

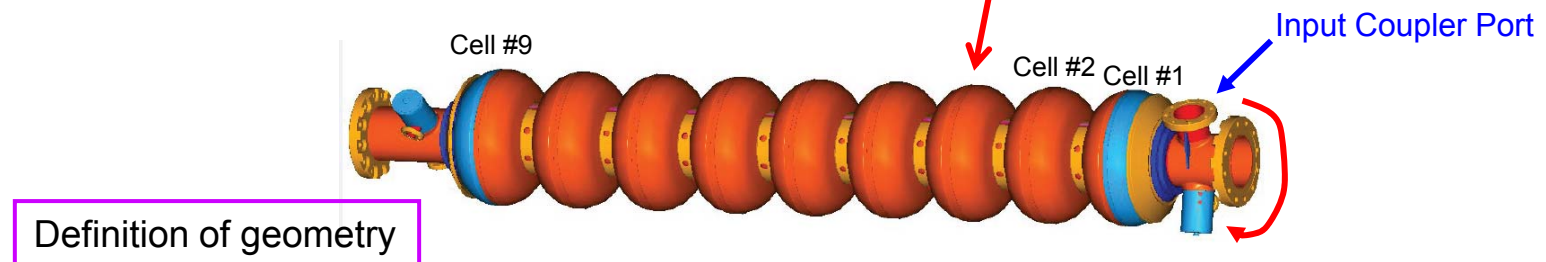
Recent Status of New Vertical Test System in KEK-STF

- Background
- History of AES#001 Cavity in Japan
- New Vertical Test Facility @STF
- New T-mapping System (Fishbone)
- Result of V.T. for AES#001 Cavity
- Summary

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H. Sakai(ISSP, Univ. of Tokyo) and T. X. Zhao(IHEP)

Background

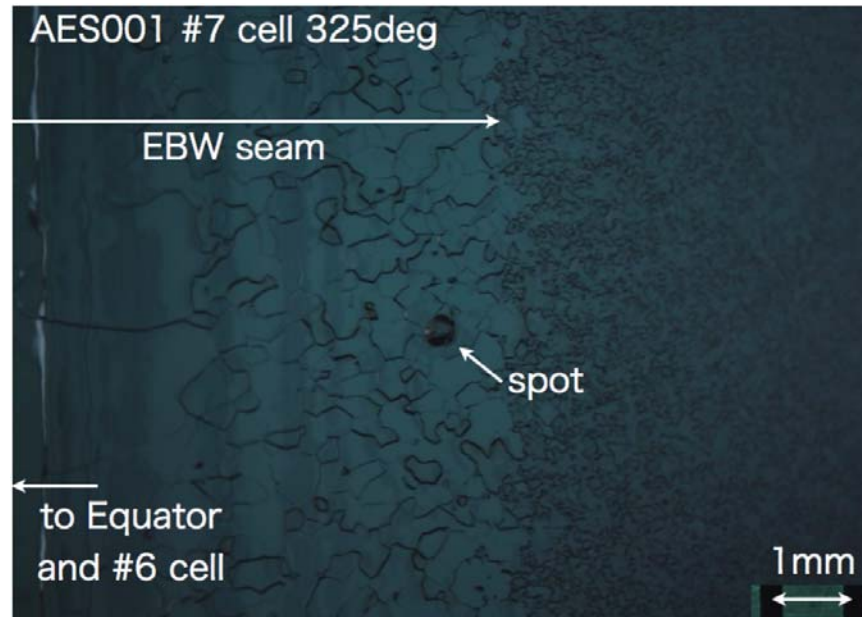
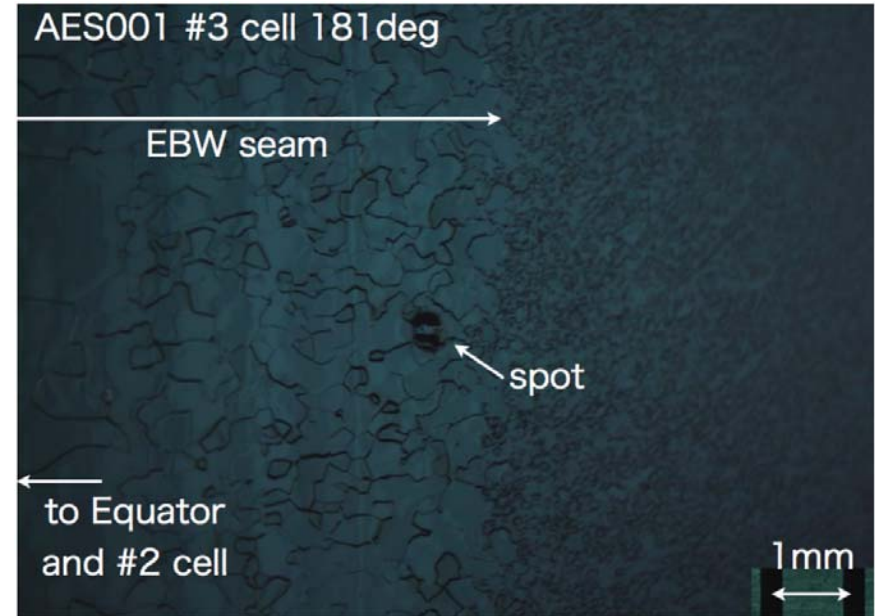
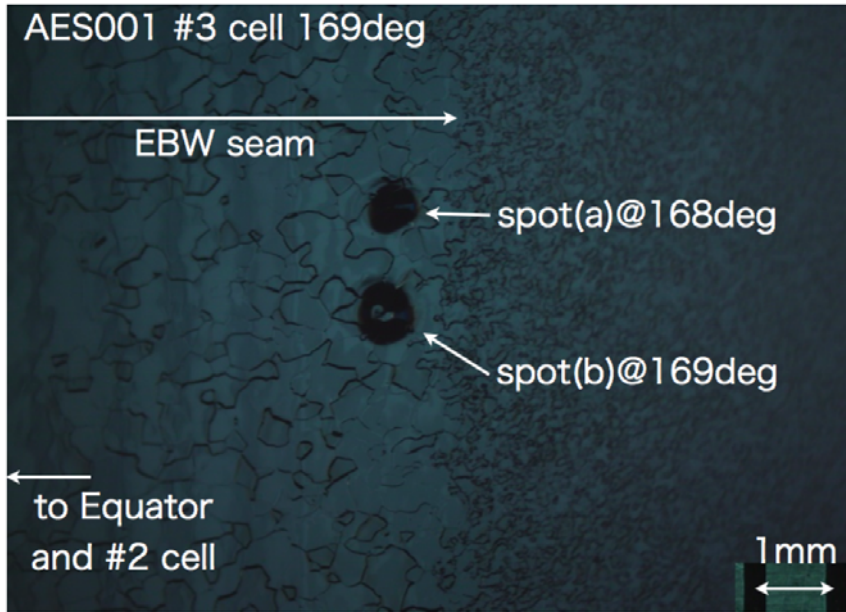
- AES#001 Cavity was sent from **FNAL** for the system check of STF at KEK including new EP facility and new V.T. facility.
- This cavity was totally measured 7 times (4 in J-Lab and 3 in FNAL) in U.S.
- The final achievable field was 15.2MV/m.
- The heating spot was found at **#3 cell**.



History of AES#001 Cavity in Japan

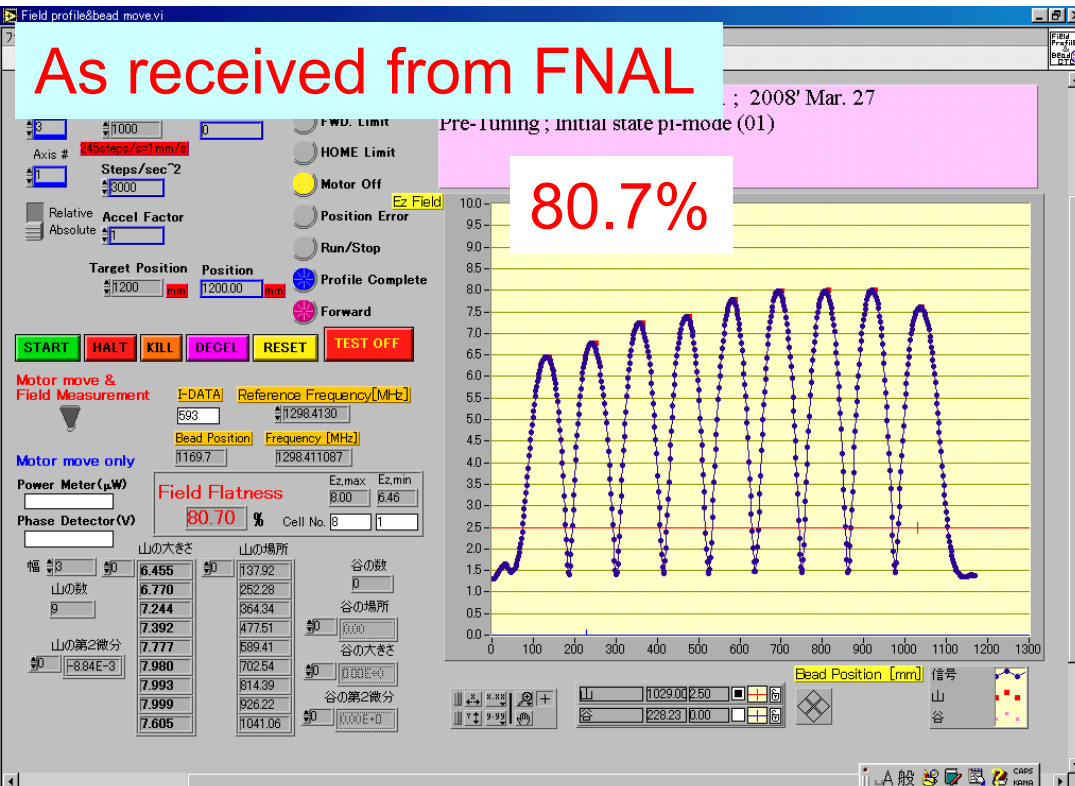
date	contents	measured value	explanation
26/Dec./2007	Cavity inspection		In Kyoto University by Y. Tajima
11/Mar./2008	Fit check for HPR		First HPR in STF
24/Mar./2008	Pre-tuning	96.6%	
27/May/2008	HPR/Assembly/Baking		
3~4/Jul./2008	V.T.	11.2MV/m	System check for the new V.T.S.
20/Aug./2008	Fit check for EP bed		
21/Aug./2008	HPR/Assembly/Baking		
27/Aug./2008	V.T.		Vacuum Leak from top flange @4.2K
2~3/Sep./2008	V.T.	8.5MV/m @4.2K	Super-leak @2K
30/Sep./2008	CP @both end flanges		First CP
	HPR/Assembly/Baking		
7~8/Oct./2008	V.T.	15.9MV/m	The heating was found at #3 cell.
15~16/Oct./2008	Cavity inspection		In STF by K. Watanabe

First Inspection by Kyoto Camera

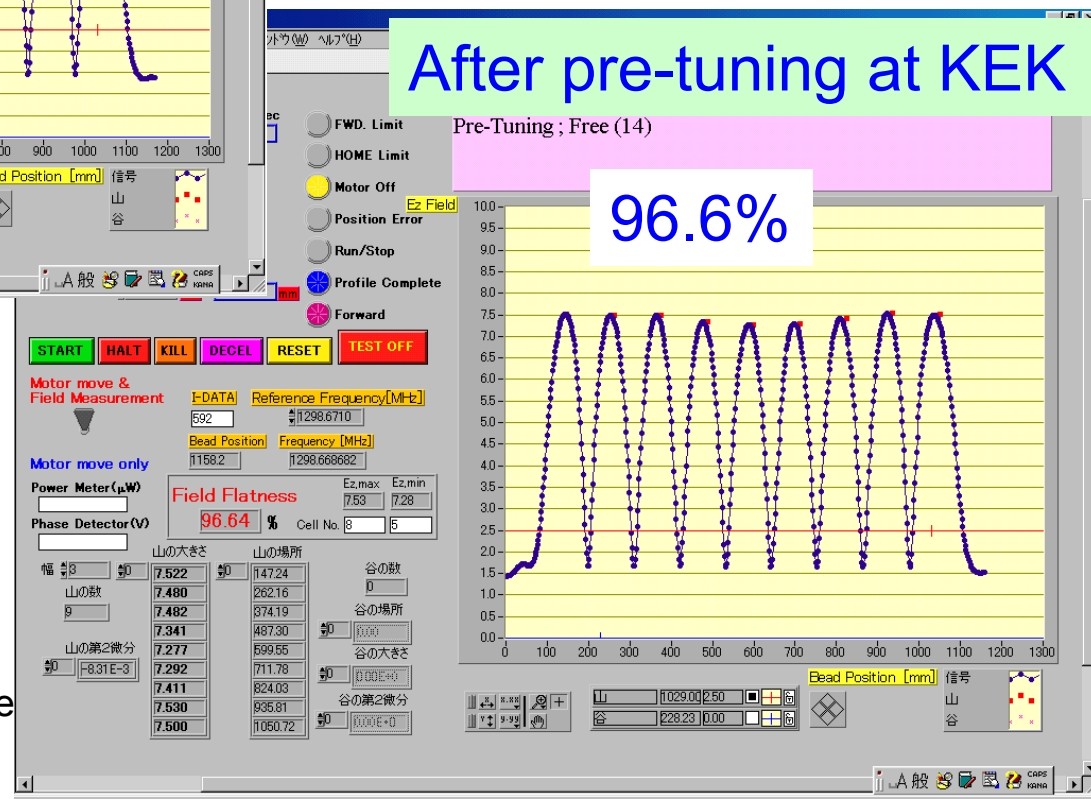


Improvement of the field flatness for AES#001 cavity

As received from FNAL



After pre-tuning at KEK

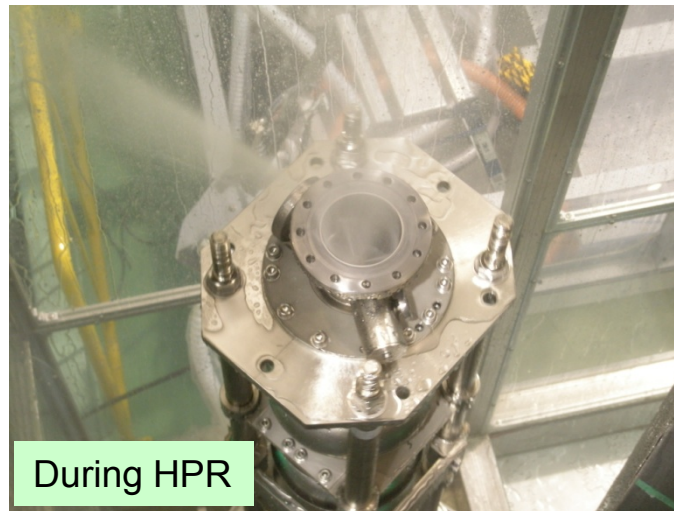
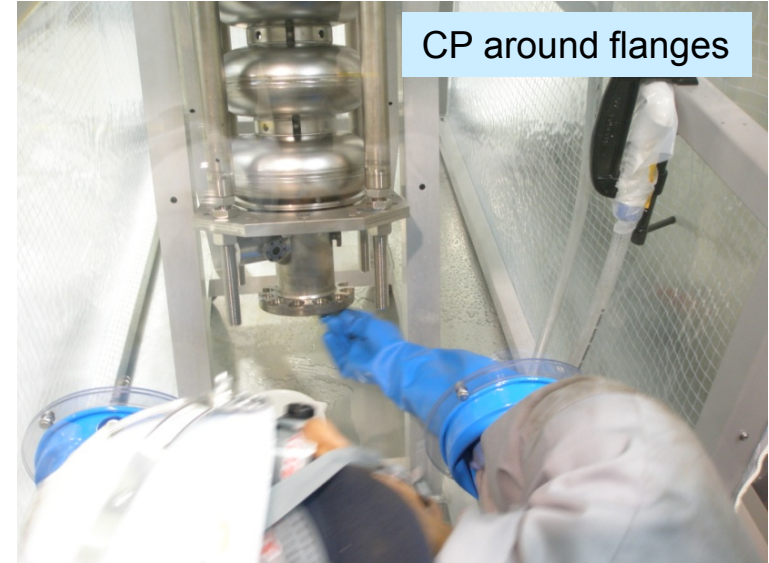
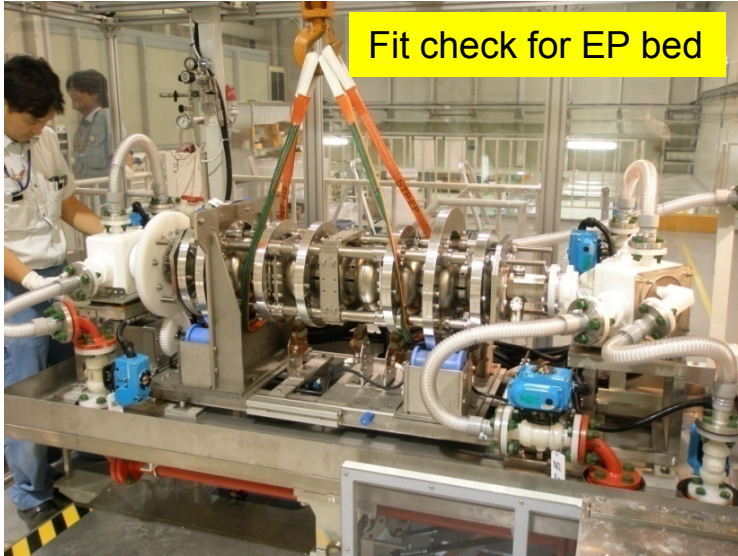


TTC Mee

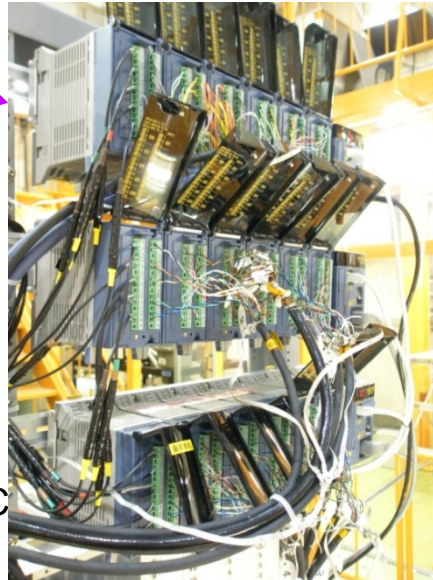
New Vertical Test Facility @STF



System Check in STF using AES#001 cavity

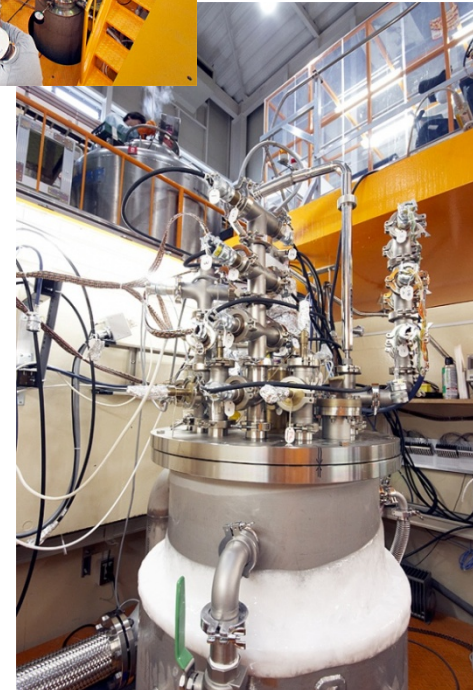


Status of V.T. in STF



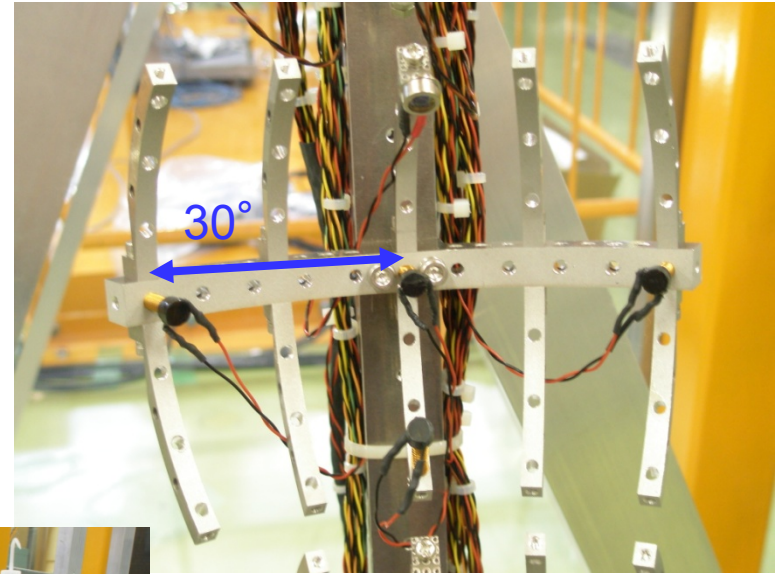
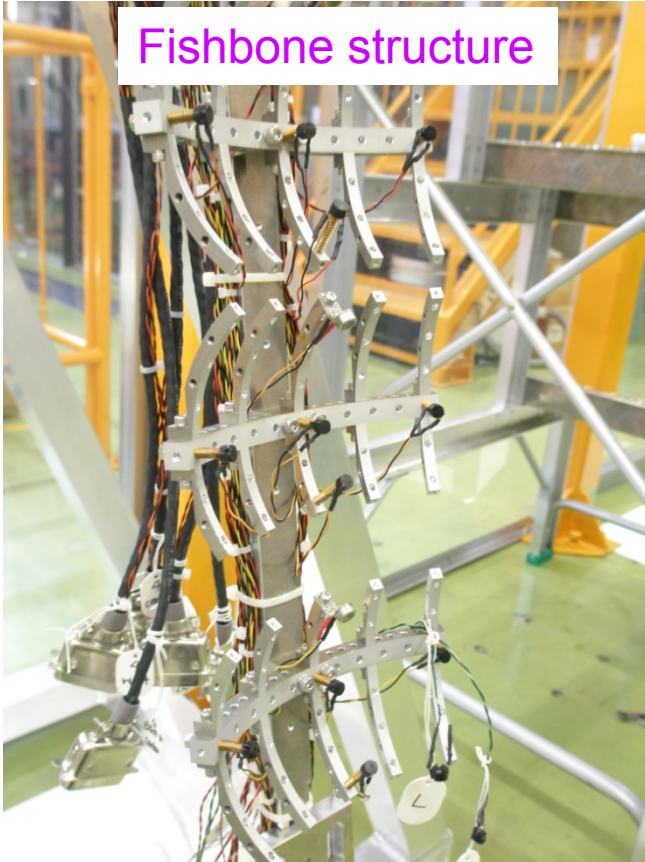
TTC

008



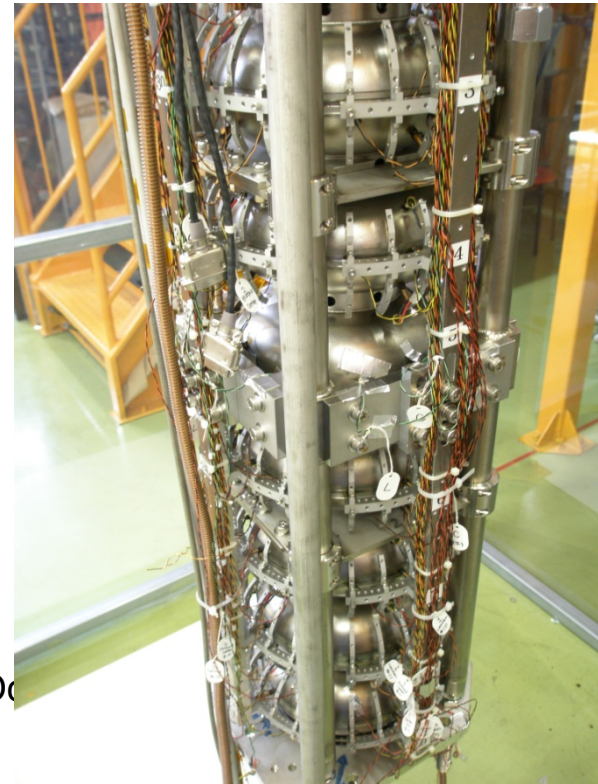
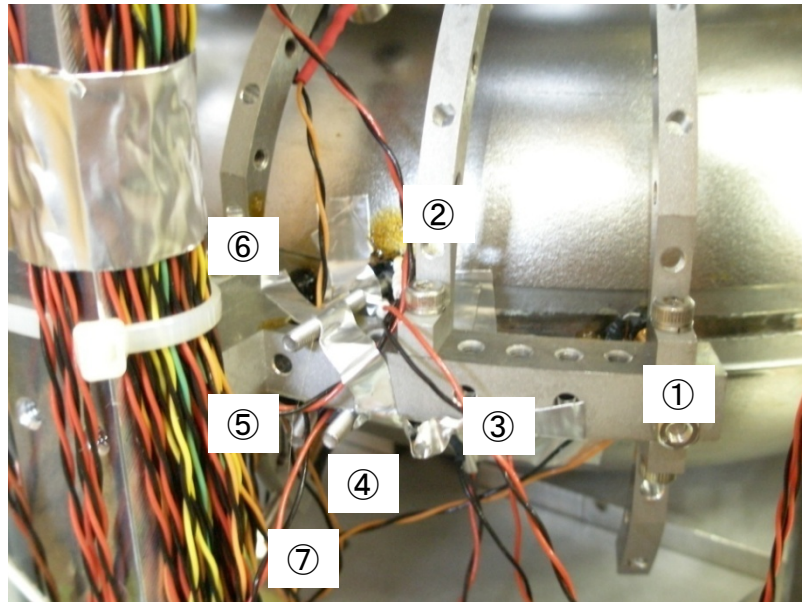
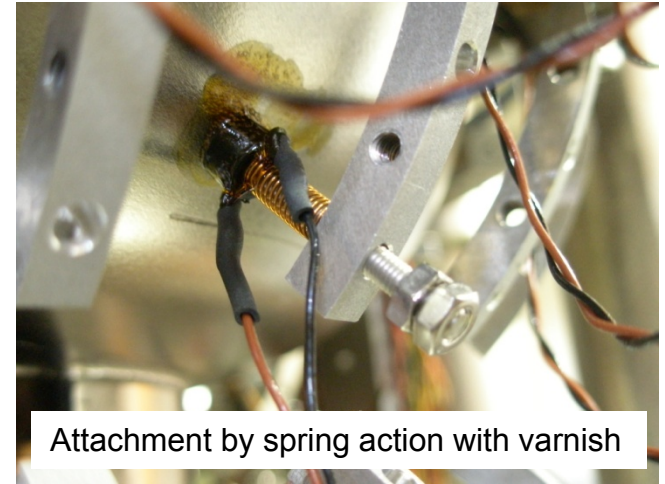
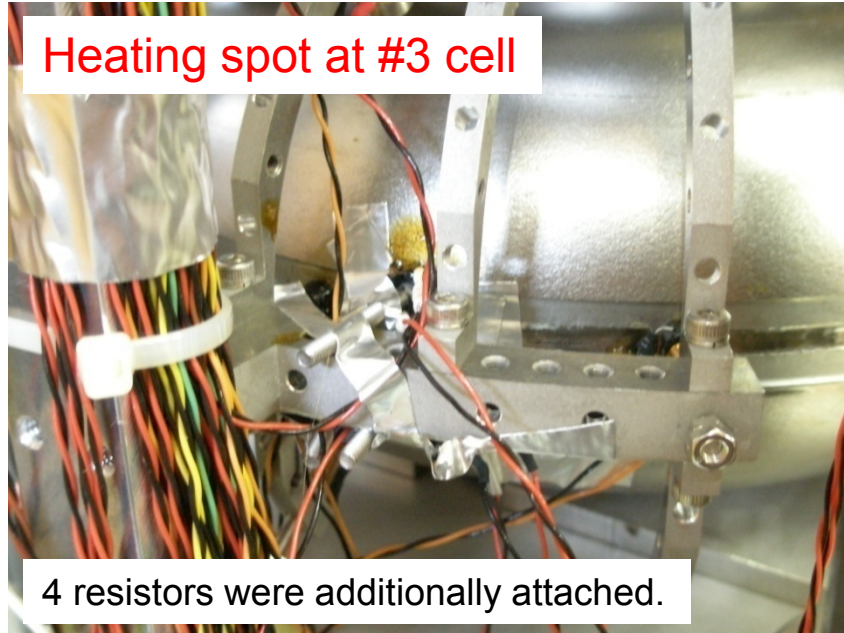
New T-mapping System (Fishbone)

Fishbone structure



The carbon resistors will be added more and more in the future.
The present goal is ~350 by the end of this year.

Attachment position of carbon resistors



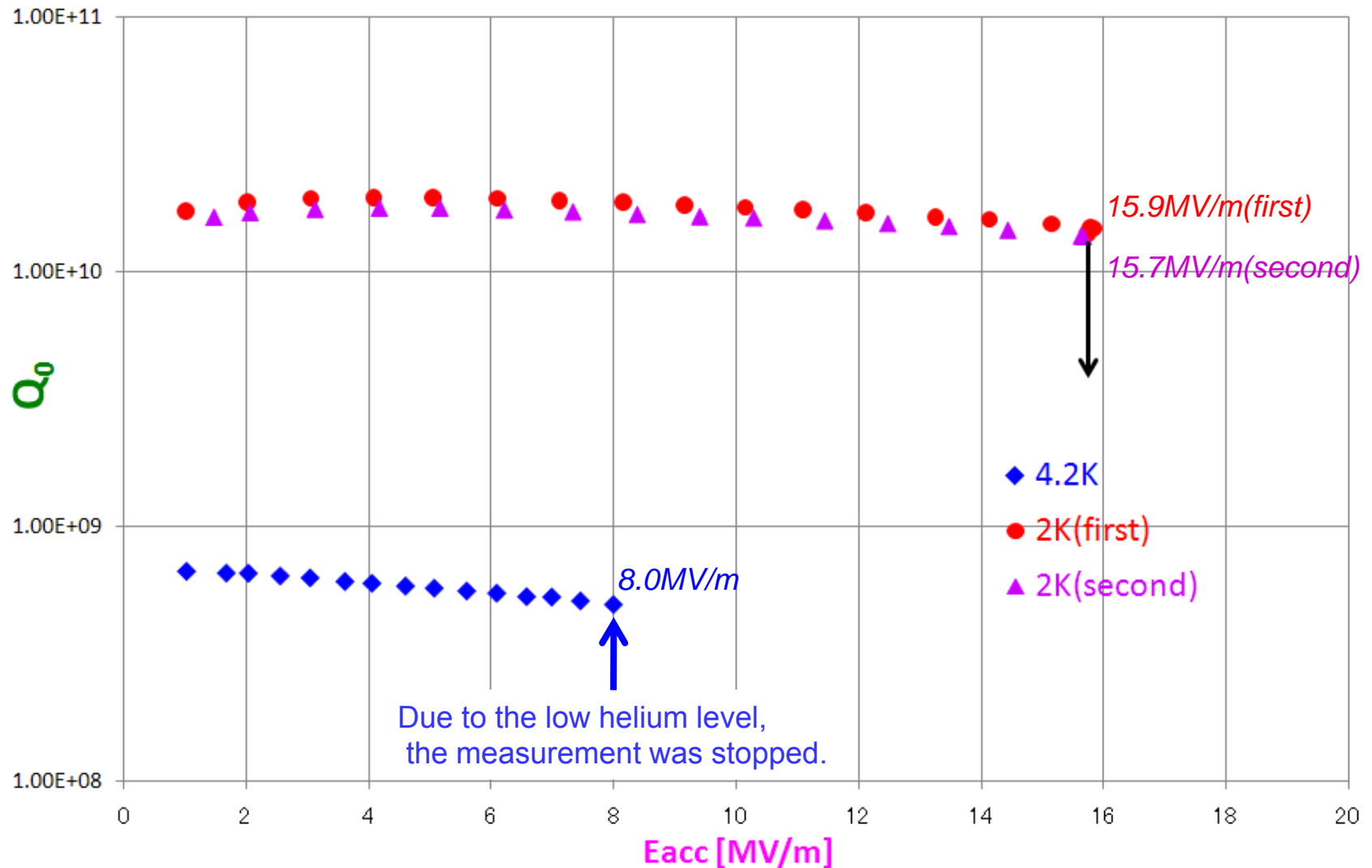
ing at India 21/Oc

Experimental Log for the first V.T.

7/Oct. (Tue)	11:00	Installation AES#001 into the Cryostat
	14:25	Start the helium transfer
	23:30	Stop the transfer
		Measuring the frequency of TM_{010} mode
8/Oct. (Wed)	10:51	Start the measurement @4.2K
	12:15	Stop the measurement @4.2K ($E_{acc, max}=8.0MV/m$)
	12:50	Start the helium transfer @4.2K
	15:22	Start the vacuum evacuation (4.2K \rightarrow 2K)
	16:40	Start the helium transfer @2.36K
	18:45	Re-start the vacuum evacuation
	21:13	π mode measurement ($E_{acc, max}=15.9MV/m$)
	22:45	$8\pi/9$ mode measurement ($E_{acc, max}=26.0MV/m$)
	23:37	$7\pi/9$ mode measurement ($E_{acc, max}=28.5MV/m$)
9/Oct. (Thu)	1:25	$6\pi/9$ mode measurement ($E_{acc, max}=16.1MV/m$)
	2:00	$5\pi/9$ mode measurement ($E_{acc, max}=13.4MV/m$)
	2:27	$4\pi/9$ mode measurement ($E_{acc, max}=17.3MV/m$)
	3:45	$3\pi/9$ mode measurement ($E_{acc, max}=14.5MV/m$)
	4:24	π mode measurement ($E_{acc, max}=15.7MV/m$)
	5:00	End...

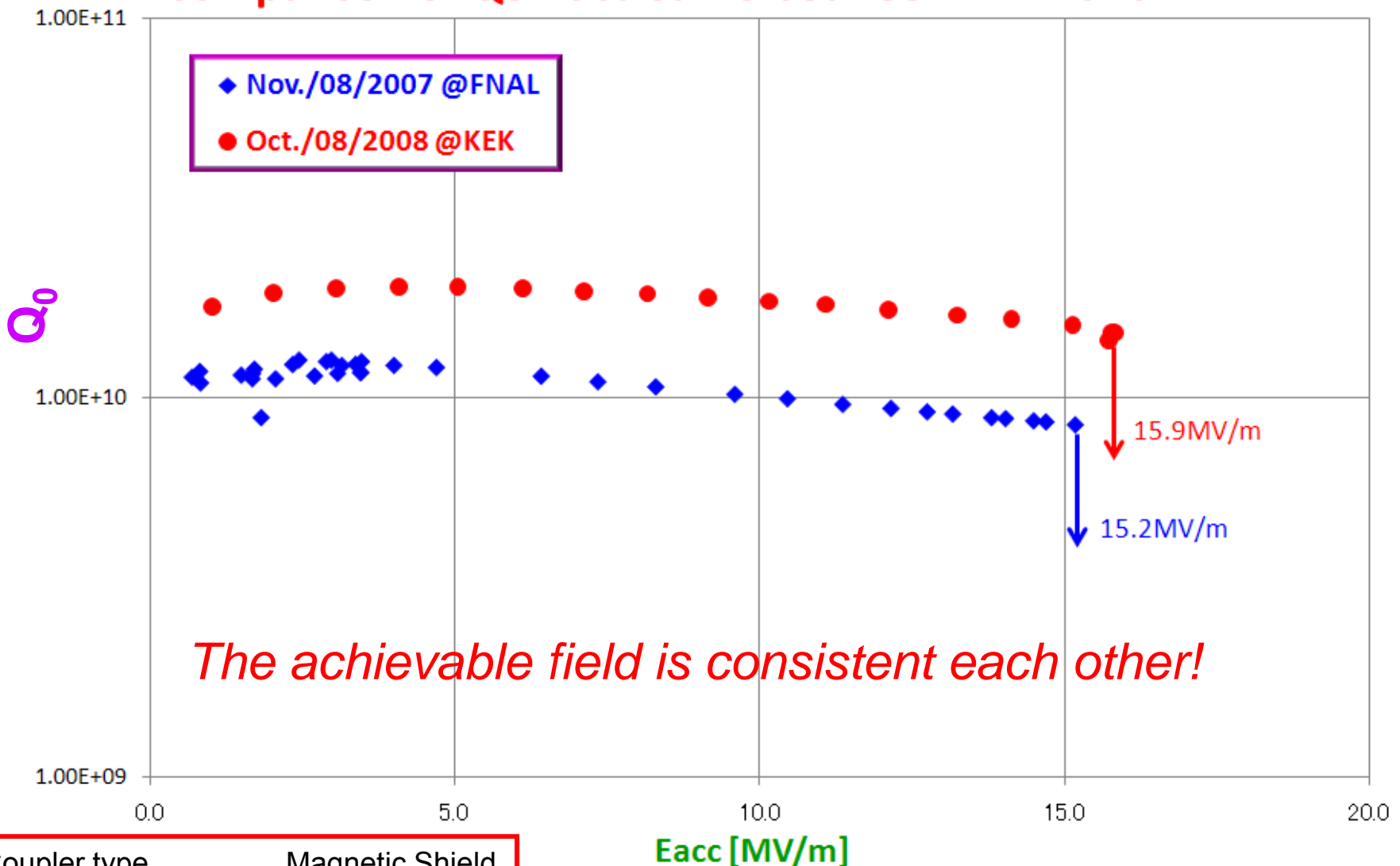
Q_0 - E_{acc} Curve for AES#001 @2K & 4.2K

Q0 vs. Eacc Curve for AES#001 @2K & 4.2K



Comparison of Q_0-E_{acc} curve between FNAL and KEK

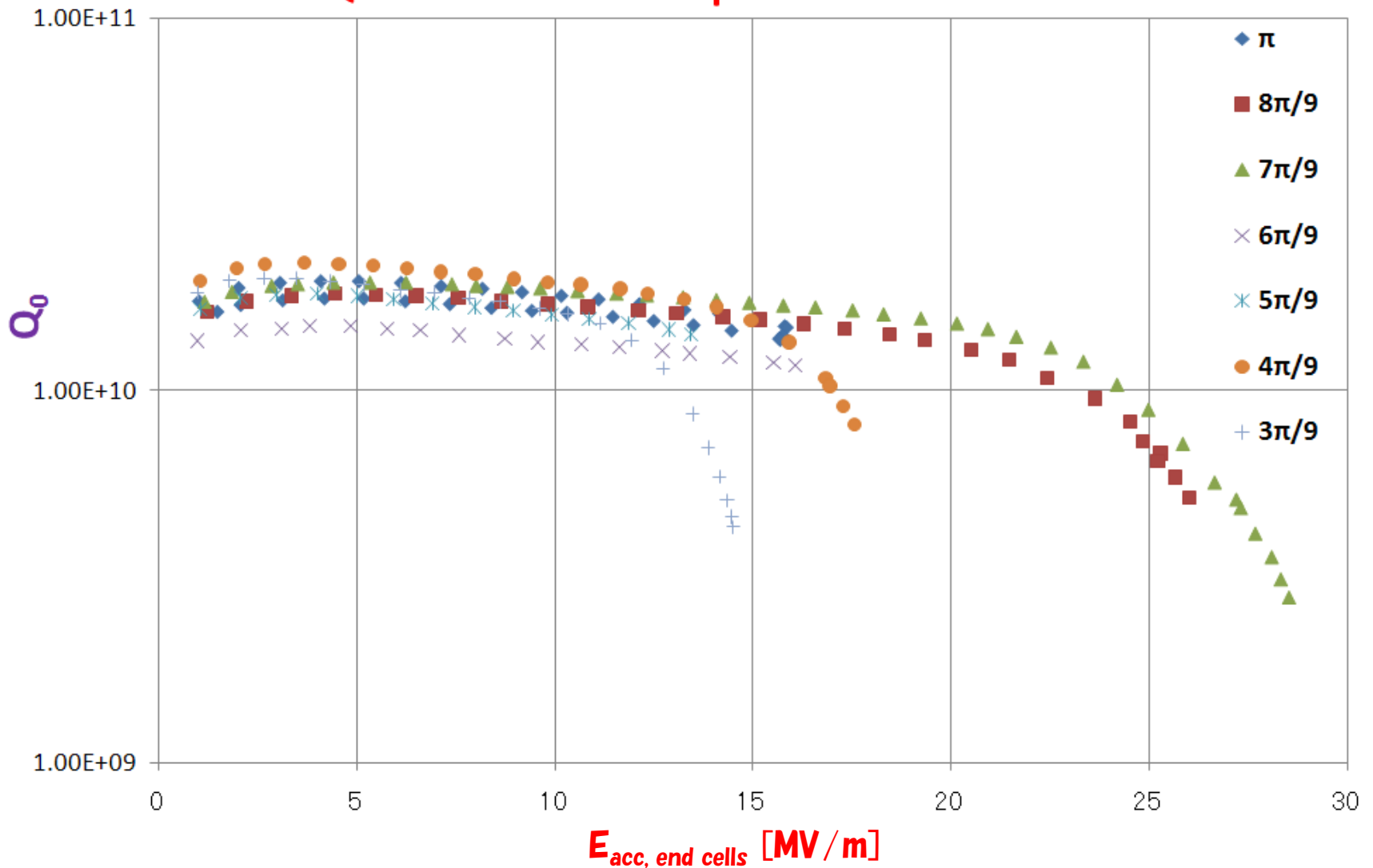
Comparison of Q0-Eacc Curve between FNAL and KEK



Coupler type	Magnetic Shield
KEK : variable	KEK : w/
FNAL : fixed	FNAL : w/o

7 Q_0 - $E_{acc, end cells}$ Curves for AES#001 @2K

Q0 vs. E Curves for 7 passband modes



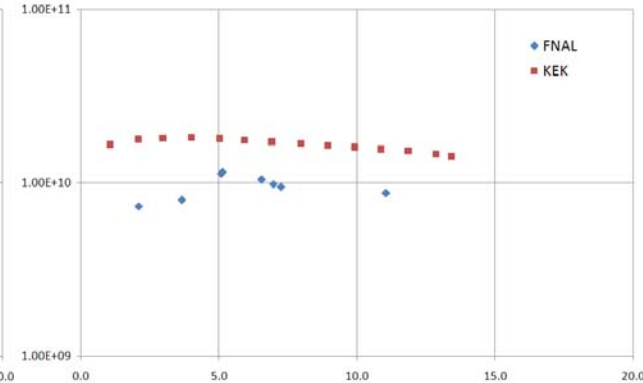
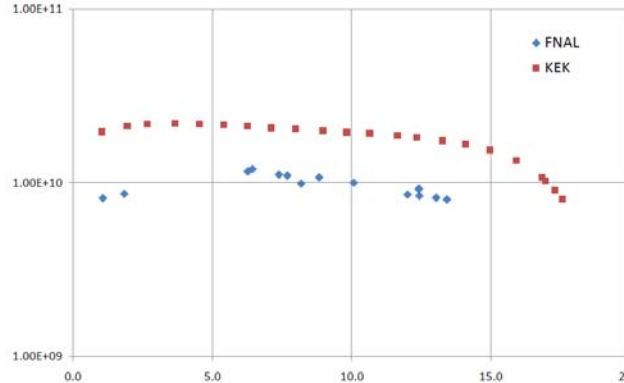
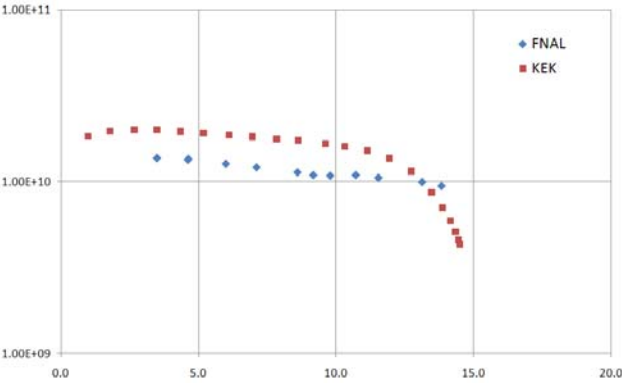
Comparison of $Q_0 - E_{\text{acc, end cells}}$ curves between FNAL and KEK

Q_0

$3\pi/9$

$4\pi/9$

$5\pi/9$

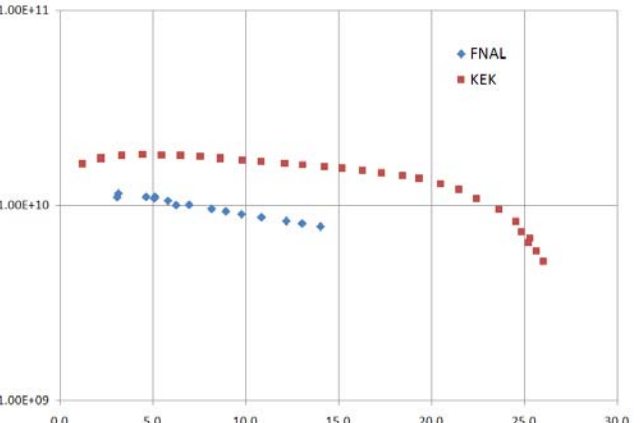
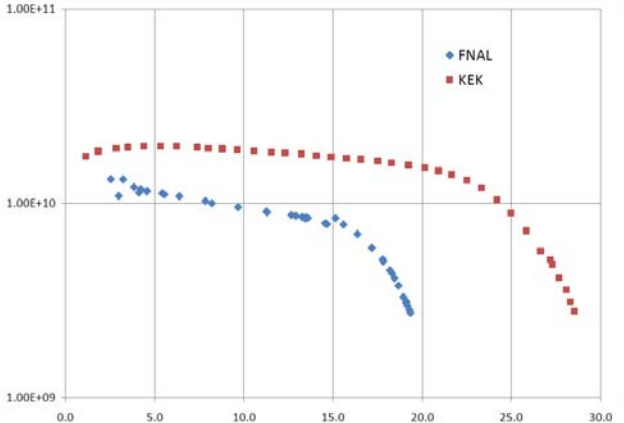
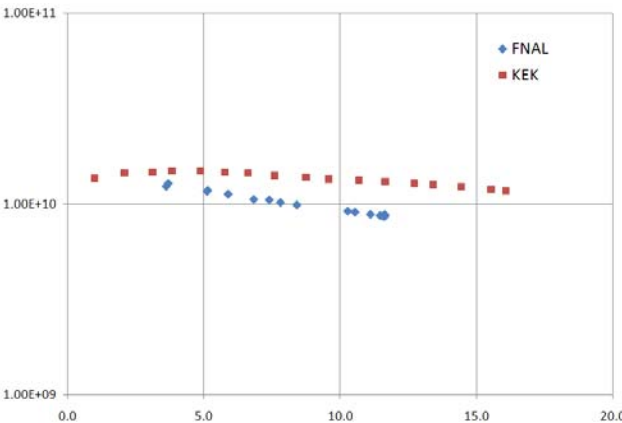


$E_{\text{acc, end cells}}$ [MV/m]

$6\pi/9$

$7\pi/9$

$8\pi/9$



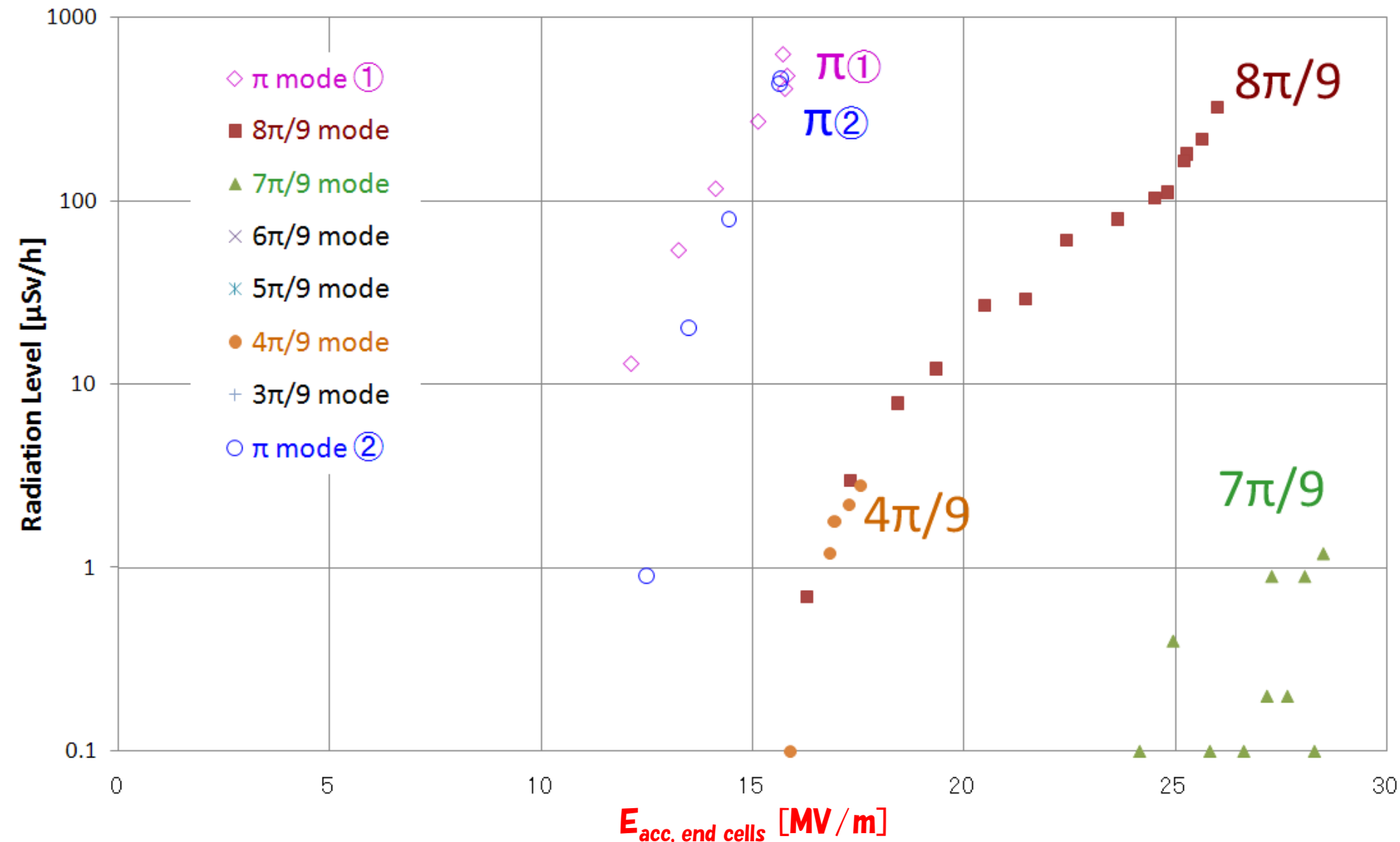
Coupler type
KEK : variable
FNAL : fixed

Magnetic Shield
KEK : w/
FNAL : w/o

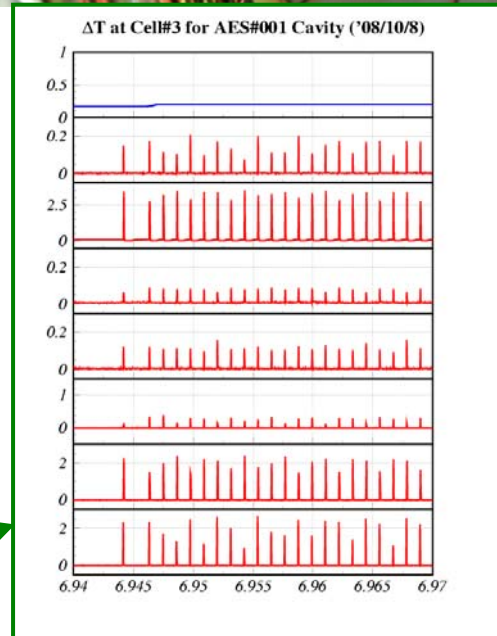
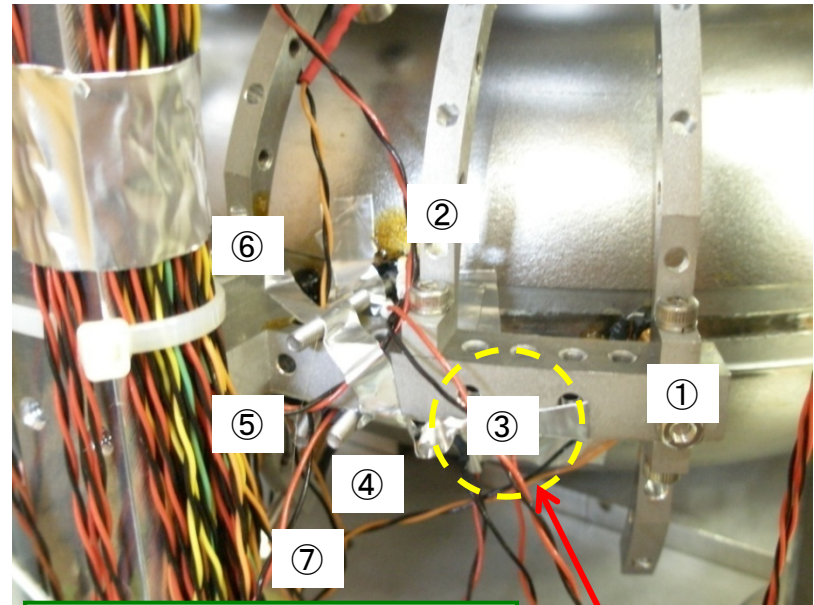
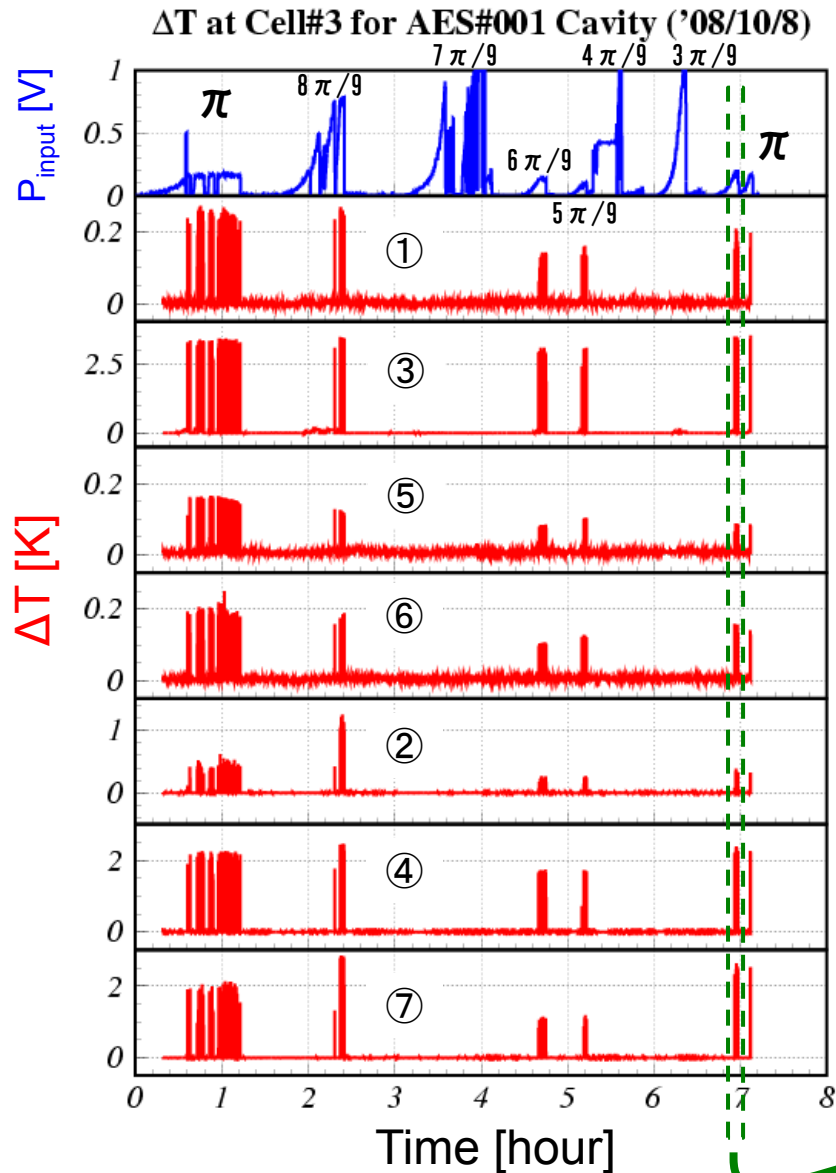
FNAL data was taken from the second V.T.

Meeting at India 21/Oct/2008

$E_{acc, end cells}$ vs. Radiation Level



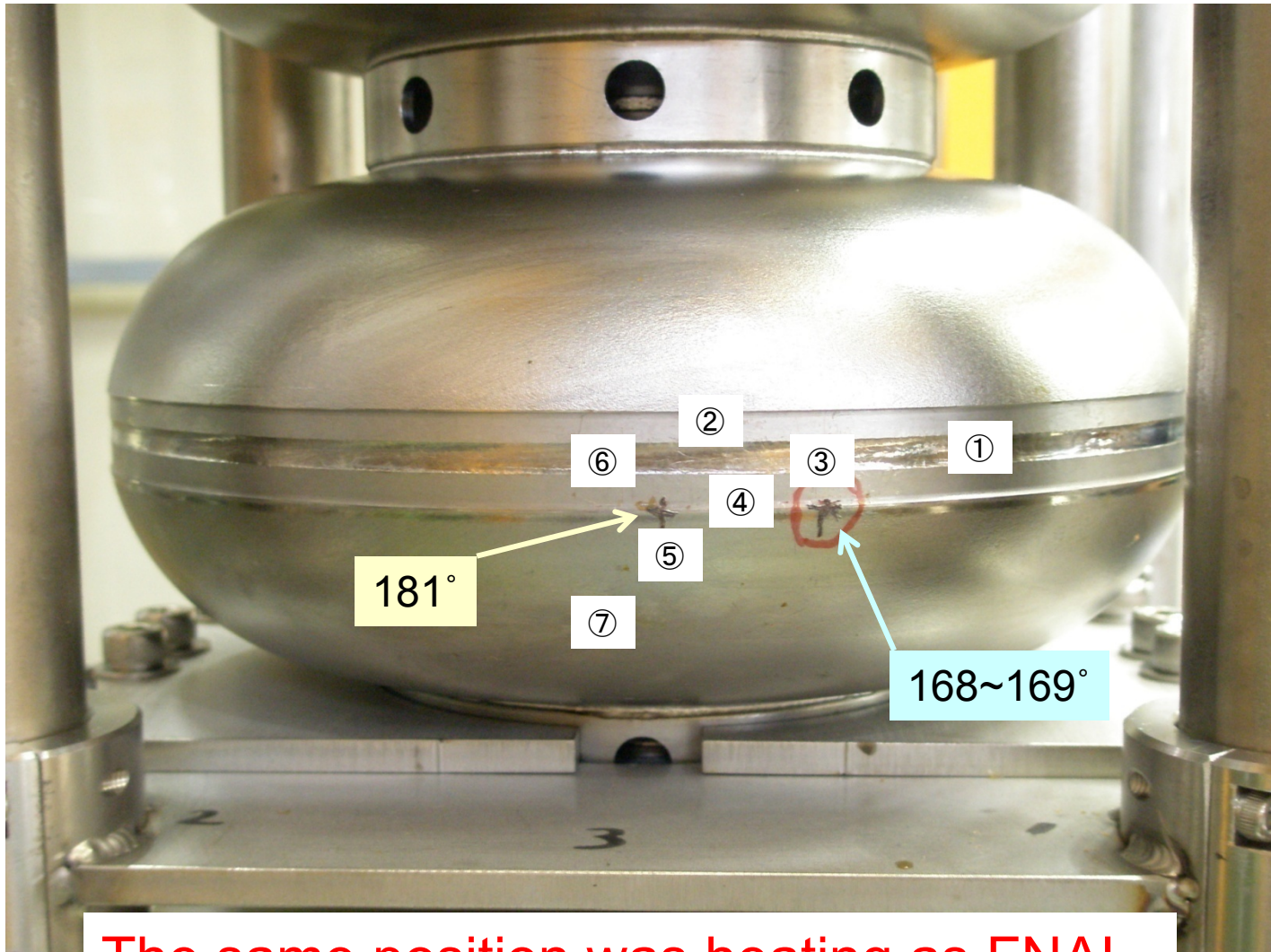
Heating at #3 cell



Max. heating!

During the self-pulsing

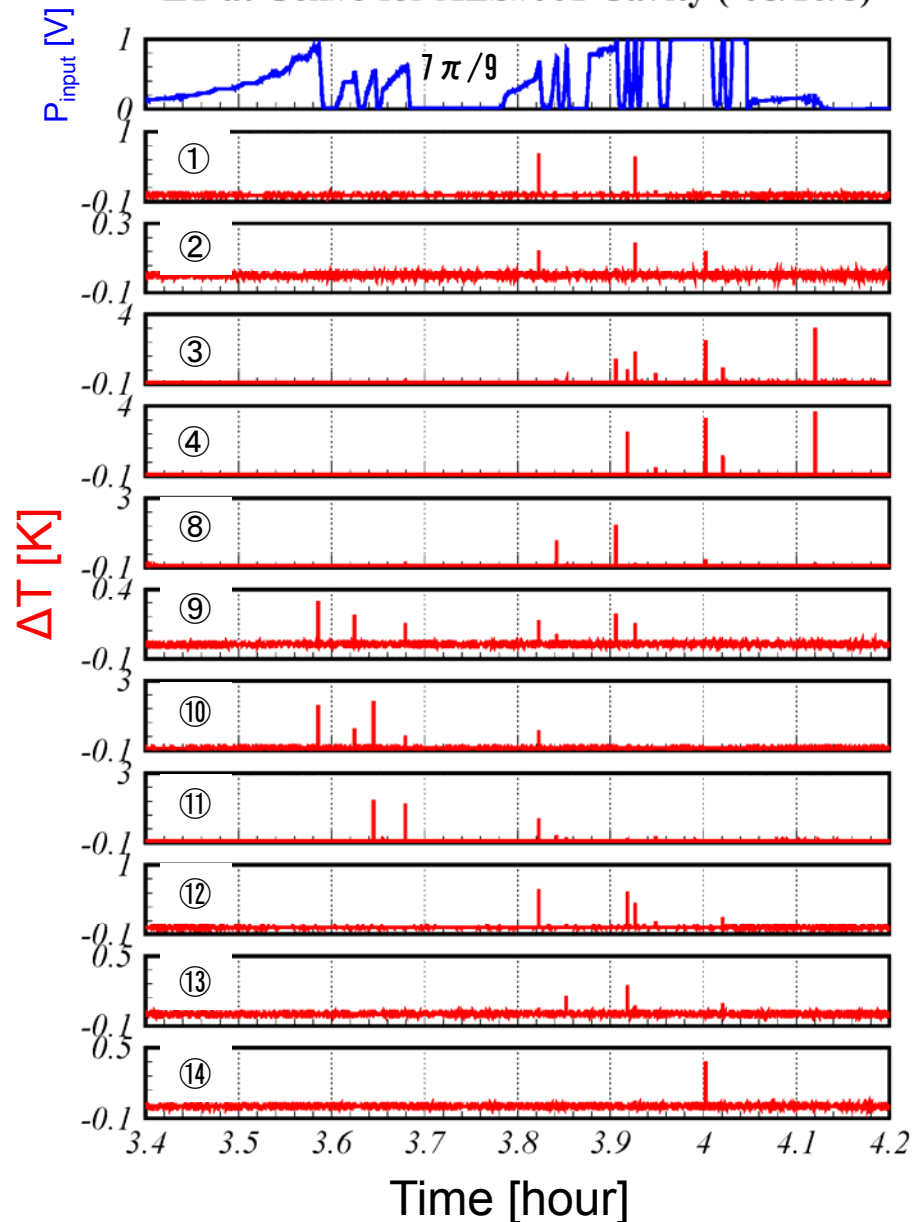
Identification of heating spot at #3 cell



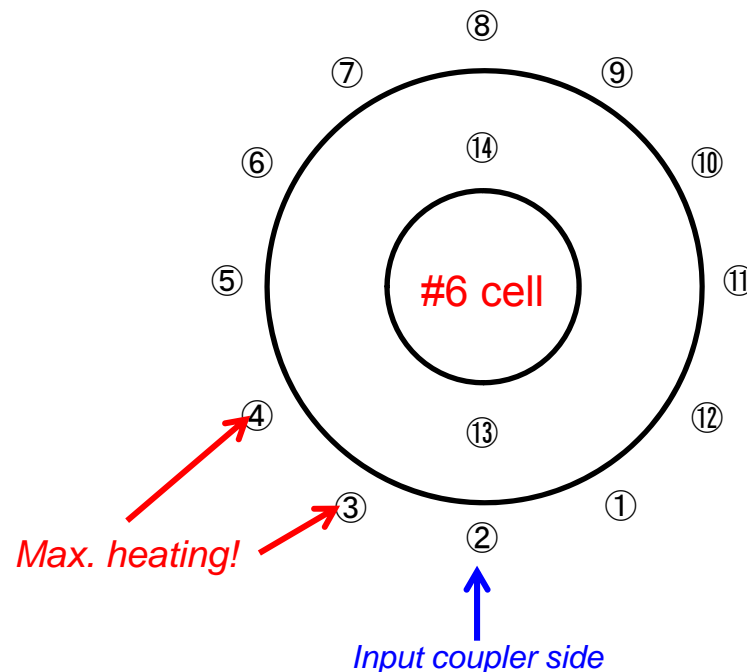
The same position was heating as FNAL.

Heating at #6 cell in $7\pi/9$ mode

ΔT at Cell#6 for AES#001 Cavity ('08/10/8)



During increasing the field, some heating occurred successively everywhere on the equator in $7\pi/9$ mode, which is likely to be triggered by multipacting. There is the trend that the heating spot is gradually transferred as the field is increased by the RF processing. This heating is not due to the defect or the contamination. They eventually disappeared around the max. achievable field.

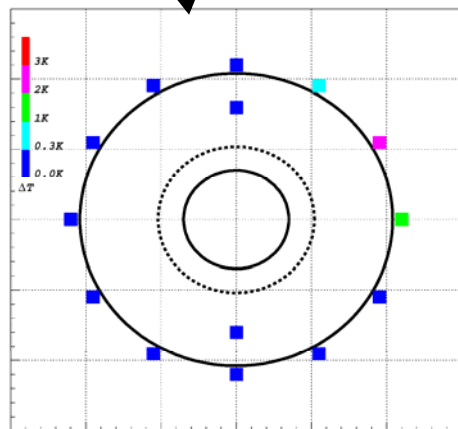
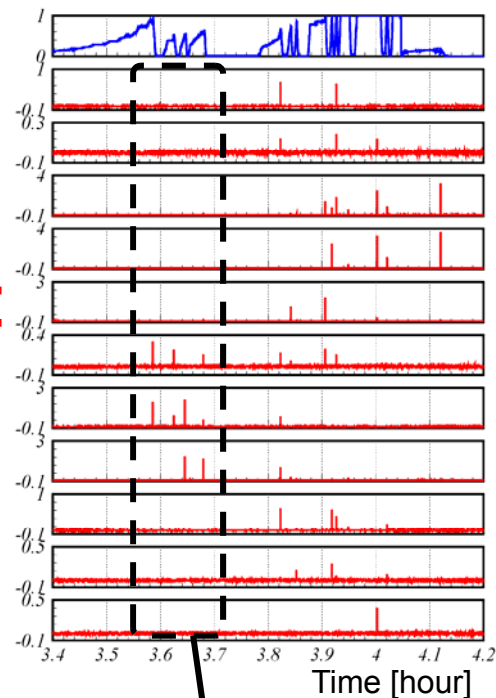


1/Oct/2008

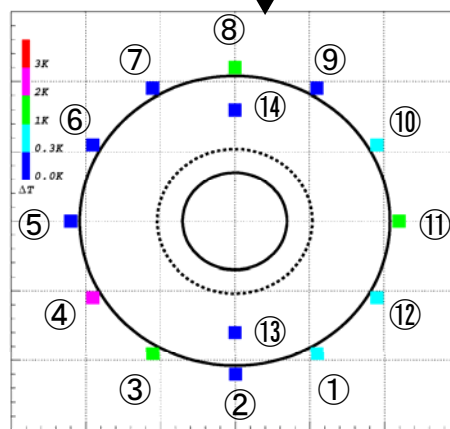
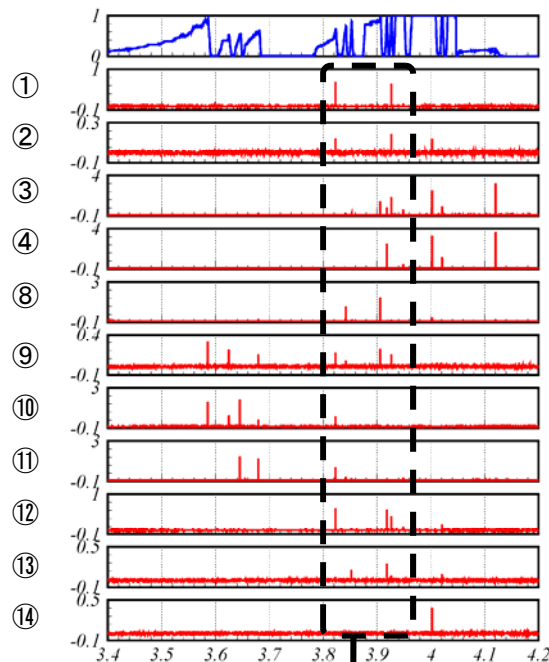
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Transferring heating spot at Cell#6

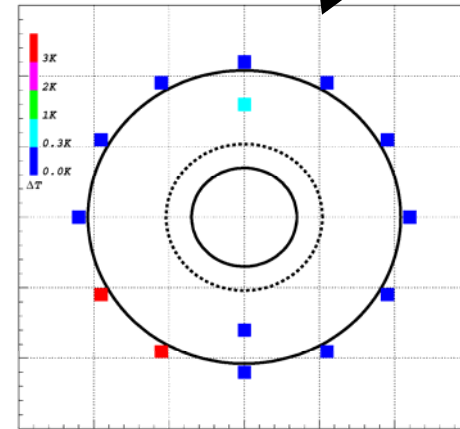
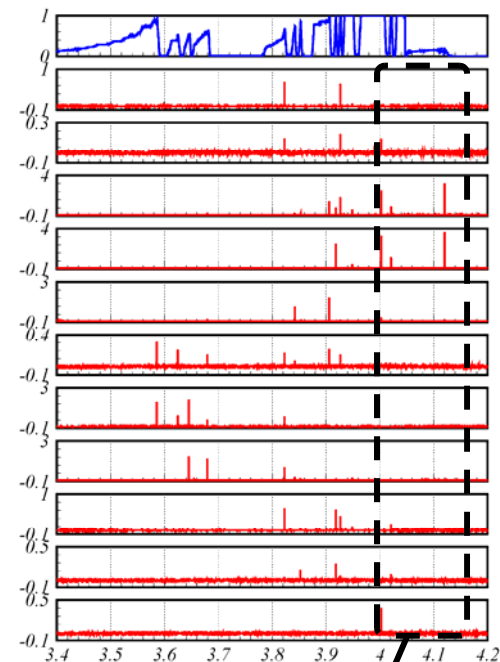
ΔT at Cell#6 for AES#001 Cavity ('08/10/8)



ΔT at Cell#6 for AES#001 Cavity ('08/10/8)



ΔT at Cell#6 for AES#001 Cavity ('08/10/8)



Summary of T-mapping result

- π
 - 7 resistors responded at the suspicious position at #3 cell.
 - **Max. heating occurred at 168~169° from the input coupler port.**
- $8\pi/9$
 - 7 resistors responded at the suspicious position at #3 cell.
 - Some heating occurred at #1 (multipacting?).
- $7\pi/9$
 - No Quench/RF Power Limit
 - Some heating occurred at #1 (multipacting?).
 - Some heating occurred everywhere on the equator at #6 (multipacting?).
- $6\pi/9$
 - 7 resistors responded at the suspicious position at #3 cell.
- $5\pi/9$
 - 7 resistors responded at the suspicious position at #3 cell.
- $4\pi/9$
 - Some heating occurred at #8 (multipacting?).
 - $\pi/9$ was excited (Another Excitation)/RF Power Limit
- $3\pi/9$
 - slightly heating (only one resistor) at the suspicious position at #3 cell
 - No Quench/RF Power Limit

E_{acc} (on axis) per Cell

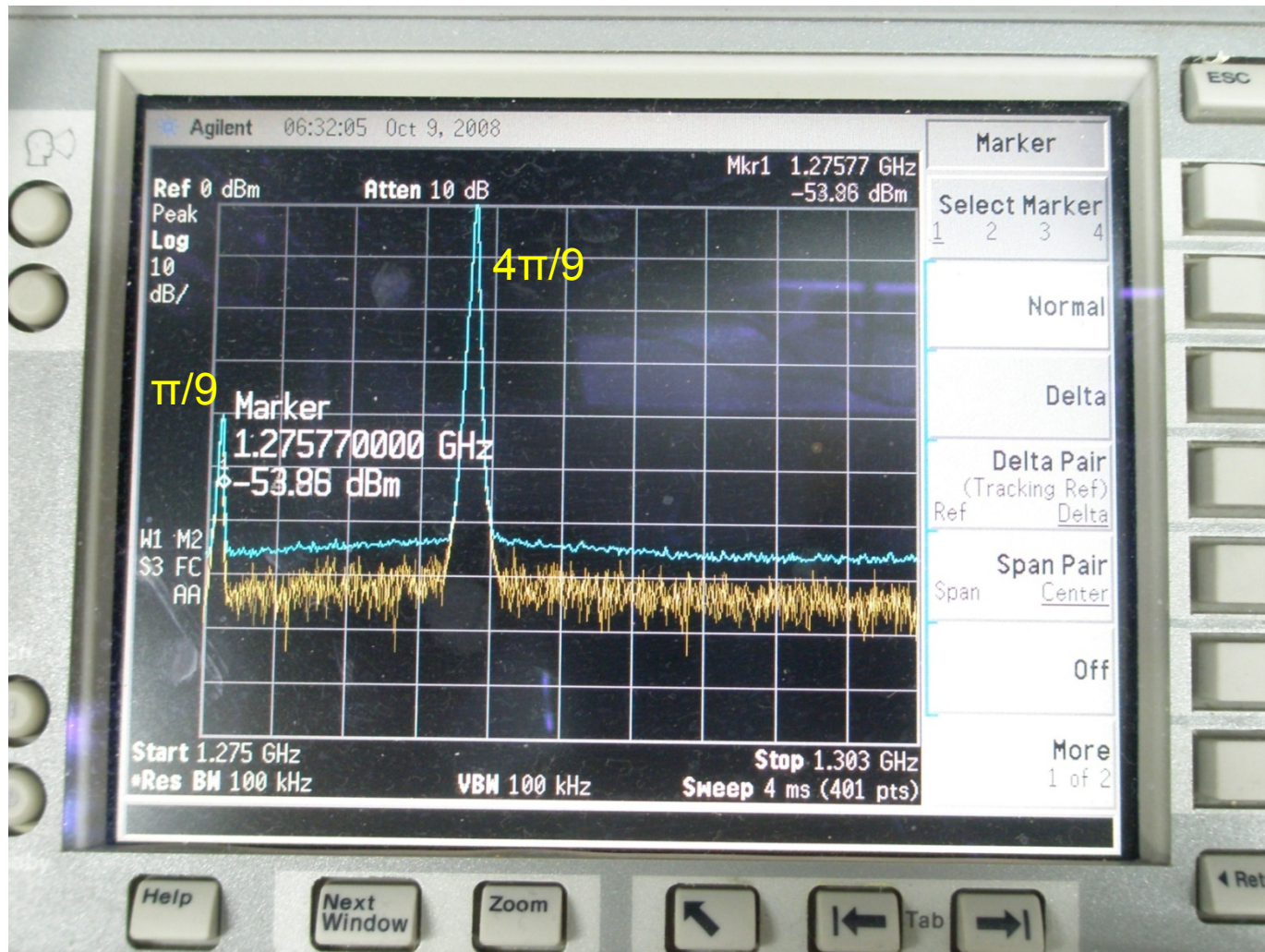
cell	π	$8\pi/9$	$7\pi/9$	$6\pi/9$	$5\pi/9$	$4\pi/9$	$3\pi/9$
1 & 9	15.9	26.0	>28.5	16.0	13.4	17.3	14.5
2 & 8	15.9	23.1	15.1	0.0	9.1	22.7	>29.0
3 & 7	15.9	17.1	5.7	16.0	15.8	9.9	14.5
4 & 6	15.9	9.6	21.9	0.0	2.7	25.1	>29.0
5	15.9	0.0	>30.5	16.0	17.0	0.0	14.5

$3\pi/9$ & $7\pi/9$ modes were limited by the RF power limit.

unit : [MV/m]

The limiting cell was #3 in π mode!

Observation of another excitation ($\pi/9$)



In our experience, this phenomenon normally appears in π mode measurement. The excited mode is $8\pi/9$ mode, although $7\pi/9$ mode in DESY.

Next plan

- **AES#001** cavity will be experienced first EP in STF at the end of this month.
- Second V.T. using **AES#001** cavity will be done in 5-6/Nov.
- **AES#001** cavity will be mechanically grinded at #3 cell? (we expect it.) Next year?
- From December, STF **Baseline #5/#6** cavities will be measured in STF.

Summary

- **AES#001 cavity was very useful for the various system checks in KEK-STF.**
- **The first vertical test using AES#001 cavity was succeeded in KEK-STF.**
- **The achievable field was 15.9MV/m in π mode, which was consistent with the result at FNAL.**
- **The new T-mapping system (Fishbone) was very effective.**
- **The heating cell was #3, which was consistent with the observation at FNAL.**
- **Some heating was observed due to multipacting likely in $4\pi/9$, $7\pi/9$ and $8\pi/9$.**
- **$\pi/9$ mode was excited in $4\pi/9$ measurement.**

Acknowledgement

- For rental of AES#001 Cavity
 - Dr. S. Mishra, Dr. B. Kephart, Dr. M. Champion and Dr. C. Ginsburg
- For Carbon Resistors
 - Dr. H. Padamsee
 - Dr. W. Moeller
 - Dr. Y. Morita
- For the assembly working of T-mapping
 - Mr. T. Okada and Mr. M. Iitake