# Pixel Sector Survey

5/17/2012

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Task:

survey {
1) Map the pixel position relative to other pixels.

Required precision: << 20 μm

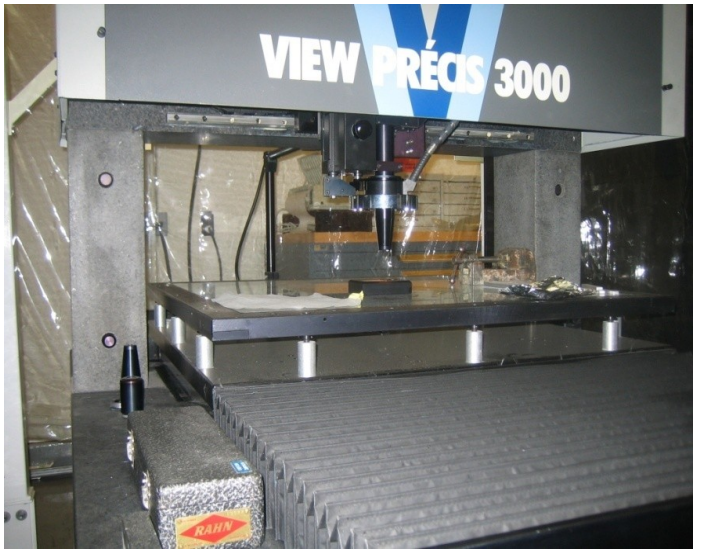
2) Measure the position of each sector within the half cylinders

tracking {
3) Relative position of the half cylinders

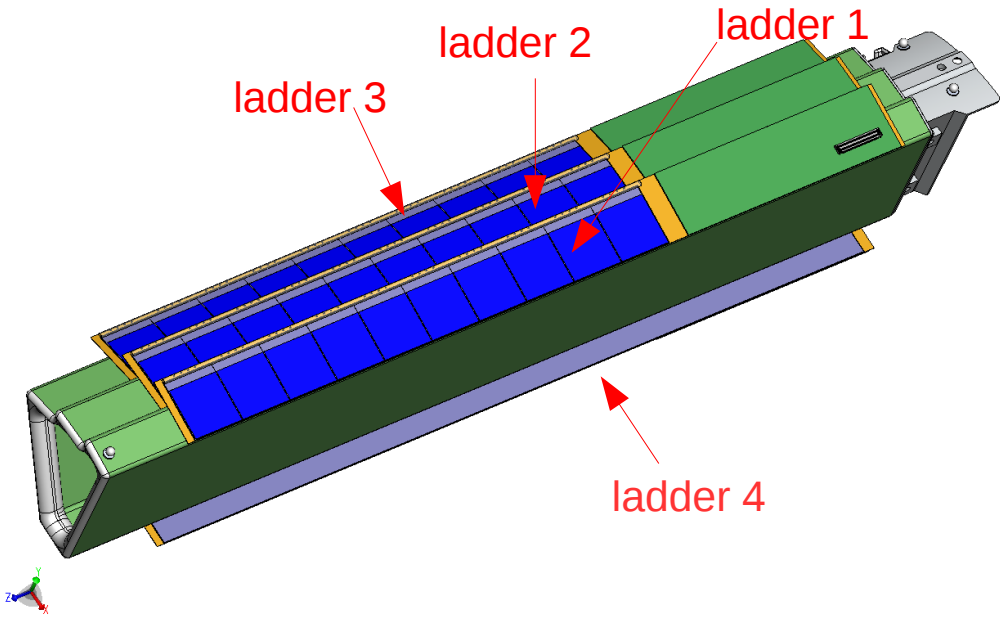
4) PXL to STAR alignment

# Tools:

CMM with microscope and touch probe (feather probe)




optics
- one point measurement: 1 µm
- repeatability: less than 5 µm
- can find features



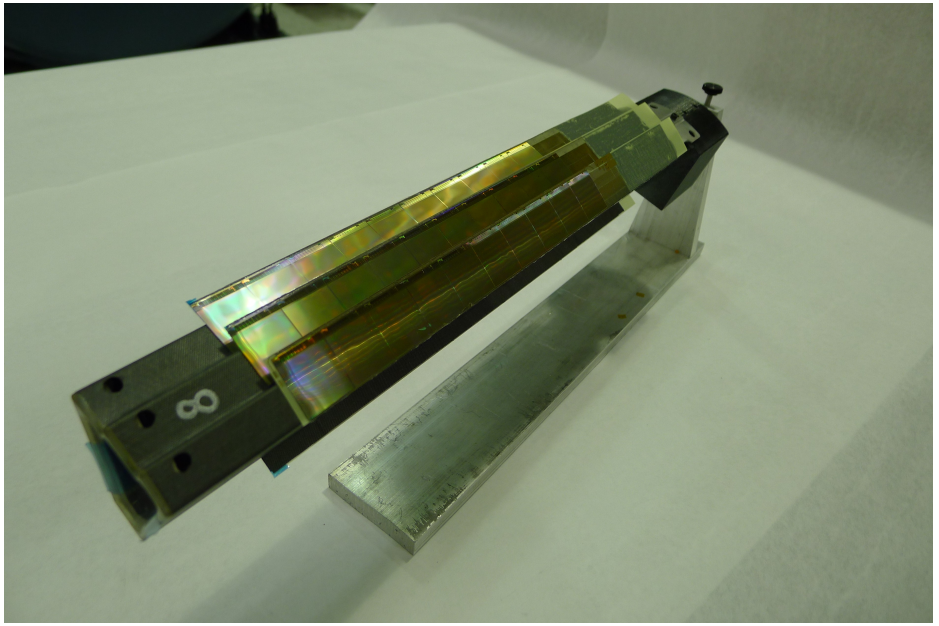

overlap → ladders 2 and 3 need to be (partially) surveyed with the touch probe

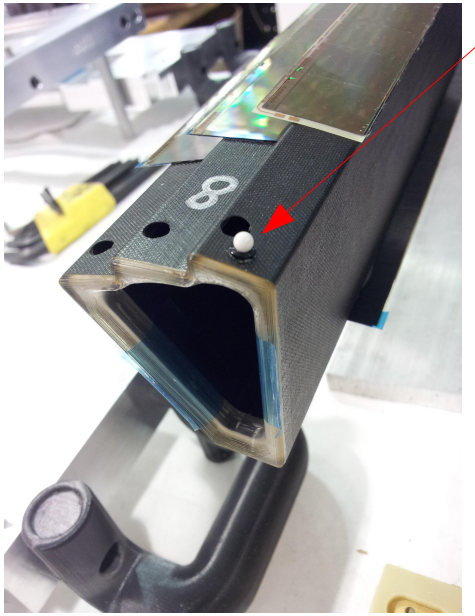
# Current Status

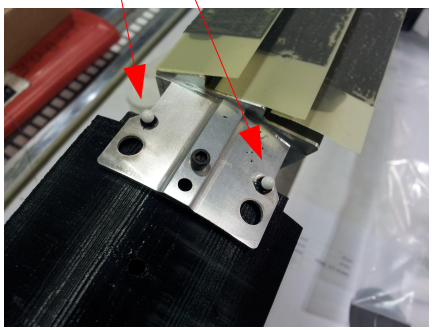
- test measurements of chip and ladder done

- testing sector arrived at LBNL

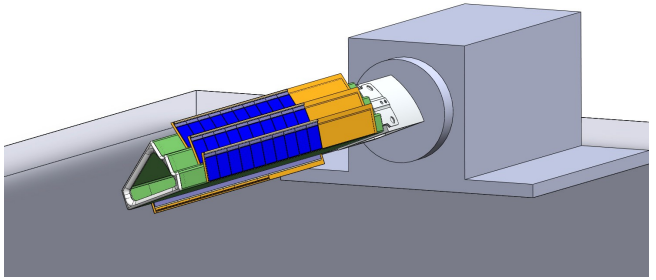
tooling balls already there





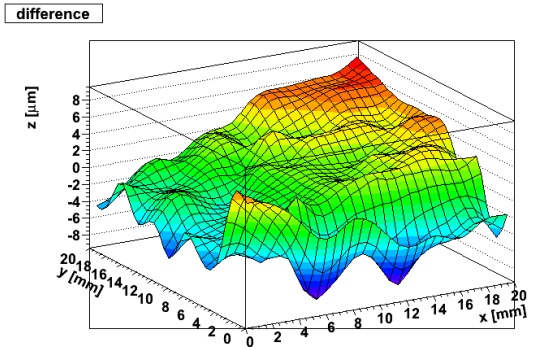


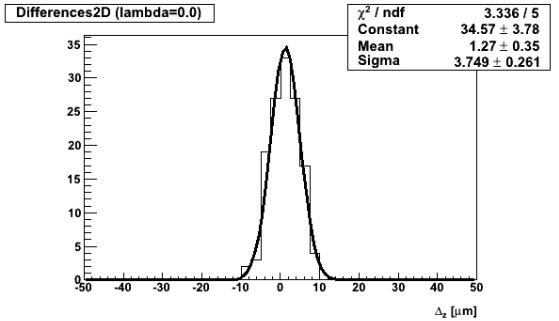
- rotatory machine installed and operational



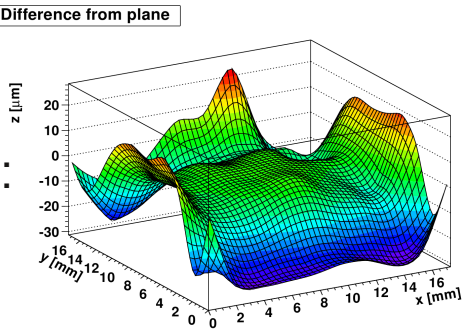
# What do we know from the test measurements:

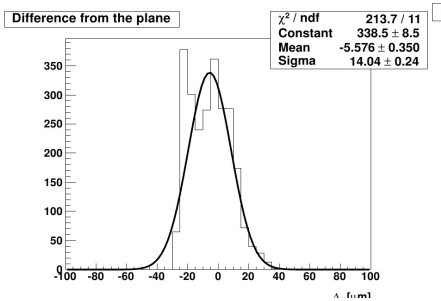
measurement reproducibility:
~ 4 µm (optics)

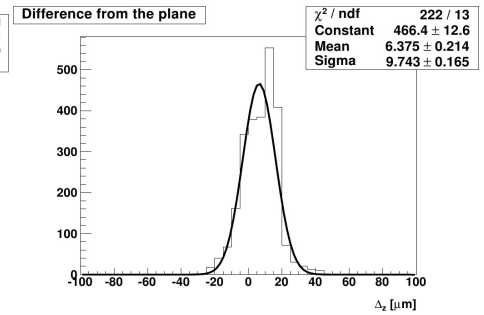


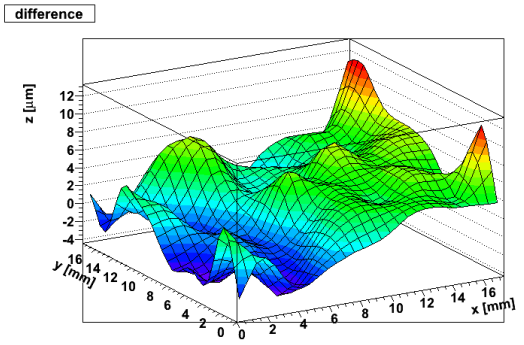

glued chips:
deviation from fitted plane:
~ 10-15 µm

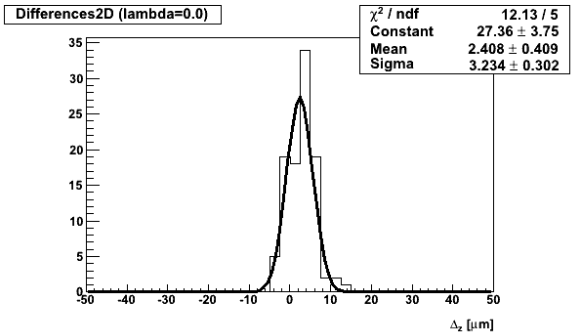



sector/ladder <-> chip transformation:
~ 4 µm



# Coordinate systems

1) Sector Coordinate System (SCS)

   - origin position: sector geometrical center

2) Ladder Local System (LLS)

   - origin position: ladder geometrical center

3) Sensor Local System (SLS)

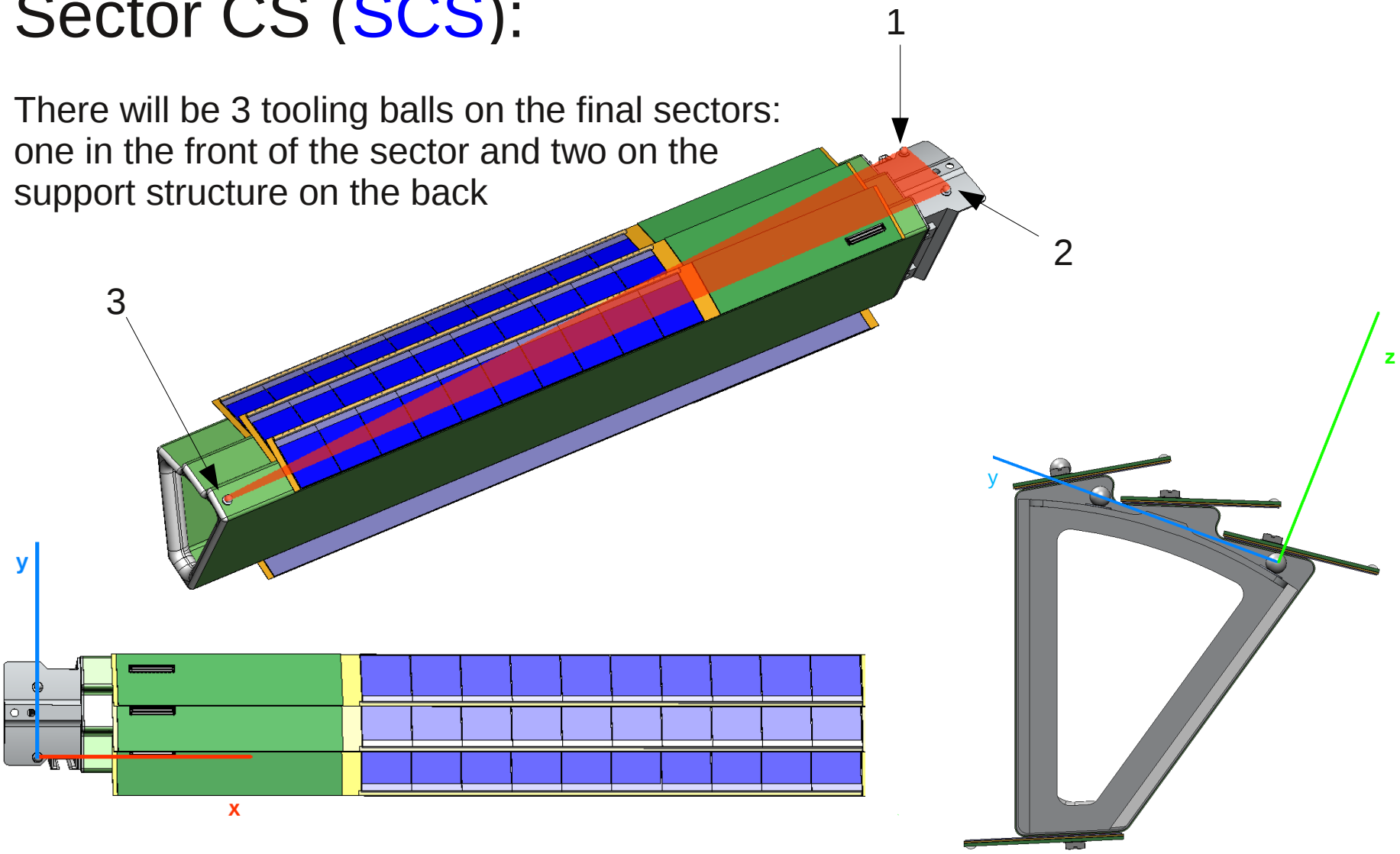
   - origin position: sensor geometrical center

These natural coordinate systems are convenient for further offline alignment with the STAR detector.

They cannot be easily set-up in the MeasureMind software → we need different coordinate systems to be used **during** the survey (SCS, SLS)

# Sector CS (SCS):

There will be 3 tooling balls on the final sectors: one in the front of the sector and two on the support structure on the back

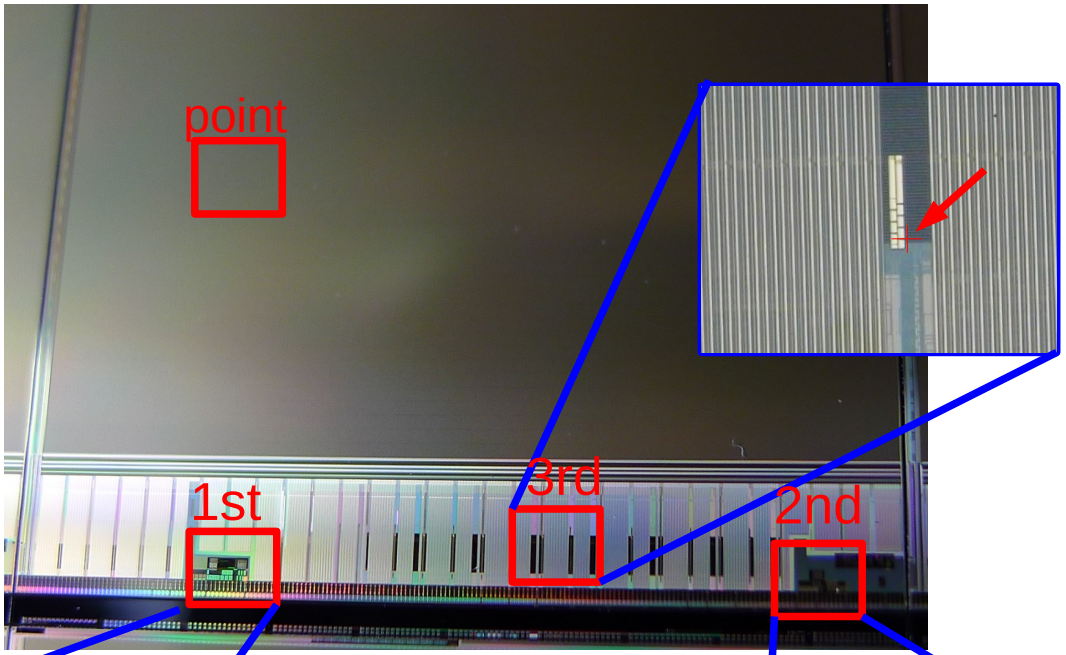



- xy plane formed by the centers of all 3 balls
- origin placed to the center of the 1st ball
- y axis aligned with the center of the 2nd ball

# Sensor Local CS (SLS):

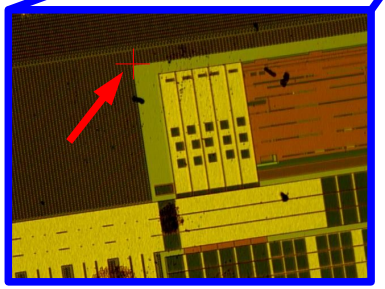
2 features + 1 point with given position
OR
3 features (easier sector ↔ sensor transformation)

x=4594.225 µm
y=10000.00 µm
z=0 µm

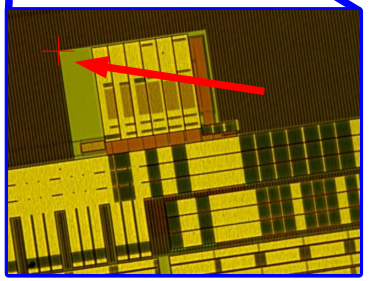



x=? µm
y=? µm
z=0 µm

x=4594.225 µm
y=920.775 µm
z=0 µm

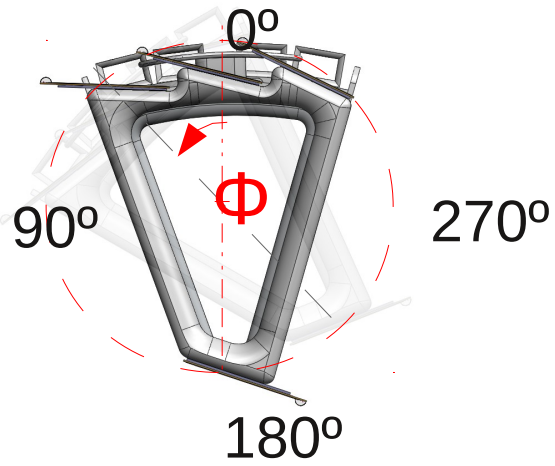


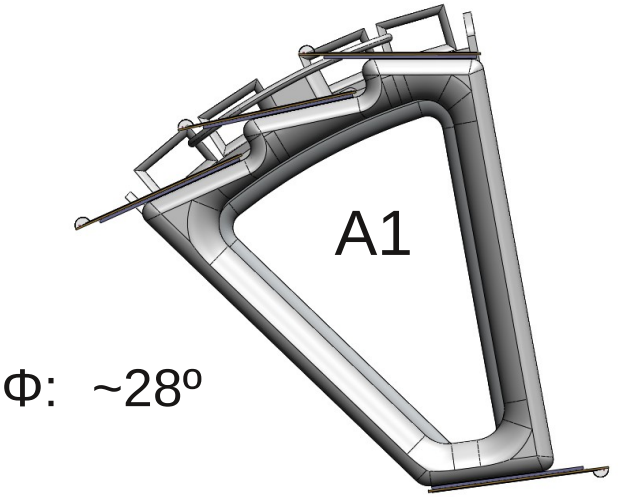
x=18165.075 µm
y=871.6 µm
z=0 µm

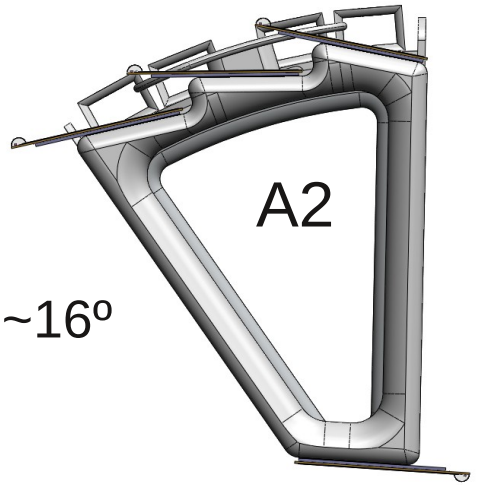


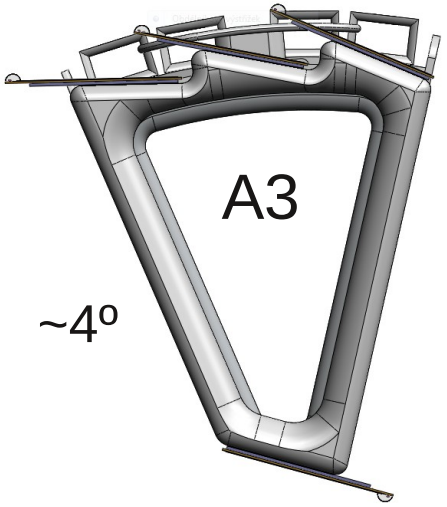
# Suggested Survey Procedure

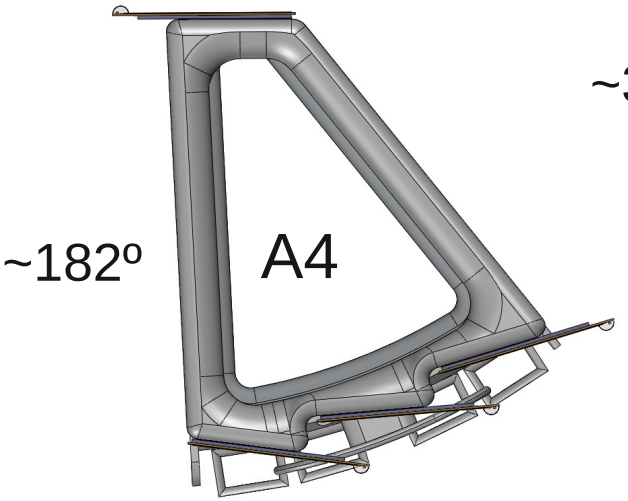
Sector positions (±1º) used for survey:

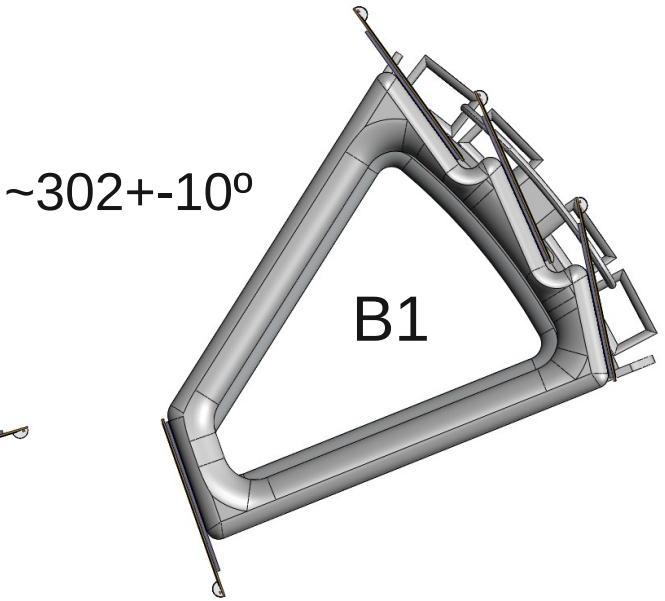


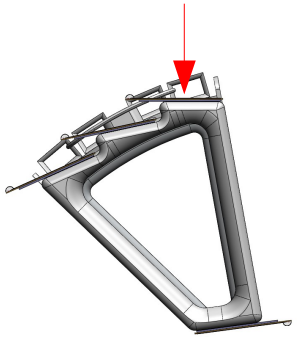



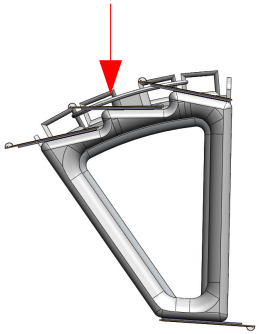



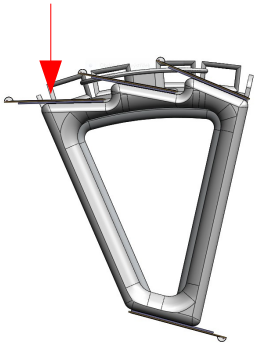





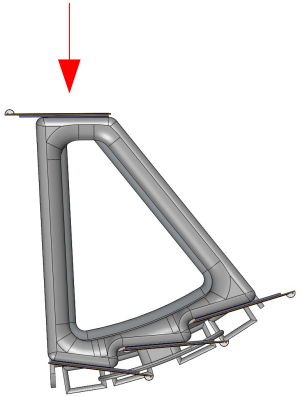
1. position A1
    1.1 measure 3 calibration balls -> set-up sector coordinate system SCS
    1.2 measure the **whole** ladder 1 using the optics
        1.2.1 measure all features (in sector coordinate system SCS)
        1.2.2 measure 3 features + NxM points in sensor local coordinate system SLS, repeat for all 10 chips
    1.3 reset the SCS! (step 1.2.2 ends up with a SLS)



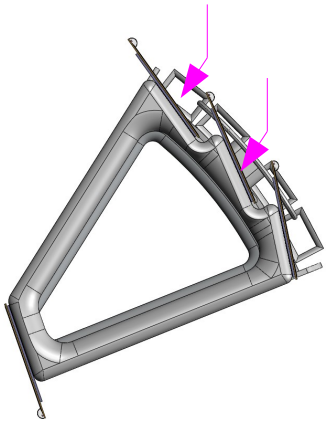
2. position A2
    2.1 set-up SCS (rotatory machine should do it automatically)
    2.2 measure (**visible part** of) ladder 2 using the optics:
        2.2.1 measure all 3x10 features (in SCS)
        2.2.2 measure 3 features + NxM1 points in sensor local coordinate system SLS, repeat for all 10 chips
    2.3 reset the SCS



3. position A3
    3.1 set-up SCS
    3.2 measure (**visible part** of) ladder 3 using the optics (SLS)
    3.3 reset the SCS



4. position A4
    - 4.1 set-up SCS
    - 4.2 measure the **whole** 4th ladder using the optics
        - 4.2.1 measure all features in SCS
        - 4.1.1 measure 3 features + NxM points in local coordinate system SLS, repeat 10x
    - 4.3 reset the SCS!



5. position B1
    - 5.1 set-up SCS
    - 5.2 measure ladder 3 using the touch probe (feather probe)
        - 5.2.1 measure N*10xM2 points in global coordinate system SCS
    - 5.3 measure ladder 2 using the touch probe (feather probe)
        - 5.3.1 measure N*10xM2 points in global coordinate system SCS
    - 5.4 one can also measure ladder 1 with the feather probe - just for comparison with the optical measurement

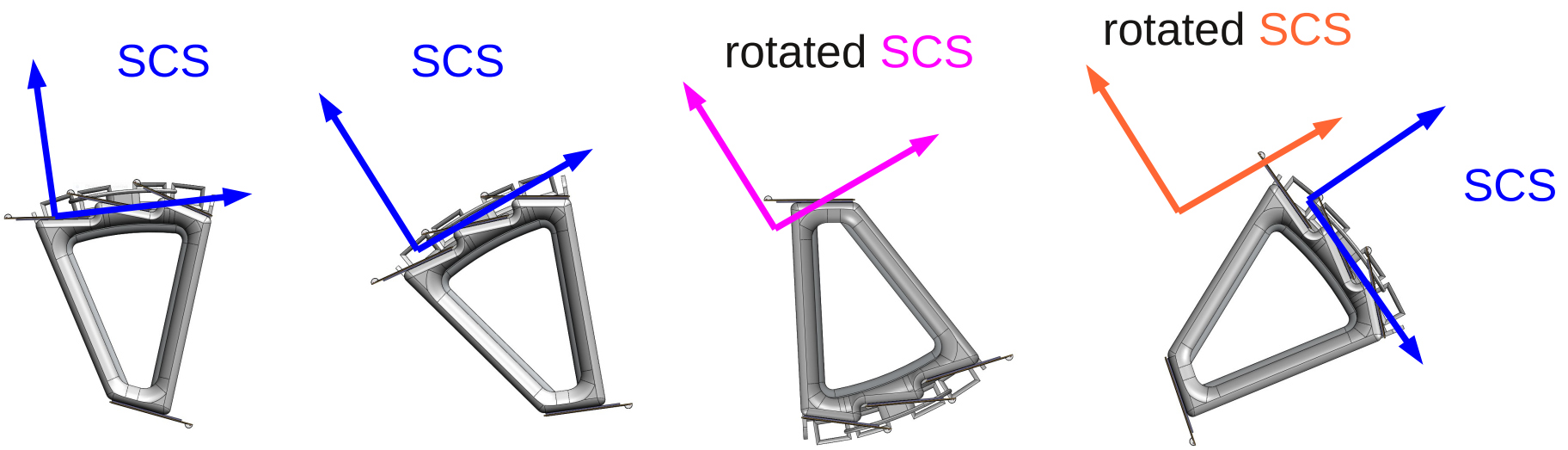
M1 = ~ M*0.6  M2 =~ M * 0.6

(so there could be an overlap between optics and touch probe measurement)

What we get:

- features on ladders 1,2,3 will be in SCS
- points measured with the optics will be in SLS -> need to transform to SCS
- features on ladder 4 will be measured either in the “normal” SCS* or in rotated SCS
- points measured with the feather probe will be either in the “normal” SCS* or in rotated SCS

=> **at the end all the points will be saved in one coordinate system** - SCS




*) if the rotatory machine will work as we anticipate

# Time Demands

one point with optics: ~ 3-5 seconds
one point with touch probe: ~ 5-10 seconds

if number of points per chip NxM=132:

2*10*(N*M)*(3-5) //two whole ladders measured with optics
2*10*(N*M1)*(3-5) //two ladders partially measured with optics
2*10*(N*M2)*(5-10) //two ladders partially measured with touch probe
(1-4)*3*60 // 1-4 measurements of 3 tooling balls
4*10*3*(3-5) //feature measurements

TOTAL: ~ 6-10 hours per sector

if NxM=42:

TOTAL: ~ 2-3 hours per sector

Add an extra time to program the machine (done only once): ~ 16 hours

# Open Issues

- feather probe:
  still don't know its exact speed and precision

- rotatory machine:
  - what is its precision?
  - rotation axis stability

- how many points do we need?

- 3rd feature