

New TRT GEANT3 Geometry and Digitization Code

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Please use CVS Tag: trt-04-02-17.

TRT GEANT3 Geometry Changes

Since the February ID Software meeting, there have been a number of changes put into CVS for the TRT GEANT3 geometry.

1. A reminder of the TRT geometry that was already in the repository:

- Shorter active lengths in the end-cap wheels with no service gap between the A & B wheels. Fido Dittus has confirmed that the lengths in the simulation are correct.
- NB: Must set GEOM=2 to select modular barrel geometry which is still NOT the default.

2. Barrel TRT geometry revisions are:

- Reduced the barrel straw active length by ~2 mm to match what is being built.
- Resized barrel module cooling tubes to match current design.
- Moved modelling of short straws to geometry from digitization.
- Adjusted twister / glass tube combination to proper length and average density.
- Renamed barrel module volumes to the form XBxx from the form XxxB to avoid naming clashes. (There are no data tapes using the old name convention.)
- Increased amount of dead material on the TRT barrel end to 13.77% X0 from 7.48% X0.
- Introduced the parameter TRTGeo in TRTG that is set to 1 for the non-modular barrel and to 2 for the modular barrel so that data files contain which type barrel geometry was used.

TRT Geometry Changes (continued)

3. End-cap TRT geometry revisions are:

- Adjusted Z positions of all end-cap wheels to match the current drawings.
- Adjusted density of end-cap radiator stacks to match current specifications: Type A & C stacks are 0.081 g/cm^3 and type B are 0.061 g/cm^3 . These densities are not used by the private TRT TR calculation and are only used by GEANT to produce secondaries.
- Density of the service material for the inner part of the TRT wheels is increased: Type A & C are now 3.0% X0 instead of 2.3% X0 and Type B is now 2.1% X0 instead of 1.5%.

4. Global TRT geometry revisions are:

- Changed service gaps to match the Geoff's latest drawings. The active part of TRT barrel now ends at $Z = 710 \text{ mm}$ and the front of the first type A wheel is at $Z = 834 \text{ mm}$.
- Introduced the parameter BECS_{hf} in TRTG that allows one to adjust the separation between the barrel and end-cap TRT with a parameter should further changes be made to the gap.
- Increased wire radius to 15.5 microns from 15.0 microns to allow for the gold plating on the wires.
- Removed material for pixel services in gap between B and C wheels because of insertable pixel design (leave 1997 amount SCT material in same gap).

TRT GEANT3 Digitization Changes

Since the February ID Software meeting, there have been a number of changes put into CVS for the TRT GEANT3 digitization.

1. Recent digitization changes that were already in the repository in February:

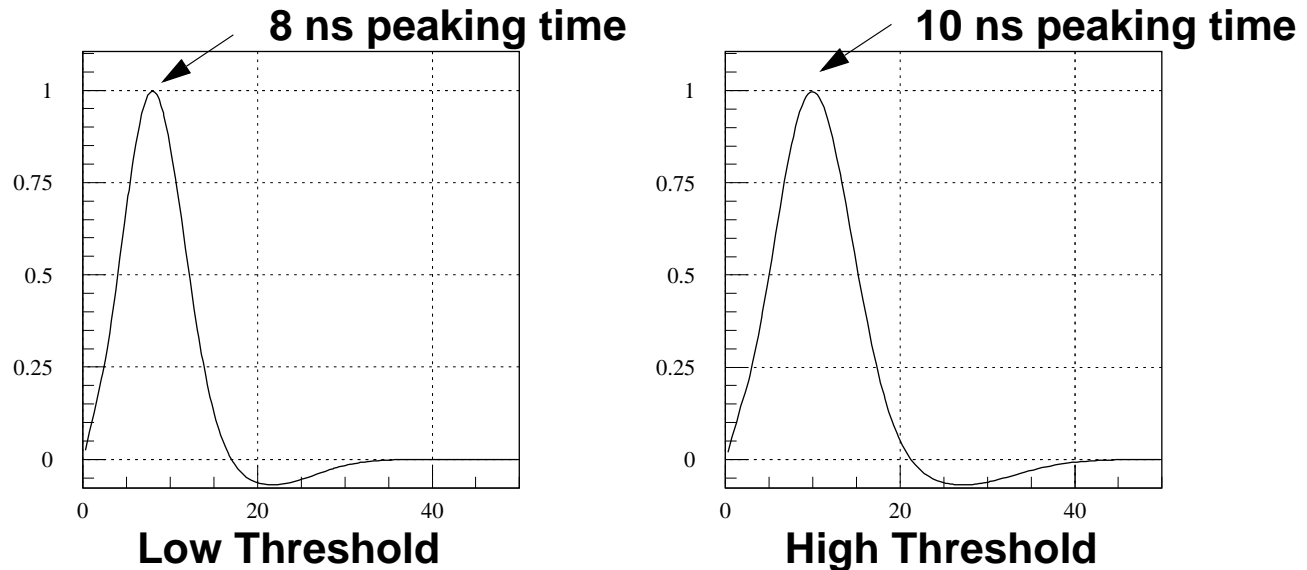
- Lowered low energy cut for range over which dN/dx is calculated.
- Introduced use of the exponential cluster resolution algorithm.
- Removed hard-coded GEANT cuts applied to TRT radiators, straw, and gas and added a check of the GEANT δ -ray cut to avoid double counting energy deposition.
- Introduced a correction to energy deposited by δ -rays created in the gas mixture.

2. Since the February meeting these changes to the digitization have been made:

- Reduced the HV used in the drift time calculation from 1830 V to 1530 V to solve a long standing problem. Thanks go to Elisabetta Barberio & Anatoli Romaniouk for recognizing problem.
- Moved the location of the check of the GEANT δ -ray cut to ensure that it worked reliably.
- Corrected a problem causing ~4% of the hits in the TOF mode to be assigned to wrong bunch crossing. Thanks go to Mogens Dam (Niels Bohr Institute) for reporting problem.
- Corrected an uninitialized variable that caused the official dice release to crash running standard muon test events. Thanks go to Gilbert Poulard for reporting problem.

TRT Digitization Changes (continued)

- Introduced two new digits (the full encoding and the trailing edge time) to match the readout scheme.
- Corrected the signal shaping function was too slow and too wide (thanks to Anatoli Romaniouk). After several iterations these ASDBLR signal shapes were put into the simulation.



- Adjusted the TOF mode validation gate in the digitization routine that recognizes hits as coming from the in-time bunch crossing to reflect the new signal shapes. The new shapes have faster rise-times and the validation gate had to be moved earlier.

TRT GEANT3 Open Issues

There are some items that are incomplete, under discussion, or not yet decided:

1. Revised TRT service material amounts (used by both the radiation task force and GEANT simulation). There now are detailed spread sheets for all parts of the TRT except the electronics and services at the outside of the end-cap wheels. There also is some uncertainty about the TRT cables runs along the outside of the end-cap and up the gap between the barrel and end-cap TRT.
2. The number ionization clusters produced by very low energy tracks. Currently the number of clusters rises linearly in with decreasing $\log(\gamma-1)$ which is proportional to $\log(1/\beta^2)$. Some editions of the particle data book suggest using $\log(1/\beta^{5/3})$. Discussion with Pavel Nevski indicates that this has a small effect.
3. The effect of electronic noise, threshold variation, crosstalk, etc. These were requested by Daniel Froidevaux and Anatoli Romaniouk and remain to be put in.
4. Variations of the signal shape with the charge received. Currently the simulated signal shapes are independent of the charge on the input though the code does permit a charge dependent signal shape. Discussion with Rick Van Berg (Penn) indicates these variations are significant in the TRT electronics and Mogens Dam's work shows that the readout simulation is sensitive to the shape used.