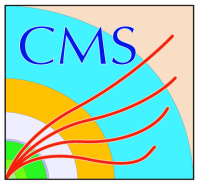


CMS/Egamma Software

Resumo das actividades no Software ORCA e da sua performance

Teresa Monteiro
LIP, 16 Novembro 2000

CMS Software (1)

Major challenges:

- Big events (raw event ~2MB)
- 17 minimum bias events/crossing (pileup at 10^{34})
- Digitization (front-end simulation) takes into account multiple crossings: ~200 minbias events (70MB) needed per signal event
- Studies at different Lumi need different pileup
- High magnetic field + ~1 rad length of tracker material: lots of bremstrahlung, non-trivial Tracker Calo matching

CSM Software (2)

Current solutions (Pileup):

- Include Pileup in digitization, not on simulation and introduce only the Pileup you need
- Filter minbias events that trigger detector,

take into account removed events

- Sample from full range of pseudo-random

minbias events

- Pileup: CPU intensive (1min Calo+Muon, 1min Tracker)

CMS Software (3)

Stages of simulation/Reconstruction/Analysis:

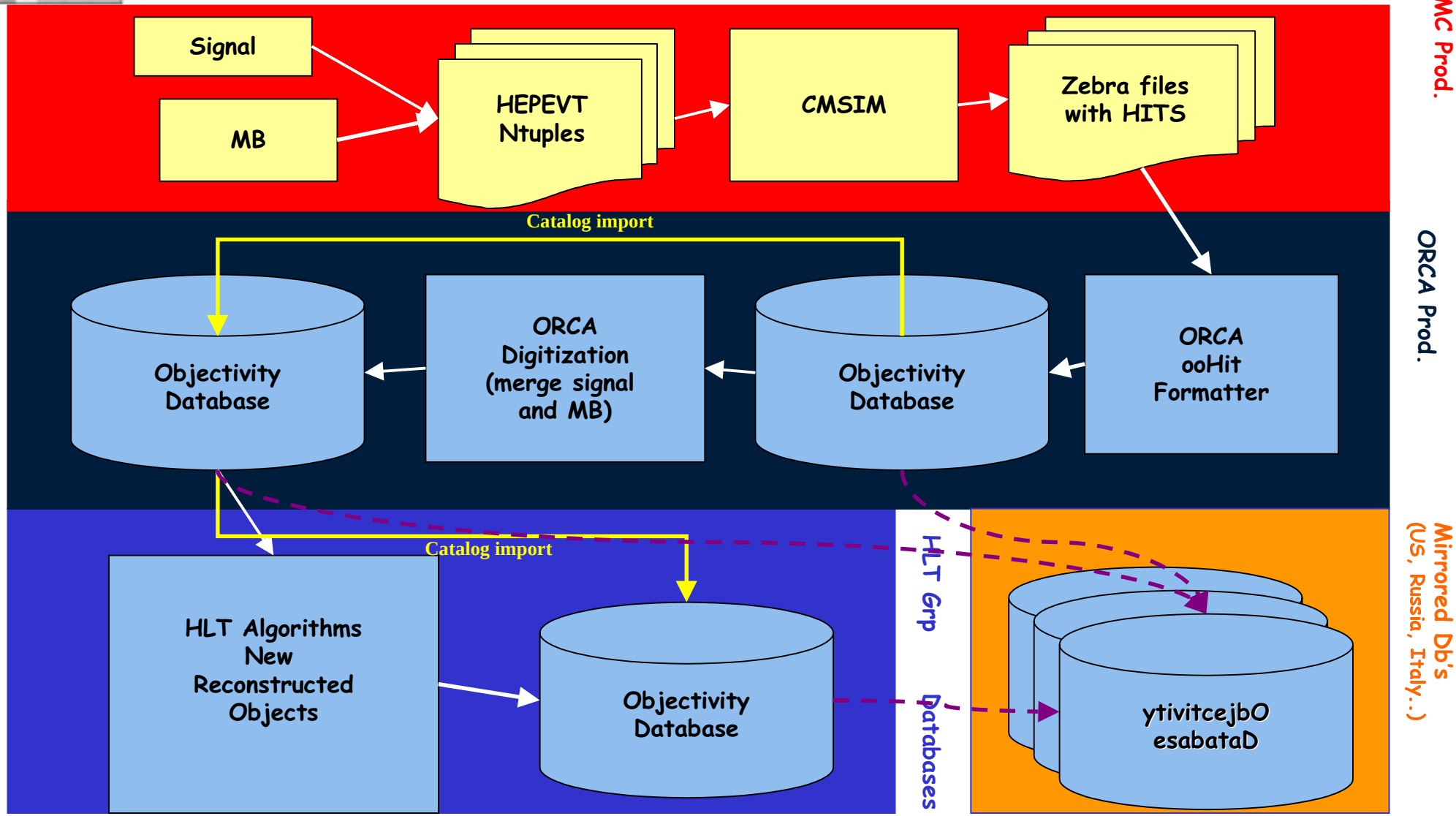
SimHits — Produced by MC, stored in DB

Digits — Include Pileup, some stored in DB (Tk)

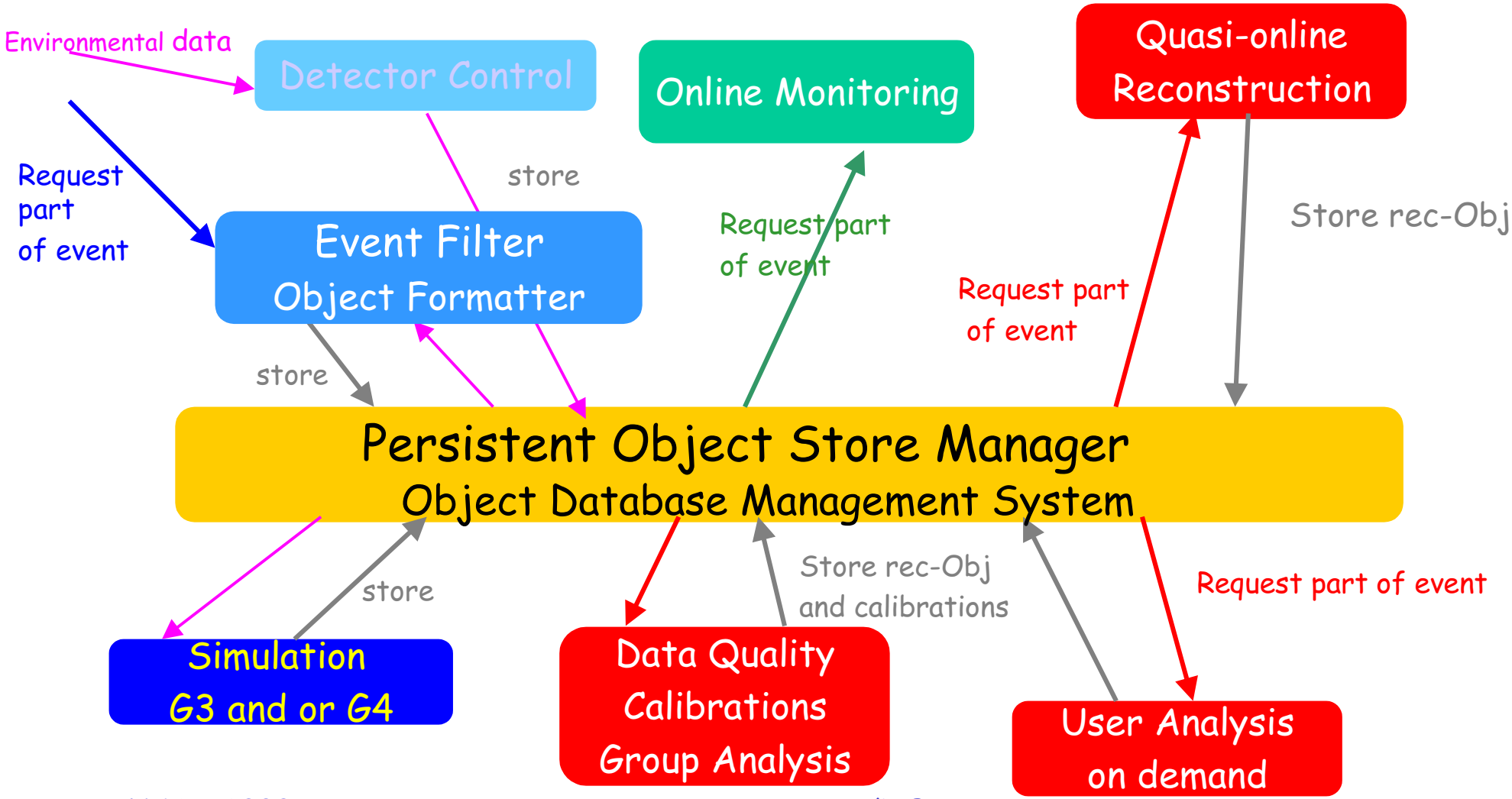
RecHits — Pre-processed digits, some stored in DB (Calo)

RecObj — Tracks, Clusters, etc, *will* be stored in DB

MC/ORCA Production Flow



CMS Data Analysis

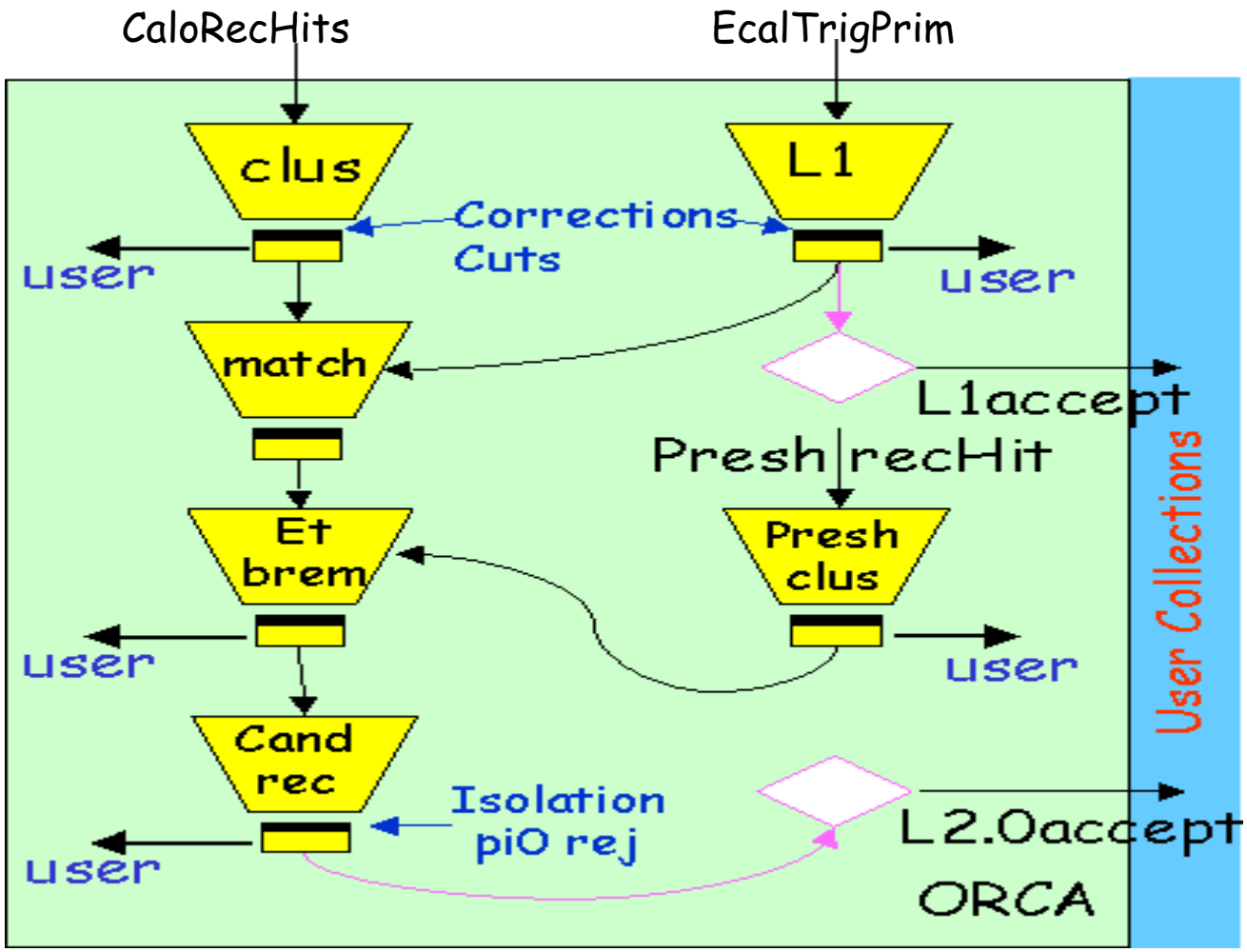


'Action on Demand'

'Action on demand' and 'implicit invocation' manage the order in which things are done, and avoid doing things that are not needed

- Algorithms register with the framework (BuildFile)
  - "I can produce Clusters of type C1"
  - "I can produce Calorimeter RecHits"
- Algorithms do nothing unless triggered
- CARF framework handles requests:
  - User asks for ECAL cluster of type C1
  - CARF sees if exist already
  - CARF triggers algorithm, requires CaloRecHits
  - CARF gets them from DB/triggers CaloRecHit algorithm

Egamma Analysis Flow

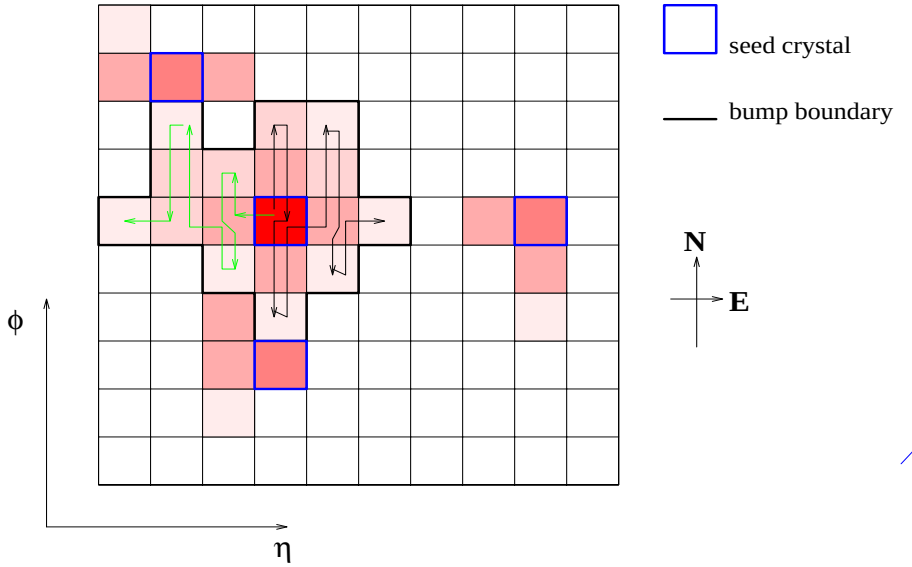


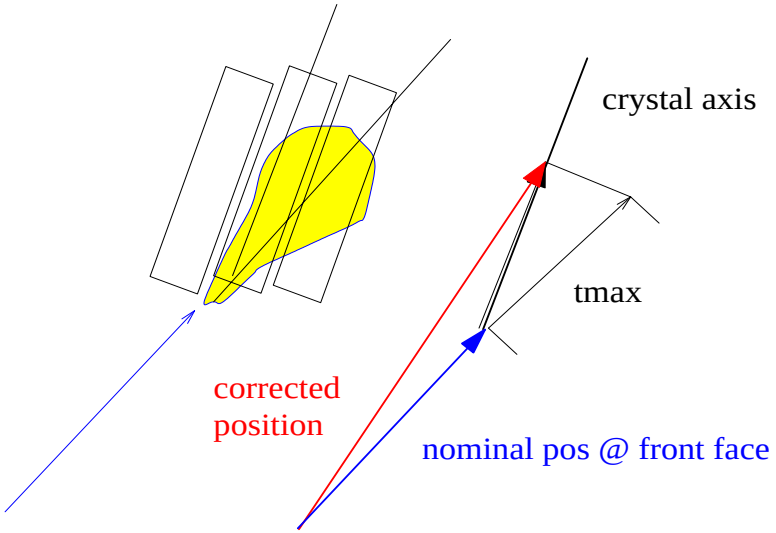
User (today):
- Make Ntuples, analyze them with PAW or ROOT;
- 'Tag' objects in
- (your copy of) the DB

Future:
Save intermediate objects in (your copy of) the DB

Clustering Algorithms (1)

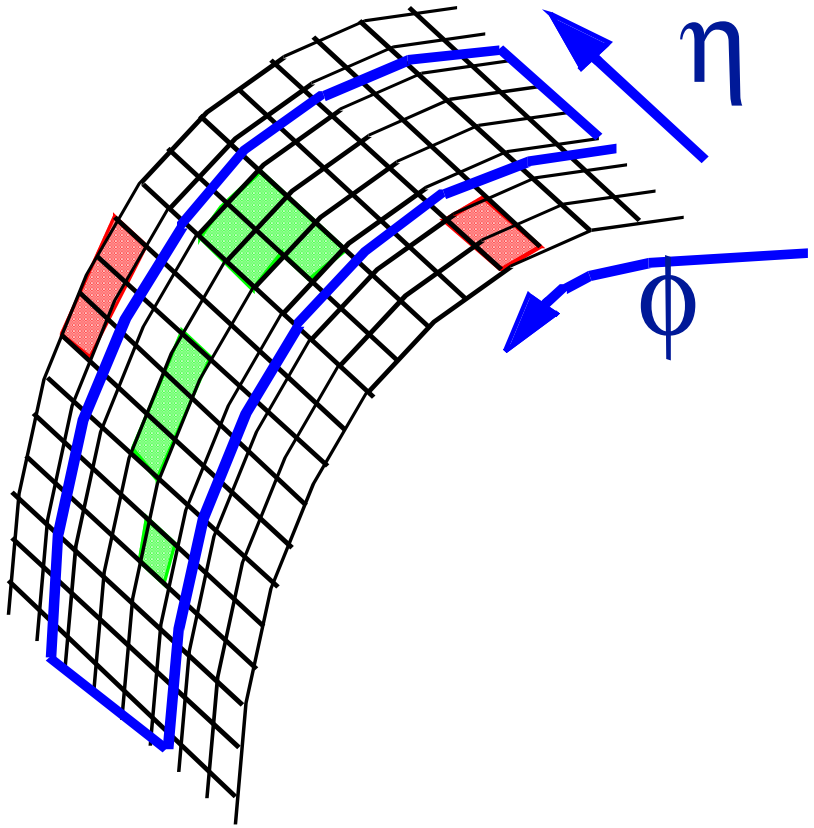
- **Island Clustering Algorithm: Fast reliable Bump Finding + Accurate position calculation (Log(En) weighted)**





Correction for crystal axis tilt

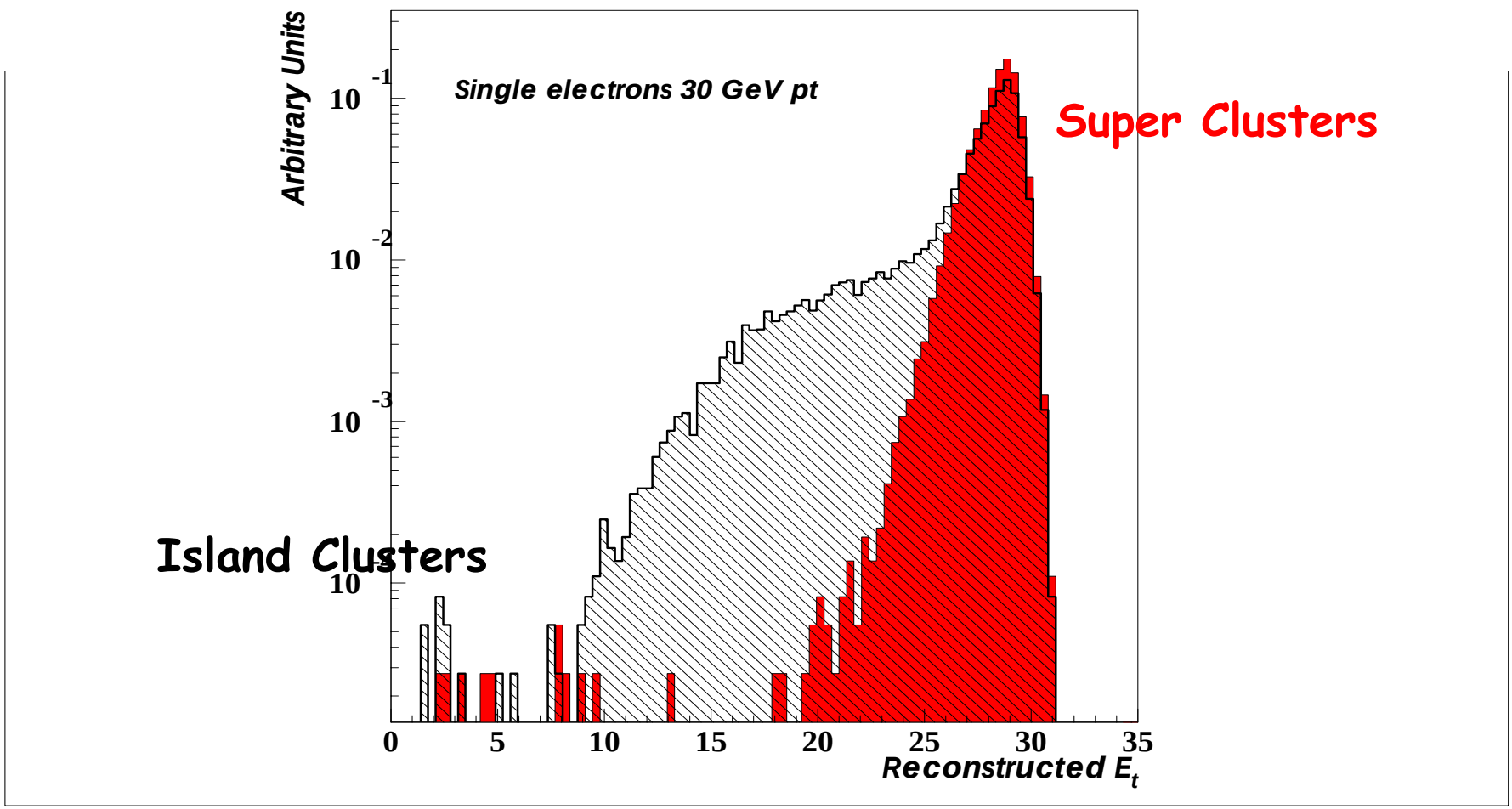
Bremstrahlung Recovery



Making Super Clusters (SC):

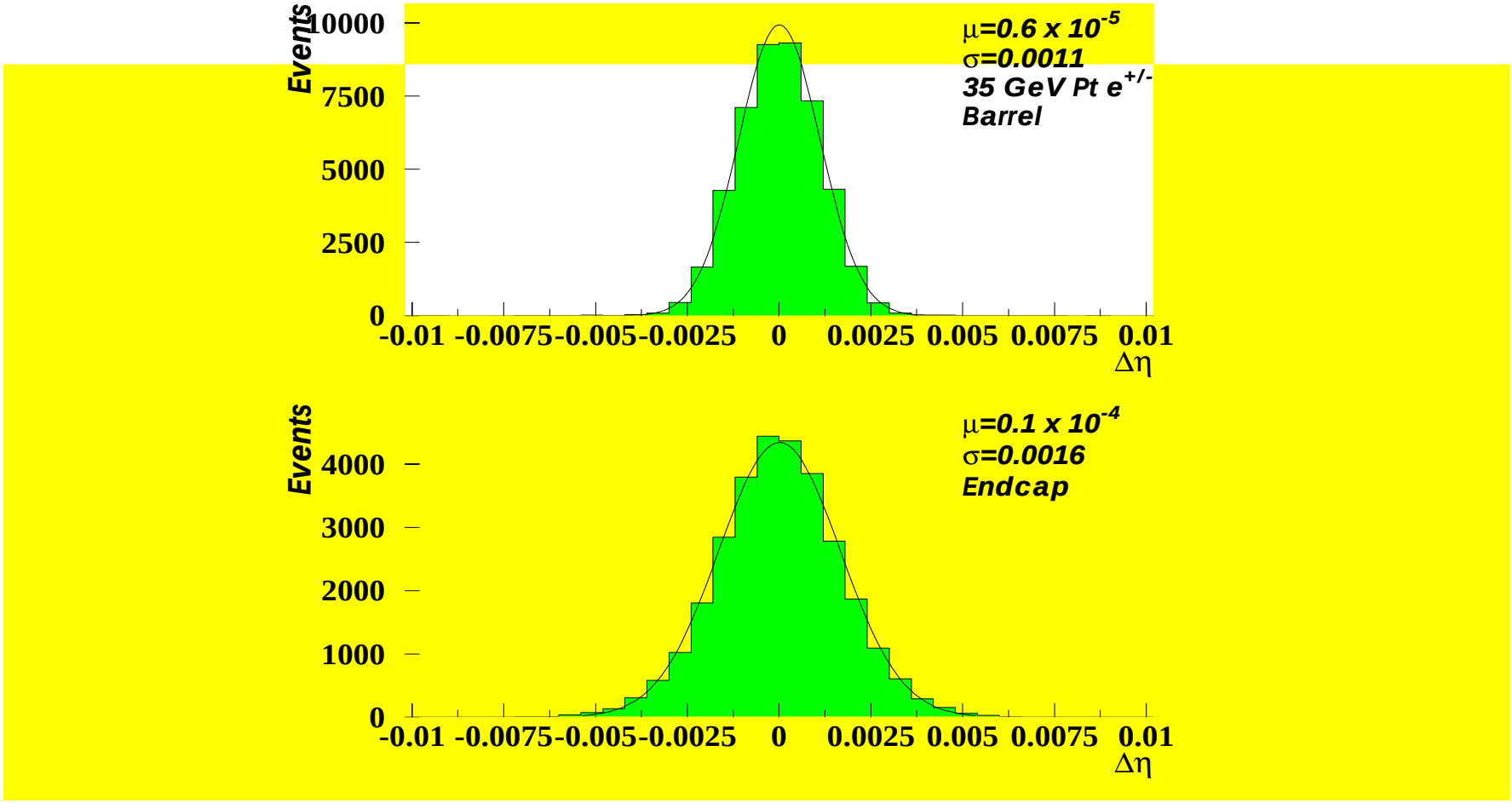
- Look for 'seed' Island cluster
- Define a road along phi (narrow eta slice)
- Collect all Island clusters in road
- Define a 'Cluster of clusters' with new energy + position

SC Performance (1)



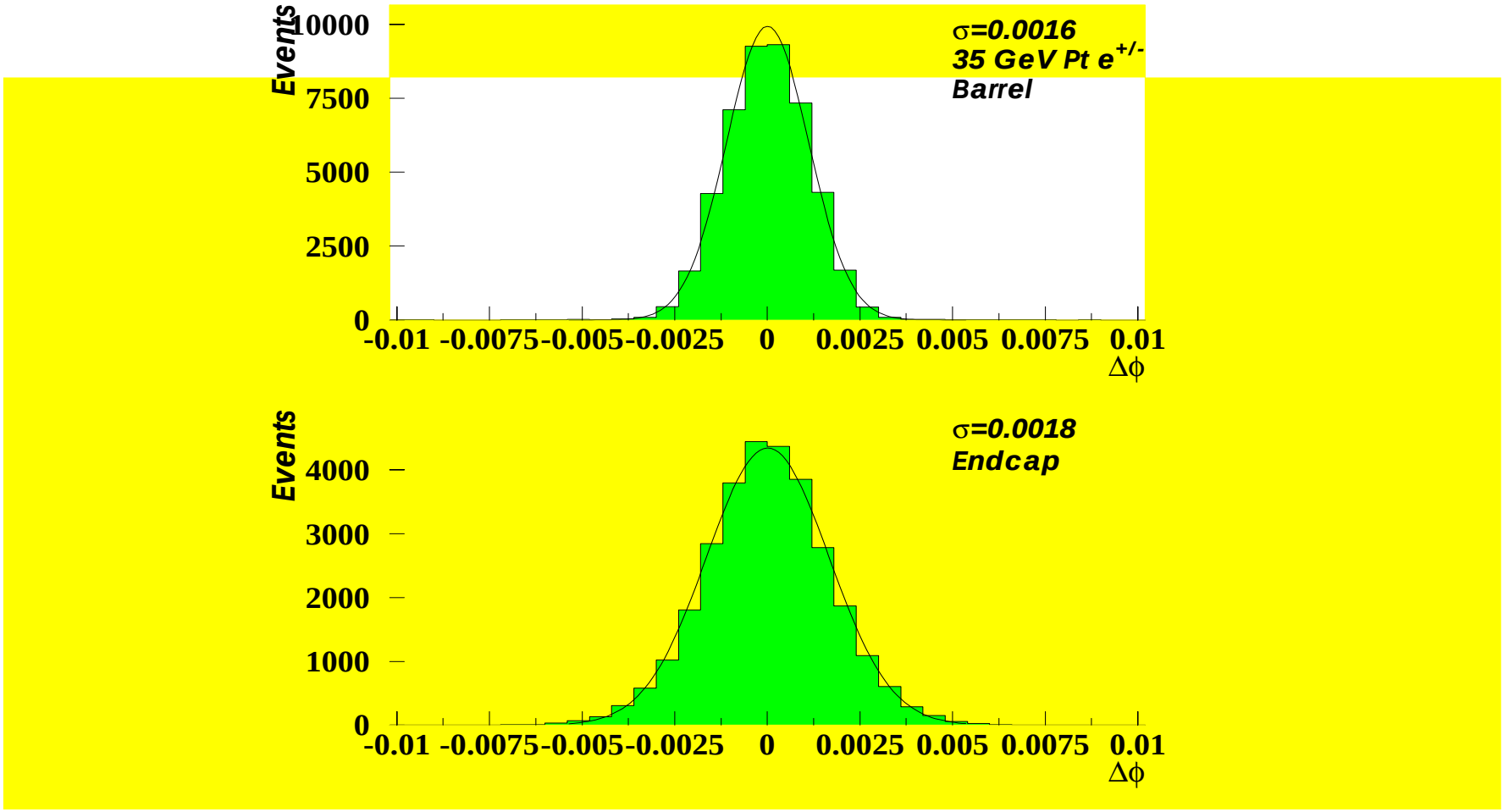
SC Performance (2)

Eta resolution



SC Performance (3)

Phi resolution



Clustering Algorithms (2)

- Hybrid Clustering Algorithm:
- Accounts for Bremstrahlung (only applicable in Barrel)
- Find seed crystal; scan some (large) number of PhiSteps
- Take 1x3 dominoes above some Ethresh1 if adjacent
- Take 1x3 dominoes

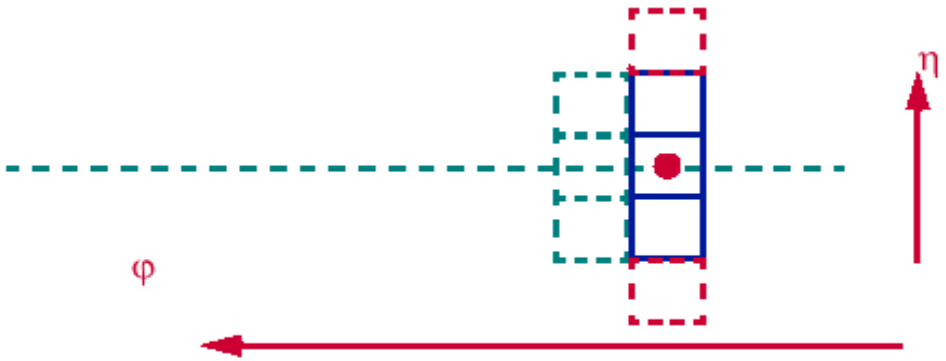
above higher Ethresh2

even if not adjacent

- Make 1x3 into 1x5 if

above even higher Ewing

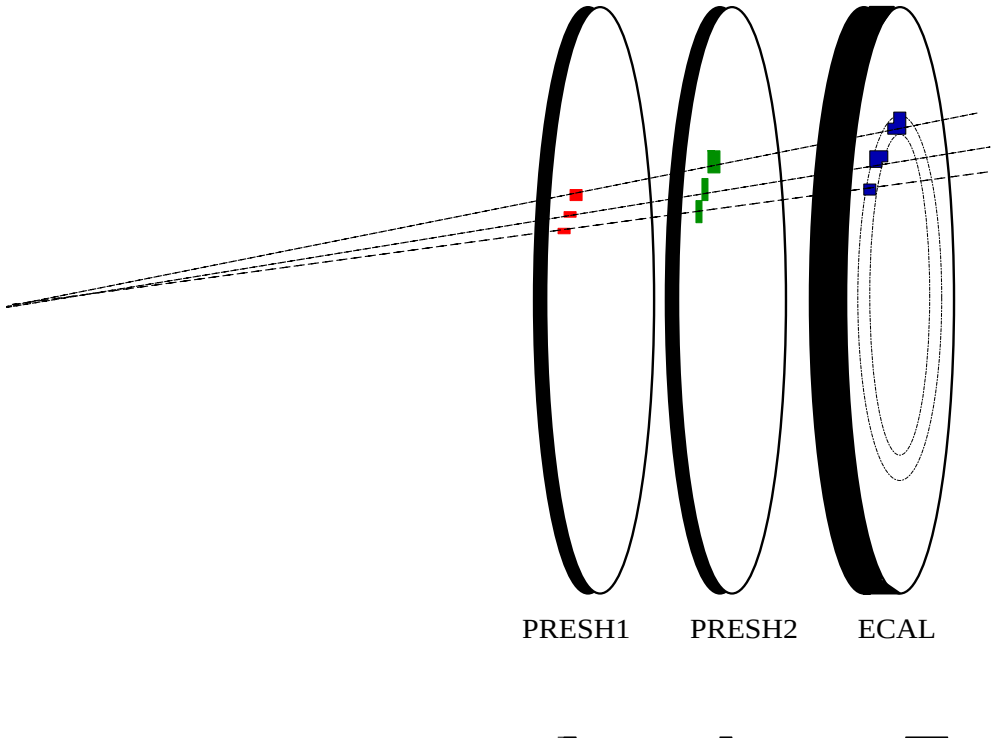
- Under optimization



Endcap Reconstruction (1)

ECAL+Preshower Association:

- Find all Endcap clusters compatible with same electron (brems recovery, SC)
- Extrapolate the position of each cluster to preshower planes
- Search for Preshower clusters in road
- Correct Endcap cluster energy using preshower
- Collect again all clusters



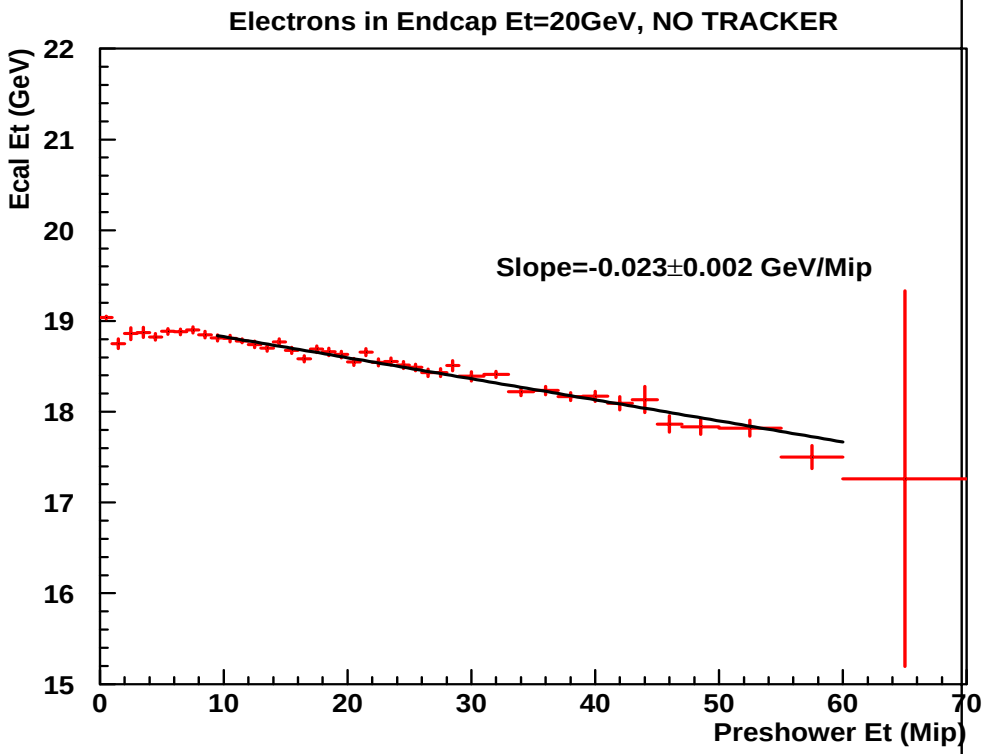
Endcap Reconstruction (2)

Electrons, Et=20GeV, No Tracker

ECAL Et versus Preshower Et:

Good ECAL<->Presh association performance

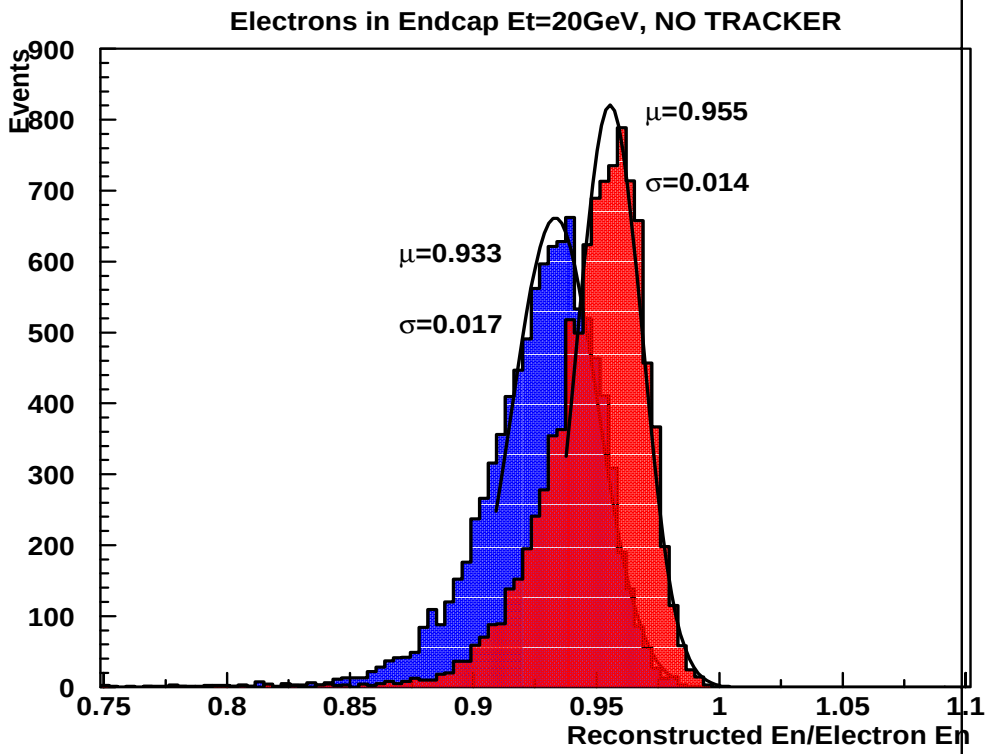
(testbeam slope:-0.030+-0.003)



Endcap reconstruction (3)

Electrons, Et=20GeV, No Tracker

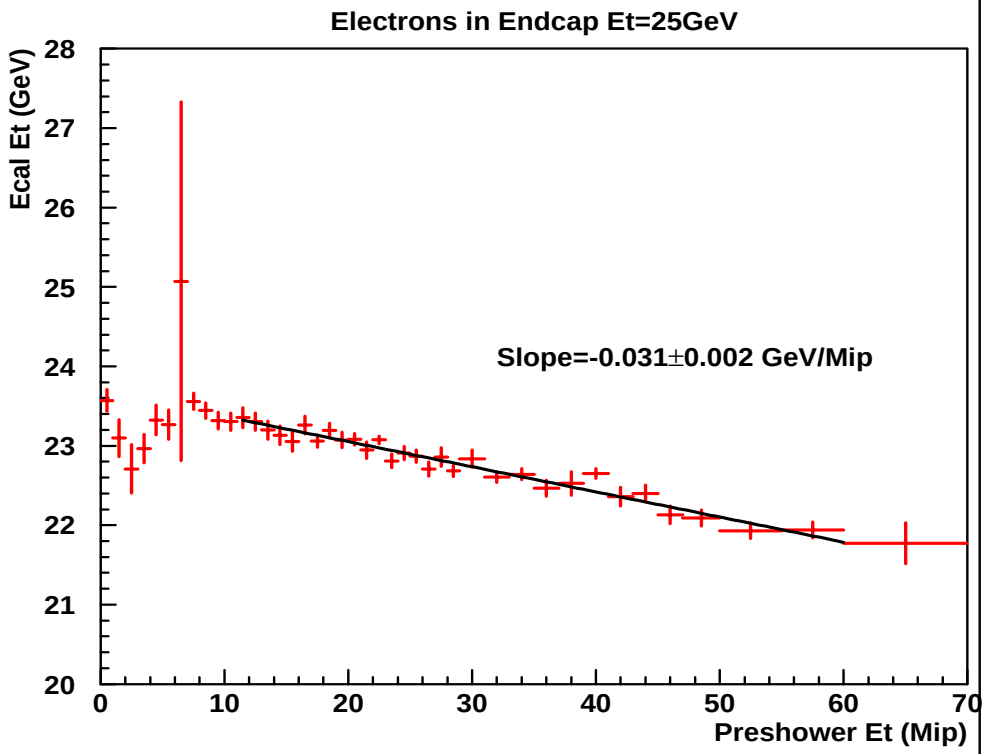
Energy resolution before and after Preshower correction:



Endcap reconstruction (4)

Electrons, Et=25GeV, Full CMS

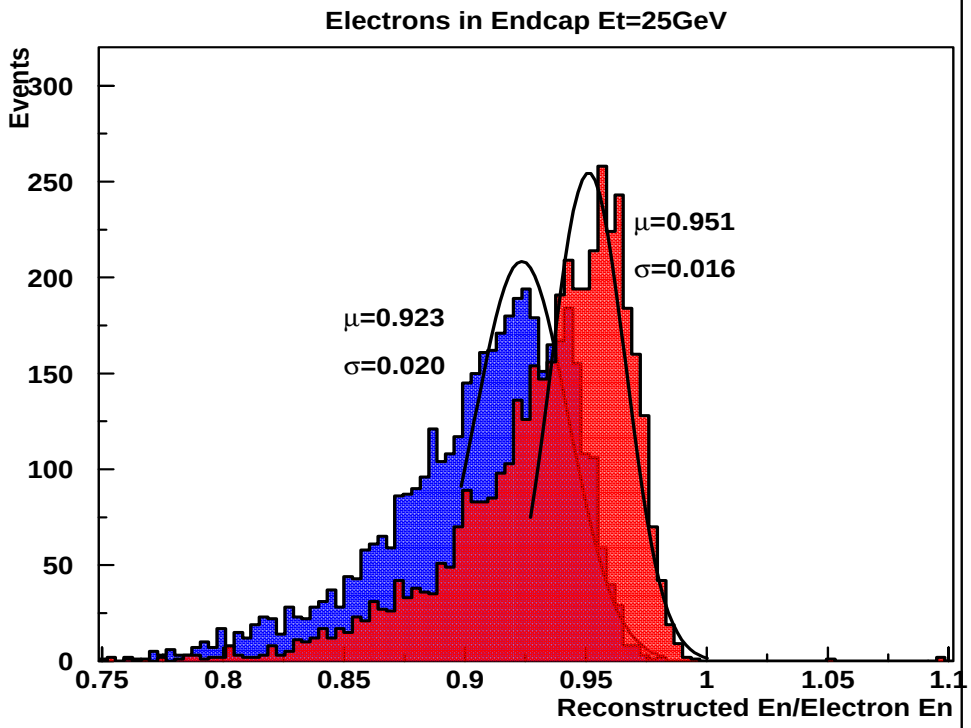
ECAL Et versus Preshower Et:



Endcap reconstruction (5)

Electrons, Et=25GeV, Full CMS

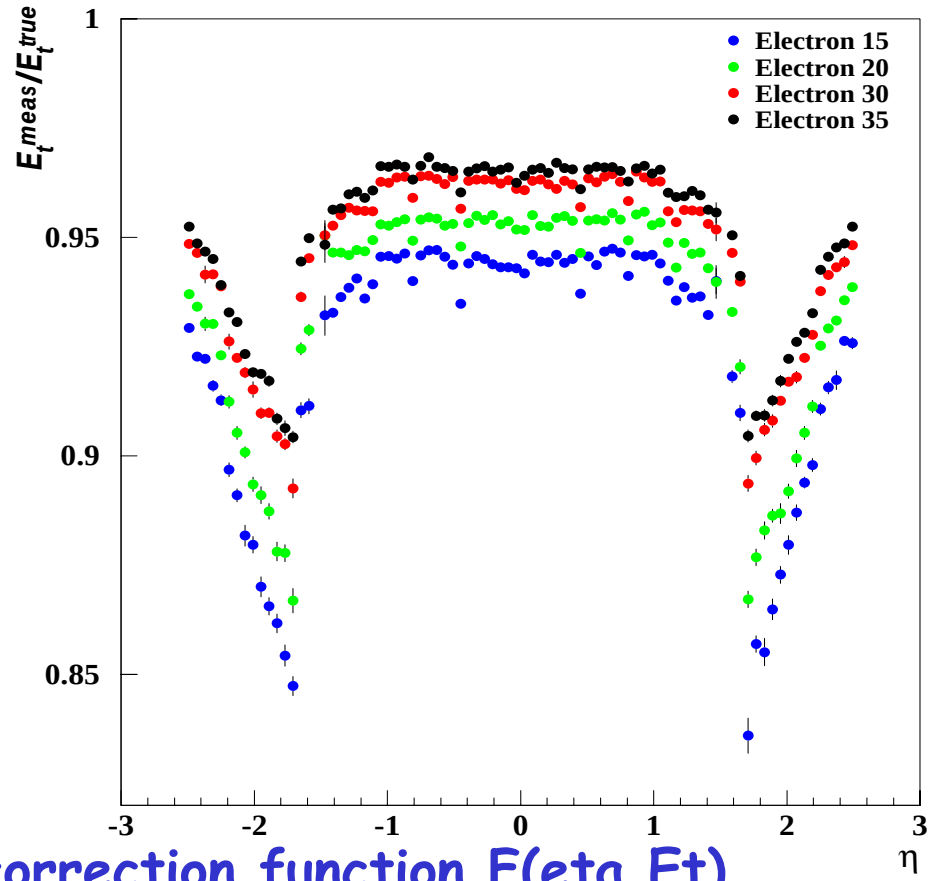
Energy resolution before and after Preshower correction:



Peak is improved but tail remains...

Calibration (1)

- Strong dependence of the fractional reconstructed energy on eta
- Part of the tails in energy measurement are due to this shape
- Need to calibrate
- Using single electrons, in Eta and Et bins: fit reconstructed energy (gaussian peak) and extract correction function F(eta,Et)

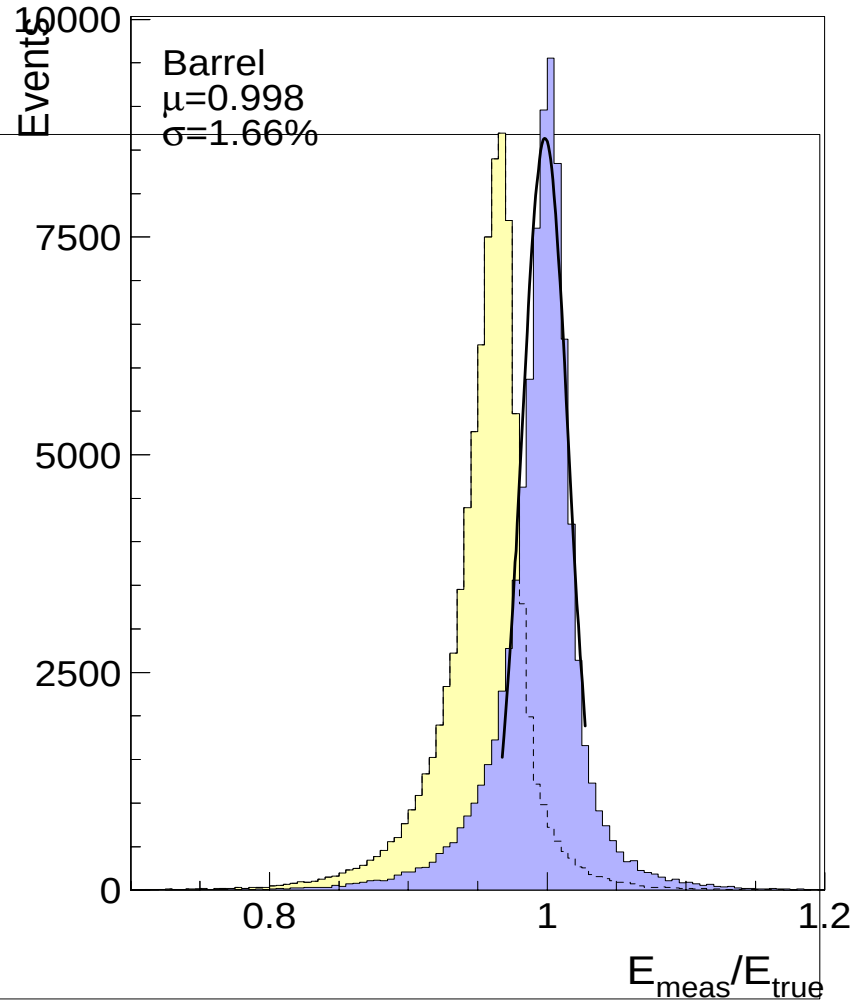


(Such energy calibration will only be available by default from ORCA_4_4_0 on)

Calibration (2)

Barrel,
resolution before and after calibration

Single electrons,
flat 10-50 GeV spectrum

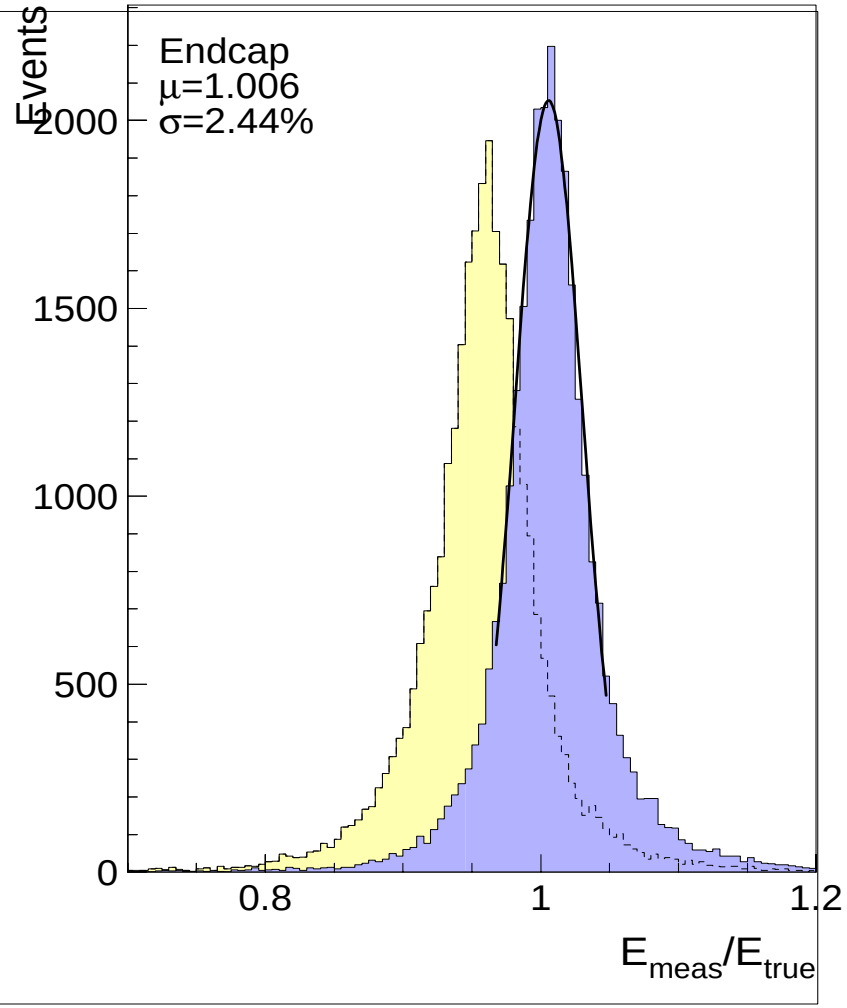


Calibration (3)

Endcap,
resolution before and after calibration

Single electrons,
flat 10-50 GeV spectrum

After calibration,
preshower corrections are only marginal: Large Brems...
(are large brem electrons actually usefull ?)



Conclusions

- Existing software allows preliminary physics/detector performance studies
- Many essential tools are still being tuned/improved
- Many usefull tools are still missing
- New ideas on how to improve performance are welcome (Endcap reconstruction)
- New use cases are welcome too (code design)
- It's the right time to contribute to this effort!