

# **New GEANT3 TRT and ID Services GEANT4 Pile-Up Requirements GEANT4 Inner Detector Hit Definitions**

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- 1. Changes in GEANT3 TRT, Service Material, and Beampipe Code**
- 2. Pile-Up Strategy and Requirements for GEANT4**
- 3. New Inner Tracker Hit Definitions for GEANT4**

# TRT GEANT3 Code Release

The revised TRT code is now in the repository.

The new code includes:

1. The current TRT geometry.

- Shorter active lengths in the end-cap wheels.
- Service gap locations and widths match engineering design from March 2000.
- NB: Must set GEOM=2 to select modular barrel geometry.

2. A revised digitization model that is tuned with testbeam data.

The main items that the new code is missing are:

1. Revised TRT service material amounts.

2. The drift time to drift distance relationship is not decided.

3. The number ionization clusters for very low energy tracks is probably wrong.

4. The digitizations are in an old format and do not match the read-out scheme.

5. Minor changes to include electronic noise, threshold variation, crosstalk etc.

# BEAMPIPE AND SERVICES

The beampipe and service material geometries have not been revised since the time of the ID TDR.

## New Beampipe:

Simulated as being 2 walls each 0.8mm thick for  $|Z| < 3650$ mm.

Inner wall has an inner radius of 29mm.

Outer wall has an inner radius of 33mm.

Need to contact Mike Shupe to get rest of beampipe (i.e.  $|Z| > 3650$  mm) before putting it in.

## Service Material

The usual suspects (Sasha - pixels, Jo - SCT, and myself - TRT) will supply the information

Urgent - material needs to be presented at the LHCC on March 19.

I haven't start work on this.

# Pile-Up Requirement for ID

**I created a requirements document for the use in developing a pile-up service in Athena. For the ID, the basic pile-up strategy remains as it has always been:**

- 1. Generate individual, fully simulated minimum bias events**
- 2. Combine the hits from the minimum bias events to get a set of simulated hits for the detector that has the density expected in real pile-up events. The LHC bunch crossing structure and time response of the ID systems is taken into account in combining the minimum bias event hits.**
- 3. Digitize the combined set hits into a single simulated read-out of the whole inner detector.**

**Starting from the experience of the Physics TDR, the document derives requirements for the Athena pile-up service.**

**After many comments from specialists, the document is nearly ready for use.**

**The requirements shown on the next slides apply ONLY to the Inner Tracker. In the document there are other requirements given by LAr calorimeter and muon system that will be much harder to implement than these from the ID.**

# Inner Tracker Pile-Up Requirements

The requirements pertaining to the Inner Detector are:

- 1. Digitizing the combined hits of the physics and the background events will create the pile-up events. Fully piled-up events will not be generated and then tracked in GEANT.**
- 2. The inner detector needs two data streams: a physics event stream and a minimum bias stream. The possibility to have more than additional data streams is desirable.**
- 3. The minimum bias events should be randomly selected from a database that contains many more minimum bias events than are needed by the largest pile-up event.**
- 4. It should be possible to reuse the minimum bias events repeatedly by randomly recombining the minimum bias events into different pile-up events.**
- 5. The minimum bias event hits should be grouped into bunch crossings and the time offset to the bunch crossing made available automatically.**
- 6. The number of events in each bunch crossing should be randomly set using a Poisson distribution with specified mean.**

# **ID Pile-Up Requirements Continued**

- 7. The number of bunch crossings used should be specifiable. It should be possible to use at least 5 preceding and 3 following bunch crossings for testing but -2 to +1 (+2?) would be the widest range needed for major production.**
- 8. For large Monte Carlo production at design luminosity, a maximum of 200 minimum bias events is a reasonable.**
- 9. The pile-up should be able to use a minimum bias event with a 4 MB event size (larger would be better). The 4 MB event size may have to be revised.**
- 10. It should be possible to revert to the previous standard pile-up method where flight-time was not used.**
- 11. The pile-up event should be written out including sufficient information that it is possible to determine which truth tracks and hits contributed to each digitization in the event.**
- 12. To control the size of the working memory set it should be possible to process the hits for parts of the detector without having the all hits for all subdetectors simultaneously in memory.**

# ID Hit Definitions

For use with GEANT4, a new Inner Tracker general hit definition is proposed. The proposed hit definitions use more memory than the GEANT3 hits.

For Each Step in an Active Volume

Hit	Proposed Size in Bits	Possible Reduced Size in Bits
Step Starting Position (X, Y, Z)	3 X 32 = 96	3 X 8 = 24
Step Ending Position (X, Y, Z)	3 X 32 = 96	3 X 8 = 24
Track Energy Loss in Step	32	16
Flight Time to Middle of Step	32	16
Track Number or Pointer to Track	32	32
Track Energy or Lorentz Gamma	32	16
Number of Clusters	32	8
List of Cluster Energies	16 per cluster	8
<b>Total (ignoring shaded fields)</b>	288	112

There may also need to be a word of flag bits. Some additional storage will be required to link each hit to a specific pixel, strip, or straw.