Update on Re-factoring the LArSoft simulation

Hans Wenzel

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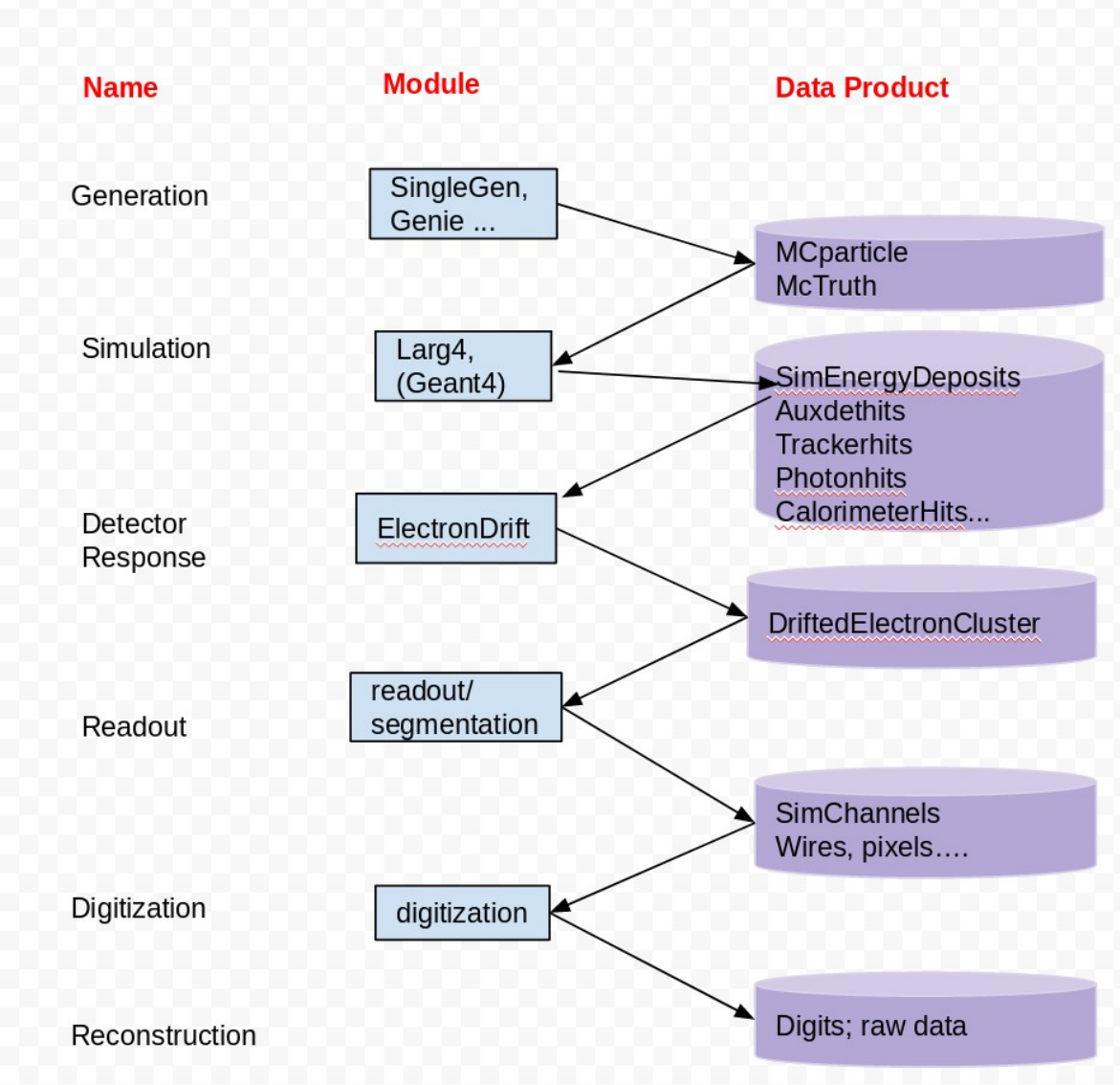
Simulation workflow



Git: larsim branch feature_wenzel_electrondrift

In larsim/ElectronDrift you find:

CMakeLists.txt
DriftElectronstoPlane_module.cc
ISCalculation.cc
ISCalculation.h
SimDriftedElectronClusterAna_module.cc
SimDriftElectrons_module.cc

Branch should be included in next release!

SimDriftElectrons_module.cc

Developed by Bill Seligman

- Does electron drift and assigns charge to simchannels
- Option to write out DriftedElectronCluster
- Uses service: LArG4Parameters (obsolete)
- Uses larsim/IonizationScintillation/ISCalcSeparate.cxx (obsolete)
- doesn't make use that the use of Sensitive Detectors links volumes to the Hit collections → makes expensive geometry checks unnecessary

DriftElectronstoPlane_module.cc

- Only does electron drift
- writes out DriftedElectronCluster
- Simple ParameterSet instead of using LArG4Parameters service

```
ISCalculation::ISCalculation(fhicl::ParameterSet const& pset)
  : fRecombA                {pset.get< double >("RecombA")}
  , fRecombk                {pset.get< double >("Recombk")}
  , fModBoxA                {pset.get< double >("ModBoxA")}
  , fModBoxB                {pset.get< double >("ModBoxB")}
  , fUseModBoxRecomb            {pset.get< bool   >("UseModBoxRecomb")}
  , fGeVToElectrons           {pset.get< double >("GeVToElectrons")}
{
```

(If you need access to parameter values later see redmine issue 13560)

- Need to evaluate other services (lar, detector properties)
- Uses larsim/ElectronDrift/ISCalculation.cc
- Uses fact that sensitive detector defines volume-→ no navigation in geometry

dune_refactored.fcl

```
[wenzel@ironman build_slf7.x86_64]$ more dune_refactored.fcl
#include "services_dune2.fcl"

standard_singlep:
{
 module_type:           "SingleGen"
 ParticleSelectionMode: "all"       # 0 = use full list, 1 =  randomly select a single listed particle
 PadOutVectors:         false       # false: require all vectors to be same length
                                    # true:  pad out if a vector is size one
 PDG:                   [ 13 ]      # list of pdg codes for particles to make
 P0:                    [ 6. ]      # central value of momentum for each particle
 SigmaP:                [ 0. ]      # variation about the central value
 PDist:                 "Gaussian"  # 0 - uniform, 1 - gaussian distribution
 X0:                    [ 0. ]     # in cm in world coordinates, ie x = 0 is at the wire plane
                                    # and increases away from the wire plane
 Y0:                    [ 0. ]      # in cm in world coordinates, ie y = 0 is at the center of the TPC
 Z0:                    [ -130. ]   # in cm in world coordinates, ie z = 0 is at the upstream edge of
                                    # the TPC and increases with the beam direction
 T0:                    [ 0. ]      # starting time
 SigmaX:                [ 0. ]      # variation in the starting x position
 SigmaY:                [ 0. ]      # variation in the starting y position
 SigmaZ:                [ 0.0 ]     # variation in the starting z position
 SigmaT:                [ 0.0 ]     # variation in the starting time
 PosDist:               "uniform"   # 0 - uniform, 1 - gaussian
 TDist:                 "uniform"   # 0 - uniform, 1 - gaussian
 ThetaXZ:               [ 0. ]      #angle in XZ plane (degrees)
 ThetaYZ:               [ 0. ]      #angle in YZ plane (degrees)
 SigmaThetaXZ:          [ 0. ]      #in degrees
 SigmaThetaYZ:          [ 0. ]      #in degrees
 AngleDist:             "Gaussian"  # 0 - uniform, 1 - gaussian
}


process_name: G4

services:
{
  TFileService: { fileName: "g4_hist.root" }
  TimeTracker:        {}
  MemoryTracker:          { } # default is one
  RandomNumberGenerator: {} #ART native random number generator
  message:      @local::standard_info
  @table::dunedphase3x1x1_simulation_services

  DetectorHolder: {}
  ActionHolder: {}
  PhysicsListHolder: {}
  PhysicsList: {
    PhysicsListName: "FTFP_BERT"
    DumpList: false
    enableCerenkov: false
    enableScintillation: true
    ScintillationByParticleType: false
    enableAbsorption: false
    enableRayleigh: false
    enableMieHG: false
    enableBoundary: false
    enableWLS: false
  }
  LArG4Detector :
  {
    category: "world"
    gdmlFileName_ : "3x1x1dphase_nowires.gdml"
  }

  MCTruthEventAction: {service_type: "MCTruthEventActionService"}
  ParticleListAction:{service_type: "ParticleListActionService"}
}

//services.PhotonVisibilityService.ParametrisedTimePropagation: false // this is still not supported in the new code

source:
{
  module_type: EmptyEvent
  maxEvents:  1000        # Number of events to create
}

physics:
{

 producers:
  {
    generator: @local::standard_singlep
    larg4Main: { module_type: "larg4Main"
                 enableVisualization: false
                 macroPath: "../macros"
                 visMacro: "vis.mac"
               }
    elecDrift:  { module_type:          "DriftElectronstoPlane"
                  SimulationLabel:      "larg4Main:LArG4DetectorServicevolTPCActive"
                  StoreDriftedElectronClusters: true
                  LongitudinalDiffusion: 6.2e-9
                  TransverseDiffusion: 16.3e-9
                  ElectronClusterSize: 600.0
                  MinNumberOfElCluster: 0
                  GeVToElectrons: 4.237e+07
                  RecombA: 0.800
                  Recombk: 0.0486
                  ModBoxA: 0.930
                  ModBoxB: 0.212
                  UseModBoxRecomb: true
                }
  }
   analyzers: {
    CheckSimEnergyDeposit: {   module_type: CheckSimEnergyDeposit
            hist_dir: "HistoDir"
            }
 //  CheckMCParticle: {   module_type: CheckMCParticle
 //          hist_dir: "HistoDir2"
 //          }
   CheckAuxDetHit: {   module_type: CheckAuxDetHit
           hist_dir: "HistoDir3"
           }
   ISCalculationAna: {   module_type: ISCalculationAna
                     EDepModuleLabel:        "larg4Main:LArG4DetectorServicevolTPCActive"
           }
   SimDriftedElectronClusterAna: { module_type: SimDriftedElectronClusterAna
                     EDepModuleLabel:        "elecDrift"
}
}
 simulate: [   generator,larg4Main, elecDrift ]
 //stream1:  [ out1,CheckSimEnergyDeposit,CheckMCParticle,CheckAuxDetHit ]
stream1:  [ out1,CheckSimEnergyDeposit,CheckAuxDetHit,ISCalculationAna,SimDriftedElectronClusterAna  ]
 trigger_paths: [simulate]
 end_paths:     [stream1]
}

outputs:
{
 out1:
 {
   module_type: RootOutput
   fileName:    "g4.root"
   dataTier:    "simulated"
   compressionLevel: 1
 }
}
```

Short term Plan

- Wiki to document the full chain
- Write module that uses the SimDriftedElectronClusters as input and creates the simchannels
- Make writing out SimDriftedElectronClusters optional to keep file size in check. (use transient object)
- Currently full example (developed by Bea, Jose and Paul for dual phase TPC) is available in dunetpc (fcl,gdml,detector helper) → move example to non detector specific area.
- profiling