Introduction

- The objective of this study is to examine the effect of increasing pixel reset time on the ability of the ECAL to record hits.
- Specifically the focus is on calculating the proportion of pixels in the ECAL which will be inactive due to a long reset at any given time and in any given region of the detector.

A Brief description of the mathematics

- Assume a single bunch crossing results in n hits on the some part of the ECAL, after some time x the number of pixels which have been hit is given by:

$$N = \frac{nx}{t}$$

Where t = the time interval between bunch crossings.

- It is reasonable to assume that the number of pixels which are inactive will increase as long as x < T (T is the reset time of a pixel). At this point each new bunch crossing will see n new pixels being hit, and roughly the same number becoming active again as they reset.

A Brief description of the mathematics

- Therefore after time T the number of inactive pixels will remain roughly constant at:

$$N = \frac{nT}{t}$$

- In a given region the proportion of pixels which are unavailable at any time > T is given by:

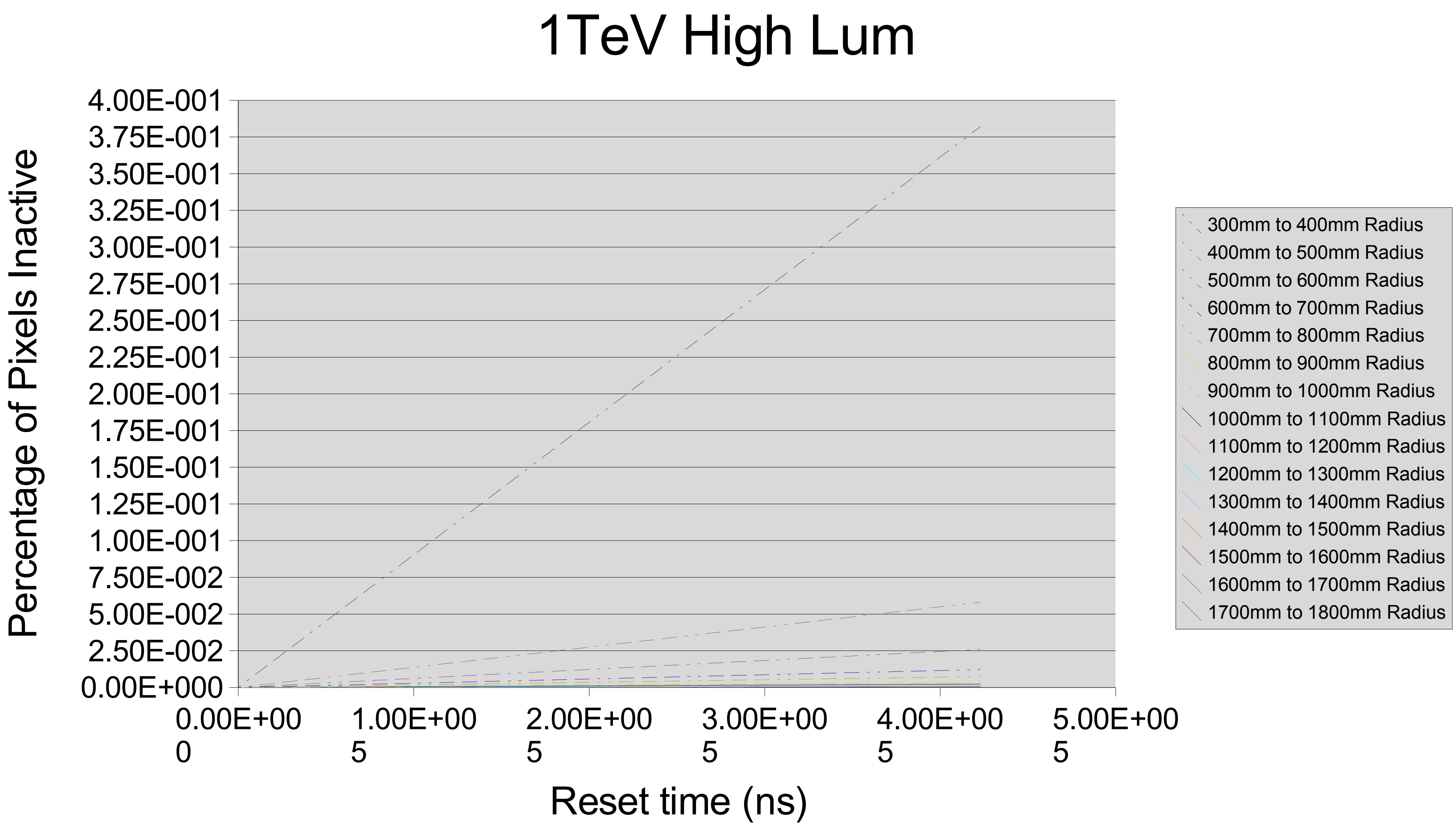
$$P = \frac{N}{D} = \frac{nT}{Dt}$$

Where: D is the number of pixels in the region
n is the number of hits in the region for a single bunch crossing.

Assumptions

- At present it is assumed that the majority of hits on the ECAL are due to incoherent pair production from beam-beam interactions. Therefore the value of n is for now determined by the number of hits on the ECAL from incoherent pair production, discounting all other processes.
- Therefore the graph on the next page is only a lower limit/order of magnitude estimate of the proportion of pixels that are inactive.
- The graph is based on GuineaPig simulations of the ILC operating at 1TeV using the High Luminosity machine parameters (since these parameters produce the most hits in the ECAL).

The Result


1TeV High Lum
Percentage of Pixels Inactive
4.00E-001
3.75E-001
3.50E-001
3.25E-001
3.00E-001
2.75E-001
2.50E-001
2.25E-001
2.00E-001
1.75E-001
1.50E-001
1.25E-001
1.00E-001
7.50E-002
5.00E-002
2.50E-002
0.00E+000
0.00E+000
1.00E+005
2.00E+005
3.00E+005
4.00E+005
5.00E+005
Reset time (ns)
300mm to 400mm Radius
400mm to 500mm Radius
500mm to 600mm Radius
600mm to 700mm Radius
700mm to 800mm Radius
800mm to 900mm Radius
900mm to 1000mm Radius
1000mm to 1100mm Radius
1100mm to 1200mm Radius
1200mm to 1300mm Radius
1300mm to 1400mm Radius
1400mm to 1500mm Radius
1500mm to 1600mm Radius
1600mm to 1700mm Radius
1700mm to 1800mm Radius

Possible extensions

- With further simulations it may be possible to incorporate hits from other background processes into the value of n. This should make the results more accurate in addition to showing the accuracy of the assumption that n is dominated by incoherent pair production.
- The first process to be incorporated in this way will probably be photon production from beam-beam interactions.
- It is possible to analyse other data produced by GuineaPig and Mokka to extend this study to different detector configurations and to the barrel region of the ECAL.
- Refining the model of the far forward region of the detector would lead to greater accuracy in the simulation, both of the number and position of hits due to incoherent pair production.
- We are presently trying to create our own Mokka geometry database based on work by Adrian Vogel to incorporate his refinements of the far forward geometry.