

Showering Merger

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Outline

- Showering muons
- Changes to upmu3
- Changes to fillnt
- Tuning upmu3
- MC Results for SK3
- Using showering muons

Showering Muons

- Developed by Shantanu for his thesis work.
- Showering muons have a peak neutrino energy of $\sim 800\text{GeV}$ whereas thru-muons have a peak energy of $\sim 100\text{GeV}$.
- In SK-III November dataset there are: 1,118 stopping, 1,467 thru, 194 shower

Changes to upmu3

- upmu3 was already set up to calculate showering muon information, but the code was not up to date.
- The code has been updated.
- upmu3 calls shower, which calculates the showering variables:
 - chi1p = showering χ^2 statistic

- shdelta = $\langle Q_{\text{corr}} \rangle - Q_{(l)}$

observed corrected charge

expected value of Q_{corr} (for non-showering) muons as a function of track length

Source Code Modified

- The following files have been changed:
upmu3.F, [showering.F](#), [chargerr.F](#),
[expcharge.F](#)
- Similar changes have been made for the SK-II version of upmu3.

Change to MCfilInt

- filInt has been modified to fill showering ntuple variables: sh_chi1p, sh_delta.
- Affected files:
 - filInt.F, upmuvtx.h
- This change should be implemented when filInt is merged with MCfilInt.

Tuning Procedure

- The showering algorithm must be tuned *separately* for data and MC.
- The tuning variable, in shower.F, is called **meanchargecal**.
- It must be adjusted until sh_delta is peaked at zero.

$$\text{sh_delta} = \text{mean} - \text{meancharge}$$

$$\text{meancharge} = \text{expcharge}(\text{len}) - \text{meanchargecal}$$

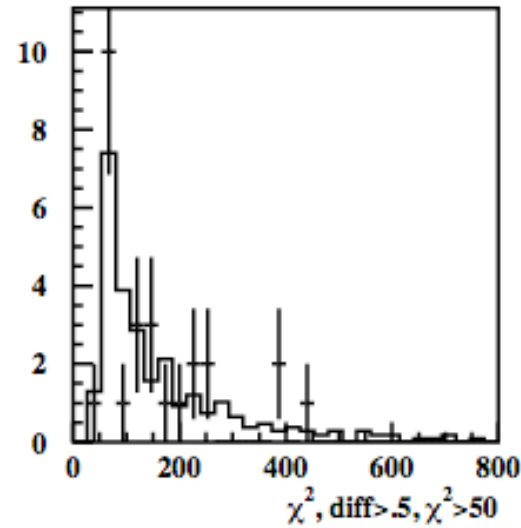
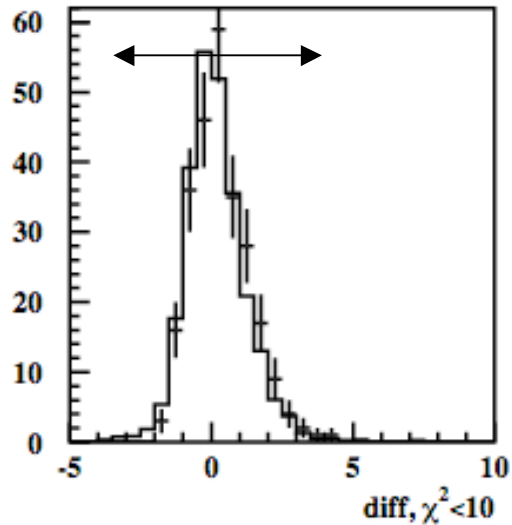
$$\text{sh_delta} = \text{mean} - \text{expcharge}(\text{len}) + \text{meanchargecal}$$
- Recompile after changing meanchargecal.
- Also check that data agrees with MC.

sh_delta

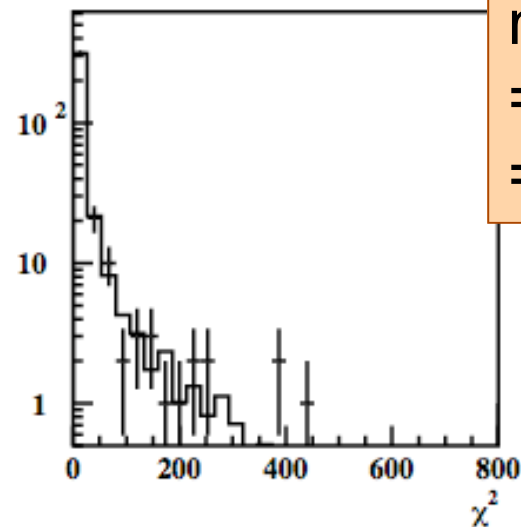
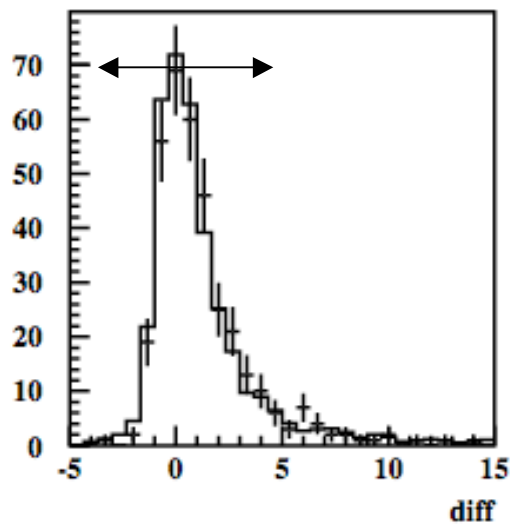
Tuning Plots (SK-III)

sh_chi1p

showering
events

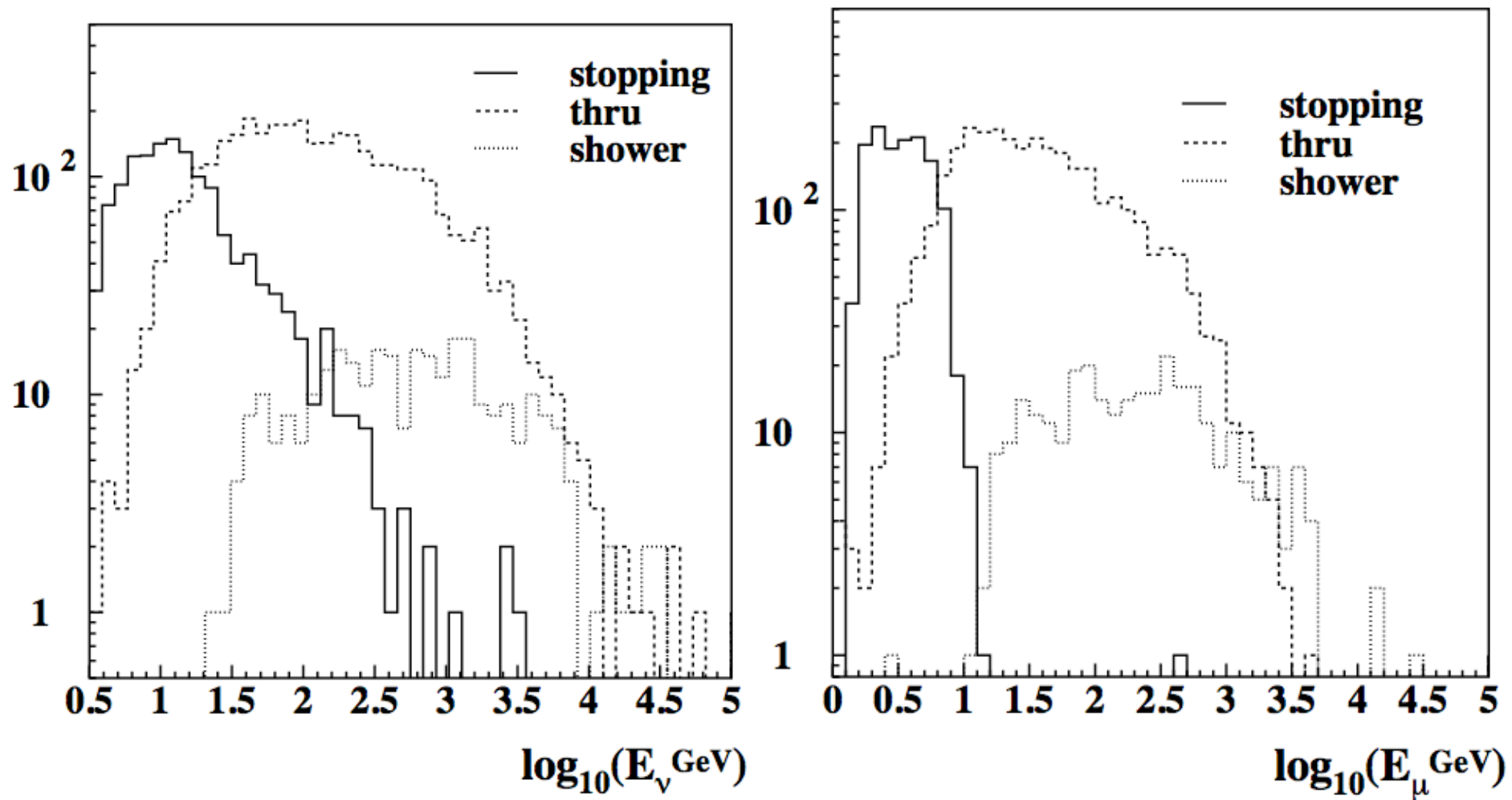


all events



meanchargecal
= 0.15 (data)
=-0.50 (MC)

MC Results for SK-III



Using Showering Muons

- Showering muons are selected using two cuts (from PAW):

sh_delta \geq 0.5 .AND.

sh_chi1p \geq 50

- These cuts are optimized for SK-I. They can be changed for SK-II and SK-III.

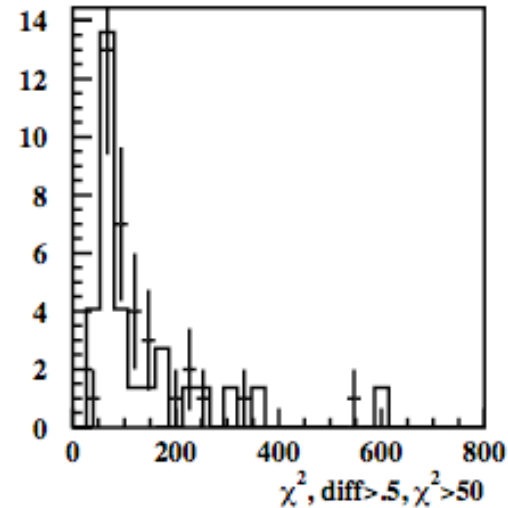
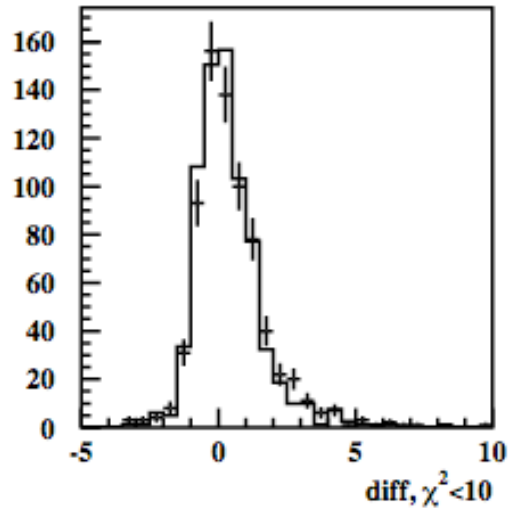
Extra Slides

sh_delta

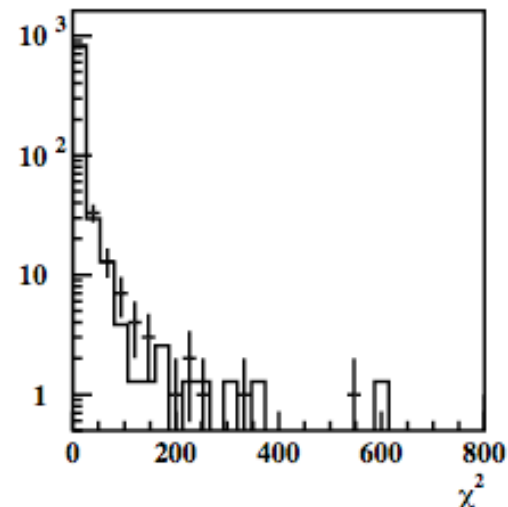
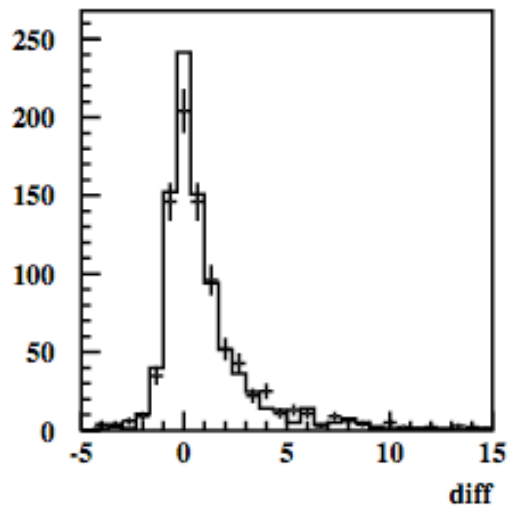
Tuning Plots (SK-II)

sh_chi1p

showering
events



all events



meanchargecal
= 2.05 (data)
= 1.65 (MC)