



Global R&D Effort of SCRF Cavity Development for the International Linear Collider

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Project Managers for
ILC Global Design Effort

To be presented during visiting Jlab
April 2-3, 2009

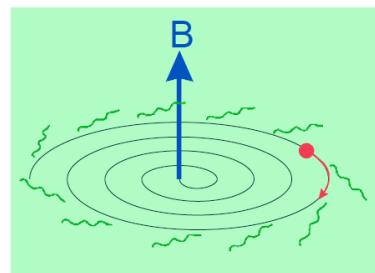
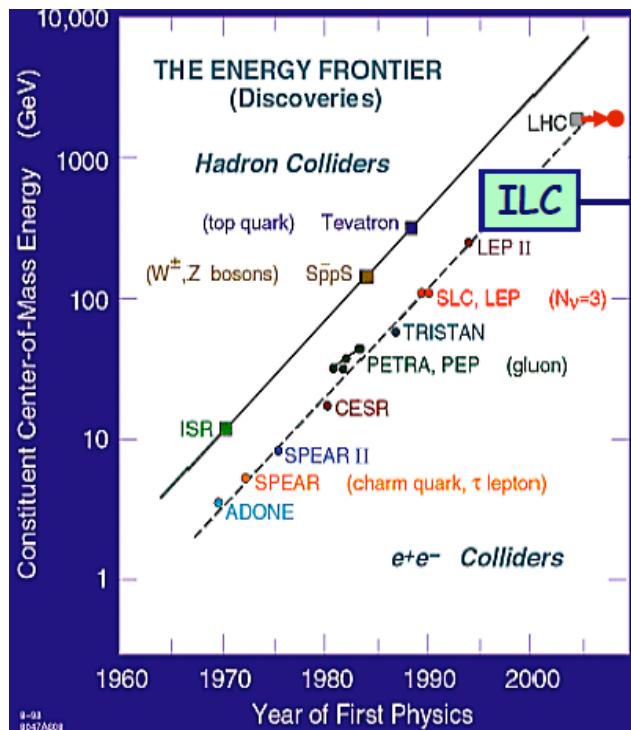


Outline

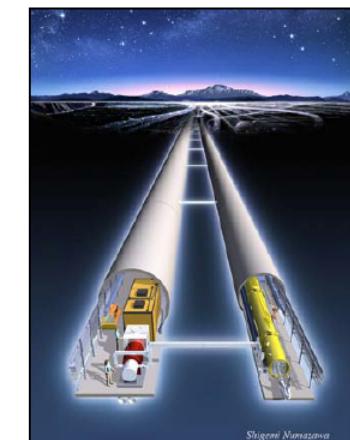
- **Introduction**
- **R&D Status**
- **Plan for Technical Design Phase**
- **Global Plan and Project Management**
- **Summary**

Particle Accelerators

beyond limit of circular accelerators

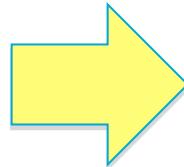


Electron machine
Ring accelerator
>> Linear Accelerator





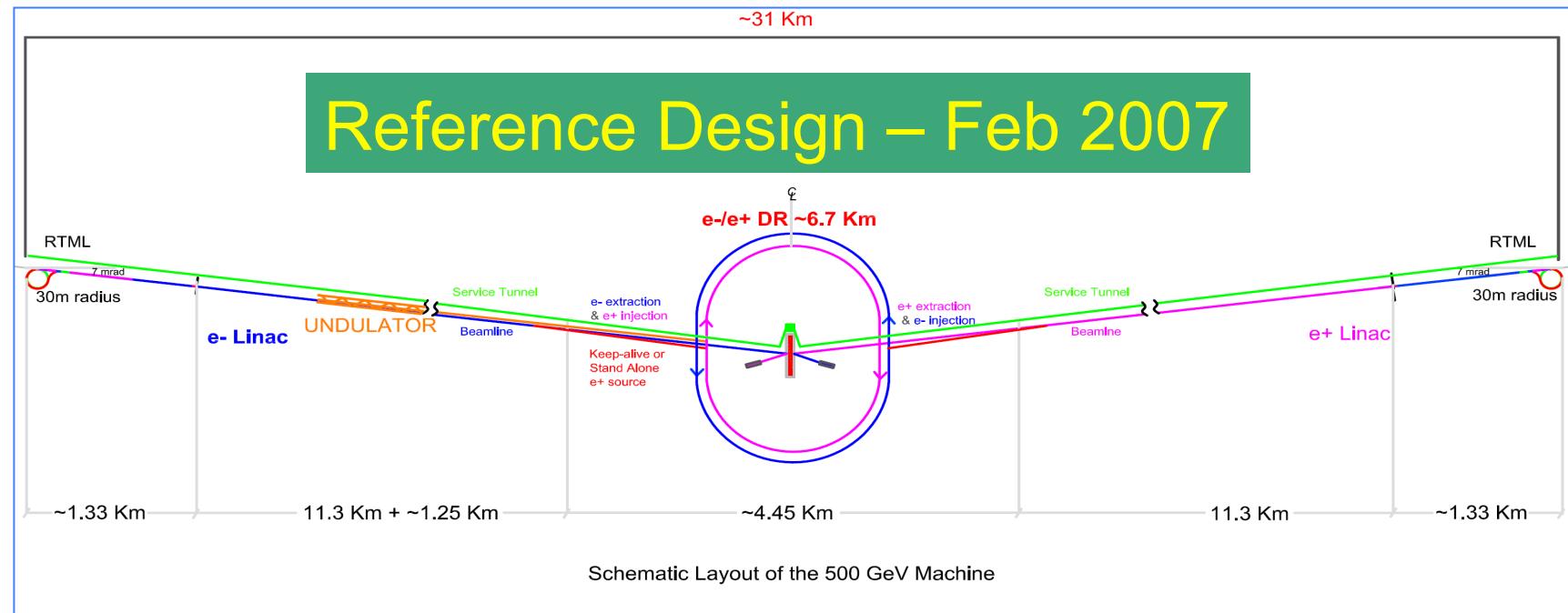
Technical Design Report to be completed by 2012



Reference Design, 2007 >> Technical Design Phase, 2008-2012
We are now at the stage of progressing from the RD to TD

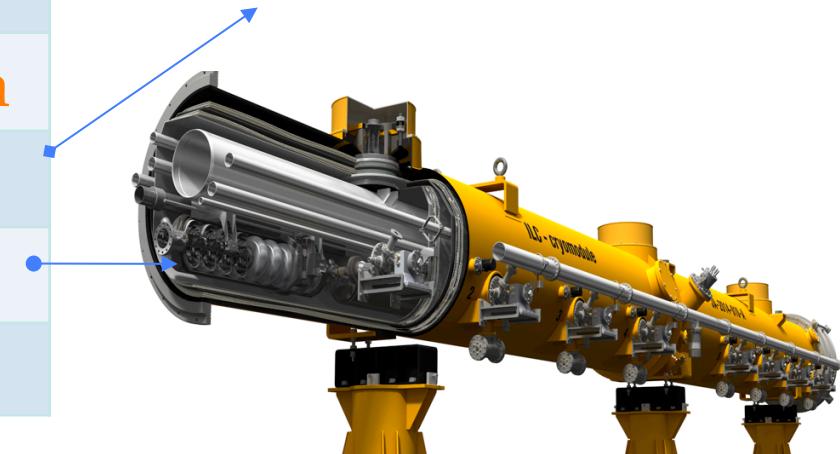
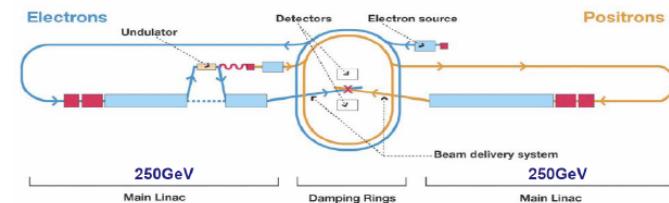
ILC Reference Design

- 11km SC linacs operating at **31.5 MV/m** for 500 GeV
- Centralized injector
 - Circular damping rings for electrons and positrons
 - Undulator-based positron source
- Single IR with 14 mrad crossing angle
- Dual tunnel configuration for safety and availability



SCRF Technology Required

Parameter	Value
C.M. Energy	500 GeV
Peak luminosity	$2 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$
Beam Rep. rate	5 Hz
Pulse time duration	1 ms
Average beam current	9 mA (in pulse)
Av. field gradient	31.5 MV/m
# 9-cell cavity	14,560
# cryomodule	1,680
# RF units	560





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Progress in Single Cell Cavity

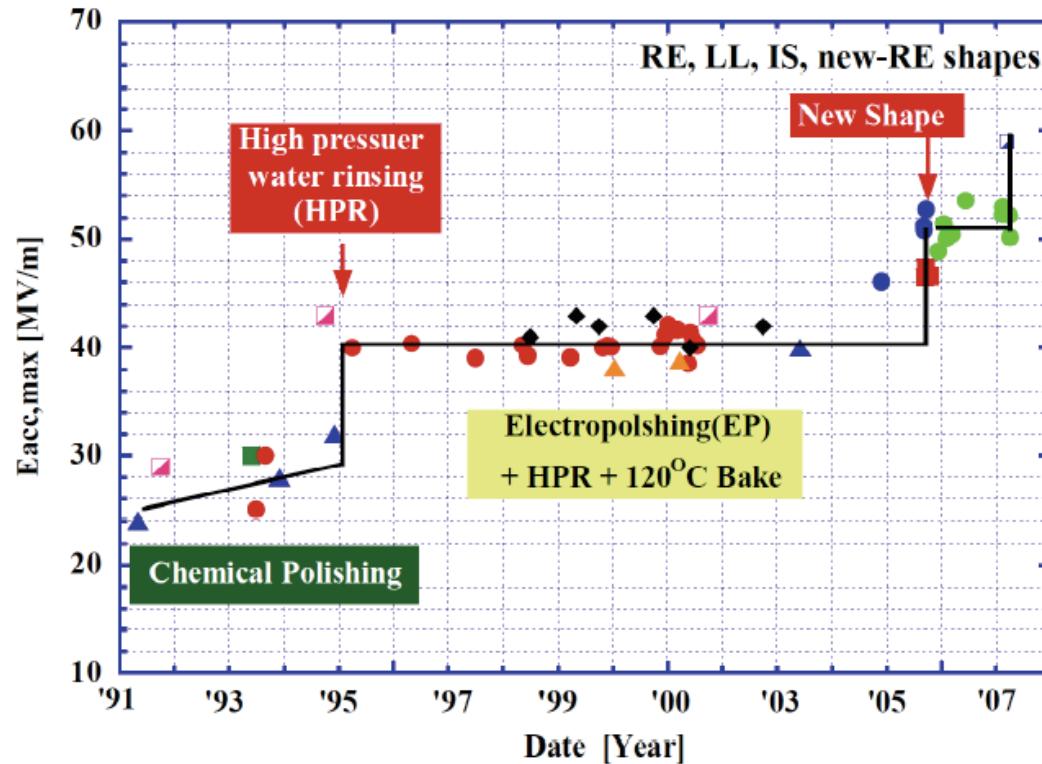
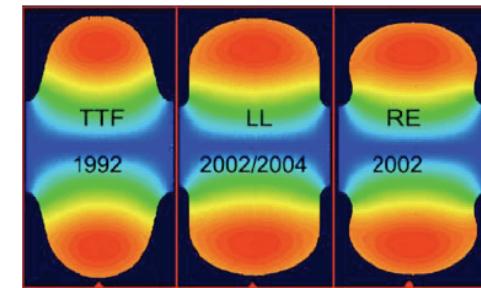


TABLE II. CAVITY SHAPES STUDIED FOR THE ILC.

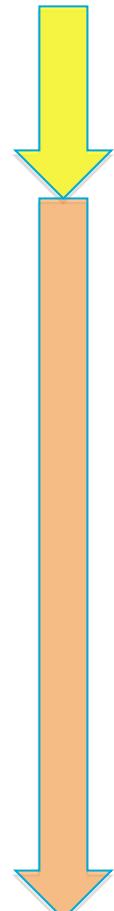
Parameter	TESLA	LL/IS	RE
Iris aperture (mm)	70	60/61	66
$E_{\text{peak}}/E_{\text{acc}}$	1.98	2.36/2.02	2.21
$B_{\text{peak}}/E_{\text{acc}}$ (mT/(MV/m))	4.15	3.61/3.56	3.76
Char. shunt impedance: R/Q (Ω)	114	134/138	127
Geometric factor: G (Ω)	271	284/285	277
$G \times R/Q$ ($\Omega \times \Omega \times 10^5$)	3.08	3.80/3.93	3.51



- Record of **59 MV/m** achieved with the RE cavity with EP, BCP and pure-water rinsing with collaboration of Cornell and KEK



Standard Procedure Established



	Standard Fabrication/Process
Fabrication	Nb-sheet purchasing
	Component Fabrication
	Cavity assembly with EBW
Process	EP-1 (~150um)
	Ultrasonic degreasing with detergent, or ethanol rinse
	High-pressure pure-water rinsing
	Hydrogen degassing at > 600 C
	Field flatness tuning
	EP-2 (~20um)
	Ultrasonic degreasing or ethanol (or EP 5 um with fresh acid)
	High-pressure pure-water rinsing
	Antenna Assembly
	Baking at 120 C
Cold Test (vertical test)	Performance Test with temperature and mode measurement

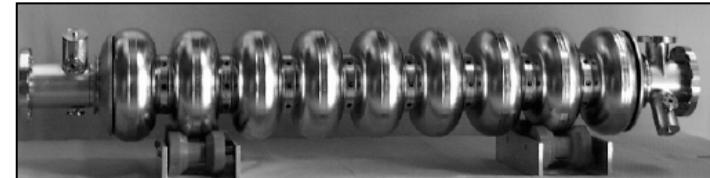
Key Process

Fabrication

- Material
- EBW
- Shape

Process

- Electro-Polishing
- Ethanol Rinsing or
- Ultra sonic. + Detergent Rins.
- High Pr. Pure Water cleaning



■ Europe (DESY, Saclay)

- Gradient: $> \sim 40 \text{ MV/m}$ (max),
- Industrial (bulk) EP demonstrated
- Field emission reduced with ethanol rinsing
- Surface process with baking in Ar-gas

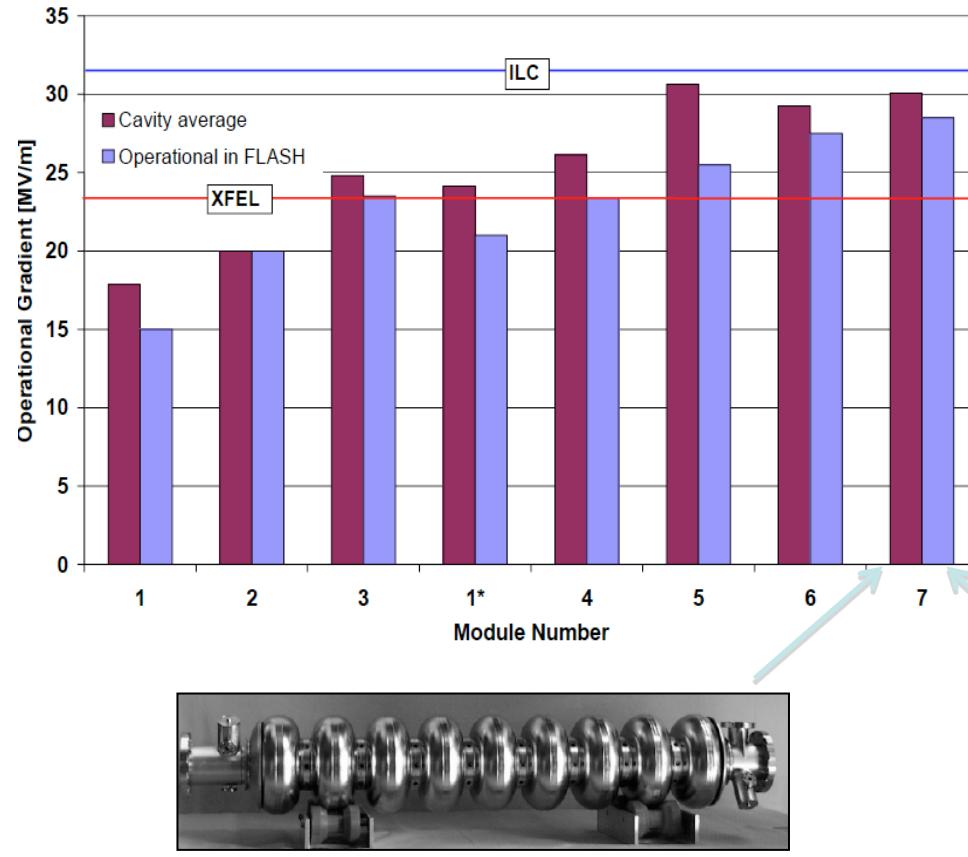
■ Americas (Jlab, Cornell, FNAL/ANL)

- Gradient: $> \sim 40 \text{ MV/m}$ (max),
- Field emission reduced w/ Ultrasonic Degreasing & Detergent

■ Asia (KEK, IHEP, RRCAT)

- Gradient: 36 MV/m (LL, KEK-JLab), 32 MV/m (TESLA-like, KEK)
- Global cooperation of Indian institutions with
 - Fermilab, ANL, Jlab, DESY, and KEK

9-Cell and Cavity String Field Gradient Progress at TESLA



ILC operation :

- $<31.5>$ MV/m

R&D Progress :

- ~ 28 MV/m to satisfy XFEL operation at 24.6 MV/m



• 20 % improvement required for ILC

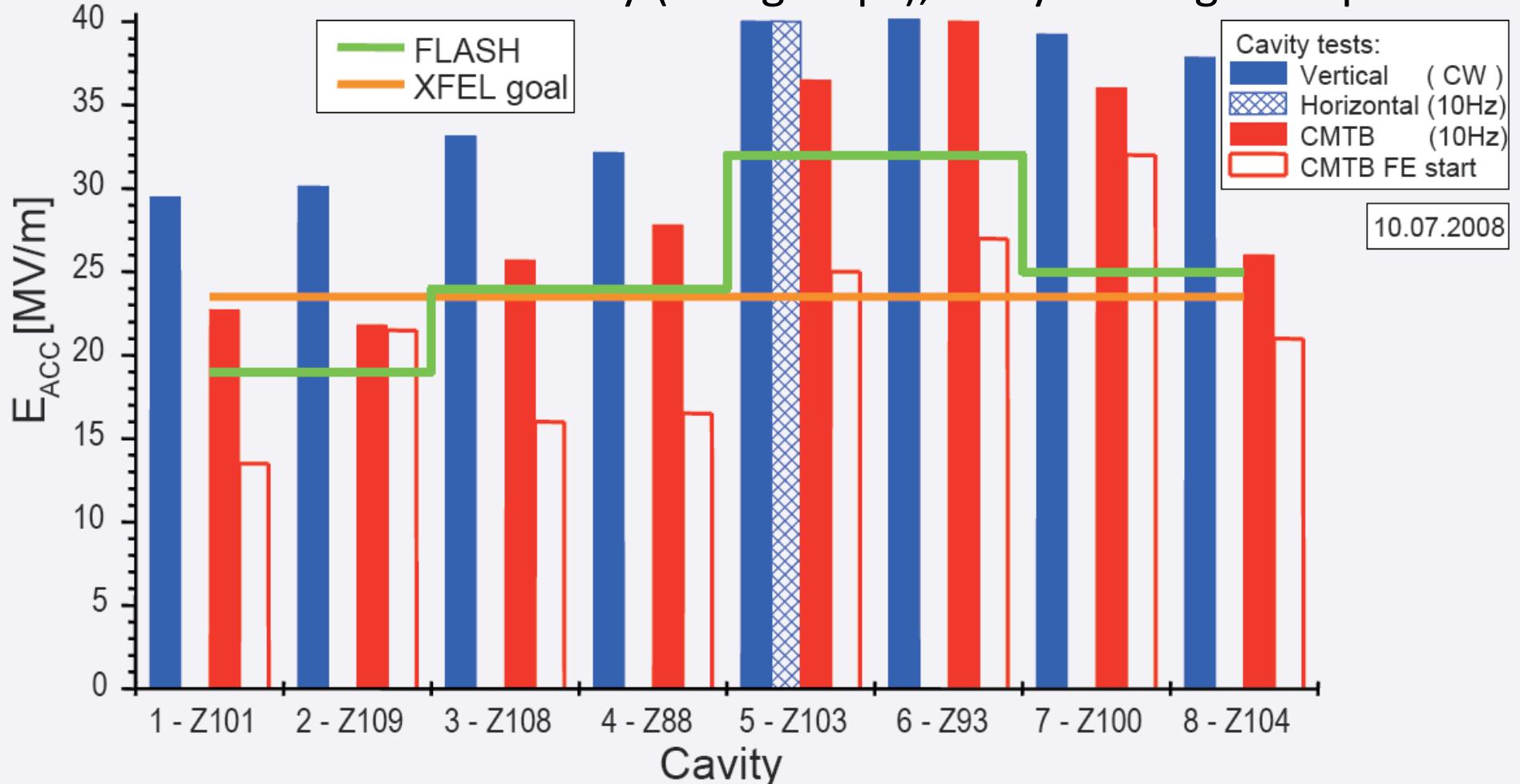
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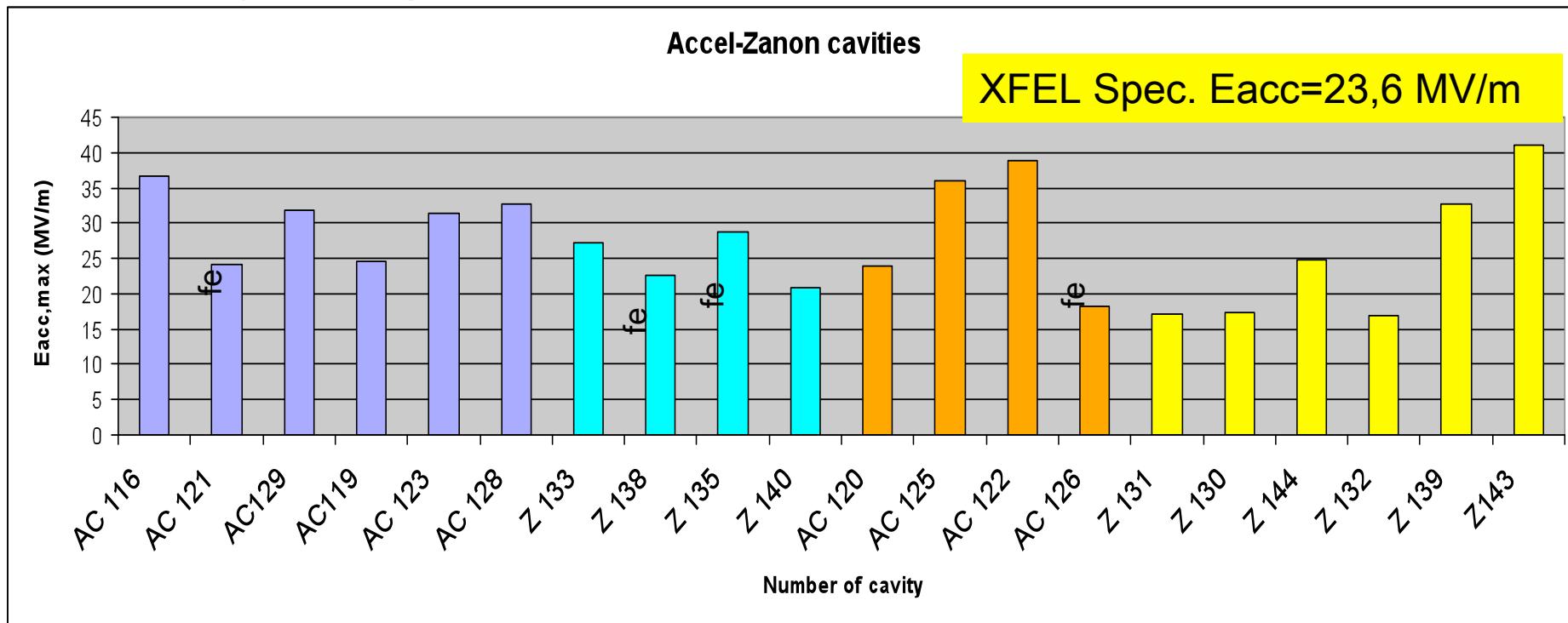
S1 Results TTC Highlights

Gradient summary
from TTC (H. Padamsee)

Module #8 test results

out-sourced module assembly (two groups), cavity venting is suspicious.





AC BCP Flash
 $E_{acc}=30,2 +/- 4,9$

Z BCP Flash
 $E_{acc}=24,9 +/- 3,8$

AC EP
 $E_{acc}=29,3 +/- 9,7$

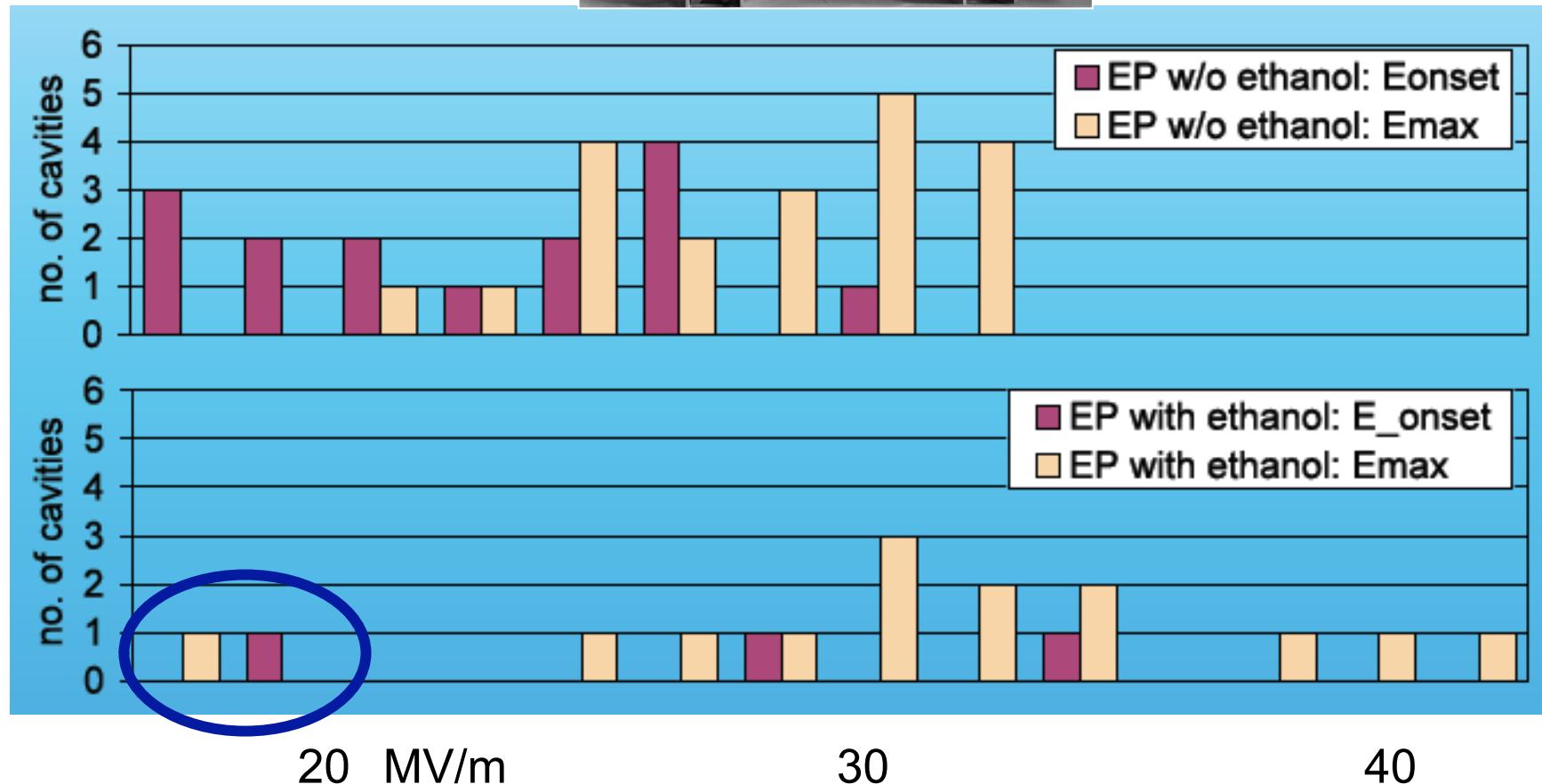
Z EP
 $E_{acc}=24,9 +/- 4,4$

- Max gradient, FE marked, if starts below 20 MV/m
- With He-vessel
- Without HOM pick up

Remark: some Z-Cavities might have suffered from fabrication problems so that the shown result could be independent of the final surface preparation process, i.e. wait for final analysis

Information provided by W. Singer

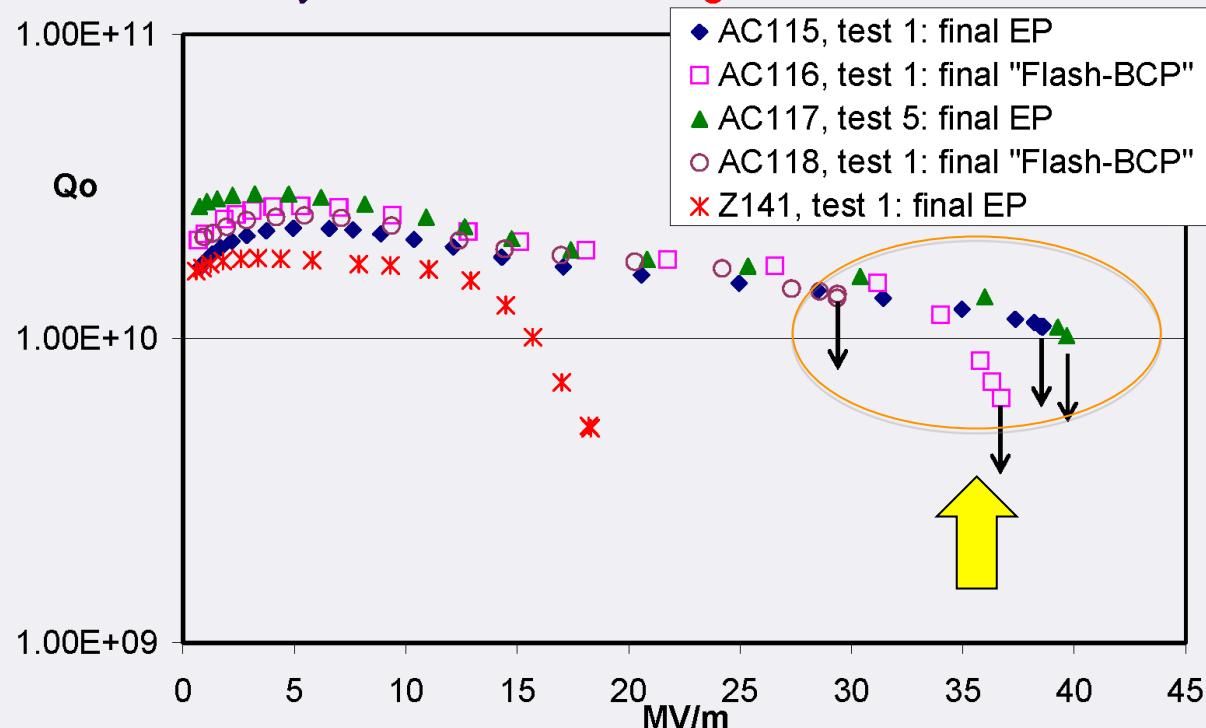
DESY: Ethanol Rinse Effect



Cavity gradient may be improved by 'ethanol rinse', and
Field emission significantly reduced.

6th cavity production – rf results

- excellent + promising first results including first Plansee nine-cell (AC115)
- Z141 as first cavity with **surfaces damages** after fabrication under investigation



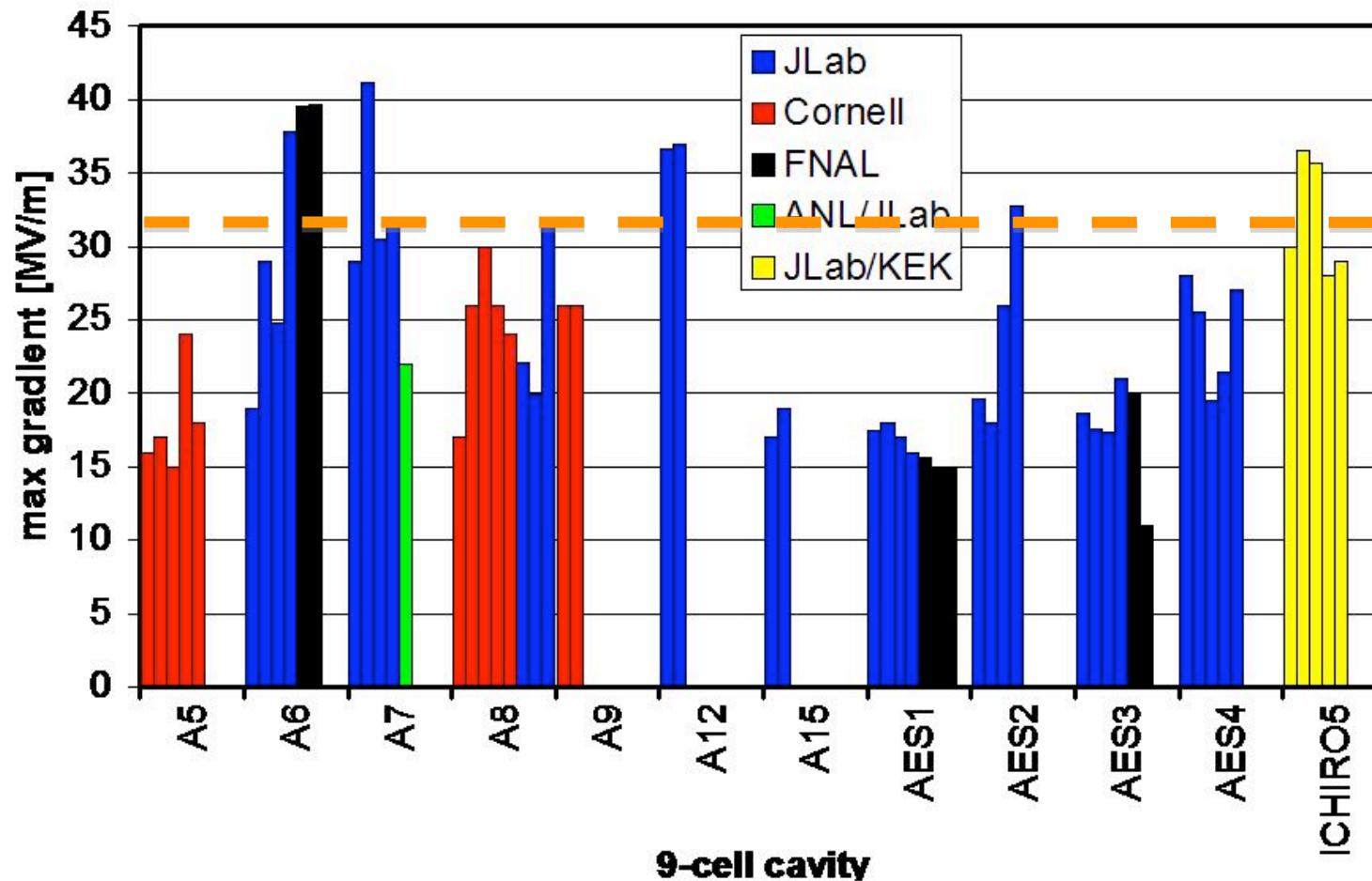
Detlef Reschke, DESY
MAC DESY, May 08, 2008



- The average gradient, **36 MV/m**, achieved with AC115-118

9-cell Progress in Americas

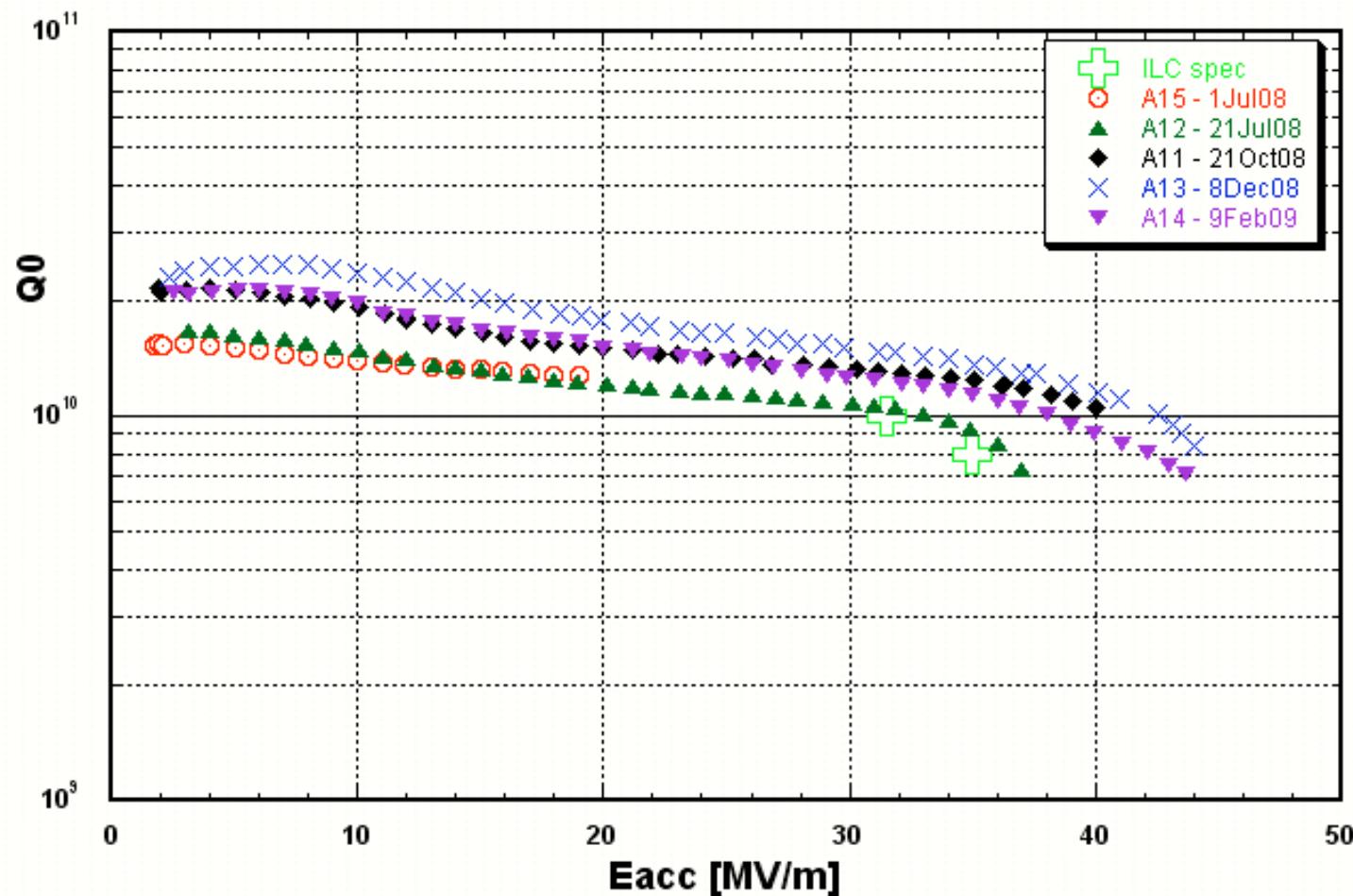
with Japanese contribution for ICHIRO-5



A (Accell), AES: TESLA shape, ICHIRO: LL shape

Most Updated Results from Jlab

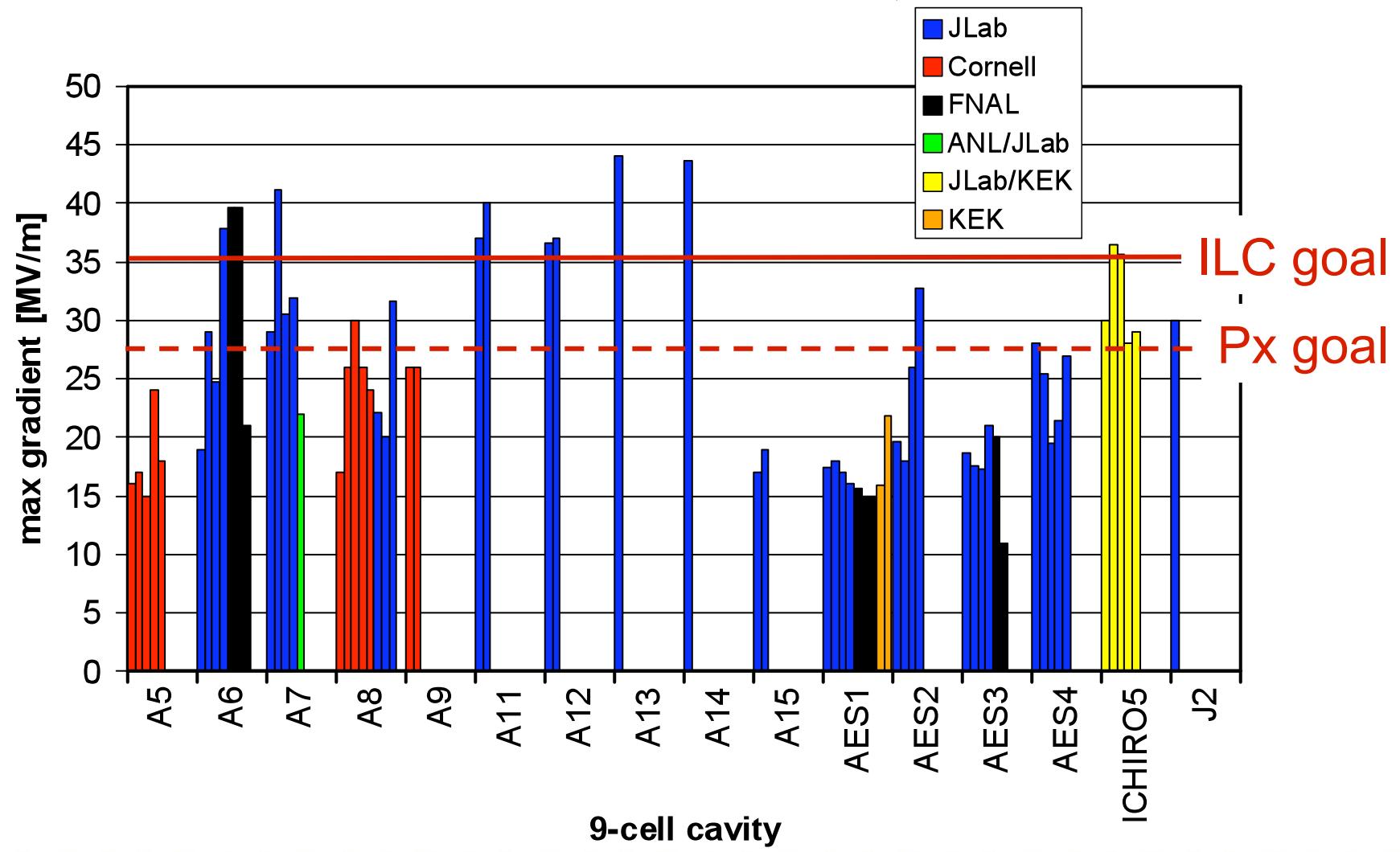
as of Feb. 18, 2009



- Five 9-cell cavities: built by ACCEL, and processed/tested at Jlab.
- All of them processed with one bulk EP followed by one light EP and by ultrasonic pure-water cleaning with detergent (2%).



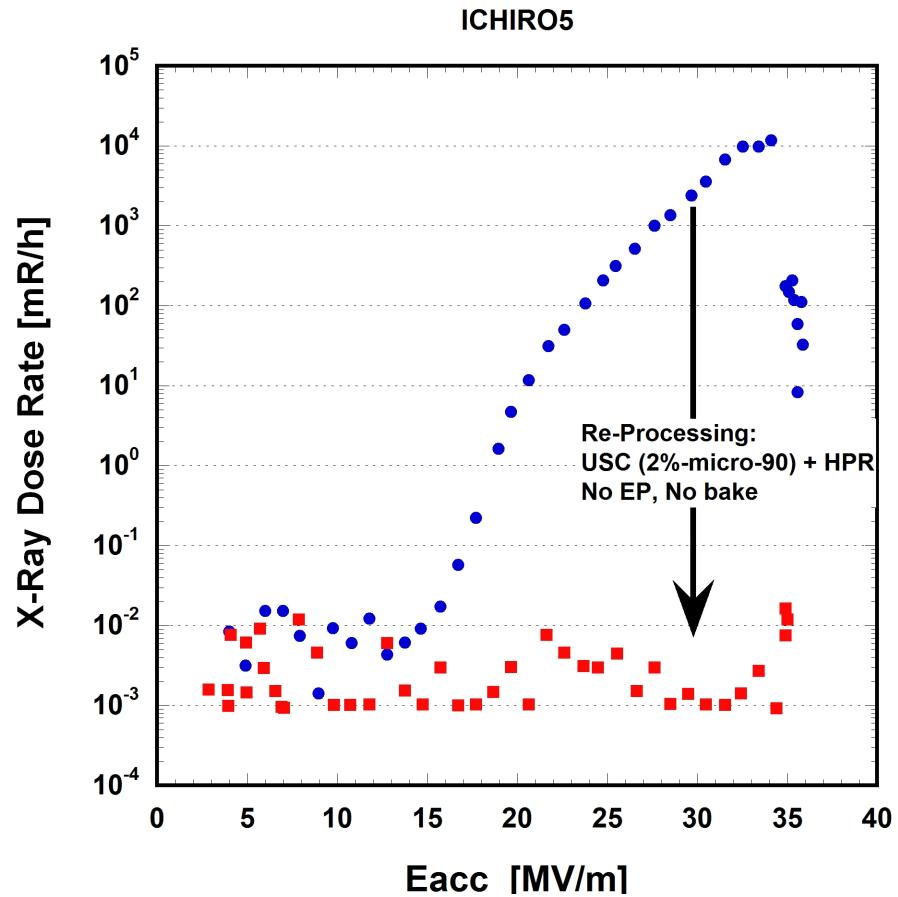
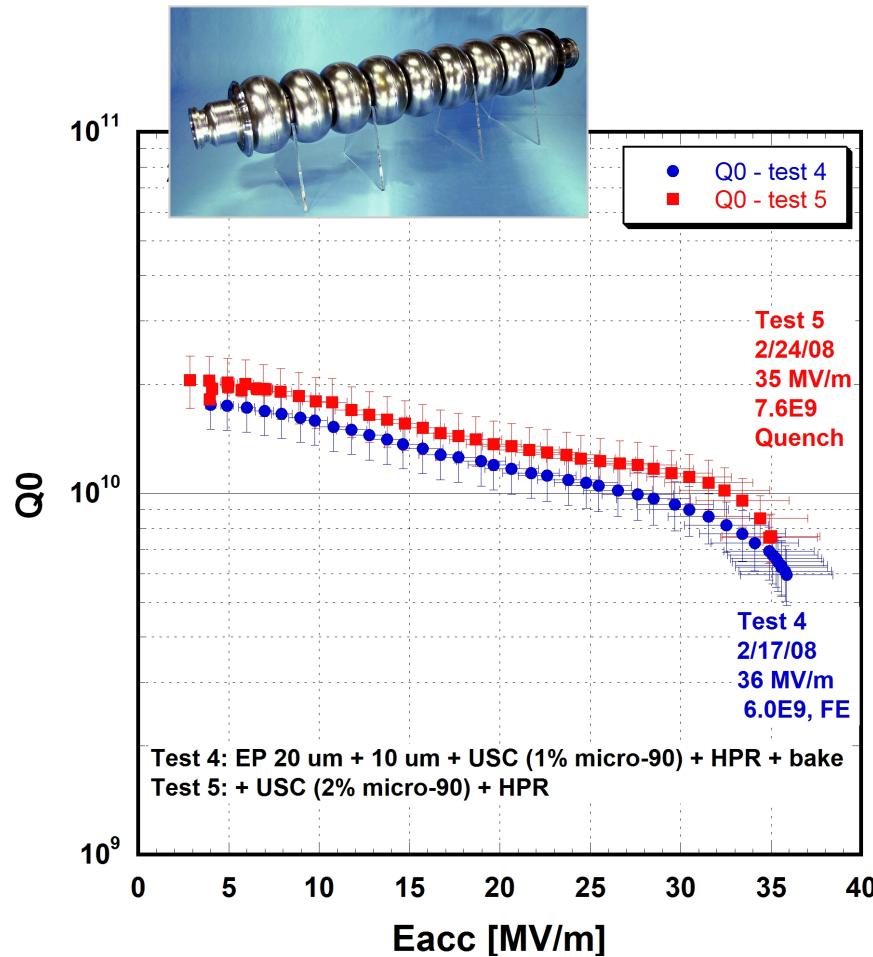
Summary of 9-cell Vertical Tests in U.S. as of Feb., 2009





JLab: Effective Ultrasonic Degreasing

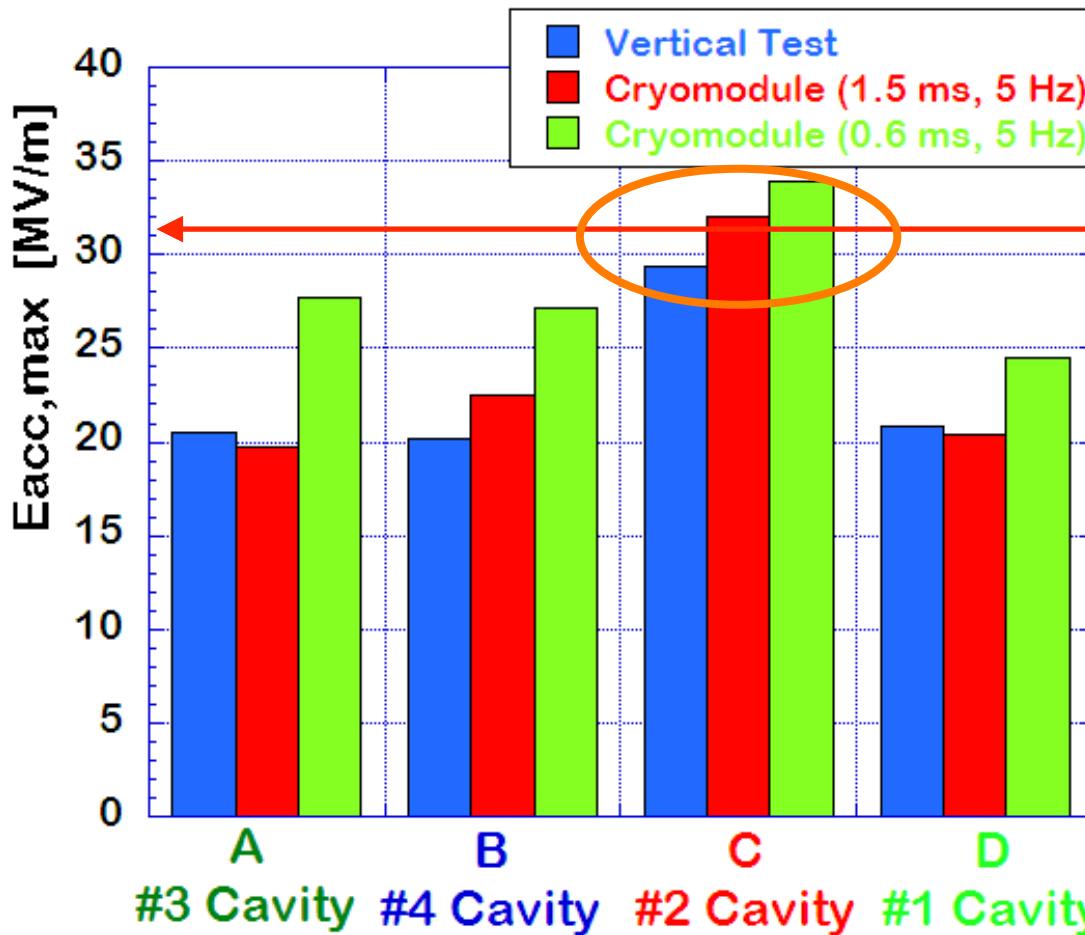
"KEK-ICHIRO-5" 9-cell cavity Processed/Tested at Jlab



Ultrasonic Cleaning with degreaser effective to
reduce field emission

Comparison of achieved $E_{acc,max}$ between Vertical Tests and Cryomodule Tests

November, 2008



RF Feedback / ON

Operational Gradient
at 31.5 MV/m for ILC

Ave. $E_{acc,max}$ (V.T)
= 22.7 MV/m

Ave. $E_{acc,max}$ (Cryo.)
= 23.7 MV/m

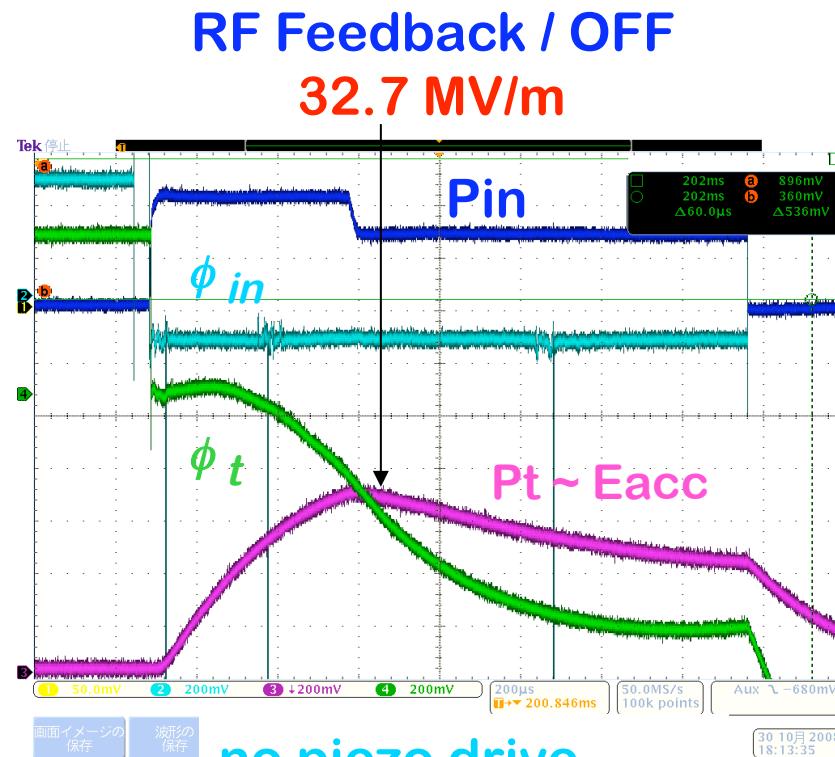
No degradation was observed
in the cryomodule tests.

Stable Pulsed Operation ; STF Phase-1.0

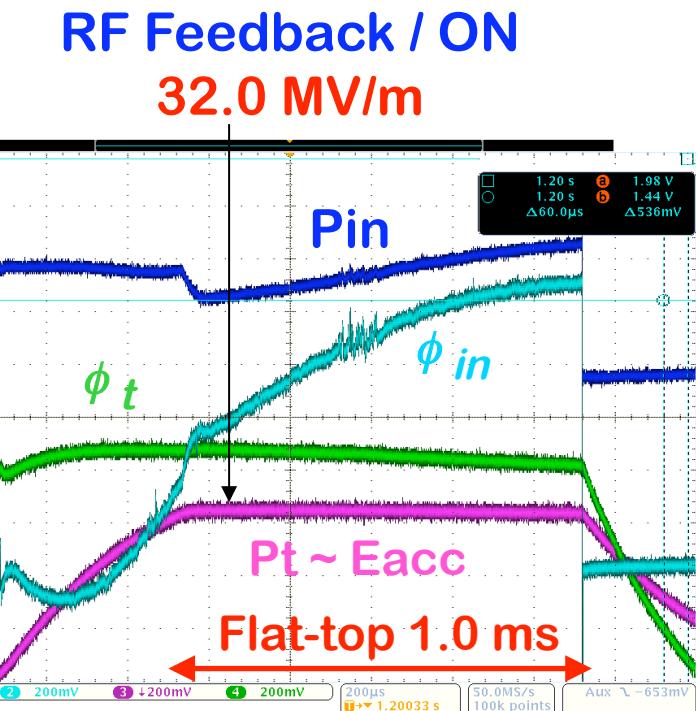
Best Result ; obtained Eacc,max in #2 Cavity

1.5 msec, 5 Hz operation

November, 2008'

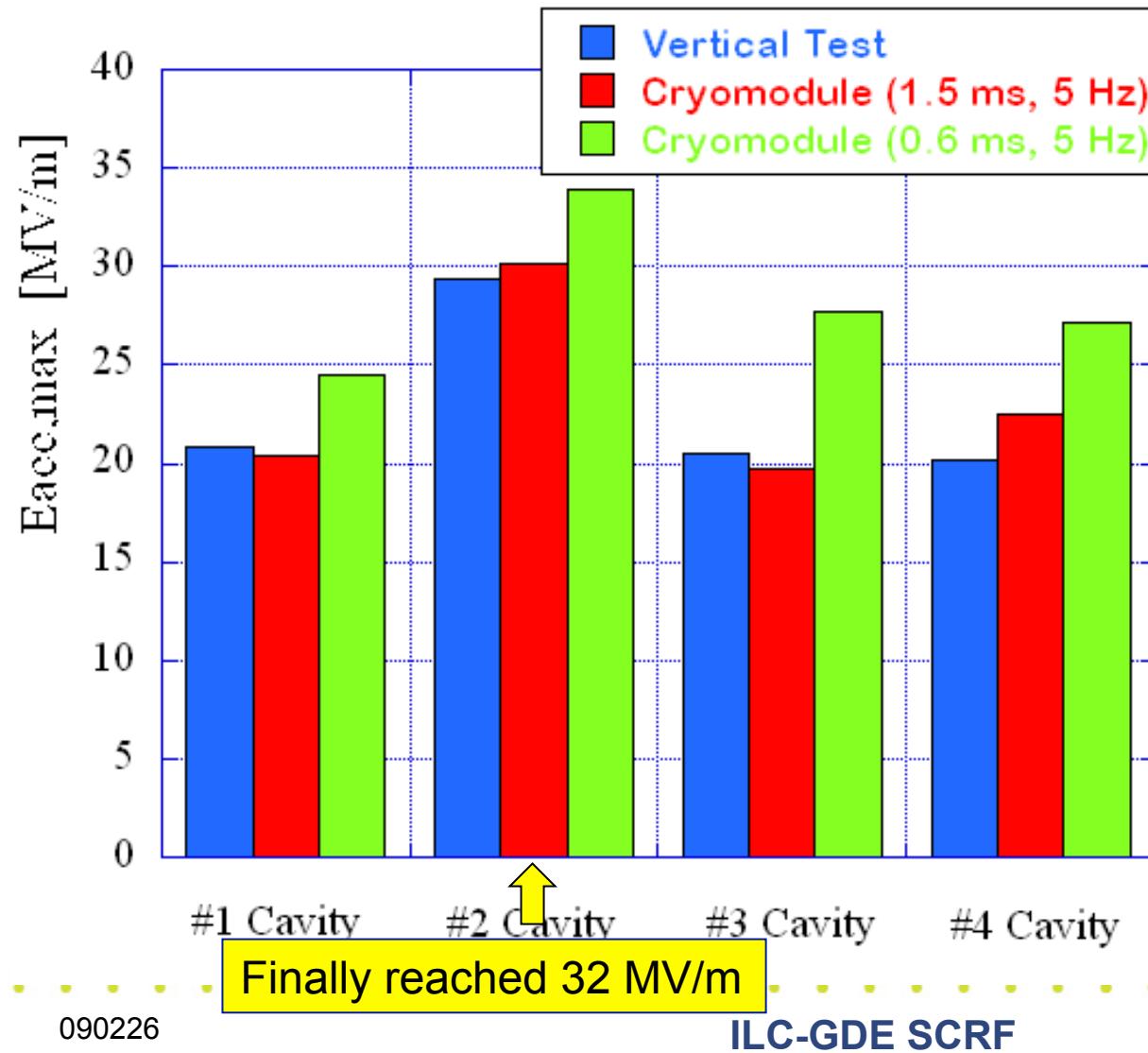


no piezo drive
no pre-detuning



no piezo drive
pre-detuning ($\Delta f = +300$ Hz)

KEK: 9-cell Cavity in VT/Cryomodule



high power test, one by one



high power test, with 4 cavities



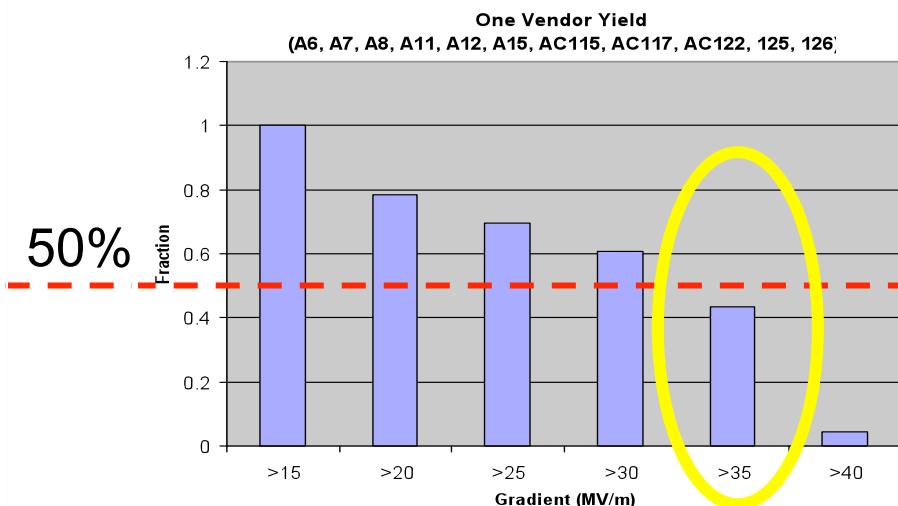
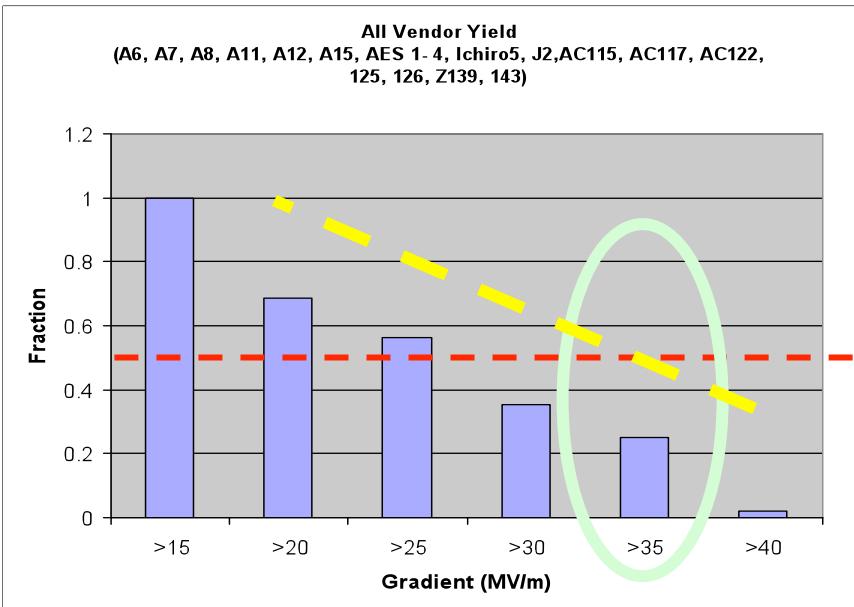
Global Yield of Cavities Recently Tested at Jlab and DESY

48 Tests, 19 cavities

ACCEL, AES, Zanon, Ichiro, Jlab

23 tests, 11 cavities

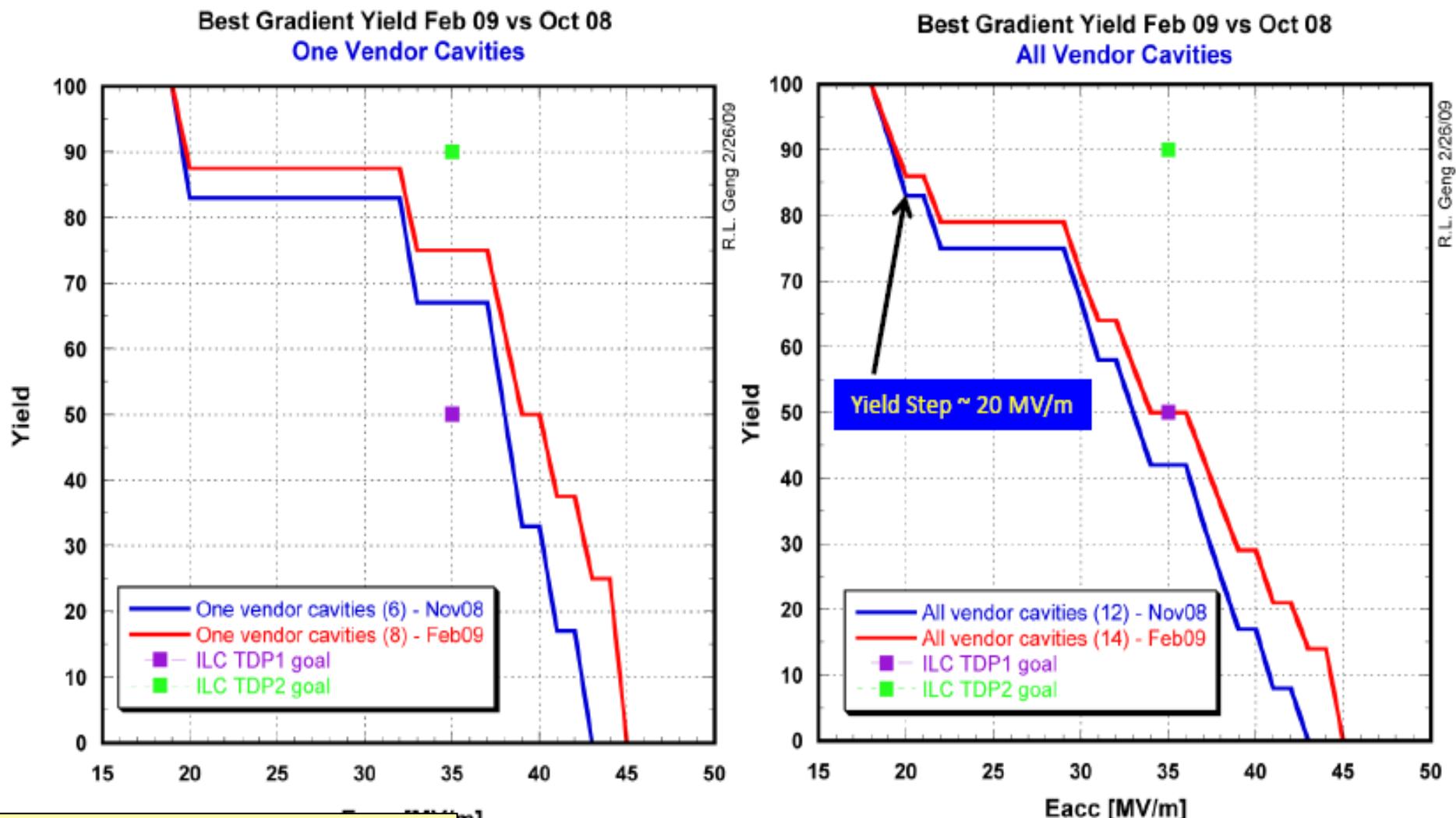
One Vendor



Yield 45 % at 35 MV/m being achieved
by cavities with a qualified vendor !!

Yield Curve – as of Feb 09

14 9-cell Cavities Processed & Tested at JLab



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TDP Goals of ILC-SCRF R&D

■ Field Gradient

- 35 MV/m for cavity performance in vertical test (S0)
- 31.5 MV/m for operational gradient in cryomodule
 - to build two x 11 km SCRF main linacs

■ Cavity Integration with Cryomodule

- “**Plug-compatible**” development to:
 - Encourage “improvement” and creative work in R&D phase
 - Motivate practical ‘Project Implementation’ with sharing intellectual work in global effort

■ Accelerator System Engineering and Tests

- Cavity-string test in one cryomodule (S1, S1-global)
- Cryomodule-string test with **Beam Acceleration** (S2)
 - With one RF-unit containing 3 cryomodule

What do we need to re-visit?

In Superconducting Cavity R&D

■ Niobium Sheet metal cavity



■ Fabrication:

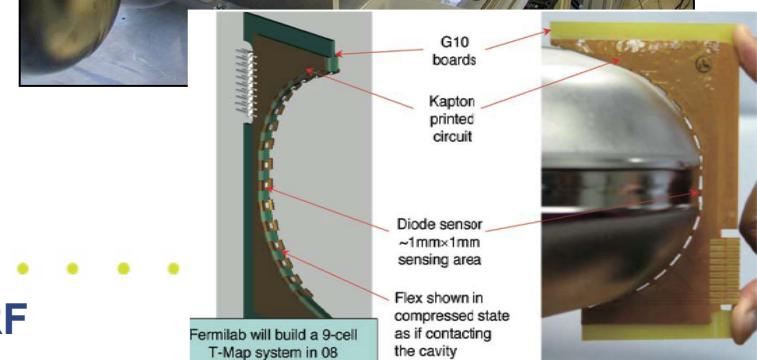
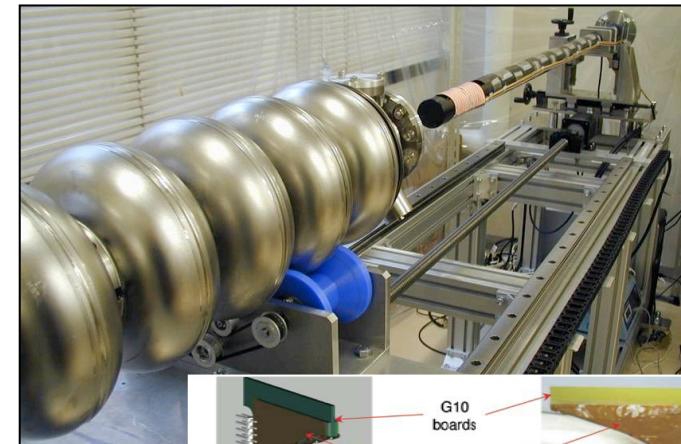
- Forming and **welding (EBW)**
- Local repair

■ Surface Process:

- Chemical etching/polishing
- Cleaning

■ Inspection/Tests:

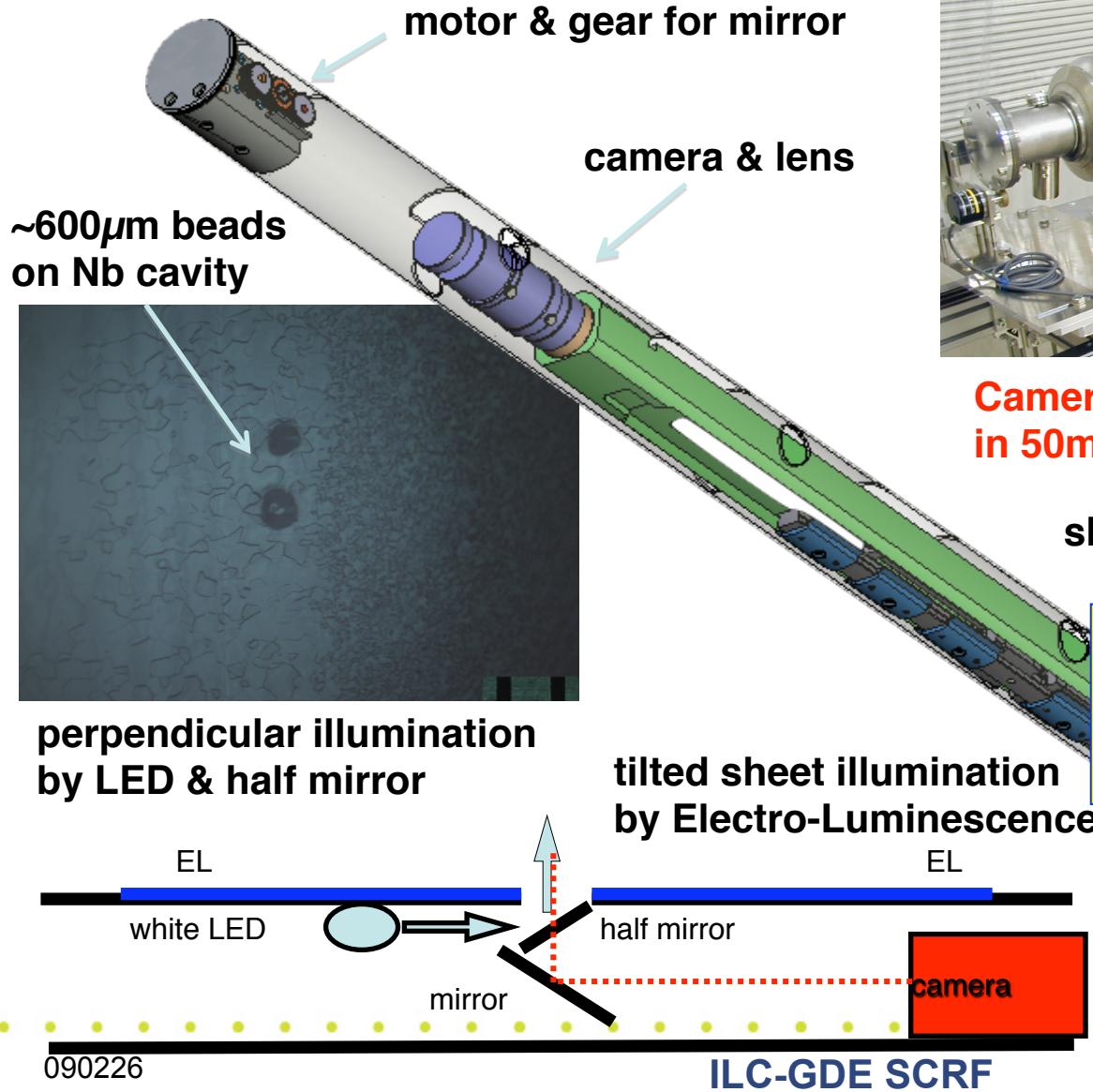
- **Optical Inspection (warm)**
- Surface Analysis (warm)
- Thermometry (cold)





A New High Resolution, Optical Inspection

For visual inspection of cavity inner surface.



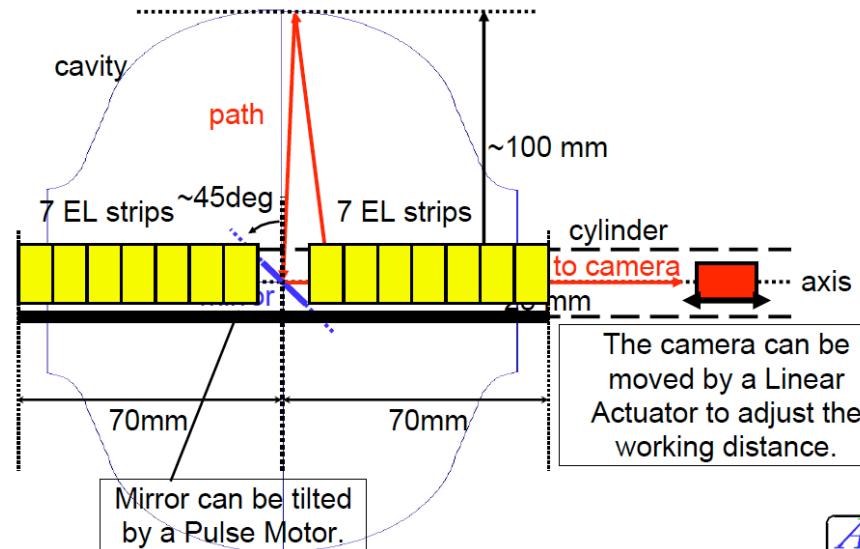
Camera system ($7\mu\text{m}/\text{pix}$)
in 50mm diameter pipe.

sliding mechanism of camera

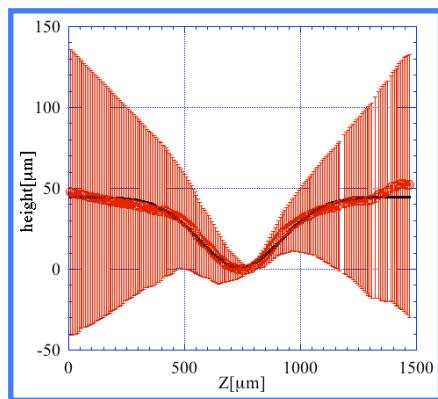
DESY and FNAL starting to
use this system in
cooperation with KEK

Concept of Profile Measurement

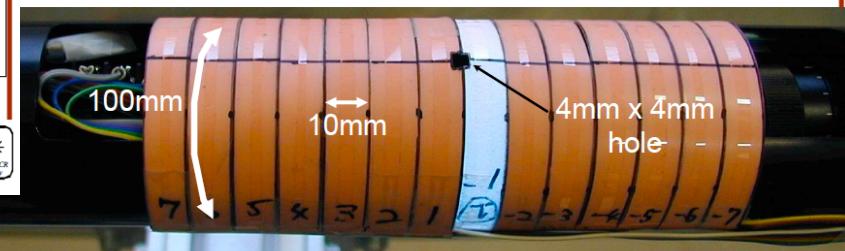
Inside the Cylinder



TTC Meeting at DESY, January 14 - 17, 2008



Stripe Illumination(SI)



- Fourteen Electro-Luminescence(EL) strip sheets are 10mm in axial direction and cover 100mm in azimuthal direction.
- These fourteen strips can be turned ON/OFF one by one.
- Assuming that cavity's interior surface is a complete mirror, we can measure wall gradients of the cavity's interior surface with these ELs.

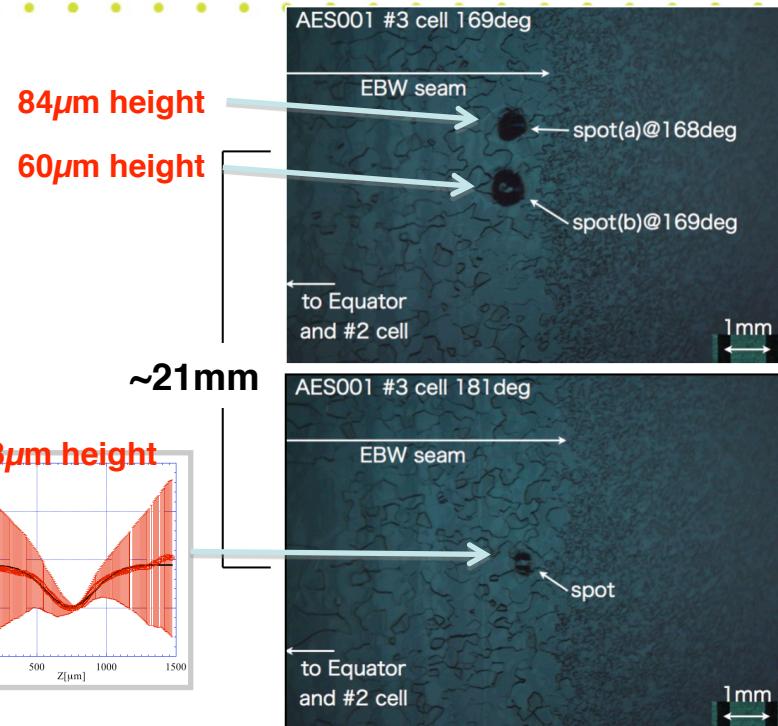
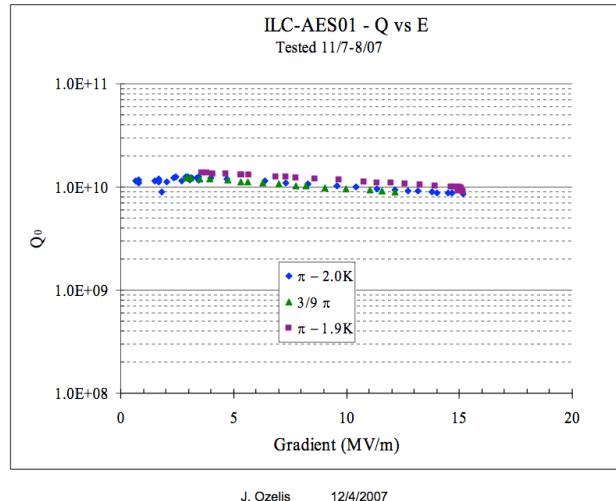
TTC Meeting at DESY, January 14 - 17, 2008



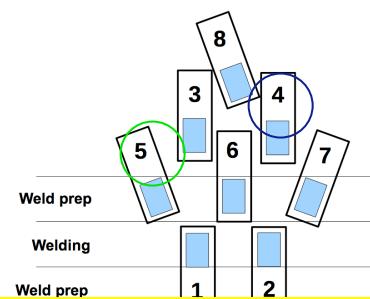
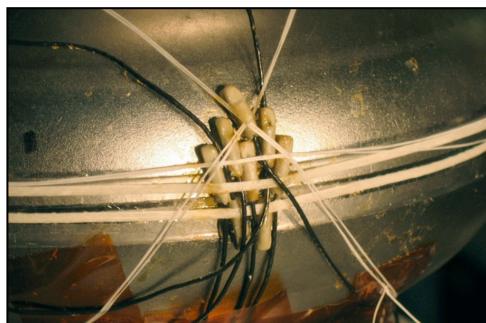
iLC

Consistent with Thermal Measurement at FNAL

3rd Test Results



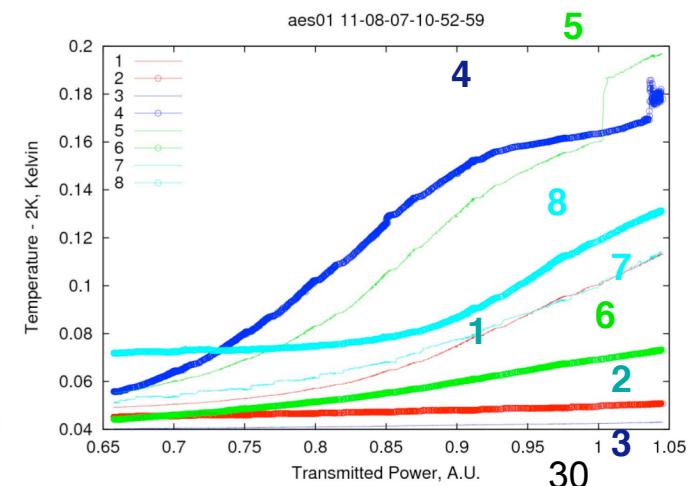
AES01 has hard quench at 15MV/m,
its location was identified by Cernox at FNAL,
(M. Champion et al., ASC-08)



Kyoto-camera found 3 spots in their exact location

090226

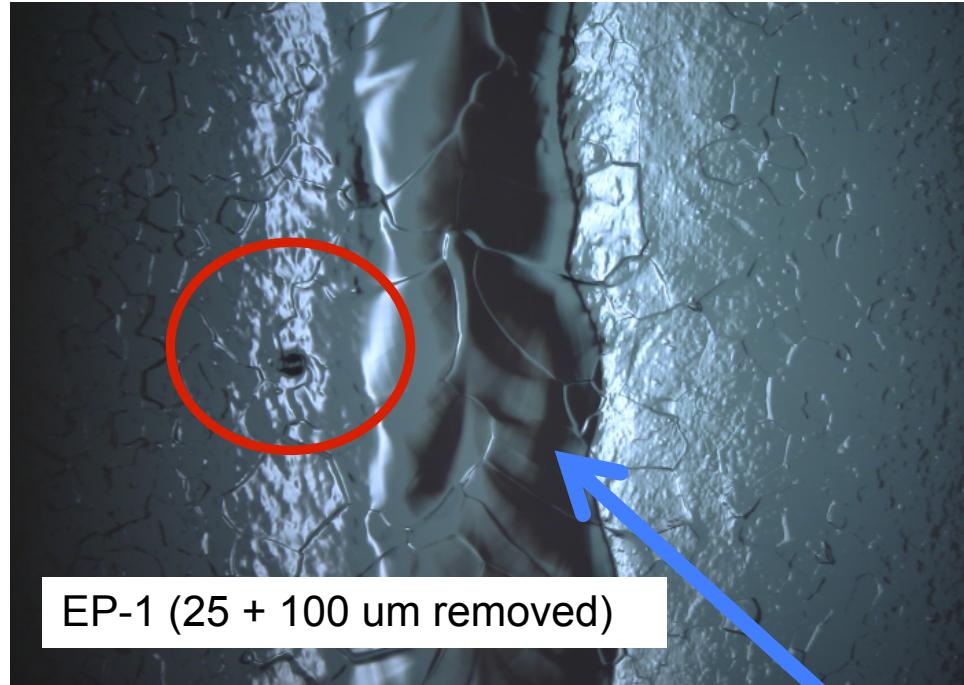
ILC-GDE SRF



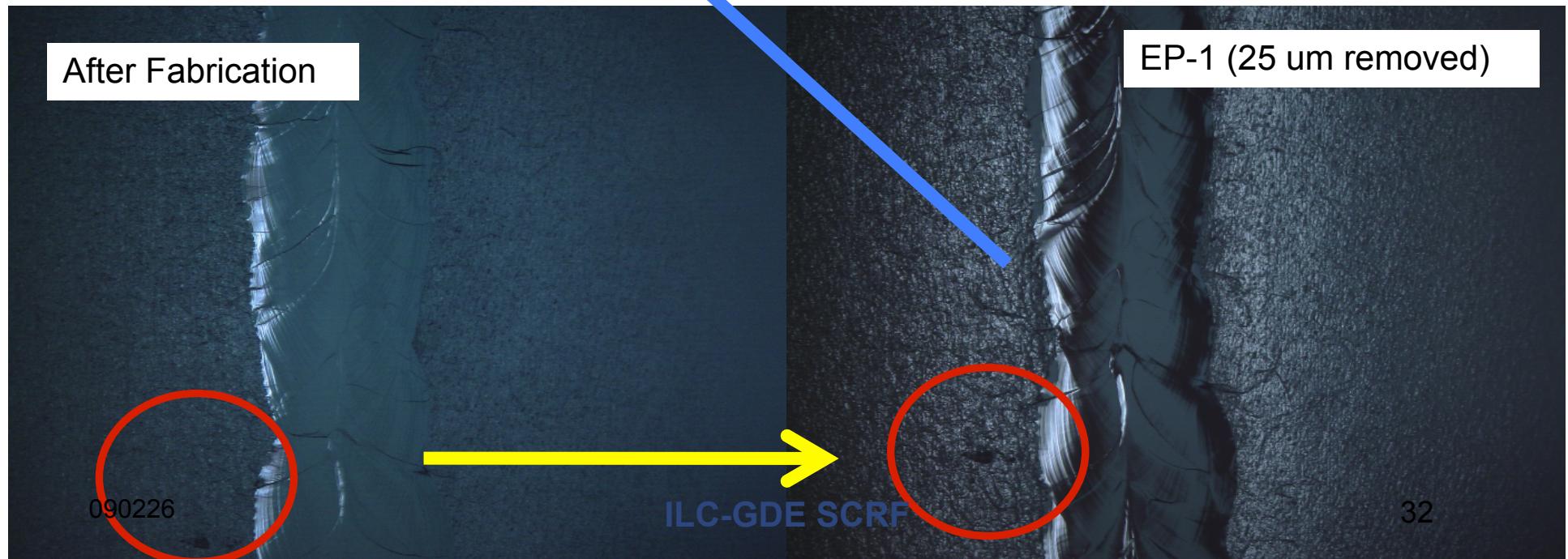


Guideline: Standard Procedure and Feedback Loop

	Standard Fabrication/Process	Acceptance Test/Inspection
Fabrication	Nb-sheet purchasing	Chemical component analysis
	Component Fabrication	Optical inspect., Eddy current
	Cavity assembly with EBW	Optical inspection
Process	EP-1 (~150um)	
	Ultrasonic degreasing with detergent, or ethanol rinse	
	High-pressure pure-water rinsing	Optical inspection
	Hydrogen degassing at 600 C	
	Field flatness tuning	
	EP-2 (~20um)	
	Ultrasonic degreasing or ethanol	
	High-pressure pure-water rinsing	
	General assembly	
	Baking at 120 C	
Cold Test (vertical test)	Performance Test with temperature and mode measurement	If cavity not meet specification Optical inspection



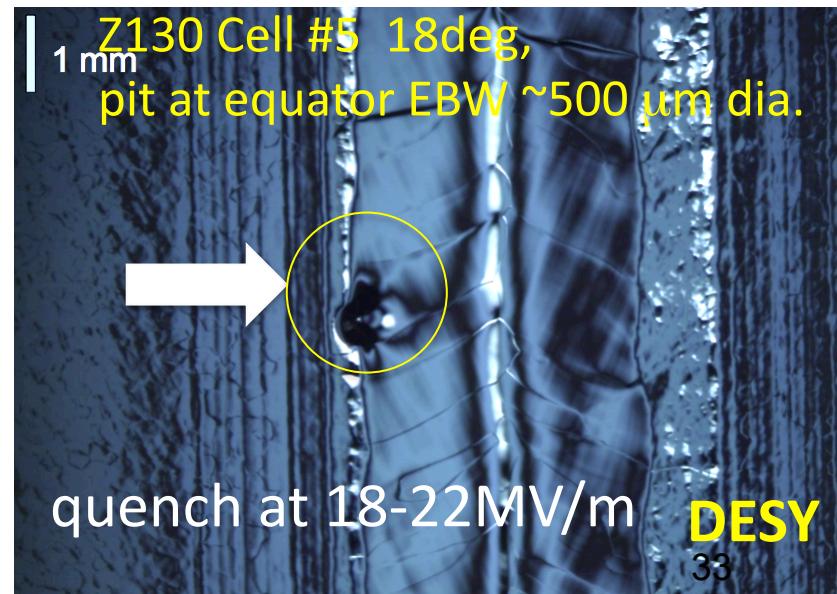
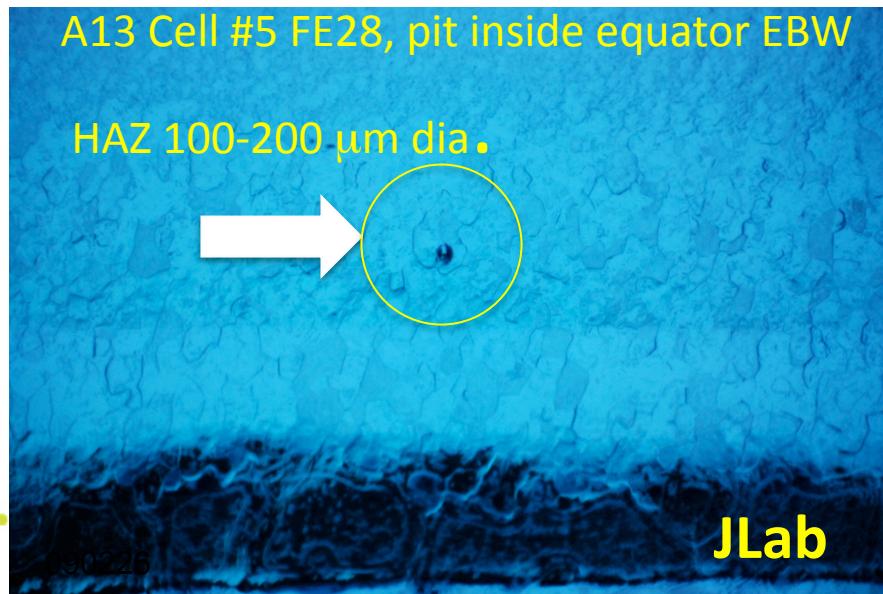
Comparison with each treatment



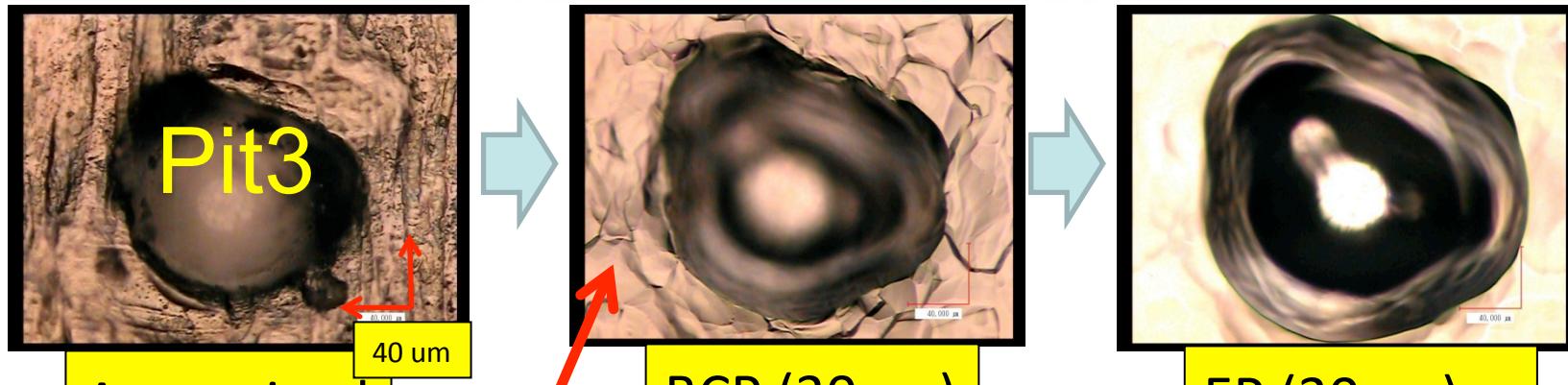
From TTC-09a Summary (by H. Padamsee)

- Sources for quench **below 25 MV/m** have been identified
- Thermometry first used to locate quench regions followed by **optical inspection**.
- Quench sites are predominantly **bumps and pits** on the **equator e-beam weld (EBW)**, or in the **heat affected zone**.

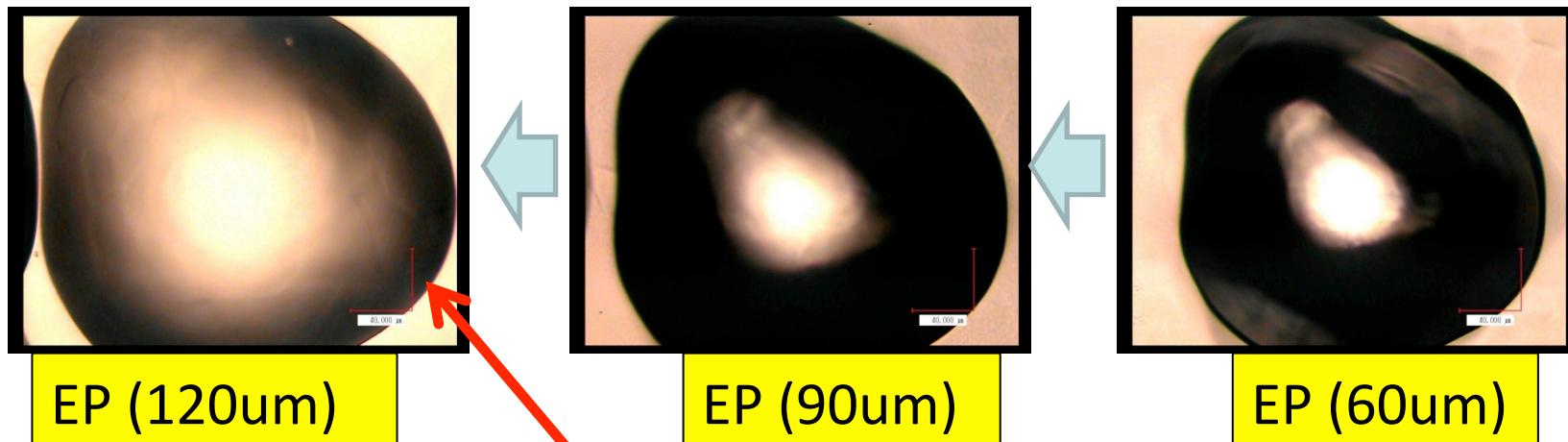
Picture example reported



Pit-shape development on Nb sample in EP



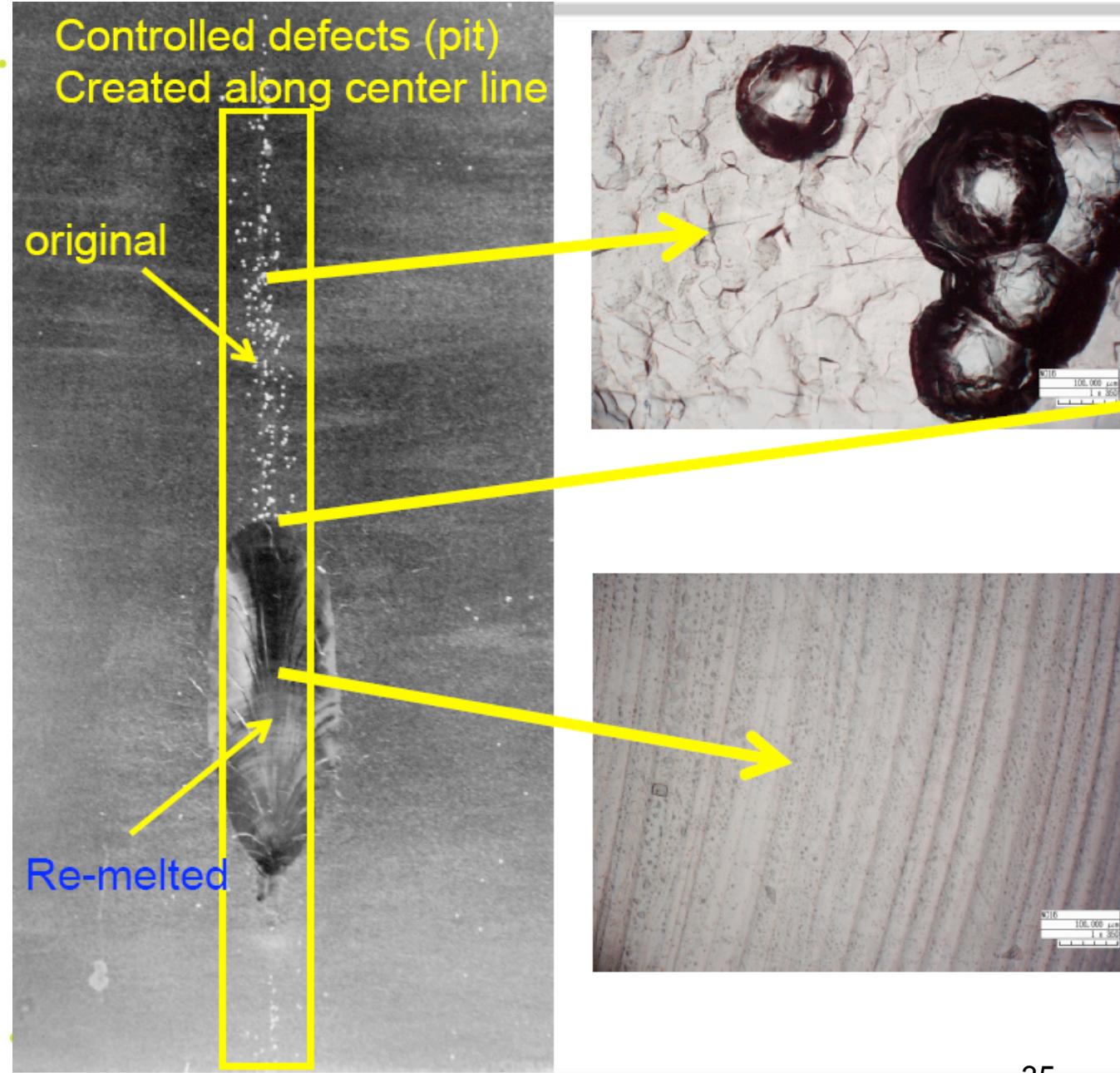
Large steps at grain-boundaries after BCP.



Edge of pit remain sharp, even after BCP(30um)+EP(120um)

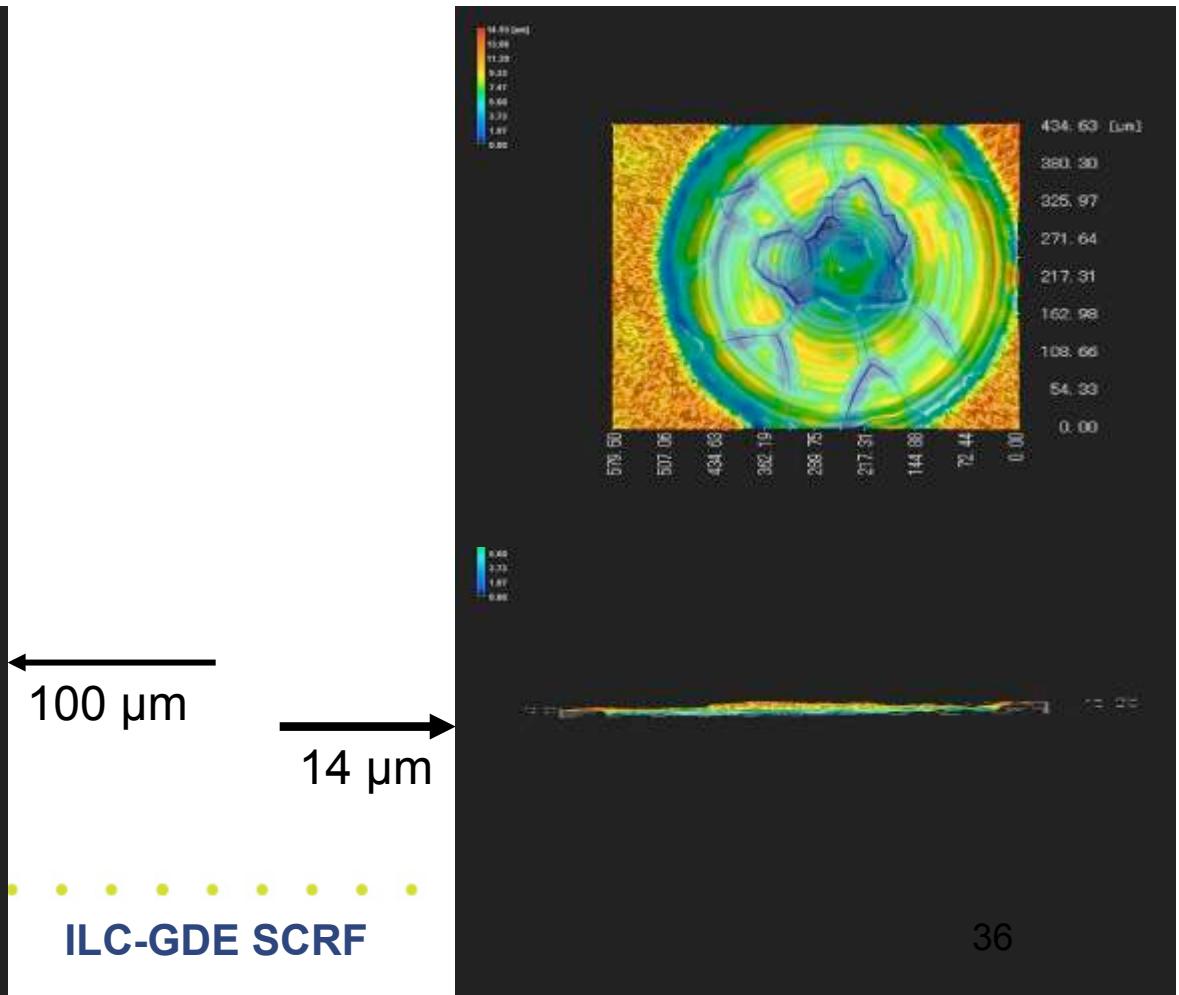
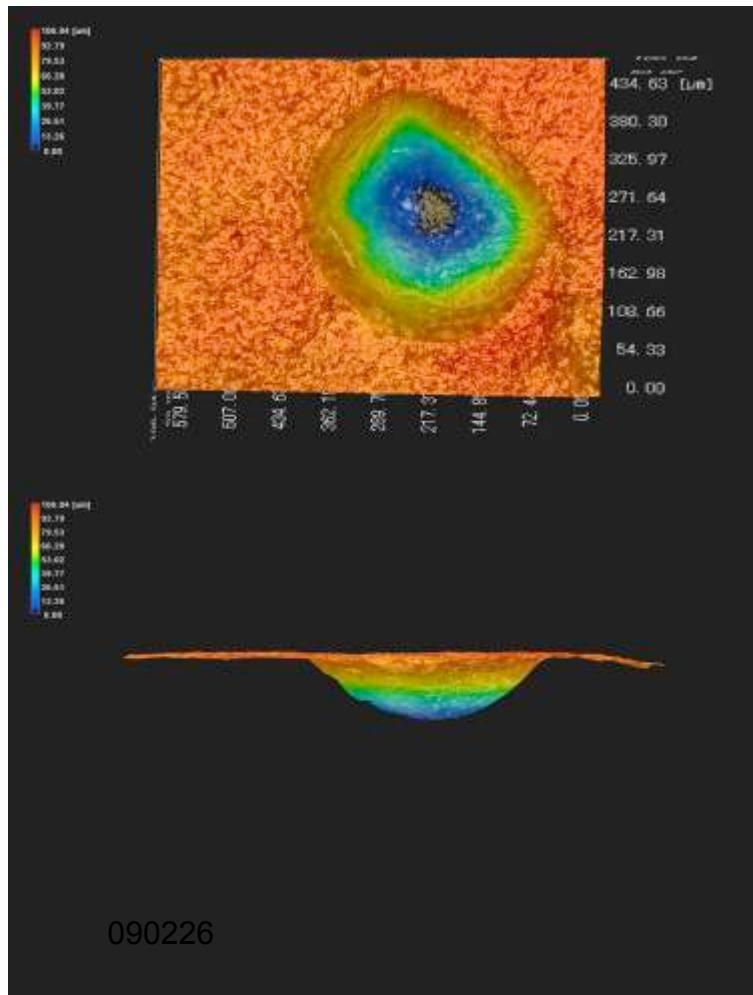
- E-beam melting to repair pits
- Try this on a single cell ?

A summary from TTC
(H. Padamsee)
090226



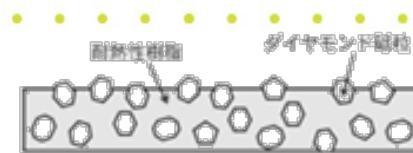
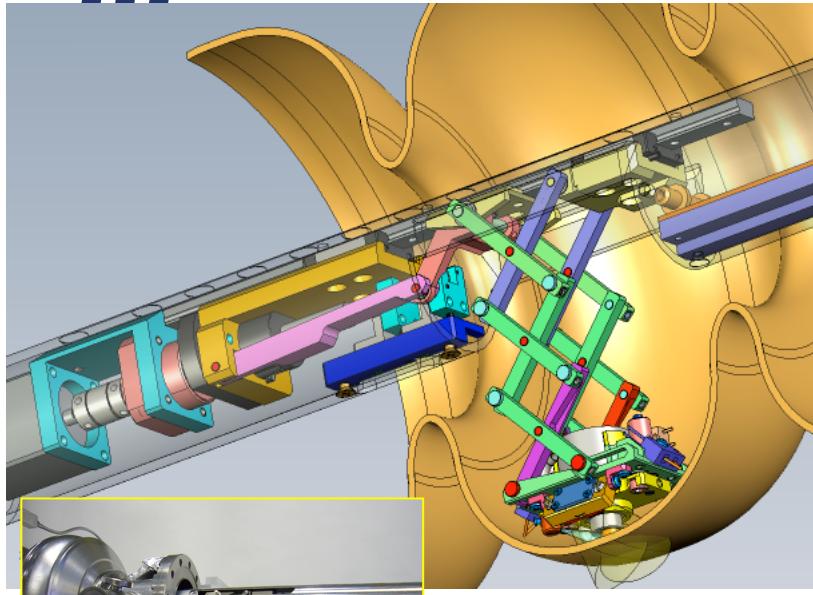
Laser Melting Shows Potential for Repair of Pits

- A pit cannot be removed by BCP or EP, even after ~ 150 μm removal, in recent investigations
- Laser melting experiments at Fermilab show potential for repair of pits:
 - Irregular pit with depth ~ 100 μm melted to form shallow circular pit of depth ~ 14 μm
 - Investigations ongoing; plan to test repair method using single-cell cavity



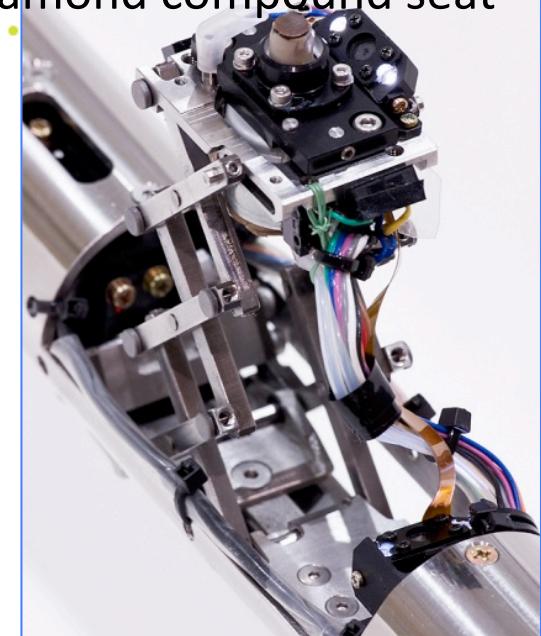


Grinding Effort at KEK

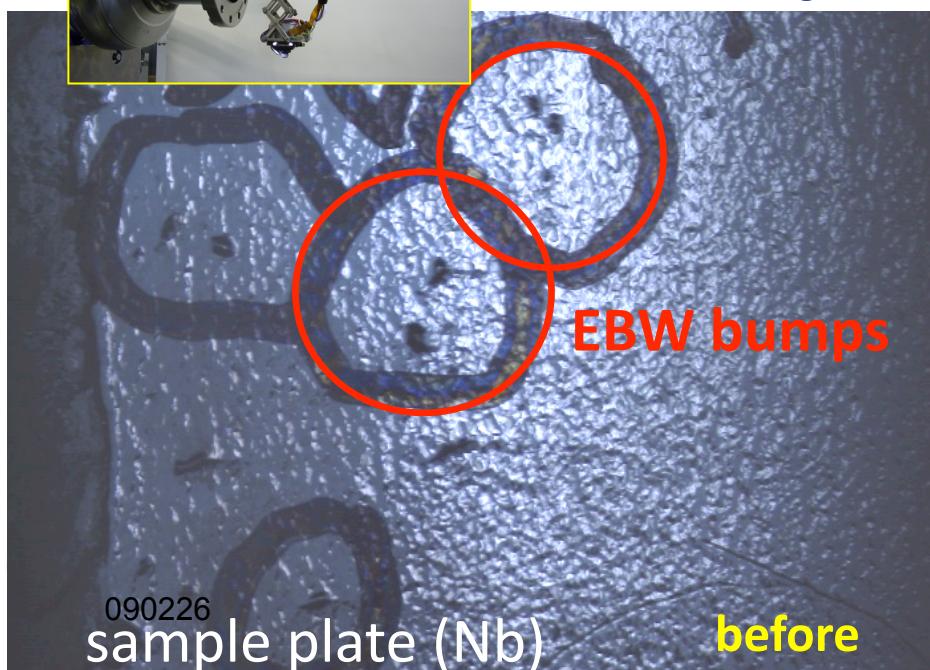


Diamond compound seat
#400 (size = 40 ~ 60 μm)
as for 1st test

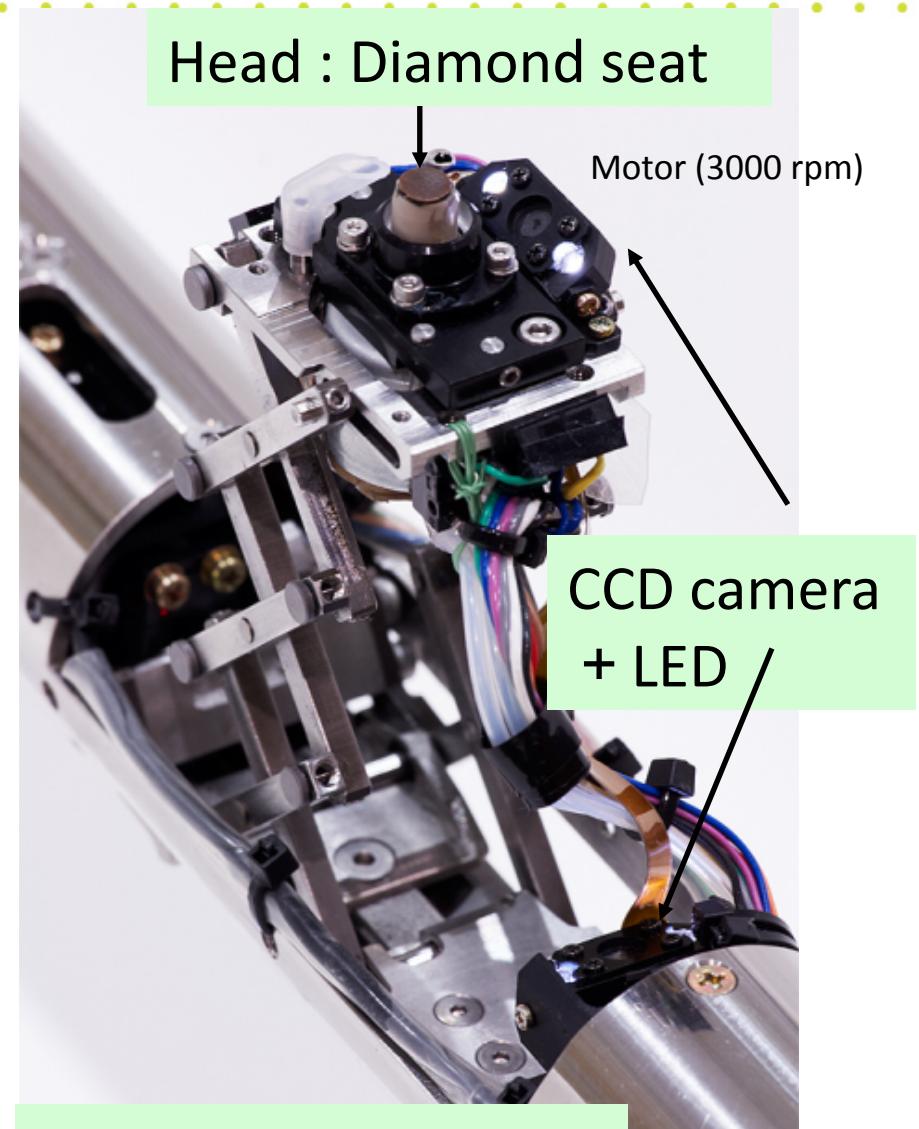
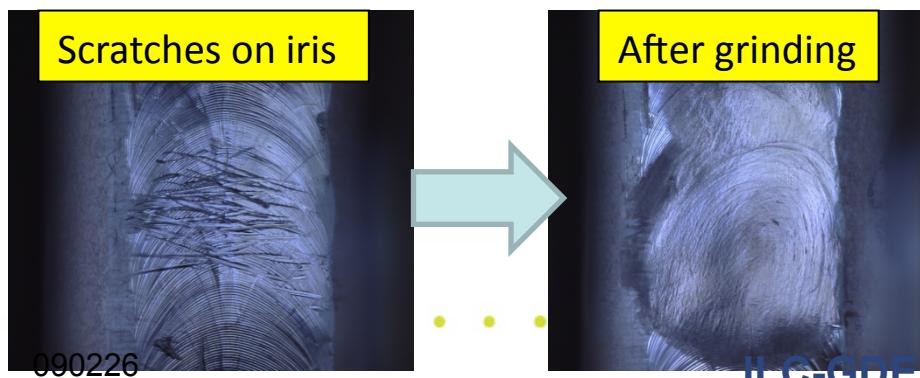
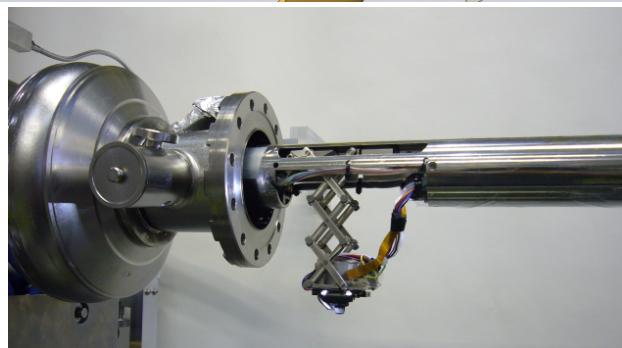
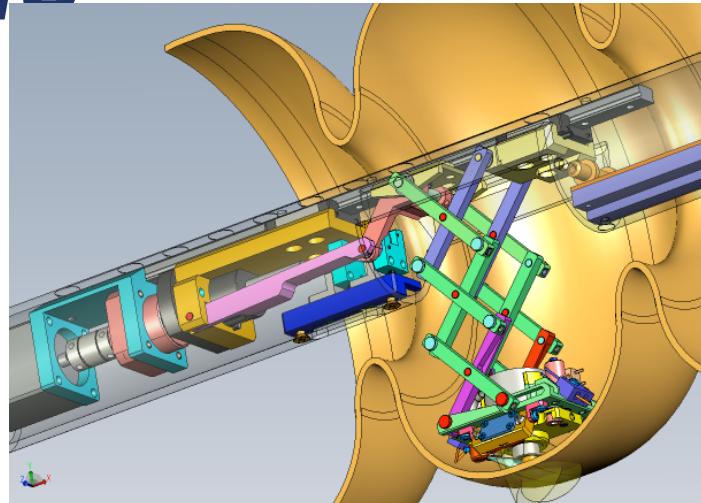
Grinder Head with
Diamond compound seat



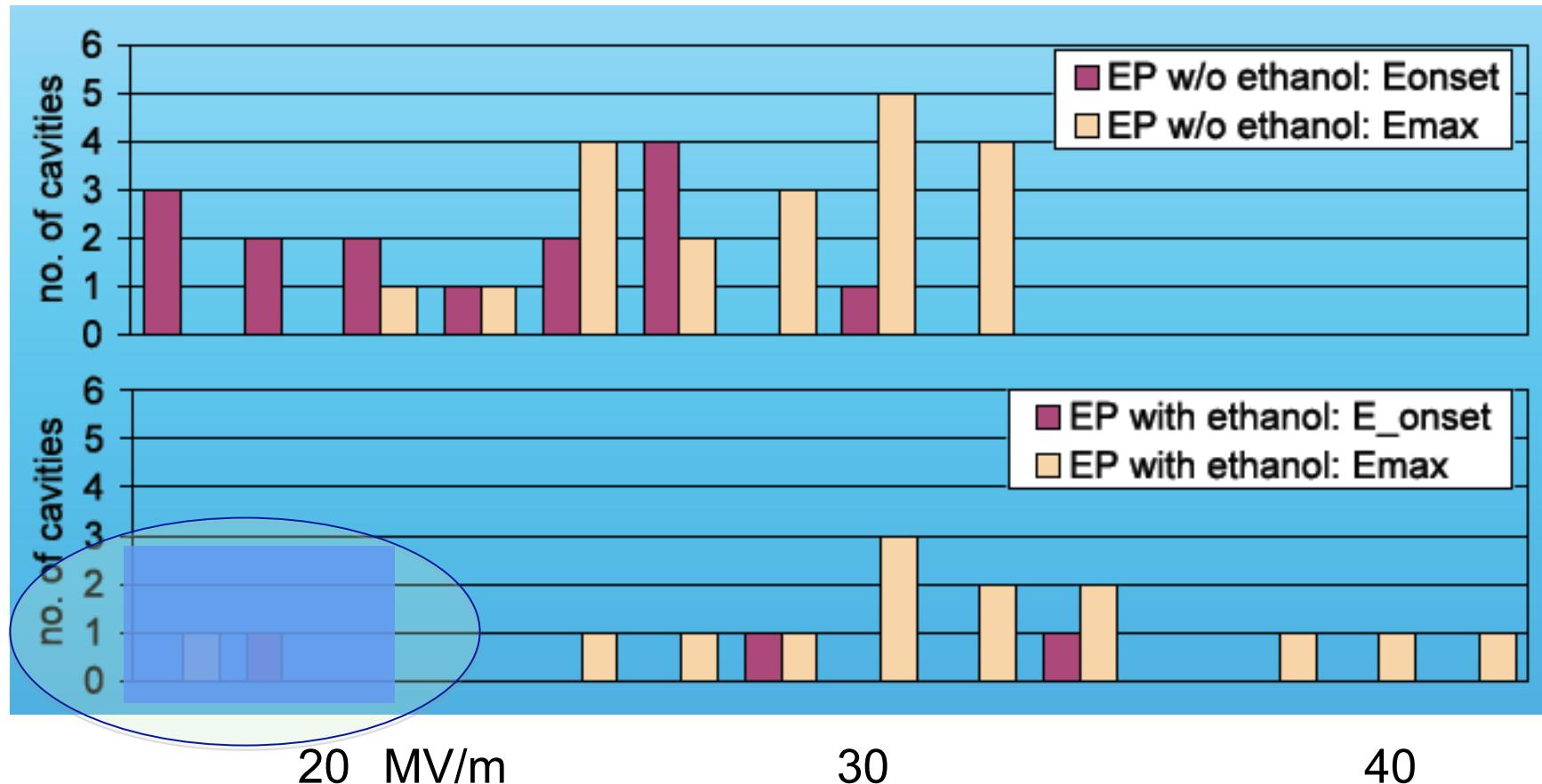
Grinding machine was delivered in last week.



Partial mechanical grinding to remove the defects



After Better Understanding To Exclude Mechanical Defect



Field gradient improved by 'ethanol rinse', and it may be more evident, if the "lowest sample" (limited due to different reasons) may be eliminated.

Rinse Effect to Remove Sulfur precipitation/contamination

Teflon texture ➤

Before rinse

Many white dots are sulfur contamination

U.P.W. ultrasonic rinse

After rinse

Ethanol ultrasonic rinse

FM-550 (>10%) rinse

Sulfur removed

Sulfur removed

	U.P.W. ultrasonic rinse	Ethanol rinse (vibration)	Ethanol ultrasonic rinse	Detergent FM-550 2 %	Detergent FM-550 5 %	Detergent FM-550 10 %	Detergent FM-550 20 %
Cleaning Result 090226	✗	△	○	△	△	○	○ 40



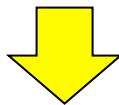
Summary of R&D Efforts/Subjects

- Establish technology for **defect-free production**, with “quick” feedback using inspection camera results
 - Upgrade “inspection camera”, and
 - Develop other inspection tools,
- Identify, more accurately, origin of field emission after surface treatment
 - Research and improve “surface-analysis”: XPS, SEM ,,,
- Establish and Demonstrate countermeasures:
 - The final treatment to remove FE source such as **sponge wipe**, degreaser rinse, ethanol rise,
 - **Repair method such as grinding tool** for curing damaged cavities



Importance of Plug-compatibility in Development Stage

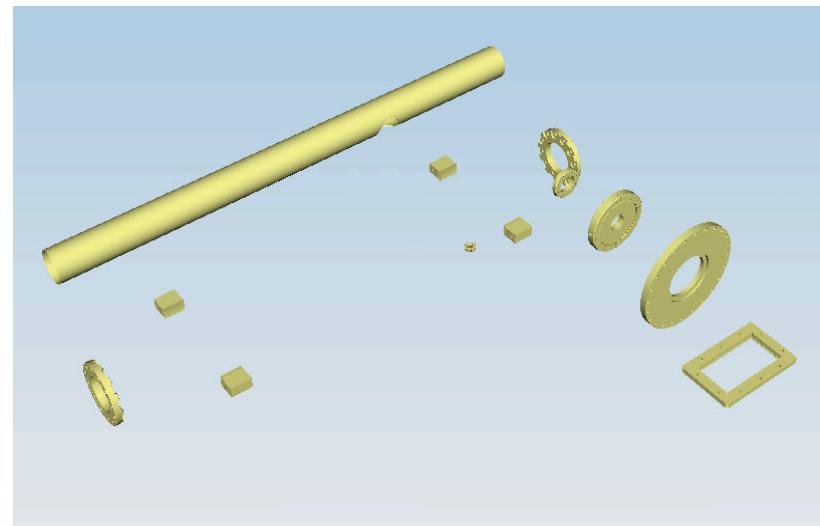
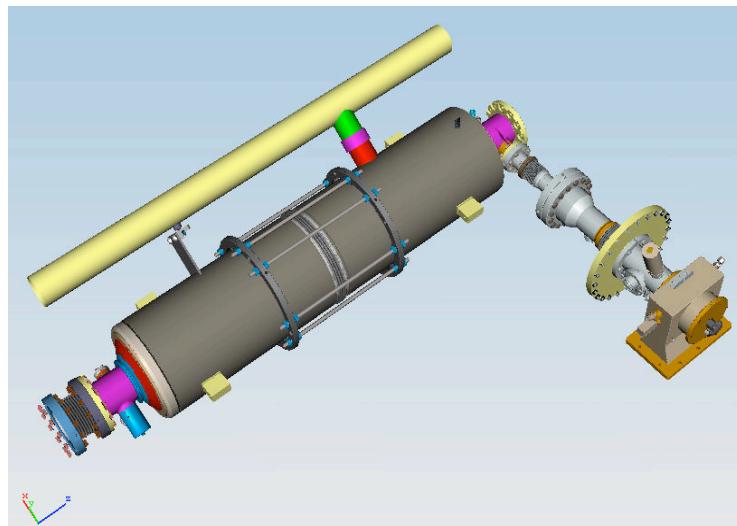
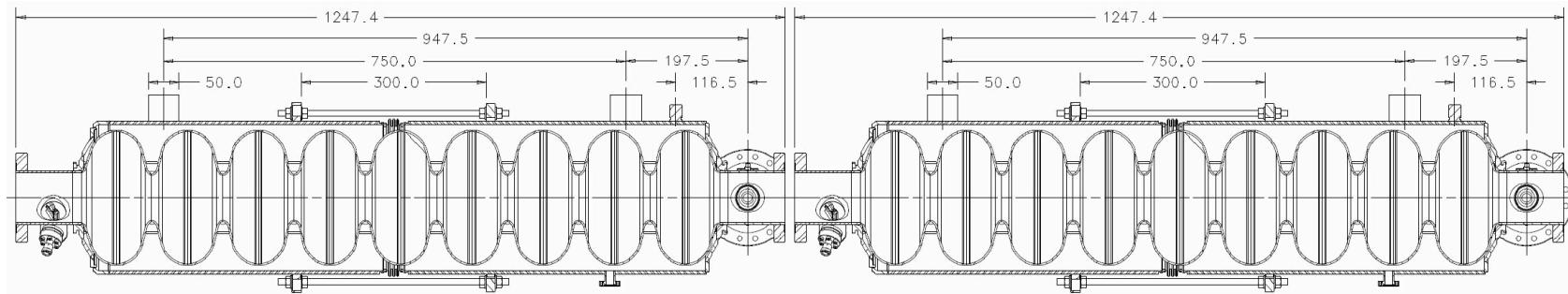
- Creative/Innovative work for further improvement with keeping “redundancy” and “replaceable >> plug-compatible” condition
- Seek for Cost-effective Fabrication for “mass production”
- Global cooperation and share for intellectual engagement



- “Plug-compatibility” essentially important.

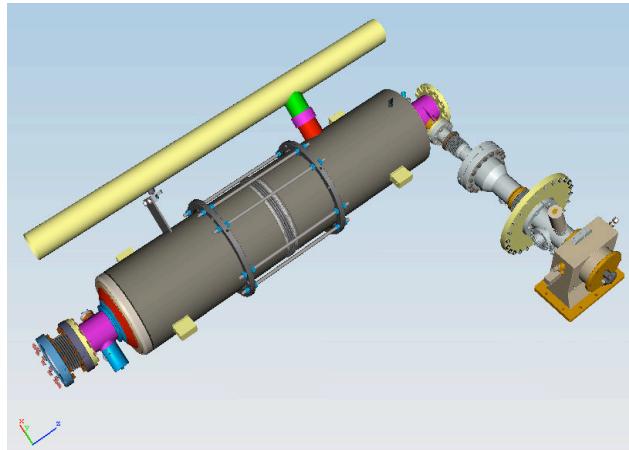
Plug-compatibility of Cavities

Important for Global Cooperation



Plug-compatible interface being established

Plug-compatible Conditions

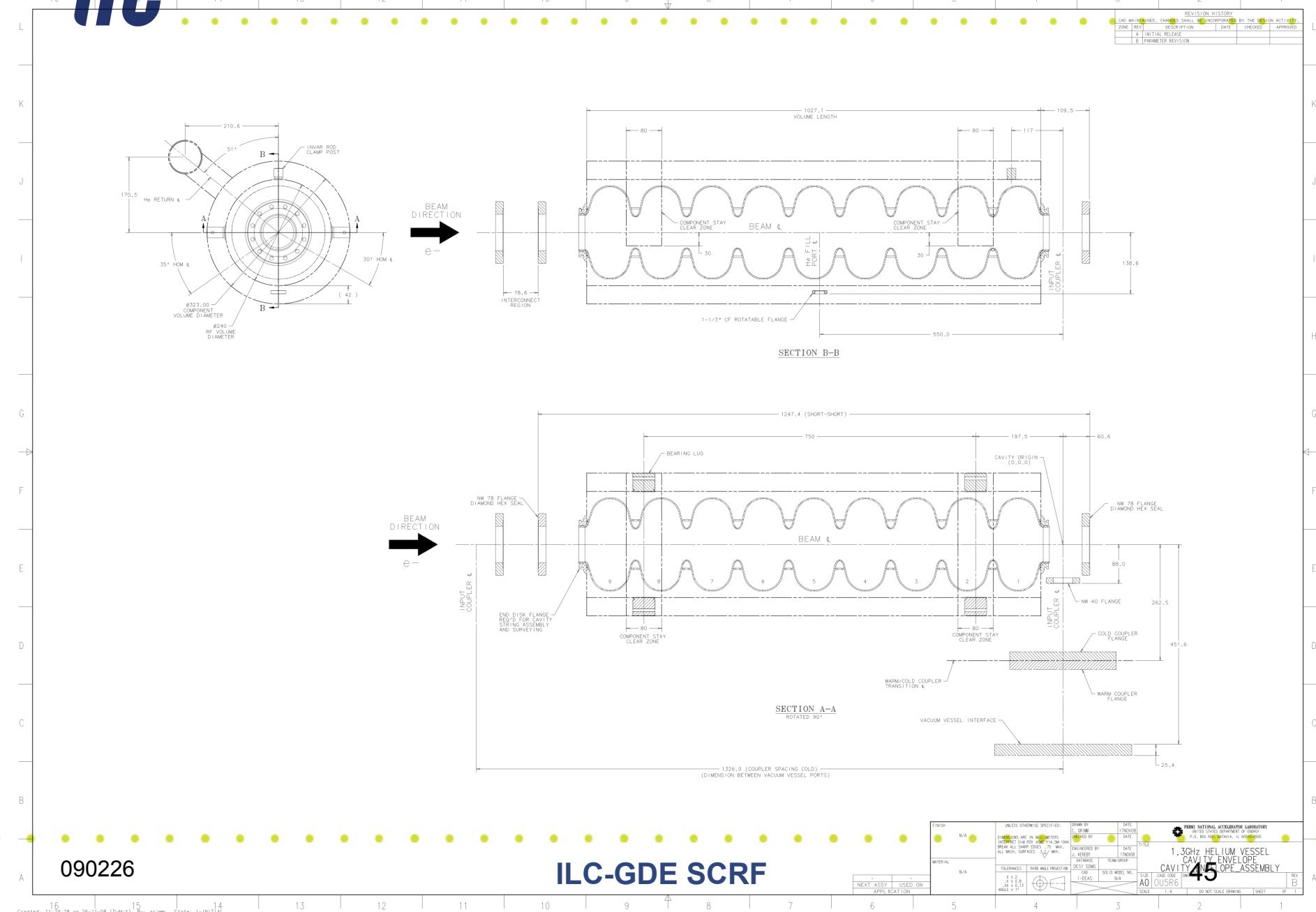


Item	Can be flexible	Plug-comp.
Cavity shape	TeV / LL / RE	
Length		Fixed
Beam pipe flange		Fixed
Suspension pitch		Fixed
Tuner	Blade/Jack	
Coupler flange (warm end)		Fixed
Coupler pitch		fixed
He -in-line joint		TBD

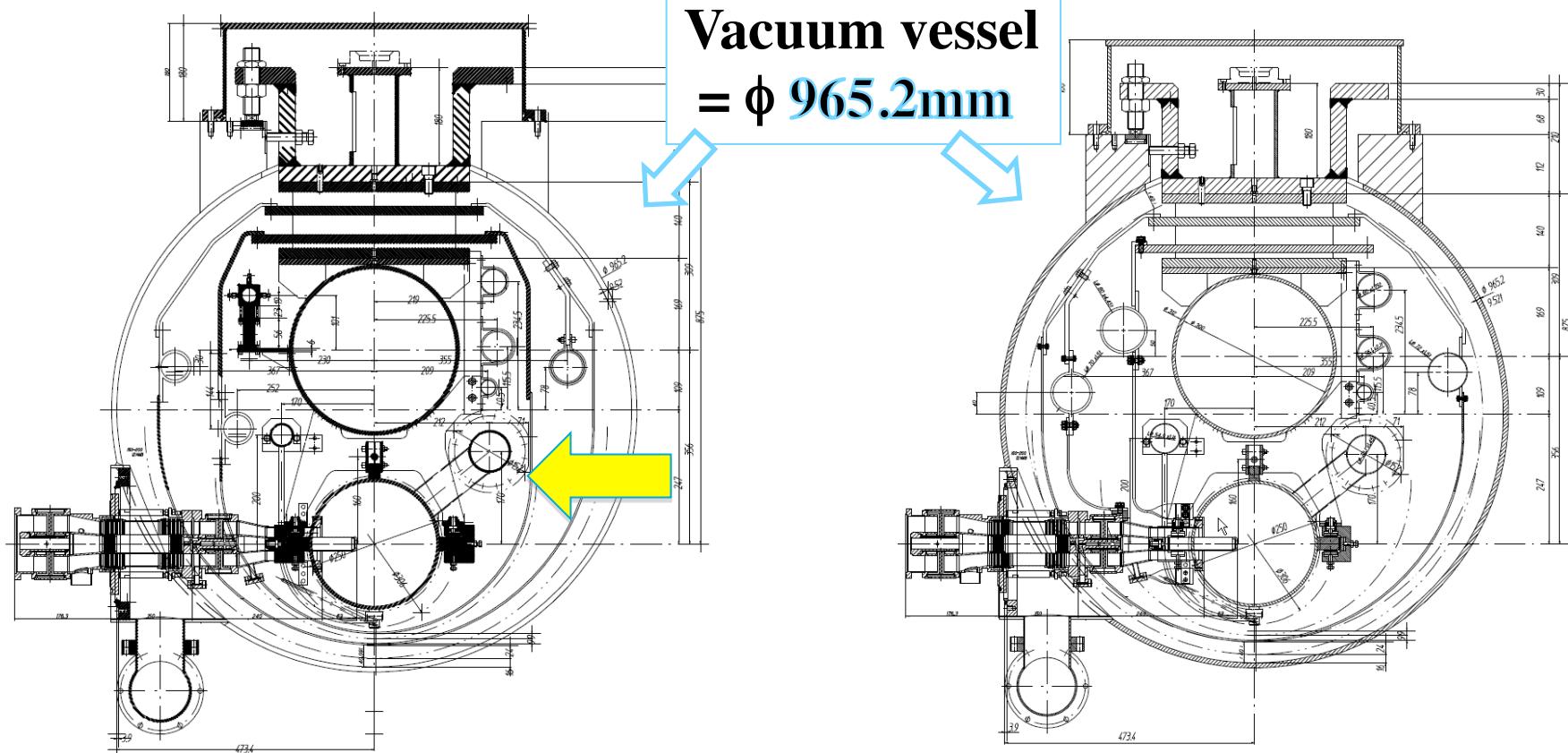
Plug-compatible interface being established



Cavity: Plug-compatible Interface



Study of the “plug-compatible” cryomodule cross-section



**Two shields model based on
TTF-III**

090209

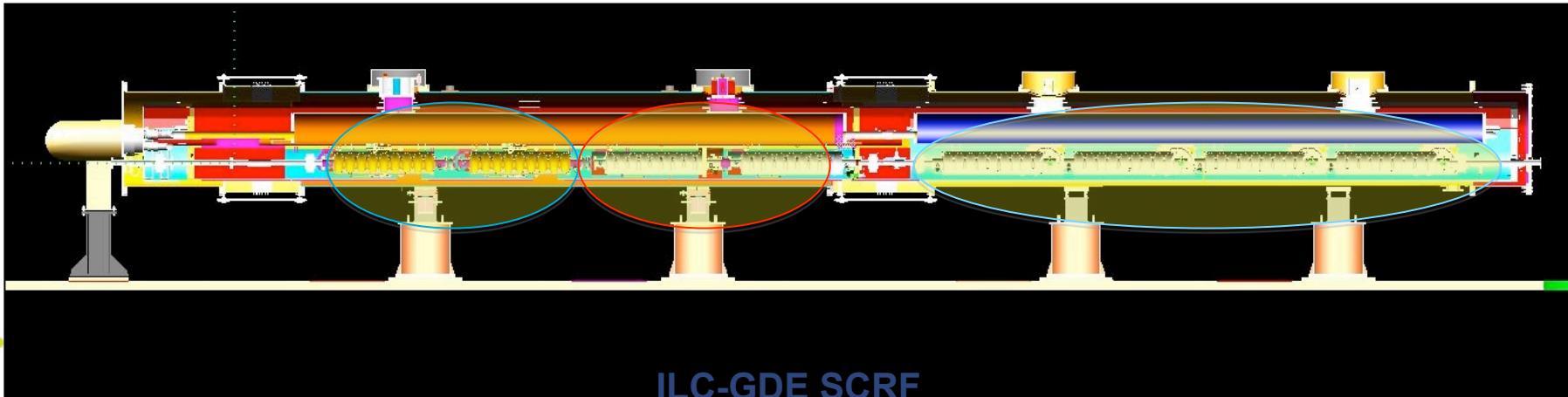
ILC Global Design Effort

**One shield model to
save fabrication cost⁴⁶**



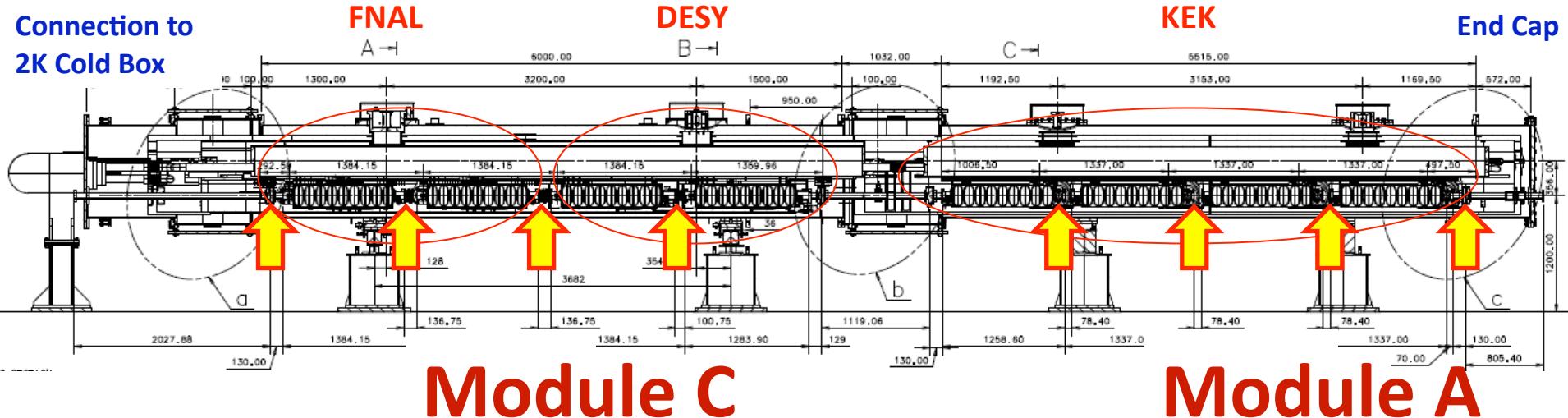
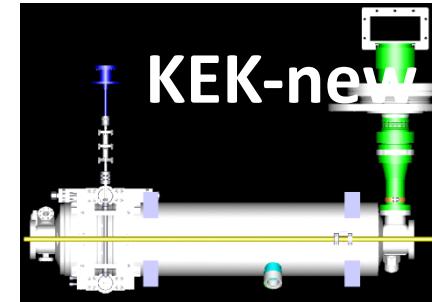
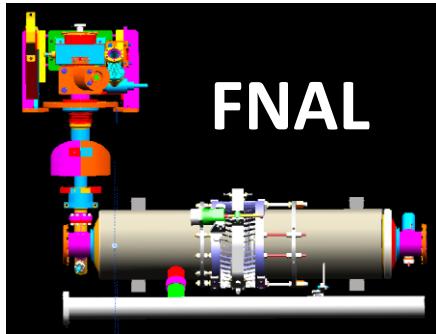
Cavity String Test in Cryomodule with Plug Compatibility

- Cavity integration and the String Test to be organized as a global cooperation (**S1-Global**):
 - **2 cavities from EU (DESY) and AMs (Fermilab)**
 - **4 cavities from AS (KEK)**
 - **Cryomodules: from EU (INFN) and AS (KEK)**
- A practice for the plug-compatible assembly





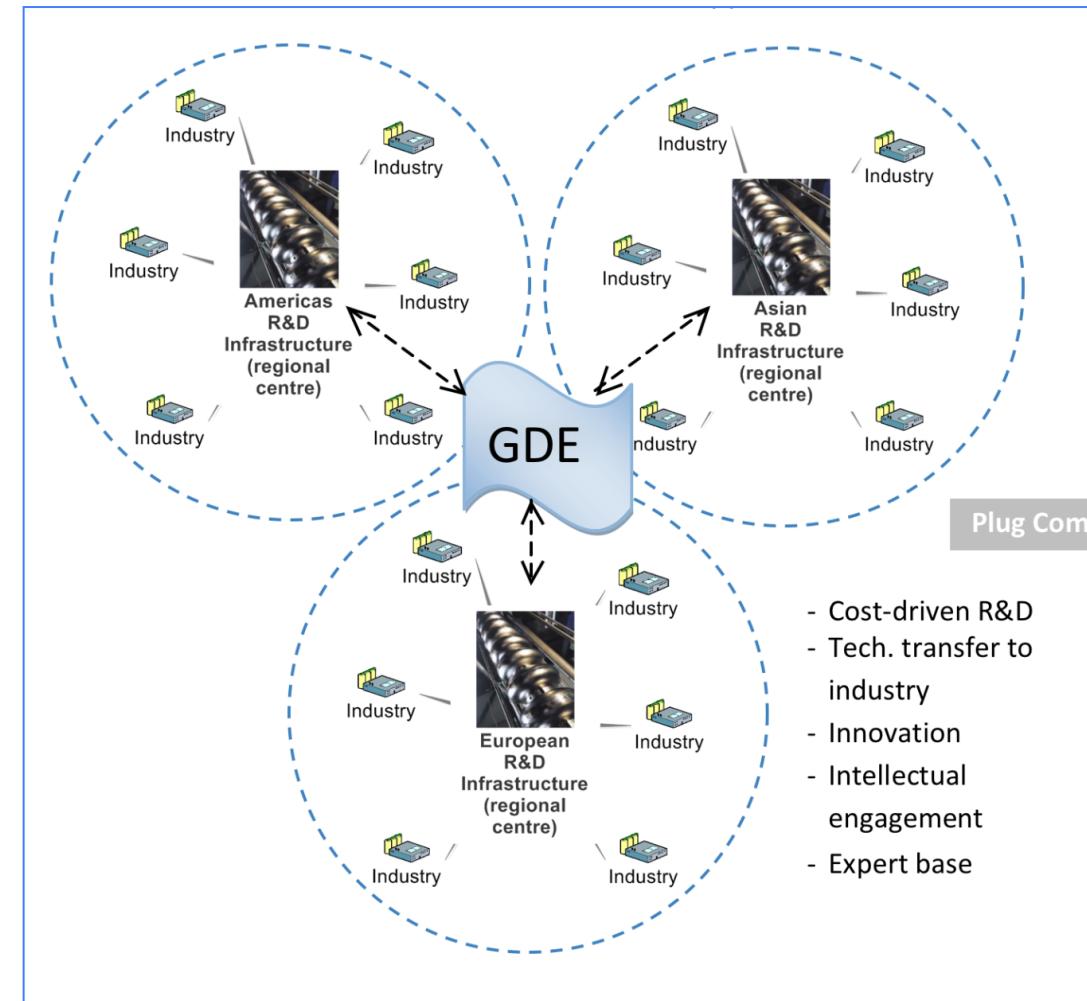
S1-Global Cryomodule design



- **Module C:** 2 FNAL cavities and 2 DESY cavities, **Module A:** 4 KEK Tesla-like cavities
- The total length=14978mm
 - Module-C = 6000 mm, Module-A = 5515 mm

Global Cooperation: Plug-compatible Design and R&D

- Cost driven R & D process
- Innovative and Intellectual engagement
- Technology transfer to Industry
- Expert base



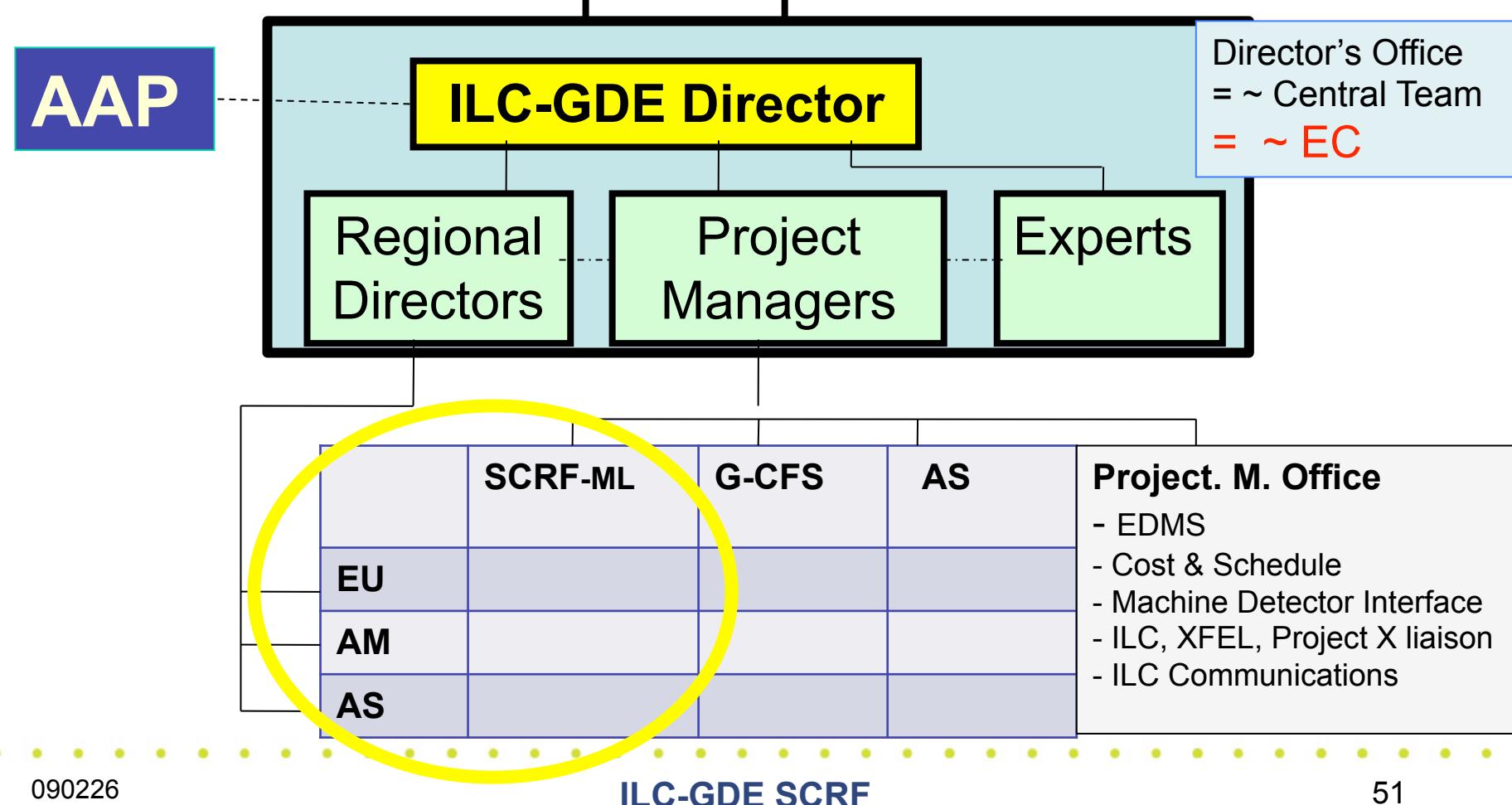
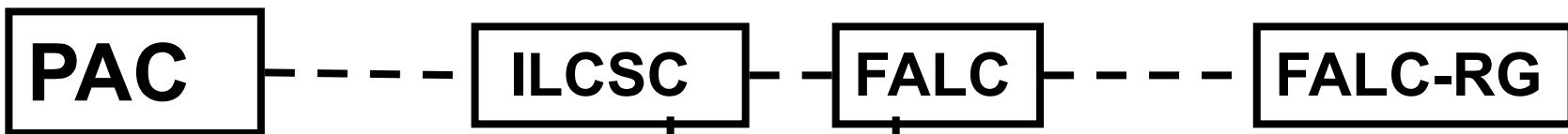


Outline

- Introduction
- R&D Status
- Plan for Technical Design Phase
- Global Plan and Project Management
- Summary



ILC-GDE Organization in TDP





SCRF Area Organization in TDP

as of Sept., 2008

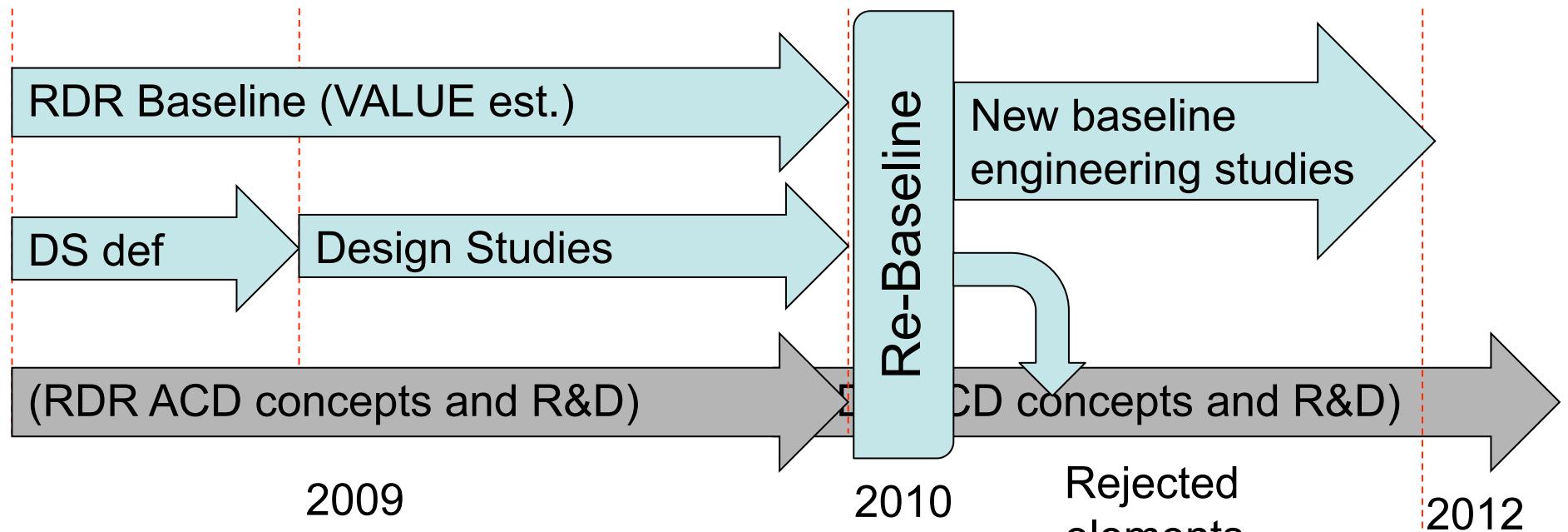
Regional Effort:			SCRF Technical Effort:					
	Institute	Institute Leaders	Cavity: Process Lilje	Cavity: Integ. Hayano	Cryomodule Ohuchii/ Carter	Cryogenics Peterson	HLRF (LLRF) Fukuda	M LI Adolphsen
A M s	Cornell Fermilab SLAC ANL J-lab	Padamsee Kephart Raubenheimer Gerig Rimmer	Padamsee Champion Kelly Reece/	Champion Adolphsen	Champion	Peterson	Adolphsen	Adolphsen
E U	DESY CERN Saclay Olsay INFN CIEMAT	Brinkmann Delahaye Dael Wormser Pagani	Lilje	L. Lilje Prat Pagani	Parma Pierini	Tavian		
A S	KEK IHEP RRCAT/ BARC IUAC VECC 090209	Yokoya Gao Sahni Sahni/Mittal Roy Bhandari	Hayano Gao 	Hayano 	Tsuchiya/ Ohuchi 	Hosoyama / Nakai 	Fukuda 	Hayano

ILC Global Design Effort



Project Plan in 2008-2010

- Field gradient (S0)
 - **To be re-optimized, based on the R&D progress (2010),**
- Plug-compatibility
 - **Common interface conditions being fixed ,**
 - **Overview document published**
- System engineering/test plan, (S1, S2)
 - **Work sharing in cavity string in global effort (S1-Global)**
 - **Accelerator system test with beam**
 - Necessary detailed study and re-coordination under limited resources, including schedule
- Effort for “minimum machine”,
 - **Cluster or Distributed RF power sources and distribution,**
- Prepare for AAP Interium Review in April, 2009
- **Global Communication and cooperation with Laboratories & Industries**
 - Visit Industries: **ACCEL, ZANON, AES, Niowave, MHI, (PAVAC in May)**



- Process
 - **RDR baseline & VALUE element are maintained**
 - Formal baseline
 - **Formal review and re-baseline process beginning of 2010**
 - Exact process needs definition
 - Community sign-off mandatory



Objectives of Visiting

- Learn industrial status and possible future at cavity manufacturers, through visiting the factory, presentations and discussions with factory staff,
- Communicate TD-Phase R&D Plan, and inform necessary boundary conditions, “plug-compatibility”, in the world-wide R&D stage,
- Request close collaboration with laboratories to further industrial R&D effort, particularly, to improve “field gradient” and “cost effective production” to prepare for the industrialization (mass production),
- Establish close communication and confident relationship between ILC-GDE and manufacturers.



URL site prepared for visiting

SCRF Cavity Manufacturers

090226

ILC Global Design Effort Project Manager visit to SCRF ca...

<http://www.linearcollider.org/cms/?pid=10006>



ILC Global Design Effort Project Manager visit to SCRF cavity manufacturers

February - March 2009

In early 2009 the ILC Global Design Effort Project Managers (Akira Yamamoto, Marc Ross, and Nick Walker) visited and were graciously hosted by many of the world's top superconducting RF cavity manufacturers. The objective of the visit was to:

1. Learn industrial status and possible future at cavity manufacturers.
2. Communicate the ILC GDE Technical Design Phase R&D Plan.
3. Request further industrial R&D effort, particularly to improve "field gradient" and "cost effective production" in order to prepare for the industrialization (mass production).
4. Establish close communication and a confident relationship between ILC GDE and vendors.

This web page is intended to capture the material presented to vendors and to include key references.

[Global R&D Effort of SCRF Cavity Development for the International Linear Collider](#) (pdf, 5Mb)
Akira Yamamoto, Marc Ross, and Nick Walker - Project Managers for the ILC Global Design Effort, material presented to each of the SCRF cavity manufacturers.

[Superconducting RF Cavity Development for the International Linear Collider](#) (pdf, 4Mb)
Akira Yamamoto for the ILC Global Design Effort, paper presented at Applied Superconductivity Conference 2008 (ASC 2008).

[Global R&D effort for the ILC linac technology](#) (pdf, 4Mb)
Akira Yamamoto for the ILC Global Design Effort, paper presented to EPAC 2008.



Reference Design Report

[Download the full report](#)

Volume 3 - Accelerator:
[Download the pdf](#) (20MB)



ILC Research and Development Plan for the Technical Design Phase

[Download the pdf](#)



Information and References

General INformation

- ILC
 - <http://www.linearcollider.org>
 - <http://www.linearcollider.org/cms/?pid=1000613>
- This presentation (Cavity Manufacturer visiting, Feb./March, 2009)
 - http://ilc-edmsdirect.desy.de/ilc-edmsdirect/file.jsp?edmsid=*868405

ILC-GDE Reports

- Reference Design Report
 - <http://www.linearcollider.org/cms/?pid=1000437>
- TDP R&D Plan, Release 3
 - http://ilc-edmsdirect.desy.de/ilc-edmsdirect/file.jsp?edmsid=*813385

Public Presentations/Proceedings:

- “Global R&D effort for the ILC linac technology”, presented by A. Yamamoto, at EPAC08,
 - http://ilc-edmsdirect.desy.de/ilc-edmsdirect/file.jsp?edmsid=*868435
- “Superconducting RF cavity development for the International Linear Collider”, presented by A. Yamamoto, at ASC08, to be published in IEEE Trans. Applied Superconductivity,
 - http://ilc-edmsdirect.desy.de/ilc-edmsdirect/file.jsp?edmsid=*868465

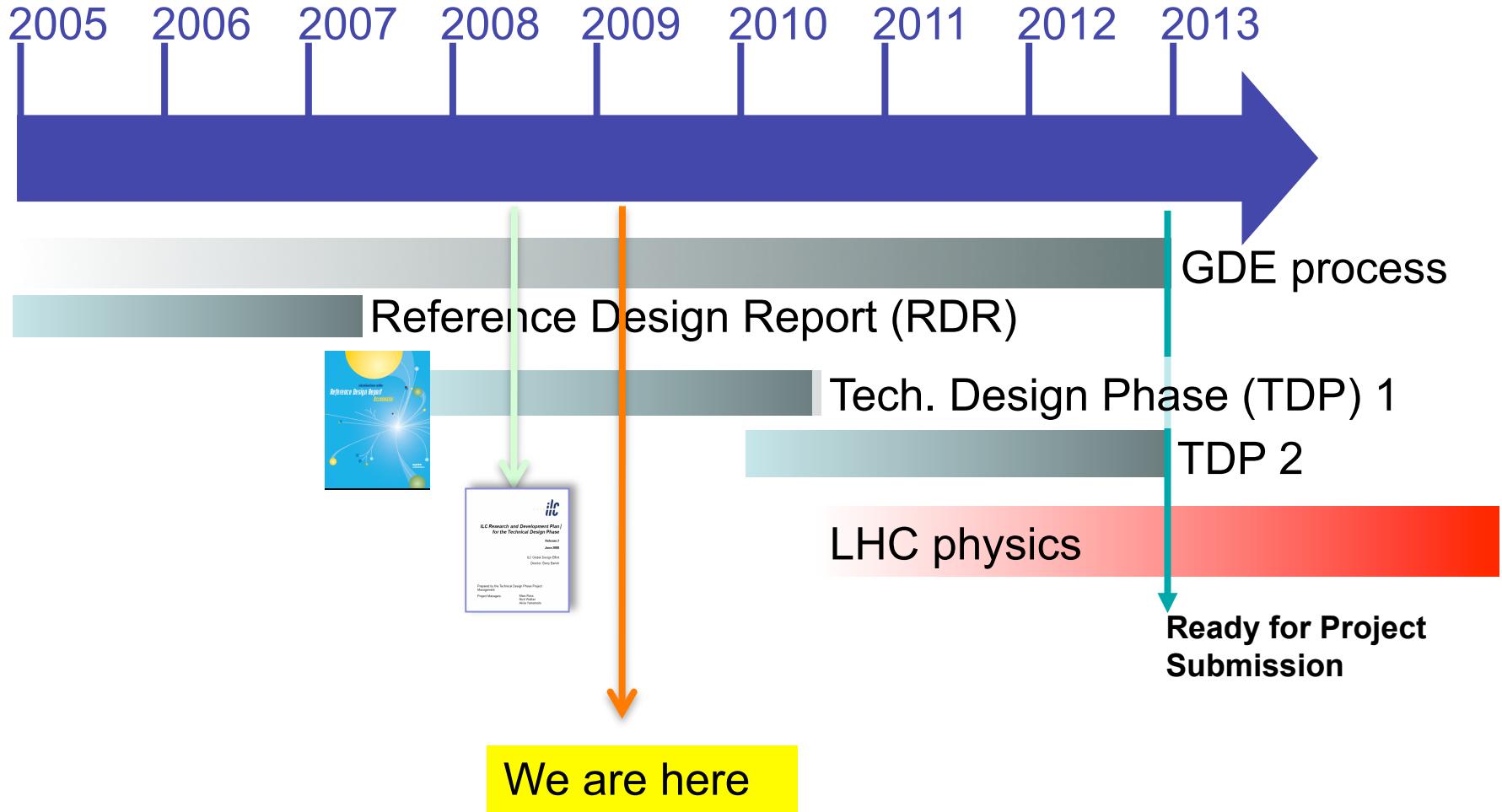


Global Plan for SCRF R&D

Calender Year	2007	2008	2009	2010	2011	2012
Technical Design Phase	TDP-1				TDP-2	
Cavity Gradient R&D to reach 35 MV/m		Process Yield $> 50\%$			Production Yield $>90\%$	
Cavity-string test: with 1 cryomodule			Global collab. For <31.5 MV/m>			
System Test with beam 1 RF-unit (3-modulce)		FLASH (DESY)			STF2 (KEK) NML (FNAL)	



GDE: ILC Timeline



■ Technical Design Phase in progress:

■ Phase-1: Technical reality to be examined,

- 35 MV/m with yield 50 % in surface process and
- 31.5 MV/m with the cavity-string in a cryomodule

■ Phase-2: Technical credibility to be demonstrated

- 35 MV/m with the yield 90 % for 9-cell in manufacturing
- Beam acceleration with the field gradient 31.5 MV/m.

■ We aim for

- Global R&D efforts with various efforts keeping “plug-compatibility” concept.
- Cooperation of world-wide Institutions and Industries would be crucially important and expected.

Field Gradient Limit in SC Cavity Current Status

■ Field Emission

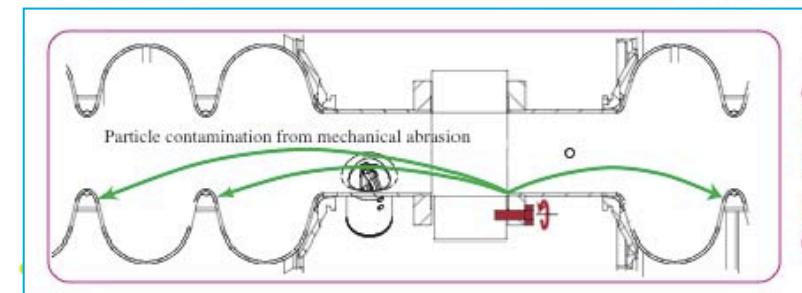
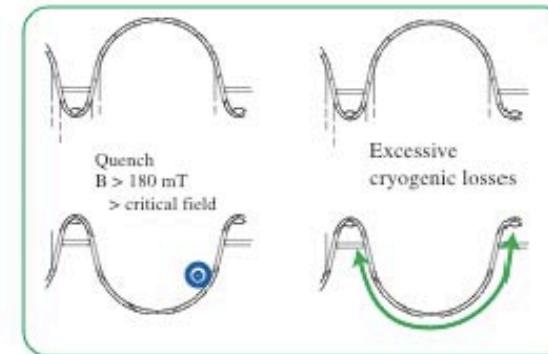
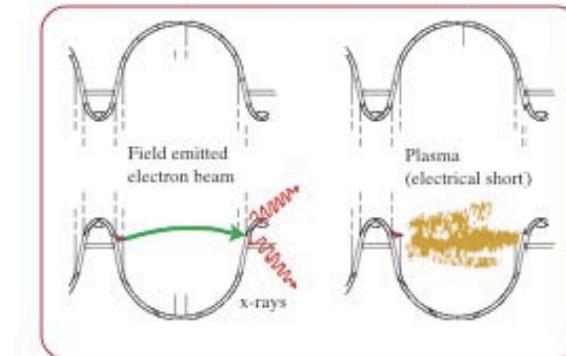
- due to high electric field
 - around “Iris”

■ Quench

- caused by surface heating from dark current, or
- magnetic field penetration.
 - around “Equator”

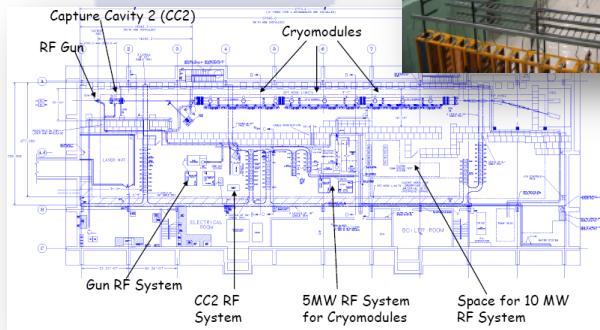
■ Contamination

- during assembly



SRF Test Facilities

FNAL

NML facility
Under construction
first beam 2010
ILC RF unit test

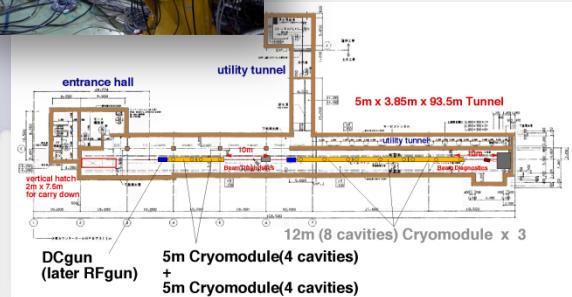


DESY




TTF/FLASH
~1 GeV
ILC-like beam
ILC RF unit
(* lower gradient)

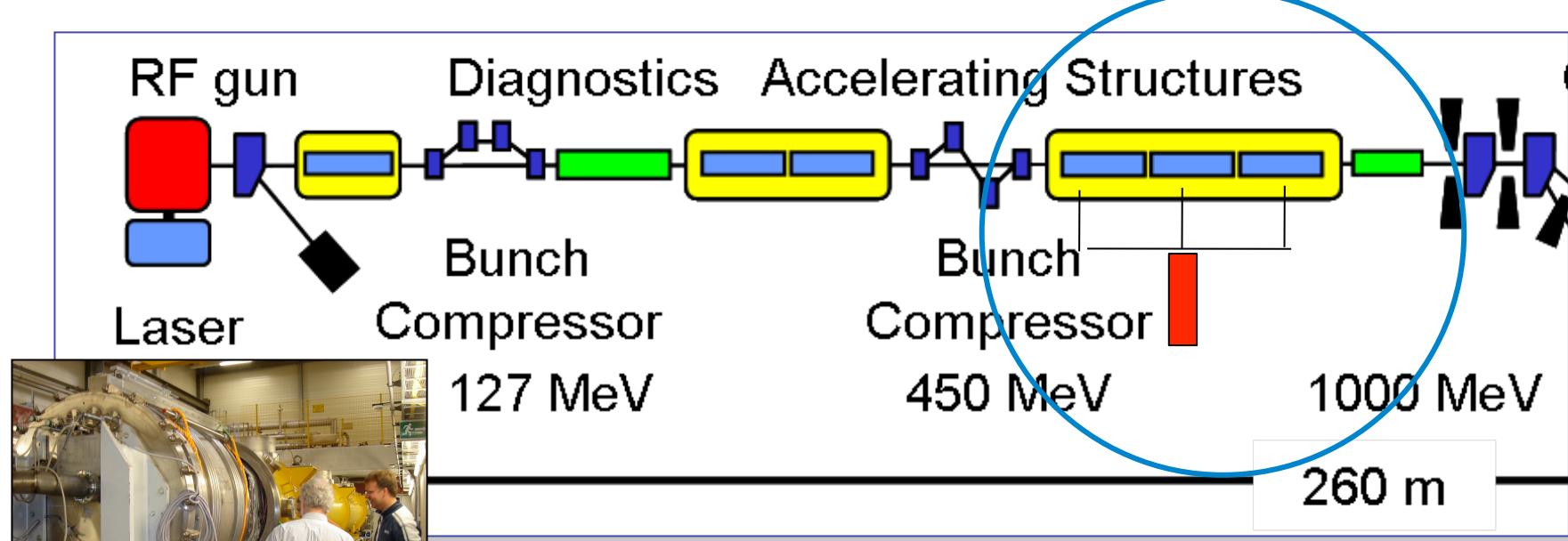
KEK, Japan

STF (phase I & II)
Under construction
first beam 2011
ILC RF unit test

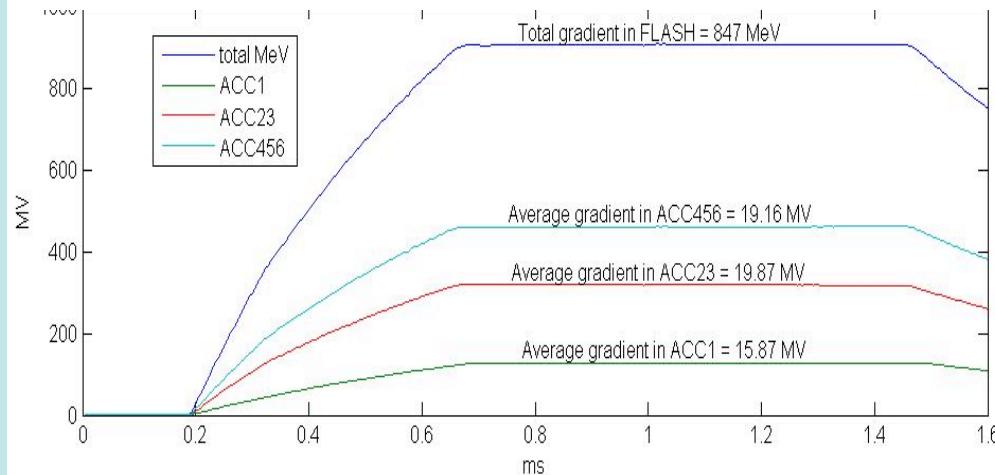


9mA Experiments in TTF/FLASH

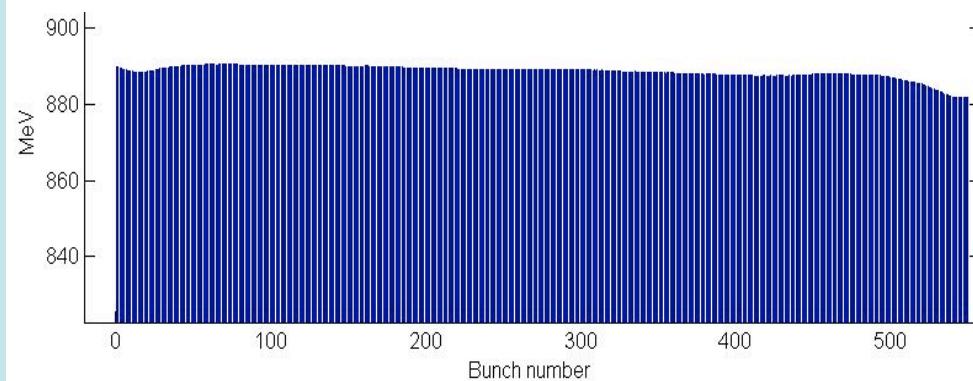


		XFEL X-Ray Free-Electron Laser	ilc	FLASH design	FLASH experiment
Bunch charge	nC	1	3.2	1	3
# bunches		3250*	2625	7200*	2400
Pulse length	μ s	650	970	800	800
Current	mA	5	9	9	9

All RF stations with 800us flat top



550 bunches at 1MHz, 3nC/bunch, 890MeV

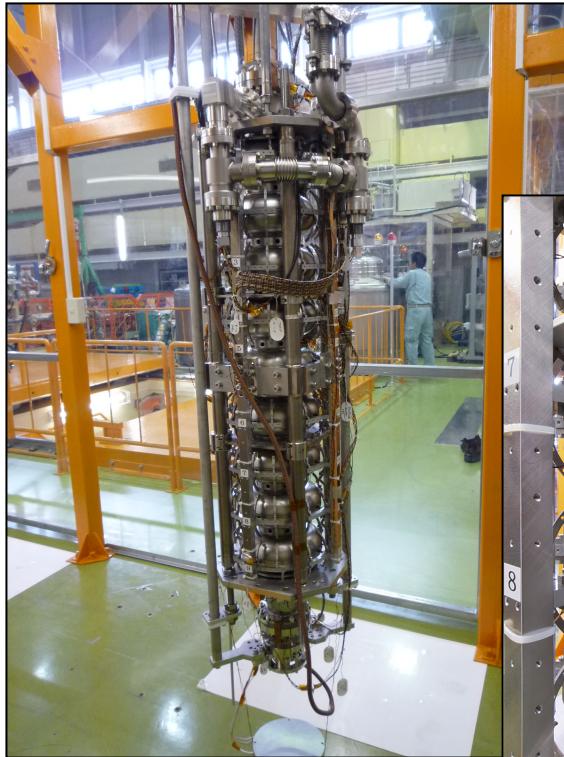


FLASH operations records

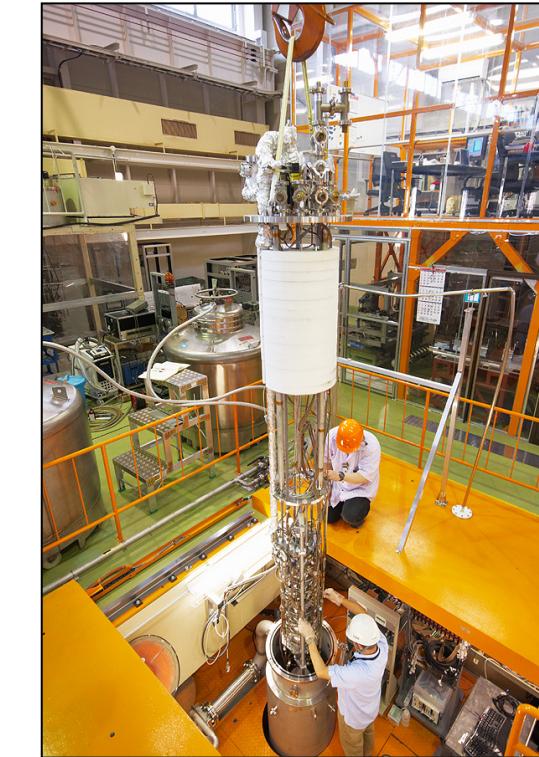
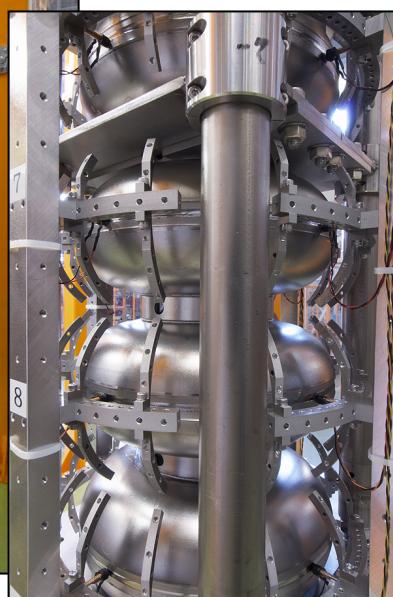
- Long bunch trains with 3nC per bunch:
 - **550 bunches at 1MHz**
 - **300 bunches at 500KHz**
 - **890MeV linac energy**
- All modules running with **800us flat-top and 1GeV total gradient**
- Limited to **1MHz (3mA)** during first (preparatory) experiments
- 6 kW achieved
- **2009 goal: 36 kW (9mA)**

Vertical Test Commissioning at KEK

- cool-down test of cryostat was done July 3 – 5, using AES01 cavity.
- EP at STF-EP facility, vertical test again in September.



AES01 cavity with T-map

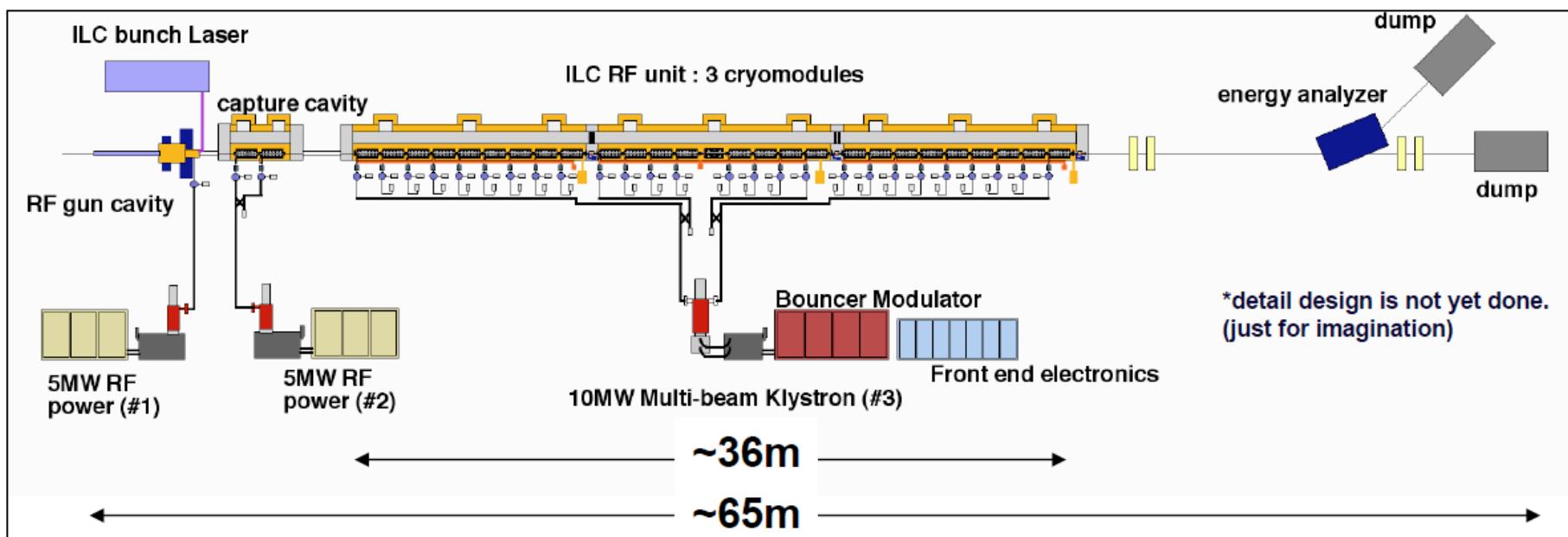


Installation into vertical cryostat



Beam Acceleration Test Plan

with RF unit at Fermilab and KEK
in TDP-2

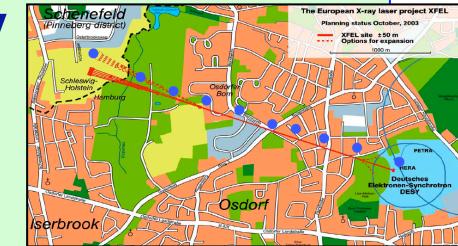




Cooperation with EuroXFEL and Further SCRF Acc. Projects

European X-ray Free Electron Laser Facility

- EuroXFEL SRF design gradient : **23.6 MV/m**
- Machine designed: **28 MV/m**
- ~ 100 SCRF cryomodule, based on the experience at TTF,DESY,
- Leading SCRF industrialization (scale: **1/20 of ILC**, in 5 years)
- Keep close cooperation with XFEL, on-going project.



Further SCRF Accelerator Project Plans:

- Project X at FNAL, SC Proton Linac at CERN, ERL at KEK, Indian Accelerator Project
- Best effort for common design and cost-effective design

ILC-GDE SCRF