

# Study of a Large Prototype TPC using Micro-Pattern Gas Detector Readouts: Z-Resolution

Peter Hayman



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# Contents

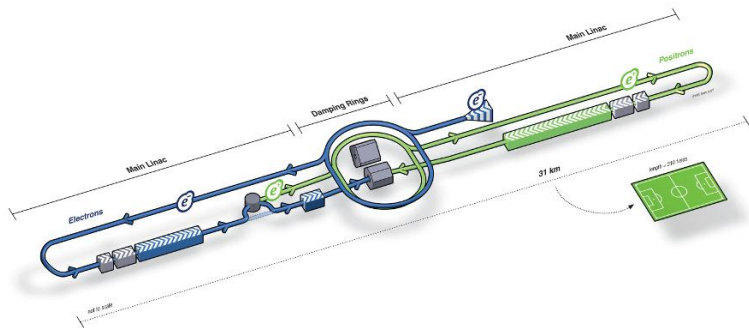
- 1 Preliminaries
- 2 Spatial Reconstruction: Z Coordinate
  - Time Estimator
  - Drift Velocity and T0
  - Resolution
- 3 Future Work and Outstanding Issues
  - Z Reconstruction
  - $r$ - $\phi$  Reconstruction

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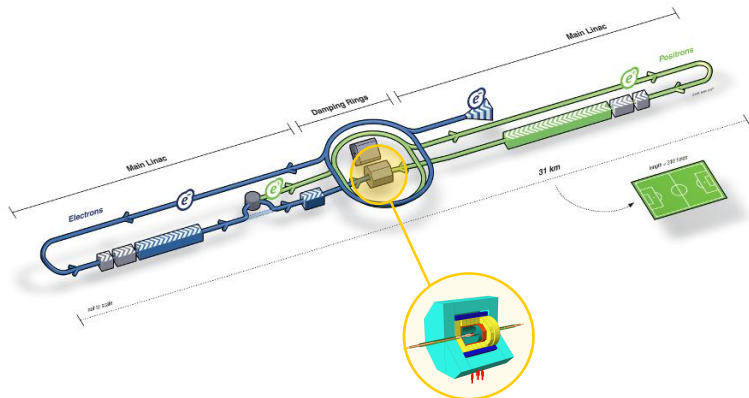
# The ILC, or LHC 2: The Revenge

The International Linear Collider (ILC):



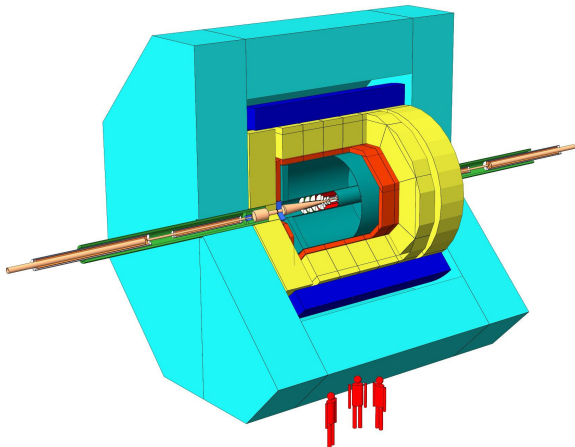
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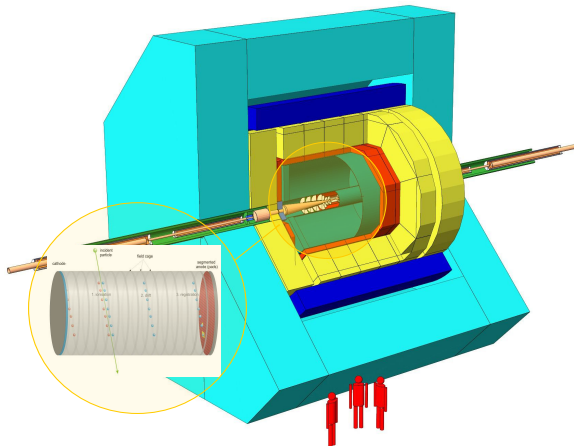
# The ILD, or Son of ATLAS

The International Large Detector (ILD):



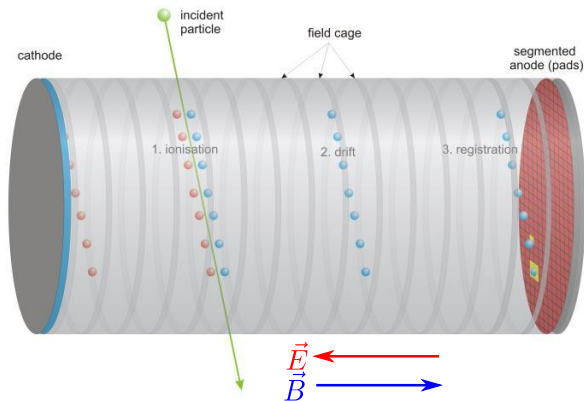
# The ILD, or Son of ATLAS

The International Large Detector (ILD):



# The TPC, or How I Learned to Stop Worrying and Love 3-Letter Initialisms

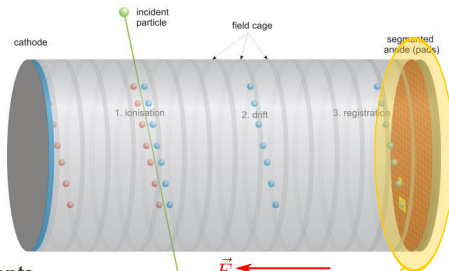
## The Time Projection Chamber (TPC):





# The TPC, or How I Learned to Stop Worrying and Love 3-Letter Initialisms

## The Time Projection Chamber (TPC):



### Requirements

Momentum resolution:

$$\delta(1/p_T) < 9 \times 10^{-5} \text{ GeV}$$

Spatial resolution:

$$\sigma(r_\phi) < 100 \mu\text{m}$$

$$\sigma(z) < 500 \mu\text{m}$$

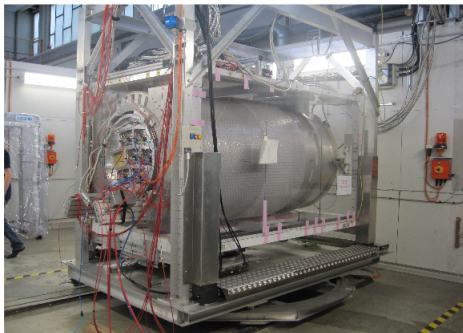
97% tracking eff. for  $p_T > 1 \text{ GeV}$

$dE/dx$  resolution  $\sim 5\%$

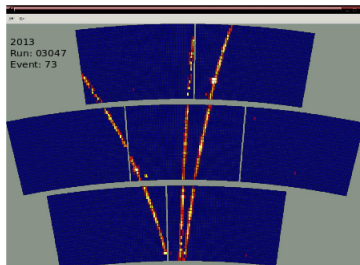


# The Large Prototype

Large Prototype TPC (LPTPC):  
60 cm Drift Length  
Supports 7 Identical Readout Modules



2012 Desy Test



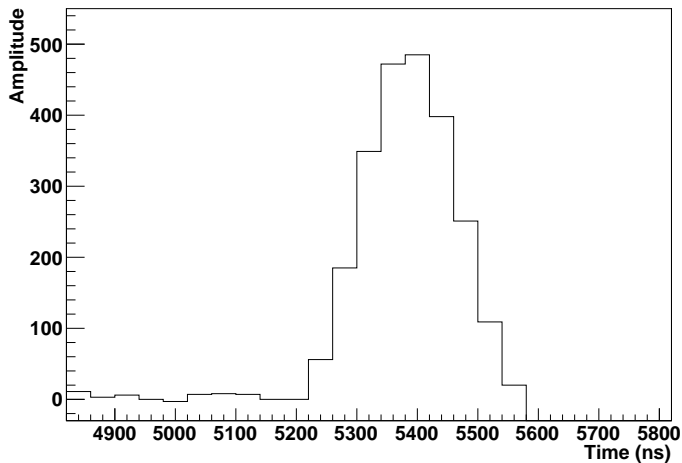
Event Display

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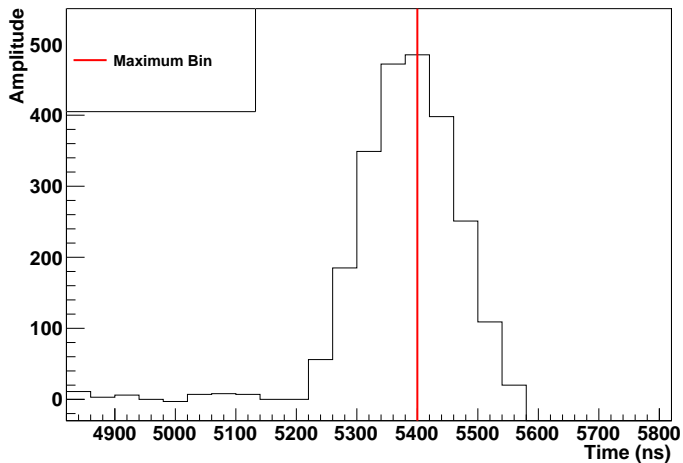
# Average Shaped Signal

Run 03047, Module 3, Row2



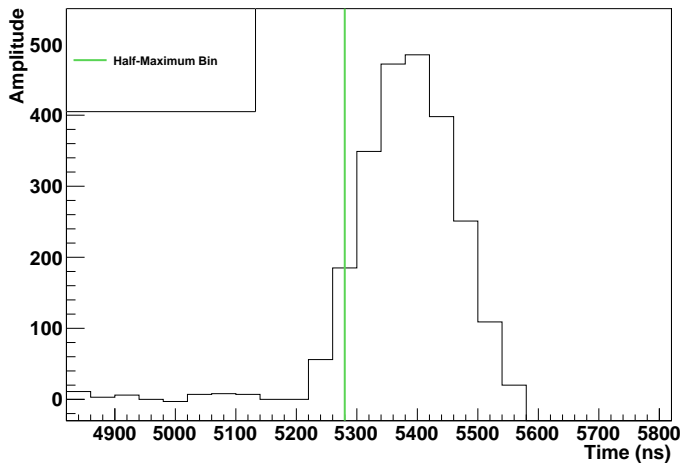
# Time Estimators

Run 03047, Module 3, Row2



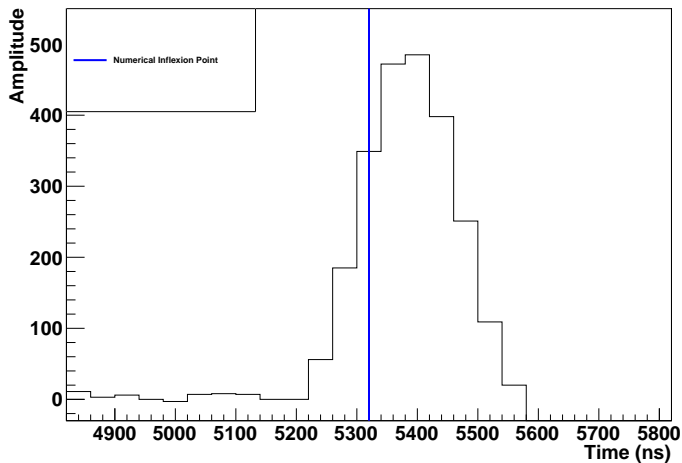
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Run 03047, Module 3, Row2



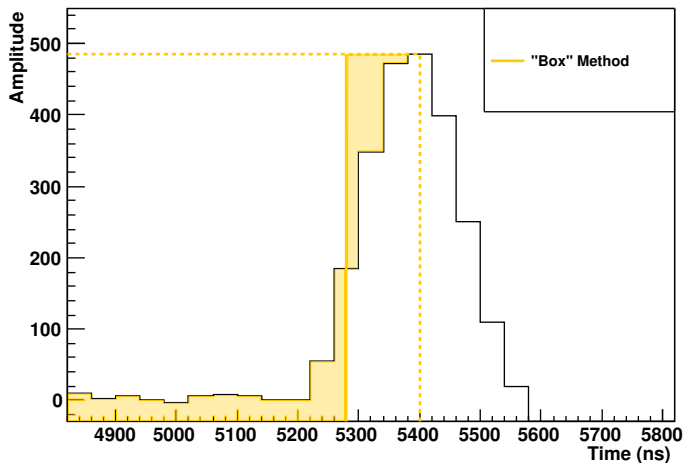
# Time Estimators

Run 03047, Module 3, Row2



# Time Estimators

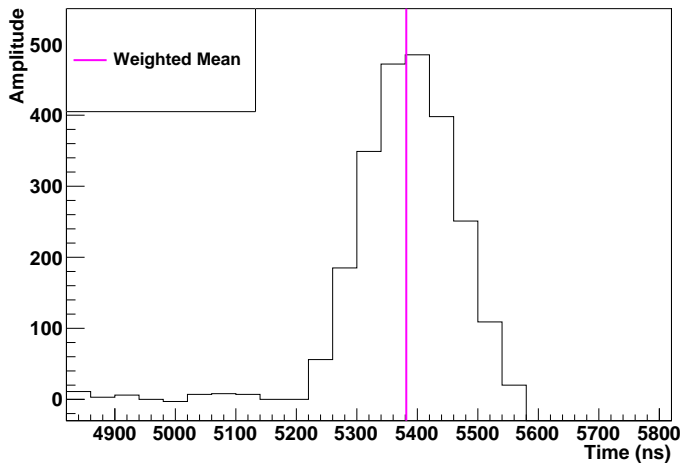
Run 03047, Module 3, Row2





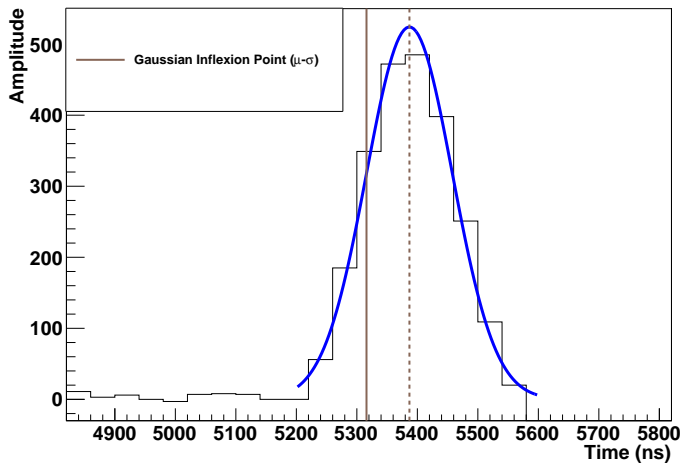
# Time Estimators

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# Time Estimators

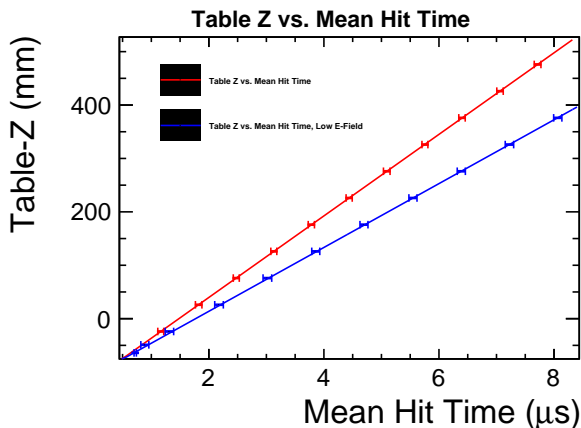
Run 03047, Module 3, Row2



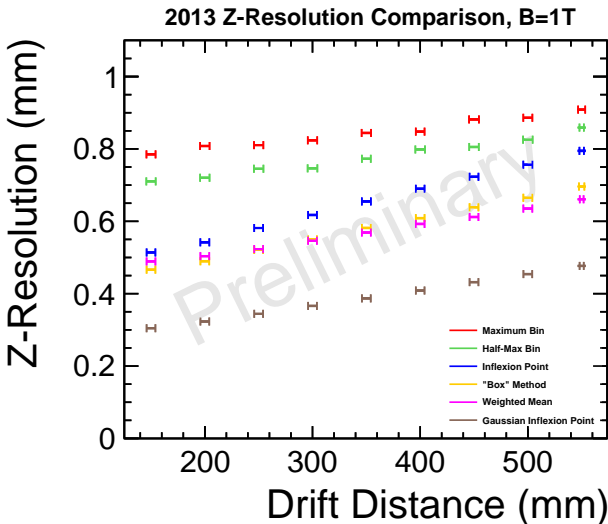
# Drift Velocity and T0 Calculation

**Drift Velocity:** Speed of electron propagation in gas (E-Field dependent)

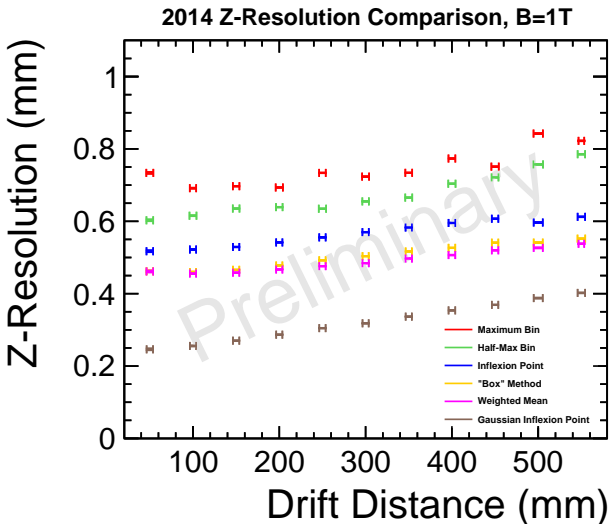
**T0:** Time offset due to electronics, signal propagation through wires, etc.



# Resolution Comparisons (2013 DESY Beam Test)



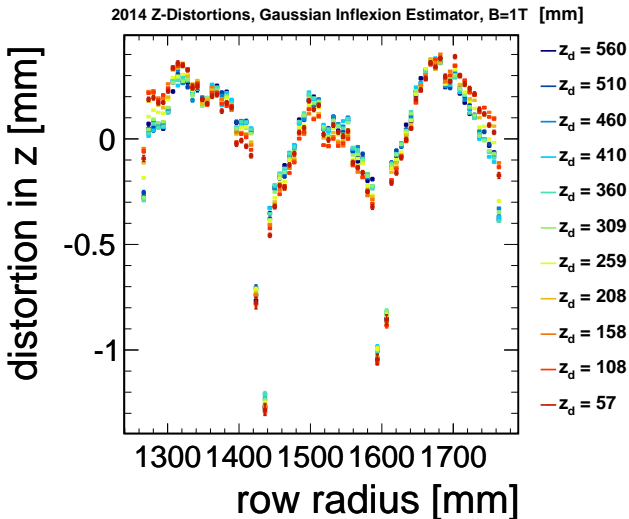
# Resolution Comparisons (2014 DESY Beam Test)



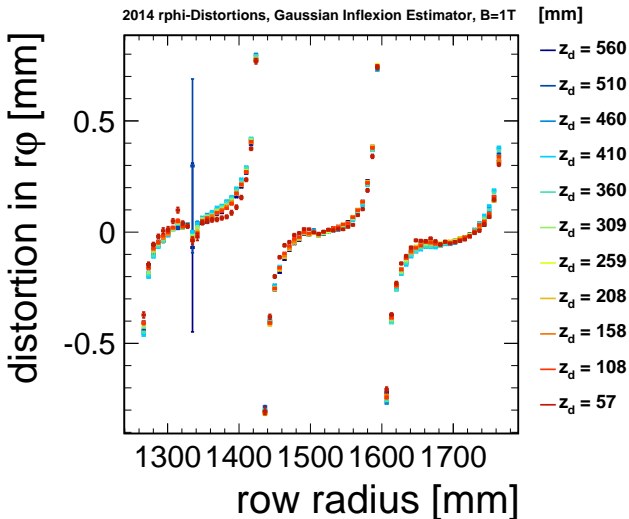
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# Field Distortions



# Field Distortions





- Pad Response Function Calibration, Optimization, etc.
- Bias Correction
- Module Alignment
- Preventing Dead Channels
- Higher Magnetic Field Beam Test

END

# Backup

# Time Estimator Comparisons

