ENERGY CALIBRATION OF THE TRIGGER TOWERS

(Draft 1.1 of a note available if anyone is interested)

THE NOTE ADDRESSES THE E-M AND TILECAL CALORIMETERS

CONTACTS	**Pascal Perrodo for all liquid argon calorimeters**
	As yet nobody for tilecal

Liquid Argon	**Absolute calibration i.e. energy -------> FADC**
	Beam tests plus physics reconstruction
	Monitoring
	Charge into front-end amplifiers
Tilecal	**Absolute calibration**
	Beam tests plus physics reconstruction
	Monitoring
	Charge into front-end amplifiers Light into PM photocathodes Radioactive sources

The calibration discussed here is charge injection unto the front-end amplifiers.

TRIGGER HAS VERY SPECIFIC REQUIREMENTS c.f. OFFLINE RECONSTRUCTION

- **Trigger is making decisions in real time**

- **Trigger tower inputs are the sum of pulse heights over many calorimeter cells (up to 60 for e-em barrel).**

- **Nobody else in ATLAS uses the trigger tower signals ----> we must monitor them.**

- **For the trigger the significance of the failure of a single calorimeter cell depends where it is in the hadronic or electromagnetic shower.**

TYPES OF TRIGGER TOWER CHECKS REQUIRED

- **Checks to test that each calorimeter cell within a trigger tower is contributing to the overall signal at the same level.**

- **Tests of the layer summing and the tower builder electronics.**

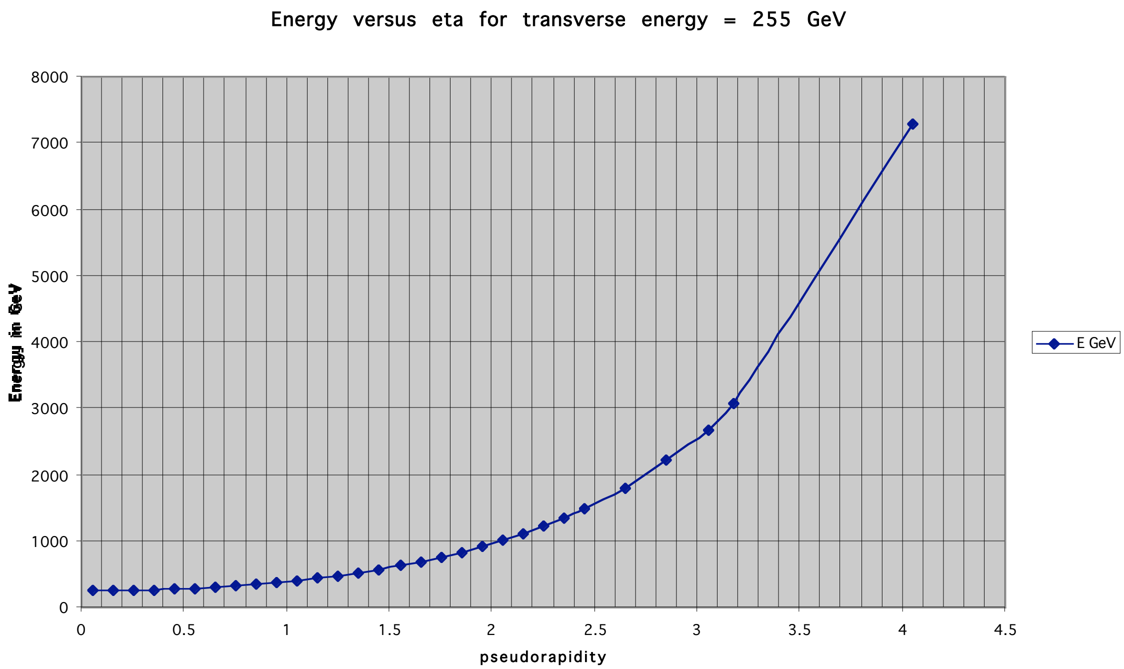
- **Tests of the response of the tower builders over the rapidity range 0 to 3.2 to check that the gain is changing in such a way as to prevent saturation of the output signal. (O/H)**

- **Tests of the receivers for correct calculation of $\sin \theta$ over the rapidity range 0 to 3.2.**

- **Test the linearity of response of the layer sums and trigger towers, i.e. relationship between injected charge and pulse height, immediately before each physics run. This needs on-line processing of PPM FADC results.**

  This test must exclude noisy calorimeter cells.

- **The effect of the removed noisy cells, and of non-functioning cells must be estimated and the loads in the LUT's of the PPM's adjusted. Regions of the calorimeter where the HV may have been lowered for operational reasons must have their response corrected in the LUT's.**



Energy versus eta for transverse energy = 255 GeV
Energy in GeV
8000
7000
6000
5000
4000
3000
2000
1000
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
pseudorapidity
E GeV

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Creator: PSCRIPT.DRV Version 4.0
Preview: This EPS picture was not saved with a preview (TIFF or PICT) included in it
Comment: This EPS picture will print to a postscript printer but not to other types of printers

LIQUID ARGON CALIBRATION SYSTEM

- **6 partitions each driven by a Local Trigger Processor (LTP). (O/H)**

- **Any combination of calorimeter cells can be pulsed.**

- **Amplitude of charge injection pulse can be set.**

- **For each setting, of pattern and pulse height they envisage 100 triggers. The mean and standard deviation of each cell is calculated in real time in their RODs and stored in their ROBs. The time is estimated as ~ 10 minutes for the whole of the liquid argon calorimetry.**

- **The configurability of the pulsing system is versatile enough to provide all of the trigger tests described above.**

ISSUES WHICH EMERGED IN DISCUSSIONS WITH PASCAL PERRODO AT CERN ON 17/9/2003

1 **The LTP's can be chained together to guarantee synchronous pulsing for all the partitions of the liquid argon calibration system, and allow the addition of a LVL1 trigger partition. Any partition can be MASTER.**

2 **In CALIBRATION mode the calorimeters store their extracted calibration constants in their ROBs. The trigger must do the same Then all data must be picked up by ATLAS DAQ to allow the calculation of the absolute energy calibration of the trigger towers.**

3 **A database will to be set up which will be updated offline after each liquid argon calibration run. This database will contain details of the response of each calorimeter cell.**

Noisy cells will NOT be turned off in the liquid argon calibration runs. The trigger will need to access this database to identify noisy cells AND dead cells.

4 **For between-fill trigger calibrations, noisy cells will have to be switched out at the layer sums. The location of these cells and of the dead cells will need to be extracted, and an algorithm evaluated to estimate the resulting reduction in the trigger tower pulse height. This will be needed to correct the trigger tower energy calibration in the LUTs in the PPM.**

5 How do we calculate the correction required to be applied to "compensate" for dead and noisy cells? The correction depends on where these cells are in the hadronic or electromagnetic shower. For electromagnetic showers the peak of the shower is in the middle layer;

dead material	1.5 X_o
presampler	0.5 X_o
strip layer	4.3 X_o
middle layer	16.0 X_o
back layer	2.0 X_o

The complete electromagnetic calorimeter comprises 0.73 hadronic interaction lengths (□), the complete tilecal 7.6 □. Since most showers will be hadronic, we will have to use a hadronic energy profile to compensate the trigger tower energy (?).

If the between-fill calibrations are done at the layer sum level (which I would recommend), then on line we will know which layer contains the missing cells.

6 Parts of the calorimeter may require the HV turned down. One HV line covers 4 trigger towers. This should be detected and incorporated in the sequence 5 described above. However we recommend another database of actual high voltage settings.

THE BETWEEN RUN CALIBRATION SEQUENCE

- **Calibration of the liquid argon calorimeters under the control of the calorimeter people, via their LTP's.**

- **Immediately following a trigger calibration run driven by the trigger LTP.**

- **The runs cannot be simultaneous because of the different pulsing configurations needed by the trigger, e.g. layer sums, noisy cells, different range of charge injections (e.g. do not need 3 TeV in each cell!), energy profile in the layers.**