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L0 Confirmation using the T stations (Hadron alley)

Malcolm John - 08 Jun 2006

This page describes the study of how to use the T-stations to [quickly] confirm a L0 trigger in the HCAL.

The starting point: L0 cluster

The highest pT cluster in the HCAL is stored at */Event/Trig/L0/Calo* in the form of the data object *L0CaloCandidate*. This object defines the 2x2 group-of-cells in which the high pT particle is expected. The energy-weighted bary-centre of the cluster is calculated from the *CaloDigits* of these four cells.

Improving the HCAL position precision: S-curve correction

As the granularity of the HCAL is larger than the average hadron shower, the bary-centre calculation is always biased towards the centre of the dominant cell. This effect can be partially corrected for by applying a simple *S-curve* correction. This correction, which is taken from Monte Carlo of 350000 minimum bias events paramterises the correction as:

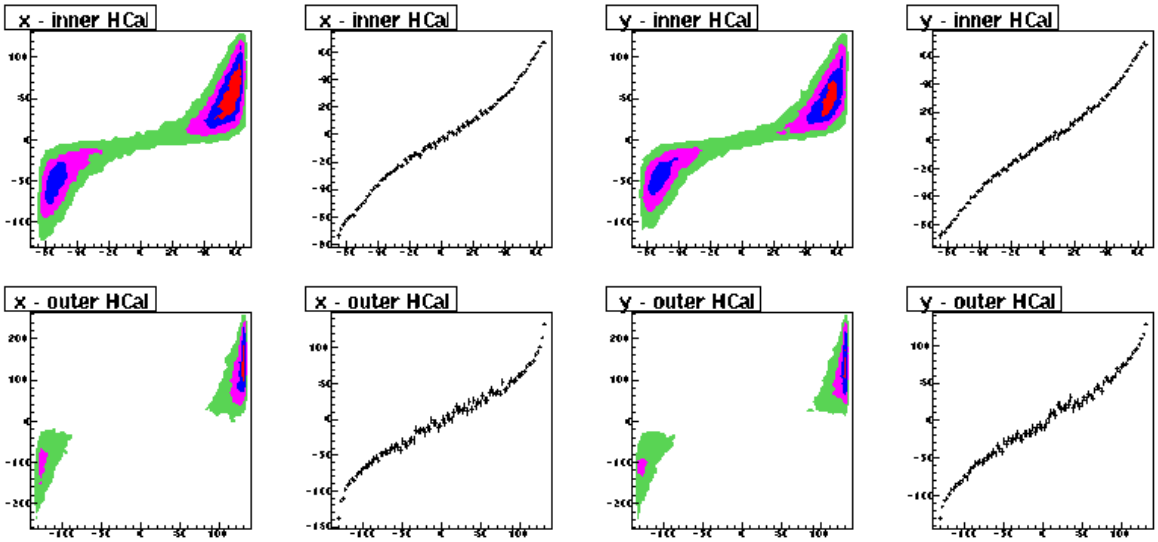
d_CORR = A * tan (B * d_REC) + C

where d_REC is the position of the bary-centre w.r.t. the centre of the 2x2 cell group and A,B,C are the parameters taken from the Monte Carlo. The same parameterisation is valid in both X and Y. The paramters used are recorded in the following table:

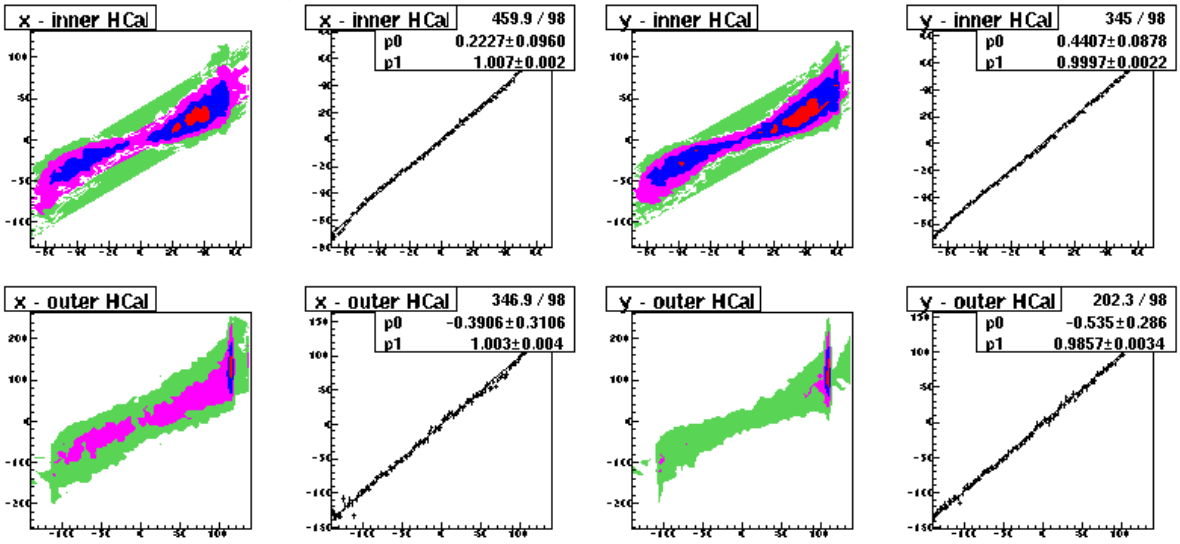
	__		parameter **A**	parameter **B**	parameter **C**
inner HCAL	X:	left	45	0.015	-14
		right	41	0.016	8
	Y:	upper	54	0.014	-10
		lower	47	0.015	8
outer HCAL	X:	left	43	0.0096	-20
		right	48	0.0092	16
	Y:	upper	61	0.0086	-18
		lower	67	0.0082	18

The before and after the S-curve correction are plotted here:

- S-Curves for the HCAL:

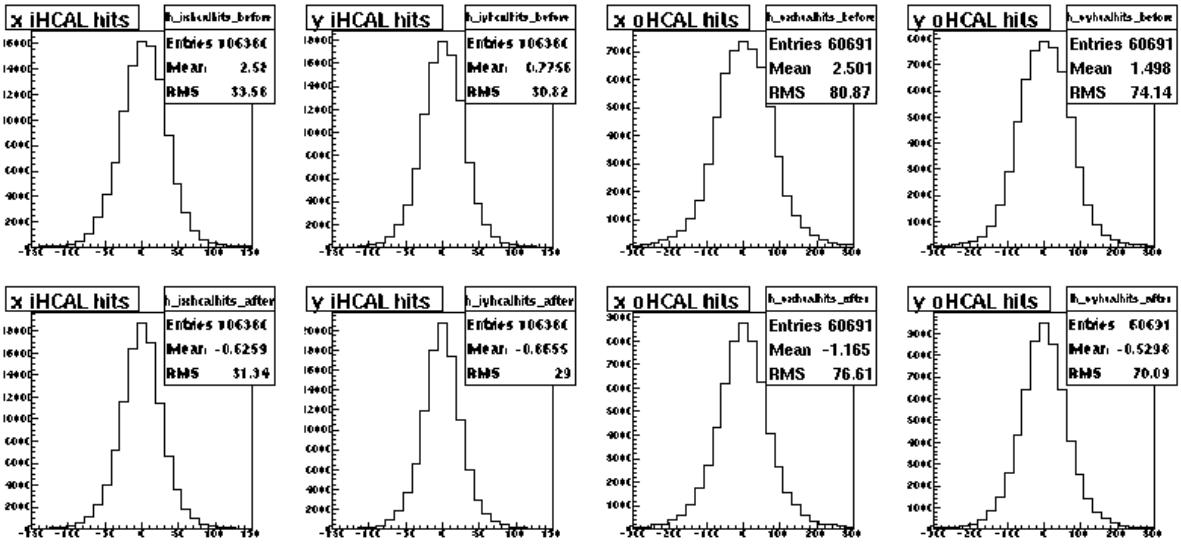


- S-Curves for the HCAL (correced):



The benefit of this correction on the position precision is small but non-negligible:

- 1st line :Before... 2nd line: After correction:



Use the ECAL as well

In approximately two-thirds of L0 HCAL triggers, the shower starts in the ECAL. The higher granularity of the ECAL means these deposits can provide additional position information on the track.

Starting from the best position estimate in the HCAL (assumed to be z=13690mm) a X-Y hit point for our track is predicted in the ECAL (assumed at z=12830mm). This point will fall in the middle of an ECAL cell. The nearest cell edge is then taken and the "reference" in both X and Y. The cross-hair of these two edges forms the centre of a 2x2 cell from which the *CaloDigits* are used to calculate a barycentre of the proto-hadron shower in the ECAL.

On the use of S-curve corrections in the ECAL

As above, an s-Curve correction can be applied. The parameters and observed improvement are recorded in the following table.

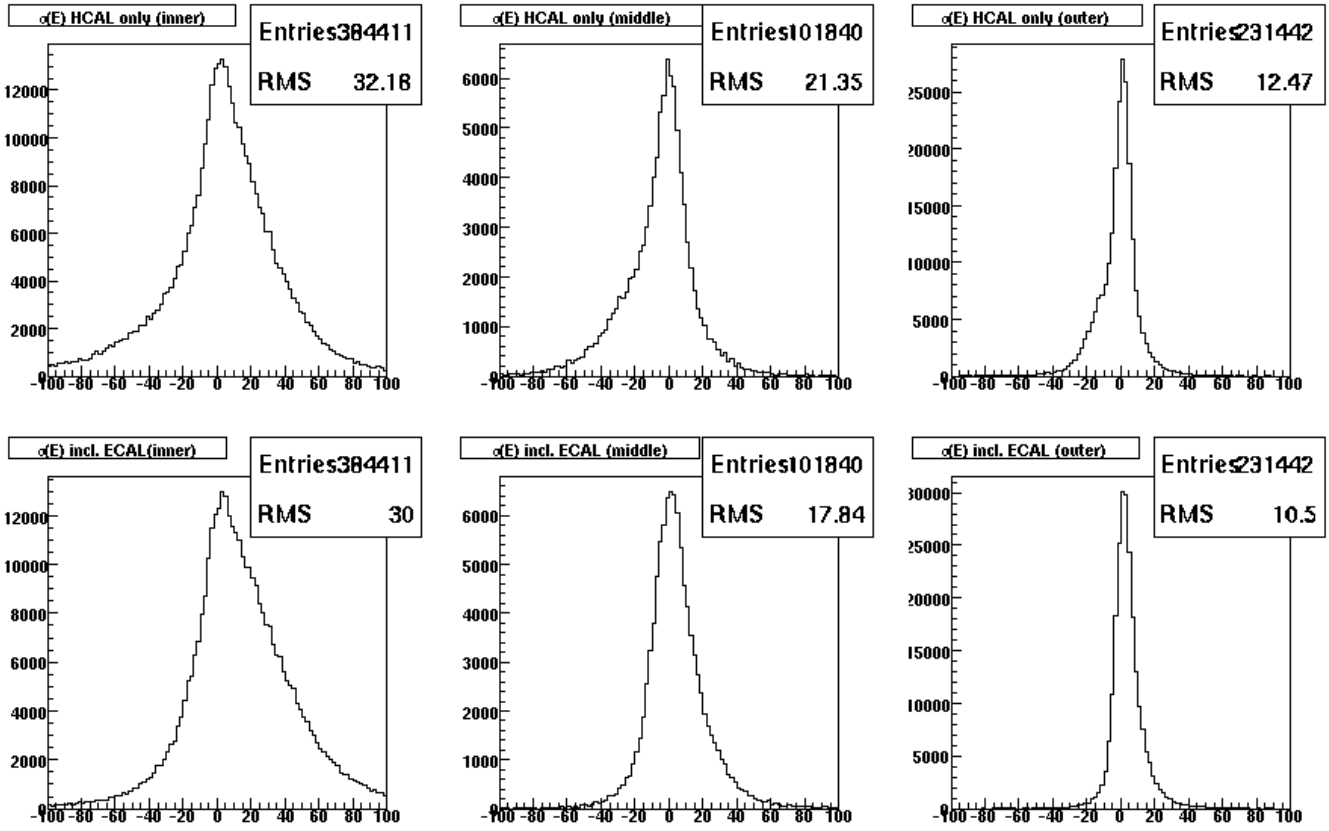
		inner ECAL		middle ECAL		outer ECAL	
		x	y	x	y	x	y
	A	8.3	9.3	13	13	22	22
	B	0.063	0.063	0.042	0.040	0.021	0.021
	C	-1.3(l)/1.8(r)	-1.0(u)/1.1(l)	-3.0(l)/1.1(r)	-1.7(u)/0.6(l)	-6.7(l)/3.7(r)	-2.0(u)/-1.1(l)
RMS	(before)	16.6	16.7	21.7	20.6	42.3	41.0
	(after)	16.5	16.4	21.3	20.1	41.4	39.9
sigma	(before)	9.5	9.2	14.3	13.6	28.0	27.7
	(after)	8.7	8.6	12.7	12.1	22.0	21.5

The corrective effect of the S-curve correction is can be visualised here: (before correction), (correction applied).

Finally a decision has to be made on the theshhold above which we assume the energy deposit in the ECAL is associated to the hadron shower. As a guide, we look at the S-curves in the ECAL as a function of four energy (not E_T!) cut-offs. To partially remove the noise tails seen at the edges of the curves, a energy cut of 1000MeV and 500MeV is applied for the inner and middle part of the ECAL. No cut is deemed necessary for the outer part.

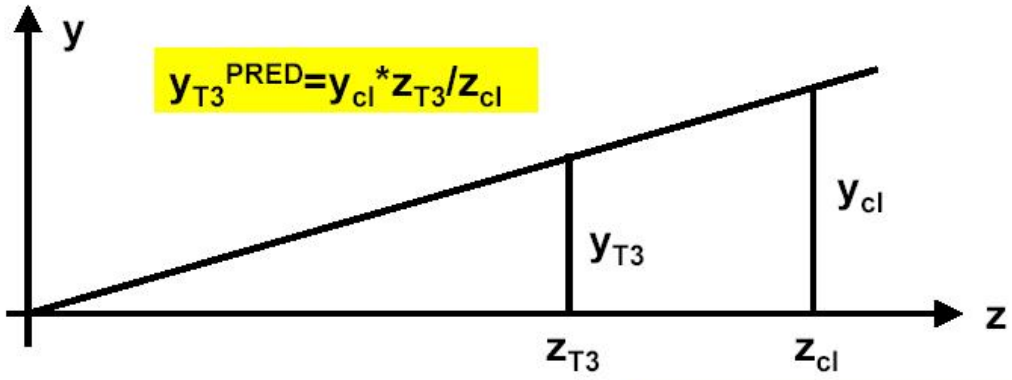
Benefit to the energy resolution from including ECAL information

Energy precision is seen to improved with using ECAL information:

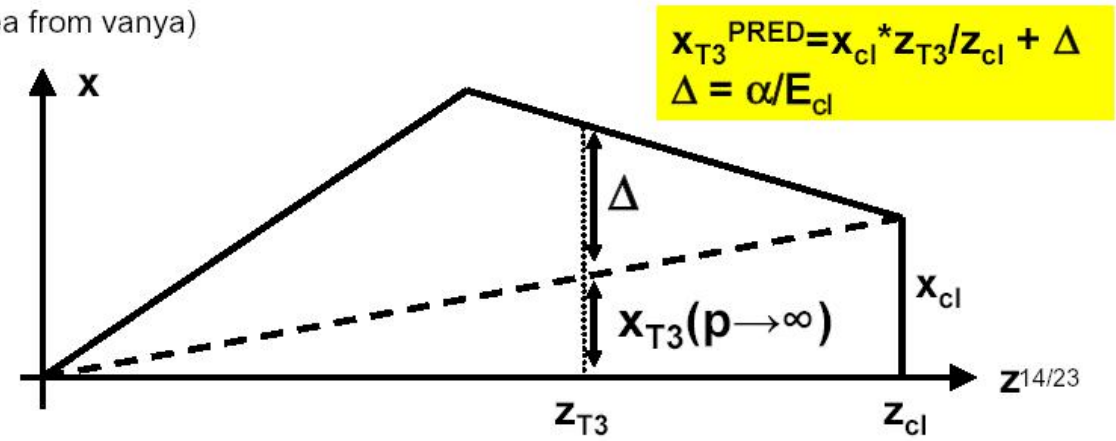


Predicting the particle track into the T-stations

To predict the track of the L0 Candidate, it is assumed the particle has followed a straight line from the IP (0,0,0) in *y*. For *x*, the deviation from a straight line due tothe magnetic field is assumed to be inversely proportional to the particle's energy. See the following sketch by Herve...



(idea from vanya)



The parameter "alpha" is obtained from a 350k minimum bias Monte Carlo sample and is recorded in the following table: Where ECAL information is used to define the x-y co-ordinate of the L0 candidate cluster, z=12830mm is the assumed starting point in the ECAL. Where no ECAL information is used z=13690mm is used. If the ECAL is used, the energy used in the projection is the sum of the deposit seen in the the HCAL 2x2 cluster plus than in the ECAL 2x2 cluster.

x10^6	T1		T2		T3	
	IT	OT	IT	OT	IT	OT
assumed z (mm)	7760	7939	8447	8625	9138	9317
ECAL	2.56	2.52	2.25	2.20	1.92	1.85
HCAL	2.80	2.78	2.52	2.47	2.21	2.15

This topic: LHCb > L0ConfHCalAndTStations
Topic revision: r10 - 2007-10-29 - StephenWotton