Hadronic interactions in the SiW ECAL (with the 2008 data)

Status of the analysis

SiW ECAL meeting - DESY

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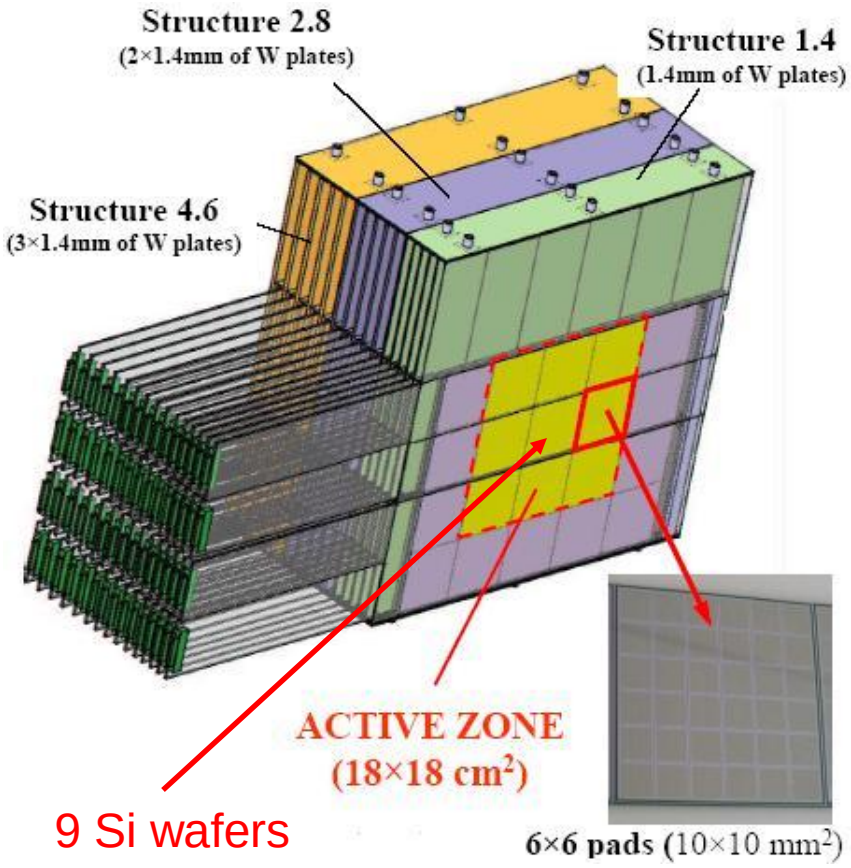
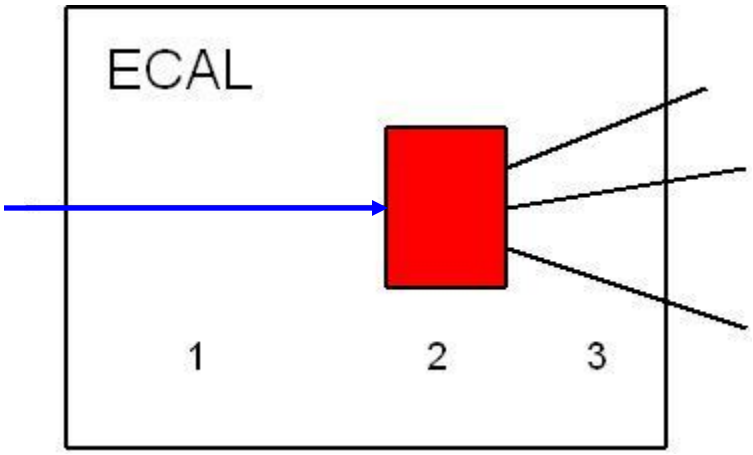
Introduction

- 2008 FNAL data used
  - Pions of 2, 4, 6, 8 and 10 GeV
  - Cuts on scintillator and Cherekov counters
- The SiW ECAL
  - ~1λ_I: more than half of the hadrons interact
  - 1x1 cm² pixels: tracking possibilities
  - 30 layers with 3 different W depths



Procedure



1. Follow the primary track
2. Find the interaction layer
3. Distinguish the types of interactions

Many results already shown at previous meetings

Ongoing work

- Calice Analysis Note submitted to the Editorial Board (~ 2 months ago)
- Many questions about stability and systematic effects of the algorithm
- Answers ready : prove the robustness of the procedure

Event selection : muon rejection

- Muons were rejected using the number of hits in each detector :

$N_{ECAL} < 50$ & $30 < N_{HCAL} < 70$ & $10 < N_{TCMT} < 35$

2 GeV ?...

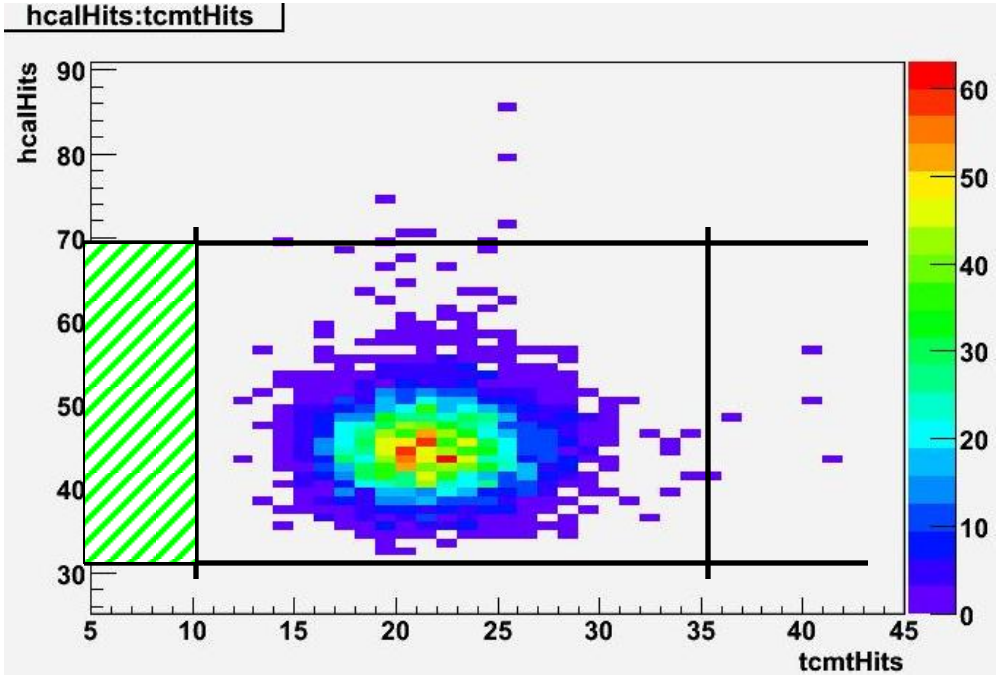
→ Estimate muon contamination

→Estimate what fraction of pions is rejected

- Remark : the distance between target and ECAL is ~ 60 m in the simulation while ~ 160 m in the MTBF

Muon rejection

- At 10 GeV :
  - 0.6% muon contamination
  - 0% pion rejection
- At 2 GeV :
  - 4.6% muon contamination
    → 0.5% / 0.6%
  - 0% pion rejection
    → 13% / 7%



$N_{TCMT} > 0 / 5$

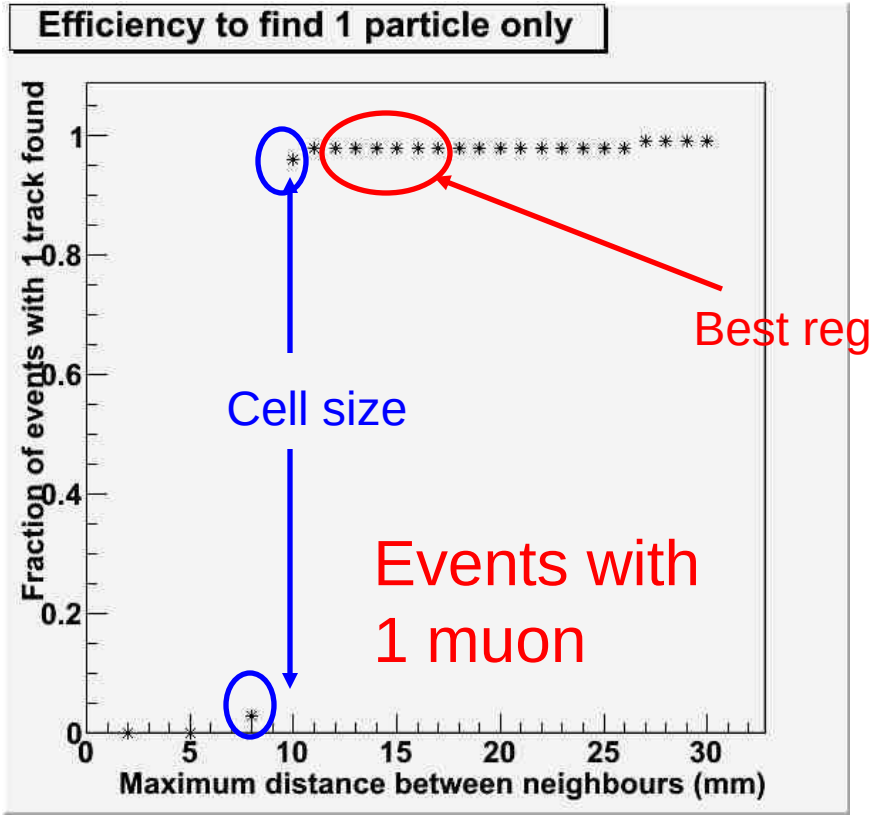
Muons at 10 GeV

Number of hits in HCAL vs TCMT

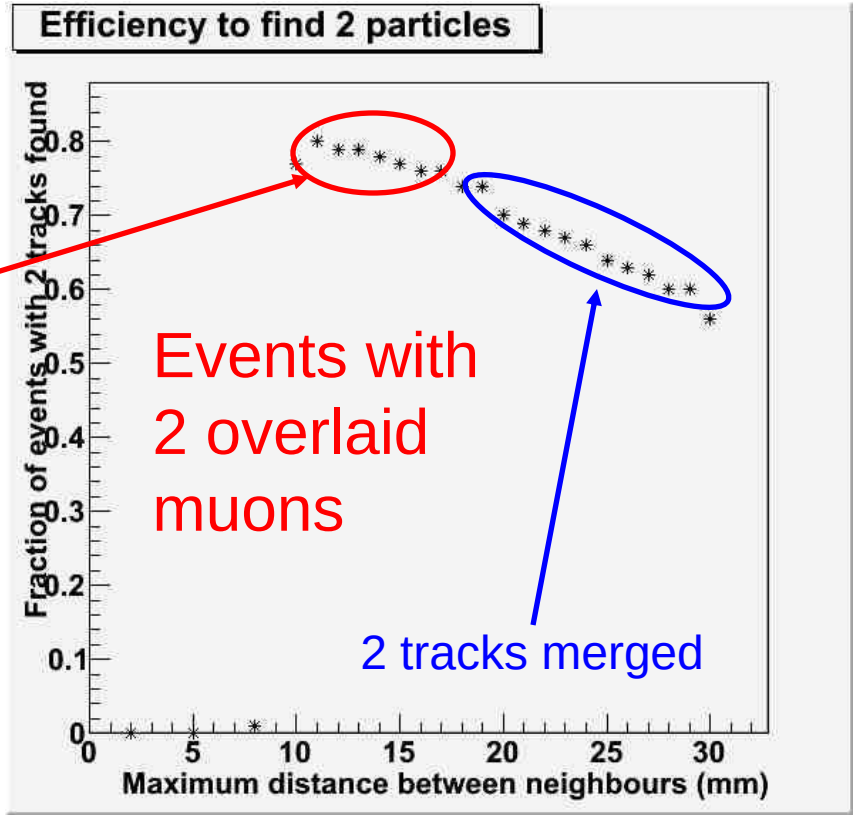
Quality of the primary track

- To find the primary track in the 6 first layers, the MipFinder was used.
- What is the efficiency to find the primary track ? (and reject double particles entering the ECAL)
- Efficiency and purity plots of the algorithm were needed to prove that the selection works well.

MipFinder : muons at 10 GeV



Best region



- To count particles, clusters of more than 3 hits are kept.
- Left plot shows 98% efficiency for single muons (84% for pions).
- Right plot shows 74% of efficiency for 2 muon events (18 mm).

Identifying an interaction and optimising the cuts

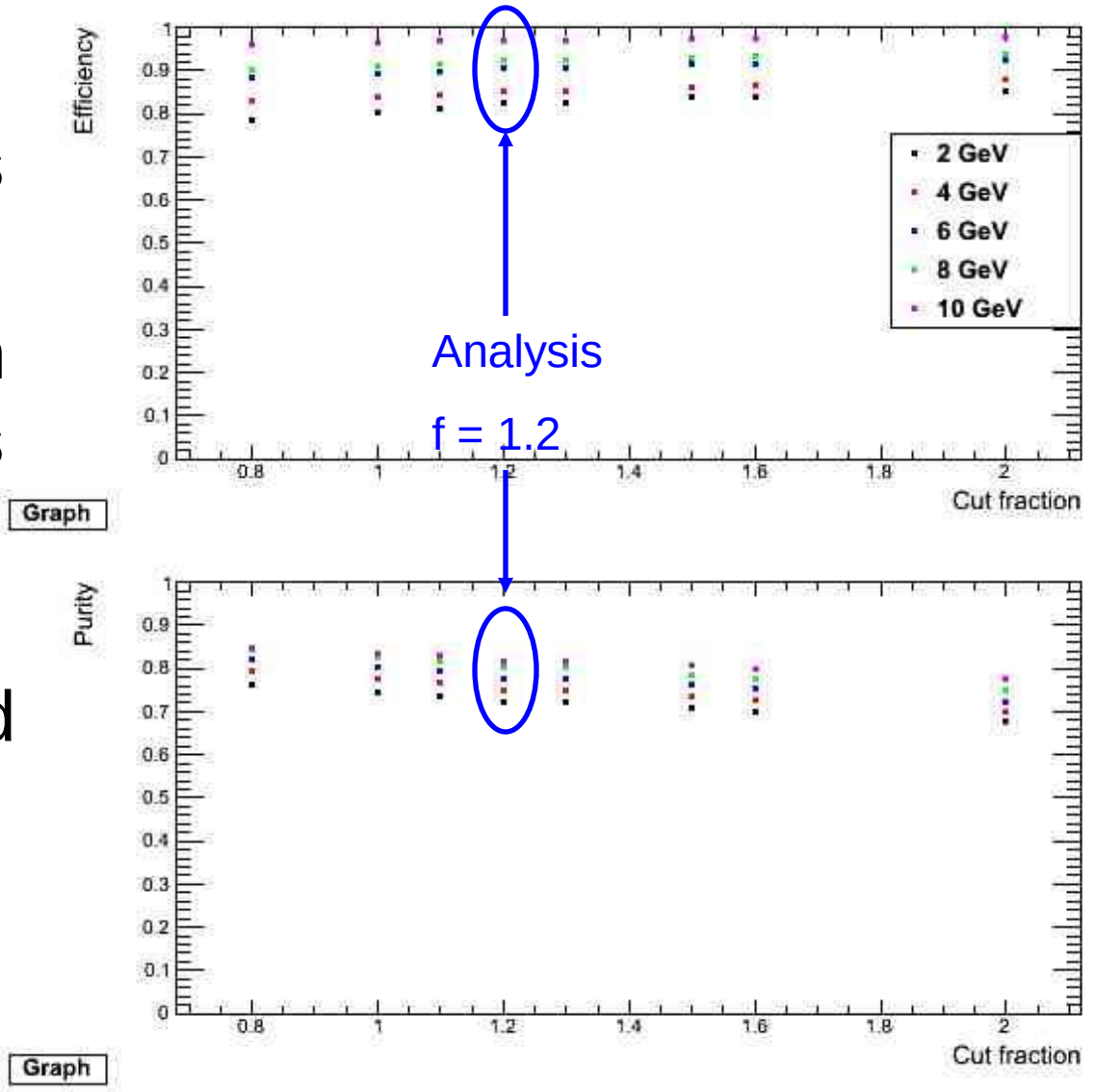
- MC information is used to optimise the identification of interactions
  - Do not consider elastic pi – nucleus scattering
  - Consider delta-rays

- To do this : define a cut f on the energy density
  - $d_{after} > f \,.\, d_{before}$ with $d = E / Nhits$
  - These events are taken as interacting events

- f = 1.2 in the analysis. Systematics ?

Systematics due to the density factor f

- Efficiency = fraction of interacting events found
- Purity = 1 – (fraction of interacting events not found)
- Small effects around 1.2 : good overall efficiency and purity

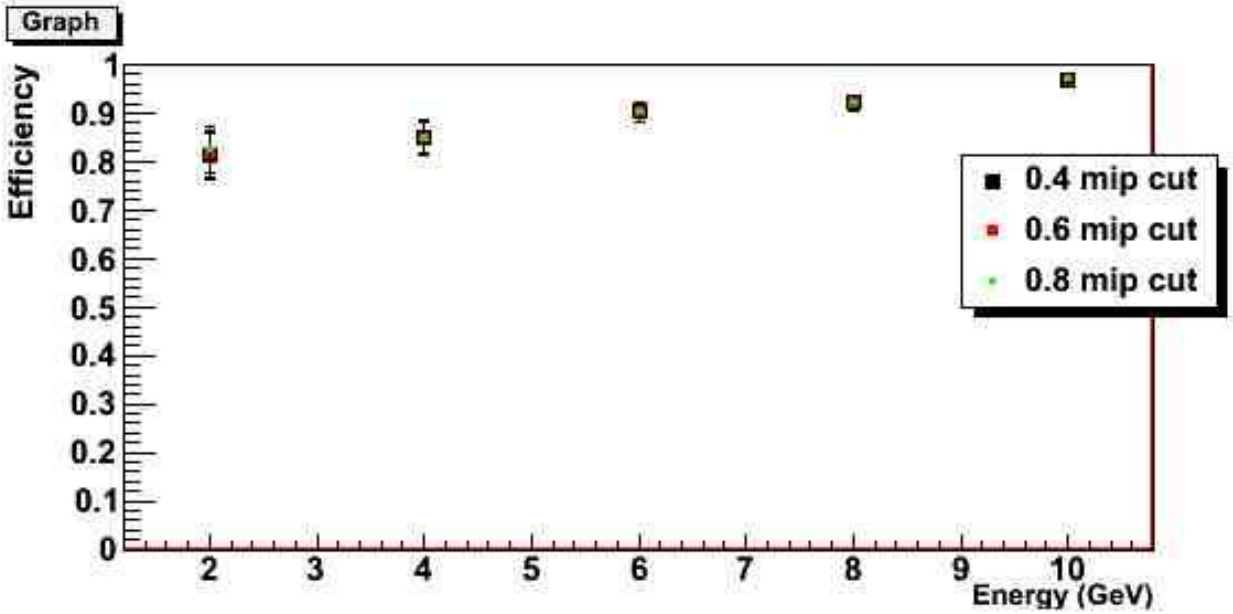


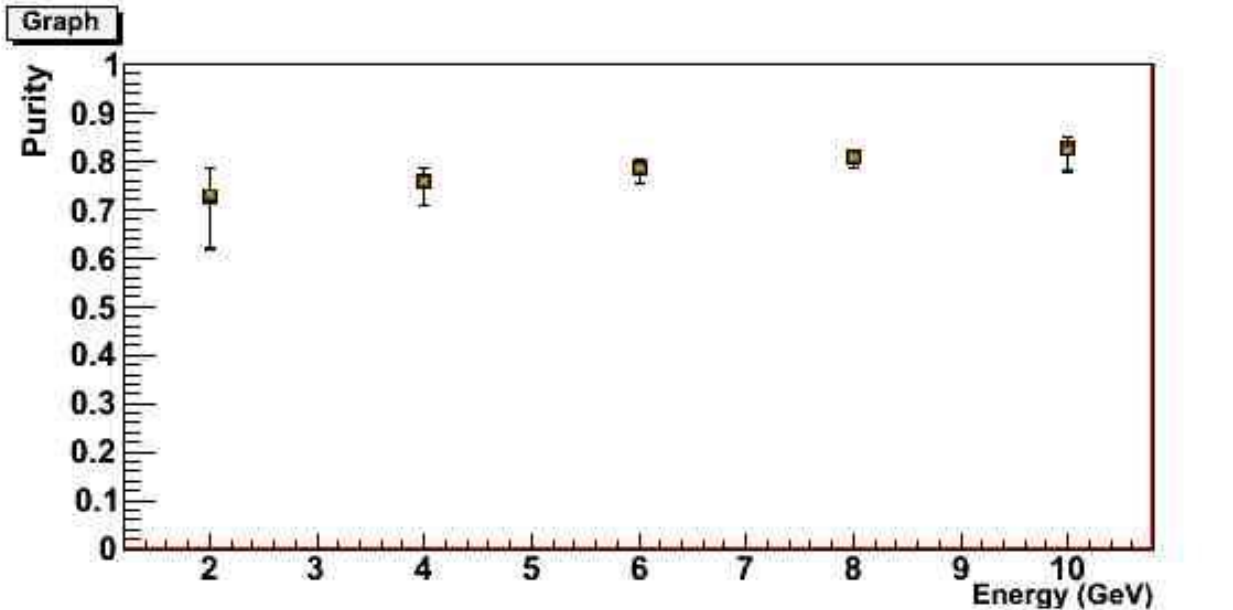
Stability with the cell threshold cut

- Usual analyses use $E_{cell} > 0.6$ MIPs as threshold
- Is this criterion robust enough with respect to the efficiency and purity to find an interaction ?
- We have a look at efficiency to find interaction and their purity using MC samples, looking at MCtruth information

Efficiency and Purity to find interactions

- All energies
- Hit threshold : 0.4, 0.6, 0.8 MIP
- Changes stay below 1%

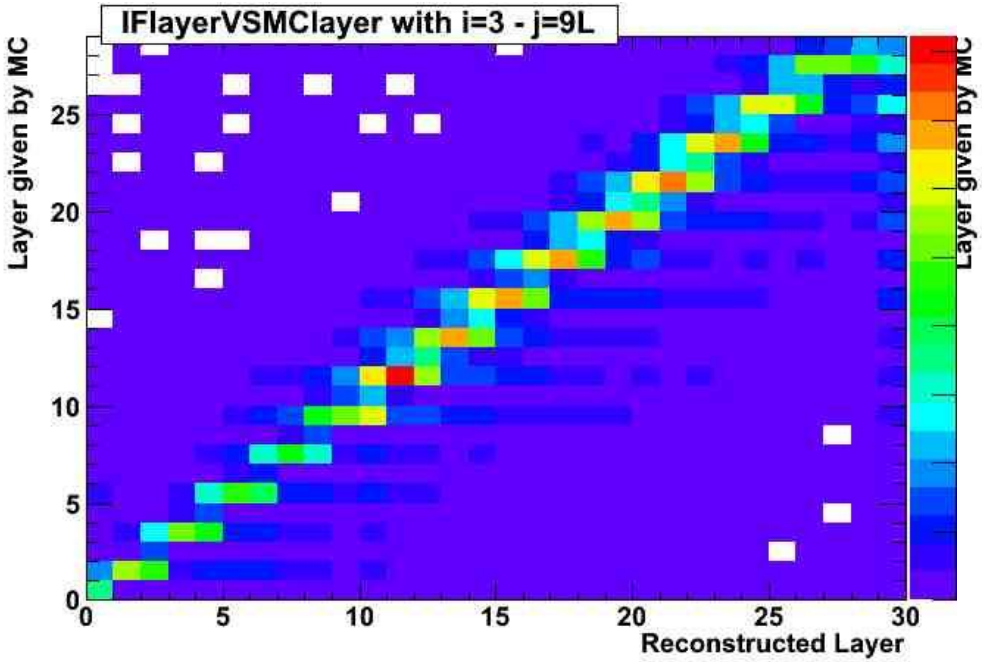




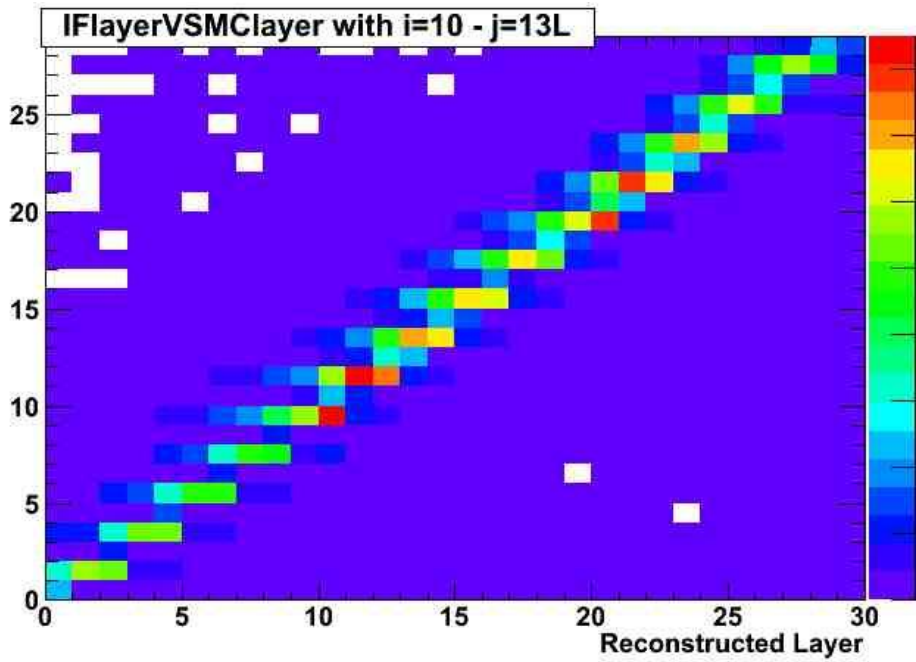
Conclusions

- Calice Analysis Note submitted
- First answers to all questions of stability and systematics of the interaction finding method
- Next step : validate these answers and carry on with the physics results
- Aim for a final note then article by September 2010

Identified vs True layer



2 GeV



10 GeV

2D Correlation plots : True layer vs Reconstructed layer

- Good correlation at 10 GeV : 84% within +/- 2 layers (76%)
- Correlation a bit worse at 2 GeV : 67% within +/- 2 layers (28%)

Stability w.r.t. the physics list ?

- Optimisation was done with QGSP BERT
- Using the same cuts, efficiency and purity are checked for other lists
- No significant deviation (<5%)
- 2 GeV still difficult