Importance of single cell test especially with exchanging cavities and Possibility for Asia to contribute S0/S1

RDB Meeting at FNAL
June 1, 2006
T. Higo

KEK general stance

- **We establish recipe with single-cell study (2006)**
  - **Aim at higher gradient, even higher than 35MV/m.**
  - **Learn basic requirements to establish BCD.**
- **We try to prove 35MV/m gradient in 9-cell cavities. (2006)**
  - **4 TESLA-like cavities and 2 ICHIRO cavities are installed into STF-I as scheduled and with gradient reached then.**
  - **2 ICHIRO cavities are reserved without scheduled installation and used for proving higher gradient.**
- **We help develop capacity from PAL, IHEP, ….**
- **We understand we need to promote industry capability**
  - **How, when,??**

R&D strategy for ILC high gradient

- **We establish the Recipe by Single cell cavities(2006)**
  - **New recipe will become in reality through recent pilot study**
  - **7 existing IS cavities are reset by CBP and evaluate yield till next TTC in Sep.**
  - **We make 6 new IS cavities and test the recipe.**
  - **We propose to evaluate DESY-made cavities.**
  - **We promote test at US by sending IS cavities.**

- **We demonstrate high gradient in 9-cell cavity (2006-2007)**
  - **Based on recipe obtained by single-cell study, we further improve the gradient with reserved two ICHIRO cavities. (2006)**
  - **Two more LL cavities, with improved ICHIRO design, are made and tested. (2006)**

- **International collaboration (2007-2009)**
  - **More cavities are made and investigate yield.**
  - **Pursue industrialization in practice.**

(IS : ICHIRO single-cell cavity)

Pilot study for 45MV/m by single cell cavity

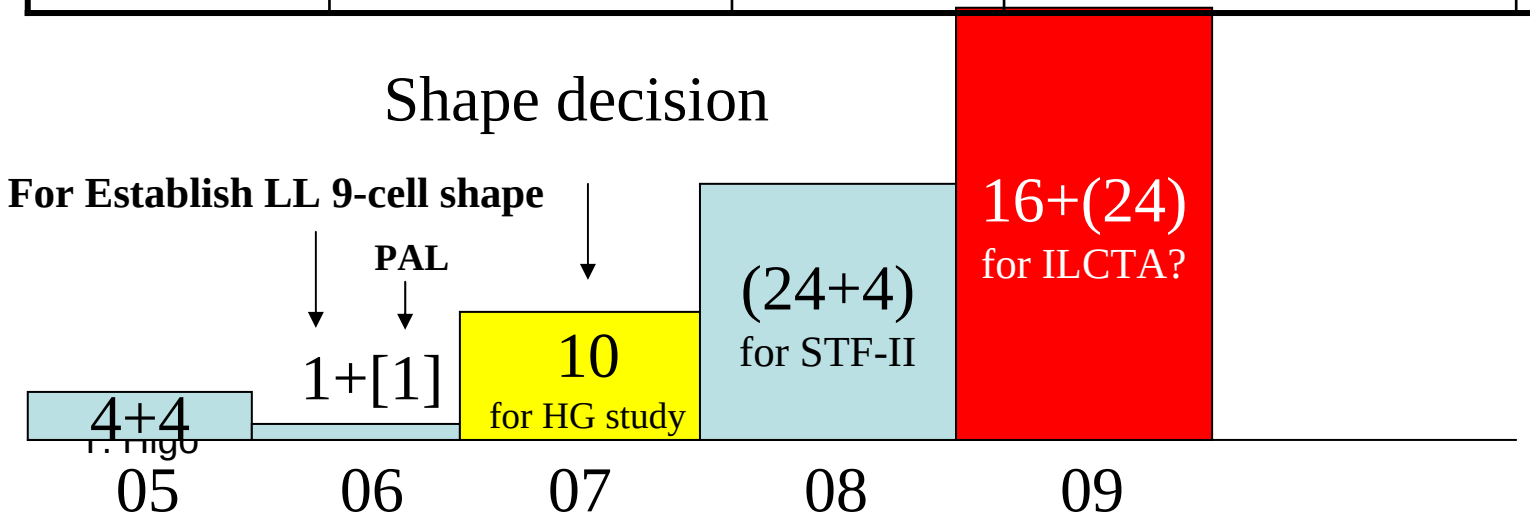
		IS#2	IS#3	IS#4	IS#5	IS#6	IS#7	RE2
ILC WG5-Asia Recipe	Eacc,max	36.9	31.4	45.1	44.2	48.8	28.3	
	Qo@Emax	1.53E10	8.66E9	9.07E9	5.38e9	9.56E9	1.94e9	
+re-HPR+No Bake(48hr)	Eacc,max	37.6	32.7	43.7	22.0	51.4	29.9	33.8
	Qo@Emax	1.42E10	7.27E9	6.07E9	8.28E9	7.77E9	1.10E10	1.23E10
+HF rinsing+No Bake, No Q-disease!	Eacc,max	37.1	36.7	50.4	Troubled	50.2	30.0	
	Qo@Emax	1.64E10	1.43E10	9.97E10		3.90E9	3.33E9	
+CP(10)+HPR+Bake(48)	Eacc,max					41.0	40.5	22.3
	Qo@Emax					6.65E9	5.57E9	3.19E9
+EP(3, closed, new acid)+ HPR+Bake(48)	Eacc,max	41.6	40.3	41.1				
	Qo@Emax	1.00E10	1.28E10	1.17E10				
+EP(20+3, closed, new acid)+ HPR+Bake(48)	Eacc,max	47.1		47.8				
	Qo@Emax	1.06E10		7.81E9				
+EP(20+3, closed, new acid)+ HF rinsing+HPR+Bake(48)	Eacc,max		44.7	May 9			43.9	
	Qo@Emax		0.98E10	May 9			1.17E10	
+EP(30+3, closed, conc. HF) +HPR+Bake(0-48hr) Q-slope!	Eacc,max		28.0(B=48)			27.6(B=48)	30.6(B=0)	
	Qo@Emax		2.14E9			3.07E9	3.17E9	
HPR@KEK TOC=16, Bacteria=80-200	Eacc,max	26.9						
	Qo@Emax	4.39E9						

Q-slope is related to oxidation of the surface.
HF rich EP acid promotes Q-slope? Or shorten the Baking term?

9-cell Cavity R&D Capacity in KEK and An Example of Cavity production for H.G. Study

K. Saito 060524

Cavity Fabrication (HPVC based) [Cavities/year]	KEK in-house	Industry	Cavity Cost	Manpower
	10	40 (20)	7M¥ KEK in-house ～20M¥ Industry fab.	3
Cavity Preparation [Cavities/year] Turn around	STF(one cavity/month) 10 - 20	STF+Nomura 20 - 30		3
Preparation re-work	STF (one cavity/week) 20-30	STF+Nomura 50-60		2
Vertical Test [Times/year]	ARE(one test/week) 40	ARE+STF 80		2



A proposal of international single-cell cavity study

- In order to hold common idea of required treatment to reach the BCD performance
  - We need quick systematic evaluation of treatments.
  - Single-cell cavities are suited for it.
  - Exchange single-cell cavities among laboratories helps mutual confirmation, in addition to information exchange.
  - Single-cell is the step before and in parallel with 9-cell cavity development.

A proposal of international 9-cell cavity study

- Exchange of 9-cell cavities, for example;
  - To apply different treatment such as CBP on some XFEL cavities
  - Asian-made LL cavities will be tested with treatment by DESY
  - Exchange cavities once proven in gradient to be evaluated at other facilities and with other treatments
- KEK can contribute more
  - Increasingly from 2007
  - Depend on international recommendation

Conclusion

- **KEK should establish recipe with single-cell study.**
  - **Several ~10 single cell cavities are used fully.**
  - **Pursue under international collaboration.**
- **KEK try to prove high gradient in 9-cell.**
  - **Firstly install 4-6 cavities in STF-I as scheduled with gradient reached then. This gives rough idea of yield of KEK then.**
  - **We use 2 ICHIRO cavities and make two new cavities to pursue higher gradient.**
  - **We want to make ~10 cavities in 2007, before STF-II. We hope it will be realized if international R&D recommendation pushes.**
- **We think it important to exchange cavities to mutually evaluate to get confidence in recipe.**
  - **Both single-cell cavities and 9-cell cavities.**
- **KEK helps PAL and IHEP develop production and test facility.**

Addendum

ILC High Gradient R&Dに向けた開発戦略(案)

K. Saito 060524

1) Establish of the Recipe by Single cell cavities(2006)

- この間のpilot studyによりnew recipeの目処あり。
- 7個のIS cavityの表面をCBPでresetして、
  next TTC meetingまでにそのrecipeでのyieldを確認
  （2006のR&D項目）。
- 6個のnew IS cavitiesで再確認（2006のR&D項目）。
- DESYのsingle cell cavitiesでの確認（Cavityの交換？）。
- USでのsingle cell でのR&Dの推進（IS Cavityの貸与？）。

2) Demonstration of the high gradient by 9-cell cavities (2006)

- 2台のICHIRO cavityを使い、
  単セルrecipeを9-cellにfeedback(2006R&D変更)。
- LL 9-cell shapeの改良 (2006R&D項目)。

3) International Study of Yield Statistics by 9-cell cavities
2007-2009

KEK cavity fabrication capacity

KEK in-house: ICHIRO 4 cavities
2005 Jan-May, one cavity/month
10 cavities(without HPVC)/year

MHI Production: STF 35MV/m 4 cavities
2005 Aug-Dec, 1-1.5 cavities/month
40 cavities (without HPVC)/year
20 cavities (with HPVC)/year

Capacity of preparation

- CBP : 4 - 10 days (depends on EBW), Capa. 2 cavities
- Light etching(BCP) + HPR : One day
- Annealing 750^{O}C : 3 days, Capa. 2 cavities
- Pre-tuning: 3 days, Capa. 2 cavities
- EP 80 micron + HPR : 3 days
- Cavity Assembly: 3hr
- Baking + Vac. Evacuation : 3 days

Total: 17.2 – 23.2 days

Capacity of Vertical Test

- Evacuation @ Test stand : 2 – 3 days
- Vertical test: 2 days
- Warm up: 2 days

One test/one week

Vertical test stand at Asia

- Present
  - KEK AR-east
    - one 9-cell dewar
    - one single-cell dewar
    - One vacant pit
- 2007~
  - KEK STF one 9-cell (not yet budgeted)
  - PAL SC facility ??
  - IHEP China ??