BSM Simulation and Software subgroup status and plan

A.Chatterjee

DUNE BSM meeting

February 18, 2020

BSM Simulation status :TDR

- **Different Physics analysis uses either DUNE ND or FD or both detector.**

- **Common tools :**

  1. Neutrino beam :

Table 8.1: Beam power configuration assumed for the LBNF neutrino beam.

Energy (GeV)	Beam Power (MW)	Uptime Fraction	POT/year
120	1.2	0.56	1.1×10^{21}

  2. ND properties :

Table 8.2: ND properties used in the BSM physics analyses.

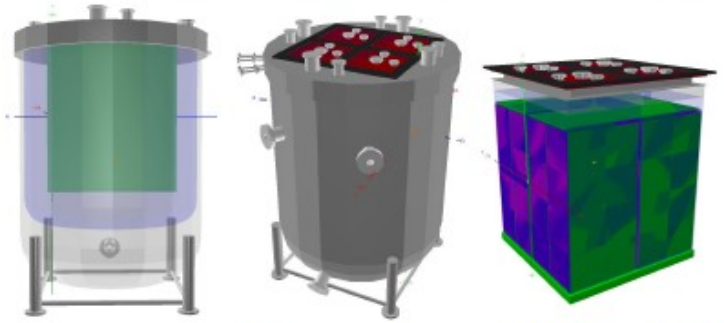
ND Properties	Values
Dimensions	7 m wide, 3 m high, and 5 m long
Dimensions of fiducial volume	6 m wide, 2 m high, and 4 m long
Total mass	147 ton
Fiducial mass	67.2 ton
Distance from target	574 m

  3. FD : GLoBES Configuration used

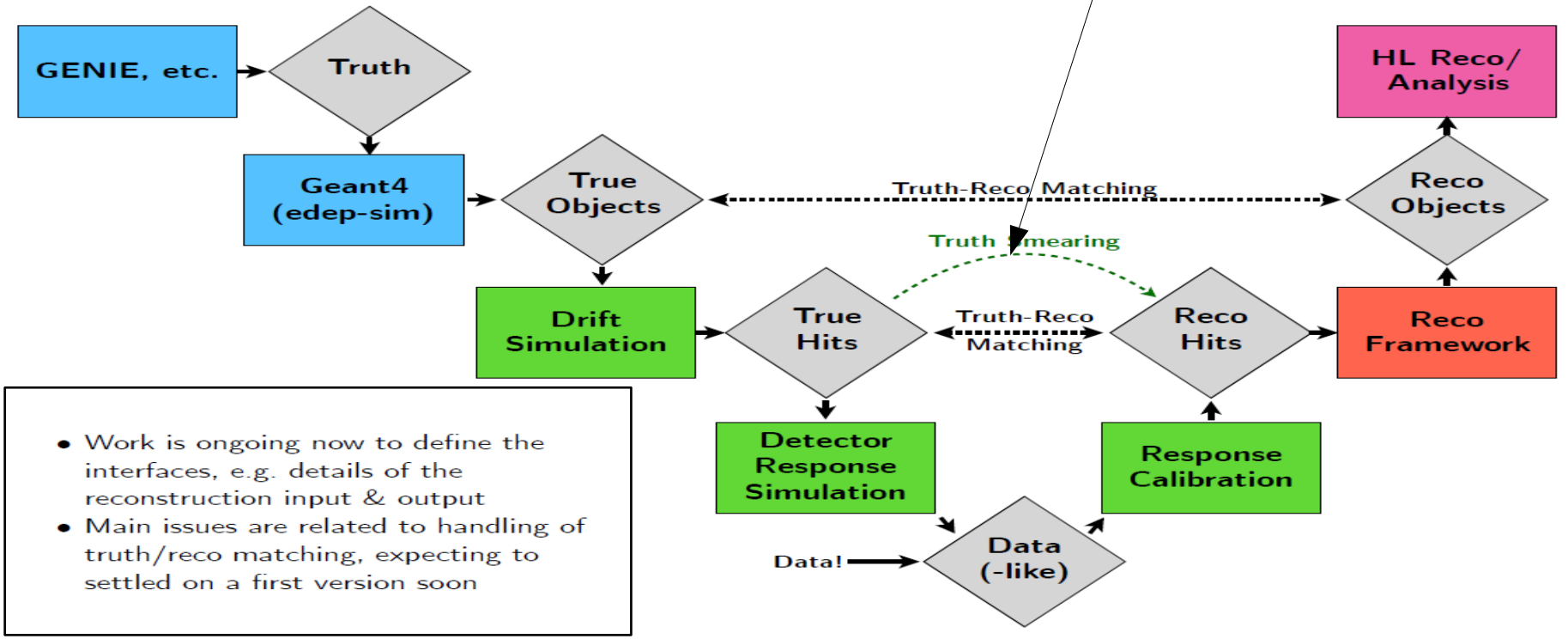
LAr-ND Development (A.Mastbaum DUNE talk)

2×2 GDML Geometry

Patrick Koller (Bern) & Hunter Sullivan (UTA)



- GDML Geometry is in stand alone code
- Reconstruction is in progress
- No detector simulation yet



- Work is ongoing now to define the interfaces, e.g. details of the reconstruction input & output
- Main issues are related to handling of truth/reco matching, expecting to settled on a first version soon

Status : LAr-ND Software (A. Mastbaum DUNE talk)

Status & Plans

Status

- Work is in progress to build an end to end simulation & analysis chain
  - Major efforts on simulation, detector response (charge & light), reconstruction
  - Reco-based ND physics studies can be developed in parallel (e.g. using truth hit smearing)
- Developments on LArSoft-based tools (see Gianluca Petrillo's talk, next)
- Recent discussions towards an additional Pandora-based reconstruction path

Plans

- Analysis supporting Module-0 and full 2×2 test runs at Bern LHEP (next ~1 year)
  - Drift field and uniformity, charge & light readout (noise, gain, linearity, cross talk)
  - Charge/light correlations, uniformity 3D imaging, track reco data/MC, cross-module matching
  - → ND physics studies with data-driven response and reco performance
- ProtoDUNE-ND (2×2 at NuMI) analysis
  - Neutrino ID & reconstruction, pileup, TPC/tracker matching
  - → Multi-detector ND studies (e.g. LAr + MPD matching) with data-driven performance
- ND physics studies supporting IDR/TDR work in parallel, using 2×2/PD-ND input as available

LAr-ND (within LArsoft:G.Petrillo)

Status and summary

We have developed a prototype extension for LArSoft geometry:

- understands anode planes with pixels
- supports the existing wire code with almost no change
- no slow down is apparent
- pixel-specific interface is not developed yet
  $\Rightarrow$ we'll bootstrap it as needed for simulation, and move from there

Status:

- ✓ legacy code complete and working $\rightarrow$ we *might have* pushed it in LArSoft months ago
- ○ design not yet discussed with LArSoft & community $\rightarrow$ we really *shouldn't* push it yet
- ✓ tested with a GDML geometry from Patrick
- ✓ can load the geometry, have channel mapping, dump its features on screen

- ***Not ready yet for using ND-Physics analysis***

Plan for IDR/TDR:BSM Physics

- LAr-ND Geometry and simulation stand-alone code is in place, but no reconstruction of the events yet
- Pixel anode geometry implemented within LArsoft, no simulation or reconstruction yet
- Plan for IDR/TDR :
- Short term plan : Use parametric response of the detector using LAr-ND standalone code.
- Long term plan :Use LAr-ND-LArsoft code with detector simulation and reconstruction are in place
- Detail discussion require within the group!

Relevant software for LAr-ND

- Andrew provided us (Justo and myself) the link for the software of Lar-ND (thanks to Andy)
- ND geometry: **https://github.com/gyang9/dunendggd**
- edep-sim (G4 simulation with the full geometry): **https://github.com/ClarkMcGrew/edep-sim**
- ArgonBox (G4 simulation in just a large argon volume): **https://github.com/dadwyer/argon_box**
- Make CAFAna files from edep-sim (used in ND+FD studies): **https://github.com/cmmarshall/DUNE_ND_CAF**
- **I didn't had a chance to run the code yet, any one wants to volunteer most welcome!**