PSD Beam-Test Simulation:
Output overview

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Simulation Output File

- **ROOT file:**
  - **Dynamic vectorial trees**
    - ***Some structures are inherited from the «Tile-simulation»***
    - ***New trees:***
      - *Event_Tree and Particles_Tree*
      - ***The information are related to active volumes***

  - **Volume IDENTIFICATION:**
    - ***Volume_ID : Describe the global element***

Volume_ID					
Out of world	World	Wrapping*	Gap*	Scintillator	SiPMs*
-1	0	1	2	3	4

*optional element

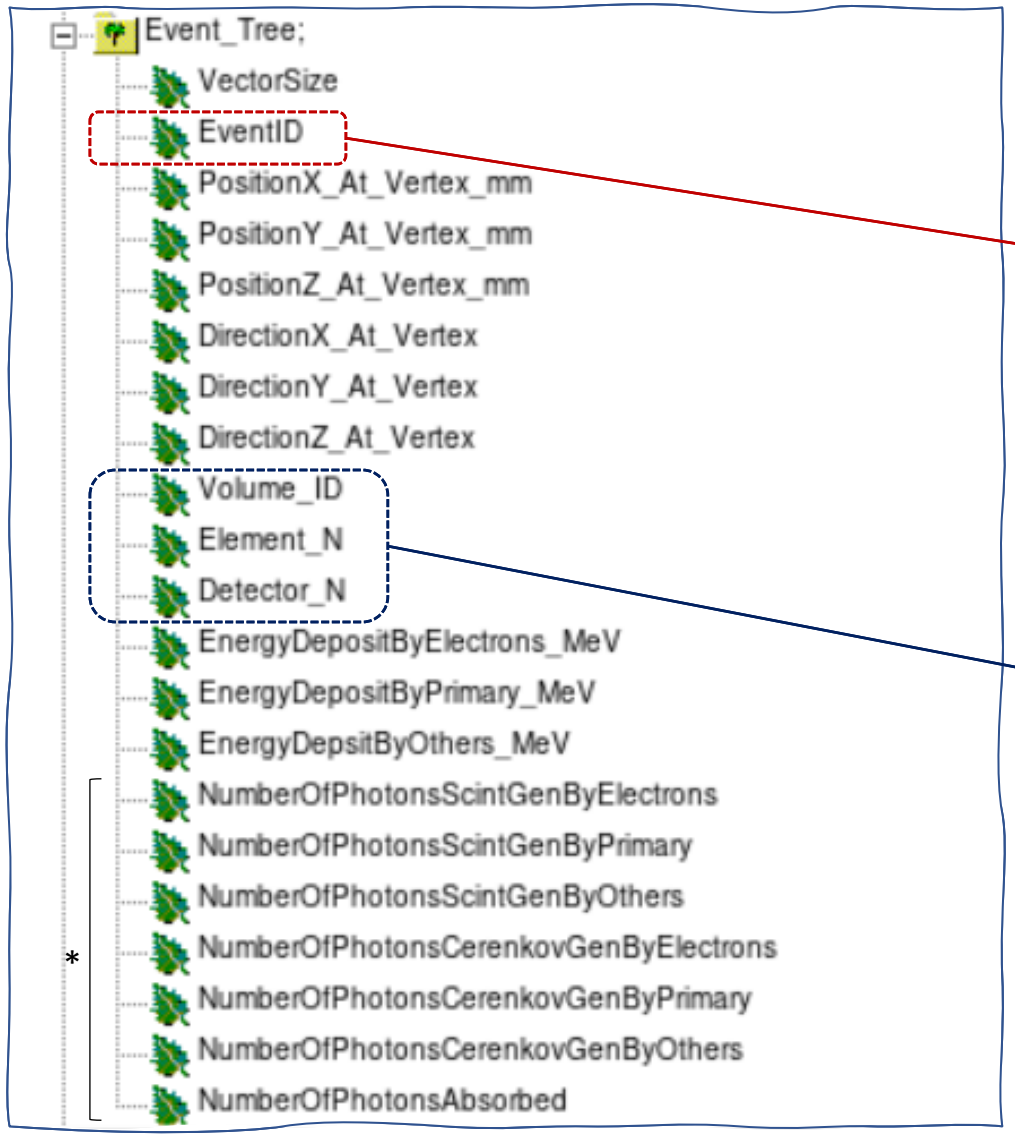
    - ***Element_N : Identify the Scintillator***
      - *Reference number in the dataCard*
    - ***Detector_N : Identify the Detector (SiPMs)***
      - *Relevant only to identify the SiPMs*
      - *0 – N-1*

Event_Tree and Particles_Tree: Overview

- **Event_Tree**
  - **Contains all the global information related to each event**
    - ***One entry per event***
    - ***Main information:***
      - *Primary particle:*
        - *Vertex position/ direction*
      - *Energy deposited in each volume*
- **Particles_Tree**
  - **Contains all the information related to individual particle produced:**
    - ***All particles are tracked***
    - ***This tree has a lot of entries per «physical event»***
      - *An EventID connect each particle to the "event" that generated it*
      - *An univoque TrackID identify each particle produced and a ParentID connect that particle to its particle parent*
    - ***Main information (tracking):***
      - *Particle types*
      - *Generation point,Vertex Energy and parent*
      - *Energy deposited in each volume*
      - *Entry point and direction in each active volume*

Event_Tree and Particles_Tree: Structure

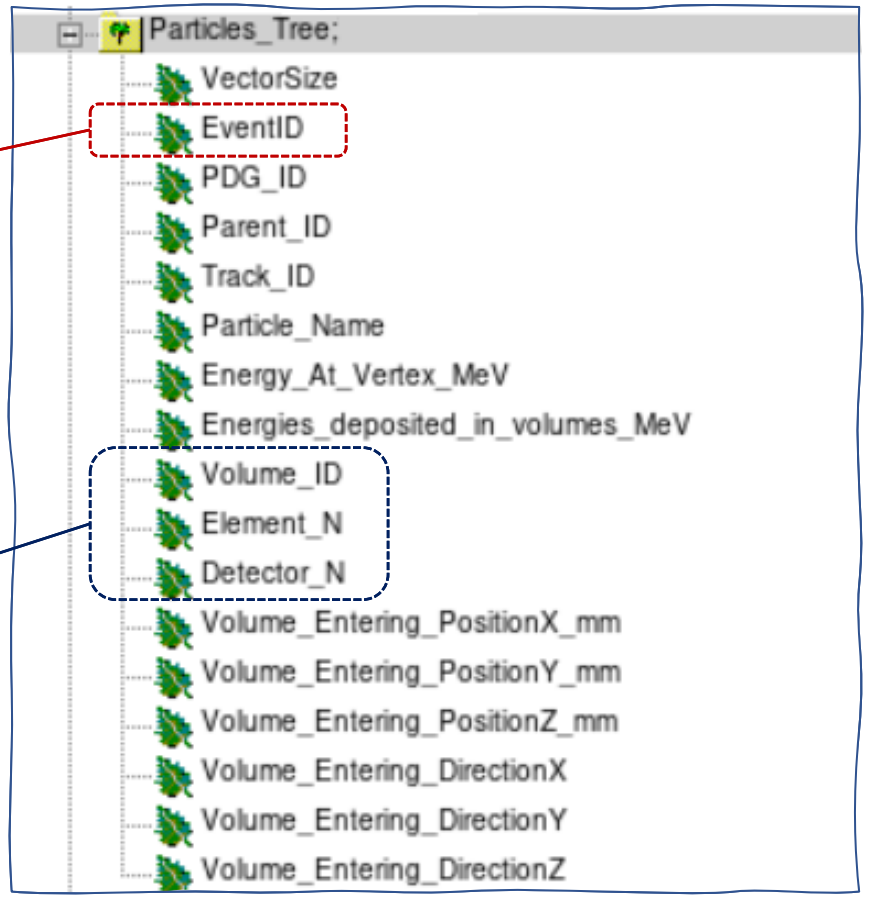
Event_Tree Structure



The information inside the trees are linked by the «event ID»

Each information for a specific "active" volume can be achieved by using the Volume's identification IDs

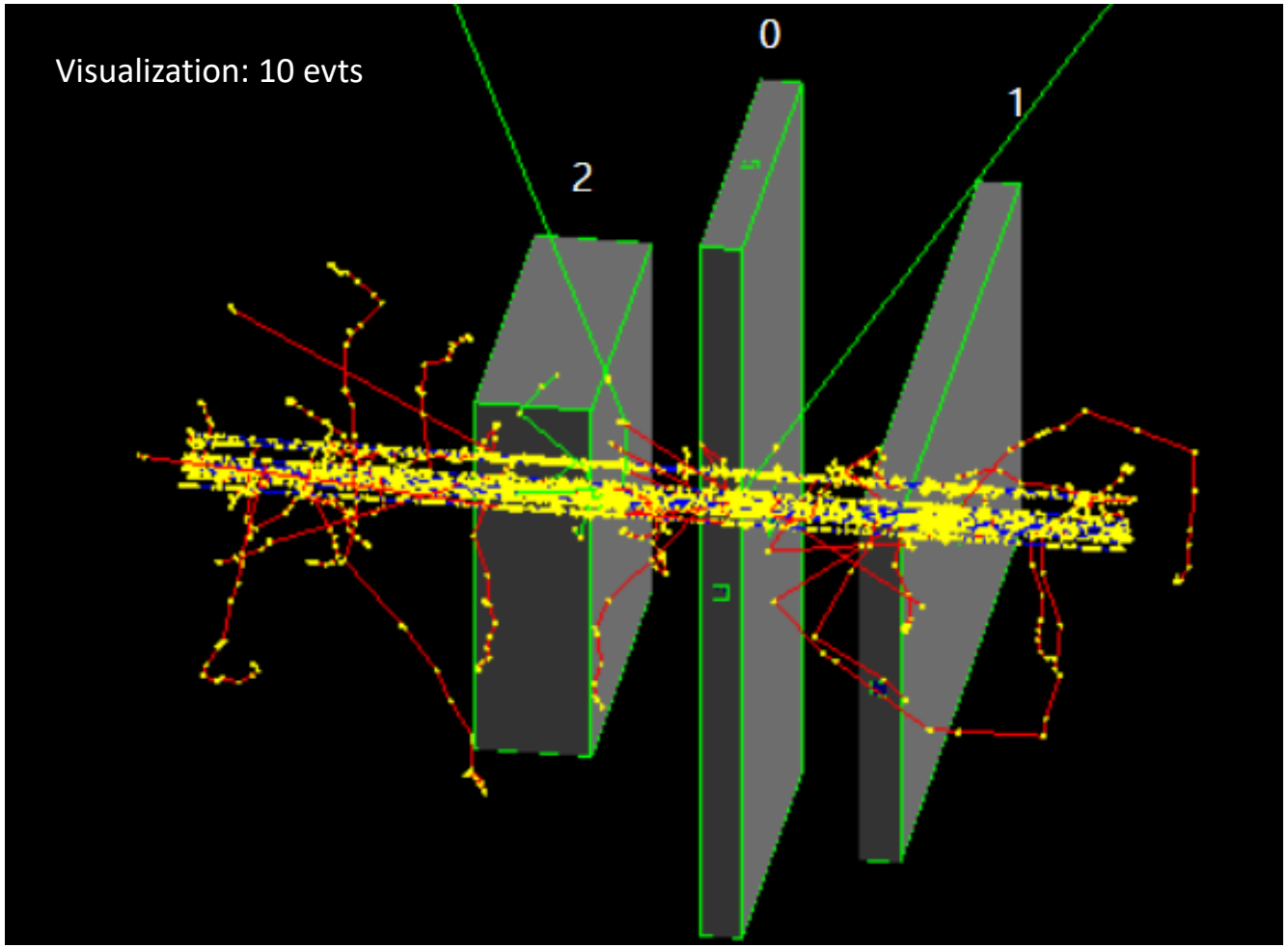
Particles_Tree Structure



* Optical processes not supported anymore ==> computational time-consuming reasons

Simple example (1)

- 10000 evts with C12 ions 400 MeV/u
- We have used the default Scintillator dataCards (example in git)
- We have changed the GPS dataCard



GPS DataCard

```
/gps/particle ion
/gps/ion 6 12              # Carbon Ions
/gps/pos/type Beam
/gps/pos/centre 0 0 10 cm
/gps/pos/radius 5 mm
/gps/pos/sigma_r 5 mm
/gps/ang/type beam2d
/gps/ang/sigma_r 0.1 mrad
/gps/ene/type Mono
/gps/energy 4800 MeV       # 400 MeV/u
```

Simple example (2)

1. Total Energy deposited by all particles in a Scintillator (from Event_Tree)

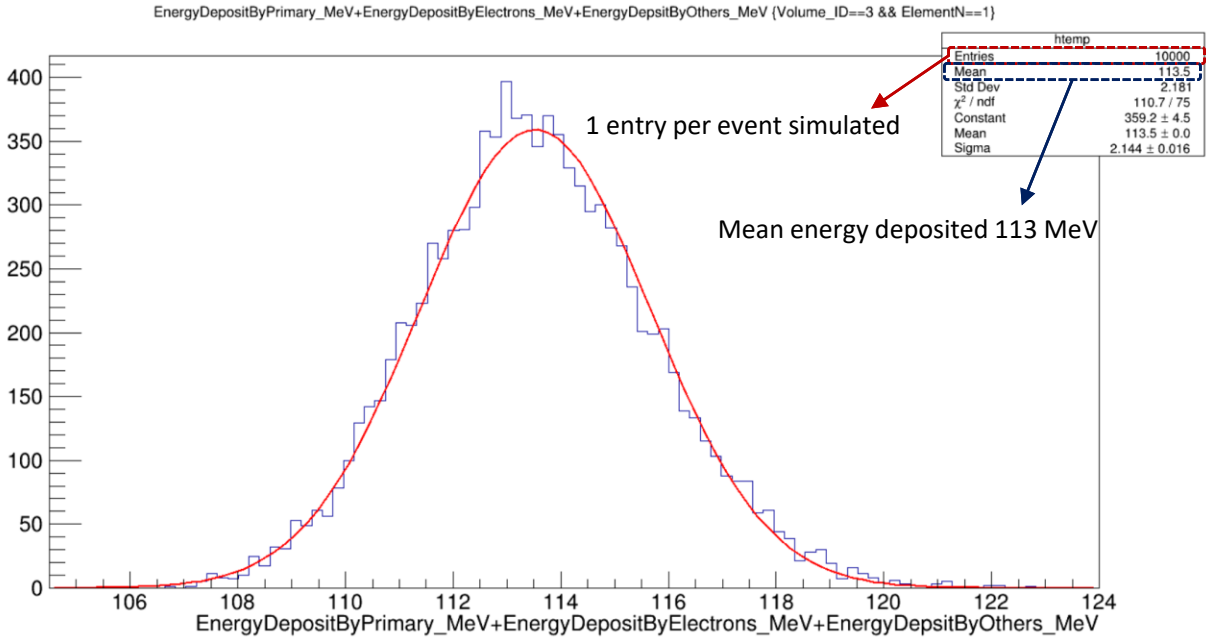
```
>> Event_Tree->Draw("EnergyDepositByPrimary_MeV+EnergyDepositByElectrons_MeV+EnergyDepositByOthers_MeV","Volume_ID==3 && ElementN==1")
```

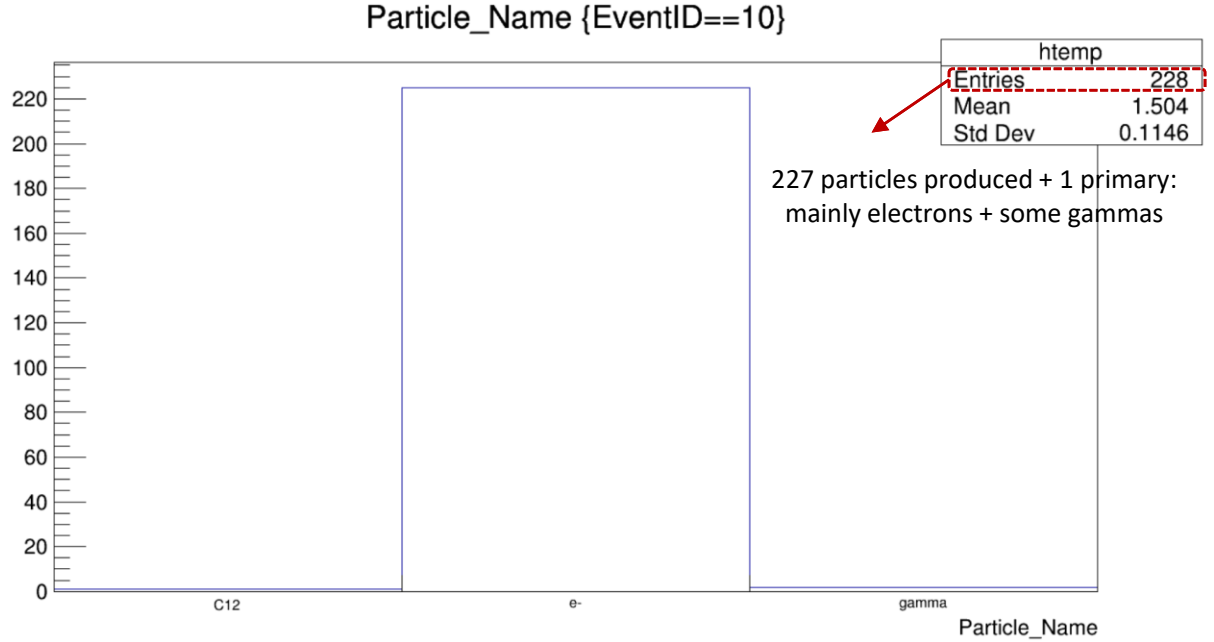
- Volume_ID == 3 indicates that we want to select a Scintillator
- ElementN == 1 indicates that we want to select Scintillator number 1

2. All particles produced during a specific event simulated (from Particles_Tree)

```
>> Particles_Tree->Draw("Particle_Name","EventID==10","")
```

- EventID == 10 select the Event number 10





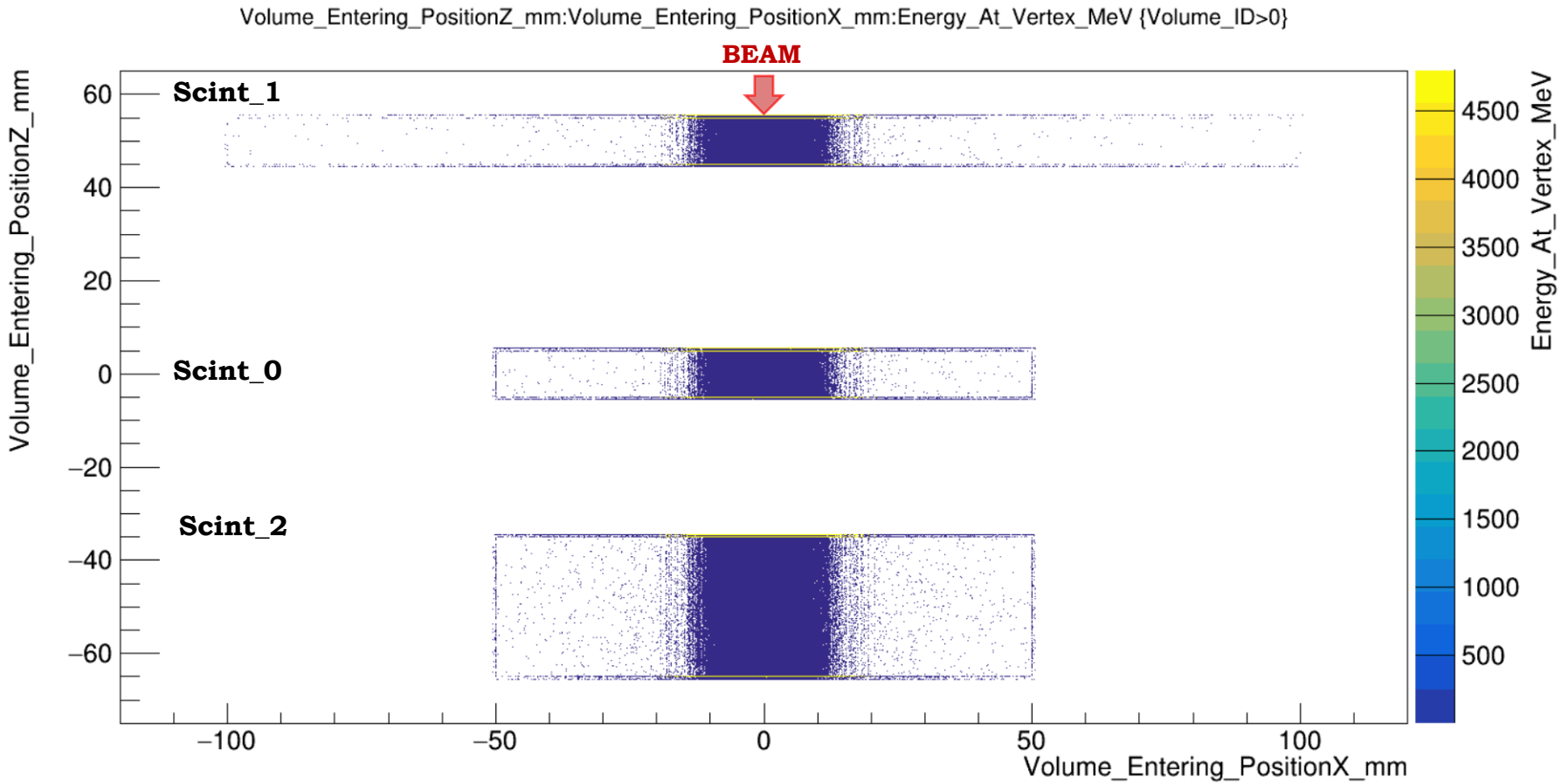
Simple example (3)

3. The entry or generation positions for all particles produced and their vertex energies:

- *This is an example of particle tracking capability from Particles_Tree*

```
>> Particles_Tree->Draw("Volume_Entering_PositionZ_mm:Volume_Entering_PositionX_mm:Energy_At_Vertex_MeV","Volume_ID>0","colz")
```

- Volume_ID > 0 indicates that we want to see only the «active volumes» (Volume_ID==0➔world)



Conclusion

- **We store the simulation results in a dynamic way using two ROOT trees in which the user can easily have access**
  - **The Event_Tree contains all the «global» information**
  - **The Particles_Tree contains all the information to track all particle produced**
  - **These information are linked by the «EventID»**
  - **These information are stored by referring to «active volumes» that can be identify by their Volume's identification IDs:**
    - ***Volume_ID identify the global element (World, Wrapping, Gap, Scintillator, SiPM)***
    - ***ElementN identify the specific scintillator (the ref. number is assigned by dataCard)***
    - ***DetectorN identify the detector number (SiPM): 0 - N-1***

We would like to maintain and improve this simulation, so all feedback and suggestion are very welcome!!