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Evaluating the use of Geant4 through LArSoft in the LArIAT simulation

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LArIAT Meeting

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Motivation

- Make you aware of and introduce you to the project.
- Ask for feedback/help.
- LArIAT will benefit greatly from having the best simulation currently available.

Charge

Begin a two week (FTE effort not real time) project evaluating the use of Geant4 through LArSoft in the LArIAT simulation. The scope includes everything from reading in the stdhep particle list/or single particle gun through digitization (Wire Sim.)

Goals

A primary goal of this project is to improve LArSoft. Also, all of the code and procedures that are in the scope of this project are in common with other LAr experiments. Any suggested improvements will benefit users of LArSoft. Another major goal is to fit this project to the effort available. Recommendations that point out problematic areas that need further study are highly appropriate.

Effort: The best candidates for this work are Hans (primary), Soon (secondary), and Krzysztof (secondary).

This project should be limited to two people working for one week (two weeks total effort).

This includes evaluation and production of the major findings. The final report can be modeled after the previous MicroBooNE profiling report.

To be evaluated:

This evaluation includes:

- physics lists - provide recommendations for improving the low-energy physics lists that are currently in use. (currently: QGSP_BERT, what about BIC, INCLXX for hadronic or precise em Option? → what are the figure of merits?)
- geometry use and energy deposition - examine voxelization and parallel geometry that is currently used for the LAr TPC. (is it too fine?)
- stepping and other Geant parameters - provide recommendations for improvement to Geant4 configuration.
- code speed - use profiling to locate slow sections of code and identify high-level causes if possible. (see microboone report)
- upstream detector integration - if there is time, provide guidance for integrating upstream auxiliary detectors into the simulation.

Prerequisites

There are several questions that need to be answered and preliminary work that needs to be completed before this project can start.

- Geant4 version - LArSoft appears to still be using 4.9.6.p04. How important is it to move to 4.10.p02 to make necessary or useful improvements? There are known bug fixes affecting the physics LArIAT is interested in → recommend updating.
- Running LArIAT simulation - The team needs to be able to run the LArIAT simulation, and have the necessary profiling tools installed and useable on an appropriate test platform. → Johnny provided me with instructions was able to run it.
- Input particle list - what set of particles will be used to drive this evaluation? (single $K^{+/-}$, p , $\pi^{+/-}$, $e^{+/-}$, $\mu^{+/-}$)
- Contacts - who are the primary experiment contacts that will answer questions about the simulation? (Brian and Jason)

First Look

Followed Johnny's instructions 100 single p+/- events took about 90 seconds (lariatgpvm03) and produced 56Mb output file.

Module	Percentage
Geant 4	18%
Wire Simulation	38%
RootIO	44%