$\nu_\mu \rightarrow \nu_e$

A. Zghiche
(LAPP-IN2P3-CNRS Université de Savoie)

10/06/2009

Electron Working Group Meeting

Just starting…

- Work with M2 student : Florian Brunet
- Aimed to calculate the event rates for signal ($\nu_\mu \rightarrow \nu_e$) and background(Beam ν_e and CC - NC fakes) for **generated** and **after reconstruction** (We have done only rates on generated so far) .
- Define topological and kinematical variables making the separation between signal and background

Tools

- OpRelease/3.1 (adapted to run on VMWARE image of sl4-32bits)
  - Running with GEANT-3
  - All steps of the analysis running: OpSim,OpDigit,OpRec
- Only Monte Carlo studies so far
  - Results with beamfiles
  - And after Running OpSim
- BUGs?

On the desktop

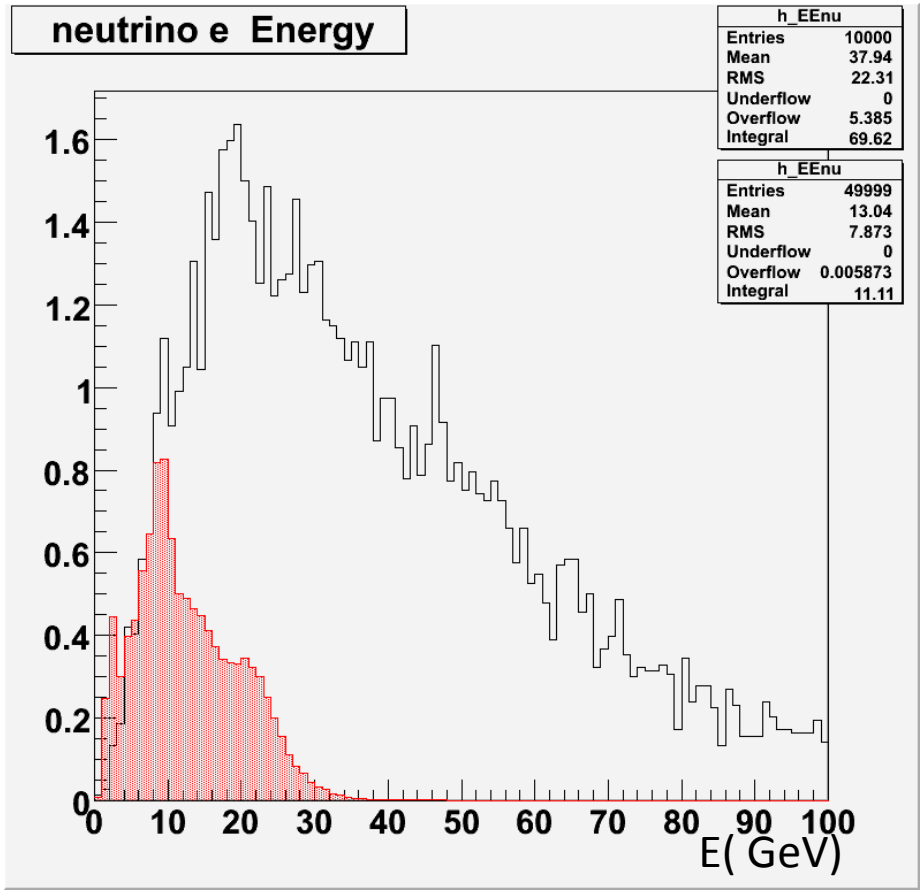
- Aimed to calculate the $\nu_\mu \rightarrow \nu_e$ rates for Signal and background
- Needed beamfiles for the different sources
  - ν_e Beam beamfile available on ccali.in2p3.fr: /sps/opera/operap/beamfiles/…
  - ν_e oscillated from ν_μ produced with :
    - OpRelease/3.1/OpNegn using FLUKA from ccali.in2p3.fr : /afs/in2p3.fr/throng/opera/operasft/OpRelease/3.2/OpNegn/OpFlukeva/v1/src/libflukeva100.a
    - and the following list of parameters values
      - $\Delta m_{23}^2 = 2.5 \times 10^{-3}$, $\theta_{13} = 9^0$, $\theta_{23} = 45^0$
  - More background to come τ -> e, true ν_μCC events (with no muon but with electron) and true NC events with fake electrons(pion misId))

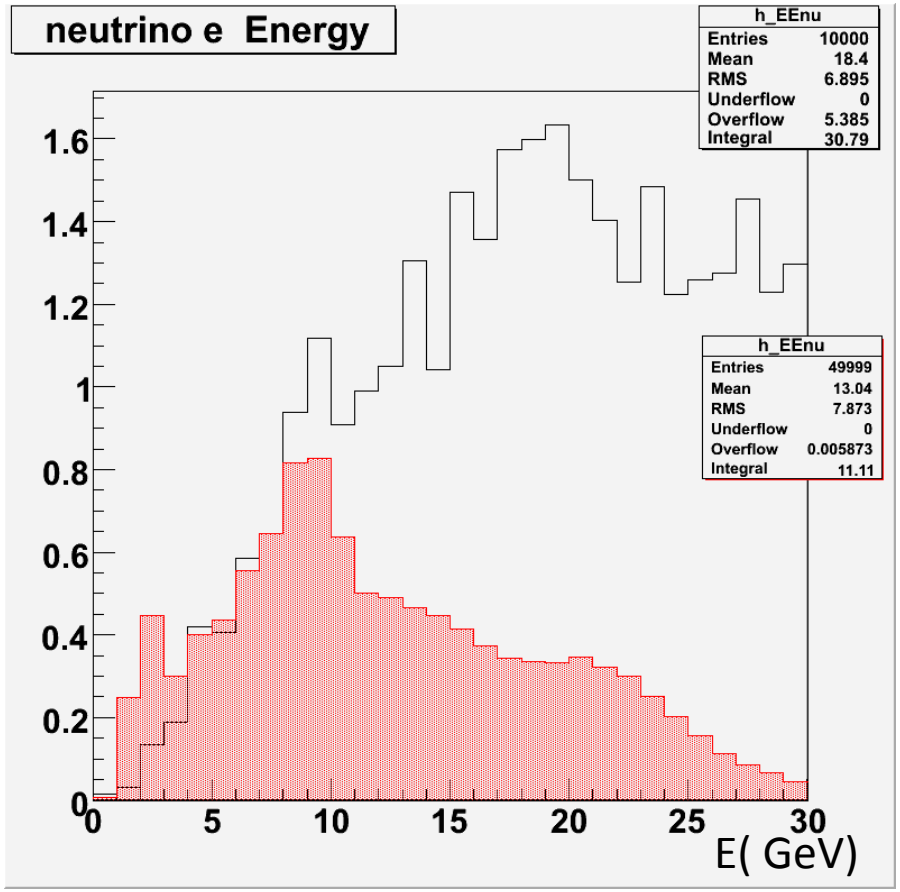
WORK shown here

- Rate calculation with CNGS files
- Oscillated ν_e beamfile generated with OpNegn
- Kinematical variable comparison: Evis?, Eelectrons?,pT? And smearing

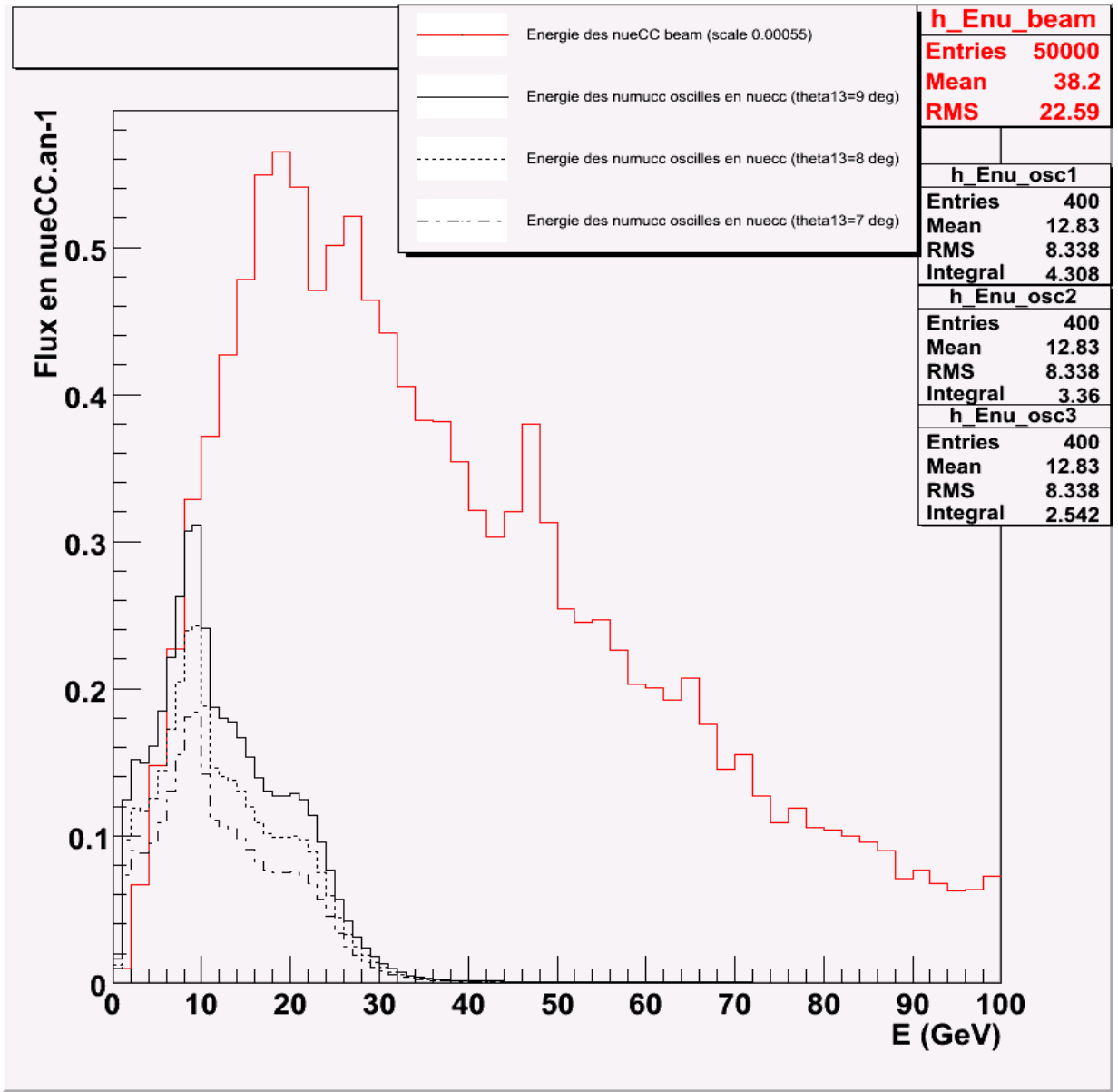
All these variables should have a convened definition among us…

with θ_{13} =9^0, Beam compared to signal

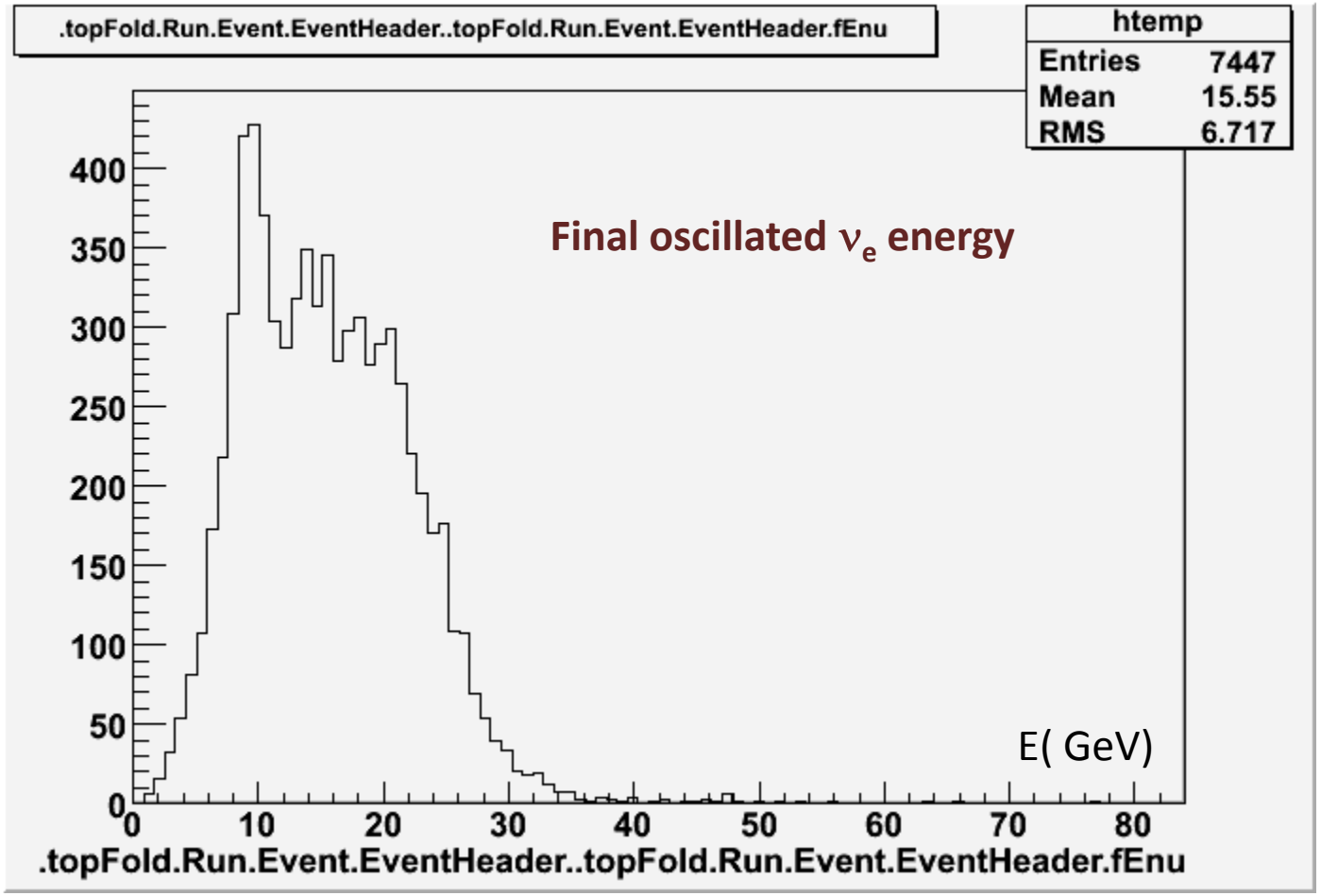




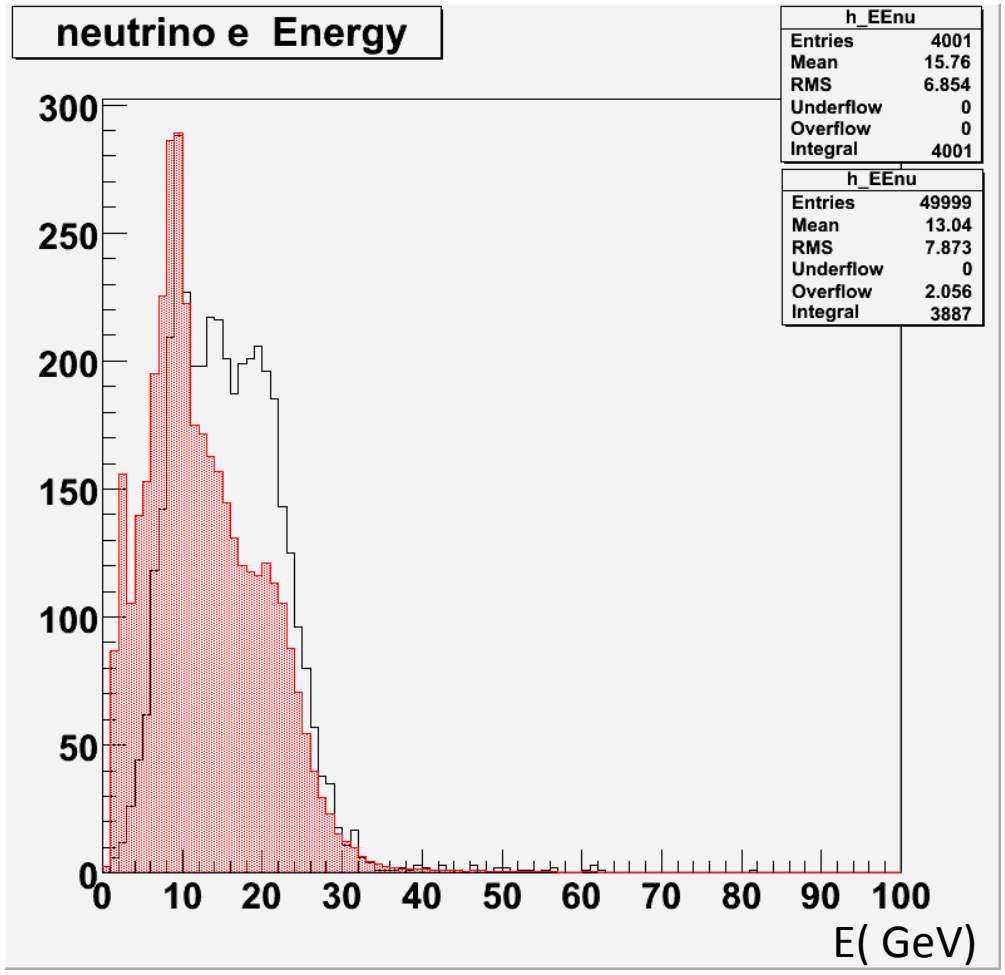
Oscillated ν_e rates in OPERA per year with different θ_{13} values compared to beam ν_e (F.Brunet)



ν_e beamfile:obtained ν_e Beam beamfile and a selection with the $\nu_\mu \rightarrow \nu_e$ spectrum

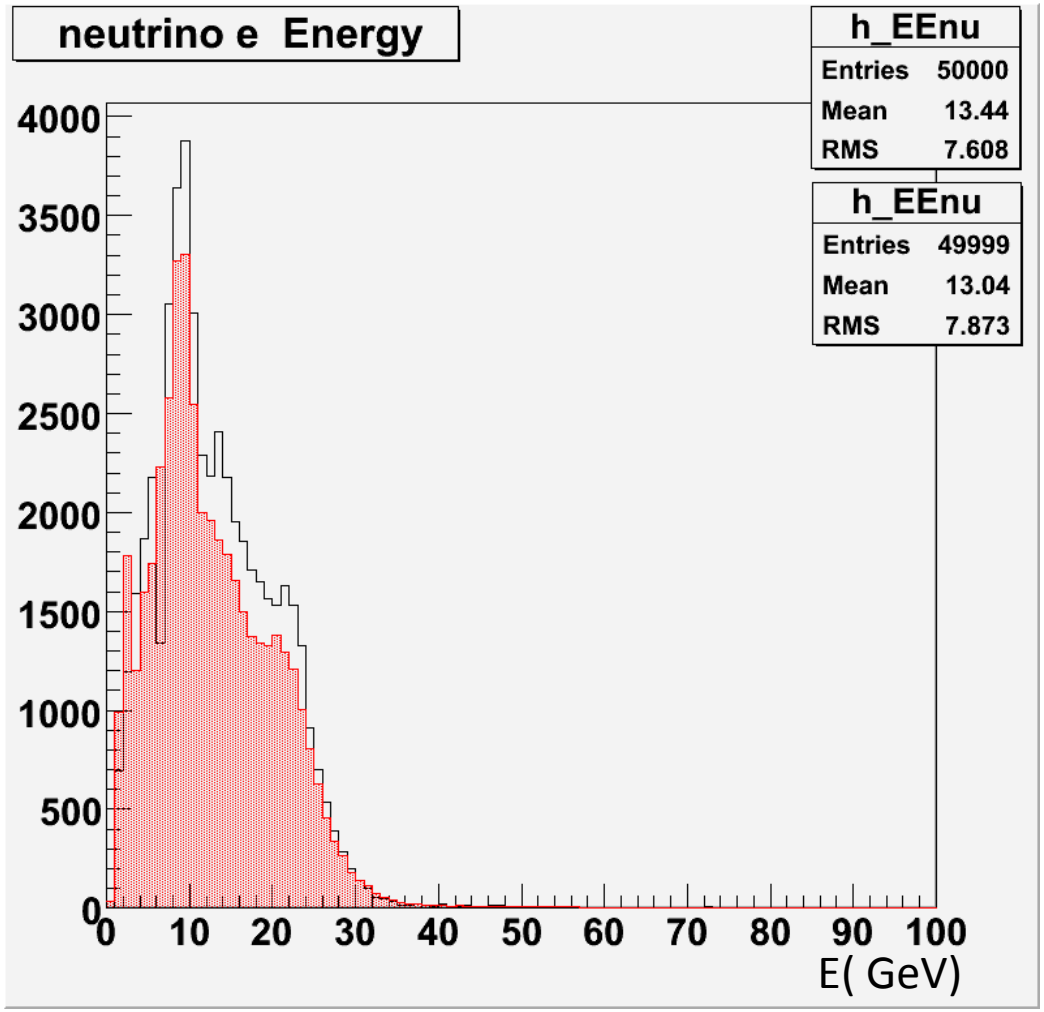


Not so satisfactory comparison in addition to the low statistics..



Final oscillated ν_e energy compared to the real oscillated ν_e spectrum

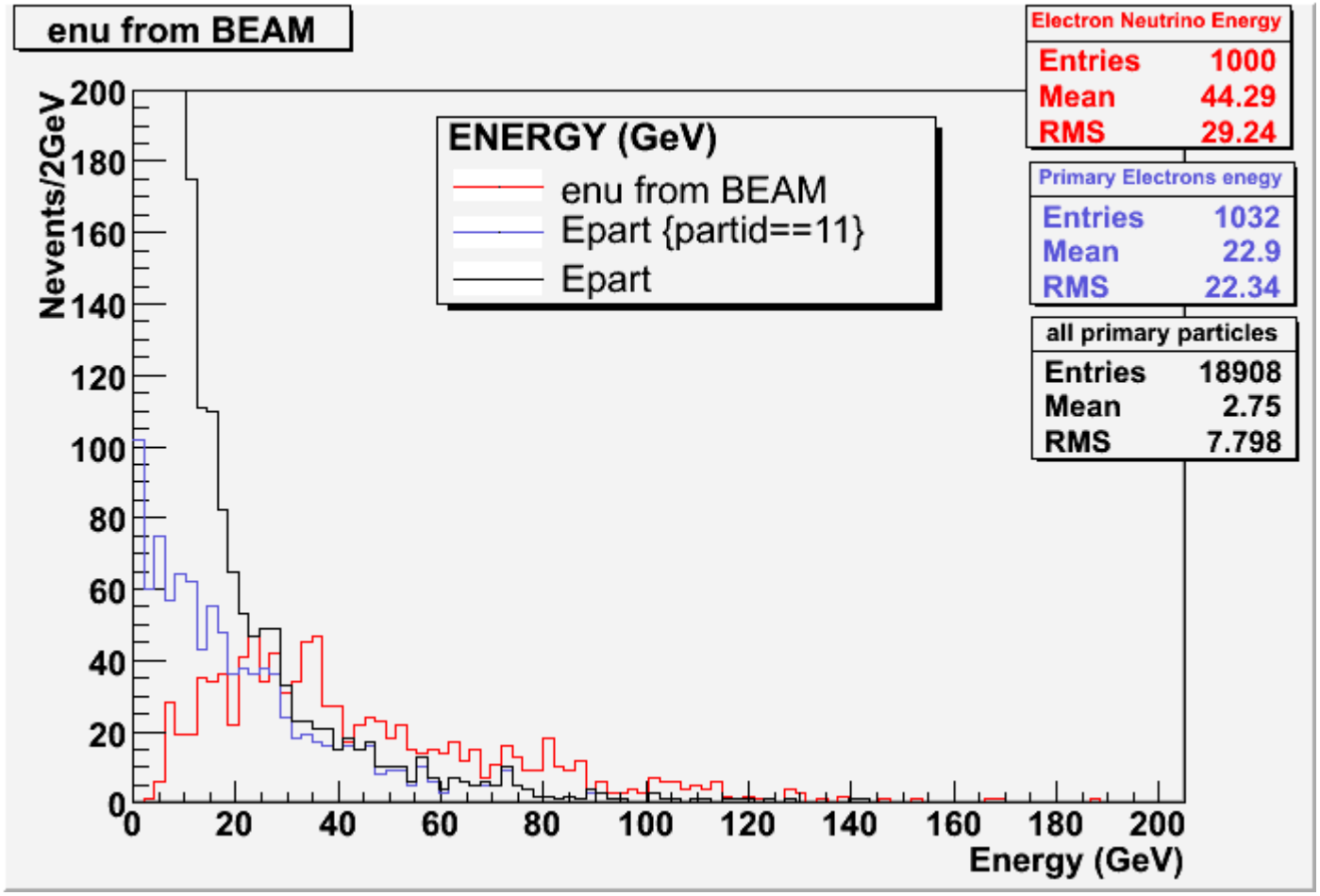
real oscillated ν_e spectrum compared to Generated oscill. ν_e with OpNegn (scaled for the purpose of the comparison)



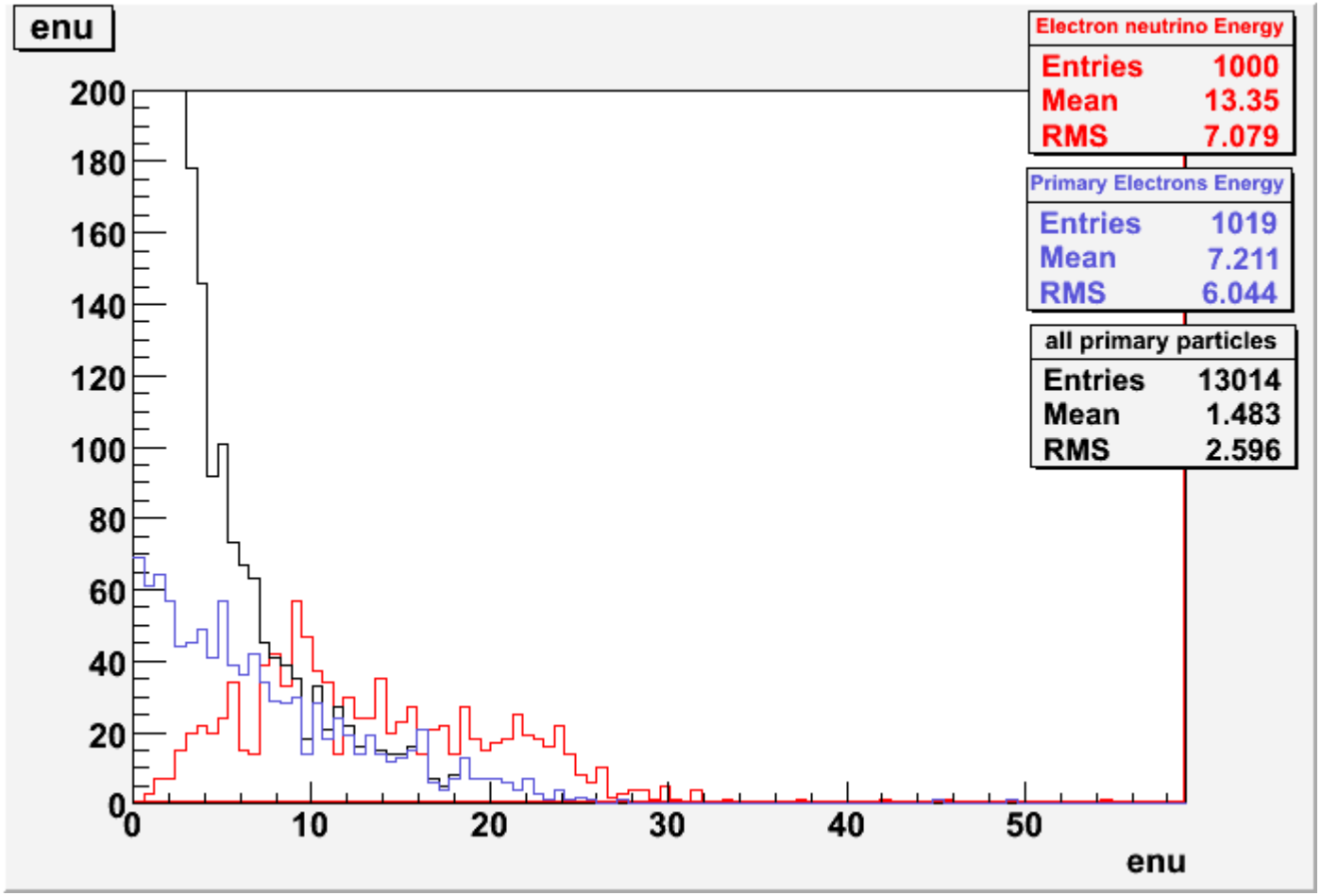
Kinematical variables

- Now we come to the kinematical variable comparison between signal and background
  - Definition:
    - **$pT = (\Sigma pxi)^2 + (\Sigma pyi)^2$** in the incident neutrino frame
    - **Visible energy**? Replaced in our study with **total energy of the tracks Etot= ΣEi**
    - Electron energy: no confusion here.
  - Smearing: We have added on each smeared variable (pxi,pyi,pzi, Ei)for each event a Gaussian smearing
    - For the momentum: a gaussian with σ=20%
    - For the energy:

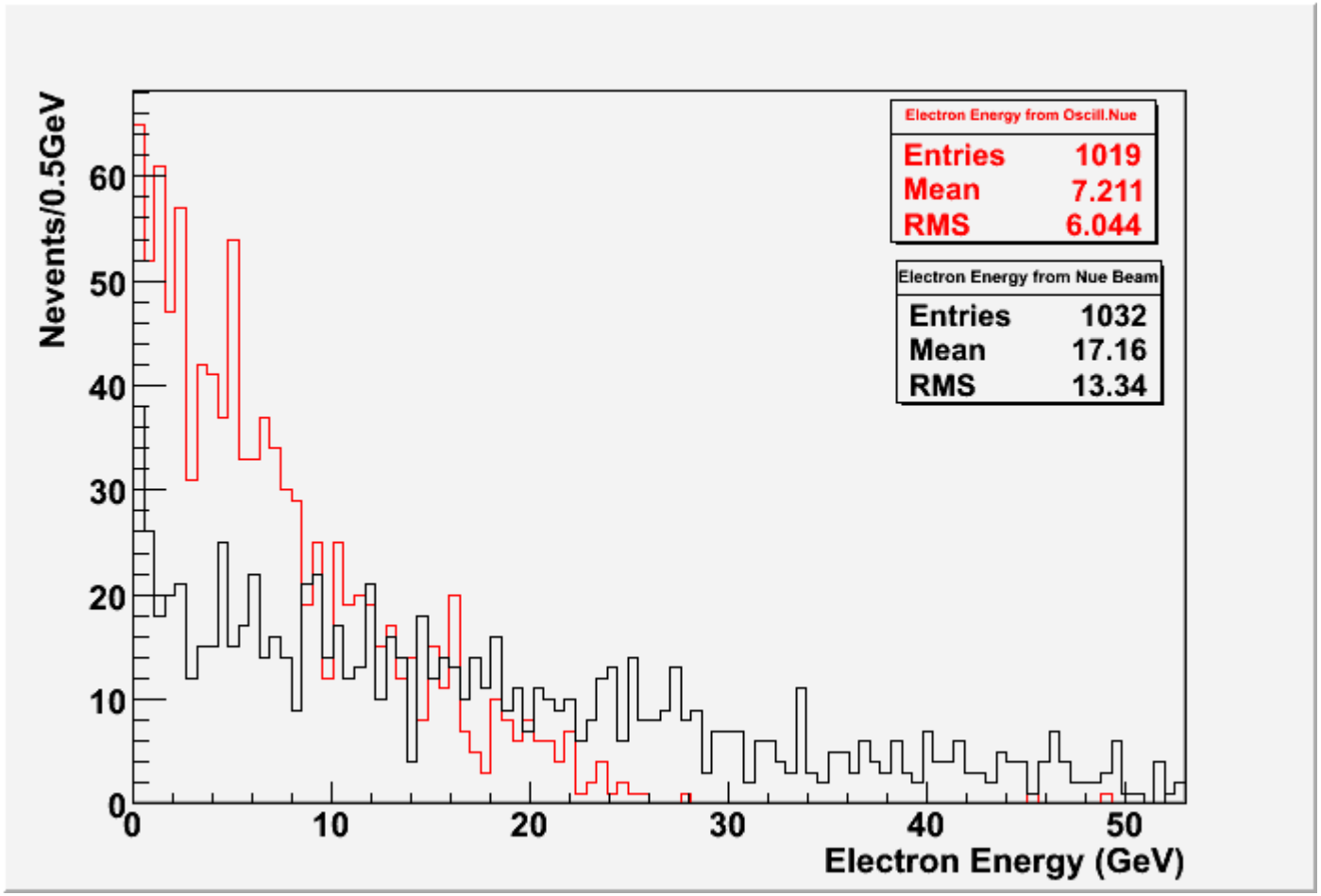
Energy comparison between Nue, electrons and all primary particles for Beam Nue



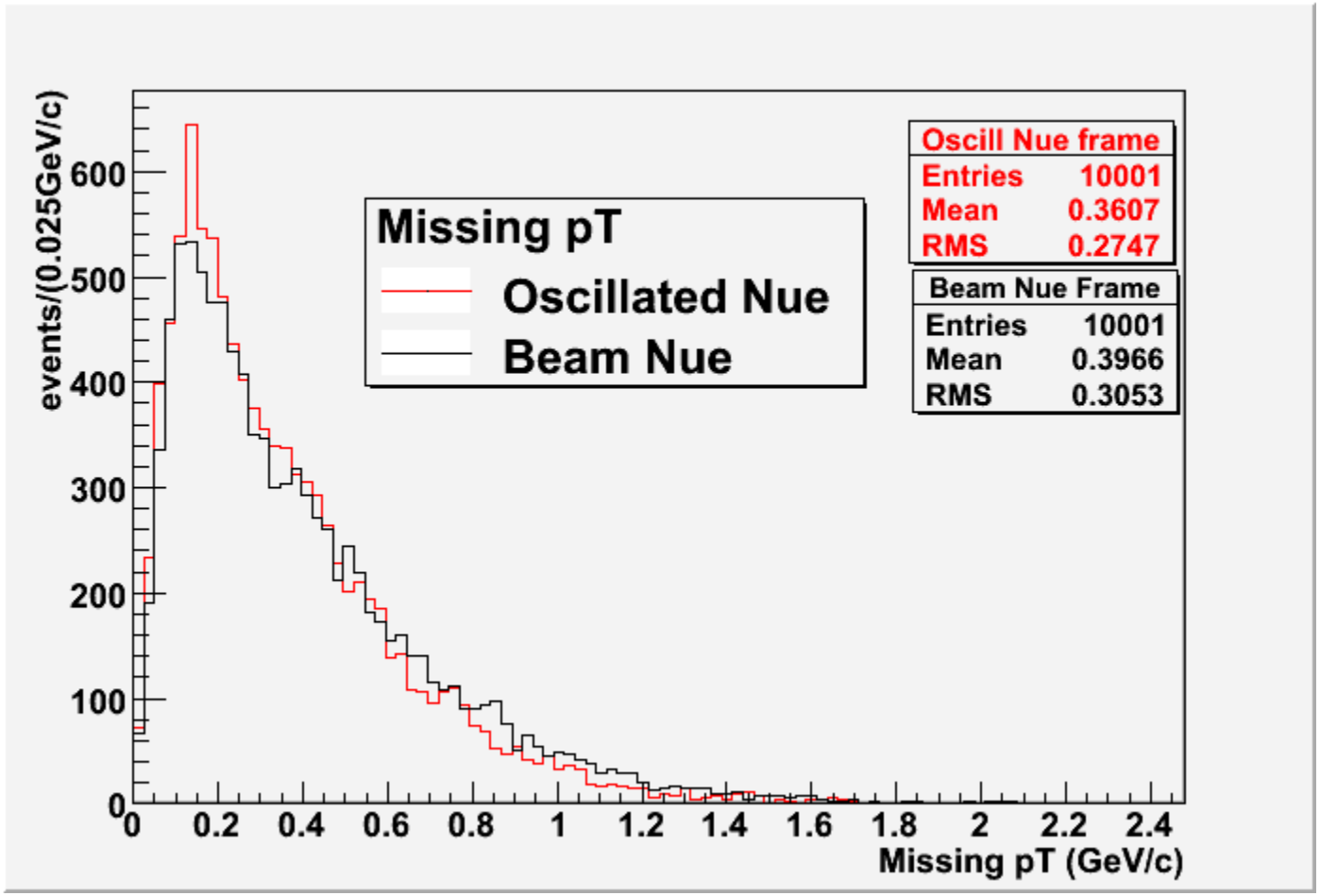
Energy comparison between Nue, electrons and all primary particles for oscillated Nue



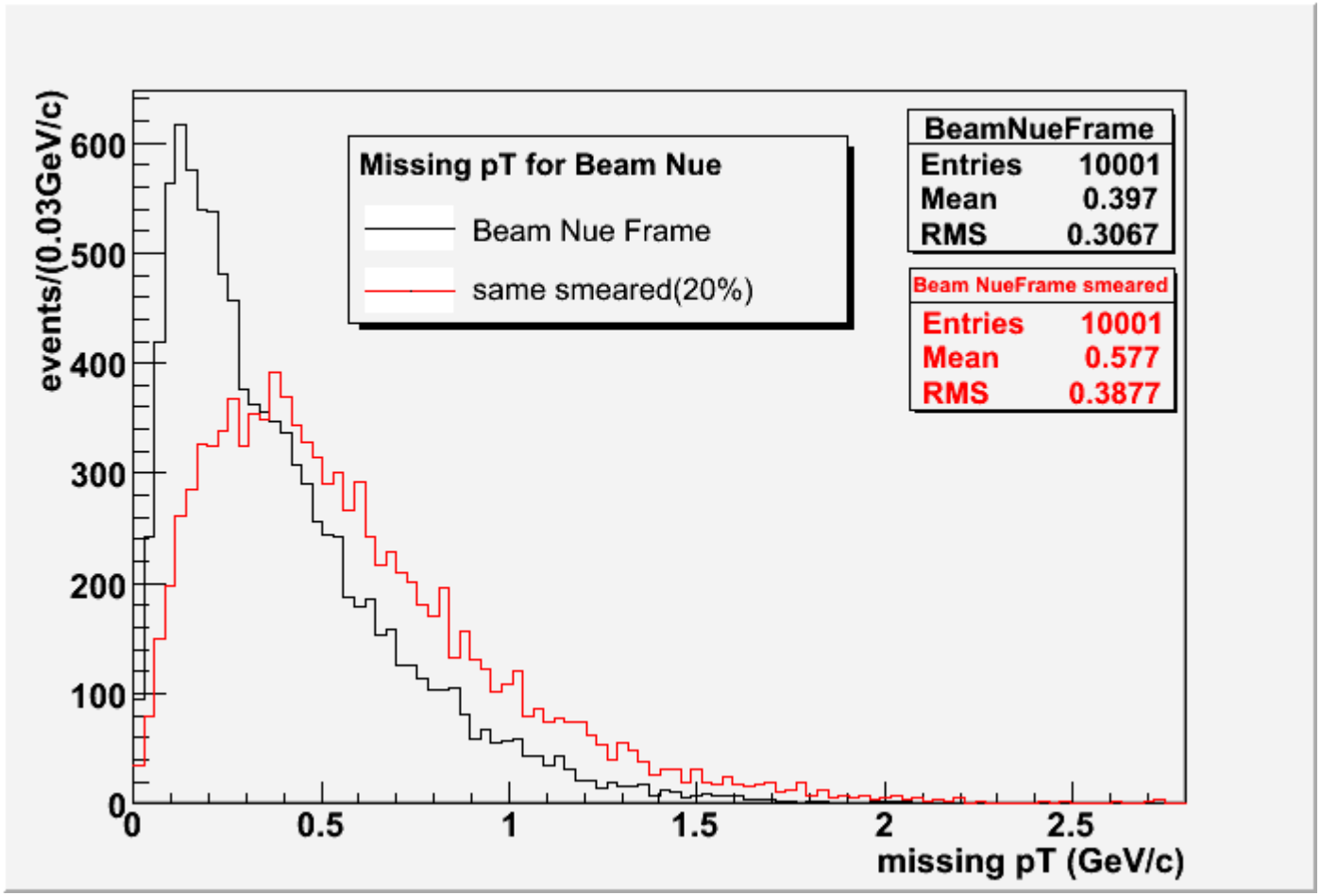
Electron Energy comparison



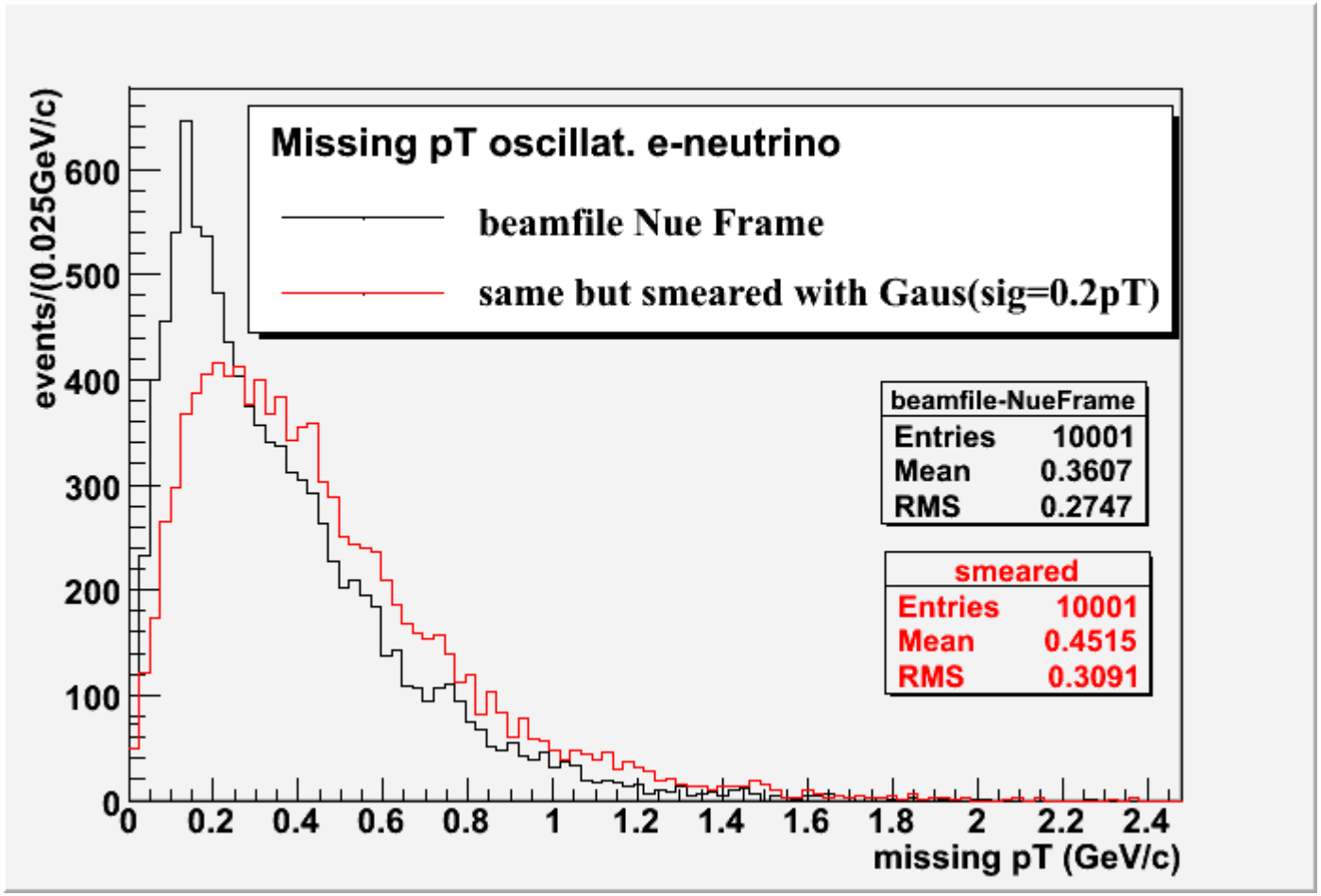
The missing pT Variable



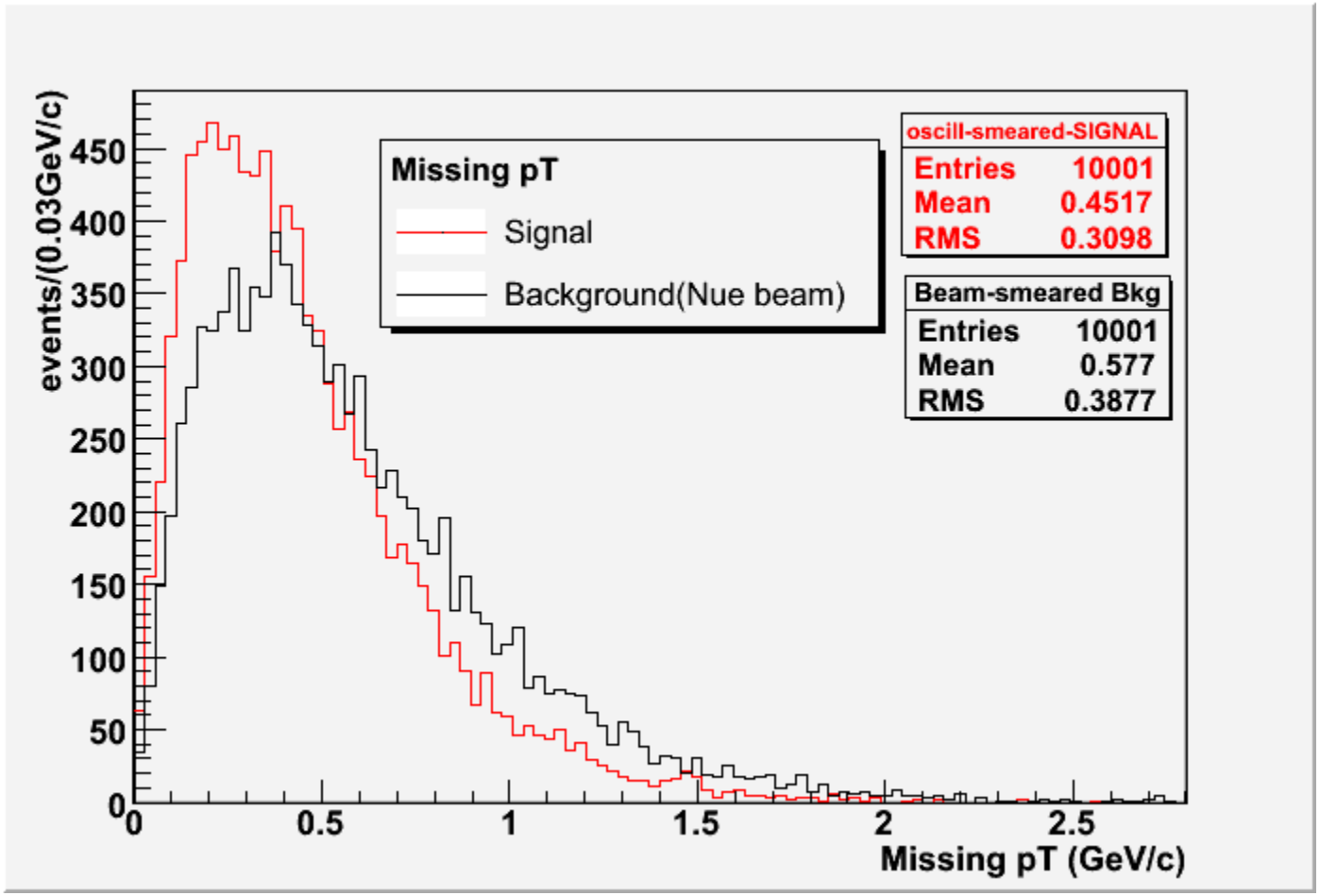
Smeared Missing pT variable for the beam ν_e



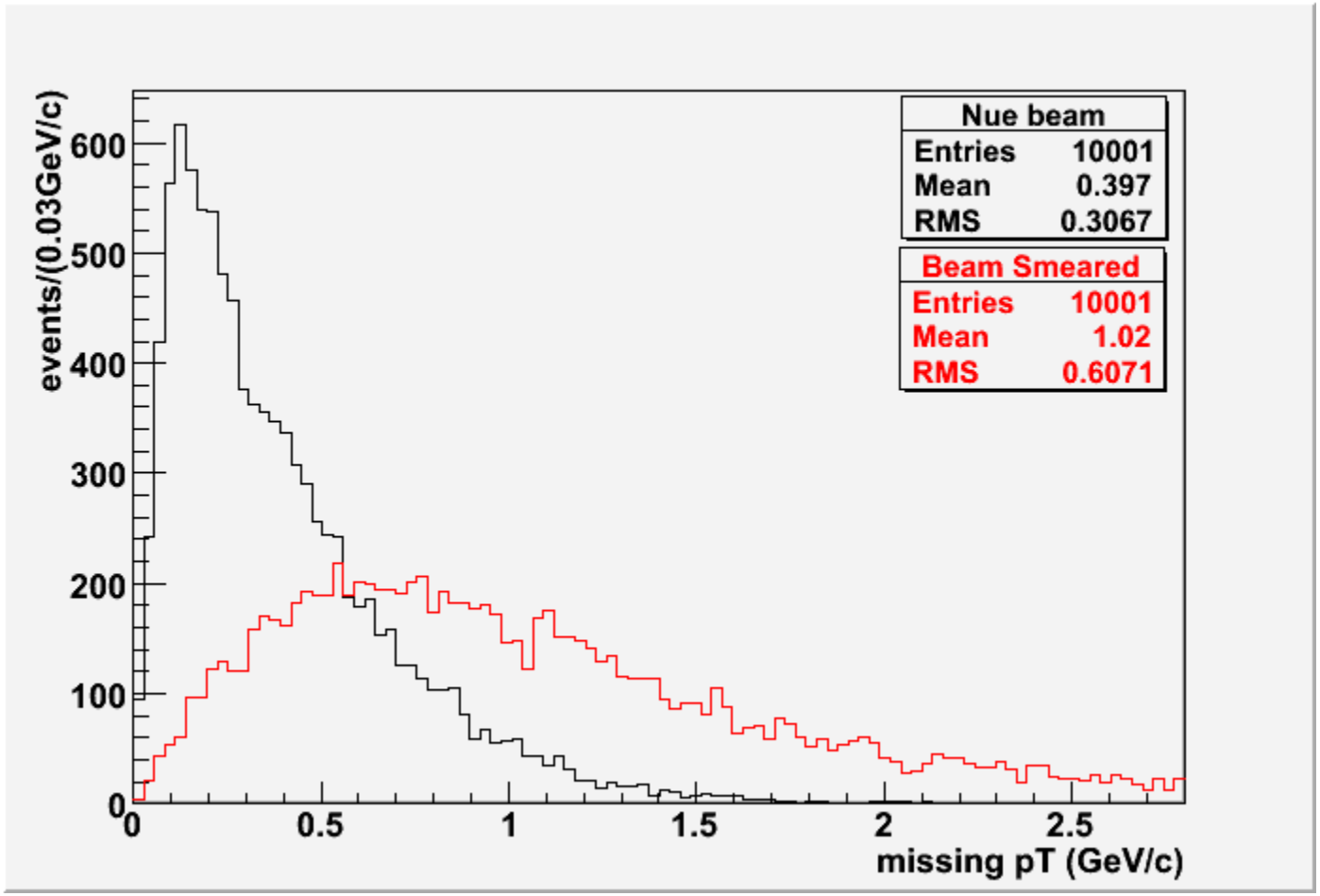
Smeared Missing pT variable for the oscillated ν_e



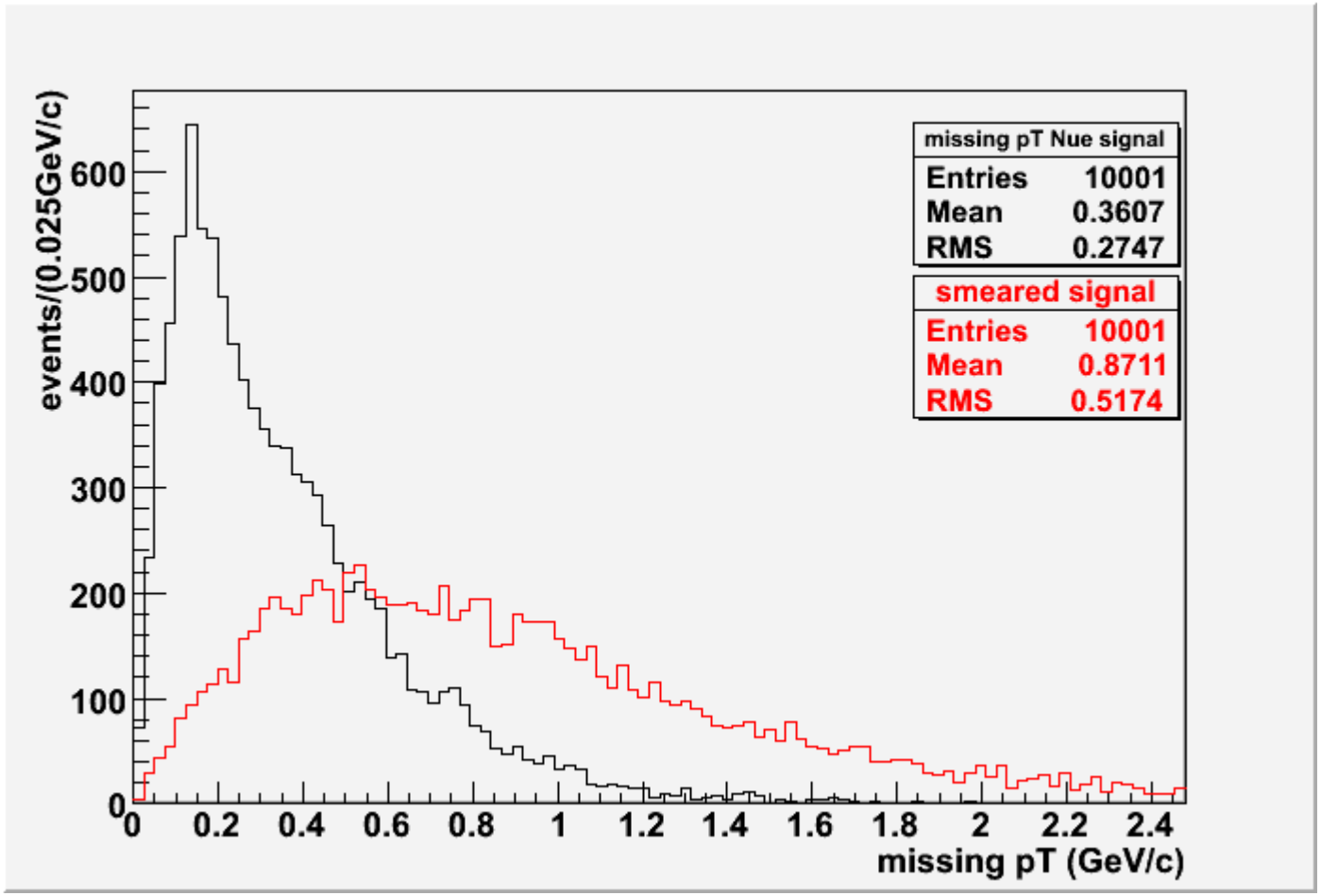
Smeared Missing pT variable for the beam ν_e Compared to oscill. ν_e



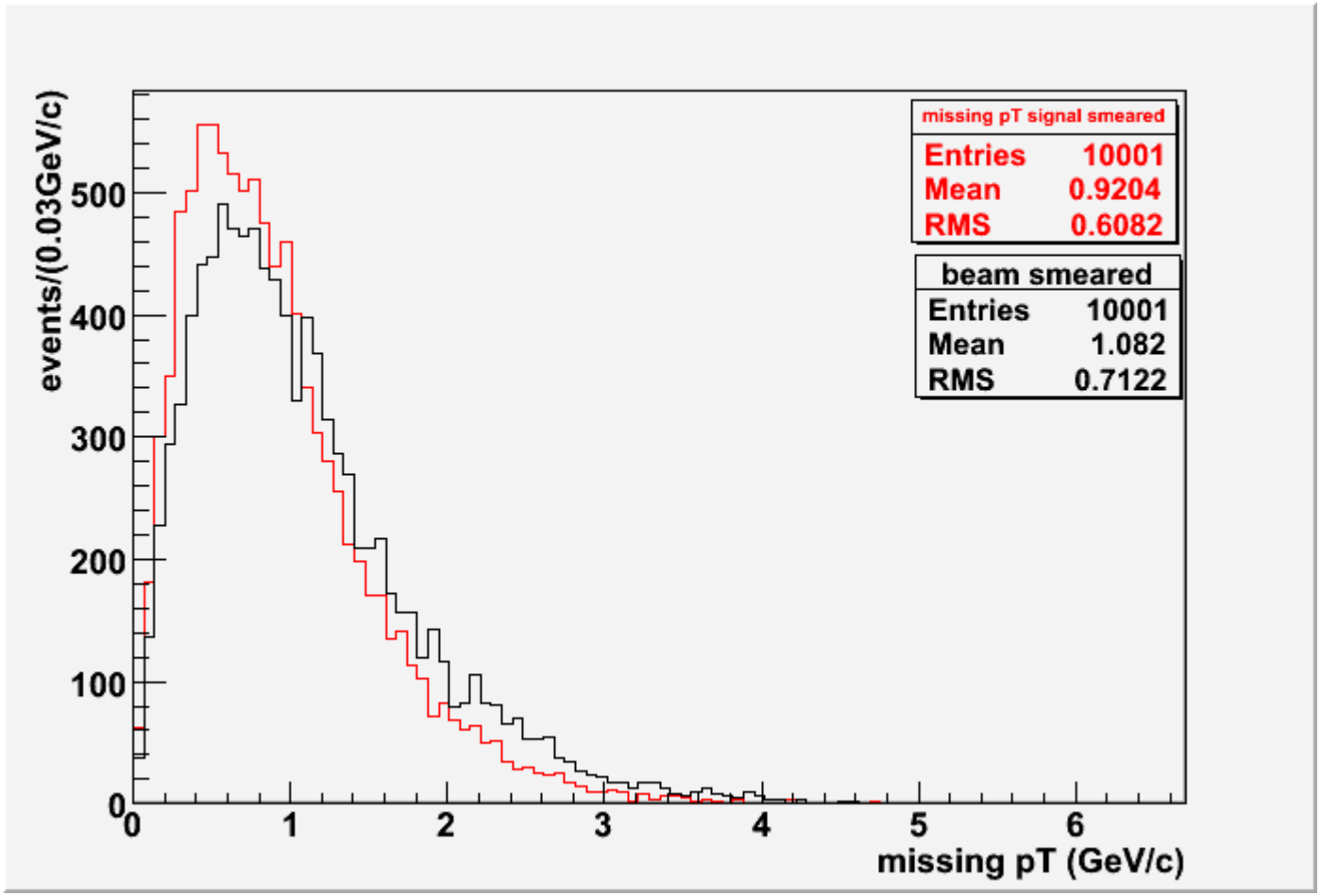
Beam missing pT+smeared as I suppose done by Giulia: the difference with my results shown in page 16 is coming from the fact that in addition to the standard deviation(rms 0.2pT) value ,neutral particles are cut as I did in this plot to try to recover Giulia's results.



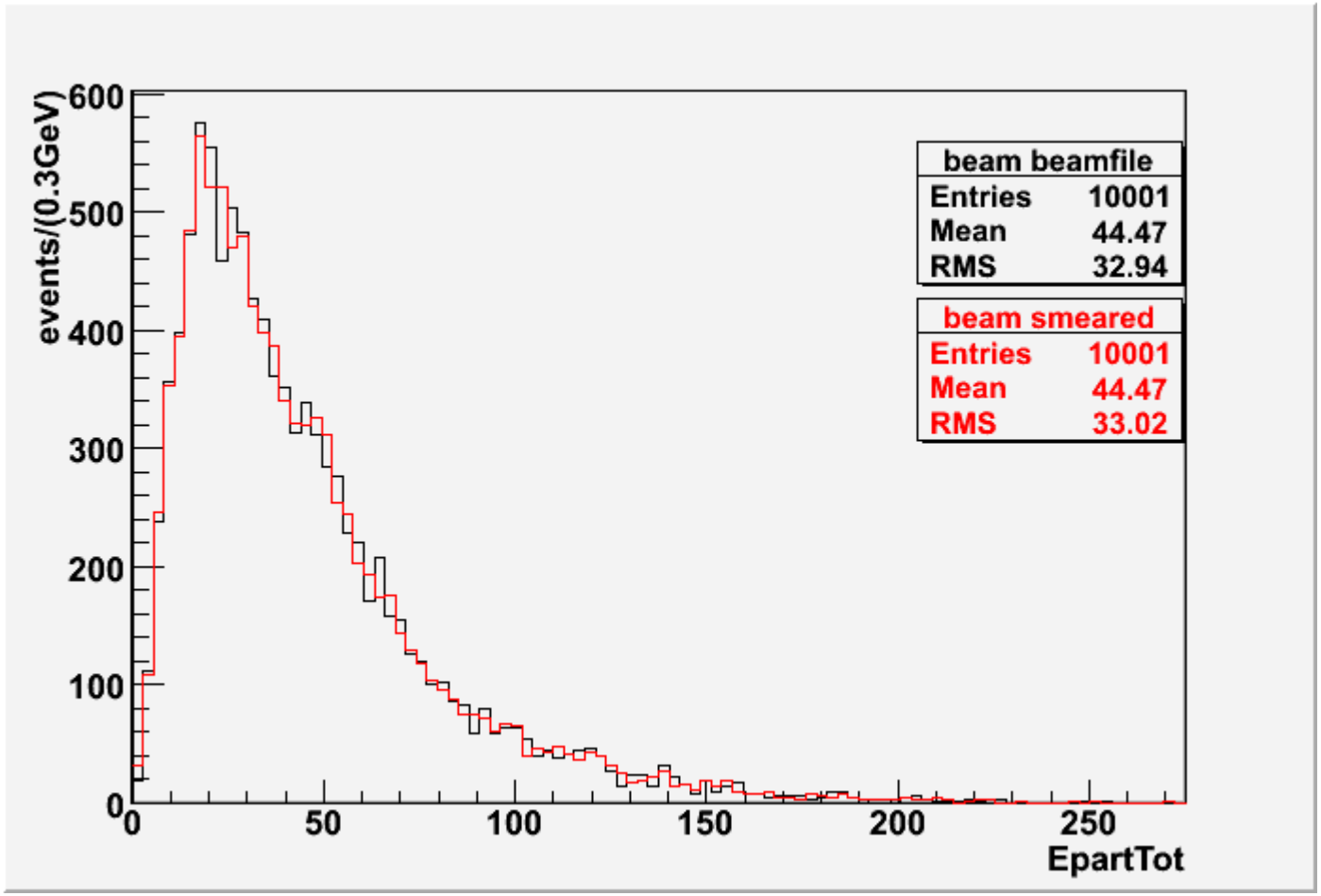
Signal missing missing pT+smeared as I suppose done by Giulia: the difference with my results shown in page 17 is coming from the fact that that in addition to the standard deviation(rms 0.2pT) value, neutral particles are cut as I did in this plot to try to recover Giulia's results.



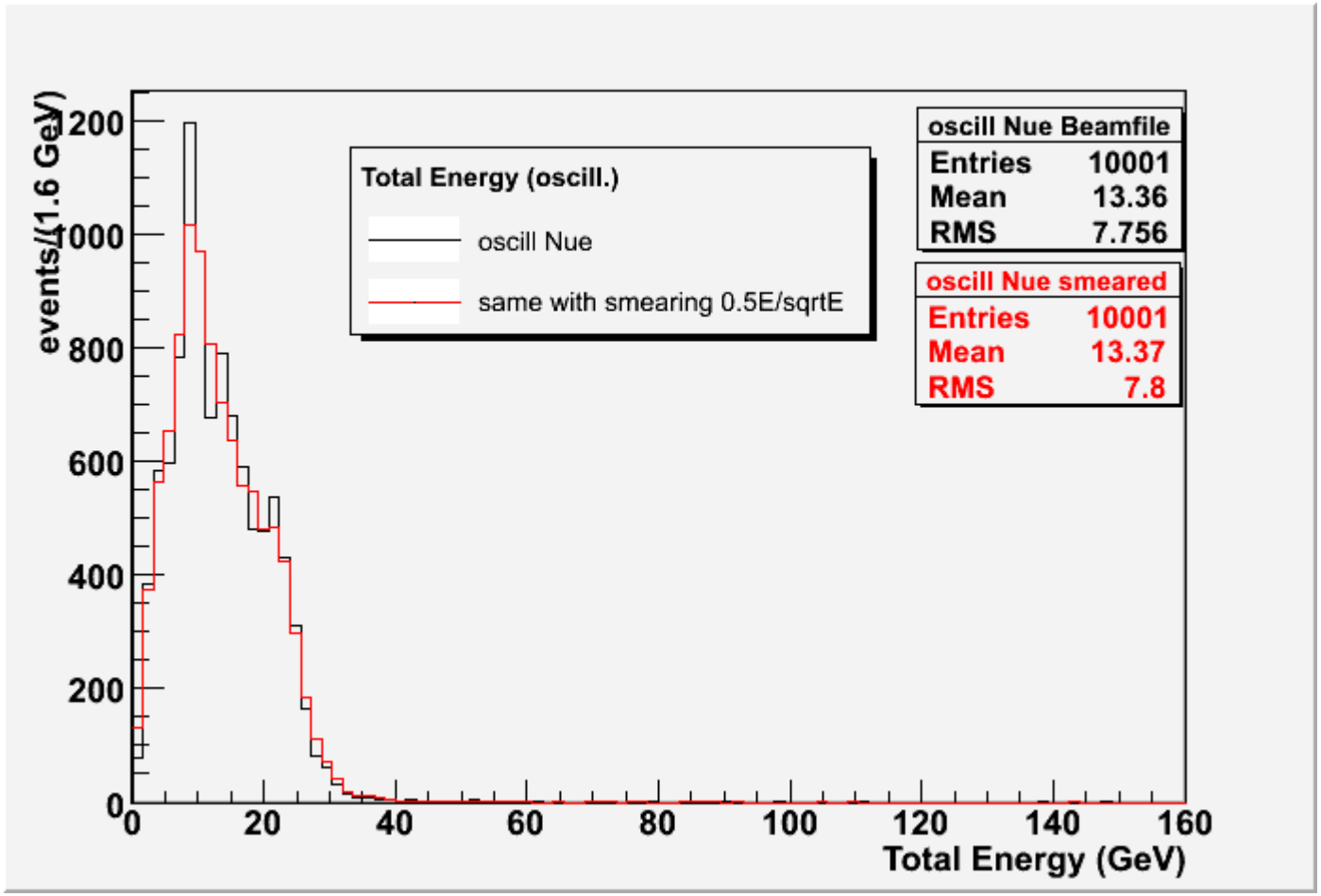
Comparison of smeared Missing pT as I suppose done by Giulia to be compared with page 18



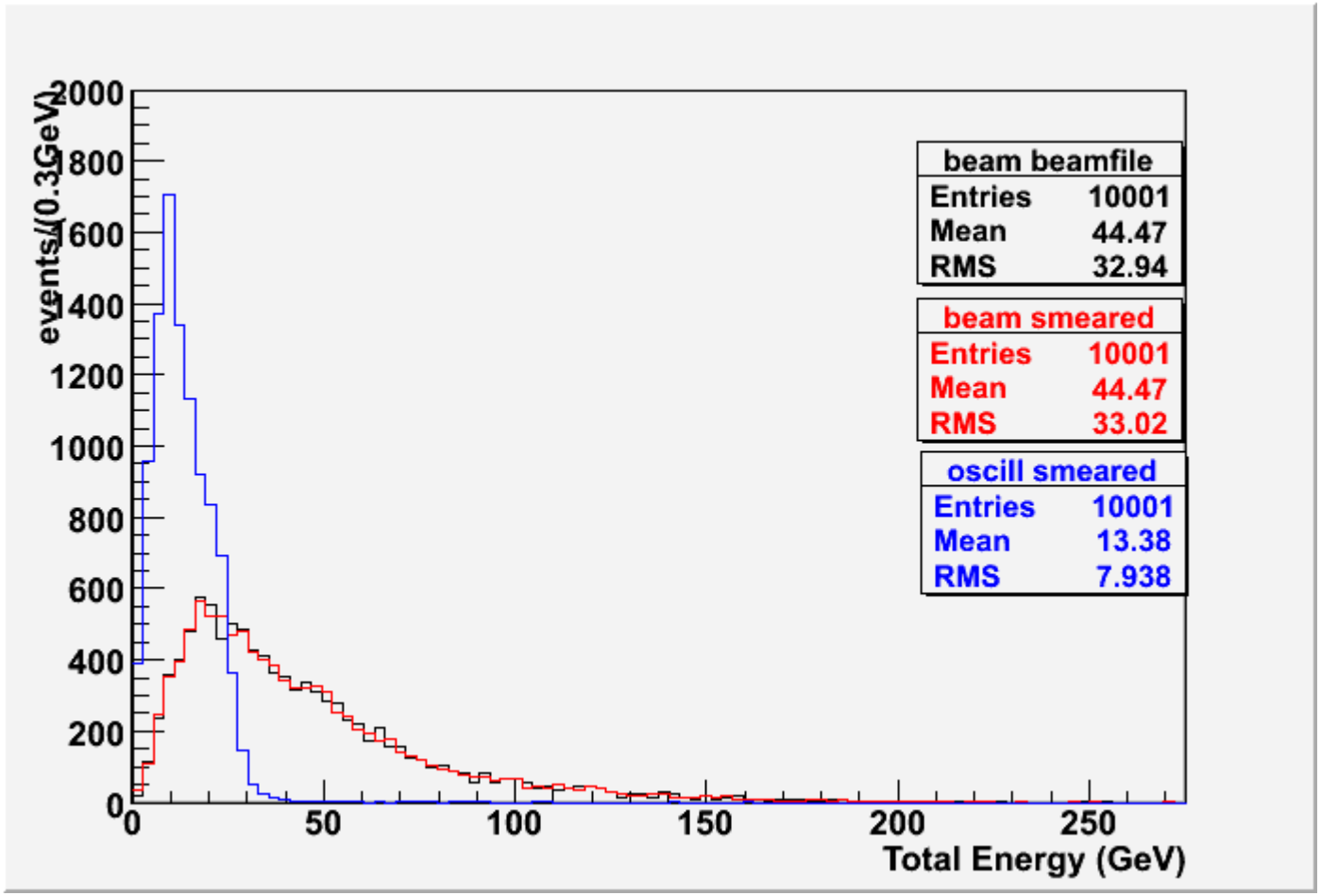
Total Energy+smearing



Total Energy+Smearing

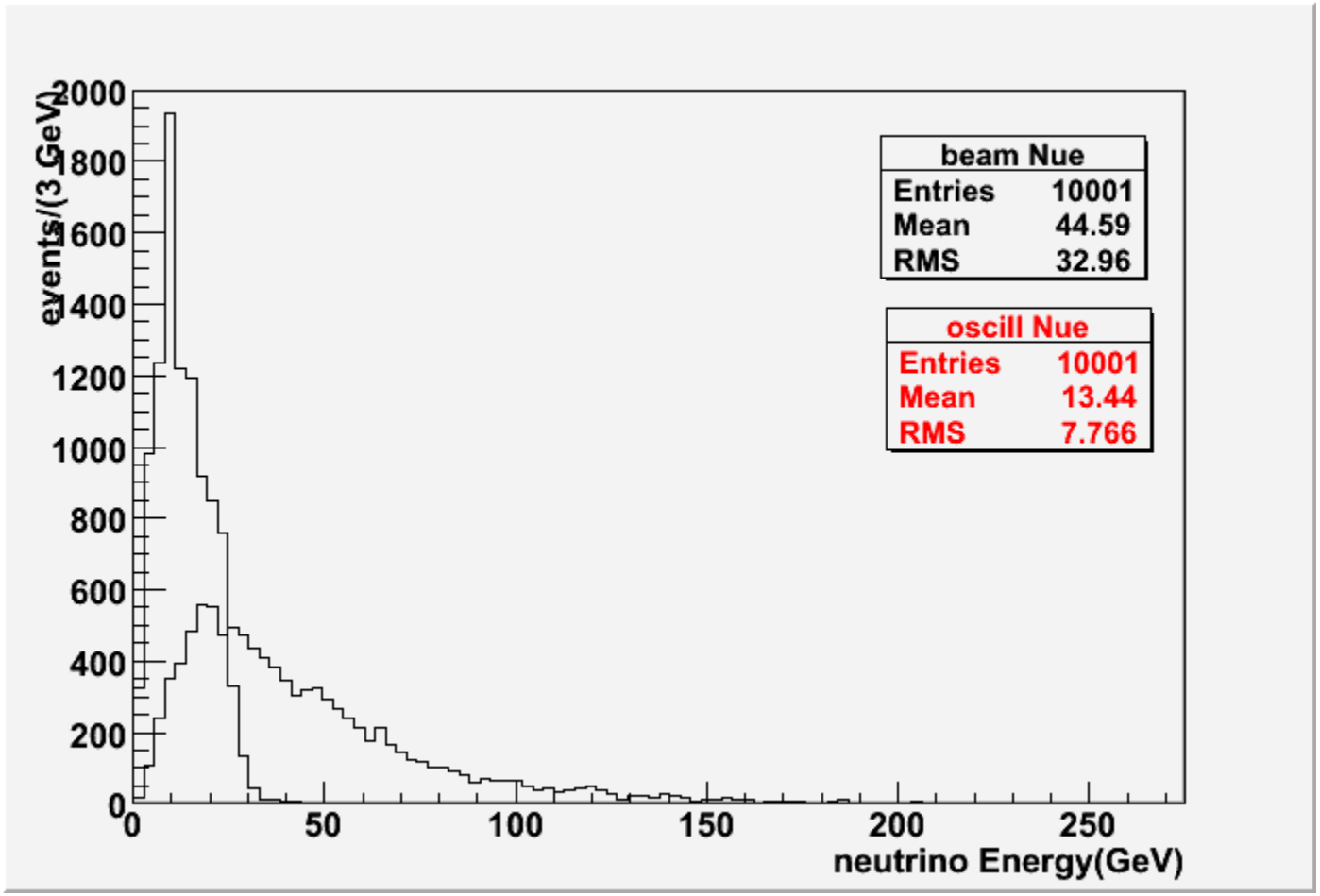


Comparison Signal/beam ν_e



BACKUP

Neutrino energy



Neutrino Energy comp. Beam versus oscill.