Last modified: June 9th, 2020
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Contents of trees (n-tuples) produced by analyzer module, icaruscode/
CRT/CRTSimAnalysis_module.cc
Note the coordinate system has origin at LAr center (between 2 cold
vessels/cryostats) with
  x-> along drift direction (east to west)
  y-> vertical (bottom to top)
  z-> along BNB direction (south to north)

Region codes used below:
  - LAr regions
    + 4 = Cryostat 0, TPC 0
    + 5 = Cryostat 0, TPC 1
    + 10 = Cryostat 0, Inactive
    + 7 = Cryostat 1, TPC 0
    + 8 = Cryostat 1, TPC 1
    + 12 = Cryostat 1, Inactive
  - CRT regions
    + 30 = Top, Roof
    + 31 = Top, Rim-West
    + 32 = Top, Rim-East
    + 33 = Top, Rim-South
    + 34 = Top, Rim-North
    + 40 = Side, West-South
    + 41 = Side, West-Center
    + 42 = Side, West-North
    + 43 = Side, East-South
    + 44 = Side, East-Center
    + 45 = Side, East-North
    + 46 = Side, South
    + 47 = Side, North
    + 50 = Bottom

// trees with branch discription and data type
GenTree -> generator level info with 1 entry per particle
  - event: event ID (int)
  - run: run ID   (int)
  - subRun: subRun ID (int)
  - nGen: number of particles generated (int)
  - trackID: generator trackID (int)
  - pdg: particle PDG code (e.g. 13 = muon, 11 = electron, 22 =
photon)
  - startXYZT: particle start position [cm] in world coords, start
time [ns] (vector<double> = {x,y,z,t})
  - endXYZT: particle end position [cm] in world coords, end time
[ns] (vector<double> = {x,y,z,t})
  - startPE: particle start momentum components [GeV/c] in world
coords, start total energy [GeV] (vector<double> = {Px,Py,Pz,E})

– endPE: particle end momentum components [GeV/c] in world
coords, end total energy [GeV] (vector<double> = {Px,Py,Pz,E})

SimTree –> G4 level info with 1 entry per particle
  – event: event ID (int)
  – run: run ID   (int)
  – subRun: subRun ID (int)
  – nPoints: number of trajectory points (int)
  – trackID: Geant4 trackID (int)
  – pdg: particle PDG code (e.g. 13 = muon, 11 = electron, 22 =
photon)
  – trackLength: distance between start and end positions [cm] (float)
  – process: code for process that produced the particle (int)
  – endProcess: code for process that killed the particle (int)
  – mother: mother particle G4 trackID (int)
  – parentPDG: PDG code of parent particle (int)
  – parentE: total energy of the parent particle [GeV] (float)
  – progenitor: particle's track ID from the generator that began the
lineage (int)
  – nDaught: number of daughters this particle produces (int)
  – startXYZT: particle start position [cm] in world coords, start
time [ns] (vector<double> = {x,y,z,t})
  – endXYZT: particle end position [cm] in world coords, end time
[ns] (vector<double> = {x,y,z,t})
  – startPE: particle start momentum components [GeV/c] in world
coords, start total energy [GeV] (vector<double> = {Px,Py,Pz,E})
  – endPE: particle end momentum components [GeV/c] in world
coords, end total energy [GeV] (vector<double> = {Px,Py,Pz,E})

  // one entry per CRT strip hit by the particle
  – nChan: number of CRT strips hit by this particle (int)
  – auxDetSensitiveID: id of the CRT strip (unique only within a CRT
module) hit by the particle (vector<int>)
  – auxDetID: id of the CRT module (globaly unique) hit by
the particle (vector<int>)
  – auxDetEDep: energy deposited in the scintillator strip
[GeV] (vector<float>)
  – auxDetdEdx   <dE/dx> [GeV/cm] within the strip
(vector<float>)
  – auxDetTrackLength: track length within the strip [cm]
(vector<float>)
  – auxDetEnterXYZT: track entry point/time (world coords) into the
strip [cm, ns] (vector<vector<float>> = vector<{x,y,z,t}>)
  – auxDetExitXYZT: track exit point/time (world coords) from the
strip [cm, ns] (vector<vector<float>> = vector<{x,y,z,t}>)
  – auxDetEnterPE: track entry momentum components/energy (world
coord) entering the strip [GeV/c, GeV] (vector<vector<float>> =
vector<{Px,Py,Pz,E}>)
  – auxDetExitPE: track entry momentum components/energy (world

coord) entering the strip [GeV/c, GeV] (vector<vector<float>> =
vector<{Px,Py,Pz,E}>)
  – auxDetRegion: region code for the CRT strip (vector<int>)
  – mac5:   front-end board ID corresponding to the CRT
module (vector<int>)
  – adType: CRT module type with 0=CERN type [top], 1=MINOS
type [side], 2=Double Chooz type [bottom] (vector<int>)

RegTree –> G4 level, particles entering/exiting different volumes with
1 entry per particle
  – event: event ID (int)
  – run: run ID   (int)
  – subRun: subRun ID (int)
  – nReg: number of regions crossed by particle (int)
  – fiducial: number of fiducial LAr volumes crossed (int)
  – active: number of active LAr volumes crossed (int)
  – inactive: number of inactive LAr volumes crossed (int)
  – crts: number of CRT regions crossed (int)
  – regions: region codes crossed by particle, time ordered
(vector<int>)
  – pdg: PDG code of particle (int)
  – trackID: Geant4 track ID of particle (int)
  – eDep: energy deposited by particle in each region [GeV]
(float)
  – dL: path length within each module [cm] (float)
  – opDetID: if region is cryostat, (globally unique) id of closest
PMT to entry point in the volume (vector<int>)
  – distToOpDet: if region is cryostat, distance from entry point into
the region to the closest PMT [cm] (vector<int>)
  – opDetXYZT: if region is cryostat, position [cm] of PMT and
(geometric) photon time of arrival [ns] at PMT (vector<vector<double>>
= vector<{x,y,z,t}>)
  – entryPE: track entry momentum components/energy (world coord)
entering the region [GeV/c, GeV] (vector<vector<double>> =
vector<{Px,Py,Pz,E}>)
  – exitPE: track exit momentum components/energy (world coord)
exiting the region [GeV/c, GeV] (vector<vector<double>> =
vector<{Px,Py,Pz,E}>)
  – entryXYZT: track entry point/time (world coords) into the region
[cm, ns] (vector<vector<double>> = vector<{x,y,z,t}>)
  – exitXYZT: track exit point/time (world coords) from the region
[cm, ns] (vector<vector<double>> = vector<{x,y,z,t}>)
  – entrySlope: track entry slope (direction cosines) into the region
(vector<vector<double>> = vector<{Cosx,Cosy,Cosz}>)
  – exitSlope: track exit slope (direction cosines) from the region
(vector<vector<double>> = vector<{Cosx,Cosy,Cosz}>)

CosmicDisplay –> G4 level, Trajectory points for event display
TO BE FILLED (FIX ME!)

DetTree -> CRT detector simulation info including FEB ID, charge, and timing
TO BE FILLED (FIX ME!)

HitTree -> CRT simulated hit reconstructon giving spatial, time, and CRT region
TO BE FILLED (FIX ME!)

CRTTrueHitTree -> truth level version of HitTree
TO BE FILLED (FIX ME!)