

compf2 – ν Event Generator

Steve Dytman (Pittsburgh)

Steven Gardiner (FNAL), Hugh Gallagher(Tufts), and others

Computational Frontier workshop (Snowmass)

10 August, 2020

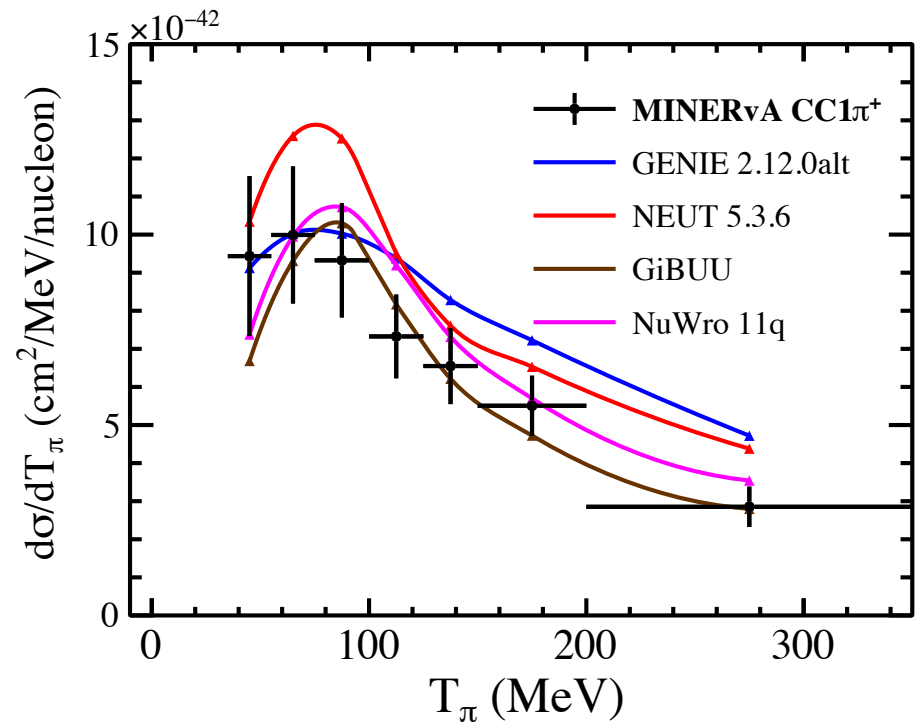
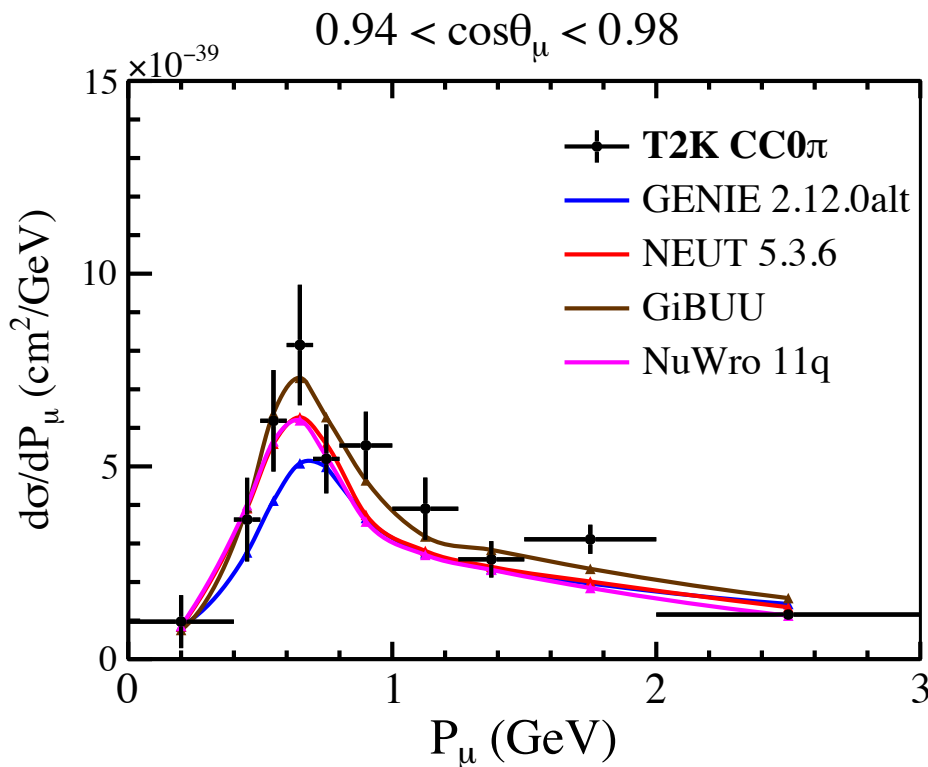
- Many ν oscillation expts need simulation
 - ❖ GENIE, NEUT, NuWro used by expts
 - ❖ GiBUU has better theory foundation
- Community-wide discussions in last few years make LOI an easier task.

Summary of existing code

- ▶ **GENIE is most often used by experiments**
 - ▶ Most developed flux/geometry/reweighting package
 - ▶ Variety of models can be easily configured
 - ▶ Recent work in producing interface to output files from GiBUU
- ▶ **NEUT is used for T2K oscillation experiment**
 - ▶ Mixture of C++ and Fortran
- ▶ **NuWro used as a sandbox**
 - ▶ Main developer is a theorist who works on experiments
 - ▶ Models migrate from there to NEUT, GENIE! (many similarities)
- ▶ **GiBUU was developed separately by NP theorists in Europe**
 - ▶ Very interesting for comparisons, differences with others not large
 - ▶ Unlikely to ever be used for experiment simulation

Backup - Plots from Tensions

- ▶ Comparison of various generator simulations of T2K, MINERvA data [Phys. Repts. 773-774, 1 (2018)]
- ▶ Plots include all generators (NUISANCE)



Recent progress/problems I

- ▶ Code work largely done by experimenters
 - ▶ Recent addition of postdocs in US and UK important
 - ▶ FNAL effort small but must provide crucial support for expts
- ▶ Significantly more interaction with NP theory
 - ▶ About 15 integration projects underway
 - ▶ Nevertheless, NP motivation not strong (funding)
- ▶ Interaction with HEP theory rapidly increasing
 - ▶ Interest in beyond standard model issues linked to neutrinos
 - ▶ Josh Isaacson and student started work on a theory interface
- ▶ Significant interest at Jefferson Lab (NP electron accelerator)
 - ▶ Ar(e,e') published
 - ▶ E4nu collaboration about to publish (e,e'p) with links to ν expts
- ▶ Efforts toward global fitting
 - ▶ NUISANCE fits output from generators, Professor in GENIE

Recent progress/problems II

- ▶ **Workshops at Trento (2018, 2019) and FNAL (2020)**
 - ▶ Gather theorists, experimenters, and event generator builders from the international community (~30 attendees)
 - ▶ Main issues - funding, code structure, theory interfaces
 - ▶ Improve theory/code builder interface
 - ▶ Do existing codes satisfy the community?
 - ▶ Issues similar to colliders!
 - ▶ White paper from FNAL workshop will be released soon
- ▶ **LOI comes from good representation of attendees at FNAL**
 - ▶ Ideas come from the workshops + experience

1 Introduction

short summary of where we are. SD

how we relate to LHC event gen, refer to HSF doc. HG

problems, recent progress - workshops, improved theory relations
structure. SG
theory. SG
funding. SD

role of elec scat. SD

role of xs expts. HG

BSM, low energy physics. SG

new computing techniques SG

needs better funding (postdocs, nuclear theory)
more professionals at FNAL
broader/more transparent platforms. ALL

Status

- ▶ Core group is formed (Steve D, Steven G, Hugh G, Minerba Betancourt, and Josh Barrow)
- ▶ Meeting with FNAL workshop/code leaders later this week to discuss outline for LOI and white paper
- ▶ Good communications with Steve Mrenna (collider event generators), direction not set
- ▶ We have many pages of ideas and TODO's for white paper
- ▶ Finish before deadline