Structure fabrication for CLIC

CLIC08,

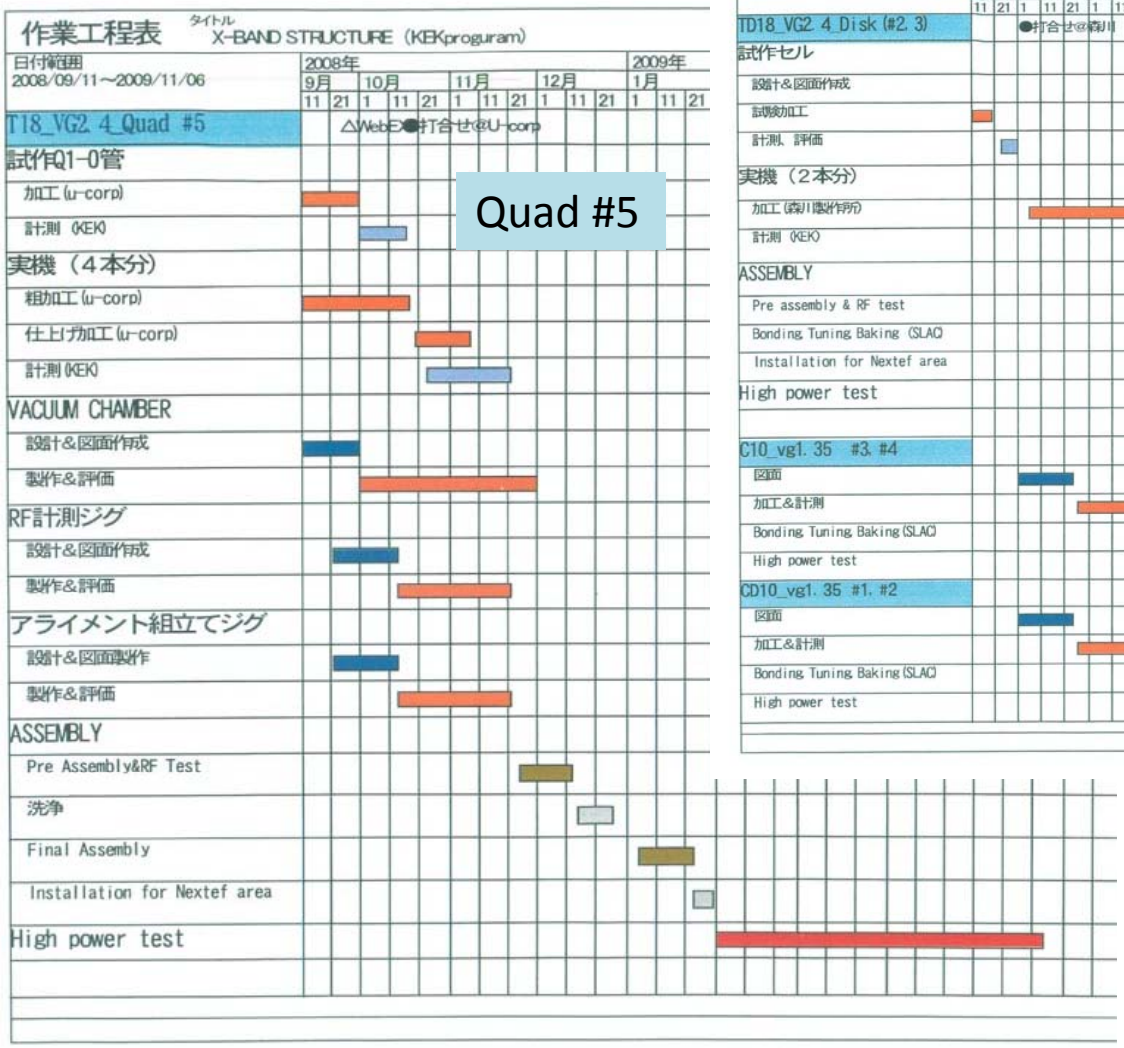
Oct. 14-17, 2008

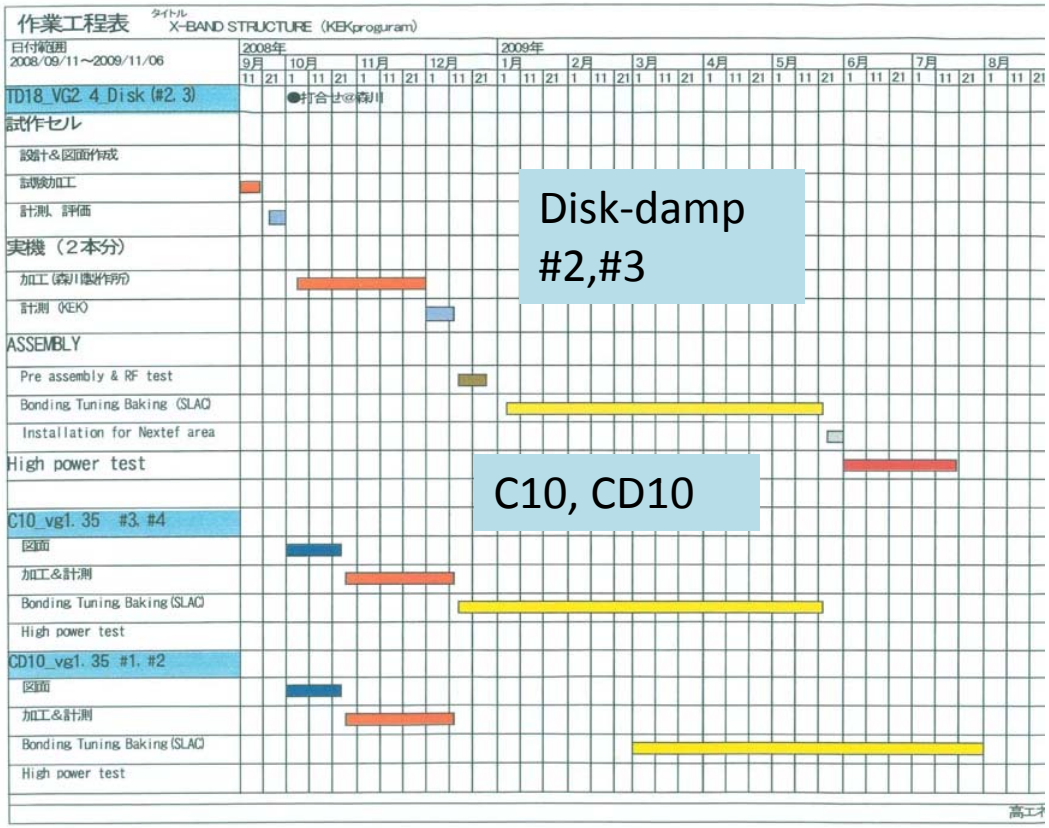
KEK, T. Higo

Strategy of structure fabrication at KEK

- Re-establish GLC/NLC structure fab technique
  - 60-100MV/m
- Extend it to heavily damped structure for CLIC
  - Disk damp confirmation
- Learn about fabrication by all milling
  - Study high gradient performance
  - Study mass production feasibility
- Discuss about the practical candidate
  - For near future application in a few years

Structure fabrication plan

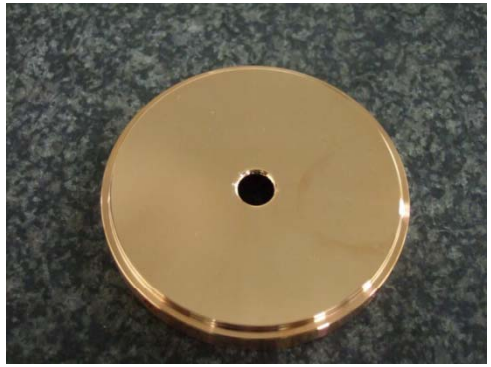


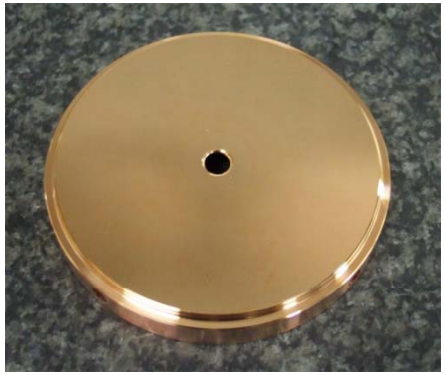


Disk-damp fabrication

- Started with technology of T18_VG2.4_Disk
  - Material
    - OFC
  - Machining
    - Usual turning for disk
    - Usual milling for coupler of mode converter type
  - Surface treatments
    - SLAC does all
    - CP, DB and VAC baking
- Take the same method but with milling in each cell
  - Mechanical design by KEK
  - Fabrication study done

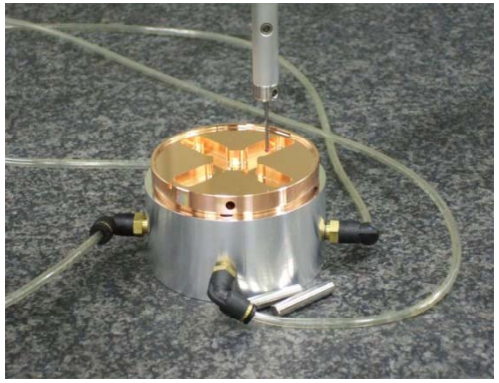
TD18_VG2.4_Disk Fabrication test





Cell #1

Cell #19



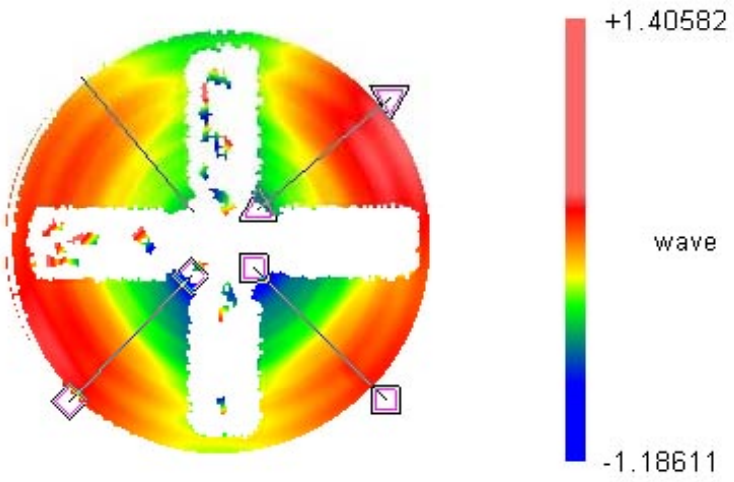
Most concerns are
- Dimension
- Flatness

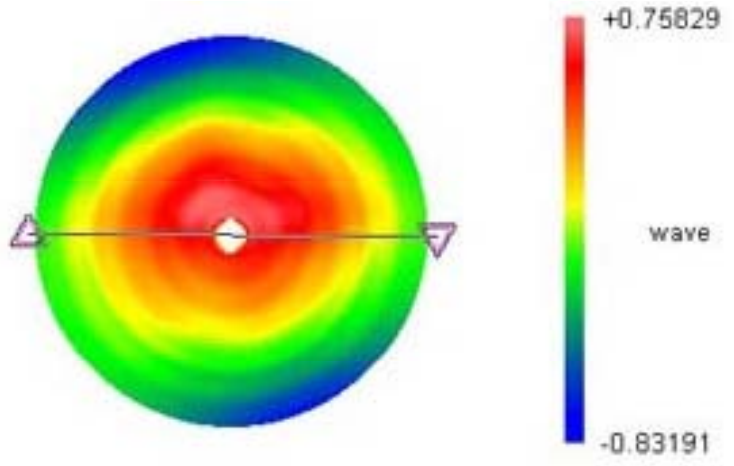
Flatness

Flatness better than 1.5micron in free position

We estimate that the flatness becomes better <1 micron when pushed onto the flat surface.

Flatness if OK.





We found recently the difficulty in dimension control

- Different measurement results between vendor and KEK
  about ~20microns!
  Vendor suffers from big burrs at the top
  The creation of burr itself should be suppressed!
  → improve finish turning. Study in progress.
  If it is not realized by vendor, KEK should do final cut.
  The re-scheduling become needed.

- Slanted wall for waveguide channel and cell wall
  by several microns / several mm depth. Too much!!
  We are under investigation of improvement.

- We wait for the confirmation of the reasonable precision
  It should be within several microns

- C10 and CD10 follow the fabrication of Disk-damp

Quad fabrication and test

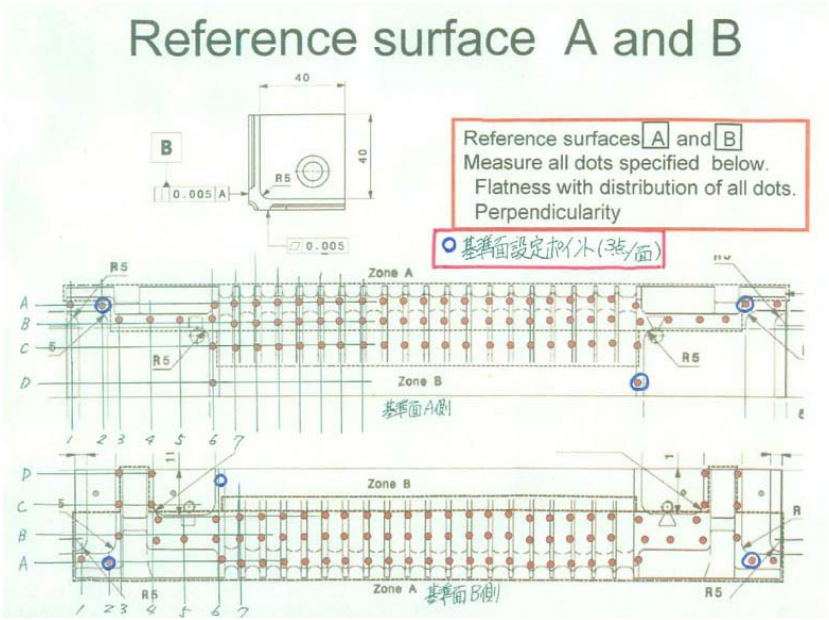
- Present mission
  - Fabrication with all ball point milling
  - Assembly for high power realization
  - Non heat treated cavity in a vacuum vessel
- Discussions to be made
  - Feasibility for near future LC
  - Pros and cons in general
  - Precision alignment issue comes after high power

Status of four quadrants

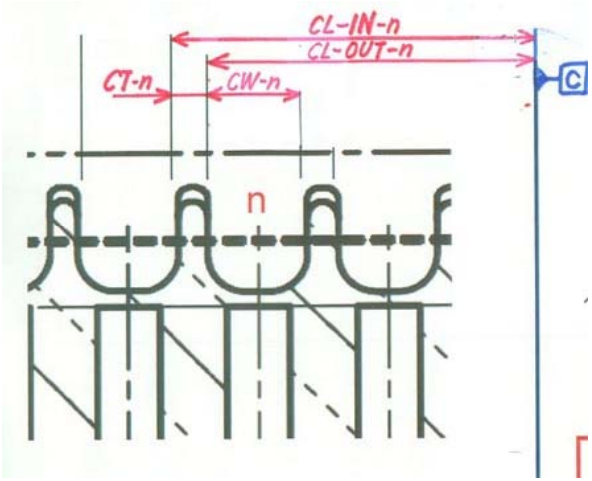
- Brushed up the machining technique
  - Longitudinal: a few microns / 200mm
    - We think this controllability necessary to assure the precision of the overall 3D surface creation
  - Transverse direction: within ± a few microns
- Now we decided to make the actual four quadrants
  - Four will be delivered to KEK by mid Nov.

Dimensions to be confirmed

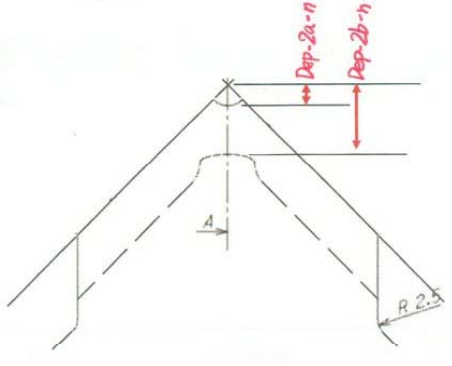
Flatness



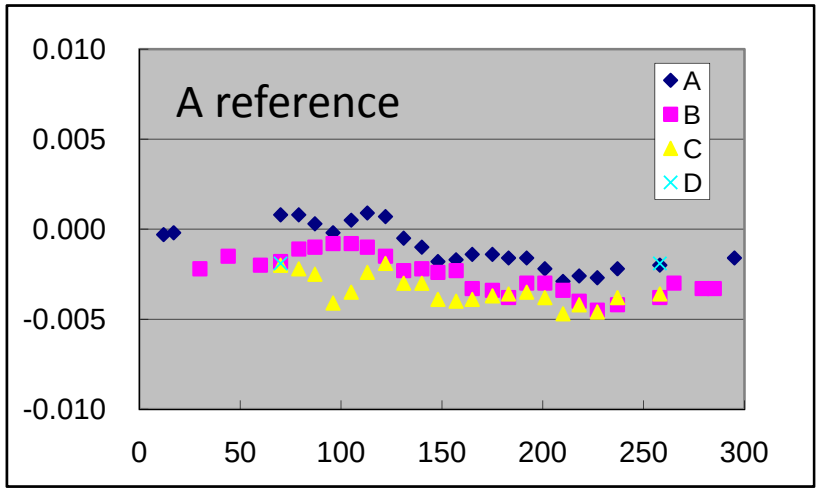
Longitudinal position

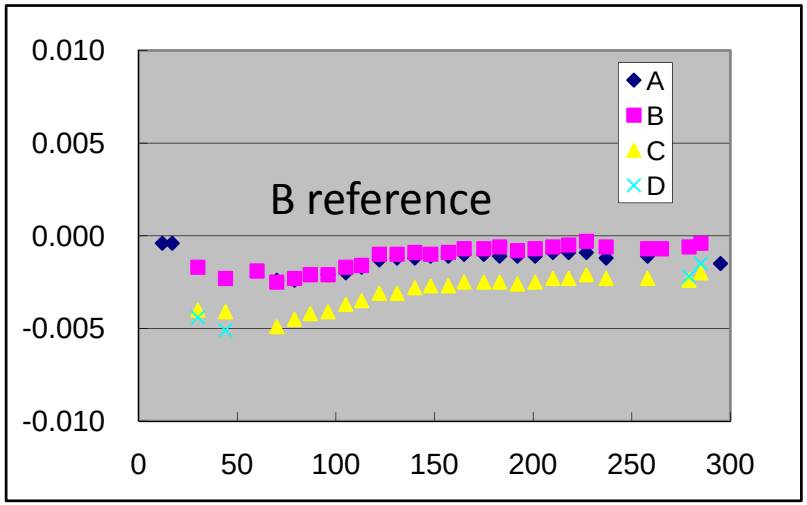


Depth of cell surface (a, b)



Reference surface flatness

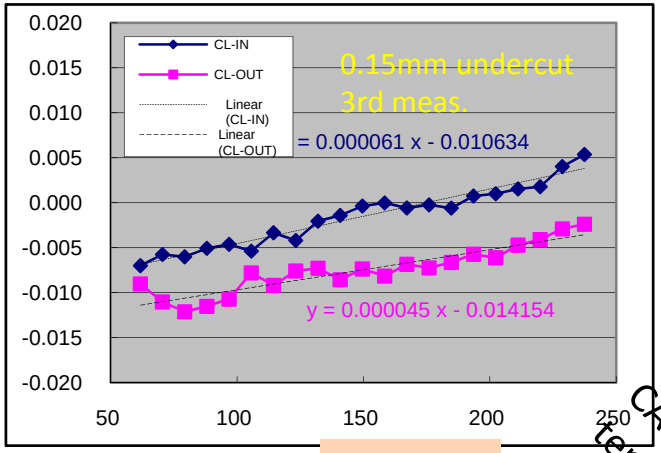




A Flatness: 4 μm
B Flatness: 3 μm, Perpendicularity w.r.t. A: 4 μm
C Perpendicularity w.r.t. A+B: 2 μm

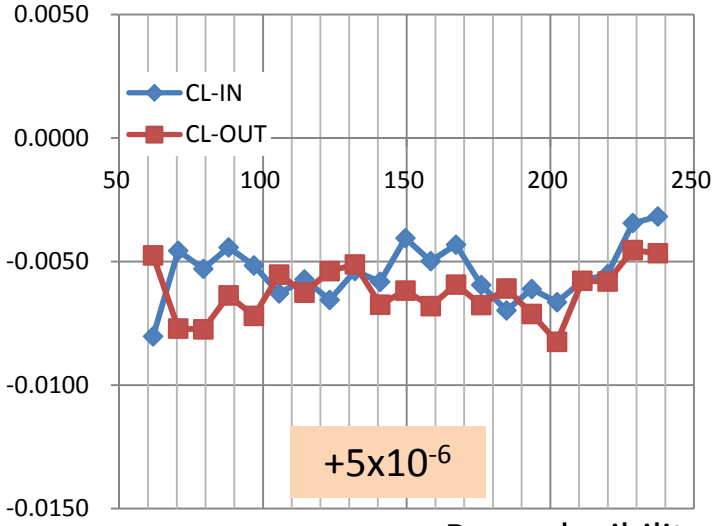
Measurement was performed by vendor.
KEK measurement is consistent.

Longitudinal dimension control



+5x10^{-5}

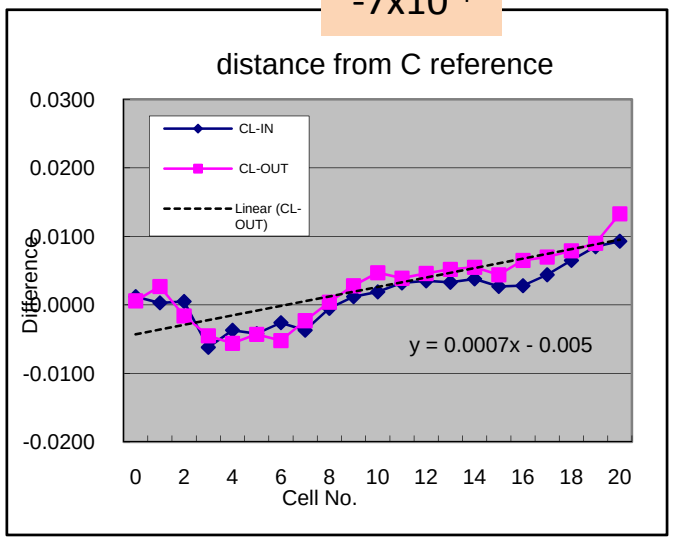
CAM temp. correction



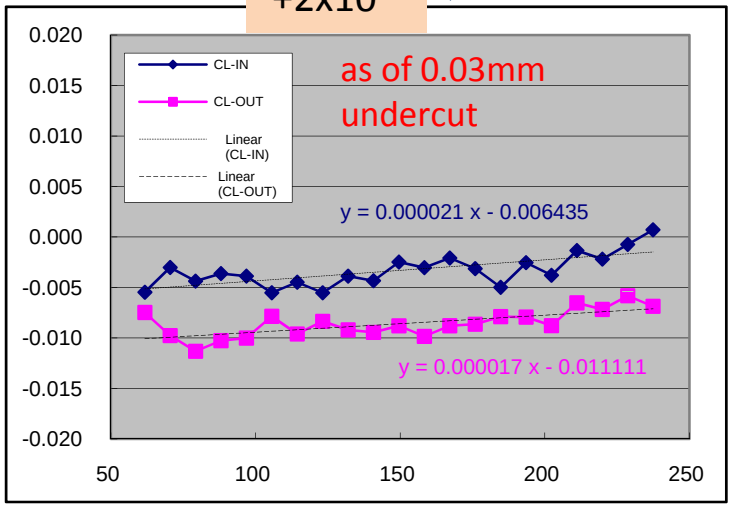
Reproducibility
~ 4µm /200mm

Machine tune up.

-7x10^{-4}



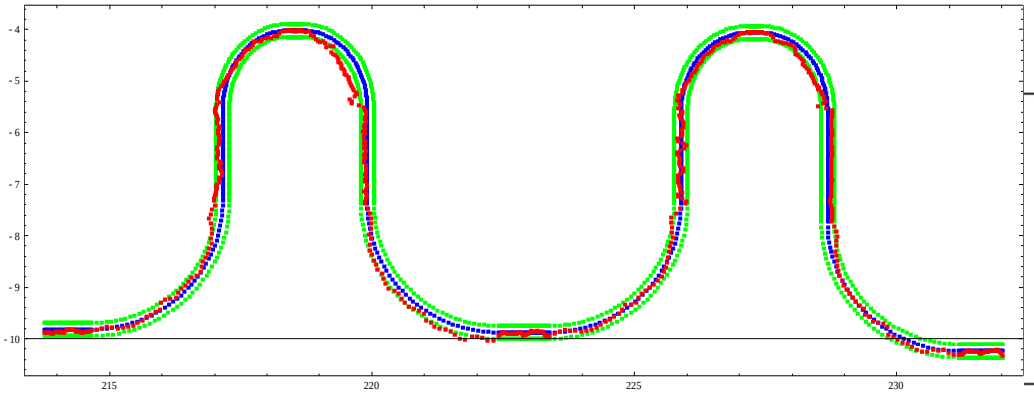
+2x10^{-5}



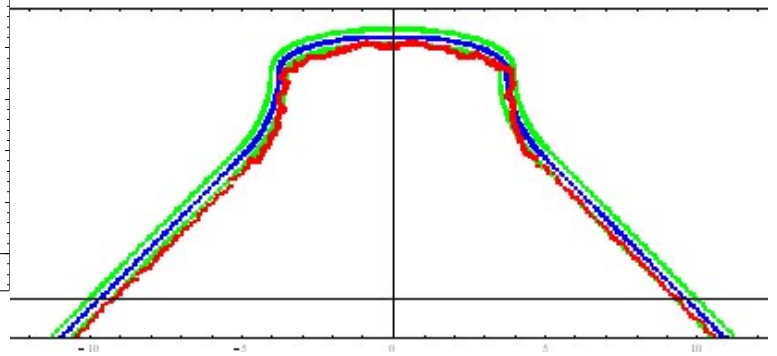
Profile of test cut quadrant Q1-0

Measured w.r.t. A-B-C reference planes. Green lines are ±2.5 microns.

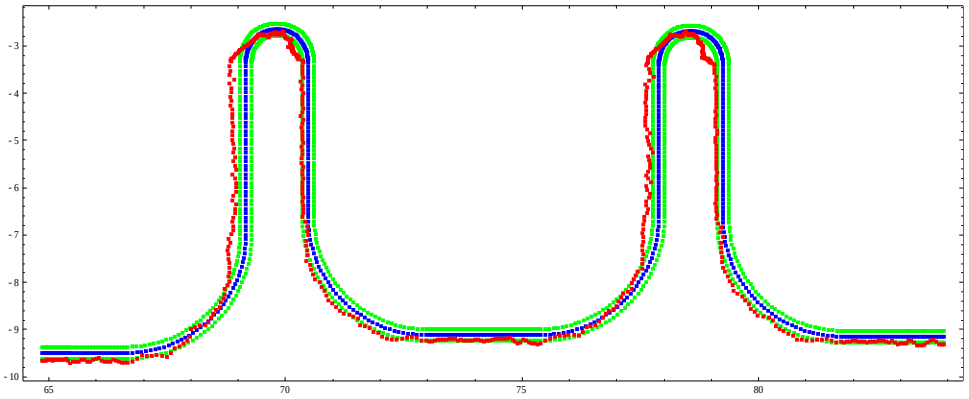
KUM data = NWDSQ7.csv



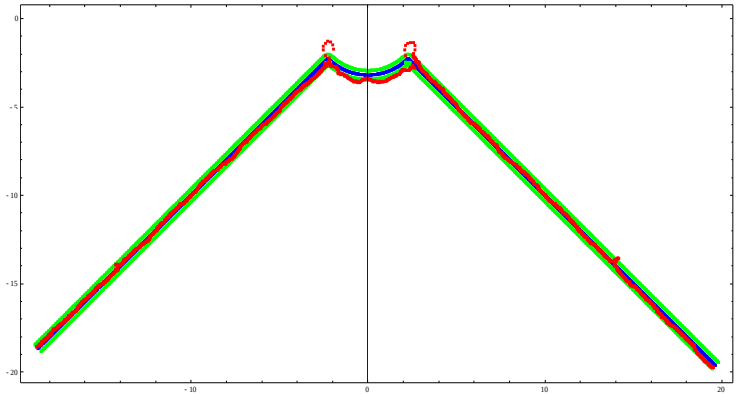
KUM data = NWDS13.csv



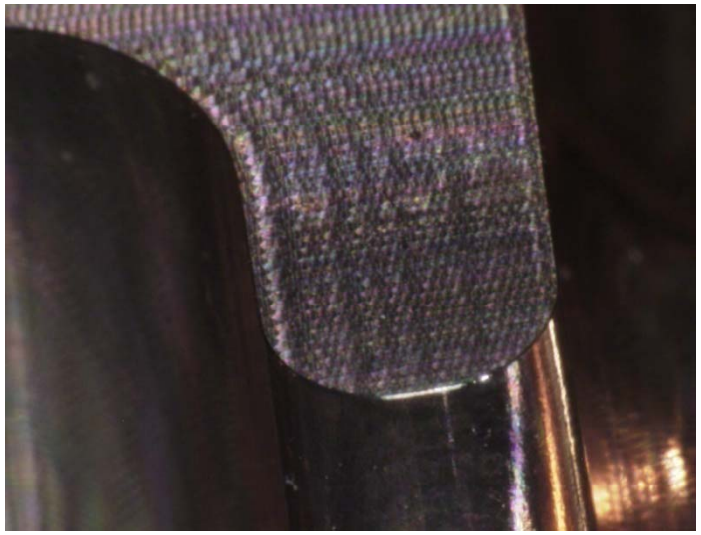
KUM data = NWDS10.csv

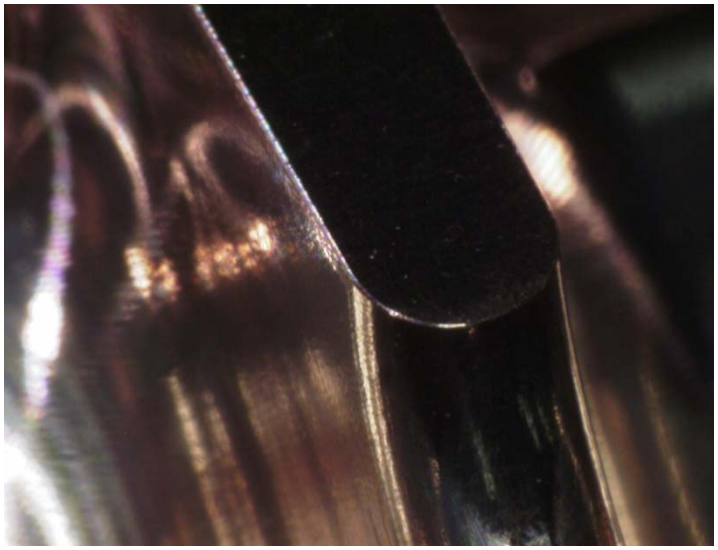


KUM data = NWDS17.csv



Milled surface view



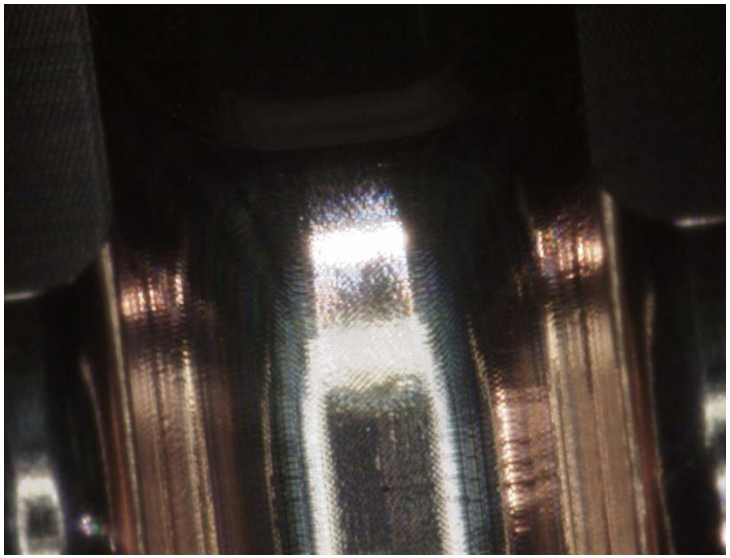


50 micron rounding

Reference plane formation by milling

Cavity wall formation

…….



Tuning sensitivity and requirement

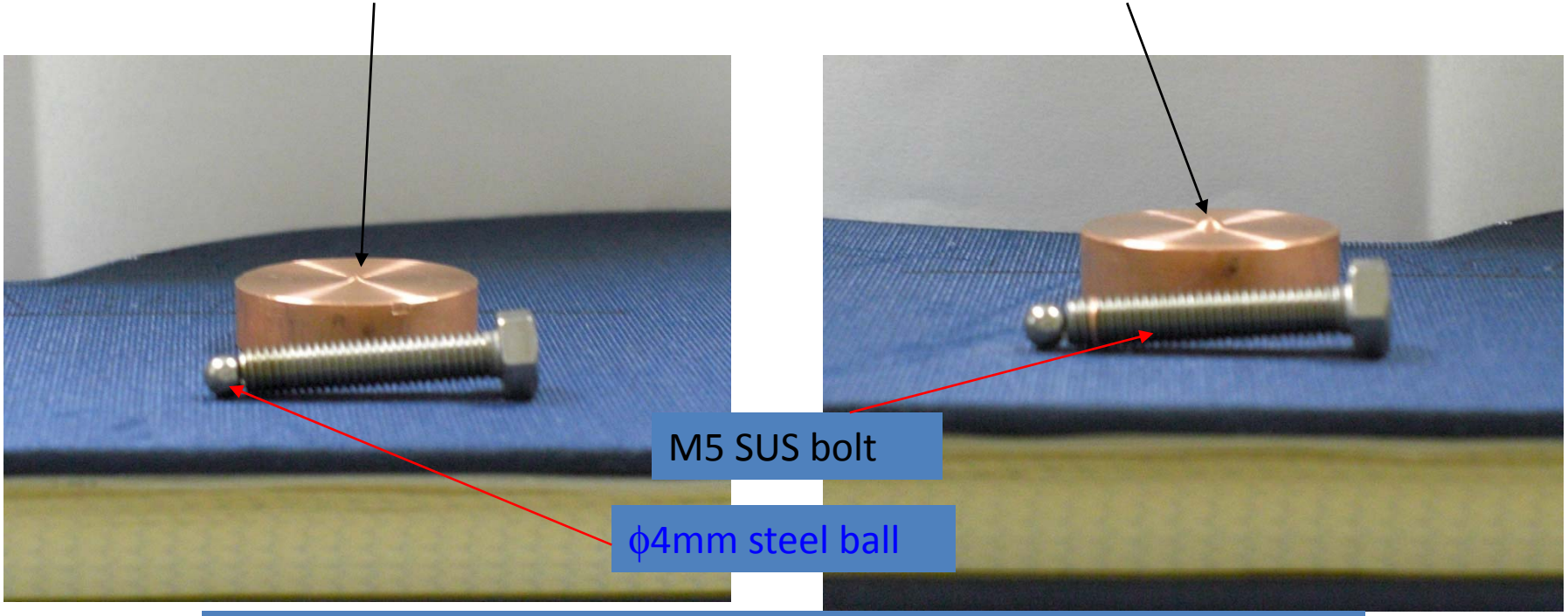
- Cavity sensitivity by Riccardo
  - df/db=－1MHz/micron
  - df/da=＋0.24MHz/micron
  - d ｆ /dgap （gap between quads） ＝ ＋0.37MHz/micron
- Tuning sensitivity
  - Riccardo: +10MHz/0.3mm-push, -10MHz/0.4mm-push-back
  - Higo: cone, height h, base r=4.2/2:
    - df/dh=＋12MHz/mm
- Tuning amount
  - Riccardo requirement form RF match: ±5MHz
  - Vendor potential ~±5μm→±5MHz
  - Required tuning amount <±10MHz → 0.5mm/hole
    - Fab. At 20C and operation at 30C → - 2MHz
    - Temperature tuning capability ±10C → ±2MHz

Rough test results of dimpling for rf tuning
081003 Y.Higashi

Dimpled height

0.43mm+/- 50μm

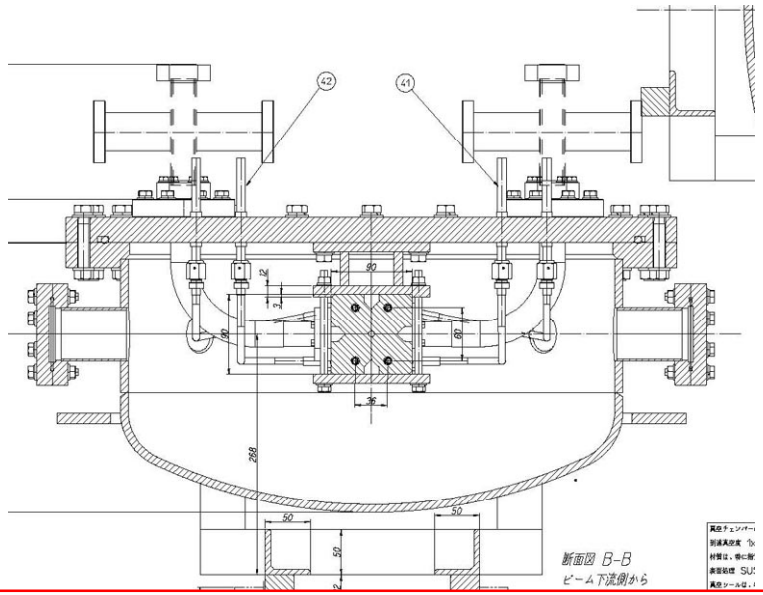
0.63mm+/- 50μm



Not big torque was applied -> standard torque for M5 bolt

@ Deterioration of flatness, straightness and twist of structure due to dimple tuning should be considered.

Vacuum chamber preparation



- Quads are assembled and fixed to upper big flange.
- CF114 flange equipped with waveguide flange feature.
- Adjustment of electric phase and position might be difficult.
  - We may introduce bellows to CF114?
  - Gaskets with different thicknesses are prepared for adjustment.
- VCR connector for copper cooling tube with EBW to quad body.
- Vacuum sealing by U-tight seal, similar to helicoflex but cheap.
- Chamber is EP finish. Baking or not??

Summary

- Disk-undamp fabrication #3, #4 in progress at SLAC.
- Disk-damp test cell inspected and some improvement was found necessary before actual fabrication all by vendor.
- Quad actual fabrication in in progress, and vacuum chamber fabrication also started.