



# Asia in the big trend

## - ILC in Asia



**J. Gao**

**IHEP, Beijing, China**

**KILC12, Daegu, Korea**  
**April 22-27, 2012**

# Content

- 1) Asia status in big trend
- 2) Asia in large science
- 3) Asia in ILC
- 4) Concluding remarks

# Asia status in big trend

# Three poles in world on science

-Asia, Europe and North America



Main countries in Asia :  
China, India, Japan, and Korea

Main countries in North  
America: Canada and USA

Main Countries in Europe:  
15 key countries out of EU (27)

# GDP in the world of 2011 (Million US\$)



EU:16106896



USA: 15924184

China+



Japan+



India+



Korea =15816663

where top 15:

1) USA: 15924184

2) China: 7426090

3) Japan: 5974297

4) Germany: 3305898

5) France: 2555439

6) UK: 2258656

7) Italy: 2023687

8) Brasil: 2023528

9) Canada: 1563664

10) Russia: 1476912

11) India: 1430020

12) Spain: 1374779

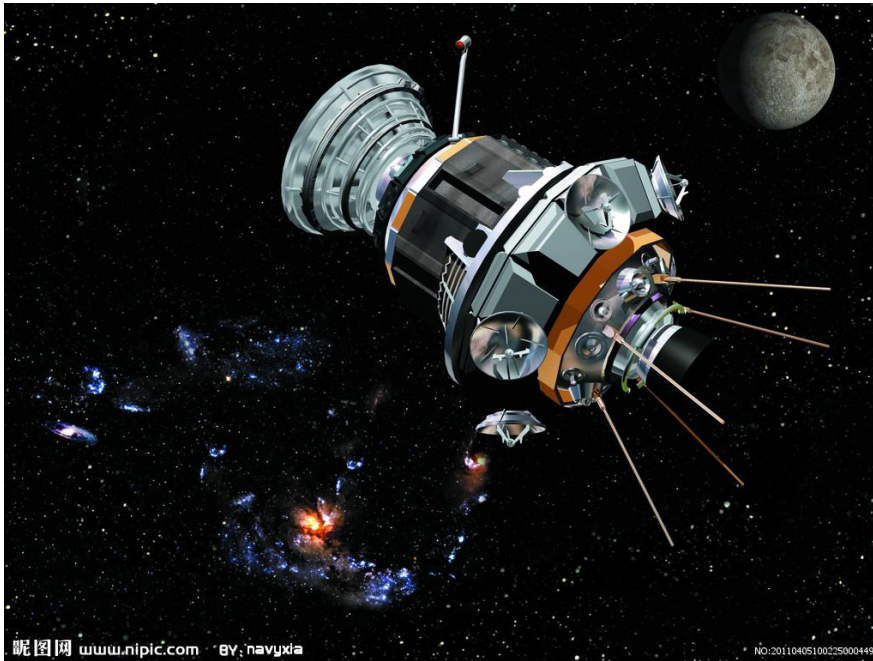
13) Australia: 1219722

14) Mexico: 1004042

15) Korea: 986256



# R&D in the world in 2012



**USA: 31% of the world R&D**

**EU: 24% of the world R&D**

**Asia: 36% of the world R&D**

**where:**

**Japan + China: 25%~EU**

**As reference, in 2009:**

**USA R&D 398.2Billion US \$**

**EU R&D 297.9 Billion US \$**

**China + Japan 2921 Billion US \$**



# Scientific output in the world

(publication in 2010)



**Asia (China, Japan, Korea): 23% of the world R&D**

**USA: 26% of the world R&D**

**EU (UK, France, Germany, Italy and Spain) : 27 % of the world R&D**

**Where top ten (quantity but not quality):**

**1) USA, 2) **China**, 3) UK, 4) Germany, 5) **Japan**,  
6) France, 7 )Italy, 8) Canada, 9) Spain, 10) **Korea****



# Asia in large science



# Japan Interests in Hosting ILC



Japanese Prime Minister Noda  
December 15, 2011



- the ILC is the project that Japan should promote as a **national commitment**
- To build the **world science center** in Japan
- Science research is not only about technology and science, but also contributes to the **culture and mentality of the citizens**

# Super-KEKB ground breaking ceremony

2011.11.18



# News from Chinese MOST

On Jan. 21, 2012, Chinese MOST launched to public the formal procedure for China's participation in large scale international collaboration (i.e. ILC)

Translated from the Chinese version of the Guidelines released on Jan. 21th, 2012  
by the Ministry of Science and Technology of the People's Republic of China

## Guidelines for the Domestic Arguments on China's Participation in Large International Science Projects and International Research Programs

(Trial Run)



1. **Significance and Feasibility Analysis of the Large International Science Projects or International Research Programs (abbr. LIPP)**
  - 1.1 List one or more scientific fields involved in the LIPP.
  - 1.2 List the scientific objectives and technical specifications of the LIPP.
  - 1.3 List the significance of the LIPP for the development of relevant scientific and technical fields.

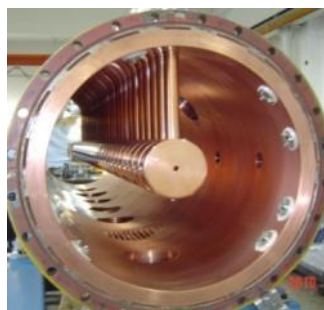
[http://www.gov.cn/gzdt/2012-01/21/content\\_2050572.htm](http://www.gov.cn/gzdt/2012-01/21/content_2050572.htm)



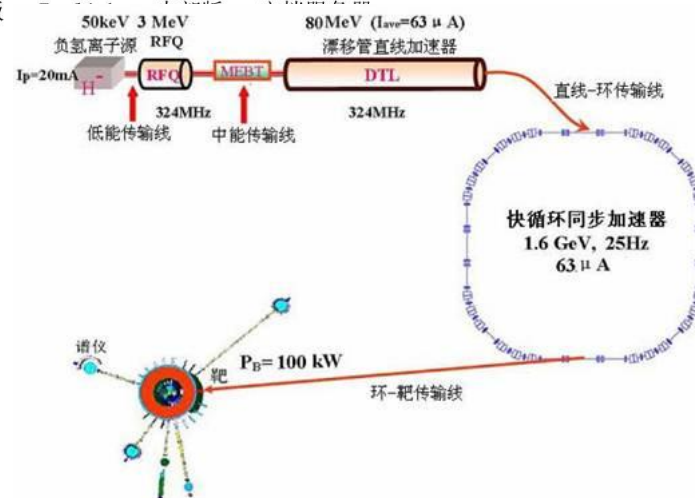


# CSNS ground breaking

## 2011.10.20

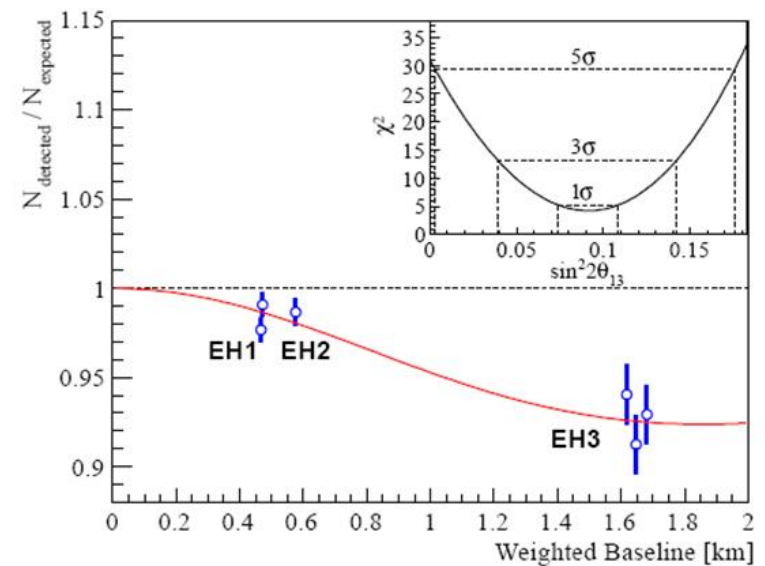
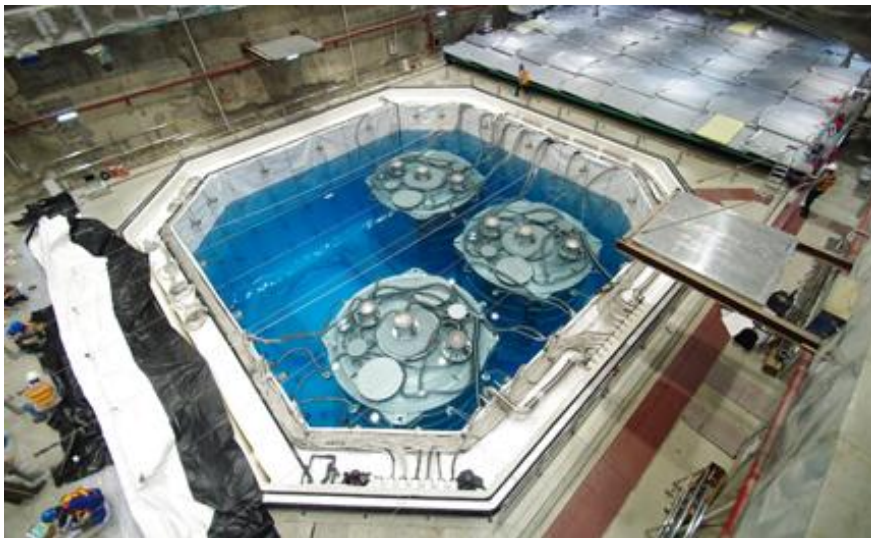


中文版



# Daya Bay: Discovery of a New Kind of Neutrino Transformation

(March 8, 2012)

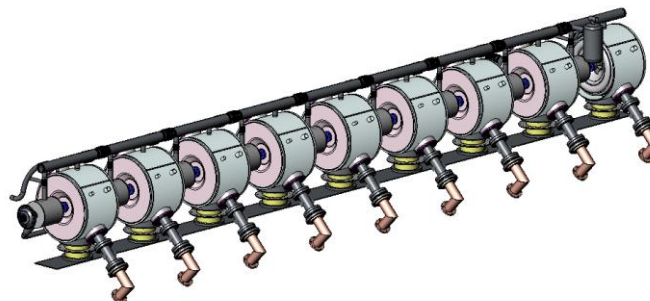
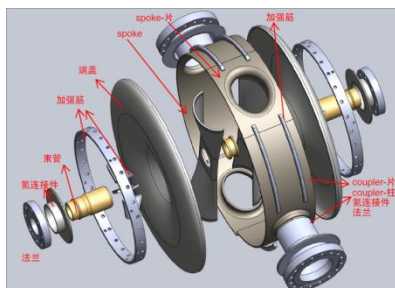
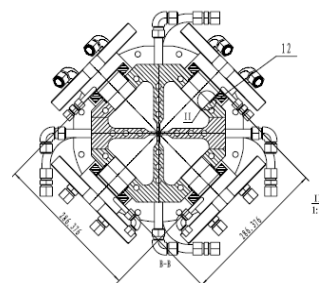
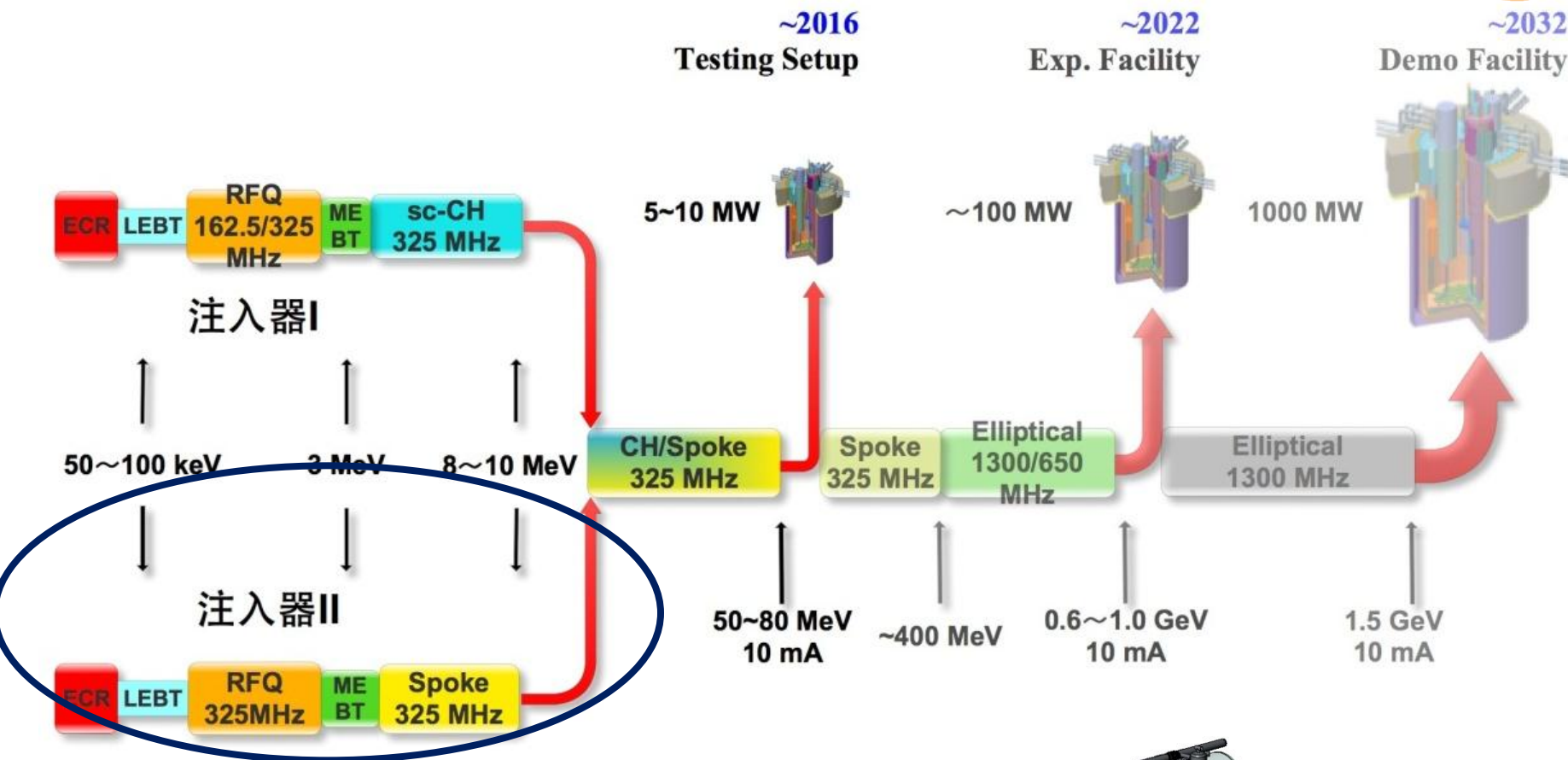


$$\sin^2 2\theta_{13} = 9.2\%, \text{ error } 1.7\%$$





# Chinese ADS





# Prof. Jialin Xie wins China's top science award of 2011



Prof. J.L. Xie in People's Great Hall, with President Hu, on Feb. 14, 2012



Chicago Medical Accelerator



BEPC: IHEP-SLAC



BFEL: IHEP-Stanford University

<http://newsline.linearcollider.org/2012/02/23/jialin-xie-wins-chinas-top-science-award/>

# CAS, China awards Prof. Shin-ichi Kurokawa for his international scientific cooperation



On Jan. 18, 2012, Prof. S. Kurokawa (KEK) obtained CAS International Collaboration Prize of 2011.

# Taiwan Photon Source



**3D Aerial View of NSRRC**



# TPS – commissioning, test-run, and open for users in Dec. 2014

**Storage ring** June 18/2011





PLS II  
(3GeV)



PAL XFEL (10GeV)

Soft x-ray: 1 nm ~ 10 nm.  
Hard X-ray: 0.7 ~ 0.1 nm,  
Extended to 0.06 nm



**KoRIA**  
Korea Rare Isotope Accelerator



**KHIMA**  
(400 MeV/u Carbon)



**PEFP**  
(100MeV, 20mA, Proton)

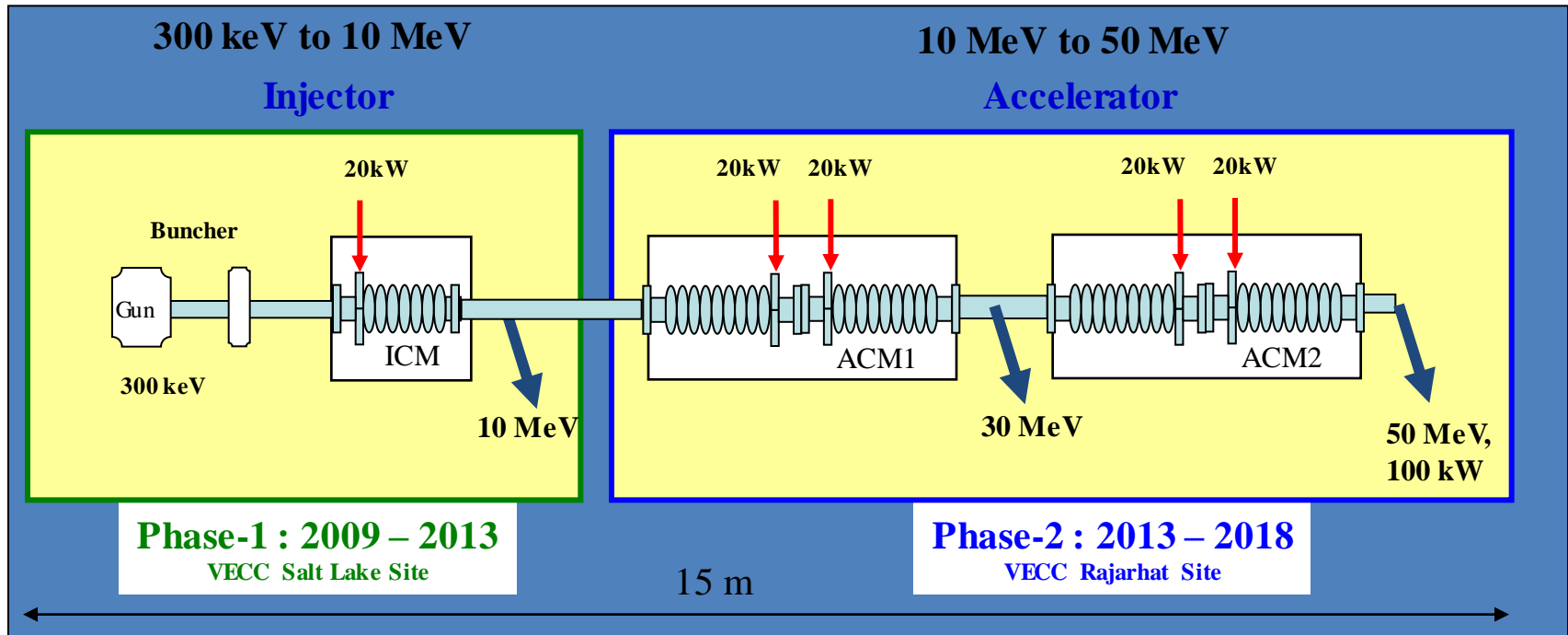
## Status

- Accelerator business is highly active in Korea.
- PEFP, PLS II are in final stage.
- PAL XFEL in progress.
- Conceptual design of KoRIA finished.
- Heavy ion therapy KHIMA will be available by 2016.



# Accelerator Projects in India

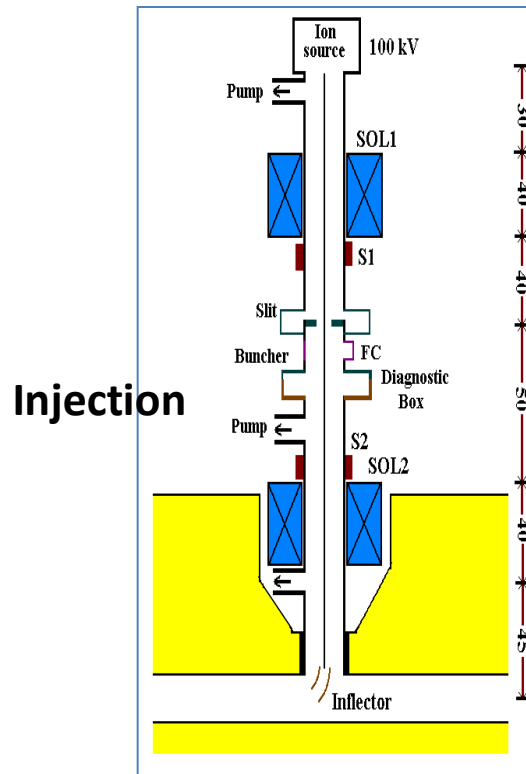
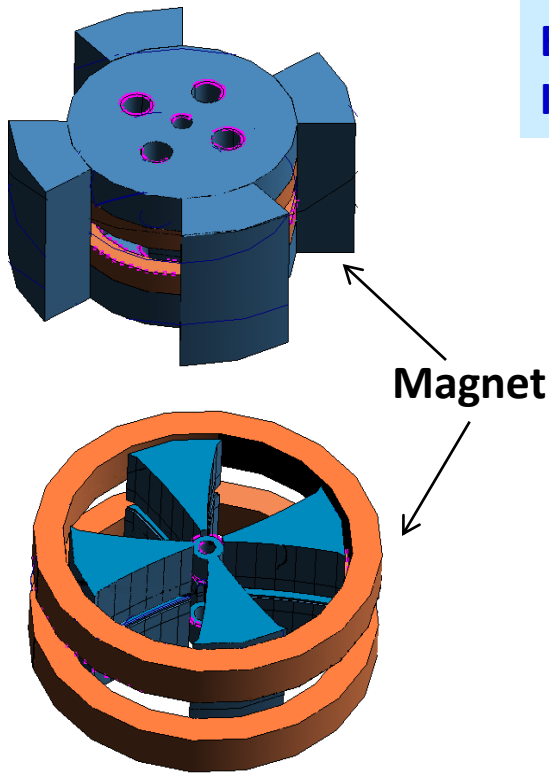
## Superconducting Electron Linac development (In collaboration with TRIUMF Canada)



- 
- **Powerful high power CW electron linear accelerator (50 MeV, 100 kW)**
- **Applications in basic science, materials research, astrophysics**

# Development of 10 MeV, 5 mA ADS Injector Cyclotron at VECC

Technology not known (space charge)  
Efficient rf system (beam loading)  
Injection and extraction



Injection Energy	100 keV
Final Energy	10 MeV
Hill Field $B_H$	1.5 T
Valley Field $B_V$	0.15 T
Pole gap Hill / Valley	4 cm / 66 cm
Hill angle max.	$34.2^\circ$
No. of resonators	2 $\Delta$ type, $45^\circ$
RF Voltage inj. / extr.	125 / 150 kV
Injection radius	$> 6.6$ cm
Phase width	$< 30^\circ$
Radial tune $\nu_r$	1.1 - 1.2
Vertical tune $\nu_z$	0.61 - 0.99
Beam current	5mA
Turn separation	6mm @5mA
I (limiting) TSC / LSC	15mA/13mA



Ion Source for high current proton beam



# Asia in ILC (Japan)

# ATF2 International Collaboration



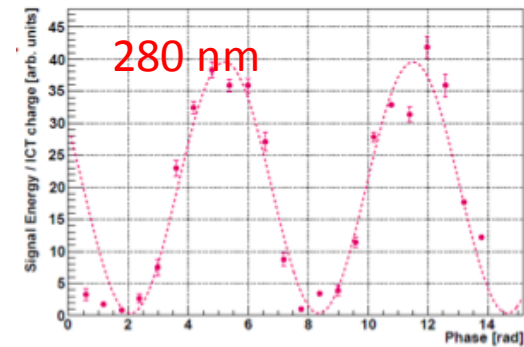
2010年10月19日 火曜日

# ATF2 - Recovery from the Earthquake

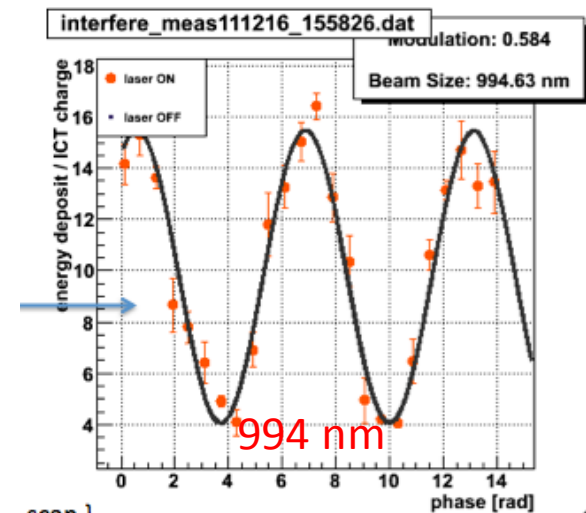


## IP-Beam Size Monitor

*Before Earthquake*

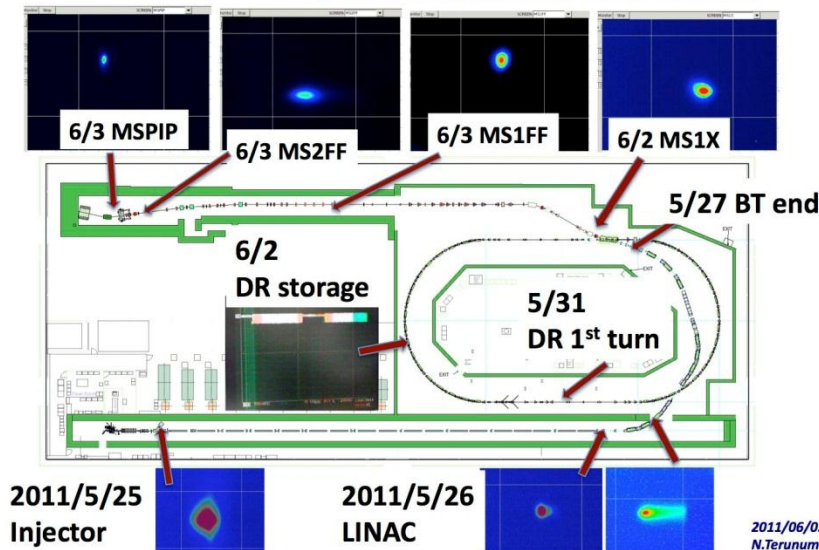


*After Recovery*



Test Beam ran the whole ATF beamline

Single bunch, 0.78 Hz,  $0.3 \times 10^{10}$  e/bunch DR&ATF2



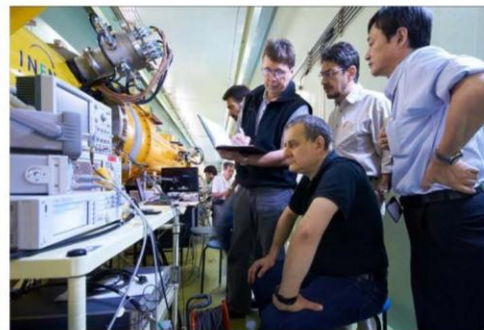
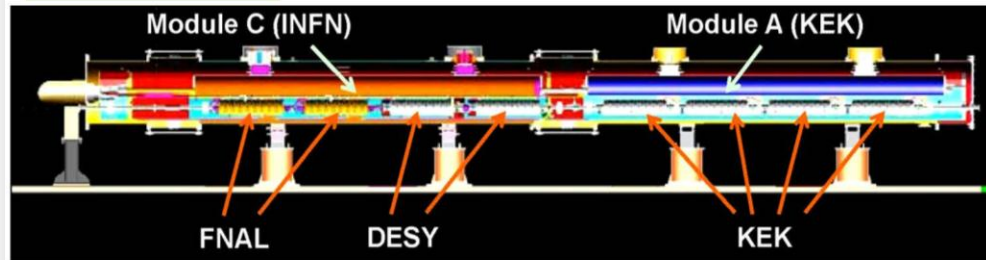


# Great effort and great progress in SCRF for ILC

**S1-Global**

## The first step of ILC

*2009 ~ 2011.2.25*

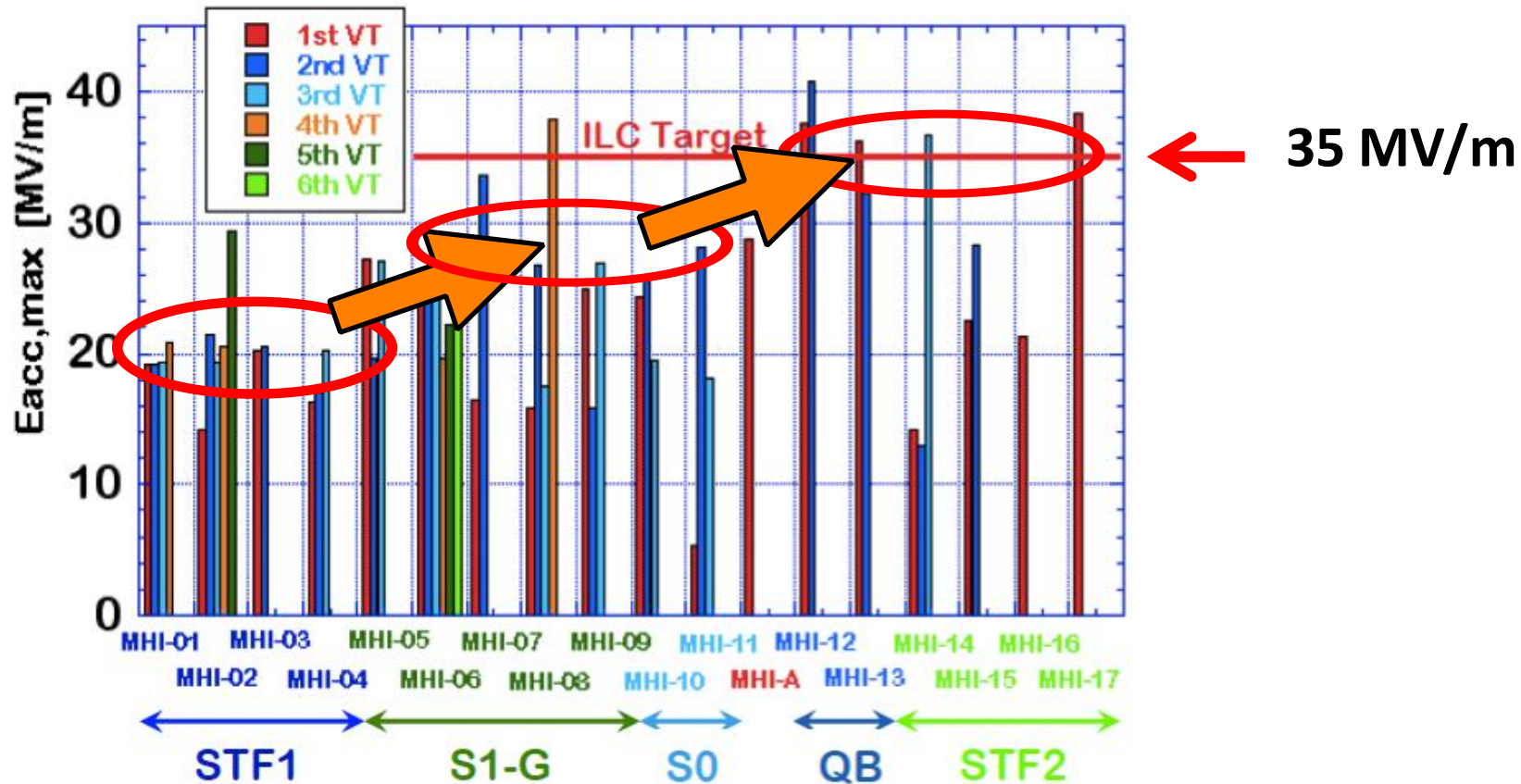


**Plug compatibility of SCRF system was successfully demonstrated by international collaboration.**





# VT Results



- Gradient is increasing step by step.
- Further R&D is necessary to obtain higher yield.

# Cavity Fabrication Facility (factory model)

Press machine



Dumbbell



EBW machine



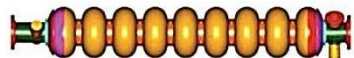
◆ KEK-00 (Press : KEK, EBW : job shop) finished on Jan. 31, 2012.



◆ KEK-01 (Press : KEK, EBW : KEK)



# SC Cavity Factory



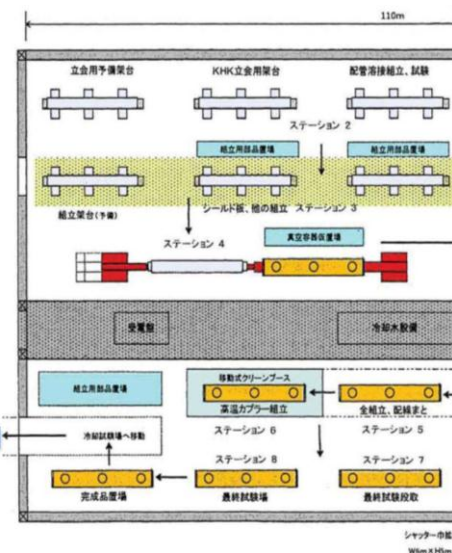
総部品点数: 56個  
総電子ビーム溶接箇所 (EBW) = 48ヶ所

ショートエンドグループ 1組 部品 12個 EBW 12ヶ所 	ショートエンドセル部品 4個	HOM1部品 4個	インプット カップラー ポート部品 2個	ビームパイプ部品 2個
ダンベル 8組 部品 32個 EBW 24ヶ所 	ダンベル部品 4個			
ロングエンドグループ 1組 部品 12個 EBW 12ヶ所 	ビームパイプ部品 2個	ピックアップ 部品 2個		

## SC Cavity Production Line : KEK-MHI



## Cryomodule Fabrication



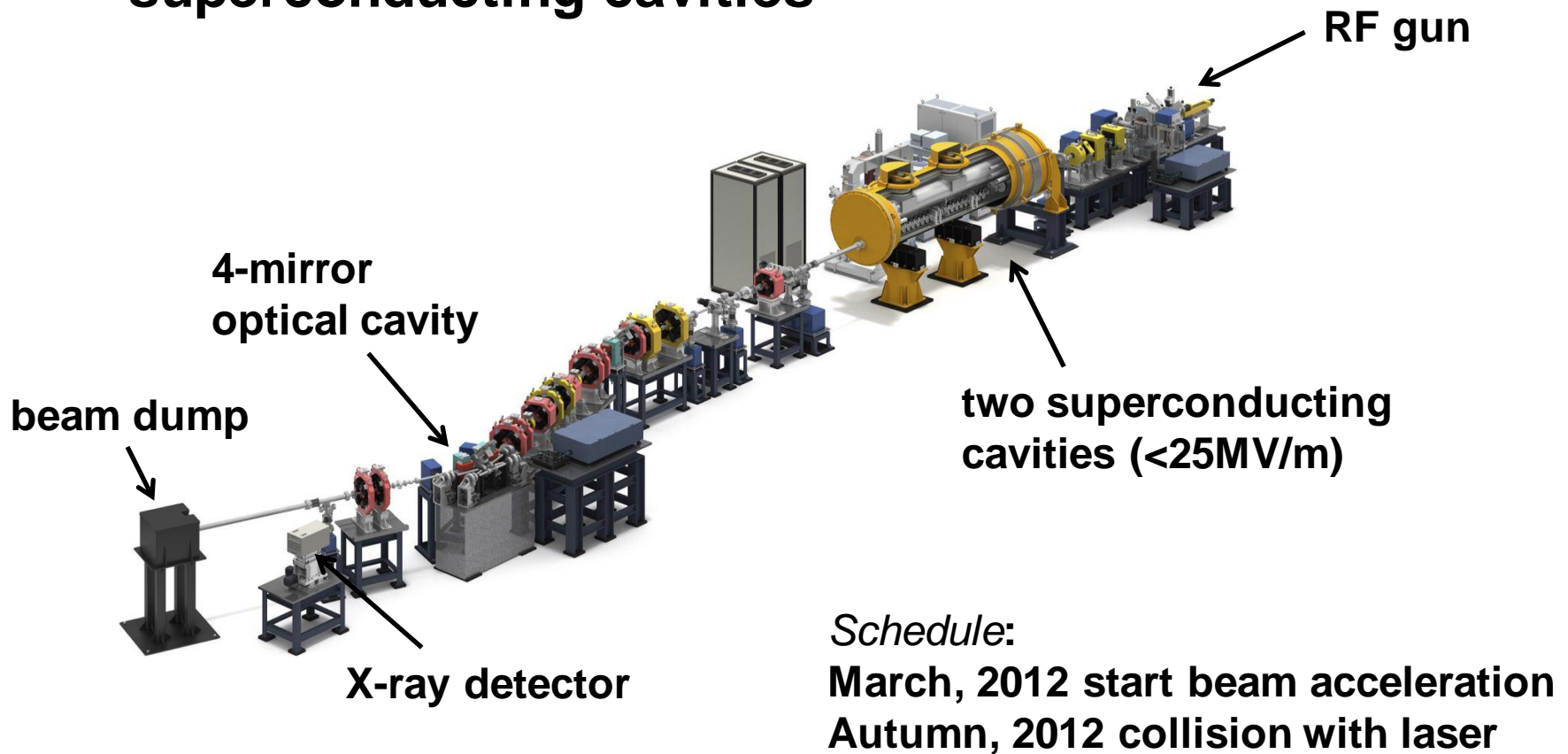
2011.11.24

ACFA@Shanghai

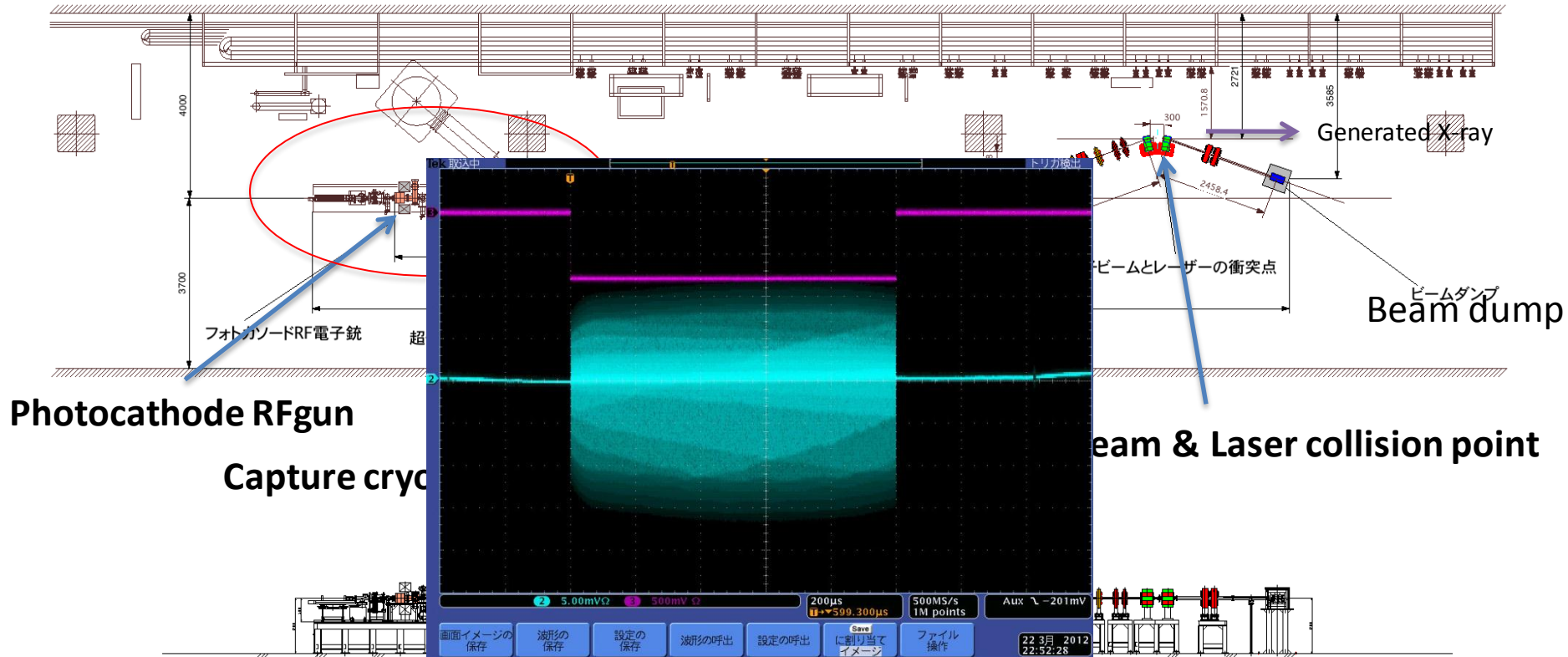
29

# QB Technology Program (2008-2012)

## □ Demonstration of compact X-ray source using superconducting cavities



# Beam Line setup of Quantum Beam Experiment



On March 22, 2012, a 1-millisecond beam for a 162.5-megahertz bunch train  
(ILC Newsline April 5, 2012)

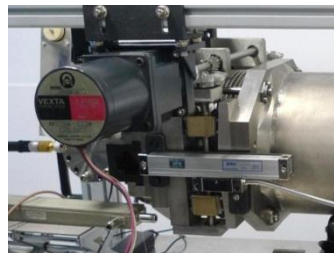
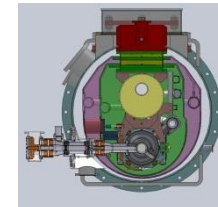
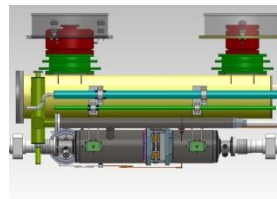
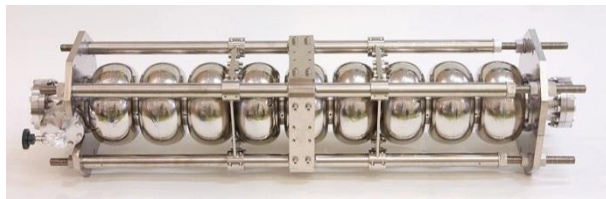


## Asia in ILC (China)

- ILC parameter optimization
- ILC SCRF
- ILC Damping Ring optimization
- ILC damping ring fast kicker
- ILC final focus: ATF2
- ILC positron source

...





Frequent visit to all the Labs  
>10 person-month/ year

IHEP ILC 1.3 GHz SCRF  
International Collaboration

IHEP-KEK ILC SRF Webex  
meeting every month

Region	Cavity development: fabrication, process and test	Cryomodule assembly/test	Linac beam test centres (beam on date)
Americas	Three industrial partners, Fermilab/ANL, JLab and Cornell	Fermilab/SLAC	ILCTA-NML (2012)
Asia	Three industrial partners, and PKU, IHEP and KEK	KEK / IHEP	Quantum-Beam/STF-2 (2011/2013)
Europe	Two industrial partners, DESY and IHEP	CEA-Irfu/CNRS-LAL/DESY for FLASH and E-XFEL	FLASH (from 2005)

IHEP-01(2011)

IHEP-02 (2012)

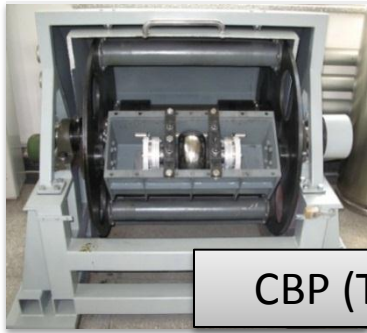
超导加速组元

IHEP-03 (2013)

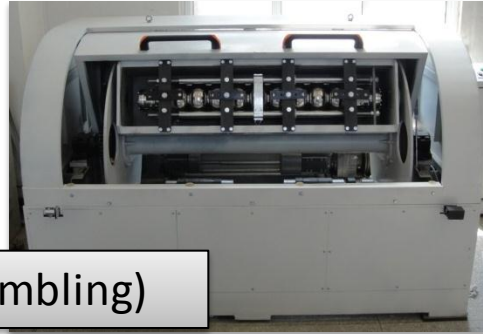
IHEP-01(2010)  
IHEP-03(2013)

PXFEL1  
58 Cryomodule

# Part of IHEP SCRF Lab



CBP (Tumbling)



BCP



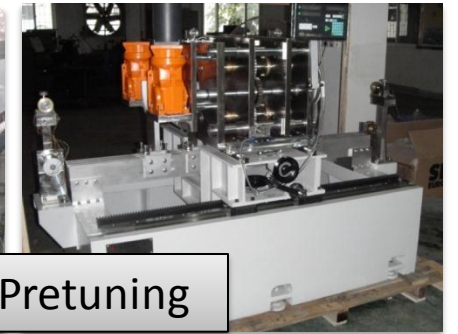
UPW & HPR



Ultrasonic



RF Pretuning



Clean Room



Vertical Test Stand





# Part of IHEP SCRF Lab



Cavity RF Lab



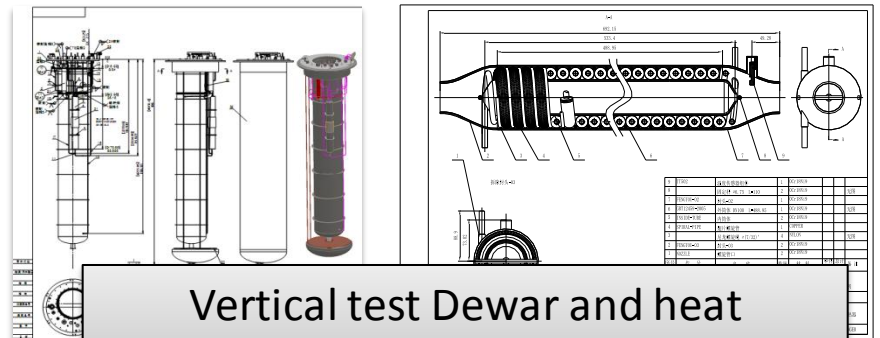
RF Measurement



Inspection Camera



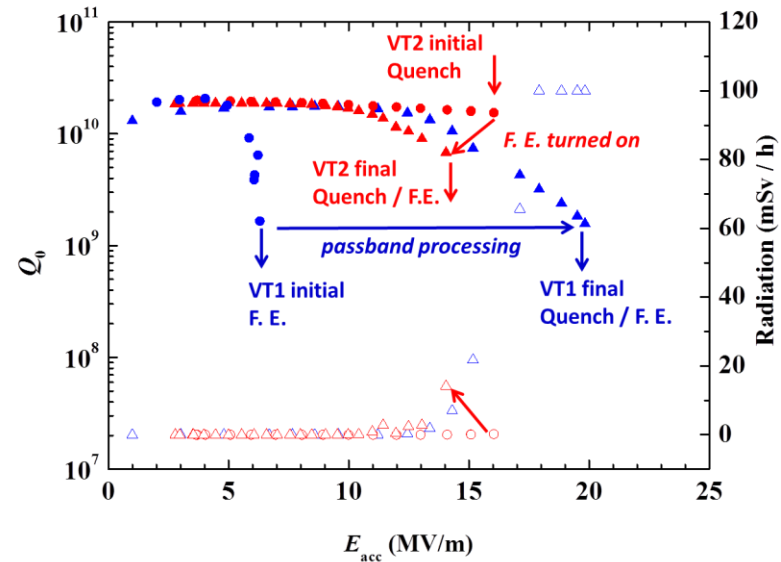
LLRF Lab



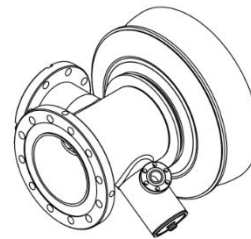
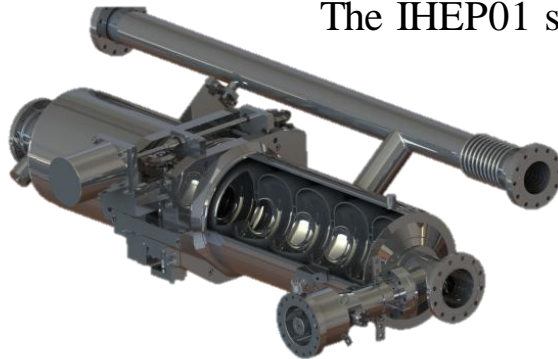
Vertical test Dewar and heat exchanger (in fabrication)

# 1.3 GHz 9-cell IHEP01 Tested at Jlab IHEP02 is under fabrication

1<sup>st</sup> and 2<sup>nd</sup> Test Results



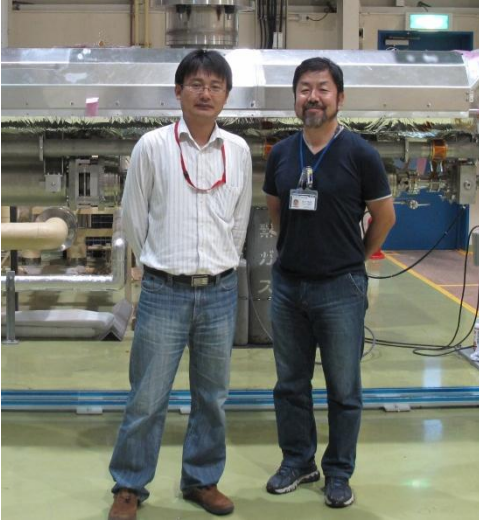
The IHEP01 second vertical test in 2011 at Jlab



IHEP02 is under construction



# IHEP Scientists in ILC Collaboration



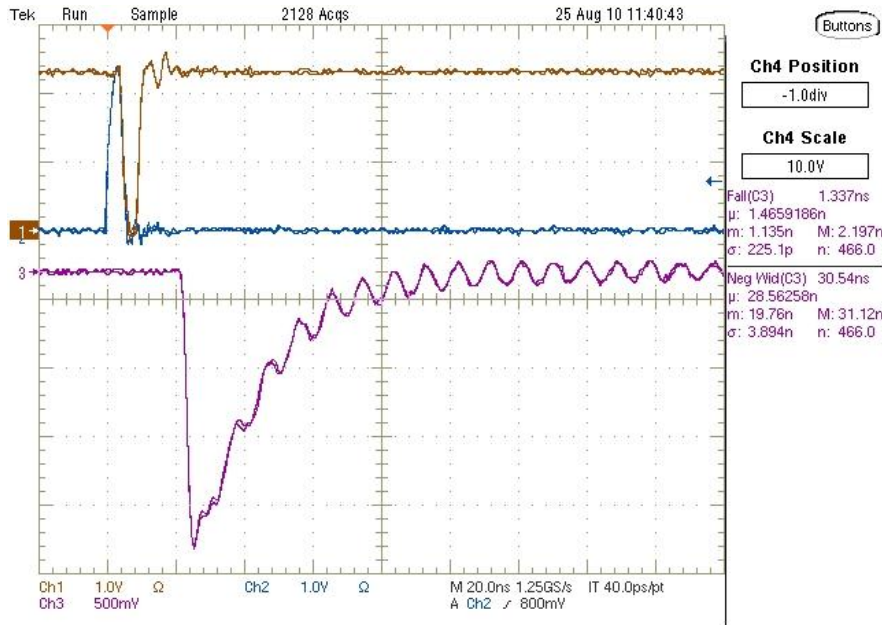
## ATF2: Post Doc Dr. Sha Bai from IHEP at KEK in 2011

- 1) Propagation of beam halo :  
Simulation of transmission and interception in different optics, taking into account physical apertures  
Sha BAI (IHEP)
- 2) Consistency of recent OTR and IP Twiss parameter measurements  
Sha BAI (IHEP)
- 3) Investigation of waist corrections in the presence of IPBSM fringe rotations and input beam  $\sigma_{13}, \sigma_{24}$  at ATF2  
: Sha BAI (IHEP)



STF cryomodule: GeRui from IHEP on cryomodule assembly at KEK

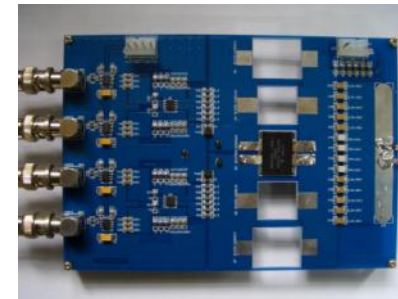
# IHEP Pulse Source for Damping Ring Kicker R&D Progress



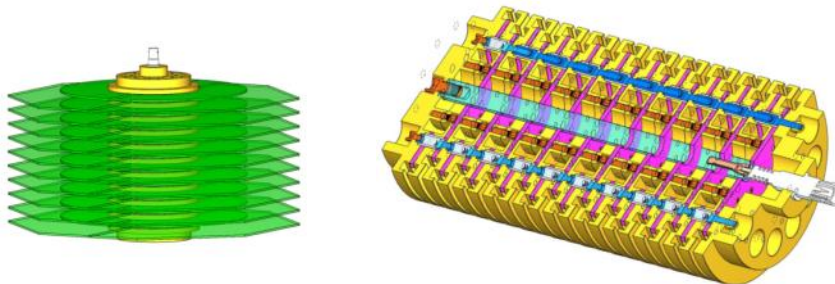
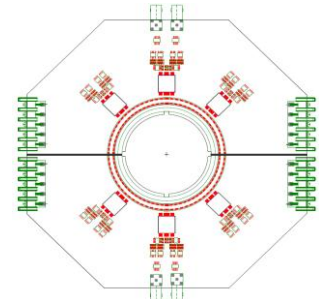
Single Switch Test Result



Multi-channel Clock



MOSFET Driver

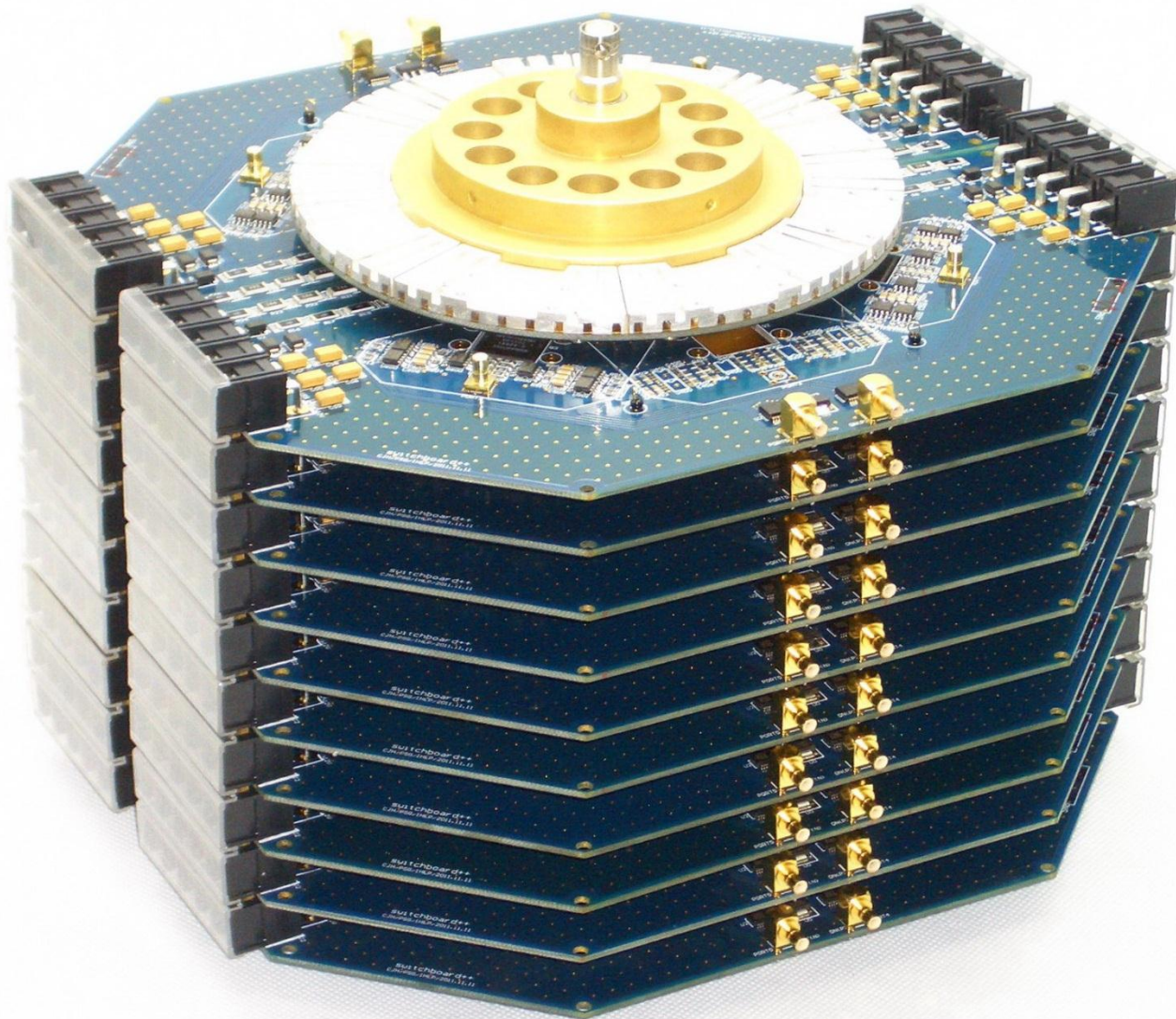


Inductive Adder

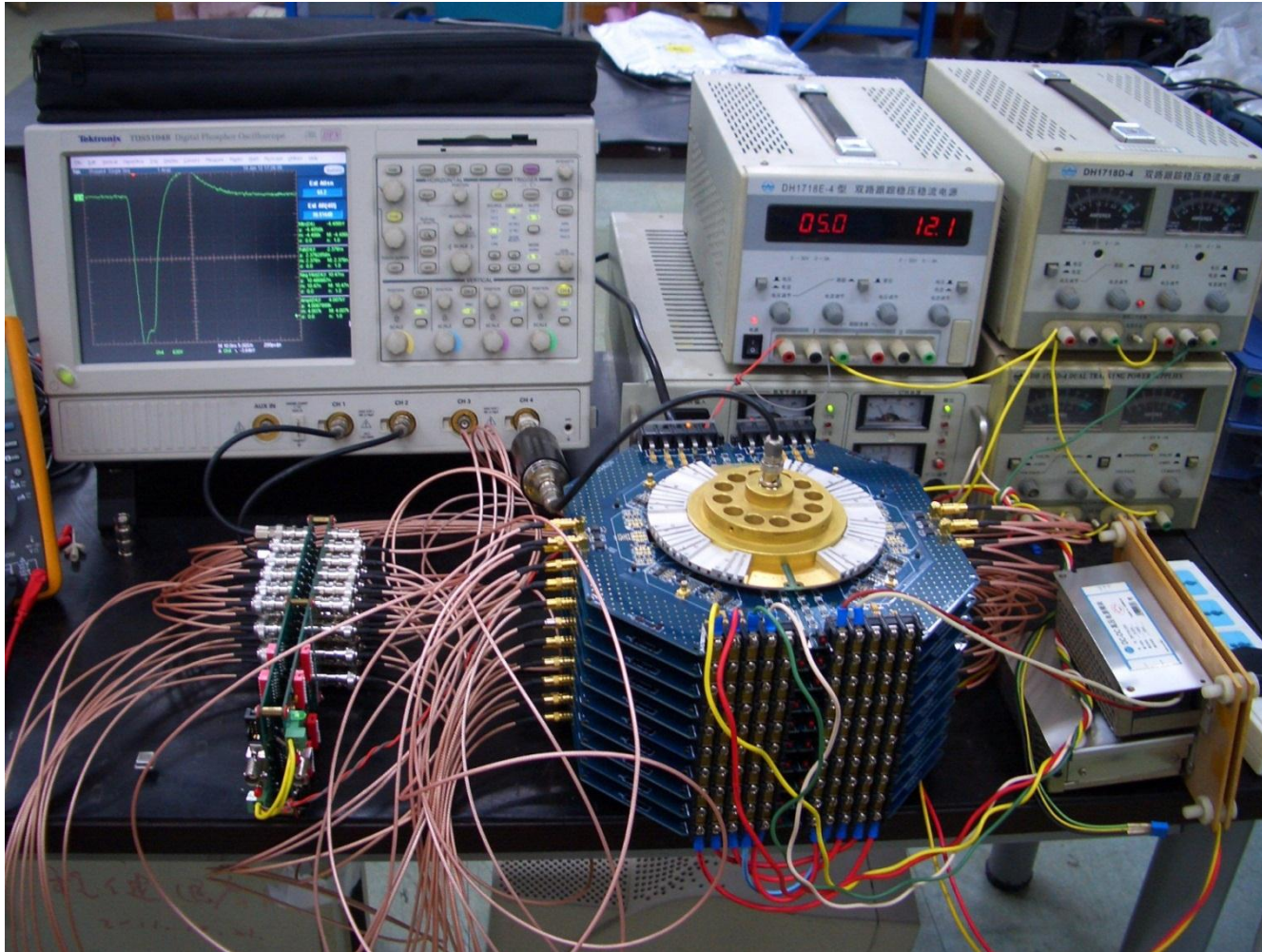
The whole system will be integrated and tested in the end of 2011 with the goal of the pulse length  $< 10$  ns, 1 MHz,  $\pm 5$  kV



# Inductive Adder 1<sup>st</sup>



# Inductive Adder under Test



The pulse length of 10ns has been obtained



# Positron source study for ILC

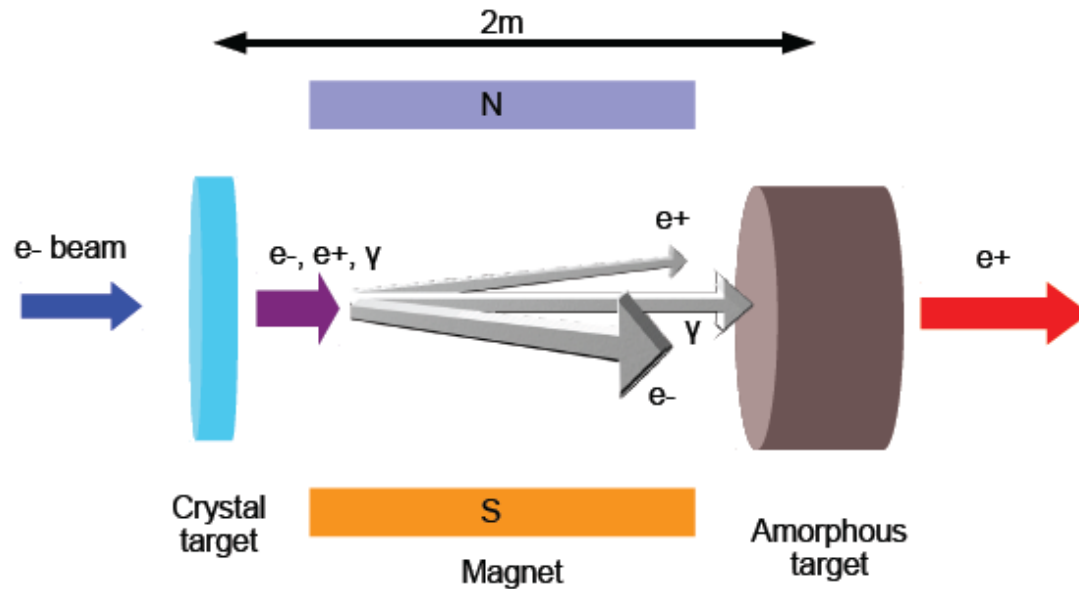


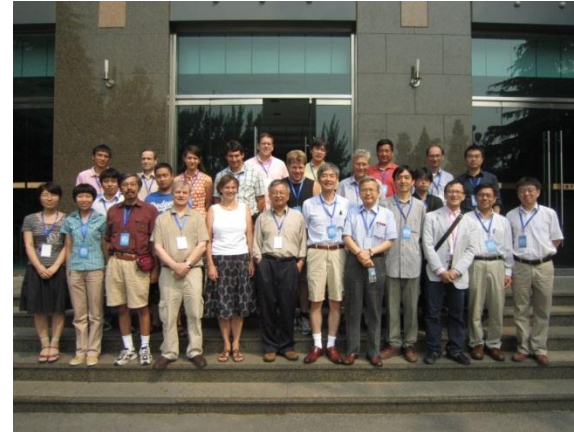
Figure 5.1: Hybrid scheme using crystal and granular target for ILC.(TODO not correct, take the figure of the bending magnet)

A Ph.D student of IHEP, Mr. Chenghai Xu, has been co-directed by supervisors LAL and IHEP

# Workshop and Meeting in 2011 held in China



POSIPOL 2011  
 August 28-30, 2011  
 IHEP, China  
 Chairman: Prof. J. Gao



TTS 2011 Beijing  
Dec. 5-8, 2011  
IHEP, China  
Chairman: Prof. J. Gao





## **Two important meetings this year in China on ILC**

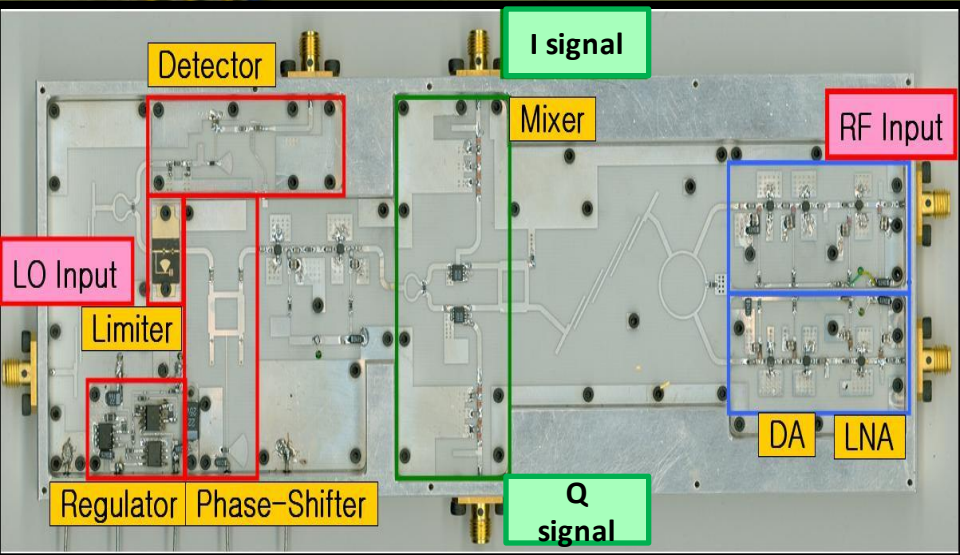
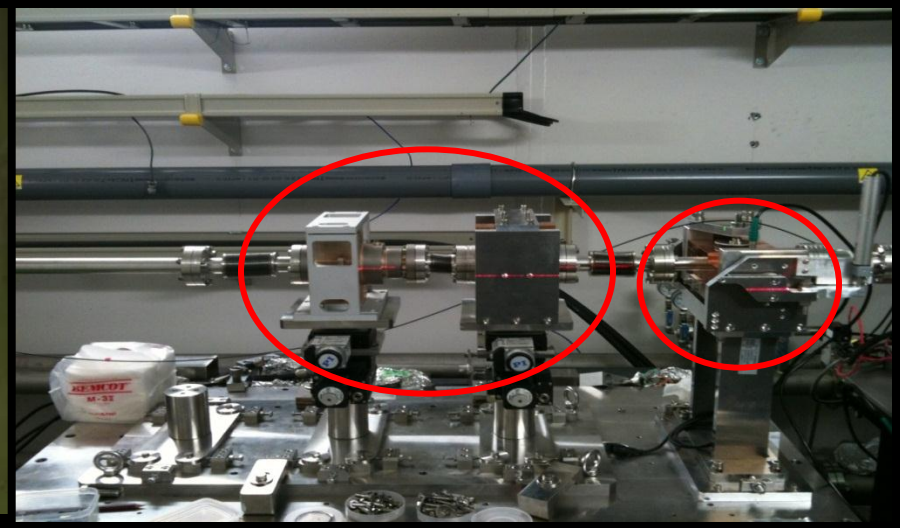
- 1) The second China ILC Workshop in May 29-30, Beijing, China**
- 2) The second Fragrant Mountain Meeting on China's Roadmap for ILC in Dec. 19-21, 2012.  
(Hopefully, just after good news from LHC then)**



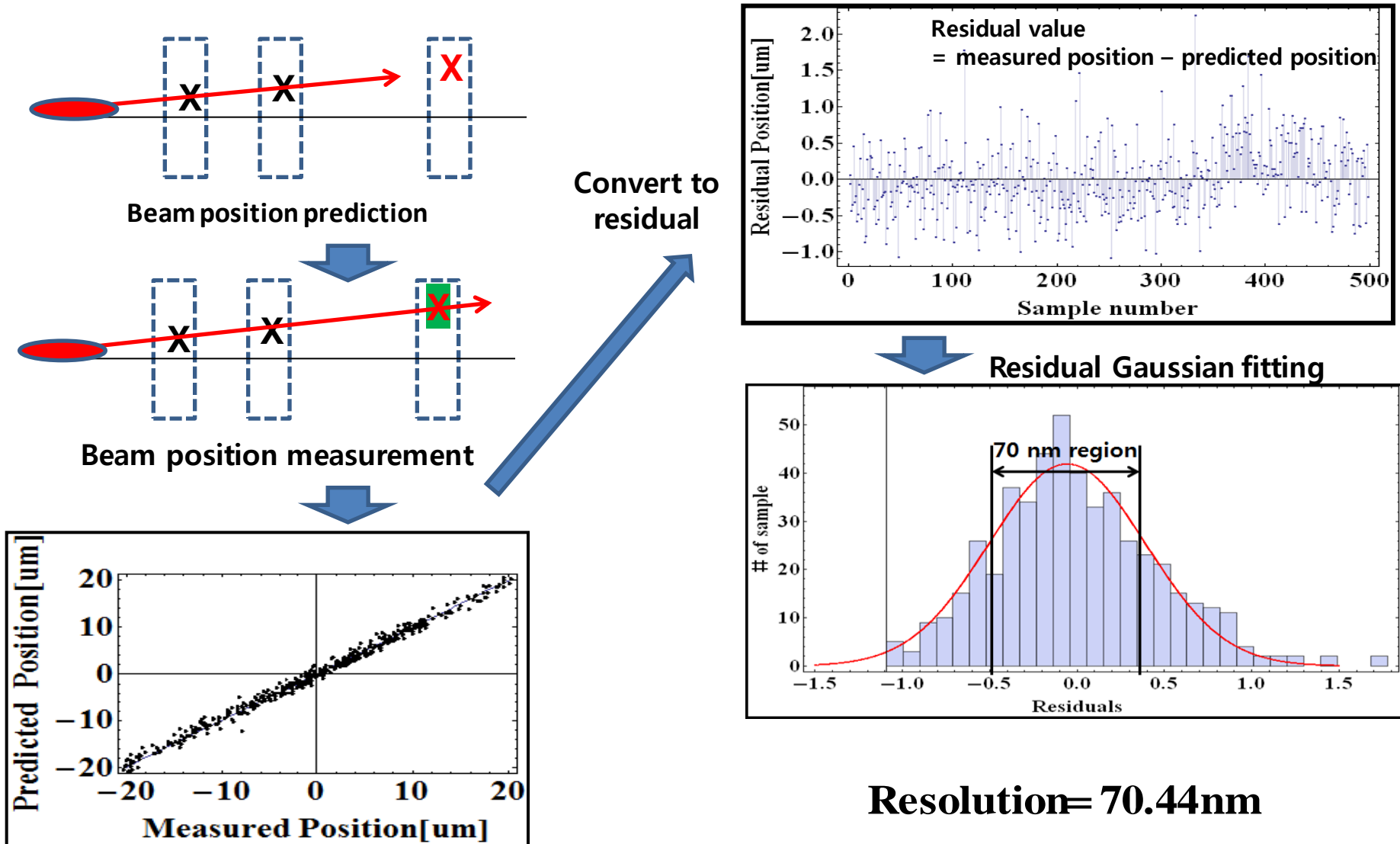
# Asia in ILC (Korea)



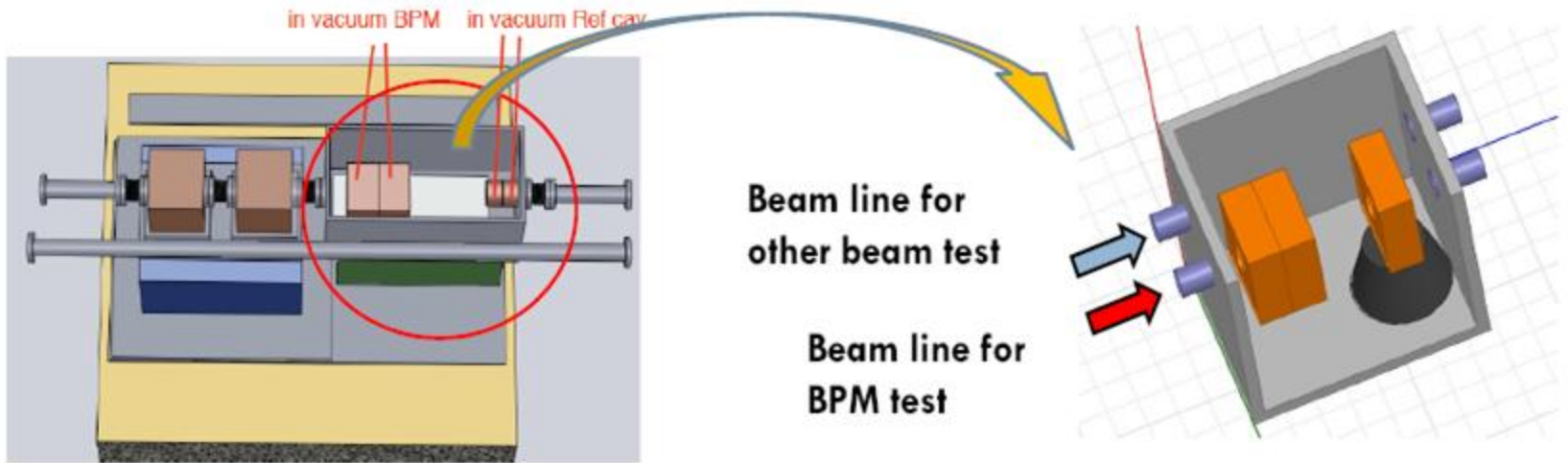
# Beam test of position resolution of KNU IP-BPM at ATF2 (Feb. 2011)



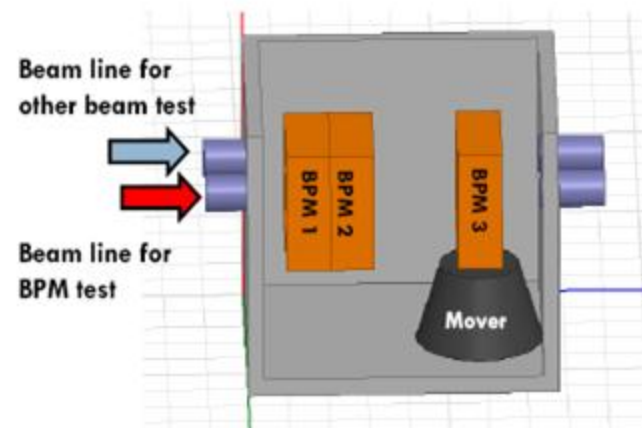
# Position resolution of KNU IP-BPM at ATF2 ( 70 nm @ Feb. 2011)



# Development of Upgrade version of KNU IP-BPM at ATF2 ( for position resolution of 2 nm)



New BPMs and Electronics are under fabrications for installation at ATF2 in Nov. 2011.





## Asia in ILC (India)

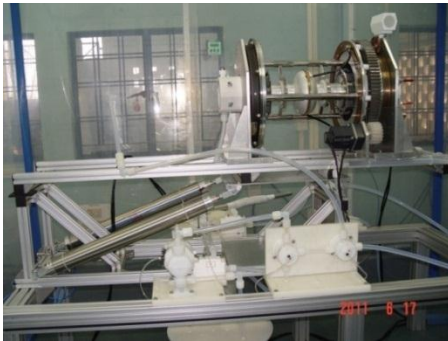


## Infrastructure for SCRF Cavity Fabrication and Processing at RRCAT, Indore

- 120 T cavity forming facility
- Electro-polishing setup for 1.3 GHz
- Centrifugal barrel polishing machine for 1.3 GHz single cell cavities
- High pressure rinsing



Cavity forming facility installed



Electro-polishing setup developed



Centrifugal barrel polishing machine developed

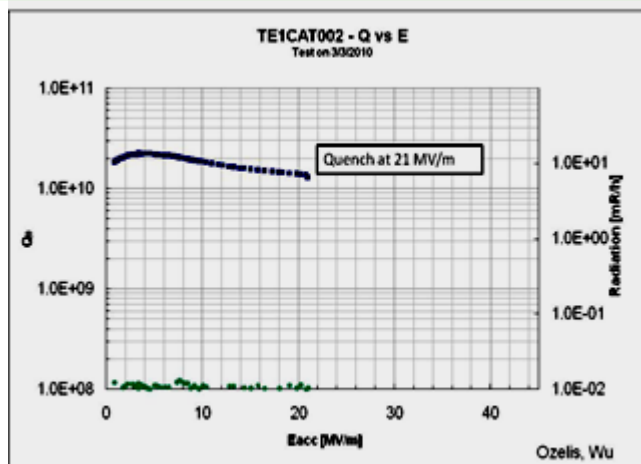


High pressure rinsing Set up developed

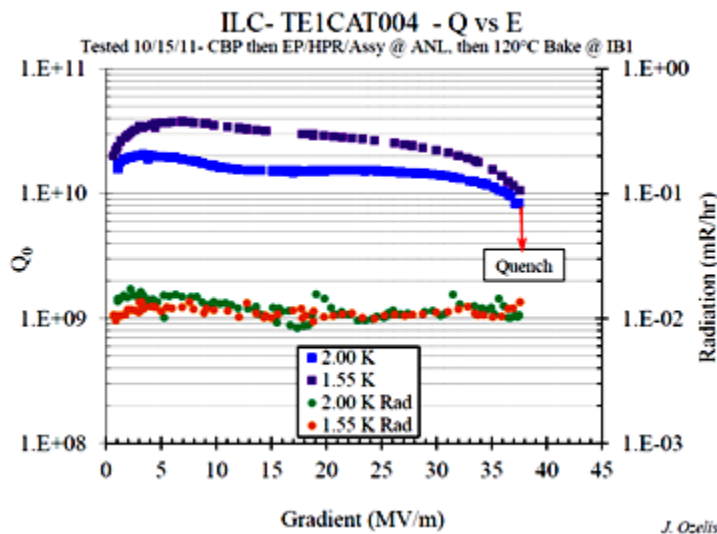
- Electron beam welding machine (15 kW) and a vacuum annealing furnace are under procurement. These are expected to be installed by December 2012

# Development of Single Cell 1.3 GHz SCRF Cavities at RRCAT -IUAC

- During 2009–10, two single cell Nb cavities were jointly developed under IIFC.
- First Indian superconducting cavity performance measured at Fermilab. Maximum accelerating field of 21 MV/m at  $Q > 1 \text{ E}+10$  achieved at 2 K.



- Subsequently during 2011, two more cavities have been fabricated and processed under IIFC to improve the performance.
- These cavities have exhibited accelerating gradients up to 37.5 MV/m with a  $Q > 1 \text{ E}+10$  at 2 K.



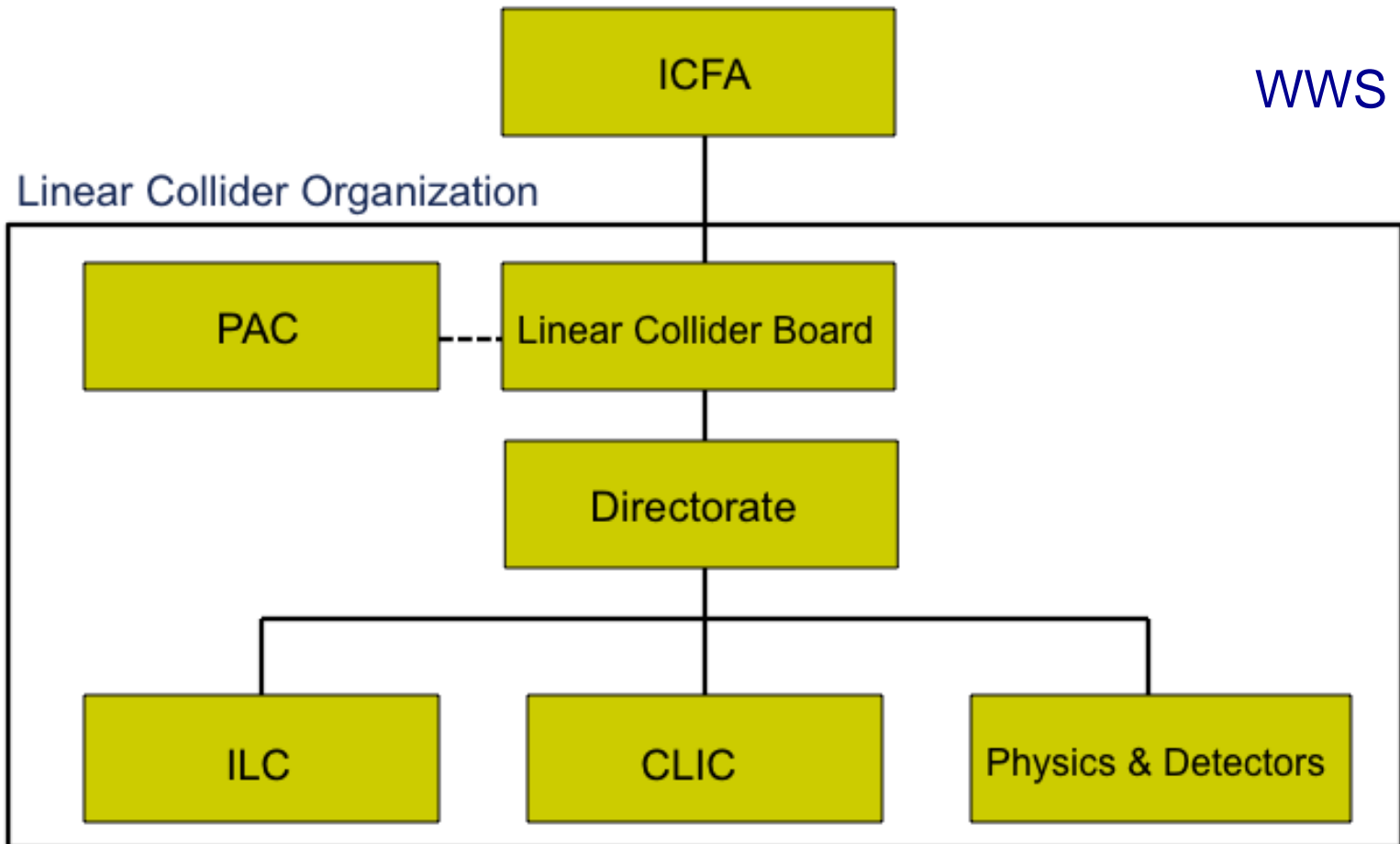


## Concluding remarks

# Possible Organization



WWS



**Asia will play its role in the new framework of LC**



# LC on Summit of G20 (20XX)

## a possible way towards LC





# Finally

- The beginning of the second decade of the 21th century is historically important for Asia (AS) to be with US and EU forming “EAU”, the important element of wonderful life in the world.**
- Asia is facing historical opportunity and responsibility on the road of development and ILC is a concrete opportunity and a subject of responsibility.**
- Asia’s vitality in its accelerator related scientific activities nurtures the soil for ILC both on technologies and human resources.**



**Many thanks to the colleagues in Japan, China, Korea and India for their providing information in preparing this talk...**

**Thank you for your attention!**