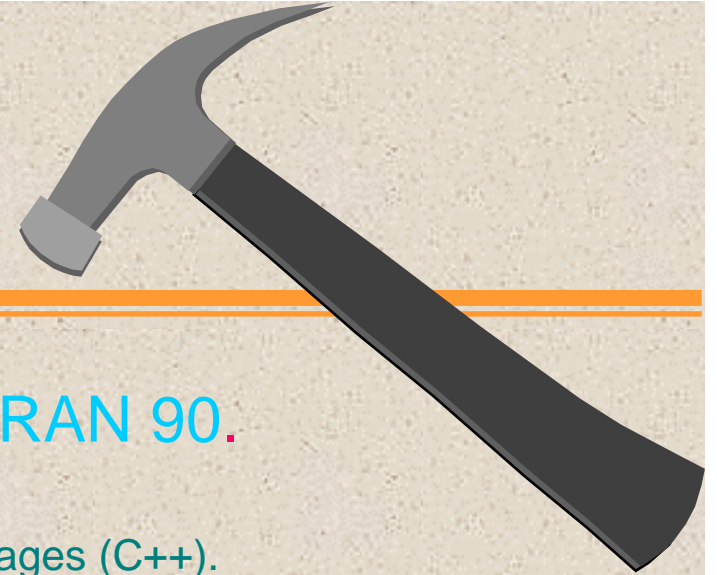


Software Tools



- **Programming Language: FORTRAN 90.**
 - ❖ Many powerful features.
 - ❖ Many features similar to modern languages (C++).
 - ❖ Object oriented!

- **Development Platform: Pentium & ALPHA.**
 - ❖ TWIST cluster: LINUX on Pentium - fast and cheap!
 - ❖ Some digital ALPHA's: multi- platforms useful to detect bugs.

- **Version control system: CVS.**
 - ❖ Very useful when multiple developers are involved.

Software Components

■ Calibration file management: CFM

- ❖ Links a set of calibration files to a group of run numbers.
- ❖ Originally developed for BNL 787.

■ GARFIELD

- ❖ To obtain space-time relations for the specific conditions of a run.

■ ROOT

- ❖ For event display.

■ HBOOK

- ❖ For histogramming.

■ MOFIA

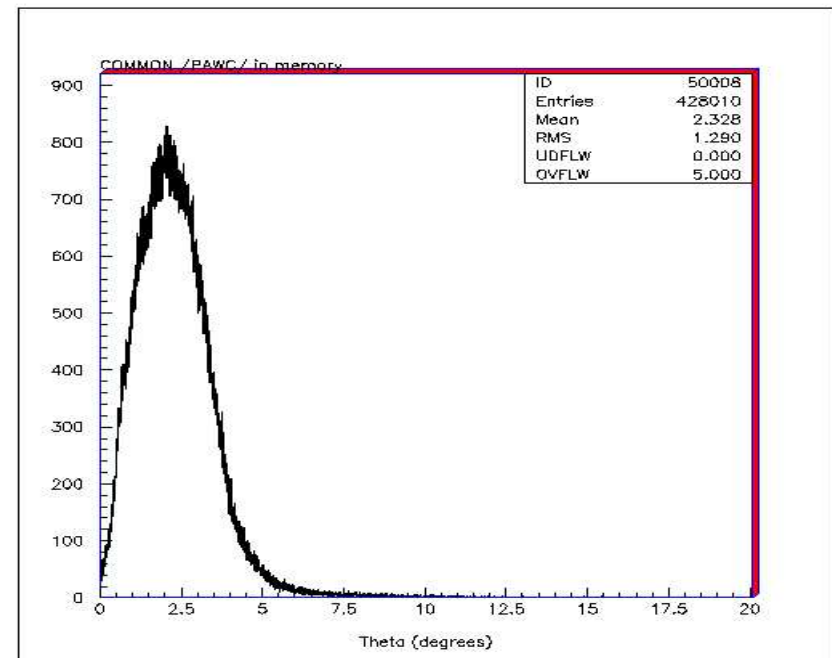
- ❖ TWIST analysis program.

MOFIA Components

- Frame work: originally developed for BNL 787.
- TDC unpacking: heavily modified from the 787 version.
- Calibrations code.
 - ❖ Time zero.
 - ❖ Plane position corrections.
 - ❖ Plane rotation corrections.
 - ❖ Wire positions determination.
- Chambers response code.
 - ❖ Efficiency.
 - ❖ Resolution.
 - ❖ Cross talk.
- Straight line tracking - Kalman filter.
- Pattern recognition.
- Helix tracking
 - ❖ χ^2 fit: currently used.
 - ❖ Kalman filter: under development

Preliminary Analysis

- Straight line tracking using Kalman filter.
- Data are for pions at a momentum of 120 MeV/c.
- Beam is within a small angular range relative to the chamber's axis.



Outline

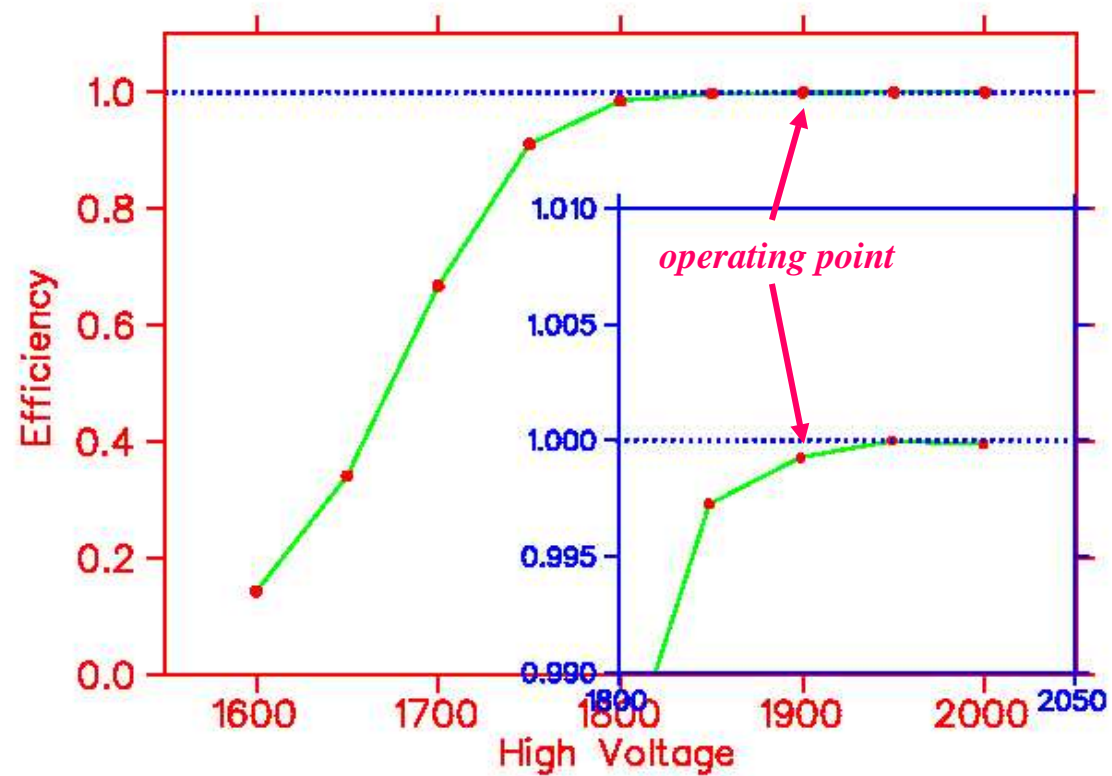
- Efficiency.
- Cross talk.
- Time zero.
- Plane alignment.
- Resolution.

I. DC Efficiency

- Efficiency vs high voltage.
- Plane-to-plane variations.
- Wire-to-wire variations.
- Code verifications.

Efficiency

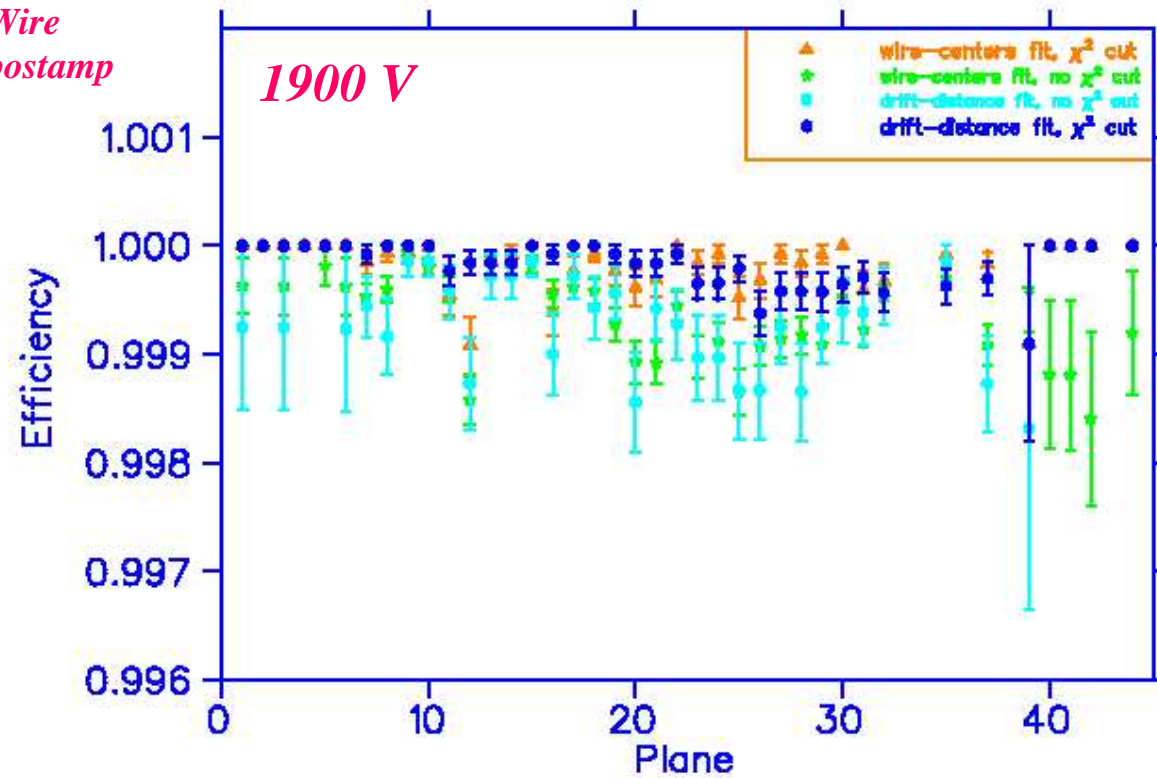
High Voltage Dependence



Efficiency

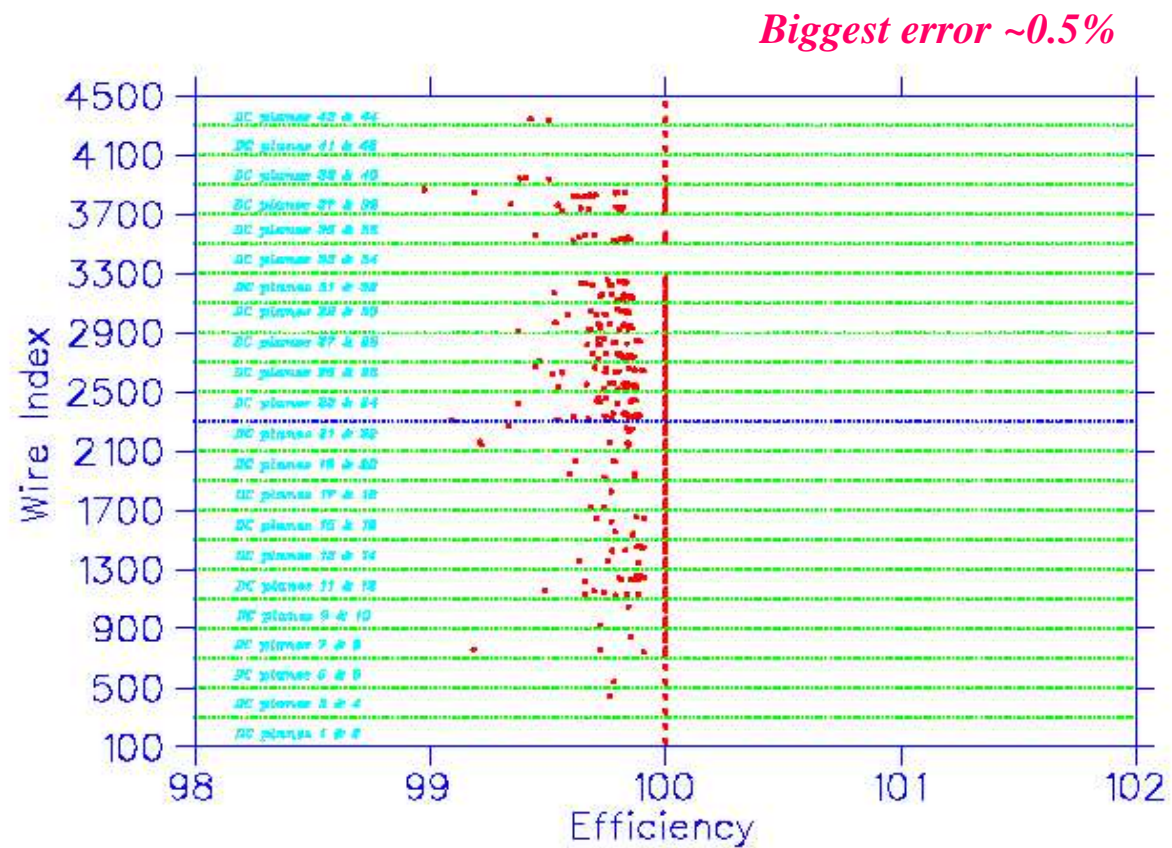
Plane-to-plane variations

3 dead Planes
1 dead Wire
1 dead postamp



Efficiency

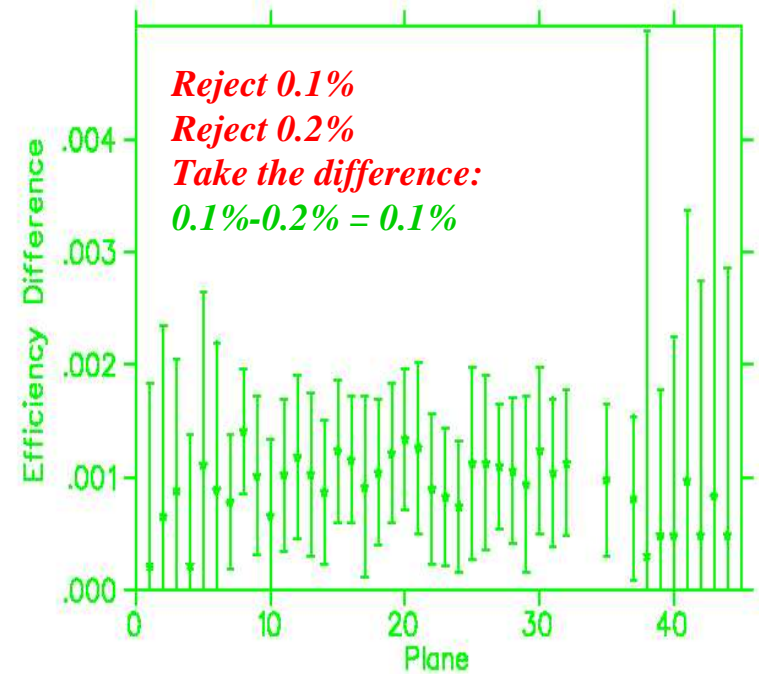
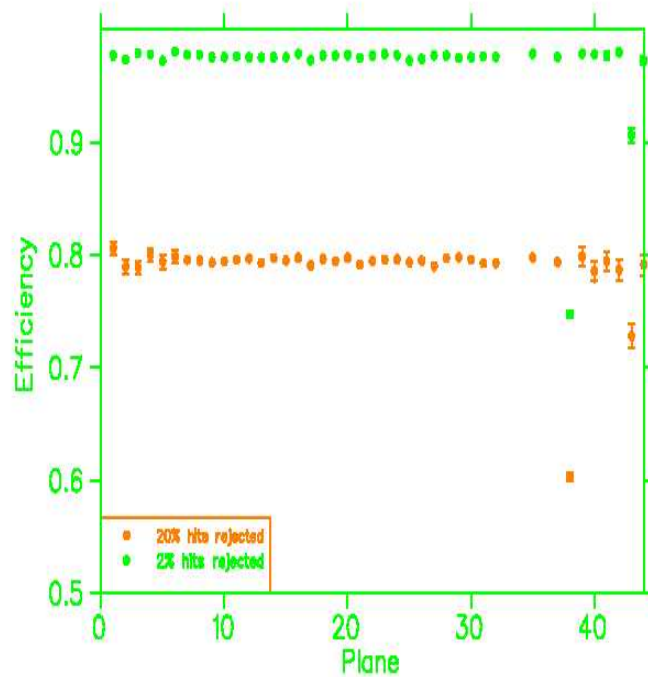
Wire-to-wire variations



Efficiency

Code verification

- A percentage of the hits was randomly rejected after the unpacking of the TDCs



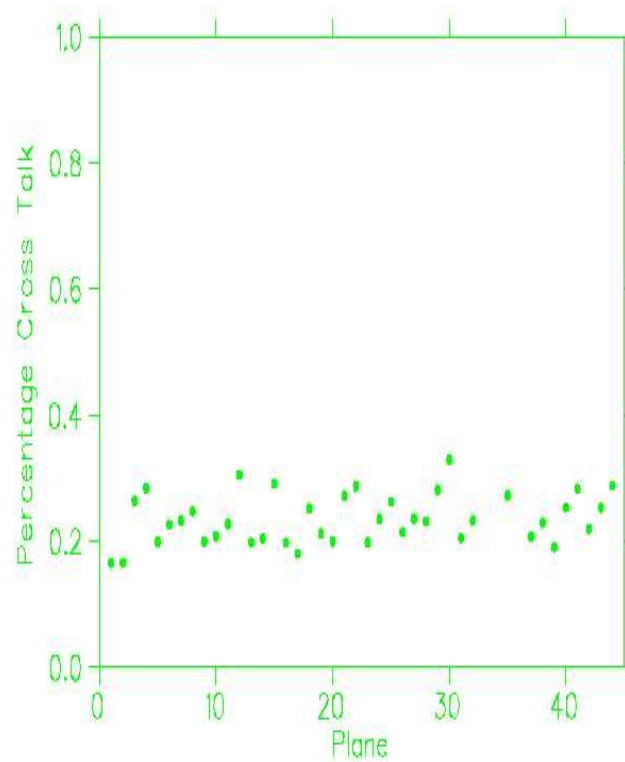
II. Cross Talk

Definition

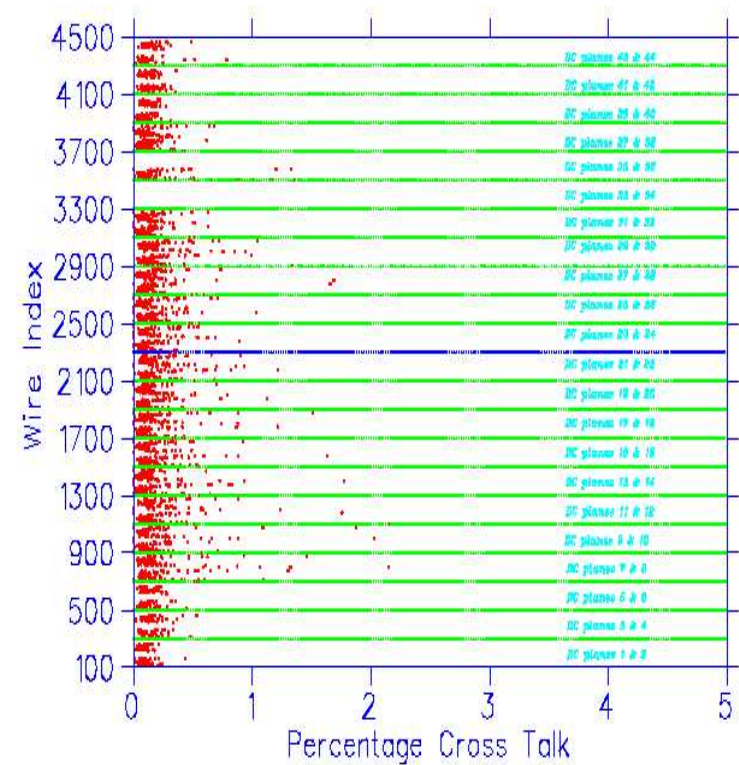
- Cross talk can be distinguished from real hits.
 - ✦ They have a small TDC width.
 - ✦ They occur adjacent to a cell with a real hit.
 - ✦ They coincide in time with the real hit.
- The ratio of hits with these characteristics to the total is the percentage cross talk.

Cross Talk

Plane and wire variations



Muon cross talk around 2%



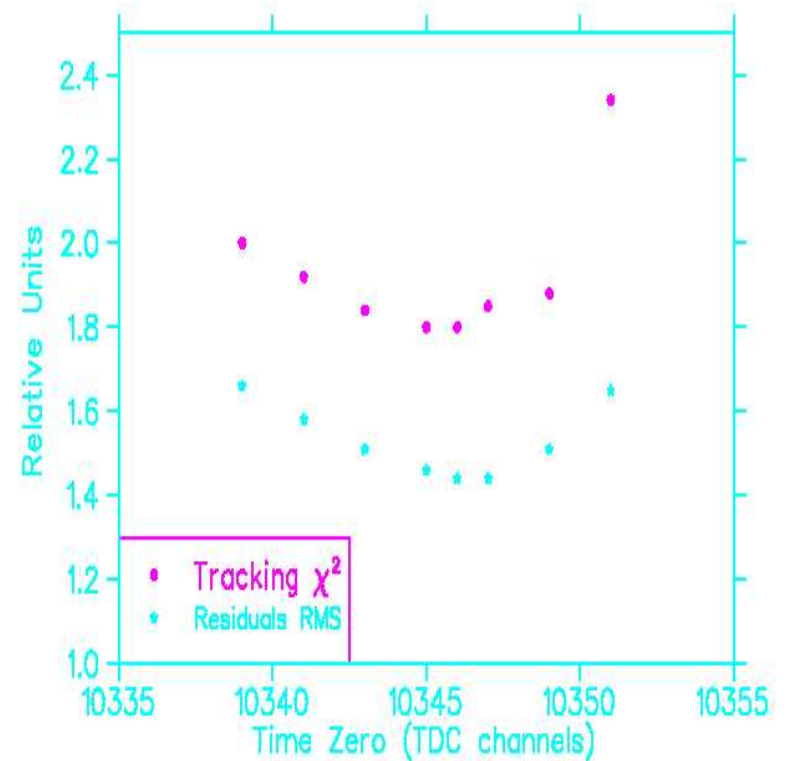
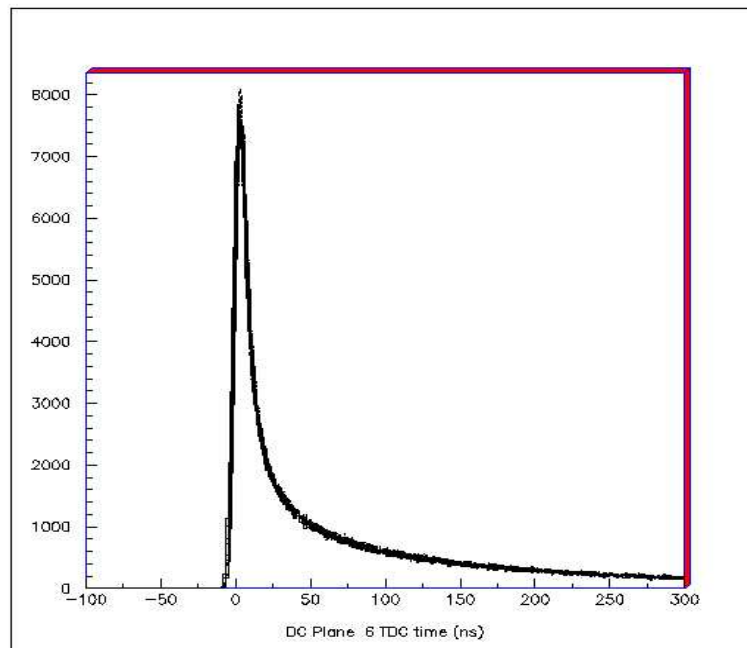
III. Time Zero Determination

Definition

- TDC time \Rightarrow drift time \Rightarrow drift distance
- TDC time is relative to trigger time
 - \Rightarrow Global offset
- Difference from plane to plane (and wire to wire)
 - ✦ Cable lengths
 - ✦ Electronics
 - ✦ Time of flight
 - \Rightarrow Relative offset

Time Zero Determination

Relative and global offsets



Time Zero Determination

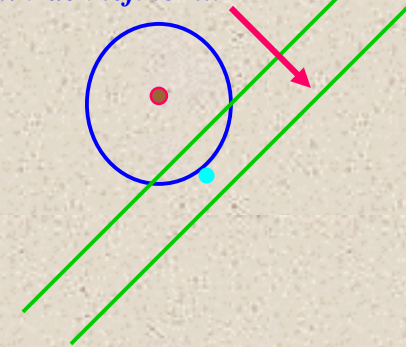
Using tracking residuals

■ Plane/wire shifts

✦ Residuals distribution:

- has positive mean: left shift
- has negative mean: right shift

- ve resid: track left to hit
+ ve resid: track left to hit



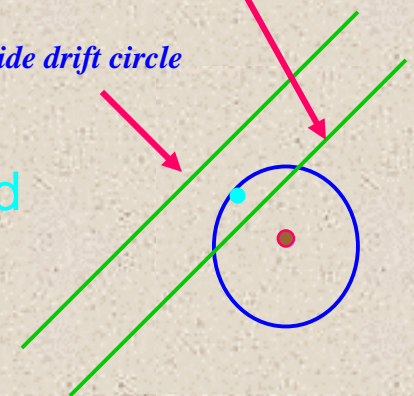
■ Time shifts (STRs & T0)

✦ Residuals distribution:

- has positive mean: T0 overestimated
- has negative mean: T0 underestimated

- ve resid: track inside drift circle

+ ve resid: track outside drift circle



Time Zero Determination

Time zero inaccuracies

