Status of KEK production

July 11, 2008 at SLAC

KEK
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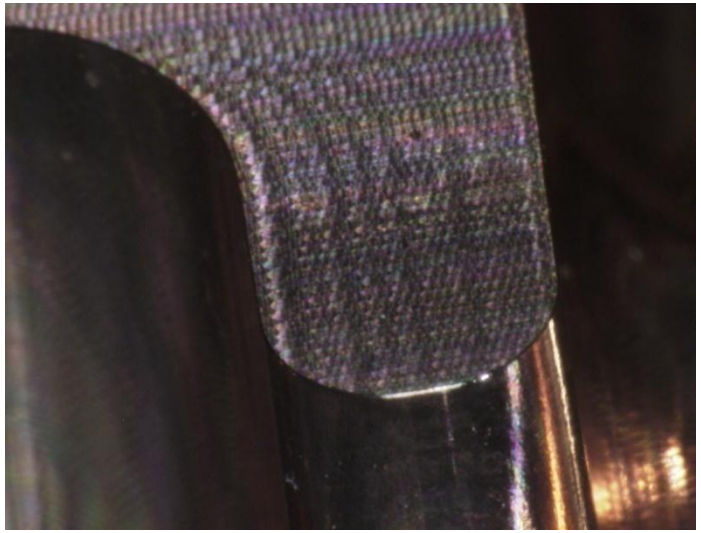
Contents

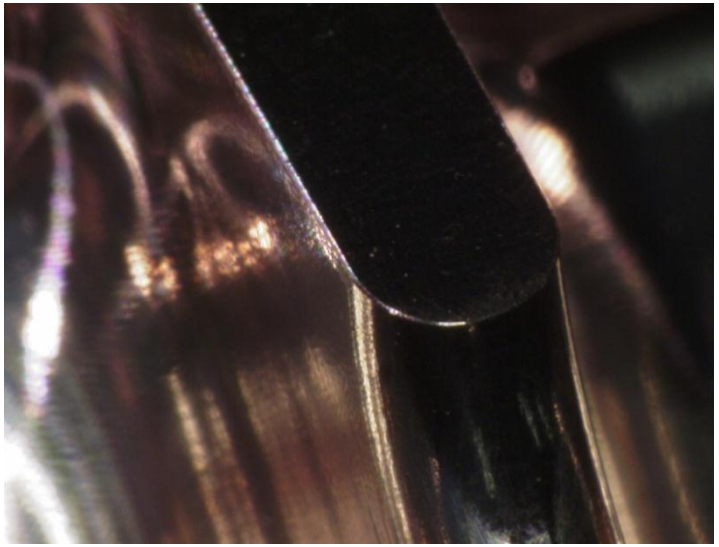
- Quadrant
  - Assembly
  - Preparation for installation to Nextef
- Disk-based structures in 2009
  - C10, CD10
  - T24, TD24
- Other group to be involved

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





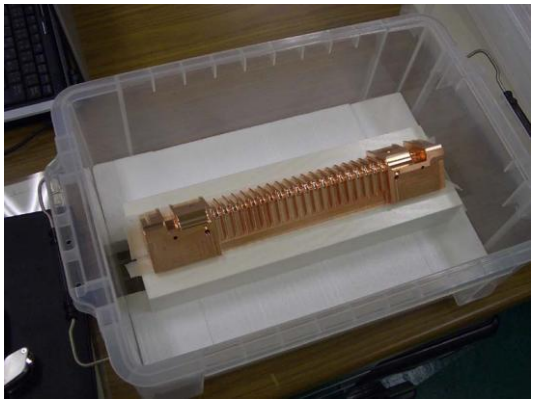
50 micron rounding seems well produced.

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.

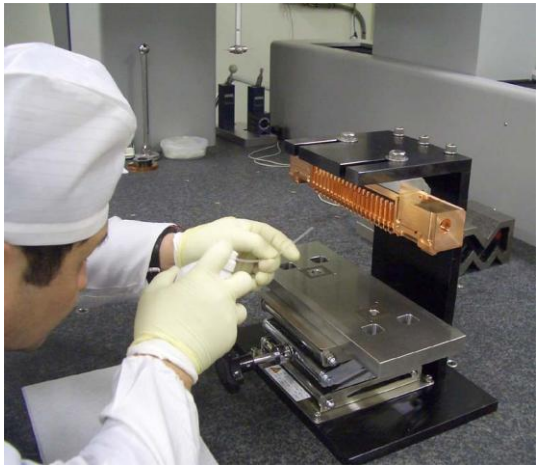
Assembly experience of quadrants

- 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.

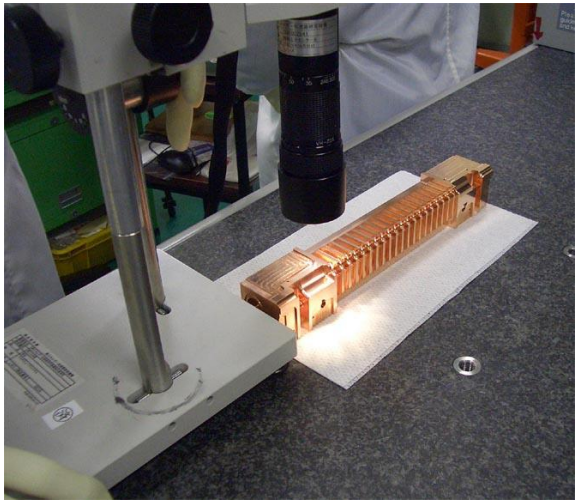


Carry and storage

First hanging

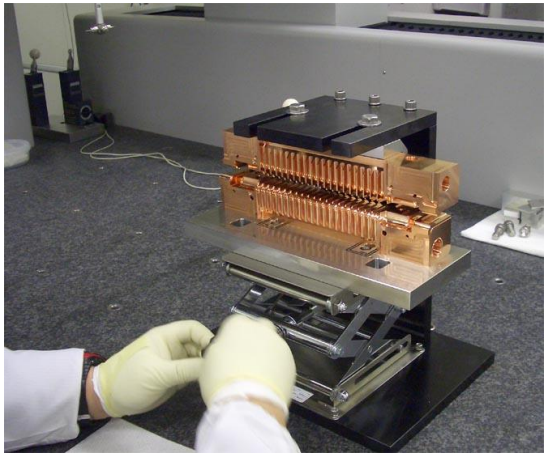


Prepare next quad approach

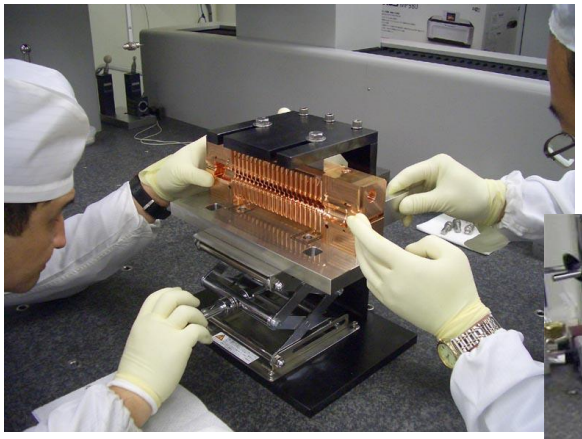


Edge inspection

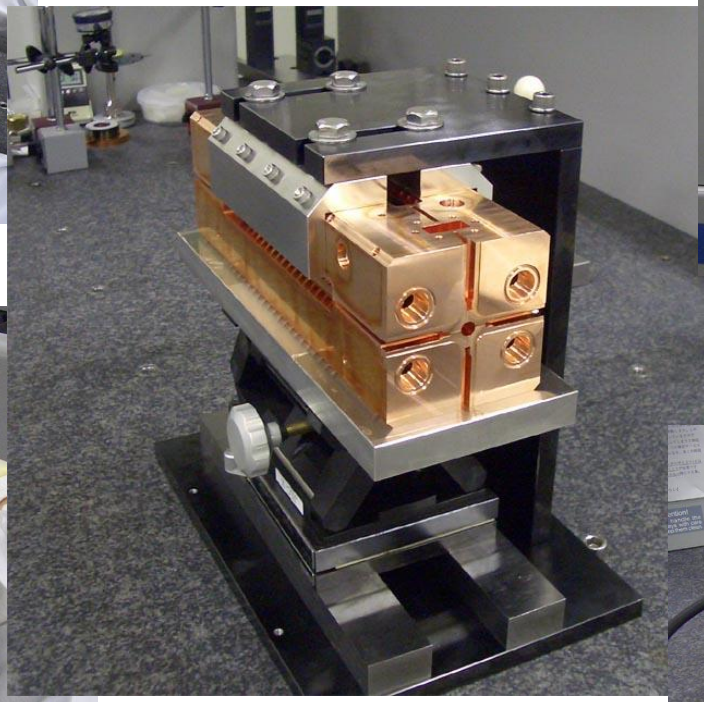
Check ball diameter



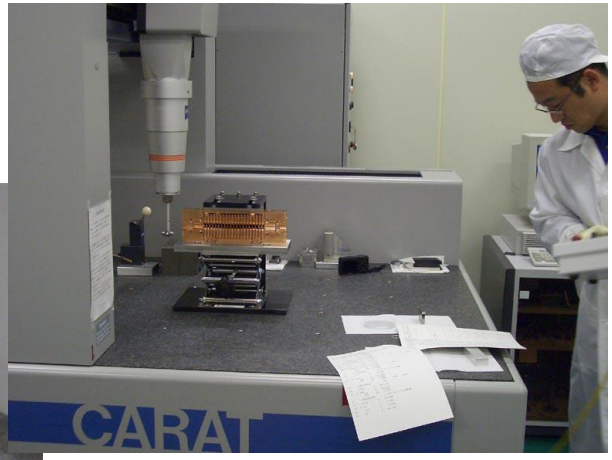
Second hanging



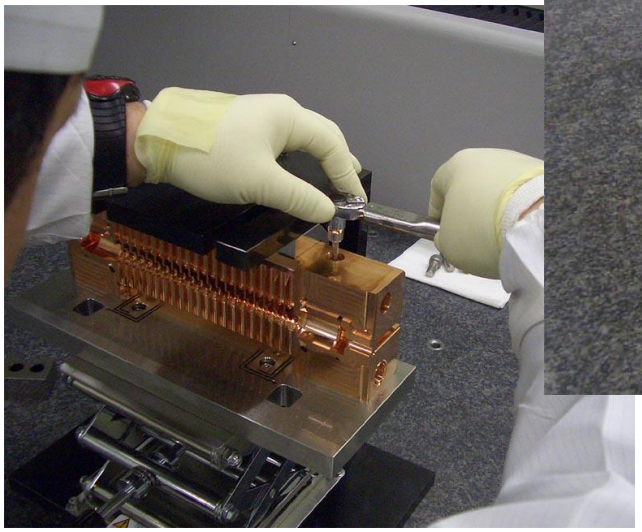
Fine adjustment



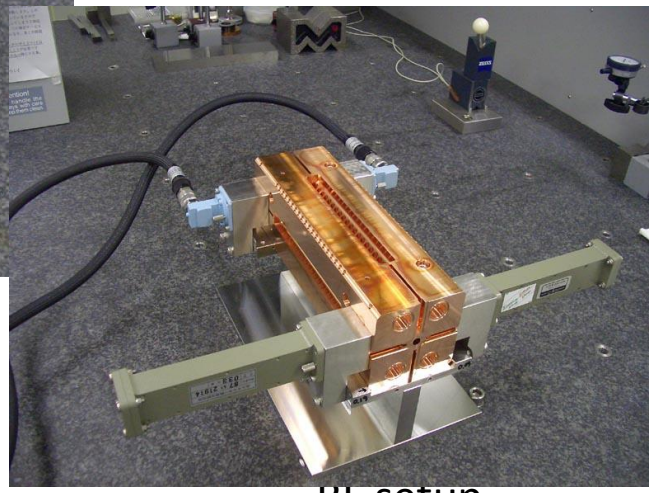
Completion of stack



Alignment checking



Fixing by bolt

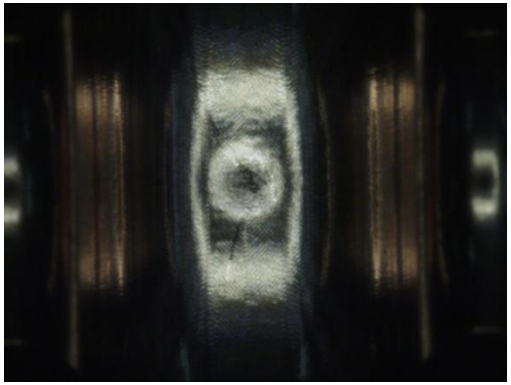


RF setup

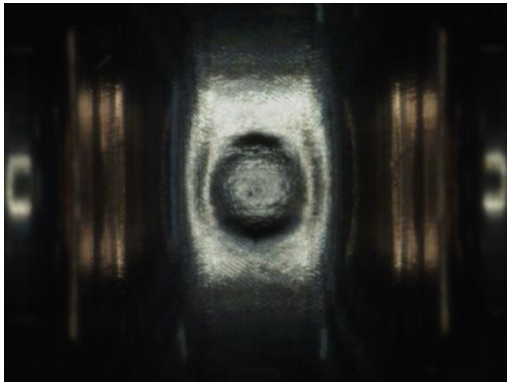
Tuning procedure

- 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

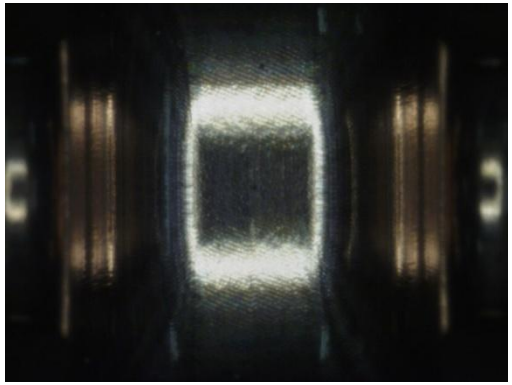
Tuning test with dummy quadrant



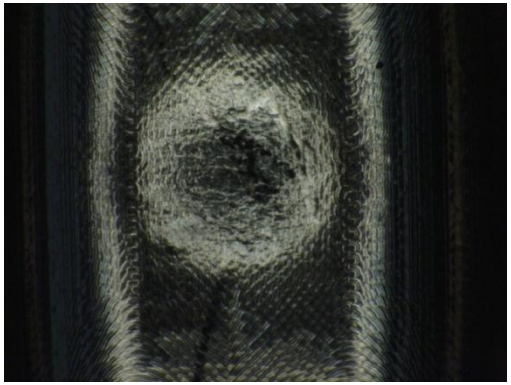
Cell 3(×35)



Cell 8(×35)

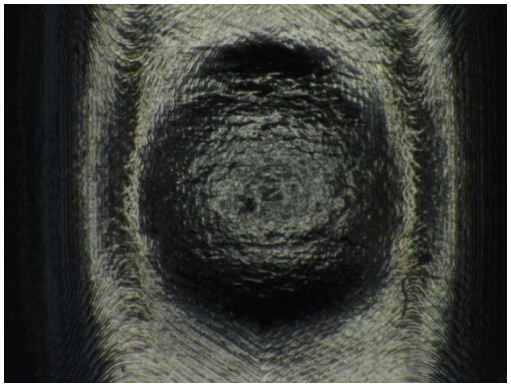


Cell 10(×35)



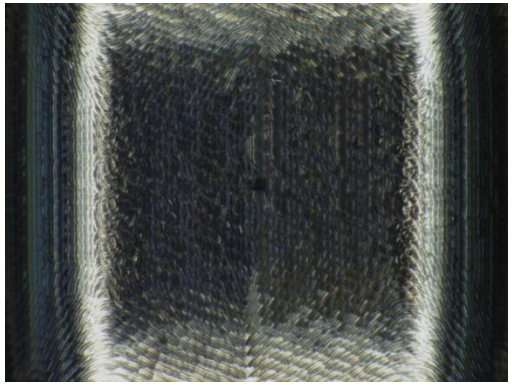
Cell 3(×100)

Cell3 deformation：0.053mm



Cell 8(×100)

Cell8 deformation：0.167mm

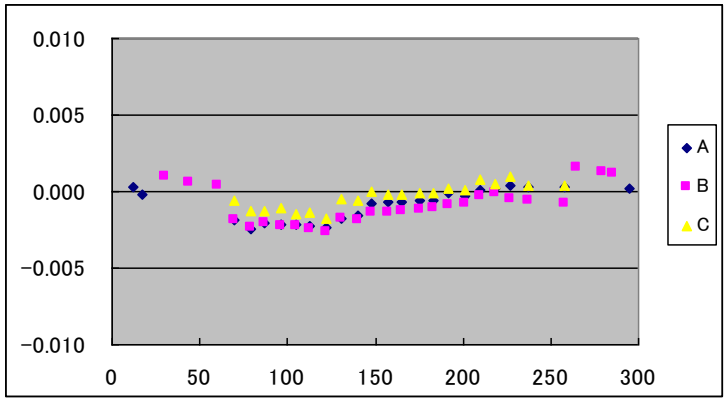


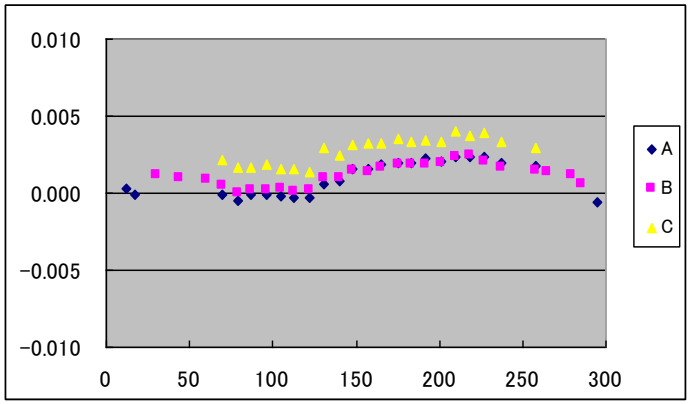
Cell 10(×100)

Cell10 no tuning

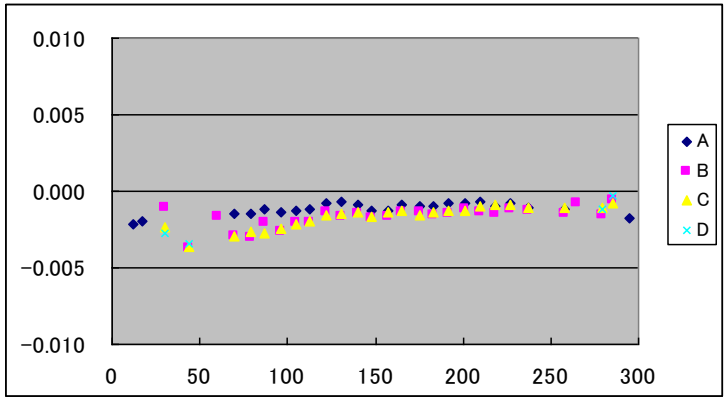
Little flatness change due to tuning

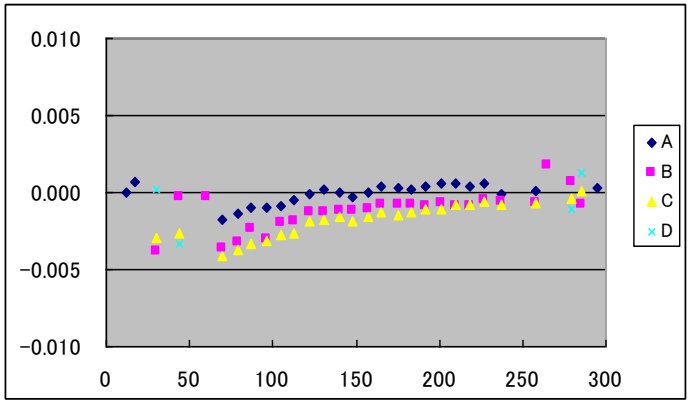
基準A面





基準B面

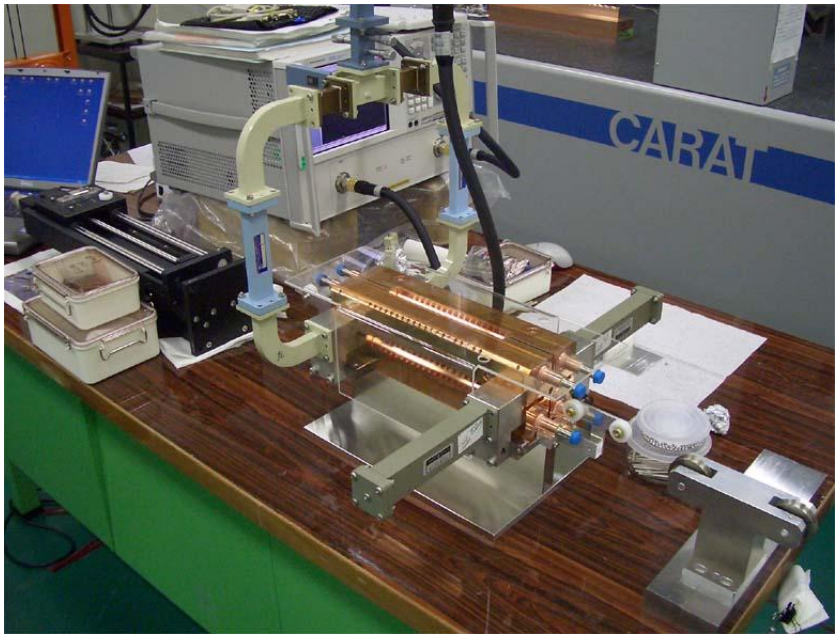


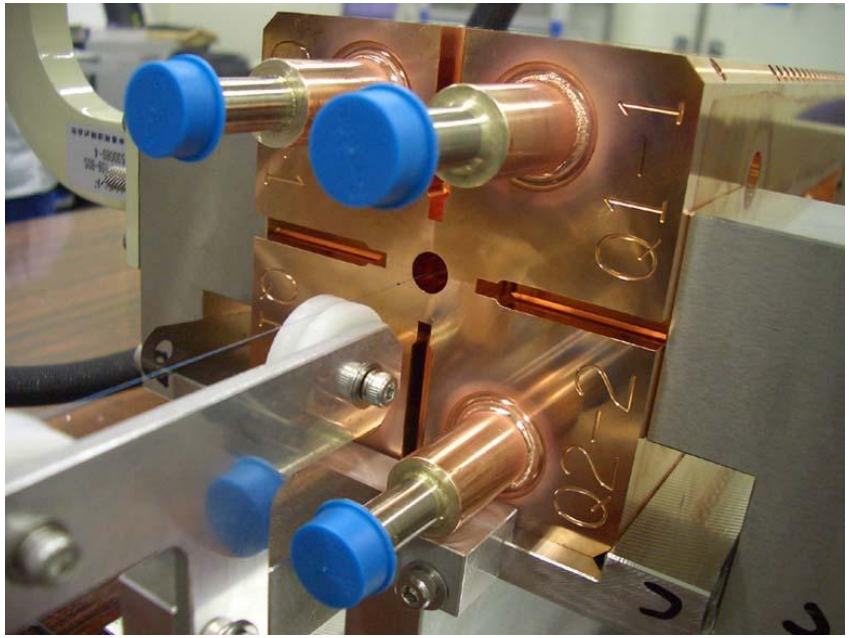


Before tuning

After tuning

Tuning setup



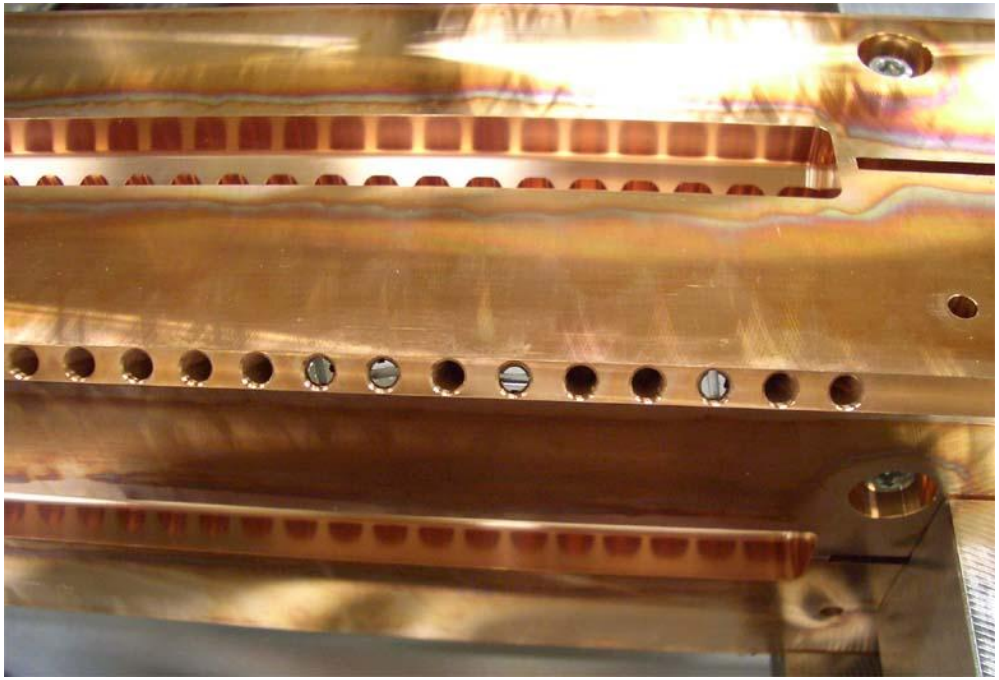


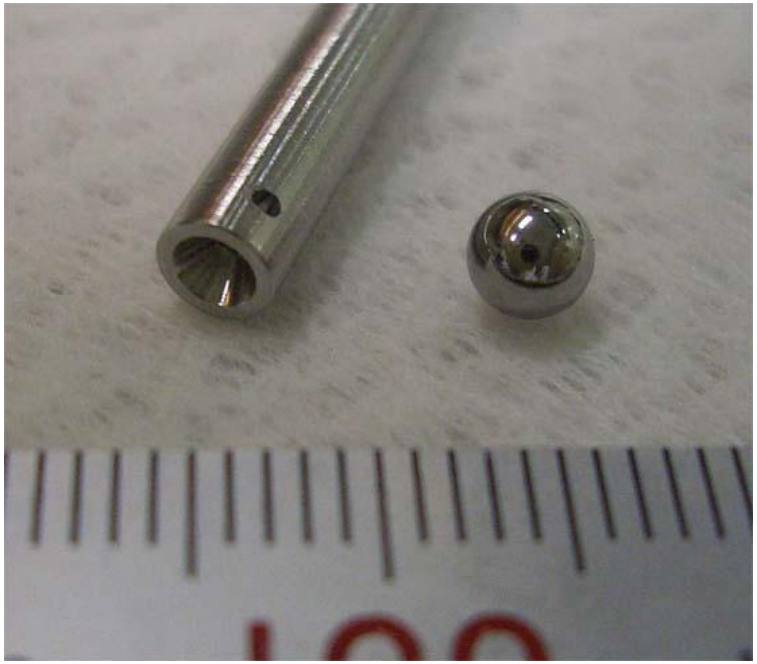
Tuning setup:
Quad#5, bead string, linear stage driven by pulse motor, input divider, network analyzer

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



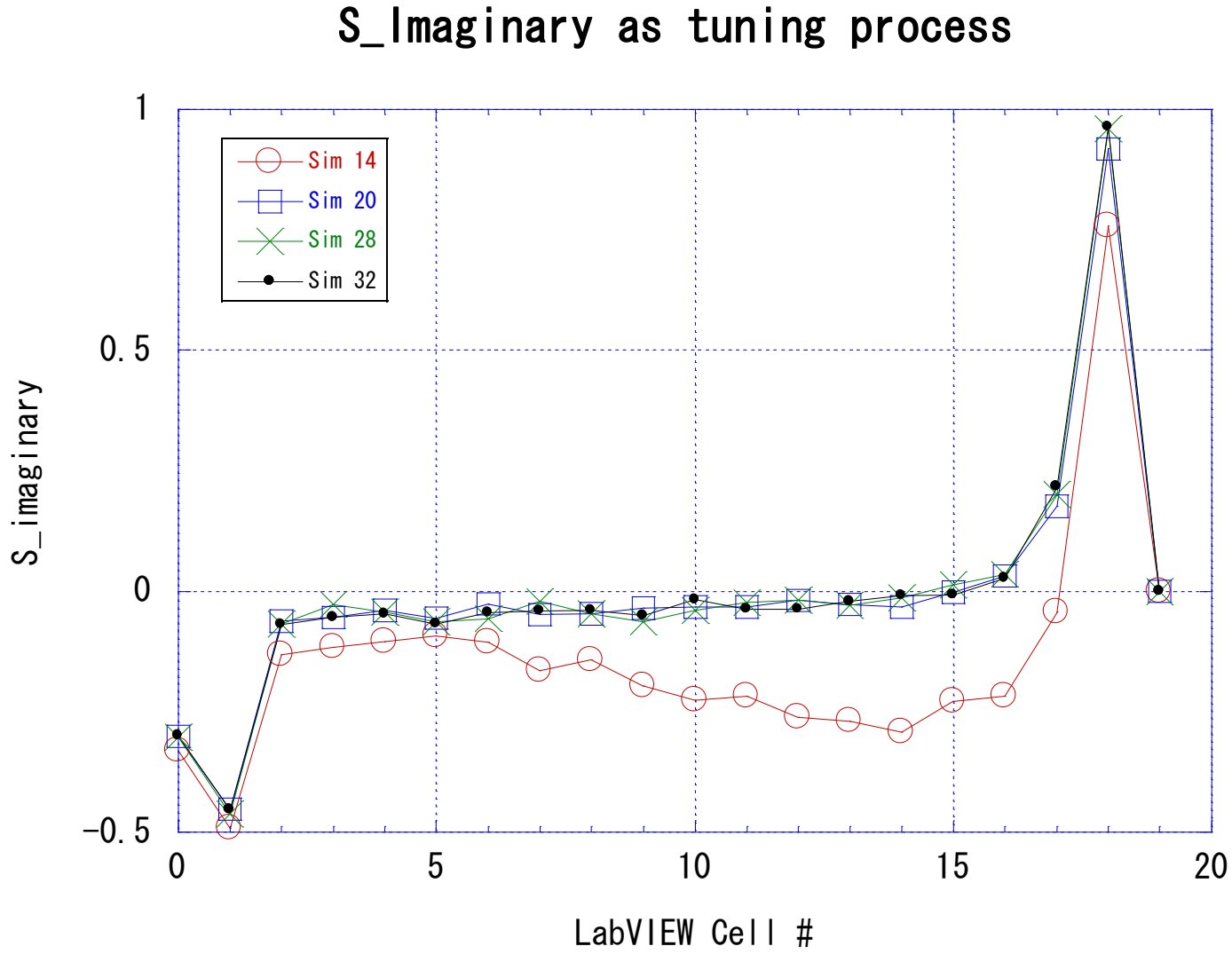


4mm stainless ball pushed by minus watch driver.
Pushing by turning with Higo's hand full force.
Elastic deformation kept, meaning that the tuning pins are kept pushing the balls.

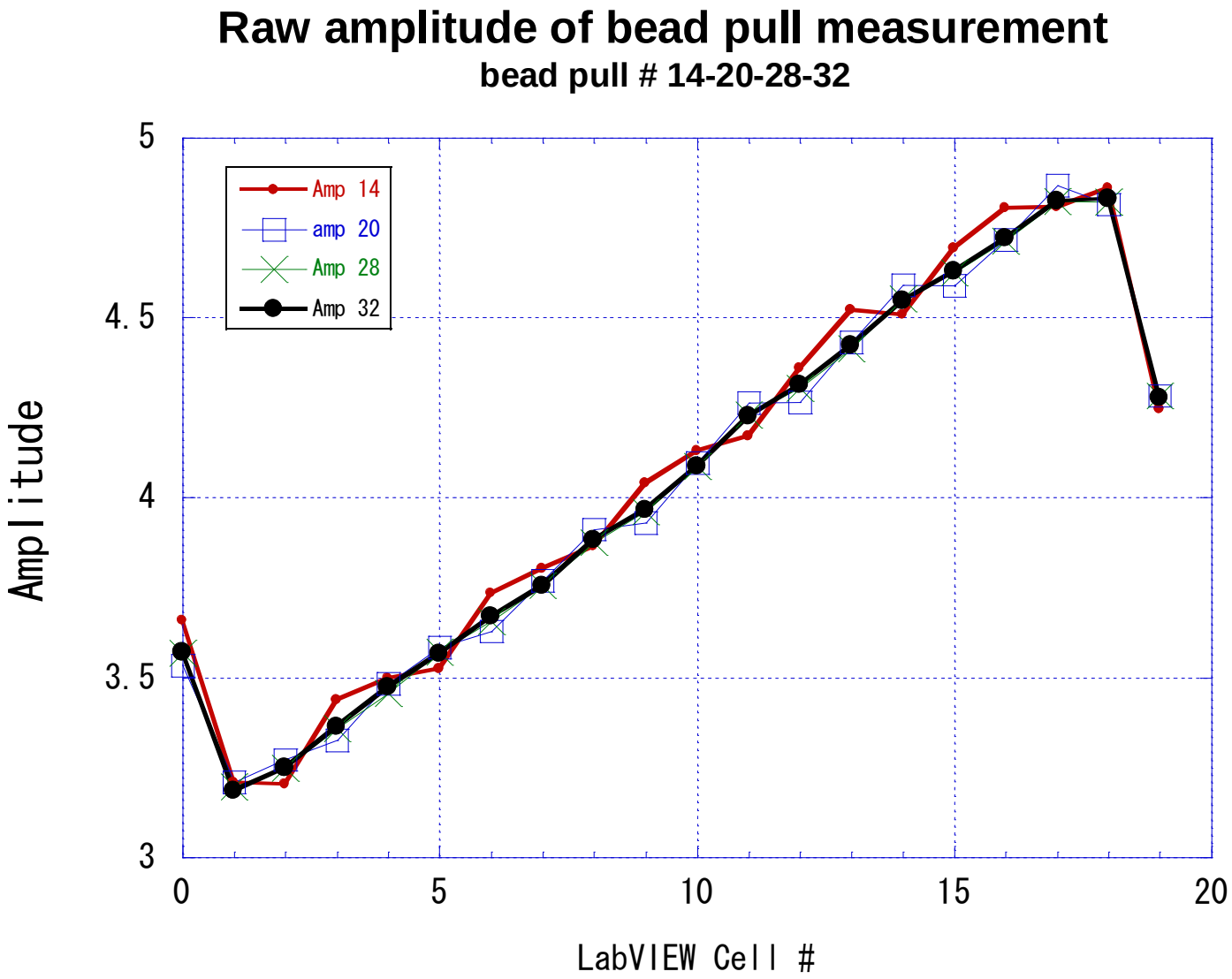
Tuning history

- 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

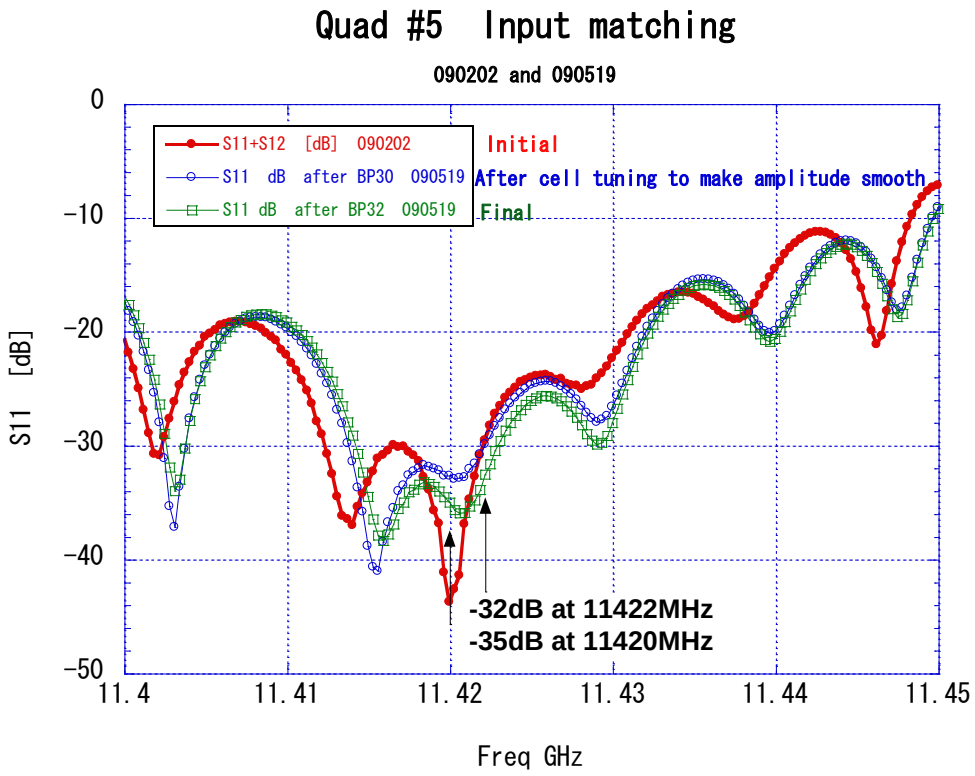


Tuning in practice



Evolution of S11 near 11420MHz

090520

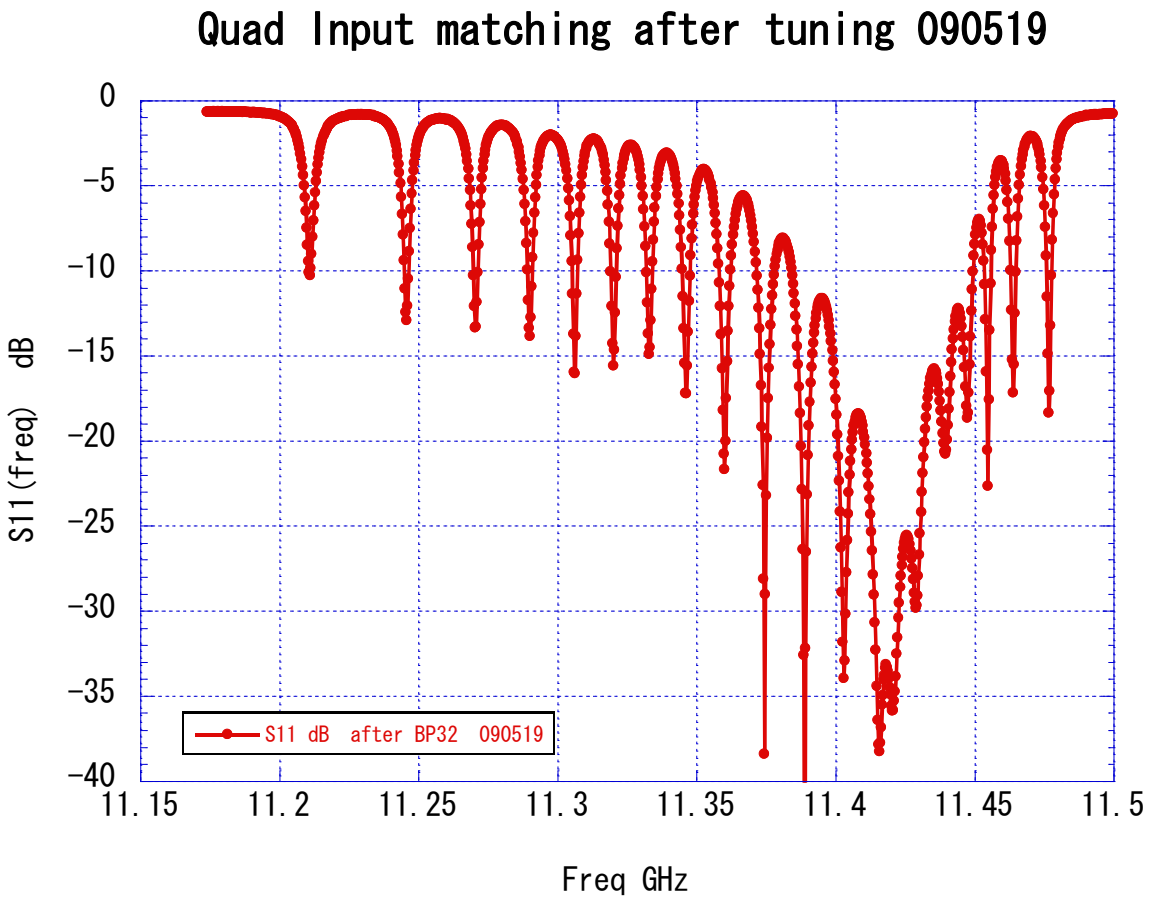


090202
initial

090519
after cell tuning, BP-30

090519
after input match tuning

Input matching after tuning



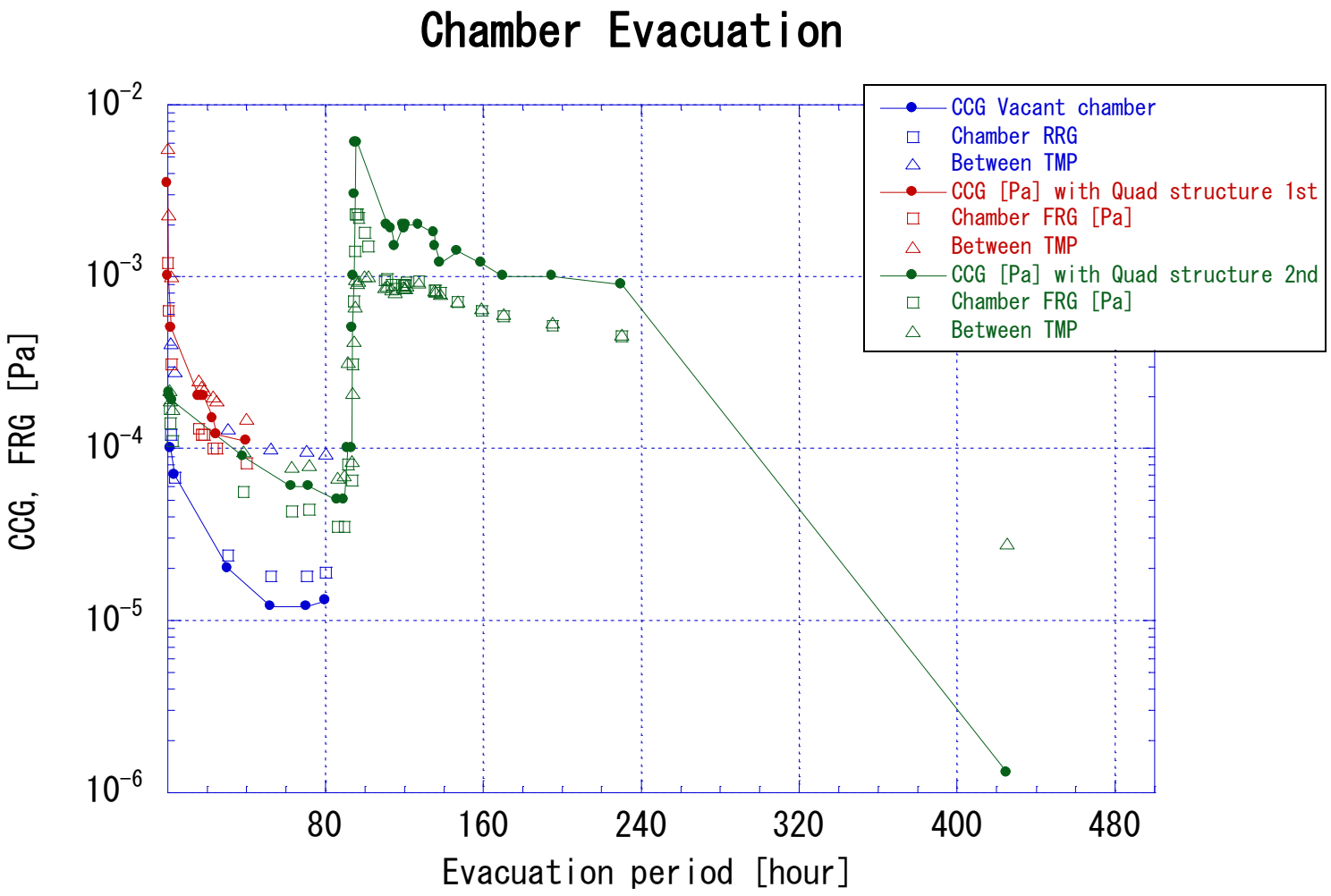
$|S_{11}|$= -32dB at 11422MHz, -35dB at 11420MHz
Operation at 11422MHz at 30C in vacuum is planned.
22C in air → 30C VAC makes 2MHz higher frequency.
So the input match should be -35dB, good enough.

Integration into chamber

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

Quadrant chamber evacuation.

as of 090622



Installation into Nextef and plan

- Installation trial
  - Gaskets sticked 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 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, Sodic, 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.