Update on MAPS digitisation

- Description of the code
- Effect of the epitaxial layer thickness on the energy resolution vs threshold
- Comparison with Geant4 information vs threshold

Description of the code

- Ready to be released ! Where ?? Calice CVS rep ??
- Globally divided into 3 Marlin processors : OrganiseCells, CreateSignalMAPS, and AddNoiseToSignal.
- The input must be a Mokka LCIO file generated with a cell size of 5*5 μm^2, in order to have the granularity needed for charge spread studies. The code would be working with other cell sizes, but the charge spread has no meaning then.
- The outputs are :
  - an LCIO files containing several LCGenericObjects collections in addition to the initial SimCalorimeterHits collection(s) created by Mokka.
  - And several ROOT files with control histograms. They can be disabled with the steering parameter SaveHistograms 0.
- The package must be compiled and run inside Marlin/package/ repository.

Description of the output LCIO collections

- OrganiseCells : LCGenericObjects equivalent to SimCalorimeterHit information + neighbours information. The interface is done thanks to the MySimHit class, which inherit from SimCalorimeterHit.
- CreateSignalMAPS :
  - Option DoChargeSpread 1 : apply charge spread. Valid only if the cell size of SimCalHits is 5*5 μm^2. Need the appropriate file from Giulio copied in include/ , and name given as a steering parameter. This file is then converted into the appropriate figures thanks to the class Readfile.
  - Else : will just convert the Geant4 energy into the appropriate LCGenericObject collection

  The output collections contain : 3 integers and a float per hit resulting from the previous option, which are resp. : KSM, I, J, energy.

Adding the noise

- AddNoiseToSignal : 2 options
  - Option CreateNoiseOnlyHits = 1 : noise only hits are added per module (= unique KSM indice). ~ 8000-16000 hits (depending on the exact dimensions of a module) , but in term of an electromagnetic shower (= tower ~ 1-2cm) Ł ~30 hits, compared to ~2,000 @ 10 GeV and 38,000 @ 200 GeV.
  - Without : LESS time consuming Ł chosen up to now.
  - Initial seed number : should be given by Mokka to be unique per file studied. Is currently given by the linux time (steering parameter InitialSeed= 0).

A bit more details about a few classes used

- CellIDDecoder : is used in all programs to convert the CellIDs into the K, S, M, I and J indices. Is also used for ex. to check if 2 hits are in the same module.
- MySimHit : inherits from SimCalorimeterHit. Methods like addSimCalorimeterHitContribution(), and addClosestNeighbour() are used to keep track of the initial geant4 hits and of the neighbouring cells inside a module.
- RandomCellSelector : to create the noise only hits, but also used to initialise parameters like Imax, Jmax, total number of cells. Interfaced with GEAR (but currently take its parameter from a file called tempGEARvariables).
- Array2D (in array/ directory) and ReadFile : to convert Giulio's output file in the valid format to apply to calorimeter hits. Will be valid until Giulio decide to change its output file !

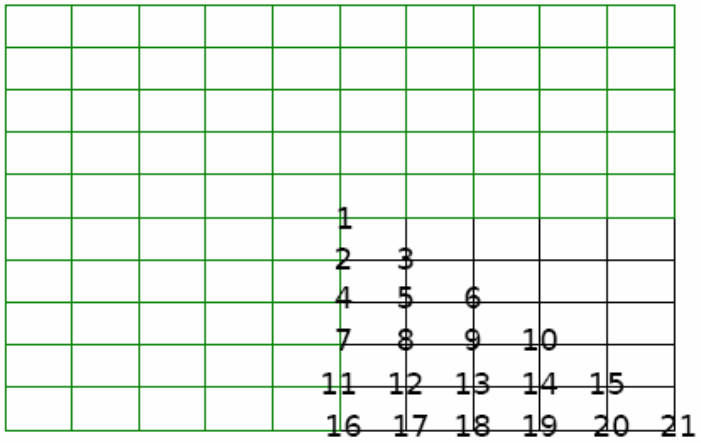
CPU time consumption

Total N_hits for 200 GeV electrons : ~38000.
10 GeV : ~2000 hits.

Marlin Processor	CPU time per 200 GeV electron event	Added CPU time
OrganiseCells	4.5 s	5.5 s
CreateSignalMAPS	With charge spread : 2.3 s Without : 0.8 s	
AddNoiseToSignal	With noise only hits : 1.6 s Without : 1.3 s	
CountCluster	11.5 s	

In terms of Charge spread

Currently :

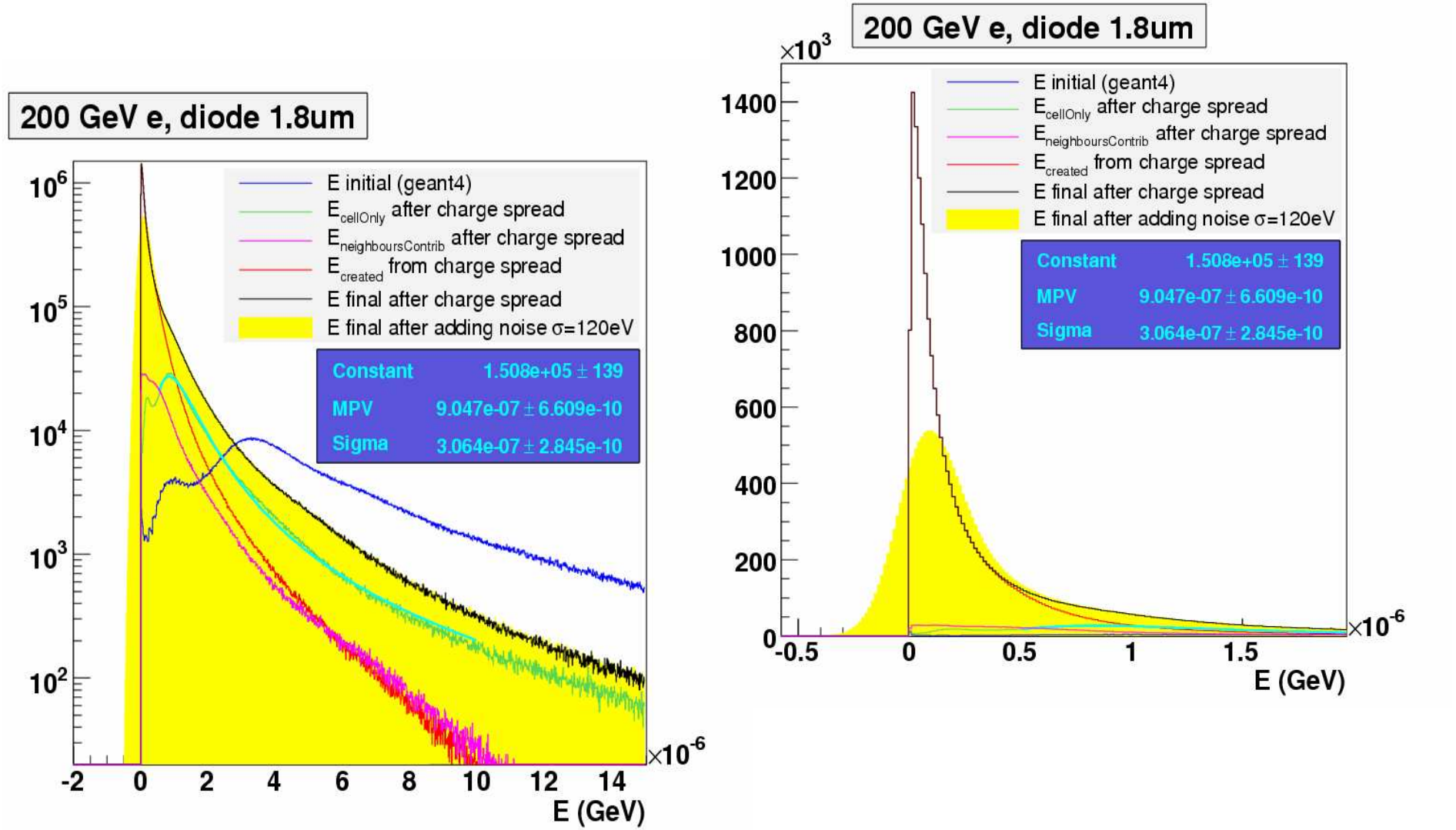


To be in agreement with geant4 hits:

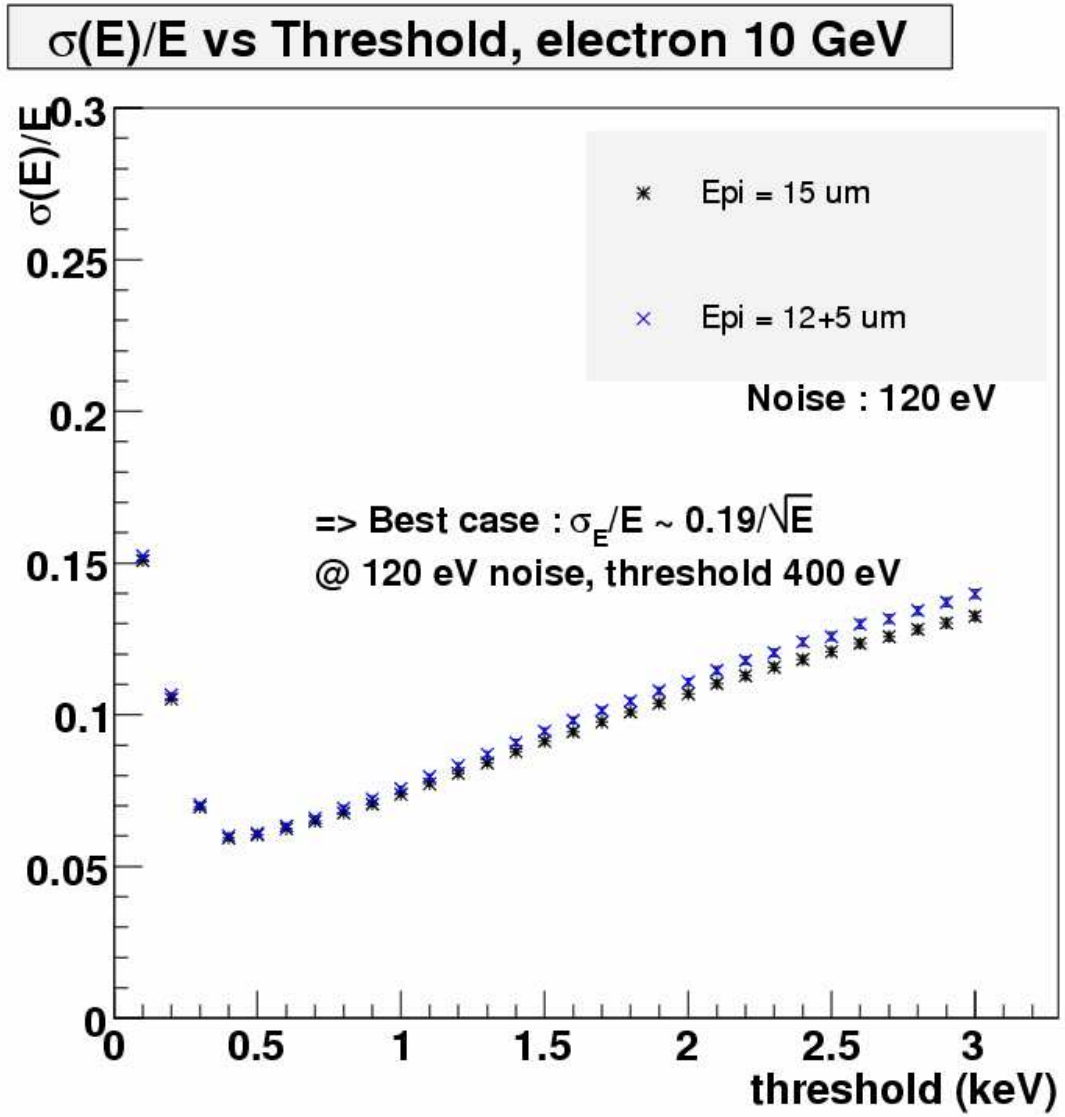
1				
2	3			
4	5	6		
7	8	9	10	
11	12	13	14	15

- Conversion by calculating the mean value of the 4 surrounding points per cell.
- Quite a lot of variations when it should be symmetrical. Is it possible to have an idea of the errors involved in those measurements ?

Results still coherent with previous one : great....



Epitaxial layer thickness



- In Giulio's simulation : 12 μm + 4-5 μm of the bulk trapped in the epi layer so potentially collected.
- In current geant4 simulation : 15 μm.
- Should be ~17 μm if we want to be coherent.
- Influence the normalisation for charge spread : 80 e/μm created, and collected for the last 17 μm = 1360 e. Would be 1200 for 15 μm.

Comparison with “truth” information

Results are better than previously : influence of the new charge spread definition ?