Efficiency Study:Introduction

- The following presentation will (hopefully) document the current state of a sensor efficiency study based on data from the DESY test beam runs.
- This study uses hit clusters and spatial correlation to attempt to establish what percentage of particles passing through a sensor will be recorded by that sensor.
- Since preliminary results indicate that the behaviour of the shaper regions is significantly different to the behaviour of the sampler regions, shapers and samplers are treated separately for the purpose of calculating sensor efficiency.

Efficiency Study:Method

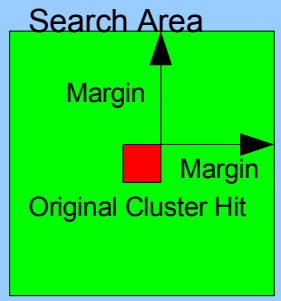
- The basic principle of this study is that a cluster of hits (i.e. two or more hits with hits adjacent to them) is a reliable indicator that a particle has passed through the sensor.
- If the sensors have a 100% efficiency then a particle which produces hits on one sensor layer should also produce hits on other layers in positions approximately above or below the first set of hits.
- Therefore when a cluster of hits is found on one sensor layer, there should be some corresponding hits not too far away in the sensor layers above or below. If corresponding hits are not found in other layers then it can be assumed that this is because the particle has passed through those layers without being recorded.
- Therefore the efficiency of a sensor is equal to the percentage of clusters in a layer above or below which have hits associated with them in the current layer.

Efficiency Study:Method

- There are however several other factors to be considered before the efficiency of a given sensor layer can be calculated:
- Due to a 180^{o} rotation of the sensor between layers, in a four layer stack, for any given shaper region there will only be one shaper regions directly above or below that region and the same will be true for sampler regions. Given that in this study shapers and samplers are investigated separately, this fact makes the study simpler since for any sensor layer there is only other layer which can be used to find its efficiency (rather than three) .
- The size and shape of a cluster of hits cannot be predicted at this point, this makes identifying all the hits in a cluster extremely complicated (at least for a computer program). However simply finding all the hits in clusters is much easier. Assuming the area searched for corresponding hits is much larger than the cluster, the percentage of hits in clusters which have hits in other layers associated with them should be the same as the percentage of clusters which have hits in other layers associated with them, which should be the efficiency of the sensor being searched for associated hits.

Efficiency Study:Results

- Runs selected for this study were 490006, 490037, 490039 and 490040 since these are all mpsBeam runs without tungsten plates in front of the beam (the tungsten plates would produce large numbers of low energy particles which would produce fewer hit clusters).
- The area searched for hits corresponding to a given cluster hit was a square with the location of the cluster hit at the centre. The size of this square was determined by a value referred to as the 'margin'. The margin was essentially the maximum difference between the column and row values of the original cluster hit and a hit on another. The search area is shown in the diagram below:

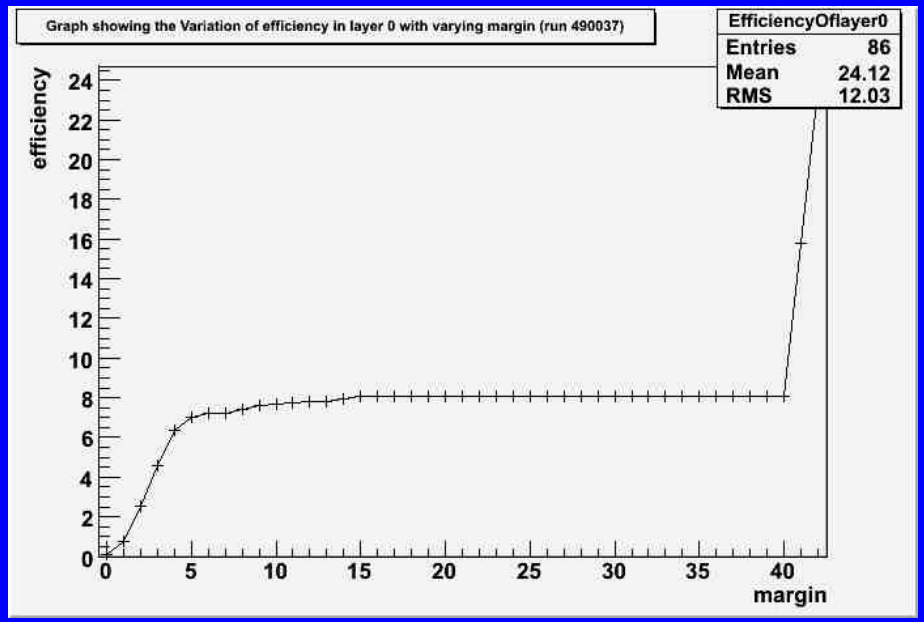


Efficiency Study:Results

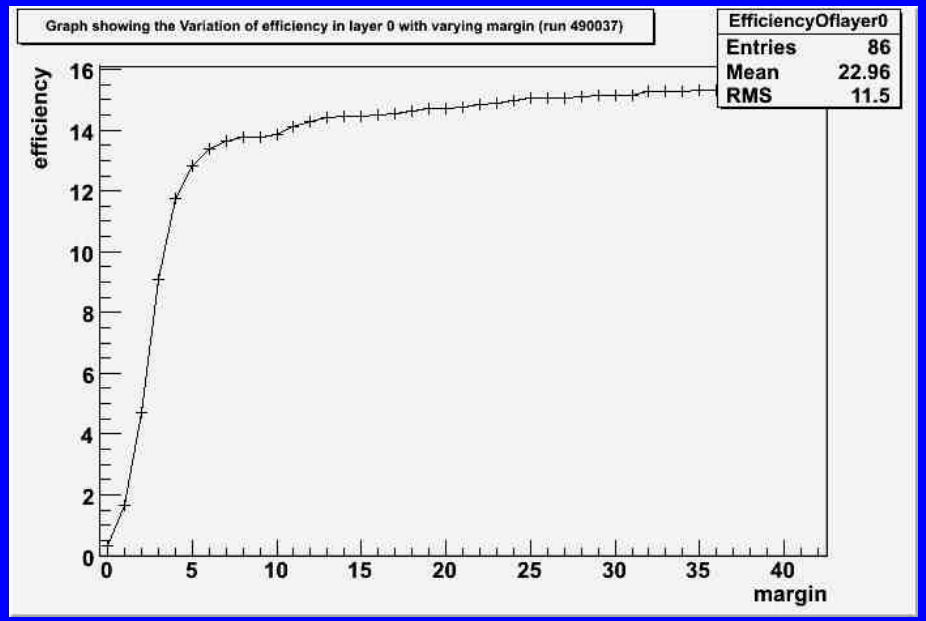
- Sensor efficiency was calculated for a range of search margins and graphs of efficiency plotted against search margin were produced for the runs listed on the previous slide.
- Two graphs were produced for each sensor layer (one for the shapers, one for the samplers).
- Due to the large number of plots produced (eight per run) only those from a single run (490037) have been included in this presentation.
- Plots from other runs will be posted on the Calice Wiki at a later date.

Efficiency Study:Results (Layer 0)

Samplers



Shapers



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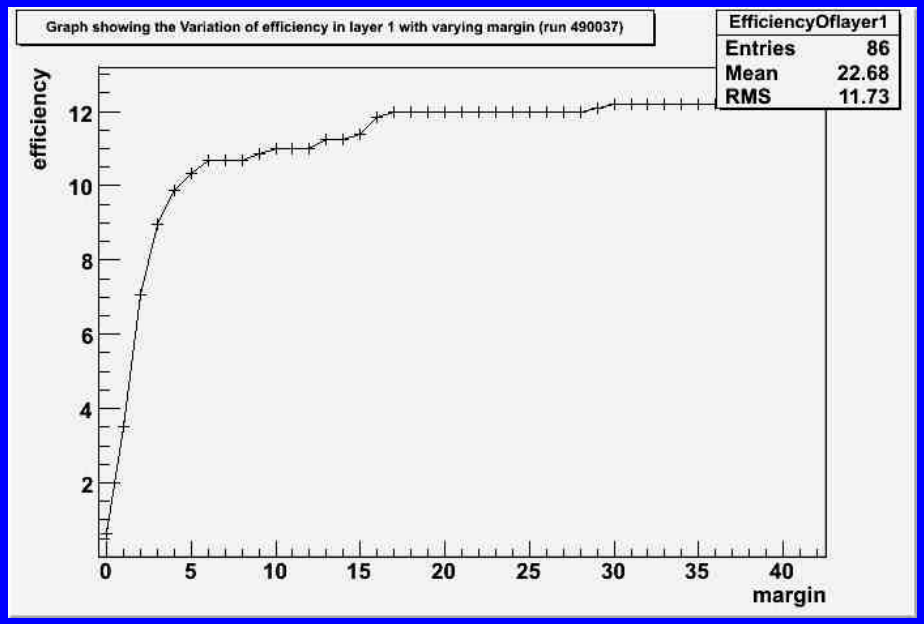
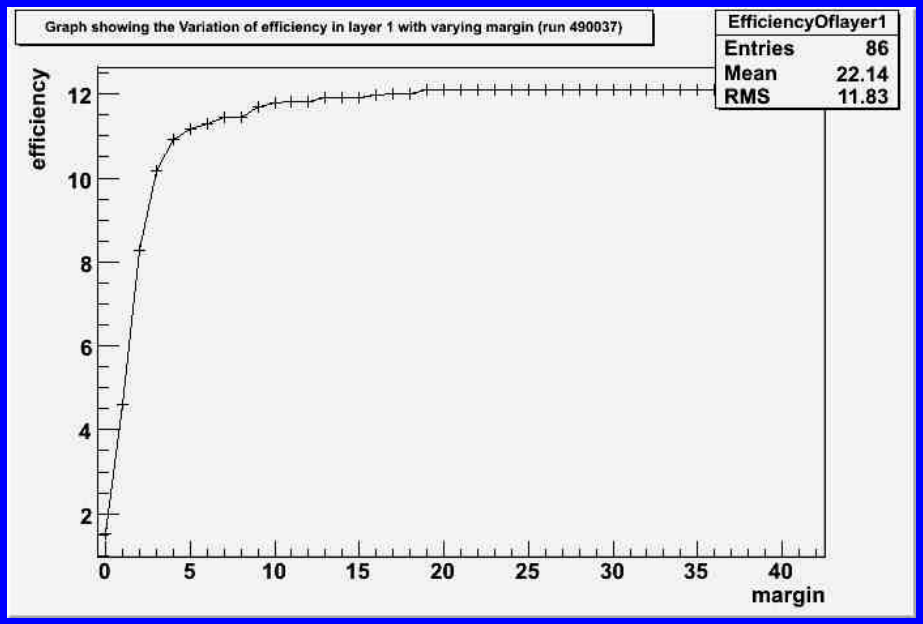
Efficiency Study:Results (Layer 1)

Samplers



Shapers



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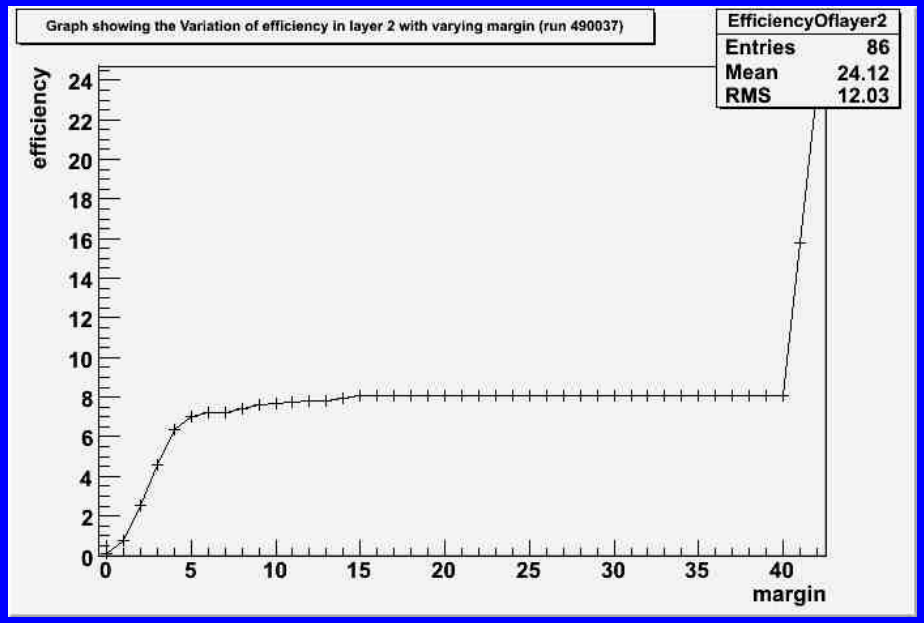
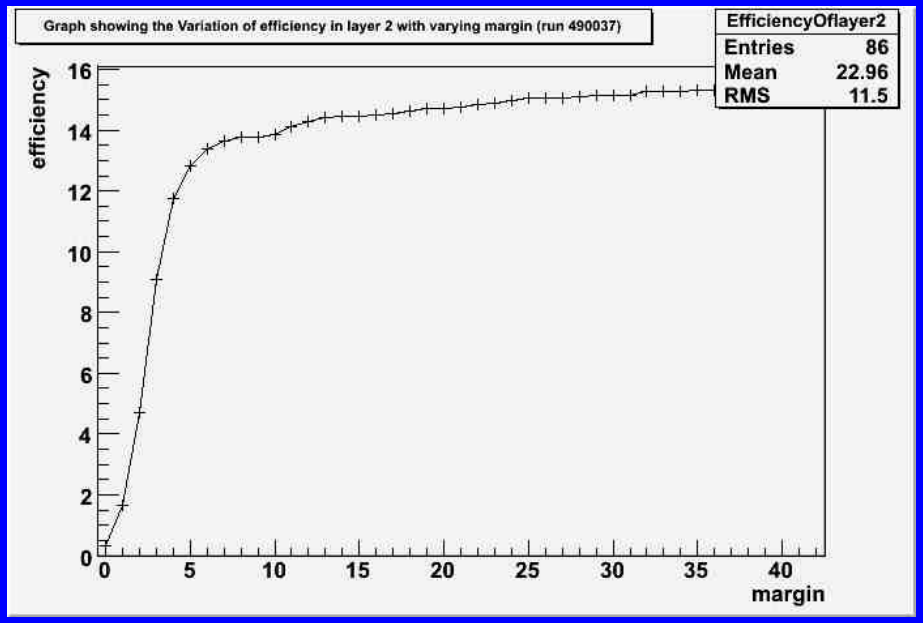
Efficiency Study:Results (Layer 2)

Samplers



Shapers



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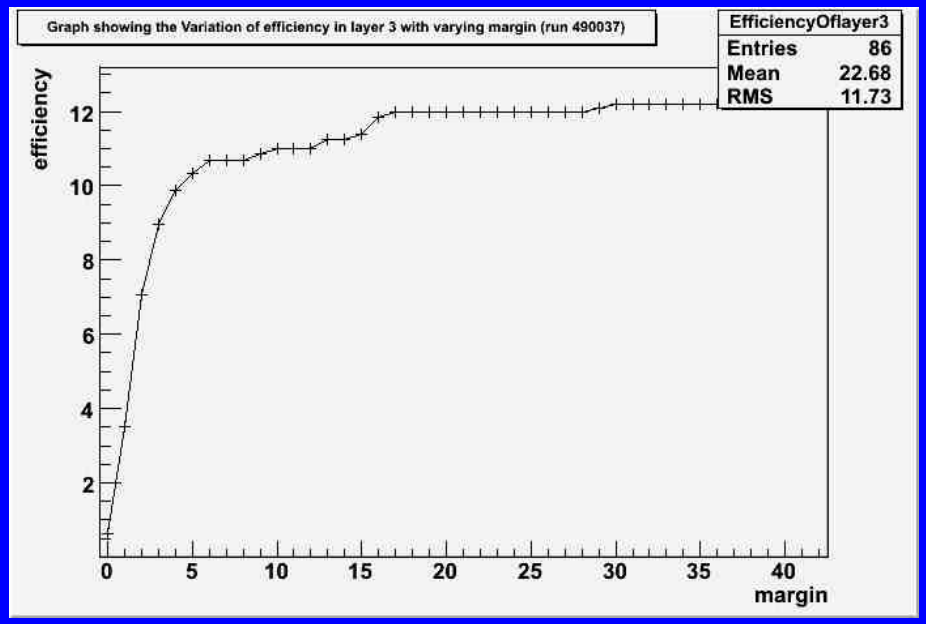
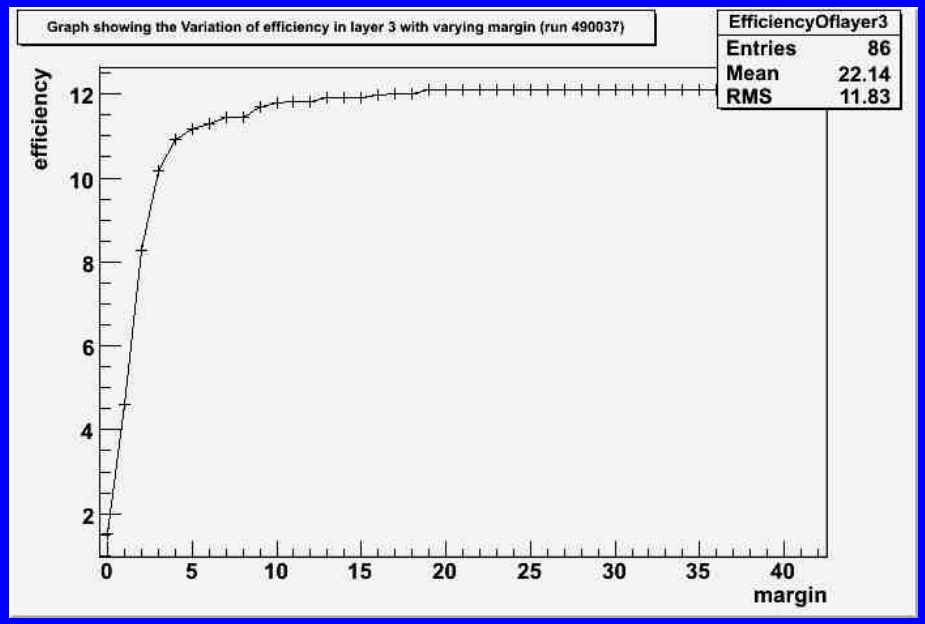
Efficiency Study:Results (Layer 3)

Samplers



Shapers



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Efficiency Study:Current Work

- One thing that these graphs do no take into account is that small numbers of cluster hits (and their associated hits) are recorded in the sensor even when there is no beam, not being generated by particles, these hits should not be part of this study.
- Currently runs 490048, 490041, 490042, 490065, 490063 and 490038 (all of them runs with no beam) are being analysed to find out how many cluster (and associated) hits are recorded without a beam. This is used to amend the numbers used to calculate the sensor efficiency, since there is some variation in the hits recorded without beam this will introduce some uncertainty into the efficiency values.