Optimizisation of the Region of Interest (RoI) using the EM Calorimeter

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Overview

- A year of work on this project has reached successfully the end.
- New knowledge about the detector and on data analysis techniques is now on my hands.
- I have developed many skills for working systematically, making comparisons, isolating problems and fixing them.

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Overview

OUTLINE:

- Some technicalities.
- Online or Offline Clusters?
- Optimize the RoI:
  - Position of the 1st and 2nd Barrel/EC Samplings
  - Reduction in phi
  - Reduction in eta.
- Results:
  - Efficiency.
  - Timing.
  - Number of SpacePoints
- Next steps/plans.

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Some technicalities

- Single e- events with Pt = 20 GeV (at Low Luminosity) and Pt = 30 GeV (High Luminosity)
- 9.0.4 ATLAS Software release used.
- Only ONE trigger AND offline Cluster close to true one required for the event to been recorded.
- Et Cut for the clusters: 15 GeV at Low Luminosity and 20 GeV at High Luminosity.

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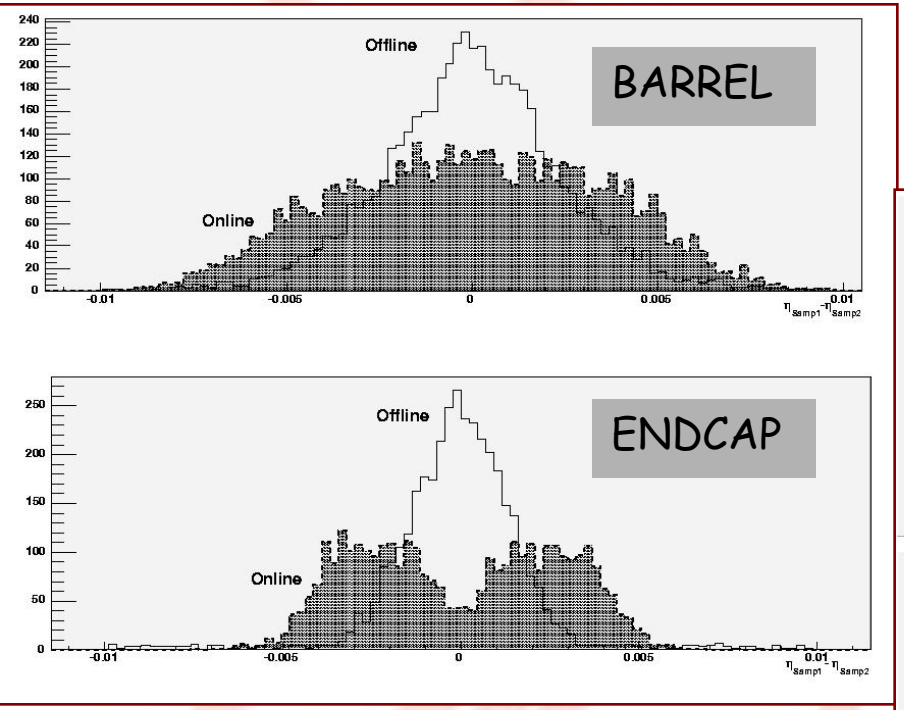
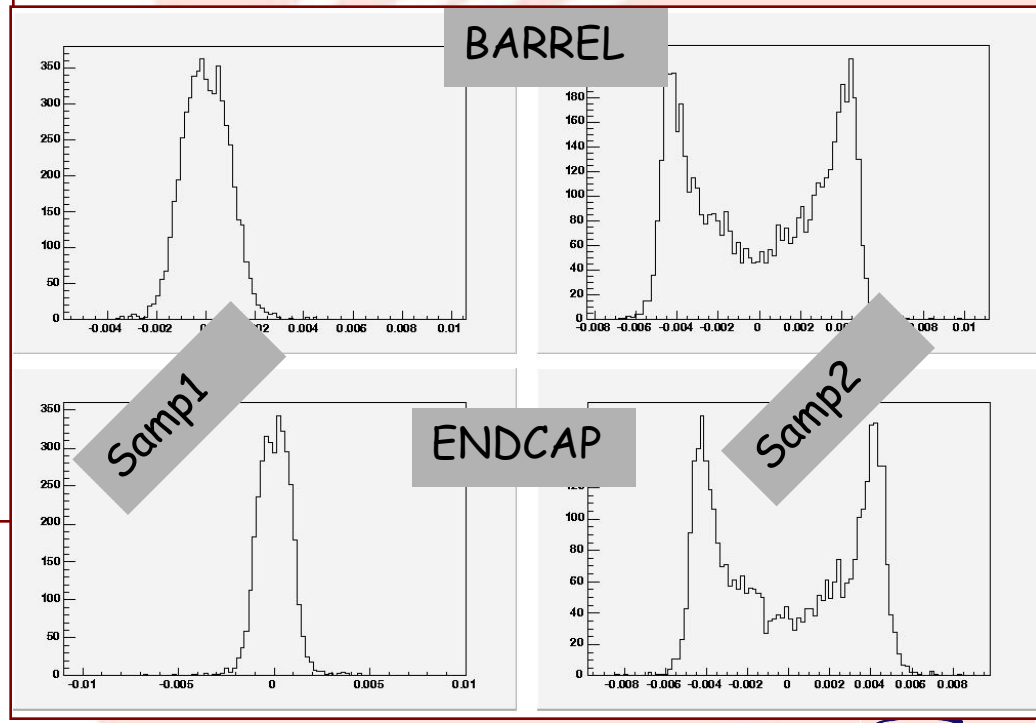
Online or Offline Clusters?

Eta Difference: Samp1 - Samp2



Eta Difference: Online Samp - Offline Samp



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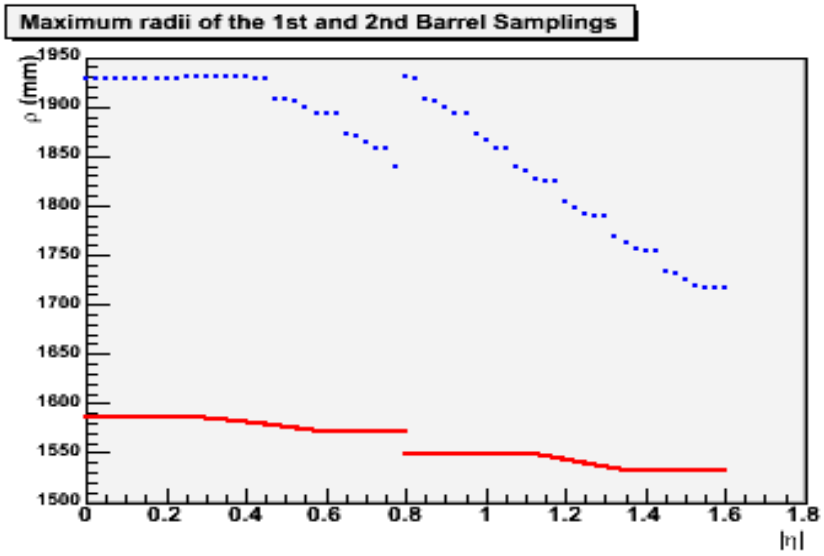
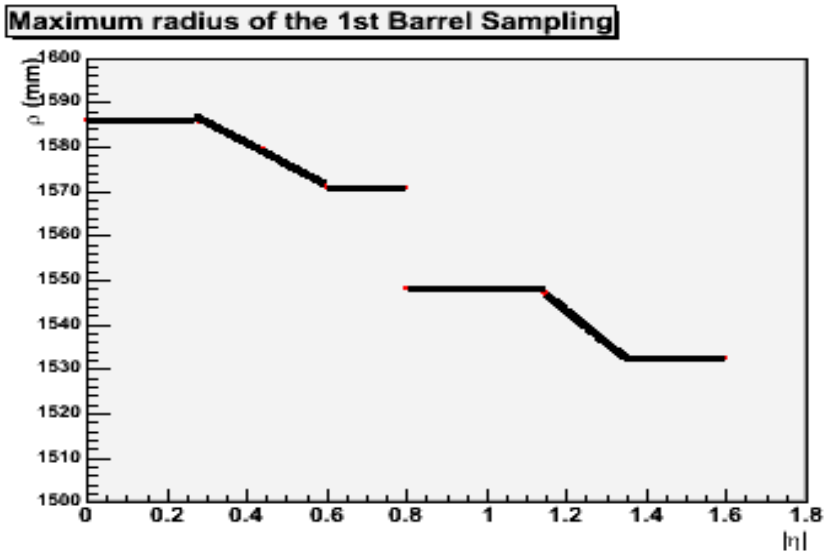
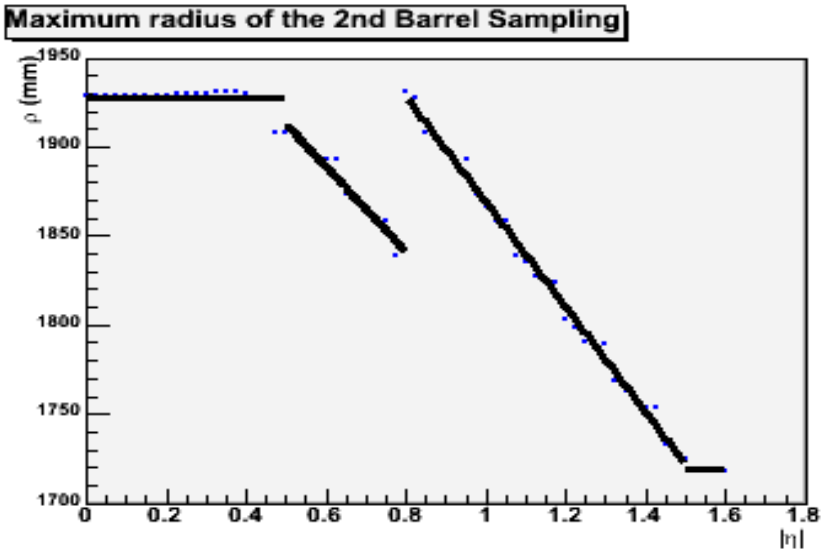
Barrel Samplings Position



- Maximum Radius of the 1st and 2nd Sampling
- Values from CVS.
- Parameterize each eta region till 1.6





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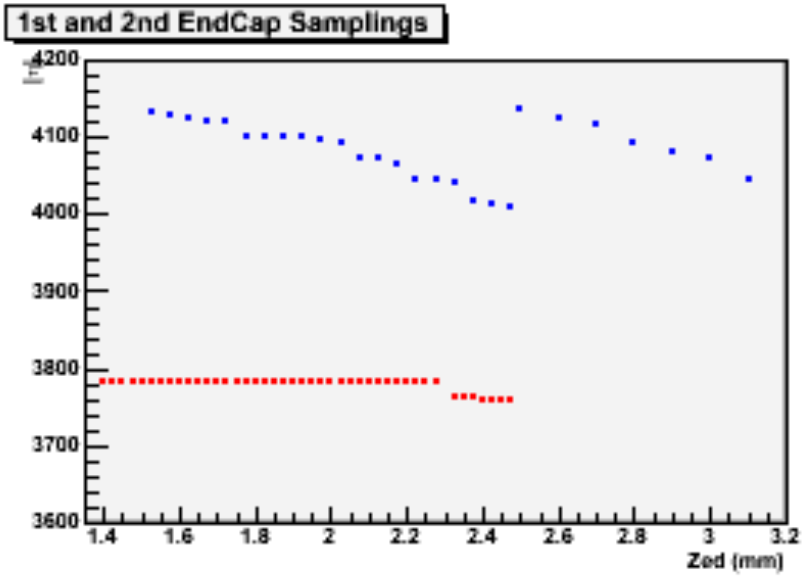
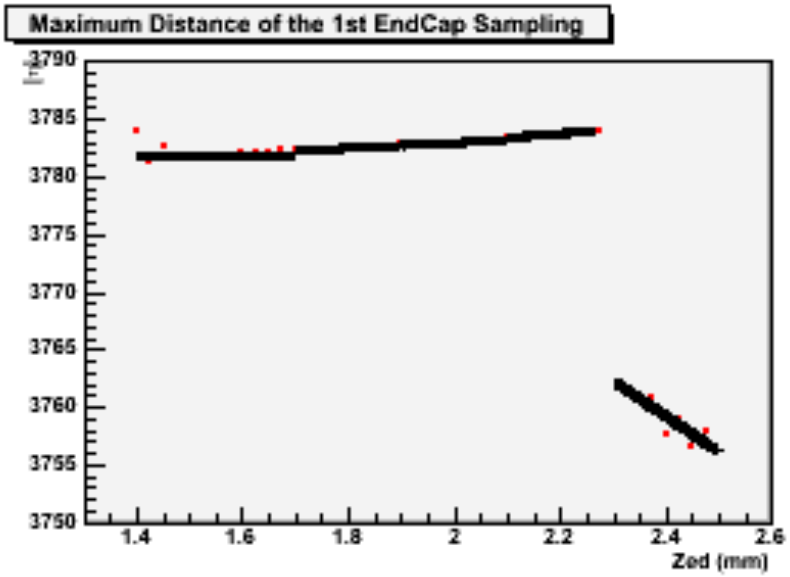
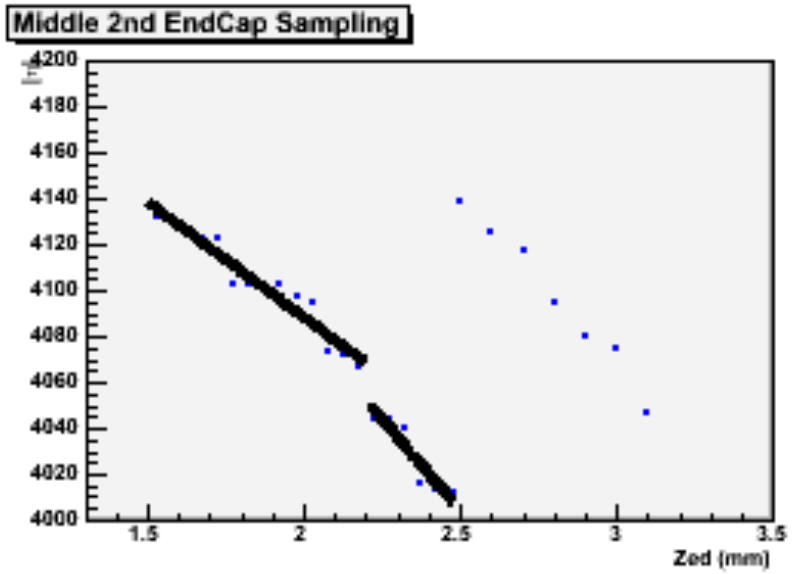
EndCap Samplings Position



- Maximum Zed of the 1st Sampling
- Middle Zed of the 2nd Sampling
- Parameterize each eta region, till 2.5. Not usage of the inner wheel.





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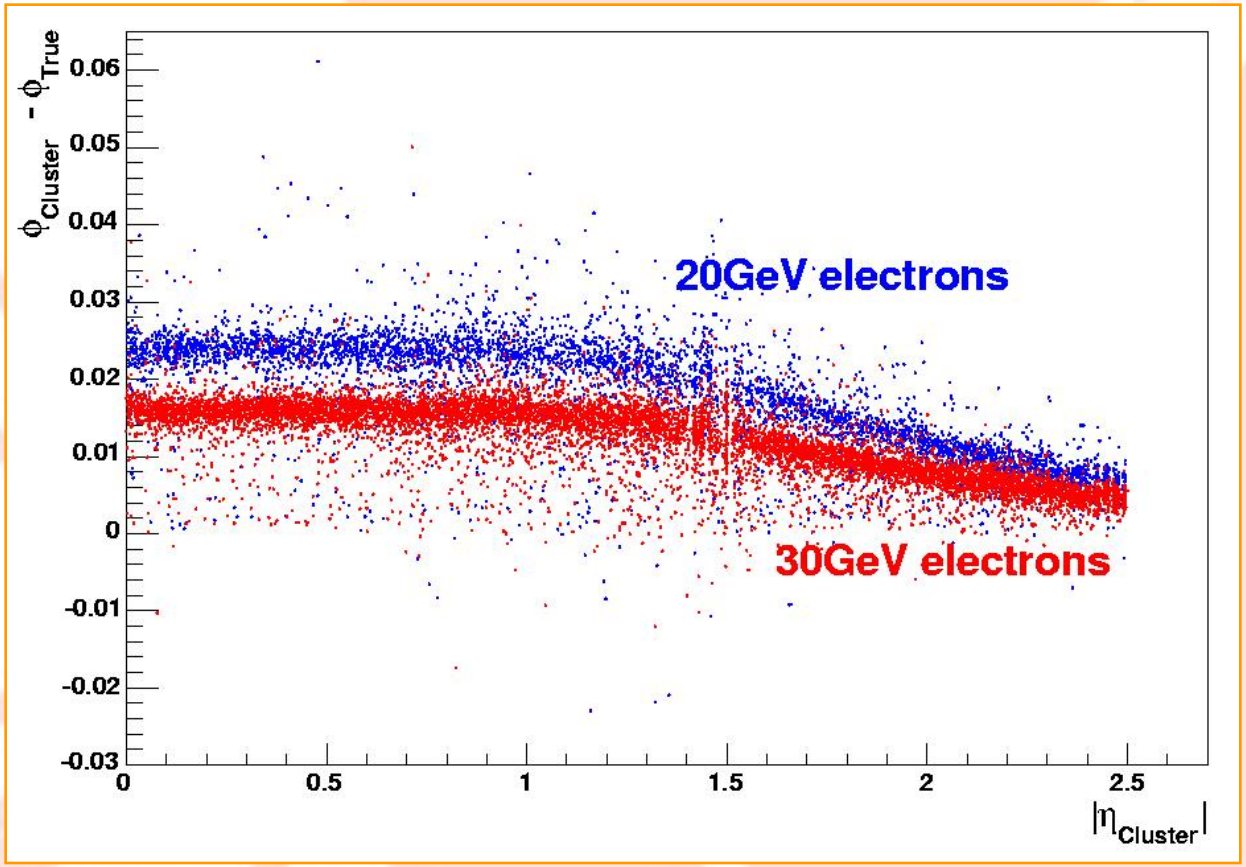
Reduction in Phi.

Phi Resolution:

- Compare the Phi of the Cluster without any corrections (eg extrapolate back to vertex).
- Different <Phi> for Barrel and EC regions. Probably due to a change in the solenoid magnetic field.
- High-energy electrons bend less (~0.015 rad) than low-energy ones (~0.025 rad)



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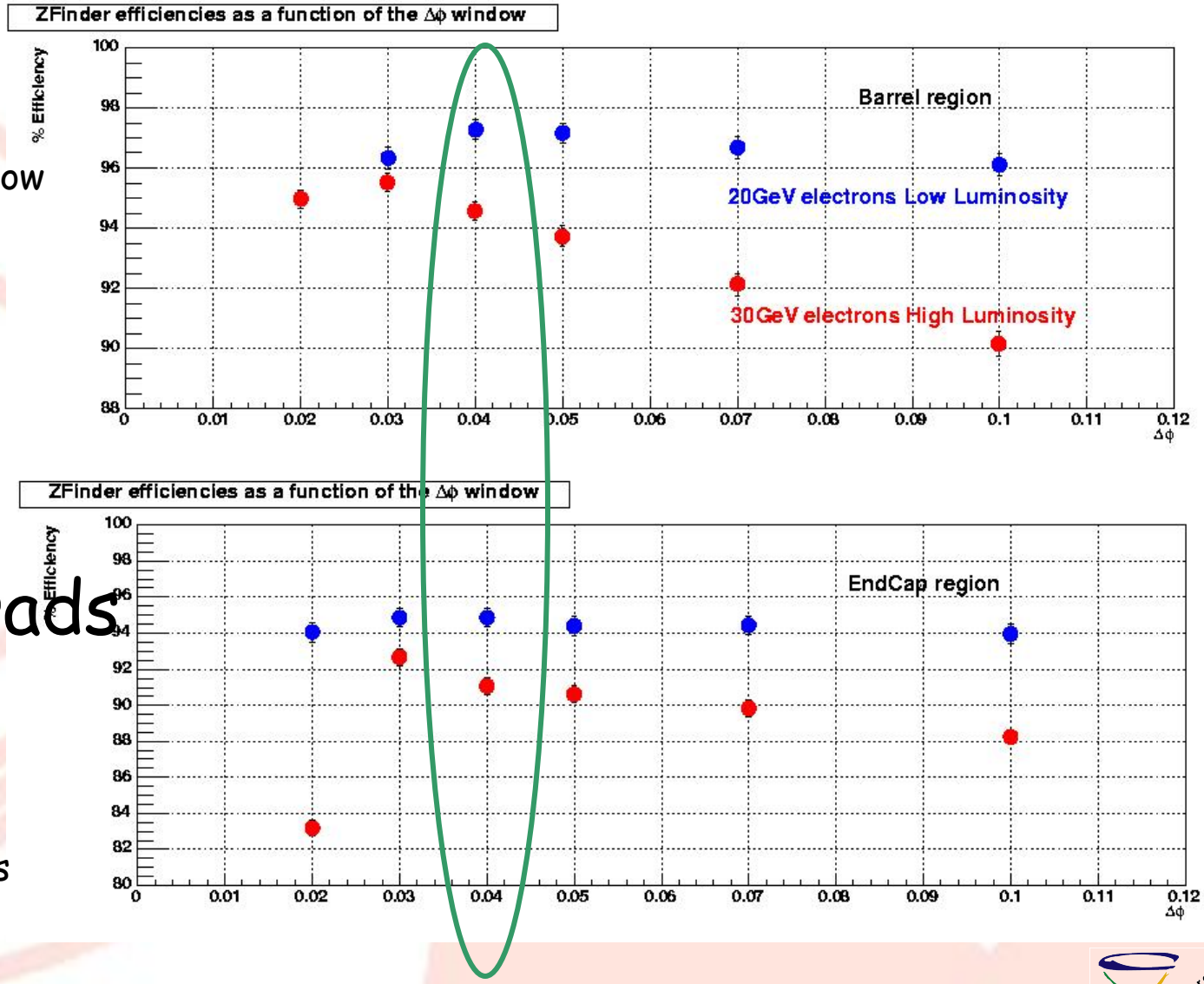
Reduction in Phi.

Phi size:

- Different optimal window for each region and for each luminosity
- Keep a common window

- Optimum:

$\phi_{cluster} \pm 0.04$ rads



The Reduction in Phi is always performed!

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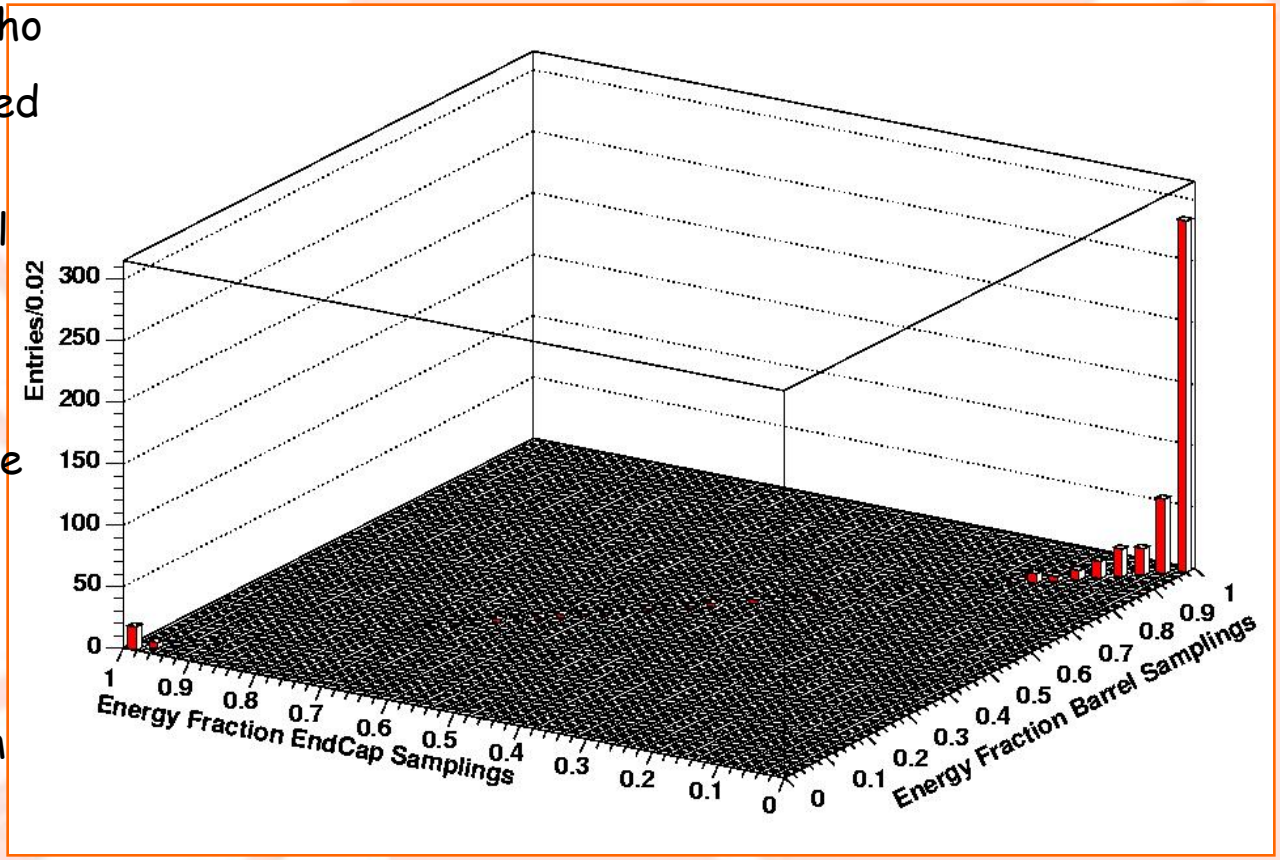
Reduction in Eta

- Barrel clusters: Constant rho
- EndCap clusters: Constant zed
- Transition clusters: Treat them as barrel if their barrel energy is more than 90% of the total energy. (similar for endcap treatment)
- For the rest of the cases the reduction doesn't apply.
- The reduction doesn't apply also if, for any reason, the vertex found is more than 20cm. (allowance of the beam spread)



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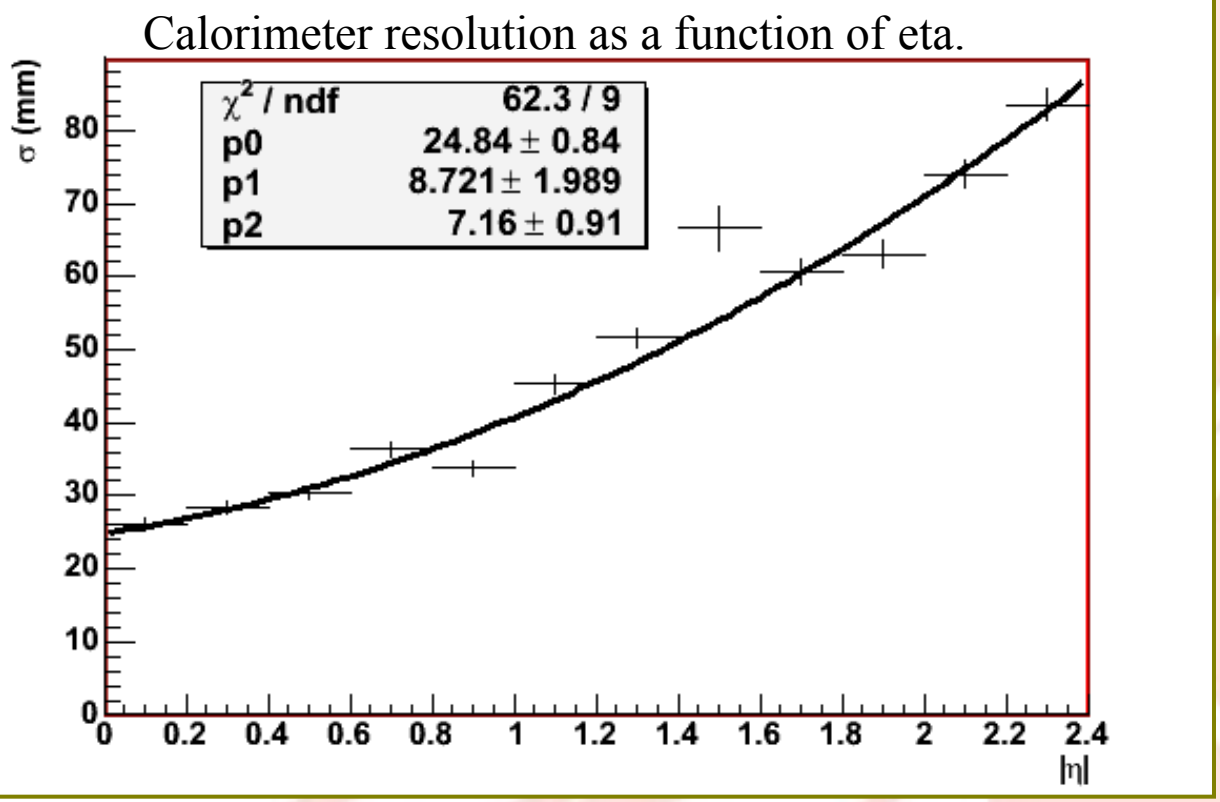
Reduction in Eta



- Same behavior for both Luminosities
- Big chi^2 due to the bad performance at the transition region around 1.5
- The sampling positions we use now give better resolution than any used before.

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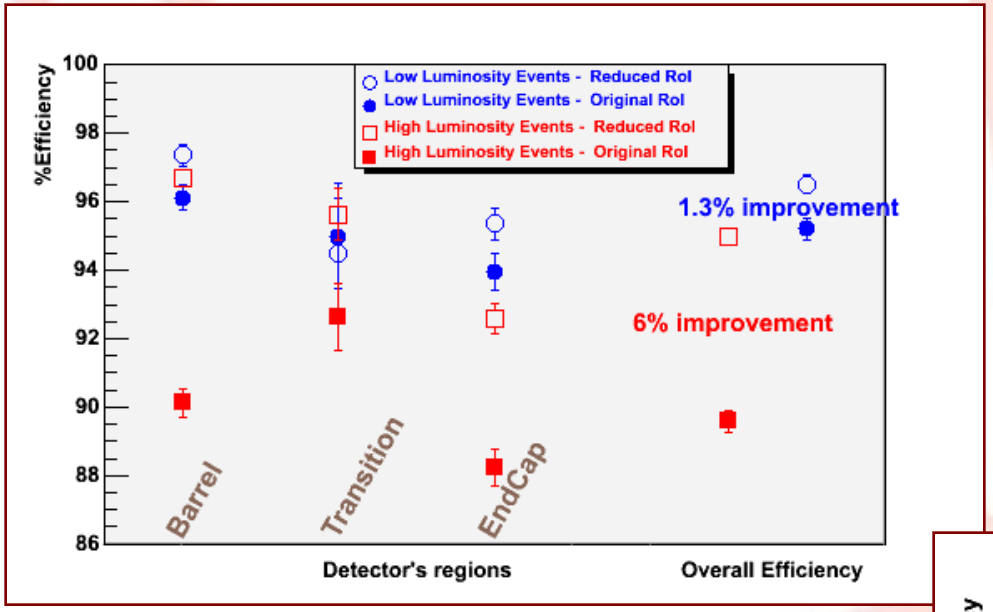
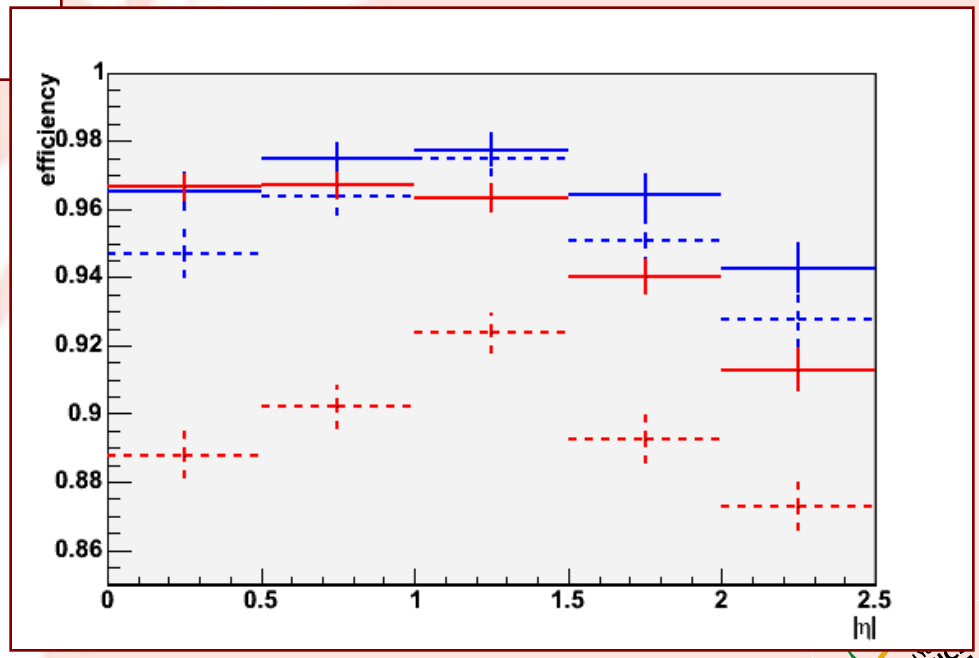
Results: Efficiency



- How well we find the true vertex using the Zfinder Algorithm from IDSCAN
- Definition: |Zreco - Ztrue | < 2mm



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Results: Timing - Number of Space Points

- How fast we find the true vertex using the Zfinder Algorithm from IDSCAN
- Pentium IV at 2.4 GHz

Low Luminosity	Mean execution time (msec)	Mean number of SP
Original RoI	1.013	43.06
Reduced RoI	0.802	18.12
% difference	-20.8%	-57.9%

High Luminosity	Mean execution time (msec)	Mean number of SP
Original RoI	2.069	156.2
Reduced RoI	1.089	44.07
% difference	-47.4%	-71.8%

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Conclusions - next steps/plans

CONCLUSIONS

- The method suggested improves the performance of IDSCAN not only on how fast can we make a decision but also how effective our decision is.
- The results will be more distinct during the High Luminosity phase, but there is important improvement for the Low Luminosity phase, as well.
- The method has been tested using only EMTau RoI (e/gamma, tau).
- It's independent of the EM particle type, Not any feature of the cluster has been used!

NEXT STEP

- Make the method part of the trigger chain.
- A note is on the way to be published. (Nikos, Mark, S.)

- A very nice and challenging project has been completed.
- Ready to use what I've gained to make an even better physics analysis for the ATLAS.

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