Status Report from Cavity Package Tech System(CPTS)

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- Preparation for the RDR Cost Estimation
- Contact Person to the Area System
- Expected Problems
- Engineering Efforts in KEK

CPTS Cost Estimation for RDR and

Contact Person to Area System

Areas covered by CPTS

	NCRF < ~100MeV	SCRF Capture 15MV/m	SCRF 0.1 – 5GeV	SCRF 0.25-5GeV	SCRF CW operation	SCRF Bunch compressor	SCRF 5-250GeV X 2	SCRF Crab cavity
E-Injector	1.3GHz Normal conducting	-	ILC Baseline like	-	-	-	-	
P-Injector		ILC Baseline like	-	ILC Baseline Like	-	-	-	
DR	-	-	-	-	650MHz KEKB/Cornell like	-	-	
RTML	-	-	-	-	-	ILC Baseline like	-	
ML	-	-	-	-	-	-	ILC Baseline	
BDS								KEKB like Crab cavity

NCRF cavity for E-source: Need to assign a volunteer

SCRF for DR: KEKB/Cornell like @ 650MHz

ILC Baseline cavity package: TESLA TDR and US cold option

BDS crab cavity system: KEKB like

Cost Estimation Items in CPTS

- NCRF Cavity
- SCRF Cavity: Material, TESLA-shape cavity Fabrication
- LHe tank on the cavity with LHe supplying tube
- Tuner
- Input coupler
- HOM @ end of the module
- Cavity Preparation
- Cavity field flat tuning
- Input coupler processing
- Cavity assembly for acceptance test (vertical test)
- Cavity Acceptance test (vertical test)
- Cavity String assembly

Red items are not clearly defined for CPTS but must be covered.

	Module*	Cavities	LHe tank	Tuner	Input coupler	HOM	Methodology of cost estimation Contact person to ASL (Candidates, not yet fix)
E-Injector	19	152	152	152	152	19	EU : TESLA TDR + input of RDR cost estimation methodology + EURO XFEL **Dieter Proch**
P-Injector	19	152	152	152	152	19	
RTML E- 1st BC	3	24	24	24	24	3	USA : USCOP + input of RDR cost estimation methodology **John Mammosser**
E-2nd BC	57	456	456	456	456	57	
P-1st BC	3	24	24	24	24	3	
P-2nd BC	57	456	456	456	456	57	
ML Electron 15 –150GeV	552	4416	4416	4416	4416	552	Asia : New cost estimation by the RDR cost estimation methodology **Kenji Saito**
Electron 150-250GeV	396	3168	3168	3168	3168	396	
Positron 15-250GeV	936	7488	7488	7488	7488	936	
Baseline cavity total	2042	16336	16336	16336	16336	2042	
DR Electron	1	1	1	1	1	2	KEKB like cavity
Positron	1	1	1	1	1	2	Shinji Mitsunobu(?)
BDS Electron crab	1	1	1	1	1	2	KEKB like crab cavity
Positron crab	1	1	1	1	1	2	Kenji Hosoyama (?)

* Module includes 8 cavities.

Contact Person to Area System

Not yet fixed, but probably D.Proch

Volunteers

- we are looking for a volunteer with normal conducting cavity
- we will ask volunteer to KEK/Cornell colleague for DR
- we will ask volunteer to KEK colleague for crab cavity in the BDS

Proposal of the on-site facilities from CPTS

- Cavity Preparation facility on the ILC site
- Cavity Acceptance Test (Vertical Test) on the ILC site
- Cavity String Assembly Facility on the ILC site
- Input coupler processing Facility on the ILC site

Cavity production rate ~17/day (for 4 years)
Acceptable resources for the ILC mass production, ~10 places:
for example preparation
DESY, Hankel, KEK, Nomura Plating, Jlab, FNAL/ANL+ Others
Current or future resources will be a half capacity of that needed in the ILC production.

1) Too much production rate for existing resource use.
2) Will be too expensive in company site facility and difficult for repairing modules.
3) We need a close communication between Preparation and VT for the reliable performance.
4) Assembled cavity string is not robust then,
   transportation will be a problem on the alignment.
5) Special cleaning tech and clean assembly facility is needed.for input coupler assembly.
   it can be shared with cavity in case of the on site.

Expected Problems in the CPTS

List of the expected problem on the cost estimation in CPTS

	Expected problems
Technical	1) Not yet fixed the BCD on the tuner system 2) Estimation of the time consuming process: coupler processing 3) Scattering of the cavity performance
Temporal	1) How to open the intellectual information
Resource limitation	1) Need a help for NCSR 2) DESY is too busy with the EURO XFEL 3) KEK crab people is too busy with the KEKB installation

Engineering Efforts in KEK

1) Cavity
2) High power input coupler
3) Coaxial ball tuner system

BCD on Cavity Package and Engineering Effort

	ILC BCD	ILC ACD
Cavity	TESLA shape by polycrystalline Nb sheet Operation 31.5MV/m	LL/RE shape, large or single crystal Nb sheet Operation 36MV/m
Input Coupler	TTF-III Type (twin cylindrical windows)	Two Disk type coupler TRISTAN type Capacitive coupling
Tuner	Saclay/TTF tuner is close to the BCD, but no candidate for BCD at the current	Coaxial tuners Blade tuner Coaxial ball tuner Slide tuner

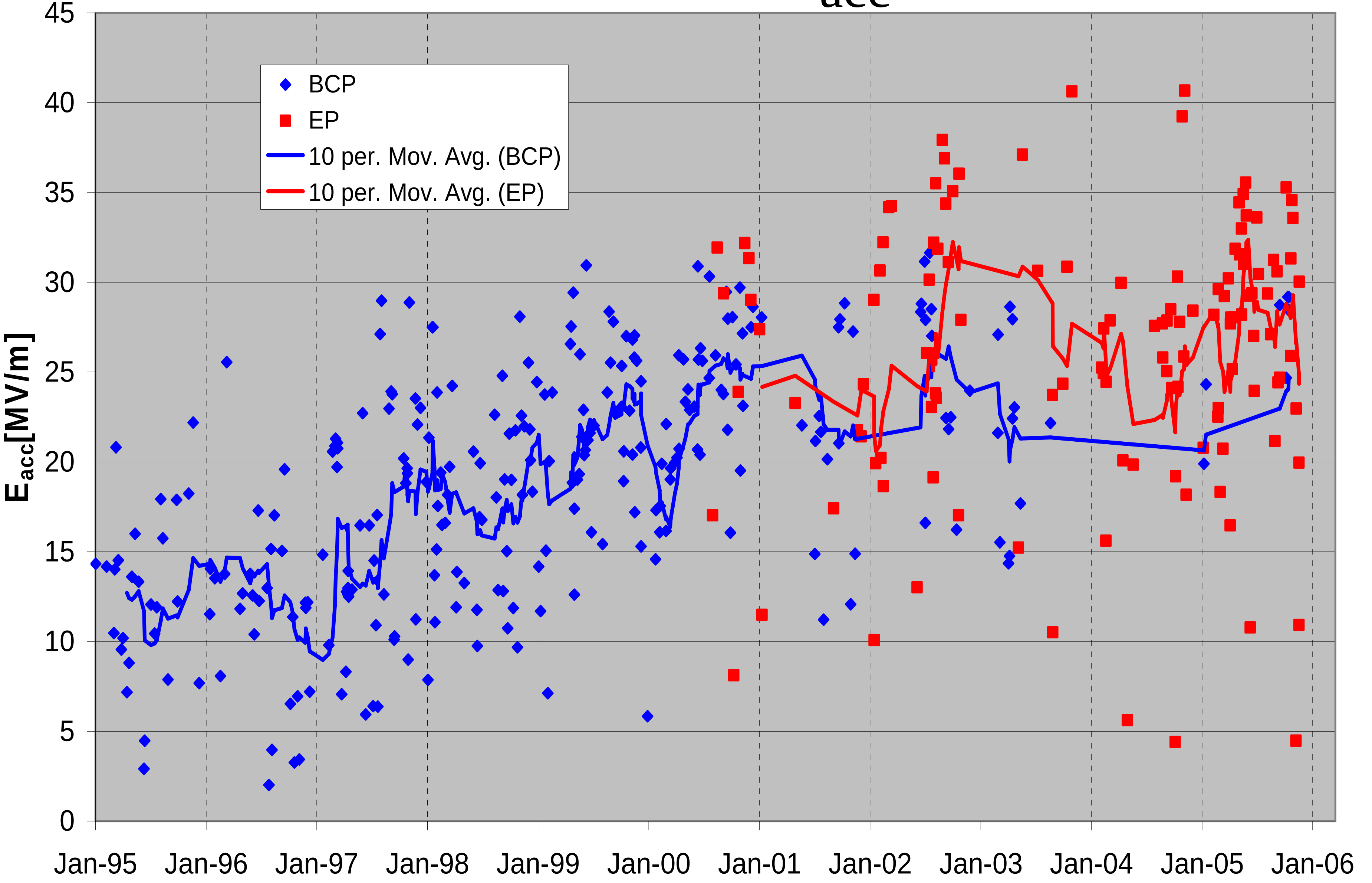
Engineering issues

Cavity : Narrow scattering in the current performance

Input coupler : Reduce the fabrication cost

Tuner : Establish the BCD

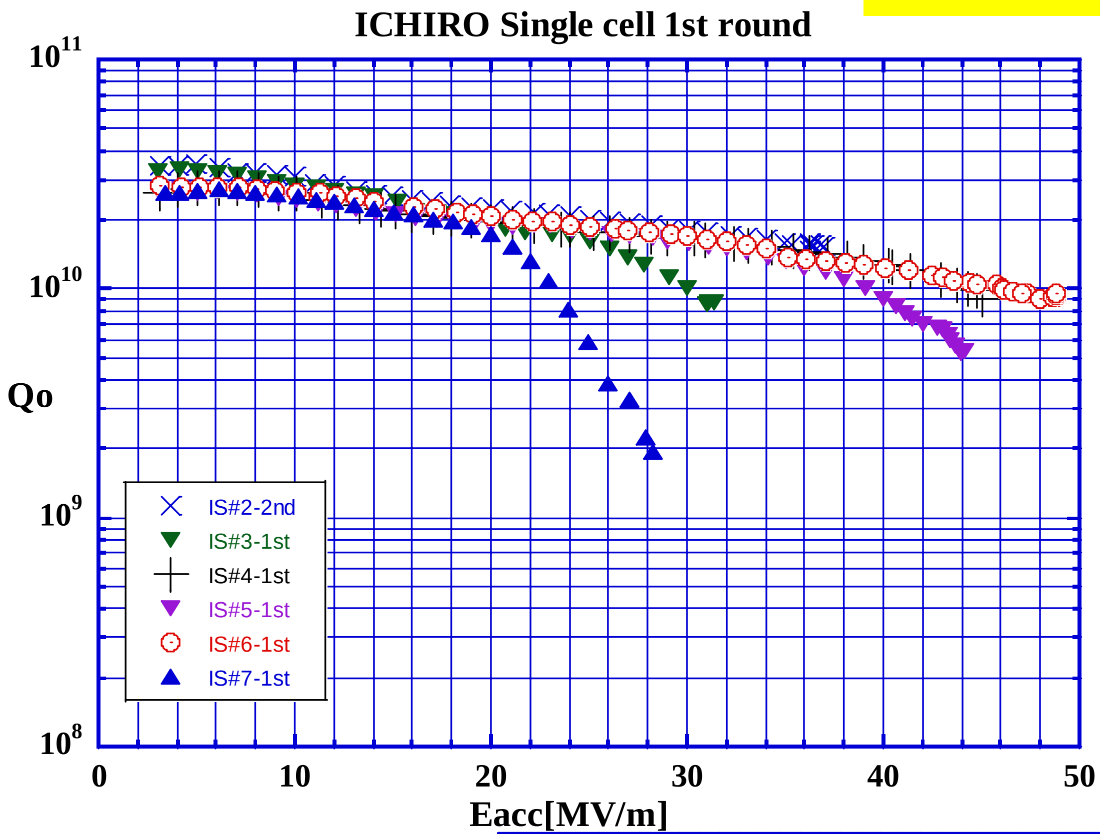
Scatter at DESY E_{acc} vs. time



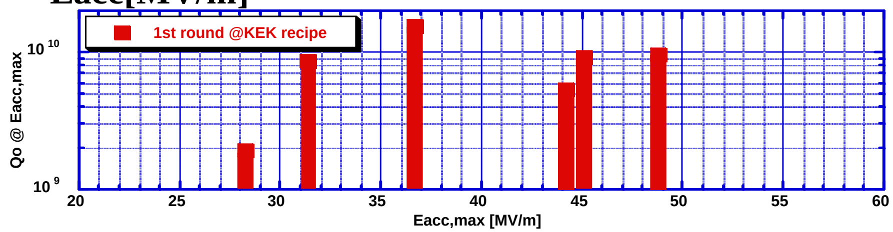
Statistics with 45MV/m achievement in the first round

45MV/m yield rate 50% now

Single cell cavity study @ KEK
ACD shape

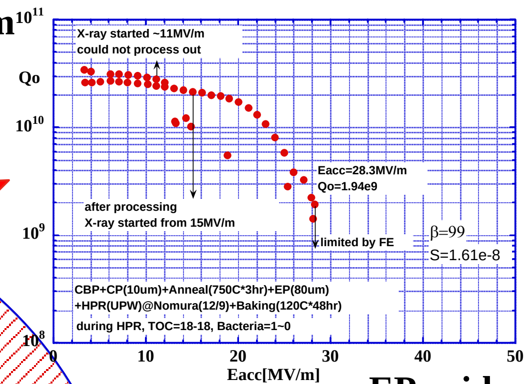


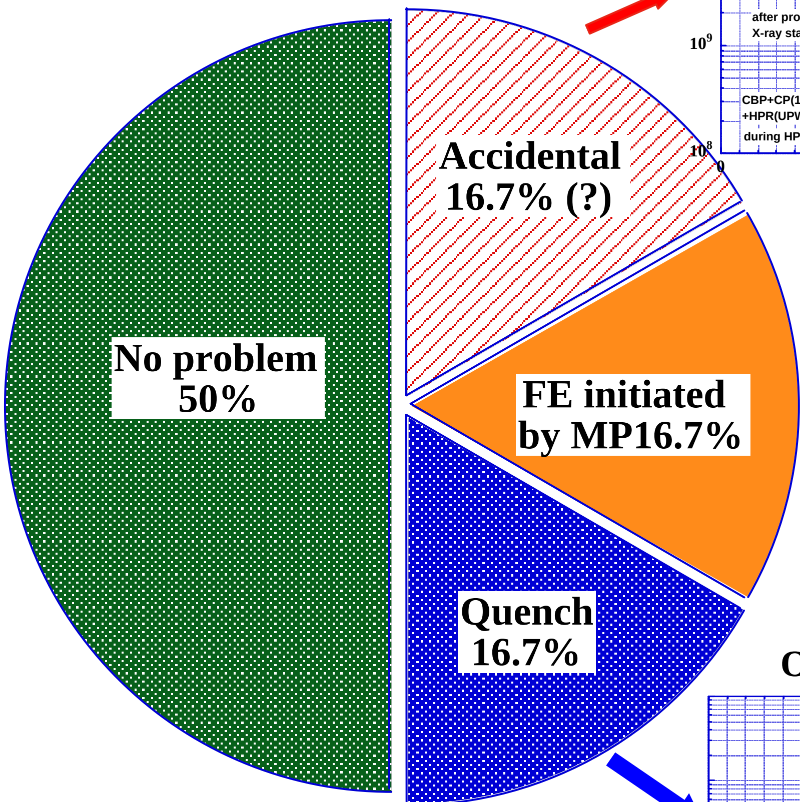
By F.Furuta, T.Saeki, K.Saito, T.Higo,T.Higo Orr-san



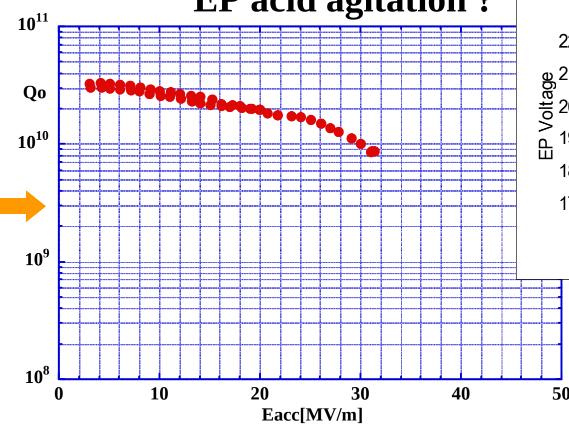
What is problem?

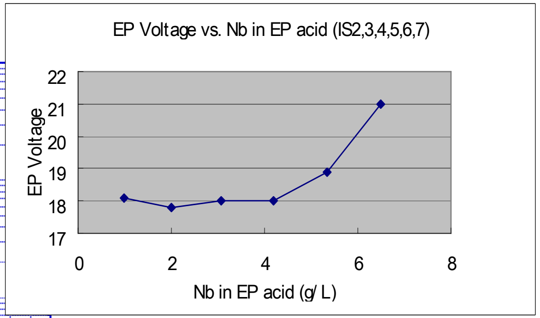
Assembly or HPR problem



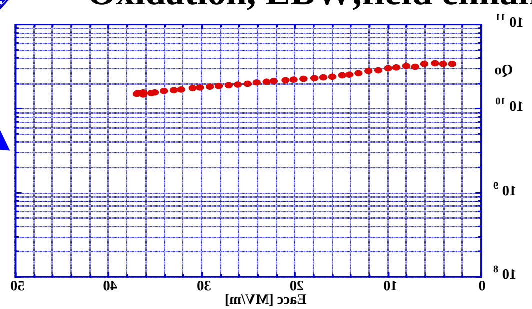


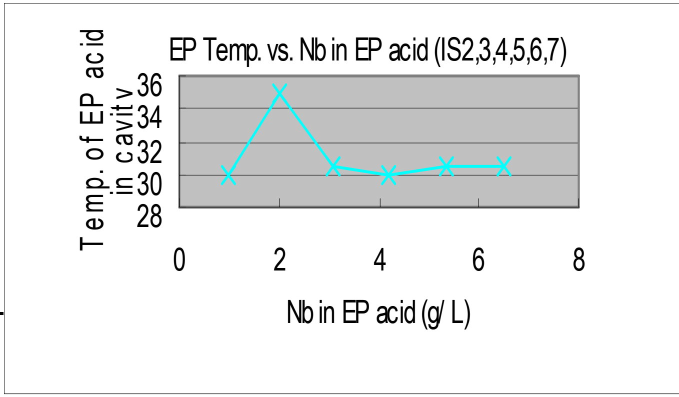
EP acid agitation ?



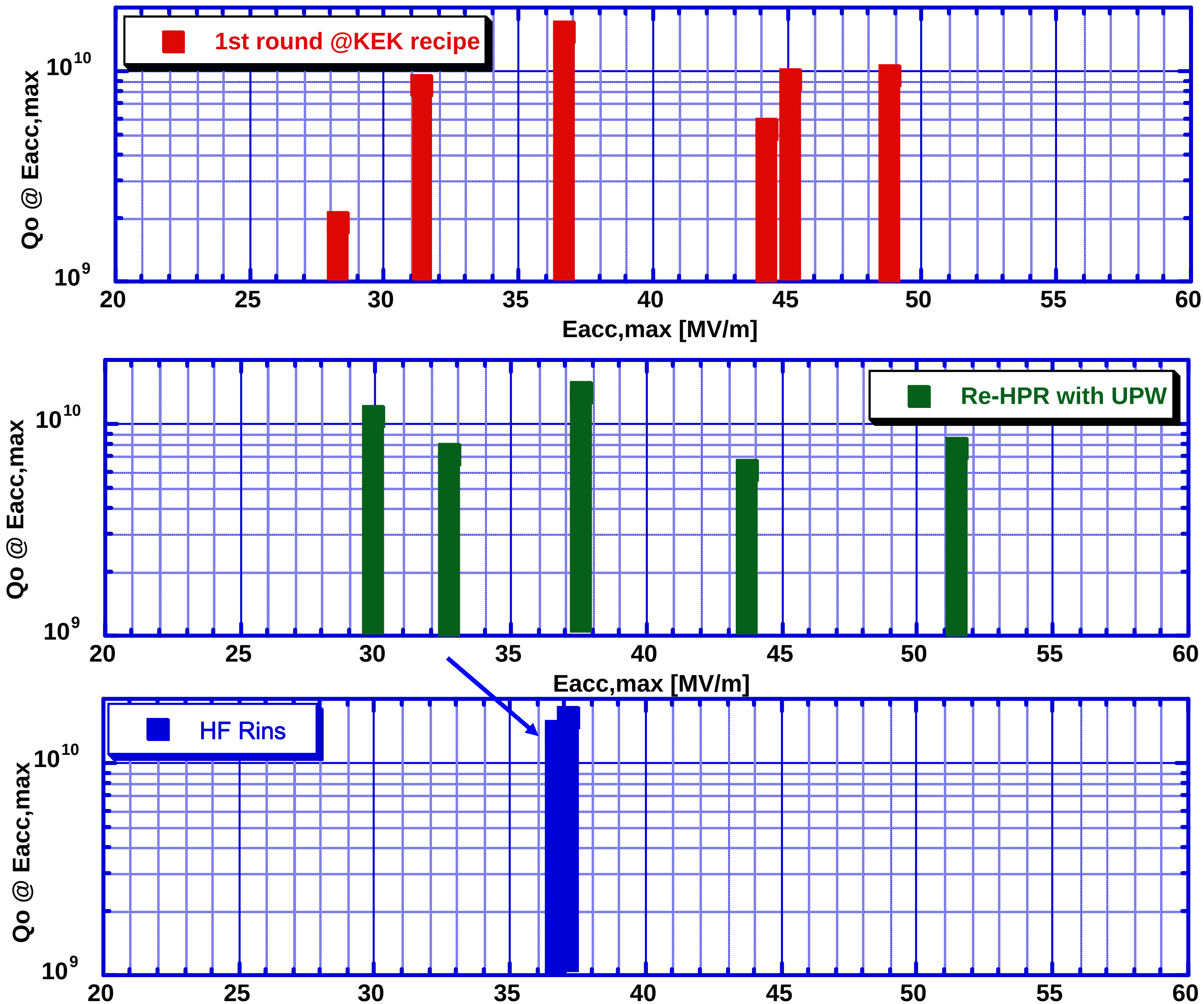


Oxidation, EBW,field enhancement ?



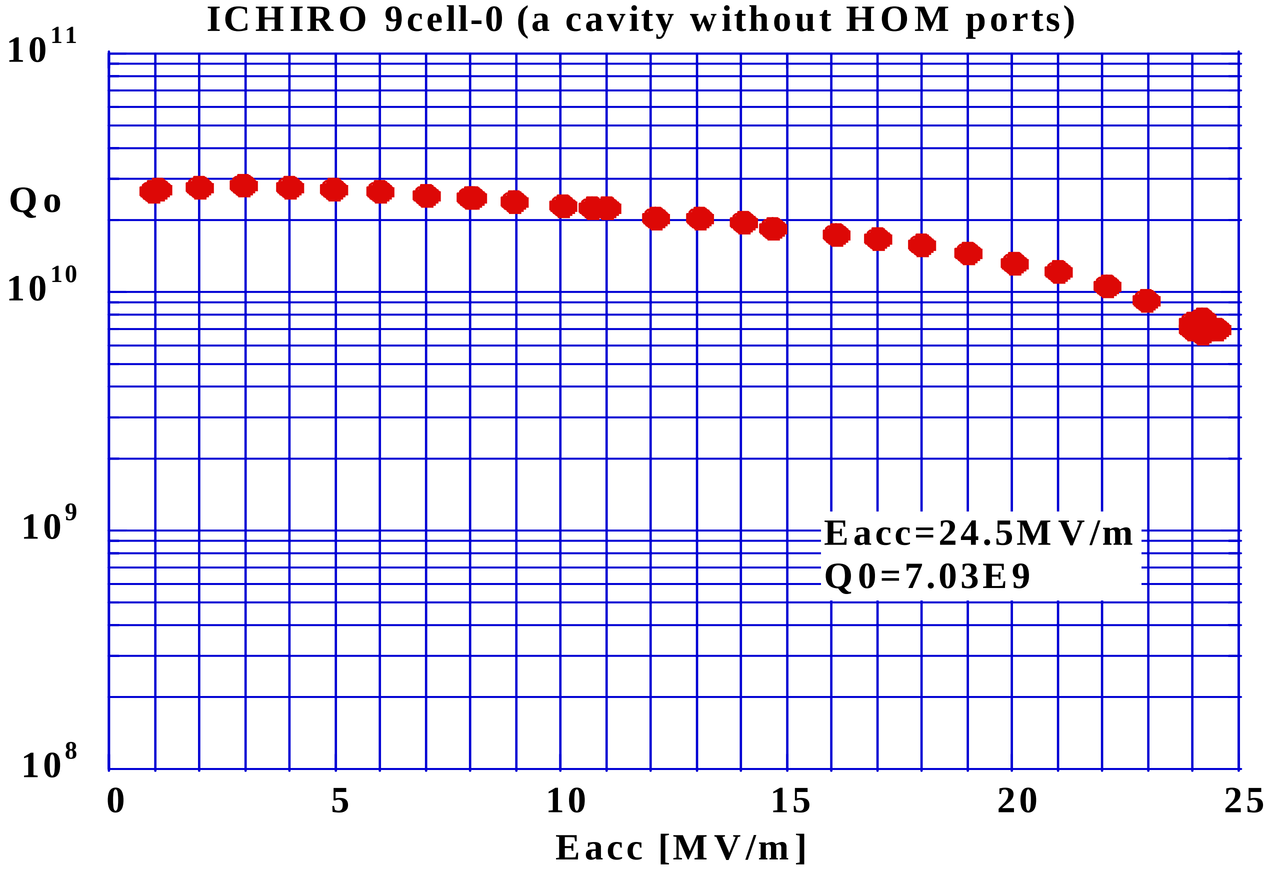


Statistics


1st round @KEK recipe
Re-HPR with UPW
HF Rins
Qo @ Eacc,max
Eacc,max [MV/m]
10^{10}
10^{9}
20
25
30
35
40
45
50
55
60

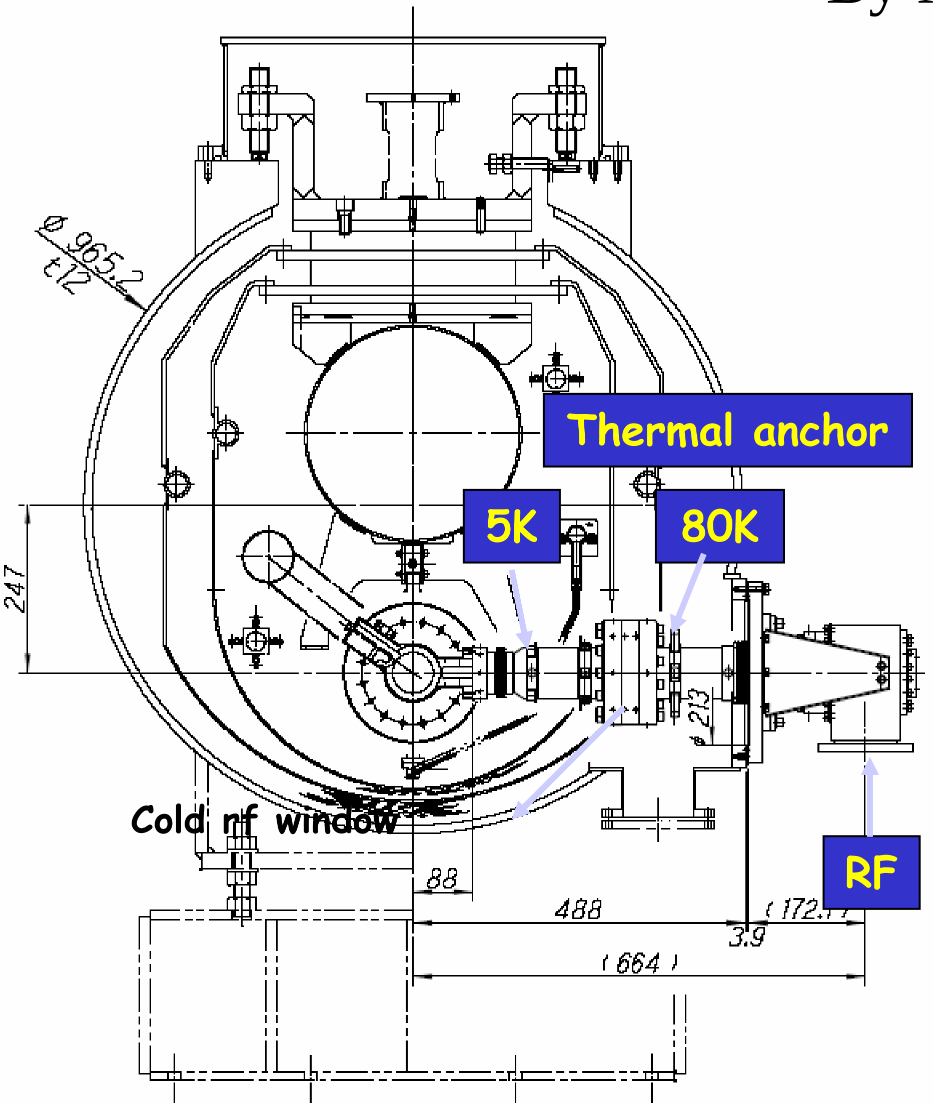
9-cell cavity R&D in KEK for ILC-ACD

35MV/m baseline cavity R&D and 45MV/m ACD (ICHIRO cavity) R&D both just started in KEK.



Input Coupler for ILC-ACD

By Matsumoto and Kazakov @ KEK



Major Parameters

Input rf power: 500 kW

Pulse width: 1.3 msec

Repetition rate: 5 Hz

Average rf power: 3.25 kW

Thermal loss [W]

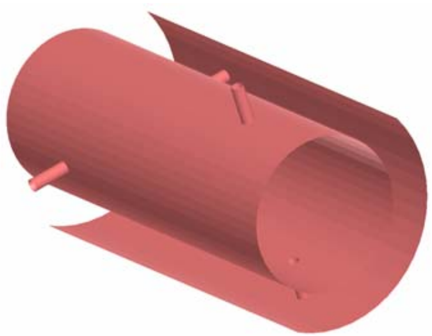
	80K	5K	2K
Static:	1.24	0.54	2.6x1e-4
Dynamic:	2.14	2.88	0.25
Total:	3.38	3.42	~0.25

RRR: 3.5 (measured data)

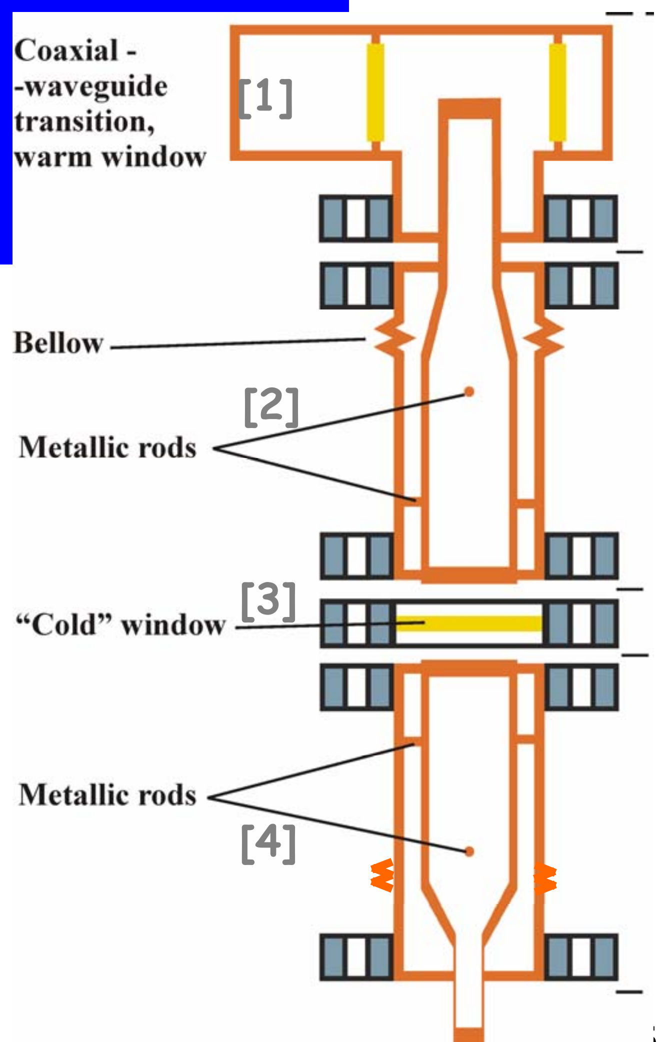
INDUSTRIALIZATION with MODULAR STRUCTURE

Input coupler comprises of four modules:

1) coaxial transformer
2) coaxial line
3) rf window
4) antenna at cold side



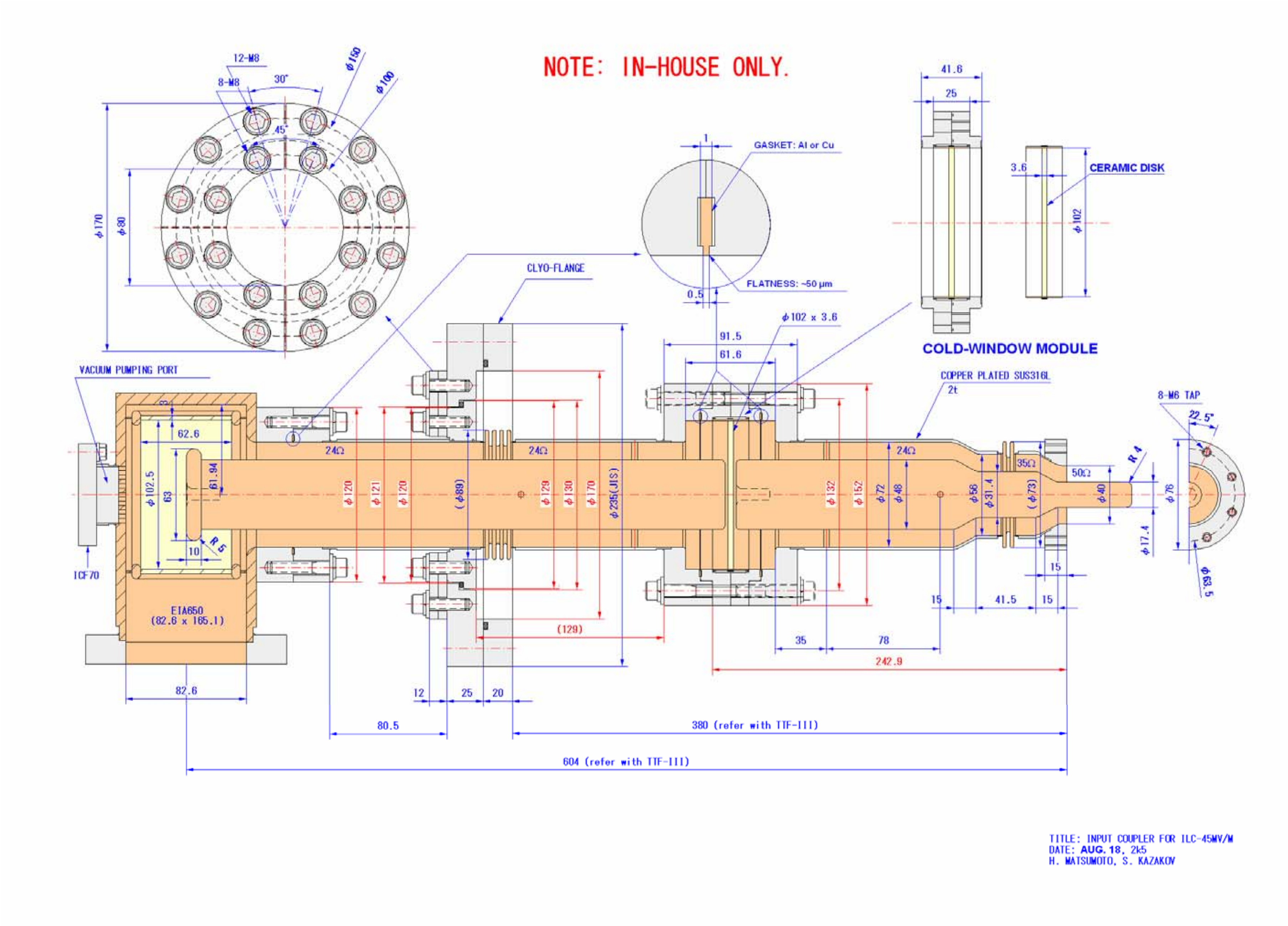
Each pair of rods is mounted in the gap between the inner- and outer-conductors, and are rotated 90 degrees from each other.



The complete input coupler can be divided into four relatively simple parts to **ease fabrication and assembly**. If we assume that the inner conductors are not attached rigidly to the waveguide, we **need only two bellows to absorb the movement of the coaxial line** due to thermal contaction and expansion between cool down and warm up.

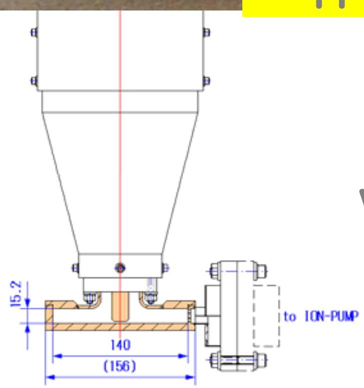
The fabrication of each module **dose not overlap for the technical requirements.**

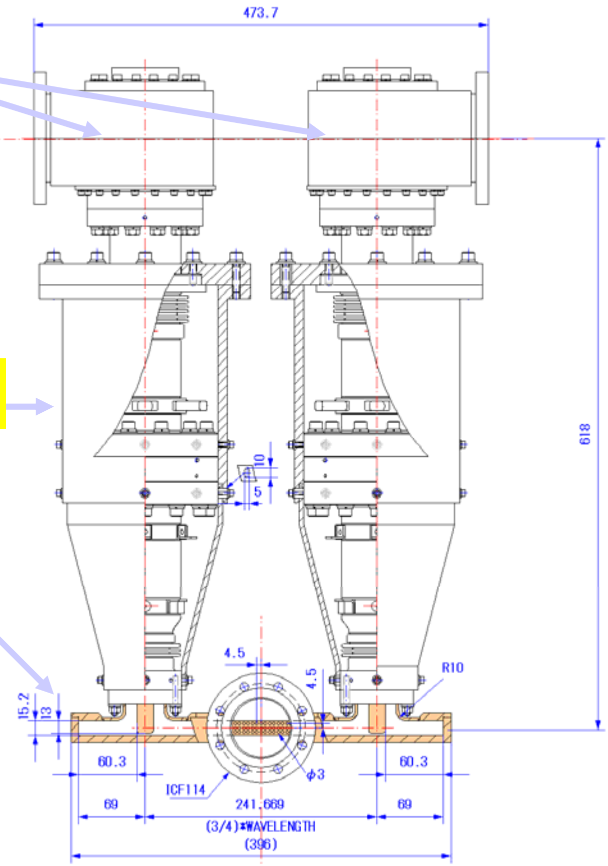
STRUCTURE FOR POWER COUPLER



High Power Test Stand for ILC-ACD

High power test stand is under preparing.





Transmission type waveguide

SCHEDULES FOR EARLY 2006

- Middle of MARCH
  High power test stand.
- End of MARCH
  Coupler fabrication.
  Deliver from TOSHIBA.
- Middle of April
  High power test

PHOTOs OF RF WINDOW AT COLD SIDE

On 23 Feb 2006

Cold RF window

PHOTOs OF PARTs FOR POWER COUPLER

Bellows at warm side

Bellows at cold side

Inner conductor at warm side

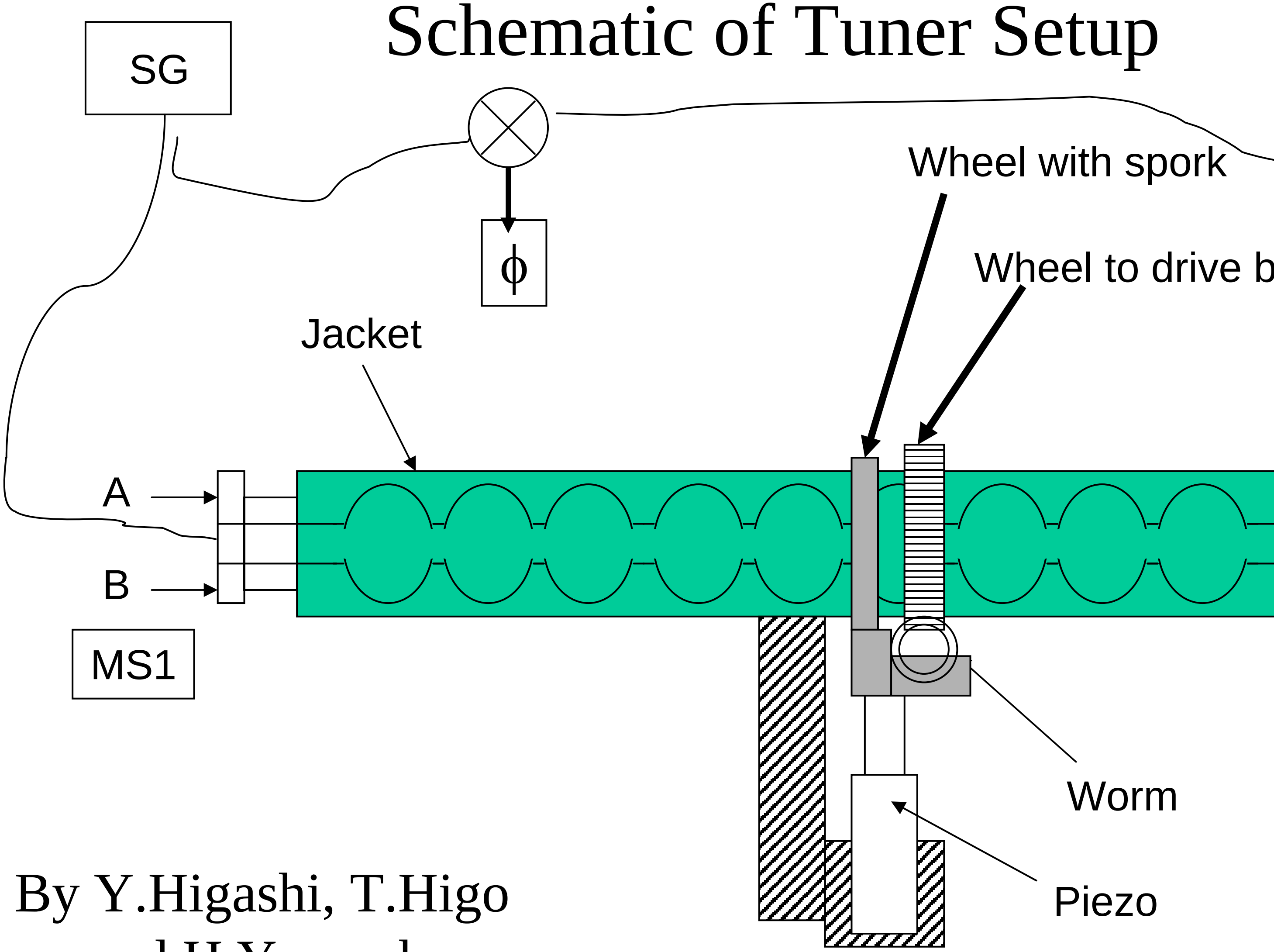
PHOTOs OF COAXIAL LINE AT COLD SIDE

Inner conductor at cold side

Outer conductor at cold side

Coaxial ball tuner system for ILC-BCD

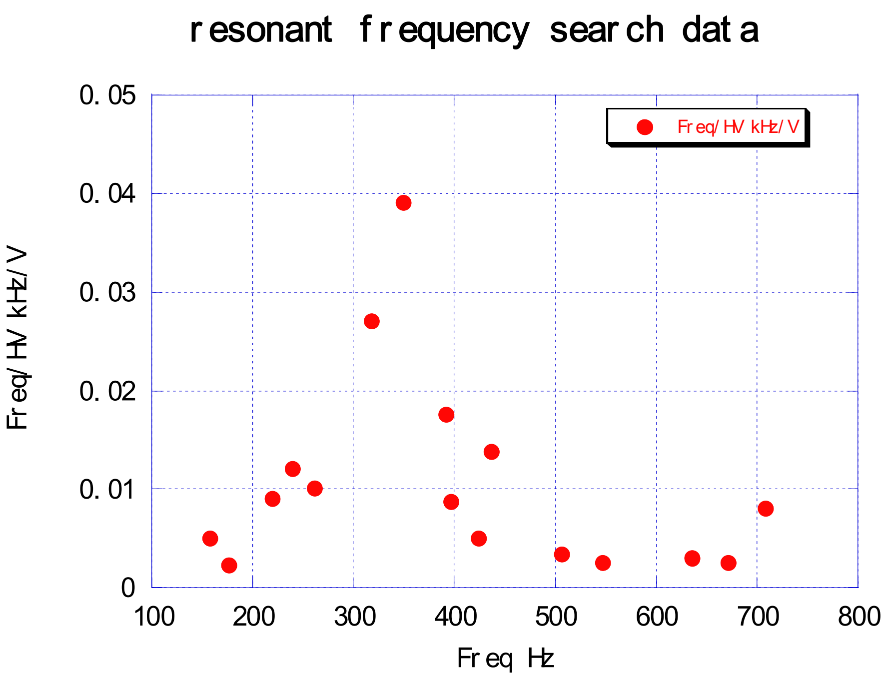
Schematic of Tuner Setup

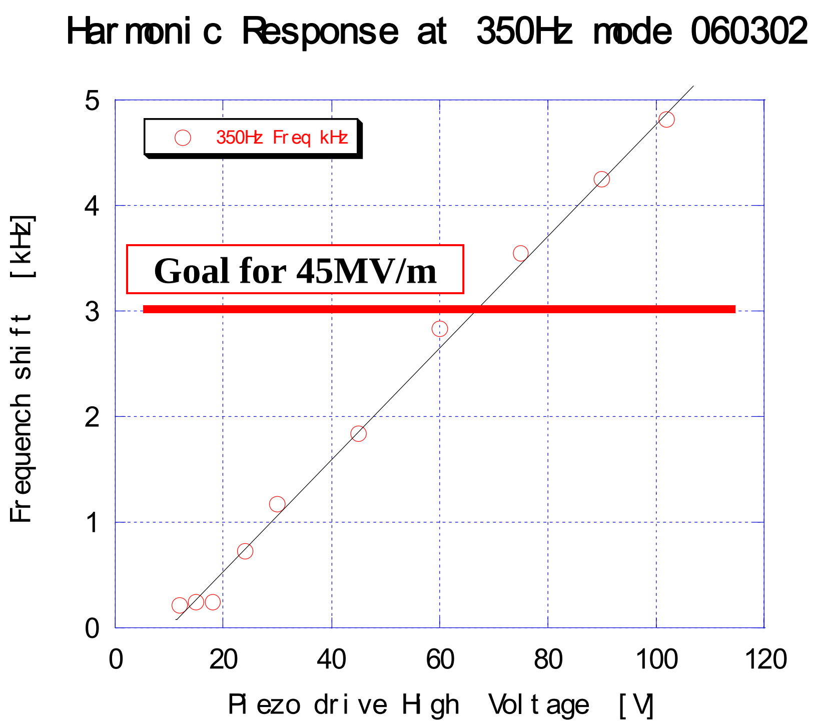


By Y.Higashi, T.Higo and H.Yamaoka

Resonant points and linearity

Resonant response by driving piezo sinusoidally.

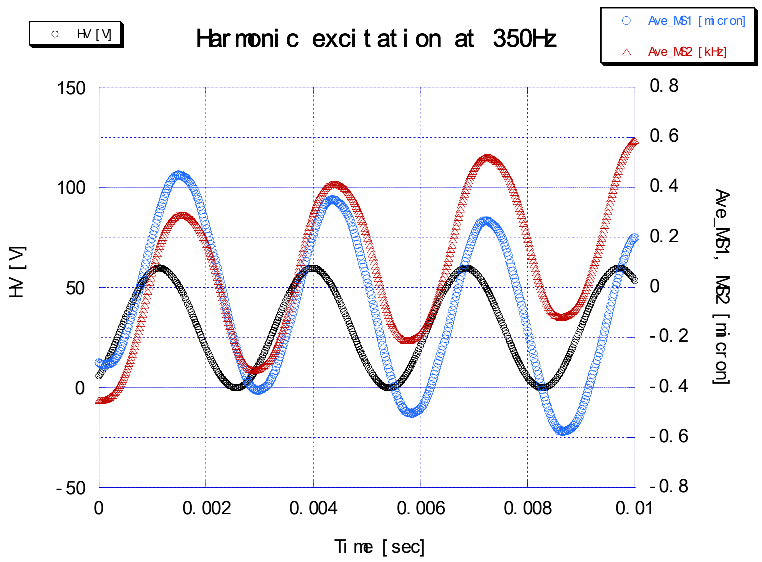


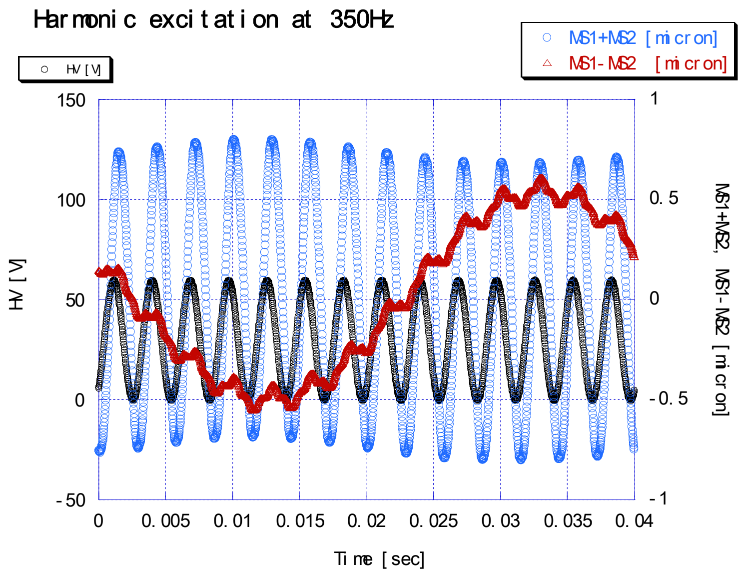


Several modes can be candidates to use for tuning

Several modes can be candidates to use for tuning. Higher end limited by present power supply.

Harmonic excitation at 350Hz



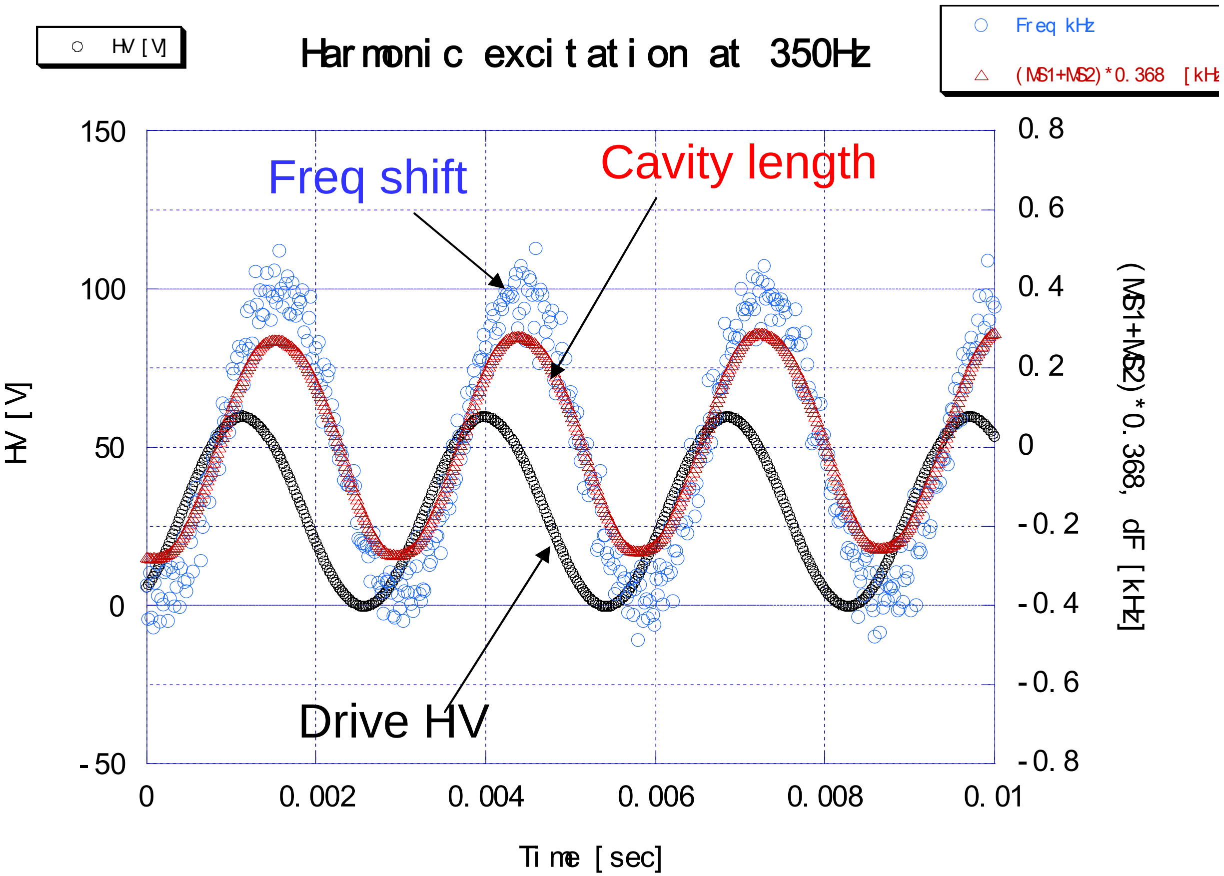


Main component is cavity breezing mode. (Blue in right figure)

Slow rolling mode coexists at very low frequency. (Red in right figure)

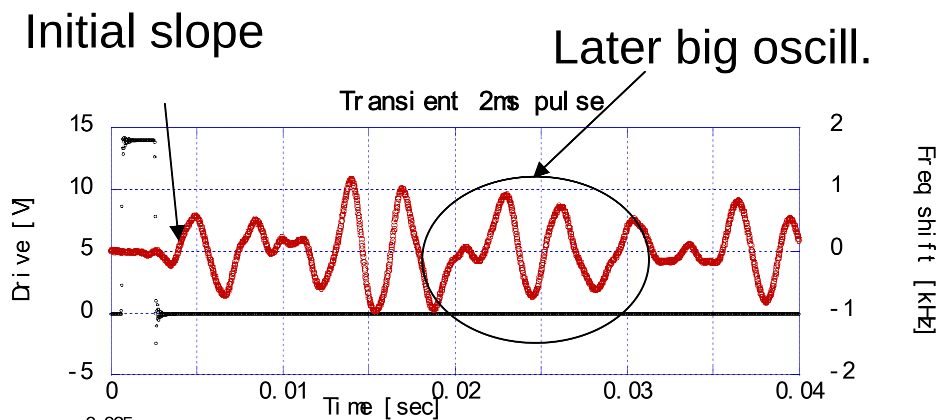
(HV might be half!? Should be checked.)

Harmonic excitation at 350Hz Frequency shift



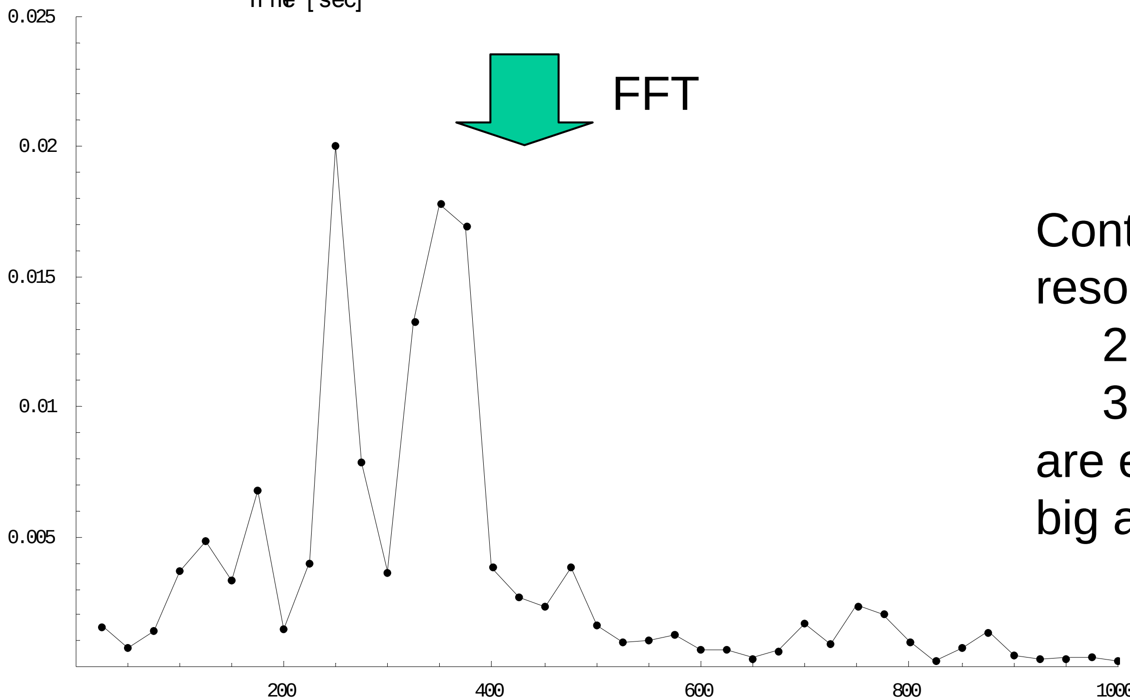
- Frequency shift agrees with cavity length within a factor of 1.5.

Frequency spectrum from transient



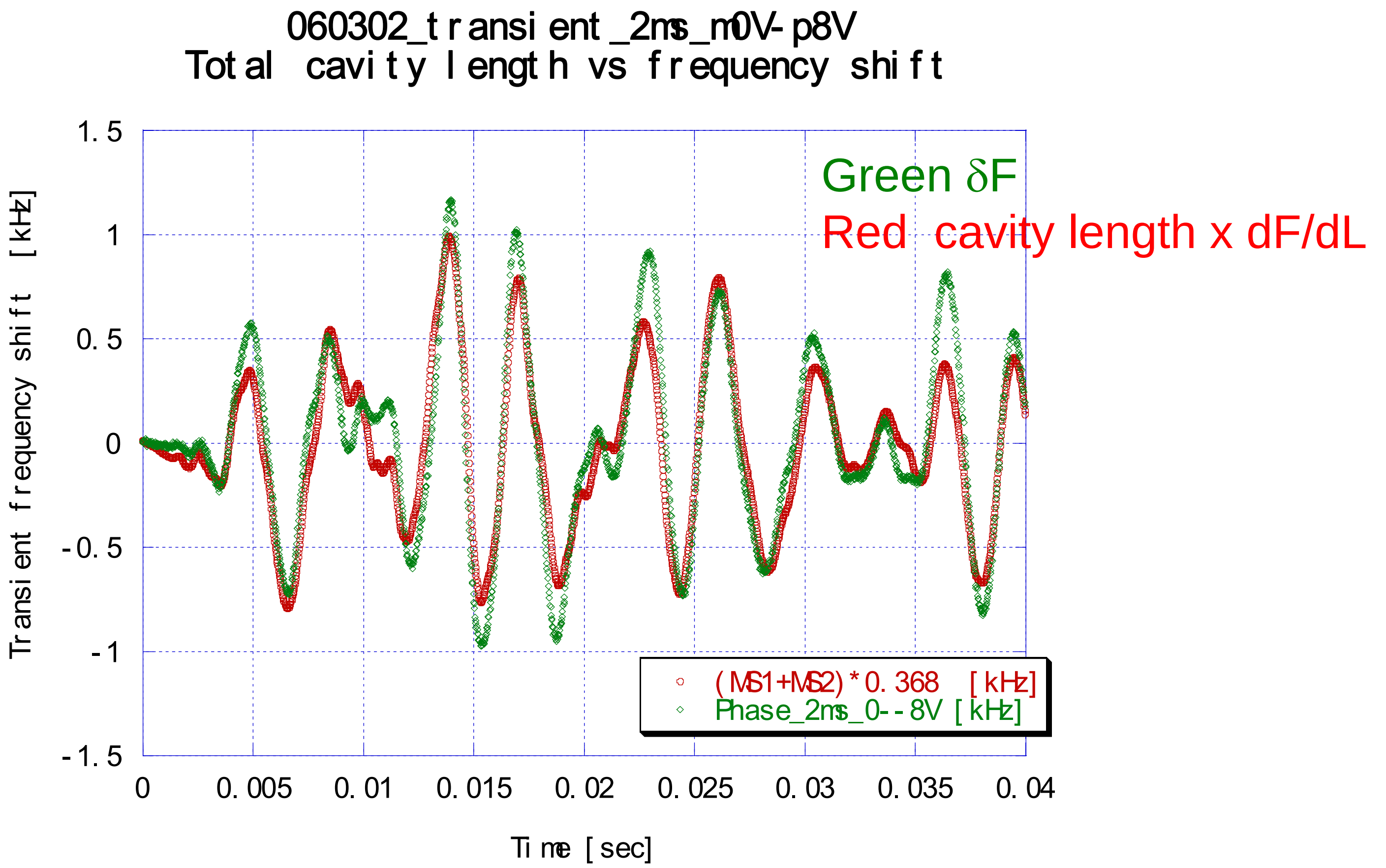
Initial slope → 3ms delay, ~0.5kHz

Later big oscill. → ~15ms later, ~2kHz



Contribution from resonances around
250Hz
350Hz
are essential for later big amplitude.

Cavity length and frequency shift



δF well agreed with cavity length expansion x dF/dL_static

Preliminary Conclusion on the coaxial ball tuner system by Higo et al.

- With slow and fast tuners integrated in a realistic configuration, cavity response by harmonic excitation and transient excitation were studied.
- Resonances around 250Hz and 350Hz are significant, both in harmonic excitation and transient excitation.
- In resonant case,
  - 100V drive at room temperature at 350Hz makes cavity frequency tuning by 5kHz.
- In transient case,
  - Frequency shift agrees with cavity total length change
  - First slope appears 3msec later. The amplitude is 0.5kHz.
  - Around 15ms later, grows to large oscillation of about 2kHz.
  - 5Hz interval (200ms) later, oscillation damps << 10%.