HFT PXL Survey Status

Qiu Hao (LBNL)

for jobs also done by

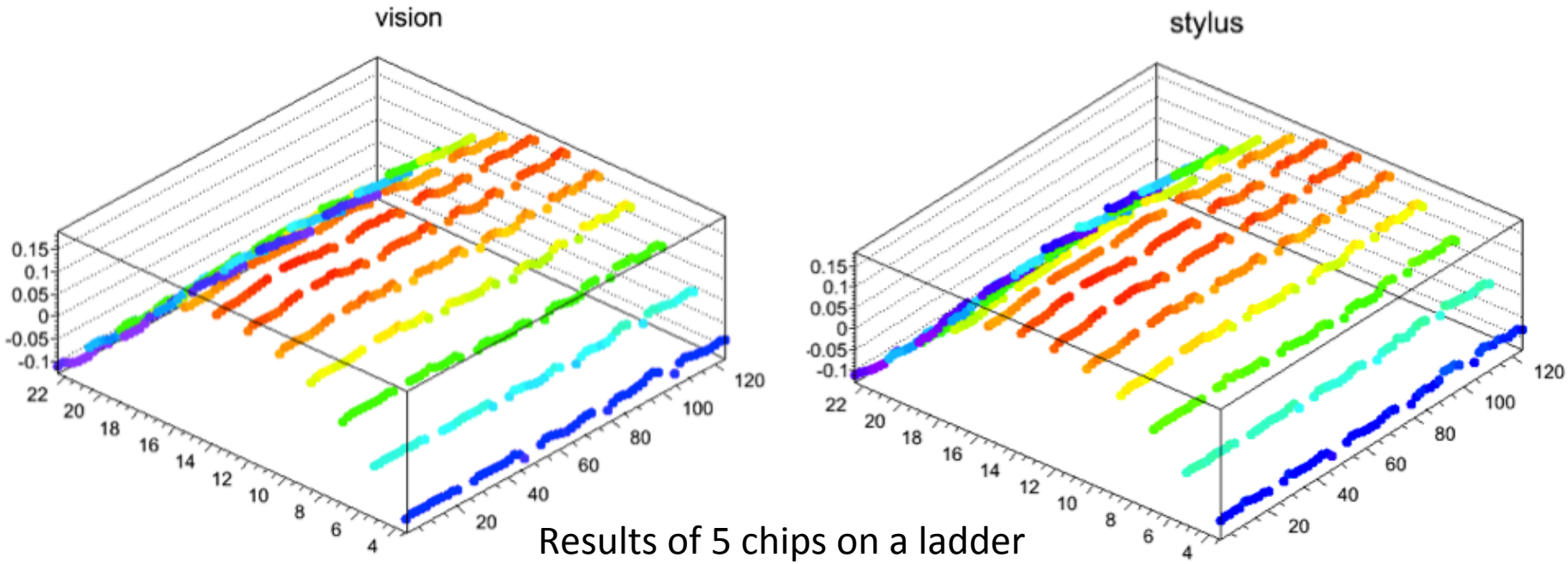
Howard, Joe, Bob, Jan, Jana and Mustafa

Outline

- Current status
- Rotation issue
- Stability issues
- Future Plan

Brief Introduction to Current Status

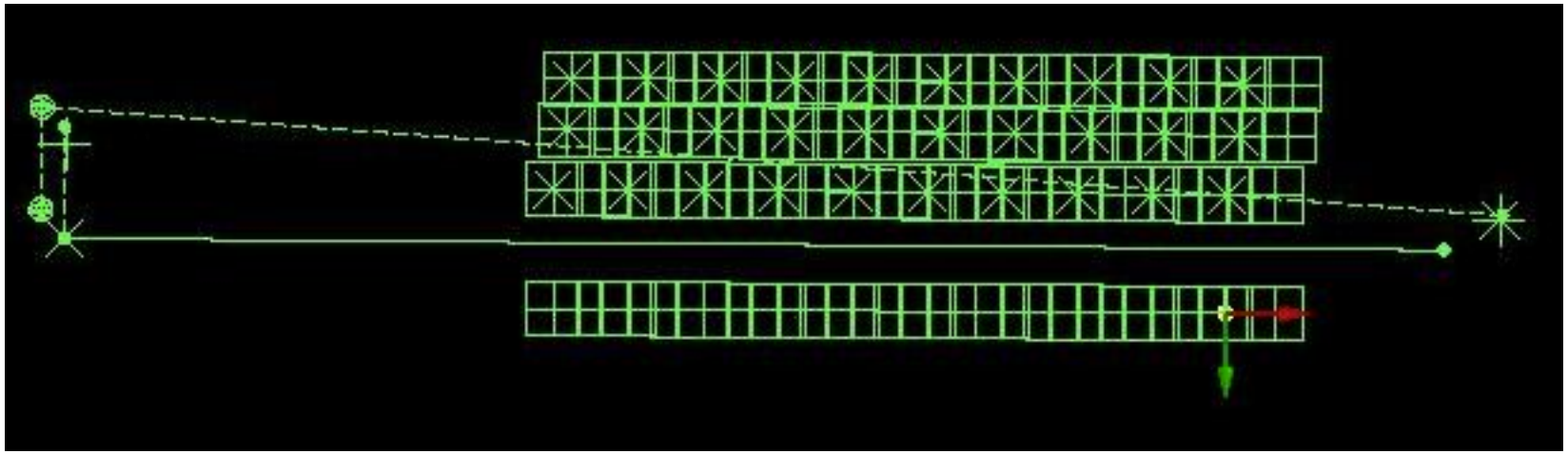
- We have a sector with ladders and chips, and the rotary head to play with.
- We have a program to survey a whole ladder. It can find the 2 features on each chip, define local coordinate system by them, and scan the chip for ~100 points.
- Due to the variation of the position of chips on ladder, feature finding involves some manure interaction. For a whole sector, this means ~ half hour operation and the rest is ~one day automatic running.

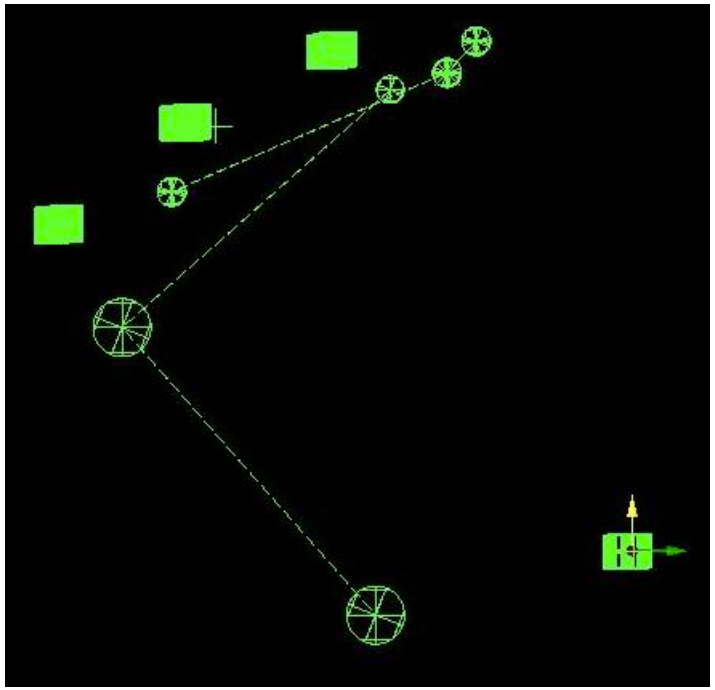


Results of 5 chips on a ladder

- The change in z is mainly along local y direction, ~200 μm.

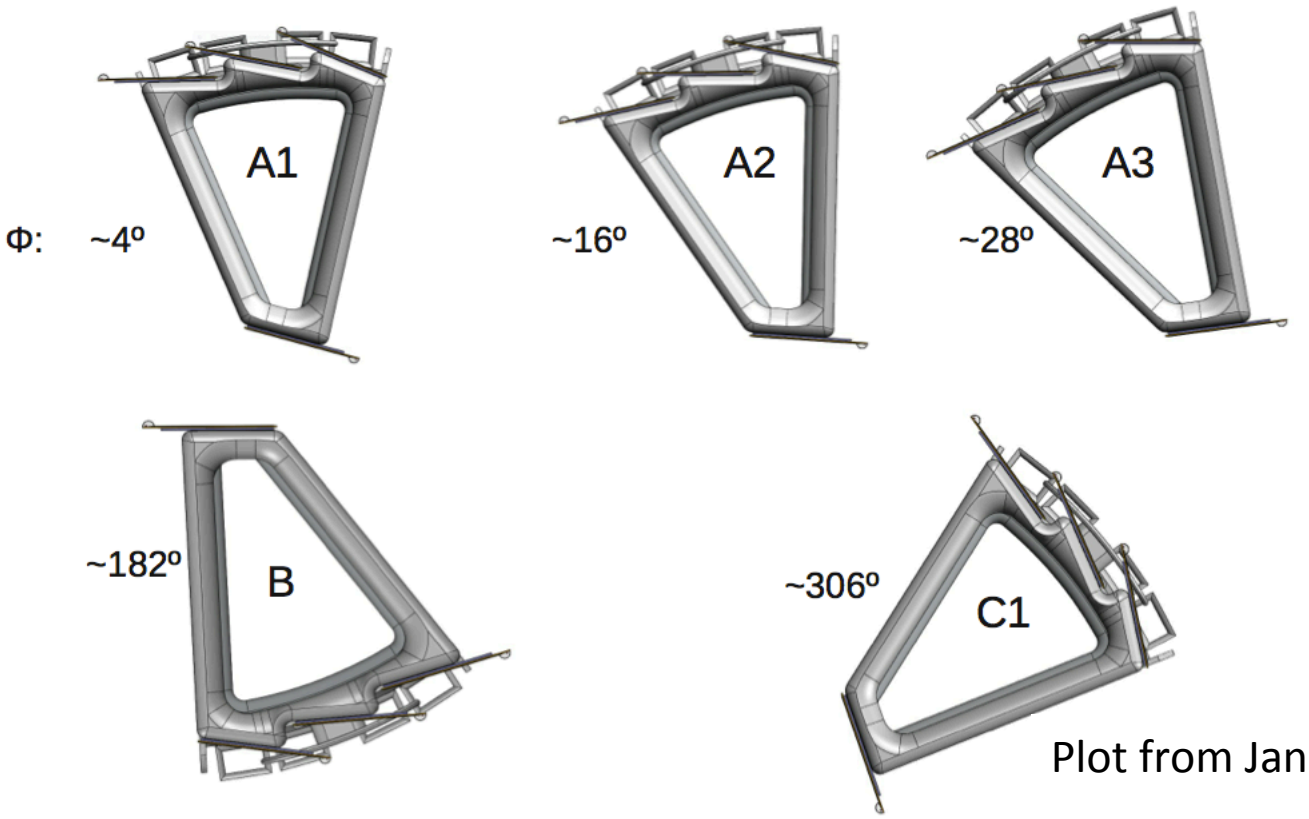
Brief Introduction to Current Status





- We also have a program able to
  - rotate the sector
  - probe the tooling balls and define coordinate system with them
  - find and measure all features on chips on all 4 ladders.
- Two main issues during the past several months:
  - rotary (solved)
  - repeatability (still need further study)

Rotation Issue

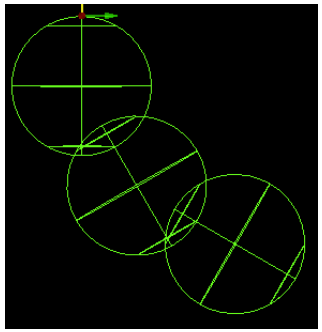


Plot from Jan

rotary head

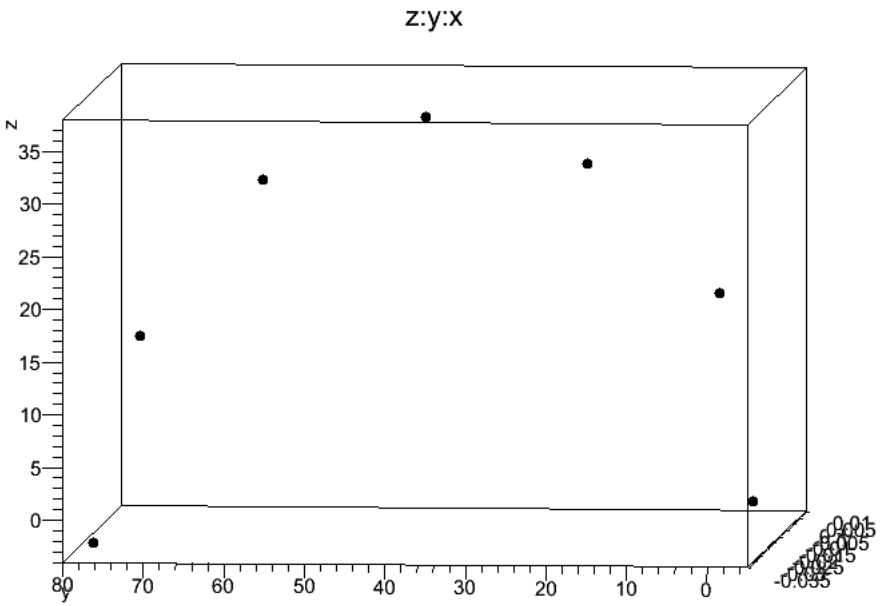
- The sector has to be surveyed at several rotation stages.
- Originally, the OGP rotary head is claimed to be able to rotate the part while maintaining the coordinate system to a precision we need, but this is not the case.

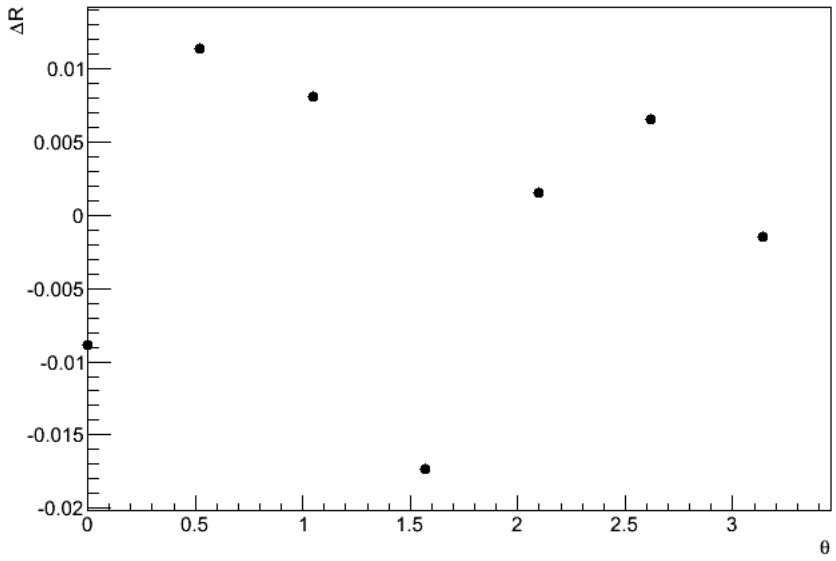
Rotary Calibration is Off



- When selecting “part on rotary” option, a ball should be measured as at the same position with any rotation angle of the rotary.
- But for a ball at the end of a sector, we see ~mm differences.
- The default rotary calibration, done by a short part only about 5 cm long, is not good for our long part and precision needed.

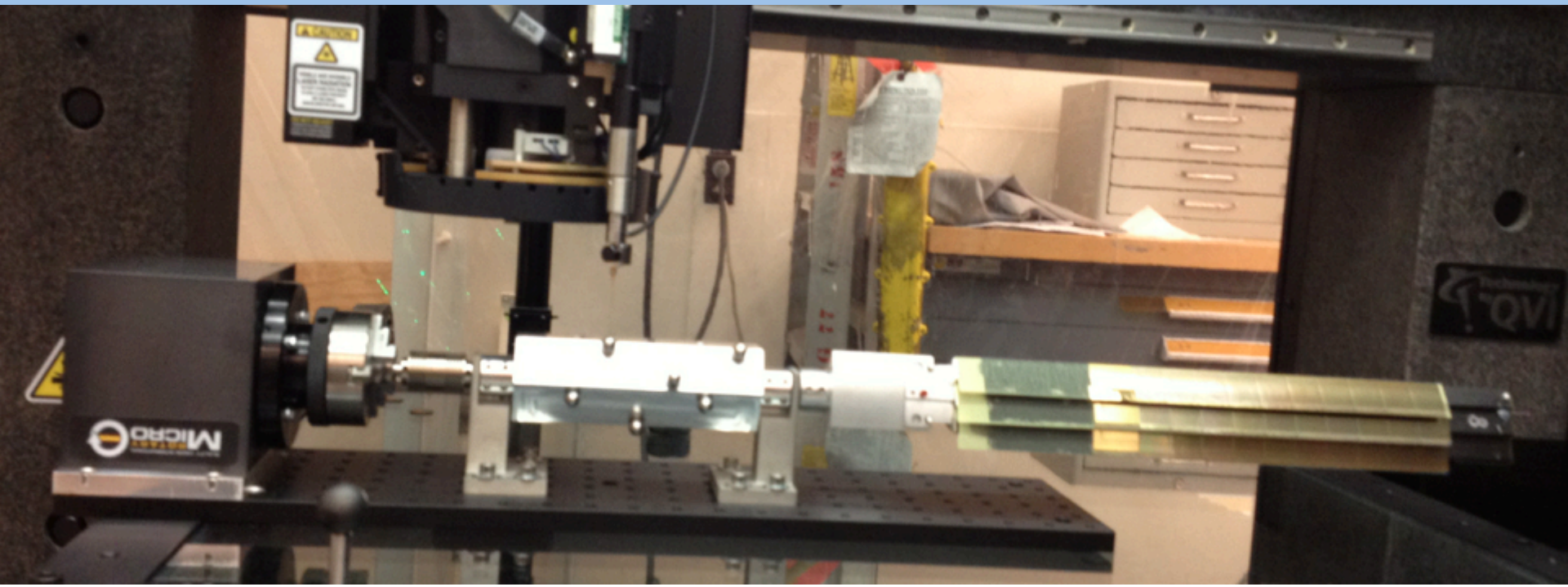
Rotation Axis Wobble





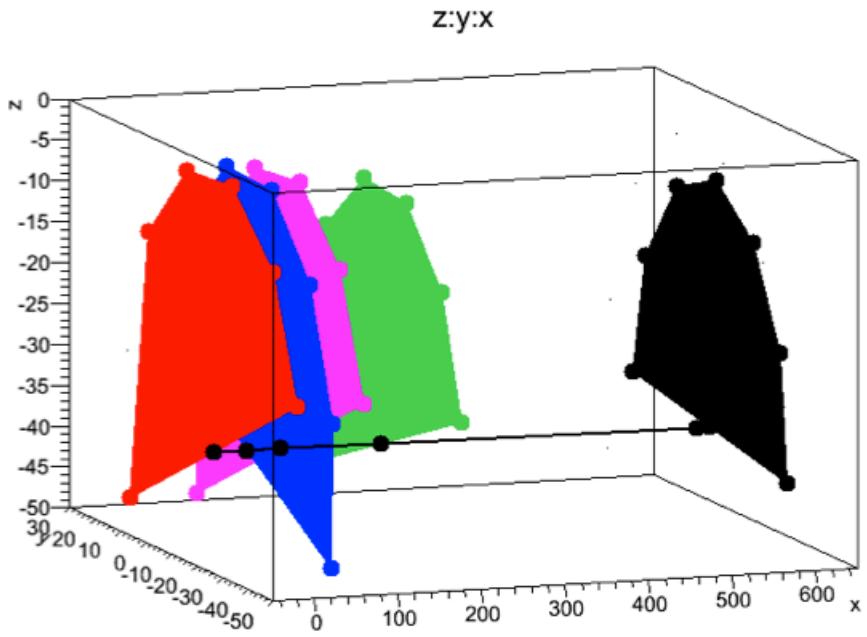
- When “part on rotary” option not selected, the ball measured at different rotation stages forms a circle.
- Fitting the measurements with a circle, we found a deviation of ~20 μm.
- This means the rotation axis is wobbling when rotating the part.
- So calibration is not the only issue. The precision of the rotary head hardware is only near but not within our requirement.

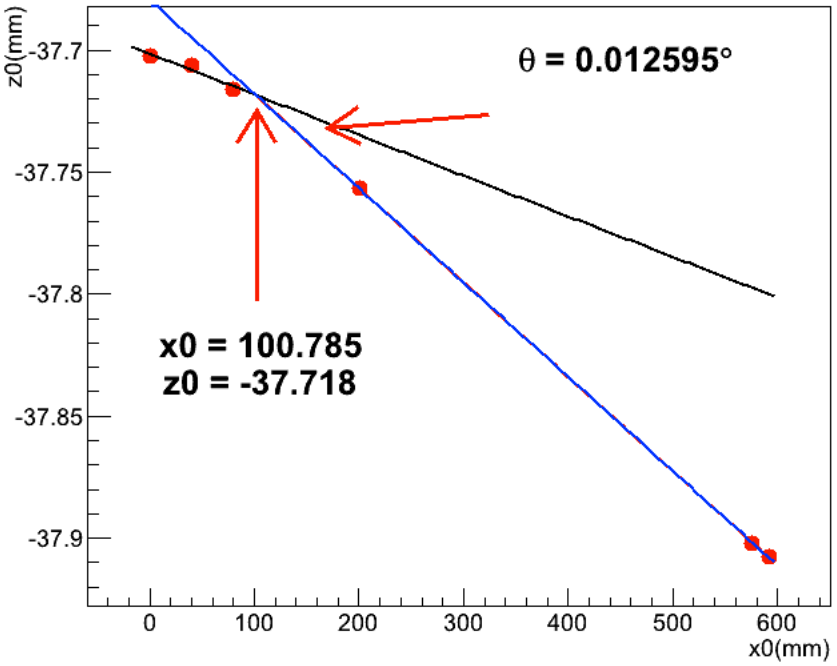
Homebrew Shaft



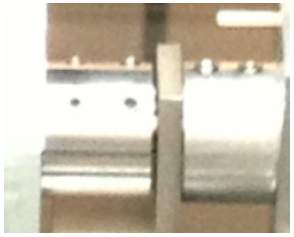
- A homebrew shaft is made and put between the rotary head and pixel sector, hoping to help better constrain the rotation axis.

Homebrew Shaft

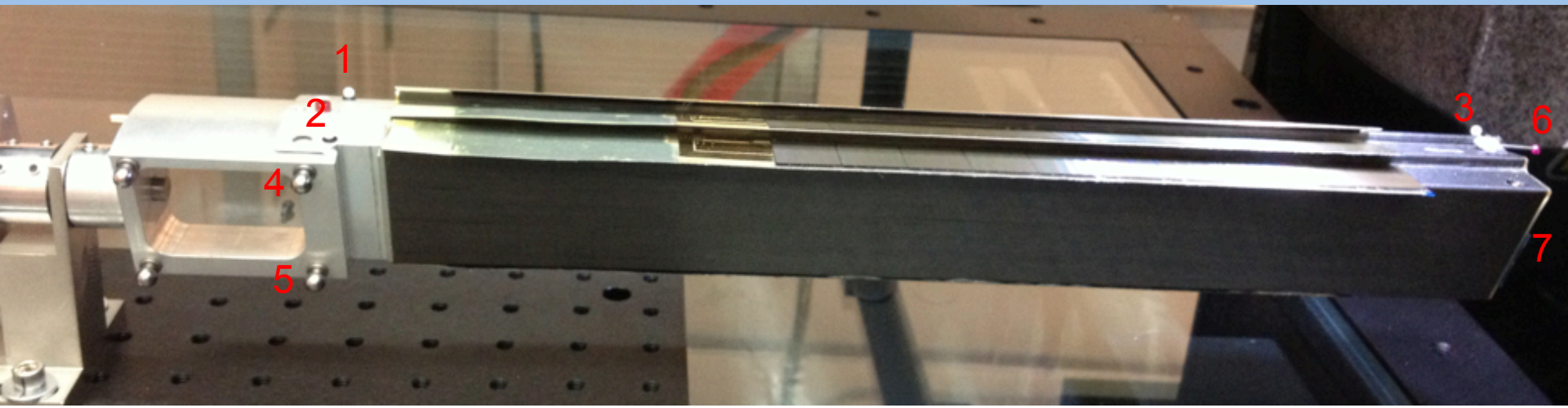




- 3 balls on shaft and 3 on sector are measured at 7 different rotation stages.
- Circles are fit to the measured positions for each ball.
- A kink is found between the fitted centers of circles on shaft and on sector.
- The connection between the shaft and the sector is not strong enough.

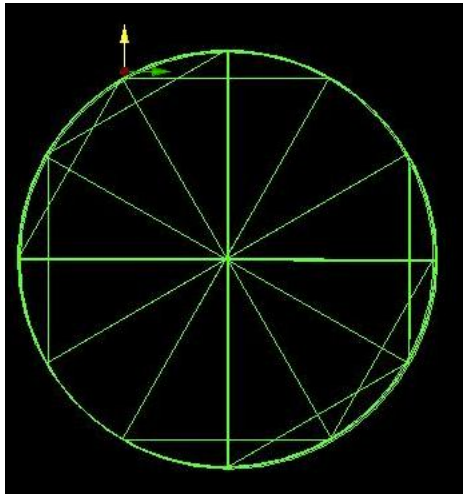


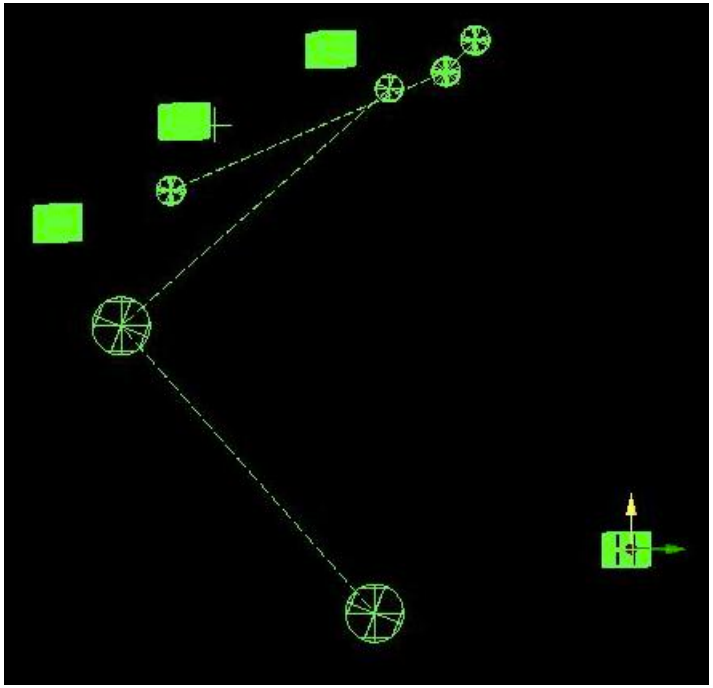
New Tooling balls



- New tooling balls are added so that we can set up and link together coordinate system at all rotation angles during the survey.
- Ball 1, 2, 3: original tooling balls to define the sector coordinate system.
- Ball 4, 5, 6: new tooling balls to pass the sector coordinate system when surveying the innermost (down side) ladder.
- 7: position where ball 3 will be relocated, so that it can be probed at all angles like ball 6.
- Now we don't need to rely on the machinery precision of the rotary or shaft to link survey measurements at different rotation angles, although the survey program will be a little bit more complicated.

New Calibration



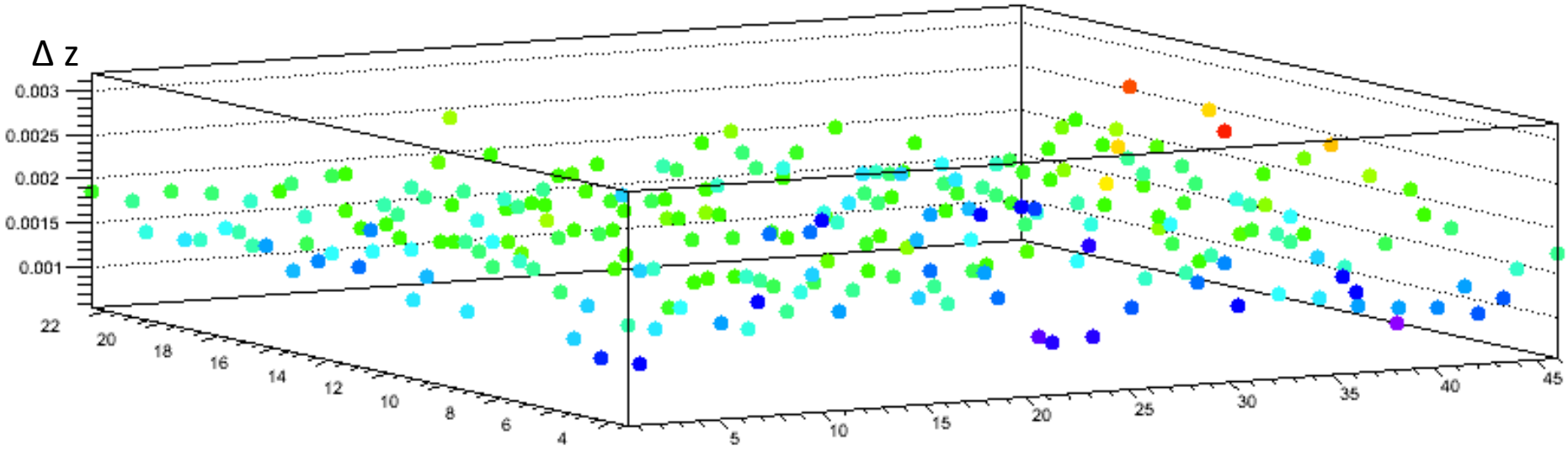


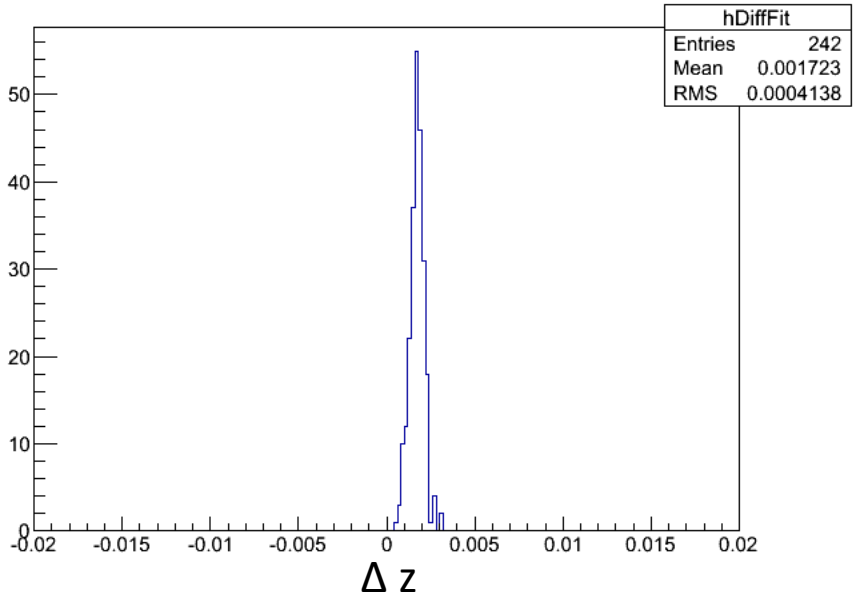
- A new calibration program is developed, using balls on the sector itself.
- ~ 20 µm difference between the same ball measured at different rotation stages is still observed, but at least they overlap in view. This makes programing the survey much easier.

Stability Issues

- Repeatability using the same probe at the same rotation angle
- Repeatability vs. time
- Repeatability using different probes (need further study)
- Repeatability at different rotation angles (to be studied)

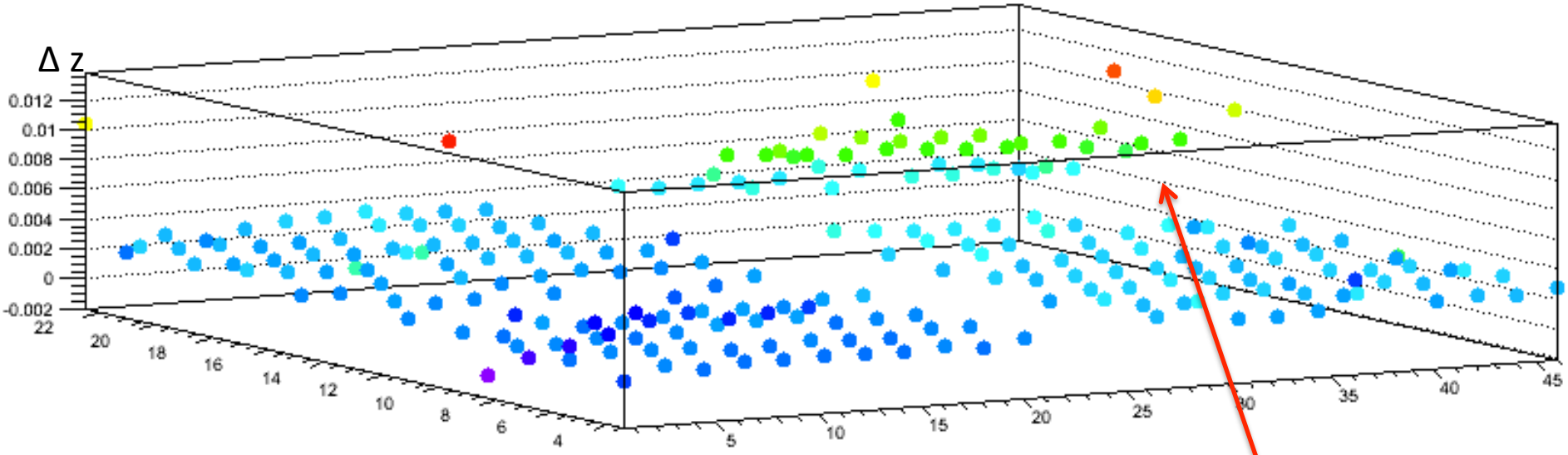
Vision Repeatability

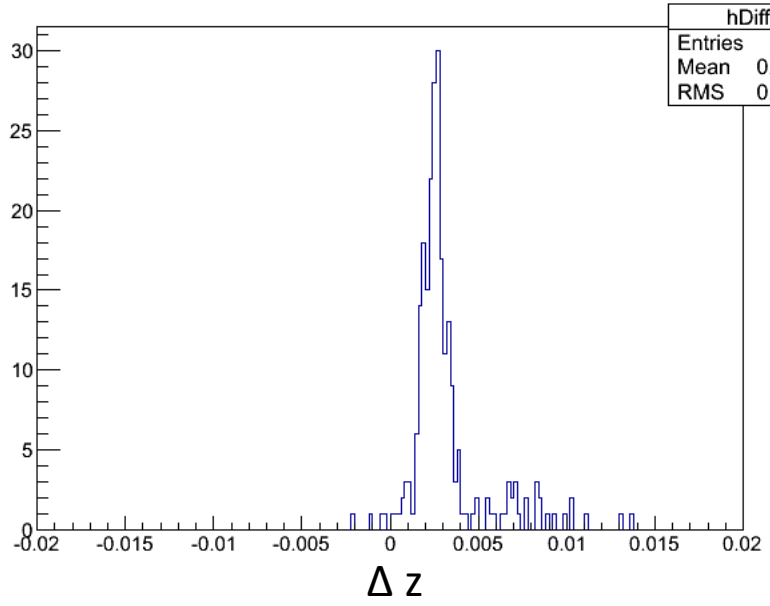




- 2 chips
- scanned with vision twice, with a stylus scan in between
- RMS ~ 0.4 μm
- a shift of ~ 2 μm ?

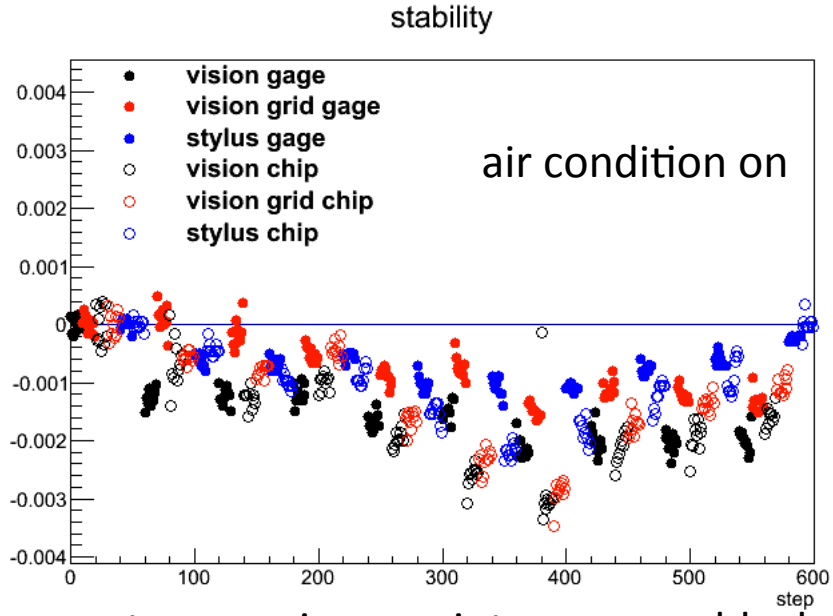
Stylus Repeatability

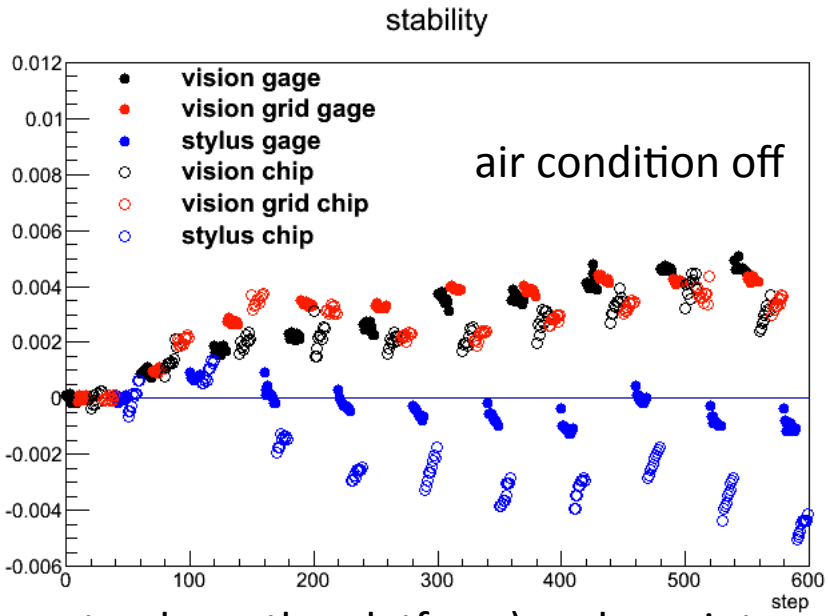




- 2 chips
- scanned with stylus twice, with a vision scan in between
- RMS ~ 2 μm
- shift ~ 3 μm ?
- Some sudden jumps when the stylus is influenced by air flow or vibration, and have to resume the program

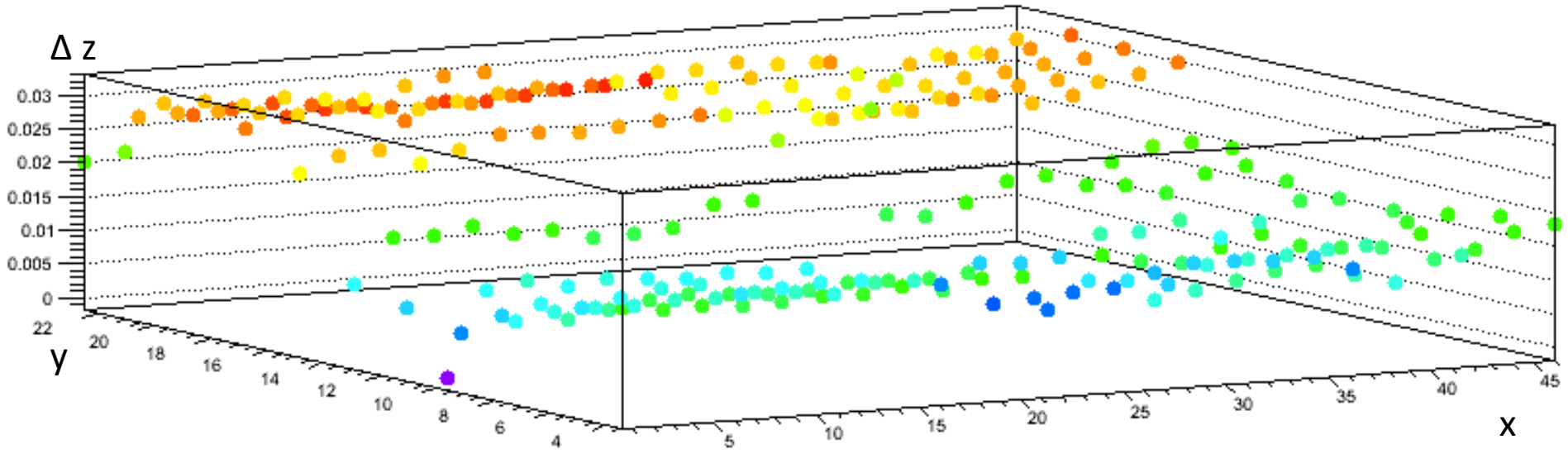
Repeatability vs. Time





- repeat measuring a point on a gage block (very steady on the platform) and a point on pixel chip on sector
- measured with stylus, and vision with/w.o. grids (which help measuring too smooth surface by projecting grids pattern on it)
- ~ 1 hour program
- A several μm drift behavior is observed
- different between different probes, and between the gage block and the chip
- can explain the previous “shift” between 2 scans
- re-measure reference point frequently during the survey will minimize this influence

Repeatability between Probes



- Difference between stylus and vision
- A y dependence of difference between probes observed ~ 20 μm
- Since chips mainly curves along y direction, this difference can be as a function of probing angle
- Need further study to find out the source

Future Plan

- Solve repeatability issue
- Finish the program to survey the whole sector, confirm at least 2 runs with consistent results
- When the real sector come, the program need to be redone because the dimensions will change a little.

- Survey between different sectors
- Survey between PXL and the whole STAR coordinate

- Create DB and software to apply the survey results

Thank You !