(preliminary)

in the bending plane

muon momentum reconstruction

SAND-DUNE
From report by Paola...

Work in progress ...

Integration of 3DST, surrounded by tracking devices, + LAr meniscus

(SAND: Solenoid for Accurate Neutrino Detection, for DUNE)

FLUKA Simulation of SAND-DUNE
MC sample

5,000 \( \nu \)-CC interactions in the 3DST

Calorimeter

STT MC hits (all particles)

STT digits (muons)

Interaction vertices

(2.24 x 2.24 x 2.4 m³)

3DST
Muon trajectories are selected from MC information, in 3DST and STT, separately, in 3DST and STT, separately.Muon trajectories are selected from MC information.

Rec-p_{yz} [GeV/c] = 0.18 * R_{curv} [m]

estimate of p_{yz} (u-momentum in the bending plane):

- yz view, assigning proper coordinate errors (Dz, Dy)
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Each muon-track is fitted by a circle function, in the yz view.

Straw Tube Layer hits provided by MC

STT: 1 "digit" for each plane in yz view (by grouping

"CellTree" in MC)

3DST: 1 hit (x, y, z coordinates) for each cubic cell

Muon tracks fits
Example events

Muon in 3DST

Muon in STT

N_{ev} = 4

Error on p_{yz} (~10% of events) absorbed

N_{ev} = 10

N_{ev} = 3

N_{ev} = 14
Muon $p_T$ reconstruction in 3DST (1)

Due to poor space resolution, energy loss, multiple scattering...

Poor muon-$p_T$ resolution from 3DST tracks...

1° method:

Muon $p_T$ reconstruction in 3DST (1)

$>$10% multiple hits in the view due to superimposed cells neglected

fit of $u$-track in $yz$ view, using $\Delta z = \Delta y = 0.5 \text{ cm}$

$N_{\text{cell}} > 90$
Muon p'\textsuperscript{yz} reconstruction in 3DST (2)

In the track fit, greater weights are assigned to cells with larger pathlengths...

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$$D_z = D_y \cdot 1/E_{\text{dep} \text{-- cell}}$$

fit of u-track in yz view, using $\forall z = \forall y \cdot 1/E_{\text{dep} \text{-- cell}}$

method:

(multiple hits in the view due to superimposed cells neglected)
Muon $p_T$ reconstruction in 3DST (2)

Giving 3DST hits a proper error depending on cell pathlength does not improve the resolution >10%.
Better muon-$p_T^z$ resolution from STT tracks (in spite of a smaller average number of hits on track)

Muon-$p_T^z$ reconstruction in STT

$\Delta z = 0.1 \text{ mm}, \ \Delta y = 0.2 \text{ mm}$

Fit of $p_T$-track in $yz$ view, using coordinate spreads
Muon $p_{yz}$ reconstruction in STT (2):

- Error related to initial $p_{y0}^z$ (Muon at generation)  
  - 7.6%

- Error related to $p_{yz}$ ofMuon entering STT  
  - 4.0%
Improvement in the resolution is observed when the STT hits are added to 3DST.

Muon $p_T^Z$ reconstruction in 3DST+STT
Conclusions

Preliminary results on muon-pyz reconstruction (using MC information) show a better resolution in spite of a greater number of hits. 

> Adding STT hits to the muon track in 3DST seems improving the resolution
> Weighing space errors of 3DST hits does not improve the resolution
> Probably due to poorer space resolution on hits, larger energy loss, multiple scatter ing,

for STT than 3DST (in spite of a greater number of hits) 

Preliminary results on muon-pyz reconstruction

Conclusions