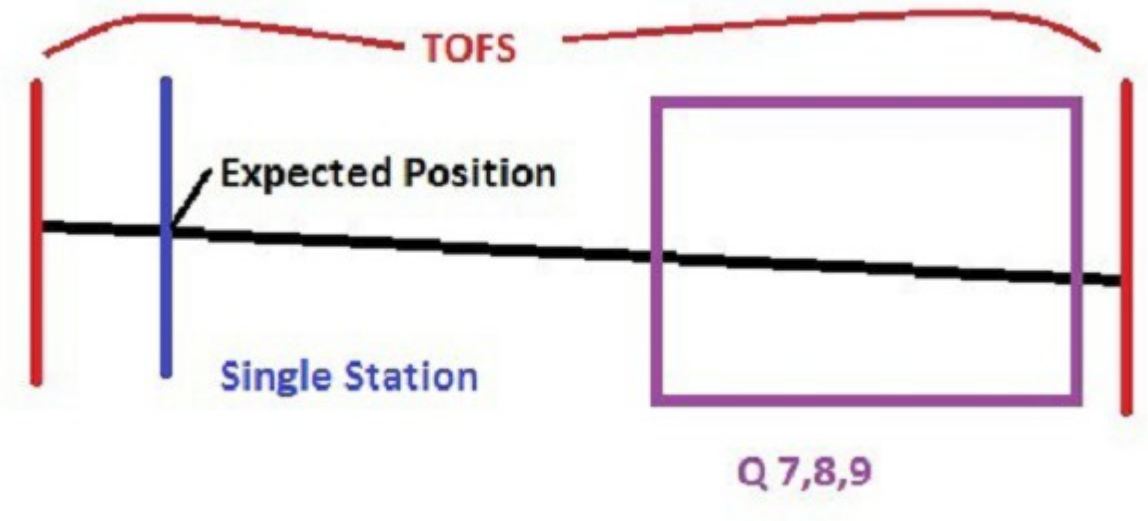
A Tentative Case Against Tracker Channel Flipping

- **My understanding of the problem**
  - Tracker channels are labeled in reverse
    - Channel 0 → Channel Max
    - Channel 1 → Channel Max – 1
    - Channel Max → Channel 0
  - This would have been done in all three planes in each station.
    - If a single plane is flipped we would see not triplet space points
      - We obviously saw triplet space points in single station
  - This problem would manifest in both the single station test we did last year and in the full tracker.
    - If not then all I'm going to talk about is useless
  - What we would expect to see
    - Space points flipped along the origin in both x and y directions
      - Corroborated by MC
      - Do we want a more rigorous study of this effect in MC?

Runs 4087, 4094, and 4096

- SS run with Q7, Q8, and Q9 turned off
  - Approximate the path from TOF0 → SS → TOF1 as a straight line
    - Ignore MS
  - Use the slab hits in the TOFs to determine expected position in SS

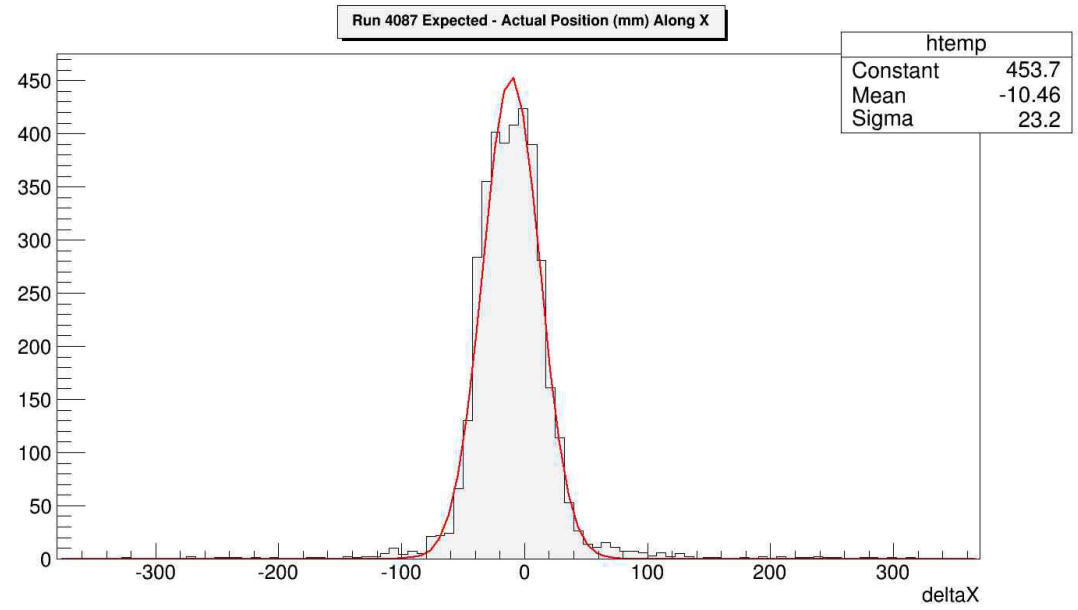


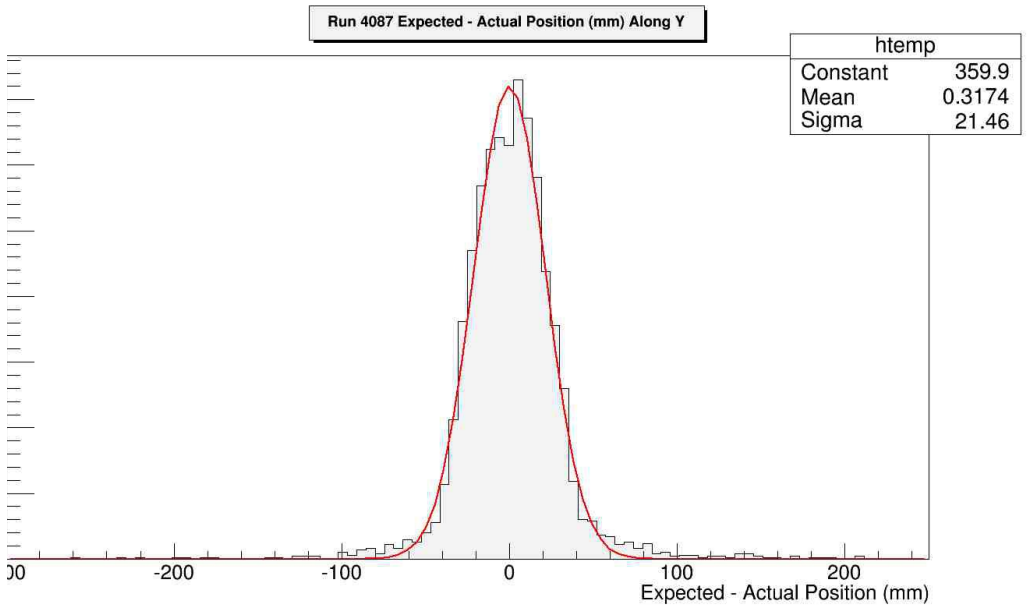
What We Should Expect

- **Important!** This is all very “back of the envelope” right now. This data is a byproduct of an earlier efficiency study. The purpose of presenting it is to start a conversation on where to go next.
- Some error analysis
  - What we know:
    - TOF1 resolution 60mm TOF0 resolution 40mm
      - Limited by TOF slab size
      - This can be improved, but TOF group has not imported calibrations into MAUS
  - Some guess work:
    - Assume we know Z position of TOFs within 10cm
    - Assume we know Z position of SS within 5cm
  - Baseless assumption that is probably wrong:
    - The TOFs and SS are both perfectly aligned along the beam line
- These assumptions produce a 20mm sigma
  - Dominated by the +/- 20mm from TOF0 position
  - See math on last slide for more detail

What We Find

- Sigma is almost the 20mm calculated earlier
  - Close to our expected spread
  - Remember tracker radius is only 150mm so we are still taking up a lot of real estate
- Not shown: Runs 4094 and 4096. Results are similar.





What More Needs Done?

- What does the tracker group need to feel confident that we are not flipping the channels?
  - Let's try to keep our eyes on the prize
- We can tighten up the expect vs actual calculation a lot
  - Lack of TOF calibrations is a large source of error
  - I have no idea how accurate Z positions are of various detectors nor do I know how to find this information
  - Again no idea about alignment of TOFs and SS in transverse plane
- How big of a role should we expect MS to have in this analysis?

Error Propagation

$$X_{ss} = \frac{X_{TOF1} - X_{TOF0}}{\Delta Z_{TOFs}}(Z_{ss}) + X_{TOF0}$$

Evaluating

$$\delta X_{SS}^2 \approx \left(\left| \frac{X_{TOF1} - X_{TOF0}}{\Delta Z_{TOFs}}(Z_{ss}) \right| \sqrt{\left(\frac{(\delta X_{TOF1}^2 + \delta X_{TOF0}^2)}{(X_{TOF1} - X_{TOF0})^2} + \frac{\delta \Delta Z_{TOFs}^2}{\Delta Z_{TOFs}^2} + \frac{\delta Z_{ss}^2}{Z_{ss}^2} \right)} \right)^2 + \delta X_{TOF0}^2$$

$$2.9\text{mm} \approx \left(\frac{360}{7800} \right)(600\text{mm}) \sqrt{\frac{30^2 + 20^2}{360^2} + \frac{(100^2 + 100^2)}{7800^2} + \frac{(100^2 + 50^2)}{7200^2}}$$

Which gives:

$$\delta X_{ss} \approx \sqrt{(2.9\text{mm})^2 + (20\text{mm})^2} \approx 20\text{mm}$$