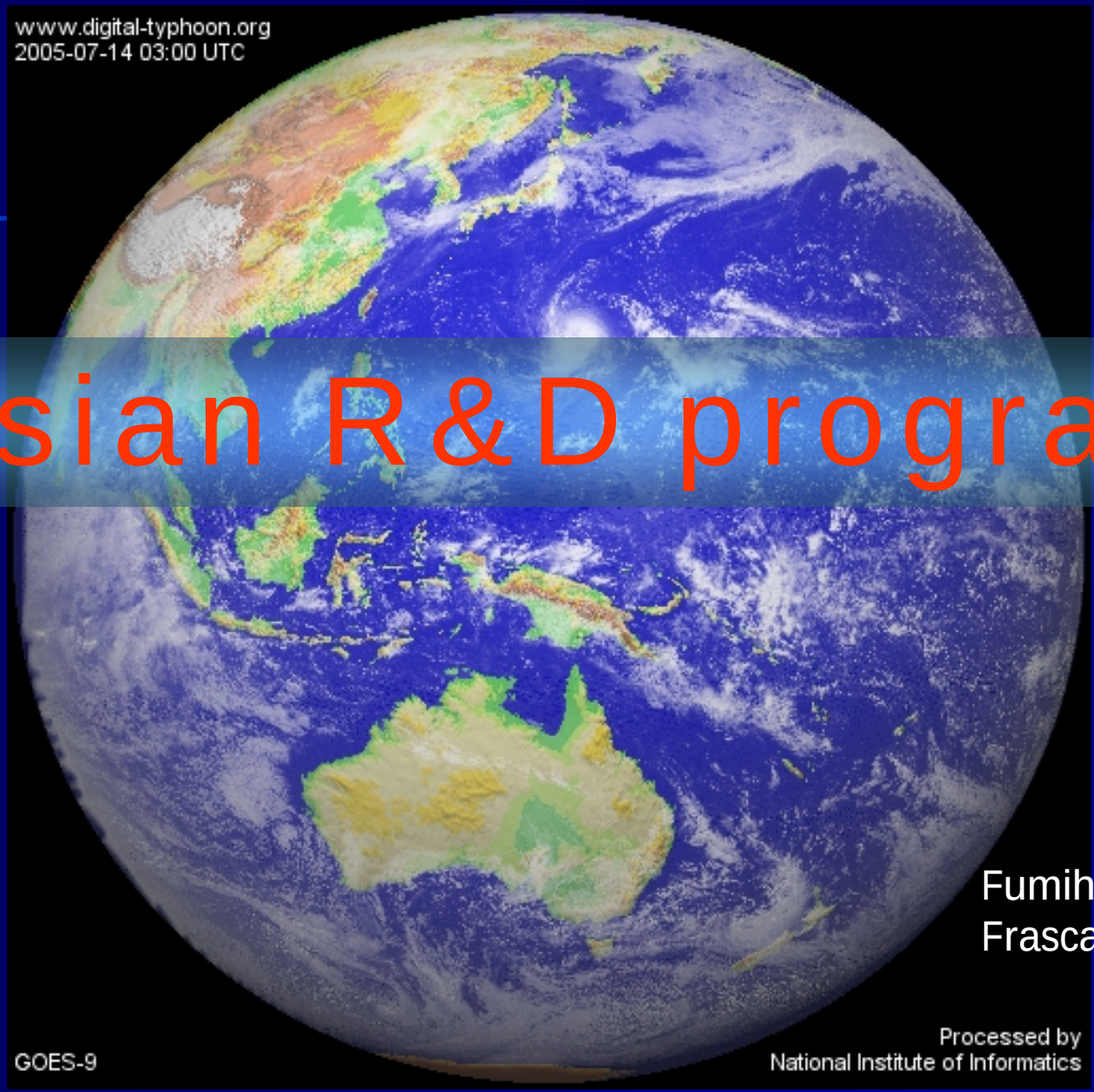


Asian R&D program

Fumihiko Takasaki
Frascati, Dec 8,2005

Major Institutions in Asia

CAT	India
CHEP	Korea
IHEP	China
KEK	Japan
PAL	Korea
TIFR	India

Memorandum of Understanding

for Research and Development efforts
toward the Realization of the International Linear Collider

Considering;
The decision to adopt the superconducting technology for beam acceleration in the Main Linacs of the International Linear Collider (hereinafter referred to as ILC), which was announced by the International Committee for Future Accelerators (hereinafter referred to as ICFA) on August 20, 2004,

And

The worldwide R&D efforts for the ILC under the auspices of ICFA,

The Center for Advanced Technology (hereinafter referred to as CAT), Center for High Energy Physics (hereinafter referred to as CHEP), Institute of High Energy Physics (hereinafter referred to as IHEP), High Energy Accelerator Research Organization (hereinafter referred to as KEK), Pohang Accelerator Laboratory of the Pohang University of Science and Technology (hereinafter referred to as PAL), and Tata Institute of Fundamental Research (hereinafter referred to as TIFR) agree to establish the framework of the cooperation and to facilitate R&D works for the ILC project in Asian region.

Definitions

For the purpose of this MOU;

(a) "Party" means any scientific and technological organization which signs this MOU;

(b) "Cooperative Activity" means any activity, in the days before the construction of ILC starts, which the Parties undertake, or support, pursuant to this MOU, and includes exchange of scientific, technical and administrative information, exchange of visits, materials and equipments, and the Joint Research defined in (d).

(c) "Intellectual Property" shall have the meaning in Article 2 of the Convention establishing the World Intellectual Property Organization, done at Stockholm, 14 July 1967 and subject to the Annexes which would be negotiated by each Party in the future and attached to this MOU; and,

(d) "Joint Research" means research that is implemented with financial support from one or more Parties and that involves collaborative research and is designated as joint research in writing by the Parties or their scientific and technological organizations and agencies, or in the case where there is funding by only one Party, by that Party and the participants in that project.

Collaboration between KEK and Other Areas

- With US (Japan-US program)
- With Europe
  - TESLA Technology Collab
  - KEK-CNRS-CEA Collab
  - KEK-INFN Collab

R&D Program before TDR

- Establish essential local activity Basis, including industrialization.
- Make maximal contribution to TDR.

Two Facilities

-- Dedicated to the ILC

-- Open to the Int'l community

- ATF/ATF2 :

  R&Ds for the issues related to the Damping Ring and Beam Delivery system.

- STF : A new facility

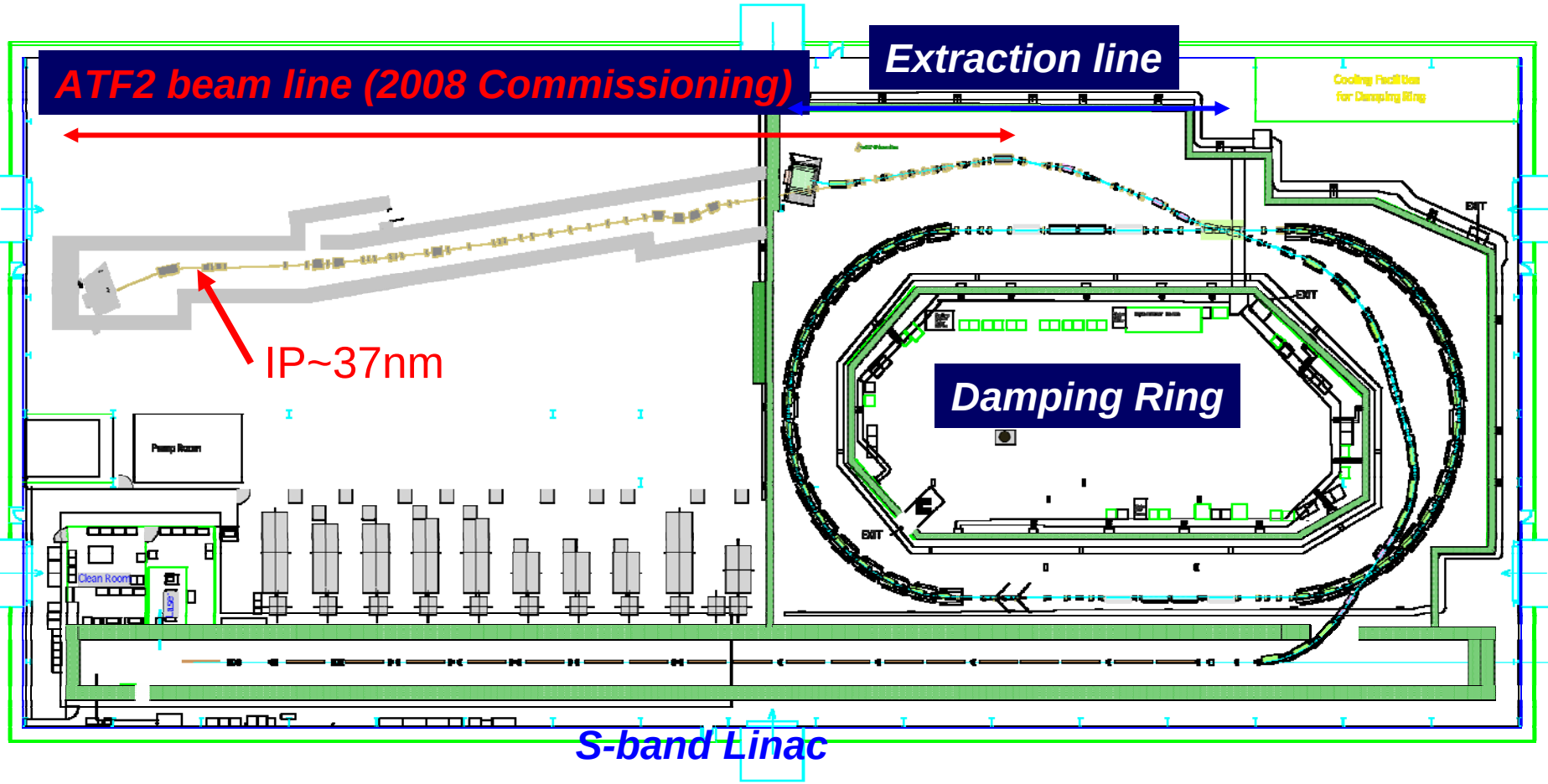
  R&Ds for the SCRF Tech. issues.

ATF : The basic facility exits since some years and it has already produced number of interesting results.

There exits an International ATF collaboration which comes up with a program and executes it.

STF : It is a new facility which we build in the coming years except for the building. The procurement of accelerator components and infrastructures is under way.

Layout of ATF/ATF2



ATF MOU

SLAC, FNAL, LBNL, Cornell

CERN, DESY, Q.M.U.L., R.H.U.L, Oxford, U.C.L.

IHEP, PAL, Tokyo, Kyoto, Nagoya, Waseda, KEK

The Memorandum of Understanding for the ATF International Collaboration

1. Preamble

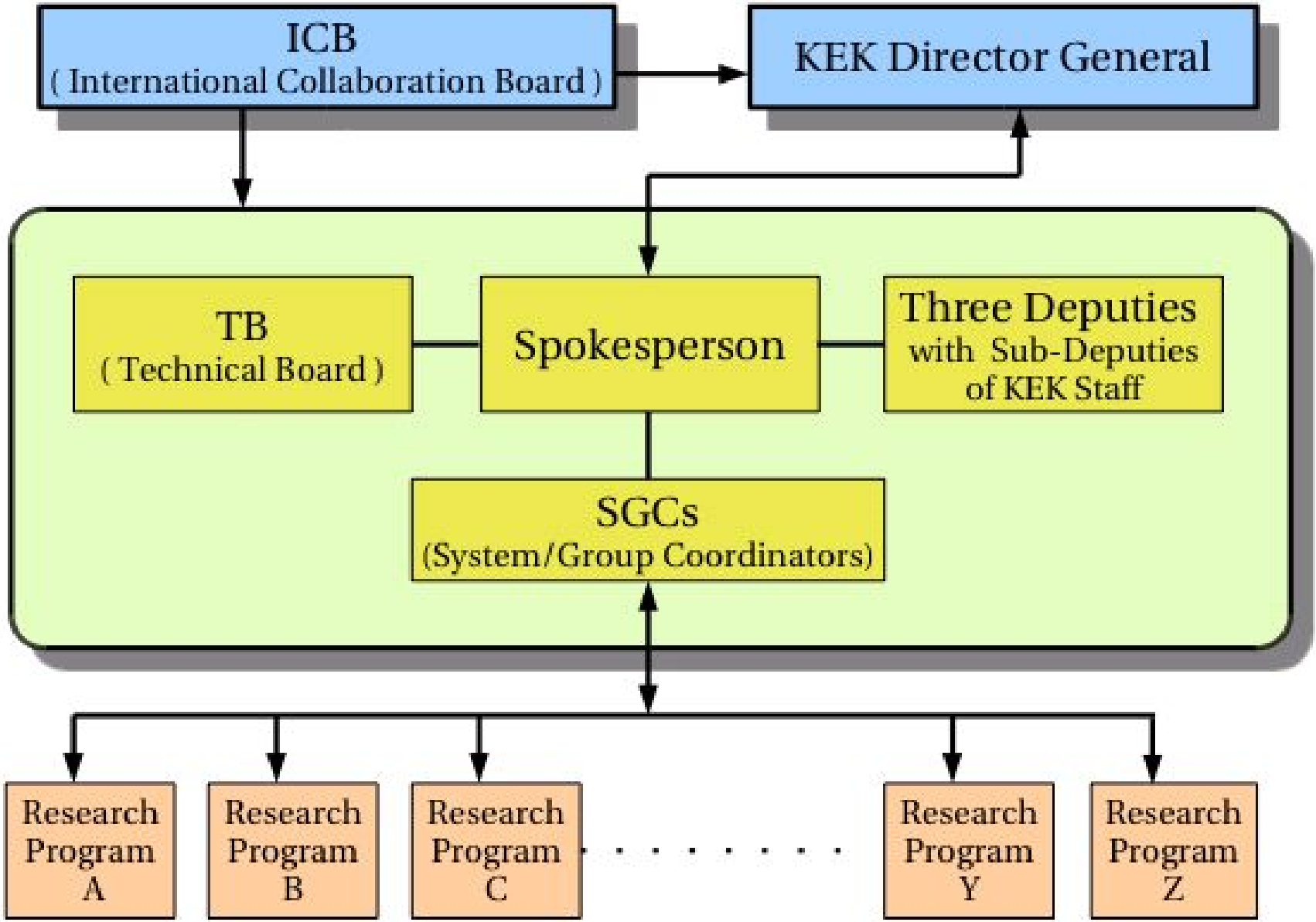
The purpose of this Memorandum of Understanding (MoU) is to define the organization of the international collaboration to carry out the research programs at Accelerator Test Facility (ATF) and its extension ATF2 which is located at KEK, so as to maximally contribute to the world design and development efforts in the areas of particle sources, damping rings, beam focusing and beam instrumentation towards the International Linear Collider (ILC) project.

The construction and operation of ATF was initiated at KEK in 1991 to bolster the R&D efforts for JLC (Japan Linear Collider) which has started in 1987. The accelerator system of ATF presently consists of: an S-band electron linac, a damping ring, and a beam extraction line. Active participants in the research programs at ATF include the members from KEK, a number of Japanese universities and overseas institutions, including, SLAC, DESY, CERN, PAL , IHEP and UK universities.

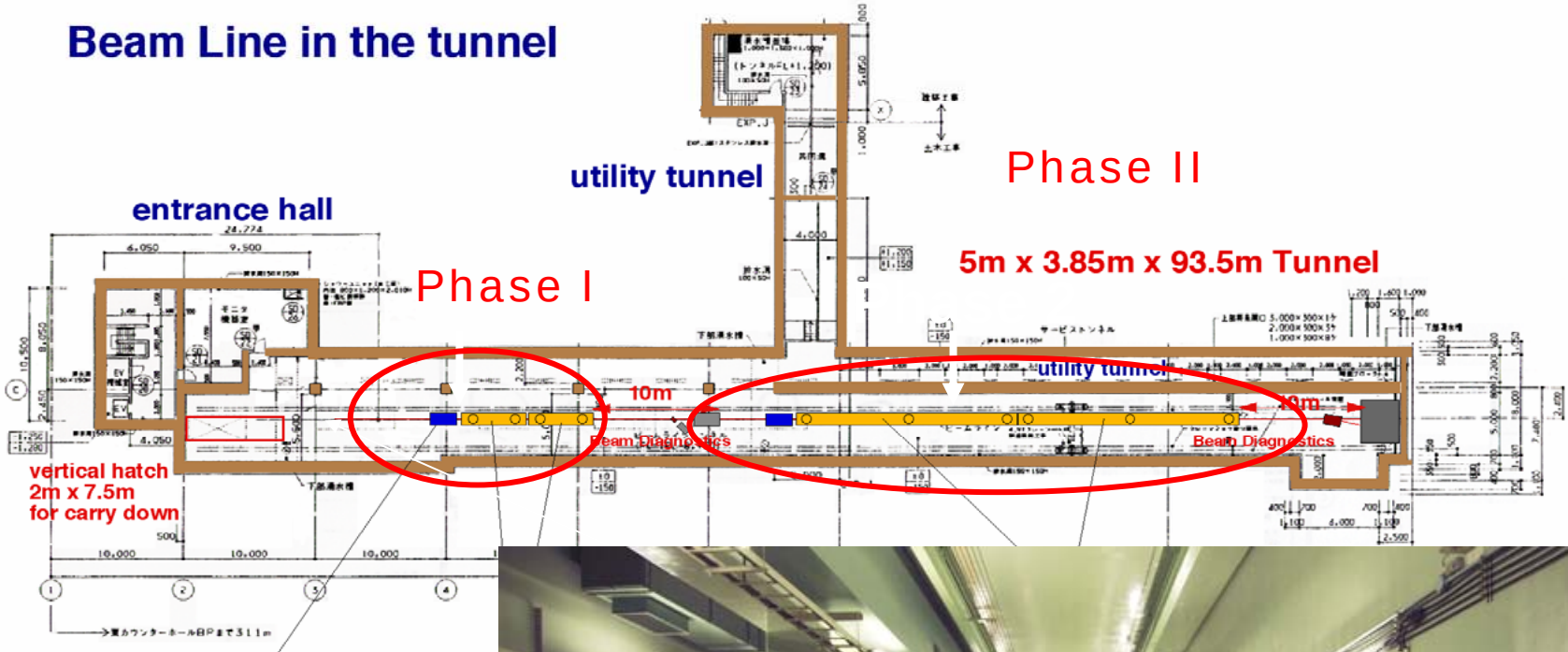
The recent development in the international affairs towards the linear collider has come to warrant reevaluation of the mission goals and the focuses of activities at ATF:

- ICFA/ITRP in August of 2004 announced the adoption of the "cold technologies" (superconducting RF) for use at the main linacs of the ILC, and the Global Design Efforts (GDE) are being initiated under the auspices of ICFA for design development of ILC.
- Some hardware reconfiguration and additional studies are subject of urgent research which is expected to clarify some key design issues of the injector systems at the "cold" ILC.
- With the technology choice for the main linacs resolved, a renewed attention is being drawn to the issues pertaining to the beam focusing and control in the beam delivery sections of ILC. ATF is expected to make a major contribution in this area by providing the ultra-low emittance beam for beam focusing studies. Thus very vigorous design efforts are currently under way for ATF2, which is expected to serve as a test bed for the ILC final focus system, starting operation in 2007.

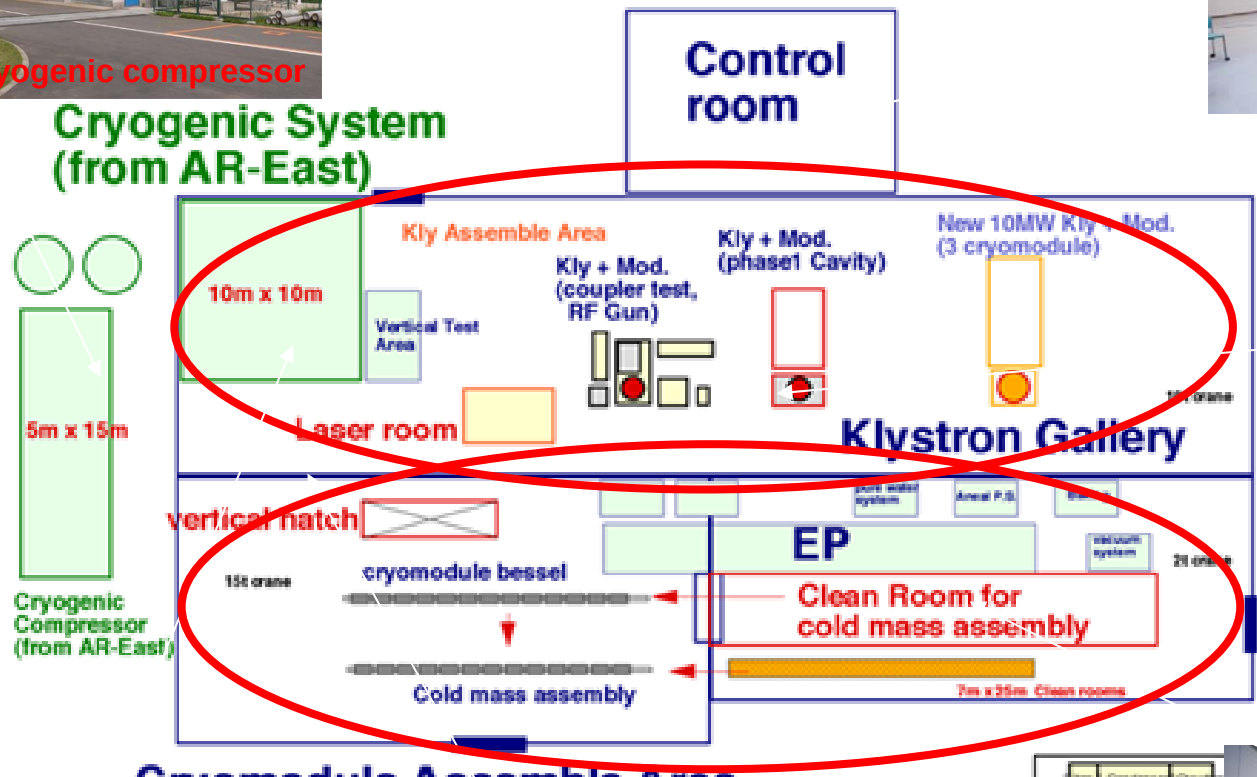
ATF International Collaboration



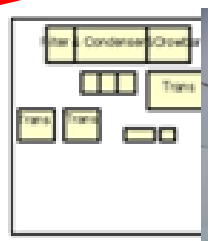
Superconducting RF system Test Facility



STF Building plane view



Cavity Process (EP)
& assemble Area
(clean rooms)



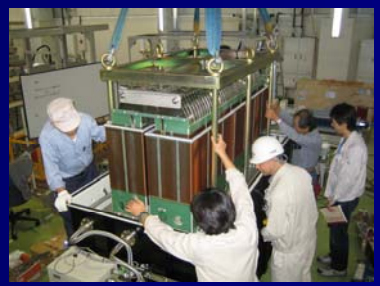
Infra-structure for SC-RF production

SRF System : Modulator, klystron

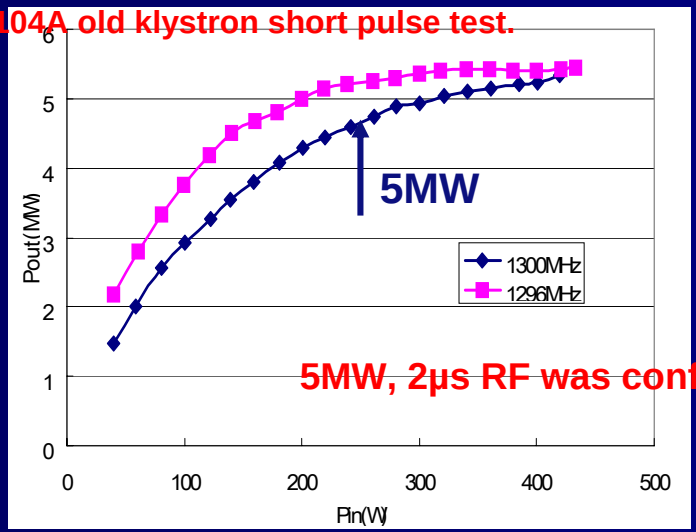
- **Refurbishing TH2104A klystron**
- **PNC modulator**

Existing PNC modulator

Additional Pulse Trans + Bouncer circuit allows to use TH2104A.



TH2104A old klystron short pulse test.



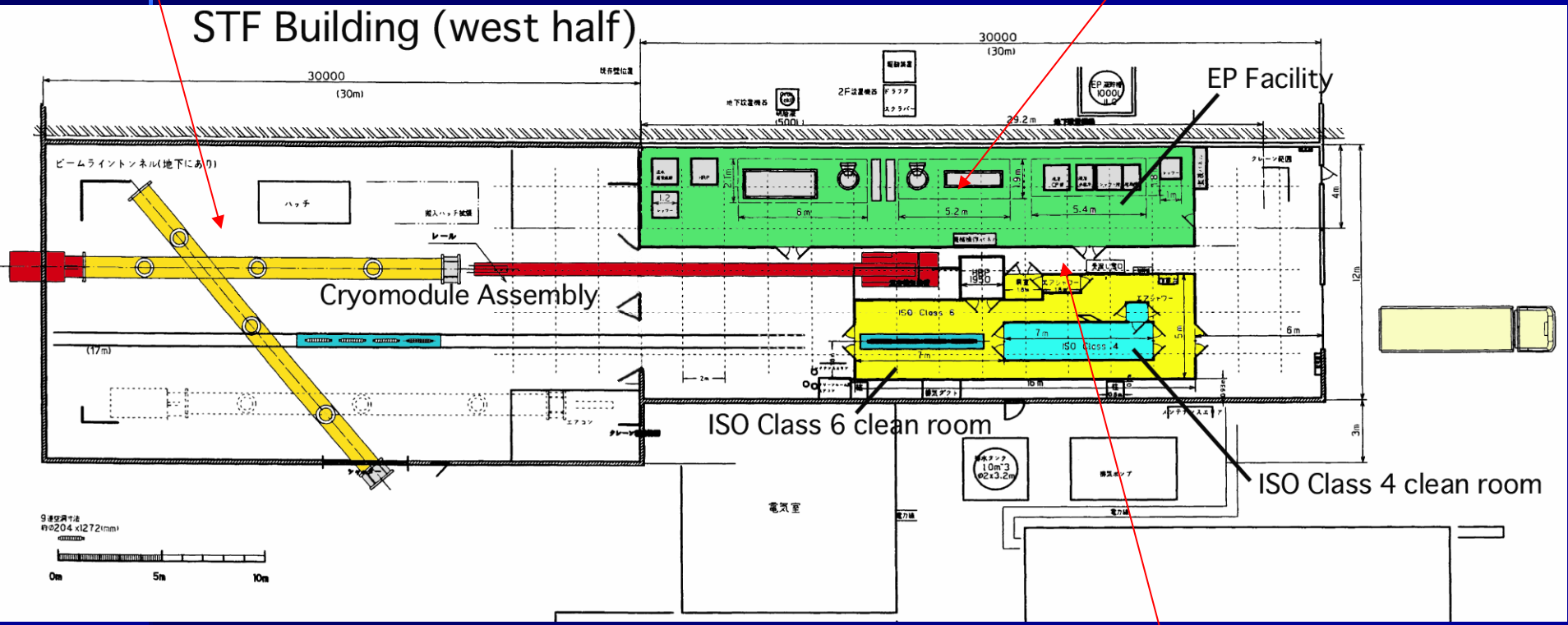
5MW, 2μs RF was confirmed.

Modulator & Klystron place.

Clean Rooms and EP Facility

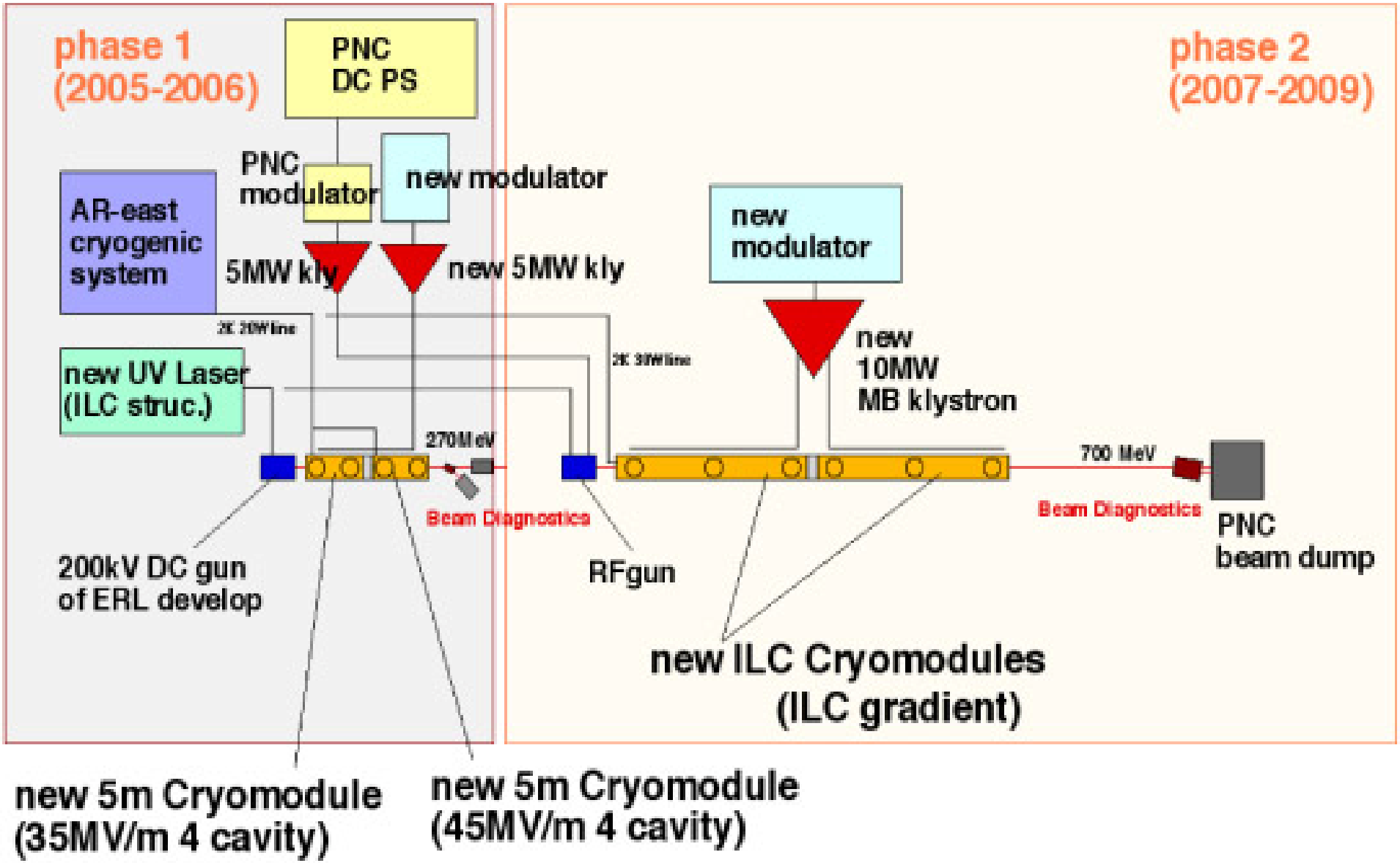
ILC Cryomodule

EP & chemical treatment

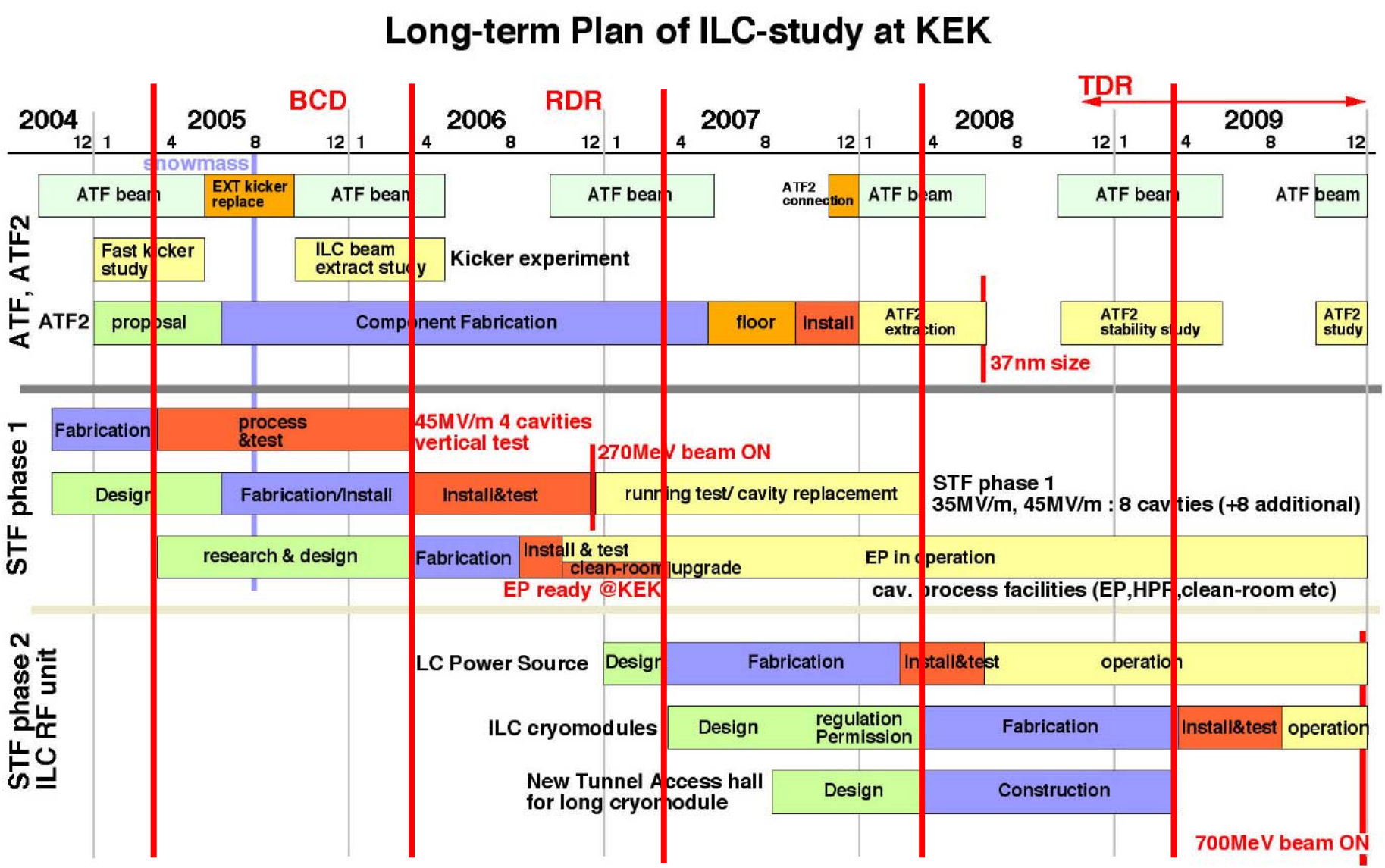


Clean-room for module assembly

Plan of Superconducting RF Test Facility (STF)



Baseline 5 Year Plan



- Baseline Plan will cost ~ 30 – 40 Oku-Yen additionally.
- STF-Phase II will cost about 20 Oku-Yen.
- ATF/ATF2 will cost ~ 3 Oku-Y annually.

Budget (Oku-Yen ~ 0.8 M$)

Salary is not included.

	2005	2006	2007	2008	2009
ATF/ATF2	3.0				
STF	4.1		?		
SCRF	2.1				
Misc.	0.7				
Total	9.9				

Human Resources (FTE)

	2005	2006	2007	2008	2009
ATF/ATF2	7.2				
STF	9.2				
SCRF	11.5				
Misc.	2.6				
Total	30.5				

Some information on the test facilities and R&D works

ATF Study item list in 2005-2006

Machine time : 16 weeks / year

Studies with Damping Ring

- *Fast Kicker for ILC damping ring*
- *Beam dynamics study*
- *Development of beam control / tuning techniques*
- *Instrumentation developments*

Using the Extracted Beam

- *High quality beam extraction*
- *nm resolution BPM test & demonstration*
- *Fast feedback test & demonstration*
- *Instrumentation developments*

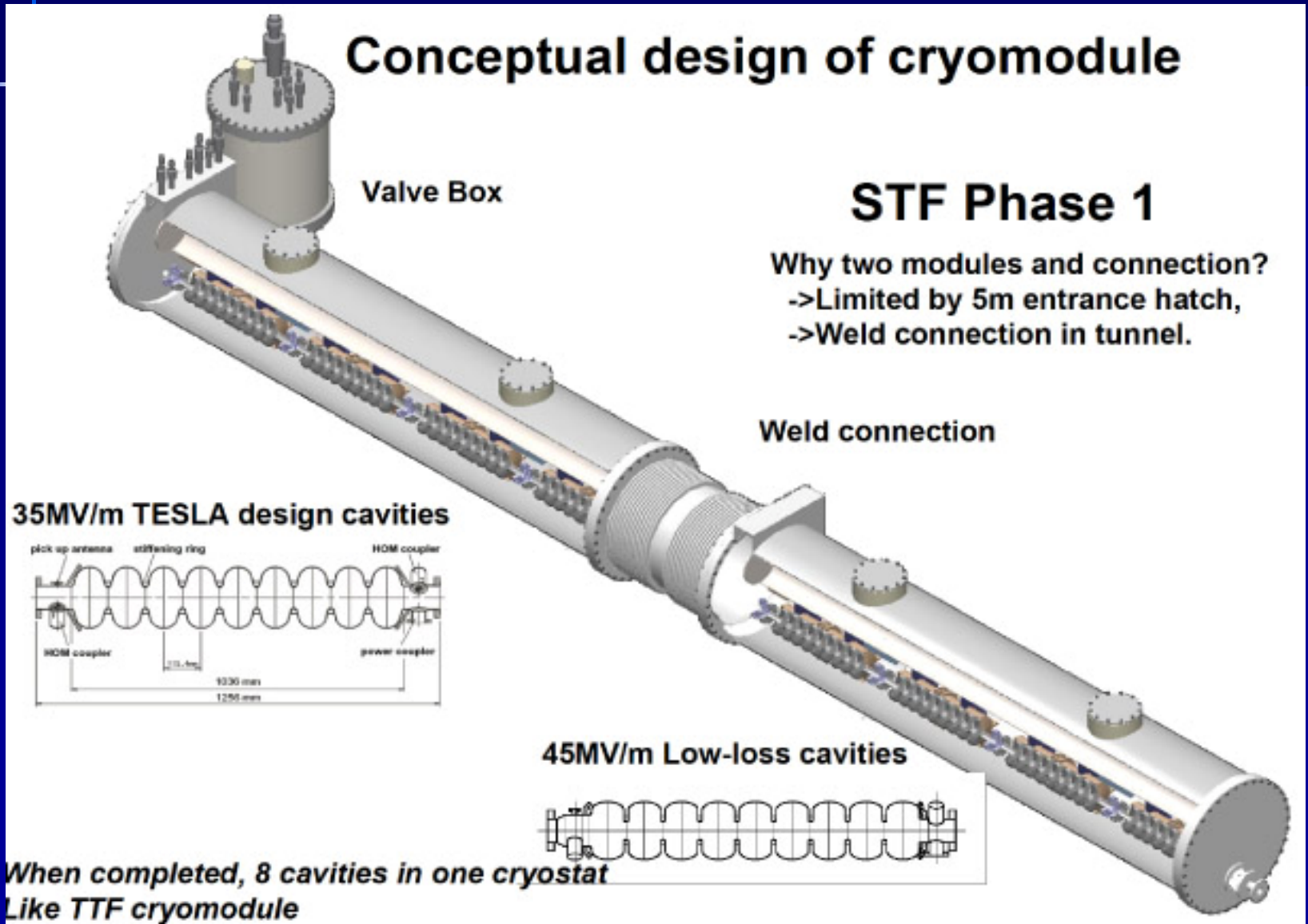
ATF2 : In Preparation

- ***ATF2 Proposal Vol. 1 was published as KEK Rep. 2005-2. Vol. 2 under way.***
- ***Layout and optics are ~ done.***
- ***Q-magnets by IHEP in JFY 2005.***
- ***Cavity BPMs for Q's by PAL in JFY2005.***
- ***Magnet PS will be prepared by SLAC likely in 2006-07.***

Construction Schedule:

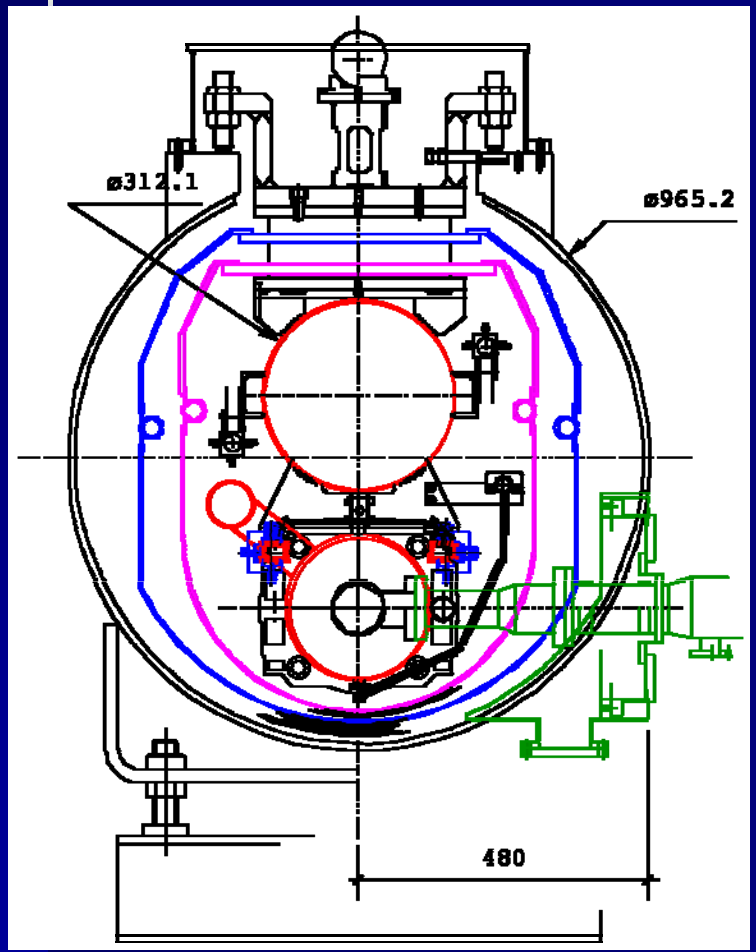
Feb 2008 : Beam on

Design of Cryomodule in STF Phase I

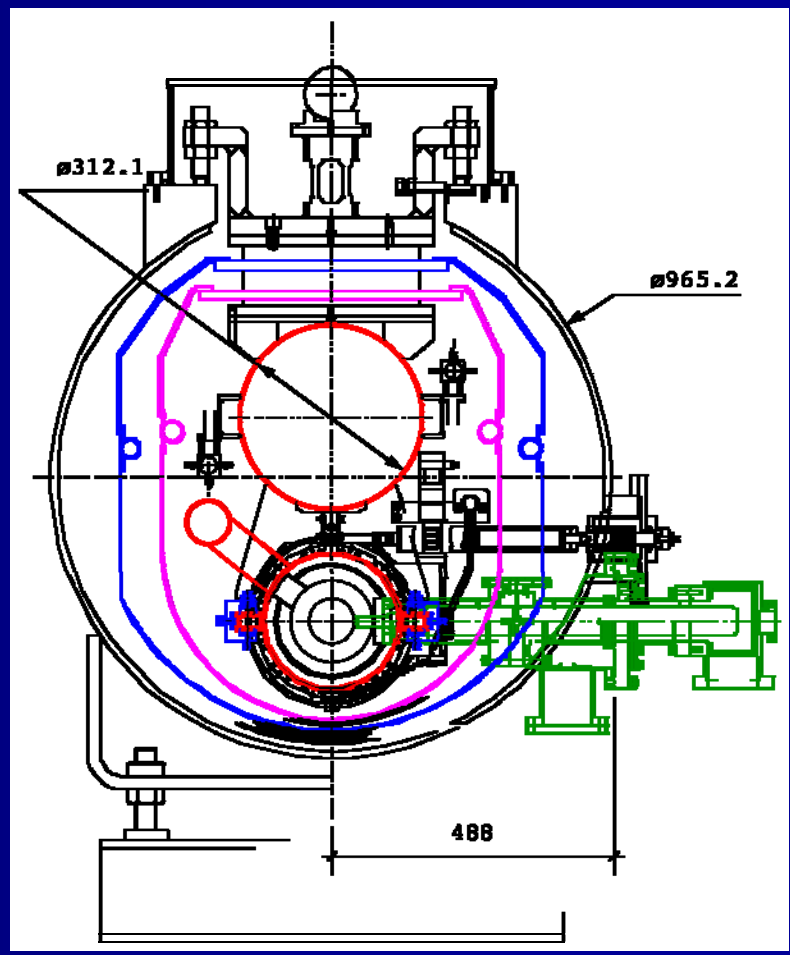


Cryomodule : Cryostat Design

for 35MV/m cavities



for 45MV/m cavities



Two Types of Cavities

TESLA type & LL type
Phase I : 4 units each

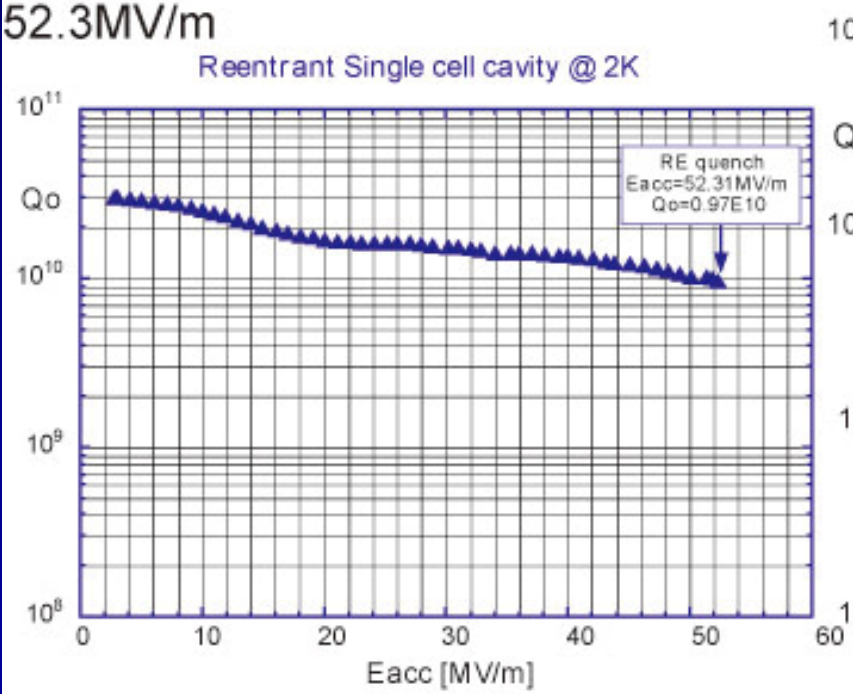
Performance of a 1-cell LL- and RE-type cavities

Cornell-KEK Reentrant (1.3GHz)

Fabricated at Cornell Univ.

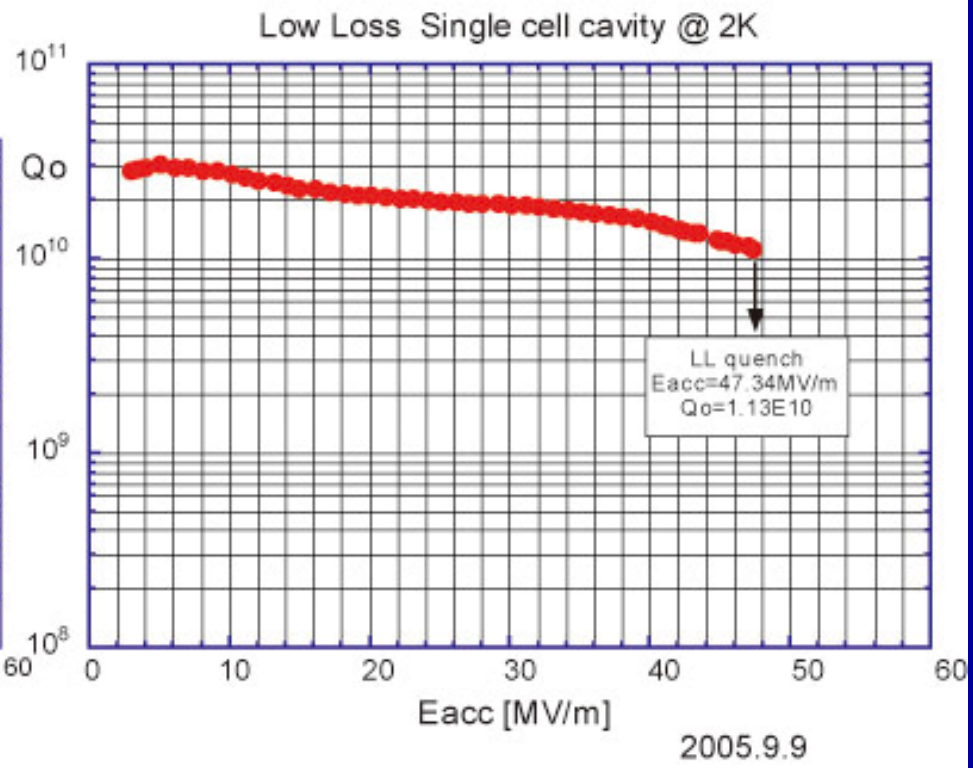
Surface-treated at KEK

52.3MV/m



KEK LL 1.3GHz

47.3MV/m



Milestones

- More 1-cell LL cavity test : up to 6 units.
- TESLA- and LL-type 9-cell cavity tests by Spring, 2006.
- Tuner testing on its way.
- Input coupler assy in coming months.
- Cryostat design (Phase-1) done.
- Vac enclosure order was placed.
- STF refrigeration system test with dummy load within JFY2004.
- Recycled TH2104A test done .

General Remarks on R&Ds

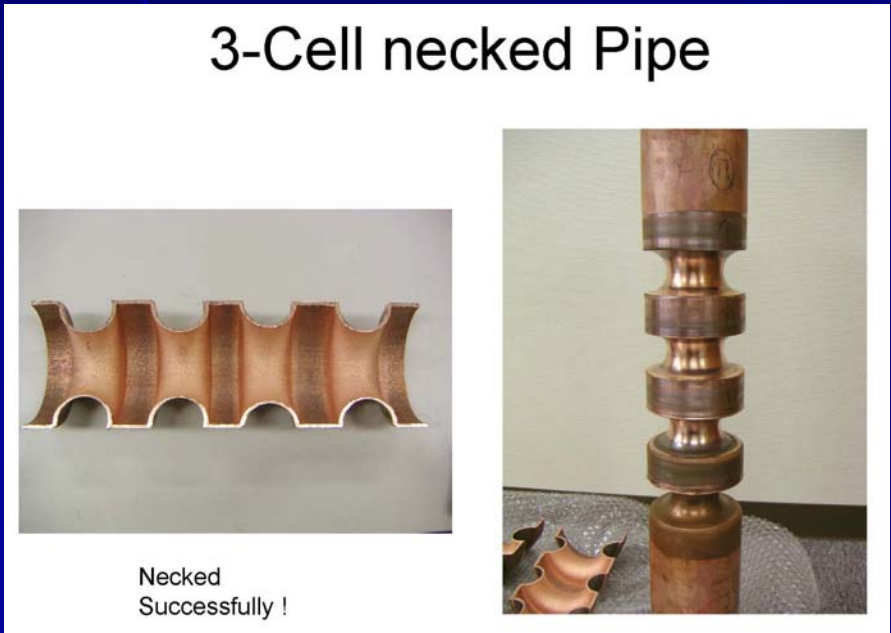
Everybody notices that the “ cost reduction and the industrialization “ are issues for the next R&D phase.

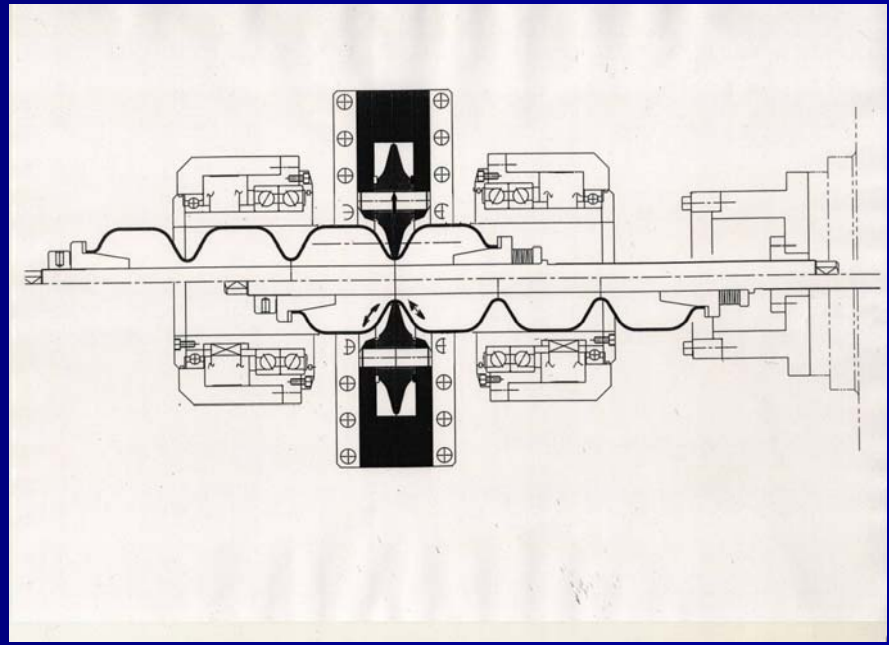
Our colleagues also spend part of their effort along this line.

R&Ds for Cavity Fabrication: Seamless Cavity

9-cell necking machine: Under fabrication.

Hydro-forming machine: Under Designing.





Remarks

To get maximal output from the STF, we would like to have more external input of ideas and suggestions.

We would like to open it to the world community as is the case for the ATF.

We are happy to join the discussion of the international task sharing and coordination.

ATF and STF

will provide

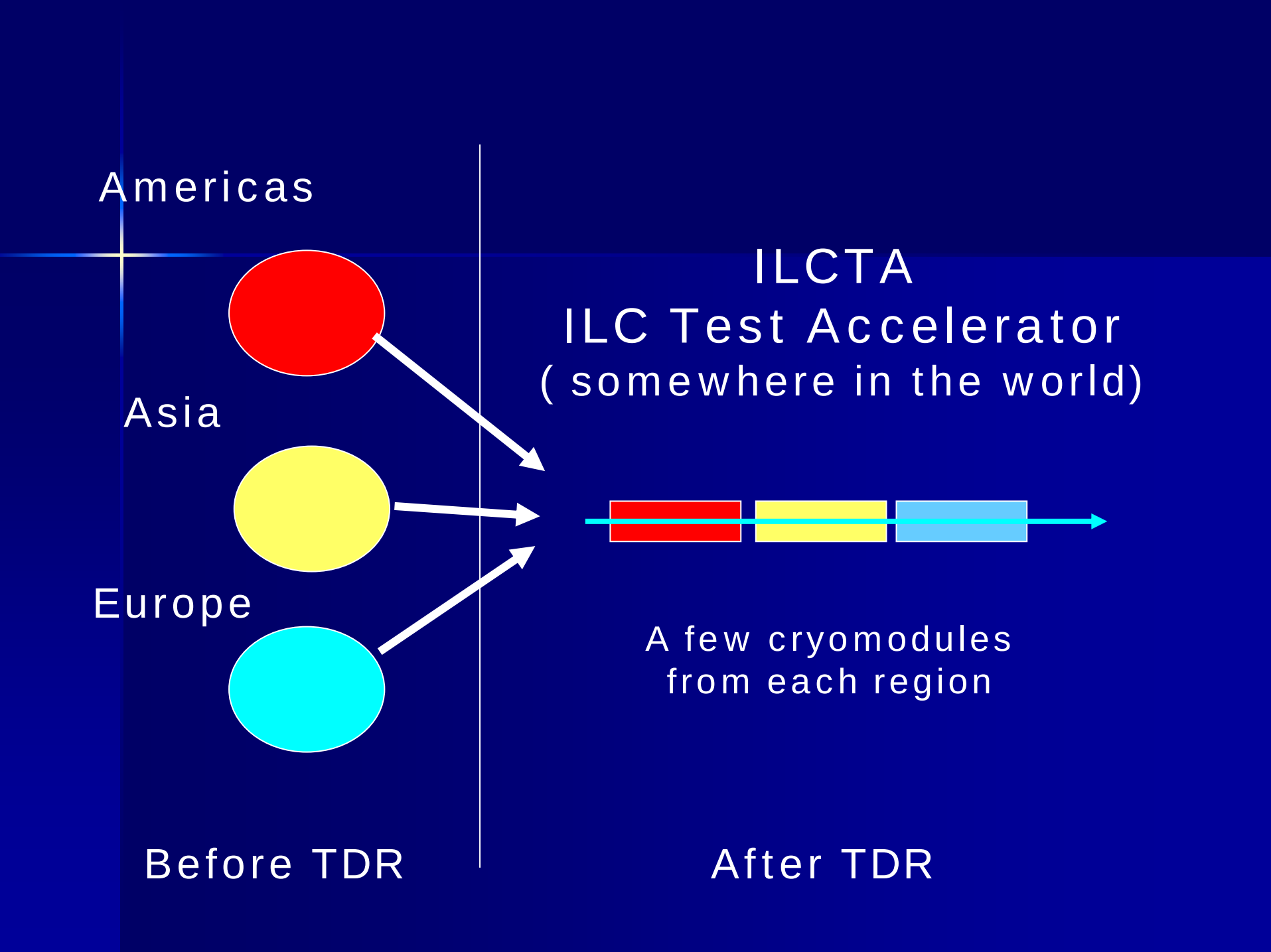
Opportunities for major international collaboration to share experiences.

Some thoughts beyond TDR

Well coordinated R&D Efforts will start soon. However, time goes fast and we should start thinking about the days beyond the TDR.

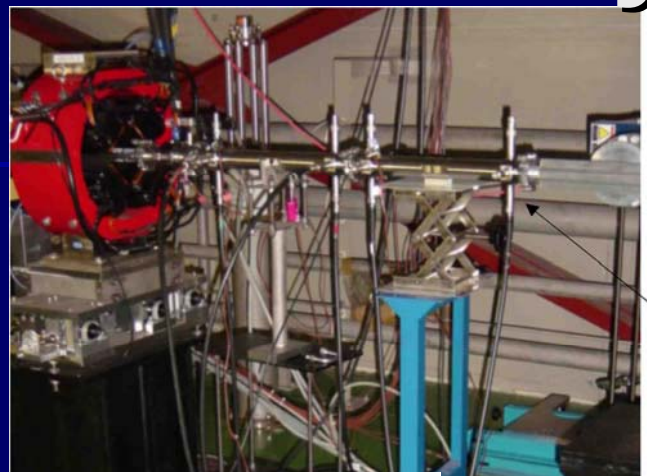
It may take some years before the construction of the ILC starts. What we should do in those days? Will we continue similar R&Ds?

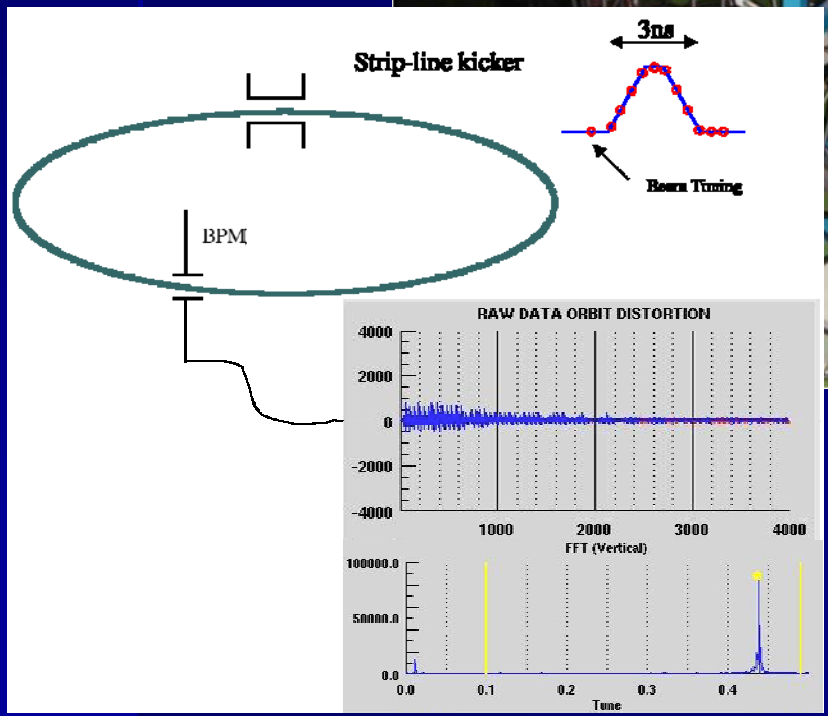
One of my dream is to build an ILC Test Accelerator, ILCTA, by a joint effort somewhere in the world.

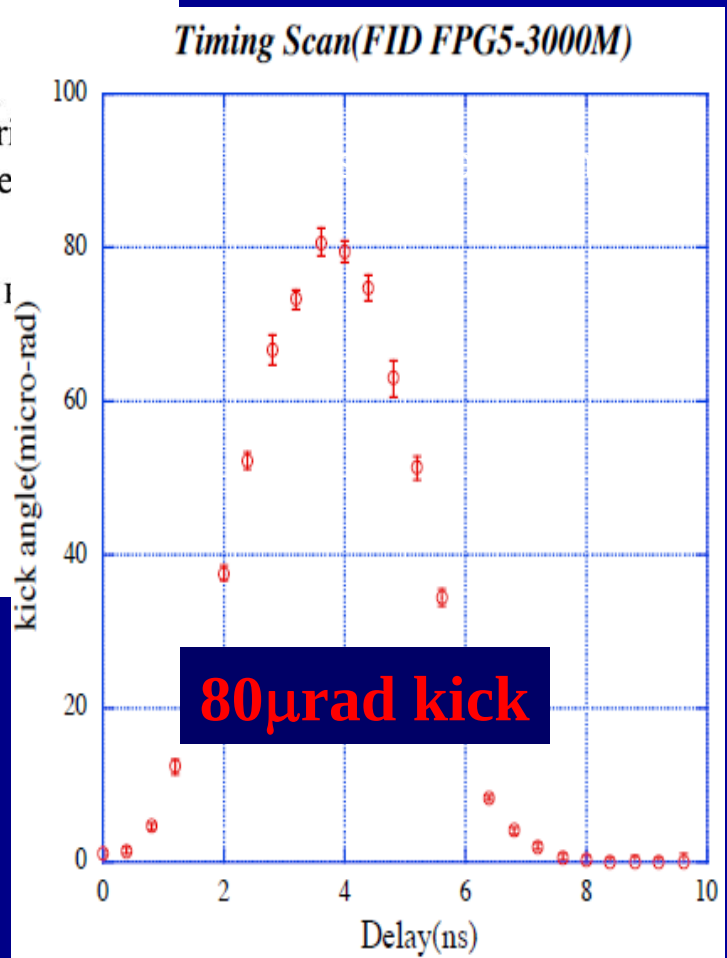

Americas
Asia
Europe
ILCTA
ILC Test Accelerator
(somewhere in the world)
A few cryomodules
from each region
Before TDR
After TDR

Back-up slides

Fast Kicker Study





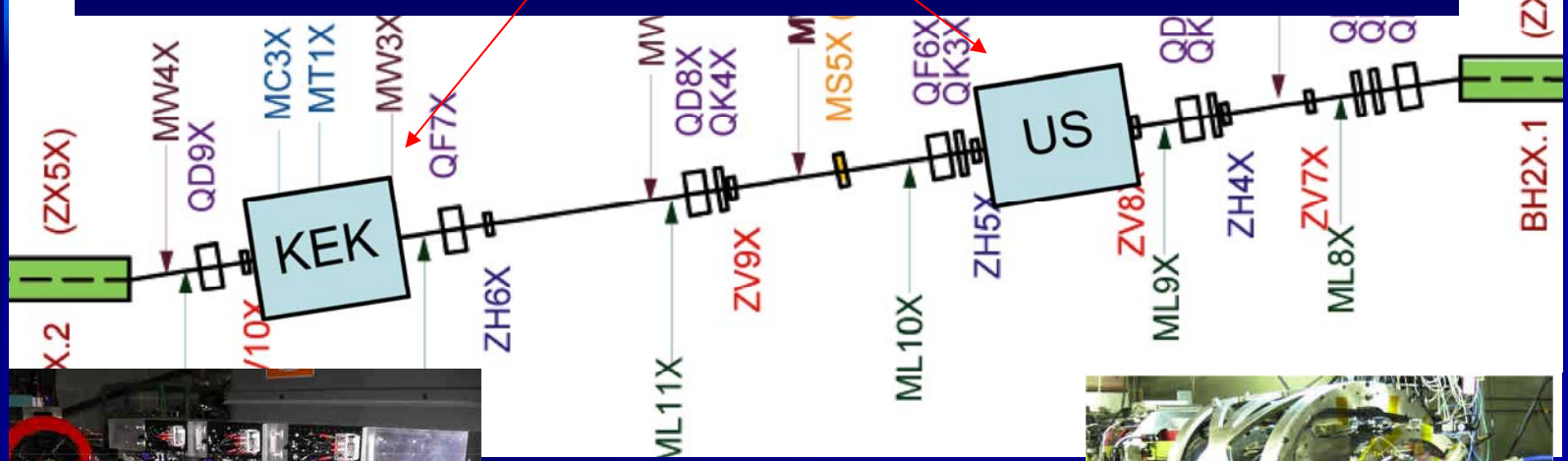


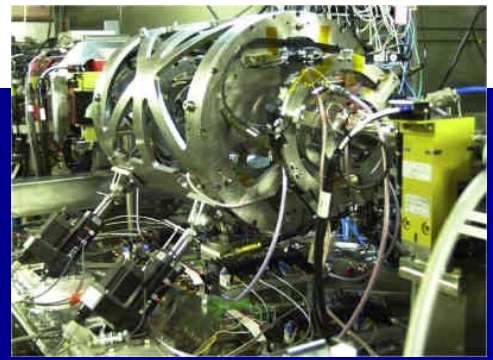
Cavity BPM Study

Continued

2 cavity BPM triplets in the ATF Extraction line

Different idea of support and position control

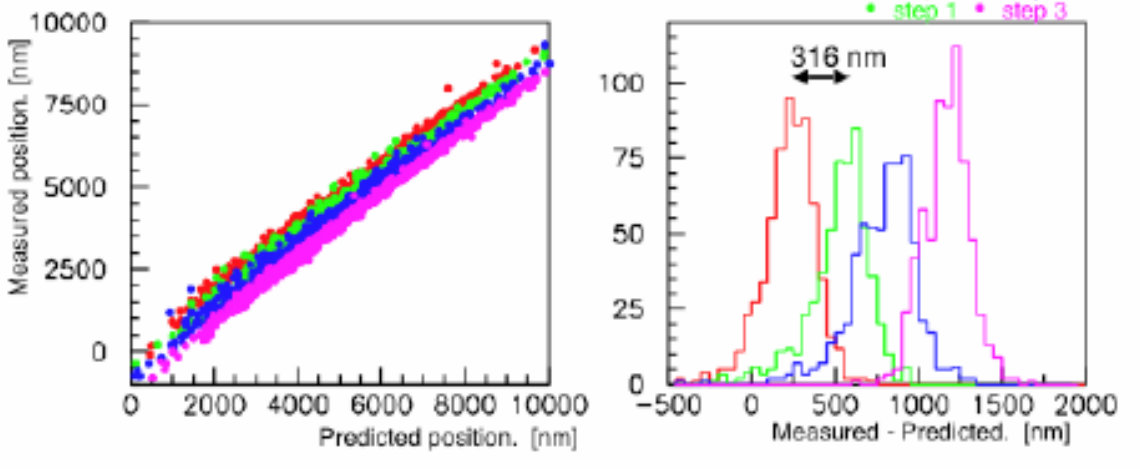




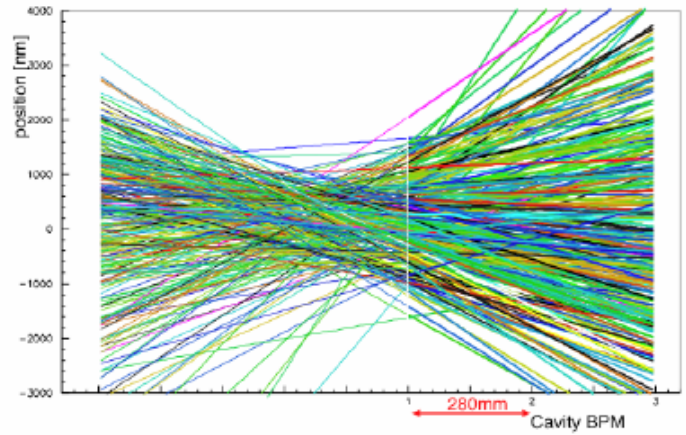
Demonstration of beam control at EXT within a resolution of 20nm position or 20nrad before the start of ATF2 construction.

Cavity BPM (KEK)

- Calibration using the BPM mover.
- resolution: 72 nm (with cut), 116 nm (all data)
- jitter at the waist: 560 nm (position) , 2.6 urad (angle)



Beam trajectory measured by three BPMs.

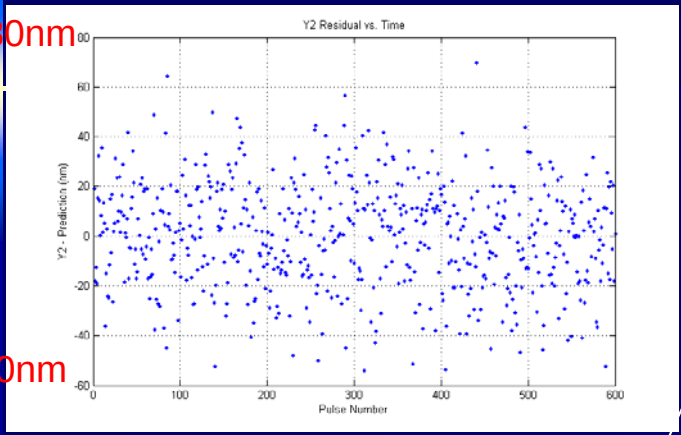


Y.Honda

Cavity BPM R&D (US)

Resolution tests (600 pulses)

+80nm



-60nm

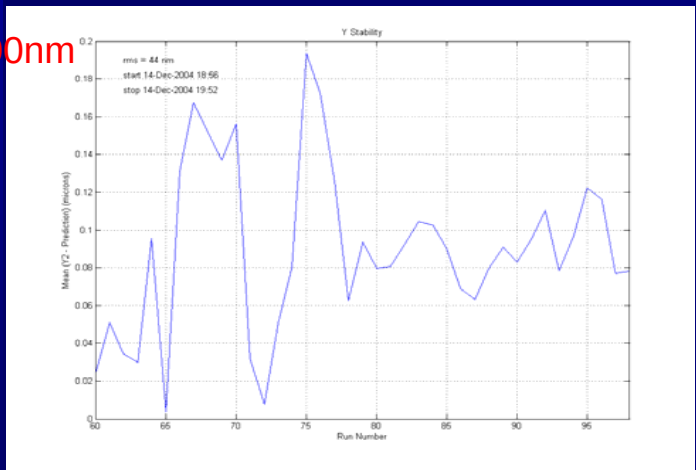
Residual of center BPM position from the predicted position by 1st and 3rd.

BPM resolution → 17 nm

Average residual of 40 sets of pulse sequences (4000 pulses total); rms offset drift = 44 nm.

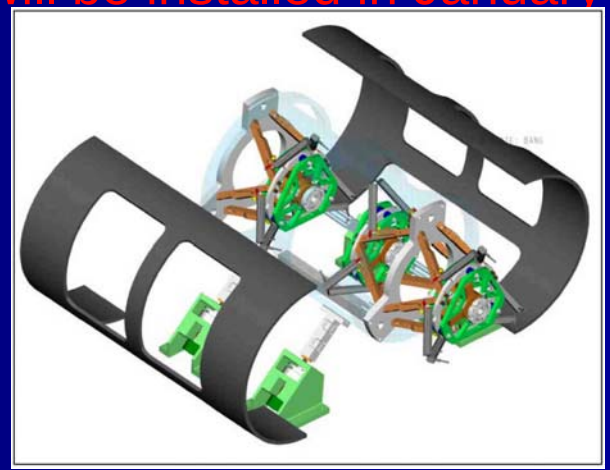
Long term stability (for 1 hour)

200nm



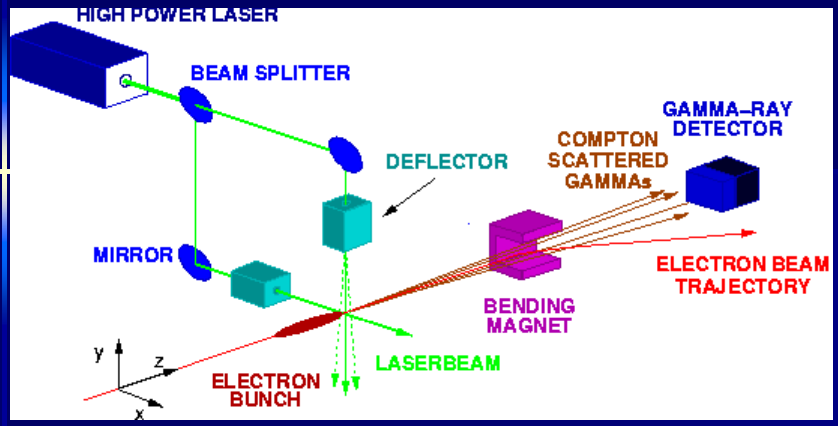
Minimize the thermal effects

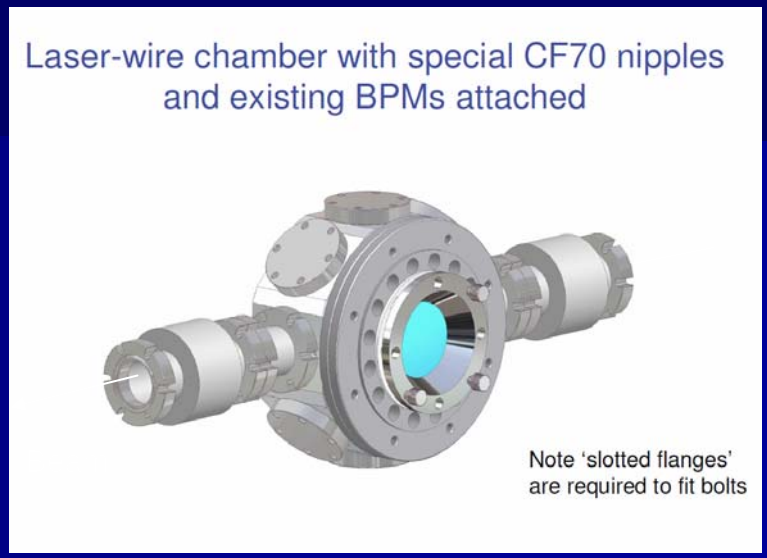
- New metrology frame (Carbon fiber) will be installed in January 2006.



New

Pulsed Laser Wire at EXT





- *University of Oxford*
- *Royal Holloway University London*
- *University College London*
- *SLAC*
- *KEK*

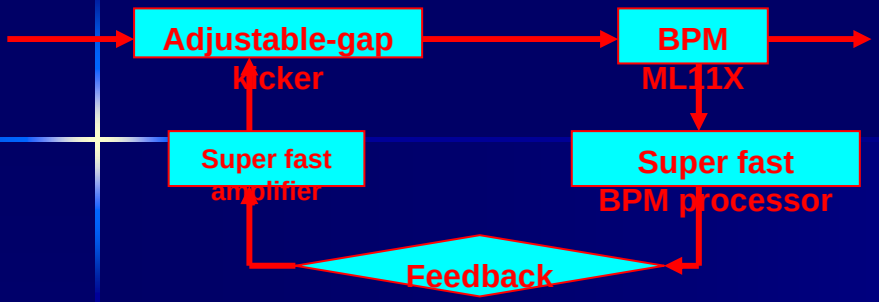
Vertical scanning Laser Wire

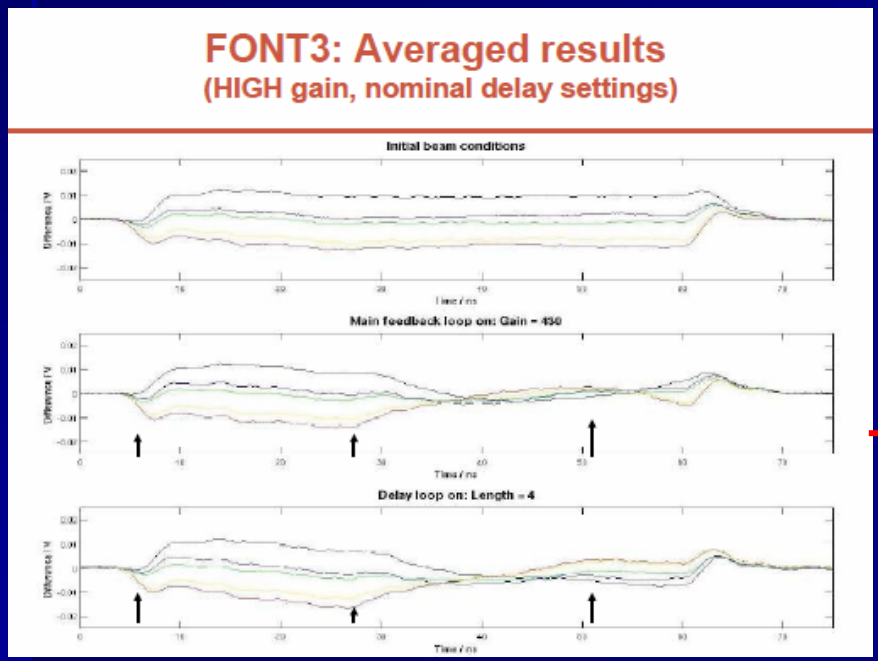
- Installation in September 2005
- Full system commissioning by December 2005.
- ATF2 beam size monitor

- Measure the electron beam profile with ~1 μm laser (waist).

G. Blair

Intra-train Beam Feedback at ATF-EXT





FONT
(Feedback On Nanosecond Timescales)

- Queen Mary Univ.
- Daresbury Lab.
- Oxford Univ.
- SLAC
- KEK

Warm

FONT1,2 (2002-2004) … NLCTA
latency 54 ns

FONT3 (2004-2005) … ATF
latency 23 ns

FONT4 (2005-2006) … ATF

- Digital FB system
- Latency 100 ns

Vital component of ATF2 beam stabilisation systems

P.Burrows

20 bunch x 2.8 nsec

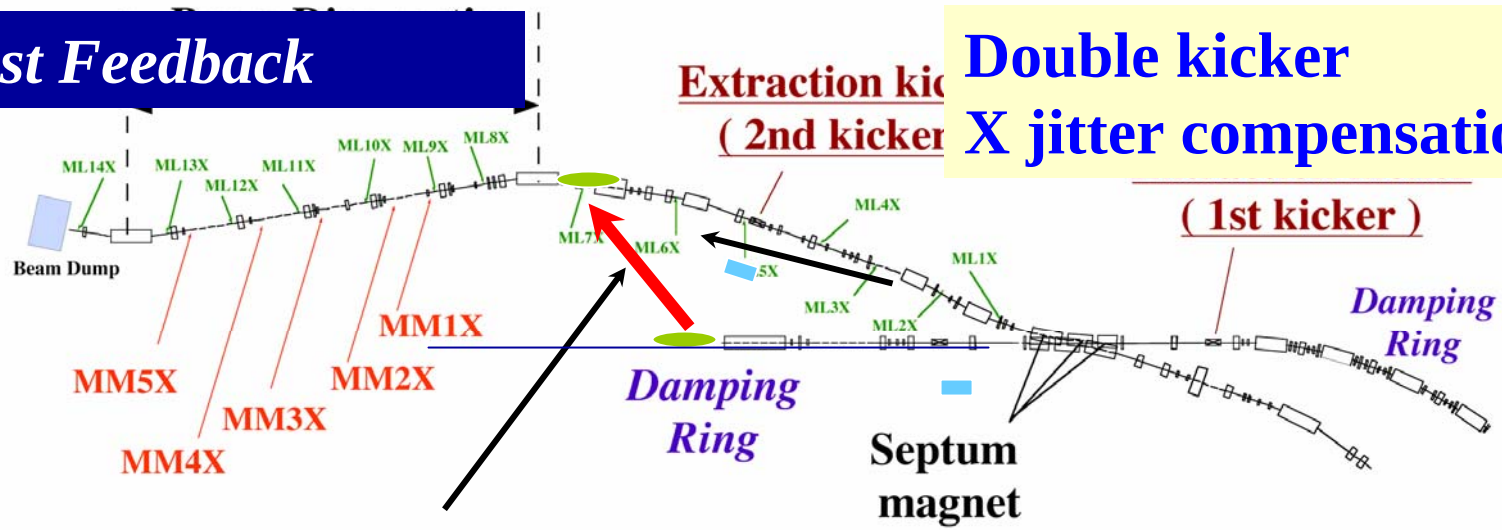
Feedforward to Extraction Line

FONT project (UK Institutes)

Planned

Layout of KEK-ATF Extraction Line

nm Fast Feedback



Double kicker
X jitter compensation

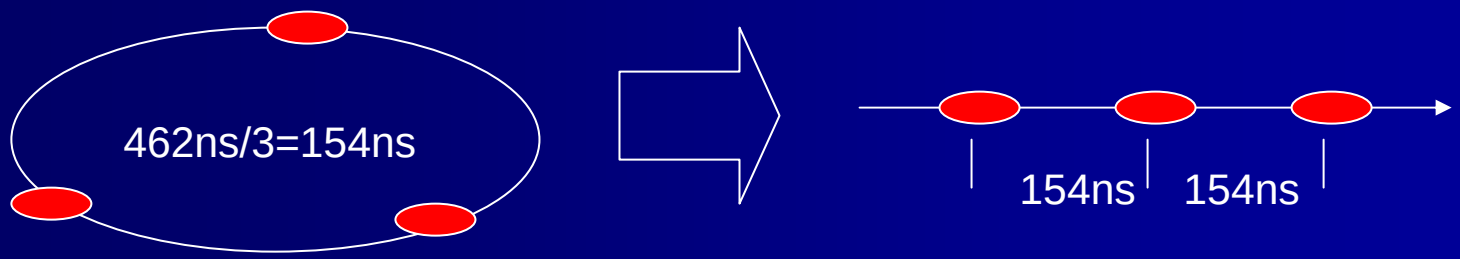
μm Feedforward (DR BPM -> EXT Line new strip line kicker)

Extract the beam from DR with ILC like bunch spacing

New

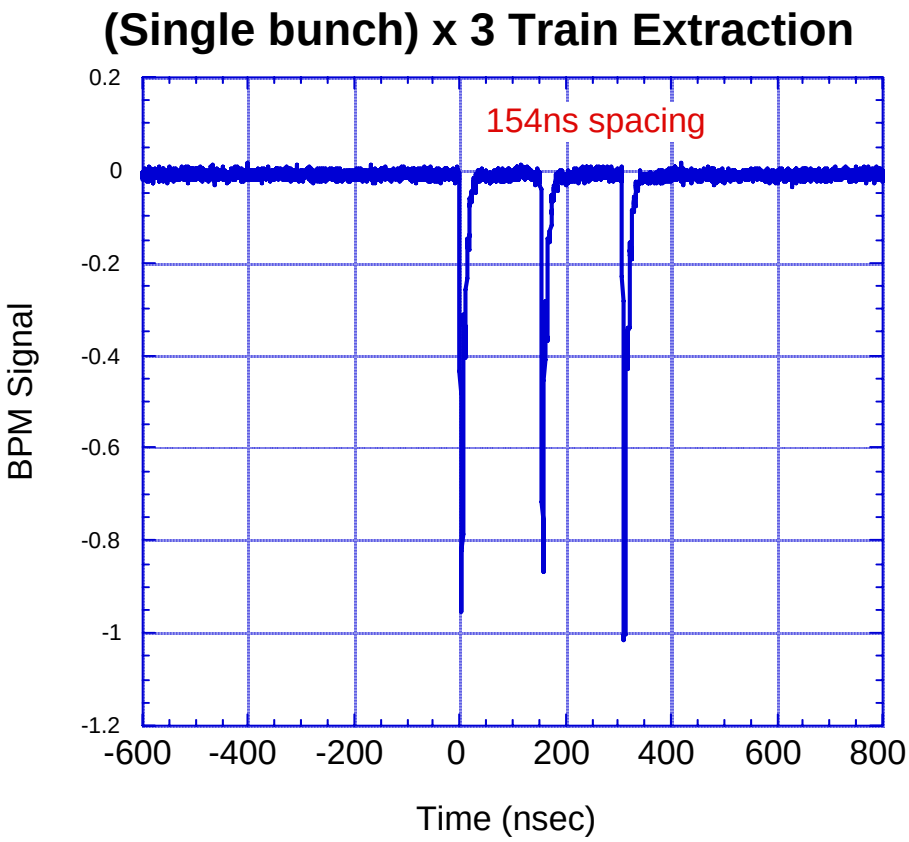
- Pulse Magnet for Beam Extraction
  (KEK/SLAC)

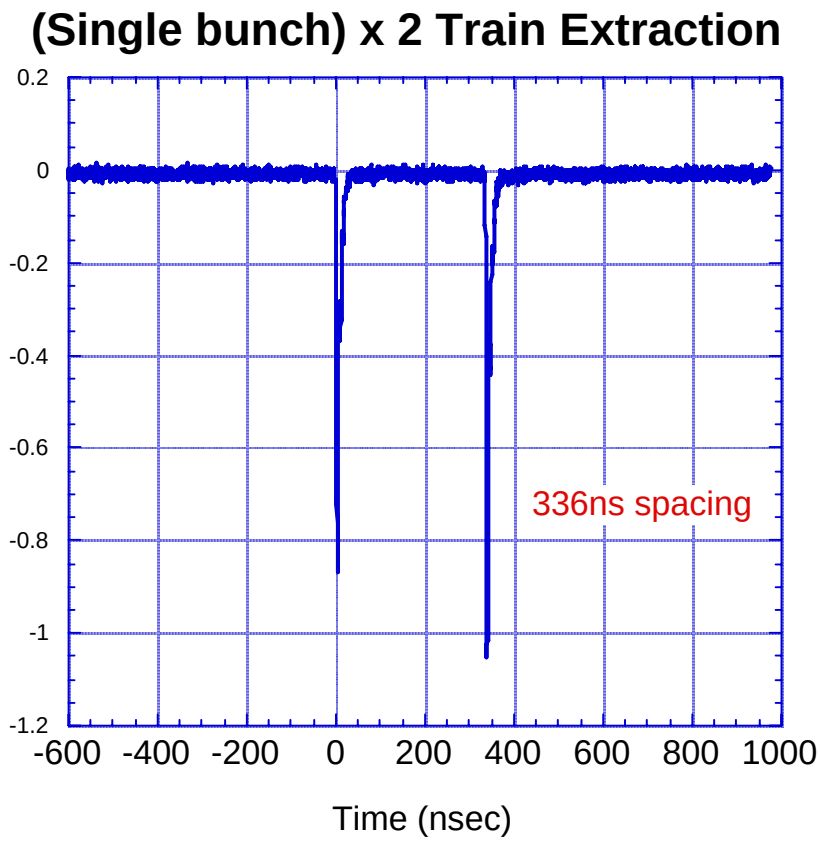
ILC (154~337ns) like beam bunches for EXT line and ATF2

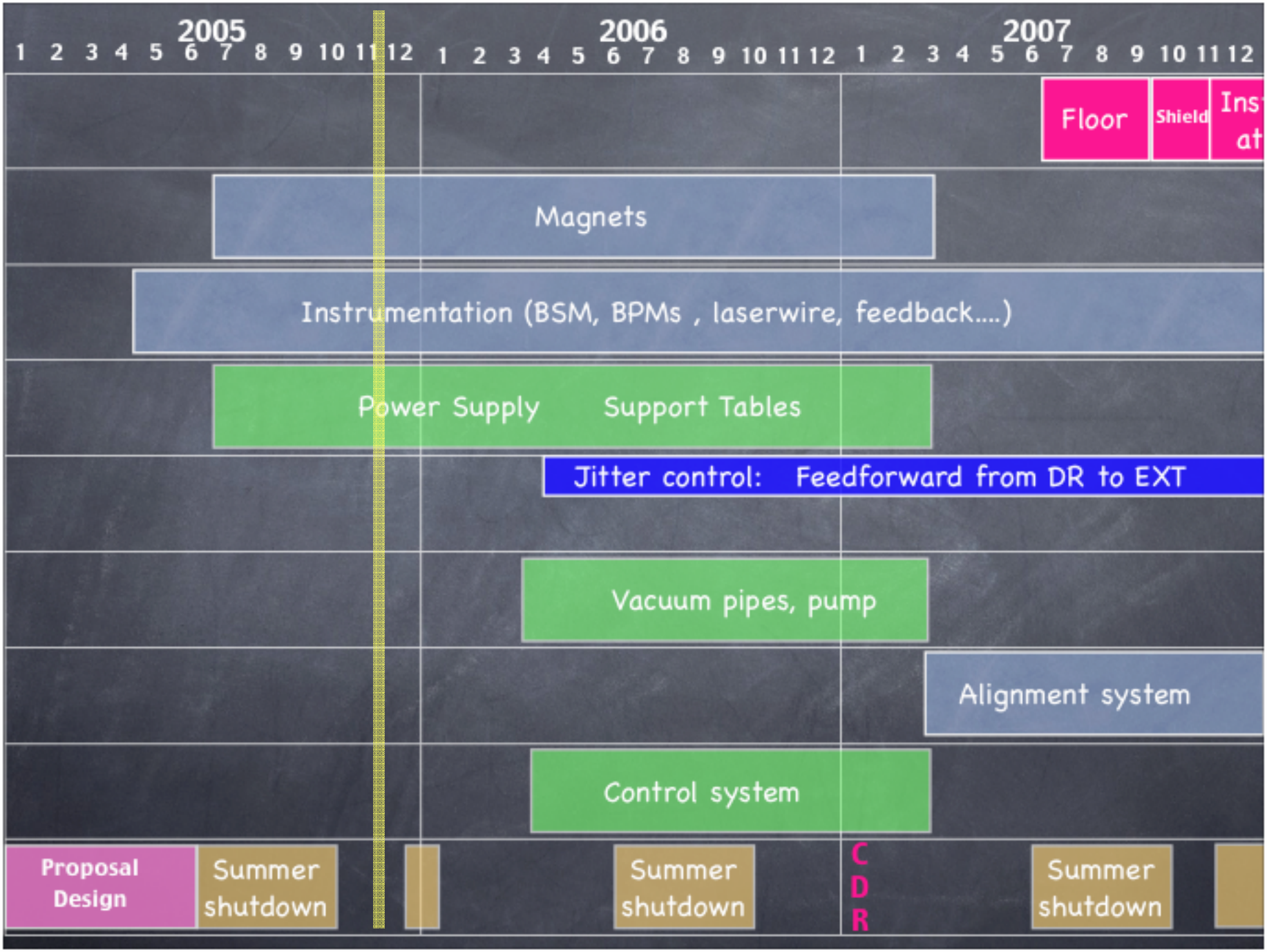


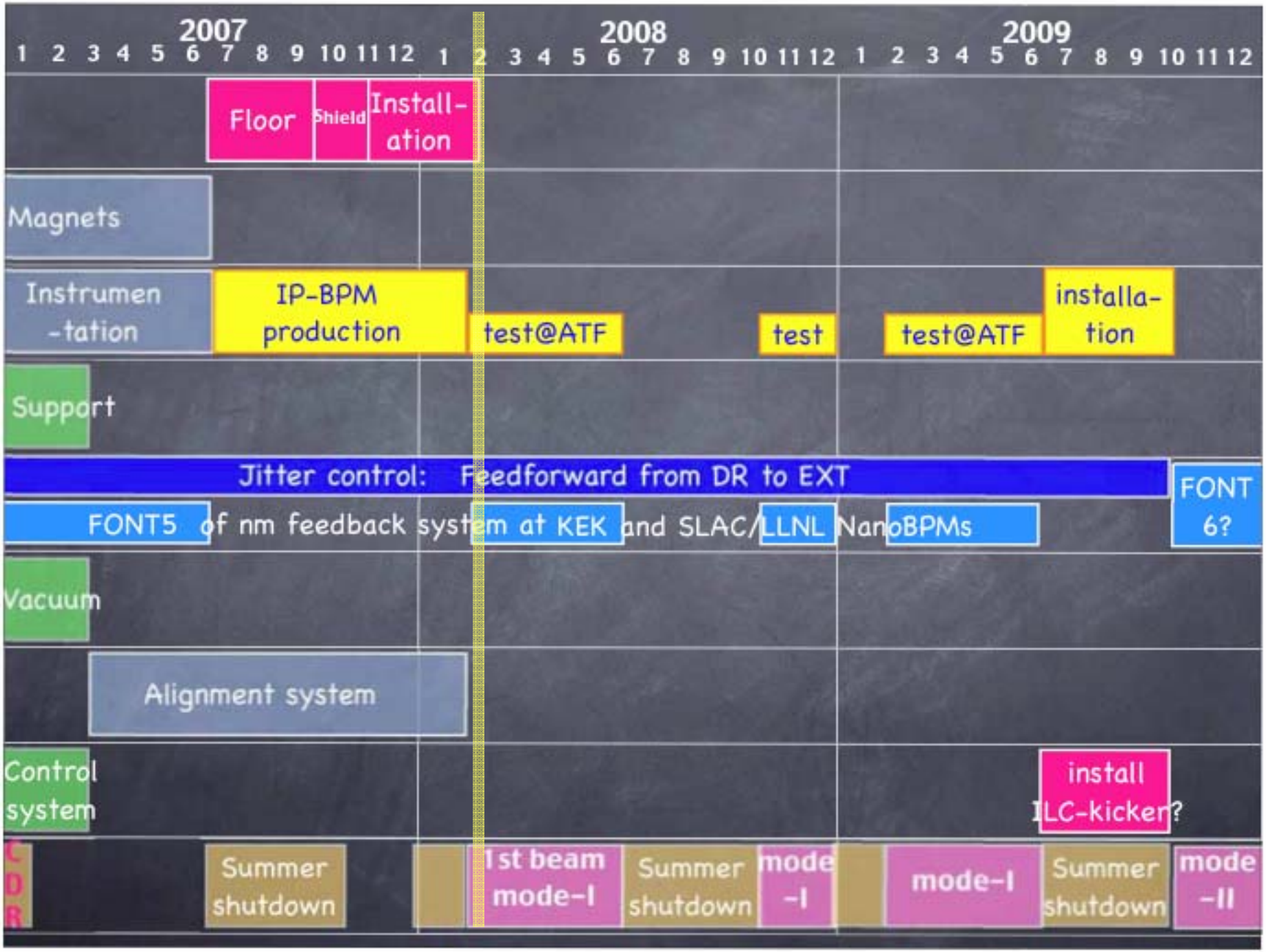
ILC like beam extraction at ATF(results)

New






2005
1 2 3 4 5 6 7 8 9 10 11 12
2006
1 2 3 4 5 6 7 8 9 10 11 12
2007
1 2 3 4 5 6 7 8 9 10 11 12
Floor
Shield
Magnets
Instrumentation (BSM, BPMs , laserwire, feedback....)
Power Supply
Support Tables
Jitter control: Feedforward from DR to EXT
Vacuum pipes, pump
Alignment system
Control system
Proposal Design
Summer shutdown
Summer shutdown
CDR
Summer shutdown


2007
1 2 3 4 5 6 7 8 9 10 11 12
2008
1 2 3 4 5 6 7 8 9 10 11 12
2009
1 2 3 4 5 6 7 8 9 10 11 12
Floor
Shield
Install-ation
Magnets
Instrumen-tation
IP-BPM production
test@ATF
test
test@ATF
installa-tion
Support
Jitter control: Feedforward from DR to EXT
FONT5
of nm feedback system at KEK
and SLAC/LLNL
NanoBPMs
FONT 6?
Vacuum
Alignment system
Control system
install ILC-kicker?
CDR
Summer shutdown
1st beam mode-I
Summer shutdown
mode-I
mode-I
Summer shutdown
mode-II

He Compressor

He-Bag

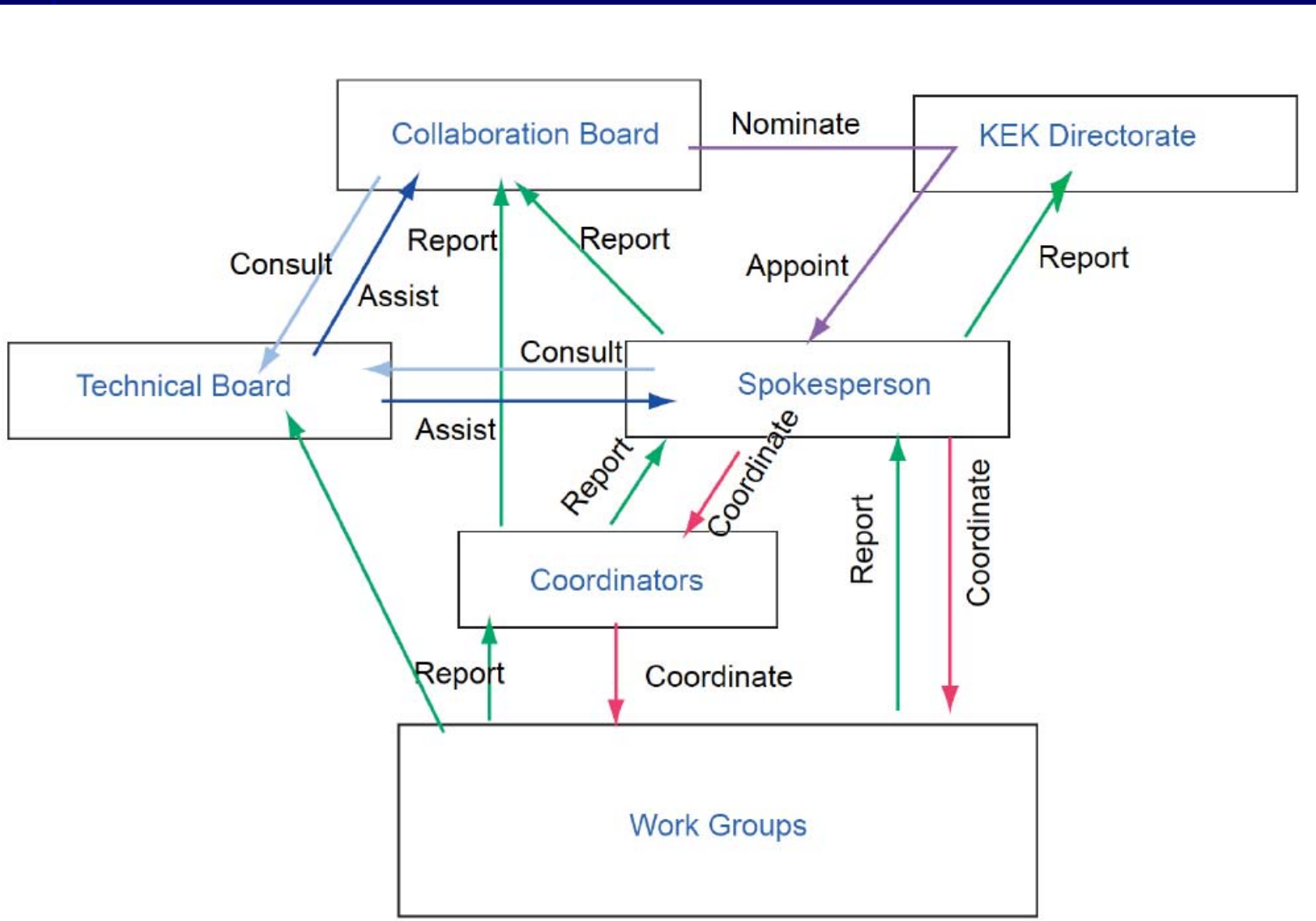
Refrigerator

He-Purifier

2000L Liq. He Reservoir

Liq N2 Reservoir

Organization Chart of the ATF Collabation



History of Field G. with SCRF cavity