Beam events in far detector

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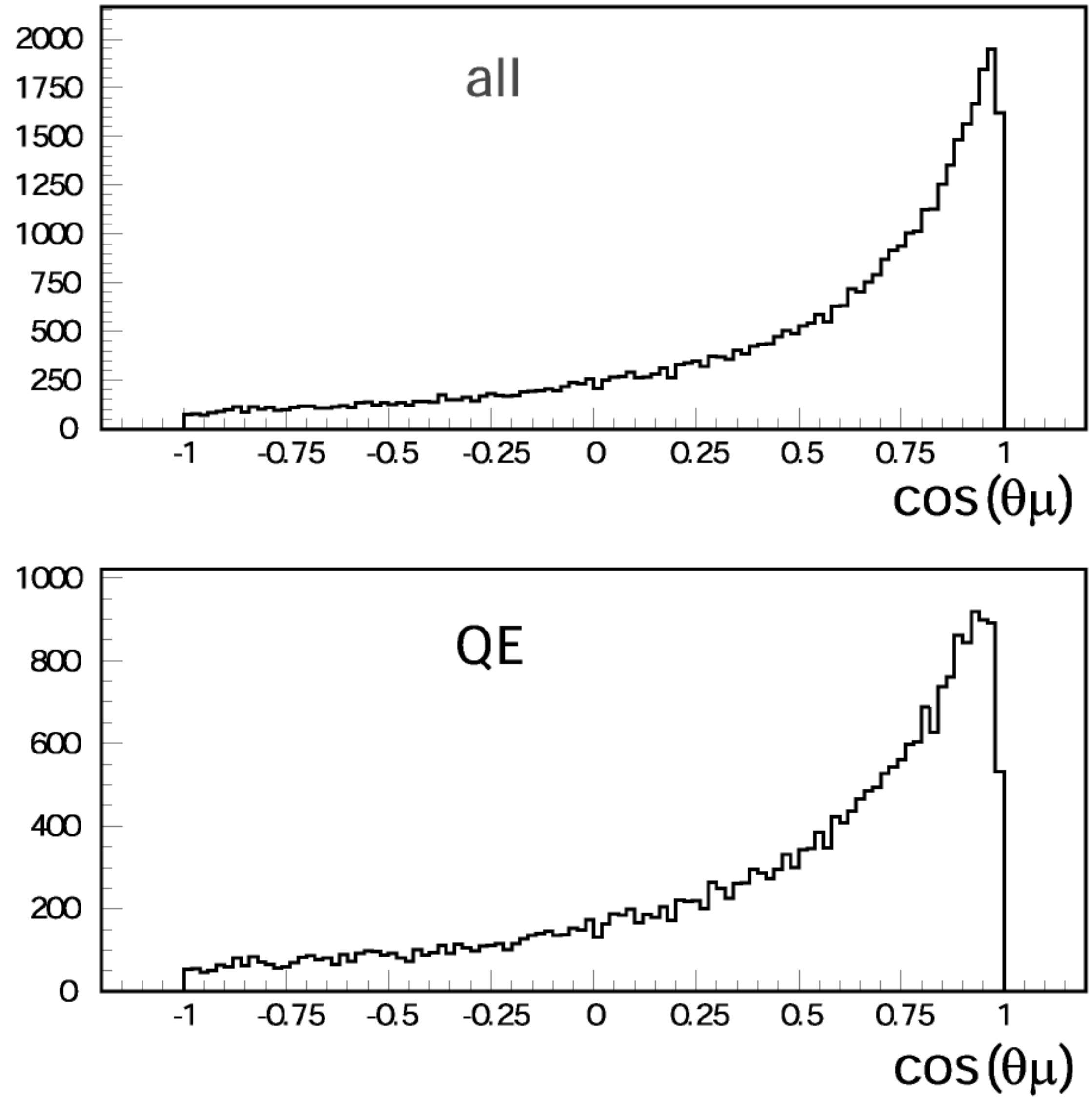
- Full simulations in the T600 detector
- Neutrino fluxes from MiniBoone and/or Sciboone datareleases
- Neutrino interactions also with FLUKA
- Two reconstruction methods (on the same simulation)
  - Fast, MC based: record basic informations on interactions and energy deposition run-time, store in ntuples, fast analysis afterwards with a few assumptions on a few parameters, such as the electron/photon separation)
  - Data-based, on wire views, trying to proceed towards an automatic reconstruction. For the moment still uses a few info from MC
- Visual scanning used to check results

Muon containment in $\nu\mu CC$

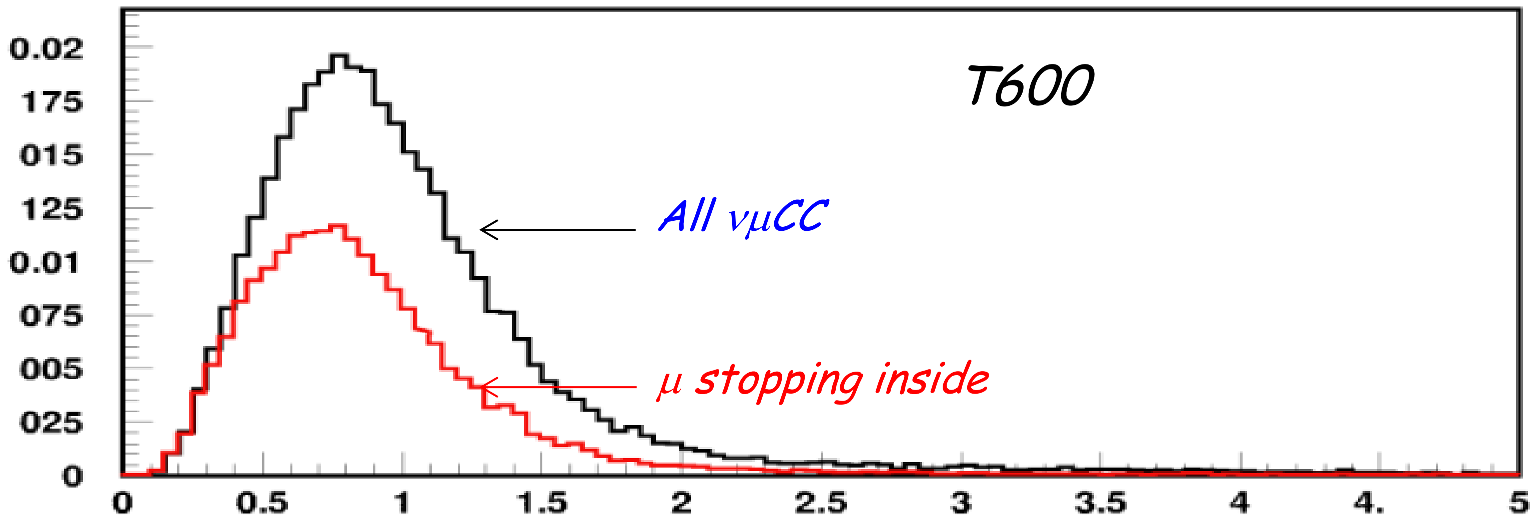
- Simulation with FLUKA using as input the Booster spectra.

- The muon in the $\nu\mu CC$ has a quite broad angular distribution (even larger in the case of QE like events)

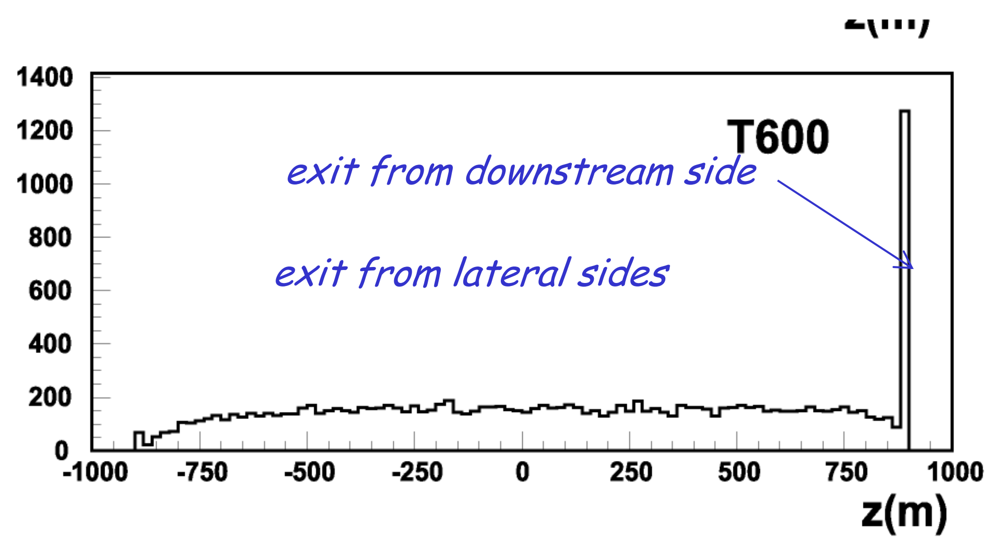


Muon containment in νμCC

- T600 with fiducial cut (distance from lateral >15 cm, distance from downstream wall>1m, fiducial mass 362 ton)



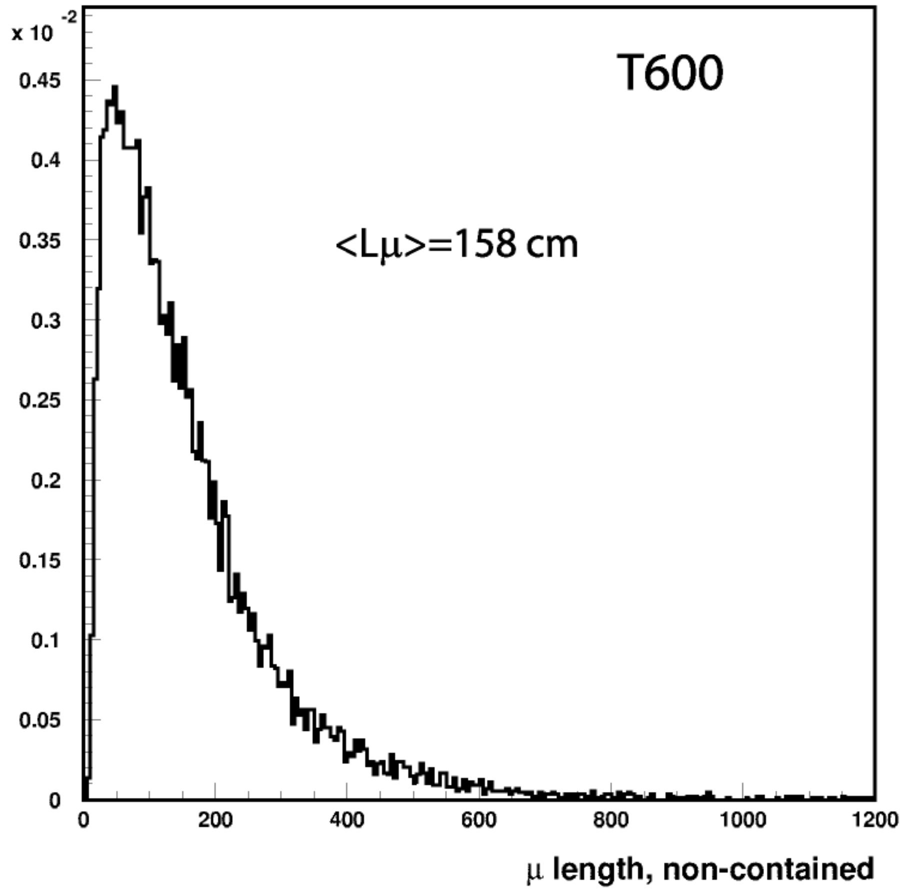
- ~55% of the muons stop inside the detector



Escaping muons

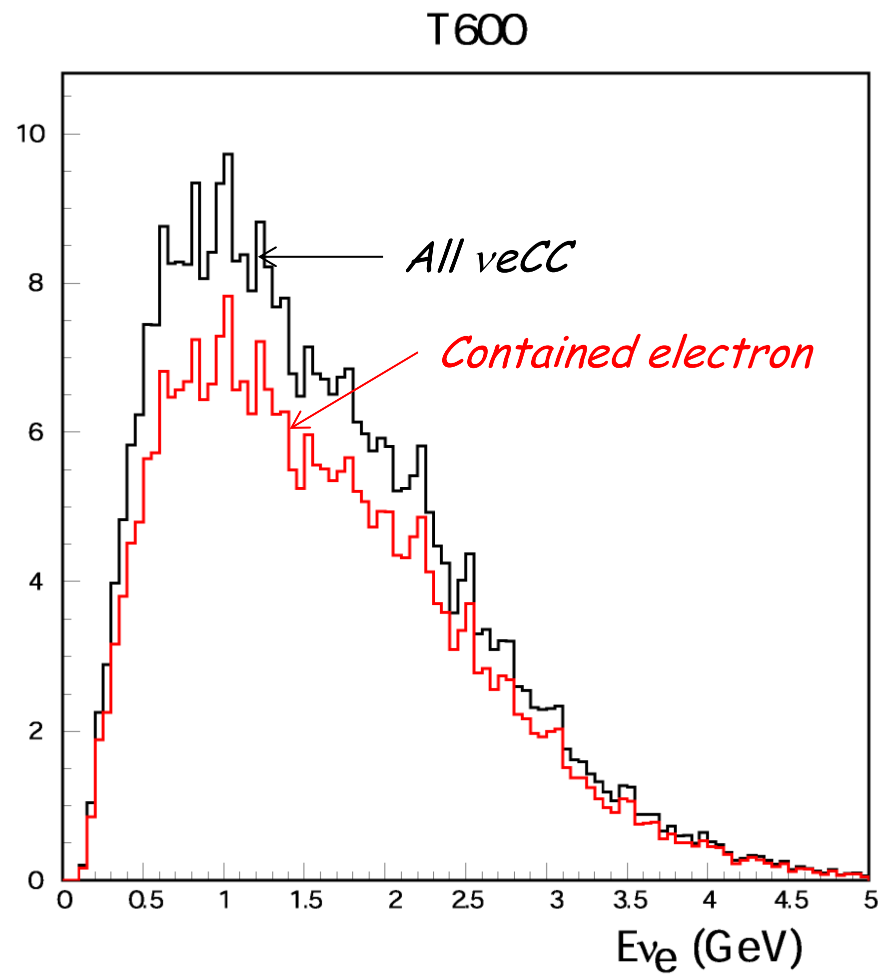
- The useful track length inside the detector for muons escaping is on average ~1.6 m T600

Lμ	T600
<1m	19%
>1 m	26%
>2.5m	8%
>4 m	3%



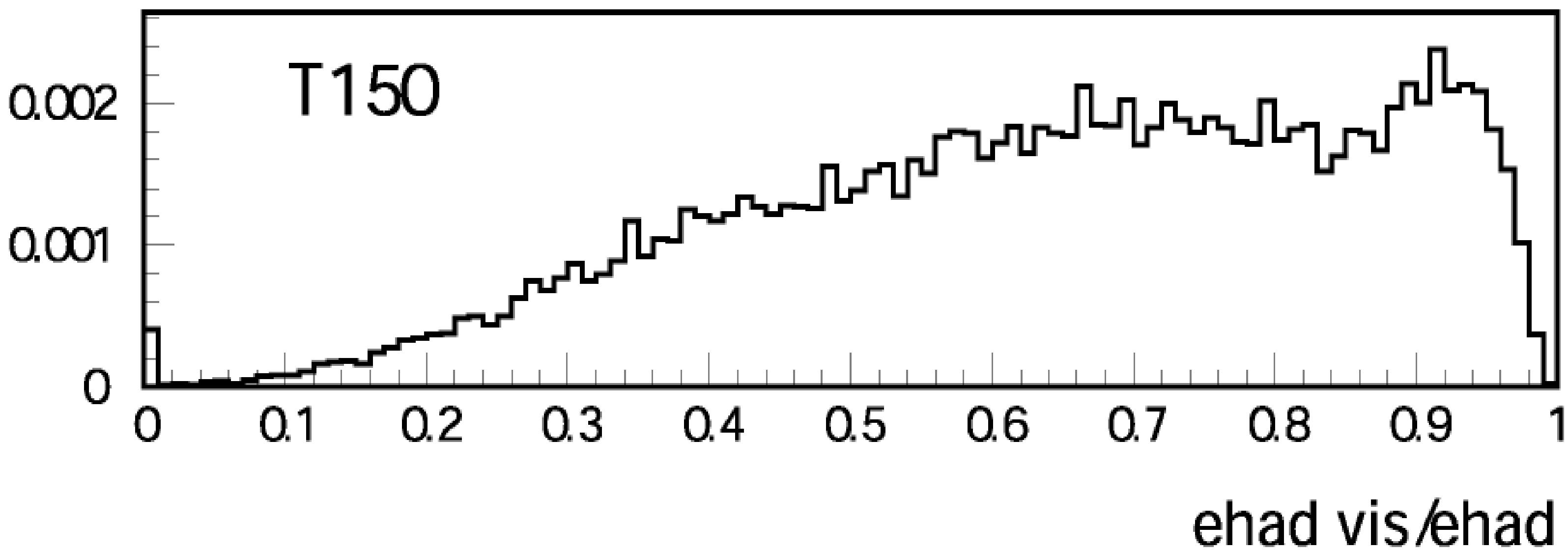
Electron containment

- The containment of the lepton is much better for the νeCC interactions since the electron shower is much shorter than the typical muon track
- The electron is defined to be contained when depositing more than 90% of its energy inside the detector
- The fraction of events with the electron contained amounts to ~82%



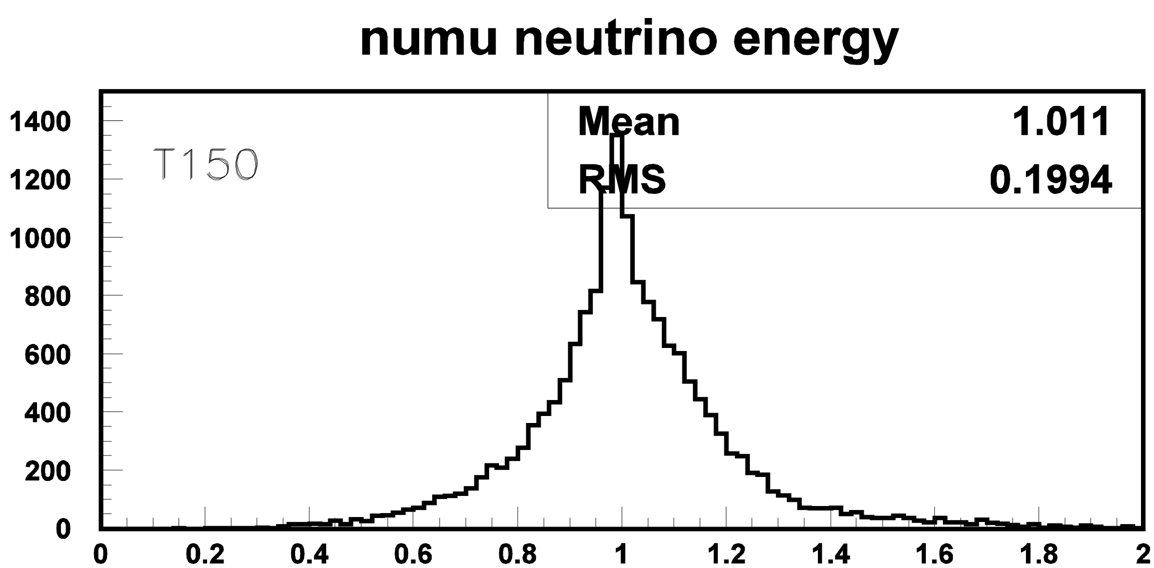
Hadronic energy

- Due the containment, escaping of neutrals and non compensation the visible hadronic energy is only a fraction of the hadronic energy generated in the neutrino interaction



Estimate of the neutrino energy in $\nu\mu$CC

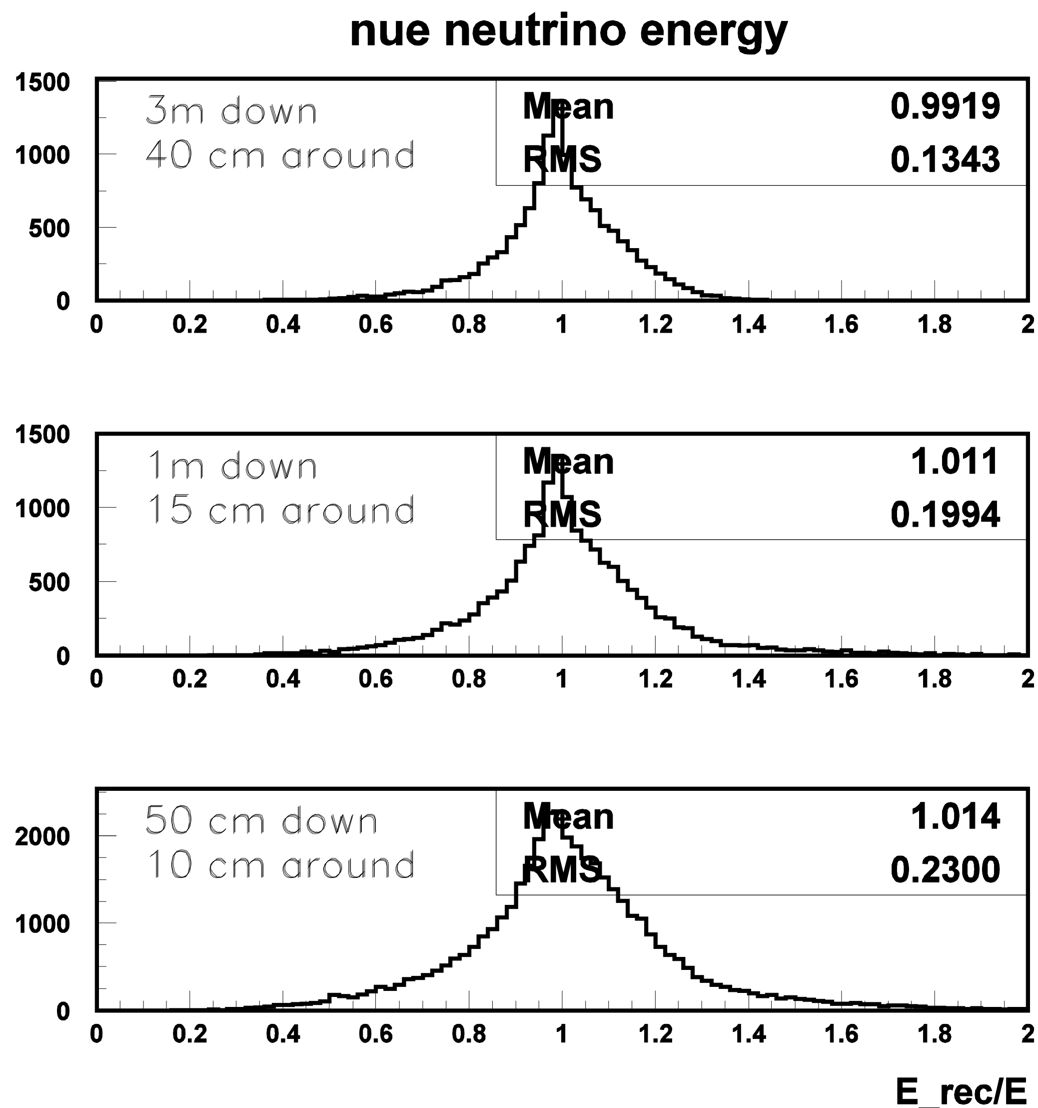
- A first approximation and rough correction for the escaping hadronic energy as a function of the position inside the detector has been obtained in MC
- For the $\nu\mu$CC the muon in measured calorimetrically when it stops in the detector and via MS when it exits
- An unbiased neutrino energy estimate for l_μ>1 m is predicted, with resolution of ~20 % for T150



E_{reco}/E_{true}

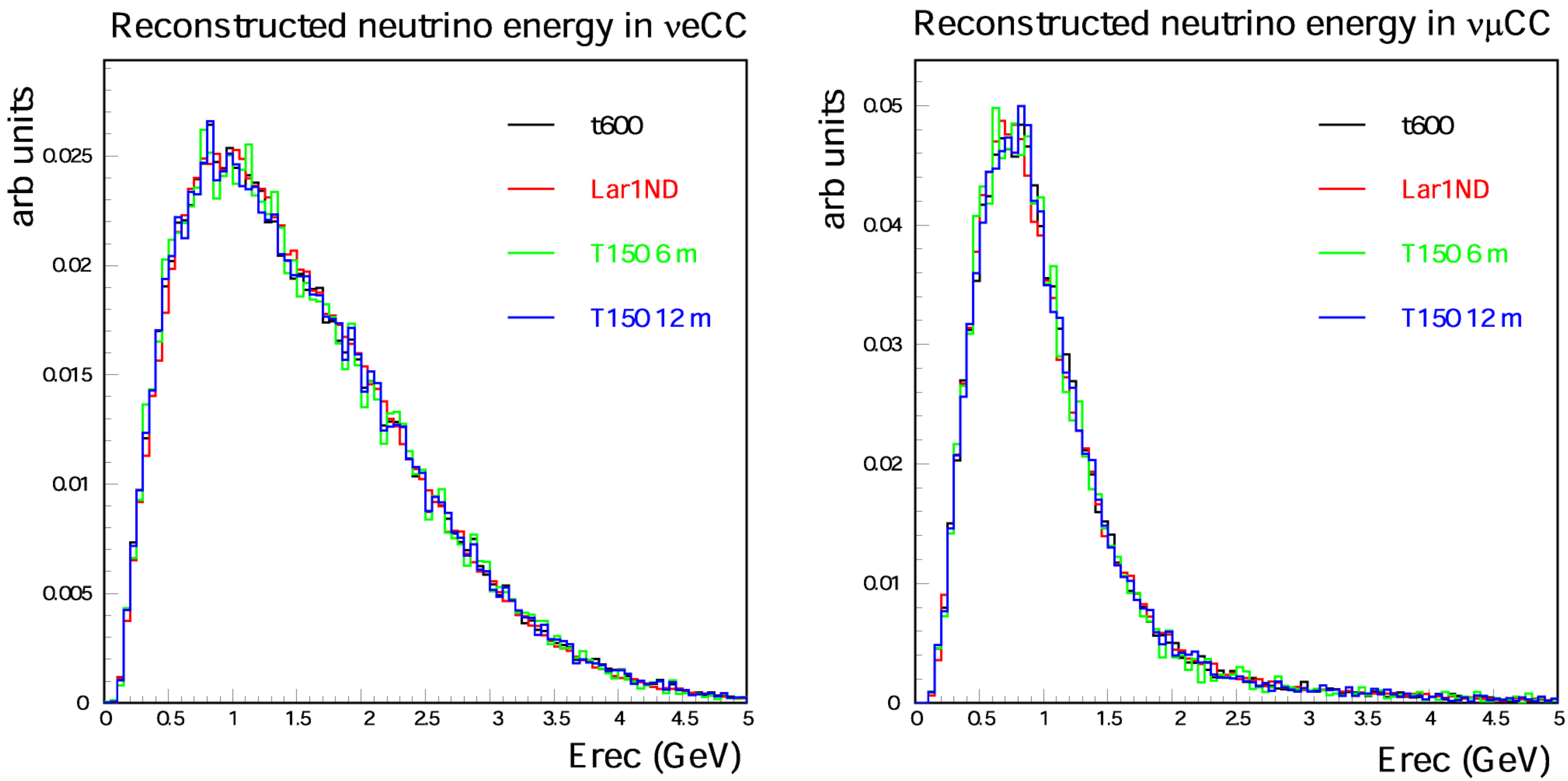
Estimate of the neutrino energy in νeCC

- A first approximation and rough estimate of the escaping energy as a function of the position inside the detector has been obtained in MC for both electron and hadrons
- Adding the reconstructed electron and hadron energies a first approximation estimate of the neutrino energy is obtained
- Unbiased measurement of the neutrino energy in νeCC with a resolution which would improve from ~23% to ~13% restricting the fiducial volume from 130 ton to 64 ton

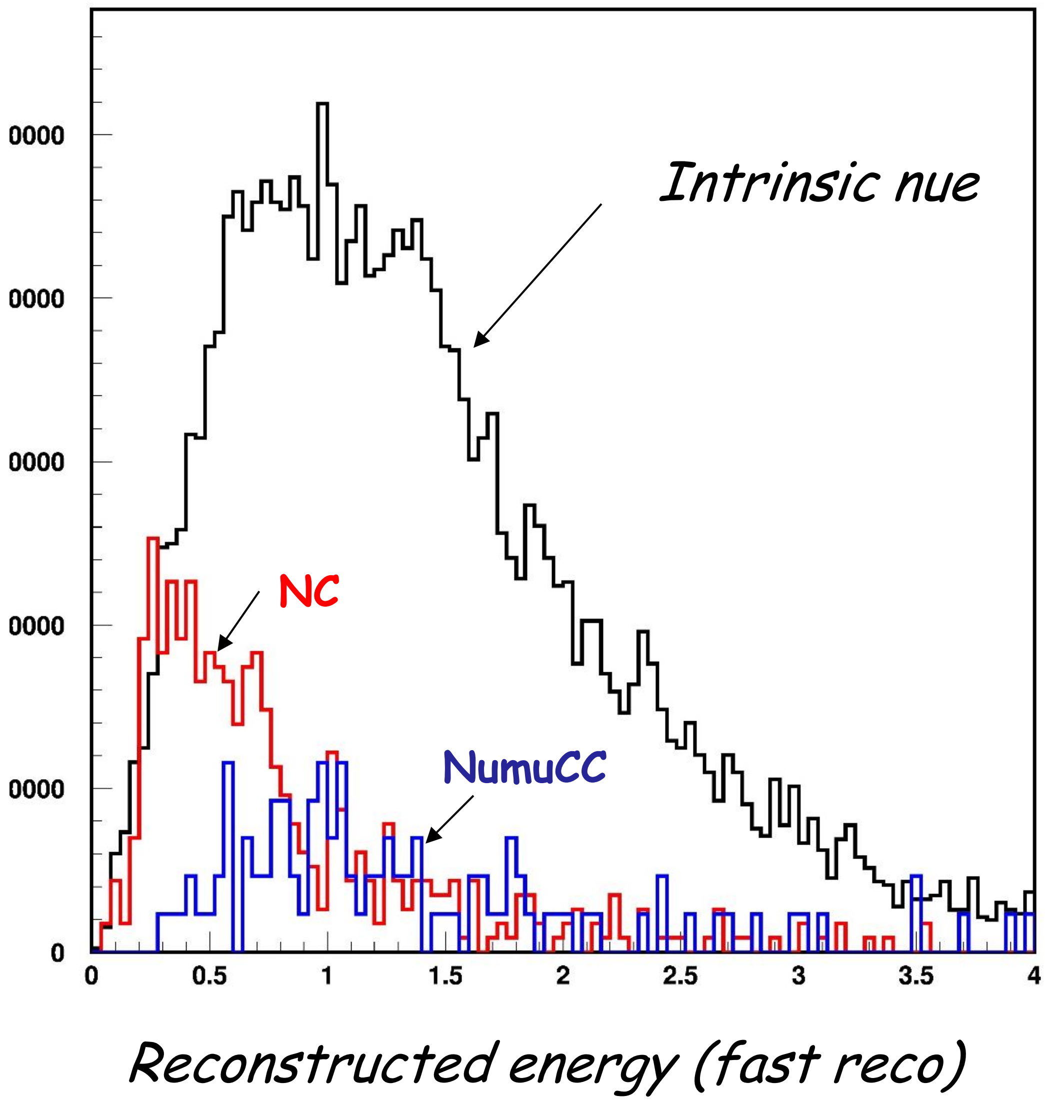


Reconstructed energy spectra

- The reconstructed neutrino energy spectra for νeCC and νμCC
- As a matter of comparison the expected results obtained with the different detectors are overlapped (normalized to the same area)



- Very very preliminary **pessimistic** estimate of the backgrounds



Assumptions:

- Muon is identified if it stops (..) or if L>200 cm
- Photon rejected to 7% by dE/dx
- No attempt to cut based on reconstruction of the pizero mass
- No attempt to cut on the photon multiplicity

Semi-automatic analisys of nueCC events

Full simulation of ν_e CC events in T600 with Booster beam

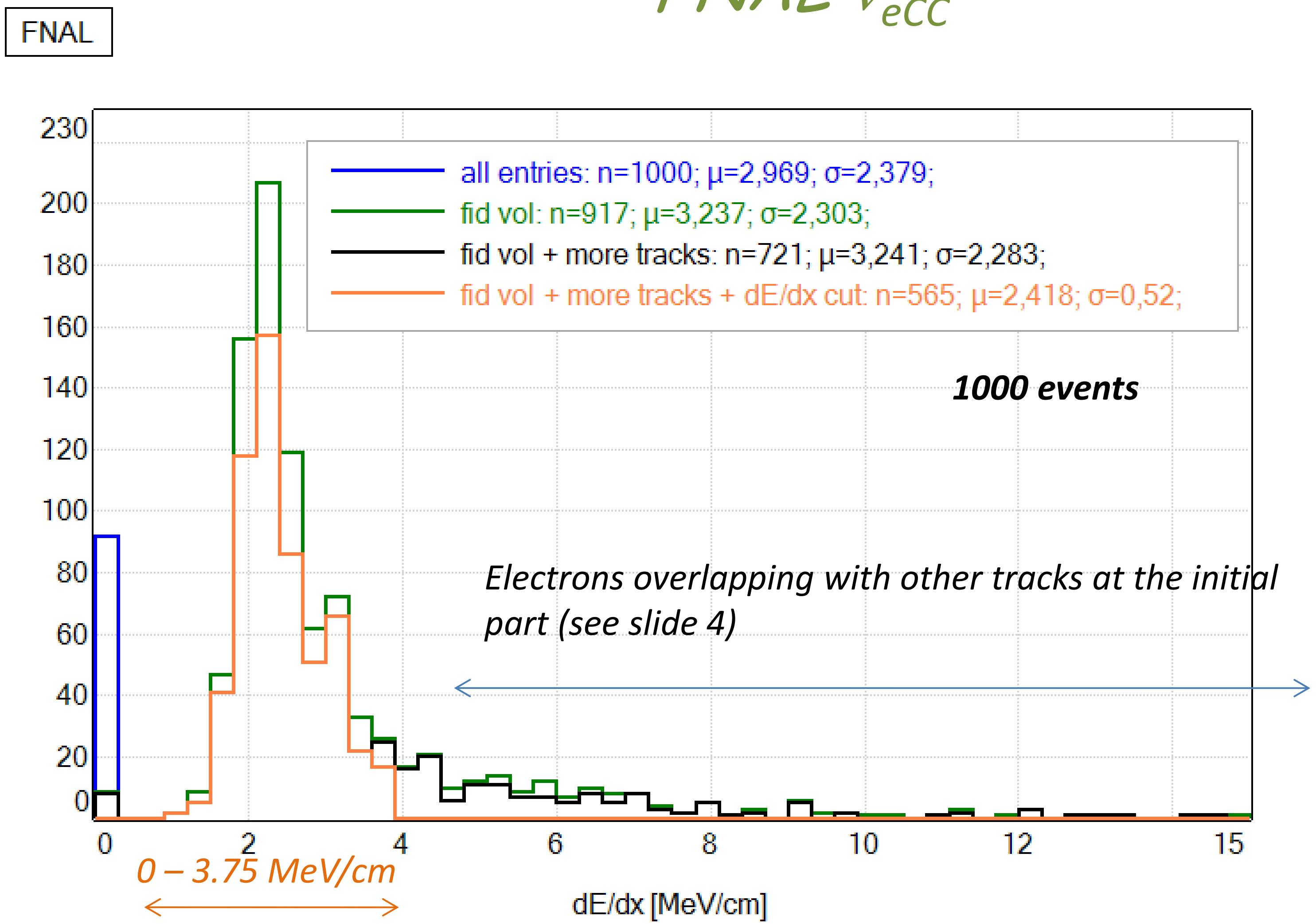
MC:

- 1Primary vertex is taken from MC and projected to 2D wire planes.
- 3D direction of electron cascade is also projected to Collection view

RECONSTRUCTION:

- Segmentation in Collection.
- The choice of the cluster that selects the initial part of the cascade is based on the MC information of the cascade direction. Cluster must follow the conditions:
  - Minimal angle between electron direction and fit to the hits of cluster (not more than 3 deg.)
  - distance of cluster hits to the electron direction is less than 0.15 cm.

FNAL ν_{eCC}



νNC

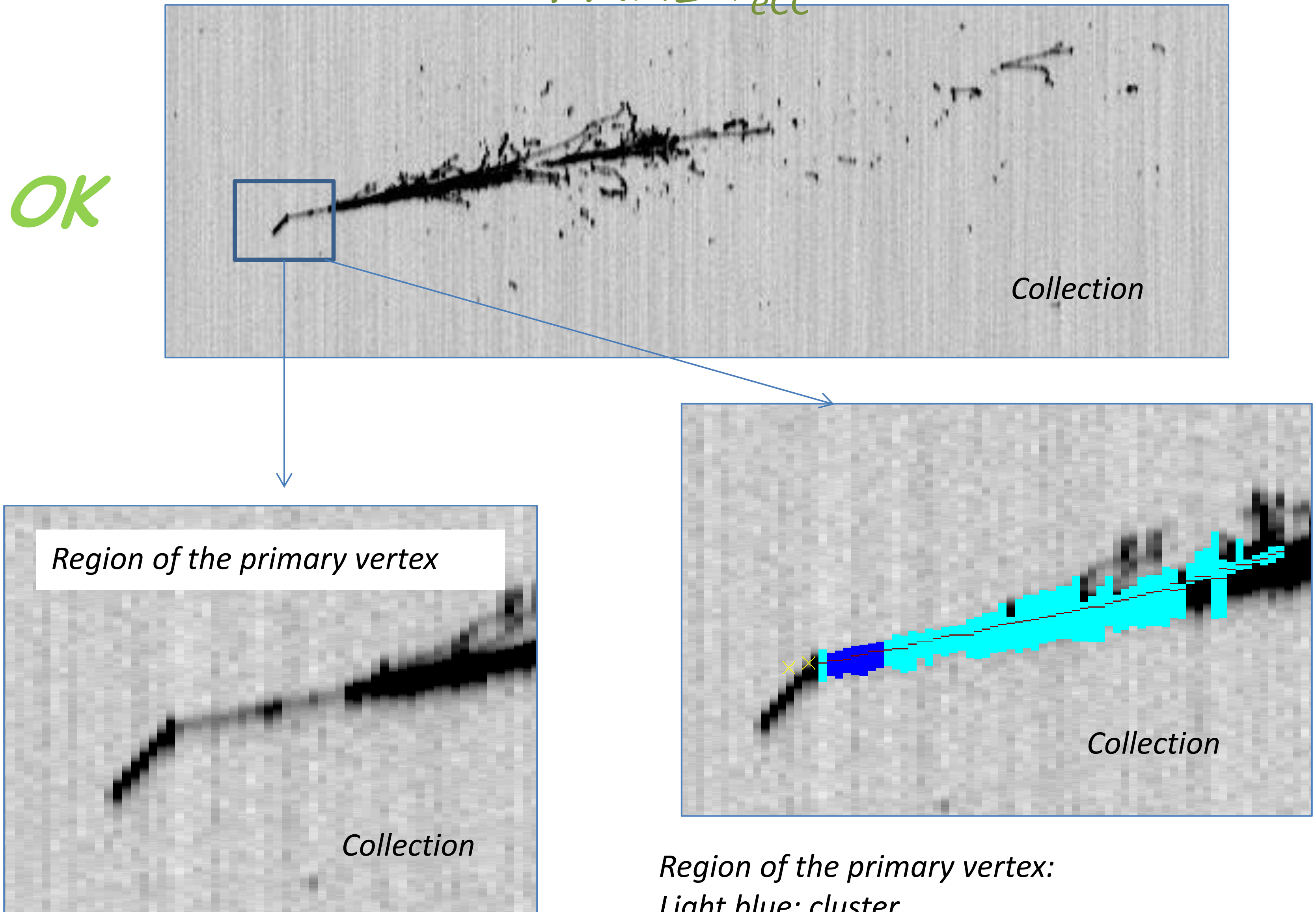
20% events with cascade > 10 MeV

53% events have electrons where initial dE/dx is in the range (0.0; 3.7 MeV/cm) + fid. Cut + requirment of the activity at the vertex.

13% events not reconstructed (lack of visible electron or very short electron track, projection of the electron initial trajectory to the Collection view is too short, very low energy electrons, see slides 5, 6)

FNAL ν_{eCC}

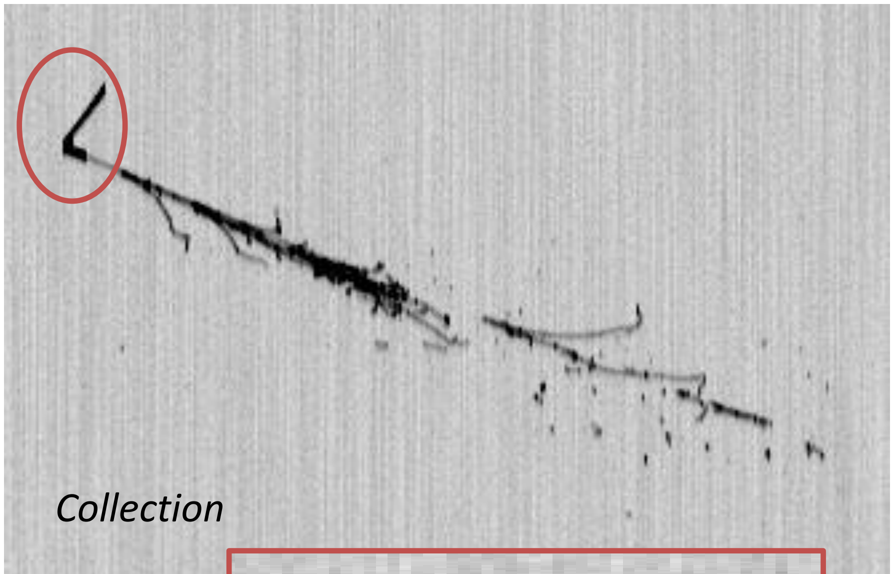
OK

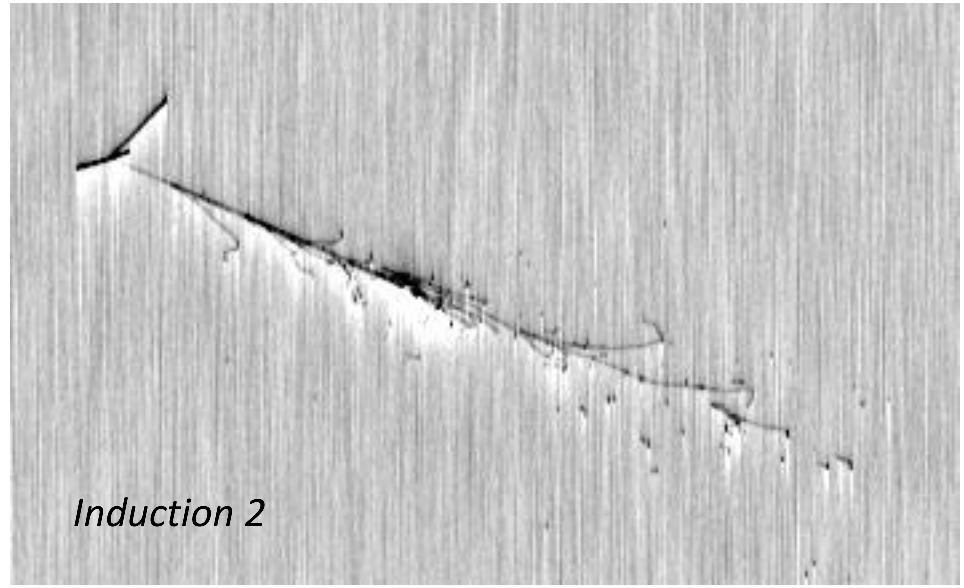


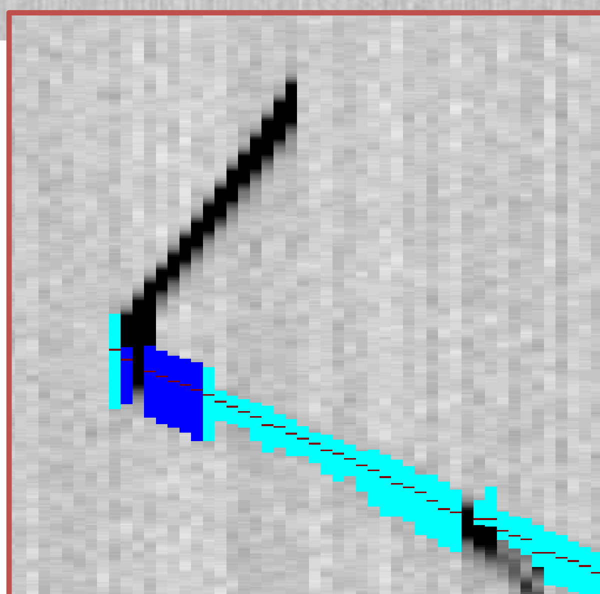
Region of the primary vertex:
Light blue: cluster.
Navy: hits corresponding to 2.5 cm of 3d length taken to compute **dE/dx ~ 3.1 MeV/cm**

FNAL ν_{eCC}

Overlapping in Collection view



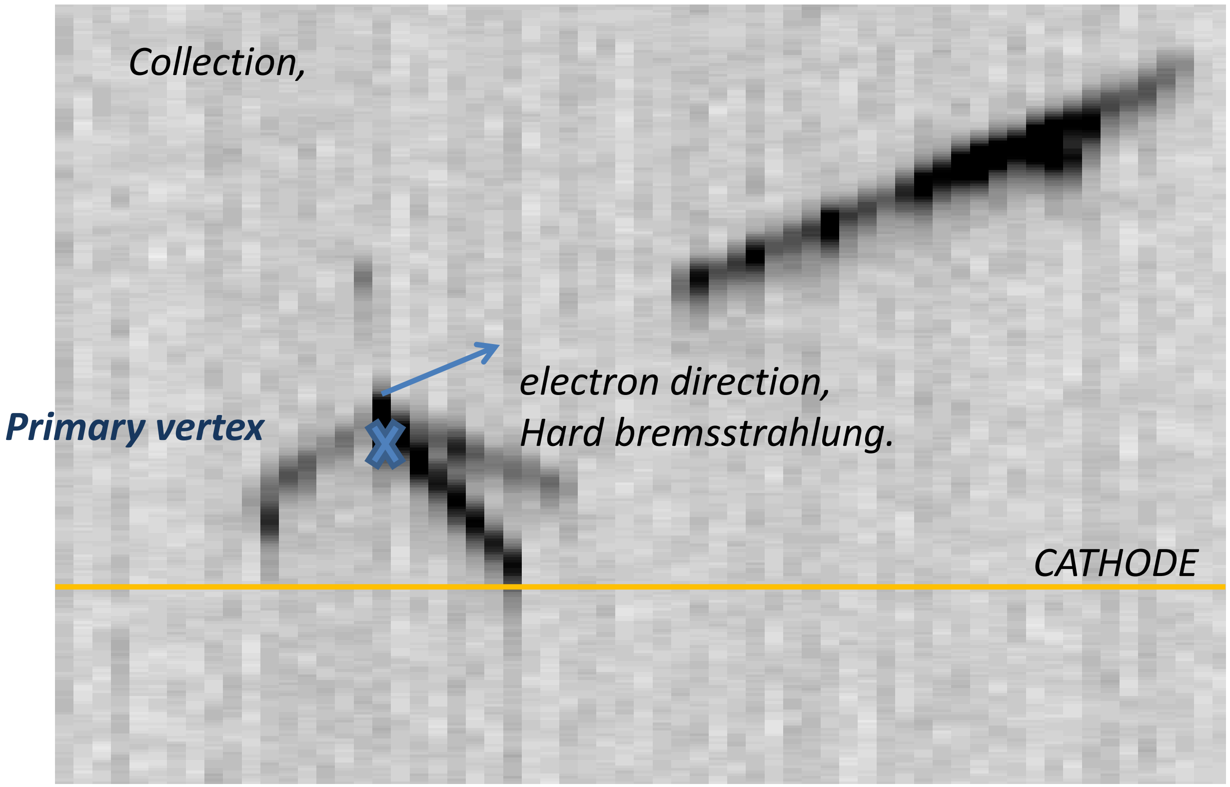




Region of the primary vertex:
Light blue: cluster.
Navy: hits corresponding to 2.5 cm of 3d length of the initial part of the cascade taken to compute dE/dx.
In this case proton track cover the initiatial part of the cascade: ***dE/dx ~ 16,8 MeV/cm***

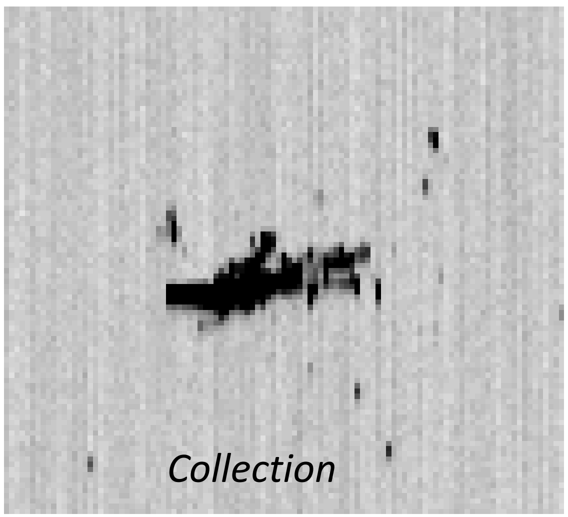
FNAL ν_{eCC}

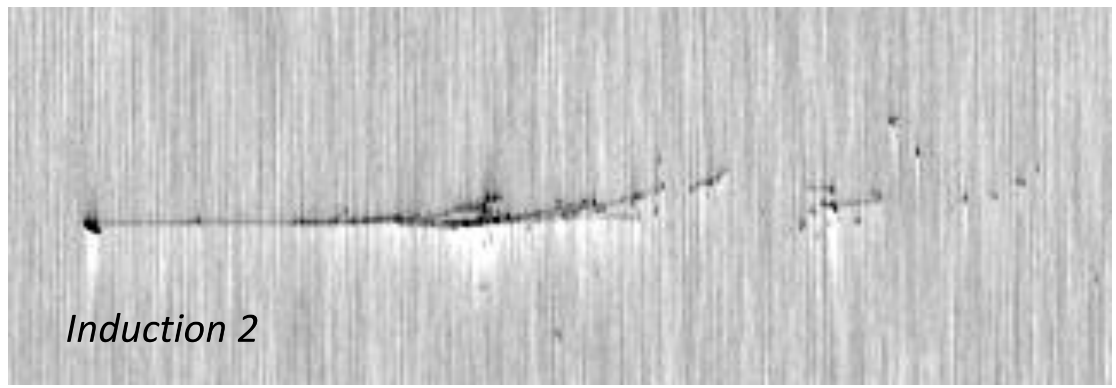
Electron track not visible



FNAL ν_{eCC}

Projection of the initial part of the electron cascade to the Collection view is too short.





Projection of 2.5 cm of the initial part of the cascade is less than one hit