SDHCAL Software & data quality control

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Outline

- Raw Data format.

- Data Reconstruction.

- SDHCAL preliminary PID

- Data Quality

- Summary

Raw Data format

- The DAQ save all hits with corresponding infomation on one time window (= 1 « Trigger »).

- The end of the trigger correspond to the time of full memory of one of the detector ASICs.

- The dead time (~400ms) between two following triggers corresponding to data transfert of all ASICs.

- The RAW data are first saved in a LCIO file as "LCGenericObject" with all information and environemental condition (temperature ...)

- The second step consist in translating the previous file on another file with RawCalorimeterHit collection. (streamout)

The Data are present in the CALICE Grid on the folowing folders for each period (PS & SPS) :

/grid/calice/SDHCAL/TB/CERN/PS_April2012

...... /SPS_May2012

Summary Diagram of SDHCAL Data Reconstruction

CALICE Analysis meeting
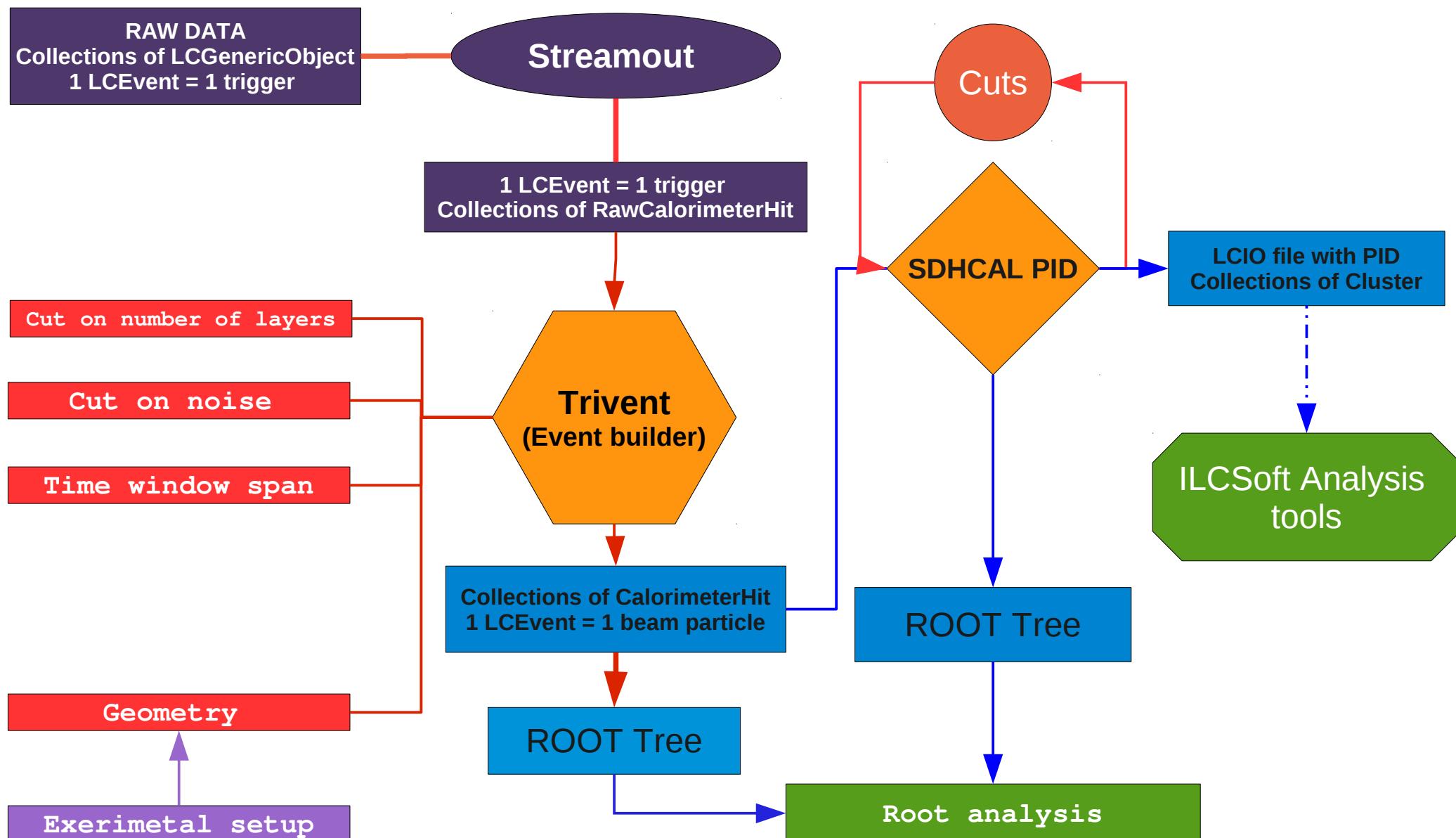
Data reconstruction Algorithm

- **To select the physical events, a framework called Trivent has been developped based on marlin processor availble on ILCSoft.**

- **Trivent selects the hits clusterised in time**

- **This selection follows 3 steps :**

  - **Determine the peaks on time spectrum with Nhit > noise_cut**

  - **Select the hits in the time window t_peak +- window_size**

  - **The selected hits are saved in the new LCIO file as CalorimeterHit collection.**

- **Cuts to take only the physical events :**

  - **Electronic noise cuts Nhit/trigger < 10^5**

  - **Numbers of the layer > 7 (example)**

- **Add PID variables of events to tag events by type.**

Trigger hits
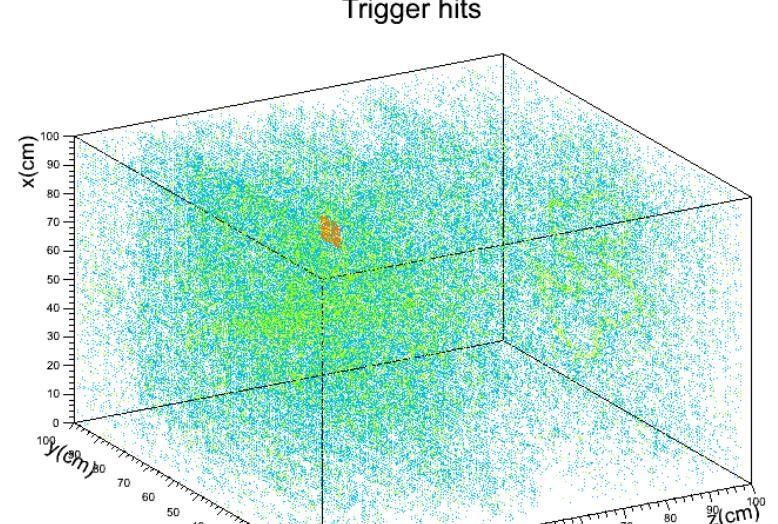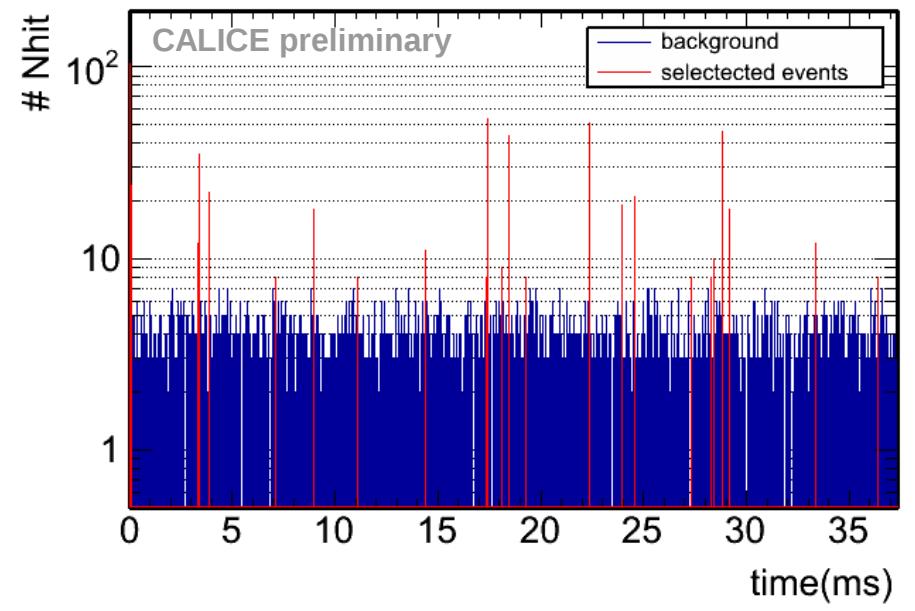
XY Map (40 GeV)

40 GeV

XY Beam profile
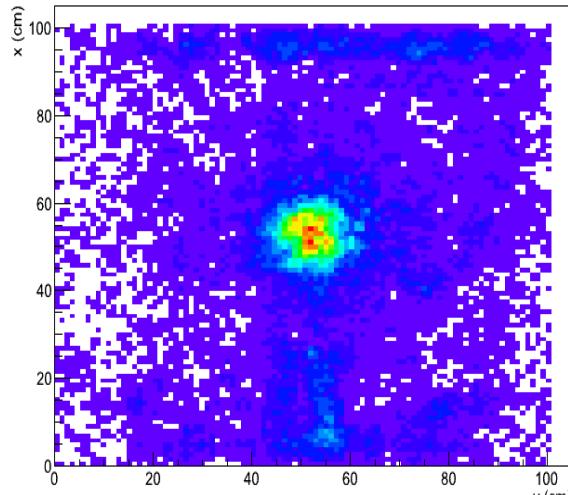
40 GeV

More than few layers
must be hit in the same time

XY Map 120 GeV

120 GeV

XY Beam profile

120 GeV

- This cut reduces significantly the noise.
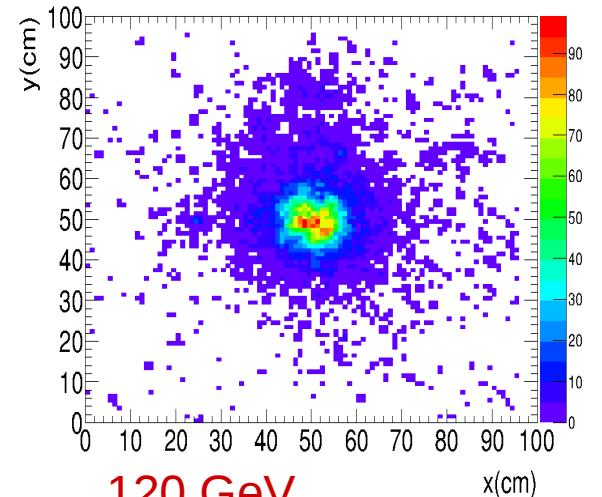
SDHCAL Event display "Druid"

Druid is one package of the ILCsoft used to display the event from LCIO file.

The folowing pictures is an example of 2 reconstructed events.

Beam

100 GeV Pion+

50 GeV Pion+
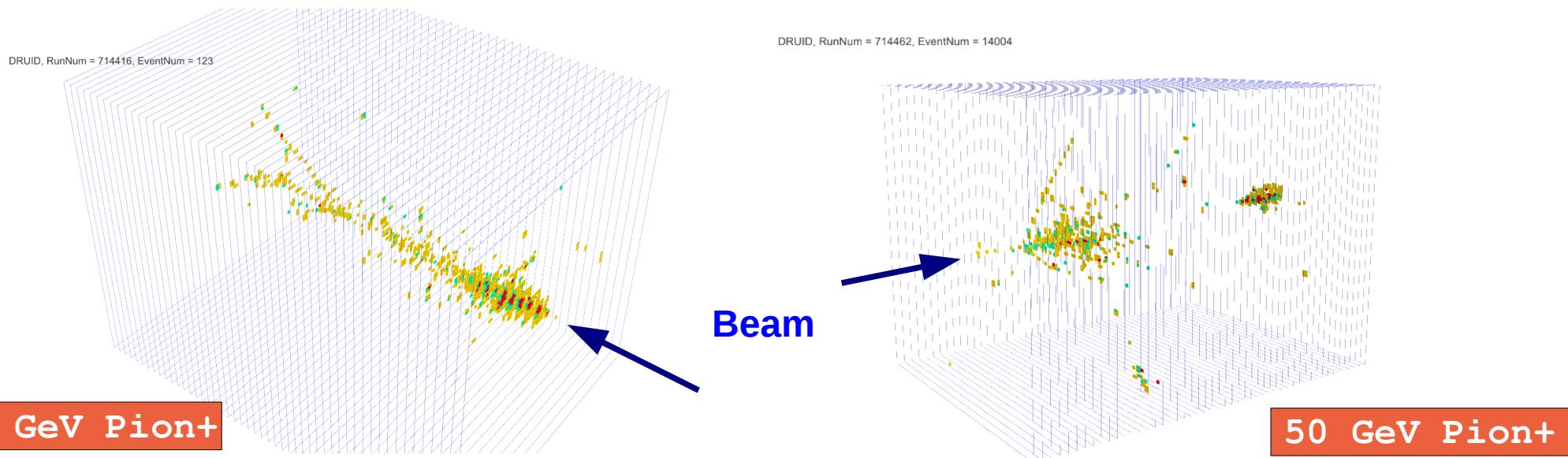
- The color is correspondig to the different thresolds.

SDHCAL preliminary PID

- A Module of PID is also under devlopement to tags the event with the particle type. A clusters are created with all hits in it, some cuts on PID variable define the kind of coming particle.

```
LCIO from Trivent ── First process ── Second process ──┬── LCIO file (with PID)
                     (PID variable     (cut on PID      │
                     calculation )      variables)      └── ROOT Tree
```
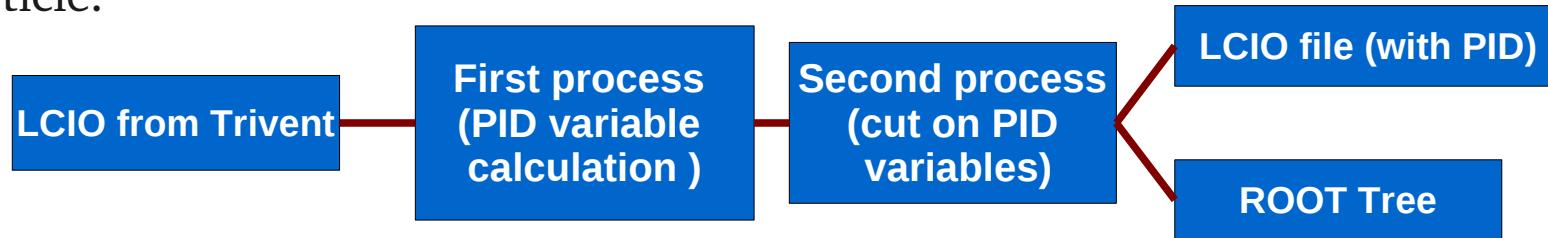
- Number of Fired Layer : Nrpc
- Total Number of hits (Nhits) and for each threshold Nthr
- Maximum of Shower logitudinal profile :

$$N_{max} = max \ \{N_{hit}(K) \ | \ K \in [1, \ 50]\}$$

- Shower maximum position :

$$Z_{max} = Z(N_{hit} = N_{max})$$

- Shower begin position :

$$Z_{begin} \ with \ N_{hit}(Z = Z_{begin}) \geq 5$$

- Ellipsoide parameters
  - Principle axes
  - Volume
  - Center of gravity
- Fractal dimension

$$FD_\beta = \left\langle \frac{\log R_{\alpha,\beta}}{\log \alpha} \right\rangle + 1 \ with \ R_{\alpha,\beta} = \frac{N_\alpha}{N_\beta}$$

- Ref : Fractal dimension analysis in a highly granular calorimeter M Ruan et al 2012 J. Phys.: Conf. Ser. 368 012038

Very preliminary Pions Selection An Example

- An example of PID using two variable tuned by hands.

Hadronic component (Pions)

Noise + cosmic

Muons (frombeam)

CALICE An
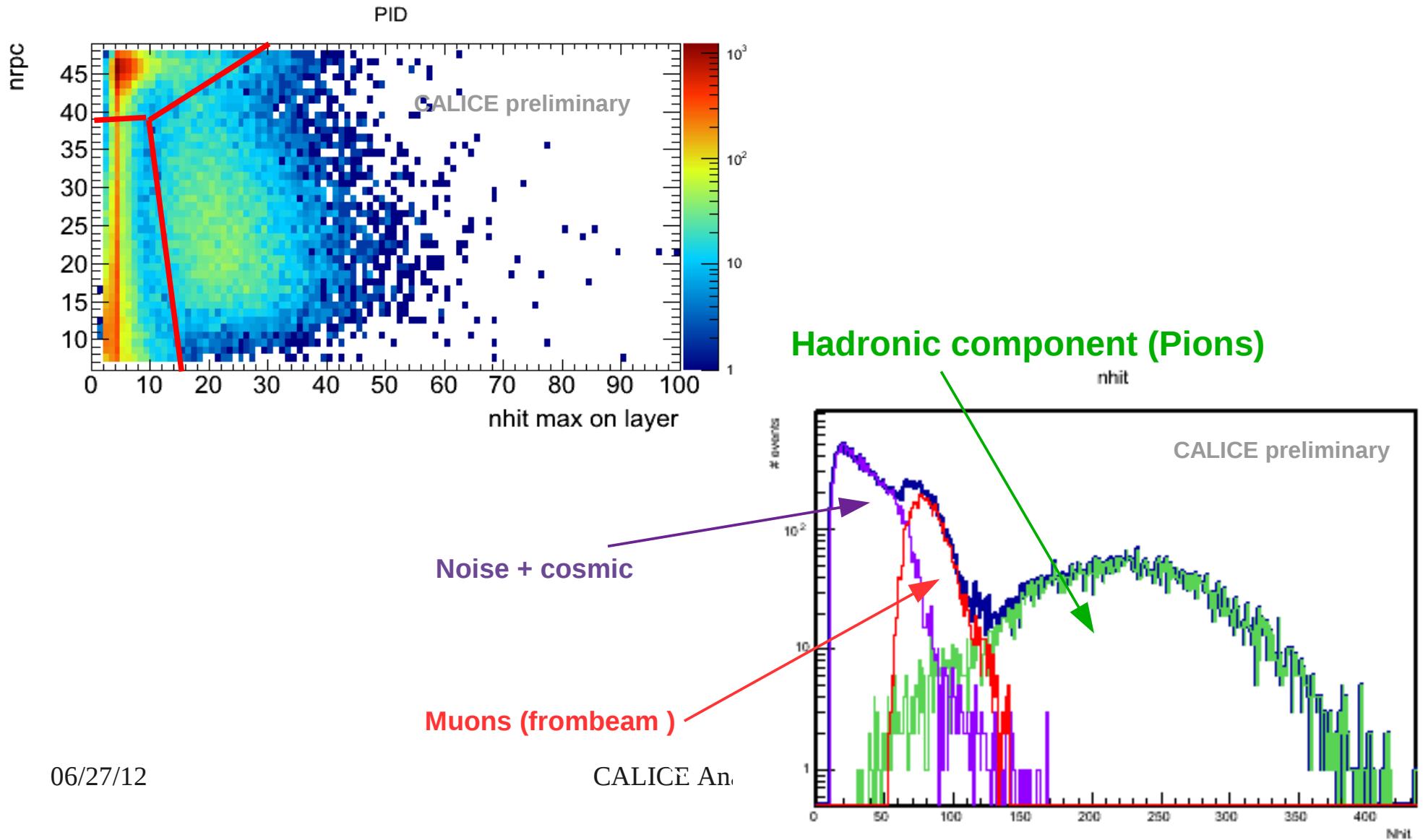
Pions Selection Example

12 GeV Pions (#run : 714133)
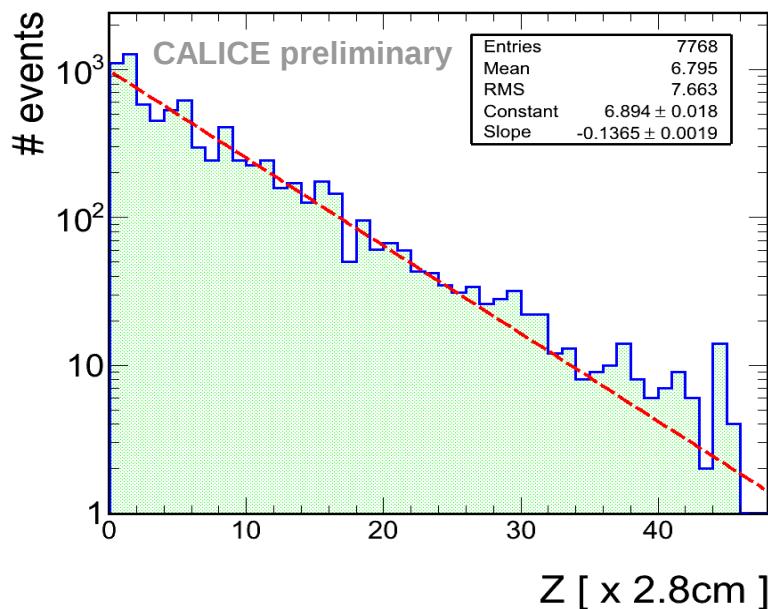
The exponentiel depth distribution of the first nuclear interaction in the showers (neglecting backscattering)
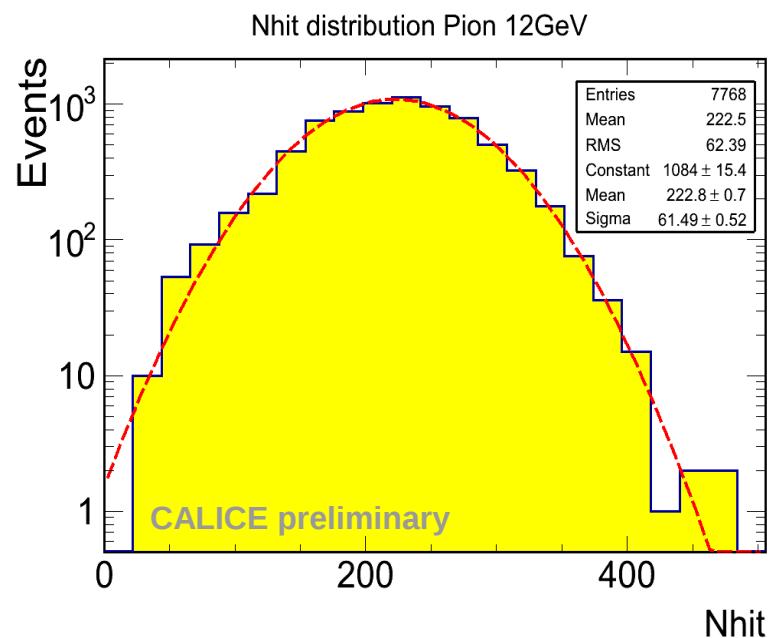
Number of the hits distribution for 12GeV Pi -

Data Quality Checks
(on going...)

Data quality (DQ) check

Two checks :
- Online DQ check
- Offline DQ check

The first DQ check is tacken directly by monitoring the data acquisition during the run by some control histograms.

- Asic & Occupancy (noise)
- Efficiency by layer
- RPC position map

efficacite pour christophe combaret qui fait rire guillaume baulieu mais qu'il a fallu demander 2 fois a laurent mirabito

Efficiency	
Entries	46
Mean	23.89
RMS	13.22

Efficiencies for 2622 tracks

```
|1|649|630|97.07|
|2|697|685|98.28|
|3|740|731|98.78|
|4|791|773|97.72|
|5|825|812|98.42|
|6|861|842|97.79|
|7|867|851|98.15|
|8|870|816|93.79|
|9|843|817|96.92|
|10|810|792|97.78|
|11|812|791|97.41|
|12|810|789|97.41|
|13|808|786|97.28|
|14|791|766|96.84|
|15|788|757|96.07|
|16|766|748|97.65|
|17|756|737|97.49|
|18|765|742|96.99|
|19|760|732|96.32|
|20|766|749|97.78|
|21|780|758|97.18|
|22|787|769|97.71|
|23|783|759|96.93|
|24|792|779|98.36|
|25|786|773|98.35|
|26|776|764|98.45|
|27|777|756|97.30|
|28|784|763|97.32|
|29|779|752|96.53|
|30|794|785|98.87|
|31|823|803|97.57|
|32|828|804|97.10|
|33|826|806|97.58|
|34|829|794|95.78|
|35|825|811|98.30|
|36|818|794|97.07|
|37|807|767|95.04|
|38|799|786|98.37|
|39|797|779|97.74|
|40|805|786|97.64|
|41|787|760|96.57|
|42|761|681|89.49|
|43|715|497|69.51|
|44|664|646|97.29|
|45|618|596|96.44|
|46|571|545|95.45|
```

OK

06/27/12

Offline DQ line
90GeV 714525_I3
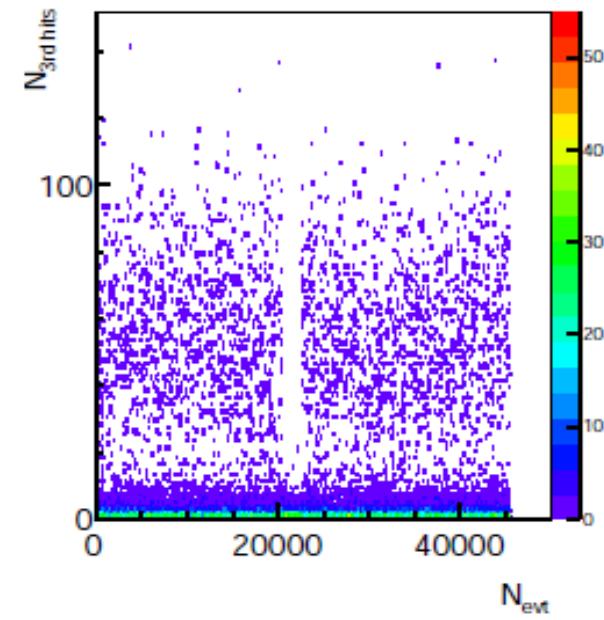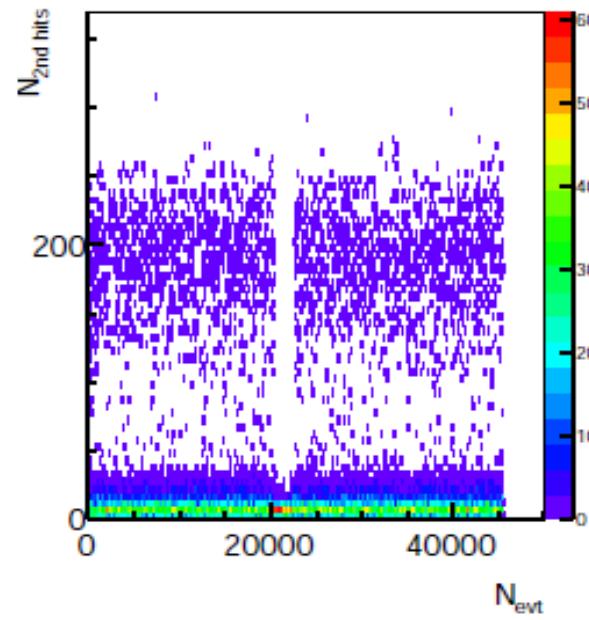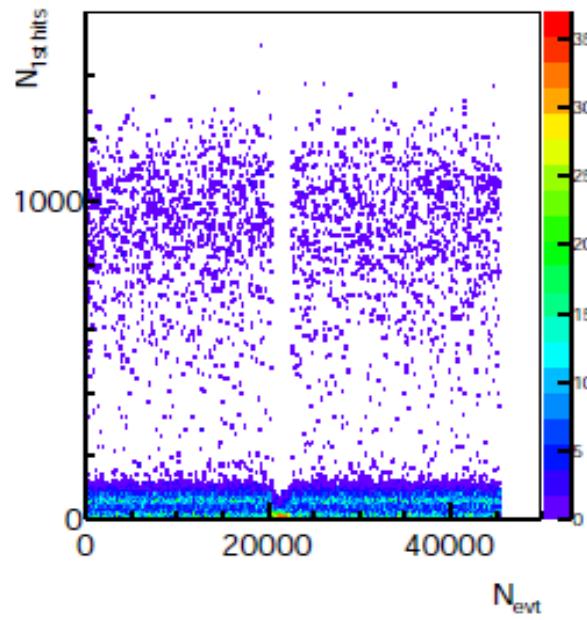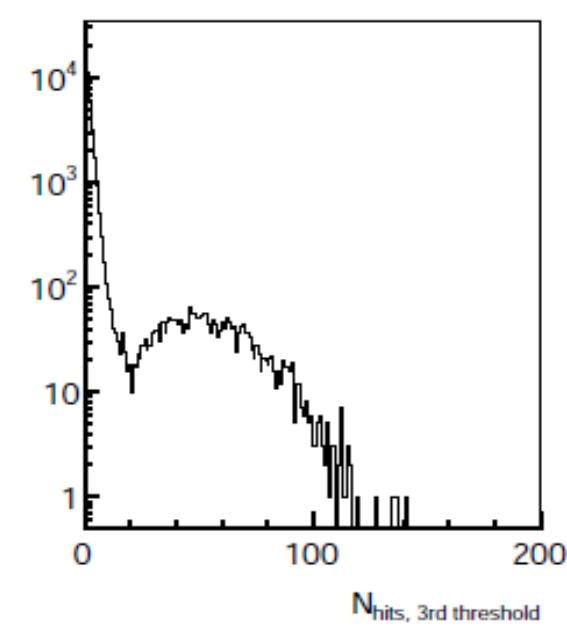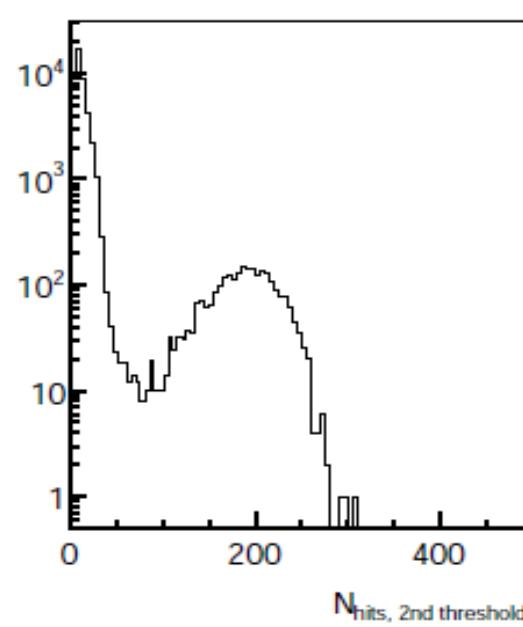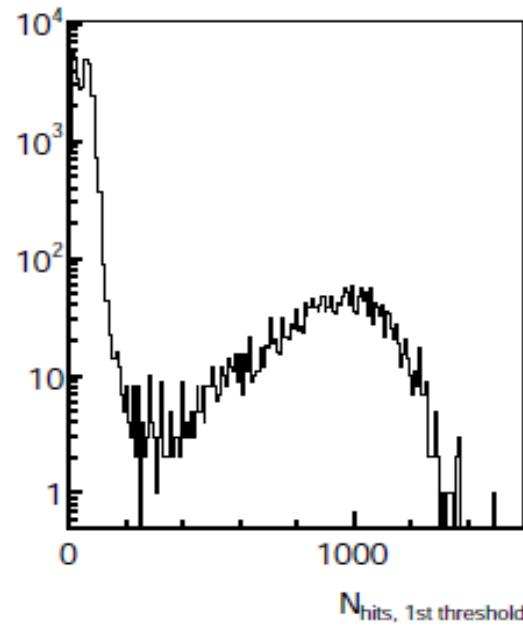

13

Offline DQ line
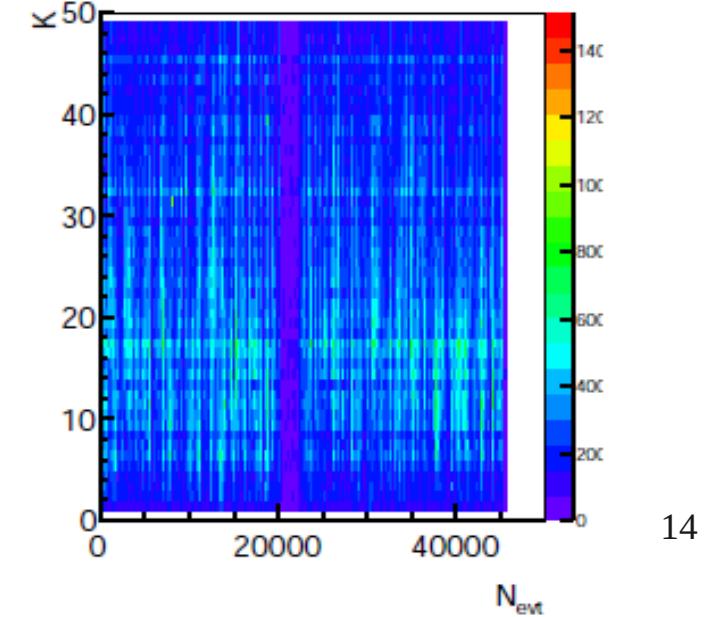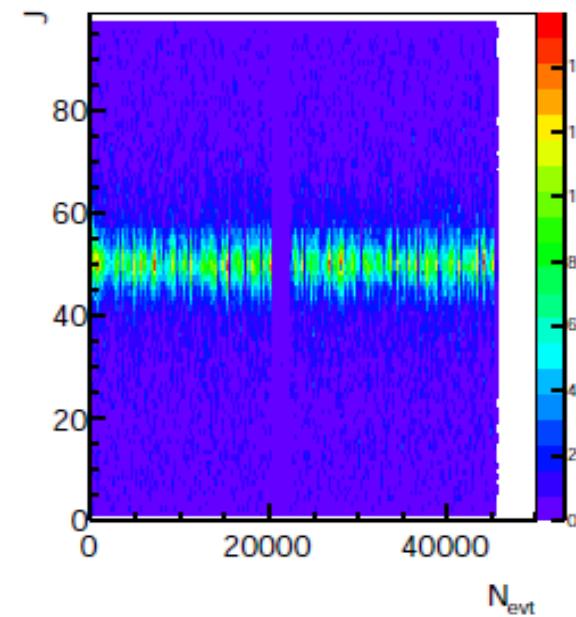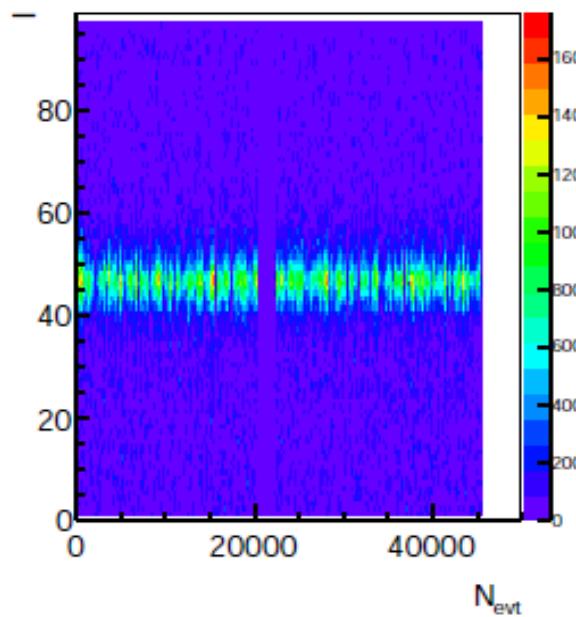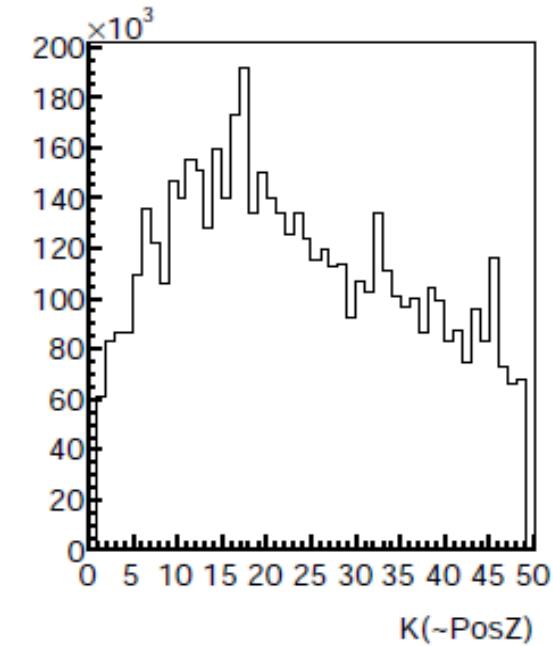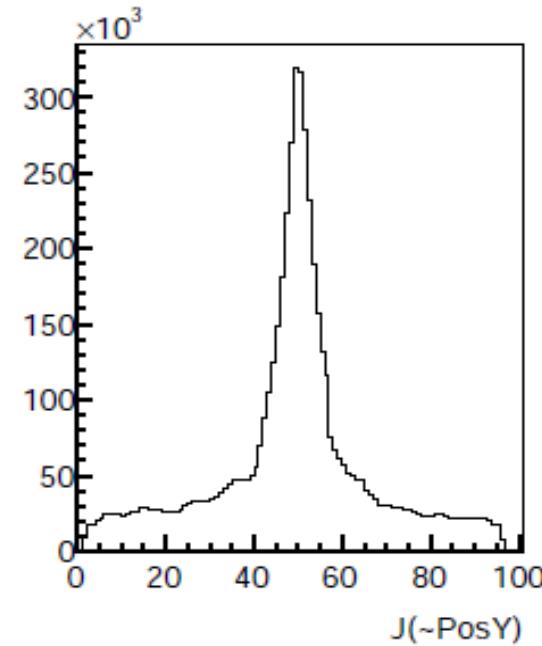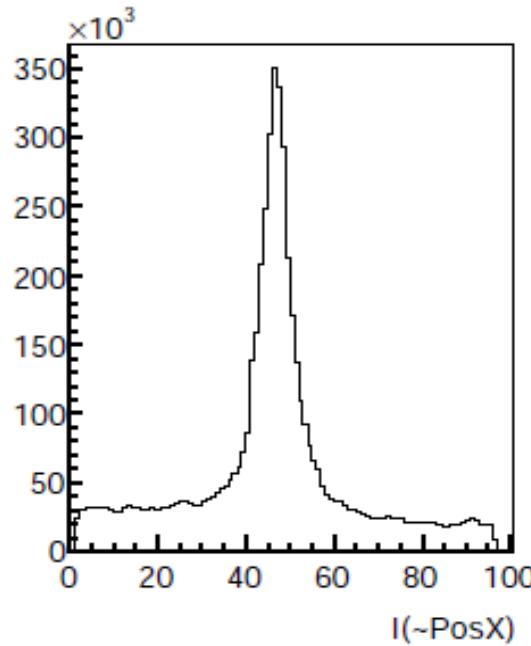
Example of abnormal events

DRUID, RunNum = 714673, EventNum = 6684
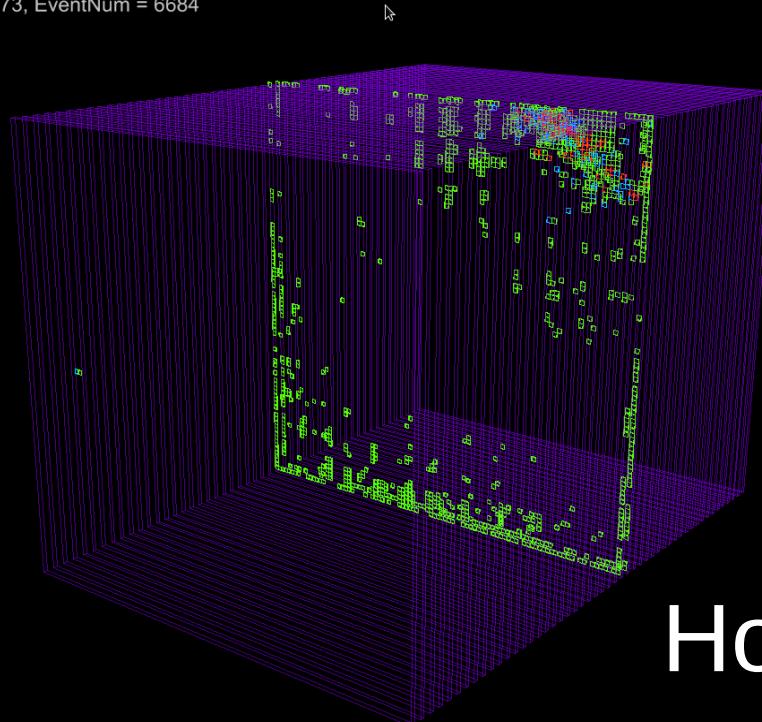
DRUID, RunNum = 714673, EventNum = 12746
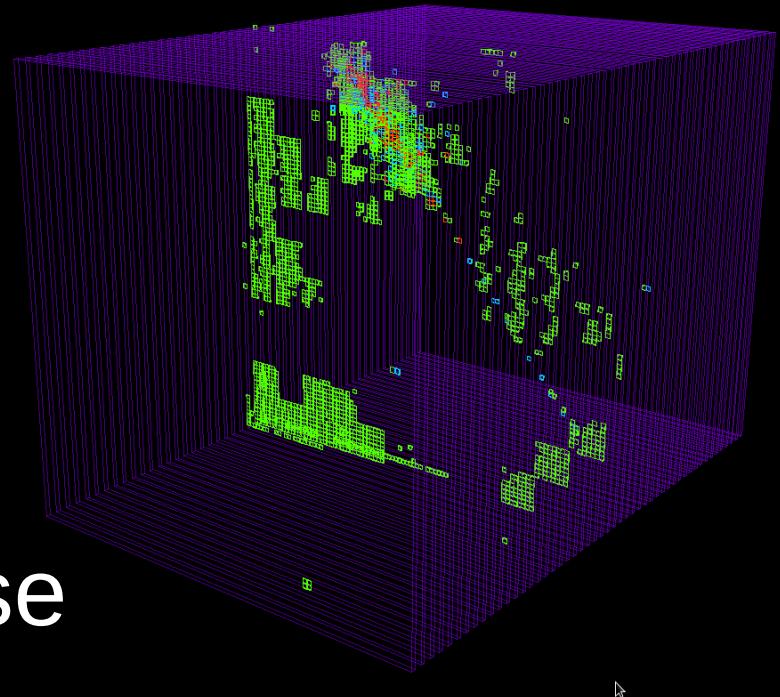
Hot Noise

Standard events

DRUID, RunNum = 714525, EventNum = 32
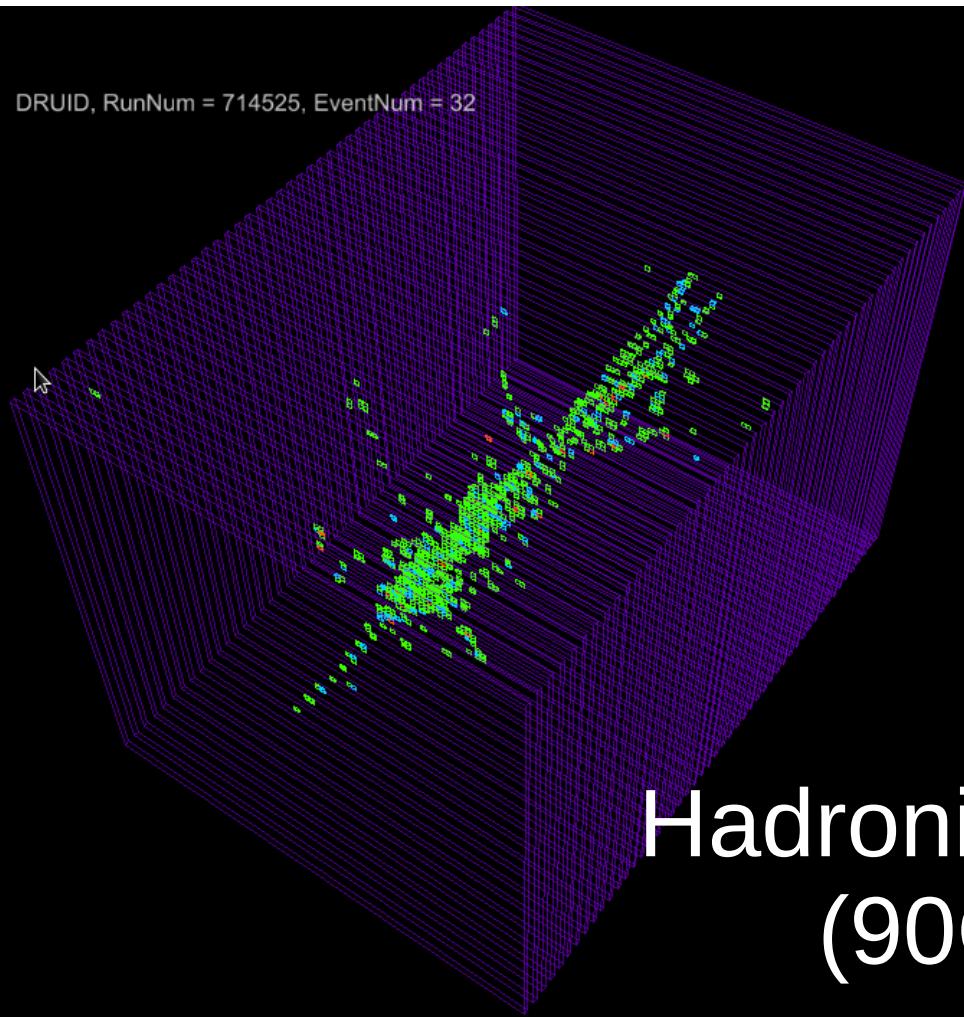
DRUID, RunNum = 714525, EventNum = 51
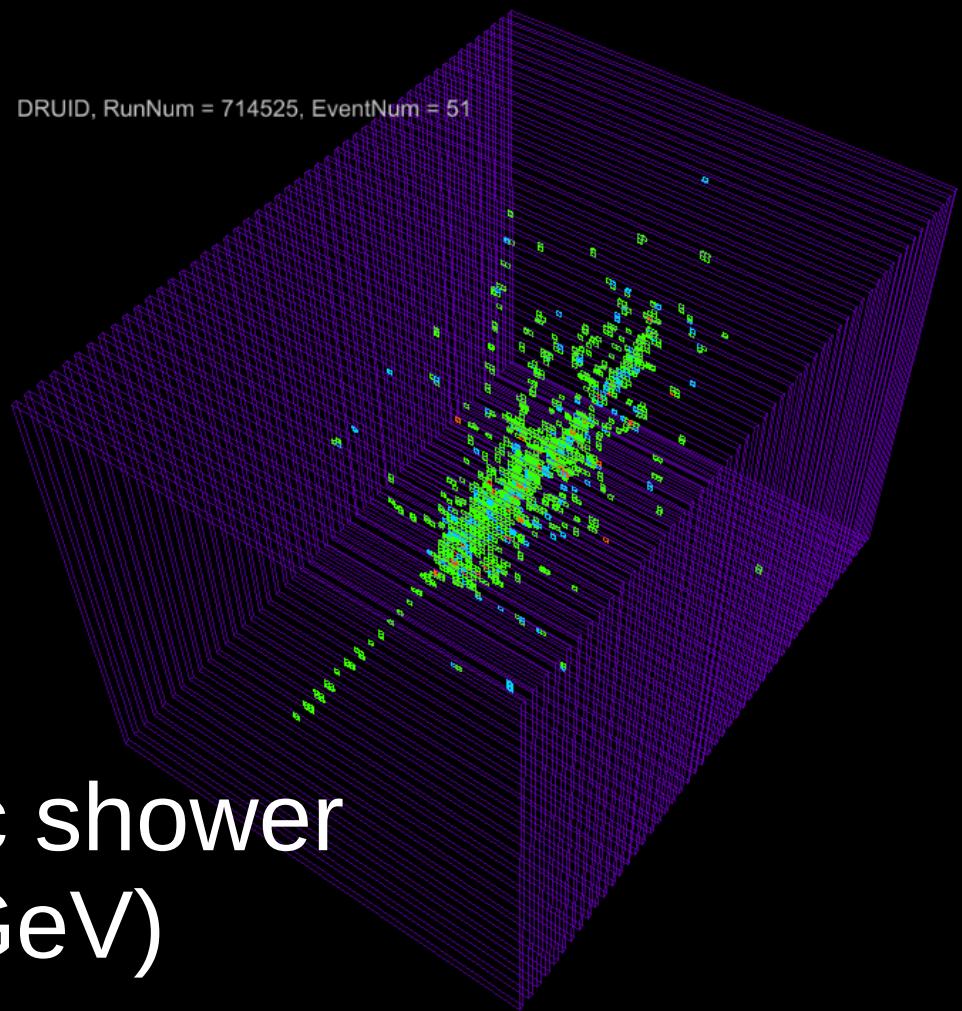
Hadronic shower
(90GeV)

Summary

- A version of data reconstruction software is ready & it available on ILCSoft.
- The framework is based on ILCSoft (LCIO, Marlin, …)
- The PID will be included very soon (some improvement are needed)
- The Raw & Reconstructed data are available for all CALICE collaboration on Grid.
- The Data analysis has also begun and a preliminary results are produced.
- To come soon: DQ reference table
  - Quality, flag to potential problems, Statistic, Composition, ...