

FD Geometry Generation Should be Better.



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FD Sim/Reco Meeting

What To Discuss

- ◆ **Required Capabilities throughout DUNE lifetime**
- ◆ **Potential problems**
- ◆ **Multiple Modes of Geometry**
 - Root Version, No-Wires G4 Version, “workspaces”
- ◆ **Version Control**
 - This needs to Change
- ◆ **Maximizing transparency to current users**
- ◆ **GDML Generation**
 - Currently single Perl script (many copy-paste versions)
 - This needs to Change

Required Capabilities

◆ **Early Stage of DUNE (Now)**

- Prototype or R&D Geometries (Real-life detectors)
- Sensitivity studies exploring different FD designs
- Workspace Geometries

◆ **Middle Stage**

- One module constructed and taking data
- Other modules in development (different tech!)
 - FD Geometry *must* remain flexible for many years to come
- Production file metadata
 - keeping geo versions in sync with *MC* and *Reco* files

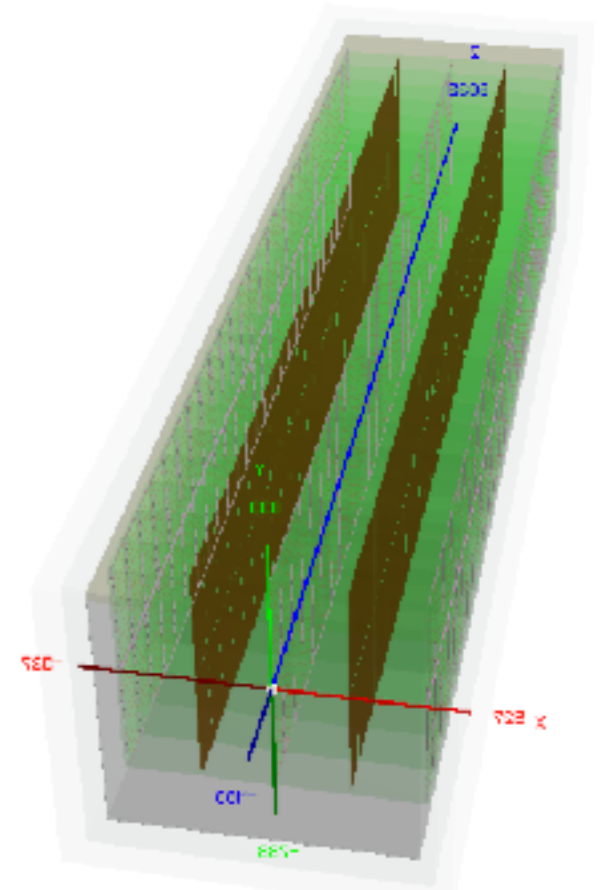
◆ **Late Stage**

- Alignment Issues (Not necessarily always a GDML solution)
- Materials Improvements (LAr hard to get wrong, but dirt etc.)

Workspace Geometries

◆ Full Geometry is a massive simulation

- Geant: **MC Particles**
 - scales with number of “volTPCActive”s
- Geant+LarSoft: **Energy Depositions** (IDEs)
 - scales with physical dimensions
- DetSim: **Digitized Waveforms** (RawDigits)
 - scales with number of channels
 - noise sim complicates things



Full 10kt

◆ Restrict “number of APAs” for efficient simulation

- Don't need all APAs for the vast majority of studies
- Could have been done better (whoops)

Workspace Geometries

◆ No such thing as an APA in LArSoft

- TPC volumes linked by sorted numbering and a channel map
- APA frame volumes (should) stay regardless of what is done with TPC volumes

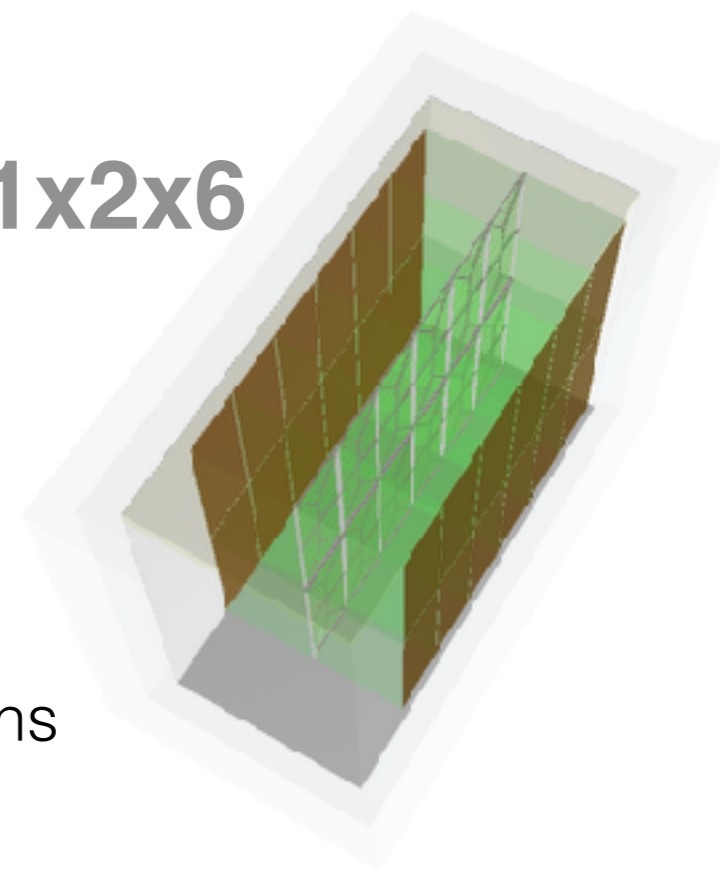
◆ Ways to make Sim more efficient without changing LArSoft

- Remove “volTPC”s from GDML (removes wire planes, which aren't in G4 anyway)
 - Fewer IDEs and MCParticles
- Use artificially smaller cryostat dimensions
 - Fewer digitized waveforms

◆ LArSoft could also be improved

- LArG4 off-switch per TPC (Leave TPCs in GDML)
 - Also makes the edge APAs more natural to simulate
- Dropping MCParticles we don't need for geometry reasons
 - Radiologicals Studies example

1x2x6



Radiological Workspace

- ◆ **1x2x6 not realistic enough for radiological backgrounds**

- When positions of APAs relative to cryostat edge matter
- Neutron bkgd studies at Sussex (Aran Borkum, Pierre Lasorak)

- ◆ **Full Cryostat, fewer volumes configured to be active**

- Raw data and Depositions not a problem
- All MC Particles will still be saved
 - Not always a problem in underground FD sim
 - **Could become standard workspace**
- Pick corner, edge, and a chunk of center APAs?

- ◆ **We will make this**

GDDL Generation

Should be....

◆ **Modular**

- Parallel development easier — Photon Detectors and TPCs
- Safer proliferation of design versions
 - Single source for things that should be identical (detector hall, or cryostat...)
 - Fixes/improvements make it into all design version that they should

◆ **Flexible / Configurable**

- Design Studies
- Version for each separate 10kt module
- No Wires Version

◆ **Versionable**

- Avoid version shears between MC/Reco processing and source geometry

◆ **Easy to Learn and Use**

- New experts inevitably needed, even late into data-taking

◆ **Testable**

- In-situ testing upon generation (overlaps, densities, key volumes...)

◆ **Aware of ROOT vs Geant4 Subtleties**

- There are actual differences capability, rules should be enforced (certain volumes, units, etc..)

General Geometry Description

By Brett Viren

◆ Modular

- Python “Builder” classes, owning “Subbuilders”, each with their own defining file
- Naturally enforces LArSoft Geometry hierarchy

◆ Flexible / Configurable

- Easy to reconfigure a builder at any level in the hierarchy
- Easy to define a new builder if something is fundamentally different and can't be solved by a new config
 - Wires vs Pixels. SP vs DP.

◆ Versionable

- Save duneggd version number and few-KB config file to each art root file.

◆ Easy to Learn and Use

- If you know python and the volume hierarchy LArSoft wants, you're good to go
- Use GGD framework instead of single custom script
 - enforces developments to progress in a clean, easy-to-understand way

◆ Testable

- Easy to include in-situ testing as an option in the “gegede-cli” executable

◆ Aware of ROOT vs Geant4 Subtleties

- GGD begins to enforce these rules, and is a good way to continue to formally do that

Documentation

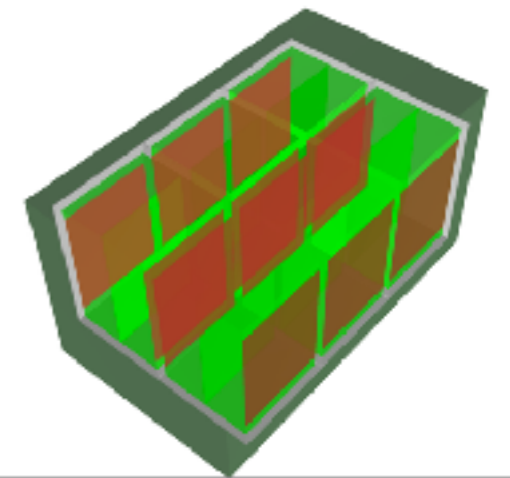
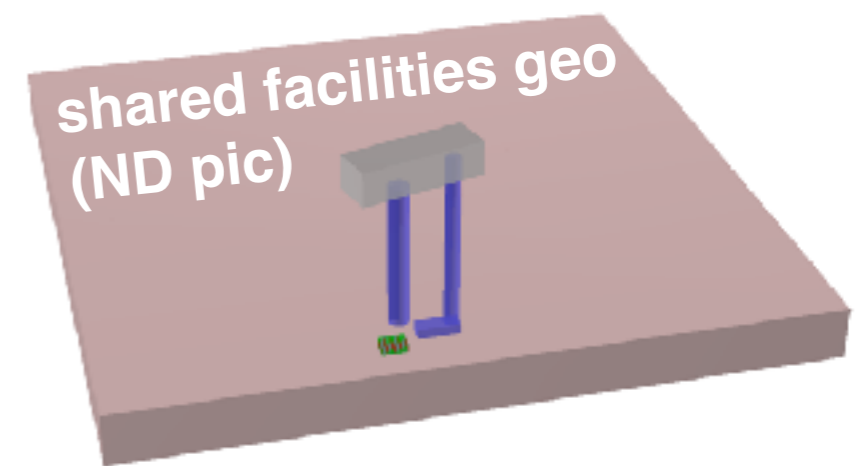
[Overview](#)

[Builders](#)

Dune GGD

By Tyler Alion

- ◆ **duneggd** repository on top of GGD
- ◆ **Documented** (hyperlinks)
 - Extremely easy to get started
 - Easy to configure
- ◆ **Used By ND groups**
 - I added a LArND which is very much like the FD workspace
 - FGT example: Easy to make a very complicated geometry
 - Parallel development, outside of MRB and LArSoft dependencies
- ◆ **Auxiliary tools**
 - I've committed testing and drawing scripts, can link to the executable
- ◆ **Can package separately (with GDML)**
 - Save duneggd version number and few-KB config file to each art root file.
 - Then dependency on another repo just becomes a matter of UPS versioning
- ◆ **Single Source** for Detector Hall, Material definitions Near and Far, etc...
 - and for all of the different versions
 - SP, DP, various designs, various 10kt modules, Workspaces!



Dune FD with GGD

- ◆ **I need to proactively share geometry expertise**

- Most natural way to do it is at my institution

- ◆ **Interested folk at Sussex**

- Me, Aran Borkum (Simon Peeters' PhD student), Pierre Losak

- ◆ **I propose to make a GGD FD**

- Next couple of months, I already started this years ago.
- Mostly me and Aran, Keep others at Sussex in the loop

- ◆ **I propose to make this the standard approach to geometry moving forward**

- What do you think?

- ◆ **Backwards compatibility not an issue**

- Existing Perl and GDML is not going anywhere

Backup

- Neutron capture position in the whole 10kT.
 - You can see the wall, argon gas etc.
 - The CPA, APA are *not* there, you would expect different capture rate there.
- We are investigating this, for now, with the 1x2x6:
 - Generated 100k isotopic muons, recorded dEdx of every GEANT4 step... not very conclusive for now.
- I checked the geometry file (gdml), and didn't find what I was looking for (APA/CPA steel volumes).

