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# The Transition Radiation Tracker

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## Introduction

ATLAS Detector

## General Concept of TRT

Detecting Elements

TRT barrel

TRT End-Caps

Front-End Electronics

## TRT Terminology

Hit Types

How a straw measures time

From time to distance

## Conclusion

- ▶ Inner Detector
  - ▶ The silicon pixel detector (6)
  - ▶ The silicon microstrip detector (5)
  - ▶ The straw-tube transition-radiation tracker (4)
- ▶ Calorimeters
  - ▶ Electromagnetic Liquid Argon Calorimeter (7)
  - ▶ Hadronic Tile Calorimeter (8)
- ▶ Muon Spectrometer (1)

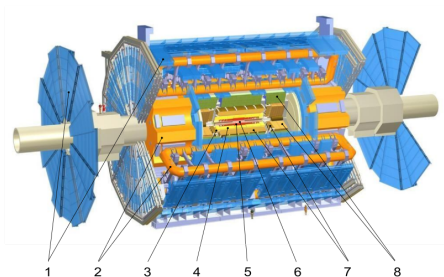


Figure: ATLAS detector

# General Concept of TRT

General Concept

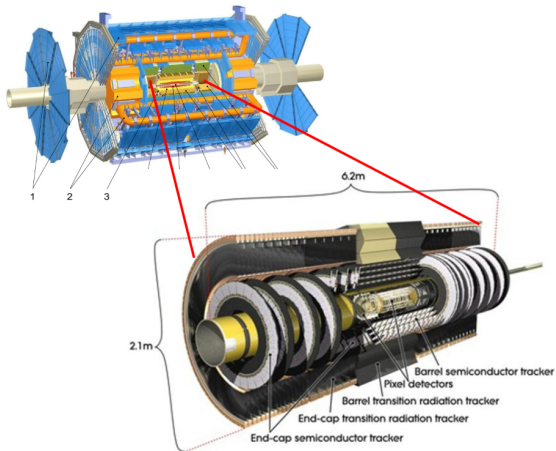


Figure: Inner Detector

# General Concept of TRT

## General Concept



The Transition Radiation Tracker is one of the three sub-detectors of the ATLAS inner detector situated in the 2T magnetic field of the central solenoid.

TRT is the outermost layer of the inner detector.

TRT: 6.8 m in length and 2.2 m in diameter and weighs about 1500 kg.

Provides tracking information for charged particles with:

$$*|\eta| < 2.5$$

$$*p_T > 0.5 \text{ GeV}$$

The TRT has two different geometrical arrangements of straws: Barrel and End-cap.

# General Concept of TRT

## Detecting elements



- ▶ consists of straw tubes ( $d = 4\text{mm}$ ) reinforced with carbon fibers
- ▶ containing a  $d = 31\ \mu\text{m}$  gold plated tungsten wire in the center.
- ▶ The straw wall is at  $-1.5\ \text{kV}$  while the wire is kept at ground.
- ▶ Filled with a gaz mixture of Xe-CO<sub>2</sub>-O<sub>2</sub> (70% : 27% : 3%)

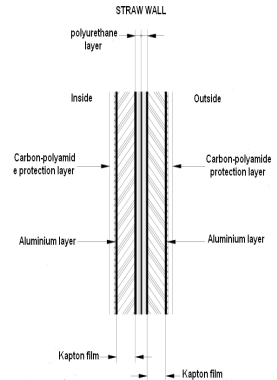


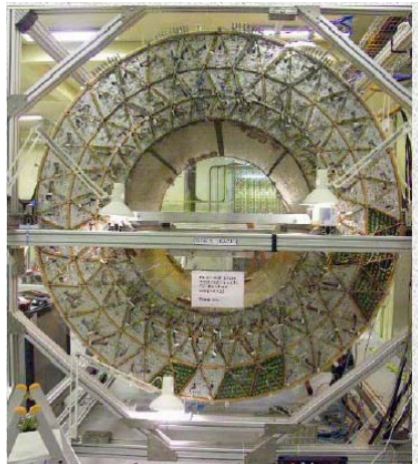
Figure: Configuration of a straw tube wall

# General Concept of TRT

TRT barrel



The barrel part contains 52544 axial straws of about 150 cm length at radii between 56 cm and 107 cm.



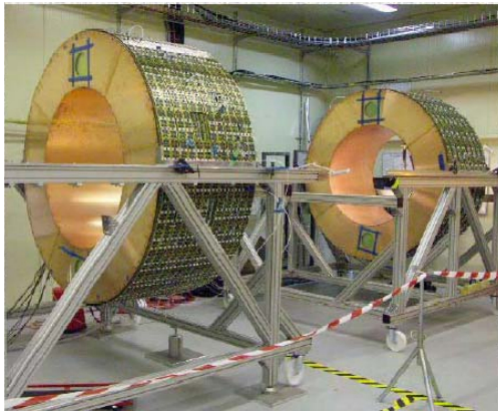
TRT barrel

# General Concept of TRT

## TRT End-Caps



The end-caps contain a total of 245760 radial straws at radii between 64 cm and 103 cm.

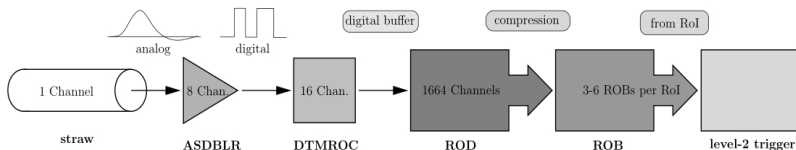


TRT End-caps



Front-end electronics contain analog and digital elements

- ▶ **Analog Element** : A particle crossing a straw tube creates a current pulse which is discriminated by ASDBLR<sup>1</sup>
- ▶ **Digital element** : The output of the ASDBLR is handed over to the DTMROC<sup>2</sup> which records the timing signal and stores it in a pipeline



**Figure:** A schematic illustration of the TRT readout chain

<sup>1</sup>ASDBLR : amplifier shaper discriminator baseline restorators

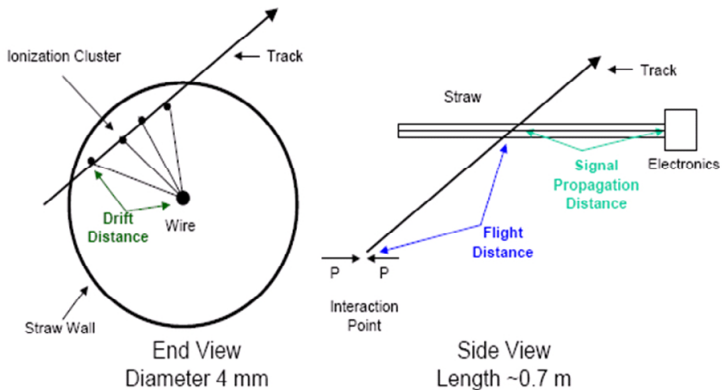
<sup>2</sup>DTMROC : digital time measuring and readout chip

Depending in the hit track we can distinguish trt hit to four types :  
Front-end electronics contain analog and digital elements

- ▶ **Precision hit** : a hit with a measured drift radius within  $\pm 2$  sigma of the fitted track
- ▶ **Tube Hit** : measured drift radius outside  $\pm 2$  sigma of fitted track
- ▶ **Outlier** : the fitted track passes  $100 \mu m$  or more of the straw wall
- ▶ **Holes** : straws crossed by a fitted track but with no hit

# TRT Terminology

How a straw measures time



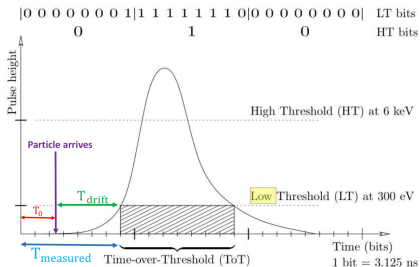
$$\text{Cluster Arrival Time} = \text{Flight Time} + \text{Drift Time} + \text{Propagation Time}$$

Figure: Descriptive schematic of time measurement by a straw tube from TRT

# TRT Terminology

How a straw measures time

- ▶ LT: for particle tracking
- ▶ HT: for particle id
- ▶ ToT: for particle id



**Figure:** Schematic display of a signal pulse and  $T_0$  and  $T_{drift}$   
 $T_0$  (Hardware level) depends on cable lengths, electronics delays...

## *R-t relation curve*

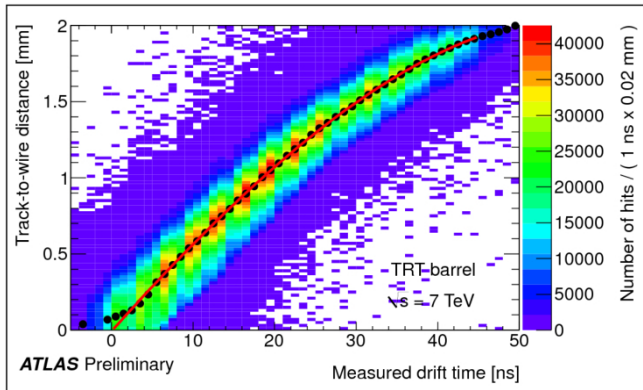


Figure: R-t relation for TRT barrel at  $\sqrt{S} = 7 \text{ TeV}$

TRT provides:

- ▶ pT measurement over wide range
- ▶ electron identification
- ▶ long lever arm for continuous tracking (30 hits per track)
- ▶ hit precision of  $130 \mu m$

A circular astronomical chart, possibly a star map or constellation diagram, is centered on the page. The chart features a dark blue background with numerous white stars and connecting lines. A prominent yellow star is visible near the center. The chart is surrounded by a ring of yellow rectangular bars of varying heights, resembling a bar chart. Three red lines intersect at the center of the chart, extending towards the corners of the image.

Thank you !