

# **BEAMPIPE RATE STUDY AND TRT GEOMETRY**

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**Inner Detector and Software  
Meeting 05/07/00**

- 1. Rate Studies For Beampipe Design**
- 2. Material Status**
- 3. TRT GEANT3 Geometry Changes**
- 4. Open TRT-Related Simulation Issues**
- 5. GEANT4 Work**

# BEAM PIPE DESIGN

Several proposed beam pipe designs were studied:

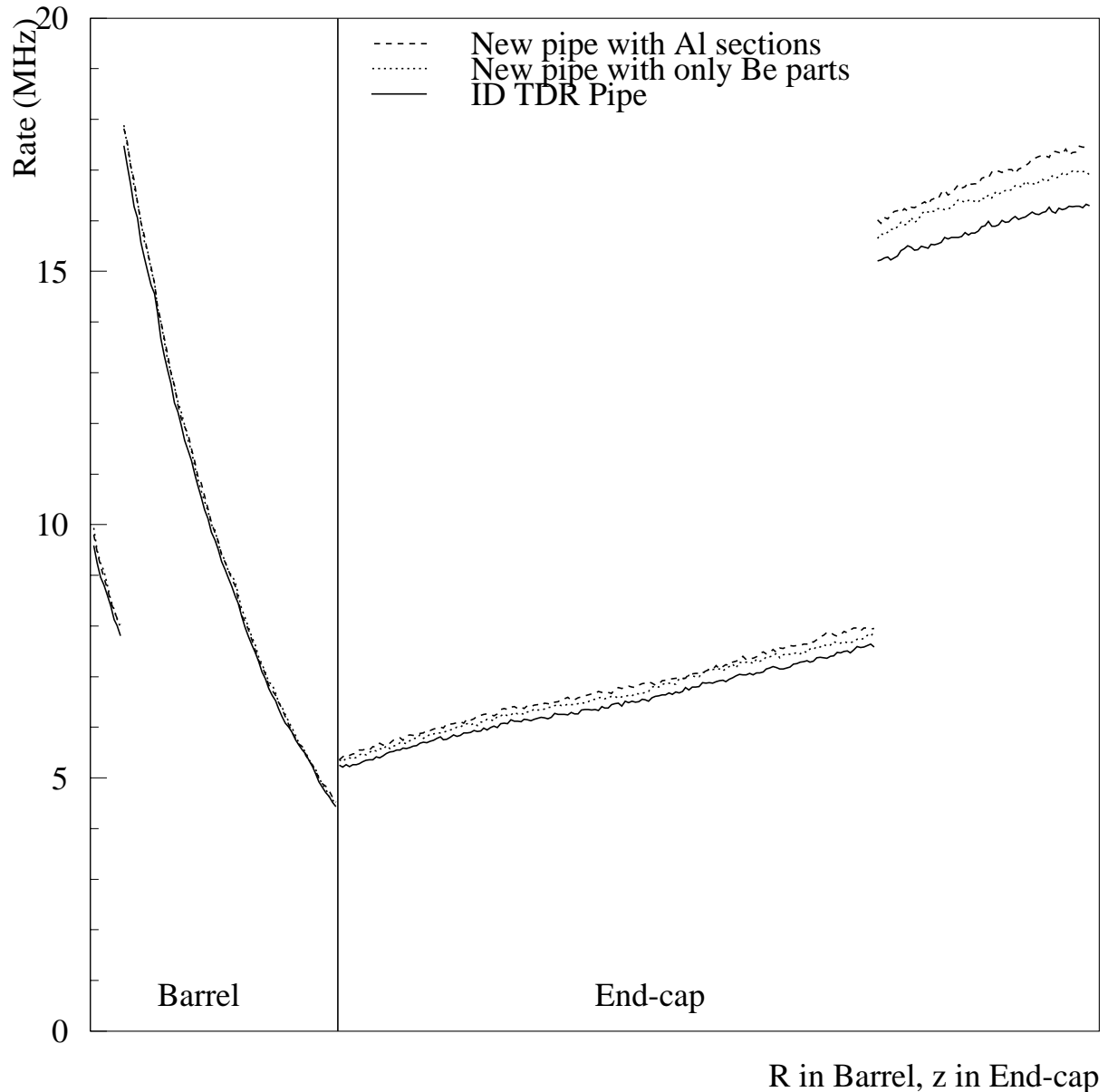
1. Simple Be pipe with OD 50 mm used in ID TDR.
2. Current design with aluminium NEG pumps.
3. Current design with beryllium NEG pumps.
4. Other designs used stainless steel NEG pumps which thankfully were discarded.

**Simulation Parameters of Various Beam Pipes**

<b>Name</b>	<b>Material</b>	<b>Wall (mm)</b>	<b>OD (mm)</b>	<b>Z Location (mm)</b>
<b>Original</b>	Be	1.0	50.0	$ Z  < 3650$
<b>Al Getter</b>	Be	0.8	59.6	$ Z  < 2750$
	Be	0.8	67.6	$ Z  < 2750$
	Al	1.1	60.2	$2750 <  Z  < 3650$
	Al	1.1	68.2	$2750 <  Z  < 3650$
<b>Be Getter</b>	Be	0.8	61.2	$ Z  < 3650$
	Be	0.8	67.6	$ Z  < 3650$

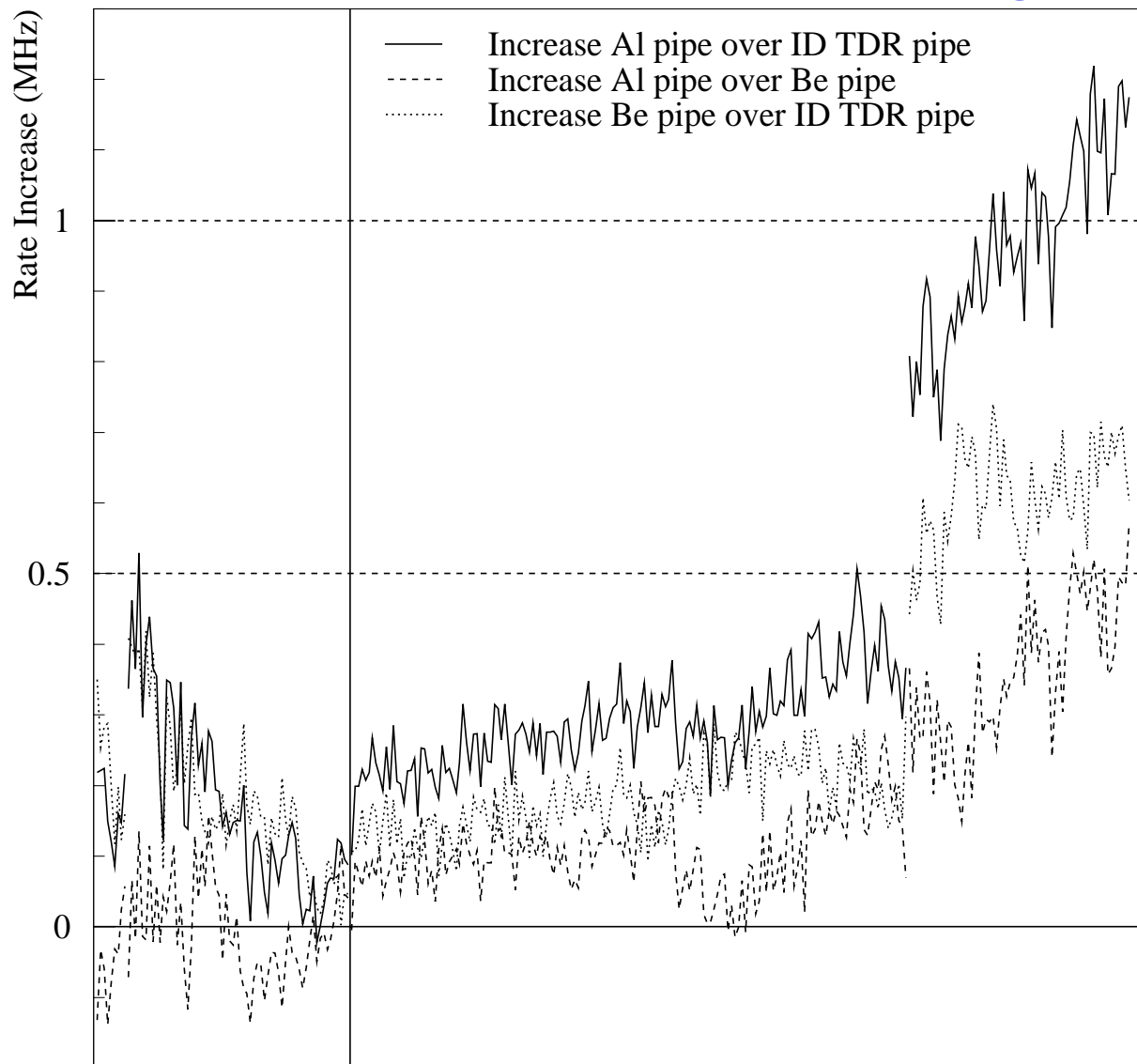
# BEAM PIPE RESULTS

The rates of TRT hits by charged particles with  $E > 100$  keV for the three beam pipe scenarios are:



# BEAM PIPE RESULTS

The rate increase for each new beam pipe design:

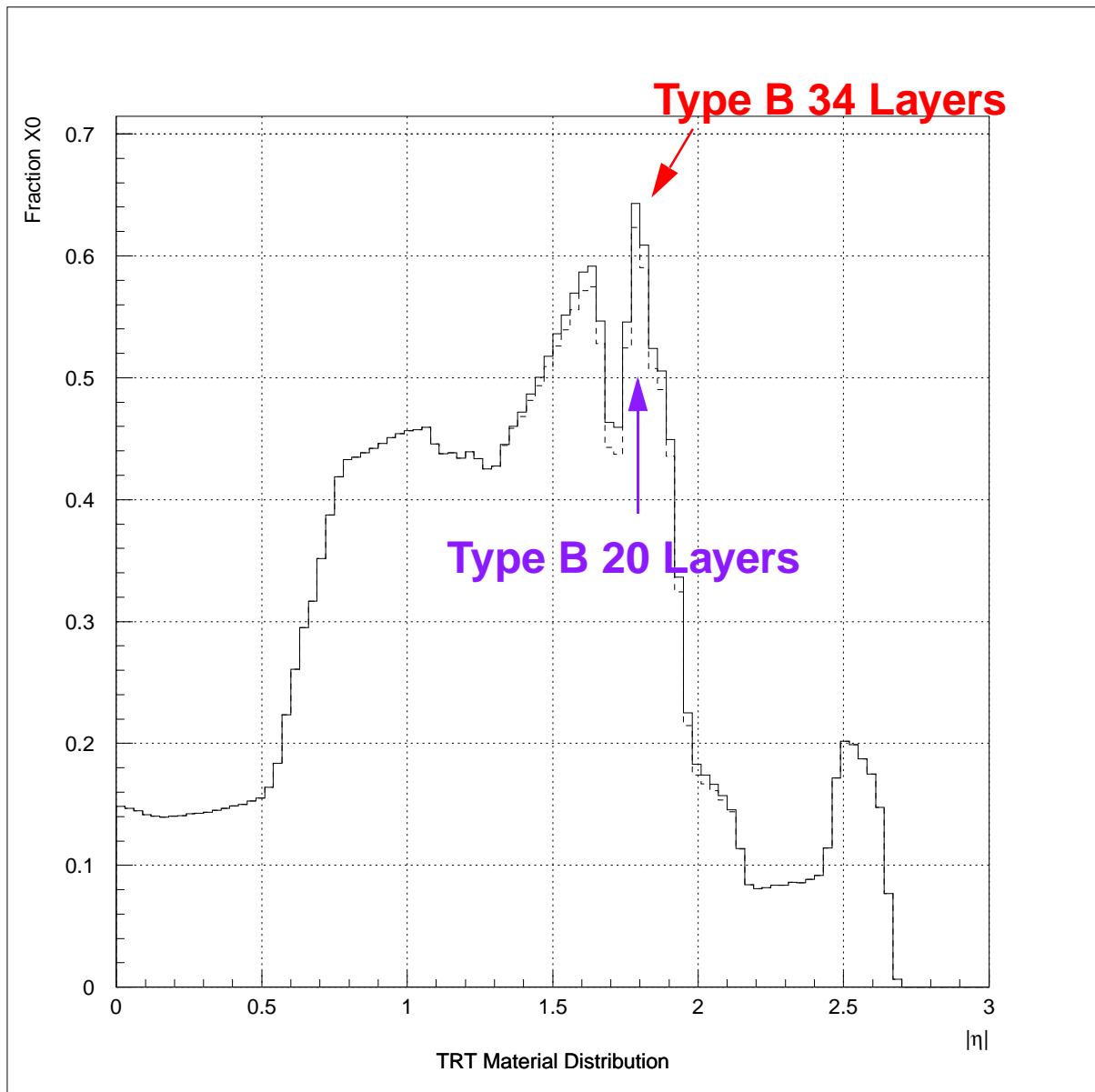


R in Barrel, z in End-cap

**The increase is probably OK for the Be designs but the Al pumps reduce the type C wheel performance.**

# MATERIAL DISTRIBUTION

The **PRELIMINARY** material plot:



Work remains especially for the end-cap TRT to get a final plot.

# MATERIAL CONCLUSION

1. The lack of a final mechanical and cooling scheme for the barrel electronics leads to difficulty in estimating the mass of the dead material at the outer ends of the barrel. The spread sheet still uses assumptions from the time of the ID TDR so some increase is inevitable.
2. There is a big increase in the barrel service region caused by the space frame and stainless steel manifolds for the cooling fluid and active gas.
3. The connectors for the active gas on the PPB1 are sub-optimal from a material point of view (though clearly this is outside of the Inner Detector active volume).
4. The current radiation length of the barrel has grown to ~10.0% X<sub>0</sub> (not including cables) while the original budget was 7.5% X<sub>0</sub>.
5. The use of a fabric spacer for the radiator stacks increases the mass in the end-cap region.
6. I am working to understand a huge pile of information about the outer edge of the wheels and the attached services (cables etc.). I hope to have this information put into a spread sheet by the end of the week.
7. The design of the end-cap is stabilizing which makes it possible to make a better estimate of its mass.
8. No one is safe from me, I have inherited responsibility for INAFGEO where the configuration of the mass of the services (cables, pipes, etc.) running out of the Inner Detector volume is stored. This means that I will be asking the Pixel and SCT people for detailed information.

# GEOMETRY CHANGES

The main changes have been in the end-cap region where the straw active length keeps getting reduced:

## The Incredible Shrinking Straws

	A,B TDR	A,B NOW	C ID TDR	C NOW
Outer Radius	1030.0 mm	1001.0 mm	1030.0 mm	968.0 mm
Inner Radius	640.0 mm	646.6 mm	480.0 mm	486.7 mm
Active Length	390.0 mm	354.4 mm	550.0 mm	481.3 mm

The Z position of the straws has been rearranged to accommodate the changing design of the support structures and services for the precision trackers:

The SCT support that was in within the type A wheels has been moved to the barrel end-cap gap which has been widened back to its original ID TDR width of 110 mm. The gap may still need to be widened by up to another 10 mm.

The gap between the type B and C wheels is widened by 53.5 mm to 91.5 mm to fit the pixel and SCT services.

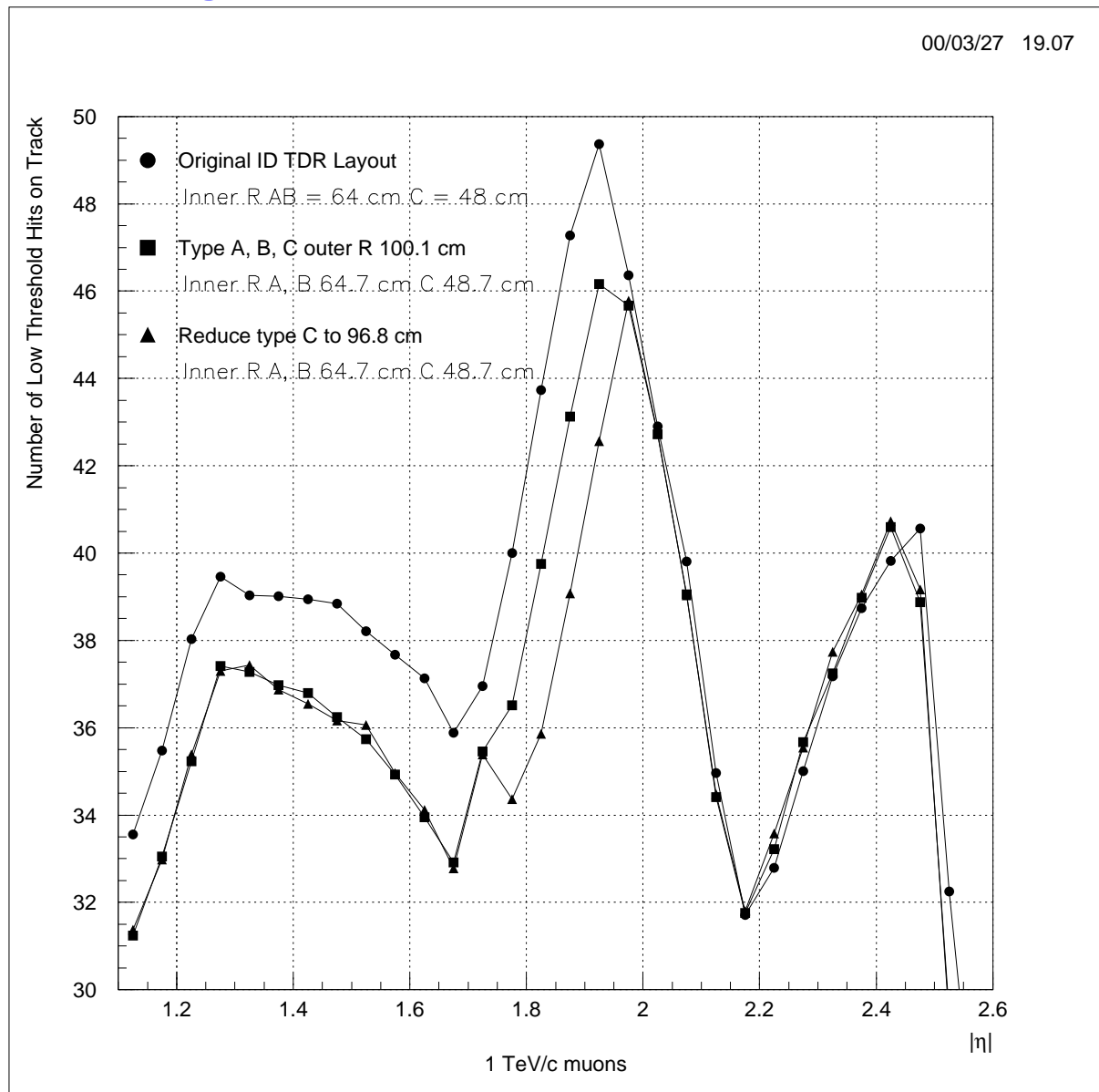
Consequently the Z positions of the TRT wheels have been redistributed for uniformity.

The Z positions of each layer within each wheel type are no longer uniform (as was the case for the ID TDR).



# WHEEL OUTER RADIUS

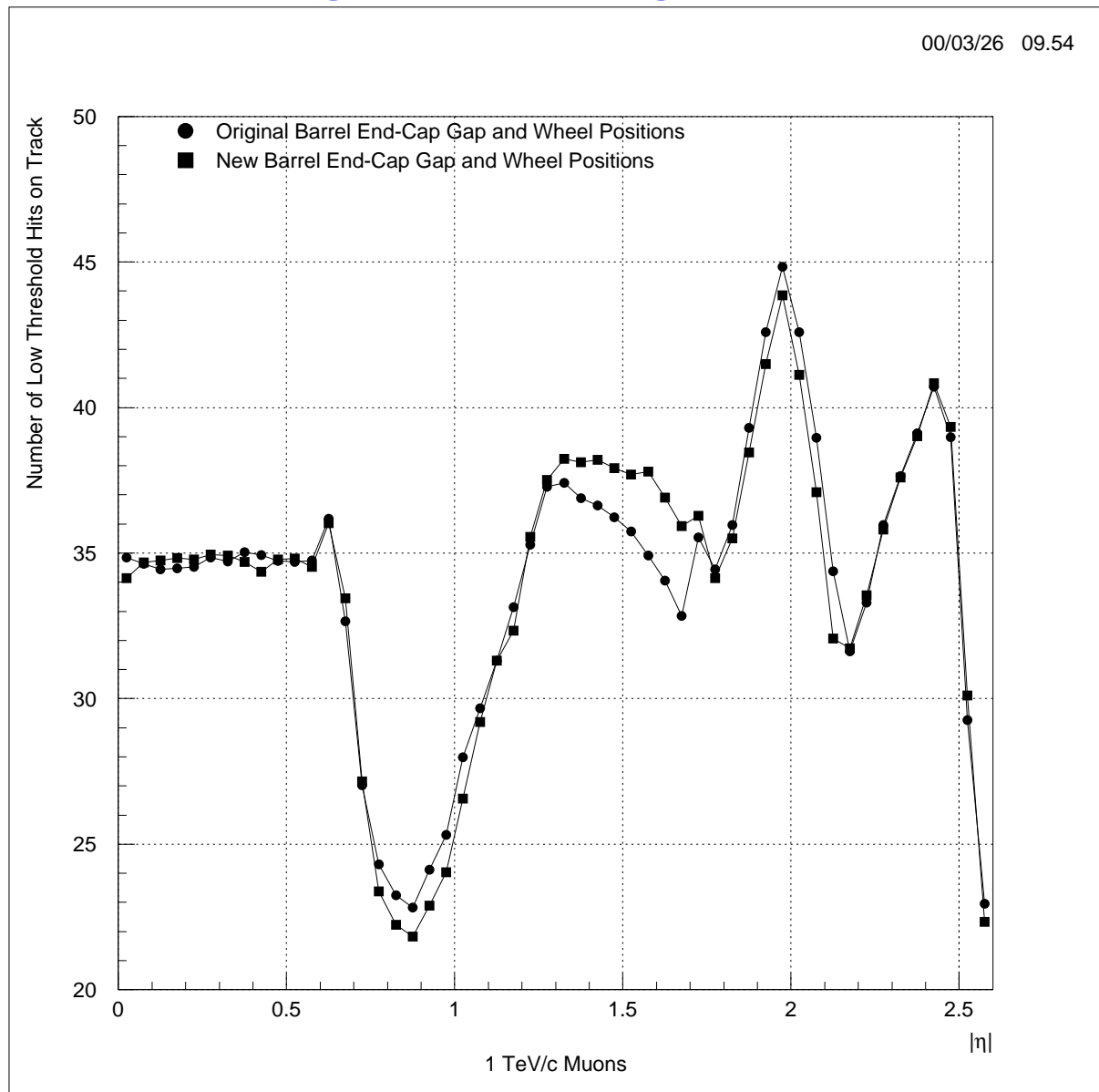
The number of possible hits on a stiff track falls as straw length is reduced:



This is tolerable because of the large number of hits.

# GAP WIDTHS

The number of hits on a stiff track crossing the barrel end-cap gap falls as the gap is widened:



**Recall that the TDR specification calls for 36+ hits...**

# OPEN GEANT3 ISSUES

The release of revised TRT GEANT3 code (last release 1997) will occur soon. The remaining things to be set for this release are:

1. Detector material (end-cap flange, electronics mass, cooling scheme mass).
2. Detector geometry (recheck end-cap gap locations and widths, new barrel module separation).
3. Default geometry - suggest modular.
4. Default digitization scheme - suggest TOF.
5. dE/dx and TR models tuning.
6. Maximum drift-time.
7. Signal shape and discriminator parameters.

Things that may have to be looked at before the ATLAS Monte Carlo production uses GEANT4:

1. Length of step for very low energy particles.
2. Bethe-Bloch function for gas mix at high- $\gamma$ .
3. Calibration of straws for B-Field effects (especially type C wheels).
4. TDC bin non-uniformity.
5. Read-out scheme (3 bin gate, signal width) and size of read-out data stream.

# TRT GEANT4 WORK

The work of converting the TRT code to GEANT4 will concentrate in two areas for the rest of the year:

## 1. Work on the XML description of the TRT geometry.

Stan has introduced a new XML tag called `<trtmodule>`. The tag does not correspond to a standard GEANT shape but eases describing the unusual shape of the TRT modules in XML.

Using the final engineering data for straw locations Stan has positioned the straws in this shape (see his talk).

I will continue this barrel work and hopefully extend it to the end-cap where the geometry is much easier.

## 2. Work on extending the TRT GEANT4 testbeam simulation to have a proper digitization routine which will let us compare the results to data.

Dario has set up the TRT testbeam geometry in GEANT4 to test the physics models and is finally getting reasonable energy depositions from the PAI model.

Ketevi will work on putting in the effect of the clusters and energy resolution to produce a reasonable energy vs. time distribution for each straw.

I will work on putting in the model of the electronics shaping, discriminator, and TDC into GEANT4 and produce digits.

Eventually the digits will be formatted to match the read-out data stream.