Stony Brook University

DUNE-ND-X update

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2017/06/09

DUNE Near Detector Workshop June 9-10

Near Detector Geometry

- DuneNDGGD* is a package containing python scripts and configurations files, to define a detector geometry.
  - ★ Based on GeGeDe* (Brett Viren - BNL)
  - ★ GDML output that's compatible with both GEANT4 and ROOT
  - ★ Define geometries to evaluate the feasibilities of a wide range of possible detector configurations
  - ★ Flexibly and quickly define geometry configurations.

*https://github.com/gyang9/dunendggd

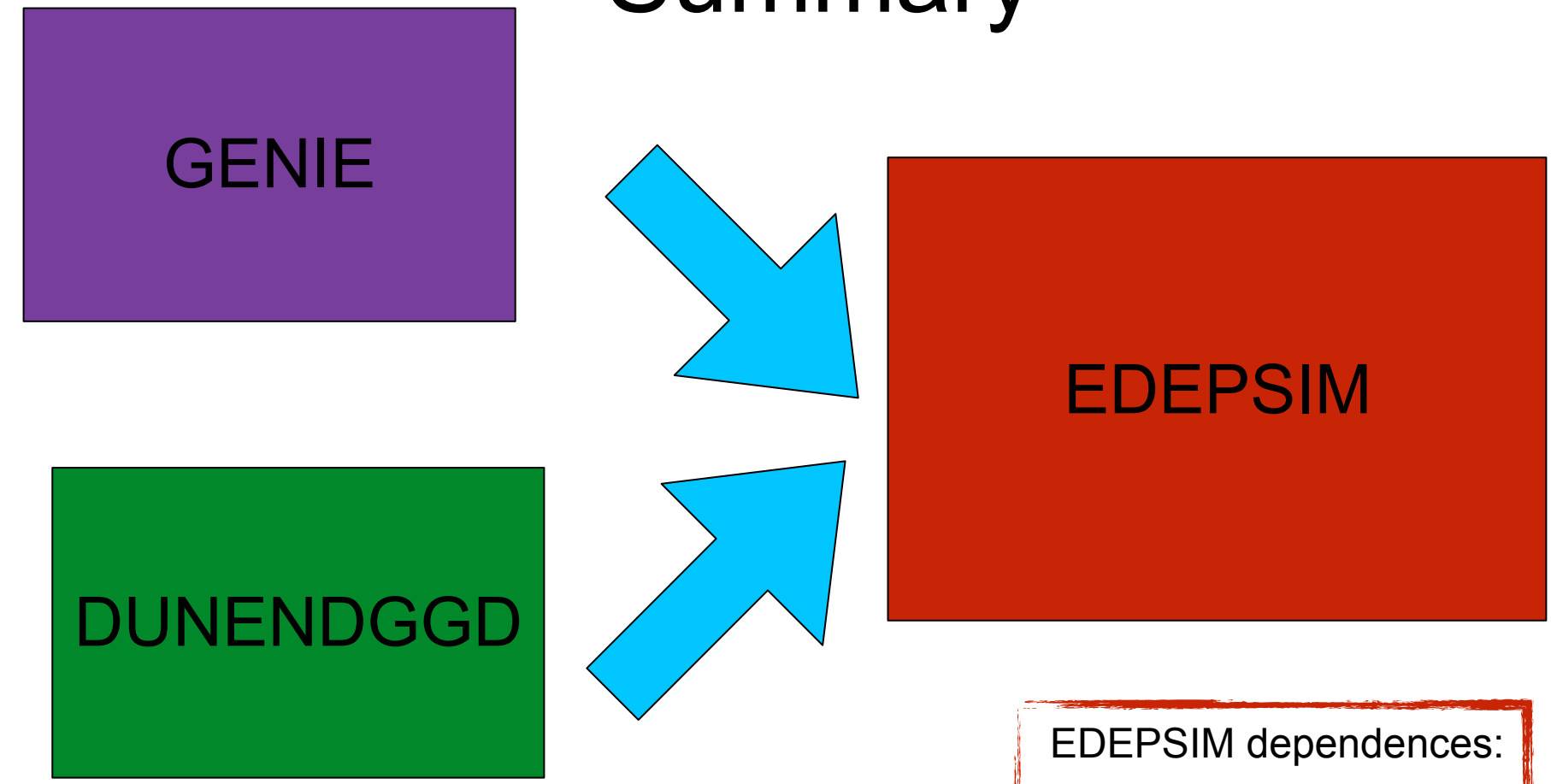
*https://github.com/brettviren/gegede

EDEP-SIM

- Experiment independent Energy DEPosition SIMulation
  - Derived from the T2K near detector simulation
  - Provides the bookkeeping and infrastructure needed to track truth information and energy deposition.
    - In T2K, the output then drives a response/digitization simulation.
  - Can be called as a library, or to used to directly write a ROOT tree
  - Being used to simulate/debug the DUNE-ND-GGD geometries
- Detailed simulation
  - Electric and magnetic fields (from GDML)
  - Can simulate full beam structure, upstream and magnet interactions.
  - Detailed model for LAr recombination using NEST†
    - Handles both ionization and optical photon production
    - Validated by CAPTAIN collaboration against published ICARUS ionization measurements
- Major Features
  - Minimal dependencies (only ROOT and GEANT4 via cmake)
  - ROOT tree format designed to make analysis easy (more in some other meeting).
  - Provides a simple ROOT (Eve) based event display
  - Fast (can simulate 10's of GeV per second)
  - Reads interactions from GENIE, NEUT, NUANCE (easily expanded)
  - Scalable: Users can start with simple geometry, but edep-sim already handles the complexity needed for a running experiment.
  - Mature code. Except for cosmetic changes, it's been in used for a long time and has been thoroughly exercised.
  - Produces geometry that's ready for GENIE

†Enhancement of NEST capabilities for simulating low-energy recoils in liquid xenon, M Szydagis, A Fyhrie, D Thorngren and M Tripathi, Journal of Instrumentation, Volume 8, (2013)

Summary



EDEPSIM dependences:
ROOT, GEANT4

DUNENDGGD dependences:
GeGeDe

DUNEND-X contains:
ROOT, GEANT4, GeGeDe

Acceptance in LAr (Preliminary)

*Using previous talk geometry

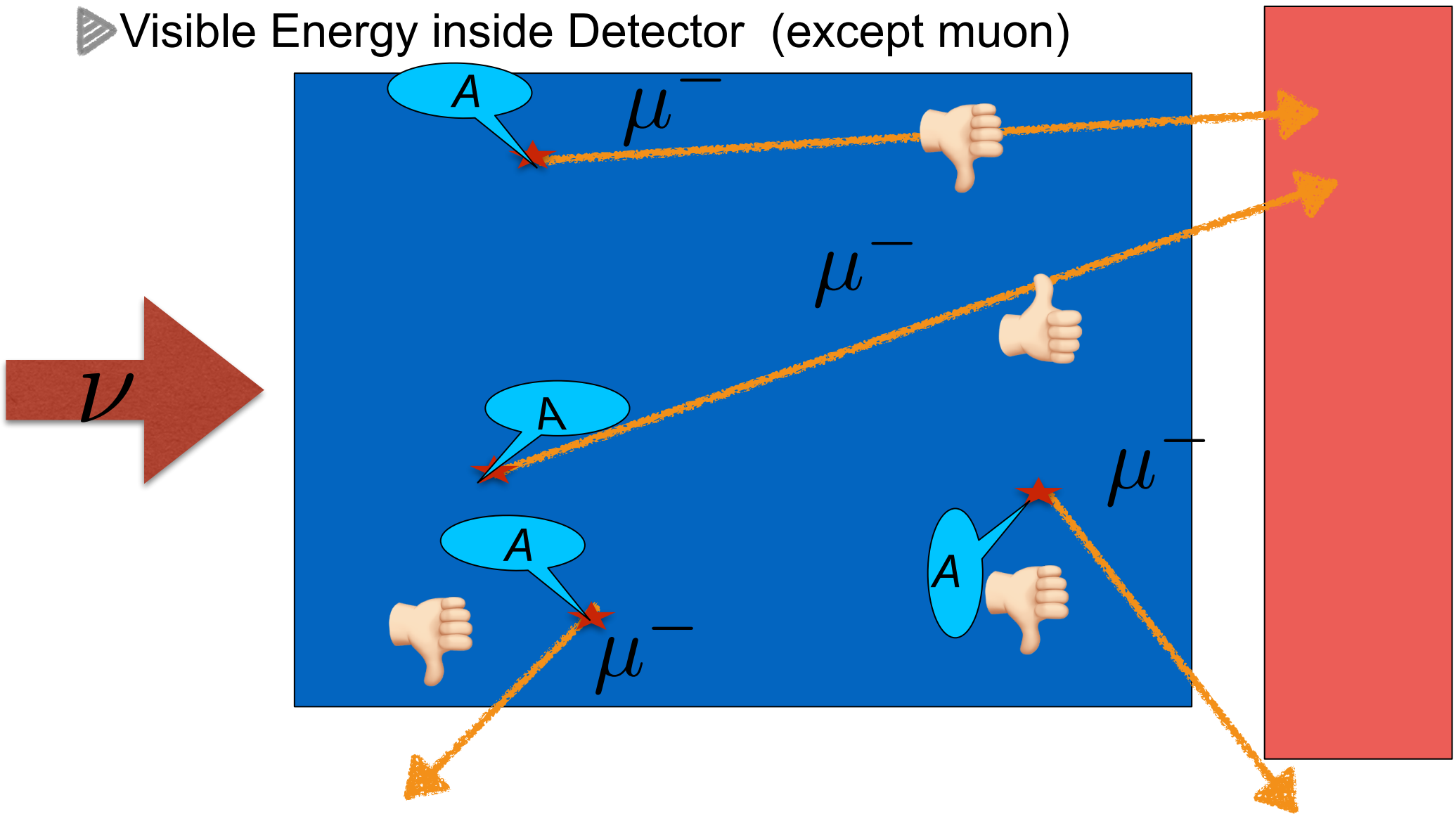
Simulation

- DuneNDGGD generated hybrid detector:
  - LArDetector 4mx3mx6m.
- GENIE rootracker based on FHC(RHC) flux (ND 459 m)*.
- Edem-sim simulated neutrino interaction inside LAr detector and kept record about the truth information and energy deposition.

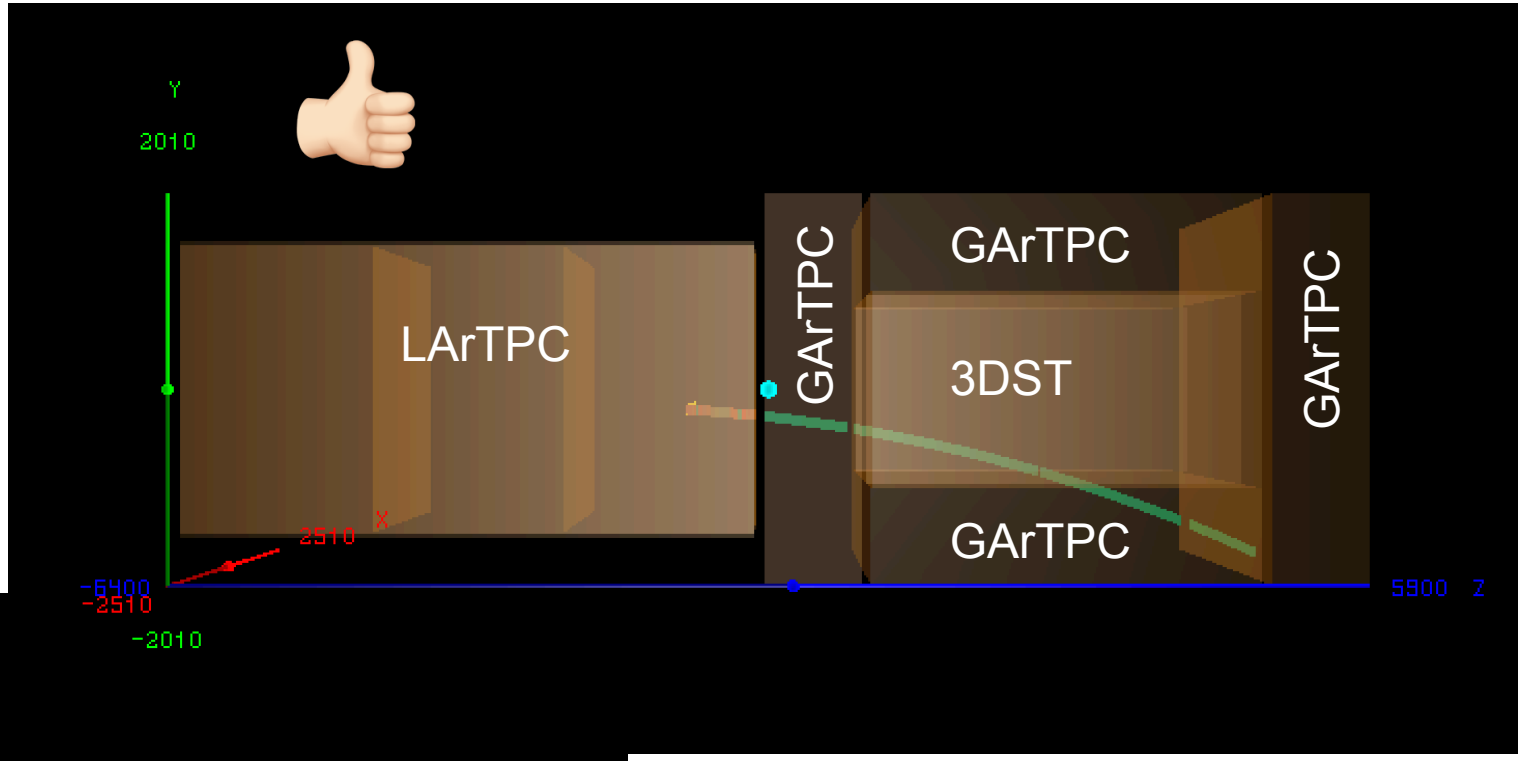
*arXiv:1606.09550

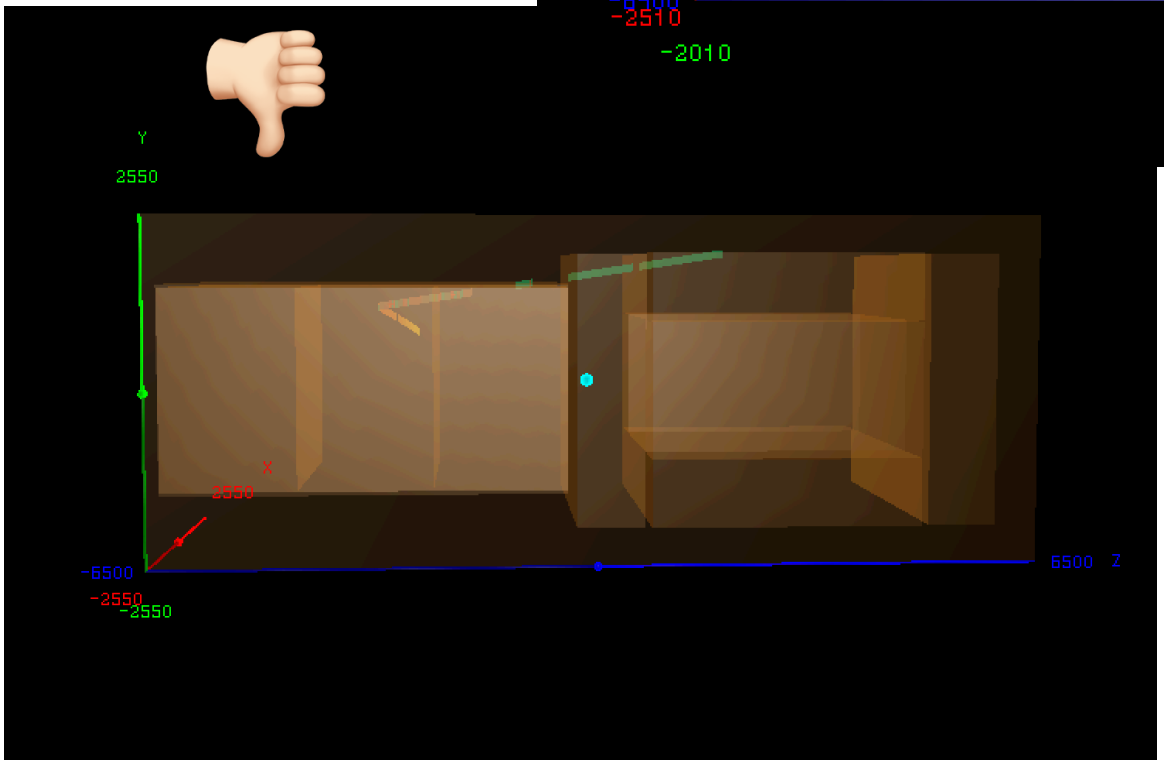
Event Selection

- Muon reaching the downstream Detector
- Vertex inside Fiducial Volume (50cm wall distance)
- Visible Energy inside Detector (except muon)

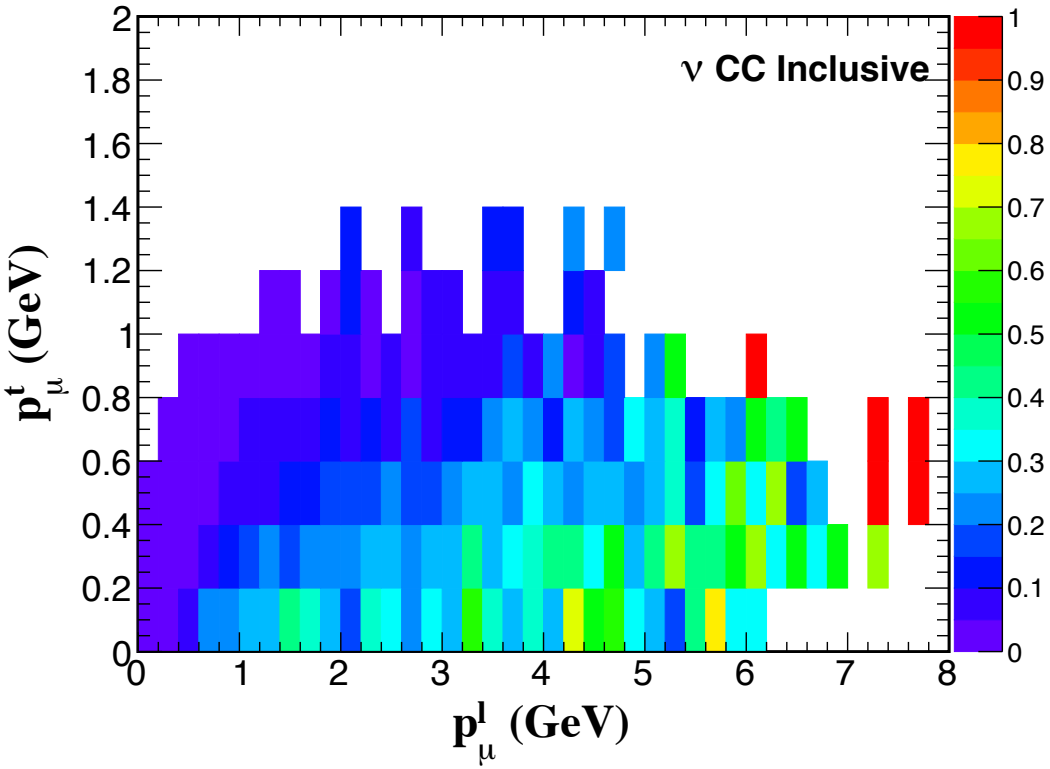


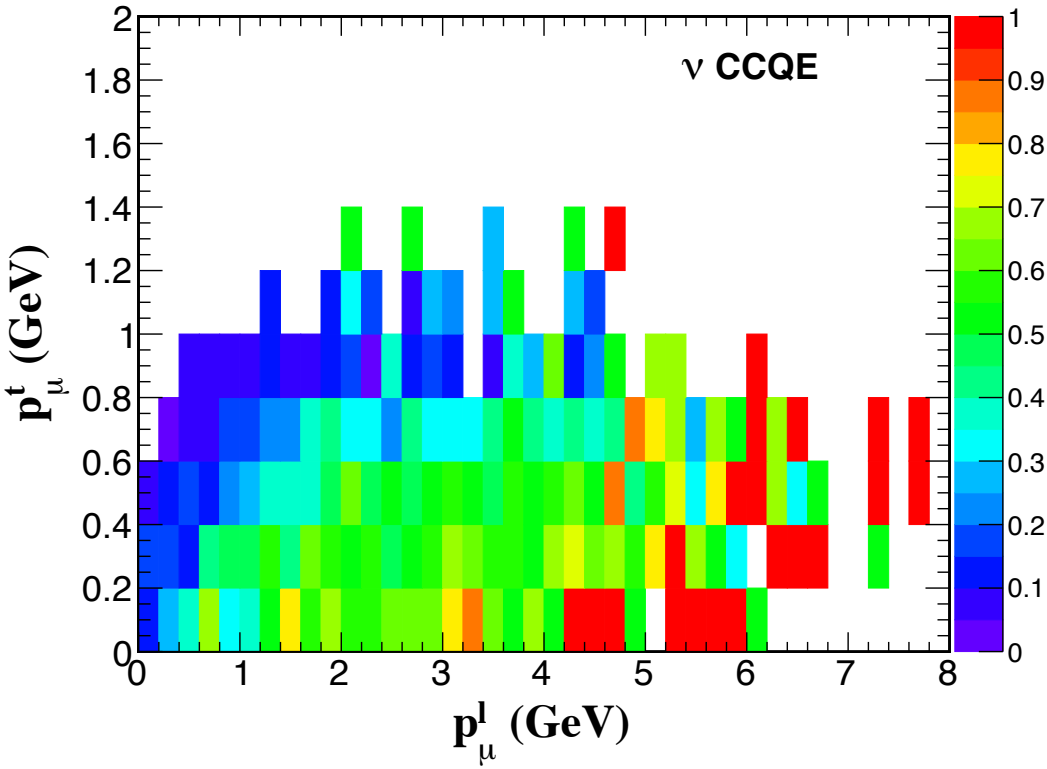
Event Selection Examples





FHC beam mode - Acceptance I



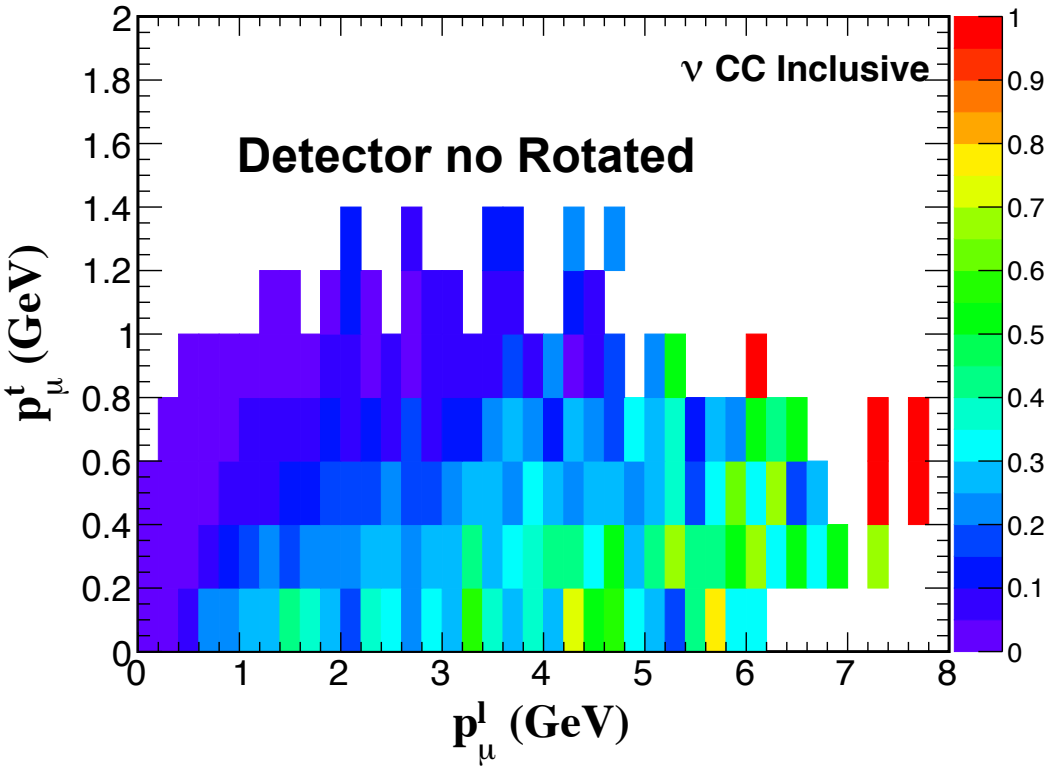


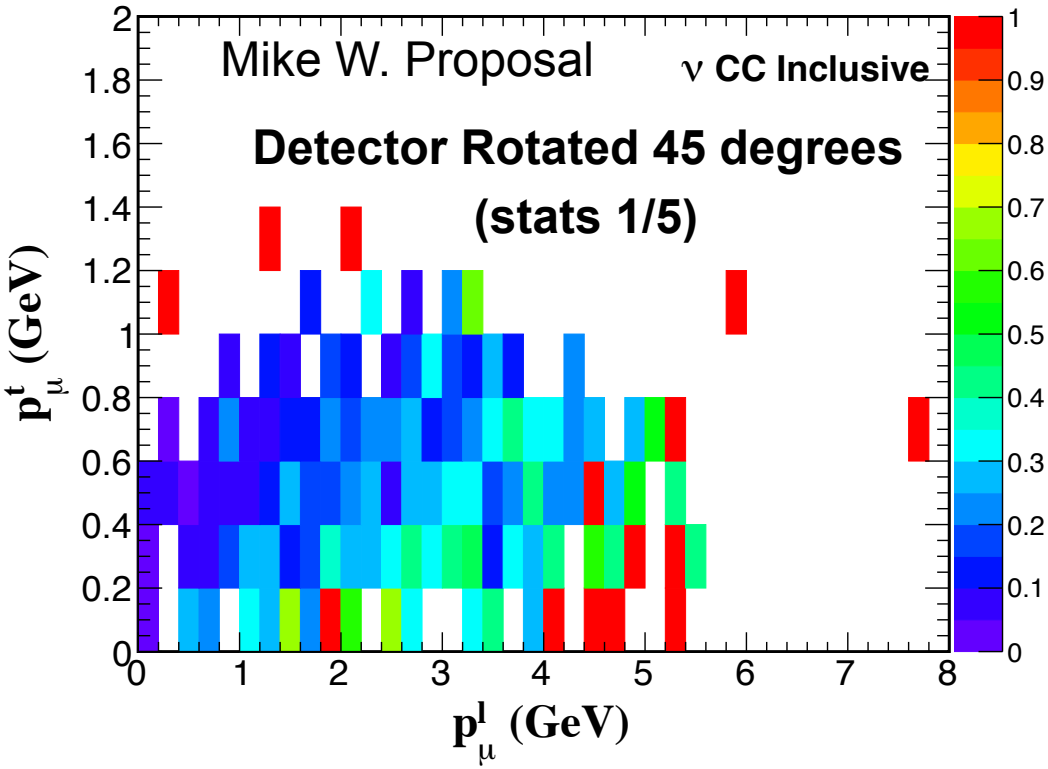
Acceptance = #N (Event Selection) / #N (generated in FV)

CC RES and CC DIS backup slides

Wrong sign sample not include

FHC beam mode - Acceptance II





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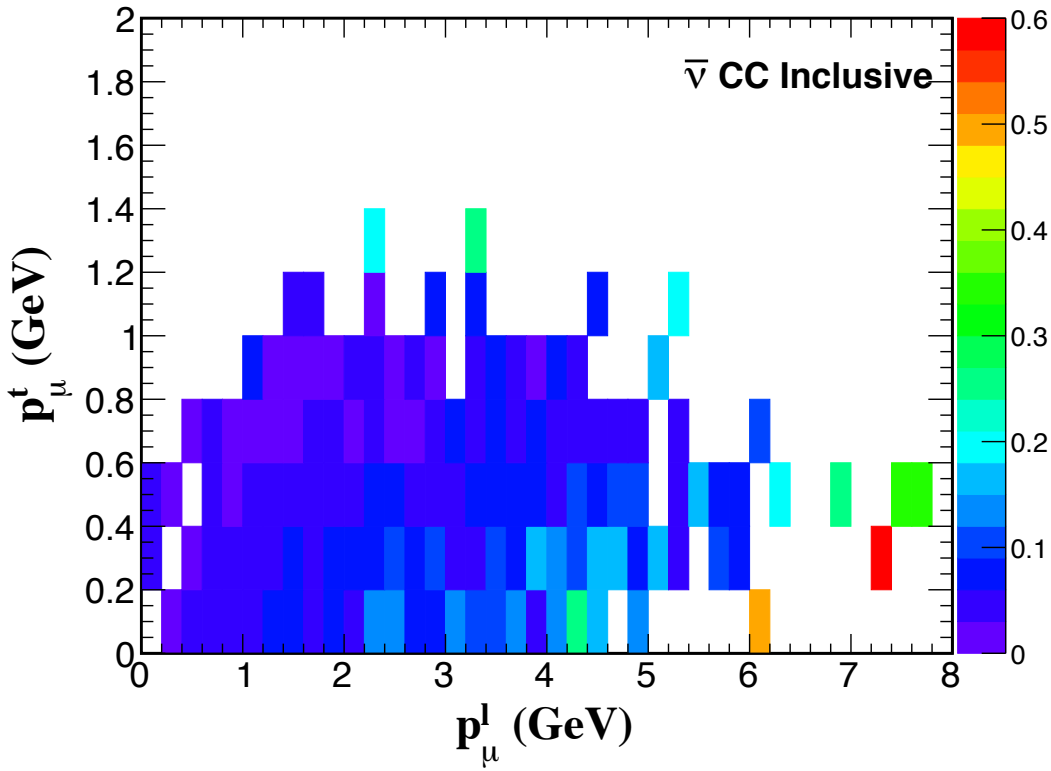
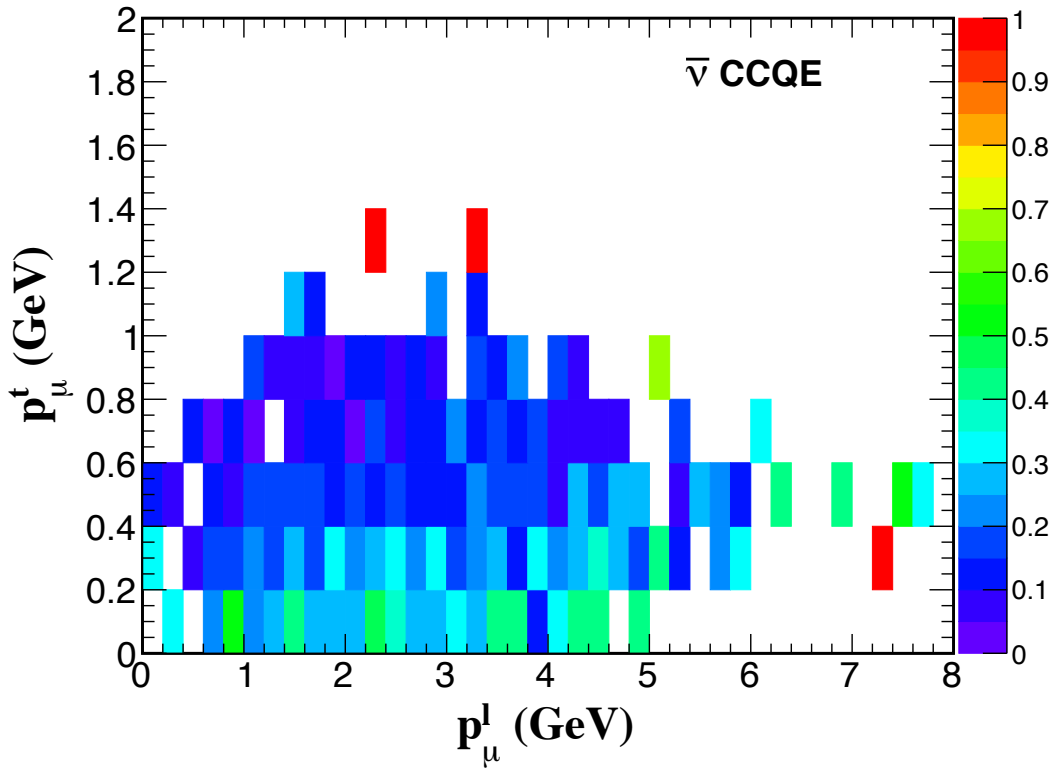
RHC beam mode - Acceptance





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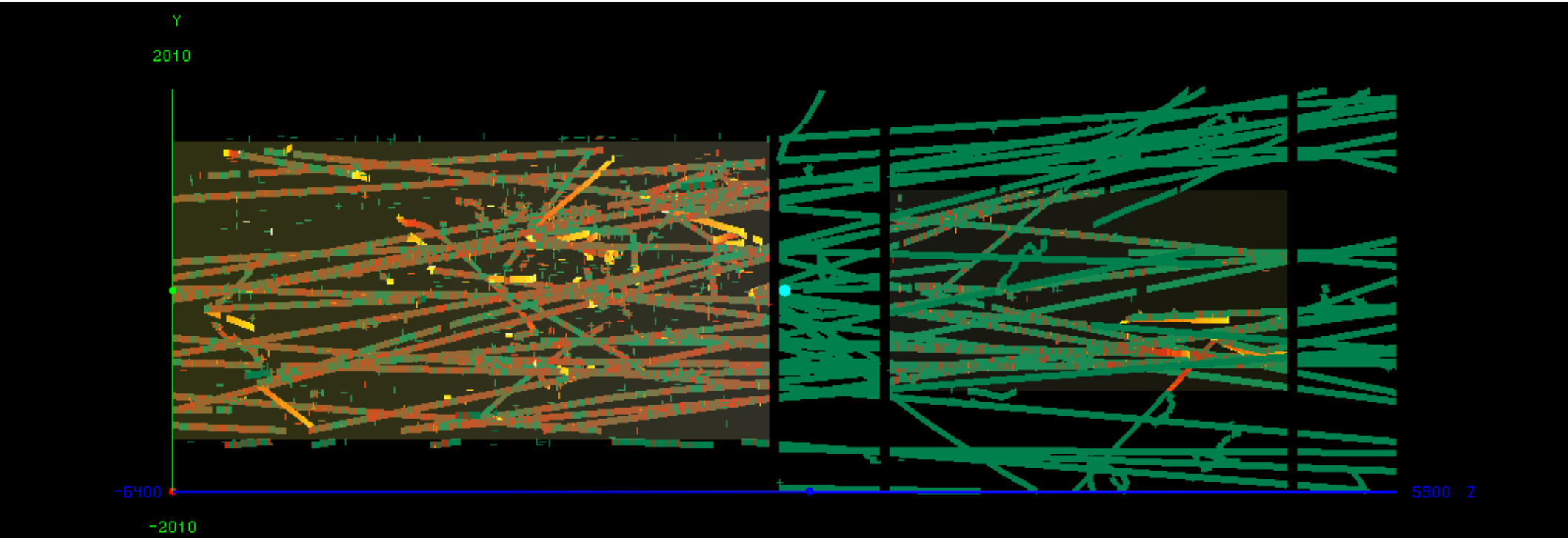
1 Spill Events (Using Edep-Sim)



Cartoon of LBNF spill at ND site: 0.2 neutrino interactions per ton, 1 rock muon per square meter

*Clark McGrew

Comments

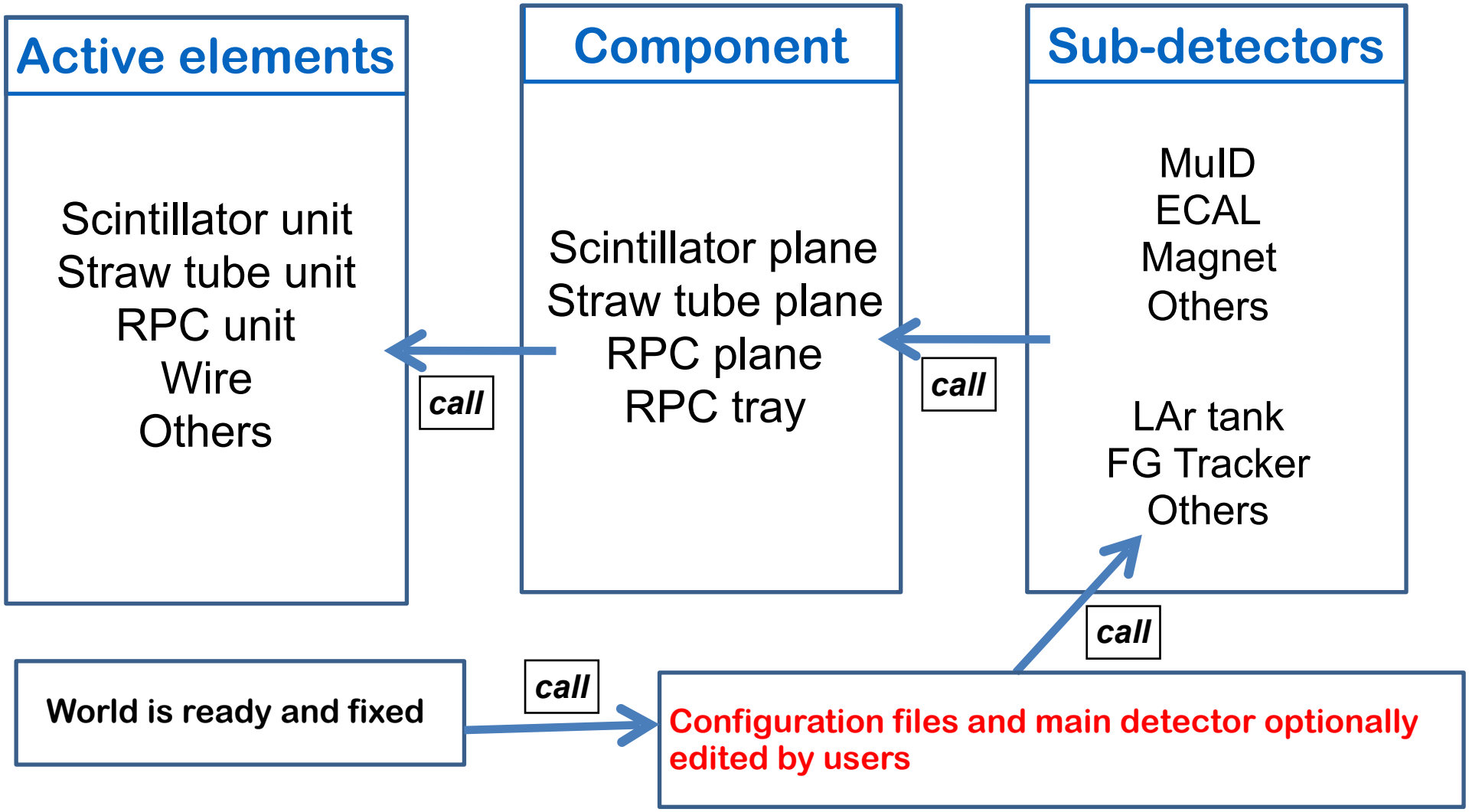
★EDEP-SIM and DUNENDGGD are ready to work hard.

★More studies are coming soon.

★Ideas or suggestions are more than welcome

Backup Slides

Detector: DUNE ND



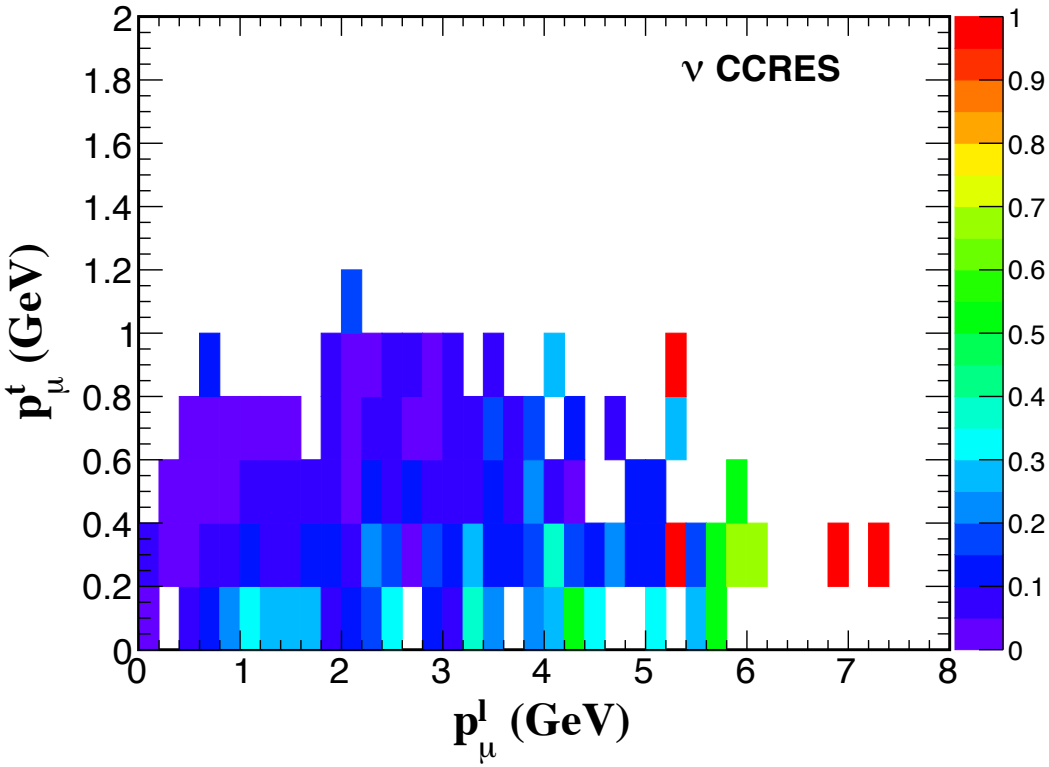
- All objects features can be defined in cfg files by users.
- It is generic structure, that each higher level just calls all sub-builders in lower level

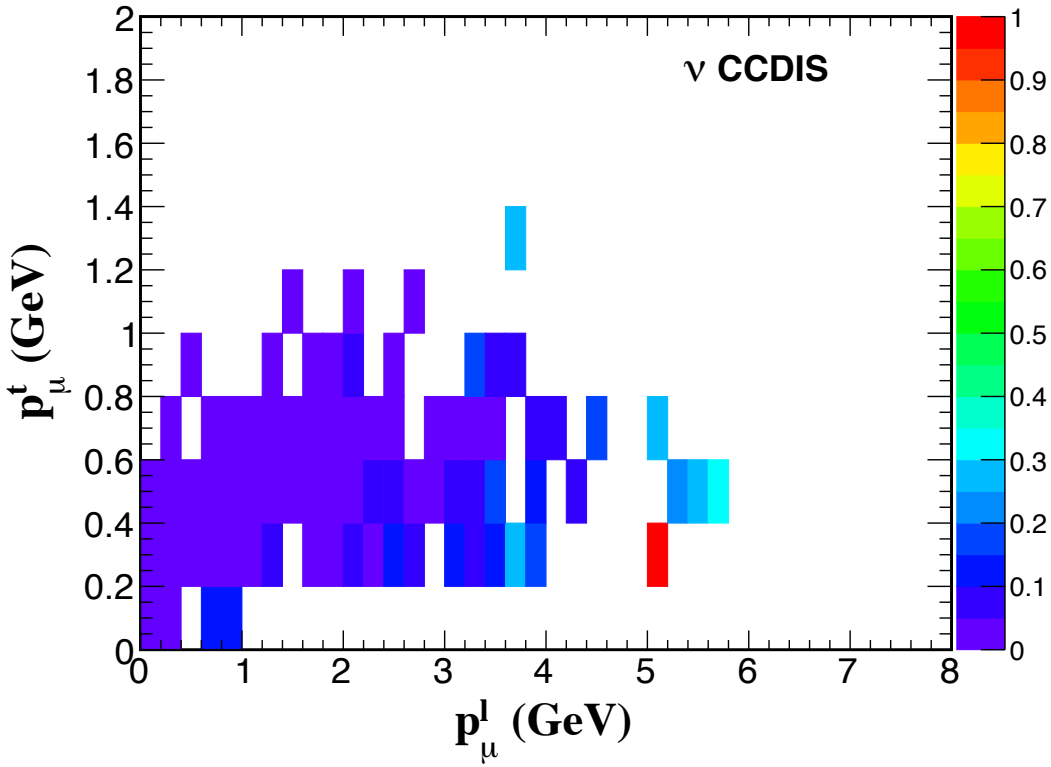
General Geometry Description

- "GeGeDe is a software system to generate a description of a constructive solid geometry as represented in GDML files. Specifically as used by Geant4 or ROOT applications. It is implemented as a pure Python module"*.
- The core of GeGeDe relies on Pint to enforce the consistent use of units.
- GeGeDe package was developed by Brett Viren, Brookhaven National Laboratory.

*https://github.com/brettviren/gegede

FHC beam mode - Acceptance





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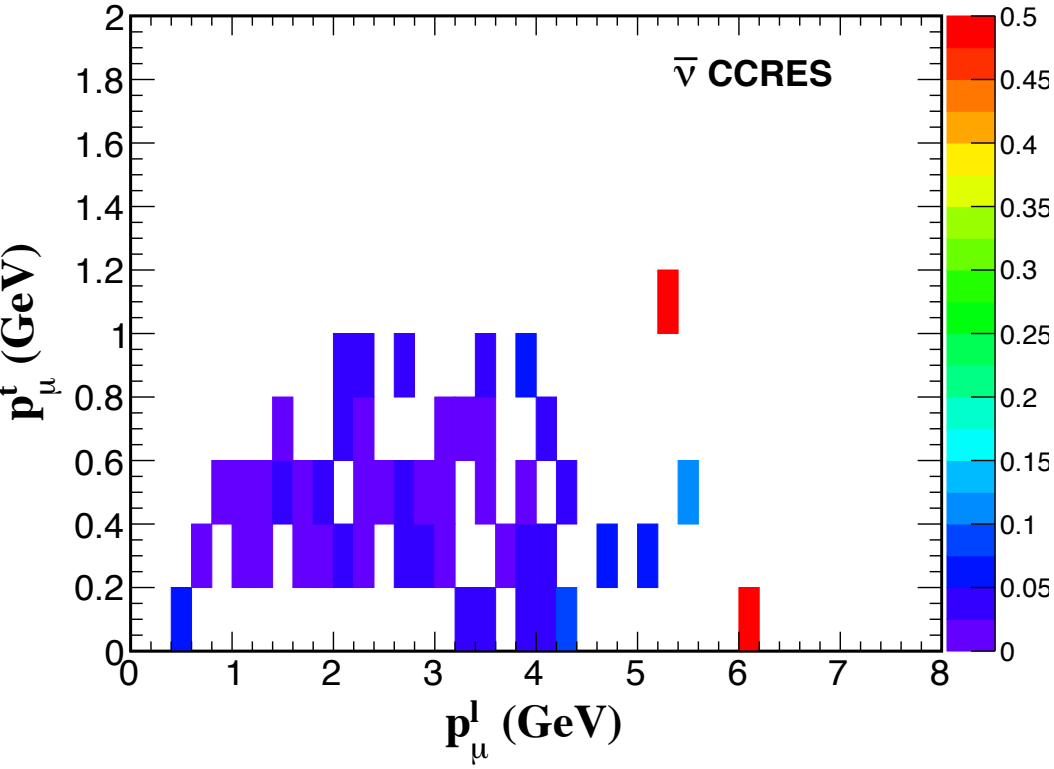
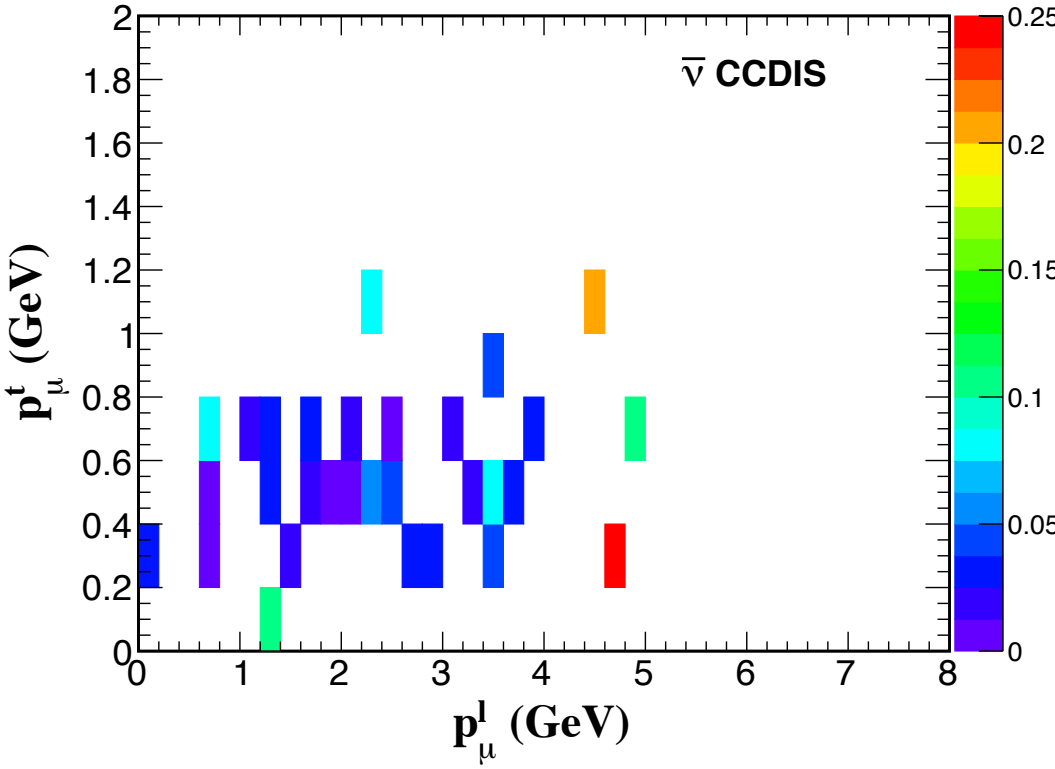
RHC beam mode - Acceptance





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