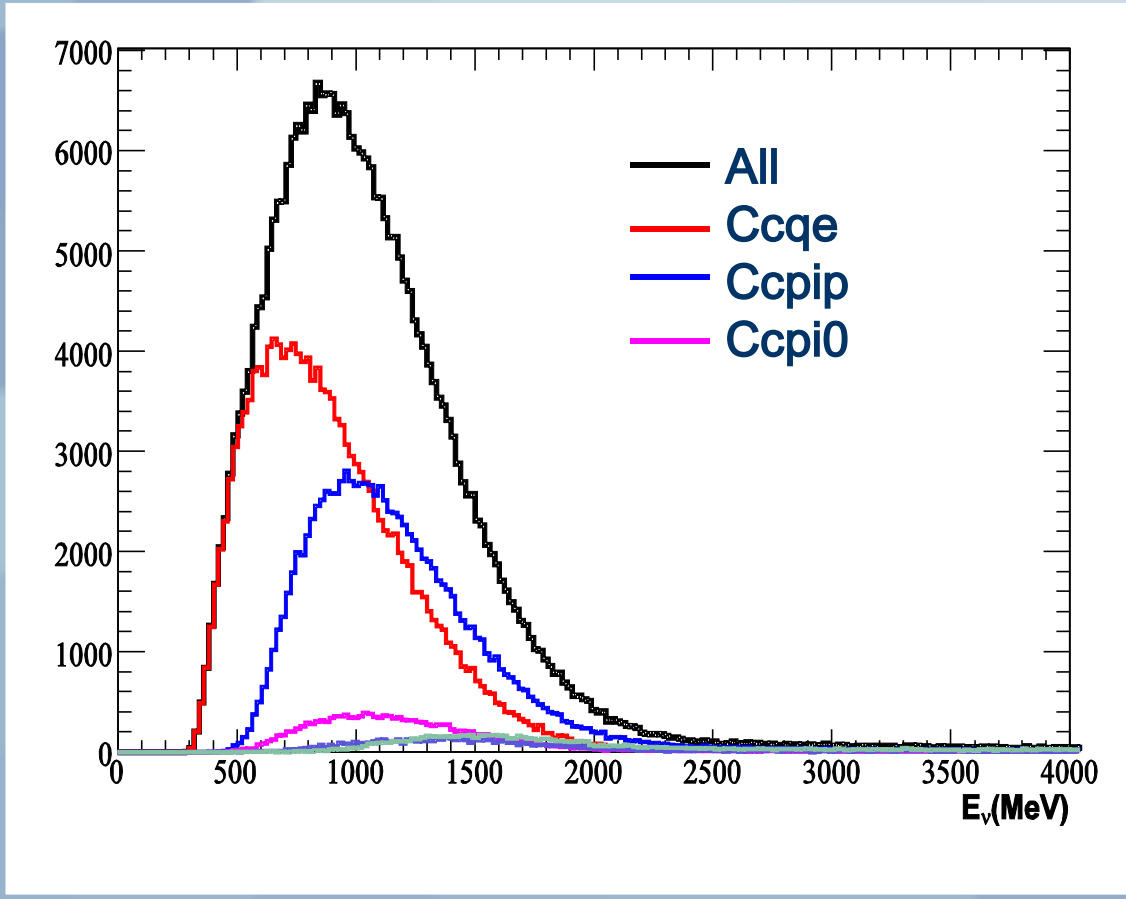
- low multiplicity final states – difficult to reconstruct hadronic energy,
- brute force - run all dedicated fitters on all events – will take forever.

CC Inclusive Sample

- events with 2 or more subevents,
- Veto hits < 6 on all subevents,
- Tank hits < 200 on all, but the first subevent,
- Tank hits > 200 on the first subevent.

Expected more than 400k events.

CCQE – 52%
CCpip - 36%
CCpi0 - 5%
Other CC – 4%
NC – 3%



CC Inclusive Reconstruction

Reconstruction of the lepton vertex:

- we have the muon kinematics from the OneTrack fit,
- we can reconstruct the neutrino energy instead,
- using MB detector as a calorimeter,
- neutrino deposits all of its energy in the tank for CC interaction,
- we can use the scintillation light to get the neutrino energy – calorimeter.

CC Inclusive Reconstruction – Stancu

Calculating the scintillation fraction:

$t_{cor} < 5ns$

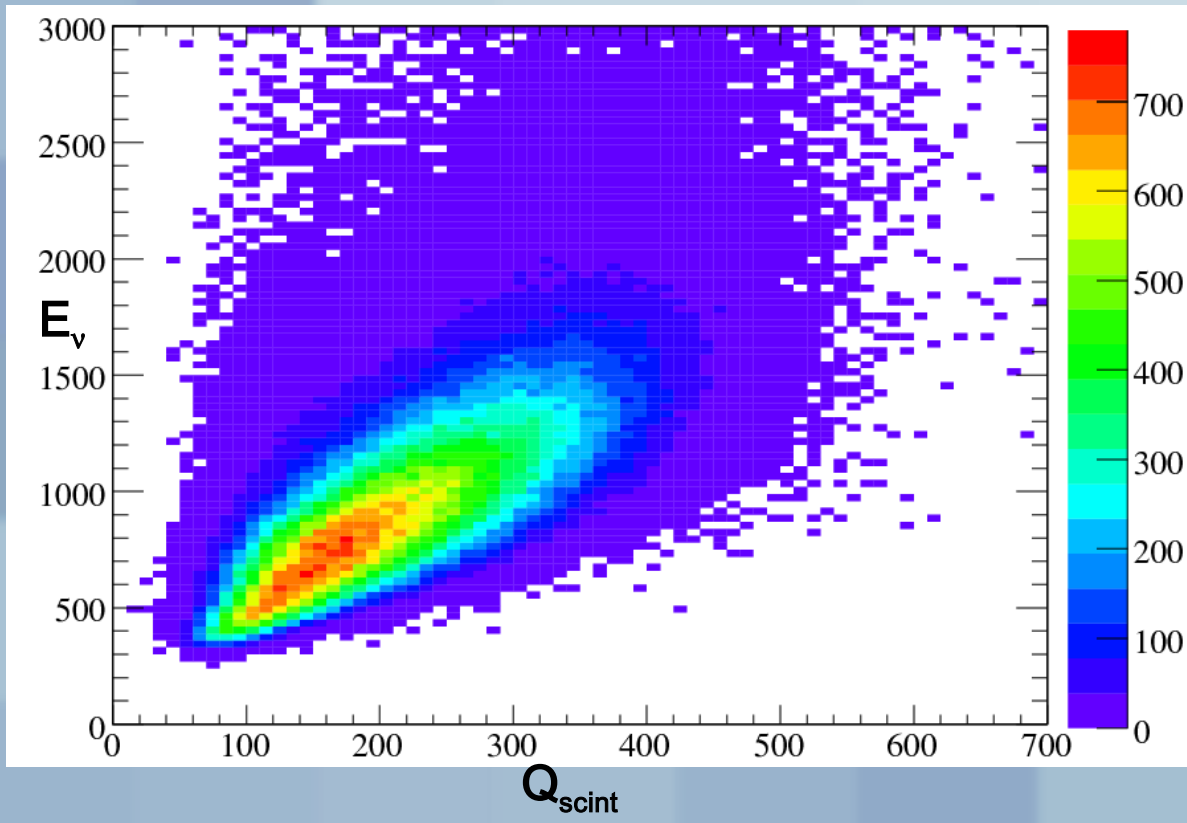
$t_{cor} = t_{rec}$ - dist / cn_light_sf – t_{vert}

using StancuFull_Fqlt05

Scintillation charge =
Q_{tot}*(1- StancuFull_Fqlt05)

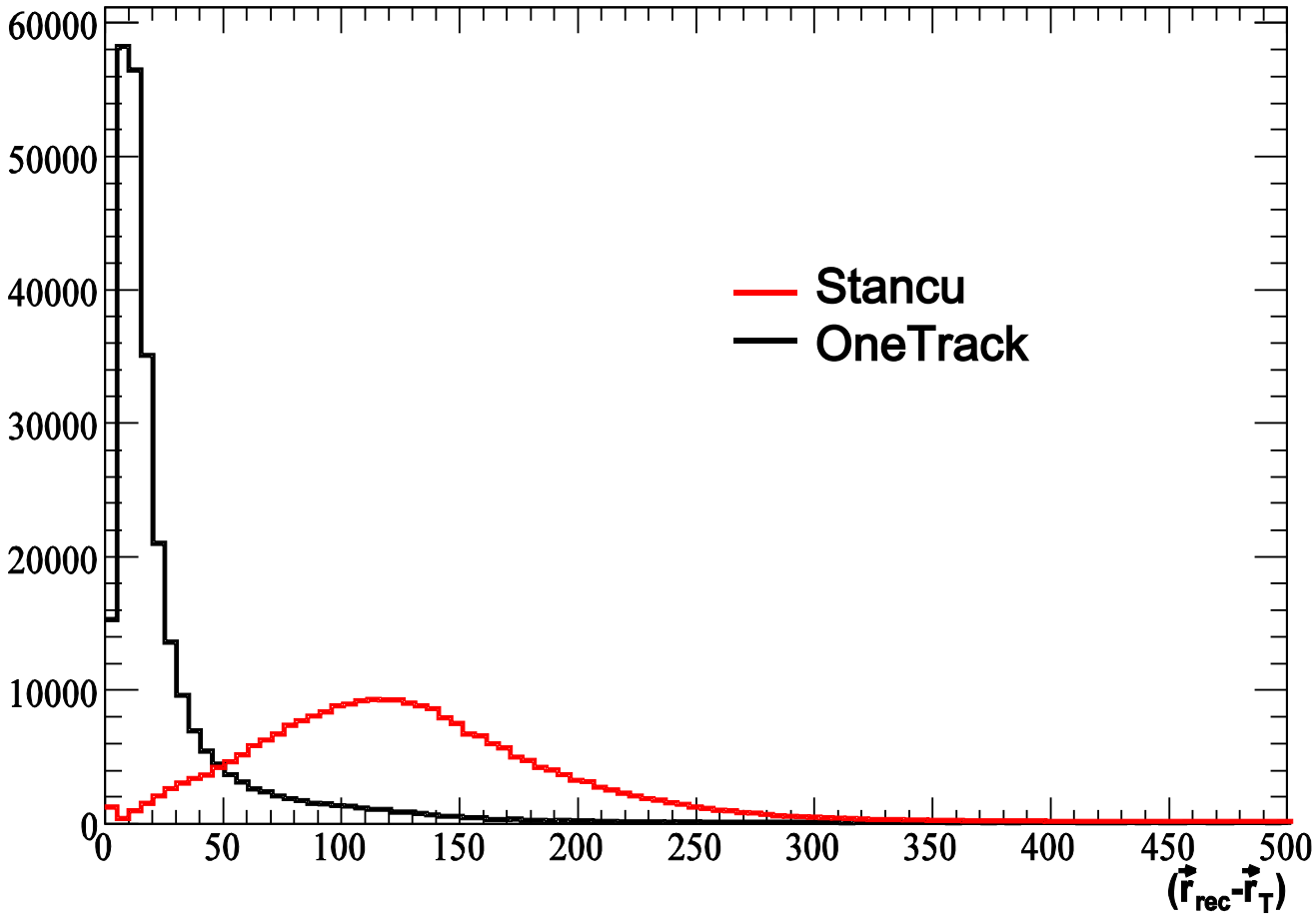
Find the correlation function -> E_ν

- 33% resolution

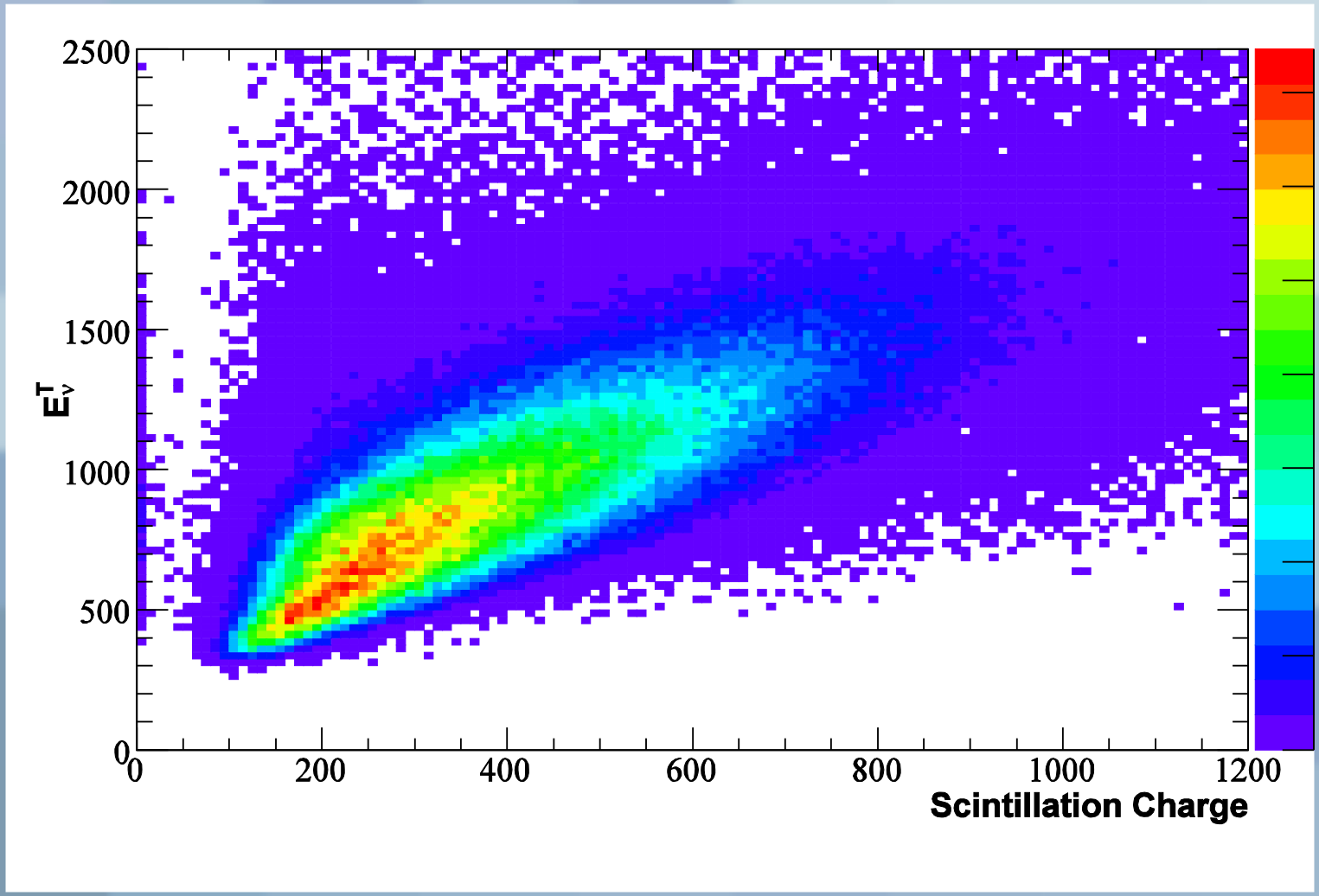


CC Inclusive Reconstruction – Vertex Resolution

- Stancu fit has bad vertex resolution,
- OneTrack fit is much better,
- repeat procedure for OneTrack.

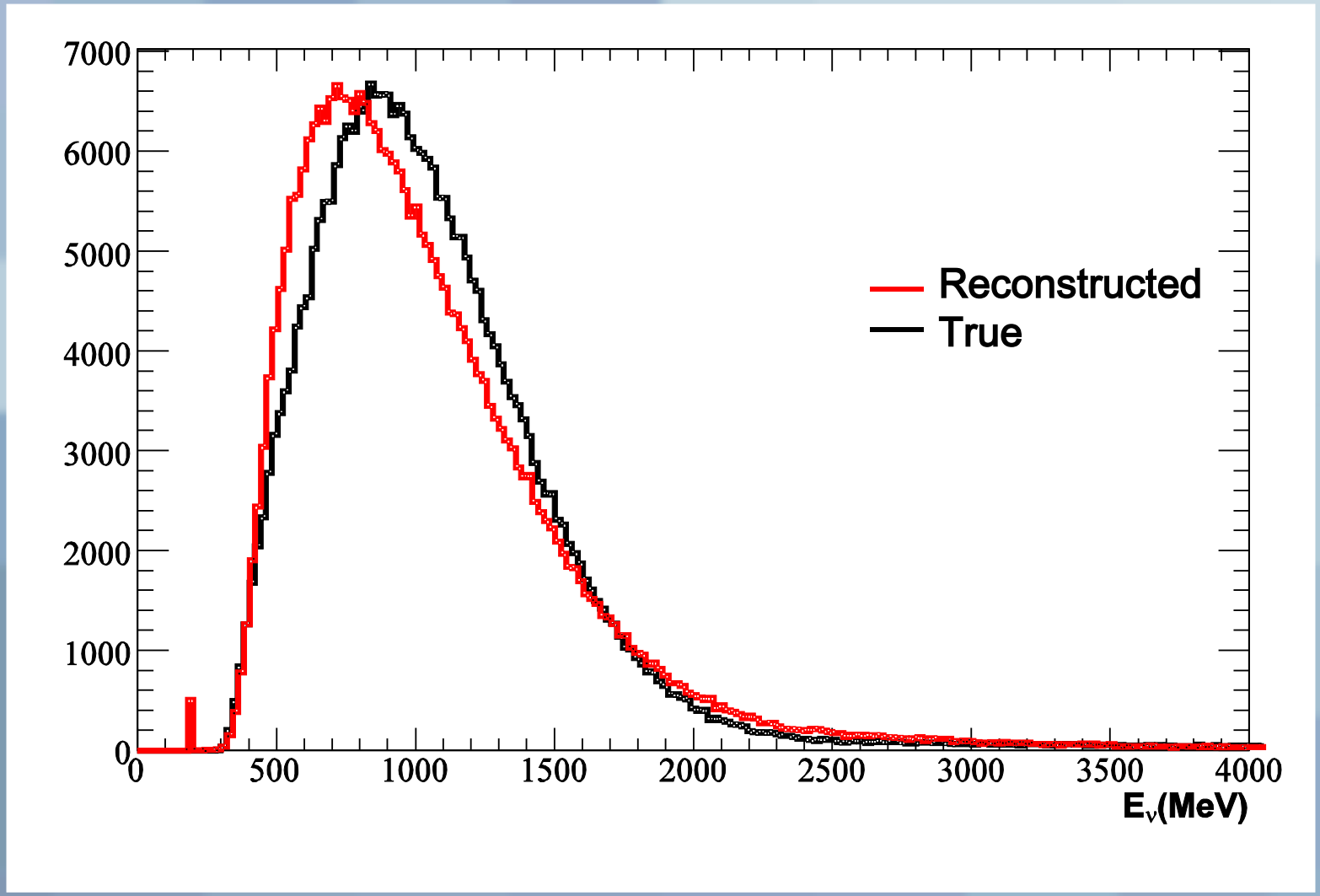


CC Inclusive Reconstruction - OneTrack

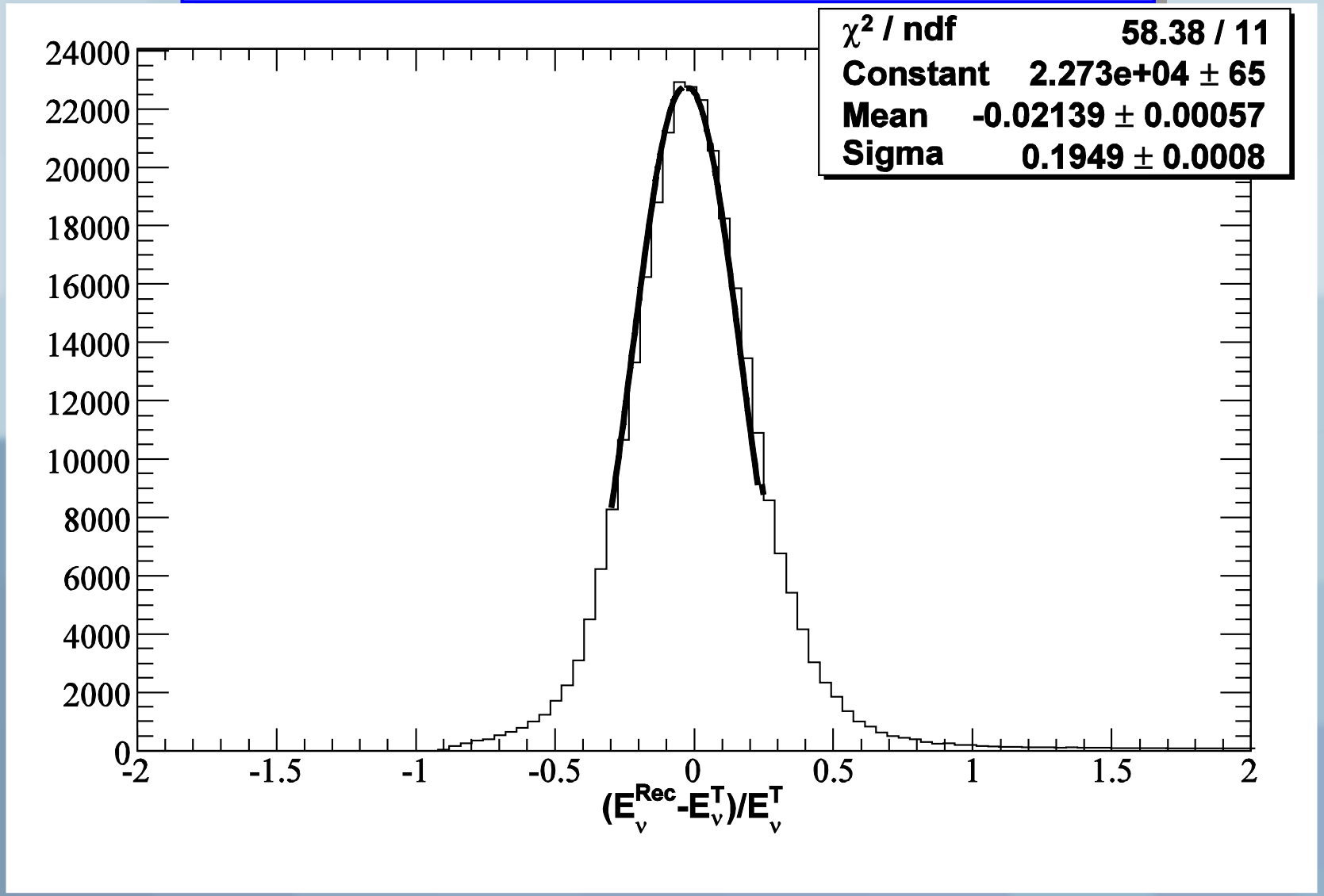


$E_\nu = 1.7576\ Q_{scint} + 81.446 + m_\mu + (SE-1)m_\pi$

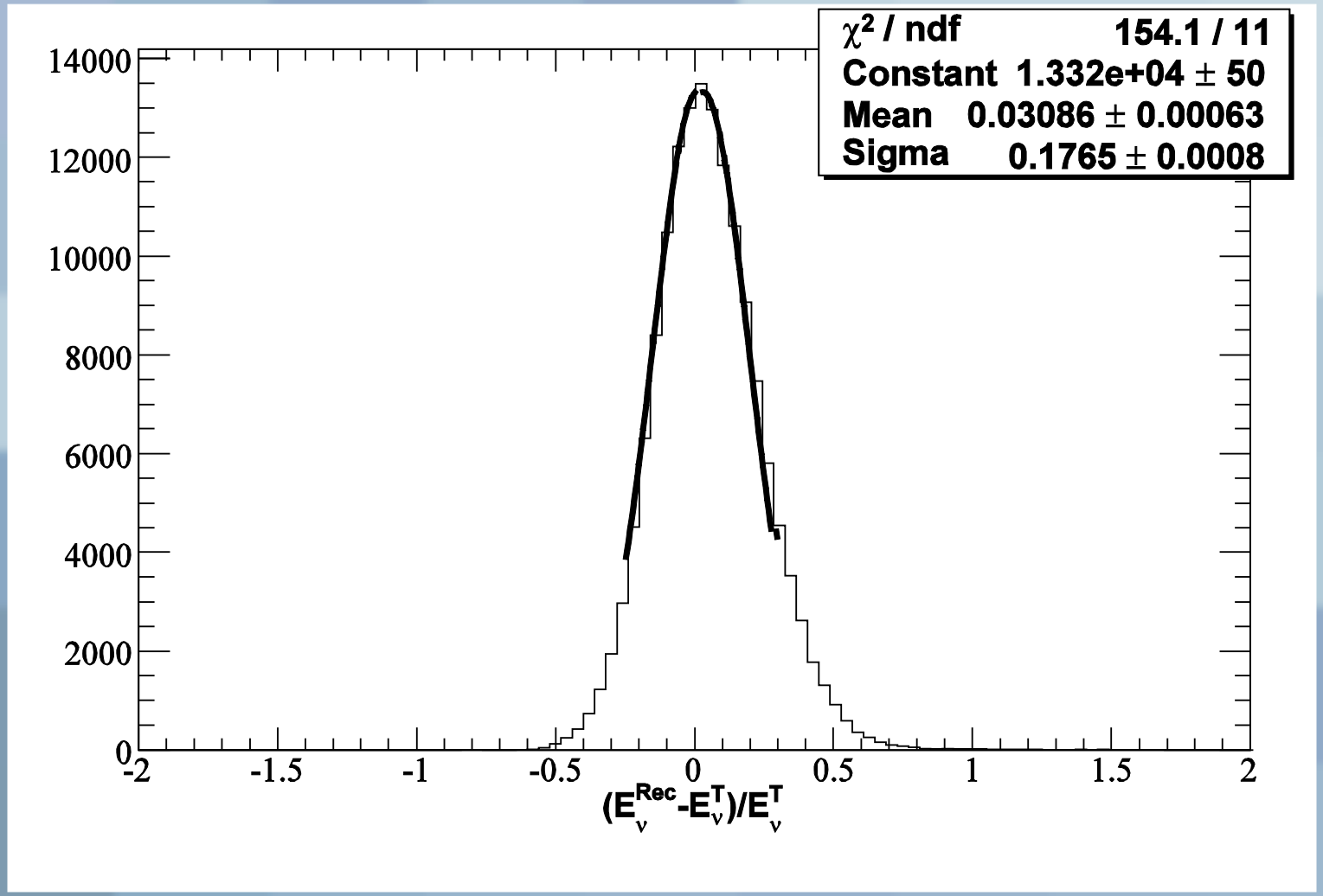
CC Inclusive Reconstruction - E_ν



CC Inclusive Reconstruction-E_ν Resolution

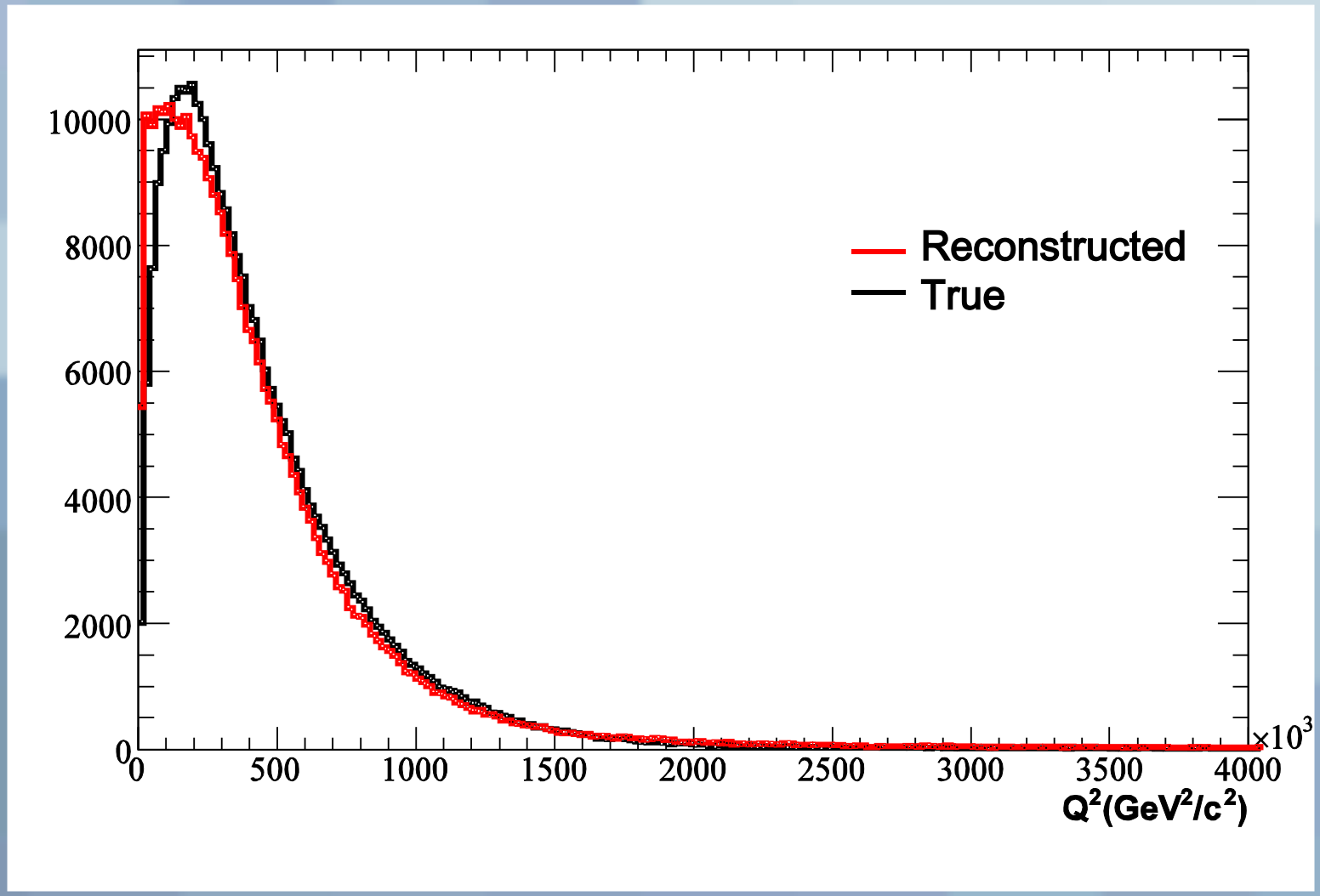


CC Inclusive Reconstruction-E_ν Resolution for CCQE

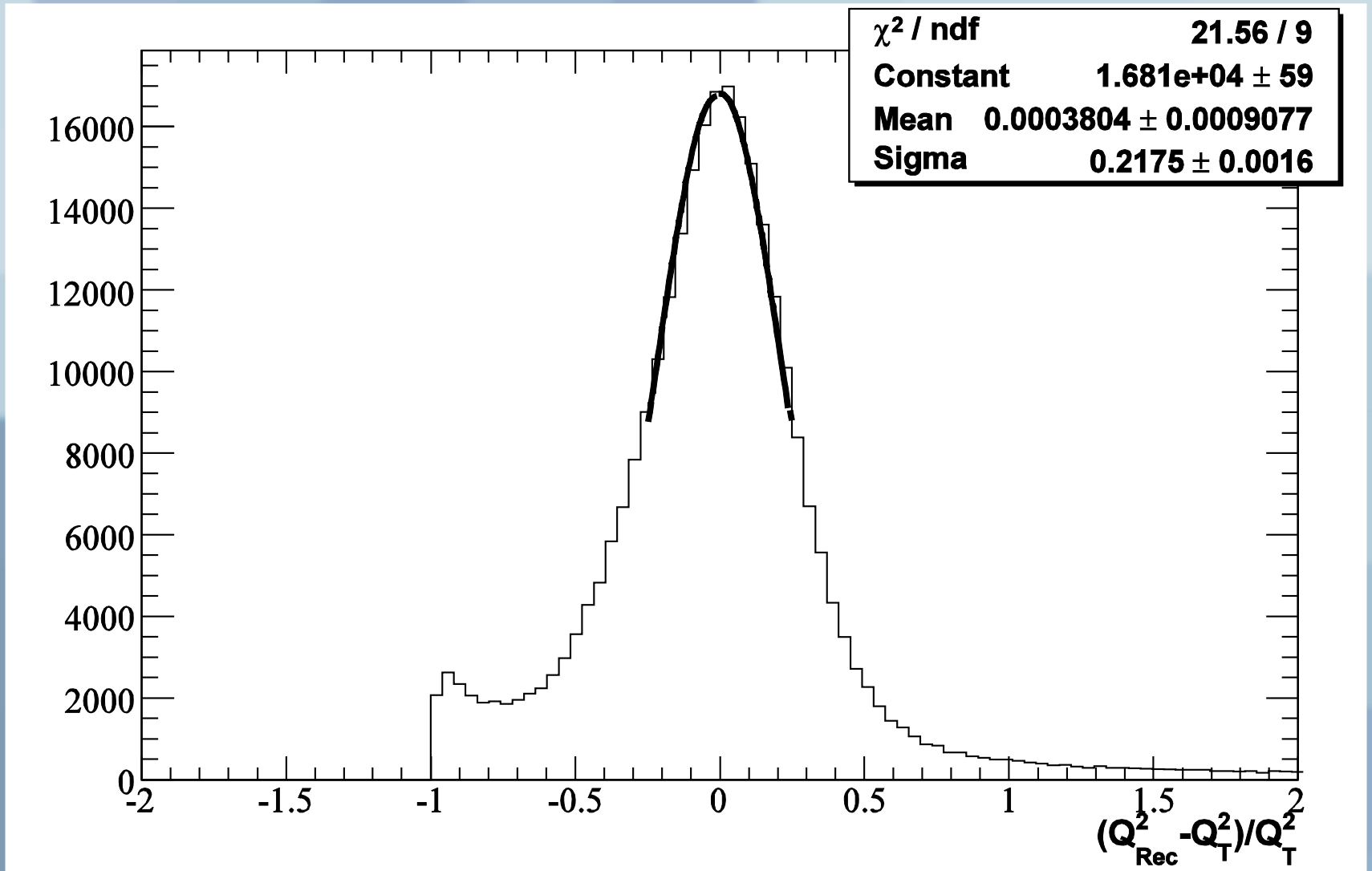


17% resolution for CCQE and CCpip– comparable to CCQE and CCpip Analysis (15%)

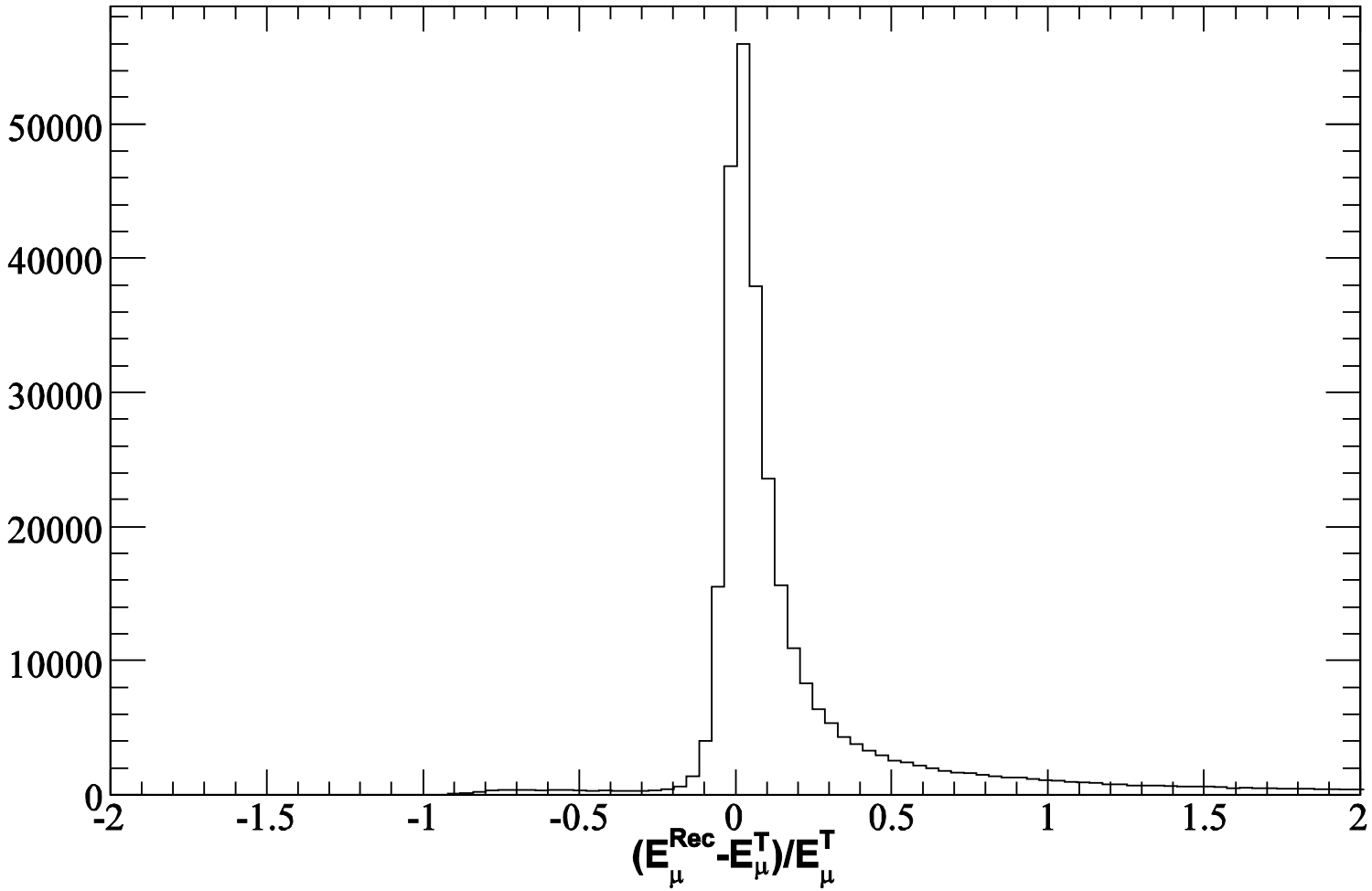
CC Inclusive Reconstruction-Q^2



CC Inclusive Reconstruction-Q^2 Resolution



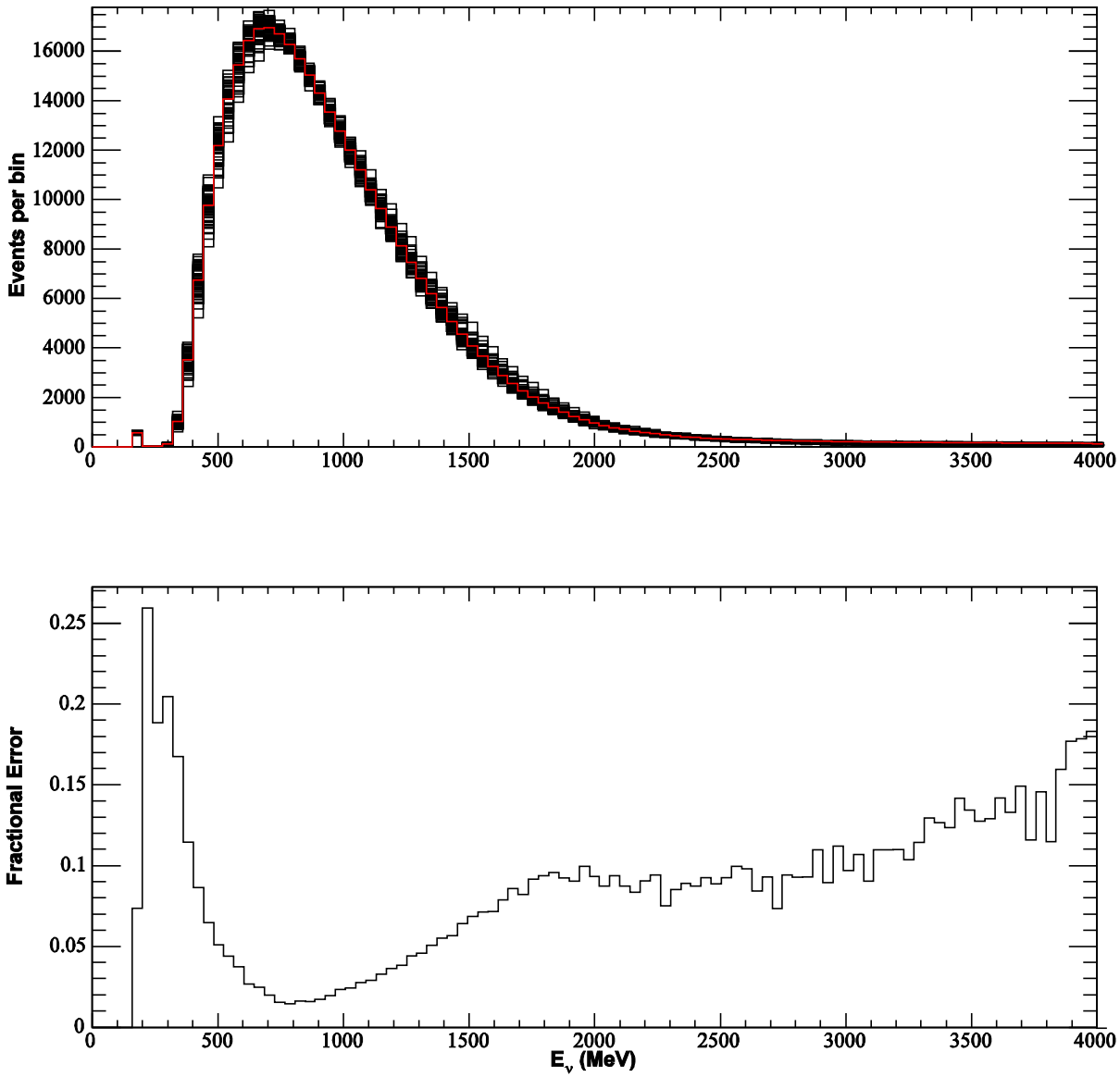
CC Inclusive Reconstruction-E_μ Resolution



For non-CCQE events OneTrack over-predicts the muon energy- more light from other rings. 5% resolution in the peak.

CC Inclusive Reconstruction- OM Multisims

- large error below 400MeV (expected)
- small error within (400 – 1800) MeV



Conclusions

- CC inclusive measurement is possible, right now – 20% resolution for E_ν
  22% resolution for Q^2
  6% resolution E_μ

- new fitter (2 or 3 ring) to improve both muon energy and vertex reconstruction for non-CCQE like events,

- new measurement with different systematics than the exclusive cross section measurements.

- low background – 3% NC.