



Detector Simulation in ν Experiments

... and what the FNAL group can do for the neutrino community



V. Daniel Elvira
Fermi National Accelerator Laboratory



- The ADSS-DS (Simulation) group
- Fermilab in the G4 Collaboration
- ADSS-DS activities relevant to the ν community
- Ideas for discussion



The ADSS-DS group

Detector Simulation - Accelerator and Detector Simulation & Support (ADSS-DS) does not describe accurately what we do

- **Generator Development & Support:** GENIE (R. Hatcher), Pythia (S. Mrenna)
- **Detector Simulation Tool Development & Support:** Geant4 (Ph. Canal, D. Elvira, K. Genser, S. Jun, H. Wenzel, J. Yarba)
 - ✓ R&D on G4 transformation for parallel computing
 - ✓ G4 Hadronic physics models (CMS), muon physics (mu2e)
 - ✓ G4 computing performance profiling, benchmarking, monitoring
- **Detector Simulation Applications:** CMS, mu2e, neutrinos, muon collider, detector R&D (K. Genser, H. Wenzel, J. Yarba)
- **ROOT Development & Support** (Ph. Canal, P. Russo)



Fermilab within Geant4

Geant4 is a collaboration of more than 100 physicists and computing professionals. A few facts about Geant4:

- Fermilab is a member institution and so are CERN, SLAC, ESA, INFN, IN2P3, TRIUMF, KEK, among others.
- Funding comes mostly from HEP but the collaboration also serves the space (ESA members) and medical (SLAC) communities.
- Geant4 development and support is strongly biased towards the LHC experiments, mostly ATLAS and CMS
- “Physics lists” are composed mostly to serve ATLAS and CMS
- The intensity or neutrino experiments were not even in the radar of the G4 team until ADSS-DS started to report on Technical Forum and Collaboration meetings.
- ADSS-DS can initiate and steer G4 effort towards the needs of the intensity and neutrino communities

But we need to learn more from you: needs, issues, plans, ...



Activities & Plans

Some examples of past and current activities:

- **CMS**: developed simulation applications for test beam experiments, software packages to test/validate G4 physics models against results from thin target experiments, modified individual models and customized physics lists accordingly
- **Mu2e**: developed large pieces of the simulation application, framework to validate G4 versus physics results within the mu2e software, revisit muon stopping and capture physics in collaboration with experts

We would like to discuss with you the possibility to:

Establish a program to **validate Geant4 physics** for the particles, materials, energy ranges relevant to the ν program, **modify or introduce new models** to improve the physics of G4, **construct a family of “physics lists”** specifically designed (if necessary) for neutrino applications



Today's Agenda

- Robert Hatcher will remind us of the detector simulation tools utilized in neutrino experiments
- Julia Yarba will teach us a little on G4 hadronic physics models and physics lists
- Discussion on ν community needs and how to move forward

[Issue to keep in mind: first neutrino interaction is handled by GENIE]