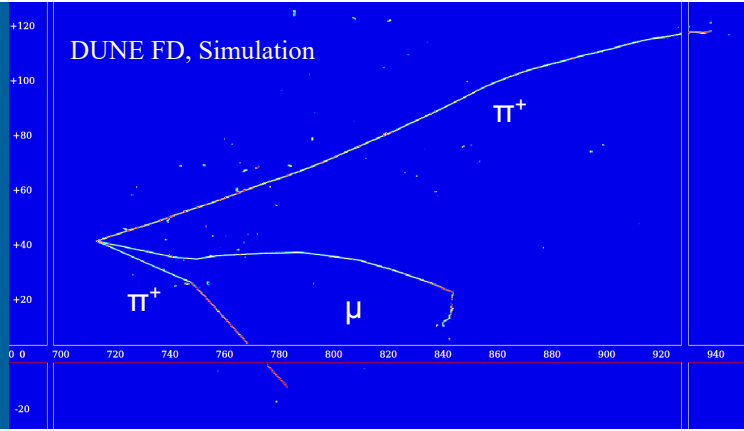
NEUTRINO ENERGY SCALE MEASUREMENTS FOR FINAL STATE INTERACTIONS USING ADVANCED COMPUTING IN DUNE



ALEENA RAFIQUE
On behalf of the DUNE collaboration
Argonne National Laboratory
NuPhys 2023

U.S. DEPARTMENT OF ENERGY
Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC.

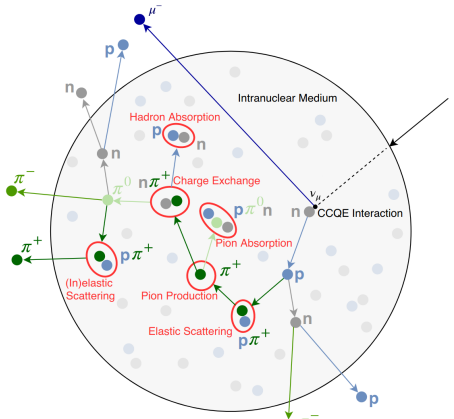
12/19/2023

INTRODUCTION

- ANL Computing resources
  - ANL Leadership Computing Facility
  - Laboratory Computing Resource Center

Resource	Description
Bebop	Intel Xenon CPUs with 1024 public nodes
Swing	NVIDIA AI100 GPUs with 6 public nodes

- Final State Interactions
  - After an initial neutrino interaction with Ar nuclei, The initial state hadrons undergo secondary interactions, called final state interaction (FSI), with the other nucleons within the same nucleus.
  - FSI can change the topology of the interactions



https://arxiv.org/pdf/2201.04664.pdf

ANALYSIS AND RESULTS

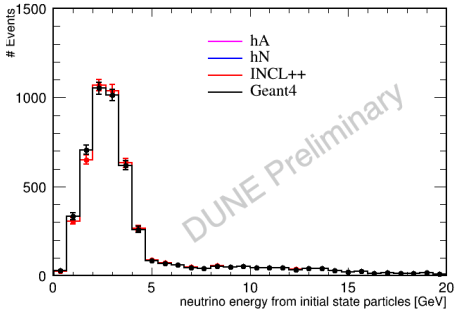
Standalone event generator

Alternate FSI models

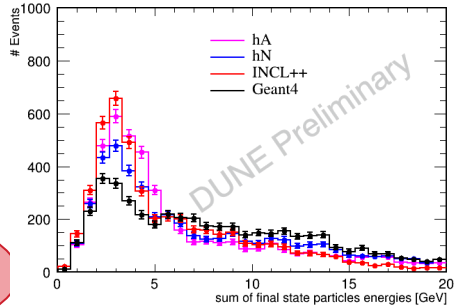
Impact on true neutrino energy

Impact on reco neutrino energy in ND and FD

Estimate the impact on the DUNE physics sensitivity

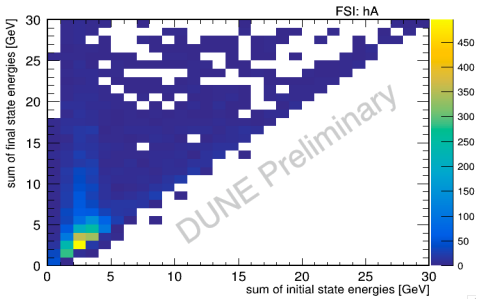


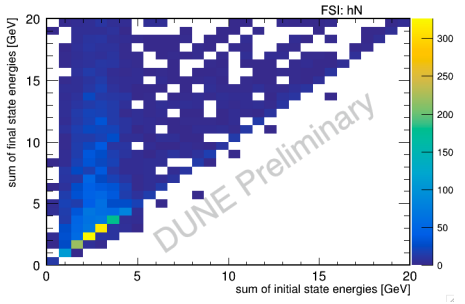
Initial state energy sum (GeV)

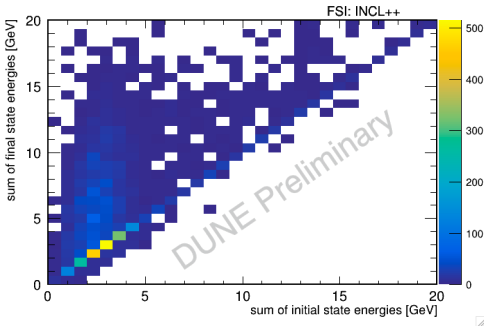


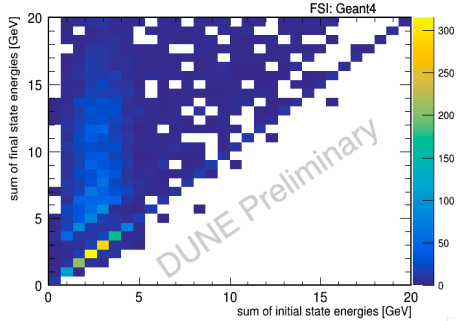
Final state energy sum (GeV)

For the same initial state interactions, the FSI energy sum differs for up to 45%









Initial versus final state energies for different FSI models. Better agreement in energies for the models hN and INCL++.

SUMMARY AND NEXT STEPS

- First demonstration of utilizing ANL computing for DUNE physics studies
- Observed how FSI can impact the neutrino energy spectrum
- Plan to look for the reconstructed neutrino energy
- Will calculate the impact on the CP violation sensitivity studies