Status of MC reconstruction

Anne-Marie Magnan

Imperial College London

MC Reconstruction Chain

Noise implementation

MC reconstruction software

Mokka LCIO file → **RunInformation Processor**

run number,
run and evt timestamp,
location,
isMC flag,
Energy,
angle should be added

Should run number be pre-filled ??
Crucial to avoid one steering file per run….

ConditionProcessor :
needed for database access to calibration constants and module location.
Noise parameters still have to be added in the database.

TBEcalDigiProcessor:
Uncalibrate hits : factor 0.147 MeV per MIP+data calibration factor, is set to 1./50 by default
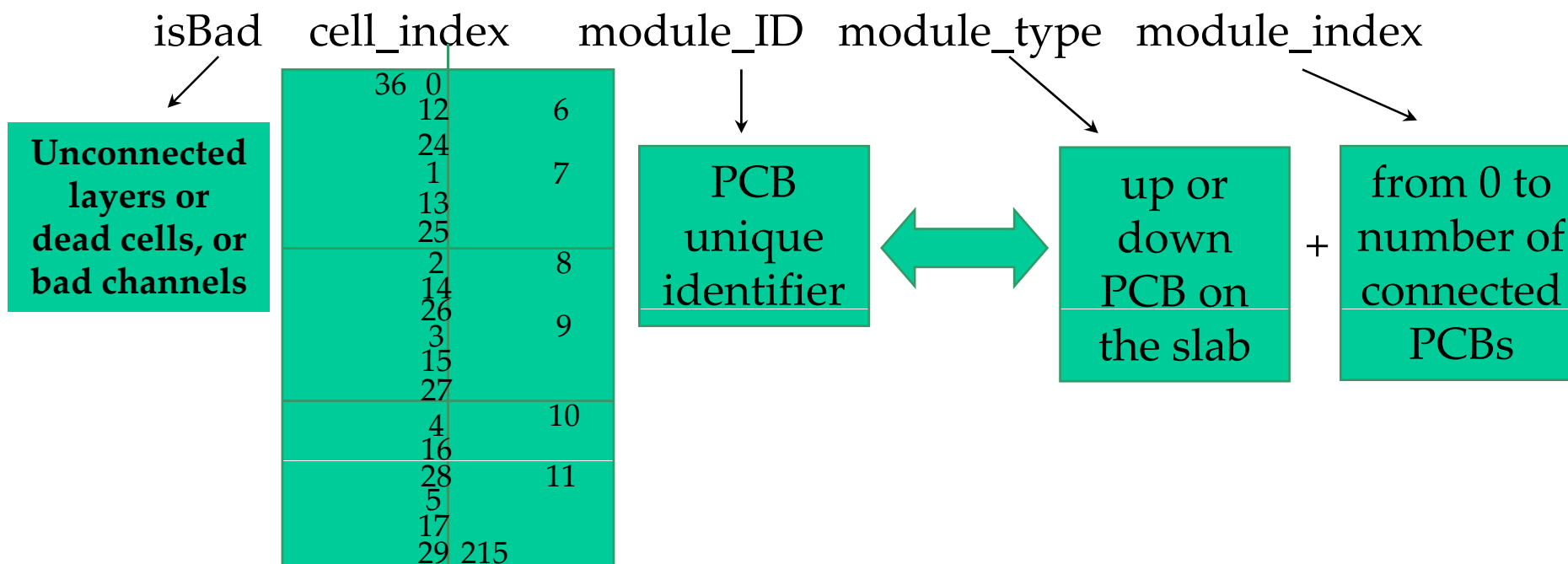
Every cell is pre-filled with a random noise value according to the database values, pedestal is randomly chosen flat between -0.5 and 0.5.

Position has to be identical between Mokka and Calice databases

CalibrateAndApplyThreshold:
step identical with the real data reco.

Output user format

- CalorimeterHit, calibrated and after 0.5MIP threshold,
- cellID1 indice is filled with "detector-like" module indices (see CellIndex class of calice_userlib) + flag to know if the cell/PCB was unconnected during the run .

1	9	15	1	6
isBad	cell_index	module_ID	module_type	module_index

Unconnected layers or dead cells, or bad channels

cell_index grid values:
36 0
12 6
24
1 7
13
25
2 8
14
26
3 9
15
27
4 10
16
28 11
5
17
29 215

PCB unique identifier ⟷ up or down PCB on the slab + from 0 to number of connected PCBs

Issue of position in the MC

- When creating noise only hits : the position has to be taken from the database.

- But: when a layer was not connected in the data, the database has currently no entry for it.

- In MC: we want to be able to extrapolate the results consistently to the whole detector.

➔ **Issue :** how to have the position mapping in MC for unconnected layers and 3rd wafer column ?

My recent understanding of the database

connected front-ends
➔ module_index
e.g. DESY : from 1 to 24

calibration constant
PCB/channel dependant

FE number ⟷ cable number ⟷ module ID ⟷ layer number
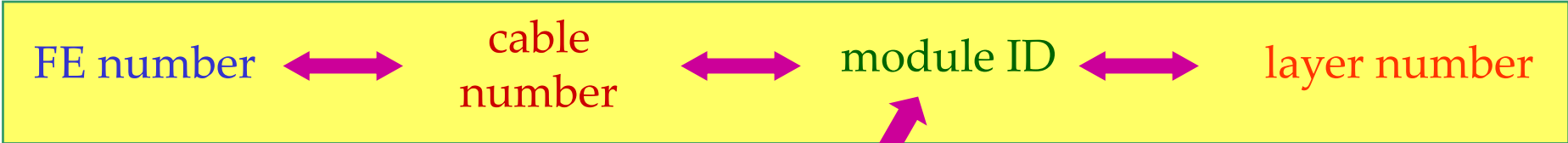
Cells can indeed be shifted locally inside a PCB : **independent of the absolute position** of the PCB in the final structure.

Position
each module has its own MySQL table with the relative position of all channels compared to an internal (0,0) : gives (x,y) position

cell_index (0 to 215) is module type dependant : formula relating chip (0 to 11) and channel (0 to 17) numbers.

Layer number will give the 3rd coordinate ➔ **The whole structure is then rotated and translated accordingly to the run parameters**

How to connect the MC

> **➔Solution for unconnected layers in the MC : create a MC specific database entry for those layers**
> **➔ but it would be better to ignore completely about module_index and other data-specific indices….**

Simple solution : replace ModuleIndexReverseLookup by
• an explicit conversion to access the module ID uniquely through the layer index (K in Mokka), in the Alignment class ??

• and the direct conversion of the other indices (S, M, I and J) into the cell_index, to access the position of each hit:
ex. type 0: $36*(I-1) + 2*(S-1) + int((J-1)/3) + 12*(J-1)\%3 + 6*(3-M)$

Cell Index class has been modified : conflict with HCAL reco !! Need to solve that ASAP….

Some additional features

- Noise ony hits are currently tagged thanks to the 31st bit of cellID0 (set explicitly to 1): will disappear when a database table is created for each layer in the MC.

- **Do you want an LCRelation class from CalorimeterHit to SimCalorimeterHit ?**

  It's currently (coming originally from digisim) an LCRelation between RawCalorimeterHit and SimCalorimeterHit, and CalorimeterHit method "getRawHit".

  Maybe a method "getSimHit" would be more useful ??

- Keeping Raw output is of course really heavy (e.g. file size 2.6 GB instead of 300 MB !!) and useless for most analysis.

- Keeping module ID is though important, for example to identify a noisy/problematic PCB independantly of the mapping.

Remaining issue : alignment

- Data-MC position not in agreement:
- e.g. 2 days ago for a particular cell:

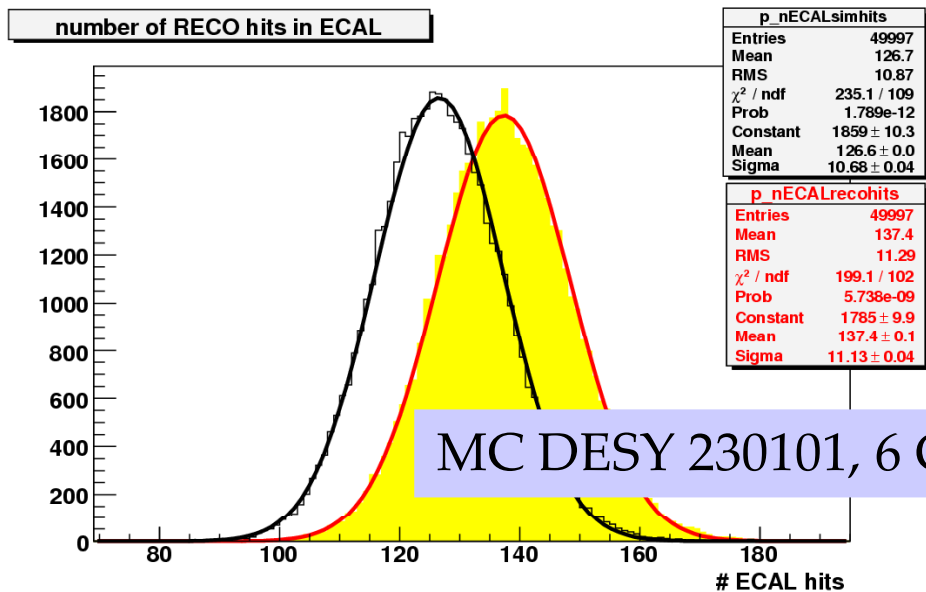|	X (mm)	Y (mm)	Z (mm)
Sim	12.85	-12.85	658.513
Reco	13.55	-26.85	657.662
shift	0.70	-14	-0.851

- BUT: **in Mokka, there is no PCB dependant position** ??

  So: should the position be exclusively defined thanks to the more accurate Calice TB database ?? Then: issue of comparing with SimCalorimeterHit position….. how important is that ??

Noise definition

- Currently defined per cell, according to the mean value calculated on signal event after pedestal corrections. Correlations are found globally negligible.

MC DESY 230101, 6 GeV

x position of hits

Alignment issue:
not only translation !!

Reconstructed Hits

Simulated Hits

➔ hits added everywhere: fine !

x (mm)
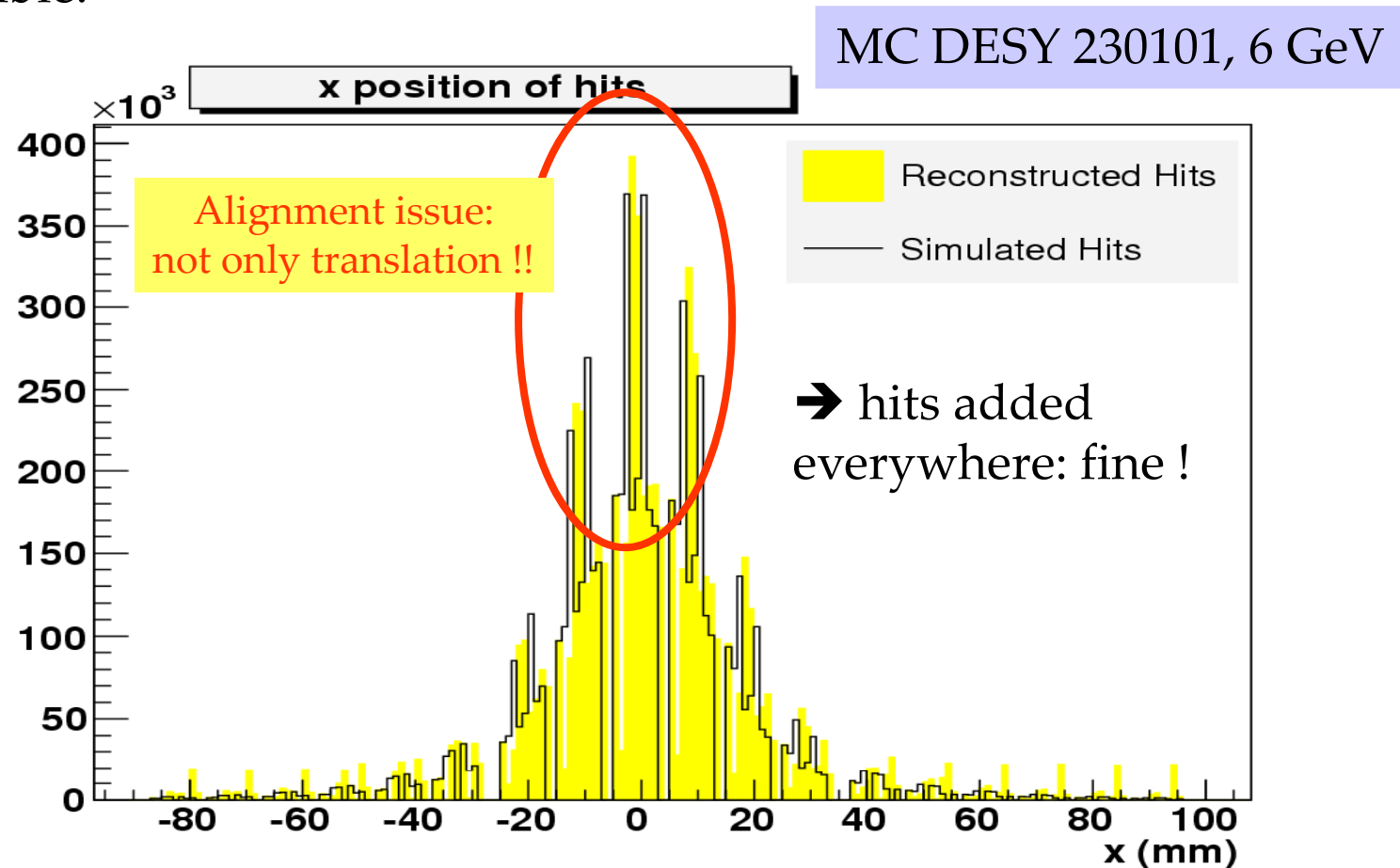
Effect of the digitisation on MC

MC DESY 230101, 6 GeV

Noisy layer reproduced…
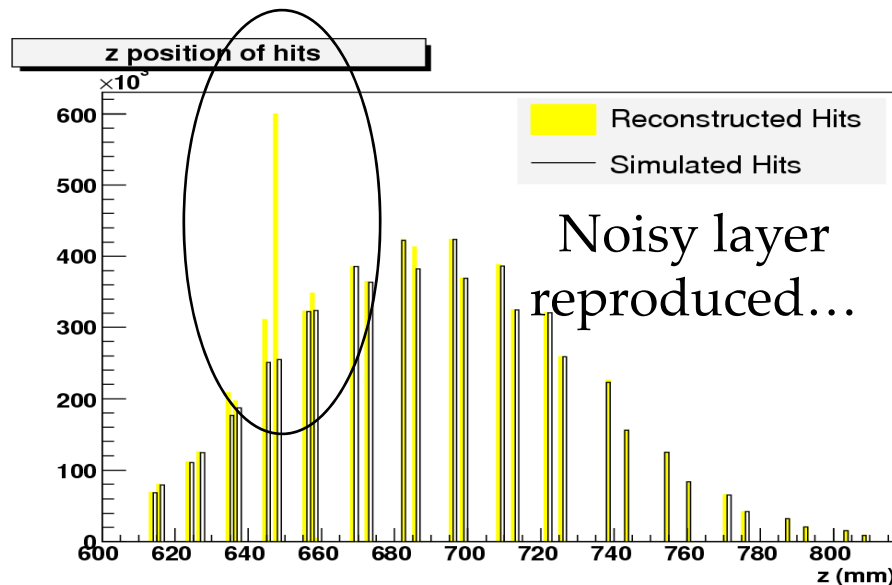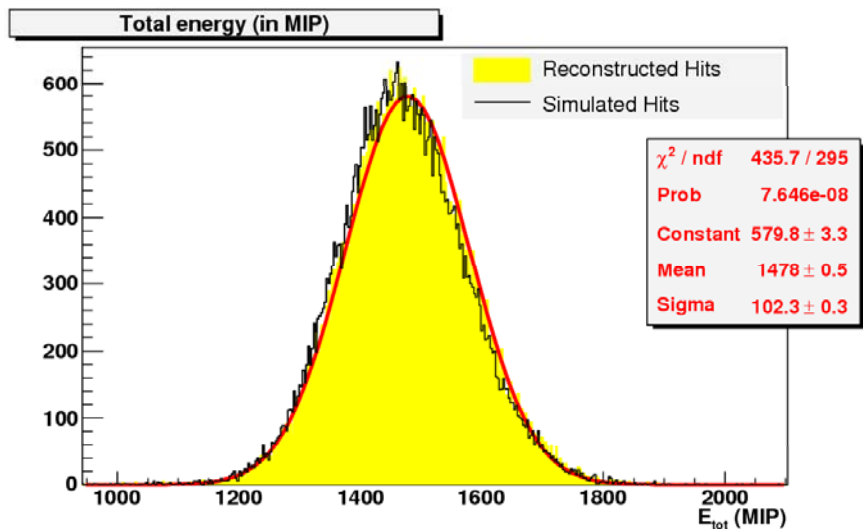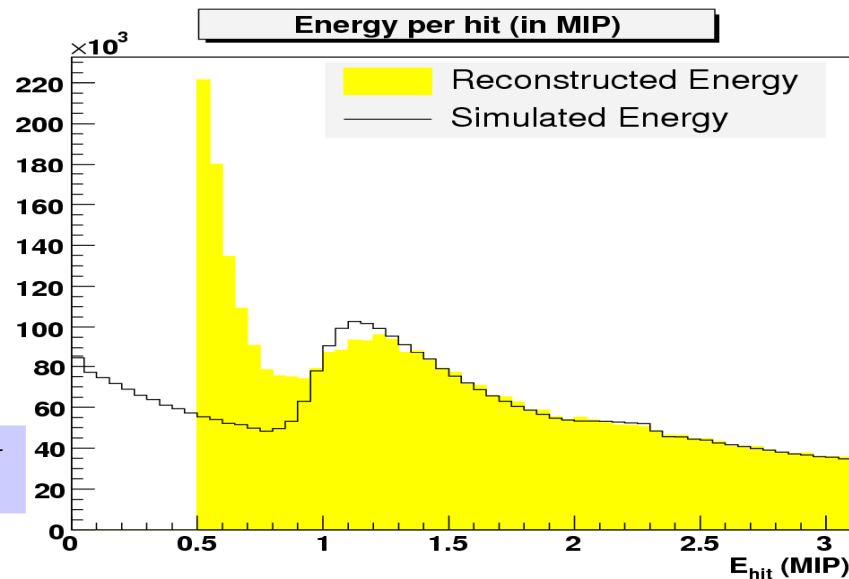
DATA/MC comparison at RawHit level

- Still a lot of discrepencies data/MC
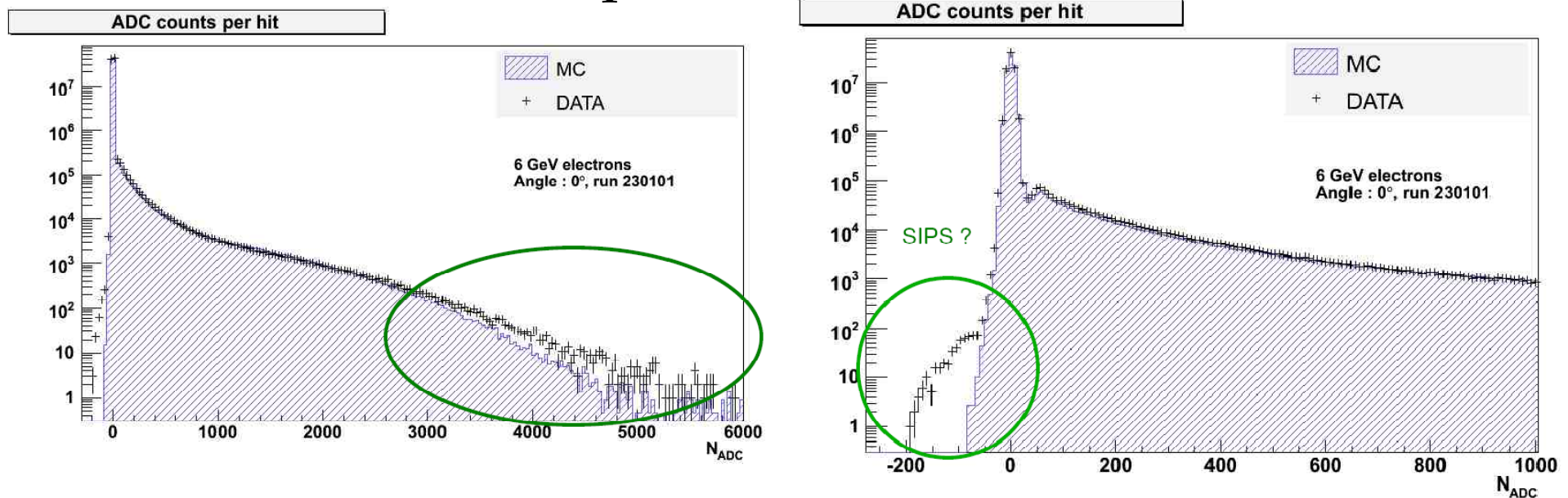
- Still to investigate at high energy : VERY large correlated noise on top of the standard one ? ➜ to study on pedestal events.
- 3 features identified : coherent noise (corrected evt by evt by global pedestal shifts), crosstalk (Signal Induced Pedestal Shift, corrected also evt by evt), and some intrinsically correlated channels…. should we refine the MC model thanks to that ? Not a huge effect expected though !!

Correlation factor between two channels per wafer
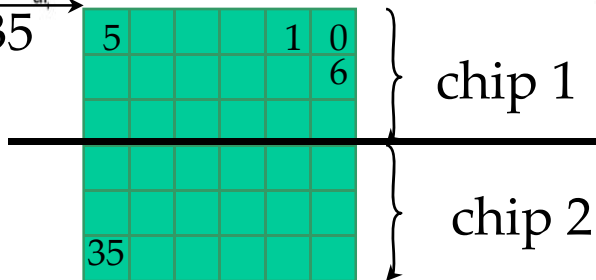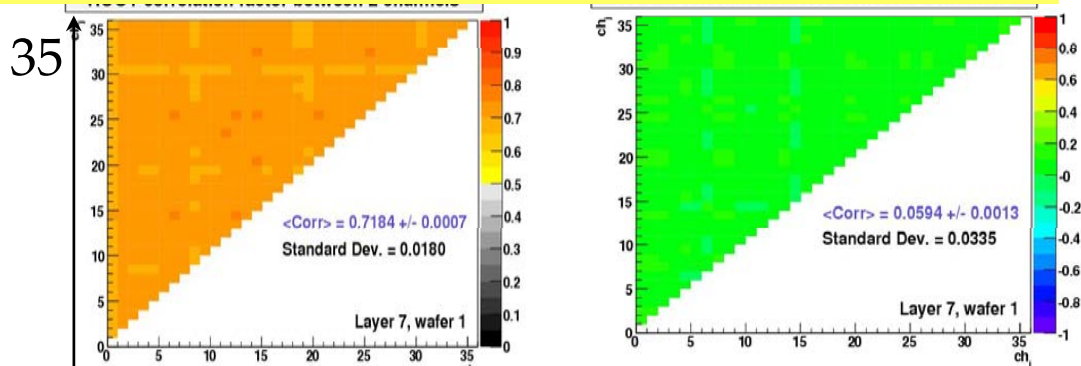
chip 1

chip 2

chip 1   chip 2
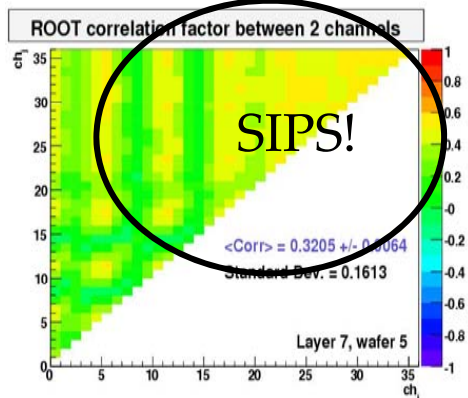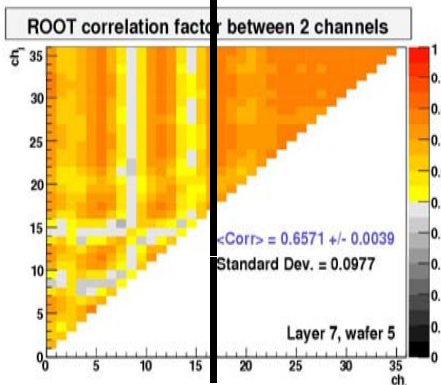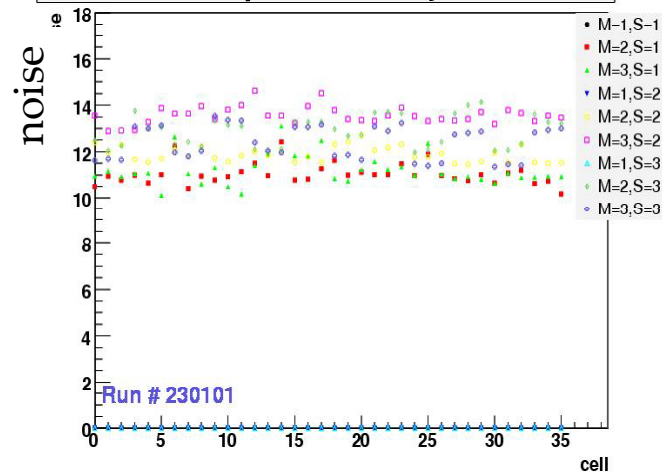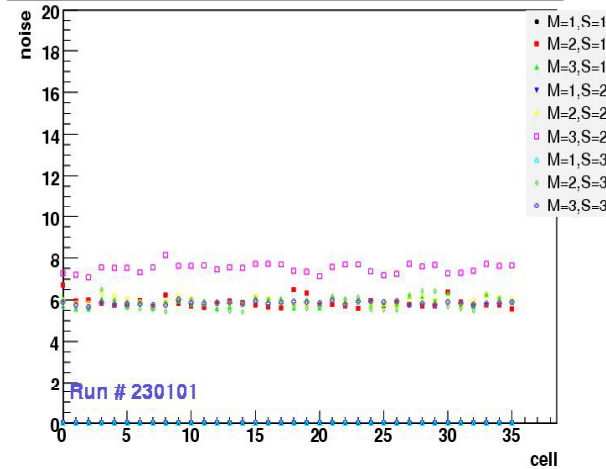
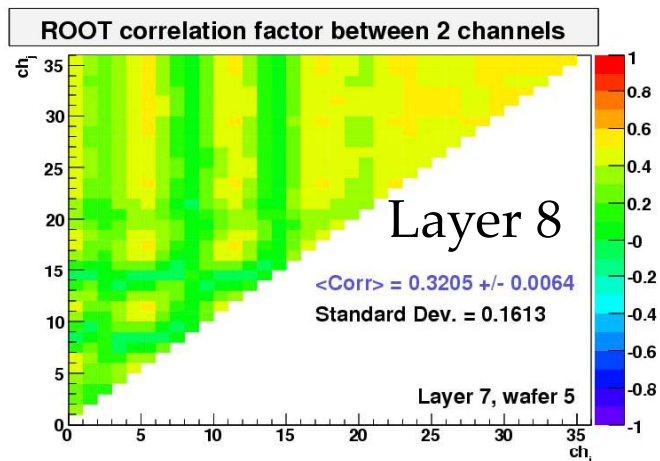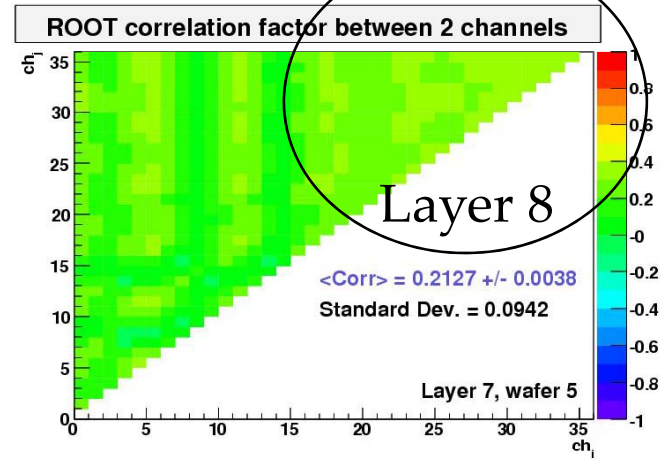SIPS!

Effect of SIPS Corrections
Example layer 8 and 9 DATA @ DESY (PCB #5_C, 11_C)
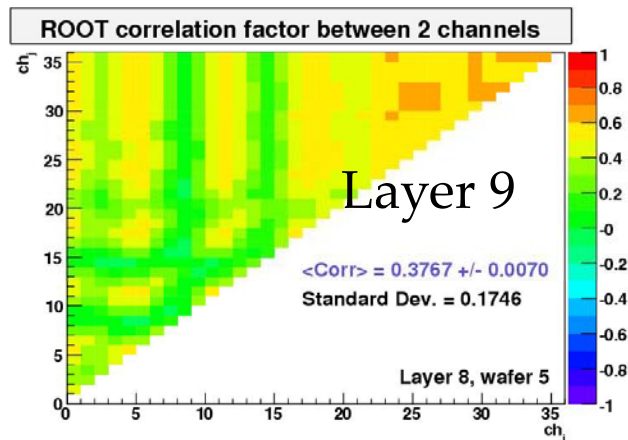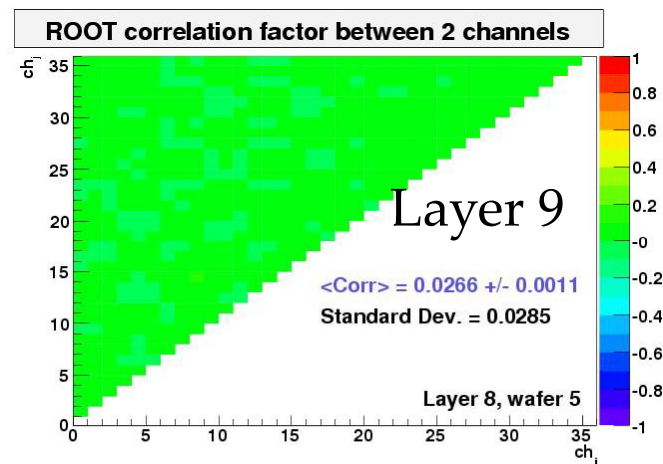

Before SIPS

Remaining correlation
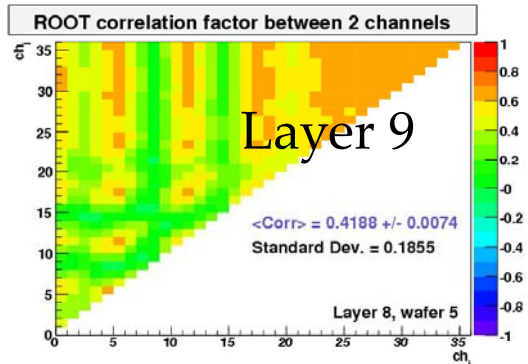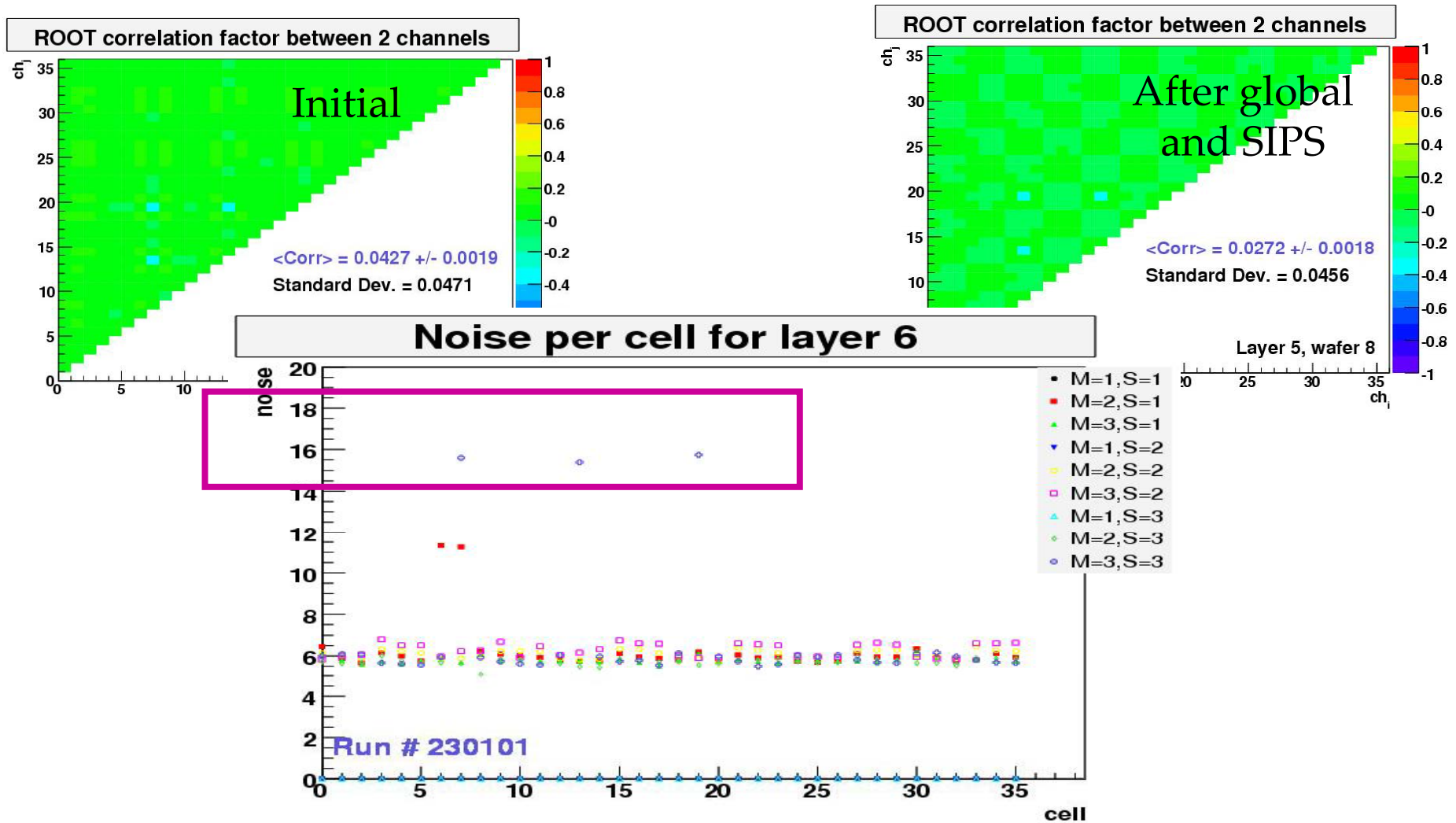
After SIPS

Initial

After global
Before SIPS

After SIPS

Intrinsically (anti)correlated cells

Refinement : take into account the correlation in the MC

Conclusion

- MC reco: most of the structure for the ECAL is now there

- still some features to decide, correct and implement

- more noise studies needed:
  - remaining effect of SIPS corrections, when SIPS on top of global pedestal drift ???
  - Very large noise on top of standard one explaining the high energy tail?

- Understanding of the disagreement data/MC at low energy : noise implementation and SIPS corrections don't seem to make any difference after the threshold cut. Superposition of a lot of small effects, e.g. few % of correlated channels, or remaining SIPS effects ? Or completely different issue ?

Thank you for your attention