

Status of KEK production

July 11, 2008 at SLAC

KEK

T. Higo et al., Accelerator div.

T. Takatomi et al., Mech. Eng. Center

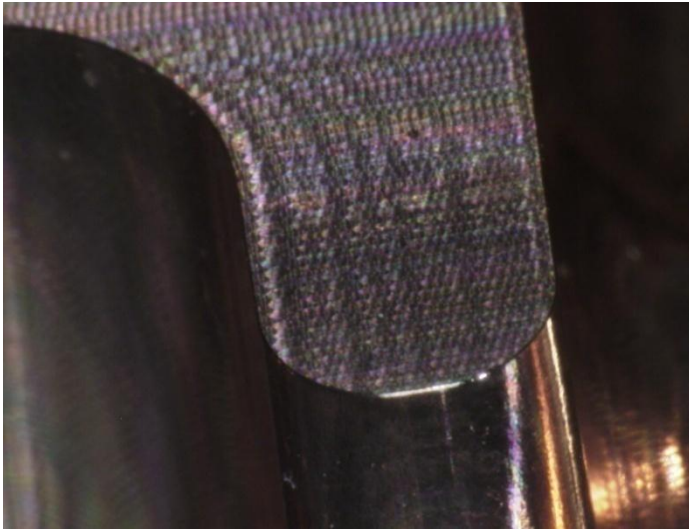
Contents

- Quadrant
 - Assembly
 - Preparation for installation to Nextef
- Disk-based structures in 2009
 - C10, CD10
 - T24, TD24
- Other group to be involved

Quadrant production since CLIC08

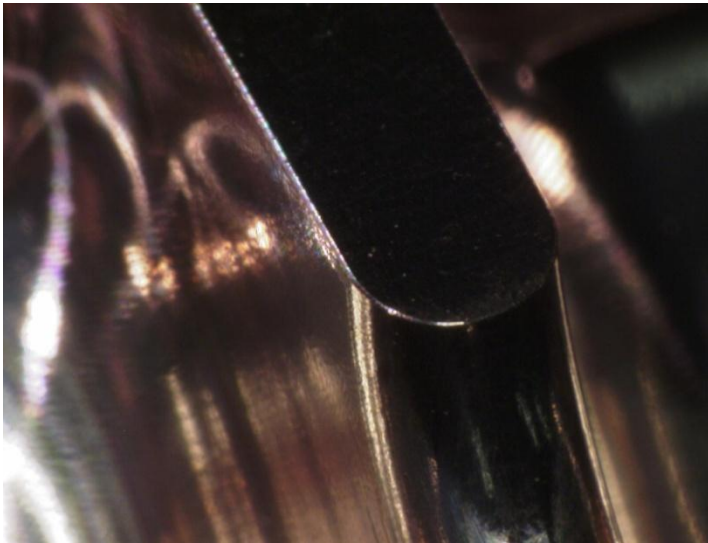
- Production of quadrants completed by Nov. 2008
- Assembly
- Tuning
- Cleaning and final assembly
- Installation into chamber
- Vacuum evacuation
- Present status and following schedule

Milled surface view



50 micron rounding seems well produced.

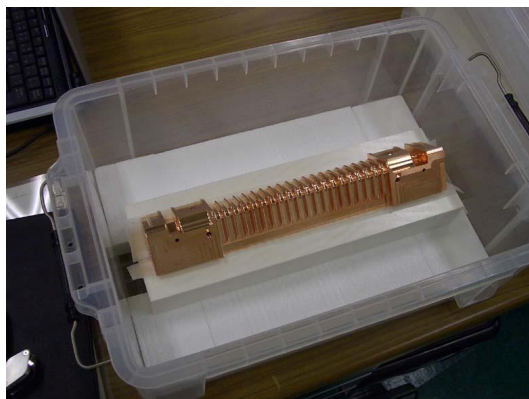
Reference planes were formed by milling in a few micron level within the same chucking for shaping cells.



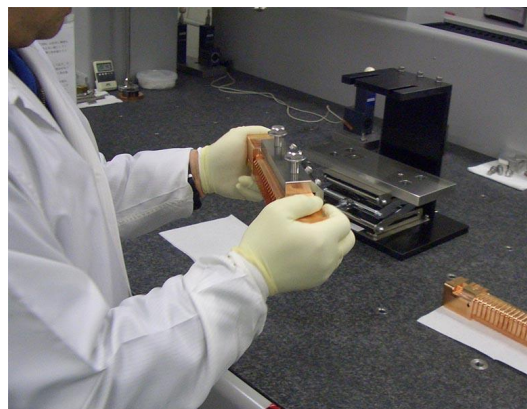
Assembly should be within ten micron level so that the steps between mating surfaces does not make any significant field enhancement.

Assembly experience of quadrants

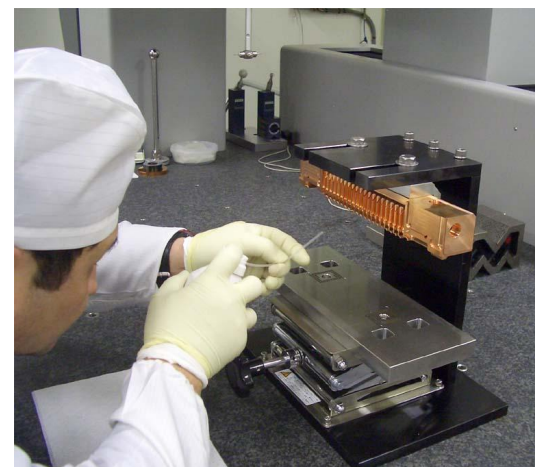
- Natural alignment error by balls is more than ten microns.
- Ten micron level alignment was established by manually-forced final pressing procedure.
- Bolt pressing is at 1Nm with M5 screw.
- Stacking is reproducible in a few micron level.



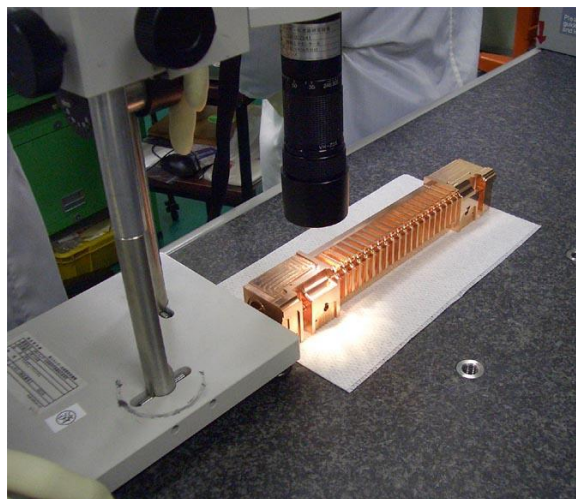
Carry and storage



First hanging



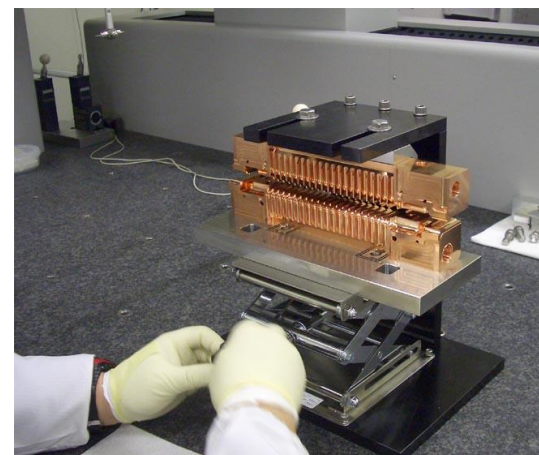
Prepare next quad approach



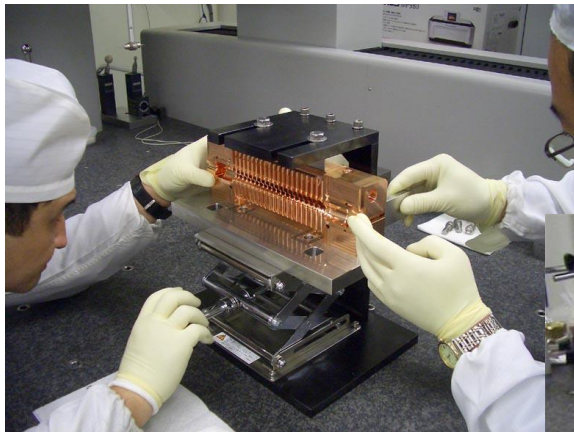
Edge inspection



Check ball diameter



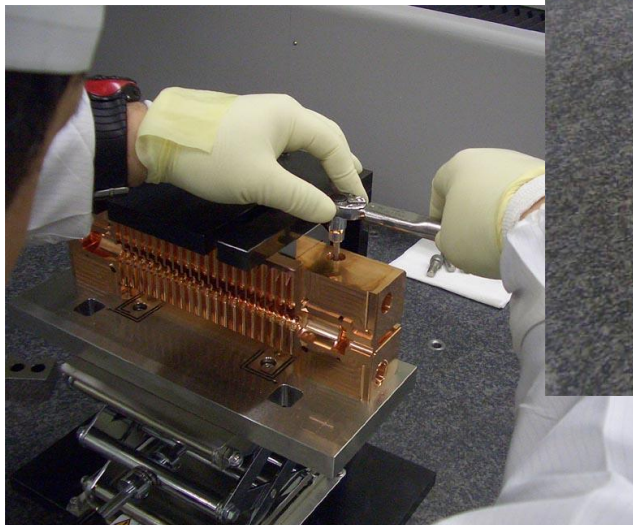
Second hanging



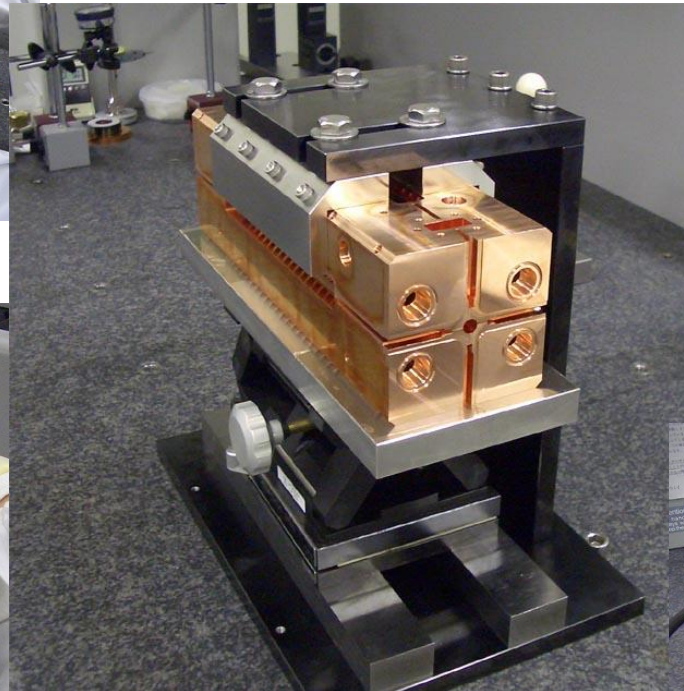
Fine adjustment



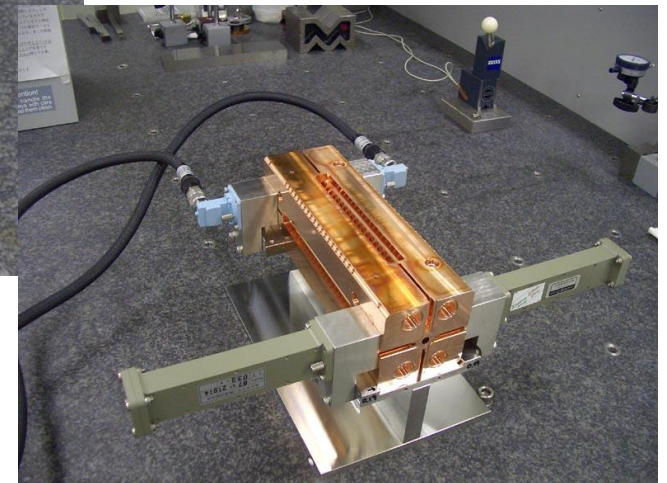
Alignment checking



Fixing by bolt



Completion of stack

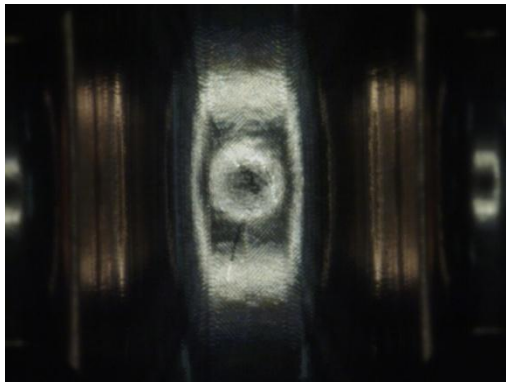


RF setup

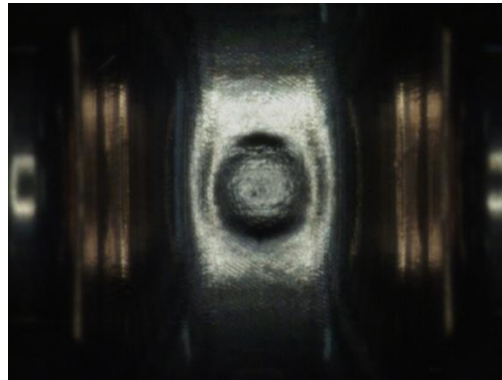
Tuning procedure

- Elastic tuning: tuning screw is kept pressing
- Takatomi measurement on test pushing
- Actual tuning done with Higo's hand tuning with maximum torque by watch screw driver

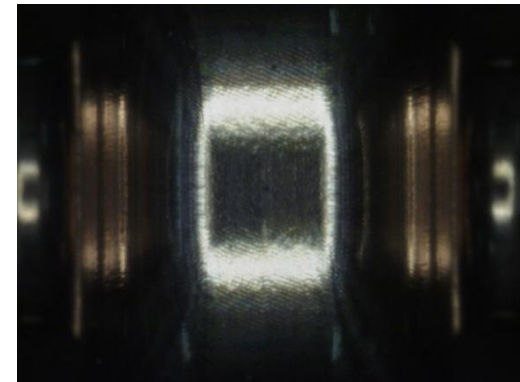
Tuning test with dummy quadrant



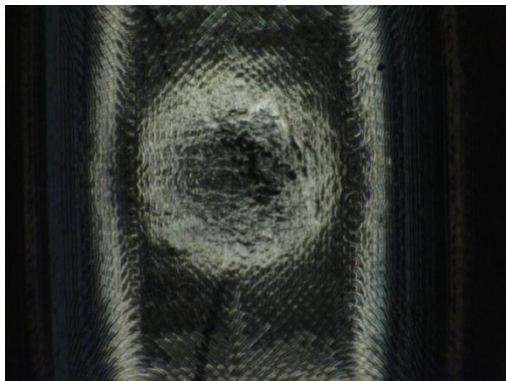
Cell 3($\times 35$)



Cell 8($\times 35$)

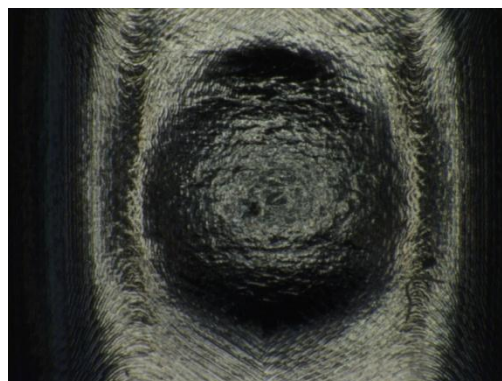


Cell 10($\times 35$)



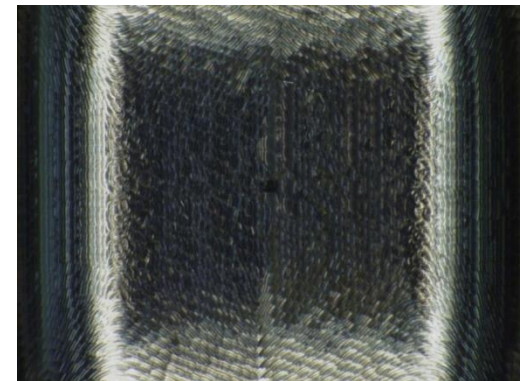
Cell 3($\times 100$)

Cell3 deformation : 0.053mm



Cell 8($\times 100$)

Cell8 deformation : 0.167mm

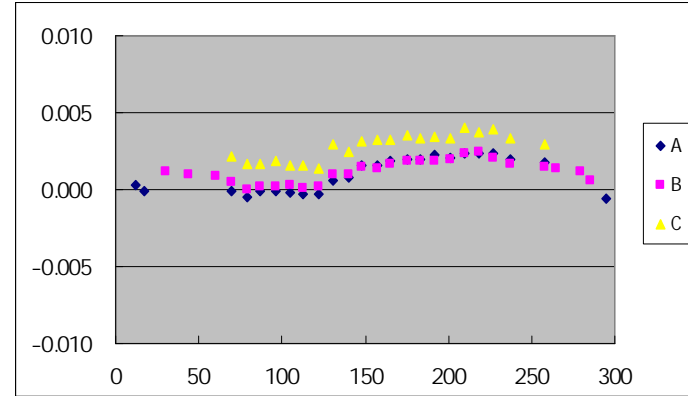
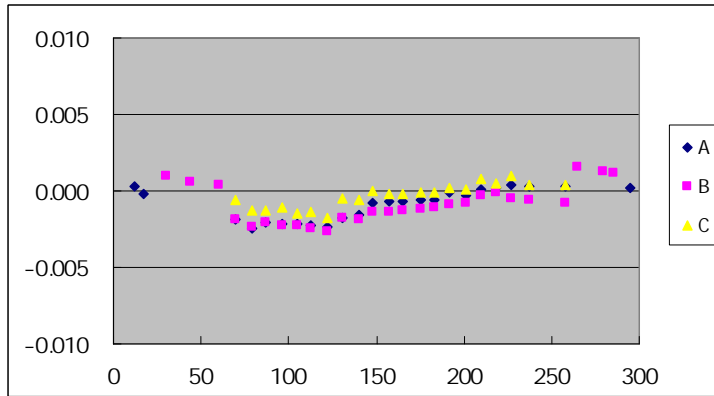


Cell 10($\times 100$)

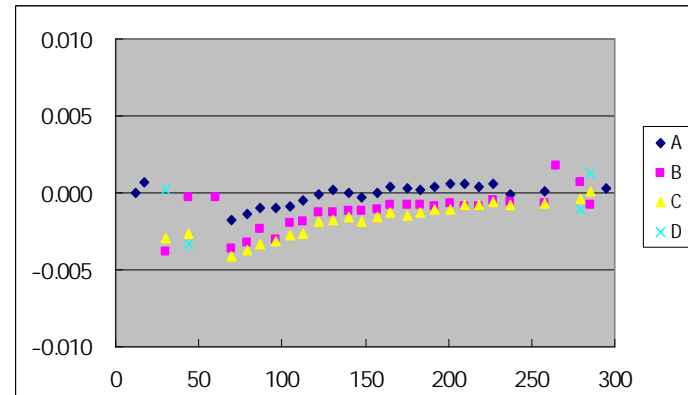
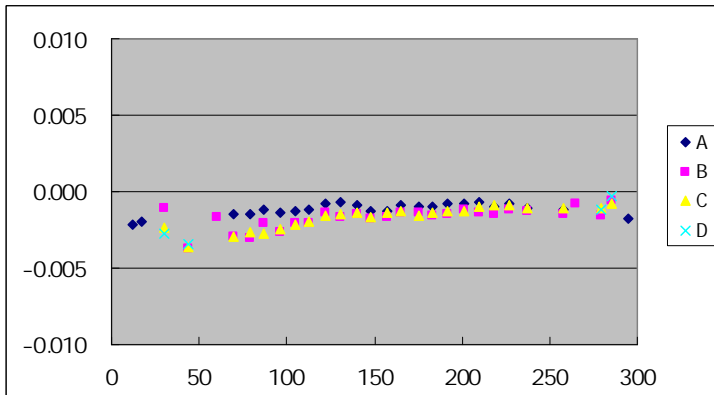
Cell10 no tuning

Little flatness change due to tuning

基準A面



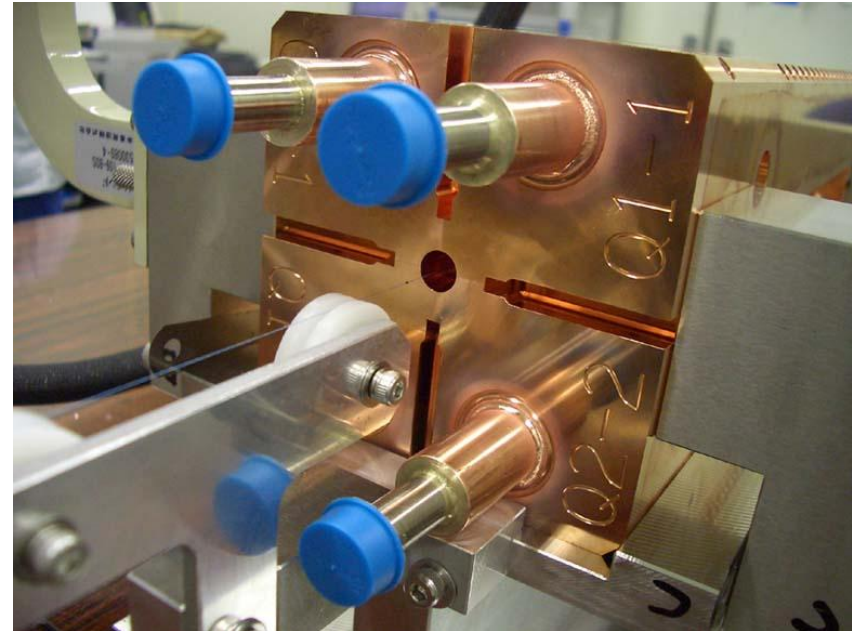
基準B面



Before tuning

After tuning

Tuning setup

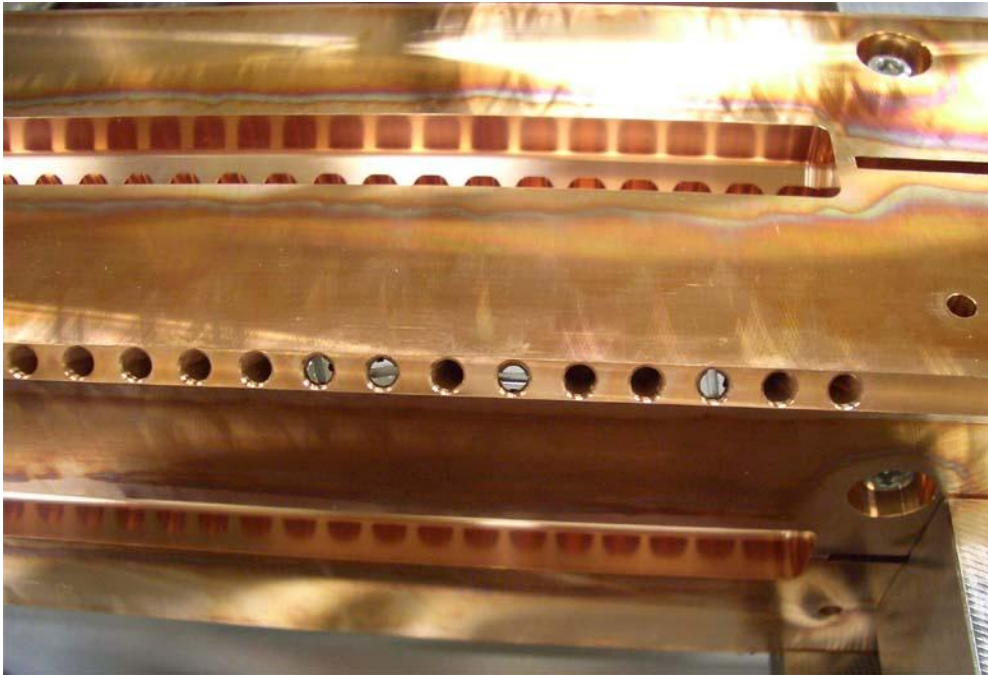


Tuning setup:
Quad#5, bead string, linear
stage driven by pulse motor,
input divider, network analyzer

Quad assembly configuration
seen from input side

Measurement was performed using SLAC LabVIEW program by courtesy of Jim Lewandowski

Tuning ball pushed by a rod



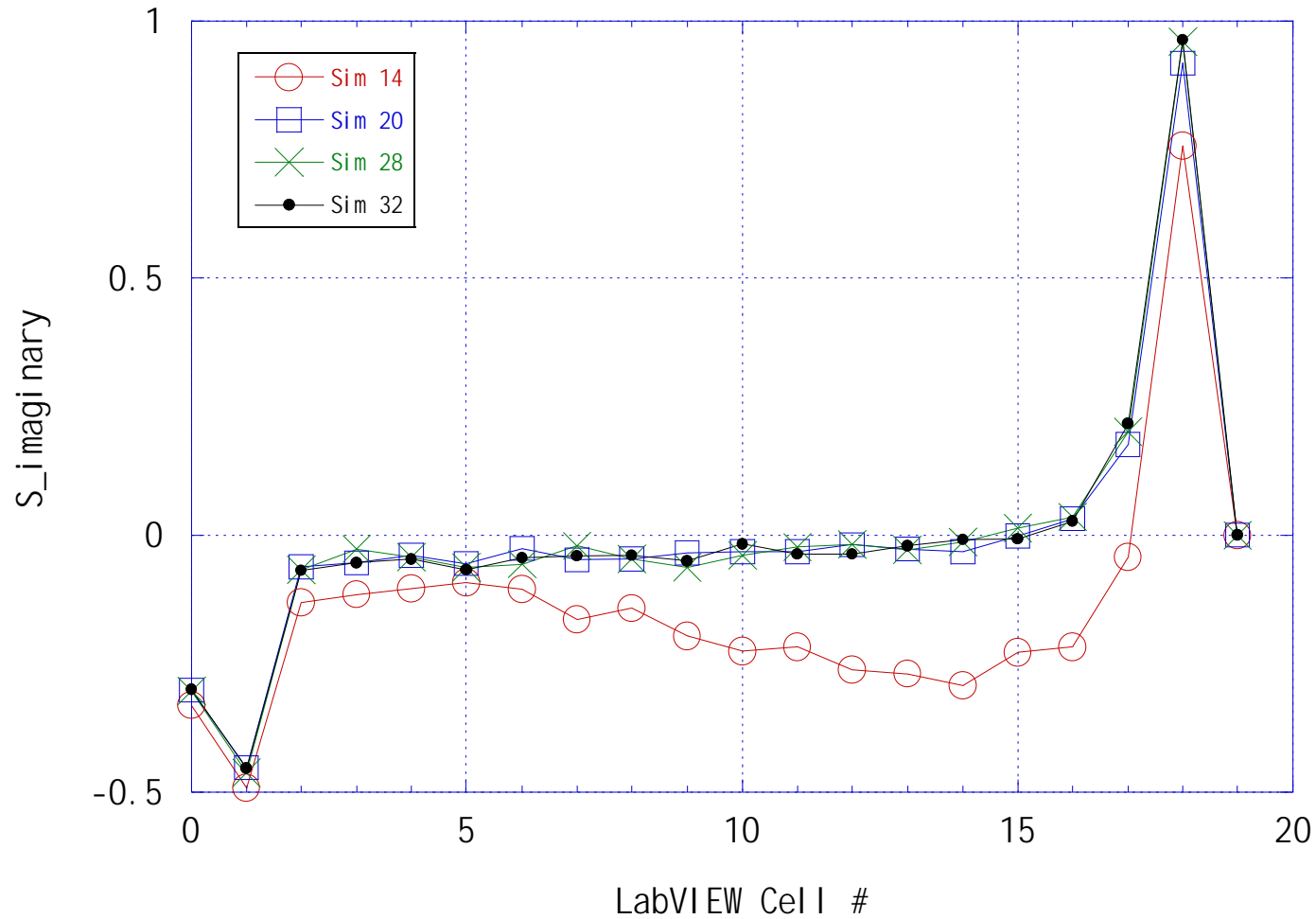
4mm stainless ball pushed by minus watch driver.
Pushing by turning with Higo's hand full force.
Elastic deformation kept, meaning that the tuning pins
are kept pushing the balls.

Tuning history

- 090202 S_{11} measured before tuning
- BP14@11422 **initial stage**
- BP20@11420 after **tune up half of the cells**
 - **Flatten the Sim pattern**, especially 9~16 area
- BP-28@11420 after **fine tuning**
- BP32@11420 after **input match** tune-2

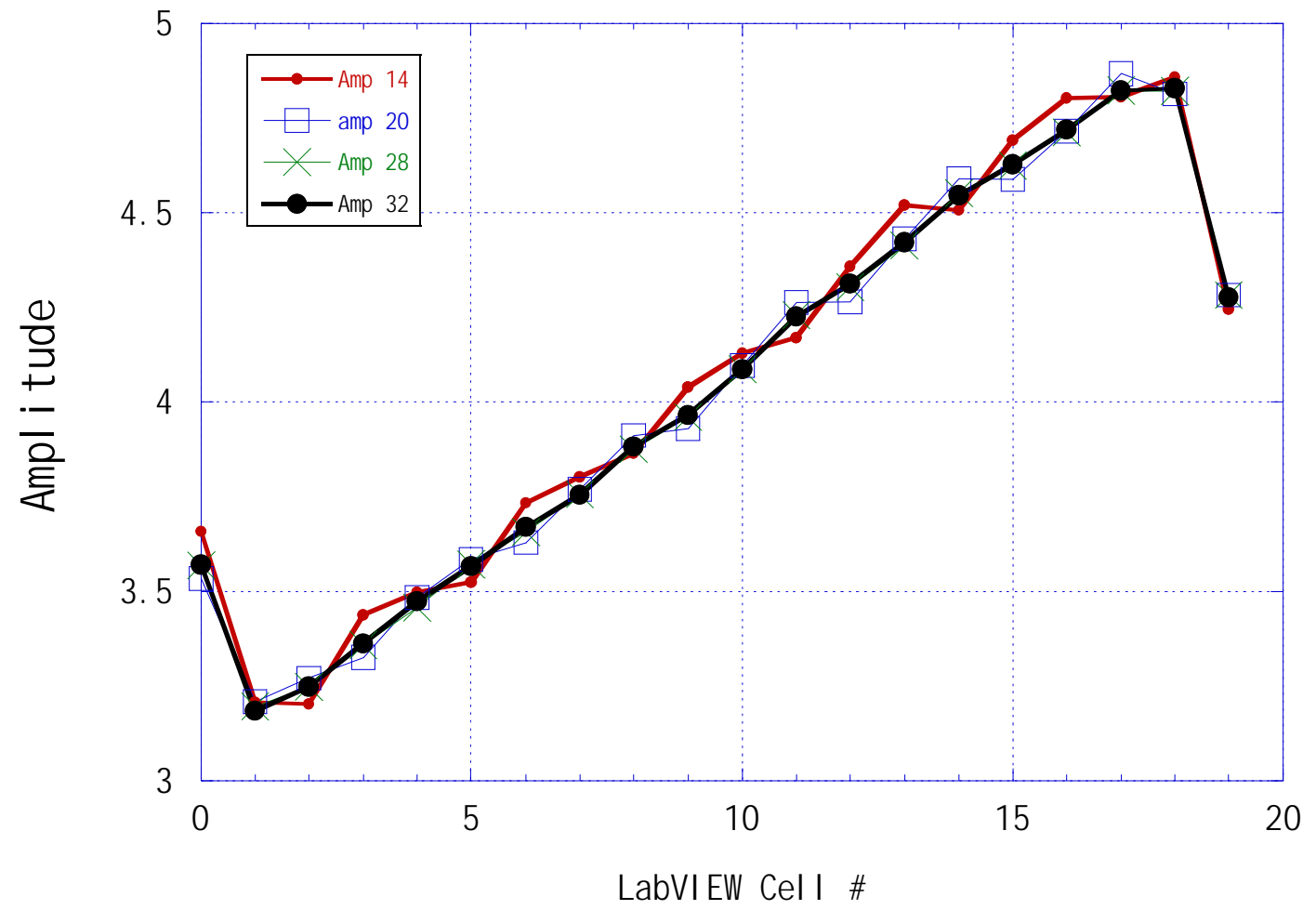
Tuning in practice

S_Imaginary as tuning process



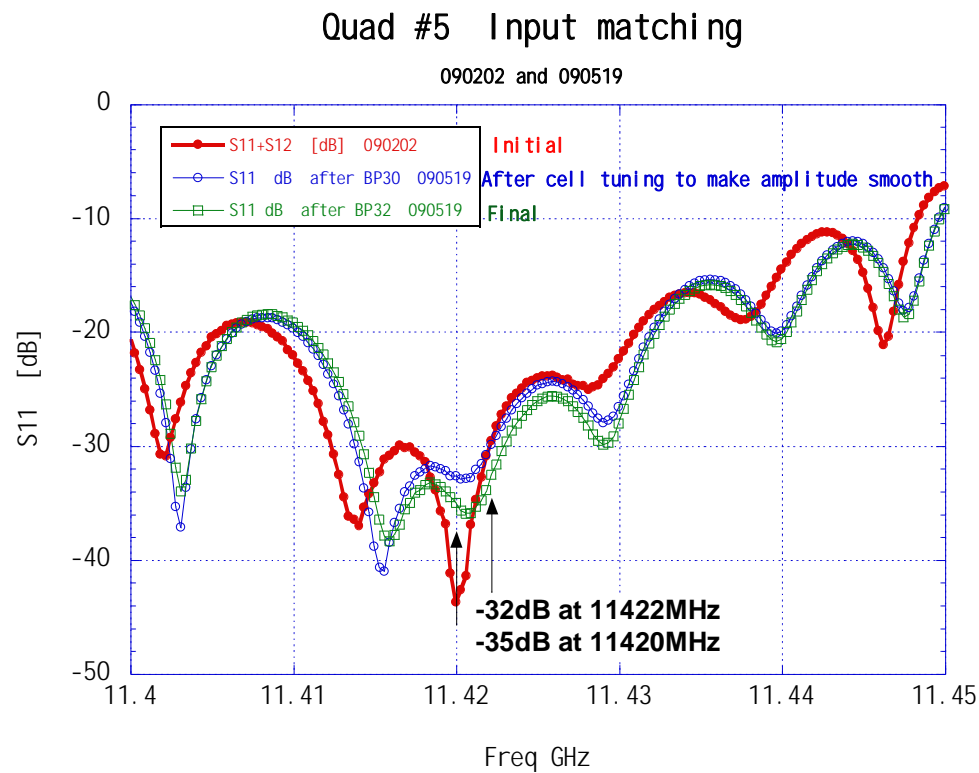
Tuning in practice

Raw amplitude of bead pull measurement
bead pull # 14-20-28-32



Evolution of S11 near 11420MHz

090520



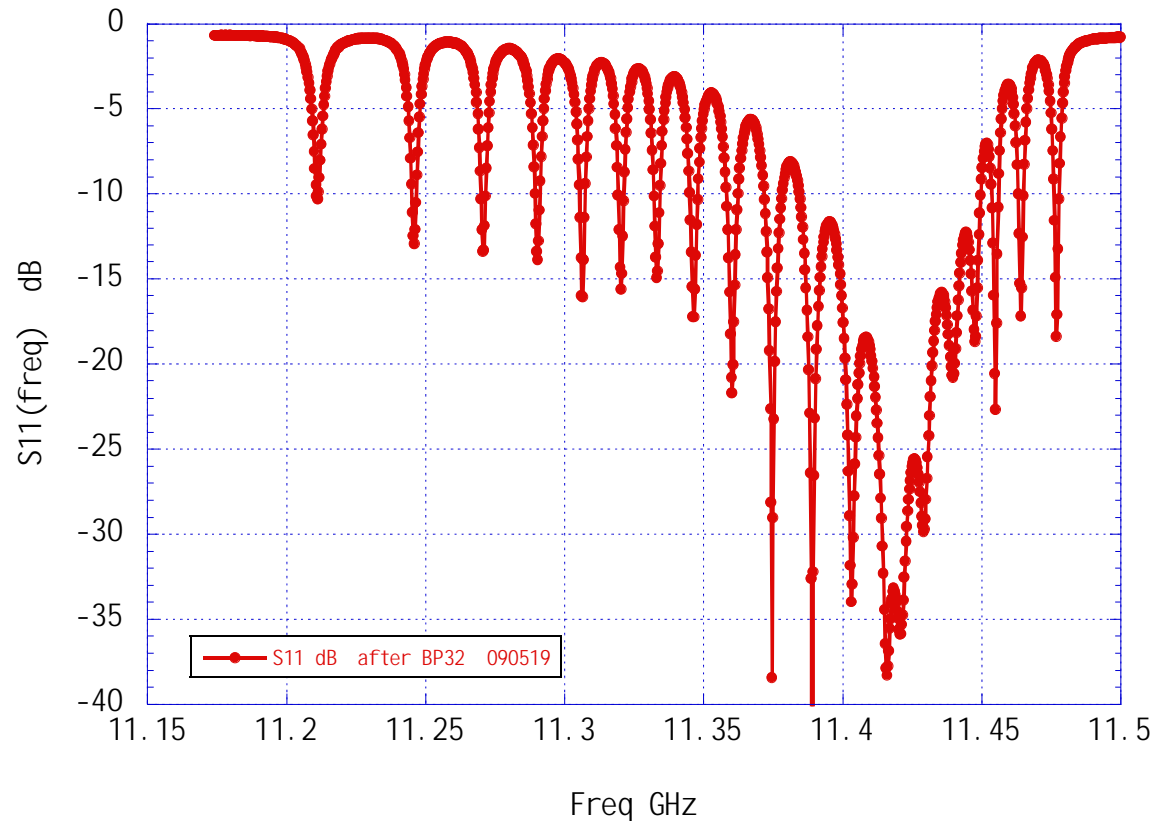
090202
initial

090519
after cell tuning, BP-30

090519
after input match tuning

Input matching after tuning

Quad Input matching after tuning 090519



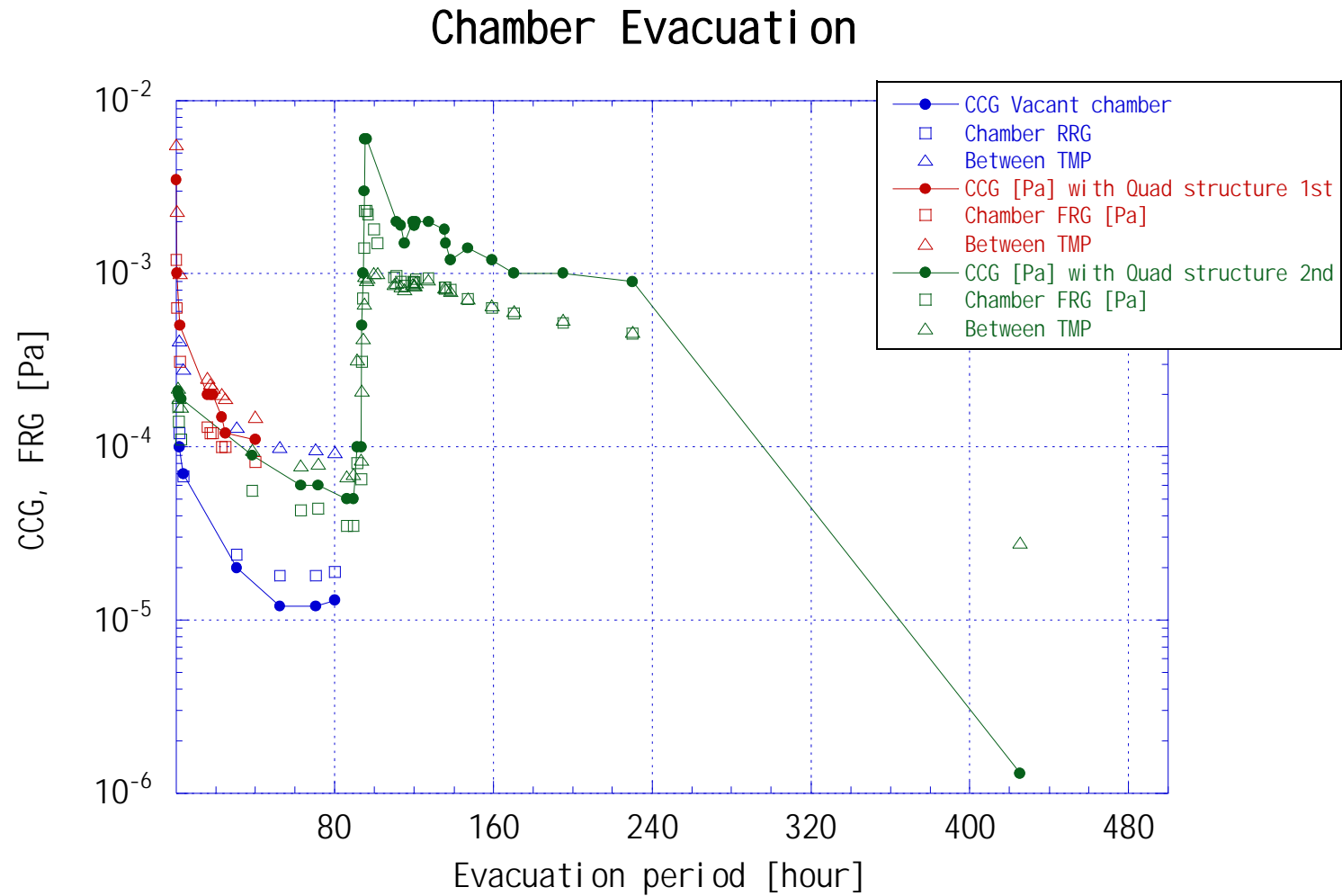
$|S_{11}| = -32\text{dB}$ at 11422MHz, -35dB at 11420MHz
Operation at 11422MHz at 30C in vacuum is planned.
22C in air \rightarrow 30C VAC makes 2MHz higher frequency.
So the input match should be -35dB , good enough.

Integration into chamber

- Two 50liter/sec TMP's in tandem.
- Bare chamber was evacuated.
 - With pumping $\rightarrow 5 \times 10^{-5} \text{Pa}$
 - With baking $\rightarrow 1 \times 10^{-5} \text{Pa}$
- Chamber with assembled quads was evacuated
 - With water pipes etc.
 - With only evacuation $\rightarrow 1 \times 10^{-4} \text{Pa}$
 - After baking finally reached $\rightarrow \sim 1 \times 10^{-6} \text{Pa}$

Quadrant chamber evacuation.

as of 090622



Installation into Nextef and plan

- **Installation trial**
 - Gaskets stuck to flanges could not connect input waveguides.
 - Flanges were re-cut at their edges, removing gasket copper material and 0.14mm base stainless material.
- **Next schedule**
 - Re-installed into chamber.
 - RF checked in input matching. No change!
 - Evacuation will start next week, July 6~.
 - Installed into Nextef after July 14~.
 - In-situ baking will be made at Nextef.
 - Start processing from late July or mid August.

C10 and CD10 fabrication

- Strategy

- Take the same design and procedure as T18 and TD18.
- Want to freeze the basic design with CERN/SLAC supervision this time.
- Each two sets are made and tested.

- Present status and plan

- Started negotiation with our usual company.
- Better machines will be used this time.
 - Thanks to the economical situation!?
 - New turning lathe, Moore, will be used.
 - New milling machine, Sodick, will be used.
- Flatness and so on will be better.
- Will be made **by the end of Oct.**
- C10 will be earlier.

- SLAC process

- Basically we assume SLAC will pursue the bonding, tuning and baking process.
- **Need to establish a practical schedule this time.**
- Need to ask SLAC to make a set of mode launchers for test at KEK.

T24 and TD24 fabrication

- Basically the same as C10 and CD10.
- Strategy
- Present status and plan
 - Will be made **by the end of Dec.**
 - T24 will be earlier.
 - Actual schedule should meet the strategy for testing T24, TD24 according to CERN-CLIC demand.
- SLAC process
 - Should be confirmed this time.

Some other activities

- A group
 - will make a trial fabrication of CD10 this year under KEK-Tohoku Univ. collaboration framework.
- Multiple companies
 - are interested in machining quads, but KEK is thinking whether to further go or stick to disk-based design.
- Basic studies
 - Materials and breakdown mechanism are to be studied at KEK.
 - Then, we hope to do more on basic material and preparation studies.

Conclusion

- Quad structure
 - In progress, though encountered various problems. Want to evaluate by late Sep.
- C10, CD10
 - Become precursor, in machining, for T24, TD24 and initiation of basic test for KEK.
- T24, TD24
 - We understand the need to meet the required time frame for CLIC important step next year.