# The case for developing the TOT capability for the GLAST LAT TKR

September 2002, Hartmut F,-W. Sadrozinski and Eduardo de Couto e Silva

The TKR TOT allows a reasonable measurement of the deposited energy in the silicon strips. It is an analog complement to the binary nature of the silicon strip readout, with certain limitations
The limitations are that the TOT signals from all the strips on one plane (one side of a tray) are OR'ed into one signal, and thus the TOT is a measure of the largest energy deposited in any strip in a plane. In addition, there is both a saturation of the TOT signal in the analog front-end (initially meant to be set in at about 25-40 fC) and a time-out in the controller chip (set at 50usec at present). A MIP signal is about 5fC.

Several studies have been performed on TOT data both with BTEM data and with BFEM data. The hardware calibration of TOT linearity with input charge was checked selecting MIPs from the Beam Tests data (good agreement). In addition we tried to study the TOT response from different incident particles. These were limited by the fact that the TOT implemented in the Monte Carlo simulation did not agree with data and needed to be modified. Only recently, a new TOT implementation in the MC was released and it is now being debugged. As a first step in the debugging process is to obtain the new response curve (TOT vs. input charge) from the hardware to check with the one implemented in the simulation. ( Note that this response curve is different for BTEM/BFEM and the prototype ASICs now being tested).
To further calibrate the MC Carlo we need real particles and we would like to study the TOT distributions during the EM model hardware test with low energy photons and cosmic rays.

In the following areas, the application of TOT has been studied or is being planned:

1) Discriminate 2 tracks against 1 track in one strip to find the gamma conversion point. This was done both for the beam test but has never been confirmed by MC.
2) Help with background rejection of charged particles (important for electrons). There is an indication that this may be helpful from BFEM data analysis.
3) Find low-energy photons and reject upward going gamma's. For the time being this an idea that is being developed.
4) Rejection of noise hits (very short pulses).
5) Tagging of heavy ions, which give many overflows along the track.

Work to be done:
Study the analog behavior of GTFE (slope TOT vs charge, analog saturation, dynamic range)
Study digitization in GTRC (LSB, resolution, dynamic range, time-out, consecutive hits)
Verify in MC charge deposition Q in SSD strips, apply correct TOT(Q) from above
Compare MC with beam test data (gamma, electron, proton) or EM data
Develop algorithms to use TOT in gamma reconstruction and background rejection