

Neutrino Simulations Group: Intro

- The Neutrino Simulations Group focuses on two major neutrino simulation tools
 - Neutrino Event Generators
 - Neutrino Beam Simulations
- In both cases, we work on
 - Developing the tools themselves
 - Interfacing the tools to the simulations frameworks of Fermilab neutrino experiments
 - Working on experiments taking data aimed at improving the precision of these simulations

Neutrino Simulations Group: People

Laura Fields

Group Leader, MINERvA/DUNE



Steven Gardiner

MicroBoONE/GENIE Postdoc



Deepika Jena

MINERvA/DUNE Postdoc



Robert Hatcher

GENIE, MINOS/NOvA



Walter Giele

GENIE/ Virtual from Theory



Leo Aliaga

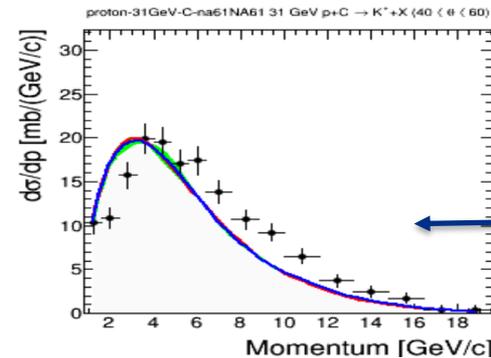
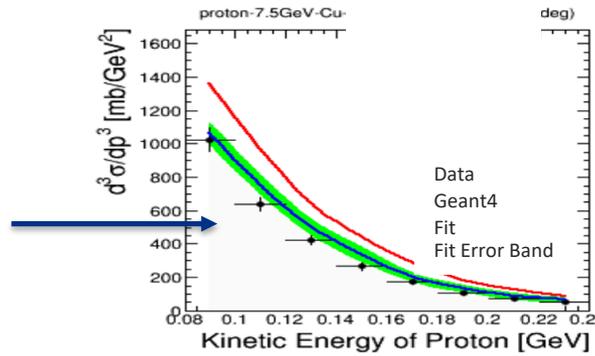
NOvA/DUNE Postdoc



Neutrino Simulations Group: Past activities

- Recently completed:
 - Geant4 Varied Model Parameters project (w/ Soon Yung Jun) recently completed its first phase, demonstrating a technique for fitting Geant4:

Identified ways to improve Geant4 physics performance



Highlights where more degrees of freedom are needed.

- Documented in paper: arXiv:1910.06417
- Indicates that many more Geant4 degrees of freedom (including the major project of varying cross sections) are needed before it will be useful to experiments -> project has now become part of PDS Geant4 activities

Neutrino Simulations Group: Current Activities

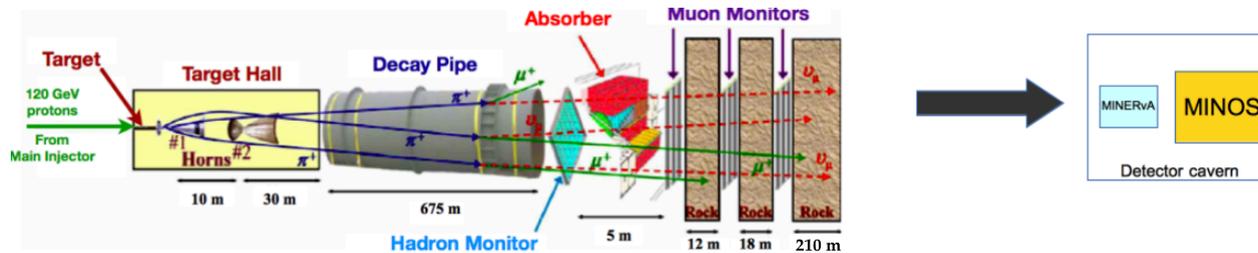
- A major focus of the group is development of the GENIE event generator



- Recent major achievements: Release of major new release (v3) with model tunes, Geant4 Bertini & INCL++ models made available in GENIE
- Major ongoing activities: Development of Unit Tests (Giele), Technical coordination and slaying of many technical problems (Hatcher), implementation of several new models (Gardiner), Incorporation of V3 for MicroBooNE (Gardiner) and NOvA (Hatcher)
- Also planning workshop at Fermilab in January to attempt to get generator authors (including non-GENIE) to agree to some common components (event format, flux driver, theory interface, input flux/geometry, separation of FSI/primary interaction)

Neutrino Simulations Group: Current Activities

- Several of us also work on neutrino beam simulations:



- Fermilab uses Geant4-based simulations to simulate our neutrino beamlines and produce predictions of neutrino fluxes at our detectors
- Robert Hatcher wrote and maintains the Dk2nu package, a (awesome!) common flux file format that all Fermilab neutrino experiments use
- Leo Aliaga wrote and maintains PPFx, a package that can be used to correct hadron production in neutrino beam simulations and assess systematic uncertainties
- Deepika Jena produces fluxes for the MINERvA experiment and implement a constraint of the neutrino flux using neutrino-electron scattering
- Deepika, Leo and Laura all participate in the DUNE beam interface working group, focused on developing and improving DUNE's neutrino flux predictions

Neutrino Simulations Group: Current Activities

- We also make many other contributions to Fermilab neutrino experiments
 - Leo Aliaga is NOvA Run Coordinator and Beam Working Group Convener
 - Working on inclusive and 0 pi cross section analyses
 - Steven Gardiner is MicroBoone Systematics Working Group Convener
 - Also working on analysis of Single Transverse Variables that highlight nuclear effects in neutrino interactions
 - Robert Hatcher makes a variety of contributions to NOvA, MicroBooNE, MINOS, MINERvA, ArgoNeuT and DUNE
 - Deepika Jena is MINERvA's production coordinator
 - Also working on an analysis of charged current neutral pion production cross sections
 - Laura Fields is Co-Spokesperson of MINERvA & DUNE Beam Interface Working Group coordinator
- We also work experiments taking data to improve beam simulations:

