Action items and decisions

Our previous decision to go to GEANT4 version 4.9.4 has been rescinded. For near term projects, we will use GEANT4 v 4.9.3 P02 with new mu-nuclear. The exact details of version and physics lists will be posted by Anthony on the DMTask Force Wiki. We will then switch directly to 4.9.5 in December when the new version is released.

The goal of this group is to understand the uncertainties surrounding cosmogenic simulations and to reduce these uncertainties in the future. Currently, we agree that we cannot trust the physics involved in the muon-induced underground hadronic showers to within a factor of two, and the uncertainty is mostly due to neutron yield. Any larger disagreements are probably due to implementation or confusions in definition, and we would like to eliminate those sorts of uncertainties. By November 29, we should be able to present a unified plan to NSF/DOE, describing how we will address these issues over the next 6-8 months. Part of that presentation should be concrete examples of how we have organized ourselves around this principle and what work has been accomplished so far.

The following near term projects will help us to characterize the relevant uncertainties by comparing simulations with respect to event generation, spectral parameterization, and implementation strategies, as well as data from several sources.

We have (or will have) the following input files of particles accessible from links found on the Task Force Wiki

1. “Groom” Parameterization of muons at Homestake depth, propagated through
 rock using GEANT4 v4.9.3 P02 with new mu-nuclear to produce neutrons and all
 secondaries. Assumes a flat overburden, but has a good angular distribution of
 incoming neutrons. Uses “Soudan” rock. Available now.

2. Muons generated via MUSUN, taking account of the geography and geology of the
 Homestake site. Muons then propagated through rock using GEANT4 v4.9.5 to
 produce neutrons and all secondaries. Available after Dec 2 release of v4.9.5

3. Muons generated via MUSUN, taking account of the geography and geology of the
 Soudan site. Muons then propagated through rock using GEANT4 v4.9.3 P02
 with new mu-nuclear to produce neutrons and all secondaries. Available now.

We also have two examples of neutrons thrown one at a time from a spectrum derived from the Mei&Hime parameterization:

A. The LZ Monte Carlo (4850 level) with isotropic angular distribution on a sphere

B. The Neutron Multiplicity Meter (2100 mwe) with cosnq distribution (partly
 derived from existing flux measurements)

File 1 versus File 2 will quantify uncertainties based on muon distributions and any changes between GEANT4 versions.

Files 1,2,3 versus A&B will highlight uncertainties due to secondary particles and angular distributions.

The “detector” should be a simple geometry and the same in the comparisons. It will be similar (or the same as) the LZ “detector” since that is already in use by Brown and can be inserted into the USD AARMSim. The link to the approved geometry is found on the Task Force Wiki

NOW

Job1: Monica and David run LZ Sim at Brown with the approved G4 version and physics list and using File 1. Compare with Implementation scheme A

Job2: Chao bring over the LZ geometry into AARMSim (with David’s help). Then run it using File 1. Compare with results of Job 1.

Job3: Angie prepare File 3 for use by Melinda to compare to Implementation scheme B. Quick comparisons that do not require re-running Sim B are

* comparing n-spectra from both methods.
* comparing angular distributions on the 5 walls of the box.

Also compare to NMM data

DECEMBER

Job4: Chao re-runs MUSUN muons and generates neutrons and secondaries using new GEANT4 v4.9.5 and distributes File 2. Uses File 2 with LZ geometry and compares to results from File 1.

Job5: Monica and David run LZ Sim with new File 2 and compares to File 1 and A results.

LONGER TERM

Tony and Anthony will continue with the FLUKA v GEANT comparison. The results from a dedicated study of muon-induced neutron yield will identify components of the uncertainty due to specific processes.

Data from Borexino will be folded into the comparison as it become available.

Chao’s work on modular backgrounds will probably folded into LUXSim, including the MUSUN muons. The near term work will serve double purpose as a validation exercise.