

Magnetic and Mechanical Center and Roll Angles in 21Q40

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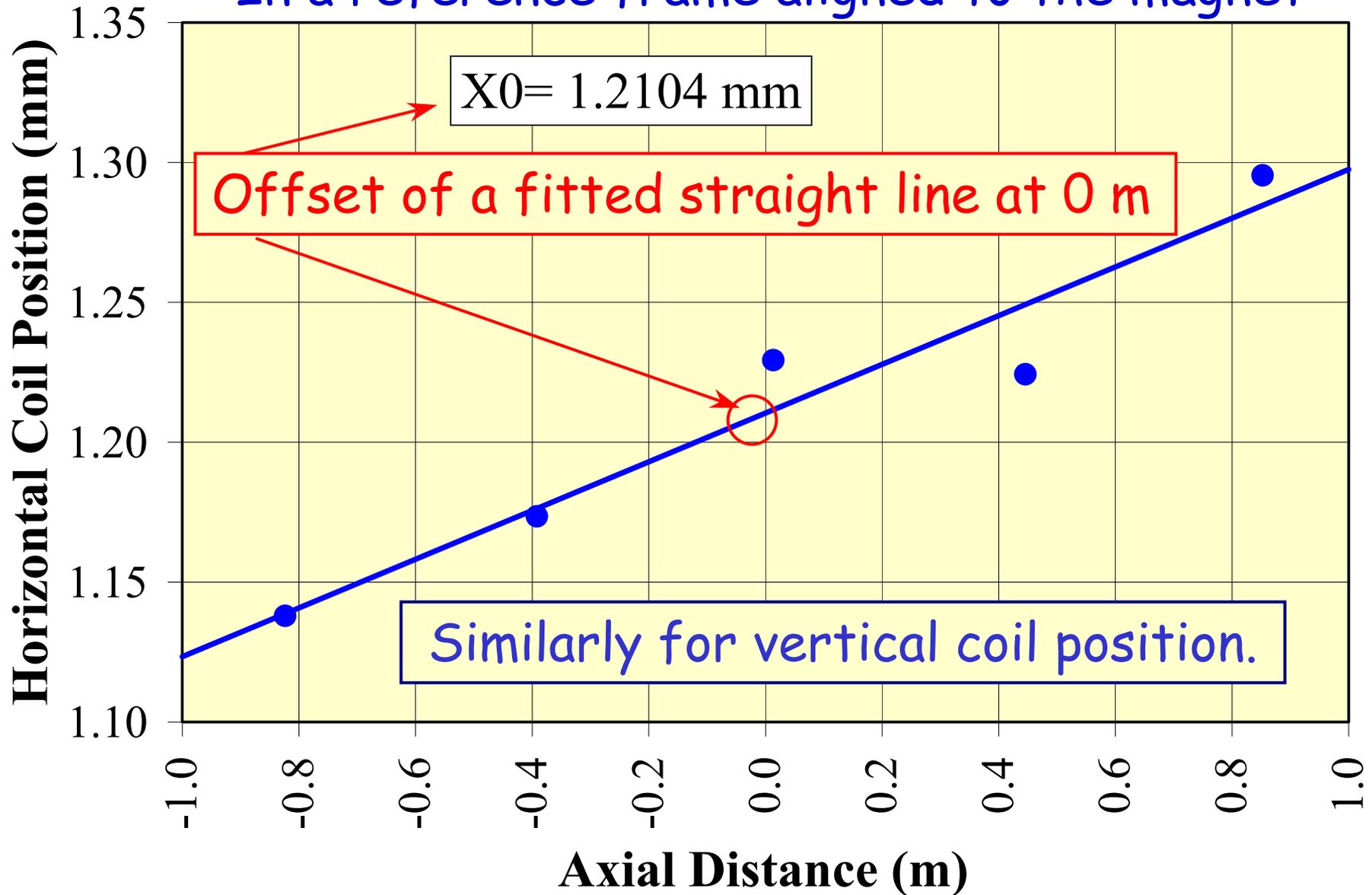
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Magnet Axis Data that Exist

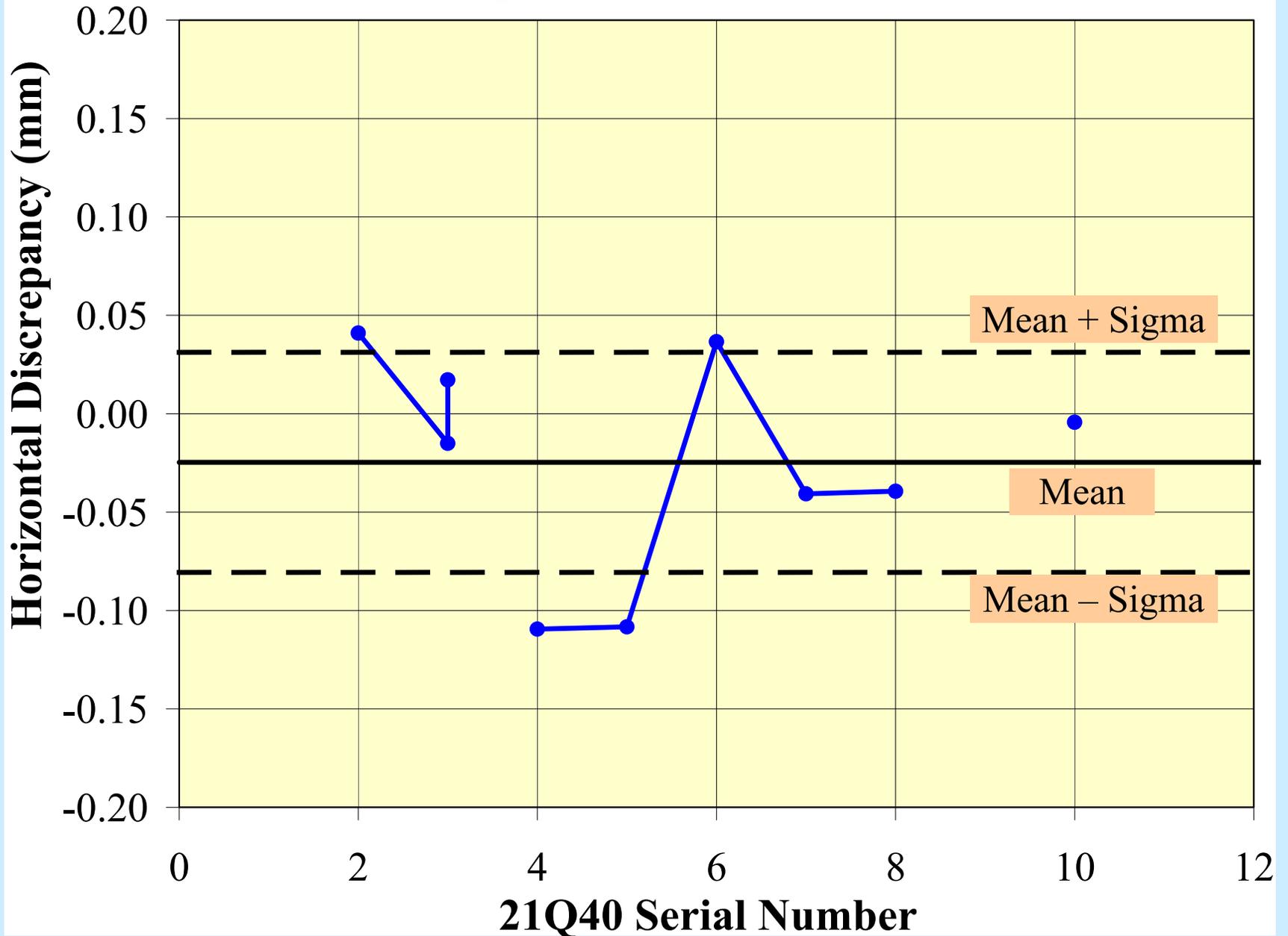
- *Magnetic center* relative to measuring coil (or, *Measuring coil* relative to the magnetic center) \Rightarrow Rotating Coil Data.
- *Measuring coil* relative to the *mechanical center* \Rightarrow Survey Data.
- The above two are expected to be consistent.
- Survey data handed over for 21Q40 serial numbers 2, 3 (2 epochs), 4, 5, 6, 7, 8, and 10.
- A comparison between magnetic and mechanical centers can be made in these 9 cases.

SQ2110, Meas. Coil Survey Data

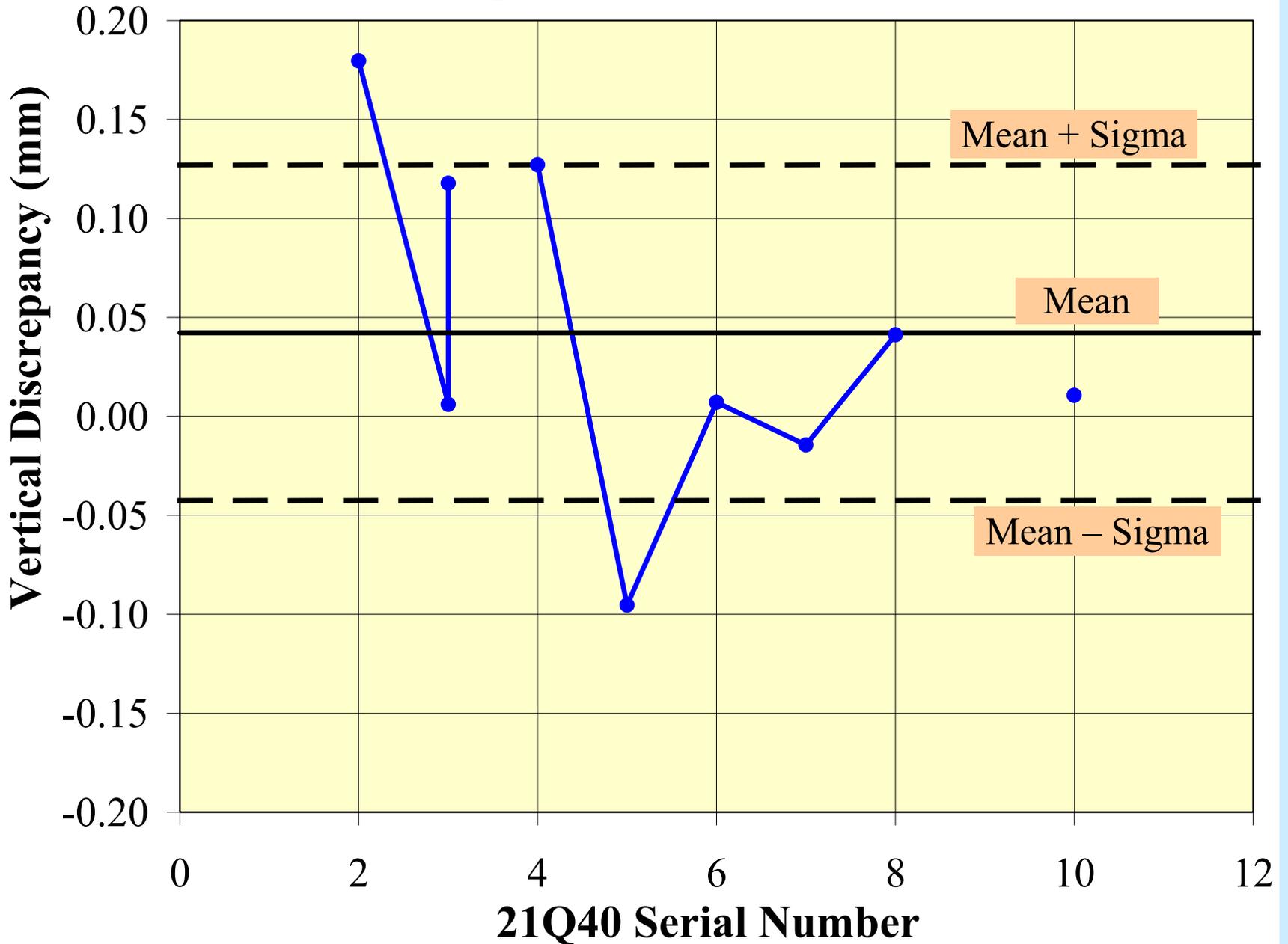
In a reference frame aligned to the magnet



Diff. between Magnetic and Mechanical Centers in 21Q40



Diff. between Magnetic and Mechanical Centers in 21Q40



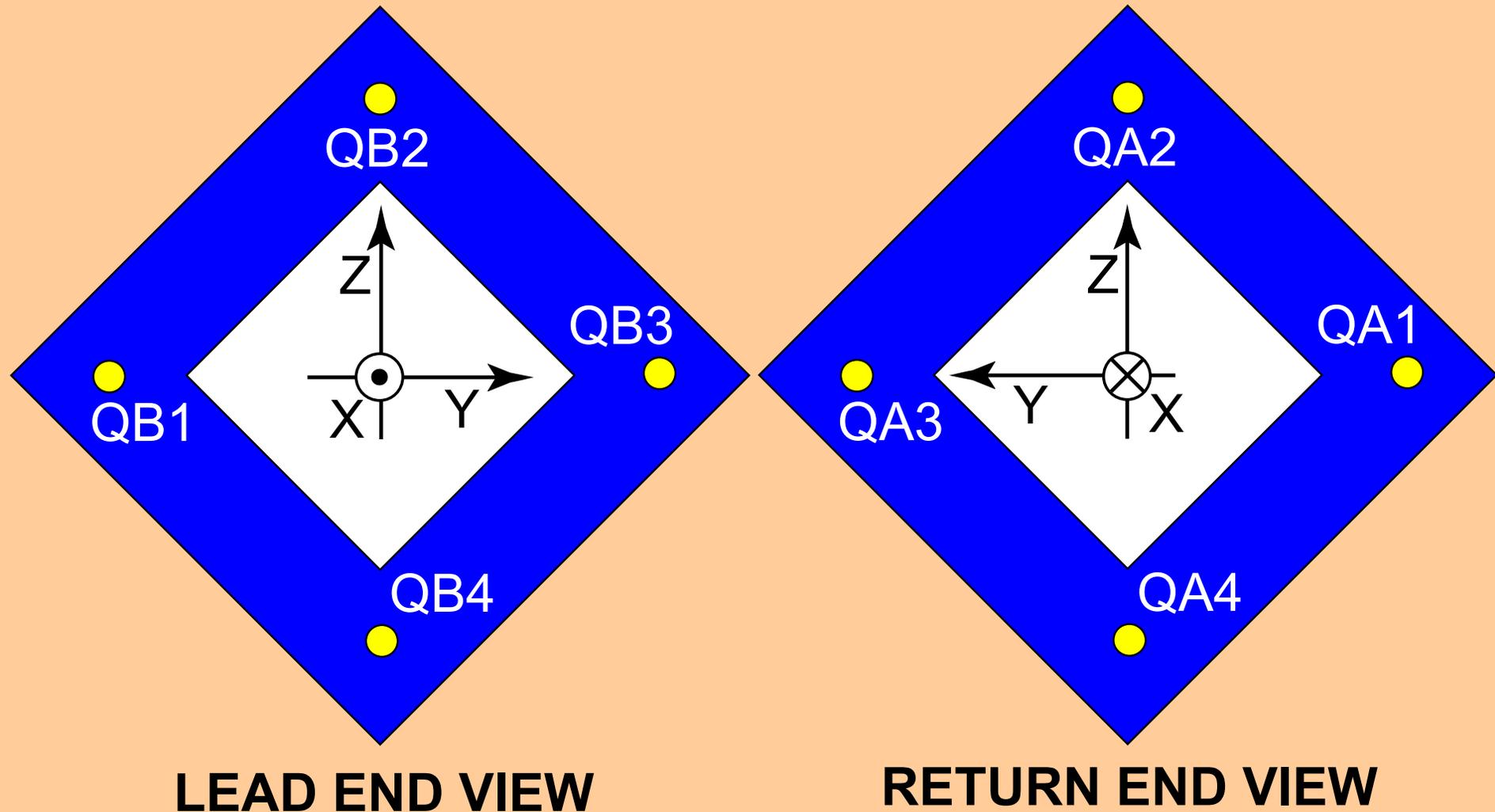
Magnet Roll Data that Exist

- *Magnetic roll* angle is measured with respect to gravity \Rightarrow Rotating Coil Data.
- The most reliable roll measurements are those where a measurement with a mole was also done to recalibrate the rotating coil.
(3 magnets; but survey data handed over for only **one** of them)
- Due to drifts in the rotating coil system (which are not fully understood), the error in the roll angle from magnetic measurements may be as much as 0.75 mrad \Rightarrow require adjusting magnetic Data.

Roll Angle from Survey Data

- We need to evaluate roll angle with respect to gravity for comparison with magnetic data.
- The “raw” survey data has coordinates with the Z-axis aligned with gravity.
- The roll can be computed from any suitable pair of fiducials (4 on each face).
- 5 fiducial pairs were selected on either face and the roll angles were computed from deviation of the vector from either a perfectly horizontal line or a 45 degree line. The average of 10 values was taken as the *Mechanical Roll* angle.

Survey Fiducials & Frame



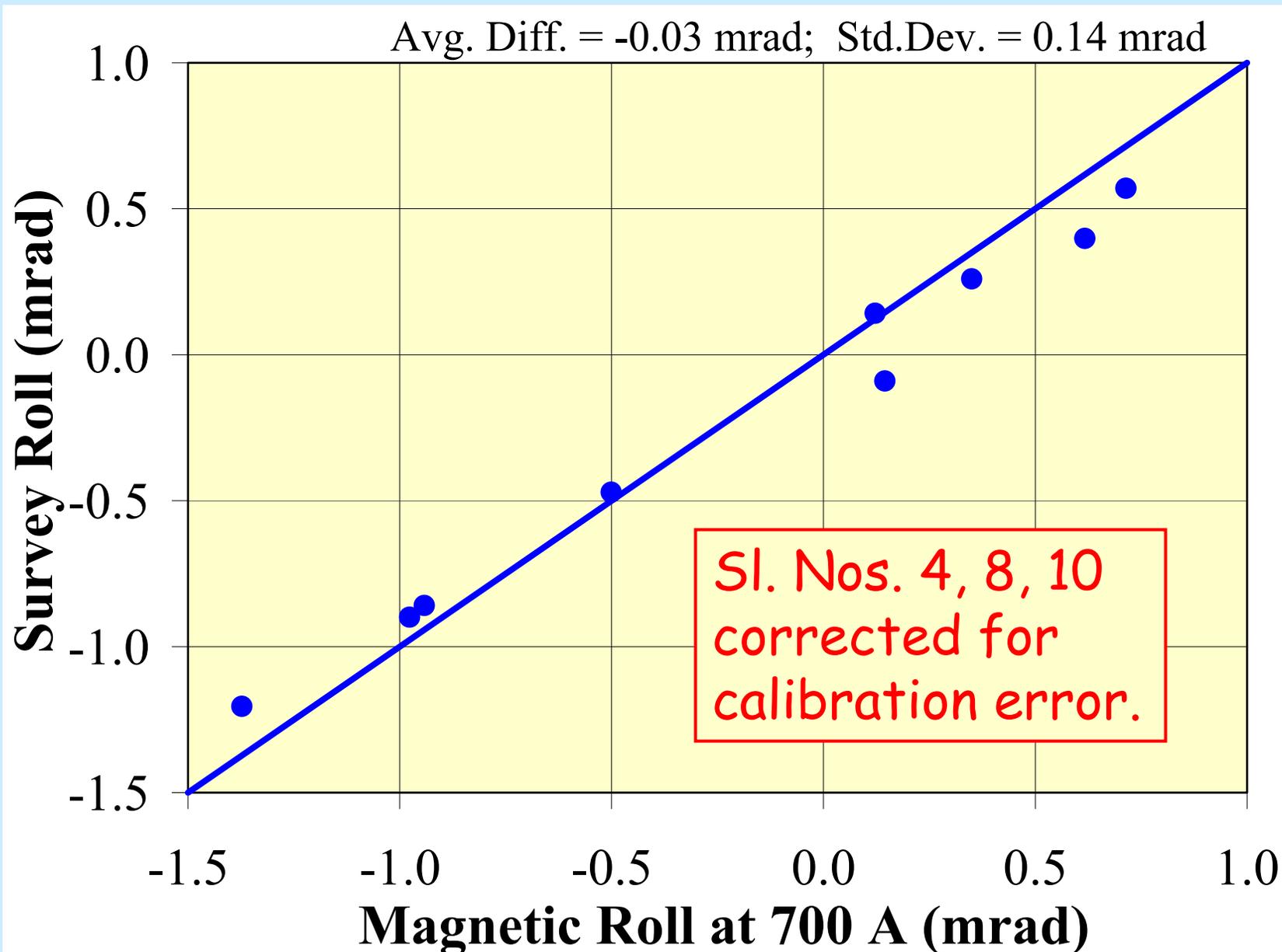
An Example of Mechanical Roll

Calculation of roll from various fiducial pairs in SQ2108

Face	Vector	Del-X (in.)	Del-Y (in.)	Del-Z (in.)	Roll (deg.)	Roll (mrad)
NLE Face	QA1 to QA3	-0.0484	35.8016	-0.0202	-0.0323	-0.564
	QA1 to QA2	-0.0063	17.9086	17.8937	-0.0238	-0.416
	QA1 to QA4	-0.0339	17.8937	-17.9109	-0.0275	-0.479
	QA2 to QA3	-0.0421	17.8930	-17.9139	-0.0334	-0.582
	QA4 to QA3	-0.0145	17.9079	17.8907	-0.0275	-0.481
LE Face	QB1 to QB3	-0.0520	35.8001	-0.0183	-0.0293	-0.511
	QB1 to QB2	-0.0113	17.9077	17.8884	-0.0309	-0.539
	QB1 to QB4	-0.0412	17.8960	-17.9095	-0.0215	-0.376
	QB2 to QB3	-0.0407	17.8924	-17.9067	-0.0228	-0.398
	QB4 to QB3	-0.0108	17.9041	17.8912	-0.0207	-0.360
Average from NLE Face =					-0.0289	-0.505
Standard Deviation =					0.0039	0.068
Average from LE Face =					-0.0250	-0.437
Standard Deviation =					0.0047	0.082
Average from both Faces =					-0.0270	-0.471
Standard Deviation =					0.0046	0.080

Magnetic measurements in SQ2108 (Run 2 at 700A, calibration corrected)= -0.501 mrad

Survey and Magnetic Roll Data in 21Q40 Quads



Conclusions

- Survey and magnetic data have been compared in a few 21Q40 quadrupoles
- The mechanical axis generally agrees with the magnetic axis within ~ 0.15 mm.
- Horizontal agreement = -0.025 mm ($\sigma = 0.056$ mm)
- Vertical agreement = $+0.042$ mm ($\sigma = 0.085$ mm)
- Survey and Magnetic roll angles agree to better than 0.1 mrad (std. dev. = 0.14 mrad)
- Not all “raw” magnetic data have accurate roll.
- **Need hand over of survey data in all magnets.**