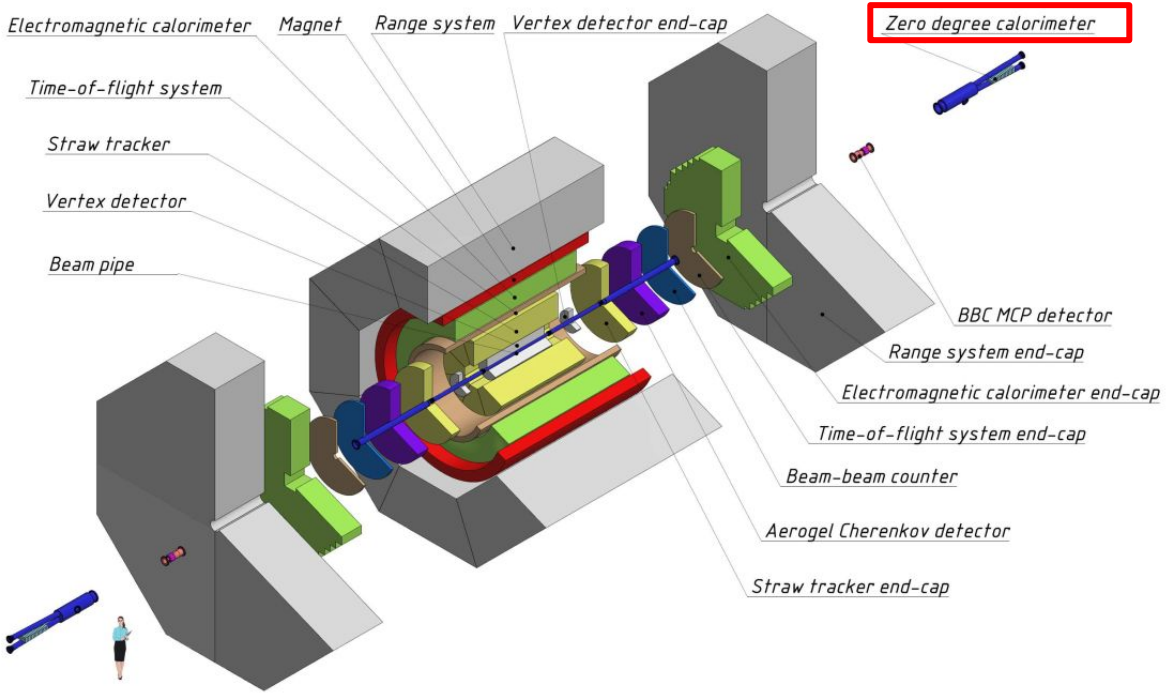
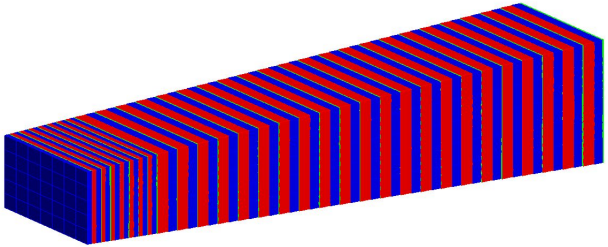
Implementation of ZDC simulation in Sampo

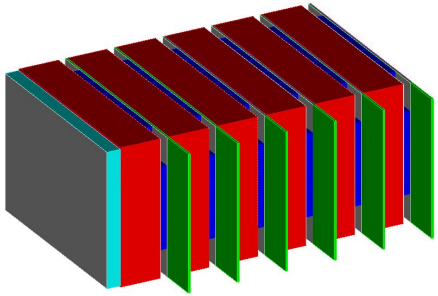
I. Zimin

Zero Degree Calorimeter (ZDC)

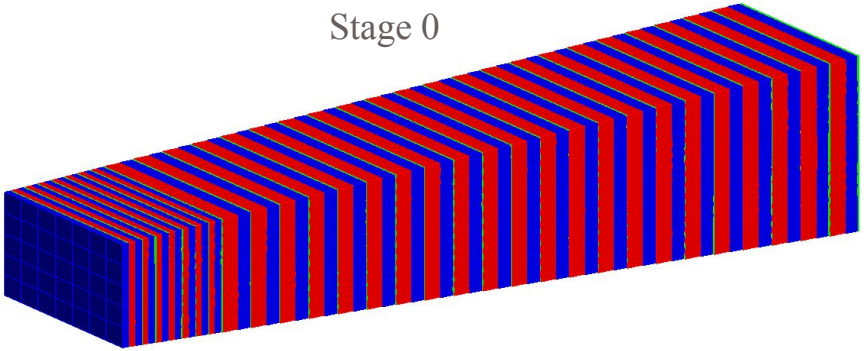








Stage 0



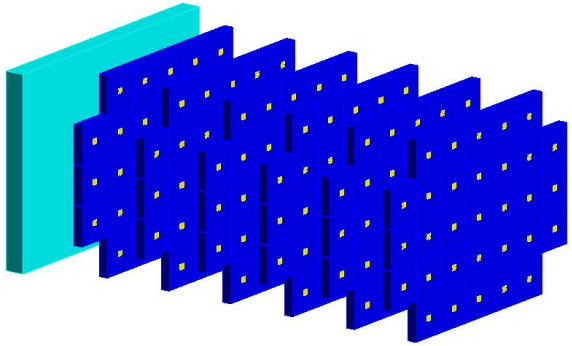
Stage 1 and 2

The model was developed J. F. Grillo

ID Encoder and ID Decoder

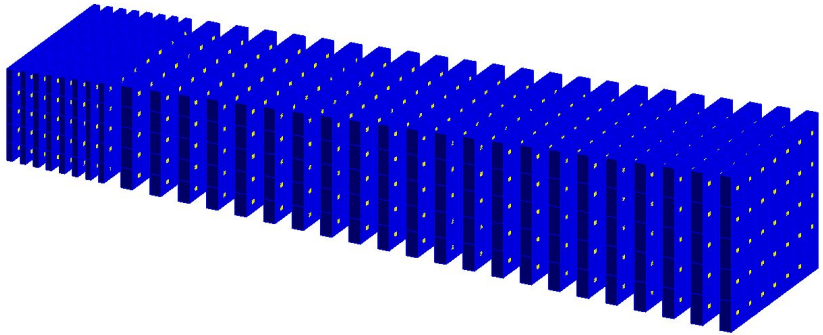
ID (Stage 0):

- SubSystem ID (18 or 19)
- Layer ID (0..6)
  - Veto (0)
  - Layer (1..6)
- X tile ID (0..4)
- Y tile ID (0..6)



ID (Stage 1 and 2):

- SubSystem ID (18 or 19)
- Layer ID (0..30)
  - Veto (0)
  - ECal (1..7)
  - HCal (8..29)
- X tile ID (0..4)
- Y tile ID (0..6)



Our goal was to create one id for each sensitive volume!

ZDC in Sampo

Generators

Geant4

ZDCMCSteps

ZDCMCHitMakerAlg

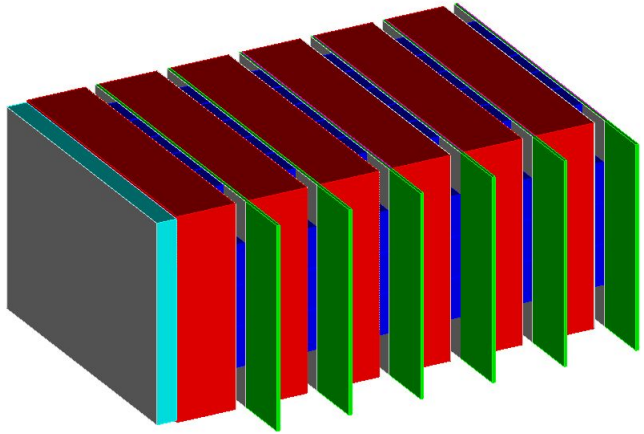
ZDCMCHits

ZDCDigiMakerAlg

ZDCDigis

Simulation

Generator of the parametrization function (standalone MC model of ZDC)



Now we are here!

Reconstruction

ZDCRecoHitMakerAlg

ZDCRecoHits

ZDCClusterMakerAlg

ZDCClusters

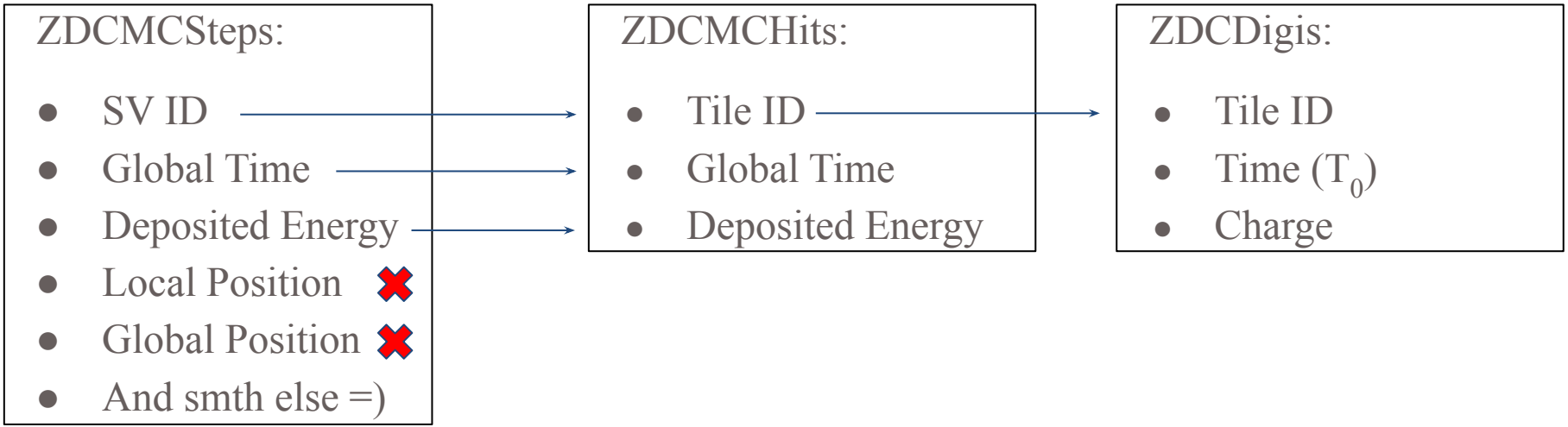
Analysis

Simulation

Geant4

The **ZDCMCHit** represents all the preparation that can be done for digitization without any knowledge of electronics parameters.

The **ZDCDigi** is the simulated response of the ZDC electronics.

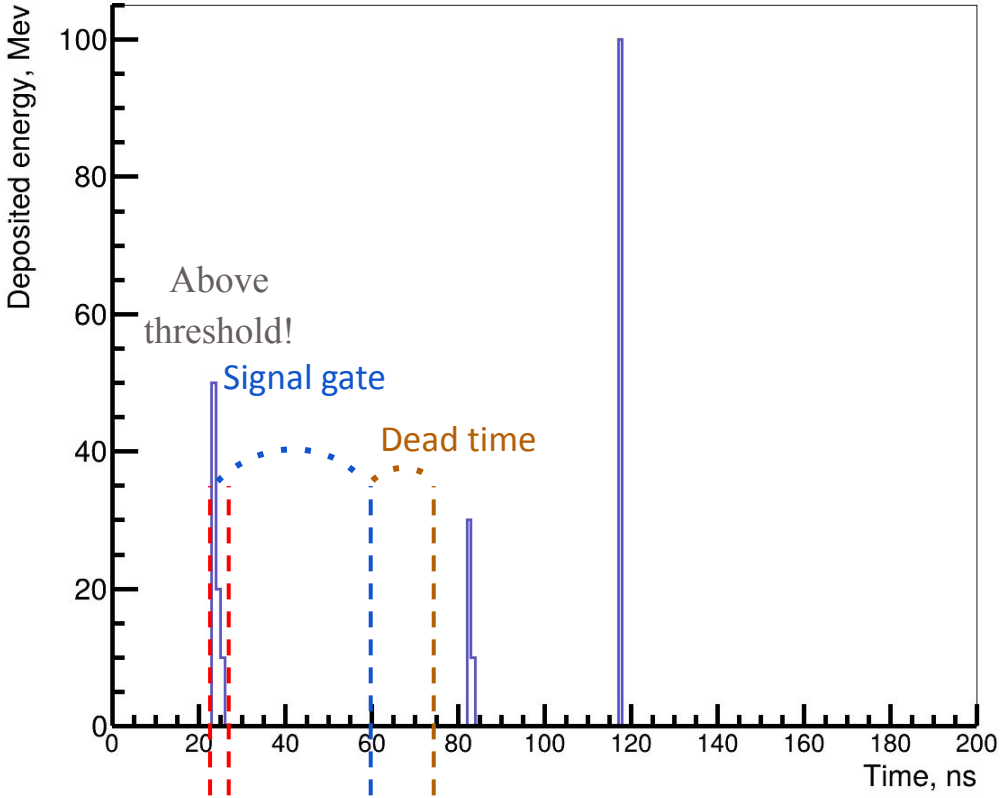


ZDCDigis: Hit sorter

Hit sorter:

1) Sort hits by tile ID.
2) For each individual tile, it finds and sorts all associated signals by their time:
   a) For each tile, a histogram is filled with all its hits, weighted by their deposited energy (see Picture).
   b) A window (3 ns) is moving to the right while energy within it reach the threshold.
   c) Perform digitization within the signal gate.
   d) The window “jumps” to the right Signal gate + Dead time.
   e) Keep going.

These are random numbers in the picture, not real data! Just for an example!



ZDCDigis: Digitization

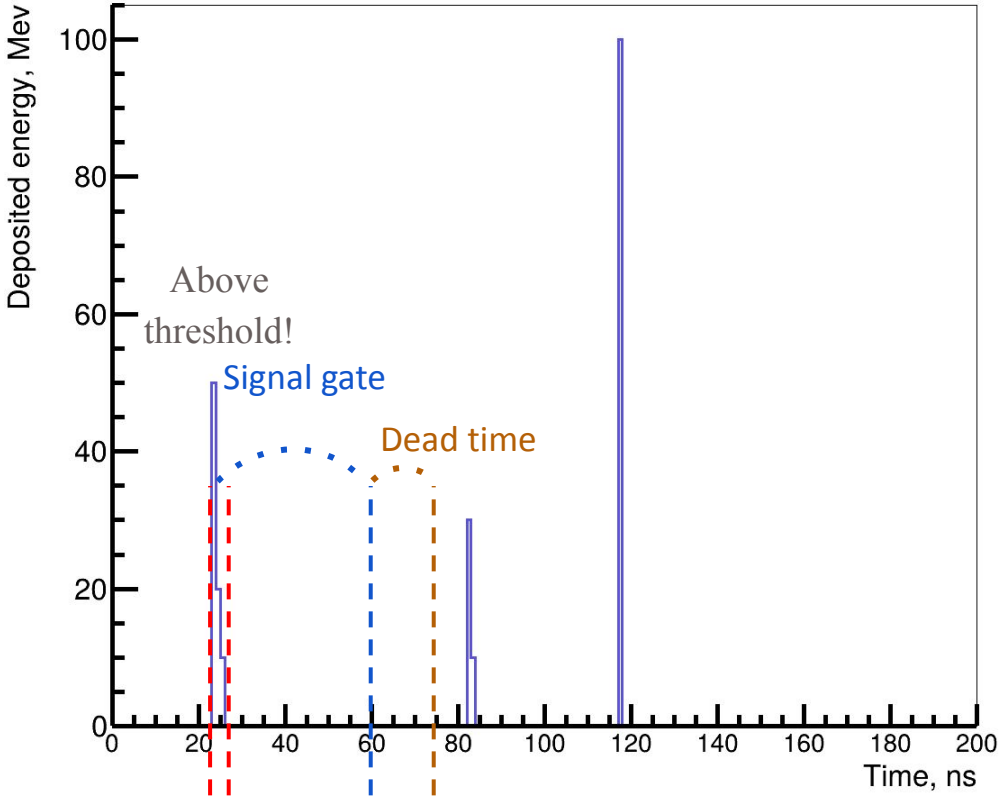
Digitization:

1) Set gate for charge integration and dead time for signals.
2) Perform a convolution of the hits in each tile with a parametrization function.

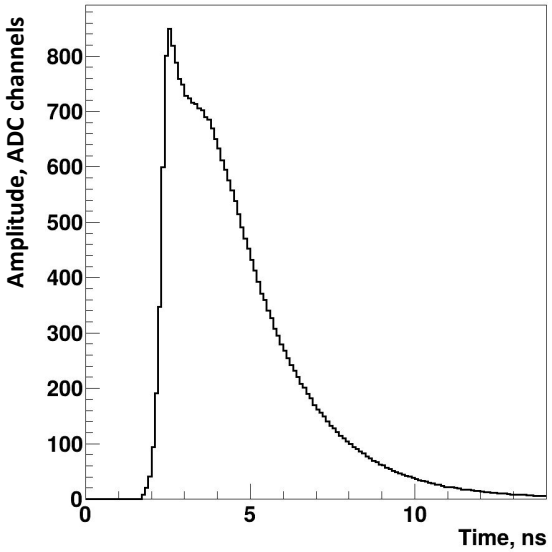
The parametrization function of the tile is a response of the detector when a particle deposits 1 MeV in this tile.

Where does the parametrization function come from?

It comes from a standalone Monte Carlo Model of the ZDC.



Convolution

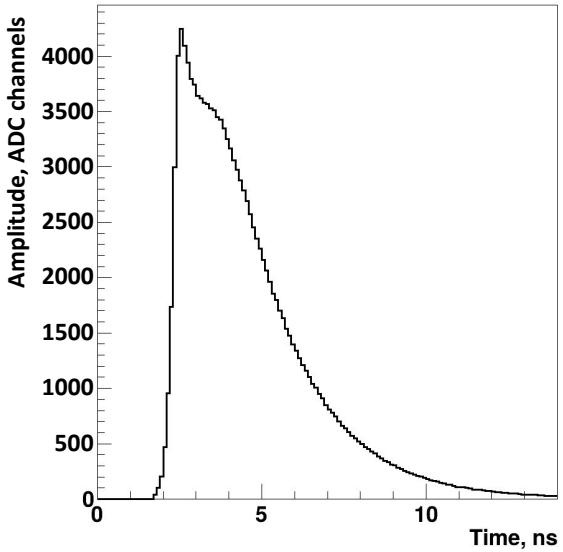


The parametrization function for the tile (the response of the detector for the i-tile)

×

Deposited energy in the tile

=



Result pulse for the tile

These are not real signals — just an example.

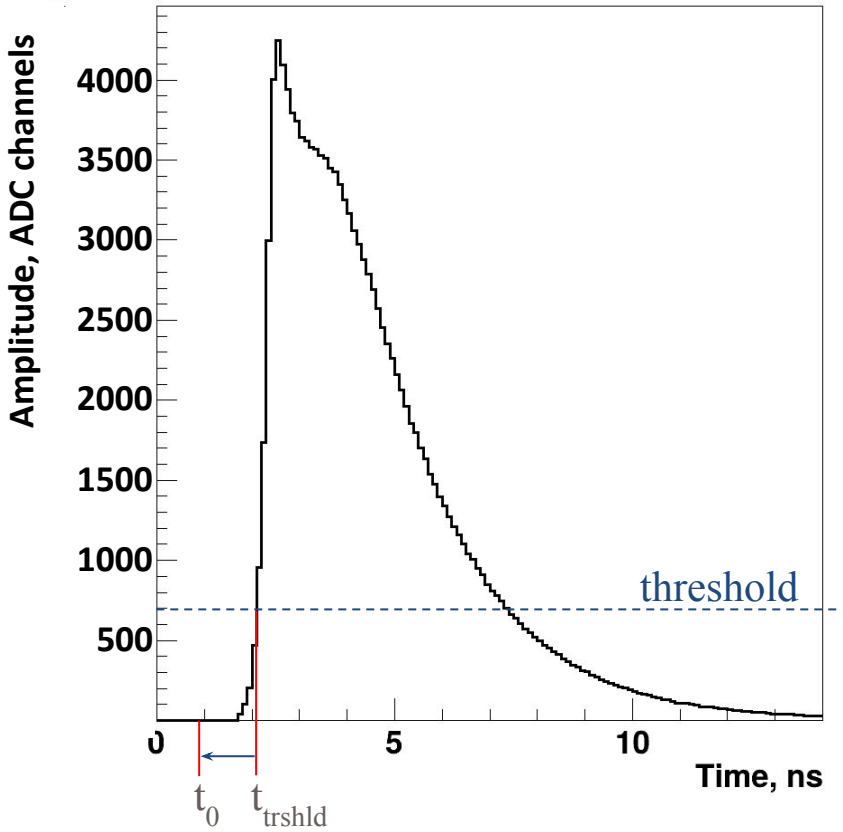
ZDCHit to ZDCDigi

Time and charge:

1) Find t_{trshld} by threshold.
2) $t_0 = t_{trshld} - t_{prestep}$
3) Charge is integral in the signal gate

ZDCDigis:

- Tile ID
- Time (T_0)
- Charge



Reconstruction

ZDC in Sampo

Generators

Geant4

ZDCMCSteps

ZDCMCHitMakerAlg

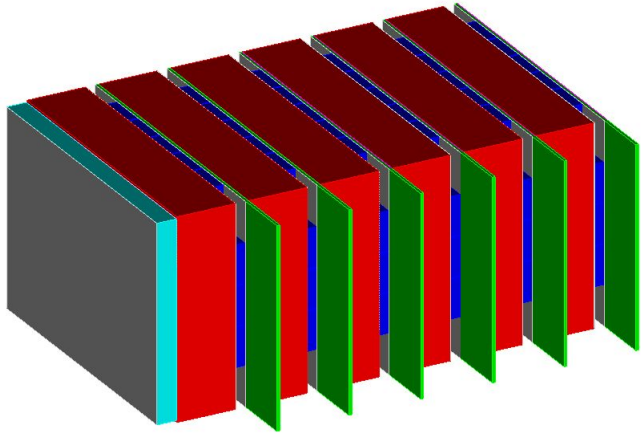
ZDCMCHits

ZDCDigiMakerAlg

ZDCDigis

Simulation

Generator of the parametrization function (standalone MC model of ZDC)



Now we are here!

Reconstruction

ZDCRecoHitMakerAlg

ZDCRecoHits

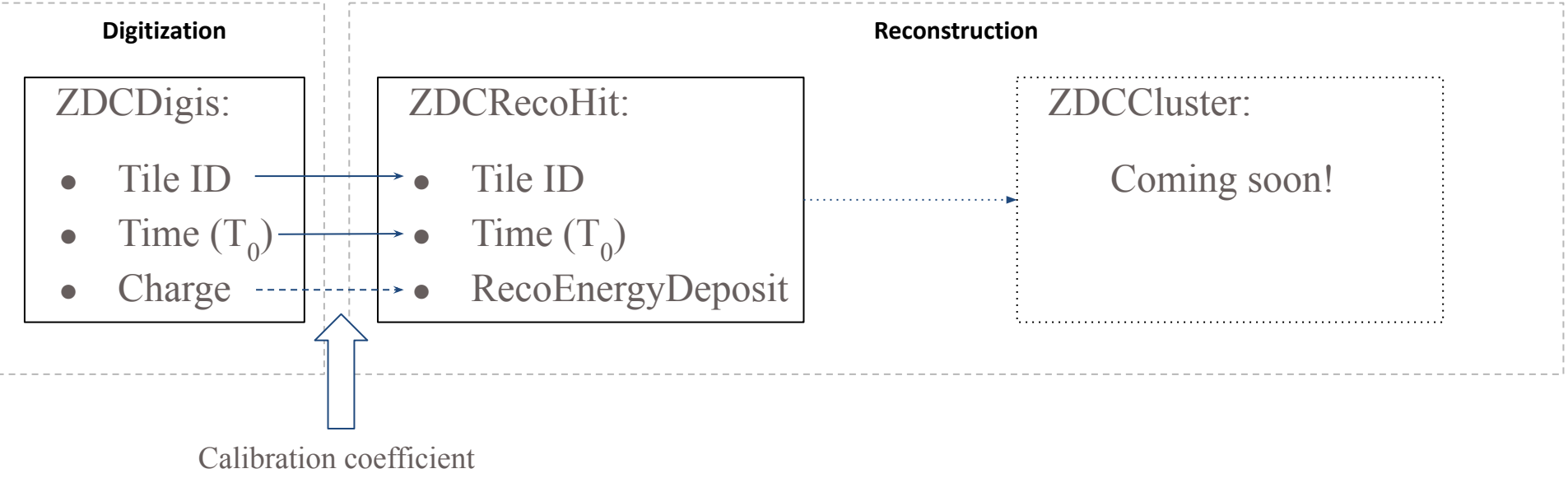
ZDCClusterMakerAlg

ZDCClusters

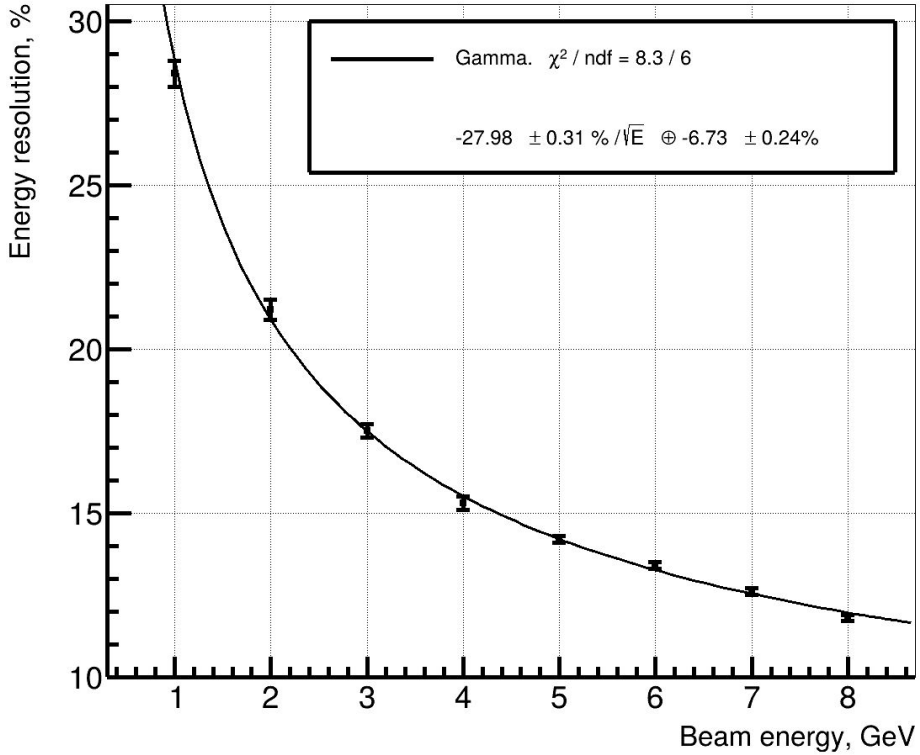
Analysis

ZDCDigis to ZDCRecoHit

The **ZDCRecoHit** represents the reconstructed energy deposited in the tile.



First simulation results from Sampo for ZDC



ZDC energy resolution for photons (obtained using Sampo)

Conclusions:

- Geometry in SDPGeoModel has been restructured.
- The ID Encoder and ID Decoder have been developed.
- The algorithm ZDCMCHitsMaker has been developed.
- The algorithm ZDCDigiMaker has been developed.
- The algorithm ZDCRecoHitsMaker has been developed.

Plans:

- The development of ZDCClusterMaker algorithm.
- The development of standalone model.

Thank you for your attention!

