3x1x1 ROOT parser: reco fast (Data, 2018_June_24)

- valid for all files in: /eos/experiment/wa105/offline/LArSoft/Data/Reco/2018_June_24/ROOT/recofast/

- 1 tick = 400 ns, channel pitch = 3 mm.

- TPC active volume: -50 cm < x < 50 cm, -48 cm < y < 48 cm, 0 < z < 288 cm

Metadata (one entry per event):

- Run: run number

- Subrun: sub run number

- EventNumberInRun: event number in run

- EventTimeSeconds: in Unix time

- EventTimeNanoseconds: nanoseconds elapsed since "EventTimeSeconds"

- IsData: 1 for data, 0 for MC

Hit variables:

- NumberOfHits: number of hits per event (one entry per event)

The following variables have one entry per hit and are stored in an array. Length of array = "NumberOfHits".

- Hit_TPC: TPC in which hit was found (always 0 for 3x1x1)

- Hit_View: view in which hit was found (view 0: 320 3m long channels, view 1: 960 1m long channels)

- Hit_Channel: channel in which hit was found (view 0: channel 0-319, view 1: channel 320 - 1279)

- Hit_PeakTime: peak time of the fitted hit (in ticks)

- Hit_ChargeSummedADC: ADC sum of the hit from first tick to last tick (both inclusive, in ADC·ticks)

- Hit_ChargeIntegral: Integral of the fitted hit from $-\infty$ to $+\infty$ (in ADC·ticks)

- Hit_Amplitude: amplitude of the hit in ADC

- Hit_StartTime: first tick of the hit (in ticks)

- Hit_EndTime: last tick of the hit (in ticks)

- Hit_Width: $\text{FWHM}/\left(2 \cdot \sqrt{2 \cdot ln\left(2\right)}\right)$
  FWHM: Full width at half maximum of the fitted hit

- Hit_GoodnessOfFit: proportional to χ^2/NDF of the fitted hit (absolute number to be checked)

- Hit_Multiplicity: Number of hits in that were fitted together with this hit

- Hit_TrackID: ID of the track to which the hit was assigned to (-999: not assigned to a track)

- Hit_ClusterID: ID of the cluster to which the hit was assigned to (-999: not assigned to a cluster)

Each hit was fitted with the following function: $f(t) = A \cdot \left(e^{\frac{t-t_0}{\tau_1}}\right) / \left(1 + e^{\frac{t-t_0}{\tau_2}}\right)$

- Hit_FitParameter_Amplitude: A
- Hit_FitParameter_Offset: t_0
- Hit_FitParameter_Tau1: τ_1
- Hit_FitParameter_Tau2: τ_2

Cluster variables:

- NumberOfClusters: number of clusters (one entry per event)

The following variables have one entry per cluster and are stored in an array. Length of array = "NumberOfClusters".

- ClusterID: ID of the cluster (first cluster: 1)

- Cluster_NumberOfHits: number of hits assigned to this cluster (sorted by cluster ID)

- Cluster_View: View in which cluster was found (view 0: 320 3m long channels, view 1: 960 1m long channels)

- Cluster_ChargeIntegral: Sum of all "Hit_ChargeIntegral" of the hits assigned to this cluster

- Cluster_ChargeIntegralAveragePerHit: "Cluster_ChargeIntegral"/"Cluster_NumberOfHits fHits"

- Cluster_StartChannel: Channel in which the cluster hast its first hit (view 0: channel 0-319, view 1: channel 320 - 1279)

- Cluster_StartTick: "PeakTime" of the first hit of the cluster (in ticks)

- Cluster_EndChannel: Channel in which the cluster hast its last hit (view 0: channel 0-319, view 1: channel 320 - 1279)

- Cluster_EndTick: "PeakTime" of the last hit of the cluster (in ticks)

- Cluster_StartCharge: "Hit_ChargeIntegral" of the first hit of the cluster (in ADC·ticks)

- Cluster_StartAngle: angle at the start of the cluster for the view it was found in (in radian, from $-\pi/2$ to $+\pi/2$). 0: parallel to the charge readout plane (CRP), $\pi/2$: pointing downwards (negative drift direction), $-\pi/2$: pointing upwards (drift direction).

- Cluster_EndCharge: "Hit_ChargeIntegral" of the last hit of the cluster (in ADC·ticks)

- Cluster_EndAngle: angle at the end of the cluster for the view it was found in (in radian, from $-\pi$ to $+\pi$). 0: parallel to the charge readout plane (CRP), $\pi/2$: pointing downwards (negative drift direction), $-\pi/2$: pointing upwards (drift direction).

Track variables:

- NumberOfTracks: number of tracks (one entry per event)

The following variables have one entry per track and are stored in an array. Length of array = "NumberOfTracks".

- TrackID: ID of the track (first track: 0)

- Track_NumberOfHits: number of hits assigned to this track

- Track_Length_Trajectory: length of the track following the trajectory points (in cm)

- Track_Length_StraightLine: distance between start and end point of the track (in cm)

- Track_StartPoint_X: x position of the start point of the track, in cm

- Track_StartPoint_Y: y position of the start point of the track, in cm

- Track_StartPoint_Z: z position of the start point of the track, in cm

- Track_StartPoint_DistanceToBoundary: Distance between start point of the track and to the closest active volume boundary, in cm

- Track_EndPoint_X: x position of the end point of the track, in cm

- Track_EndPoint_Y: y position of the end point of the track, in cm

- Track_EndPoint_Z: z position of the end point of the track, in cm

- Track_EndPoint_DistanceToBoundary: Distance between end point of the track and to the closest active volume boundary, in cm

- Track_StartDirection_Theta: angle at the start of the track with respect to the x-axis in degrees, from 0° to 180°. x-axis is drift axis. 0 is in +x direction (upwards), 90° is horizontal, 180° is in -x direction (downwards).

- Track_StartDirection_Phi: angle at the start of the track in y-z plane in degrees, from -180° to +180°. 0° is in +z direction (parallel to channels in view 0), ±90° in ±y direction (parallel to channels in view 1) and ±180° in -z direction (parallel to channels in view 0).

- Track_StartDirection_X: x-component of the unit vector pointing in track direction at the start of the track

- Track_StartDirection_Y: y-component of the unit vector pointing in track direction at the start of the track

- Track_StartDirection_Z: z-component of the unit vector pointing in track direction at the start of the track

- Track_EndDirection_Theta: angle at the end of the track with respect to the x-axis in degrees, from 0° to 180°. x-axis is drift axis. 0° is in +x direction (upwards), 90° is horizontal, 180° is in -x direction (downwards).

- Track_EndDirection_Phi: angle at the end of the track in y-z plane in degrees, from -180° to +180°. 0 is in +z direction (parallel to channels in view 0), ±90° in ±y direction (parallel to channels in view 1) and ±180° in -z direction (parallel to channels in view 0).

- Track_EndDirection_X: x-component of the unit vector pointing in track direction at the end of the track

- Track_EndDirection_Y: y-component of the unit vector pointing in track direction at the end of the track

- Track_EndDirection_Z: z-component of the unit vector pointing in track direction at the end of the track

The following variables have one entry per track and view and are stored in an array. Length of array = "NumberOfTracks"*2.

- Track_PitchInViews: track pitch in both views (first view 0, then view 1, (in radian, from 0 to $+\pi$))

- Track_NumberOfHitsPerView: number of hits in each view that are assigned to this track (first view 0, then view 1)

Hits inside tracks variables:

The following variables have one entry per hit and are stored in an array. Length of array = "NumberOfHits". The array is sorted by "Hit_TrackID". The hits inside one track are sorted by their 3D positions → the following arrays have the same sorting (which is different from the hit array sorting on page 1). If a hit was not assigned to a track, the respective value is set to -999 by default. These hits are stored at the end of the array.

- Track_Hit_X: Hit position in x, in cm

- Track_Hit_Y: Hit position in y, in cm

- Track_Hit_Z: Hit position in z, in cm

- Track_Hit_LocalTrackDirection_X: x-component of the unit vector pointing in track direction at the 3D position of this hit

- Track_Hit_LocalTrackDirection_Y: y-component of the unit vector pointing in track direction at the 3D position of this hit

- Track_Hit_LocalTrackDirection_Z: z-component of the unit vector pointing in track direction at the 3D position of this hit

- Track_Hit_LocalTrackDirection_Theta: angle of the track at the 3D position of this hit with respect to the x-axis in degrees, from 0° to 180°. x-axis is drift axis. 0° is in +x direction (upwards), 90° is horizontal, 180° is in -x direction (downwards).

- Track_Hit_LocalTrackDirection_Phi: angle of the track at the 3D position of this hit in y-z plane in degrees, from -180° to +180°. 0 is in +z direction (parallel to channels in view 0), ±90° in ±y direction (parallel to channels in view 1) and ±180° in -z direction (parallel to channels in view 0)

- Track_Hit_ds_LocalTrackDirection: Hit ds calculated from the local track direction at the 3D position of this hit and the channel pitch, in cm

- Track_Hit_ds_3DPosition: Hit ds calculated from the 3D position of this hit and the neighbouring hits, in cm

- Track_Hit_TPC: see Hit_TPC

- Track_Hit_View: see Hit_View

- Track_Hit_Channel: see Hit_Channel

- Track_Hit_PeakTime: see Hit_PeakTime

- Track_Hit_ChargeSummedADC: see Hit_ChargeSummedADC

- Track_Hit_ChargeIntegral: see Hit_ChargeIntegral

- Track_Hit_Amplitude: see Hit_Amplitude

- Track_Hit_StartTime: see Hit_StartTime

- Track_Hit_EndTime: see Hit_EndTime

- Track_Hit_Width: see Hit_Width

- Track_Hit_GoodnessOfFit: see Hit_GoodnessOfFit

- Track_Hit_Multiplicity: see Hit_Multiplicity

3x1x1 geometry used for ROOT parser files:

gas argon

active liquid argon

+x

-x

-z

+z

+y

-y
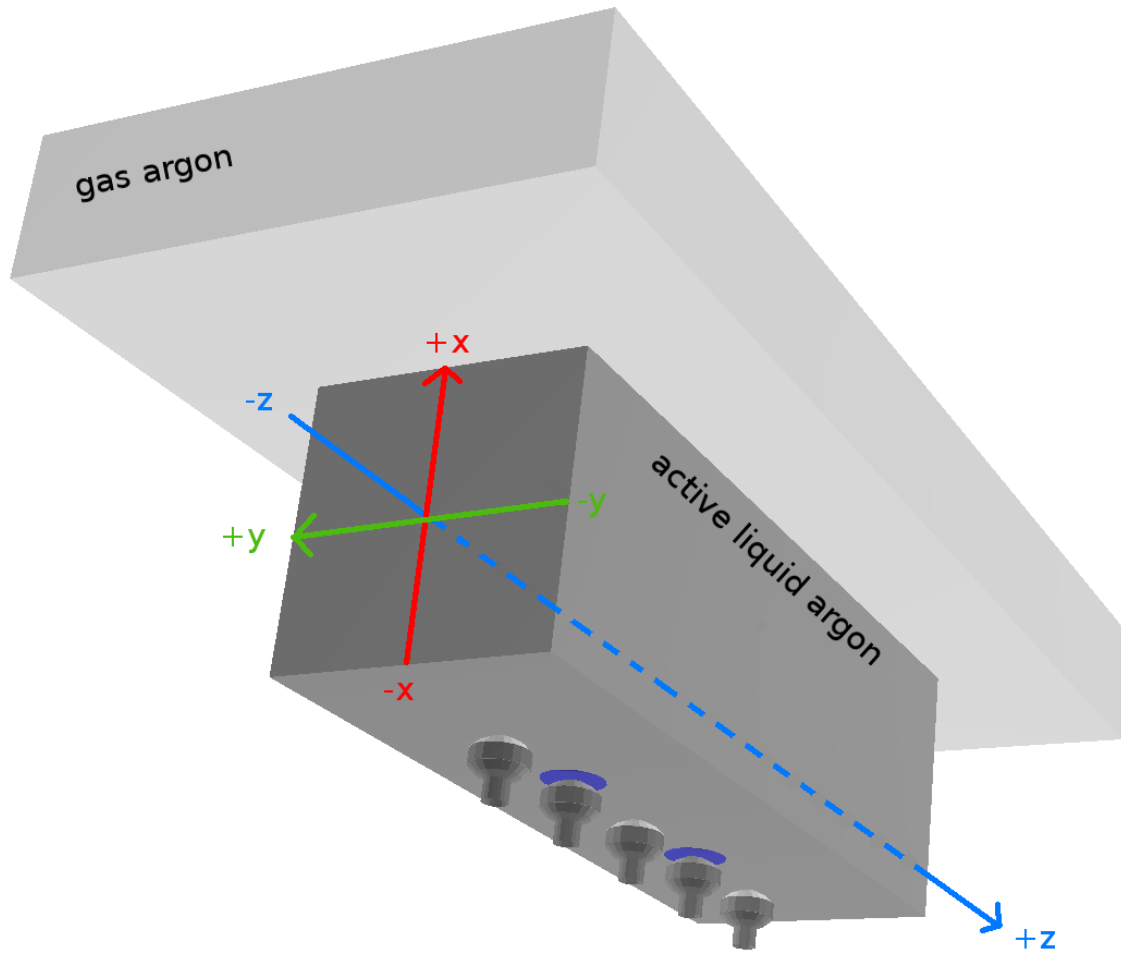
Definiton of θ and φ:
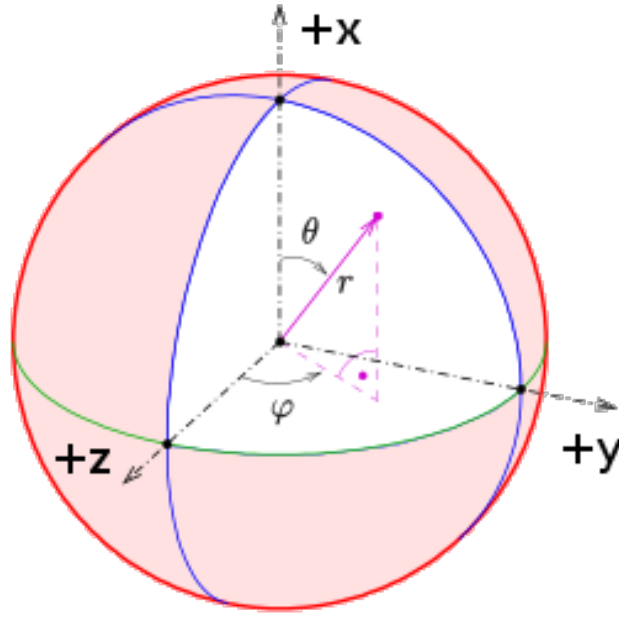
$$0° < \theta < +180°$$

$\theta = 0°$: +x direction (upwards)
$\theta = 90°$: horizontal
$\theta = 180°$: -x direction (downwards)

Note: in this reconstruction, start and end points of the tracks are defined
w.r.t. to the x-axis (drift direction): Track_StartPoint_X > Track_EndPoint_X
$\rightarrow$ this means that all tracks are downgoing $(+90° < \theta < +180°)$.

$$-180° < \varphi < +180°$$

$\varphi = 0°$: +z direction (parallel to channels in view 0)
$\varphi = 45°$: 45° in both views
$\varphi = 90°$: +y direction (parallel to channels in view 1)
$\varphi = 135°$: 45° in both views
$\varphi = 180°$: -z direction (parallel to channels in view 0)

$\varphi = -45°$: 45° in both views
$\varphi = -90°$: -y direction (parallel to channels in view 1)
$\varphi = -135°$: 45° in both views
$\varphi = -180°$: -z direction (parallel to channels in view 0)