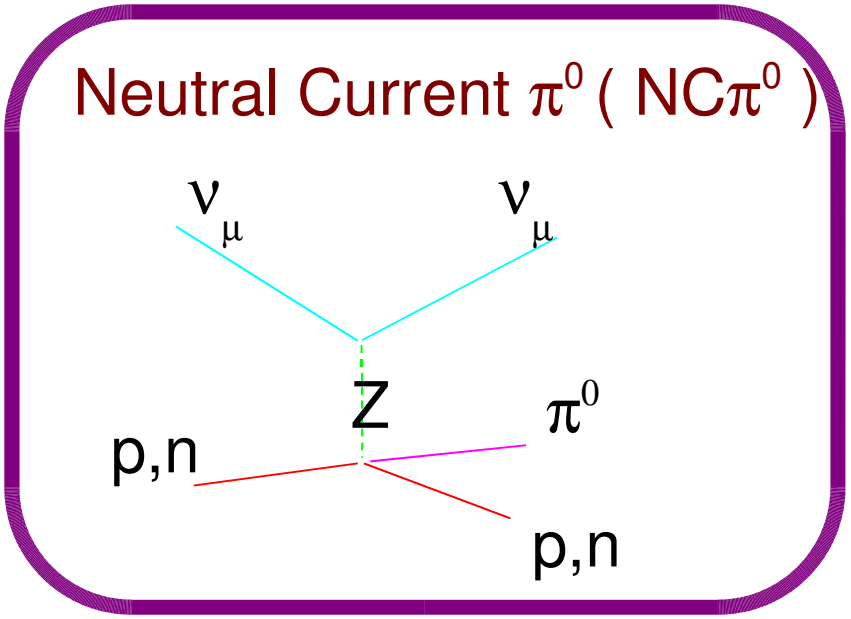
The Neutral Current π^0 Production σ_ν Measurement

Yoshinori Kurimoto

Kyoto University

Japan

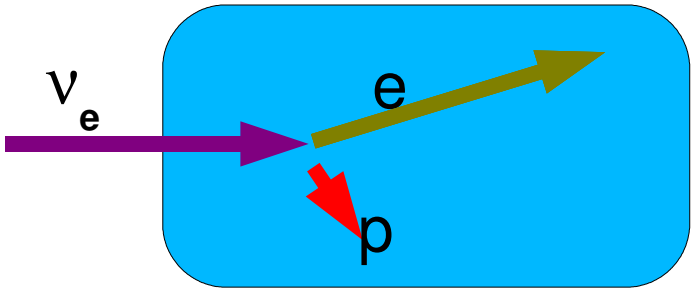
Neutral Current π^0 Production



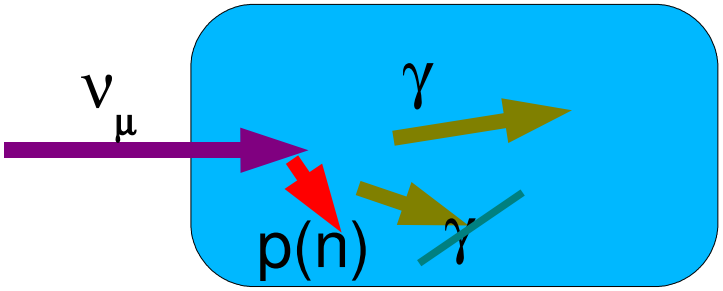
NCπ^0 is the main background of the search for ν_μ to ν_e oscillation

γ mimics e from ν_e

The ν_e signal : electron

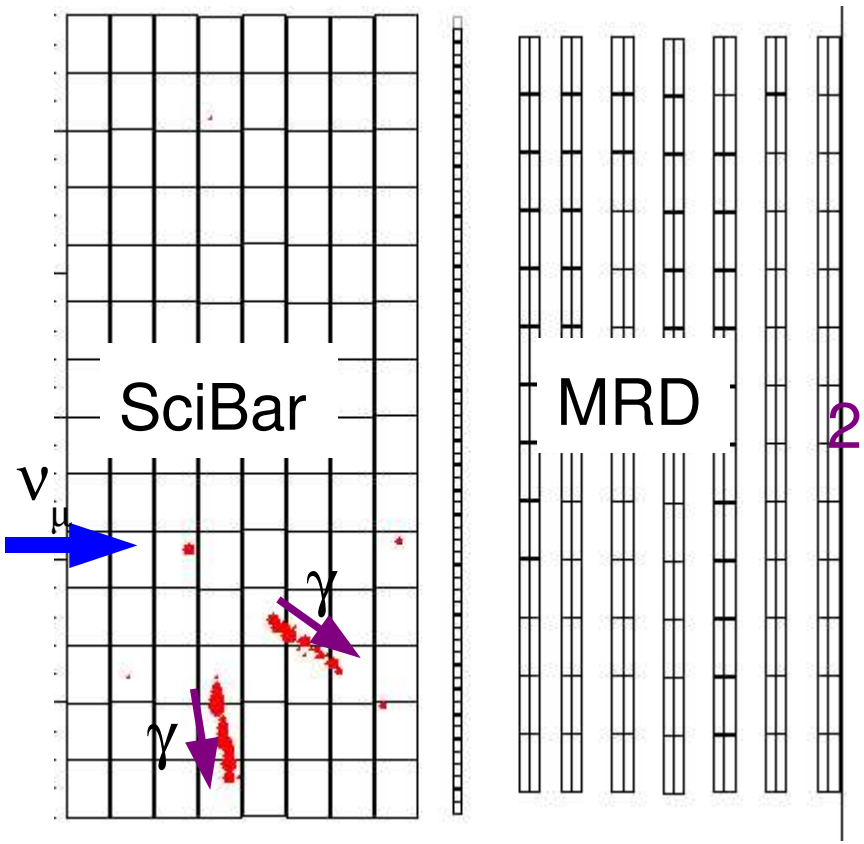


The background from NCπ^0
: One γ from π^0 , miss another γ



NCπ^0 in the SciBar detector

NCπ^0 Candidate



We want 2γ from π^0, No μ

→ Event Selection

1.Pre-Selection

Two tracks not reaching MRD

2. Using the track information

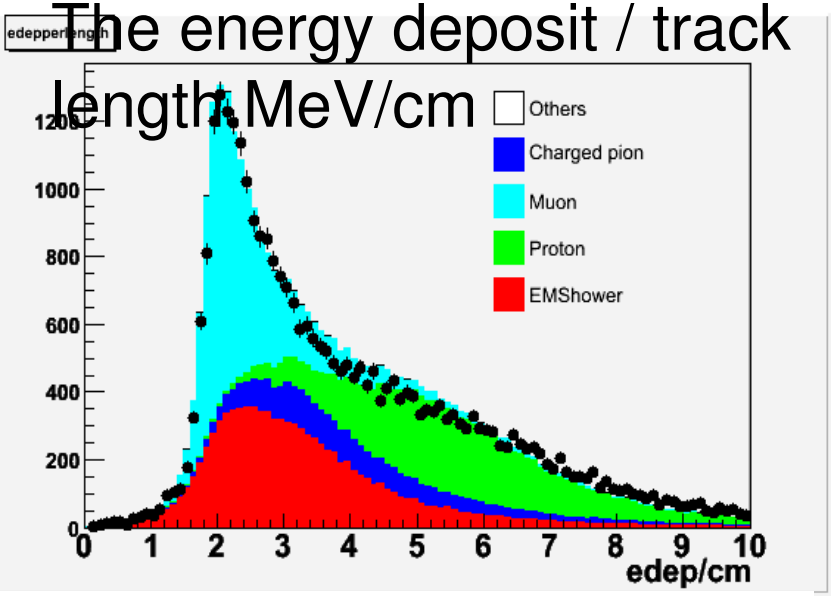
- Reject p using the dE/dX
- Reject μ using the decay e

3. Using the event topology

Disconnection b/w 2 tracks

The proton rejection using dE/dx

The energy deposit / track length MeV/cm



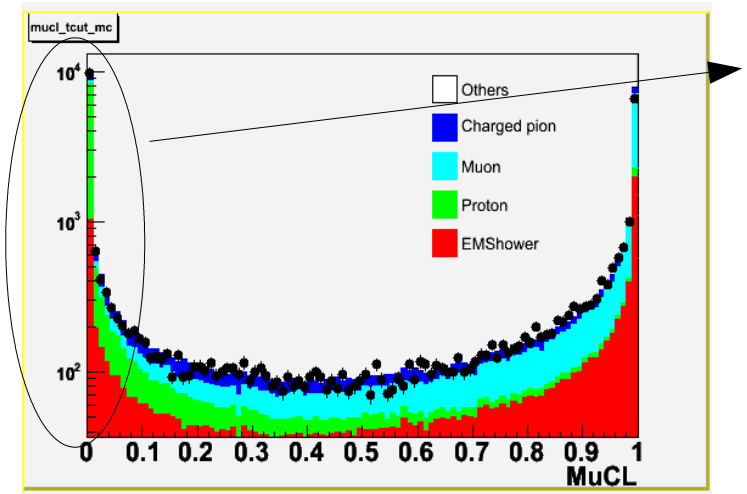
After Pre-Selection

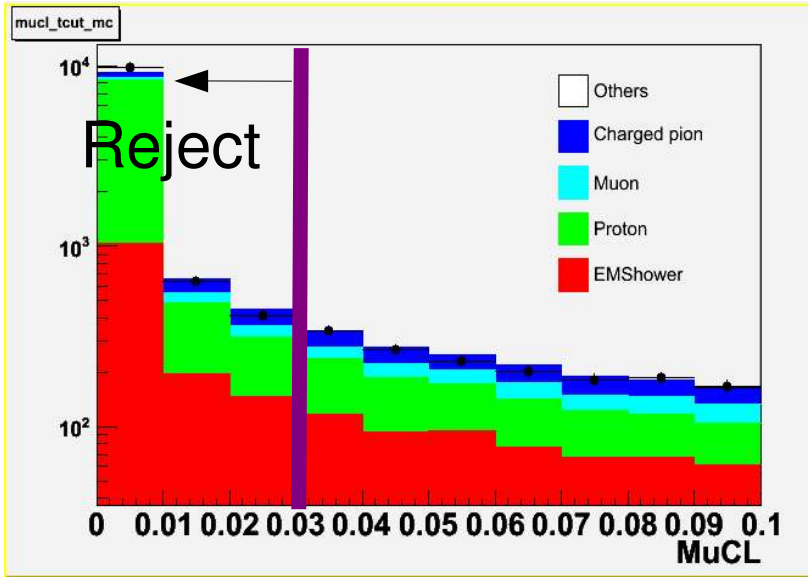
Muon
Proton
EM Shower
Charged pion

Protons have higher energy deposit than any particle does

→ Reject MuCL < 0.03

The Muon Confidence Level



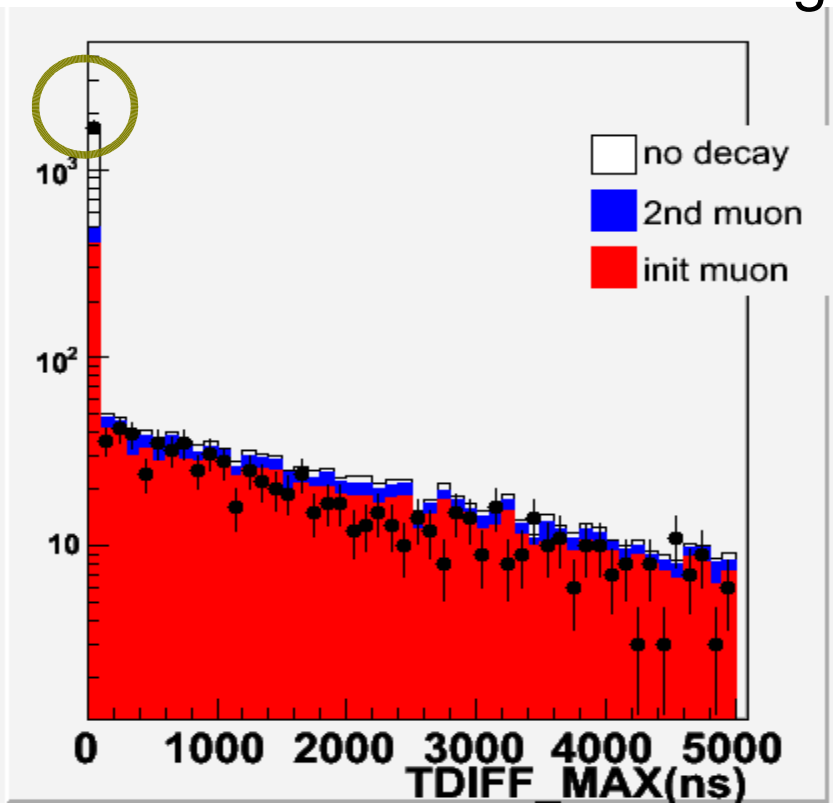


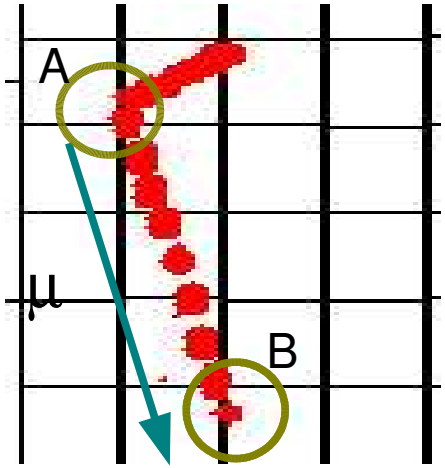
Muon Rejection with the decay e

There are μs stopping in SciBar (not reaching MRD)

These μs can be removed using the decay e

Time difference b/w track edges





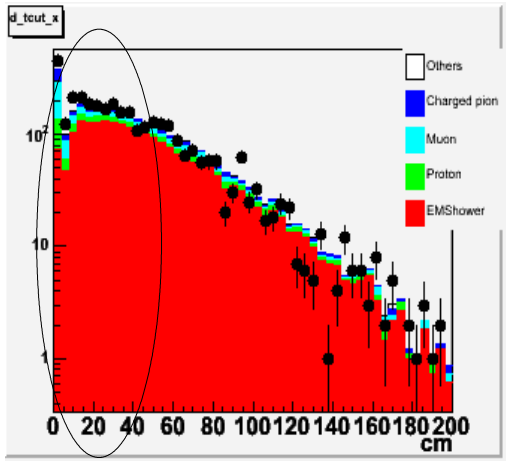
TimeB - TimeA

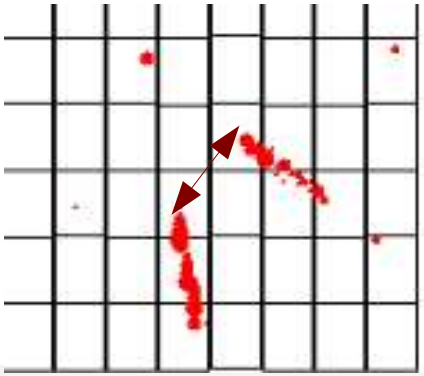
Most “no decay” events is in the region < 100 ns (first bin)

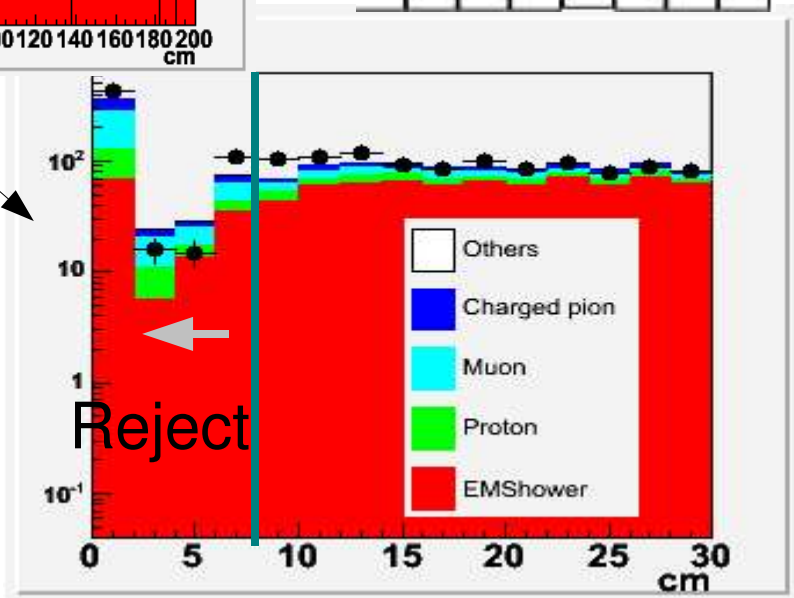
Reject “ > 100 ns "

The disconnection b/w tracks

This distance b/w tracks
(after all events selection)







To get 2γ from π^0

Reject events < 8cm

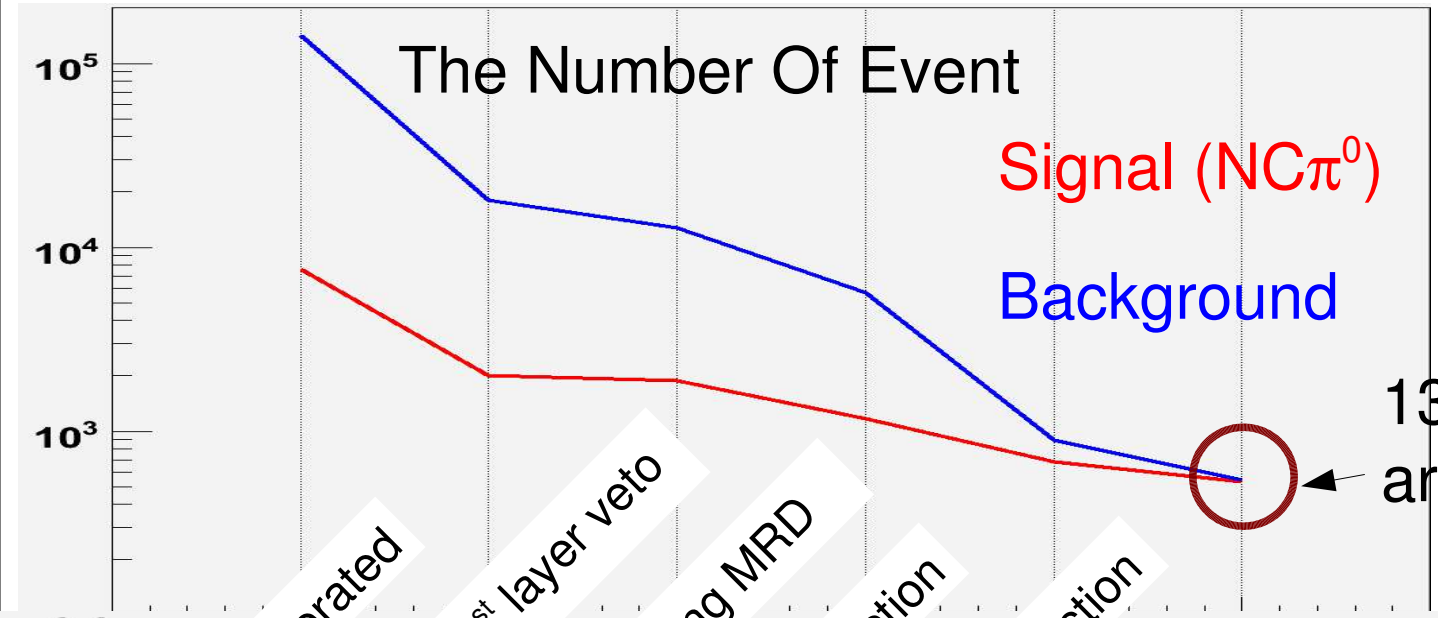
Dot : Data

Colored histograms : MC

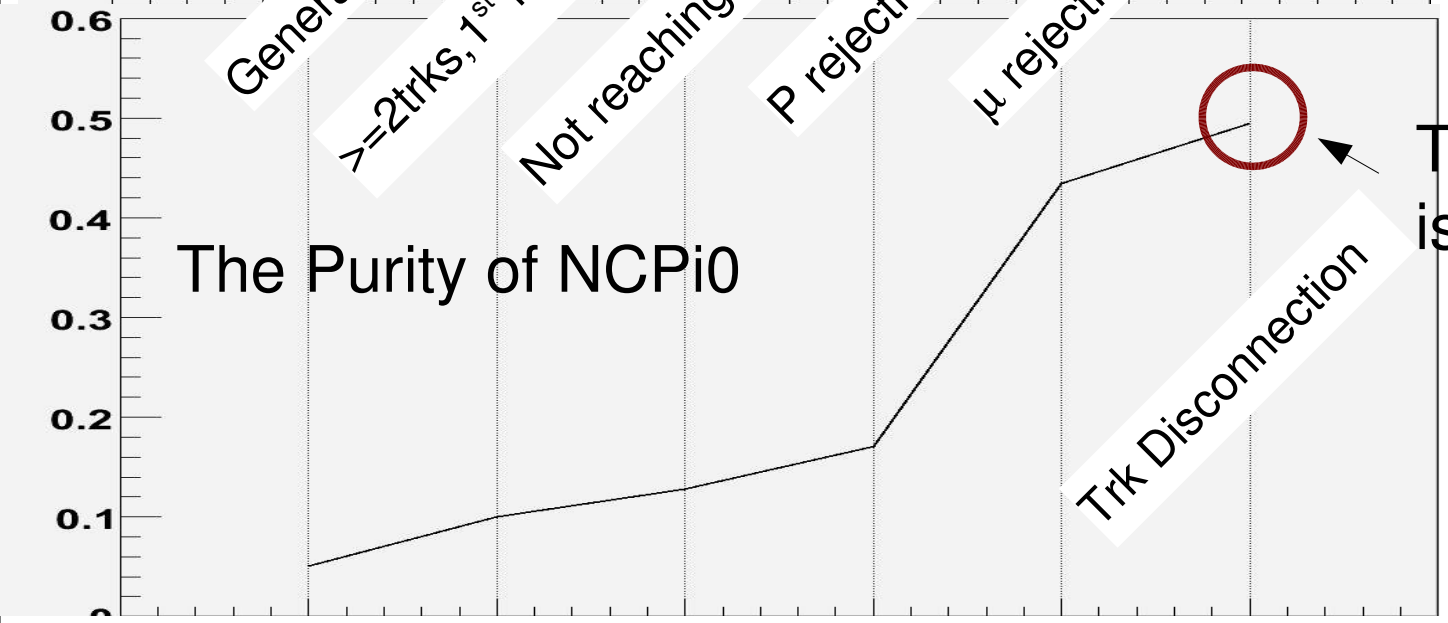
Muon : 8 %
Proton 8 %
EM Shower 77 %

From NCπ^0 : 43 %
From CCπ^0:12 %
From Secodary π^0:16 %

Event Reduction for each selection



1356 events (S+B) are selected

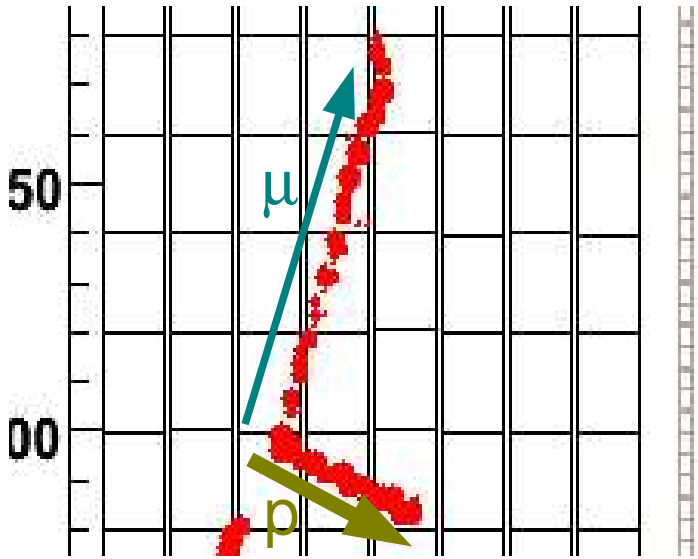


The NCπ0 purity is 49.0 %

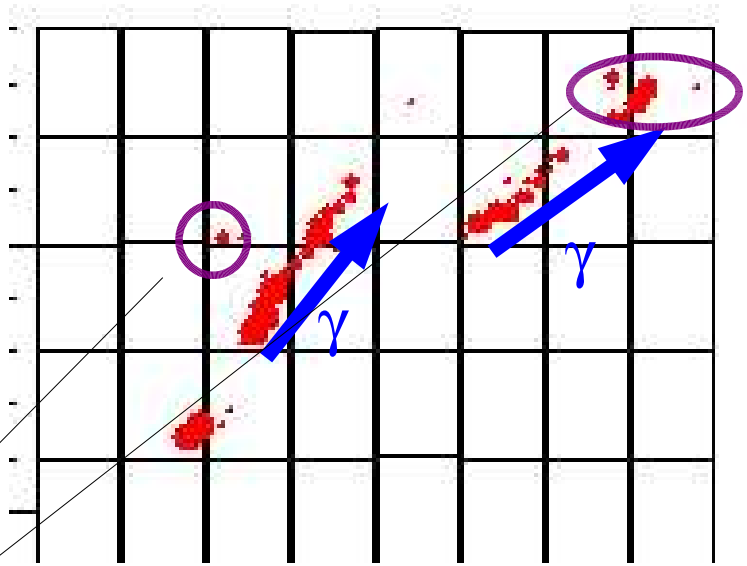
Next Step

Development for γ reconstruction algorithm

Charged Current Candidate (μ,p)



NCπ^0 Candidate (γ)



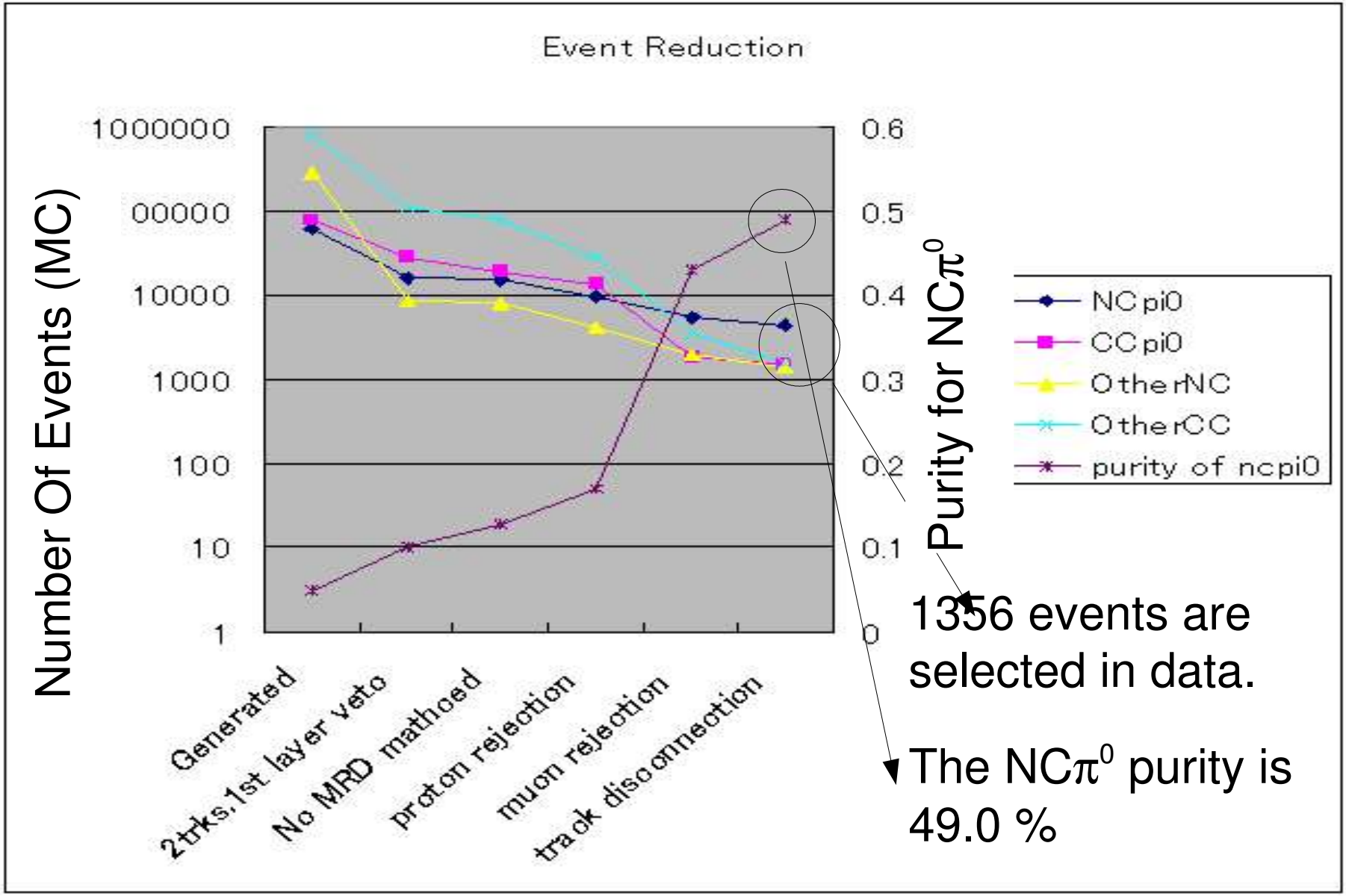
γs have more cluster than other particles do

Summary

- $NC\pi^0$ is the main background in the search for ν_μ to ν_e oscillation
- $NC\pi^0$ sample in SciBar was made by removing other particles (μ,p) than γ
- 1356 events were selected in Data, $NC\pi^0$ purity is 49% according to MC
- The γs reconstruction algorithm will be considered

Backup slide

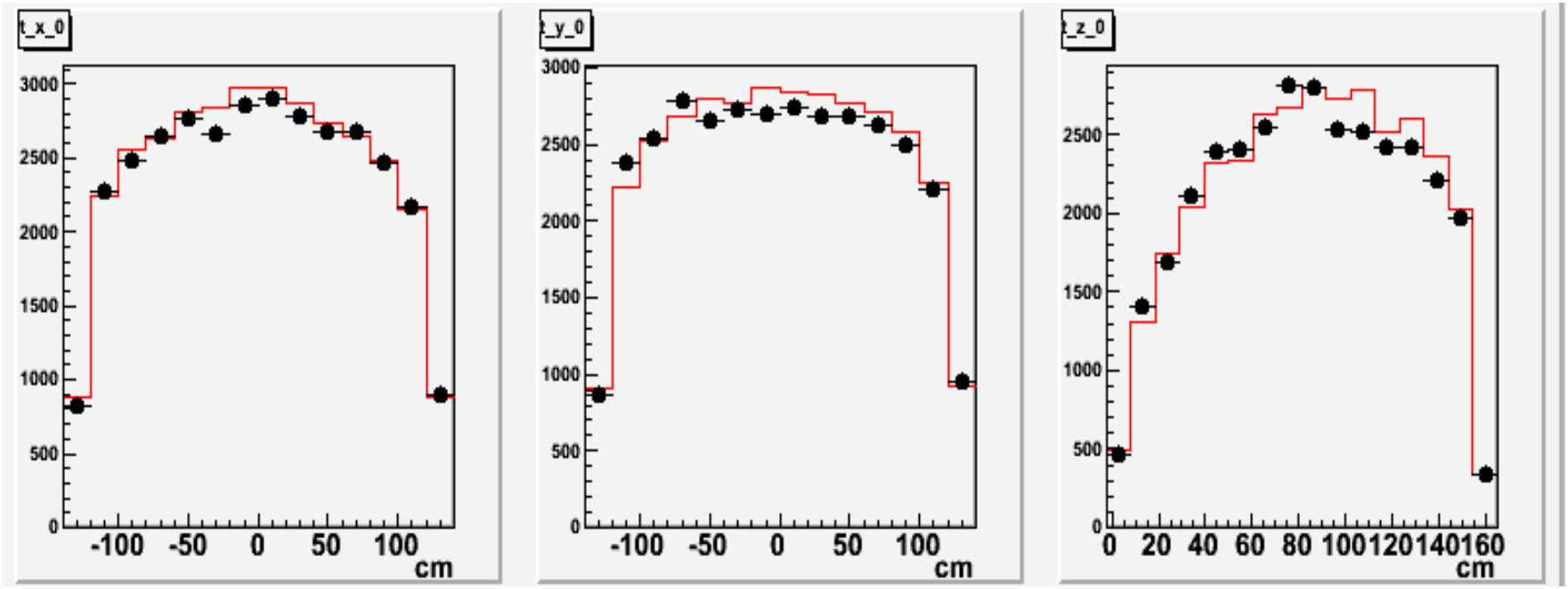
Efficiency and purity



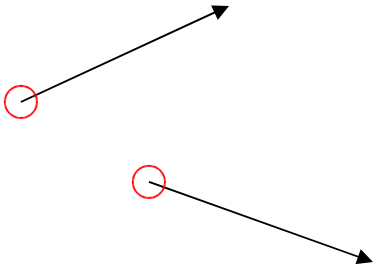
1356 events are selected in data.

The NCπ^0 purity is 49.0 %

The track edge distribution



No Mrd-matched events, 2 trakcs



Pi0 Kinematics

From the top left figure , clock wise,

Pi0 momentum

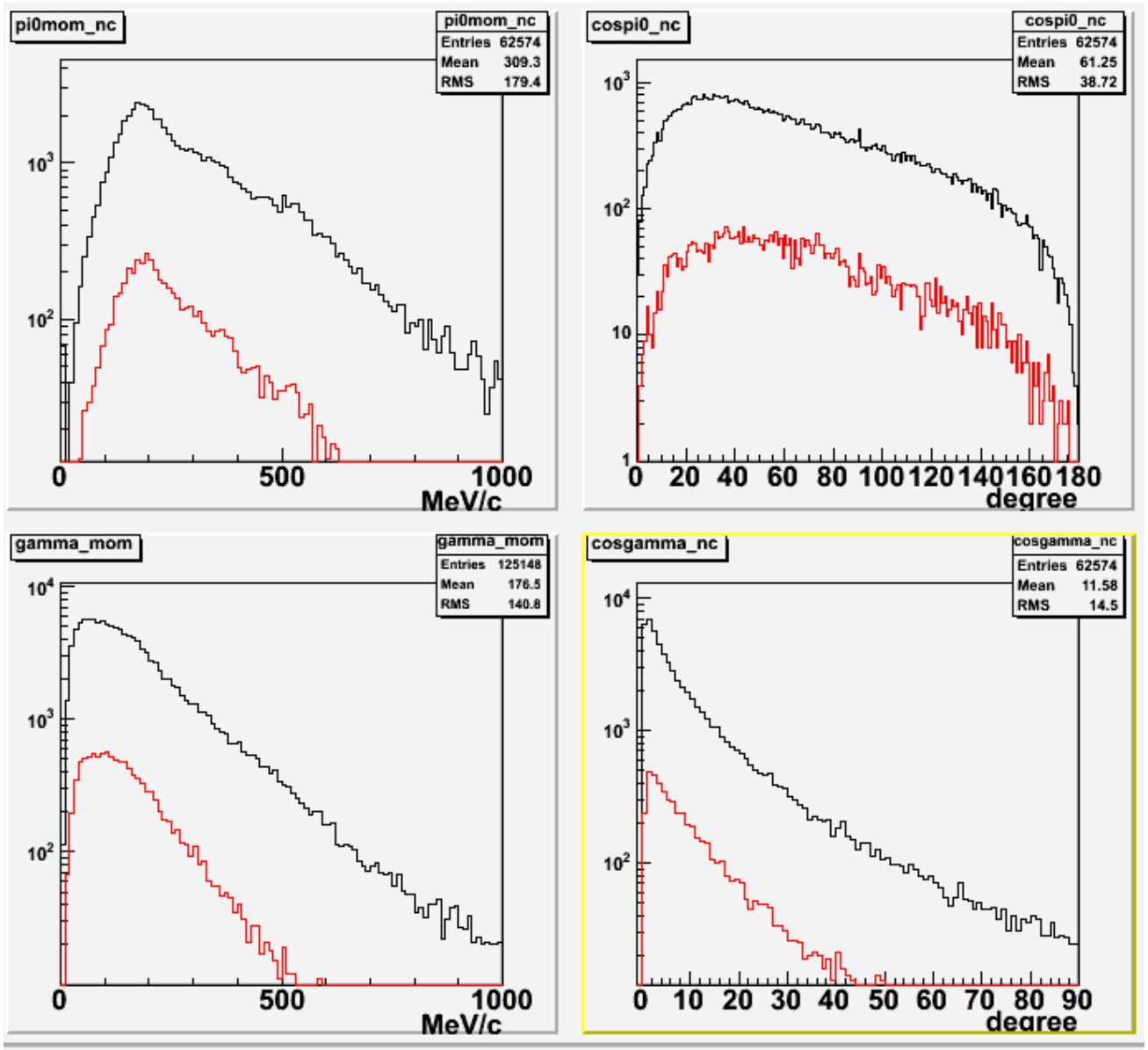
Pi0 angle to beam axis

Gamma angle at pi0 rest frame

Gamma momentum

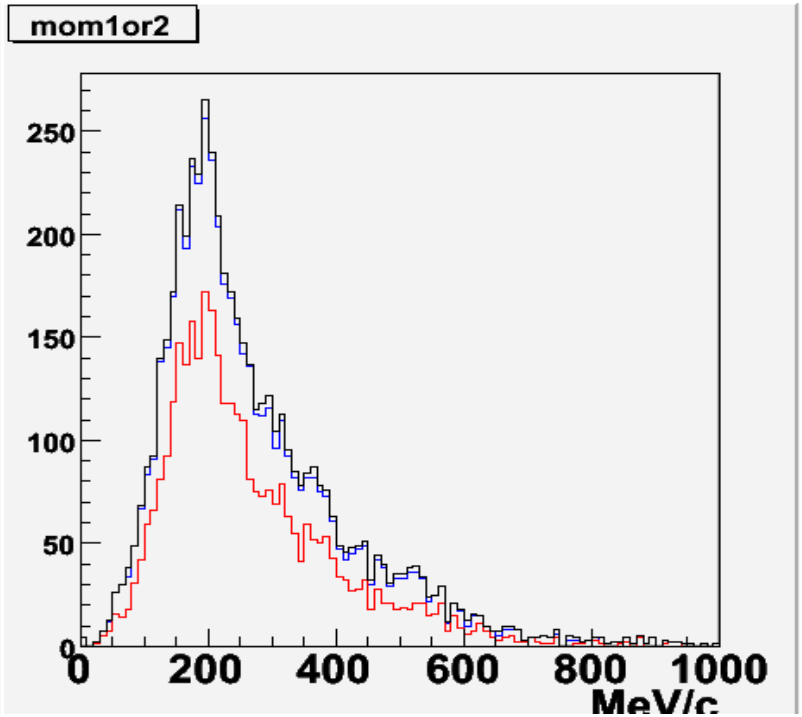
Black : Generated

Red : after all event selection



Probability that 2 γs are reconstructed

- check if reconstructed tracks include hits associated with γ using NCpi0 sample (MC)
- If this probability is so low , pi0 reconstruction means nothings



Pi0 momentum Distribution

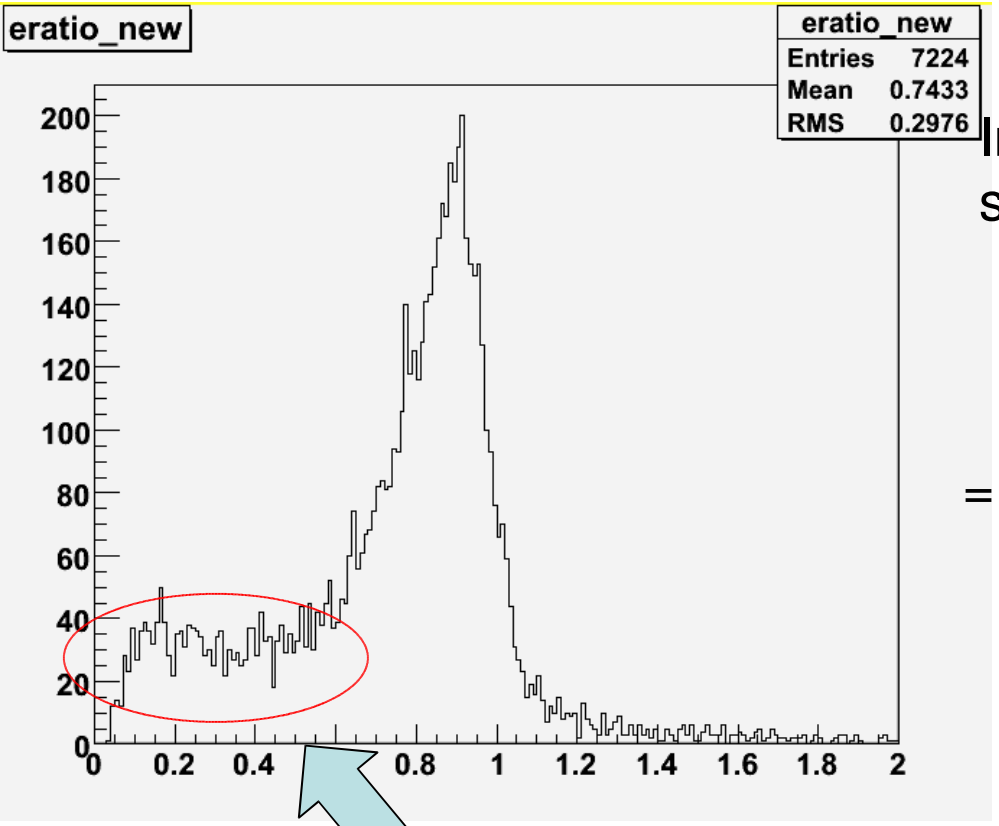
Events pass all selection

At least one γ makes hits associated with some reconstructed tracks (90%)

Both γs make hits associated with some reconstructed tracks (65%)

In 64% of selected events , 2 γ are reconstructed apart from the quality

Energy collection efficiency for γ



In NCpi0 sample passing all selction ,

Energy Collection Efficiency

$$= \frac{\text{True Energy Deposit in Rec. Track}}{\text{True Energy Deposit in SciBar}}$$

Mean = 0.74

at Peak = ~ 0.9

The energy reconstruction method for γ

is needed to recover this low efficiency