CAF - caf::StandardRecord

Generated by Doxygen 1.8.11

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3.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 4

Namespace Documentation

4.1 caf Namespace Reference

Common Analysis Files.

Classes

- struct CVNFinalState
- class SRBeam

  Information about the neutrino production. Docs from http://www.hep.utexas.edu/~zarko/wwwgnumi/v19/v19/outpu _gnumi.html.
- class SRBpf
- class SRBPFEnergy

  BPF energy estimator output.
- class SRBpfId

  Breakpoint ID (BpfId) output.
- class SRBpfTrack
- class SRContain

  Containment variables.
- class SRCosmic

  Truth information for cosmic rays.
- class SRCosmicCVN

  The SRCosmicCVN contains a vector of time slices and cosmic CVN scores used forearly cosmic filtering. These time slices are not directly associated with analysis slices.
- class SRCosRej

  Output from Cosmic Rejection (CosRej) module.
- class SRCVNFeatures

  CVN features.
- class SRCVNParticleResult

  CVN PID output for a single particle.
- class SRCVNResult

  CVN PID output.
- class SRElastic

  A potential interaction point from the ElasticArms algorithm.
- class SRELid

Output of the LIDBuilder module (slid::lid objects).

- class SREnergy

  This is a simple class for energy estimators in the standard record. More complicated energy estimators will have extra fields for other output.
- class SREnergyBranch

  An SREnergyBranch contains vectors of energy objects.
- class SRFluxWeights

  Reweight information for flux systematic.
- class SRFuzzyK
- class SRFuzzyKProng
- class SRGenieWeights

  Reweight information for a single GENIE systematic.
- class SRGlobalTruth

  Information about the event from which the slice came. Information in this branch should be used with caution since it can be duplicated across entries (slices) in the CAF tree.
- class SRHadClust

  Overarching information for a numu hadronic cluster.
- class SRHeader

  Header representing overview information for the current event/slice.
- class SRHoughVertex

  A potential interaction point found by the HoughVertex algorithm.
- class SRIDBranch

  Event ID and selection variables.
- class SRJMEid

  Output of the jmshower::NueSel module.
- class SRJMShower

  A reconstructed shower from the JMShower module.
- class SRKalman
- class SRKalmanTrack
- class SRLem

  This class contains the LEM PID output.
- class SRLorentzVector

  4-vector with more efficient storage than TLorentzVector
- class SRMCReweight

  Various weights for systematic reweights of MC.
- class SRMichelE
- class SRMRCCParent

  An SRMRCCParent holds information about the slice that was parent to the current slice. It is currently being used by Muon Removed Charged Current Analysis.
- class SRMRProperties

  A reconstructed shower from the MRProperties module.
- class SRMuId

  This class contains the LLH muon PID output.
- class SRMuonID

  Contains the reco muon PID (ReMId) output.
- class SRNCCosRej

  Output from Cosmic Rejection (Nuecosrej) module.
- class SRNCPi0BkgRej
- class SRNDSandbox

  Class for storing information necessary for nu_e analysis. This information might not exist here forever, it may eventually be moved somewhere else.
- class SRNeutrino

The SRNeutrino is a representation of neutrino interaction information.

- class SRNueCosRej

  Output from Cosmic Rejection (Nuecosrej) module.
- class SRNueEnergy

  Nue energy estimator output in the standard record.
- class SRNueSandbox

  Class for storing information necessary for nu_e analysis. This information might not exist here forever, it may eventually be moved somewhere else.
- class SRNumuEnergy

  Numu energy estimator output.
- class SRNumuSandbox

  Class for storing information necessary for nu_mu analysis. This information might not exist here forever, it may eventually be moved somewhere else.
- class SRNuonEResult

  NuonE output.
- class SRNusSandbox

  Class for storing information necessary for nu_e analysis. This information might not exist here forever, it may eventually be moved somewhere else.
- class SRParentBranch
- class SRParticleTruth

  The truth information of reco objects within a slice.
- class SRPixelMap

  Variables describing Michel E's found around the end of a track.
- class SRPixelObjMap

  Variables describing Michel E's found around the end of a track.
- class SRPresel

  preselection information
- class SRProng

  An SRProng is a simple descriptor for a prong. This class does not contain individual cell hits, but does know it's start point and direction.
- class SRProngTrainingData
- class SRProngXSec
- class SRQepid

  Contains the quasielastic muon PID (QePId) output.
- class SRRegCVNResult

  Regression CVN output.
- class SRRemid

  Contains the reco muon PID (ReMId) output.
- class SRRvp

  Contains the RVP PID output.
- class SRSandbox

  Class for storing information necessary for analysis that may not fit elsewhere. This information might not exist here forever, it may eventually be moved somewhere else. eventually be moved somewhere else.
- class SRShower

  An SRShower is a simple descriptor for a shower. This class does not contain individual cell hits, but does know it's energy and direction.
- class SRShowerBranch

  The SRShowerBranch is a container for SRShowers. It will contain a vector of showers for each shower making algorithm that is part of the standard reconstruction.
- class SRShowerLID

  An SRShower is a simple descriptor for a shower. The SRShwLID inherits from it to add more fields. This class does not contain individual cell hits, but does know it's energy and direction.
- class SRShowerPID

Shower level PID information (LID)

- class SRSlcME

  Represents output from SlcMEFilter.
- class SRSlice

  An SRSlice contains overarching information for a slice.
- class SRSliceLID
- class SRSliceMap

  Variables describing Michel E's found around the end of a track.
- class SRSLid

  This class contains the LID pid information for a shower (slid::ShowerLID objects).
- class SRSLidEnergy

  This is a class for the NueSel energy estimate.
- class SRSPid

  Contains the SPID pid information for a shower (slid::ShowerLID objects).
- class SRSpill

  The SRSpill contains information about the NuMI spill and POT associated with the slice, as well as EventQuality info on spill by spill basis.
- class SRSpillTruthBranch

  Truth info for all neutrinos in the spill.
- class SRTrack

  Representation of a rb::Track, knows energy and direction, but not a list of hits.
- class SRTrackBase
- class SRTrackBranch

  Reconstructed tracks found by various algorithms.
- class SRTrainingBranch

  Event ID training variables.
- class SRTrainingData
- class SRTrkME

  Variables describing Michel E's found around the end of a track.
- class SRTrueMichelE

  Truth information for a Michel electron.
- class SRTrueNumuEnergy

  Truth information for numu energy fitting.
- class SRTrueParticle

  The SRTrueParticle is used to represent primary daughters of a neutrino interaction.
- class SRTruth

  Represents a true neutrino.
- class SRTruthBranch

  Contains truth information for the slice for the parent neutrino/cosmic.
- class SRVector3D

  A 3-vector with more efficient storage than TVector3.
- class SRVertex

  Time and position of a reconstructed vertex.
- class SRVertexBranch

  Vectors of reconstructed vertices found by various algorithms.
- class SRVertexDT

  A vertex found by the VertexDT algorithm.
- class SRVeto

  Details of processing cuts made by the veto modules.
- class SRXnue

  Store BDT variables for the short-baseline oscillation study.
- class StandardRecord

  The StandardRecord is the primary top-level object in the Common Analysis File trees.

Enumerations

- enum Det_t {
  kUNKNOWN, kNEARDET, kFARDET, kNDOS,
  kNDSBTEST, **kTESTBEAM**, **kNDetector**, **kFCCDAQ** }

  Which NOvA detector?
- enum View_t { kX, kY, kXorY }

  Detector view, following GeometryObjects/PlaneGeo.h.
- enum generator_ { **kUnknownGenerator**, **kGENIE**, **kGIBUU** }

  Known generators of neutrino interactions (extend as other generators are used)
- enum gen_process_t {
  kModeUnknown, **kPrimary**, **kHadElastic**, **kDecay**,
  kPionInelastic, **kProtonInelastic**, **kNeutronInelastic**, **kOther** }

  Interaction type responsible for particle production.
- enum mode_type_ {
  kUnknownMode, **kQE**, **kRes**, **kDIS**,
  kCoh, **kCohElastic**, **kElectronScattering**, **kIMDAnnihilation**,
  kInverseBetaDecay, **kGlashowResonance**, **kAMNuGamma**, **kMEC**,
  kDiffractive, **kEM**, **kWeakMix** }

  Neutrino interaction categories.
- enum int_type_ {
  kUnknownInteraction, kNuanceOffset, kCCQE, kNCQE,
  kResCCNuProtonPiPlus, kResCCNuNeutronPi0, kResCCNuNeutronPiPlus, kResNCNuProtonPi0,
  kResNCNuProtonPiPlus, kResNCNuNeutronPi0, kResNCNuNeutronPiMinus, kResCCNuBarNeutronPi↩
  Minus,
  kResCCNuBarProtonPi0, kResCCNuBarProtonPiMinus, kResNCNuBarProtonPi0, kResNCNuBarProton↩
  PiPlus,
  kResNCNuBarNeutronPi0, kResNCNuBarNeutronPiMinus, **kResCCNuDeltaPlusPiPlus**, **kResCCNu↩
  Delta2PlusPiMinus**,
  kResCCNuBarDelta0PiMinus, **kResCCNuBarDeltaMinusPiPlus**, **kResCCNuProtonRhoPlus**, **kResCC↩
  NuNeutronRhoPlus**,
  kResCCNuBarNeutronRhoMinus, **kResCCNuBarNeutronRho0**, **kResCCNuSigmaPlusKaonPlus**, **k↩
  ResCCNuSigmaPlusKaon0**,
  kResCCNuBarSigmaMinusKaon0, **kResCCNuBarSigma0Kaon0**, **kResCCNuProtonEta**, **kResCCNu↩
  BarNeutronEta**,
  kResCCNuKaonPlusLambda0, **kResCCNuBarKaon0Lambda0**, **kResCCNuProtonPiPlusPiMinus**, **k↩
  ResCCNuProtonPi0Pi0**,
  kResCCNuBarNeutronPiPlusPiMinus, **kResCCNuBarNeutronPi0Pi0**, **kResCCNuBarProtonPi0Pi0**, k↩
  CCDIS,
  kNCDIS, **kUnUsed1**, **kUnUsed2**, **kCCQEHyperon**,
  kNCCOH, kCCCOH, kNuElectronElastic, kInverseMuDecay }

  Neutrino interaction type.

Variables

- const int **kNumCVNFinalStates**
- const CVNFinalState **cvnStates** [kNumCVNFinalStates]
- const int **kCVN_nM_Other**
- const int **kCVN_nE_Other**
- const int **kCVN_nT_Other**
- const int **kCVN_Cosmic_PT**
- const int **kCVN_Other_PT**

4.1.1 Enumeration Type Documentation

4.1.1.1 enum caf::Det_t

Enumerator

kUNKNOWN Unknown detector.

kNEARDET Near Detector underground.

kFARDET Far Detector at Ash River.

kNDOS Prototype Near Detector on the Surface.

4.1.1.2 enum caf::View_t

Enumerator

kX Vertical planes which measure X.

kY Horizontal planes which measure Y.

kXorY X or Y views.

4.1.1.3 enum caf::int_type_

Enumerator

kNuanceOffset offset to account for adding in Nuance codes to this enum

kCCQE charged current quasi-elastic

kNCQE neutral current quasi-elastic

kResCCNuProtonPiPlus resonant charged current, $\nu p \to l^- p \pi^+$

kResCCNuNeutronPi0 resonant charged current, $\nu n \to l^- p \pi^0$

kResCCNuNeutronPiPlus resonant charged current, $\nu n \to l^- n \pi^+$

kResNCNuProtonPi0 resonant neutral current, $\nu p \to \nu p \pi^0$

kResNCNuProtonPiPlus resonant neutral current, $\nu p \to \nu p \pi^+$

kResNCNuNeutronPi0 resonant neutral current, $\nu n \to \nu n \pi^0$

kResNCNuNeutronPiMinus resonant neutral current, $\nu n \to \nu p \pi^-$

kResCCNuBarNeutronPiMinus resonant charged current, $\bar{\nu} n \to l^+ n \pi^-$

kResCCNuBarProtonPi0 resonant charged current, $\bar{\nu} p \to l^+ n \pi^0$

kResCCNuBarProtonPiMinus resonant charged current, $\bar{\nu} p \to l^+ p \pi^-$

kResNCNuBarProtonPi0 resonant charged current, $\bar{\nu} p \to \bar{\nu} p \pi^0$

kResNCNuBarProtonPiPlus resonant charged current, $\bar{\nu} p \to \bar{\nu} n \pi^+$

kResNCNuBarNeutronPi0 resonant charged current, $\bar{\nu} n \to \bar{\nu} n \pi^0$

kResNCNuBarNeutronPiMinus resonant charged current, $\bar{\nu} n \to \bar{\nu} p \pi^-$

kCCDIS charged current deep inelastic scatter

kNCDIS charged current deep inelastic scatter

kCCCOH charged current coherent pion

kNuElectronElastic neutrino electron elastic scatter

kInverseMuDecay inverse muon decay

Chapter 5

Class Documentation

5.1 caf::CVNFinalState Struct Reference

Public Attributes

- int **nuPdg**
- int **nElectron**
- int **nMuon**
- int **nPi0**
- int **nChargedPion**
- int **nNeutron**
- int **nProton**

5.2 caf::SRBeam Class Reference

Information about the neutrino production. Docs from http://www.hep.utexas.edu/~zarko/wwwgnumi/v19/v19/output_gnumi.html.

Public Member Functions

- void **setDefault** ()

Public Attributes

- SRVector3D tv

  "target vertex". Exit point of parent particle at the target
- SRVector3D tp

  "target momentum". Parent momentum exiting the target
- float runjob

  Flux run number, indicates which FLUGG job created this flux.
- int potnum

  Proton event number, indicates which simulated proton was taken.
- int tptype

"target particle type". Parent particle ID exiting the target (PDG code)

- float nimpwt

  "neutrino importance weight". Weight of neutrino parent
- int ndecay

  "neutrino decay". Decay mode that produced neutrino
- SRVector3D v

  "vertex". Position of hadron/muon decay
- SRVector3D pdp

  "parent decay momentum". Parent momentum at decay point
- float ppdxdz

  "parent particle momentum dx/dx". Parent dx/dz direction at production
- float ppdydz

  "parent particle momentum dy/dz". Parent dy/dz direction at production
- float pppz

  "parent particle p_z". Parent Z momentum at production
- float ppenergy

  "parent particle energy". Parent energy at production
- int ppmedium

  "parent particle medium". Tracking medium number where parent was produced
- int ptype

  "parent type". Parent PDG code
- SRVector3D ppv

  "parent particle vertex". Parent production vertex
- SRVector3D muparp

  Muon neutrino parent momentum, x component.
- float mupare

  Muon neutrino parent energy.
- float necm

  Neutrino energy in CM frame.
- int tgen

  nu parent generation 1=primary proton, 2=secondary, 3=tertiary, etc
- int tgptype

  PDG of parent of the particle exiting the target.
- float dk2gen

  distance from decay to ray origin (ray origin is the intermediate point on the flux window)
- float gen2vtx

  distance from ray origin to event vtx
- float **dk2vtx**

5.3 caf::SRBpf Class Reference

Public Attributes

- SRBpfTrack muon

  The track reconstructed under the muon assumption.
- SRBpfTrack pion

  The track reconstructed under the pion assumption.
- SRBpfTrack proton

  The track reconstructed under the proton assumption.

5.4 caf::SRBPFEnergy Class Reference

BPF energy estimator output.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- float E1

  Total event energy (GeV) (using an unoscillated training sample)
- float Eres1

  Estimated event energy resolution (GeV) (using an unoscillated training sample)
- float E2

  Total event energy (GeV) (using a training sample with dm^2 = 2.4e-3, sin^2(2th23) = 0.95)
- float Eres2

  Estimated event energy resolution (GeV) (using a training sample with dm^2 = 2.4e-3, sin^2(2th23) = 0.95)
- float E3

  Total event energy (GeV) (using a training sample with dm^2 = 2.4e-3, sin^2(2th23) = 1.0)
- float Eres3

  Estimated event energy resolution (GeV) (using a training sample with dm^2 = 2.4e-3, sin^2(2th23) = 1.0)
- float EventID

  BPF muon PID value used to pick out the most muon like track.
- float PMuon

  BPF reconstructed momentum for the prong with the best muon PID value.
- float DirZMuon

  BPF reconstructed track direction for the prong with the best muon PID value.
- float N3DProngs

  Number of fuzzyK 3D prongs.
- float EFuzzyK3D

  Summed energy from hits on fuzzyK 3D prongs (not including the prong with the best muonPID)
- float ERemain

  Summed remaining energy in the slice (not on fuzzyK 3D prongs)
- float SumPE

  Summed PE for all hits not on the muon track.

5.5 caf::SRBpfId Class Reference

Breakpoint ID (BpfId) output.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- int bestVtxIdx

  elastic arms vertex index for the best muon track
- int bestPngIdx

  fuzzyk prong index for the best muon track
- int bestBpfIdx

  bpf track index for the best muon track
- int pdg

  pdg code for the tracking assumption used to make the best muon track
- float pid

  muon PID value from the best muon track
- float chi2T

  total chi^2 from the track fit for the best muon track
- float dEdXLL

  dE/dx log-likelihood from the best muon track (input to the muon PID)
- float hitRatio

  ratio of hits in track to hits in prong (input to the muon PID) for the best muon track
- SRVector3D momentum

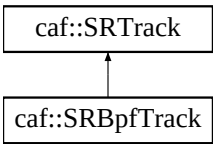
  reconstructed momentum for the best muon track (access via: sel.bpfid.momentum.{x,y,z})
- float energy

  reconstructed total energy for the best muon track
- float len

  reconstructed track length for the best muon track (input variable for the muon PID)

5.6 caf::SRBpfTrack Class Reference

Inheritance diagram for caf::SRBpfTrack:



Public Attributes

- bool IsValid

  This defaults to false, and only gets set to true in CAFMaker if there is a valid BPF track.
- int pdg

  pdg code for the tracking assumption used to make this track
- float pid

  pid score for this track
- float chi2T

  total chi^2 from the track fit ([hit-trajectory chi^2] + [scattering angle chi^2]) (input to the muon PID)
- float chi2Hit

  chi^2 from the hit-trajectory
- float chi2Scat

chi^2 from the scattering angle

- float dEdXLL

  dE/dx log-likelihood (input to the muon PID)
- float hitRatio

  ratio of hits in track to hits in prong (input to the muon PID)
- SRVector3D momentum

  reconstructed momentum (access via: sel.bpfid.momentum.{x,y,z})
- float energy

  reconstructed total energy
- float scatt15

  measure of track scatter ignoring 15 cm near EA vertex
- float scatt30

  measure of track scatter ignoring 30 cm near EA vertex
- float dedx15

  measure of dedx ignoring 15 cm near EA vertex
- float dedx30

  measure of dedx ignoring 30 cm near EA vertex
- float activity15

  measure of activity within 15 cm of end of track ignoring 30 cm near vertex
- float activity30

  measure of activity within 30 cm of end of track ignoring 30 cm near vertex
- float activity45

  measure of activity within 45 cm of end of track ignoring 30 cm near vertex
- float **prox15**
- float **prox30**
- float mvapiE

  measure of reconstructed energy assuming this track is a charged pion
- unsigned short nhit

  number of hits
- unsigned short nhitx

  number of hits in x-view
- unsigned short nhity

  number of hits in y-view
- unsigned short nplane

  number of planes spanned
- unsigned short maxplanecont

  maximum number of contiguous planes in prong
- unsigned short maxplanegap

  maximum number of gapped planes in prong
- unsigned short nplanegap

  total number of missing planes on track
- float calE

  energy based on summed calibrated deposited charge [GeV]
- SRVector3D start

  Shower start point in detector coordinates. [cm].
- SRVector3D dir

  Shower direction at start point [unit vector recommended].
- float pngminx

  Minimum X that contain all the cell hits. [cm].
- float pngmaxx

  Maximum X that contain all the cell hits. [cm].

- float pngminy

  Minimum Y that contain all the cell hits. [cm].
- float pngmaxy

  Maximum Y that contain all the cell hits. [cm].
- float len

  track length [cm]
- View_t view

  Prong view caf::kX = 0, caf::kY = 1 or caf::kXorY = 2.
- float lenE

  energy based on track length and MIP assumption [GeV]
- float overlapE

  overlapping energy calculated by the NumuEnergy/TrackOverlapECalc module.
- SRVector3D stop

  Track end point in detector coordinates. [cm].
- SRVector3D stopdir

  Track direction at end point [unit vector recommended].
- SRParticleTruth truth

  Truth information for the track.
- SRParticleTruth truthXView

  Truth information for the track.
- SRParticleTruth truthYView

  Truth information for the track.
- std::vector< SRTrkME > **me**
- std::vector< SRMRProperties > mrdif

  cosmogenic DiF shower properties
- std::vector< SRMRProperties > mrbrem

  cosmogenic Brem shower properties
- int trkfwdcell

  track forward cell from end to detector edge
- int trkfwdcellnd

  track forward cell from end to detector edge with muon catcher included
- int trkbakcell

  track backeard cell from start to detector edge
- int trkbakcellnd

  track backeard cell from start to detector edge with muon catcher included
- double leninact

  track length in active detector
- double lenincat

  track length in muon catcher
- float trkyposattrans

  Y position at transition to muon catcher, for determining if track went through air gap (ND only)
- float **vtxdist**
- float **enddist**
- float trkfwddist

  Kalmantrack projected distance (cm) from end point forwards to det edge.
- float trkfwdair

  for Kalmantrack projected distance forwards how much is through air (ND only, NYI)
- float trkfwdsteel

  for Kalmantrack projected distance forwards, how much is through steel (ND only, currently is just distance in muon catcher, cells and all)
- float trkbakdist

Kalmantrack projected distance (cm) from start point backwards to det edge.

- float trkbakair

  for Kalmantrack projected distance backwards how much is through air (ND only, NYI)
- float trkbaksteel

  for Kalmantrack projected distance backwards, how much is through steel (ND only, currently is just distance in muon catcher, cells and all)
- float avedEdxlast10cm

  Average dE/dx in the last 10 cm approximately.
- float avedEdxlast20cm

  Average dE/dx in the last 20 cm approximately.
- float avedEdxlast30cm

  Average dE/dx in the last 30 cm approximately.
- float avedEdxlast40cm

  Average dE/dx in the last 40 cm approximately.
- float meantime

  Average time weighted by the energy of the cell(s) hit.
- float maxtime

  Max time of cell(s)
- float mintime

  Min time of cell(s)
- float meantimeRes

  Average time weighted by the time resolution of the cell(s) hit.

5.7 caf::SRContain Class Reference

Containment variables.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- bool numucontain

  is this contained by Numu Standards? (can use as general containment)
- bool numucontainSA

  is this contained by second analysis Numu Standards?
- float missE

  sum of energy of particles that leave detector. example cut: missE/trueE $>$ 0.01 is truly uncontained
- int nplanestofront

  number of planes between the front of the detector (configuration dependent) and hit with the smallest Z position
- int nplanestoback

  number of planes between the back of the detector (configuration dependent) and hit with the largest Z position
- float vtxdist

  shortest distance to wall from primary Kalman track start position (proxy for vertex)
- float enddist

  shortest distance to wall from primary Kalman track end position
- float cosfwddist

cosmictrack projected distance (cm) from end point forwards to det edge

- int cosfwdcell

  cosmictrack projected # cells from end point forwards to det edge

- int cosfwdcellnd

  cosmictrack projected # cells from end point forwards to det edge, including muon catcher, ND only

- float cosfwdair

  for cosmictrack projected distance forwards how much is through air (ND only, NYI)

- float cosfwdsteel

  for cosmictrack projected distance forwards, how much is through steel (ND only, currently is just distance in muon catcher, cells and all)

- float cosbakdist

  cosmictrack projected distance (cm) from start point backwards to det edge

- int cosbakcell

  cosmictrack projected # cells from start point backwards to det edge

- int cosbakcellnd

  cosmictrack projected # cells from start point backwards to det edge, including muon catcher, ND only

- float cosbakair

  for cosmictrack projected distance backwards how much is through air (ND only, NYI)

- float cosbaksteel

  for cosmictrack projected distance backwards, how much is through steel (ND only, currently is just distance in muon catcher, cells and all)

- float kalfwddist

  Kalmantrack projected distance (cm) from end point forwards to det edge.

- int kalfwdcell

  Kalmantrack projected # cells from end point forwards to det edge.

- int kalfwdcellnd

  Kalmantrack projected # cells from end point forwards to det edge, including muon catcher, ND only.

- float kalfwdair

  for Kalmantrack projected distance forwards how much is through air (ND only, NYI)

- float kalfwdsteel

  for Kalmantrack projected distance forwards, how much is through steel (ND only, currently is just distance in muon catcher, cells and all)

- float kalbakdist

  Kalmantrack projected distance (cm) from start point backwards to det edge.

- int kalbakcell

  Kalmantrack projected # cells from start point backwards to det edge.

- int kalbakcellnd

  Kalmantrack projected # cells from start point backwards to det edge, including muon catcher, ND only.

- float kalbakair

  for Kalmantrack projected distance backwards how much is through air (ND only, NYI)

- float kalbaksteel

  for Kalmantrack projected distance backwards, how much is through steel (ND only, currently is just distance in muon catcher, cells and all)

- float cosyposattrans

  Y position of cosmic track at transition (ND only, use to check if went through air gap)

- float kalyposattrans

  Y position of Kalman track and transition (ND only, use to check if went through air gap)

- float xmin2

  x position of hit second closest to edge in -X dimension (slc.boxmin.fX gives first closest)

- float ymin2

  y position of hit second closest to edge in -Y dimension (slc.boxmin.fY gives first closest)

- float zmin2

  Z position of hit second closest to edge in -Z dimension (slc.boxmin.fZ gives first closest)
- float xmax2

  x position of hit second closest to edge in +X dimension (slc.boxmax.fX gives first closest)
- float ymax2

  y position of hit second closest to edge in +Y dimension (slc.boxmax.fY gives first closest)
- float zmax2

  z position of hit second closest to edge in +Z dimension (slc.boxmax.fZ gives first closest)
- float xmint

  x position of hit closest to edge in -X dimension that has > 100 photoelectons (TODO: use pecorr)
- float ymint

  y position of hit closest to edge in -Y dimension that has > 100 photoelectons (TODO: use pecorr)
- float zmint

  z position of hit closest to edge in -Z dimension that has > 100 photoelectons (TODO: use pecorr)
- float xmaxt

  x position of hit closest to edge in +X dimension that has > 100 photoelectons (TODO: use pecorr)
- float ymaxt

  y position of hit closest to edge in +Y dimension that has > 100 photoelectons (TODO: use pecorr)
- float zmaxt

  z position of hit closest to edge in +Z dimension that has > 100 photoelectons (TODO: use pecorr)

5.8 caf::SRCosmic Class Reference

Truth information for cosmic rays.

Public Attributes

- short pdg

  pdg code
- float E

  True energy [GeV].
- float visE

  Sum of FLS hits that made CellHits from this neutrino [GeV].
- float visEinslc

  Sum of FLS hits that made CellHits from this neutrino in this subevent [GeV].
- float eff

  Slicer efficiency for this truth interaction.
- float pur

  Slicer purity for this truth interaction.
- unsigned int nhitslc

  Number of hits recorded in this slice by this truth interaction.
- unsigned int nhittot

  Total number of hits recorded for this truth interaction.
- float time

  interaction time.
- SRLorentzVector p

  True momentum [GeV].
- SRLorentzVector penter

True momentum when entering the detector [GeV].

- SRVector3D vtx

  Vertex position in detector coordinates [cm].

- std::vector< SRTrueMichelE > michel

  Vector of true Michel electrons.

- float azimuth

  Azimuth angle (w.r.t y-axis)

- float zenith

  Zenith angle (w.r.t y-axis)

- SRVector3D enter

  Cosmic entrance point in detector coordinates. [cm] When the primary doesn't enter the detector, coordinates are -5e9.

- SRVector3D exit

  Cosmic exit point in detector coordinates. [cm] When the primary doesn't enter the detector, coordinates are -5e9.

- SRVector3D stop

  Cosmic end point in detector coordinates, regardless of whether it is inside or outside the detector. [cm].

5.9 caf::SRCosmicCVN Class Reference

The SRCosmicCVN contains a vector of time slices and cosmic CVN scores used forearly cosmic filtering. These time slices are not directly associated with analysis slices.

Public Attributes

- int **nHits**
- float **timeWinMin**
- float **timeWinMax**
- float **numuVal**
- float **nueVal**
- float **nutauVal**
- float **ncVal**
- float **cosmicVal**
- bool **passSel**

5.10 caf::SRCosRej Class Reference

Output from Cosmic Rejection (CosRej) module.

Public Member Functions

- void **setDefault** ()

Public Attributes

- float kfitspeed

  fit inverse speed (ns/cm) of Hough timing fit (TimingFit module) for best ReMId Kalman track
- float cfitspeed

  fit inverse speed (ns/cm) of Hough timing fit (TimingFit module) for cosmic track
- float kdirscore

  chisq score difference between +c and -c assumptions in Hough timing fit (TimingFit module) for best ReMId Kalman track
- float cdirscore

  chisq score difference between +c and -c assumptions in Hough timing fit (TimingFit module) for cosmic track
- float kscorediff

  chisq score difference between best +c/-c assumption and free fit in Hough timing fit (TimingFit module) for best ReMId Kalman track
- float cscorediff

  chisq score difference between best +c/-c assumption and free fit in Hough timing fit (TimingFit module) for Cosmic track
- float kalslope

  slope of track timing fit (kalmantrack)
- float kalchisq

  chisq value of slope fit (kalmantrack)
- float kalchidiff

  chisq difference of track timing fits (kalmantrack)
- float cosslope

  slope of track timing fit (cosmictrack)
- float coschisq

  chisq value of slope fit (cosmictrack)
- float coschidiff

  chisq difference of track timing fits (cosmictrack)

Track Projections

- float mindist

  minimum projected distance to edge of any Kalman track with $>$ 15 hits
- int mincell

  minimum projected cells to edge of any Kalman track with $>$ 15 hits

Other Track Information

- float anglekal

  cos of angle of best ReMId Kalman track
- float anglecos

  cos of angle of Cosmic Track
- int nkal3d

  number of 3D tracks as determined by Kalman tracker
- float costhetatrue

  cosine of angle between cosmic trk dir and true dir of most contributing particle
- float kalthetatrue

  cosine of angle between kalman trk dir and true dir of most contributing particle
- int pdgbest

  pdg code of most contributing true particle to best kalman trk

PIDs

- float numucontpid2020

  cosmic rejection PID for contained events; 2020 Analysis
- float numucontpid2019

  cosmic rejection PID for contained events; 2019 Analysis
- float numuunconttunedpid

  tuned cosmic rejection PID for uncontained events - Jose's;

Scattering Variables

- float scatt

  sum of all all angular deviation (looping over kaltrk traj pts) / trk len
- float fscattmax

  maximum scattering angle (Fernanda)
- float fscattsum

  sum of scattering angles (Fernanda)
- float fscattext

  scattering variable (Fernanda)
- float fscattsig

  sigma of scattering variable distribution (Fernanda)

Energy and Activity

- float eratio

  ratio of best kalman track GeV / slice GeV
- float hadE

  GeV sum of non (Kalman best ReMId) track E.

5.11 caf::SRCVNFeatures Class Reference

CVN features.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- std::vector< float > output

  List of net output nodes.
- unsigned int noutput

  Number of entries in output vector.
- std::vector< float > components

  Principal components of output.
- unsigned int ncomponents

  Size of components vector.

5.12 caf::SRCVNParticleResult Class Reference

CVN PID output for a single particle.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- float muonid

  Likelihood muon.
- float electronid

  Likelihood electron.
- float protonid

  Likelihood proton.
- float neutronid

  Likelihood neutron.
- float pionid

  Likelihood pion.
- float pizeroid

  Likelihood pizero.
- float photonid

  Likelihood photon.
- float otherid

  Likelihood other.
- float maxval

  Maximum likelihood among net outputs.
- unsigned int pdgmax

  pdg of largest likelihood

5.13 caf::SRCVNResult Class Reference

CVN PID output.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- std::vector< float > output

  List of net output nodes.
- float numuid

  Likelihood Charge Current NuMu.
- float nueid

  Likelihood Charge Current NuE.
- float nutauid

  Likelihood Charge Current NuTau.
- float ncid

  Likelihood Neutral Current.
- float cosmicid

  Likelihood Cosmic Interaction.
- float maxval

  Maximum value among net outputs.
- unsigned int argmax

  Index of maximum value.
- unsigned int noutput

  Number of entries in output vector.

5.14 caf::SRElastic Class Reference

A potential interaction point from the ElasticArms algorithm.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- float time

  Time [ns].
- SRVector3D vtx

  Vertex position in detector coordinates. [cm].
- bool **IsValid**
- SRFuzzyK fuzzyk

  Primary 3D prong object.

5.15 caf::SRELid Class Reference

Output of the LIDBuilder module (slid::lid objects).

Public Member Functions

- void **setDefault** ()

Public Attributes

- float ann

  ann output for the slice, currently the same as most energetic shower
- float rnn

  ann output for the slice, currently the same as most energetic shower
- float anne

  ann output with energy for the slice, currently the same as the most energetic shower
- float annepi0

  e/pi0 ann output with energy for the slice, currently the same as the most energetic shower
- float annecos

  e/cosmic ann output with energy for the slice, currently the same as the most energetic shower

5.16 caf::SREnergy Class Reference

This is a simple class for energy estimators in the standard record. More complicated energy estimators will have extra fields for other output.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- float E

  Energy [GeV].

5.17 caf::SREnergyBranch Class Reference

An SREnergyBranch contains vectors of energy objects.

Public Attributes

- SRNueEnergy nue

  Nue energy variables.
- SRNumuEnergy numu

  Numu energy estimator.

5.18 caf::SRFluxWeights Class Reference

Reweight information for flux systematic.

Public Member Functions

- void **setDefault** ()

Public Attributes

- float cv

  Reweight for the central value (cv)
- std::vector< float > vuniv

  Reweight values for the multi-universe.
- unsigned int nvuniv

  Number of universes.

5.19 caf::SRFuzzyK Class Reference

Public Member Functions

- void **fillSizes** ()

Public Attributes

- std::vector< SRFuzzyKProng > png

  Vector of 3D prong objects.
- std::vector< SRProng > png2d

  Vector of 2D prong objects.
- unsigned int longestidx

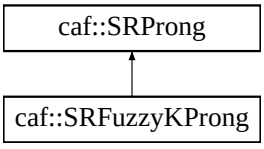
  index of longest prong
- unsigned int nshwlid

  number of shwlid showers - either 0 or number of 3d prongs
- size_t **npng**
- size_t **npng2d**
- size_t **ntot**
- float orphCalE

  calorimetric energy of hits that don't appear in any FuzzyK prongs

5.20 caf::SRFuzzyKProng Class Reference

Inheritance diagram for caf::SRFuzzyKProng:



Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- SRShowerLID shwlid

  Shower information.
- SRBpf bpf

  Container class for BreakPointFitter tracks.
- SRRegCVNResult regcvn

  Regression CVN information.
- float dedx15

  PionReco dedx calc ignoring 15 cm near vertex.
- float dedx30

  PionReco dedx calc ignoring 30 cm near vertex.
- float activity15

  PionReco activity within 15 cm of prong end, in GeV, ignoring 30 cm near vertex.
- float activity30

  PionReco activity within 30 cm of prong end, in GeV, ignoring 30 cm near vertex.
- float activity45

  PionReco activity within 45 cm of prong end, in GeV, ignoring 30 cm near vertex.
- float prox15

  PionReco measure of proximity to other prongs, ignoring 15 cm near vertex.
- float prox30

  PionReco measure of proximity to other prongs, ignoring 30 cm near vertex.
- float mvapiE

  PionReco measure of particle energy, assuming a charged pion.
- unsigned short nhit

  number of hits
- unsigned short nhitx

  number of hits in x-view
- unsigned short nhity

  number of hits in y-view
- unsigned short nplane

  number of planes spanned
- unsigned short maxplanecont

  maximum number of contiguous planes in prong
- unsigned short maxplanegap

  maximum number of gapped planes in prong
- float calE

  energy based on summed calibrated deposited charge [GeV]
- float weightedCalE

  calE, weighted to take into account hits shared between prongs [GeV]
- SRVector3D start

  Shower start point in detector coordinates. [cm].
- SRVector3D dir

  Shower direction at start point [unit vector recommended].
- float pngminx

  Minimum X that contain all the cell hits. [cm].

- float pngmaxx

  Maximum X that contain all the cell hits. [cm].
- float pngminy

  Minimum Y that contain all the cell hits. [cm].
- float pngmaxy

  Maximum Y that contain all the cell hits. [cm].
- float len

  track length [cm]
- View_t view

  Prong view caf::kX = 0, caf::kY = 1 or caf::kXorY = 2.
- SRParticleTruth truth

  Truth information for the prong.
- SRParticleTruth truthXView

  Truth information for the prong.
- SRParticleTruth truthYView

  Truth information for the prong.
- SRCVNParticleResult cvnpart

  CVN prongID information for 4 views.
- std::vector< SRPixelMap > cvnmaps

  Pixel maps used in CVN evaluation and training 80 cells x 100 planes in each view.
- std::vector< SRProngTrainingData > prongtrainingdata

  Prong label information.
- float meantime

  Average time of cell(s) hits weighted by their energy.
- float maxtime

  Max time of cell(s) hits.
- float mintime

  Min time of cell(s) hits.
- float meantimeRes

  Average time of cell(s) hits weighted by their time resolution.

5.21 caf::SRGenieWeights Class Reference

Reweight information for a single GENIE systematic.

Public Attributes

- float minus2sigma

  Reweight for -2σ shift.
- float minus1sigma

  Reweight for -1σ shift.
- float plus1sigma

  Reweight for $+1\sigma$ shift.
- float plus2sigma

  Reweight for $+2\sigma$ shift.

5.22 caf::SRGlobalTruth Class Reference

Information about the event from which the slice came. Information in this branch should be used with caution since it can be duplicated across entries (slices) in the CAF tree.

Public Attributes

- unsigned int nnu

  Number of true neutrinos in the event < WARNING: this variable is duplicated across slices.

5.23 caf::SRHadClust Class Reference

Overarching information for a numu hadronic cluster.

Public Member Functions

- void **setDefault** ()

Public Attributes

- unsigned int nhit

  number of hits
- unsigned int ncalhit

  number of hits with calibration
- unsigned int nmiphit

  number of minimum ionizing hits
- unsigned int ncontplanes

  number of continuous planes
- unsigned int firstplane

  first plane
- unsigned int lastplane

  last plane
- unsigned int firstcell

  first cell
- unsigned int lastcell

  last cell
- unsigned int ncellsfromedge

  minimum number of cells to edge of detector
- float calE

  Calorimetric energy of the cluster [GeV].
- SRVector3D boxmin

  Minimum coordinates box containing all the hits [cm].
- SRVector3D boxmax

  Maximum coordinates box containing all the hits [cm].
- SRVector3D meanpos

  Mean position of hits in cluster, weighted by charge [cm].

5.24 caf::SRHeader Class Reference

Header representing overview information for the current event/slice.

Public Member Functions

- void **setDefault** ()

Public Attributes

- unsigned int run

  run number
- unsigned int subrun

  subrun number
- int cycle

  MC simulation cycle number.
- int batch

  MC simulation batch number.
- unsigned int evt

  ART event number, indexes trigger windows.
- unsigned short subevt

  slice number within spill
- bool ismc

  data or MC? True if MC
- Det_t det

  Detector, ND = 1, FD = 2, NDOS = 3.
- bool blind

  if true, record has been corrupted for blindness
- bool filt

  if true, record has ben filtered
- unsigned short dibfirst

  first diblock in detector configuration (1-14)
- unsigned short diblast

  last diblock in detector configuration (1-14)
- unsigned short dibmask

  diblock mask (bitfield, lowest bit = diblock 1)
- unsigned short maskstatus

  0 no mask found in DB, 1 mask used ok, 2 masking turned off. If 0 or 2 dibmask is instead the configuration based on what RH says is alive. dibfirst/last may be wrong in this case.
- unsigned short year

  year of spill
- unsigned short month

  month of spill
- unsigned short day

  day of spill within month
- unsigned short doy

  day of spill within year
- unsigned short hour

  hour of spill

- unsigned short minute

  minute of spill
- unsigned short second

  second of spill
- float unixtime

  unix time of spill
- float subevtstarttime

  time of beginning of slice within spill [ns]
- float subevtendtime

  Slice end time [ns].
- float subevtmeantime

  Slice mean time [ns].
- unsigned int nbadchan

  Number of bad channels in a subrun. Ignores channels in diblocks that are masked off for analysis.
- unsigned int ntotchan

  Total number of channels in the analysis masked region of the detector.
- unsigned short gain

  Global gain setting of the detector.
- bool finetiming

  Is fine timing enabled in this run?

5.25 caf::SRHoughVertex Class Reference

A potential interaction point found by the HoughVertex algorithm.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- float time

  Time [ns].
- SRVector3D vtx

  Vertex position in detector coordinates. [cm].
- SRFuzzyK fuzzyk

  Primary 3D prong object.

5.26 caf::SRIDBranch Class Reference

Event ID and selection variables.

Public Attributes

- SRRemid remid

  Output from RecoMuonID (ReMId) package.
- SRMuonID muonid

  Output from ND Group MuonID BDT.
- SRBpfId bpfid

  Output from the BreakPointFitter PID (BPFPIdMaker) package.
- SRELid lid

  Output from LIDBuilder (LID) package.
- SRLem lem

  Output from Library Event Matching (LEM)
- SRPresel nuepre

  Official nue preselection information.
- SRPresel rockpre

  Official rock preselection information.
- SRRvp rvp

  Output from RecoVariablePID (RVP)
- SRCosRej cosrej

  Output from CosRej (Cosmic Rejection)
- SRNueCosRej nuecosrej

  Output from NueCosRej (Nue Cosmic Rejection)
- SRNCCosRej nccosrej

  Output from NCCosRej (NC Cosmic Rejection)
- SRNCPi0BkgRej ncpi0bkgrej

  Output from NCCosRej (NC Cosmic Rejection)
- SRContain contain

  Output from SRContain (containment related variables)
- SRVeto veto

  Output from CosmicVeto (Preliminary preselection)
- SRCVNResult cvn

  Horrible hack to appease CAFAna.
- SRCVNResult cvnloosepreselptp

  Output from CVN - Loose Presel plus PtP cut (many-class PID)
- SRCVNResult cvnoldpresel

  Output from CVN - Preselection used in Prod3/4 (many-class PID)
- SRCVNResult cvnnocosmics

  Output from CVN - No cosmics ued in training (many-class PID)
- SRXnue xnuepid

  Output from BDT (XnuePID)
- SRSliceLID slicelid

  Output of SliceLID classifier.
- SRNuonEResult nuone

  Ouput of nuone classifier.
- double **wsid**

5.27 caf::SRJMEid Class Reference

Output of the jmshower::NueSel module.

Public Member Functions

- void **setDefault** ()

Public Attributes

- float ann

  ann output
- float annE

  ann output, with E
- float annEL

  ann output,
- float annEPi0

  ann output, EPi0
- float annEPi0EL

  ann output, EPi0 Elastic scattering
- float annNoCos

  ann output, without cosTheta
- float annENoCos

  ann output, with E without cosTheta
- int ismuon

  Boolean to distinguish muons from electrons.
- float **dedx0**
- float dedx1

  Plane Dedx.
- float dedx2

  Plane Dedx.
- float dedx3

  Plane Dedx.
- float dedx4

  Plane Dedx.
- float dedx5

  Plane Dedx.
- float eglll

  Plane Dedx.
- float eglLt

  Electron - gamma ll for ltransverse shower.
- float emulll

  Electron - muon ll for longitudinal shower.
- float emullt

  Electron - muon ll for ltransverse shower.
- float epi0lll

  Electron - Pi0 ll for longitudinal shower.
- float epi0llt

  Electron - Pi0 ll for ltransverse shower.
- float eplll

  Electron - proton ll for longitudinal shower.
- float epllt

  Electron - proton ll for ltransverse shower.
- float enlll

Electron - neutron ll for longitudinal shower.

- float enllt

  Electron - neutron ll for ltransverse shower.

- float epilll

  Electron - pion ll for longitudinal shower.

- float epillt

  Electron - pion ll for ltransverse shower.

- float vtxgev

  Energy of slice in vertex region.

- float pi0mass

  best pi0 mass hypothesis coming from combinations of JMShowers

- float shwEFrac

  fraction of energy of leading shower out of total energy of slice

- float gap

  gap from vertex to start of shower

- float costheta

  cosine of track with respect to beam direction

- float elll

  electron ll for longitudinal shower

- float ellt

  electron ll for transverse shower

- float eellll

  electron el ll for longitudinal shower

- float eelllt

  electron el ll for transverse shower

- float mulll

  muon ll for longitudinal shower

- float mullt

  muon ll for transverse shower

5.27.1 Member Data Documentation

5.27.1.1 int caf::SRJMEid::ismuon

Below are the training variables for the EID <These variables all use the leading (most energetic) shower in each slice <The first 12 variables are calculating by computing the log likelihood <that the leading shower (in both transverse and longitudinal directions) <is an electron, and then subtracting the loglikelihood that the shower is <another particle.

5.27.1.2 float caf::SRJMEid::eglll

Electron - gamma ll for longitudinal shower

5.27.1.3 float caf::SRJMEid::costheta

The following variables are not used directly in the training but may be useful

5.28 caf::SRJMShower Class Reference

A reconstructed shower from the JMShower module.

Public Attributes

- unsigned short nhit
  number of hits
- unsigned short nhitx
  number of hits in x-view
- unsigned short nhity
  number of hits in y-view
- unsigned short nplane
  number of planes spanned
- unsigned short maxplanecont
  maximum number of contiguous planes in prong
- unsigned short maxplanegap
  maximum number of gapped planes in prong
- float calE
  energy based on summed calibrated deposited charge [GeV]
- SRVector3D start
  Shower start point in detector coordinates. [cm].
- SRVector3D dir
  Shower direction at start point [unit vector recommended].
- float len
  track length [cm]
- View_t view
  Prong view caf::kX = 0, caf::kY = 1 or caf::kXorY = 2.
- float width
  Shower width [cm].
- unsigned short nplanex
  number of planes spanned in x view
- unsigned short nplaney
  number of planes spanned in y view
- float gap
  gap from shower start to ElasticArms vertex [cm]
- SRVector3D stop
  shower stop point
- float shwE
  reconstructed shower energy [GeV]
- float vtxE
  calorimetric energy of [GeV]

5.29 caf::SRKalman Class Reference

Public Member Functions

- void **fillSizes** ()
- virtual void **setDefault** ()

Public Attributes

- std::vector< SRKalmanTrack > tracks

  3D Tracks produced by KalmanTrack
- std::vector< SRTrack > tracks2d

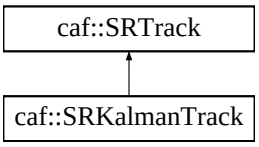
  2D Tracks produced by KalmanTrack
- size_t **ntracks**
- size_t **ntracks2d**
- unsigned int idxremid

  index number of the best ReMId track
- unsigned int idxmuonid

  Index number of the highest scoring muonid track.
- unsigned int **idxlongest**

5.30 caf::SRKalmanTrack Class Reference

Inheritance diagram for caf::SRKalmanTrack:



Public Attributes

- float remavededx

  average dE/dx value as computed by remid
- float **rempid**
- float muonid

  MuonID classifier value.
- float **scatllh**
- float **dedxllh**
- float **measfrac**
- int **remcont**
- float scatt15

  measure of track scatter ignoring 15 cm near EA vertex
- float scatt30

  measure of track scatter ignoring 30 cm near EA vertex
- float dedx15

  measure of dedx ignoring 15 cm near EA vertex
- float dedx30

  measure of dedx ignoring 30 cm near EA vertex
- float activity15

  measure of activity within 15 cm of end of track ignoring 30 cm near vertex
- float activity30

  measure of activity within 30 cm of end of track ignoring 30 cm near vertex
- float activity45

  measure of activity within 45 cm of end of track ignoring 30 cm near vertex

- float **prox15**
- float **prox30**
- float mvapiE

  measure of reconstructed energy assuming this track is a charged pion
- unsigned short nhit

  number of hits
- unsigned short nhitx

  number of hits in x-view
- unsigned short nhity

  number of hits in y-view
- unsigned short nplane

  number of planes spanned
- unsigned short maxplanecont

  maximum number of contiguous planes in prong
- unsigned short maxplanegap

  maximum number of gapped planes in prong
- unsigned short nplanegap

  total number of missing planes on track
- float calE

  energy based on summed calibrated deposited charge [GeV]
- SRVector3D start

  Shower start point in detector coordinates. [cm].
- SRVector3D dir

  Shower direction at start point [unit vector recommended].
- float pngminx

  Minimum X that contain all the cell hits. [cm].
- float pngmaxx

  Maximum X that contain all the cell hits. [cm].
- float pngminy

  Minimum Y that contain all the cell hits. [cm].
- float pngmaxy

  Maximum Y that contain all the cell hits. [cm].
- float len

  track length [cm]
- View_t view

  Prong view caf::kX = 0, caf::kY = 1 or caf::kXorY = 2.
- float lenE

  energy based on track length and MIP assumption [GeV]
- float overlapE

  overlapping energy calculated by the NumuEnergy/TrackOverlapECalc module.
- SRVector3D stop

  Track end point in detector coordinates. [cm].
- SRVector3D stopdir

  Track direction at end point [unit vector recommended].
- SRParticleTruth truth

  Truth information for the track.
- SRParticleTruth truthXView

  Truth information for the track.
- SRParticleTruth truthYView

  Truth information for the track.
- std::vector< SRTrkME > **me**

- std::vector< SRMRProperties > mrdif

  cosmogenic DiF shower properties
- std::vector< SRMRProperties > mrbrem

  cosmogenic Brem shower properties
- int trkfwdcell

  track forward cell from end to detector edge
- int trkfwdcellnd

  track forward cell from end to detector edge with muon catcher included
- int trkbakcell

  track backeard cell from start to detector edge
- int trkbakcellnd

  track backeard cell from start to detector edge with muon catcher included
- double leninact

  track length in active detector
- double lenincat

  track length in muon catcher
- float trkyposattrans

  Y position at transition to muon catcher, for determining if track went through air gap (ND only)
- float **vtxdist**
- float **enddist**
- float trkfwddist

  Kalmantrack projected distance (cm) from end point forwards to det edge.
- float trkfwdair

  for Kalmantrack projected distance forwards how much is through air (ND only, NYI)
- float trkfwdsteel

  for Kalmantrack projected distance forwards, how much is through steel (ND only, currently is just distance in muon catcher, cells and all)
- float trkbakdist

  Kalmantrack projected distance (cm) from start point backwards to det edge.
- float trkbakair

  for Kalmantrack projected distance backwards how much is through air (ND only, NYI)
- float trkbaksteel

  for Kalmantrack projected distance backwards, how much is through steel (ND only, currently is just distance in muon catcher, cells and all)
- float avedEdxlast10cm

  Average dE/dx in the last 10 cm approximately.
- float avedEdxlast20cm

  Average dE/dx in the last 20 cm approximately.
- float avedEdxlast30cm

  Average dE/dx in the last 30 cm approximately.
- float avedEdxlast40cm

  Average dE/dx in the last 40 cm approximately.
- float meantime

  Average time weighted by the energy of the cell(s) hit.
- float maxtime

  Max time of cell(s)
- float mintime

  Min time of cell(s)
- float meantimeRes

  Average time weighted by the time resolution of the cell(s) hit.

5.31 caf::SRLem Class Reference

This class contains the LEM PID output.

Public Member Functions

- void **setDefault** ()

Public Attributes

- float pid
  The default PID value - normally use this one.
- float pidfit
  Fraction of matches that are signal, "fit".
- float pidexp
  Fraction of matches that are signal, "exp".
- float pidexpfit
  Fraction of matches that are signal, "expfit".
- float meany
  Mean hadronic y of matches.
- float meanyfit
  Hadronic y of matches, "fit".
- float meanyexp
  Hadronic y of matches, "exp".
- float meanysig
  Mean hadronic y of matches that are signal.
- float meanysigexp
  Hadronic y of matches that are signal, "exp".
- float meanqfrac
  Mean fraction of charge matched.
- float meanqfracfit
  Fraction of charge matched, "fit".
- float meanqfracexp
  Fraction of charge matched, "exp".
- float meanqfracsig
  Fraction matched in signal matches.
- float meanqfracsigexp
  Fraction matched in signal matches "exp".
- float meanqfracbkg
  Mean fraction matched in background matches.
- float meanqfracbkgexp
  Fraction matched in background matches, "exp".
- float energydiff
  Potential diff between sig and bkg matches.
- float energydiffexp
  Pot. diff between sig and bkg matches, "exp".
- float enrichfrac
  Fraction of matches that are "enriched".
- float enrichfracexp

Fraction of matches that are "enriched", "exp".

- float fannid

  ANN output, "fann" package.

- float fannidenrich

  ANN output, including enrichfracexp.

- float chisig

  chi-square of a fit assuming best match is signal

- float chibkg

  chisq of a fit assuming best match is background

- float chisigexp

  chisq of a fit assuming best match is signal, "exp"

- float chibkgexp

  chisq of a fit assuming best match is bkg, "exp"

- float avginvE

  Fraction of signal matches, 1/E weighting.

- float avgexpE

  Fraction of signal matches, "exp" weighting.

- float avgsigE

  Fraction of signal matches, sigmoid weighting.

- float tmvabdtg

  TMVA boosted decision tree, gradient boost.

- float tmvabdt

  TMVA boosted decision tree, adaptive boost.

- float tmvabdtd

  TMVA boosted decision tree, decorrelation.

- float tmvabdtmf

  TMVA boosted decision tree, Fisher discriminant.

- float tmvamlp

  TMVA ANN ("multi layer perceptron")

- float dectree

  Decision tree PID.

5.31.1 Detailed Description

Many variables are some kind of average over the matches. There are simple means (no suffix), means exponentially weighted by the match potential ("exp"), and a procedure by which one fits a linear trend and evaluates it at the potential of the best match ("fit").

5.32 caf::SRLorentzVector Class Reference

4-vector with more efficient storage than TLorentzVector

Public Member Functions

- **SRLorentzVector** (const TLorentzVector &v)
- operator TLorentzVector () const

  Recommend users convert back to TLorentzVector for boosts etc.
- float **T** () const
- float **X** () const
- float **Y** () const
- float **Z** () const
- float **Mag** () const
- float **Beta** () const
- float **Gamma** () const
- TVector3 **Vect** () const

Public Attributes

- float **E**
- float **px**
- float **py**
- float **pz**

5.33 caf::SRMCReweight Class Reference

Various weights for systematic reweights of MC.

Public Attributes

- std::vector< SRGenieWeights > genie

  GENIE weights.
- SRFluxWeights ppfx

  ppfx weights

5.34 caf::SRMichelE Class Reference

Public Member Functions

- void **fillSizes** ()

Public Attributes

- std::vector< SRTrkME > **trkkalman**
- std::vector< SRTrkME > **trkdiscrete**
- std::vector< SRTrkME > **trkcosmic**
- std::vector< SRTrkME > **trkbpf**
- std::vector< SRSlcME > **slc**
- size_t **nkalman**
- size_t **ndiscrete**
- size_t **ncosmic**
- size_t **nbpf**
- size_t **nslc**

5.35 caf::SRMRCCParent Class Reference

An SRMRCCParent holds information about the slice that was parent to the current slice. It is currently being used by Muon Removed Charged Current Analysis.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- int slcidx

  Index of the parent slice.
- float eff

  Efficiency with which this event matched to the parent slice.
- float pur

  Purity with which this event matched to the parent slice.
- int nhit

  number of hits in parent slice
- int contplanes

  number of contiguous planes
- int ncellsfromedge

  number of cells from detector edge
- int firstplane

  first plane in slice
- int lastplane

  last plane in slice
- float remid

  ReMId value of the parent slice.
- float cvnm

  CVNm value of the parent slice.
- SRVector3D muonstart

  muon track start
- SRVector3D muonstop

  muon track stop
- float muonyattrans

  muon y position at transition plane
- int muonfwdcell

  forward projected distance of muon end from detector edge in cells
- int muonbkcell

  backward projected distance of muon start from detector edge in cells
- float numuE

  energy of parent slice
- float muE

  energy of muon
- float hadEinmucat

  hadronic energy in muon catcher and transition planes

5.36 caf::SRMRProperties Class Reference

A reconstructed shower from the MRProperties module.

Public Attributes

- unsigned short nhit
  number of hits
- unsigned short nhitx
  number of hits in x-view
- unsigned short nhity
  number of hits in y-view
- unsigned short nplane
  number of planes spanned
- unsigned short maxplanecont
  maximum number of contiguous planes in prong
- unsigned short maxplanegap
  maximum number of gapped planes in prong
- float calE
  energy based on summed calibrated deposited charge [GeV]
- View_t view
  Prong view caf::kX = 0, caf::kY = 1 or caf::kXorY = 2.
- unsigned short nplanex
  number of planes spanned in x view
- unsigned short nplaney
  number of planes spanned in y view
- unsigned short minplane
  minimum plane from the cluster
- unsigned short maxplane
  maximum plane from the cluster
- float gap
  gap from shower start to ElasticArms vertex [cm]
- bool **isDiF**
- bool **isShwDiF**
- SRParticleTruth truth
  Truth information for the prong.
- SRParticleTruth truthXView
  Truth information for the prong.
- SRParticleTruth truthYView
  Truth information for the prong.
- SRShowerLID lid
  LID PID information for the MR Shower.
- SRCVNResult cvnloosepreselptp
  Output from CVN - Loose Presel plus PtP cut (many-class PID)
- SRCVNResult cvnoldpresel
  Output from CVN - Preselection used in Prod3/4 (many-class PID)
- SRCVNResult cvnnocosmics
  Output from CVN - No cosmics ued in training (many-class PID)

5.37 caf::SRMuId Class Reference

This class contains the LLH muon PID output.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- int pdg
  PDG code of identified track, pion or muon.
- float pid
  PID value output by kNN.
- float scatllh
  Log-likelihood value from scattering angle.
- float dedxllh
  Log-likelihood value from dE/dx.
- float len
  Track length of identified track.
- float measfrac
  Fraction of planes used to measure dE/dx.
- int cont
  True if track is contained as defined by ReMId.

5.38 caf::SRMuonID Class Reference

Contains the reco muon PID (ReMId) output.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- float pid
  MuonID value output by ND-trained BDT.

5.39 caf::SRNCCosRej Class Reference

Output from Cosmic Rejection (Nuecosrej) module.

Public Member Functions

- void **setDefault** ()

Public Attributes

- float pngptp

  Event transverse momentum fraction, based on prongs. See ncid::NCCosRej::ProngTransMom.
- float cospidbdt

  NC Cosrej PID. A real adaptive BDT using 13 variables.
- float cospidbdtg

  NC cosrej PID. A Keras using 15 variables.

5.40 caf::SRNCPi0BkgRej Class Reference

Public Member Functions

- void **setDefault** ()

Public Attributes

- double **ncpidbdtg**
- double **ncpidbdtglt**

5.41 caf::SRNDSandbox Class Reference

Class for storing information necessary for nu_e analysis. This information might not exist here forever, it may eventually be moved somewhere else.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- float cvnFSNDccPi

  Likelyhood Charge Current NuMu.
- unsigned int **cvnFSNDccPiNoutput**

5.42 caf::SRNeutrino Class Reference

The SRNeutrino is a representation of neutrino interaction information.

Public Attributes

- short pdg

  pdg code
- float E

  True energy [GeV].
- float visE

  Sum of FLS hits that made CellHits from this neutrino [GeV].
- float visEinslc

  Sum of FLS hits that made CellHits from this neutrino in this subevent [GeV].
- float visENeutron

  Sum of FLS hits that made CellHits from this neutrino [GeV] that were daughters of neutrons.
- float visEinslcNeutron

  Sum of FLS hits that made CellHits from this neutrino in this subevent [GeV] that were daughters of neutrons.
- float visEBirks

  Sum of FLS hits that made CellHits from this neutrino [GeV] with birks suppression.
- float visEinslcBirks

  Sum of FLS hits that made CellHits from this neutrino in this subevent [GeV] with birks suppression.
- float visENeutronBirks

  Sum of FLS hits that made CellHits from this neutrino [GeV] that were daughters of neutrons with birks suppression.
- float visEinslcNeutronBirks

  Sum of FLS hits that made CellHits from this neutrino in this subevent [GeV] that were daughters of neutrons with birks suppression.
- float L

  True distance from hadron/muon decay to neutrino interaction [km].
- bool isvtxcont

  Checks if neutrino true vertex is within detector.
- float eff

  Slicer efficiency for this truth interaction.
- float pur

  Slicer purity for this truth interaction.
- unsigned int nhitslc

  Number of hits recorded in this slice by this truth interaction.
- unsigned int nhittot

  Total number of hits recorded for this truth interaction.
- float time

  interaction time.
- SRLorentzVector p

  True momentum [GeV].
- SRVector3D vtx

  Vertex position in detector coordinates [cm].
- std::vector< SRTrueMichelE > michel

  Vector of true Michel electrons.
- short pdgorig

  Unoscillated (unswapped) pdg code.
- int hitnuc

  PDG code of struck nucleon (or, in the case of MEC, struck nucleon-nucleon pair). For MEC, the codes are: 2000000200 –> nn, 2000000201 –> np, 2000000202 –> "pp".
- float woscdumb

  Simplest possible oscillation weight.
- int mode

interaction mode from enum mode_type::[QE, RES, COH, ...]

- bool iscc

  true if charged-current interaction, false if not.
- int inttype

  Interaction type enum int_type::[...].
- unsigned int npiplus

  Number of π^+'s after neutrino reaction, before FSI.
- unsigned int npiminus

  Number of π^1's after neutrino reaction, before FSI.
- unsigned int npizero

  Number of π^0's after neutrino reaction, before FSI.
- unsigned int nproton

  Number of protons after neutrino reaction, before FSI.
- unsigned int nneutron

  Number of neutrons after neutrino reaction, before FSI.
- bool ischarm

  Is a charmed quark in interaction.
- bool isseaquark

  Did neutrino scatter off a sea quark.
- int resnum

  Straight from GENIE, resonance number.
- float xsec

  xsec for thrown interaction, in 1/GeV^2, as stored by the GENIE spline
- int tgtZ

  Z of target nucleus.
- int tgtA

  A of target nucleus.
- float q2

  Squared momentum transfer [GeV^2].
- float x

  Bjorken x = (k-k')^2 / (2∗p.q), [Dimensionless].
- float y

  Bjorken y = (p.q) / (k.p), fractional energy loss of incoming particle [Dimensionless].
- float W2

  Invariant mass of final state squared. [GeV^2].
- float genweight

  Weight, if any, assigned by the generator.
- std::vector< SRTrueParticle > prim

  Primary daughters, lepton comes first in vector.
- generator_ generator

  The generator that created this neutrino interaction.
- std::vector< unsigned int > genVersion

  Version of the generator that created this neutrino interaction.
- std::string genConfigString

  String associated with generator configuration. (For GENIE 3, this is the "Comprehensive Model Configuration", sometimes a.k.a. "tune".
- SRMCReweight **rwgt**
- SRBeam beam

  Information about neutrino production.
- unsigned int run

  run number

- unsigned int subrun

  subrun number
- unsigned int evt

  ART event number, indexes trigger windows.
- int cycle

  MC repition index on a given run,subrun.
- bool **isFHC**
- bool **is0HC**
- bool **isRHC**
- Det_t **det**

5.43 caf::SRNueCosRej Class Reference

Output from Cosmic Rejection (Nuecosrej) module.

Public Member Functions

- void **setDefault** ()

Public Attributes

- float hitsperplane

  Number of slice hits per prong planes. See cosrej::NueCosRej::HitsPerPlane.
- float pngptp

  Event transverse momentum fraction, based on prongs. See cosrej::NueCosRej::ProngTransMom.
- float partptp

  Event transverse momentum fraction, based on showers. See cosrej::NueCosRej::ParticleShowerTransMom.
- float photptp

  Event transverse momentum fraction, based on showers. See cosrej::NueCosRej::PhotonShowerTransMom.
- float photpxp

  Reconstructed relative momentum in the X direction, based on showers. See cosrej::NueCosRej::PhotonShower↩ MomX.
- float photpyp

  Reconstructed relative momentum in the Y direction, based on showers. See cosrej::NueCosRej::PhotonShower↩ MomY.
- float starttop

  Leading prong start to detector top. See cosrej::NueCosRej::StartDistToTop.
- float startbottom

  Leading prong start to detector bottom. See cosrej::NueCosRej::StartDistToBottom.
- float startfront

  Leading prong start to detector front. See cosrej::NueCosRej::StartDistToFront.
- float startback

  Leading prong start to detector back. See cosrej::NueCosRej::StartDistToBack.
- float startwest

  Leading prong start to detector west. See cosrej::NueCosRej::StartDistToWest.
- float starteast

  Leading prong start to detector east. See cosrej::NueCosRej::StartDistToEast.
- float stoptop

Leading prong start to detector top. See cosrej::NueCosRej::StartDistToTop.

- float **stopbottom**
- float stopfront

  Leading prong start to detector front. See cosrej::NueCosRej::StartDistToFront.
- float stopback

  Leading prong start to detector back. See cosrej::NueCosRej::StartDistToBack.
- float stopwest

  Leading prong start to detector west. See cosrej::NueCosRej::StartDistToWest.
- float stopeast

  Leading prong start to detector east. See cosrej::NueCosRej::StartDistToEast.
- float distallpngtop

  Minimum distance of all prongs from to detector top. See cosrej::NueCosRej::DistallpngDistToTop.
- float distallpngbottom

  Minimum distance of all prongs from to detector bottom. See cosrej::NueCosRej::DistallpngDistToBottom.
- float distallpngfront

  Minimum distance of all prongs from to detector front. See cosrej::NueCosRej::DistallpngDistToFront.
- float distallpngback

  Minimum distance of all prongs from to detector back. See cosrej::NueCosRej::DistallpngDistToBack.
- float distallpngwest

  Minimum distance of all prongs from to detector west. See cosrej::NueCosRej::DistallpngDistToWest.
- float distallpngeast

  Minimum distance of all prongs from to detector east. See cosrej::NueCosRej::DistallpngDistToEast.
- float cospidcontain

  Nue cosrej PID. A BDT using 5 variables relating to containment.
- float cospidcontainxy

  Nue cosrej PID. A BDT using 6 variables relating to containment which uses pX/p and pY/p instead of pT/p.
- float cospidlight

  Nue cosrej PID. A BDT using 6 variables relating to containment plus CVNe.
- float cospidperibdt

  Nue cosrej PID for the peripheral sample for 2020+.
- float cospidcorebdt

  Nue cosrej PID for the core sample for 2020+.
- float cosdang

  Cosine of angle between 1st and 2nd leading prongs. See cosrej::NueCosRej::CosAngleToNextProng.
- float vtxdoca

  Distance of closest approach of leading prong to vertex. See cosrej::NueCosRej::ProngDistToVtx.
- float prongmaxx

  Leading prong max X between start and stop. See cosrej::NueCosRej::ProngMaxX.
- float prongmaxy

  Leading prong max Y between start and stop. See cosrej::NueCosRej::ProngMaxY.
- float prongmaxz

  Leading prong max Z between start and stop. See cosrej::NueCosRej::ProngMaxZ.
- float prongminx

  Leading prong min X between start and stop. See cosrej::NueCosRej::ProngMinX.
- float prongminy

  Leading prong min Y between start and stop. See cosrej::NueCosRej::ProngMinY.
- float prongminz

  Leading prong min Z between start and stop. See cosrej::NueCosRej::ProngMinZ.
- float sparsenessasymm

  Leading prong forward-backward sparseness asymmetry See cosrej::MakeNueCosRej::SparsenessAsymmetry and cosrej::NueCosRej::SparsenessAsymm.

- float hitsperplaneasymm

  Leading prong forward-backward hits per plane asymmetry See cosrej::MakeNueCosRej::SparsenessAsymmetry and cosrej::NueCosRej::HitsPerPlaneAsymm.

- float sparsenessasymmslice

  Slice forward-backward sparseness asymmetry See cosrej::MakeNueCosRej::SparsenessAsymmetry and cosrej::↩ NueCosRej::SparsenessAsymmSlice.

- float hitsperplaneasymmslice

  Slice forward-backward hits per plane asymmetry See cosrej::MakeNueCosRej::SparsenessAsymmetry and cosrej↩ ::NueCosRej::HitsPerPlaneAsymmSlice.

- int musliceidxbydist

  Index of the slice selected by closest approach that is most likely to be the muon parent according to distance of closest approach, in case this slice is a decay in flight or a brem shower.

- float muanglediffbydist

  Difference in angle between the leading prong and the possible muon parent (selected by closest approach).

- float mutimediffbydist

  difference in time between the leading prong and the possible muon parent (selected by closest approach).

- float muclosestapproachbydist

  closest approach between the leading prong and the possible muon parent (selected by closest approach).

- int musliceidxbytime

  Index of the slice selected by closest approach that is most likely to be the muon parent according to difference in time, in case this slice is a decay in flight or a brem shower.

- float muanglediffbytime

  Difference in angle between the leading prong and the possible muon parent (selected by difference in time).

- float mutimediffbytime

  Difference in time between the leading prong and the possible muon parent (selected by difference in time).

- float muclosestapproachbytime

  Closest approach between the leading prong and the possible muon parent (selected by difference in time).

5.43.1 Member Data Documentation

5.43.1.1 float caf::SRNueCosRej::stoptop

Leading prong start to detector bottom. See cosrej::NueCosRej::StartDistToBottom

5.44 caf::SRNueEnergy Class Reference

Nue energy estimator output in the standard record.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- float rawgevshw

  Uncorrected leading shower energy [GeV].
- float rawgevhad

  Uncorrected hadronic energy [GeV].
- float rawgevslice

  Uncorrected slice energy [GeV].
- SRSLidEnergy lid

  Energy estimate from lid for slice pid (most energetic shower for now)
- float regcvnEvtE

  Regression CVN neutrino energy estimate [GeV].

5.45 caf::SRNueSandbox Class Reference

Class for storing information necessary for nu_e analysis. This information might not exist here forever, it may eventually be moved somewhere else.

Public Attributes

Simple containment

- bool infid

  Geometry::isInFiducialVolume() on slice MeanXYZ.
- float slicemeanx

  slice's Cluster::MeanXYZ().X()
- float slicemeany

  slice's Cluster::MeanXYZ().Y()
- float slicemeanz

  slice's Cluster::MeanXYZ().Z()

WARNING: Truth variables

- int npi0

  Number of primary pi0.
- int npip

  Number of primary pi+.
- int npim

  Number of primary pi-.
- float pi0E

  Energy of largest primary pi0.
- float pipE

  Energy of largest primary pi+.
- float pimE

  Energy of largest primary pi-.
- float phot0E

  Energy of largest pi0's largest photon.
- float phot1E

  Energy of largest pi0's smallest photon.
- float opencos

  Opening angle of largest pi0's photons.

- float conv0
  Conversion length of photon 0.
- float conv1
  Conversion length of photon 1.

Ruth's additions

- float mincellcosmic
  Mincell using all cosmictracker.
- float mincellwallcosmic
  Mincellwall using all cosmictracker.
- float anglecosmic
  Angle of longest cosmictrack.
- int nplanesfilled
  Number of filled planes.
- unsigned int nxplanes
  Extent in planes for slice X-view.
- unsigned int nyplanes
  Extent in planes for slice Y-view.
- int ncellrow
  Max number contiguous cells, single plane.
- int ncellsum
  Max number cells in total, single plane.
- float mincellavg
  Mincell using regression through event.
- float mincellkalman
  Mincell using regression through event (MIP frac events)
- int nmiphits
  Number of MIP Hits (Adjustable boundary)
- SRVector3D mipmin
  Minimum coordinates of box with MIP range hits.
- float ecfNu
  Energy Containment Fraction of the mother neutrino.
- SRVector3D mipmax
  Maximum coordinates of box with MIP range hits.

Jianming's additions:

- unsigned int evtncell
  total # of cell in a slice
- float evtsumcostheta
  event direction
- float evtsump
  event total momentum
- float evtsumpt
  event total transverse momentum
- float evtsump0
  event total momentum without pid
- float evtsumpt0
  event total transverse momentum without pid
- float evtetot
  event total energy on showers
- float evtminx
  min x of a event, looping over all showers
- float evtminy

min y of a event, looping over all showers

- float evtminz

  min z of a event, looping over all showers
- float evtmaxx

  max x of a event, looping over all showers
- float evtmaxy

  max y of a event, looping over all showers
- float evtmaxz

  max z of a event, looping over all showers
- float evtgaptns

  tns to closet slice
- int evtncelltoedge

  ncell to detector edge for the event
- float sh1energy

  Leading shower energy.
- float sh1exclenergy

  Leading shower excluded energy.
- float sh1totalL

  Leading shower length.
- SRVector3D sh1start

  Leading shower start pt.
- SRVector3D sh1stop

  Leading shower stop pt.
- SRVector3D sh1dir

  Leading shower dir.
- float sh1vtxdoca

  Leading shower DOCA to vertex.
- float sh1gap

  Leading shower gap.
- unsigned int sh1nplane

  Leading shower NPlane.
- unsigned int sh1xnplane

  Leading shower XView NPlane.
- unsigned int sh1ynplane

  /Leading shower YView NPlane
- unsigned int sh1ncell

  Leading shower # of cell.
- unsigned int sh1xncell

  Leading shower XView # of cell.
- unsigned int sh1yncell

  Leading shower YView # of cell.
- int sh1pid

  Leading shower pid based on longitudinal+transverse log likelihoods.
- int sh1ncelltoedge

  ncell to detector edge for the leading shower
- float **sh1sh2dang**
- float sh2energy

  2nd shower energy
- float sh2exclenergy

  2nd shower excluded energy
- float sh2totalL

  2nd shower length
- SRVector3D sh2start

  2nd shower start pt
- SRVector3D sh2stop

2nd shower stop pt

- SRVector3D sh2dir

  2nd shower dir
- float sh2vtxdoca

  2nd shower DOCA to vertex
- float sh2gap

  2nd shower gap
- unsigned int sh2nplane

  2nd shower NPlane
- unsigned int sh2xnplane

  2nd shower XView NPlane
- unsigned int sh2ynplane

  /2nd shower YView NPlane
- unsigned int sh2ncell

  2nd shower # of cell
- unsigned int sh2xncell

  2nd shower XView # of cell
- unsigned int sh2yncell

  2nd shower YView # of cell
- int sh2pid

  2nd shower pid based on longitudinal+transverse log likelihoods
- int sh2ncelltoedge

  ncell to detector edge for the secondary shower
- float elll

  Electron likelihood.
- float sh1d2edge

  Shower distance to edge.
- float eedge2cell

  Energy deposit within 2 cells to detector edges.
- float eedge5cell

  Energy deposit within 5 cells to detector edges.
- float eedge10cell

  Energy deposit within 10 cells to detector edges.
- std::vector< SRJMShower > jm

  vector of JMShowers
- size_t njm

  number of jmshowers
- SRJMEid jmid

  jmshower pid object
- SRVector3D vtx

  jmshower vertex
- float time

  jmshower vertex time [ns]
- float E

  jmshower neutrino energy estimate
- float depE

  jmshower energy deposited
- float shwE

  jmshower energy of primary shower

Chris' variables

- float fracangchanges

  See FillNueSandbox::FracAngChanges.
- float fracangchangesloose

See FillNueSandbox::FracAngChanges.

- float fracmodalhits

  See FillNueSandbox::FracModalHits.
- float fracnoncontig

  See FillNueSandbox::FracNonContiguous.
- float fracnoncontigloose

  See FillNueSandbox::FracNonContiguous.
- int maxgap

  See FillNueSandbox::MaxGap.
- int maxhitsx

  See FillNueSandbox::MaxHits.
- int maxhitsy

  See FillNueSandbox::MaxHits.

Himansu's variables

- float dedxpng1

  Average dE/dx of the longest 3D prong in the slice. Planes with 0 hits are not counted. See FillNueSandbox::↩ GetdEdx.
- float dedxpng2

  Average dE/dx of the 2nd longest 3D prong in the slice. Planes with 0 hits are not counted. See FillNueSandbox↩ ::GetdEdx.

5.46 caf::SRNumuEnergy Class Reference

Numu energy estimator output.

Public Member Functions

- virtual void **setDefault** ()
- void **setLSTMDefault** ()

Public Attributes

- float E

  Neutrino energy, set to match trkccE [GeV].
- float calccE

  Calorimetric charged current neutrino energy [GeV].
- float trkqeE

  Track length quasielastic neutrino energy [GeV].
- float trknonqeE

  Track length non-quasielastic neutrino energy [GeV].
- float trkccE

  Track length cc neutrino energy [GeV].
- float shiftedtrkccE

  Track length cc neutrino energy `GeV`
- float angleE

  Quasielastic angle formula neutrino energy [GeV].
- float angleerror

1-sigma error from using quasielastic angle formula for neutrino energy

- float recomuonE

  Reconstructed muon energy for all neutrino energy estimators [GeV].
- float ucrecomuonE1trk

  Reconstructed muon energy for uncontained single track events at the FarDet from TMVA [GeV].
- float ucrecomuonE

  Reconstructed muon energy for uncontained non-single track events at the FarDet from TMVA [GeV].
- float recotrkcchadE

  Reconstructed hadronic energy for track cc neutrino energy estimator [GeV].
- float hadcalE

  Hadronic calorimetric energy NOT on the muon track[GeV].
- float hadtrkE

  Hadronic calorimetric energy on the muon track[GeV].
- float ndtrklenact

  Near detector – muon track length in active region [cm].
- float ndtrklencat

  Near detector – muon track length in muon catcher [cm].
- float ndtrkcalactE

  Near detector – muon calorimetric energy in active region [GeV].
- float ndtrkcaltranE

  Near detector – muon calorimetric energy in transition plane [GeV].
- float ndtrkcalcatE

  Near detector – muon calorimetric energy in muon catcher [GeV].
- float ndhadcalactE

  Near detector – hadronic calorimetric energy NOT on the muon track in active region [GeV].
- float ndhadcaltranE

  Near detector – hadronic calorimetric energy NOT on the muon track in transition plane [GeV].
- float ndhadcalcatE

  Near detector – hadronic calorimetric energy NOT on the muon track in muon catcher [GeV].
- float ndhadtrkactE

  Near detector – hadronic calorimetric energy on the muon track in active region [GeV].
- float ndhadtrktranE

  Near detector – hadronic calorimetric energy on the muon track in transition plane [GeV].
- float ndhadtrkcatE

  Near detector – hadronic calorimetric energy on the muon track in muon catcher [GeV].
- float ndtrktranx

  Near detector – if muon track crosses transition plane, the x location [cm].
- float ndtrktrany

  Near detector – if muon track crosses transition plane, the y location [cm].
- SRHadClust hadclust

  Cluster information for hits in slice but not on muon track (track with higest ReMId value)
- SRTrueNumuEnergy mc

  True information used for retuning numu energy fits.
- SRBPFEnergy bpfenergy

  BreakPointFitter energy estimator.
- float lstmmuon

  Muon Energy predicted by LSTM EE [GeV].
- float lstmnu

  NuMu Energy predicted by LSTM EE [GeV].
- float regcvnhadE

  Hadronic Energy predicted by Regression CNN [GeV].

5.47 caf::SRNumuSandbox Class Reference

Class for storing information necessary for nu_mu analysis. This information might not exist here forever, it may eventually be moved somewhere else.

Public Member Functions

- void **setDefault** ()

Public Attributes

- int pimudecay
  did slice contain pi->mu decay?
- int **nprotons**
- int **nmutrks**
- int nhadHits
  number of hits from hadronic system
- int nhadCellsFromEdge
  cells from edge from hadronic system
- float offTrkFra
  proxy for off track energy fraction
- float actVtx
  proxy for (hadE-calE[2nd trk])/nu energy
- float avedEdxtrk1
  average dEdx for first track in slice
- float avedEdxtrk2
  average dEdx for second track in slice
- float avedEdxtrk1Last4Cells
  average dEdx for first track in slice for last 4 cells
- float avedEdxtrk2Last4Cells
  average dEdx for second track in slice for last 4 cells
- float avedEdxtrk1Last6Cells
  average dEdx for first track in slice for last 6 cells
- float avedEdxtrk2Last6Cells
  average dEdx for second track in slice for last 6 cells
- float avedEdxtrk1Last8Cells
  average dEdx for first track in slice for last 8 cells
- float avedEdxtrk2Last8Cells
  average dEdx for second track in slice for last 8 cells
- float scattAngtrk1
  scattering angle for second track in slice
- float scattAngtrk2
  scattering angle for second track in slice
- float vtxE20
  Energy within 20 cm of vtx.
- float vtxE40
  Energy within 40 cm of vtx.
- float vtxE60
  Energy within 60 cm of vtx.

5.48 caf::SRNuonEResult Class Reference

NuonE output.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- std::vector< float > output
  List of net output nodes.
- float rawgevslice
  event energy in GeV
- float nuoneid
  Likelihood nu-on-e.
- float pi0id
  Likelihood primary prong is a pi0.
- float nueccid
  Likelihood nuecc events.
- float otherid
  Likelihood other.
- float epi0nuoneid
  Likelihood nu-on-e from epi0 classifier.
- float epi0pi0id
  Likelihood pi0 from epi0 classifier.
- unsigned int noutput
  Number of entries in output vector.

5.49 caf::SRNusSandbox Class Reference

Class for storing information necessary for nu_e analysis. This information might not exist here forever, it may eventually be moved somewhere else.

Public Attributes

Shaokai NC rejection variables

- float sumtx
  sum of track direction XZ-view unit vectors
- float sumty
  sum of track direction YZ-view unit vectors
- float ewsumtx
  energy-weighted sum of track direction XZ-view unit vectors
- float ewsumty
  energy-weighted sum of track direction YZ-view unit vectors
- float cossumtx
  cosine angle with respect to beam of sum of track direction XZ-view unit vectors

- float cossumty

  cosine angle with respect to beam of sum of track direction YZ-view unit vectors
- float cosewsumtx

  cosine angle with respect to beam of energy-weighted sum of track direction XZ-view unit vectors
- float cosewsumty

  cosine angle with respect to beam of energy-weighted sum of track direction YZ-view unit vectors
- float angsumtx

  angle with respect to beam of sum of track direction XZ-view unit vectors
- float angsumty

  angle with respect to beam of sum of track direction YZ-view unit vectors
- float angewsumtx

  angle with respect to beam of energy-weighted sum of track direction XZ-view unit vectors
- float angewsumty

  angle with respect to beam of energy-weighted sum of track direction YZ-view unit vectors

5.50 caf::SRParentBranch Class Reference

Public Attributes

- SRMRCCParent mrccpar

  Parent to the MRCC slice.

5.51 caf::SRParticleTruth Class Reference

The truth information of reco objects within a slice.

Public Attributes

- int pdg

  PDG Code of the best matched truth particle.
- int motherpdg

  PDG Code of the mother of the best matched truth particle.
- float eff

  True deposited energy collection efficiency for the best matched particle relative to the slice.
- float pur

  True deposited energy purity for the best matched particle.
- SRLorentzVector p

  True energy 4-vector of the best matched particle.
- SRLorentzVector motherp

  True energy 4-vector of the mother particle.
- int trkID

  GEANT trackId for particle.
- SRVector3D start

  Start point of true particle in detector coordinates (cm) vector containing pdg of mother particles. Index 0 is the immedieate mother, the last particle in the index will be a primary to the neutrino interaction. If this particle is a primary the vector will be empty.
- std::vector< int > **motherlist**
- std::vector< int > daughterlist

vector containing pdg of the immediate daughter particles. If there are no daughters the vector will be empty.

- float visE

  Visible Energy in detector, all summed FLSHits that made CellHits [GeV].
- float visEinslc

  Visible Energy in detector, slice summed FLSHits that made CellHits [GeV].
- float daughterVisE

  Visible Energy in detector for all daughters of this particle, all summed FLSHits that made CellHits [GeV].
- float daughterVisEinslc

  Visible Energy in detector for all daughters of this particle, slice summed FLSHits that made CellHits [GeV].
- float visEBirks

  Visible Energy in detector, all summed FLSHits that made CellHits [GeV] with birks suppression.
- float visEinslcBirks

  Visible Energy in detector, slice summed FLSHits that made CellHits [GeV] with birks suppression.
- float daughterVisEBirks

  Visible Energy in detector for all daughters of this particle, all summed FLSHits that made CellHits [GeV] with birks suppression.
- float daughterVisEinslcBirks

  Visible Energy in detector for all daughters of this particle, slice summed FLSHits that made CellHits [GeV] with birks suppression.
- std::vector< float > daughterVisEnergies

  Energy of each particle contributing to the prong.
- gen_process_t processMax

  The process conributing the most the prong.
- float processParticleE

  Energy of the particle causing the process that contirbuted the most.
- std::vector< float > primNeutronE

  Energy of the primary neutron that is linked to the prong, if one exists.
- std::vector< float > primNeutronProcessE

  Fls energy contributing to the prong from neutronInelastic scatters with a proton/photon <in the final state and elastic with proton in final state. Order (inelastic proton, inelastic photon, elastic proton)

5.52 caf::SRPixelMap Class Reference

Variables describing Michel E's found around the end of a track.

Public Attributes

- unsigned int nplanes

  number of planes in pixel map
- unsigned int ncells

  number of cells in pixel map
- unsigned int nchan

  number of channels in pixel map
- unsigned int firstplane

  global position of first plane in map
- unsigned int lastplane

  global position of last plane in map
- unsigned int firstcellx

  global position of first x cell in map

- unsigned int lastcellx

  global position of last x cell in map
- unsigned int firstcelly

  global position of first y cell in map
- unsigned int lastcelly

  global position of last y cell in map
- float hitfracx

  faction of x hits in slice in x view pixel map
- float hitfracy

  fraction of y hits in slice in y view pixel map
- unsigned char cvnmap [16000]

  store 1D array the size of the pixel map, currently 80 cells x 100 planes x 2 views. Although sparse, store this way for easier conversion and compression in hdf5. First element is channel 0, plane 0, cell 0, then channel 0, plane 0, cell 1, etc. Channel 0 is x view, 1 is y view

5.53 caf::SRPixelObjMap Class Reference

Variables describing Michel E's found around the end of a track.

Public Attributes

- unsigned int nplanes

  number of planes in pixel map
- unsigned int ncells

  number of cells in pixel map
- unsigned int nchan

  number of channels in pixel map
- unsigned int firstplane

  global position of first plane in map
- unsigned int lastplane

  global position of last plane in map
- unsigned int firstcellx

  global position of first x cell in map
- unsigned int lastcellx

  global position of last x cell in map
- unsigned int firstcelly

  global position of first y cell in map
- unsigned int lastcelly

  global position of last y cell in map
- float hitfracx

  faction of x hits in slice in x view pixel map
- float hitfracy

  fraction of y hits in slice in y view pixel map
- unsigned char cvnmap [16000]

  store 1D array the size of the pixel map, currently 80 cells x 100 planes x 2 views. Although sparse, store this way for easier conversion and compression in hdf5. First element is channel 0, plane 0, cell 0, then channel 0, plane 0, cell 1, etc. Channel 0 is x view, 1 is y view
- unsigned char cvnlabmap [16000]

  store 1D array with hit labels
- unsigned char cvnobjmap [16000]

  store 1D array with hit object id

5.54 caf::SRPresel Class Reference

preselection information

Public Member Functions

- void **setDefault** ()

Public Attributes

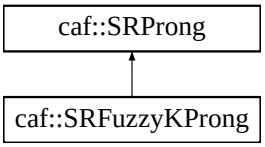
- bool passpre

  Bool saying if event passed Preselection.

5.55 caf::SRProng Class Reference

An SRProng is a simple descriptor for a prong. This class does not contain individual cell hits, but does know it's start point and direction.

Inheritance diagram for caf::SRProng:



Public Attributes

- unsigned short nhit

  number of hits
- unsigned short nhitx

  number of hits in x-view
- unsigned short nhity

  number of hits in y-view
- unsigned short nplane

  number of planes spanned
- unsigned short maxplanecont

  maximum number of contiguous planes in prong
- unsigned short maxplanegap

  maximum number of gapped planes in prong
- float calE

  energy based on summed calibrated deposited charge [GeV]
- float weightedCalE

  calE, weighted to take into account hits shared between prongs [GeV]
- SRVector3D start

  Shower start point in detector coordinates. [cm].
- SRVector3D dir

Shower direction at start point [unit vector recommended].

- float pngminx

  Minimum X that contain all the cell hits. [cm].
- float pngmaxx

  Maximum X that contain all the cell hits. [cm].
- float pngminy

  Minimum Y that contain all the cell hits. [cm].
- float pngmaxy

  Maximum Y that contain all the cell hits. [cm].
- float len

  track length [cm]
- View_t view

  Prong view caf::kX = 0, caf::kY = 1 or caf::kXorY = 2.
- SRParticleTruth truth

  Truth information for the prong.
- SRParticleTruth truthXView

  Truth information for the prong.
- SRParticleTruth truthYView

  Truth information for the prong.
- SRCVNParticleResult cvnpart

  CVN prongID information for 4 views.
- std::vector< SRPixelMap > cvnmaps

  Pixel maps used in CVN evaluation and training 80 cells x 100 planes in each view.
- std::vector< SRProngTrainingData > prongtrainingdata

  Prong label information.
- float meantime

  Average time of cell(s) hits weighted by their energy.
- float maxtime

  Max time of cell(s) hits.
- float mintime

  Min time of cell(s) hits.
- float meantimeRes

  Average time of cell(s) hits weighted by their time resolution.

5.56 caf::SRProngTrainingData Class Reference

Public Attributes

- int label3d

  Class of the 3D prong.
- int labelx

  Class of the X view prong.
- int labely

  Class of the Y view prong.
- bool **isprimary**
- double **purity3d**
- double **purityx**
- double **purityy**
- double **rece**

- unsigned int **ncellx**
- unsigned int **ncelly**
- double **vertx**
- double **verty**
- double **vertz**
- double **plength**
- double **pangle**
- double **pgap**

5.57 caf::SRProngXSec Class Reference

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- float **ccpi0bpi**
- float **ccpi0phll**
- bool **ccpi0ismu**

5.58 caf::SRQepid Class Reference

Contains the quasielastic muon PID (QePId) output.

Public Member Functions

- void **setDefault** ()

Public Attributes

- int pdg

  PDG code of slice.
- int mode

  Neutrino mode of slice.
- int ntrk

  Number of tracks used by qepid.
- float pid

  PID value of output kNN.
- float offE

  Ratio of energy not associated with tracks to energy on tracks.
- float ediff

  Difference in energy between QE angle energy formula and weighted fit, normalized to fit energy.
- float ediffz

  Difference in energy between QE angle energy formula and weighted fit, normalized to error in QE angle energy formula.
- float dedx

  Ratio of average dE/dx in non-muon track to muon identified track.

5.59 caf::SRRegCVNResult Class Reference

Regression CVN output.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- float **prongE**

5.60 caf::SRRemid Class Reference

Contains the reco muon PID (ReMId) output.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- float pid
  PID value output by kNN.
- float scatllh
  Log-likelihood value from scattering angle.
- float dedxllh
  Log-likelihood value from dE/dx.
- float len
  Track length of identified track.
- float measfrac
  Fraction of planes used to measure dE/dx.
- int cont
  True if track is contained as defined by ReMId.

5.61 caf::SRRvp Class Reference

Contains the RVP PID output.

Public Member Functions

- void **setDefault** ()

Public Attributes

- float pid
  The output value from the BDT.
- int ncell
  number of cells in slice
- float recoE
  reco energy of slice
- float longtr
  longest discrete track merge track
- float longtrfrac
  fraction of cells in longest track out of total cells in slice
- float mipfrac
  fraction of mip hits out of total number of hits
- float miphits
  number of mip hits in slice
- float epl20frac
  fraction of energy in first 20 planes out of total slice energy
- float efrac2plwin
  largest fraction of energy in a 2 plane window out of total slice
- float efrac6plwin
  largest fraction of energy in a 6 plane window out of total slice
- float efrac2sigrd
  fraction of slice energy within 2sigma of mean energy weighted slice position
- int prongs3D
  number of 3D FuzzyK prongs associated with slice
- float prongEbal3D
  the energy balance between the two highest energy 3D prongs in slice
- int prongs2D
  number of 2D FuzzyK prongs associated with slice
- float prongEbal2D
  the energy balance between highest energy 2D prong and 3D prong in the opposite view
- float eiso3sig
  fraction of slice energy more then 3sigma from mean energy weighted slice position
- float rvp12
  PID value for 12 variable RVP for comparison purposes.

5.62 caf::SRSandbox Class Reference

Class for storing information necessary for analysis that may not fit elsewhere. This information might not exist here forever, it may eventually be moved somewhere else. eventually be moved somewhere else.

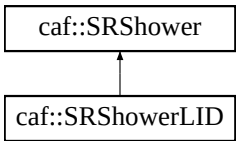
Public Attributes

- SRNueSandbox nue
  Sandbox for ν_e group.
- SRNumuSandbox numu
  Sandbox for ν_μ group.
- SRNusSandbox nus
  Sandbox for NC/ν_s group.
- SRNDSandbox **nd**

5.63 caf::SRShower Class Reference

An SRShower is a simple descriptor for a shower. This class does not contain individual cell hits, but does know it's energy and direction.

Inheritance diagram for caf::SRShower:



Public Attributes

- unsigned short nhit
  number of hits
- unsigned short nhitx
  number of hits in x-view
- unsigned short nhity
  number of hits in y-view
- unsigned short nplane
  number of planes spanned
- unsigned short maxplanecont
  maximum number of contiguous planes in prong
- unsigned short maxplanegap
  maximum number of gapped planes in prong
- float calE
  energy based on summed calibrated deposited charge [GeV]
- SRVector3D start
  Shower start point in detector coordinates. [cm].
- SRVector3D dir
  Shower direction at start point [unit vector recommended].
- float len
  track length [cm]
- View_t view
  Prong view caf::kX = 0, caf::kY = 1 or caf::kXorY = 2.
- float width
  Shower width [cm].
- unsigned short nplanex
  number of planes spanned in x view
- unsigned short nplaney
  number of planes spanned in y view
- float gap
  gap from shower start to ElasticArms vertex [cm]
- SRVector3D stop
  shower stop point
- SRParticleTruth truth
  Truth information for the prong.
- SRParticleTruth truthXView
  Truth information for the prong.
- SRParticleTruth truthYView
  Truth information for the prong.

5.64 caf::SRShowerBranch Class Reference

The SRShowerBranch is a container for SRShowers. It will contain a vector of showers for each shower making algorithm that is part of the standard reconstruction.

Public Member Functions

- void **fillSizes** ()

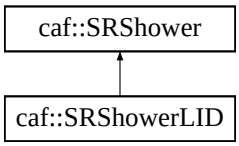
Public Attributes

- std::vector< SRShower > **shwlid**
- size_t **nshwlid**

5.65 caf::SRShowerLID Class Reference

An SRShower is a simple descriptor for a shower. The SRShwLID inherits from it to add more fields. This class does not contain individual cell hits, but does know it's energy and direction.

Inheritance diagram for caf::SRShowerLID:



Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- float shwE
  reconstructed shower energy [GeV]
- float vtxE
  calorimetric energy of [GeV]
- SRSLidEnergy **lidE**
- SRSLid **lid**
- unsigned short nhit
  number of hits
- unsigned short nhitx
  number of hits in x-view
- unsigned short nhity
  number of hits in y-view
- unsigned short nplane
  number of planes spanned

- unsigned short maxplanecont

  maximum number of contiguous planes in prong
- unsigned short maxplanegap

  maximum number of gapped planes in prong
- float calE

  energy based on summed calibrated deposited charge [GeV]
- SRVector3D start

  Shower start point in detector coordinates. [cm].
- SRVector3D dir

  Shower direction at start point [unit vector recommended].
- float len

  track length [cm]
- View_t view

  Prong view caf::kX = 0, caf::kY = 1 or caf::kXorY = 2.
- float width

  Shower width [cm].
- unsigned short nplanex

  number of planes spanned in x view
- unsigned short nplaney

  number of planes spanned in y view
- float gap

  gap from shower start to ElasticArms vertex [cm]
- SRVector3D stop

  shower stop point
- SRParticleTruth truth

  Truth information for the prong.
- SRParticleTruth truthXView

  Truth information for the prong.
- SRParticleTruth truthYView

  Truth information for the prong.

5.66 caf::SRShowerPID Class Reference

Shower level PID information (LID)

Public Attributes

- float elll

  Electron ll for longitudinal shower.
- float ellt

  Electron ll for ltransverse shower.
- float mulll

  Muon ll for longitudinal shower.
- float mullt

  Muon ll for ltransverse shower.
- float pi0lll

  Pi0 ll for longitudinal shower.
- float pi0llt

Pi0 ll for ltransverse shower.

- float plll

  Proton ll for longitudinal shower.
- float pllt

  Proton ll for ltransverse shower.
- float nlll

  Neutron ll for longitudinal shower.
- float nllt

  Neutron ll for ltransverse shower.
- float pilll

  Pion ll for longitudinal shower.
- float pillt

  Pion ll for ltransverse shower.
- float annepi0

  e/pi0 separation for nue analysis
- float annecos

  e/cosmic separation for nue analysis
- float annepi0el

  e/pi0 separation for nu-e scattering analysis

5.67 caf::SRSlcME Class Reference

Represents output from SlcMEFilter.

Public Attributes

- float mid

  Michel Electron Identifier LL.
- unsigned short nhitx

  Number of hits in Michel cluster.
- unsigned short nhity

  Number of hits in Michel cluster.
- float calE

  Calorimetric Energy of ME (GeV)
- float deltat

  Time delay (ns)
- float adc

  Total ADC in the ME cluster.
- float disttoslc

  Minimum distance between hits in ME and parent (cm)
- SRVector3D meanpos

  The mean position of the ME cluster.
- SRParticleTruth truth

  Truth information for the michel cluster.

5.68 caf::SRSlice Class Reference

An SRSlice contains overarching information for a slice.

Public Member Functions

- void **setDefault** ()

Public Attributes

- unsigned int nhit

  number of hits
- unsigned int ncalhit

  number of hits with calibration
- unsigned int nmiphit

  number of minimum ionizing hits
- unsigned int ncontplanes

  number of continuous planes
- unsigned int firstplane

  first plane
- unsigned int lastplane

  last plane
- unsigned int firstcell

  first cell
- unsigned int lastcell

  last cell
- unsigned int ncellsfromedge

  minimum number of cells to edge of detector
- unsigned int nnonnoise

  number of non noise slices in event from which this slice came < or number of slices in CAF coming from the same event.
- unsigned int nnoisehit

  Number of noise hits (calibrated)
- float fracnoiseE

  Fraction of energy which comes from noise.
- float fracnoisePE

  Fraction of energy which comes from noise.
- float calE

  Calorimetric energy of the cluster [GeV].
- float starttime

  start time [ns]
- float endtime

  end time [ns]
- float meantime

  mean time, weighted by charge [ns]
- float tsd

  standard deviation of slice hits in time in nanoseconds
- float closestslicetime

  time difference between meantime of this slice and meantime of slice closest in time, in nanoseconds.
- unsigned int closestslicenhit

  Number of hits in the closest-in-time slice.
- float closestslicecalE

  Calorimetric energy of the closest-in-time slice (GeV)
- SRVector3D boxmin

Minimum coordinates box containing all the hits [cm].

- SRVector3D boxmax

  Maximum coordinates box containing all the hits [cm].

- SRVector3D meanpos

  Mean position of hits in slice, weighted by charge [cm].

- float closestsliceminfromtop

  minimum distance to edge of detector in the closest slice

- float closestsliceminfrombottom

  minimum distance to edge of detector in the closest slice

- float closestsliceminfromfront

  minimum distance to edge of detector in the closest slice

- float closestsliceminfromback

  minimum distance to edge of detector in the closest slice

- float closestsliceminfromeast

  minimum distance to edge of detector in the closest slice

- float closestsliceminfromwest

  minimum distance to edge of detector in the closest slice

- float closestslicemindist

  minimum distance to the closest slice in time domain

5.69 caf::SRSliceLID Class Reference

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- float ncid

  Likelihood of Neutral Current.

- float numuid

  Likelihood of Charge Current NuMu.

- float nueid

  Likelihood of Charge Current NuE.

- float nutauid

  Likelihood of Charge Current NuTau.

- float cosmicid

  Likelihood of Cosmic.

5.70 caf::SRSliceMap Class Reference

Variables describing Michel E's found around the end of a track.

Public Attributes

- unsigned char slicemap [344064]

  store 1D array the size of the detector for exploration in CVN training of different sized pixel maps. Although sparse, store this way for easier conversion and compression in hdf5. First element is channel 0, plane 0, cell 0, then channel 0, plane 0, cell 1, etc. Channel 0 is x view, 1 is y view. Storing FD size map, but in ND events the image will fint and can still be translated out the same from this larger array

5.71 caf::SRSLid Class Reference

This class contains the LID pid information for a shower (slid::ShowerLID objects).

Public Member Functions

- void **setDefault** ()

Public Attributes

- float ann

  ann output
- float anne

  ann with energy output
- float annepi0

  e/pi0 PID for oscillation analysis
- float annecos

  e/cos PID for oscillation analysis
- int ismuon

  Boolean to distinguish muons from electrons.

LID training variables

These variables all use the leading (most energetic) shower in each slice The first 12 variables are calculating by computing the log likelihood that the leading shower (in both transverse and longitudinal directions) is an electron, and then subtracting the loglikelihood that the shower is another particle.

- float eglll

  Electron - gamma LL for longitudinal shower.
- float egllt

  Electron - gamma LL for transverse shower.
- float emulll

  Electron - muon LL for longitudinal shower.
- float emullt

  Electron - muon LL for transverse shower.
- float epi0lll

  Electron - Pi0 LL for longitudinal shower.
- float epi0llt

  Electron - Pi0 LL for transverse shower.
- float eplll

  Electron - proton LL for longitudinal shower.
- float epllt

  Electron - proton LL for transverse shower.

- float enlll

  Electron - neutron LL for longitudinal shower.
- float enllt

  Electron - neutron LL for transverse shower.
- float epilll

  Electron - pion LL for longitudinal shower.
- float epillt

  Electron - pion LL for transverse shower.
- float vtxgev

  Energy of slice in vertex region.
- float pi0mass

  best pi0 mass hypothesis coming from combinations of JMShowers
- float shwEFrac

  fraction of energy of leading shower out of total energy of slice
- float gap

  gap from vertex to start of shower
- float costheta

  cosine of track with respect to beam direction

Variables not directly used in the training

- float invglll

  photon LL for longitudinal shower, assuming shower started at opposite end
- float elll

  Electron LL for longitudinal shower.
- float ellt

  Electron LL for transverse shower.
- float mulll

  Muon LL for longitudinal shower.
- float mullt

  Muon LL for transverse shower.

Plane dedx for e/photon/pi0 identification

- float **dedx0**
- float **dedx1**
- float **dedx2**
- float **dedx3**
- float **dedx4**
- float **dedx5**

dE/dx for e/cos pid

- float **dedxp0c0**
- float **dedxp0c1**
- float **dedxp1c0**
- float **dedxp1c1**
- float **dedxp2c0**
- float **dedxp2c1**
- float **dedxp3c0**
- float **dedxp3c1**
- float **dedxp4c0**
- float **dedxp4c1**
- float **dedxp5c0**
- float **dedxp5c1**

5.72 caf::SRSLidEnergy Class Reference

This is a class for the NueSel energy estimate.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- float E
  Energy [GeV].
- float depE
  Total energy deposited in shower [GeV].
- float shwE
  Energy of shower [GeV].
- float hadE
  Hadronic energy [GeV].

5.73 caf::SRSPid Class Reference

Contains the SPID pid information for a shower (slid::ShowerLID objects).

Public Member Functions

- void **setDefault** ()

Public Attributes

- float annepi0
  ann for e/pi0 separation
- float annepi0el
  ann with e/pi0 speration for nu-e scattering < particle PID.
- float elll
  Electron ll for longitudinal shower.
- float ellt
  Electron ll for ltransverse shower.
- float glll
  Gamma ll for longitudinal shower.
- float gllt
  Gamma ll for ltransverse shower.
- float mulll
  Muon ll for longitudinal shower.
- float mullt
  Muon ll for ltransverse shower.
- float pi0lll

Pi0 ll for longitudinal shower.

- float pi0llt

  Pi0 ll for ltransverse shower.

- float plll

  Proton ll for longitudinal shower.

- float pllt

  Proton ll for ltransverse shower.

- float nlll

  Neutron ll for longitudinal shower.

- float nllt

  Neutron ll for ltransverse shower.

- float pilll

  Pion ll for longitudinal shower.

- float pillt

  Pion ll for ltransverse shower.

- float dedx0

  Plane dedx for e/photon/pi0 identification.

- float dedx1

  Plane dedx for e/photon/pi0 identification.

- float dedx2

  Plane dedx for e/photon/pi0 identification.

- float dedx3

  Plane dedx for e/photon/pi0 identification.

- float dedx4

  Plane dedx for e/photon/pi0 identification.

- float dedx5

  Plane dedx for e/photon/pi0 identification.

5.74 caf::SRSpill Class Reference

The SRSpill contains information about the NuMI spill and POT associated with the slice, as well as EventQuality info on spill by spill basis.

Public Attributes

- unsigned int run

  run number

- unsigned int subrun

  subrun number

- unsigned int evt

  ART event number, indexes trigger windows.

- Det_t det

  Detector, ND = 1, FD = 2, NDOS = 3.

- bool ismc

  data or MC? True if MC

- bool isgoodspill

  Was the pot for a spill good? (only applicable to data, default true)

- unsigned long int spilltimesec

Spill time in seconds [s].

- unsigned long int spilltimensec

  Spill time in nanoseconds [ns].
- unsigned long int gpsspilltimesec

  Spill time from GPS [s].
- unsigned long int gpsspilltimensec

  Spill time from GPS [ns].
- signed long long int deltaspilltimensec

  Delta time [ns].
- float spillpot

  POT in spill including factor of 1e12 so that a < user does not have to apply this correction.
- float livetime

  Length of readout [s].
- float hornI

  Horn current.
- bool isFHC

  Flags for horn direction.
- bool **is0HC**
- bool **isRHC**
- std::vector< float > **intx**
- std::vector< float > **inty**
- std::vector< float > **bposx**
- std::vector< float > **bposy**
- float posx

  x position on target
- float posy

  y position on target
- float widthx

  Spill width in x dimension.
- float widthy

  Spill width in y dimension.
- unsigned short dibfirst

  first diblock in detector configuration (1-14)
- unsigned short diblast

  last diblock in detector configuration (1-14)
- unsigned short dibmask

  diblock mask (bitfield, lowest bit = diblock 1) 0 no mask found in DB, 1 mask used ok, 2 masking turned off. If 0 or 2 dibmask is instead the configuration based on what RH says is alive. dibfirst/last may be wrong in this case.
- unsigned short **maskstatus**
- unsigned int nmissingdcms

  # of missing DCMs
- float fracdcm3hits

  fraction of DCM3 hits in horizontal modules
- unsigned int nouttimehits

  # of out-of-time hits
- unsigned int nnoisyapds

  # of noisy APDs
- unsigned int nmissingdcmslg

  # of DCMS with 63 or more bad FEBs (LiveGeometry, subset of baddcmslg)
- unsigned int nbaddcmslg

  # of DCMS with too many bad channels (LiveGeometry)

- float dcmedgematchfrac

  How many hits at the DCM edge are matched in the adjacent DCM?
- unsigned int nmicroslices

  # of micro slices
- int ndcms

  # of DCMs in partition; may not = # of LIVE DCMs = (hdr.diblast-hdr.dibfirst+1)∗12
- bool eventincomplete

  Data Quality DAQ Header information.
- int ndiblocks

  # of diblocks reporting in event
- int emptydatablock

  # of empty data blocks
- int nmicroblocks

  # of many microblocks
- int nemptymicroslice

  # of empty micro slices
- int ndroppedmicroblocks

  # of dropped micro blocks
- int ndatablockmissingdata

  # of occurances of isMissingData
- int nmicroslicedatanotpresent

  # of microslices with !DataPresent
- int nnanoslices

  # of nano slices in the event
- int nanoslicedatanotpresent

  # of nanoslices reporting !DataPresent
- int nanoslicenolinkstatus

  # of nanoslices reporting !LinkPresent
- int nanoslicebufferempty

  # of nanoslices reporting BufferEmpty
- int nanoslicebufferfull

  # of nanoslices reporting BufferFull
- int nanoslicecommerror

  # of nanoslices reporting CommError
- int nanoslicepacketerror

  # of nanoslices reporting PacketError
- int nanosliceoverflowerror

  # of nanoslices reporting OverflowError
- int nanosliceadcerror

  # of nanoslices reporting ADCError
- unsigned char trigger

  The trigger type from RawTrigger::fTriggerMask_TriggerType.
- std::vector< SRCosmicCVN > cosmiccvn

  Contain cosmic CVN scores for all time windows in event.
- short **ncosmiccvn**

5.74.1 Member Data Documentation

5.74.1.1 float caf::SRSpill::dcmedgematchfrac

Low values mean out-of-sync detector

5.74.1.2 bool caf::SRSpill::eventincomplete

Is the event incomplete?

5.75 caf::SRSpillTruthBranch Class Reference

Truth info for all neutrinos in the spill.

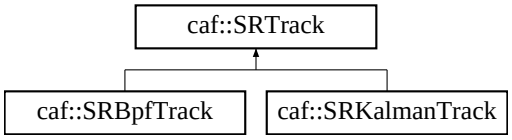
Public Attributes

- SRNeutrino **nu**

5.76 caf::SRTrack Class Reference

Representation of a rb::Track, knows energy and direction, but not a list of hits.

Inheritance diagram for caf::SRTrack:



Public Attributes

- unsigned short nhit
  number of hits
- unsigned short nhitx
  number of hits in x-view
- unsigned short nhity
  number of hits in y-view
- unsigned short nplane
  number of planes spanned
- unsigned short maxplanecont
  maximum number of contiguous planes in prong
- unsigned short maxplanegap
  maximum number of gapped planes in prong
- unsigned short nplanegap
  total number of missing planes on track
- float calE
  energy based on summed calibrated deposited charge [GeV]
- SRVector3D start
  Shower start point in detector coordinates. [cm].
- SRVector3D dir
  Shower direction at start point [unit vector recommended].

- float pngminx

  Minimum X that contain all the cell hits. [cm].
- float pngmaxx

  Maximum X that contain all the cell hits. [cm].
- float pngminy

  Minimum Y that contain all the cell hits. [cm].
- float pngmaxy

  Maximum Y that contain all the cell hits. [cm].
- float len

  track length [cm]
- View_t view

  Prong view caf::kX = 0, caf::kY = 1 or caf::kXorY = 2.
- float lenE

  energy based on track length and MIP assumption [GeV]
- float overlapE

  overlapping energy calculated by the NumuEnergy/TrackOverlapECalc module.
- SRVector3D stop

  Track end point in detector coordinates. [cm].
- SRVector3D stopdir

  Track direction at end point [unit vector recommended].
- SRParticleTruth truth

  Truth information for the track.
- SRParticleTruth truthXView

  Truth information for the track.
- SRParticleTruth truthYView

  Truth information for the track.
- std::vector< SRTrkME > **me**
- std::vector< SRMRProperties > mrdif

  cosmogenic DiF shower properties
- std::vector< SRMRProperties > mrbrem

  cosmogenic Brem shower properties
- int trkfwdcell

  track forward cell from end to detector edge
- int trkfwdcellnd

  track forward cell from end to detector edge with muon catcher included
- int trkbakcell

  track backeard cell from start to detector edge
- int trkbakcellnd

  track backeard cell from start to detector edge with muon catcher included
- double leninact

  track length in active detector
- double lenincat

  track length in muon catcher
- float trkyposattrans

  Y position at transition to muon catcher, for determining if track went through air gap (ND only)
- float **vtxdist**
- float **enddist**
- float trkfwddist

  Kalmantrack projected distance (cm) from end point forwards to det edge.
- float trkfwdair

  for Kalmantrack projected distance forwards how much is through air (ND only, NYI)

- float trkfwdsteel

  for Kalmantrack projected distance forwards, how much is through steel (ND only, currently is just distance in muon catcher, cells and all)
- float trkbakdist

  Kalmantrack projected distance (cm) from start point backwards to det edge.
- float trkbakair

  for Kalmantrack projected distance backwards how much is through air (ND only, NYI)
- float trkbaksteel

  for Kalmantrack projected distance backwards, how much is through steel (ND only, currently is just distance in muon catcher, cells and all)
- float avedEdxlast10cm

  Average dE/dx in the last 10 cm approximately.
- float avedEdxlast20cm

  Average dE/dx in the last 20 cm approximately.
- float avedEdxlast30cm

  Average dE/dx in the last 30 cm approximately.
- float avedEdxlast40cm

  Average dE/dx in the last 40 cm approximately.
- float meantime

  Average time weighted by the energy of the cell(s) hit.
- float maxtime

  Max time of cell(s)
- float mintime

  Min time of cell(s)
- float meantimeRes

  Average time weighted by the time resolution of the cell(s) hit.

5.77 caf::SRTrackBase Class Reference

Public Member Functions

- void **fillSizes** ()

Public Attributes

- std::vector< SRTrack > **tracks**
- size_t **ntracks**

5.78 caf::SRTrackBranch Class Reference

Reconstructed tracks found by various algorithms.

Public Attributes

- SRKalman kalman

  Tracks produced by KalmanTrack.
- SRTrackBase discrete

  3D tracks produced by DiscreteTrack
- SRTrackBase cosmic

  Tracks produced by CosmicTrack.
- SRTrackBase window

  Tracks produced by WindowTrack.

5.79 caf::SRTrainingBranch Class Reference

Event ID training variables.

Public Attributes

- SRCVNFeatures cvnfeatures

  Features extracted by the convolutional part of the CVN ID.
- std::vector< SRPixelObjMap > cvnmaps

  Pixel maps used in CVN evaluation and training 80 cells x 100 planes in each view.
- std::vector< SRSliceMap > slicemaps

  Full detector sized maps used for CVN training or other slice hit level studies.
- std::vector< SRTrainingData > trainingdata

  Collection of labels associated with the Pixel maps.

5.80 caf::SRTrainingData Class Reference

Public Attributes

- unsigned int parent

  Class of the event by parent particle.
- unsigned int interaction

  Class of the event.
- unsigned int finalstate

  Class of the event by final state.
- unsigned int **finalstateprong**
- unsigned int particles

  Class of the event by primary n prongs.
- float nuenergy

  True energy of neutrino event.
- float lepenergy

  True energy of outgoing lepton.
- double vtxx

  True vertex of X position.
- double vtxy

  True vertex of Y position.
- double vtxz

  True vertex of Z position.

5.81 caf::SRTrkME Class Reference

Variables describing Michel E's found around the end of a track.

Public Attributes

- float mid
  Michel Electron Identifier.
- unsigned short nhitx
  number of hits in xview
- unsigned short nhity
  number of hits in yview
- float calE
  Calorimetric Energy [GeV].
- float deltat
  time difference [ns]
- float adc
  Total ADC in the ME cluster.
- float disttotrack
  Distance between end of track and Michel hits [cm].
- SRVector3D meanpos
  The mean position of the ME cluster.
- SRParticleTruth truth
  Truth information for the michel cluster.

5.82 caf::SRTrueMichelE Class Reference

Truth information for a Michel electron.

Public Attributes

- float E
  True energy of electron [GeV].
- float visE
  Visible Energy in detector, all summed FLSHits that made CellHits [GeV].
- float time
  Time of first Michel electron trajectory point [GeV].
- SRLorentzVector mustop
  Stopping position of parent muon [cm].
- SRLorentzVector p
  Momentum 4-vector.

5.83 caf::SRTrueNumuEnergy Class Reference

Truth information for numu energy fitting.

Public Member Functions

- void **setDefault** ()

Public Attributes

- float truemuonE

  True energy of primary muon [GeV].
- float truemuoncatcherE

  ND value: true energy of muon as it crosses the transition plane into muon catcher [GeV].
- bool truegoodmuon

  Have a primary muon that contributes to at least three hits in each view.

5.84 caf::SRTrueParticle Class Reference

The SRTrueParticle is used to represent primary daughters of a neutrino interaction.

Public Attributes

- int pdg

  pdg code
- float visE

  Visible Energy in detector, all summed FLSHits that made CellHits [GeV].
- float visEinslc

  Visible Energy in detector, slice summed FLSHits that made CellHits [GeV].
- float daughterVisE

  Visible Energy in detector for all daughters of this particle, all summed FLSHits that made CellHits [GeV].
- float daughterVisEinslc

  Visible Energy in detector for all daughters of this particle, slice summed FLSHits that made CellHits [GeV].
- float visEBirks

  Visible Energy in detector, all summed FLSHits that made CellHits [GeV] with birks suppression.
- float visEinslcBirks

  Visible Energy in detector, slice summed FLSHits that made CellHits [GeV] with birks suppression.
- float daughterVisEBirks

  Visible Energy in detector for all daughters of this particle, all summed FLSHits that made CellHits [GeV] with birks suppression.
- float daughterVisEinslcBirks

  Visible Energy in detector for all daughters of this particle, slice summed FLSHits that made CellHits [GeV] with birks suppression.
- float enteringE

  The kinetic energy the particle had when it first entered the detector, using truth information [GeV].
- float totEscE

  The total escaping energy, from the particle and all of its daughters, using truth information [GeV].
- float time

  Time from electron vertex [GeV].
- SRLorentzVector p

  Momentum 4-vector.
- int trkID

GEANT trackID.

- std::vector< int > **daughterlist**
- std::vector< float > daughterEnergies

  Vector containing energy of each daughter.
- float elasticProtonSumVisE

  Visible energy coming from sum of elastic processes with protons in final state linked to primary.
- float inelasticProtonSumVisE

  Visible energy coming from sum of inelastic processes with protons in final state linked to primary.
- float inelasticPhotonSumVisE

  Visible energy coming from sum of inelastic processes with photons in final state linked to primary.
- float elasticProtonSumVisEinslc

  Vis energy in slc coming from sum of elastic processes with protons in final state linked to primary.
- float inelasticProtonSumVisEinslc

  Vis energy in slc coming from sum of inelastic processes with protons in final state linked to primary.
- float inelasticPhotonSumVisEinslc

  Vis energy in slc coming from sum of inelastic processes with photons in final state linked to primary.
- float elasticProtonMaxVisE

  Visible energy coming from max elastic process with protons in final state linked to primary.
- float inelasticProtonMaxVisE

  Visible energy coming from max inelastic process with protons in final state linked to primary.
- float inelasticPhotonMaxVisE

  Visible energy coming from max inelastic process with photons in final state linked to primary.
- float elasticProtonMaxVisEinslc

  Vis energy in slc coming from max elastic process with protons in final state linked to primary.
- float inelasticProtonMaxVisEinslc

  Vis energy in slc coming from max inelastic process with protons in final state linked to primary.
- float inelasticPhotonMaxVisEinslc

  Vis energy in slc coming from max inelastic process with photons in final state linked to primary.
- float maxInelasticProtonTrueE

  Energy of the proton daughter going through the most energetic inelastic process.
- float maxInelasticPhotonTrueE

  Energy of the photon daughter going through the most energetic inelastic process.
- float maxElasticProtonTrueE

  Energy of the proton daughter going through the most energetic elastic process.

5.84.1 Member Data Documentation

5.84.1.1 int caf::SRTrueParticle::trkID

vector containing pdg of the immediate daughter < particles. If there are no daughters the vector will be empty.

5.85 caf::SRTruth Class Reference

Represents a true neutrino.

Public Attributes

- short pdg

  pdg code
- float E

  True energy [GeV].
- float visE

  Sum of FLS hits that made CellHits from this neutrino [GeV].
- float visEinslc

  Sum of FLS hits that made CellHits from this neutrino in this subevent [GeV].
- float eff

  Slicer efficiency for this truth interaction.
- float pur

  Slicer purity for this truth interaction.
- unsigned int nhitslc

  Number of hits recorded in this slice by this truth interaction.
- unsigned int nhittot

  Total number of hits recorded for this truth interaction.
- float time

  interaction time.
- SRLorentzVector p

  True momentum [GeV].
- SRVector3D vtx

  Vertex position in detector coordinates [cm].
- std::vector< SRTrueMichelE > michel

  Vector of true Michel electrons.

5.86 caf::SRTruthBranch Class Reference

Contains truth information for the slice for the parent neutrino/cosmic.

Public Member Functions

- void **setDefault** ()

Public Attributes

- std::vector< SRNeutrino > nu

  implemented as a vector to maintain mc.nu structure, i.e. not a pointer, but with 0 or 1 entries.
- std::vector< SRCosmic > cosmic

  implemented as a vector to maintain mc.cosmic structure
- std::vector< SRNeutrino > allnus

  vector holding all Neutrinos
- std::vector< SRCosmic > allcosmics

  vector holding all Cosmics
- short faveidxeff

  Index of favorite in allnus when sorted by slicer efficiency.
- short faveidxenergy

Index of favorite in allnus when sorted by energy.

- short faveidxpur

  Index of favorite in allnus when sorted by purity.

- short faveidxeffpur

  Index of favorite in allnus when sorted by product of efficiency and purity.

- short faveidxeffthenpur

  Index of favorite in allnus when neutrinos are sorted by efficiency and slices break ties by purity.

- short nnu

  Number of neutrinos in nu vector (0 or 1)

- short ncosmic

  Number of cosmics in cosmic vector (0 or 1)

- short nallnus

  Number of neutrinos in allnus vector.

- short nallcosmics

  Number of cosmics in allcosmics vector.

- SRGlobalTruth global

  Information about the event from which the slice came. < Variables in this branch should be used with caution since it can be < duplicated across entries (slices) in the CAF tree.

5.87 caf::SRVector3D Class Reference

A 3-vector with more efficient storage than TVector3.

Public Member Functions

- **SRVector3D** (float x, float y, float z)
- SRVector3D (const TVector3 &v)

  Easy conversion from TVector3.

- void **SetXYZ** (float x, float y, float z)
- operator TVector3 () const

  Easy conversion back to TVector3.

- void **SetX** (float _x)
- void **SetY** (float _y)
- void **SetZ** (float _z)
- float **X** () const
- float **Y** () const
- float **Z** () const
- float **Mag2** () const
- float **Mag** () const
- float **Dot** (const SRVector3D &v) const
- SRVector3D **Unit** () const

Public Attributes

- float **x**
- float **y**
- float **z**

5.88 caf::SRVertex Class Reference

Time and position of a reconstructed vertex.

Public Member Functions

- virtual ~SRVertex ()

  Default destructor.
- virtual void **setDefault** ()

Public Attributes

- float time

  Time [ns].
- SRVector3D vtx

  Vertex position in detector coordinates. [cm].

5.89 caf::SRVertexBranch Class Reference

Vectors of reconstructed vertices found by various algorithms.

Public Member Functions

- void **fillSizes** ()

Public Attributes

- SRElastic elastic

  Single vertex found by Elastic Arms.
- std::vector< SRHoughVertex > hough

  Vector of vertices found by HoughVertex.
- size_t nhough

  Number of vertices in HoughVertex (hough.size())
- std::vector< SRVertexDT > vdt

  Vector of vertices found by VertexDT.
- size_t nvdt

  Number of vertices in VertexDT (vdt.size())

5.90 caf::SRVertexDT Class Reference

A vertex found by the VertexDT algorithm.

Public Member Functions

- SRVertexDT ()

  Default constructor for SRVertexDT.
- virtual ~SRVertexDT ()

  Default destructor.

Public Attributes

- float time

  Time [ns].
- SRVector3D vtx

  Vertex position in detector coordinates. [cm].

5.91 caf::SRVeto Class Reference

Details of processing cuts made by the veto modules.

Public Member Functions

- virtual void **setDefault** ()

Public Attributes

- int ncell

  Number of hits in the slice.
- float fwddist

  Projected live distance to the edge projected forwards from track end.
- float bakdist

  Projected live distance to the edge projected backwards from track start.
- float ratio

  Number of hits in the track relative to the slice.
- float diry

  Cosine of CosmicTrack with respect to the y-direction.
- float angle

  Cosine of CosmicTrack with respect to the beam direction.
- float anglevar

  Defined as: abs(angle)∗(diry+1) - new angle variable for new angle cut.
- float anglevarold

  Difference of squares between beam angle and Y-direction (Also labeled CosmicVar AnglePID and AngleVar) - the old angle variable for old angle cut.
- bool passthru

  Would this slice pass the (fixed) through-going check?
- bool passthruold

  Would this slice pass the (not fixed, no ratio check) through-going check?
- bool passangle

  Would this slice pass the most recent angle cut?

- bool passanglefirstana

  Would this slice pass the old angle cut used for first analysis.
- bool passnumicut

  Does this event pass the NuMI timing cuts?
- bool keep

  Boolean variable that determines whether the slice was actually kept or thrown away (Also labeled sel for selected); false if ANY cut is false (if fails through-going check, or angle cut, or has number hits $<$ 20). It doesn't account for the numi timing cut. Does the event past nue version of veto? (see doc-db 14654)
- bool **keepnue**

5.92 caf::SRXnue Class Reference

Store BDT variables for the short-baseline oscillation study.

Public Member Functions

- void **setDefault** ()

Public Attributes

- float **p1energy**
- float **p1Fmip**
- float **p2Fmip**
- float **emaxfrac6p**
- float **efrac10p**
- float **efracp2**
- float **efracp3**
- float **efracp4**
- float **efrac2sig**
- double **bdt**

5.93 caf::StandardRecord Class Reference

The StandardRecord is the primary top-level object in the Common Analysis File trees.

Public Attributes

- SRHeader hdr

  Header branch: run, subrun, etc.
- SRSpill spill

  Beam spill branch: pot, beam current, etc.
- SRSlice slc

  Slice branch: nhit, extents, time, etc.
- SRTrackBranch trk

  Track branch: nhit, len, etc.
- SRVertexBranch vtx

Vertex branch: location, time, etc.

- SRMichelE me

  Michel electron branch.

- SREnergyBranch energy

  Energy estimator branch.

- SRIDBranch sel

  Selector (PID) branch.

- SRTruthBranch mc

  Truth branch for MC: energy, flavor, etc.

- SRParentBranch parent

  True parent branch for matching, e.g. MRCC.

- SRTrainingBranch training

  Extra training information for prototyping PIDs etc.

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