



Optimization of Reconstruction Algorithm for BeamCal (ILC)

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HELMHOLTZ

The Aim and Content

The Aim:

- find optimal parameters for reconstruction algorithm
- investigate and compare characteristics of calorimeter applying this algorithm

Content:

- Introduction
 - Searching for algorithm parameters
 - looking into energy depositions in cells precisely
 - comparing with another algorithms
 - fake rate
- Calorimeter characteristics studies
 - shower reconstruction efficiency
 - energy deposition and resolution
 - spatial resolution?
- Conclusion



Beam Calorimeter for ILC



Beam parameters from the ILC Technical Design Report (November 2012)

- Nominal parameter set
- Center-of-mass energy 1 TeV

BeamCal aimed:

- Detect sHEe
- Determine Beam Parameters
- Masking backscattered low energetic particles





Beam Calorimeter for ILC



Energy Deposition due to Beamstrahlung



Shower from Single High Energy Electron



Search parameters for reconstruction Algorithm

The goal:	find optimal parameters of reconstruction algorithm
In my hands:	deposited energy in each cell of calorimeter from shower and RMS of background(BG)
Parameters to apply:	 how many sigma(RMS) to apply which layers should be considered how many cells in a row

Requirements: - fake rate < 2% (strictly!) - increase: --efficiency of reconstruction --energy resolution --spatial resolution



Simulation Showers

- Sector area
- Distribution: RD





Algorithm

- 1. SH + BG average_BG
- 2. Layers from 5 to 20
- 3. Energy threshold 5 RMS
- 4. Combine to towers
- 5. Search Max energetic tower
 - * if there \geq 13 cells (not necessarily sequent), search for neighbor towers
 - * if in neighbor \geq 9 cells & at least 1 neighbor
 - => shower defined
 - * Consider candidate towers to shower within Rm=1.2 cm or at least 8 pads around max energetic tower
 - => shower created
- 6. Next shower: repeat step 5
- 7. For each shower calculate
 - R COG and Phi COG
 - Energy



Algorithm

1. SH + BG

with BG

wo BG

- +
- 2. average BG by $10^{th}\ previous\ BX$
- 3. Select layers from 5th to 30th. Search for towers contains at least 10 sequent pads with Edep>0 along Z axis.
- 4. Searching in that towers tower with maximum energy deposition
- 5. Look on to 8 neighbor towers around that tower
- 6. Get output: R_{COG} , ϕ_{COG} , E_{clu}







Idea

Compare energy deposition on small radii (most problematic area for reconstruction) along Z-axis for:

- tower of the shower core and tower of the RMS on small radii
- max energetic tower of (BG average_BG) and

tower of the RMS





Tower profiles from Shower core and RMS on small R



Tower profiles from Subtracted BG and RMS on small R



But for showers(previous slide) we still have possibility to reconstruct, especially going further with radius



Choosing parameters. Fake Rate.

Source	Difference in conditions	Layers to be considered	RMS applyed	Min number of cells in a row	
				In SH max	In neighbor
Max SH Tower and RMS along Z comparison (previous slides)	1 Tev	5-20 (25?)	>2 RMS (chosen 5 RMS)	13	9
Thesis of Katharina Kuznetsova, 2006	500GeV , diff size of pads, type of segmentation - US	4-17	3 RMS	10	6
FCAL Paper, 2004	500 GeV	2-20	5 RMS	9	6

Checking fake rate (100 files were used)

	Layers to be consider ed	RMS applyed	Min number of cells in a row		Fake rate	
			SH max	Neighbor	US	PS
Case 1 (suitable)	5-20	5 RMS	13	9	2 %	0 %
Case 2 (relaxed)	5-20	5 RMS	10	6	3%	3%



Efficiency

- 1. Reconstruction showers on top of BG -> Number of ring rReco and phiReco
- Reconstruct showers, no threshold applied (0*RMS, cause not all SH on small radii reconstructing) -> rTrue, phiTrue
- 3. If | rTrue rReco| < Rm and |phiTrue phiReco| < Rm, then shower reconstructed correctly and ratio rReco/rTrue = efficiency
- 4. Else (| Rtrue- Rreco| > Rm) fake shower



Efficiency 500 GeV







Efficiency 200 GeV







Efficiency 50 GeV







E deposition from 200GeV electrons



Edep vs Ee for radius: 3.5<R<7 (cm)

Without BG - sigma criteria is zero!!



Edep vs Ee for radius: 7<R<12 (cm)





E resolution vs Ee for radius: 3.5<R<7(cm)









E resolution vs Radius





Conclusion



Back up



