GENIE-xyzzy:
Support for Pythia8

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February 12, 2024

Abstract

In GENIE the external package Pythia (Ref. [1]) is used to support two separate features. One of those tasks is the decay of unstable short-lived particles. The second task is to hadronize quark-diquark systems above the energies where the AGKY empirical model is deemed satisfactory. The hadronization happens by itself and in the presence of a charm hadron; these are handled separately. From an early date these were handled by the fortran-based Pythia6 via the ROOT interface. Pythia6 was deprecated as of July 2013 and ROOT intends to remove the Pythia6 interface soon (probably in 2024). This document discusses changes necessary to migrate to directly using the C++-based Pythia8 code base.

Contents

1 Implementation

1.1 Work Plan

I started with the work plan (Ref. [2]) that Costas laid out in 2002 as an initial outline of things that needed to be done. I also needed to modify the "configure" script to allow GENIE to be built without any reference to Pythia6.

1.2 Modifications

changes to "configure"

renaming old classes, new implementations to parallel the pythia6 variants

example code for exclusion in absence of pythia6

2 Running the Code

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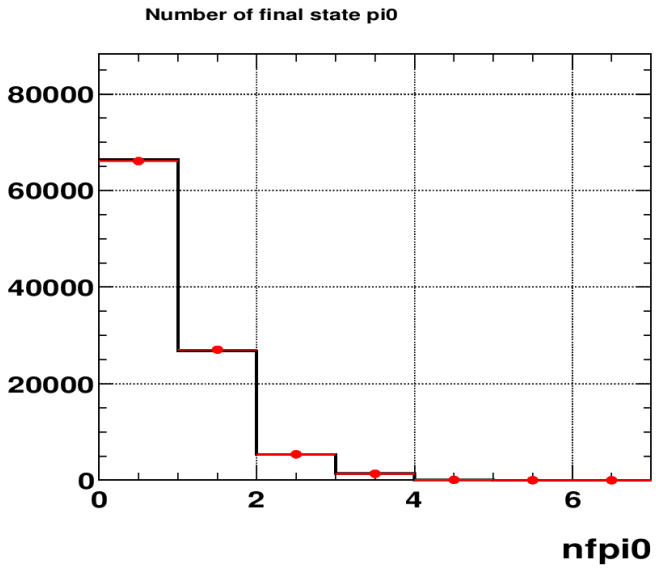

Figure 1: Number of π^0 for default 3 GeV ν_μ

2.1 Comparisons

For comparisons I generated three samples of 100000 events for each configuration of using Pythia6 or Pythia8 with the "gevgen" application. One with the default generator list and 3 GeV ν_μs. Then to more thoroughly exercise the modified code: a sample of 25 GeV ν_μ with the "Charm" generator and a sample of 25 GeV ν_τ with the "Charm" generator where charm hadrons and tau leptons were forced to decay.

References

[1] Pythia8 authors. Welcome to pythia. https://pythia.org, 2024.

[2] Costas Andreopoulos. Complete replacement of pythia6 with pythia8. https://github.com/GENIE-MC/Generator/wiki/Complete-replacement-of-PYTHIA6-with-PYTHIA8-(2022), 2022.

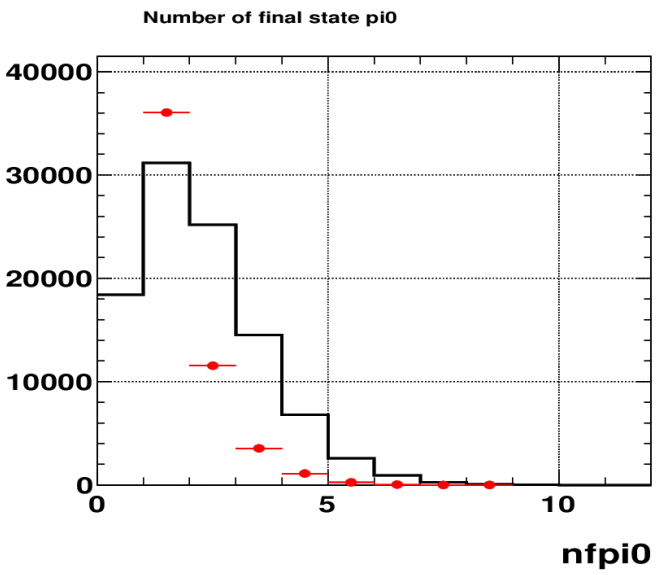

Figure 2: Number of π^0 for 25 GeV charm ν_μ

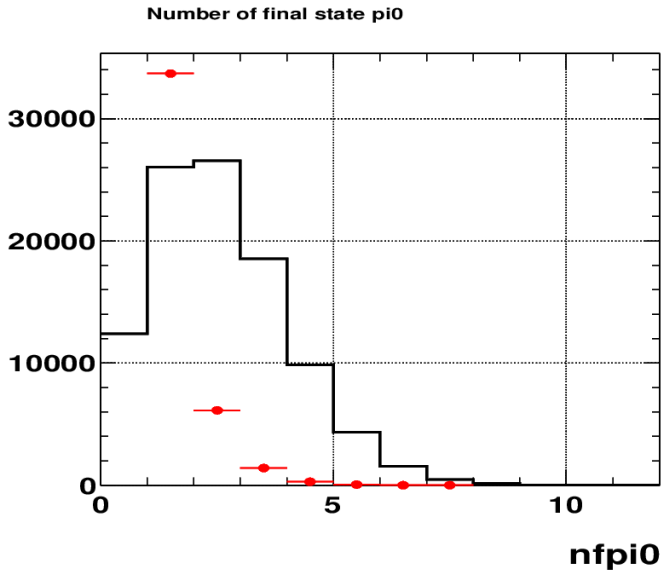

Figure 3: Number of π^0 for 25 GeV charm ν_τ

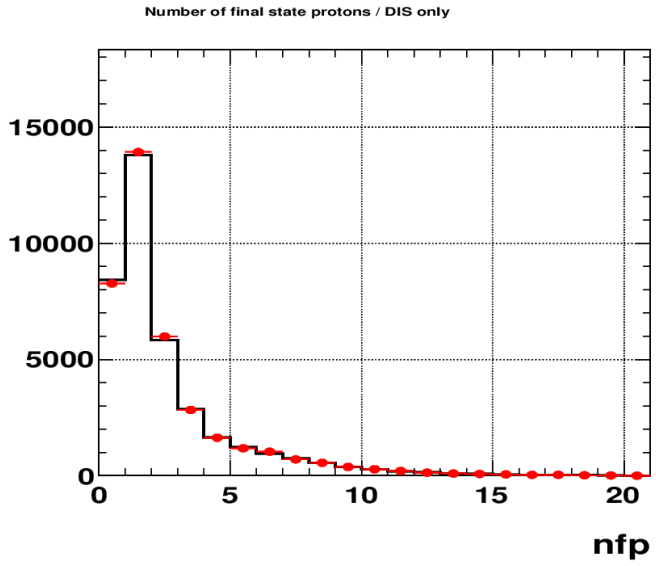

Figure 4: Number of final state protons for default 3 GeV ν_μ

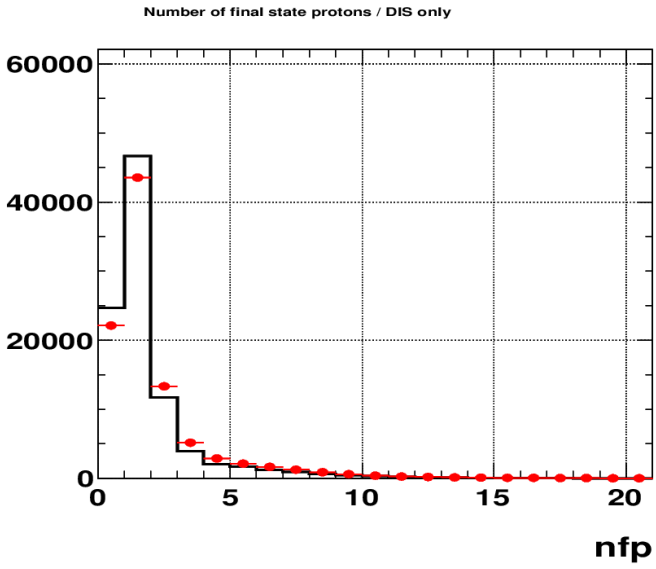

Figure 5: Number of final state protons for 25 GeV charm ν_μ

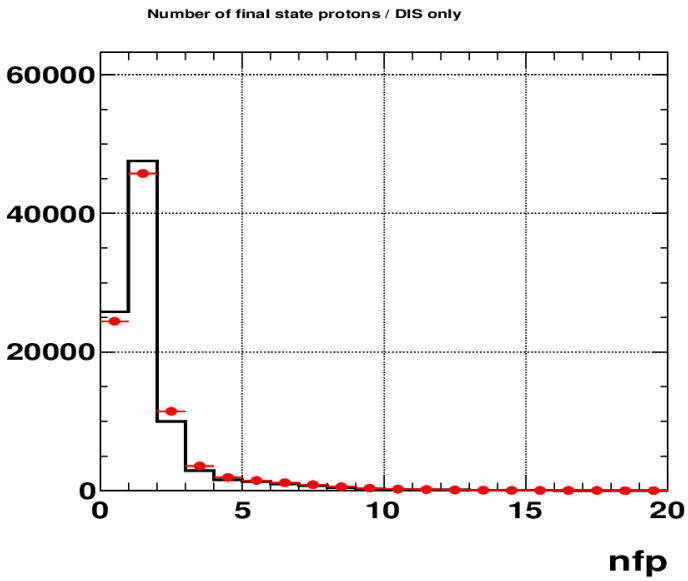

Figure 6: Number of final state protons for 25 GeV charm ν_τ

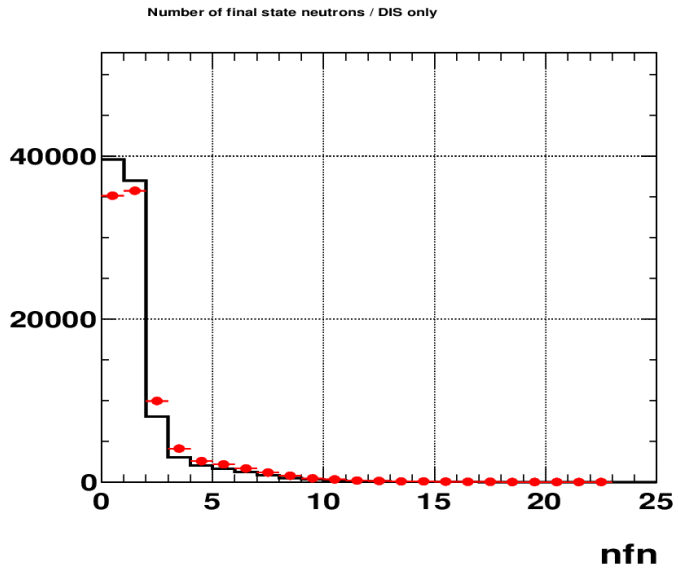

Figure 8: Number of final state neutrons for 25 GeV charm ν_μ

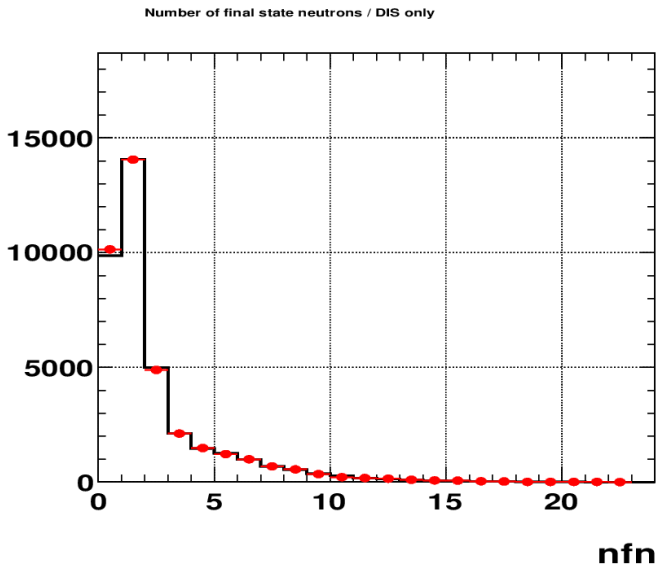

Figure 7: Number of final state neutrons for default 3 GeV ν_μ

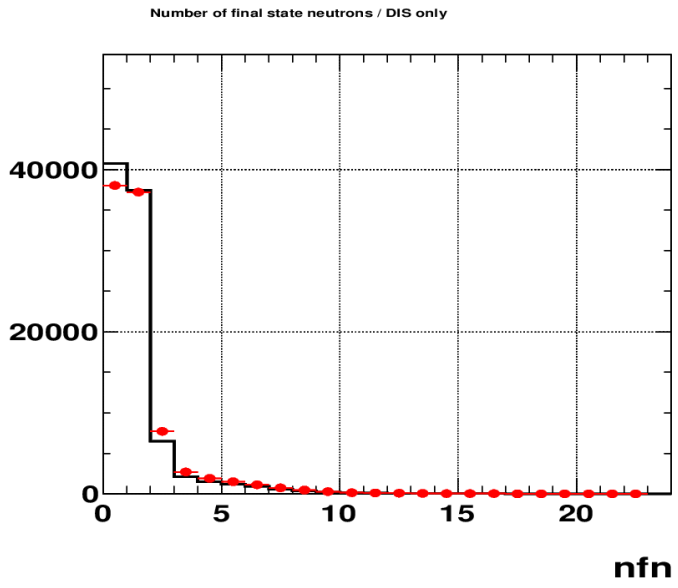

Figure 9: Number of final state neutrons for 25 GeV charm ν_τ