Magnetic Field Simulation Studies in the DUNE-TMS

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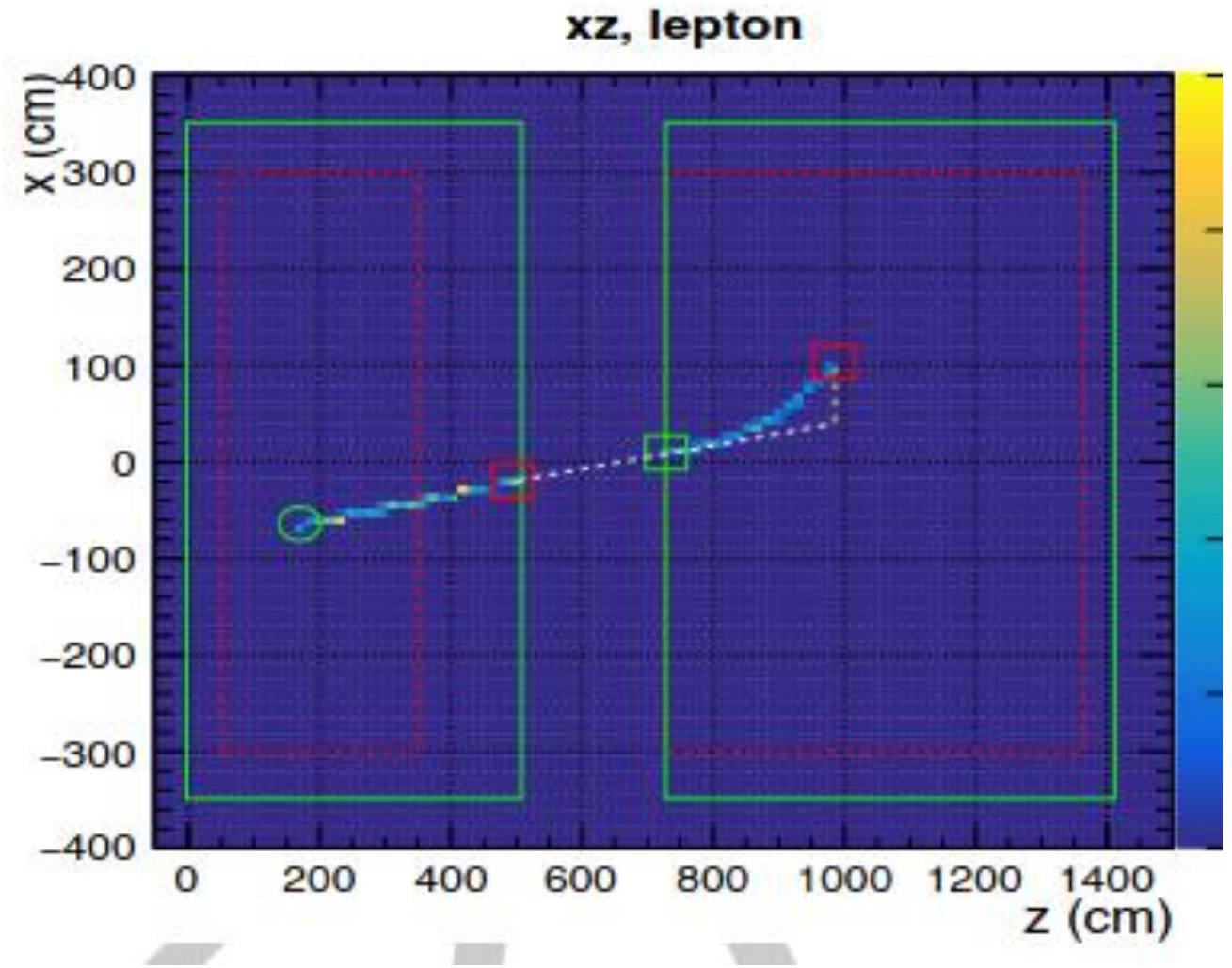
The Muon Sign Selection:

- The charge is determined by the bend of the particle in the magnetic field.
- It is estimated by comparing the deviation of particle tracks from a straight- line using truth information in the x − z view.
- The equation derived for the **“signed distance”** is,

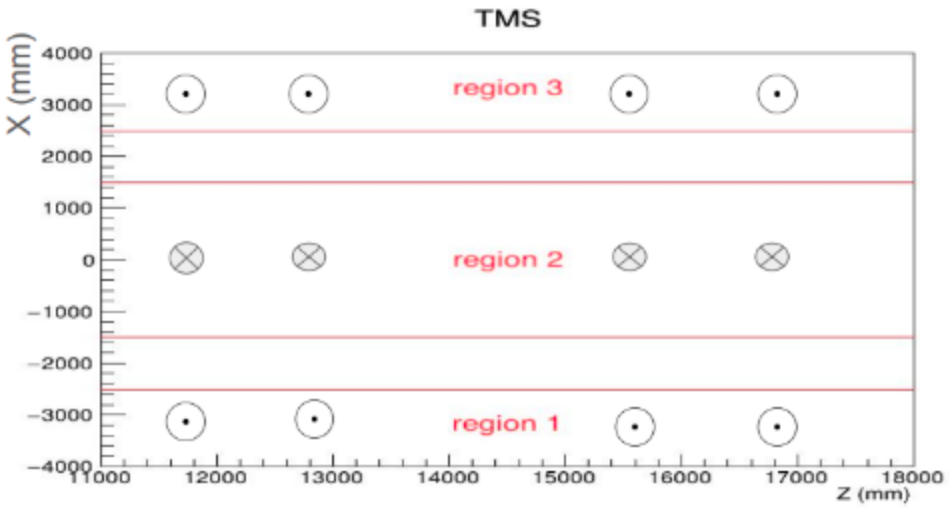
S.D = (x3 − x1) − (x2 − x1)(z3 − z1)/z2 − z1

where , x1,2,3, z1,2,3 is the x, z position of the ND-LAr exit point (or ND-LAr start point), TMS entry point (or ND-LAr exit point), and the last hit in the TMS, respectively.



Current Study:

- The Previous study uses the track in the central region of the steel.
- The current study involves all three regions.
- In region 1 and 3 magnetic field is pointed downwards.
- In region2 magnetic field is pointed upwards
- Intermediate region is included and extended so that muon experience uniform field.



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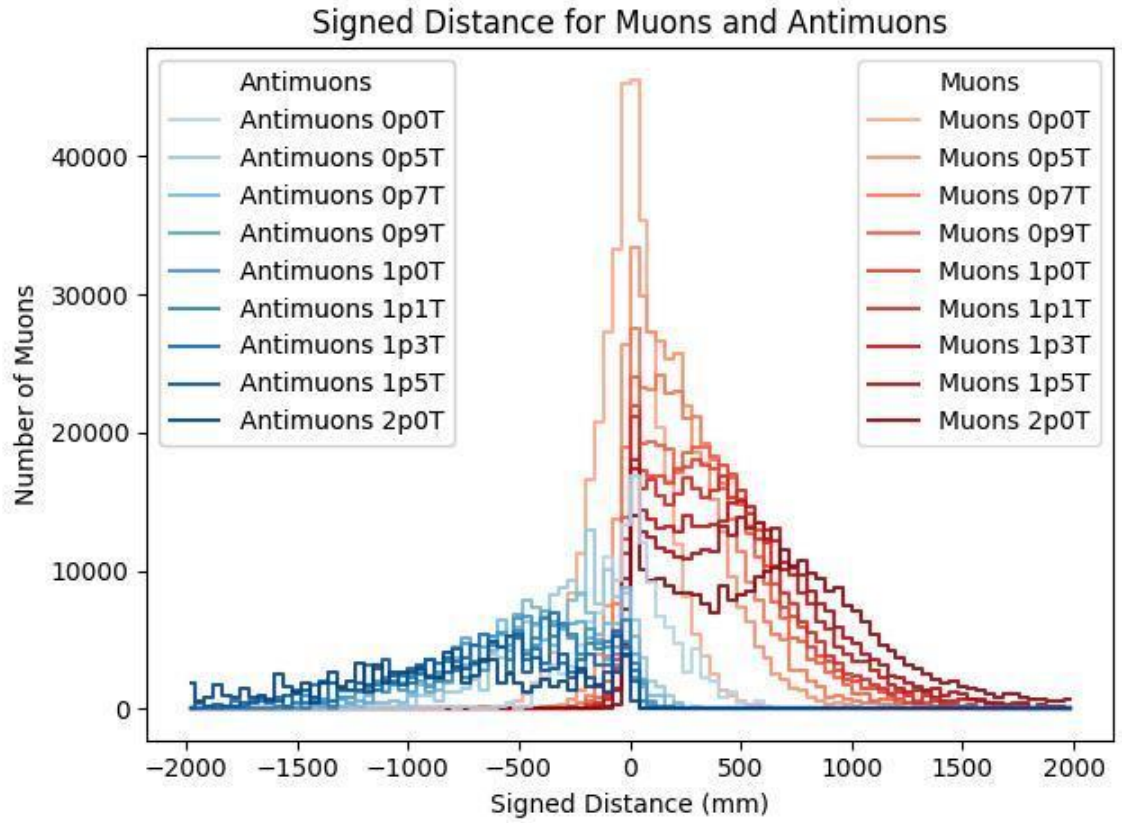
- FHC generated sample files with events generated both at ND LAr and TMS .
- NeutrinoX4 is a 4 vectors representing the position (x, y, z, t) of the neutrino interaction vertex.
- Determine whether the NeutrinoX4 falls inside the LAr(skipping the events where neutrinoX4 is outside of LAr Volume).
- LAR has fixed starting and ending points as stated in the constants file(Location: dune-tms/src/TMS_Constants.h).

a) LAr_Start_Exact = {-3478.48, -2166.71, 4179.24};

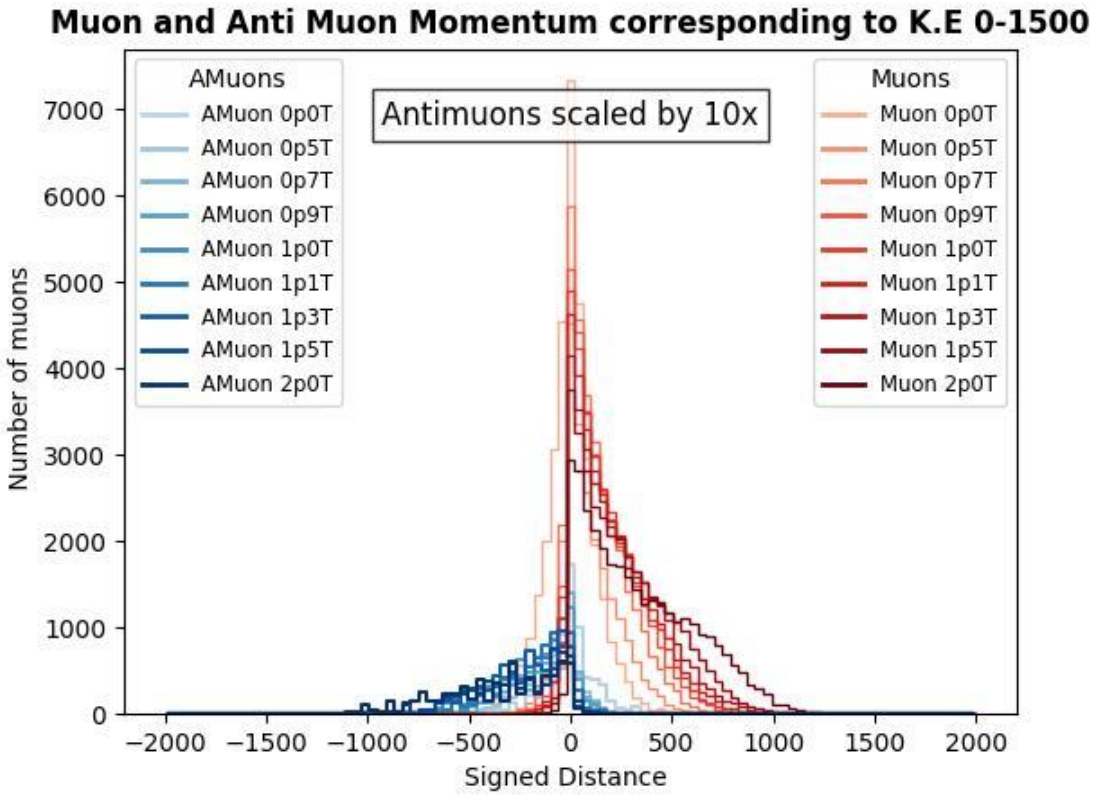
b) LAr_End_Exact = {3478.48, 829.282, 9135.8};

- Now we want to use the fiducial volume cut to exclude the edges. otherwise ,those events won't be reconstructed well.
- Fiducial volume cuts of 50cm from each edges(Location:dune-tms/src/TMS_Geom.h)
- Events are generated only in ND LAr and are Contained in the TMS .

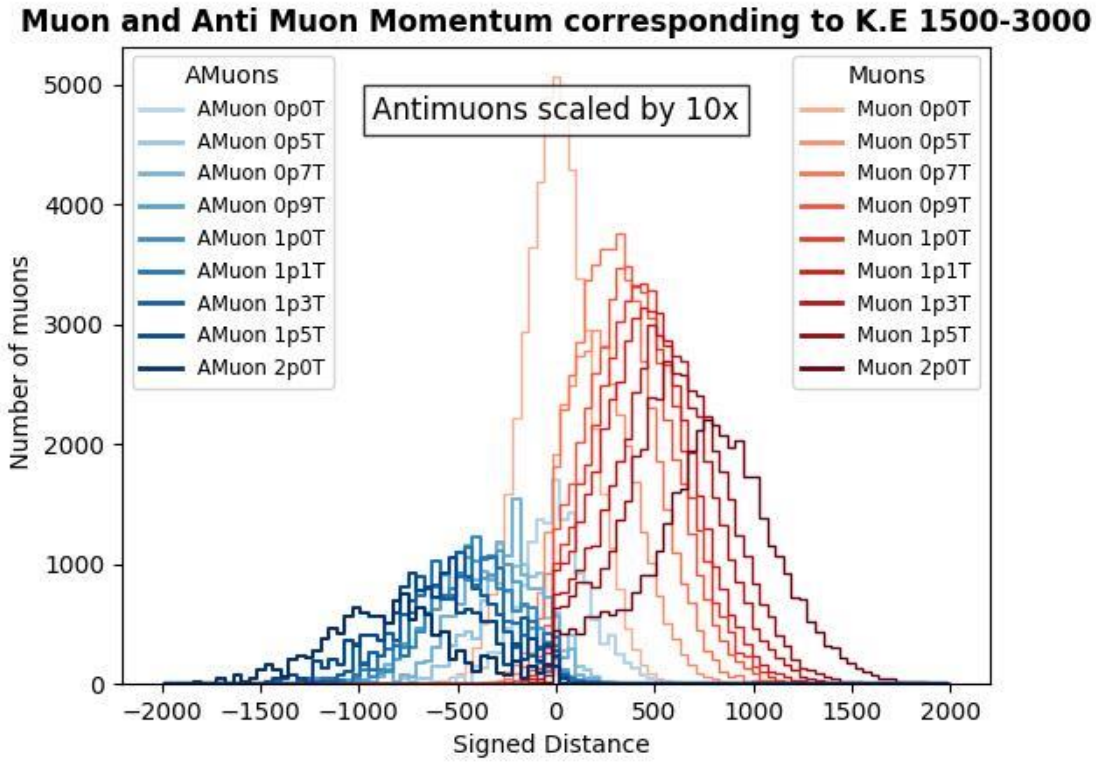
No of Muons Vs Signed distance @ different B fields:

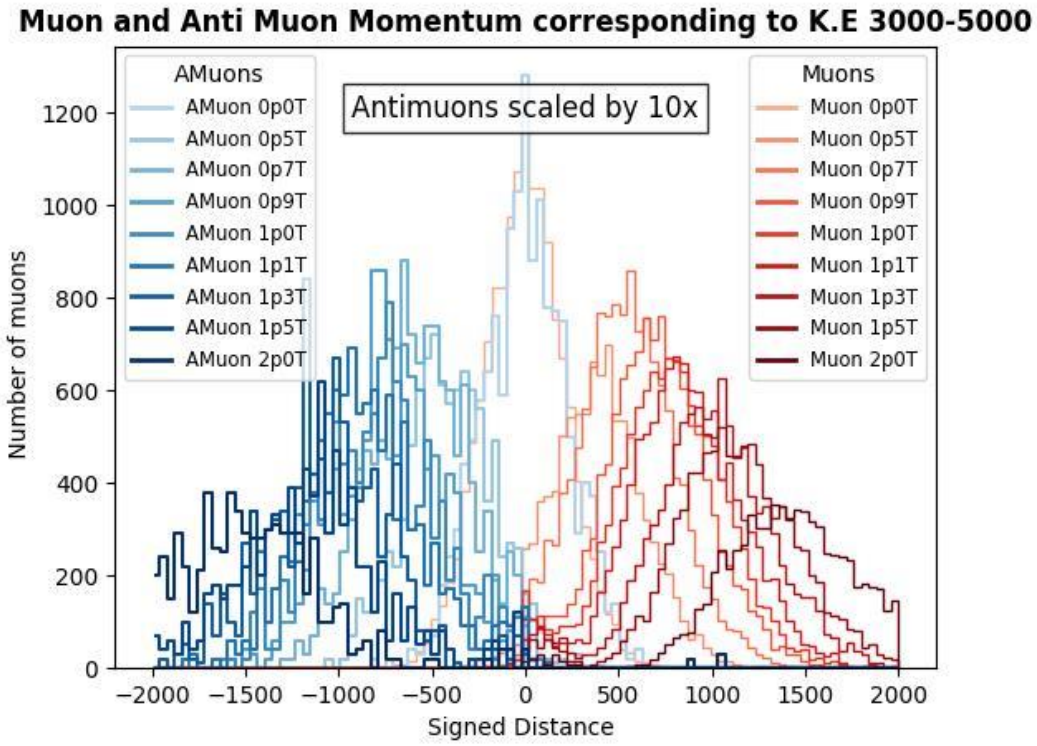


Overlaid plots for different magnetic fields within the same momentum range:

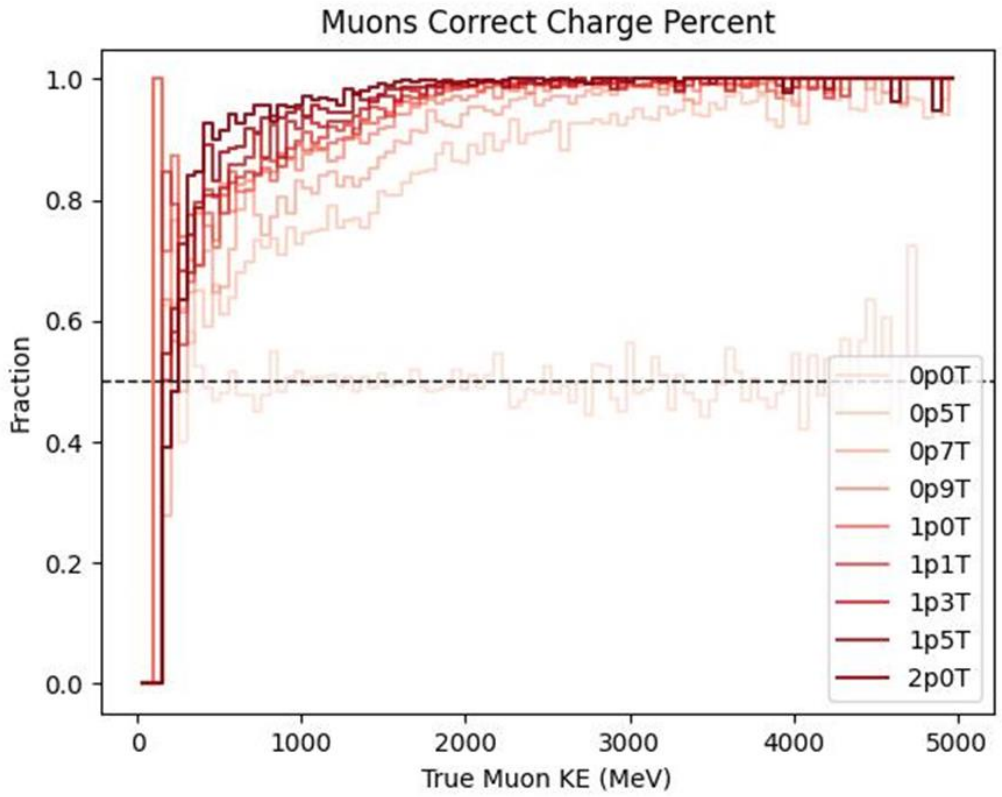


Overlaid plots for different magnetic fields within the same momentum range:

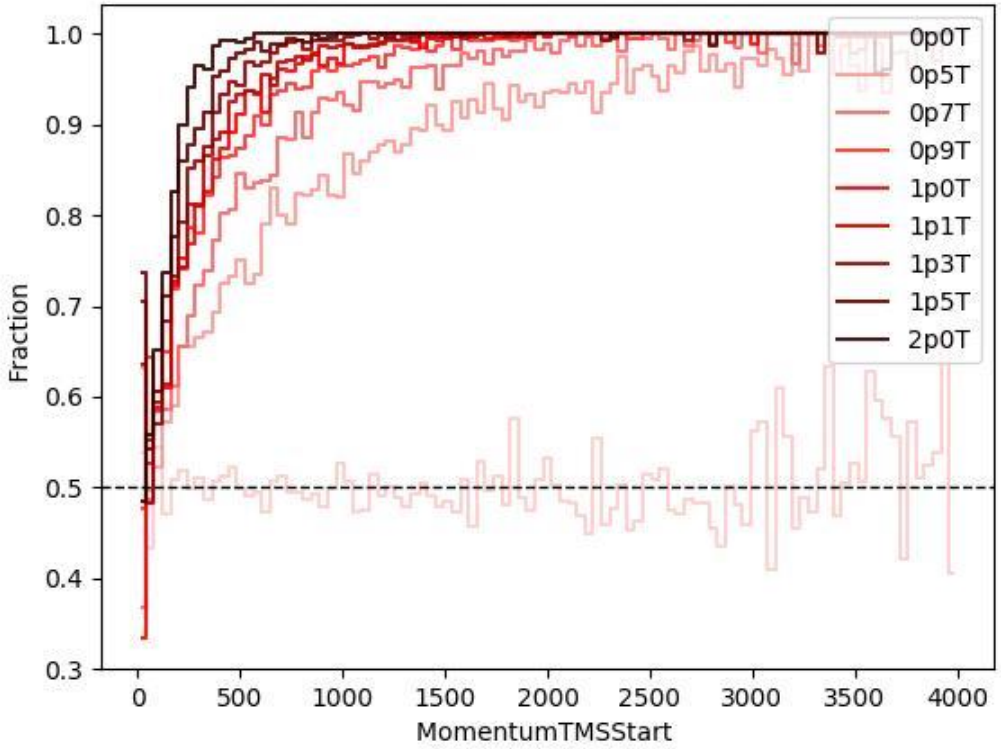




Fraction Vs True Muon K.E @ different B fields :



Fraction Vs MomentumTMSStart @ different B fields :



Files used for generation of plots can be found at following location:

- **Signed distance Vs no of muons at different B fields:**/exp/dune/app/users/sushils/new_files/dune-tms/scripts/Reco/correct_Signed_Distance_Plots@diff_Bfield.py
- **Overlaid plots for different magnetic fields within the same momentum range:**/exp/dune/app/users/sushils/new_files/dune-tms/scripts/Reco/histograms.py
- **Fraction Vs True muon KE @diff mag Fields:**/exp/dune/app/users/sushils/new_files/dune-tms/scripts/Reco/correct_Eff_Vs_True_Muon_KE.py
- **Fraction Vs MomentumTMSStart @ different B fields:**/exp/dune/app/users/sushils/new_files/dune-tms/scripts/Reco/correct_momentumtmsstart.py
- **Signed distance Vs no of muons at various momentum ranges:**/exp/dune/app/users/sushils/new_files/dune-tms/scripts/Reco/updated_correct_SD_MUONS_AMuons@momentum_ranges5.py

Thank you !!