May 6, 1998

Grounding and Power Distribution for the Tile Calorimeter

1. Objective

This note proposes a grounding structure for the Tile Calorimeter which is should minimize undesirable noise components in analog signals, provide a safe and reliable system, and not degrade the signals of other ATLAS detector systems. To implement a satisfactory structure will require the cooperation of all TileCal groups associated with the electronics, as well as all other ATLAS detector systems. Each of the ATLAS detector systems has been asked to prepare such a plan.

2. The Problem

Currents flowing in the ground network result in different points of the network being at different potentials. Because of this, signals referred to ground have different amplitudes at different points depending on the ground reference used. In some cases a time dependent ground potential may be superimposed on the signal of interest. Ground currents may include switching transients such as high frequency clocks, as well as a 50 Hz component from mains current. Even capacitive coupling to grounds may produce such currents.

Loops can easily occur in the ground network and substantial currents may be induced. If the ground network develops without planning, it will be difficult to diagnose and to rectify problems. The goal of this recommendation is to minimize such effects for the Tile Calorimeter.

3. TileCal Structure

The TileCal detector is a cylindrical geometry consisting of a barrel section and two extended barrel sections as shown in the figure below.

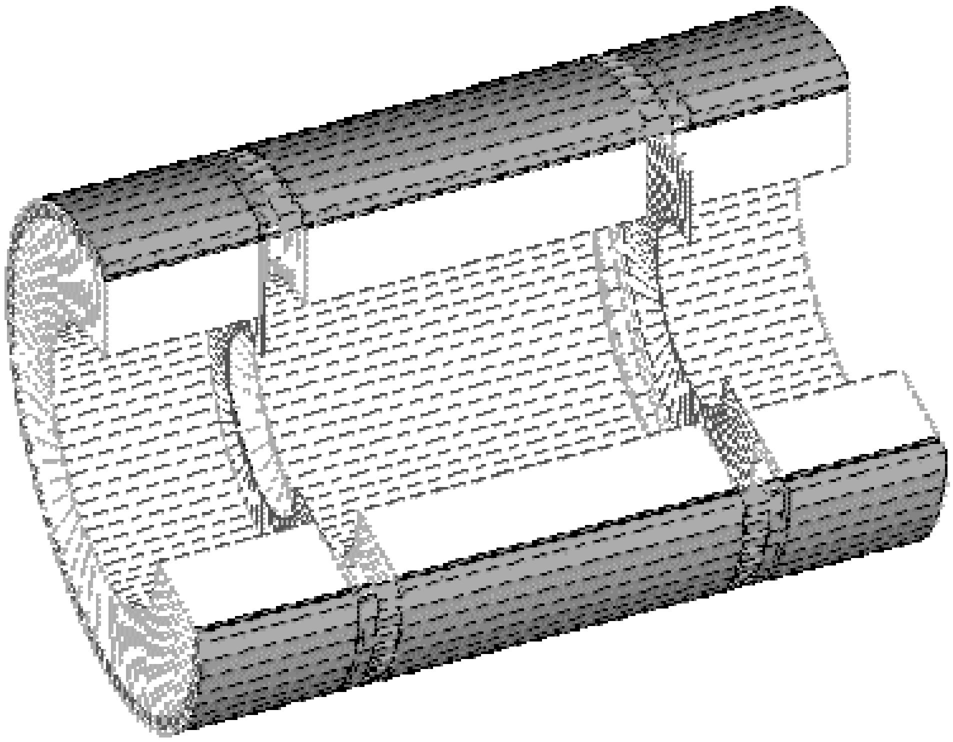

Figure 1: Tile Calorimeter structure.

Each of the three section is composed of 64 azimuthal sectors with the readout electronics for each sector located in 3-m-long "drawers" at its outer radius. All 256 drawers are nearly identical and contain photomultiplier tubes, high voltage distribution and regulation for the tubes, signal shaping, signal digitizing, slow integrators, adders for the LVL1 trigger, and electronic calibration system. The only electrical elements outside the drawers is the control circuitry for the cesium source calibration system which consists of hydraulically driven source capsules which pass through stainless steel tubes in the calorimeter.

4. Connections to the Electronics Drawers

Each drawer has the following connections:

- low voltage power (+15V, +5V analog, +5V digital, -5V)
- one common high voltage input (a shielded coax with SHV connector)
- optical fiber carrying high voltage control information
- optical fiber carrying TTC information
- optical fiber carrying digitized signals out of the drawer to the RODs
- shielded twisted pair carrying CANbus digital control data and integrator ADC output
- 9 shielded twisted pairs carrying analog signals to the LVL1 trigger

- metal tubes for input and output of the cooling water

4. Proposed Ground Structure

(a) None of the power or signal grounds should be directly connected to the iron ground of the calorimeter or to any external “chassis” ground. These “chassis” grounds should be connected to a safety ground with a single clean connection.

(b) The water cooling tubes must have an insulated section at the entry to the drawers to prevent electrical connection to the external conducting tubes.

(c) It is proposed to divide the detector into azimuthal groups of 16 drawers with separate power supplies for each group. Overall, the detector would have 16 such groups. A single bundle of power cables from the supplies would service each group.

(d) The low voltage power supply grounds should be floating, except for a single connection to the primary ground in USA-15.

(e) The HV ground to each drawer cannot be floating but should be connected to ground through a 1K resistor.

(f) In the case of signals carried on shielded twisted pairs, the shield should be connected to ground at one end only.

5. Conclusions

The grounding problems of the Tile Calorimeter are eased by the fact that most connections to the electronics are on either optical fibers or shielded twisted pairs. In addition, it should be possible to locate the power supplies at a small number of locations.

It is believed that the procedure described above will result in a sound and verifiable ground structure.