

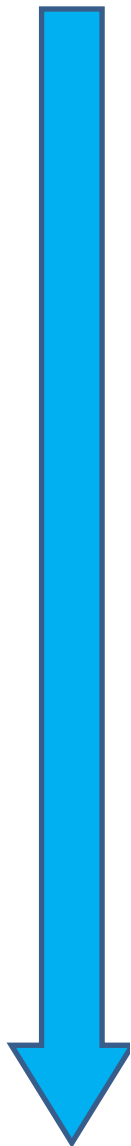
ICHIRO cavity progress at Jlab

Fumio Furuta, Kenji Saito, Taro Konomi
KEK

14Dec2010 Jlab

Introduction

Brief history of LL/ICHIRO group at KEK



2005 WG5 (ICHIRO cavity, CC coupler, ball screw tuner)
50MV/m w/ single cell cavities, (LL, ICHIRO, RE)

2006 29.3MV/m w/ first ICHIRO 9-cell (bare cavity)

2007 Jlab/KEK S0-study on ICHIRO#5 (bare cavity)

2008 36.5MV/m @ JLAB, 33.4MV/m @KEK

STF 0.5: High power test for one cavity package,
BL, ICHIRO both succeeded operate at ~20MV/m.
STF 1 started w/ BL cavity shape.

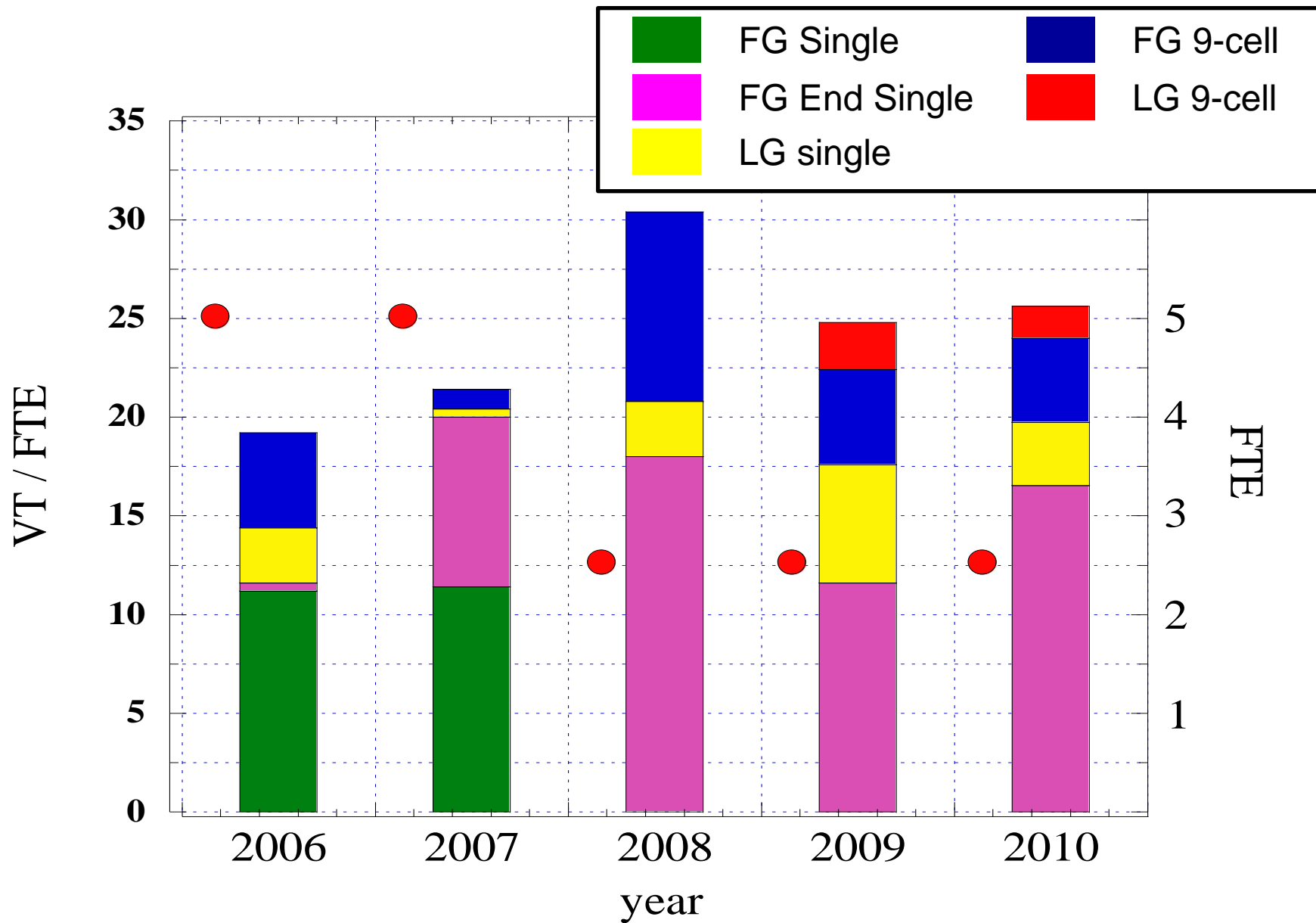
Reorganized WG5, FTE was reduced (Saito and Furuta)
Concentrate on Ichiro HG cavity.
Reduced R&D budget ~2% (0.2M\$) of KEK ILC budget.

2009 KEK EP facility ready.
Nomura EP facility shut down in summer.

Re-start Nomura EP/BCP facility in winter

2010 Jlab/KEK S0-study on ICHIRO#7 (full cavity)

ICHIRO VT activities, 2006~2010



ICHIRO cavities at KEK

		Fine Grain		Large Grain		Total
Center Single		IS#1~#8 tested IS#9~#16 no test	16	USLG, CHLG#1~#3	4	20
End single	w/o HOM	ISE#1~#3	5	ISE#6	1	10
	w/ HOM	ISE#4,#5,#7,#8	2	ISE#9, #10	2	
Single total		FG	23	LG	7	30
Bare 9-cell		I9#0 (Old) I9#5, #6 (New)	6	I9#9, #10	2	8
Full 9-cell		I9#1~#3(Old) I9#7, #8 (New)	2	I9#11	1	3
9-cell total		FG	8	LG	3	11



Center
Single



End
Single



Full-end
Single



Bare 9-cell



Full 9-cell

KEK LL/ICHIRO cavity strategies

1) Principle proof of High gradient

Fine Grain + ICHIRO + EP, based on CBP

S0-study at Jlab on ICHIRO#7.

End group singles R&D.

2) Cost reduction + best performance

Large Grain + ICHIRO + BCP, based on CBP

Multi-wire slicing techniques is in hand.

Single cell, 9-cell R&D are on going.

3) Further R&D: High gradient, High yield, Low cost

Large Grain + ICHIRO + BCP, inner EBW, w/ or w/o CBP

Post EP cleaning R&D on going.

Single crystal ingot R&D is started.

ICHIRO progress at Jlab

KEK/Jlab S0-study on ICHIRO#5 in 2008

9-cell Step-1 : bare cavity

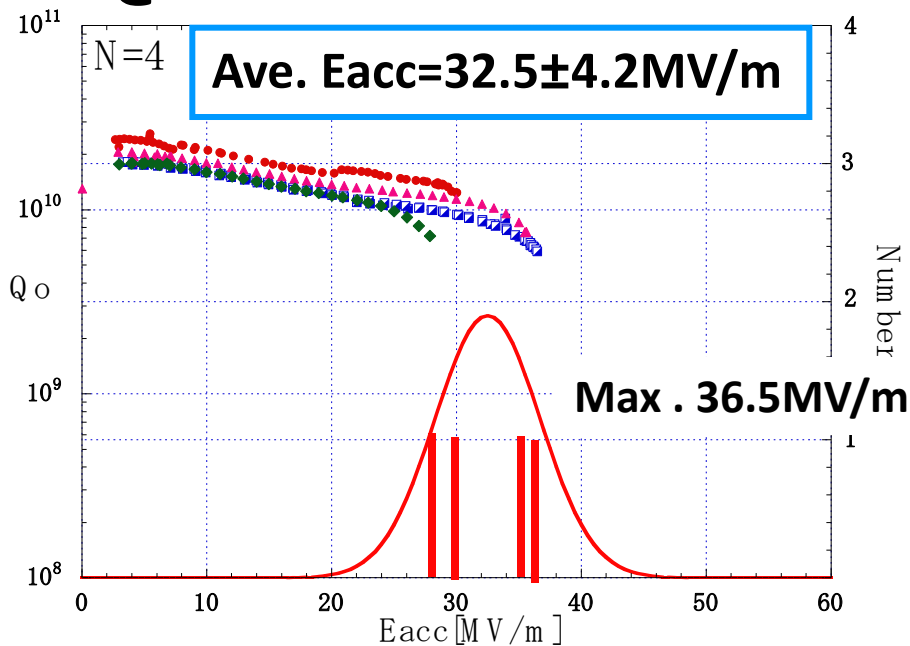
Ichiro#5



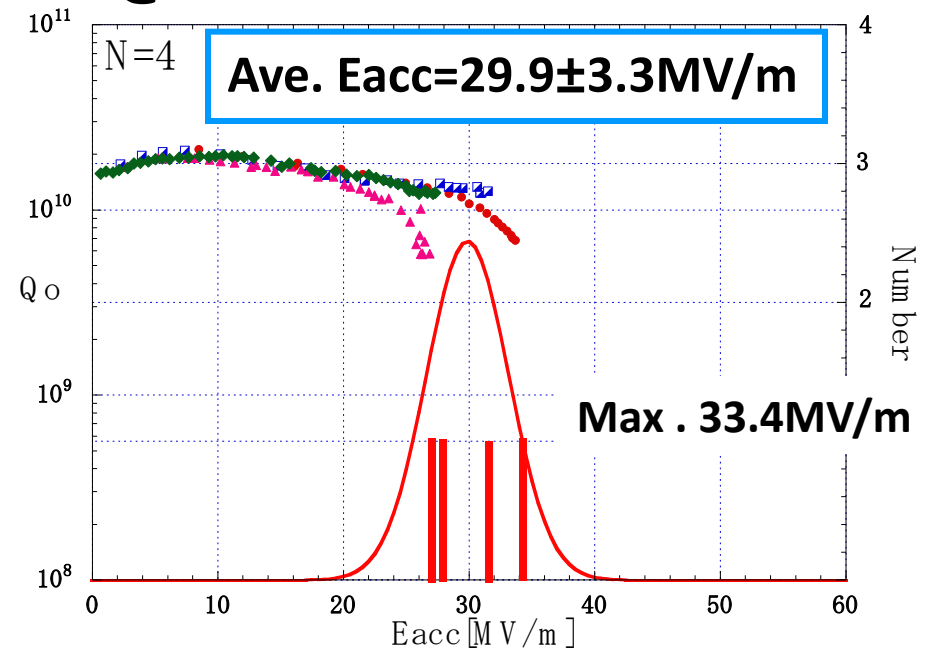
no end groups

Repeat (EP + Rinsing + HPR + Bake + VT)

@JLAB



@KEK



Tight loop test results on ICHIRO #5 (bare cavity)

KEK/Jlab S0-study on ICHIRO#7 in 2010

Step-II : full cavity

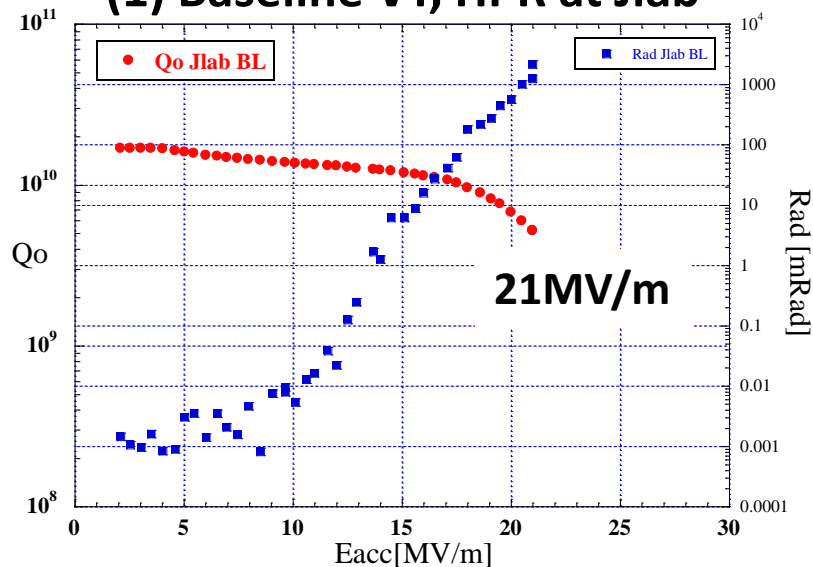
Ichiro#7



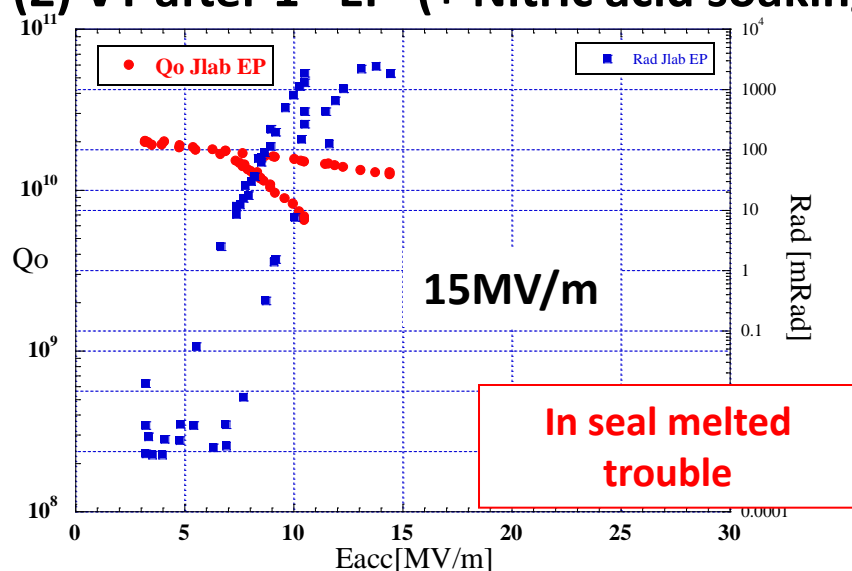
Jan.	Feb.	March	April	May	June
	<div>↔</div> <p>2weeks, Fumio, Kenji</p> <p>1 RF test (baseline)</p>			<div>←</div> <p>10weeks, Fumio w/ family</p> <p>3 RF test (2 EP, 1 re-HPR)</p>	
July	Aug.	Sep.	Oct.	Nov.	Dec.
<div>→</div> <p>All commissioning were done for ICHIRO</p>		<div>↔</div> <p>SSTIN @Jlab Fumio, Kenji</p>		<div>↔</div> <p>9weeks, Fumio w/ family</p> <p>2 RF test (1 EP, 1 re-HPR)</p>	

ICHIRO#7 VT results at Jlab, June ~ Aug.

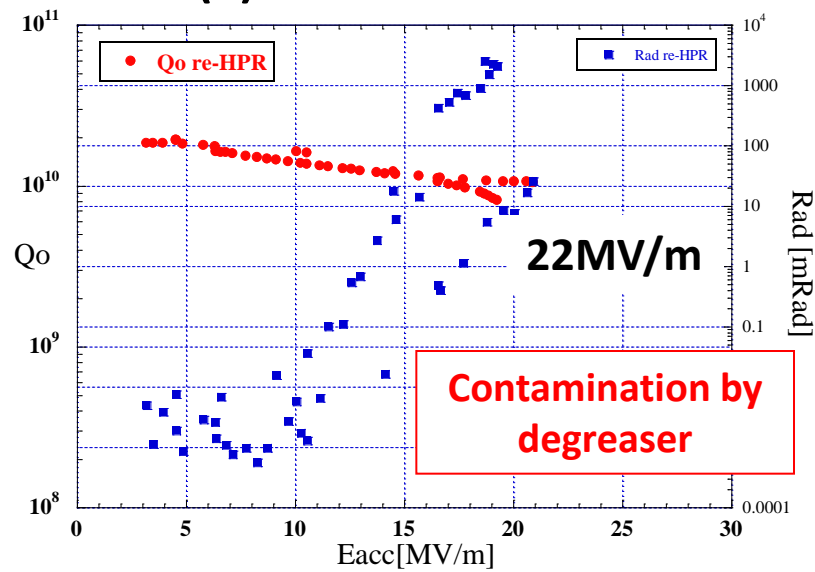
(1) Baseline VT, HPR at Jlab



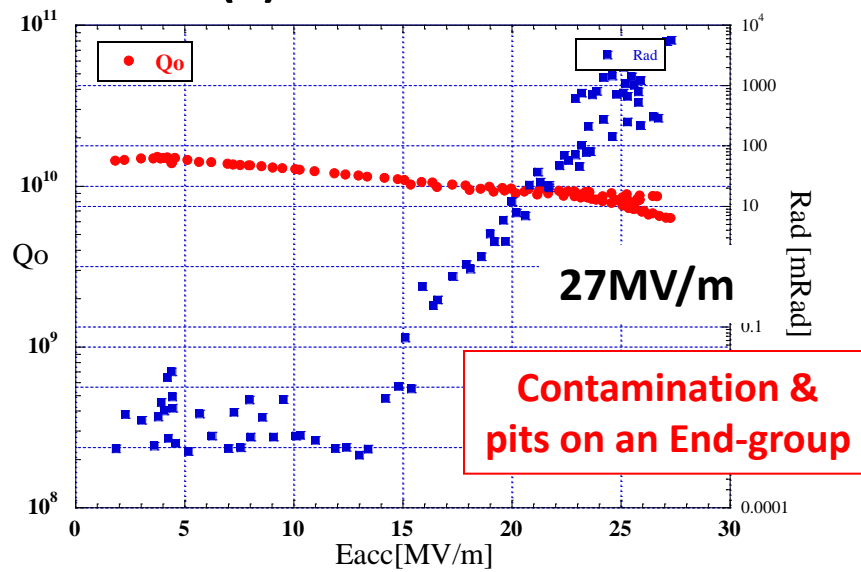
(2) VT after 1st EP (+ Nitric acid soaking)



(3) VT after +re-HPR

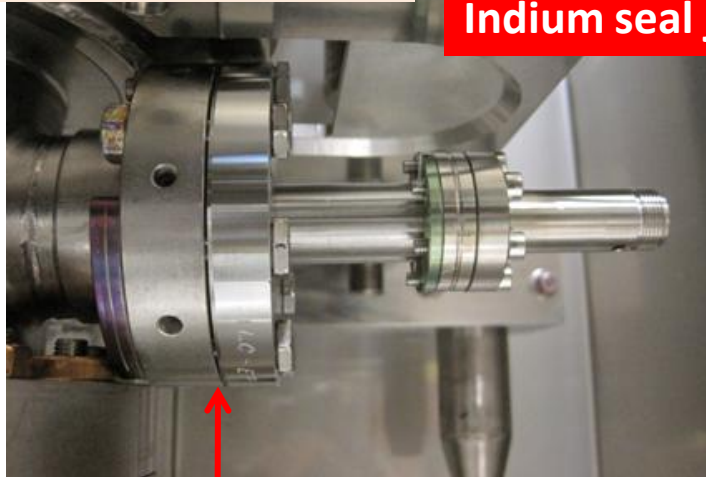


(4) VT after 2nd EP



Trouble (1) In seal melted at bake out

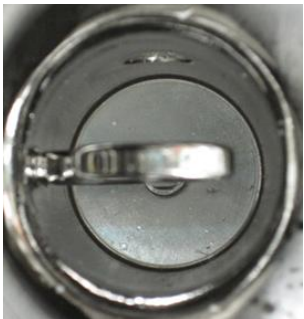
Input antenna



Indium seal joint



Cavity was contaminated by indium

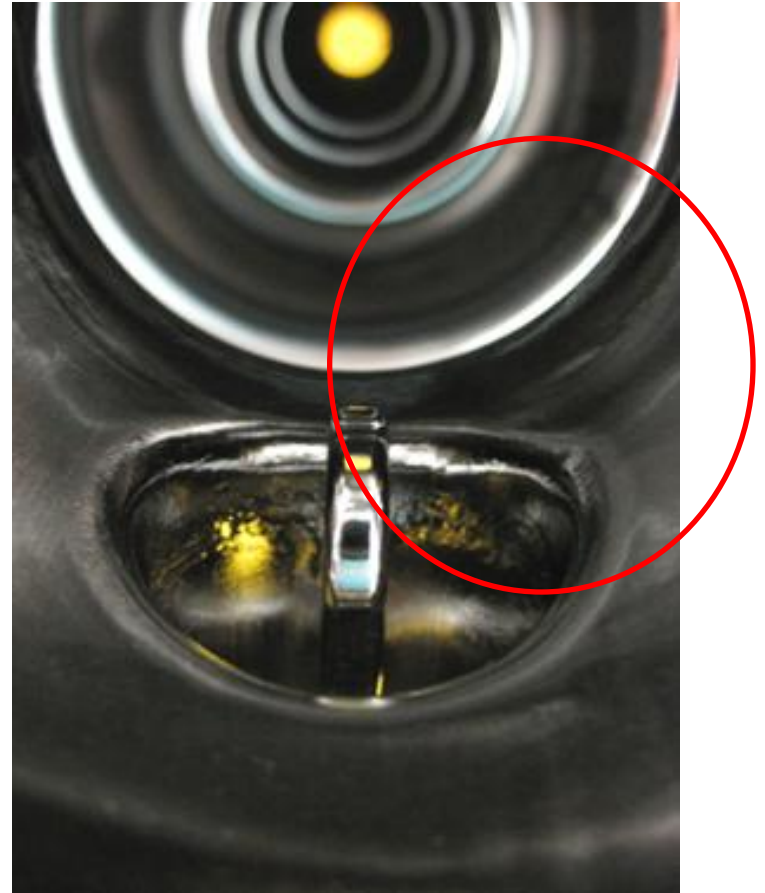


Nitric acid soaking was done

Trouble (2) contamination by degreaser



Contamination by degreaser was found after Re-HPR VT.



Cleaning by BCP before 2nd EP.

Trouble (3) Pits on an end-group

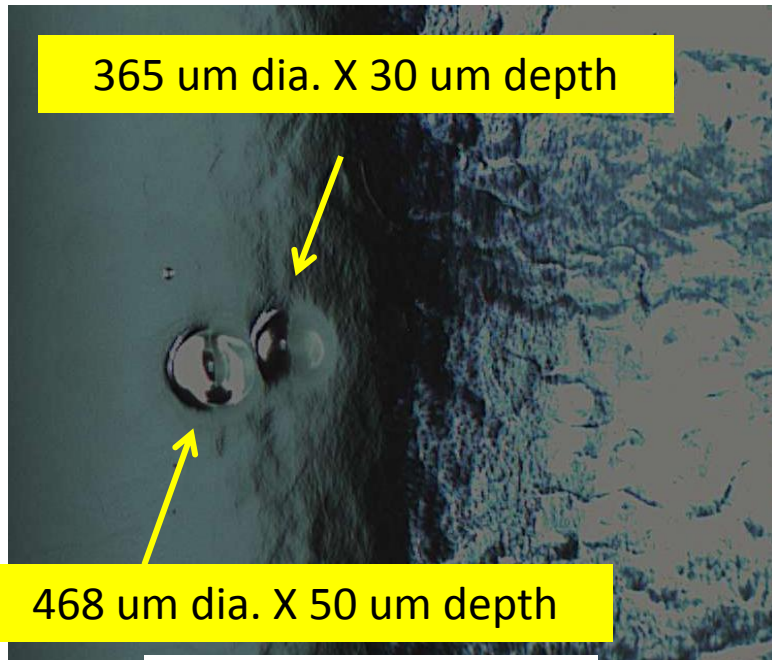
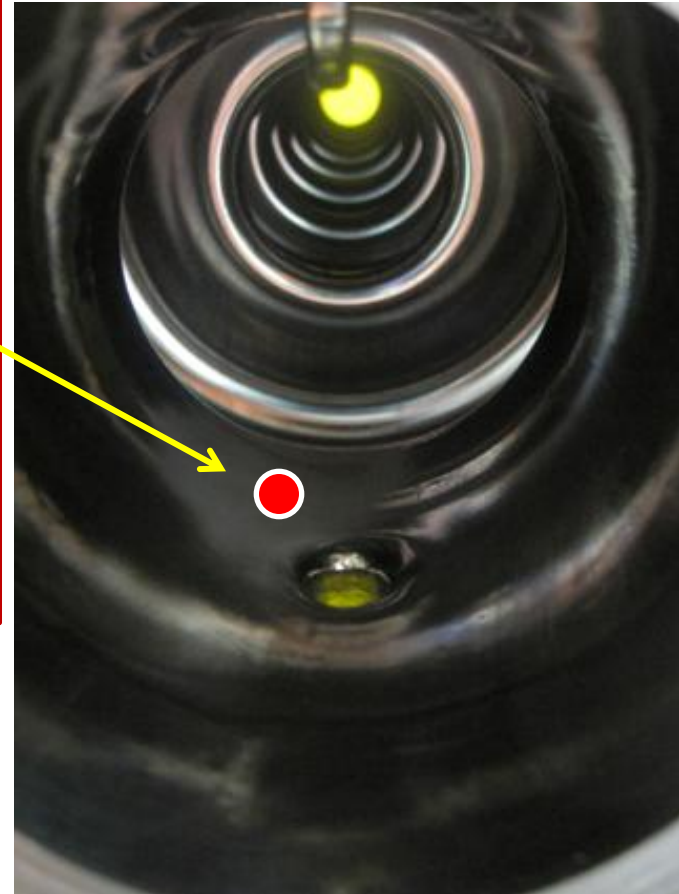
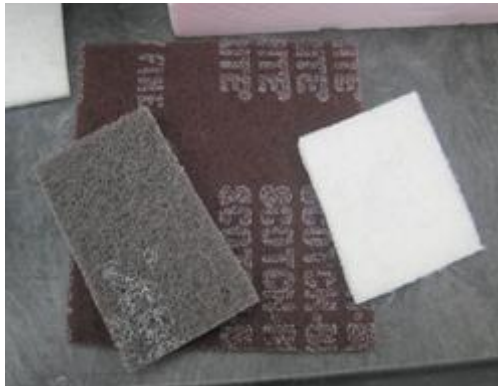


Photo by Rongli



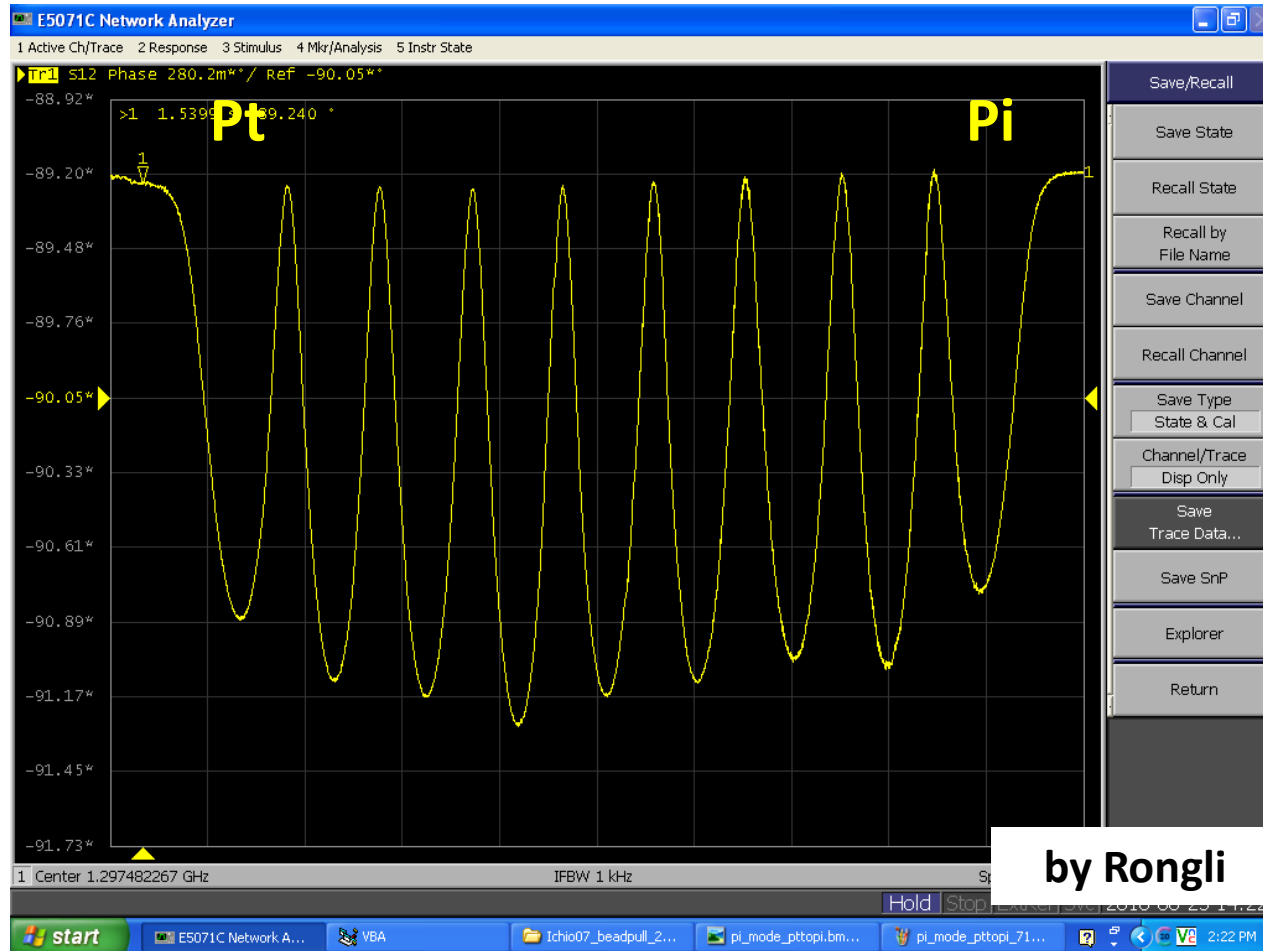
After polishing, no visible pits.
Then, go to Ultra-sonic cleaning

Polishing w/
Scotch-Brite



Trouble (4) Flatness degradation

Pi-Mode Field Flatness 87% after 2nd EP + VT

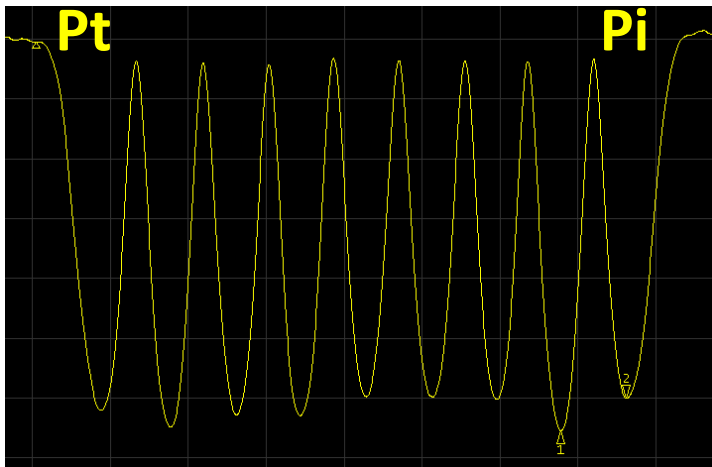


All bead pull data measured vertically with cavity in vertical test cage
bead moving from Pt port to Pi port (top to bottom)

Flatness tuning before 3rd EP



f.f.=96% on tuning table



f.f.=95% in cage



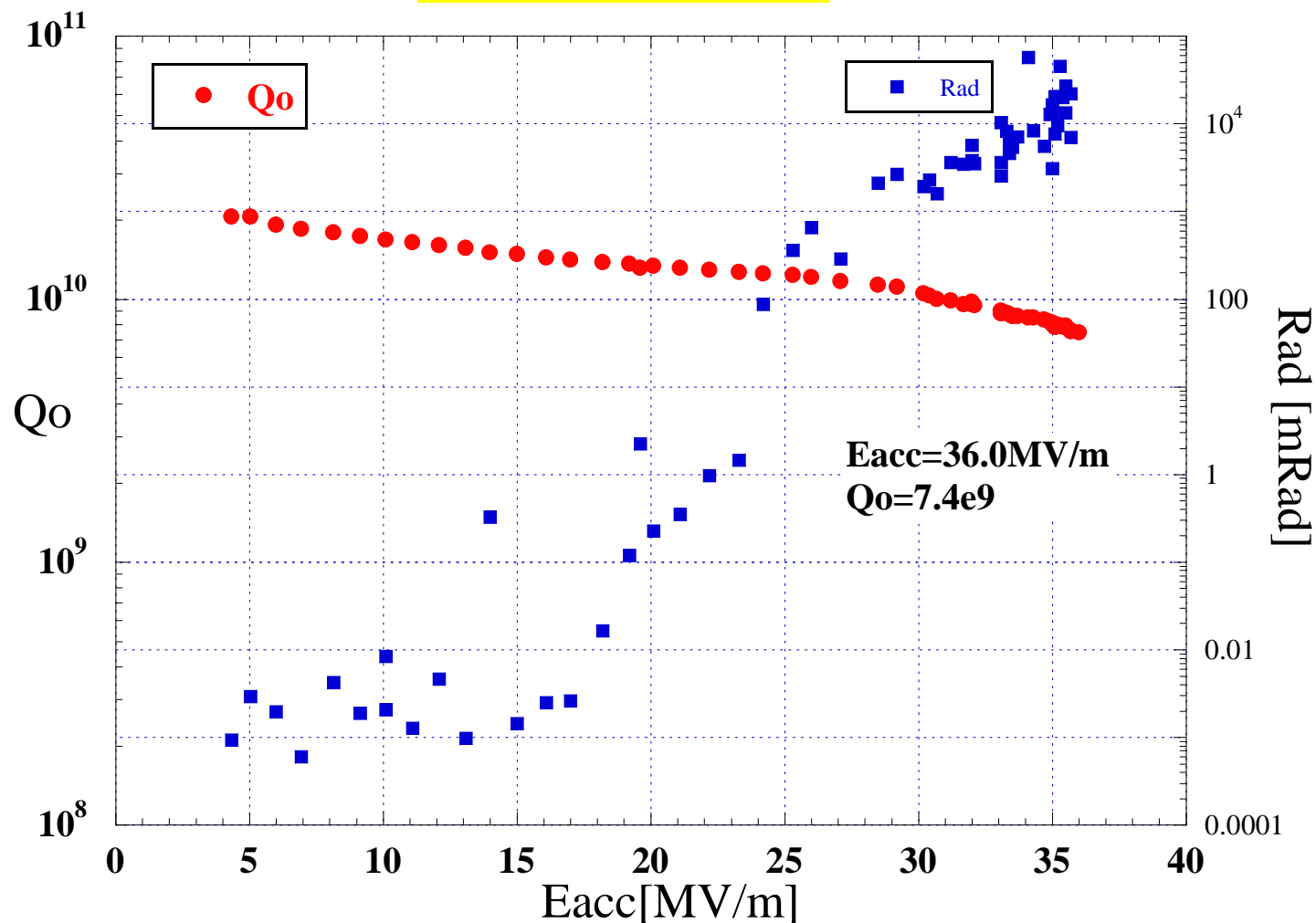
2010 November, ICHIRO#7 activities @Jlab

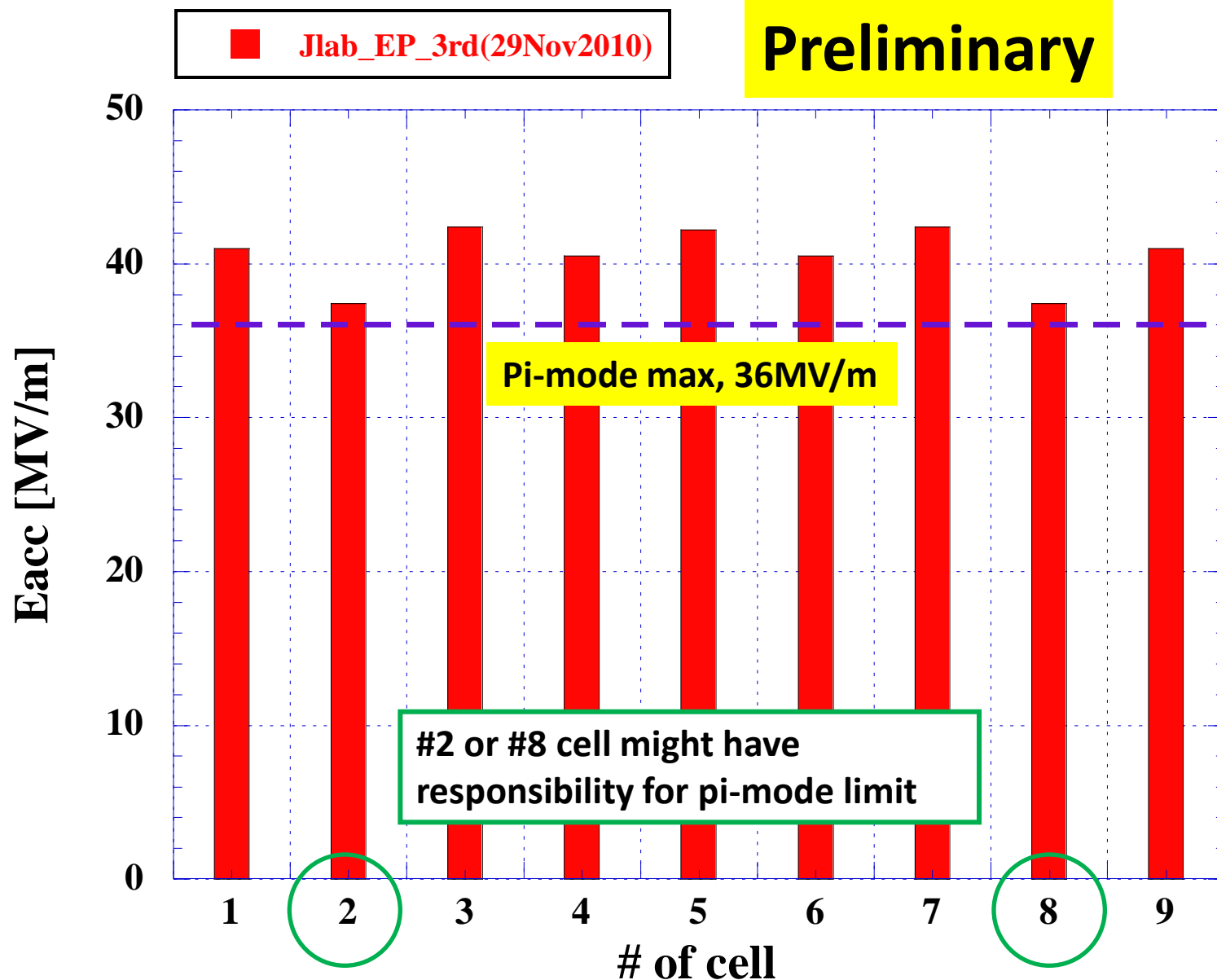
	Sun.	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.
Date		11/1	2	3	4	5	6
Week 1	Jlab visit Paper works Polishing of BP pit degreasing Pre-tuning						
Date	7	8	9	10	11	12	13
Week 2	Jig fitting, degreasing Hardware preparation EP set-up				EP(20um) USC HPR(1)	Pre-assy	
Date	14	15	16	17	18	19	20
Week 3	Final HPR Final Assy				leak check		
	slow pump down				← Baking (120C*48h) →		
Date	21	22	23	24	25	26	27
Week 4				VT, pi-mode			
Date	28	29	30				
Week 5		VT, pass-band					

VT results after 3rd EP at Jlab

Preliminary

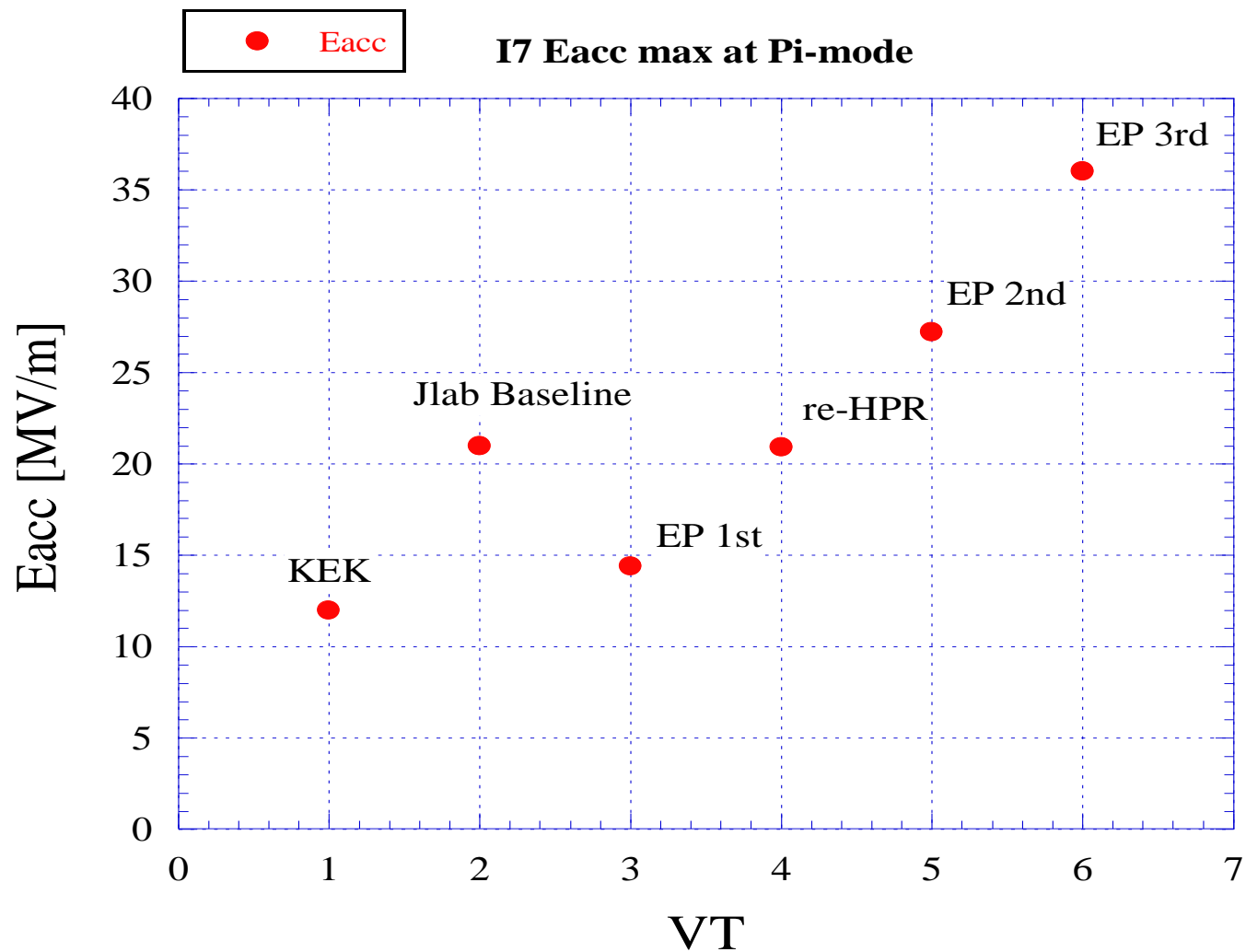
2010 Nov. 24th





ICHIRO7 S0-study history

Preliminary



LG R&D

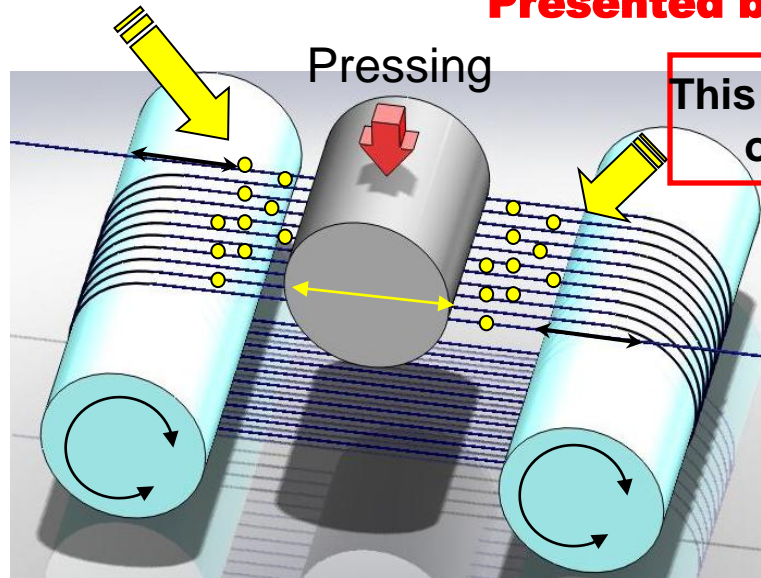
Multi-Wire slicing @KEK/Tokyo Denkai

Conventional Silicon wafer
slicing machine



Tokyo Denkai already
installed this machine.

Presented by K. Saito at SRF2009



This is established technology
on silicon wafer slicing.

Slicing used very thin
piano wire (0.16Φ)
and liquid abrasive



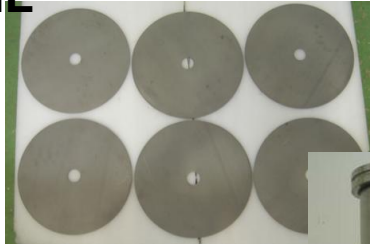
265Φ 307mmL



102 sheets(2.8t), ~50hrs

Experience of Multi-wire slicing

2008July 6 sheets(2.8t)
270Φ 20mmL

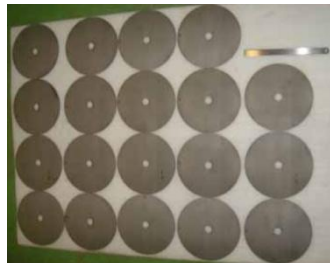


ISE-LG

2008Sept. 58 sheets(3.2t for Jlab)
270Φ 201mmL



2008Sept. 19 sheets (2.8t)
270Φ 61mmL



LG-I9#9



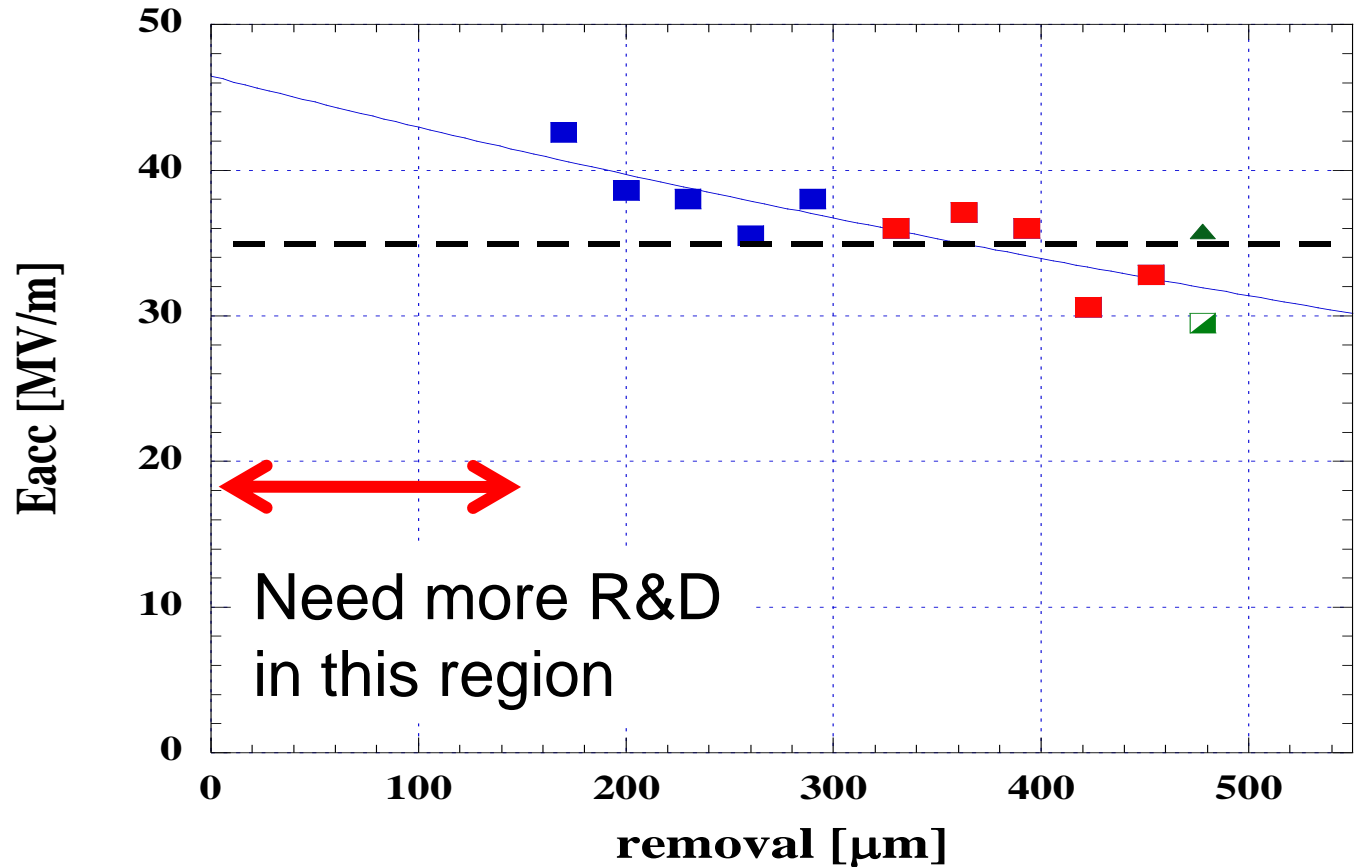
2009Aug. 102 sheets(2.8t)
265Φ 307mmL



LG-I9#10, 11



LG single + BCP, tight loop test history

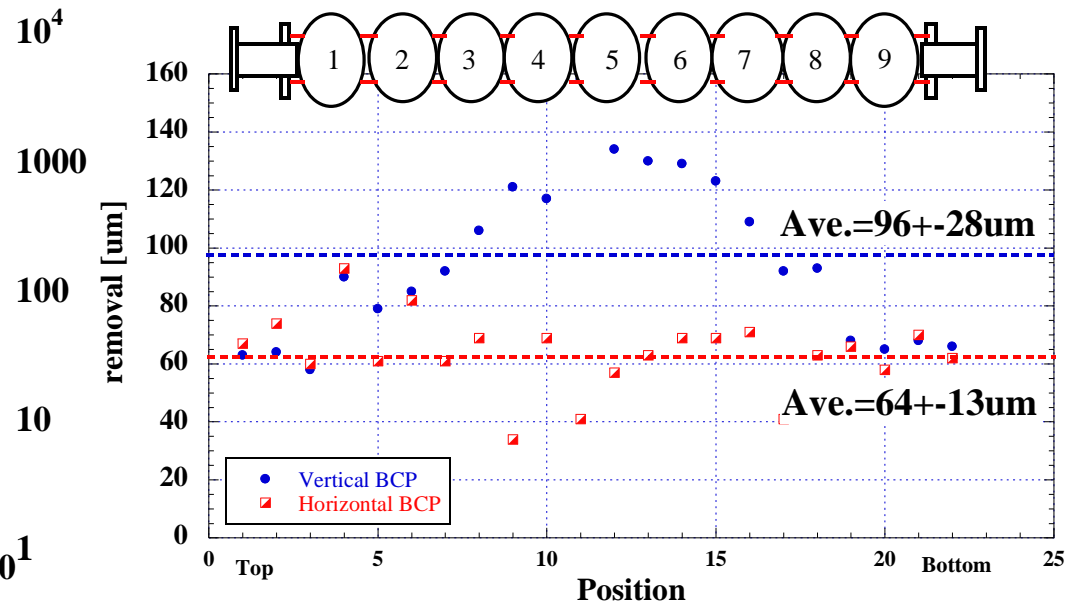
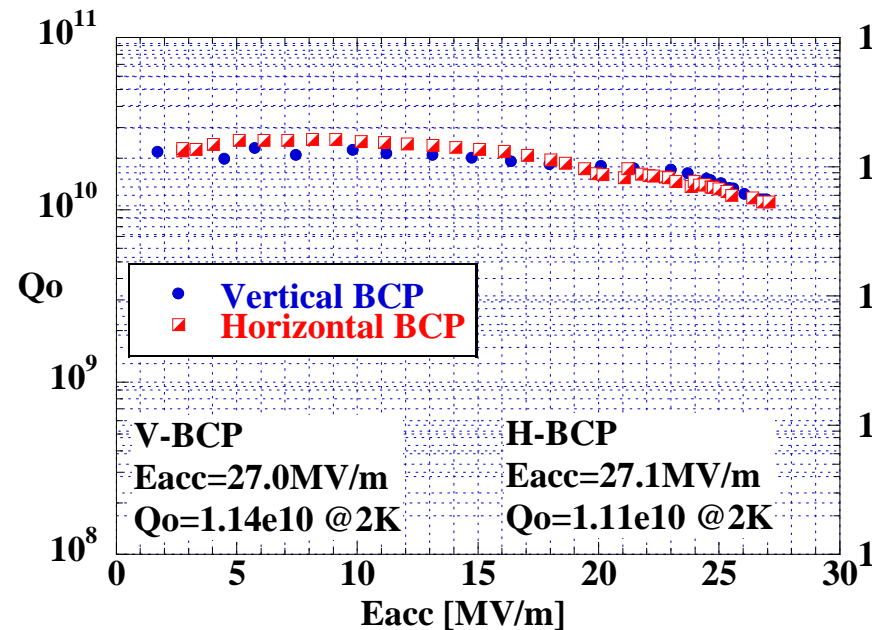


LG ICHIRO 9-cell + BCP



ICHIRO#9

w/o end group



Horizontal BCP produced uniform removal.

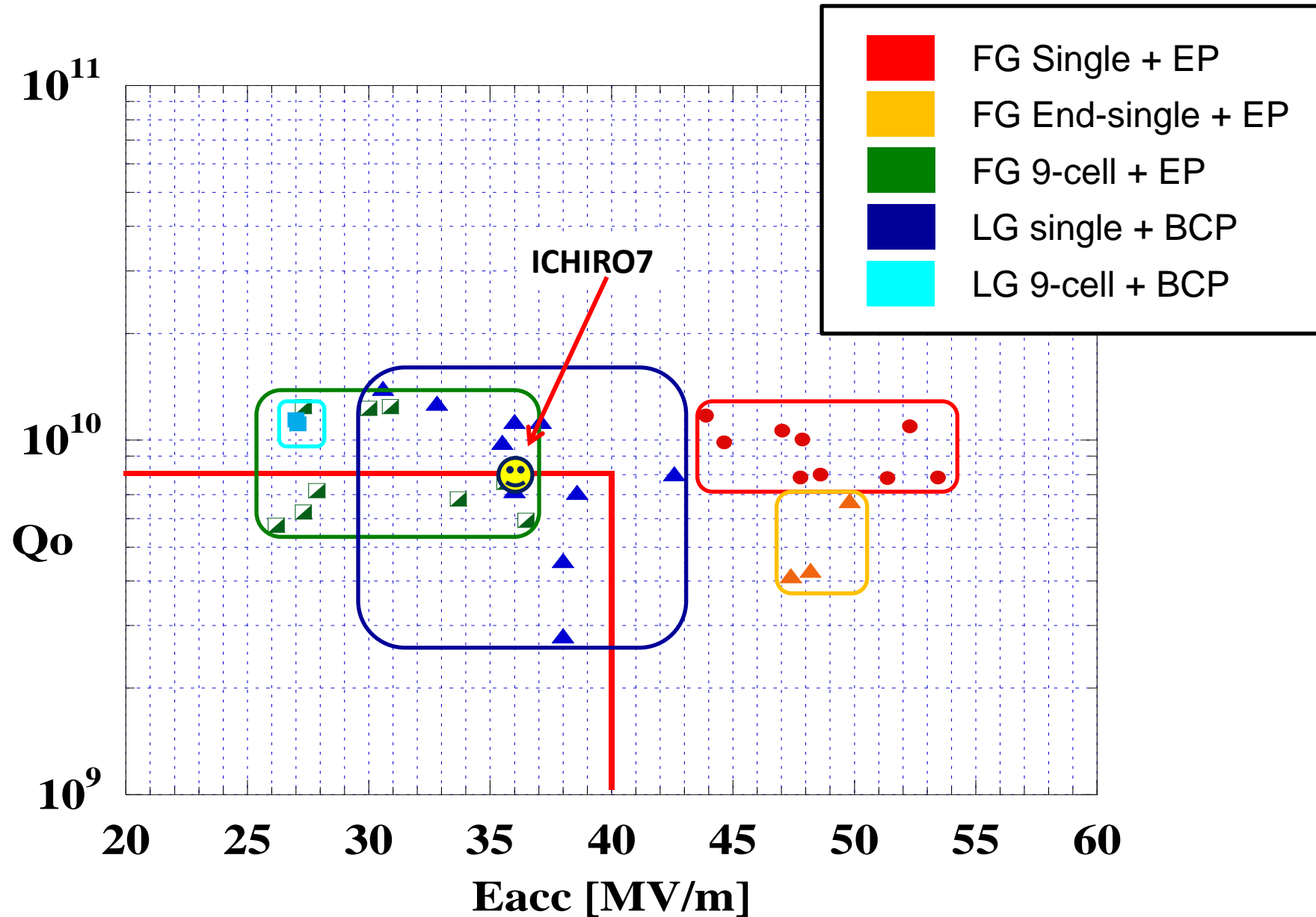
Gradient was same as vertical BCP so far. We will continue H-BCP and VT.

New full LG 9-cell was fabricated



All equator and iris are welded from inside.
Processed by horizontal BCP but no-CBP.
RF test is scheduled on end of Dec.

Current status of ICHIRO cavities



Summary

Top priority: high gradient

S0 study on ICHIRO#7 is successfully on going in collaboration with Jlab/KEK.

Eacc of 36MV/m in pi-mode was achieved so far, further process and RF test are scheduled.

R&D

LG ICHIRO + BCP + Inner EBW.

Reliable EBW technology by Inner EBW.

Post EP cleaning.

R&D of single crystal ingot is on going in collaboration with KEK/Tokyo Denkai. The key is the seed material.

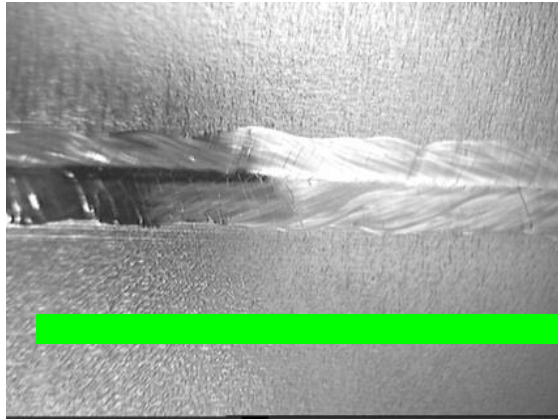
Final goal

High gradient, high yield, low cost by the combination of LG/SC + ICHIRO shape + BCP, inner EBW.

Back up slide for inner EBW

Emergred defects after heavy EP at equator seam

As outer EBW typical



After 1st CBP



After final CBP



All EBW seam looks smooth and no defect after CBP.

After EP (total~140 μ m) , we found several defects at equator seam of end cells.
-> Depends on production accuracy?

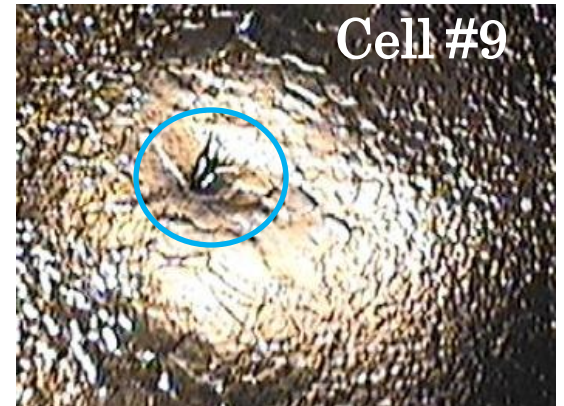
Cell #1-a



Cell #1-b



Cell #9



Comparison of FG and LG EBW seam after CBP

As EBW typical

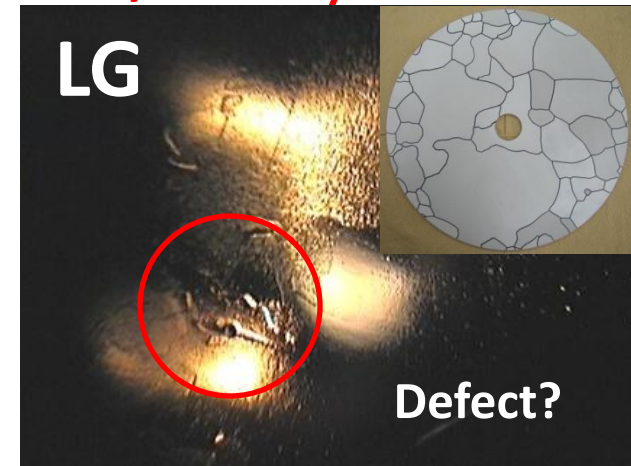
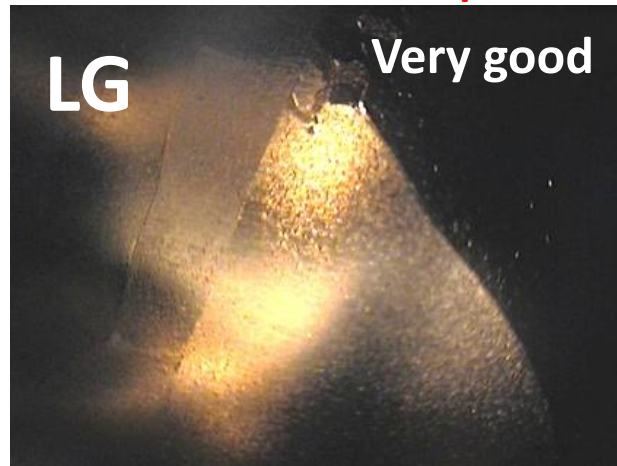
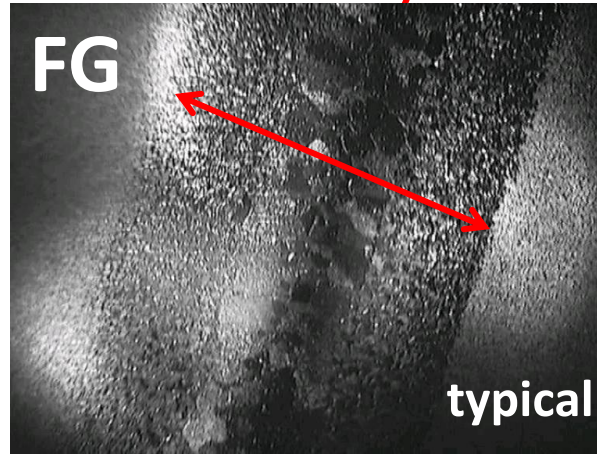


FG(I9#6 PAL)

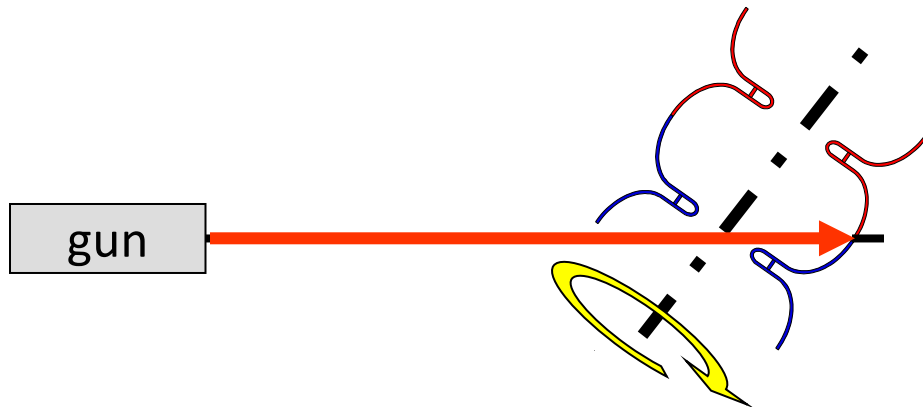
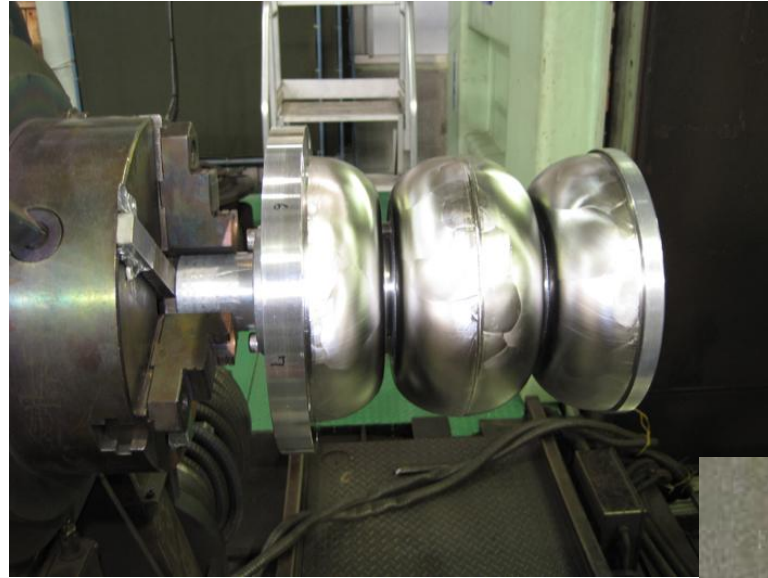


LG(I9#9)

After CBP+CP



Inner EBW for all seams



All equator and iris parts can be welded by inner EBW.

Comparison of Outer and Inner EBW

typical seams

Outer EBW

Fine grain



Outer EBW

Large grain



Inner EBW

Fine grain

