Scintillator Update

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ITC Scintillator Update

(cryostat (or crack) scintillators)

(gap scintillators)
Intended to correct for energy loss (both EM and HAD) in the near-forward rapidity region

- segmentation into two readouts
  - $1.2 < |\eta| < 1.4$
    - $r_{\text{min}} = 1.838$ m, $r_{\text{max}} = 2.28$ m
  - $1.4 < |\eta| < 1.6$
    - $r_{\text{min}} = 1.473$ m, $r_{\text{max}} = 1.838$ m

Also may be of interest for luminosity monitoring

Design has readout by WLS fibers coupling to ITC fiber assemblies

- because of space constraints, thickness of counter is only 8 mm (with 6 mm scintillator)
- read out using 6 0.9 mm WLS mirrored fibers

Standard techniques; counters of similar design have been constructed
Transition region

- Barrel/end-cap transition region is one of the two most critical “crack regions” in ATLAS
- Particles incident at this rapidity see 6 cryostat walls, the coil, inner detector cables and services, dead liquid and calorimeter electronics (~$7\times_0$)
- Well within the region for precision physics ($|\eta|<2$)
Degradation in detector response: EM

- In the region from $1.45 < |\eta| < 1.55$, the energy lost in material in front of calorimeter is too large to be recovered with presampler.
- Have to use crack scintillator:
  - more efficient because it samples the dead material at the middle of its thickness.

After correction with the crack scintillator, energy response is recovered and sampling term improves by factor of 4 (less at higher energies).

Figure 2-48: Calibrated energy reconstructed in the calorimeter as a function of the energy deposited in the scintillator for electrons of $E=30$ GeV at $\eta = 1.47$ before (closed symbols) and after (open symbols) correction.

Figure 2-51: Energy resolution for electrons of $E=80$ GeV as a function of rapidity in the barrel/end-cap transition region before (closed symbols) and after (open symbols) adding the energy deposited in the scintillator and presampler. Electronic and pile-up noise are not included.
Degradation in detector response: HAD

- Similar situation with both pions and jets
- Linearity and resolution recovered with scintillator
Crack Scintillator (E3, E4)

- Outer End piece
- Mounting bracket
- Optical connector sockets (2) pinned and sealed into end piece
- Compression plate with set screws in same holes as mounting screws
- Bottom cover panel is epoxied to end pieces. Black felt light seals line the surfaces in contact with fibers or scintillator edges. Top cover panel overlaps the bottom cover and end pieces and is taped at the edges.
- 6 mm thick PVT Scintillator, wrapped in Tyvek
- (6) WLS Fibers for cell E3
- Optical Isolators on edges as necessary
- (6) WLS Fibers for cell E4
- Inner End piece
- (1/8 x 3/4) pin

1. Dimensions are in mm with a tolerance of ±0.1 unless stated otherwise. Dimensions in parentheses are in inches.

NOTES:

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Mounting Proposal

GAP SCINTILLATOR

CRACK SCINTILLATOR

TILECAL EB

(2) M4 x 15 Socket Hd. CS attaches crack ctr. to bracket

Bracket

Bar is Integral to crack ctr.

Bar is Integral to gap ctr.

eta=1.20

Shim as needed to clear LAr Cryost.

LAR CRYOSTAT

MOUNTING DETAIL

NOTES:
* Indicates Envelope Dimension
Dimensions assume 2 mm between Ctrs.

Bar is Integral to crack ctr.

Bar is Integral to gap ctr.

Shim as needed to clear LAr Cryost.

LAR CRYOSTAT

MICHIGAN STATE UNIVERSITY
HIGH ENERGY PHYSICS

DRAWN | R. Miller
DATE | 9-21-01 | REV | E
PROJECT | ATLAS ITC SCINTILLATOR
MATERIAL
TITLE | MOUNTING
DWG. NO | HEP-B-025-371
SCALE | 1:5
Cryostat scintillator status as of 2004

- Optics, PMT’s, electronics and even mechanical shells were available
- Scintillator purchase was a victim of management contingency and the cryostat scintillators were on the upgrade path
- In the last few months, thanks to Marzio and Howard Gordon, the money is now available for construction and installation
- ...but, construction has to be complete by the end of this FY
- Completed counters will be sent to CERN at the end of 2005
  - when does installation make sense?

...and, to save money, we will use polystyrene scintillator provided by Dubna, rather than the PVT scintillator from Bicron; factor of 2 less light yield, i.e. more like 2-3 pe/mip

- calibration issues
MBTS counters

Completion of cryostat counters made possible by tying this project in with MBTS counters:

- Trigger scintillation counters mounted on LAr endcap cryostats covering the radial dimension of the Inner Detector
- To be used for first beam, 3-4 months at low luminosity for triggering/timing information
- Will be interesting to study just what all they can be used for
MBTS counters

• Dubna has already produced the scintillator for all of the MBTS counters
  - awaiting some final decisions regarding clearances, then scintillator will be shipped to CERN->MSU
  - construction will also take place this summer, available for shipping this fall
  - testing of prototype counter with ATLAS electronics currently taking place at the University of Chicago
  - when does installation make sense?
Radiation Questions

- Cryostat scintillators are in a higher radiation environment than the rest of the Tilecal
  - at highest value of $\eta$, can expect up to 1 Mrad for 10 years of operation at $10^{34}$
  - intensity falls off very quickly at lower values of $\eta$
- Can expect a light loss of order of 25-50% at high $\eta$ for this time period
  - scintillator can be replaced fairly straightforwardly if we have access to that region
  - use Bicron scintillator for high luminosity running, if funding is available
Questions

● What information is available as far as number of shower particles in cryostat scintillator for the energies of electrons, photons and jets that we would like to correct?

● What is the best way of calibrating these counters, given that light yield might be low for the use of muons?