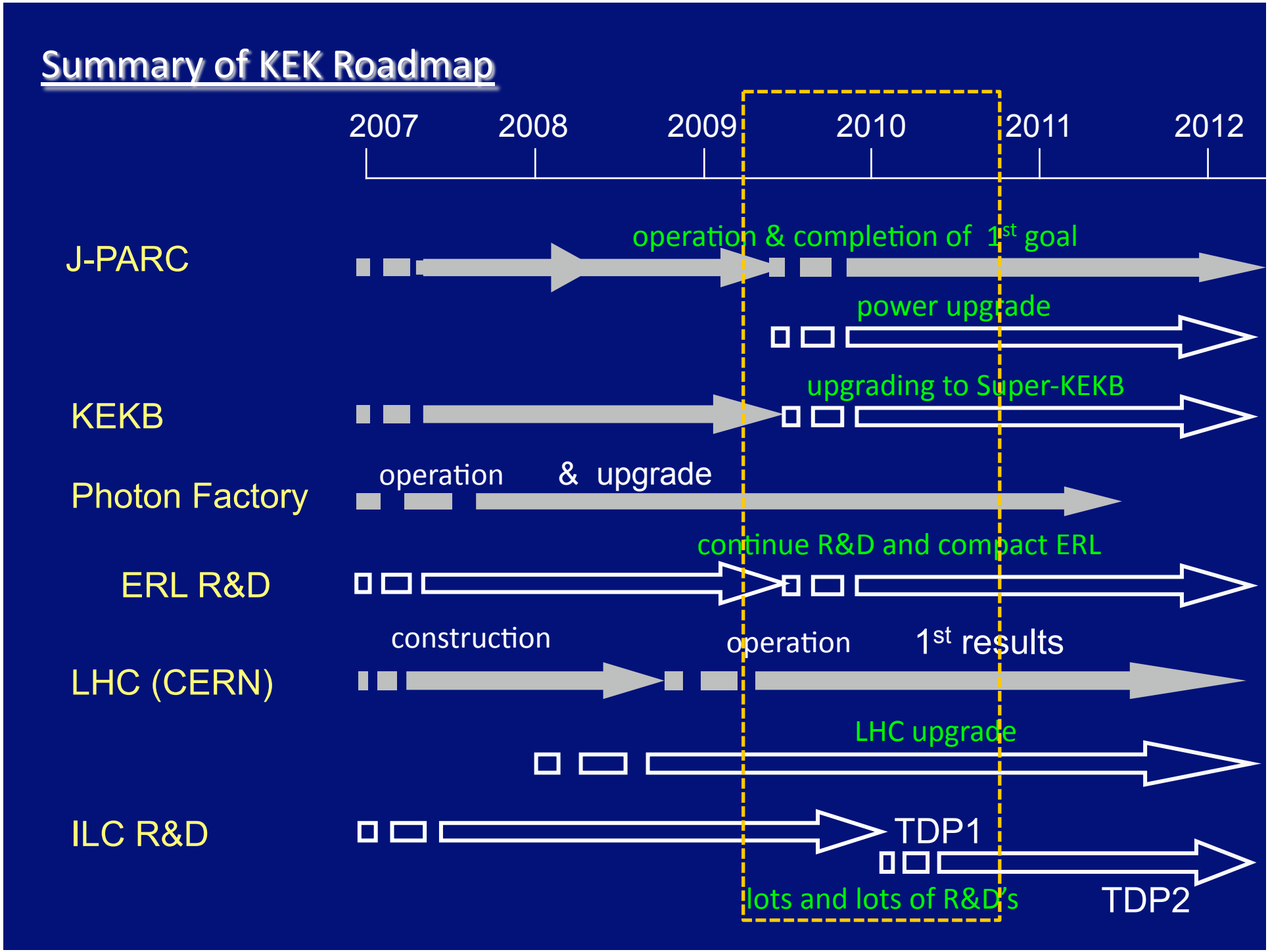
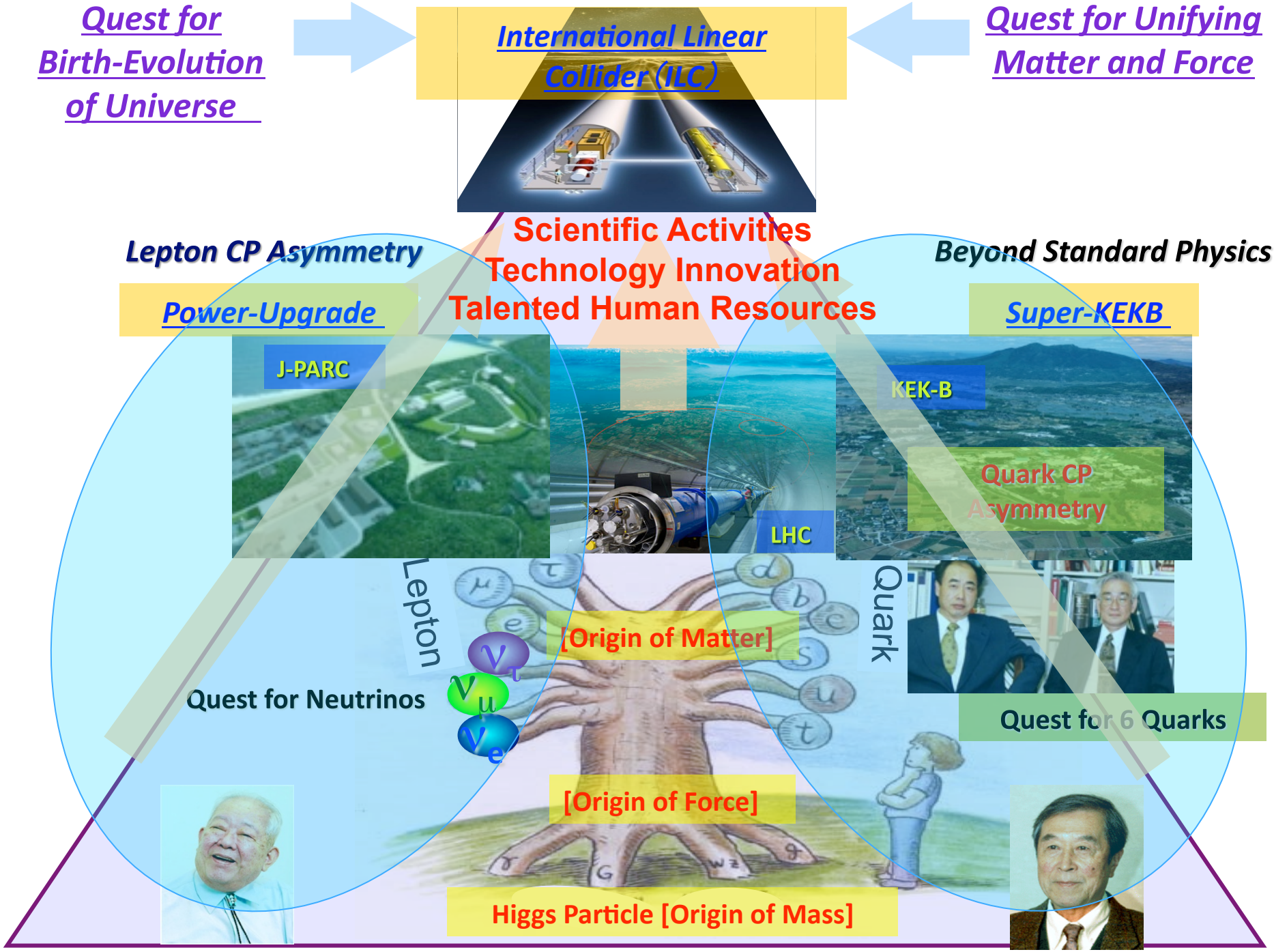
Project Roadmap at KEK

Atsuto Suzuki

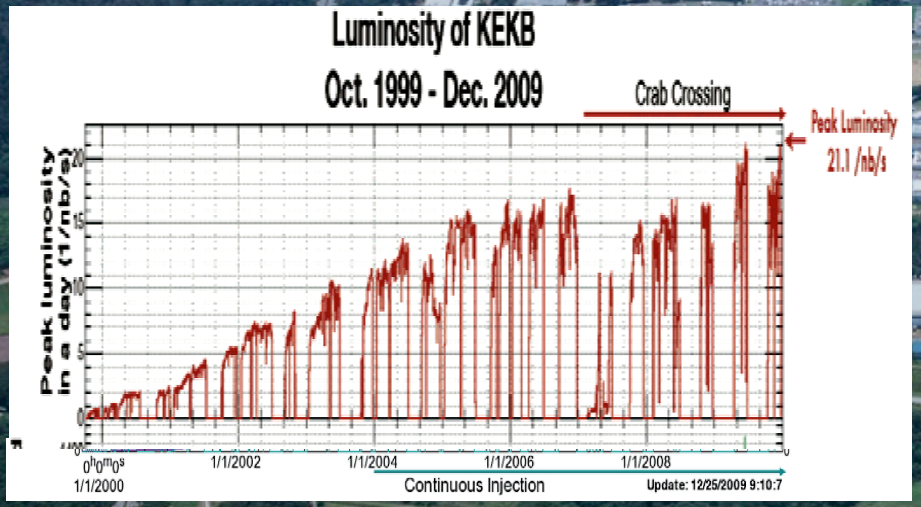
Summary of KEK Roadmap

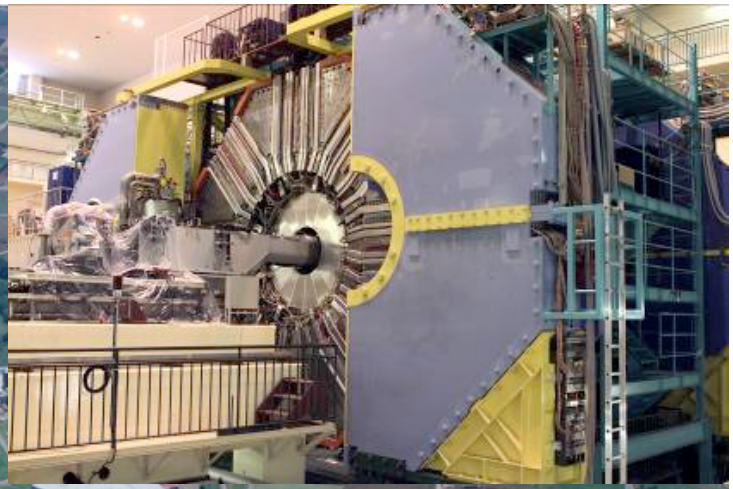


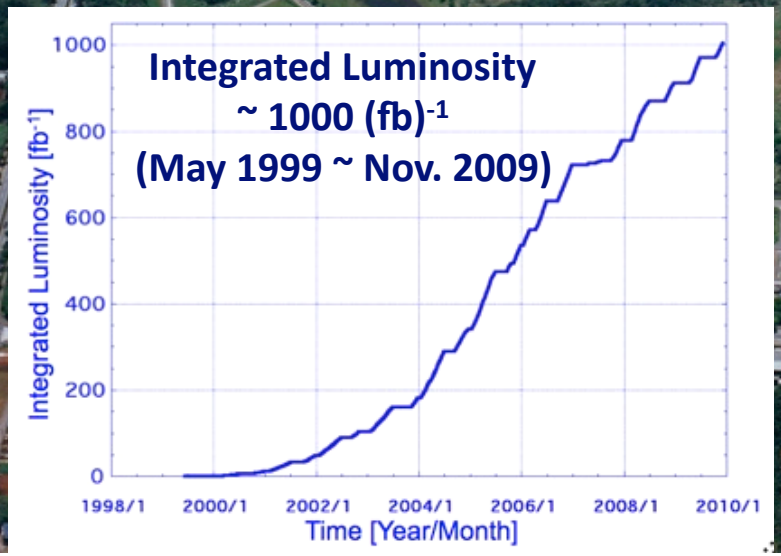

Quest for Birth-Evolution of Universe
International Linear Collider (ILC)
Quest for Unifying Matter and Force
Scientific Activities
Technology Innovation
Talented Human Resources
Lepton CP Asymmetry
Power-Upgrade
J-PARC
LHC
Beyond Standard Physics
Super-KEKB
KEK-B
Quark CP Asymmetry
Lepton
Quark
[Origin of Matter]
Quest for Neutrinos
Quest for 6 Quarks
[Origin of Force]
Higgs Particle [Origin of Mass]

KEKB and Belle

world record : 1.6 x 10^{34}/cm^2/s (2005)
2.0 x 10^{34}/cm^2/s (2009)







Terminal Station
Stazione Terminale
終着駅

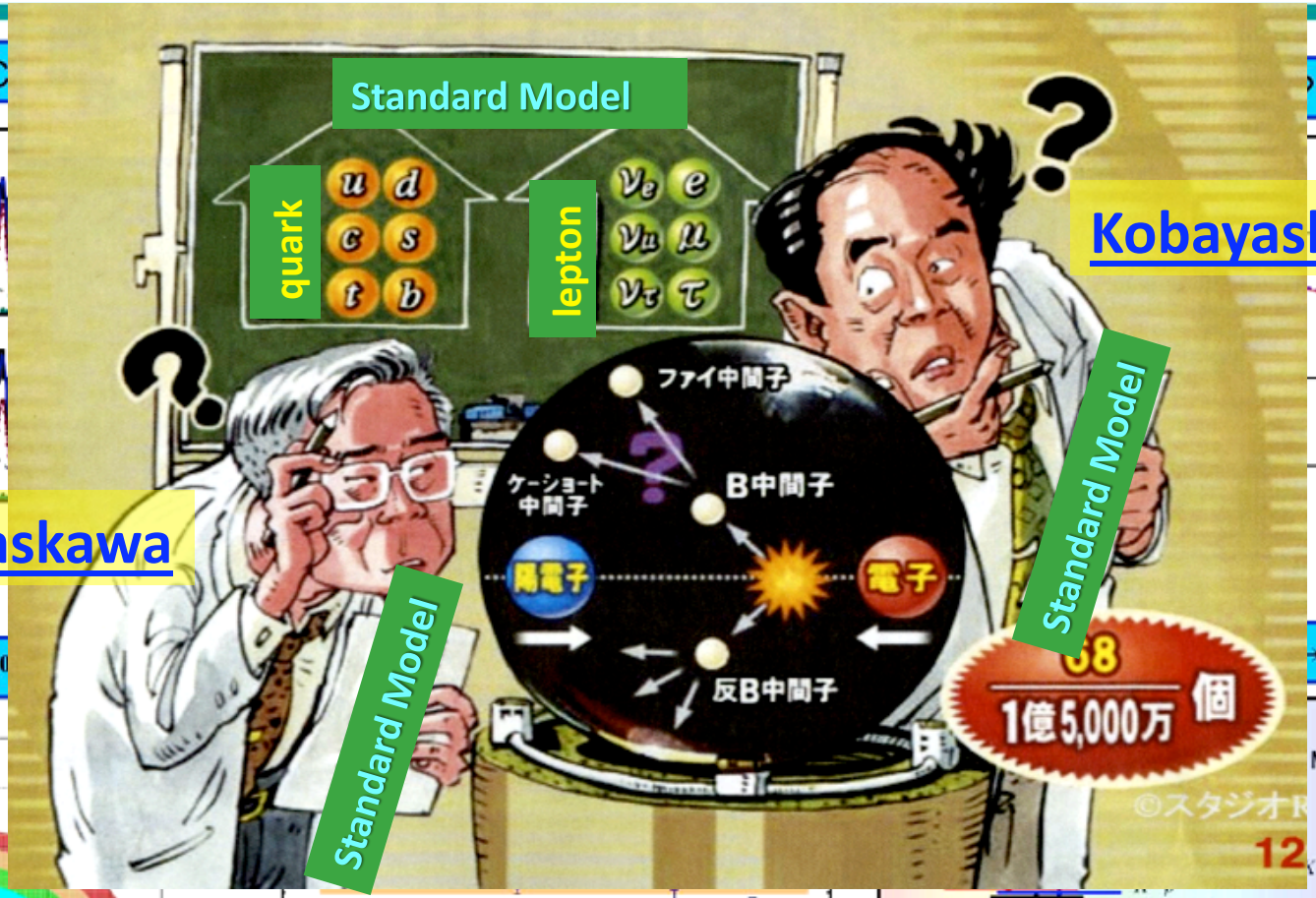
Terminal Station
Stazione Terminale
終着駅

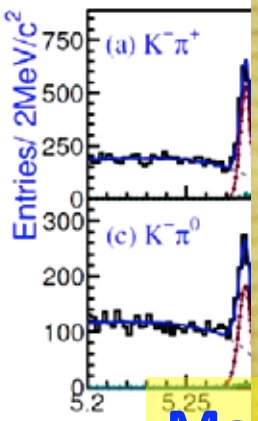
||

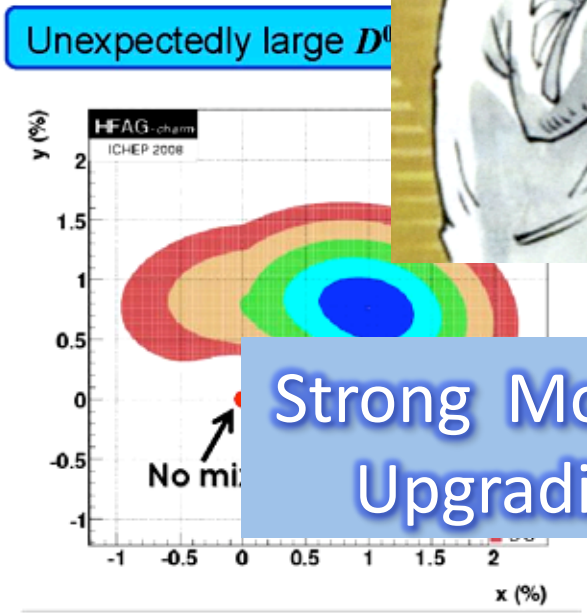
Station of Origin
Stazione di partenza
始発駅

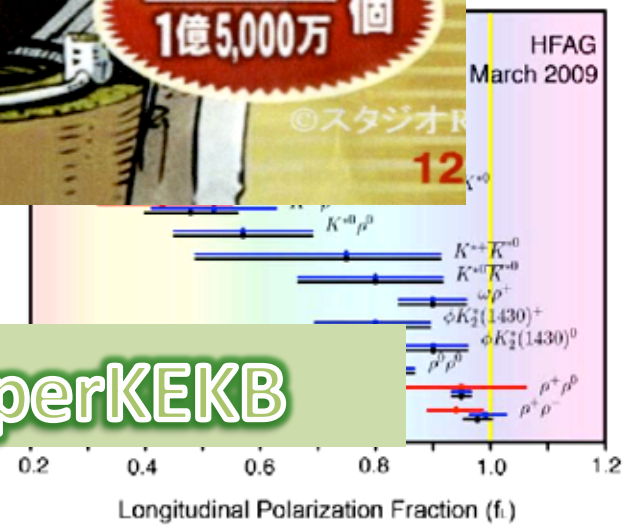
Super-KEKB :
just taking off from the station

Possible Hints for New Physics in Flavor Decays





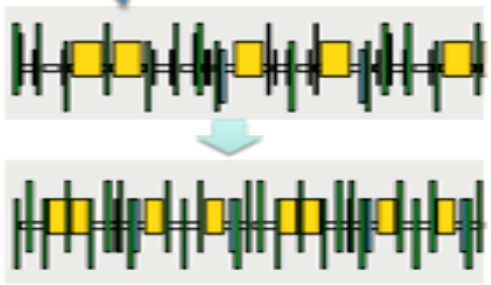




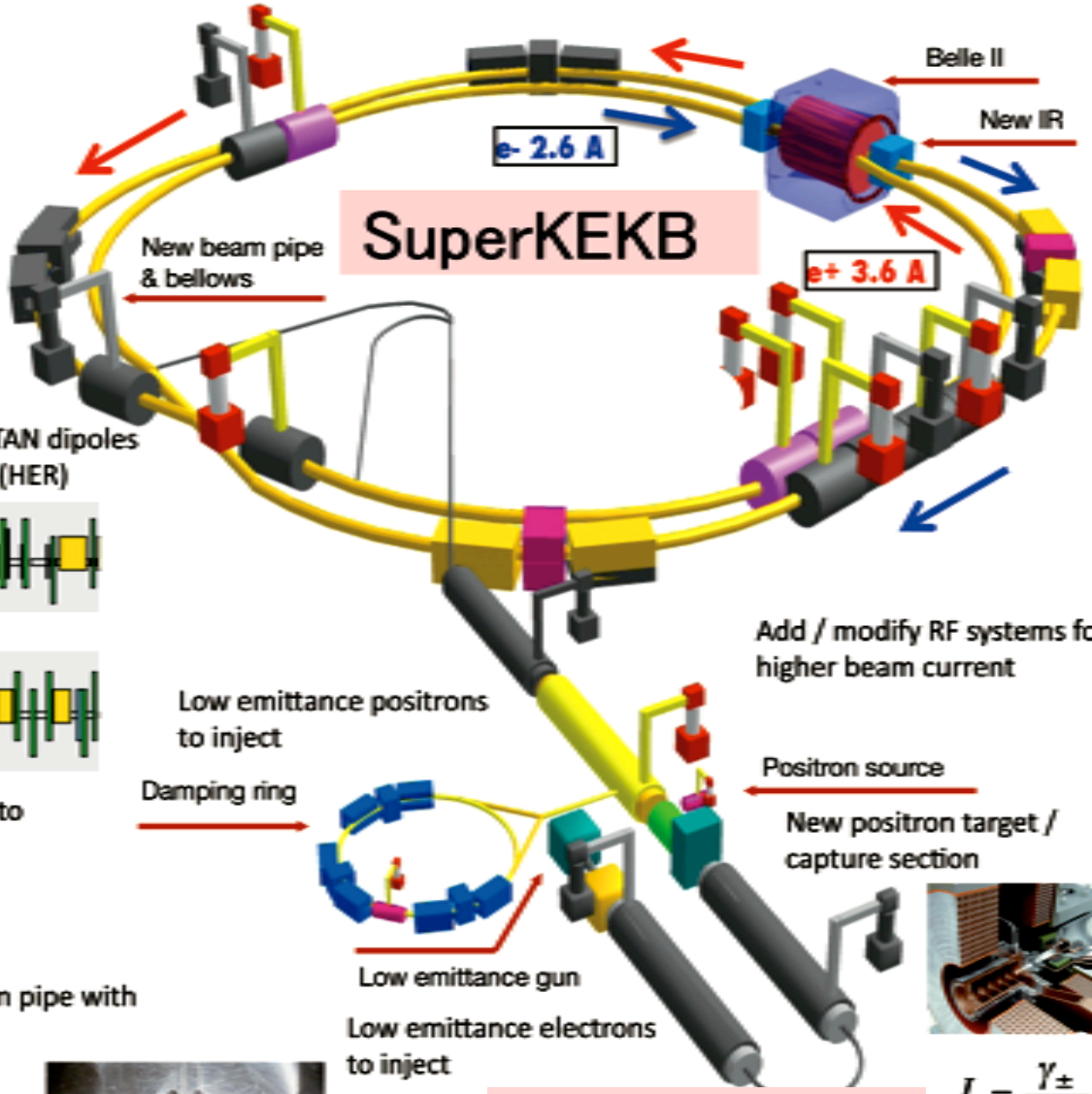
Strong Motivation to Upgrading KEKB

: SuperKEKB

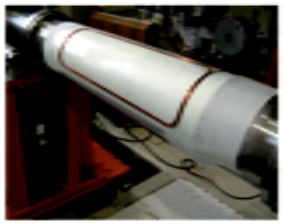
Replace long TRISTAN dipoles with shorter ones (HER)



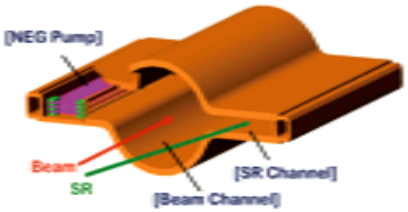
Redesign the HER arcs to squeeze the emittance

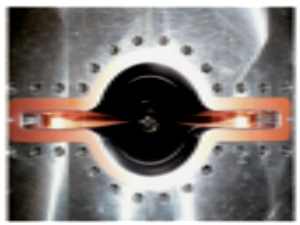


New superconducting / permanent final focusing quads near the IP



TiN coated beam pipe with antechambers



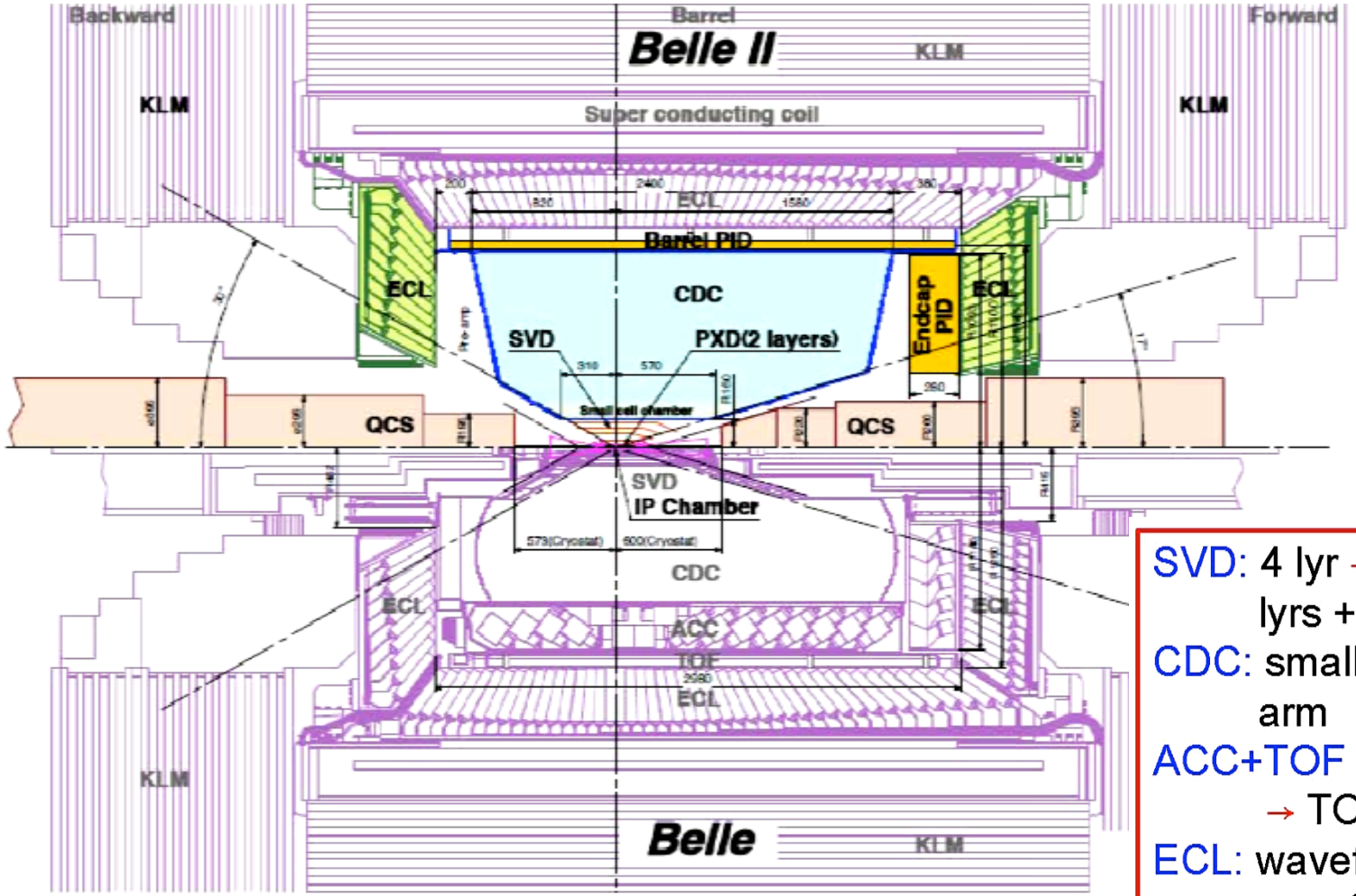


$$L = \frac{\gamma_\pm}{2er_e}\left(1+\frac{\sigma_y^*}{\sigma_x^*}\right)\frac{I_\pm \xi_{\pm y}}{\beta_y^*}\left(\frac{R_L}{R_y}\right)$$

$8 \times 10^{35}\ (cm^2 s)^{-1}$

40 times Gain in Luminosity

Belle - II



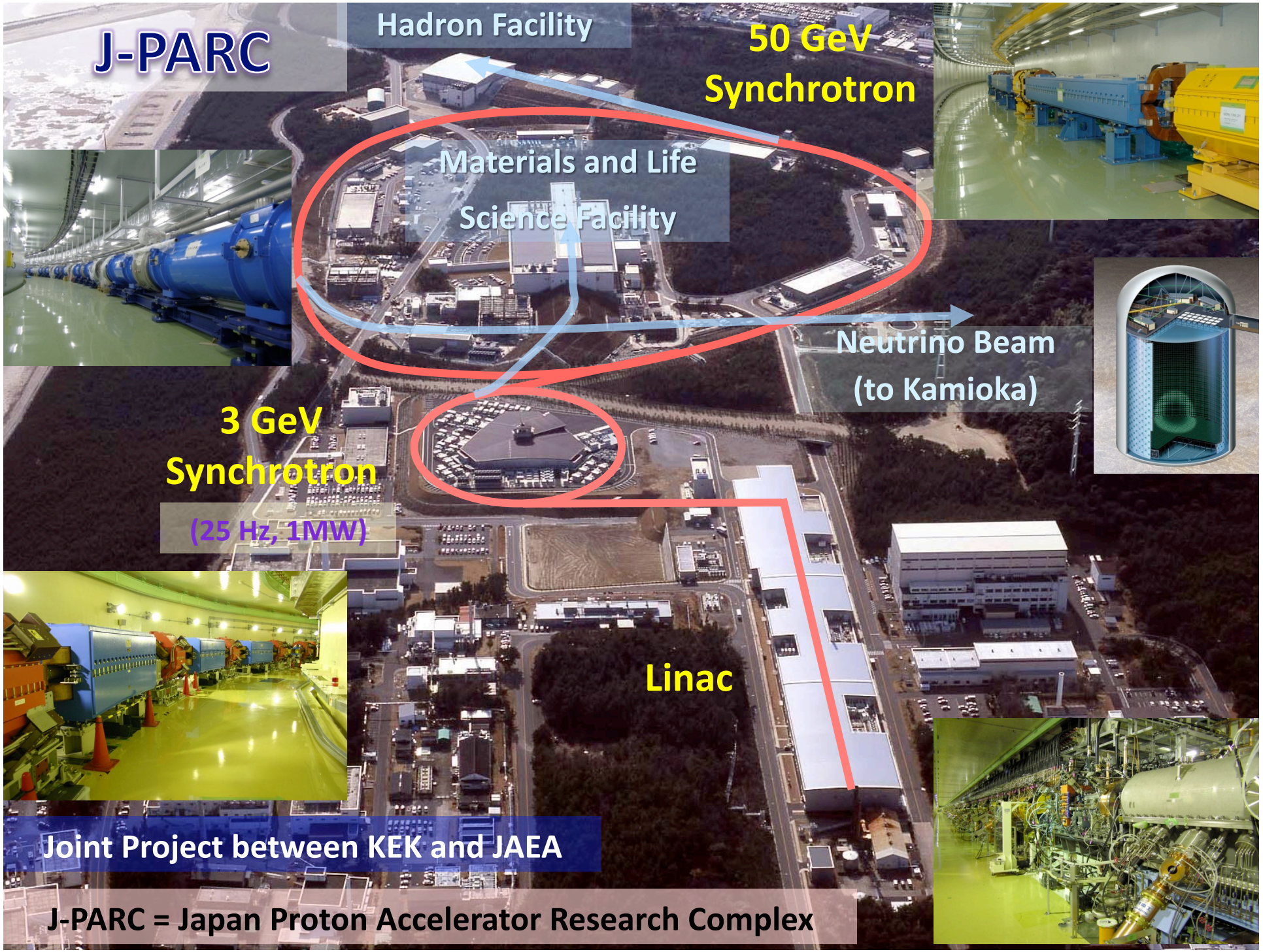
SVD: 4 lyr → 2 DEPFET lyrs + 4 DSSD lyrs

CDC: small cell, long lever arm

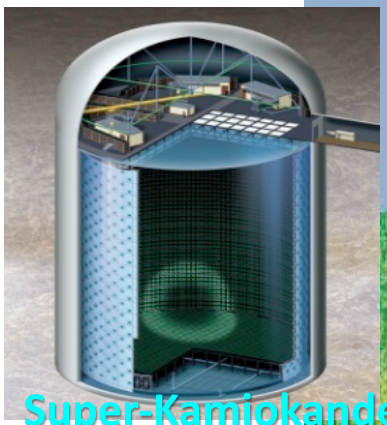
ACC+TOF → TOP+A-RICH

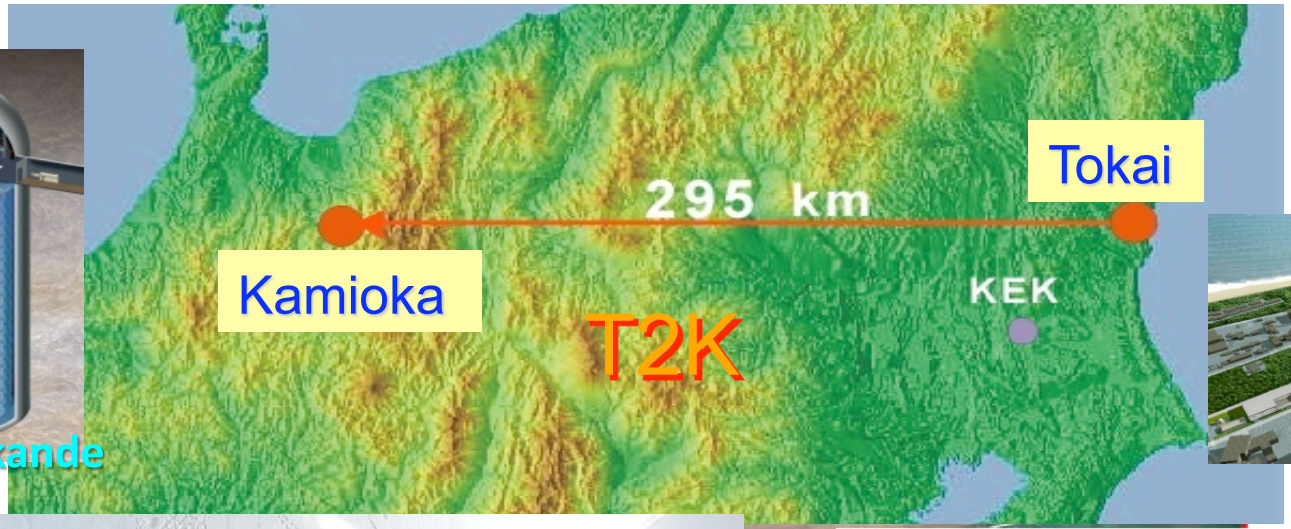
ECL: waveform sampling, pure CsI for endcaps

KLM: RPC → Scintillator +SiPM (end-caps)


J-PARC
Hadron Facility
50 GeV
Synchrotron
Materials and Life
Science Facility
Neutrino Beam
(to Kamioka)
3 GeV
Synchrotron
(25 Hz, 1MW)
Linac
Joint Project between KEK and JAEA
J-PARC = Japan Proton Accelerator Research Complex

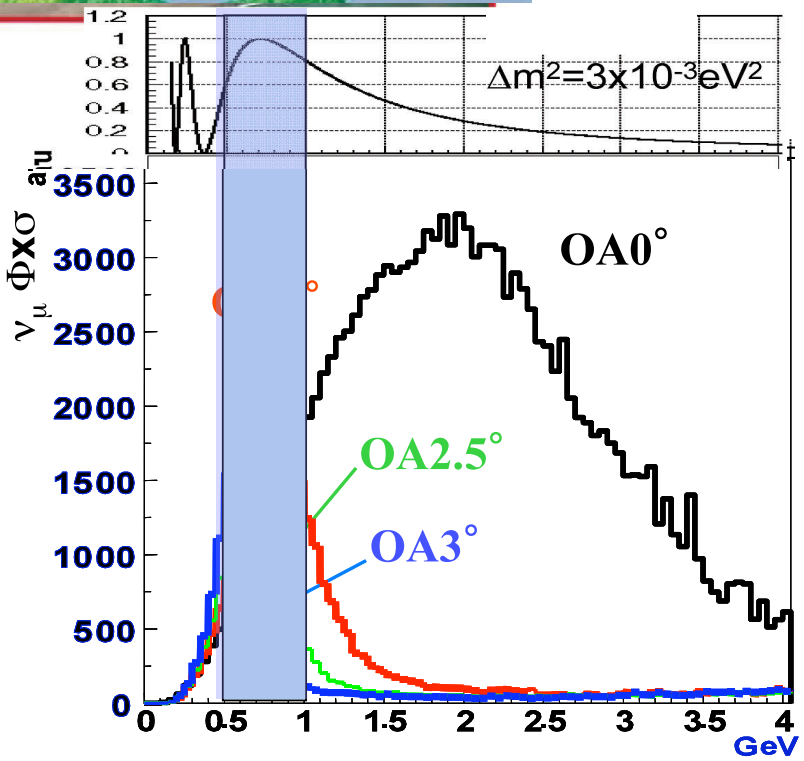
T2K : Long Baseline Neutrino Experiment





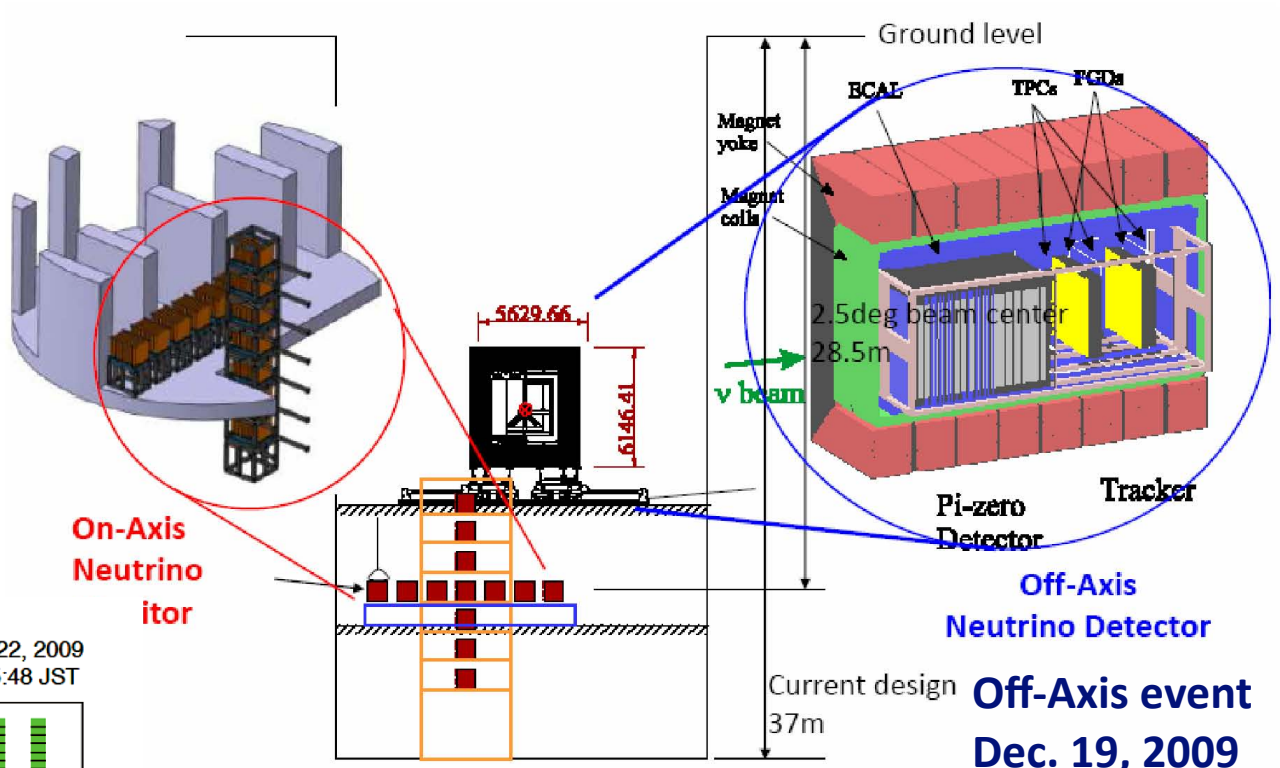
~400 members from 12 Countries:

Japan(91), Canada(66), US(58), France(38), UK(37), Switzerland(31), Poland(22), Korea(13), Russia(12), Spain(11), Italy(9), Germany(2)

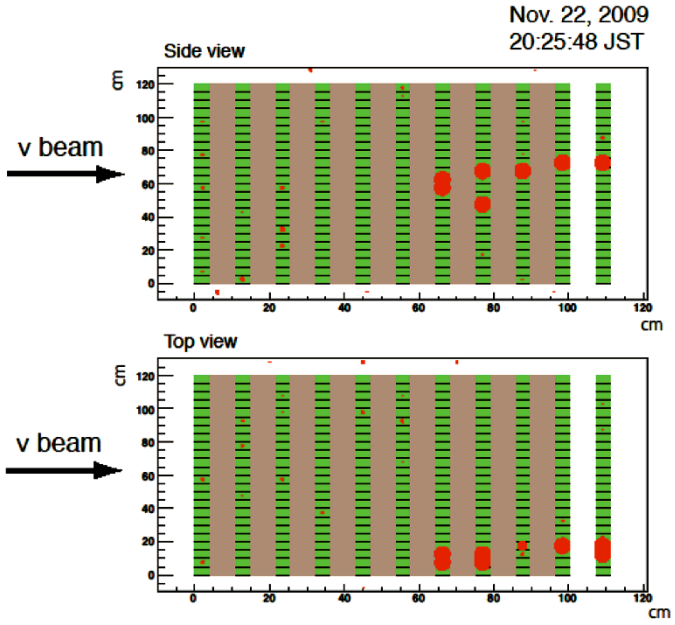


First Neutrino Event at Near Detectors

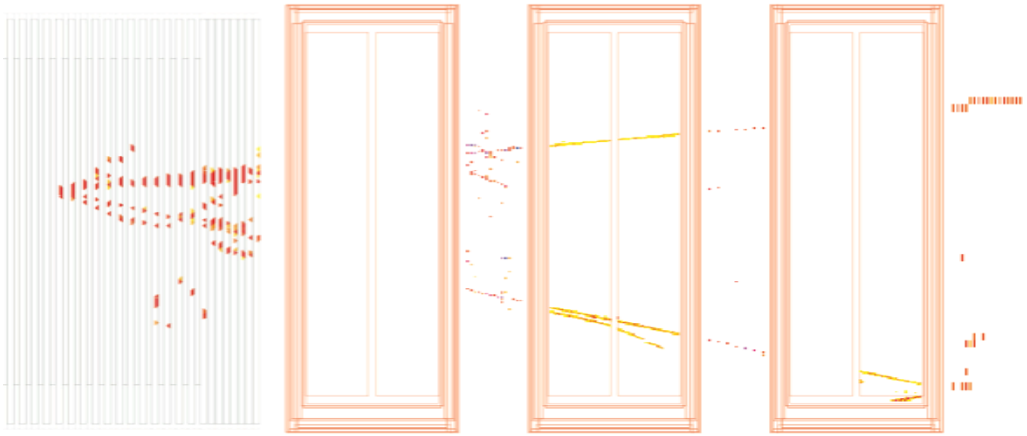
280m Near detectors :

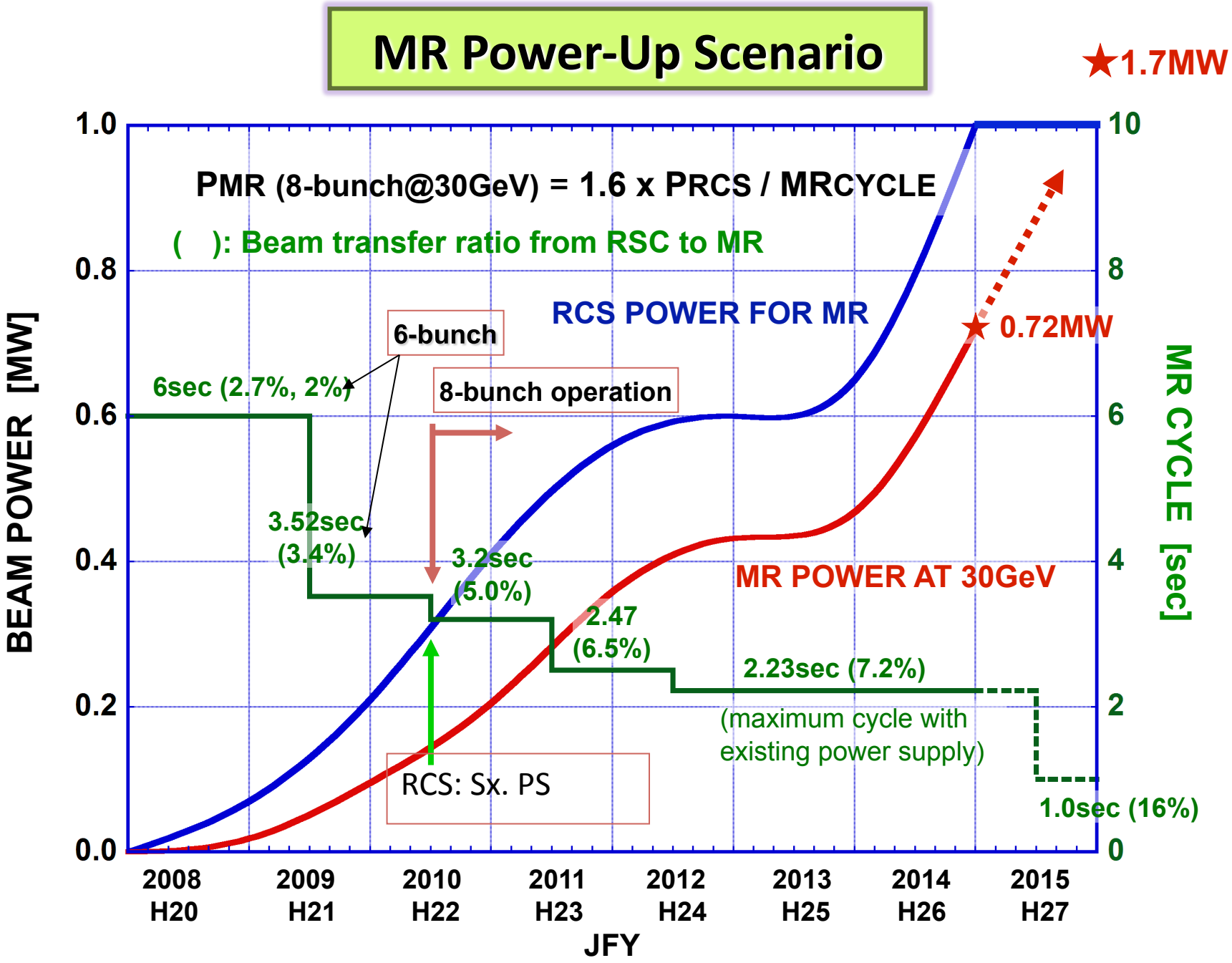


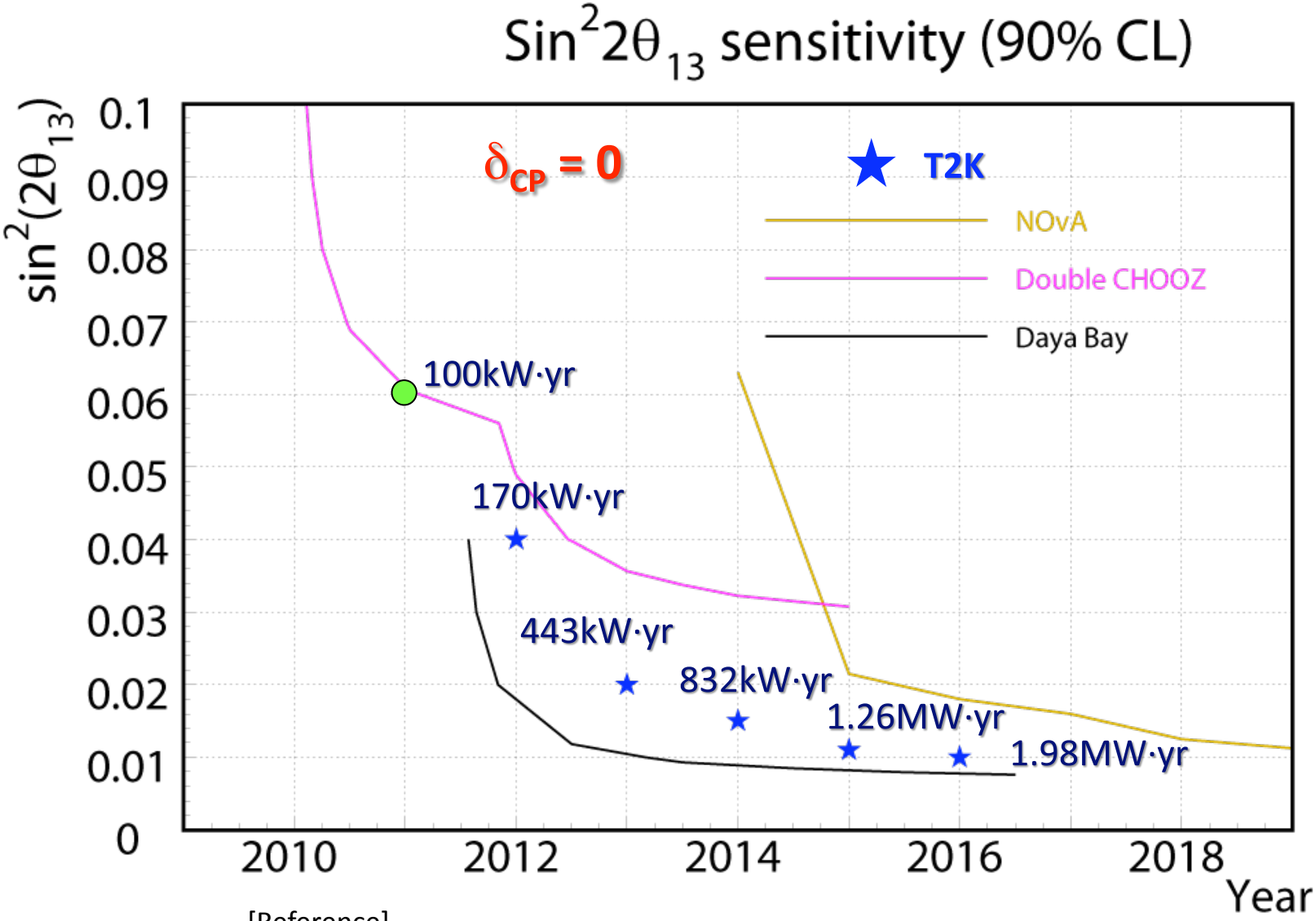
On-Axis event
Nov. 22, 2009



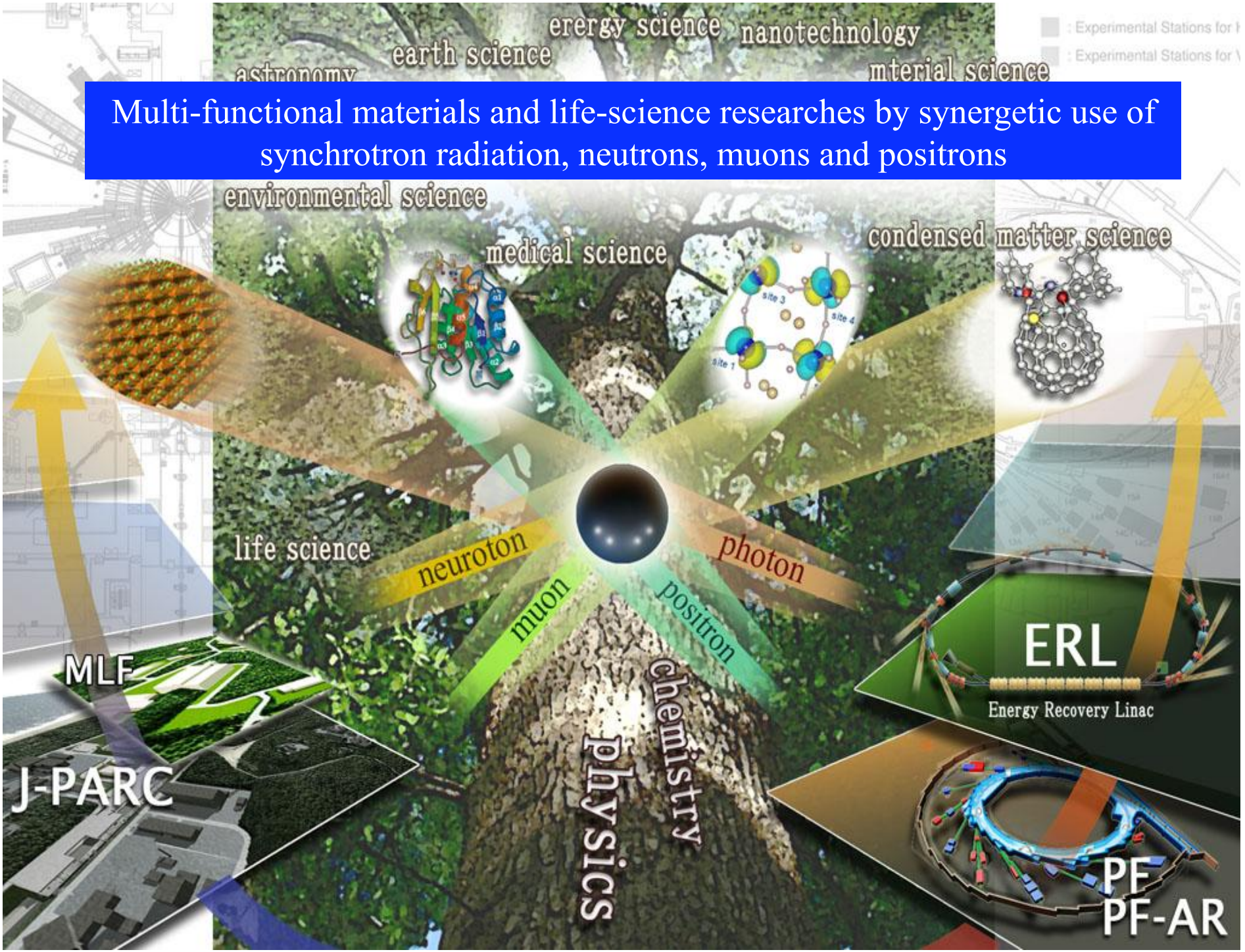
Off-Axis event
Dec. 19, 2009




MR Power-Up Scenario
★1.7MW
PMR (8-bunch@30GeV) = 1.6 x PRCS / MRCYCLE
( ): Beam transfer ratio from RSC to MR
RCS POWER FOR MR
6-bunch
8-bunch operation
6sec (2.7%, 2%)
3.52sec (3.4%)
3.2sec (5.0%)
2.47 (6.5%)
2.23sec (7.2%)
(maximum cycle with existing power supply)
1.0sec (16%)
MR POWER AT 30GeV
★0.72MW
RCS: Sx. PS
BEAM POWER [MW]
MR CYCLE [sec]
1.0
0.8
0.6
0.4
0.2
0.0
10
8
6
4
2
0
2008 H20
2009 H21
2010 H22
2011 H23
2012 H24
2013 H25
2014 H26
2015 H27
JFY

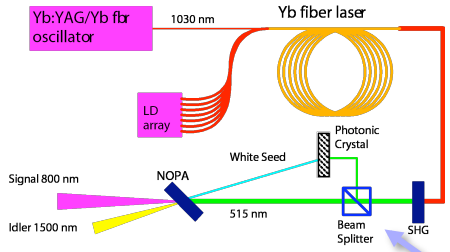


[Reference]
NOvA: M. Messier, FNAL Director's CD-3b Review, 2009/6/16
Double CHOOZ: A. Porta, Rencontres de Moriond EW 2009, 2009/3/13
Daya Bay: P. Rubin, ibid


Multi-functional materials and life-science researches by synergetic use of synchrotron radiation, neutrons, muons and positrons
erergy science
nanotechnology
earth science
astronomy
mterial science
environmental science
medical science
condensed matter science
life science
neuroton
photon
muon
positron
chemistry
physics
MLF
J-PARC
ERL
Energy Recovery Linac
PF
PF-AR

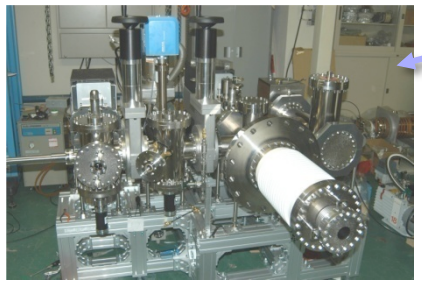
R&D Efforts toward ERL-based Synchrotron Light Source

Compact ERL: 60 ~ 200 MeV



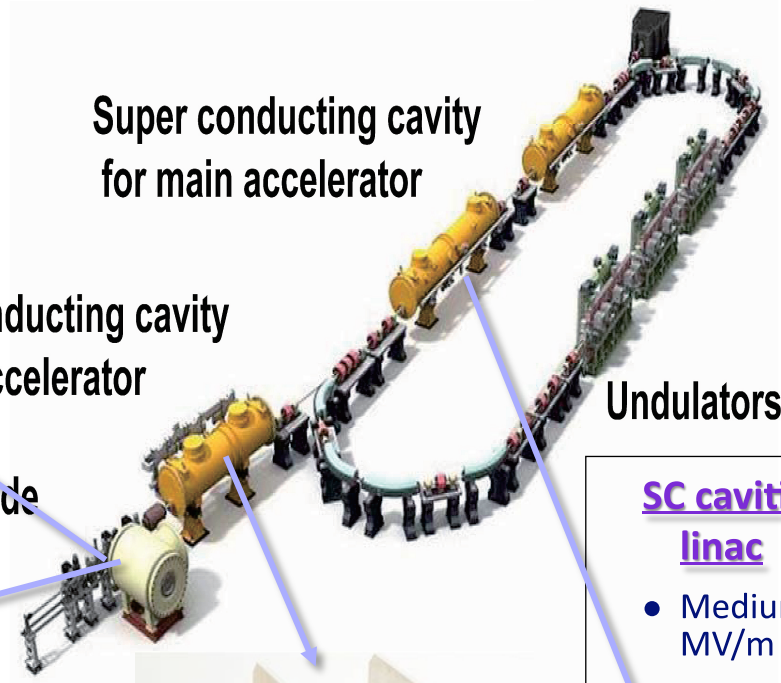
Gun drive laser:

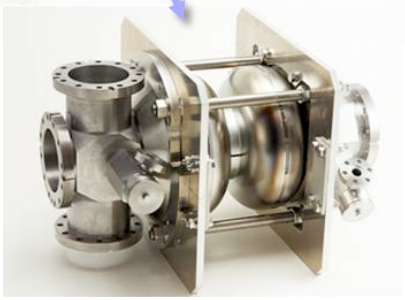
- High average power : 15 W CW
- Repetition : 1.3 GHz, λ ~ 800 nm



High-brightness photocathode DC gun:

- 500 kV, 100 mA
- Normalized emittance: 0.1 - 1 mm·mrad





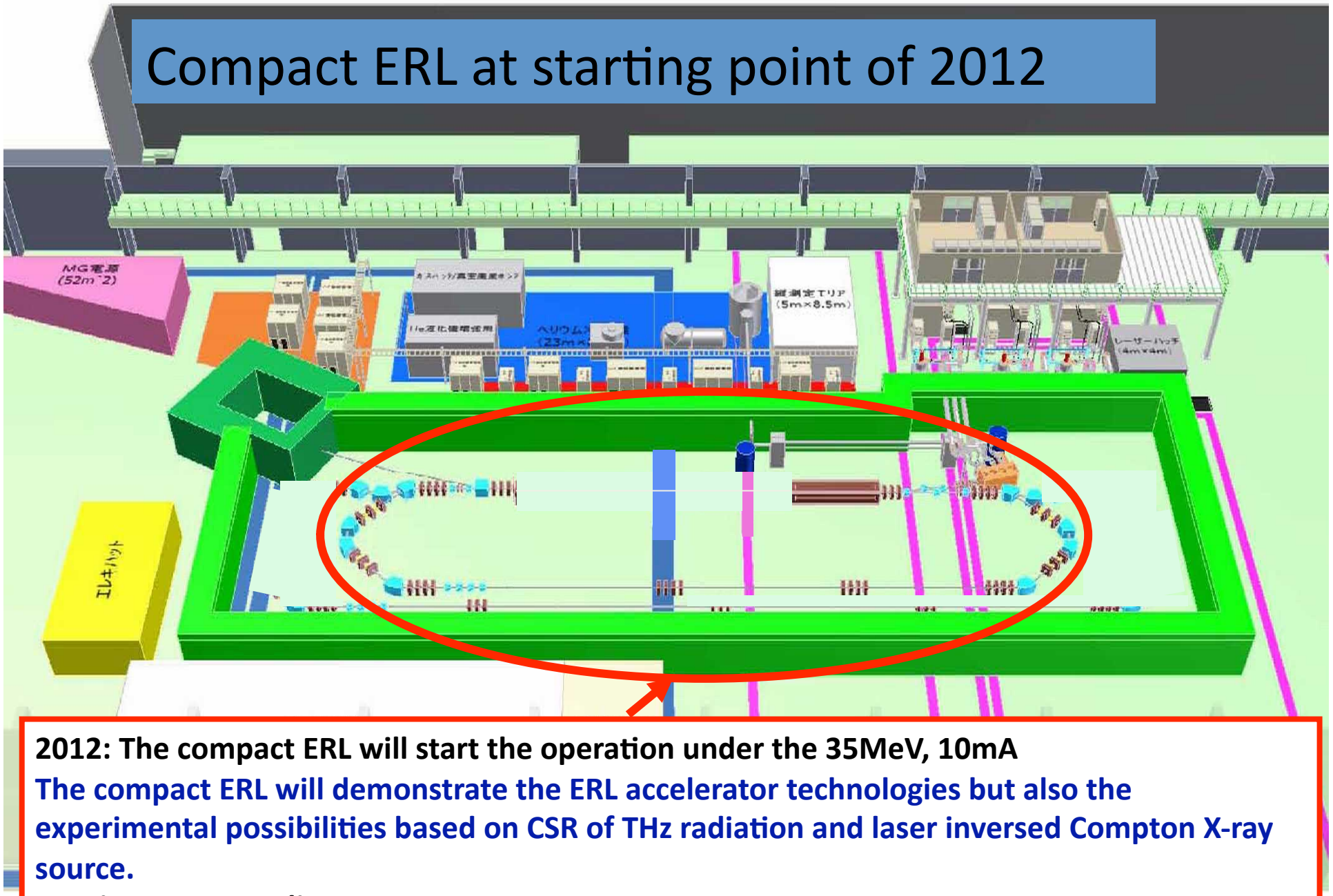
SC cavities for injector

- High input power: 170 kW/coupler
- Medium gradient: 15 MV/m
- High beam currents: 100 mA (CW)

SC cavities for main linac

- Medium gradient : 15-20 MV/m (CW)
- High average current : 200 mA
- Higher-order- mode damping

Compact ERL at starting point of 2012



2012: The compact ERL will start the operation under the 35MeV, 10mA

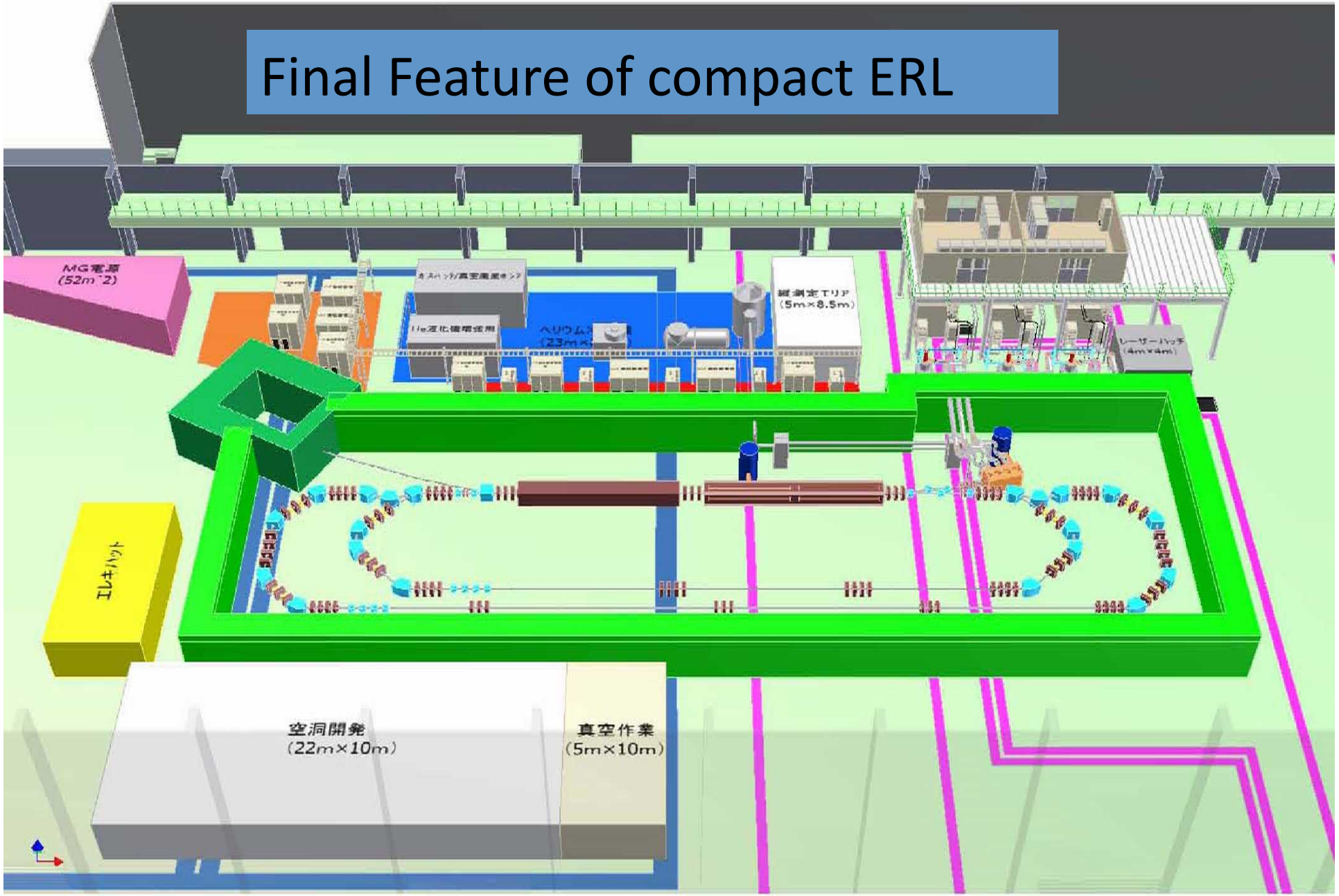
The compact ERL will demonstrate the ERL accelerator technologies but also the experimental possibilities based on CSR of THz radiation and laser inversed Compton X-ray source.

Continuous upgrading:

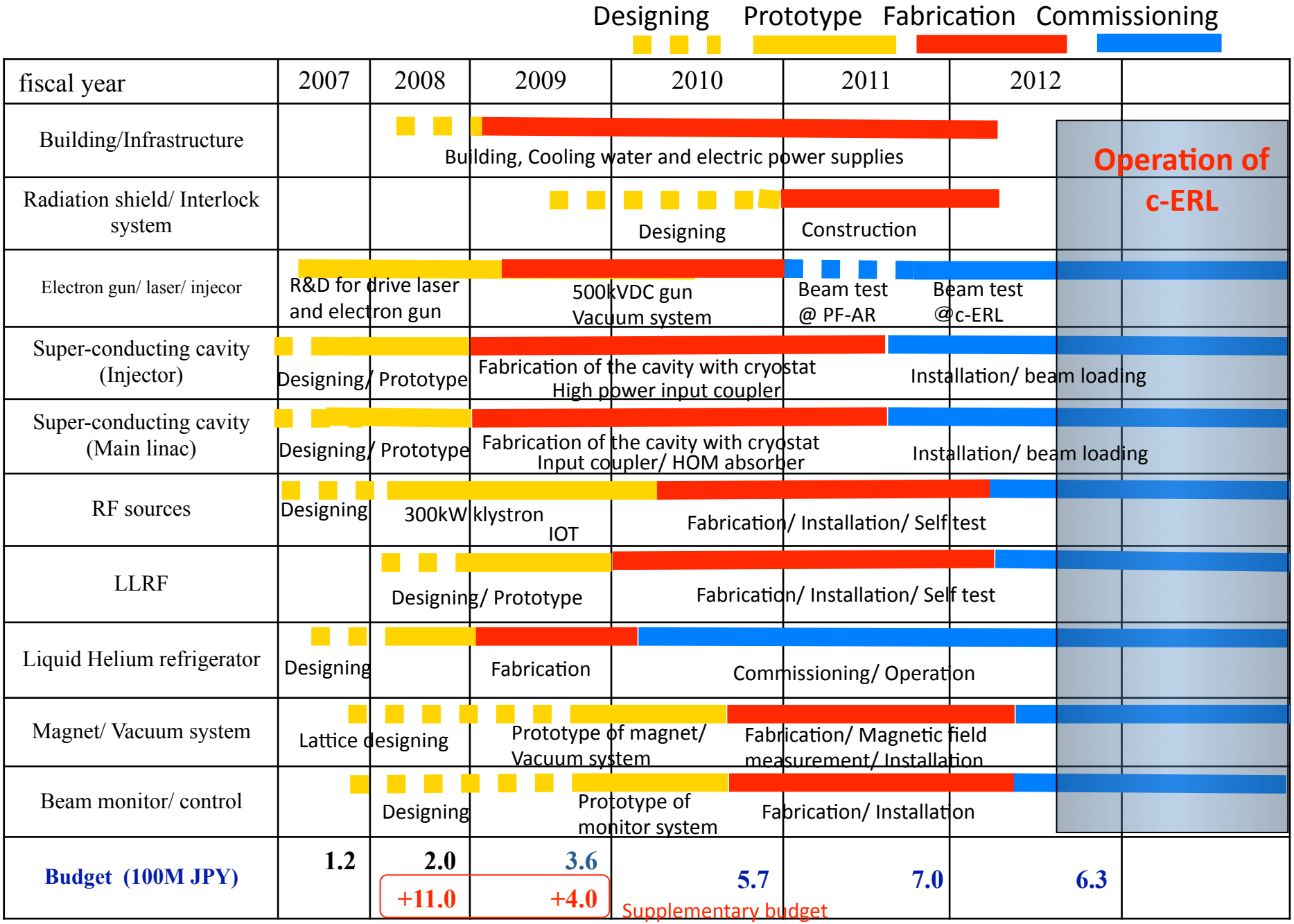
2014: 65MeV, 10mA

2016: two-loop operation (125MeV, 10mA)

Final Feature of compact ERL

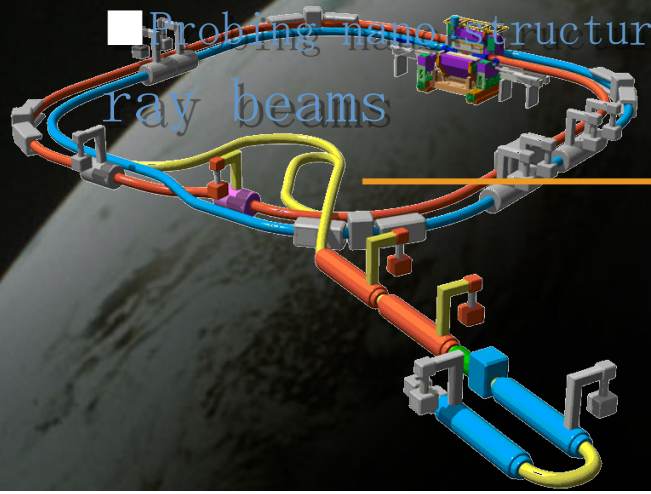


Time schedule of the compact ERL construction



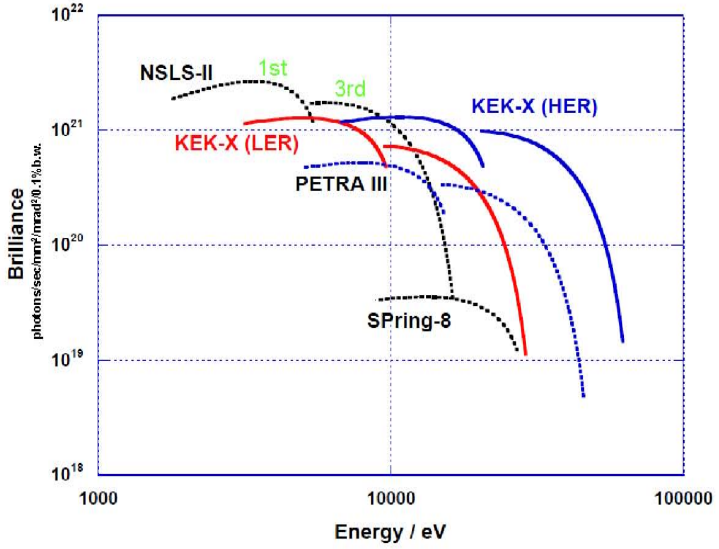
Nano beams from KEK-X

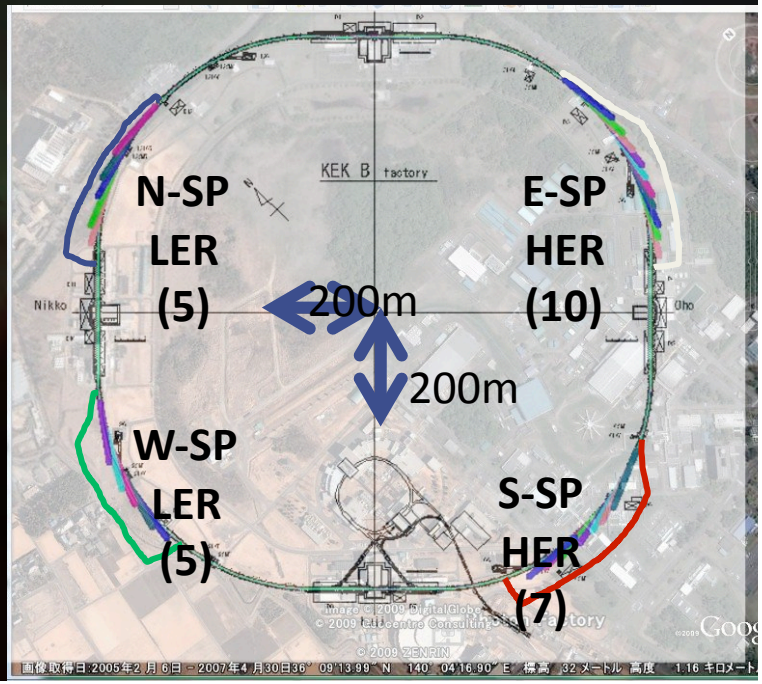
- Probing nanostructures/domains with Extremely Intense X-ray beams



KEK－X

Brilliance of SR with 2-m long undulators





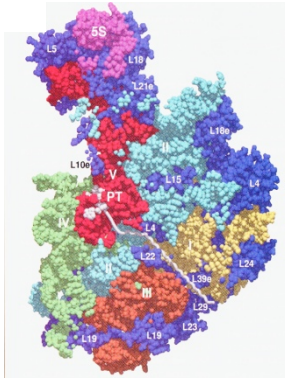
Nobel Prize in Chemistry in 2009

For the studies of structures and function of ribosome

V. Ramakrishnan

T. A. Steizs

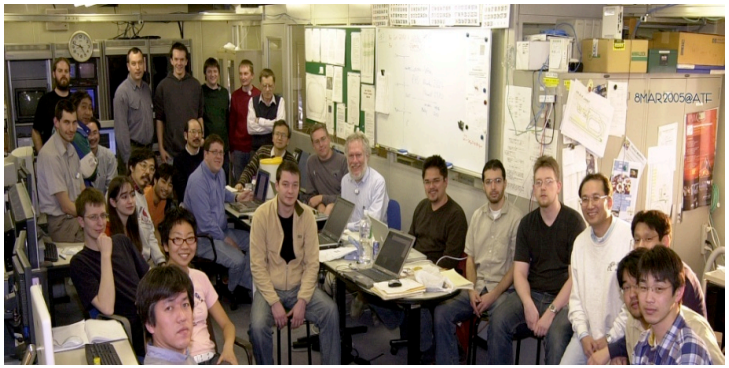
Ada Yonath



- A heavy user in 1980 – 90 at the KEK-PF
- She started to develop crystallization of ribosome at the KEK-PF in 1983

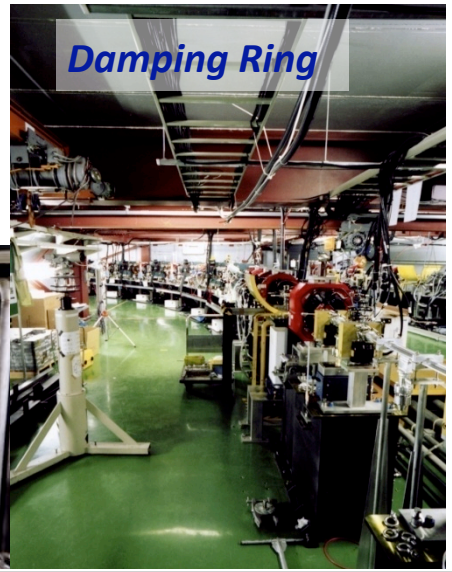
R&D for Energy Frontier Projects

International Linear Collider

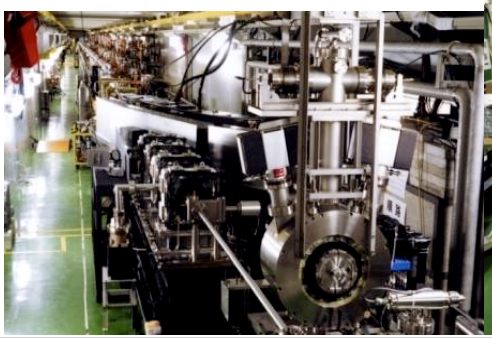


ATF : nano-size beam generation and handling

Damping Ring



Injection Linac



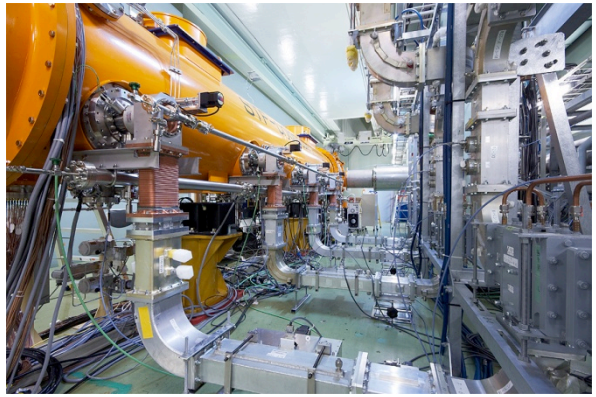
ATF2 Beam Line

Final Doublet System

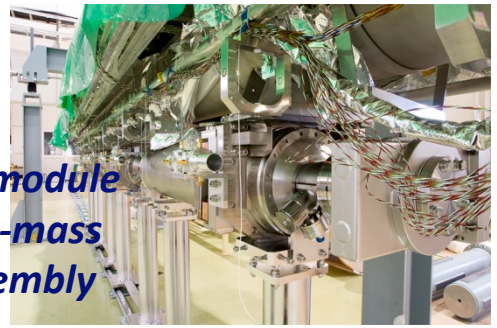
STF : Super-Conducting RF Test Facility

Vertical Test

Unit Test

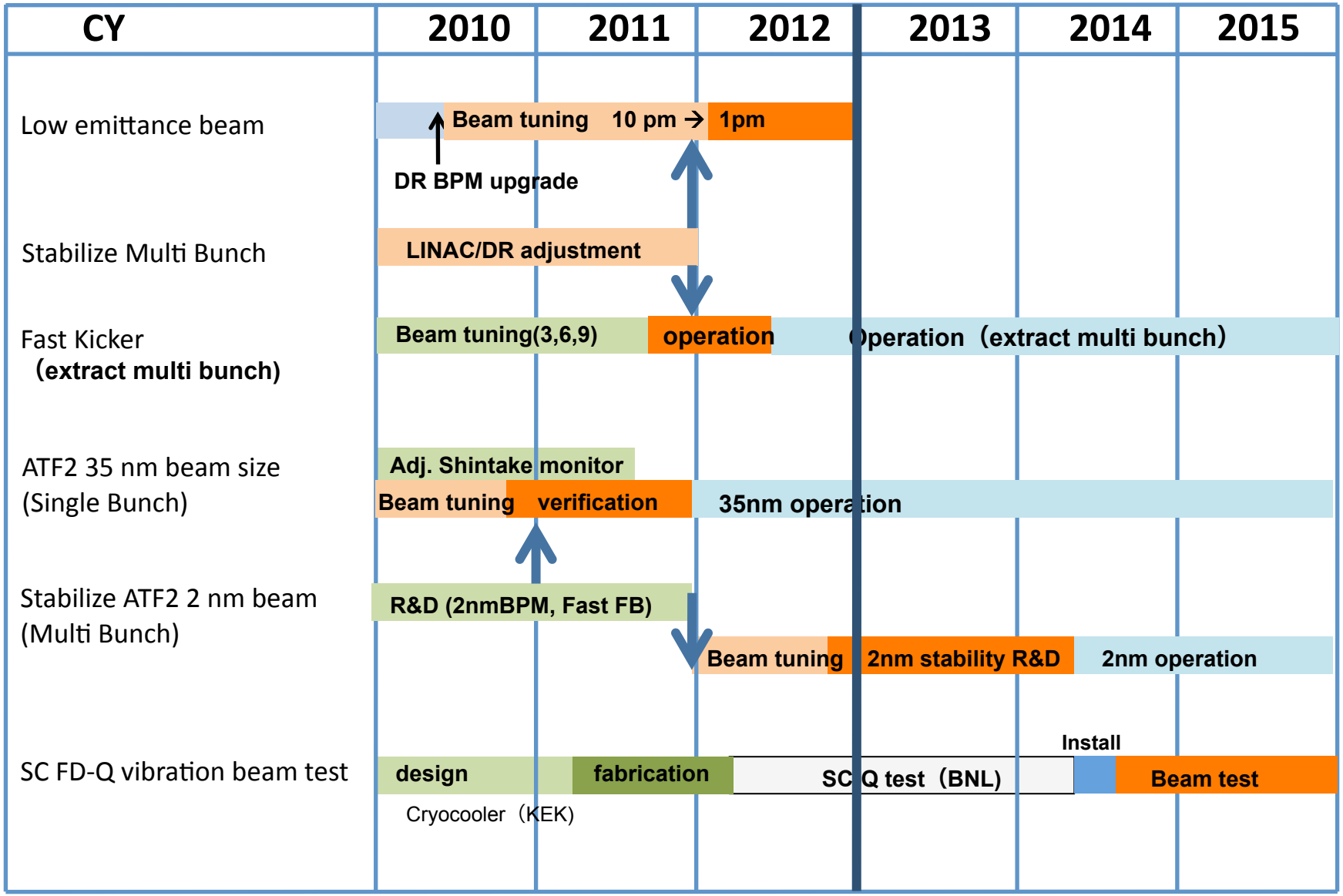


Cavity assembly in clean room

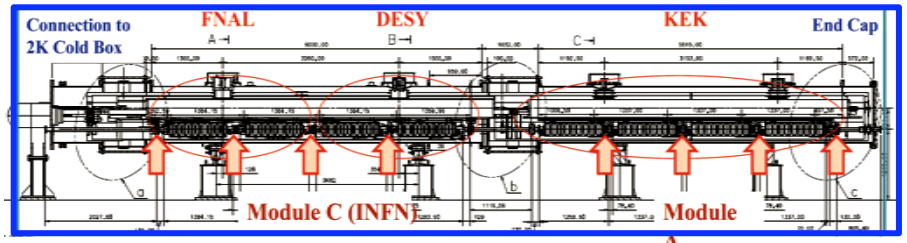


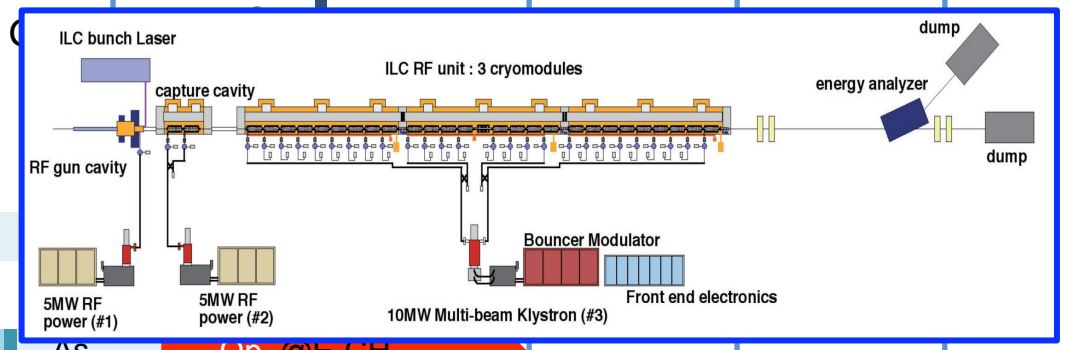
Cryomodule cold-mass assembly

ATF Schedule



STF Schedule



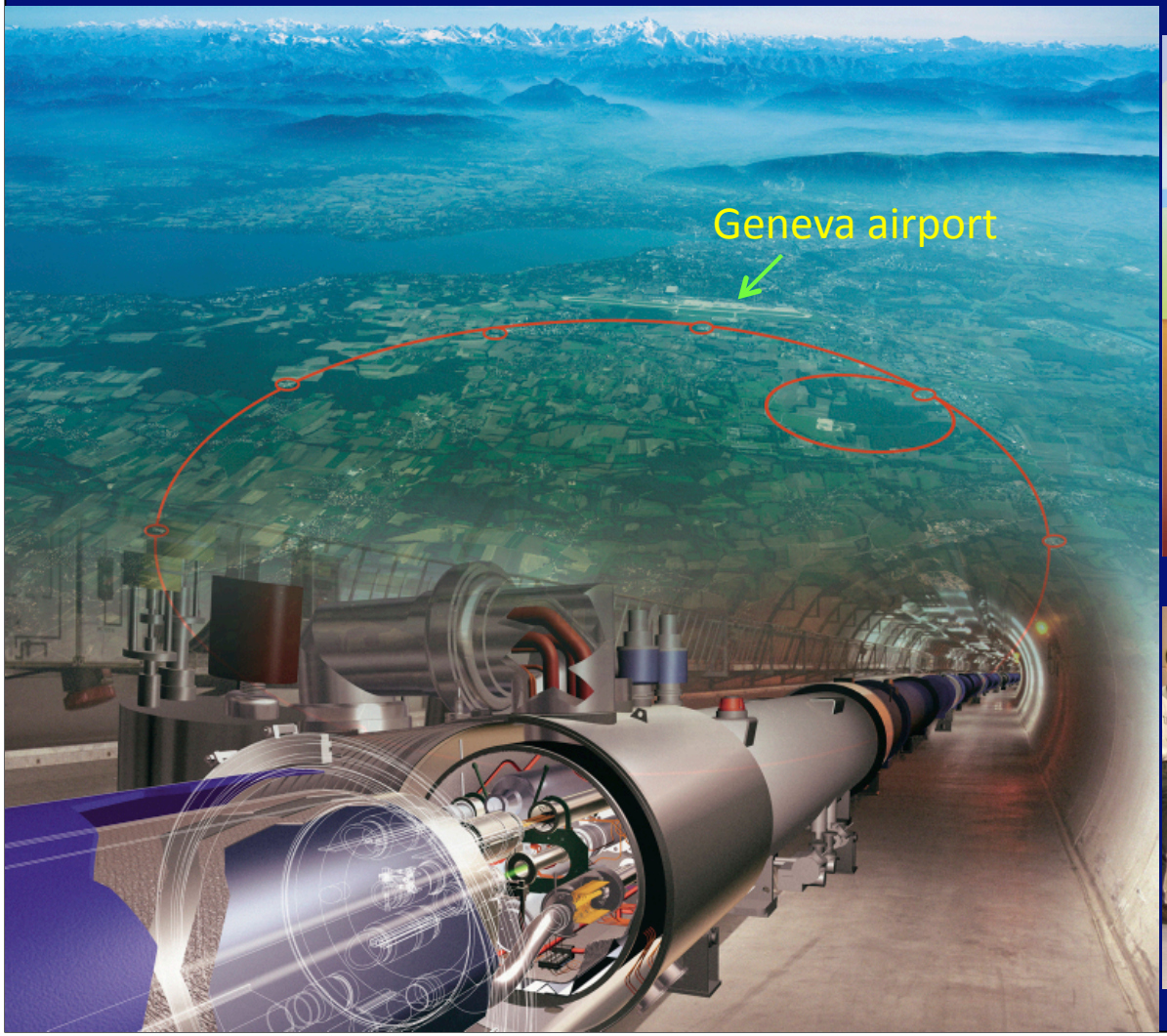


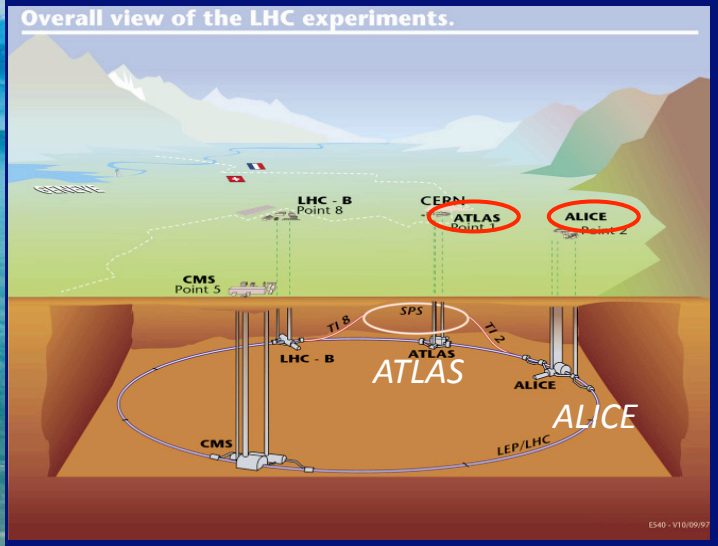
CY	2009	2010	2011	2012	2013	2014	2015
S1 Global	V.T. Ja. As. Op.						
S0		V.T.					
Quantum Beam		2 cavity fab. V.T. Ja. As.					
(ERL injector)			3 cavity fab V.T. Ja. As. Op. @E-CH				
Phase2	CM1	9 cavty fab.	V.T. Ja.	As. Op.			
KLY(DRFS)		Fab.		3～4			
MBK		Fab.		#3 station			
			4(2) cavity fab. V.T. Ja.				
	CM1'				V.T. Ja. As. Op.		
Cavity Fab.R&D			EBW study, design of jigs				
Cavity Fabrication			KEK01 KEK02	Maker + KEK			
Pilot Facility	EBW contract	fabrication		Set up	operation		

V.T.=vertical test, As.=assembly, Ja.=attach He jacket, HPC=High Pressure Gas Code

Energy Frontier : CERN

LHC（large hadron collider:
World highest energy accelerator, 14 TeV)

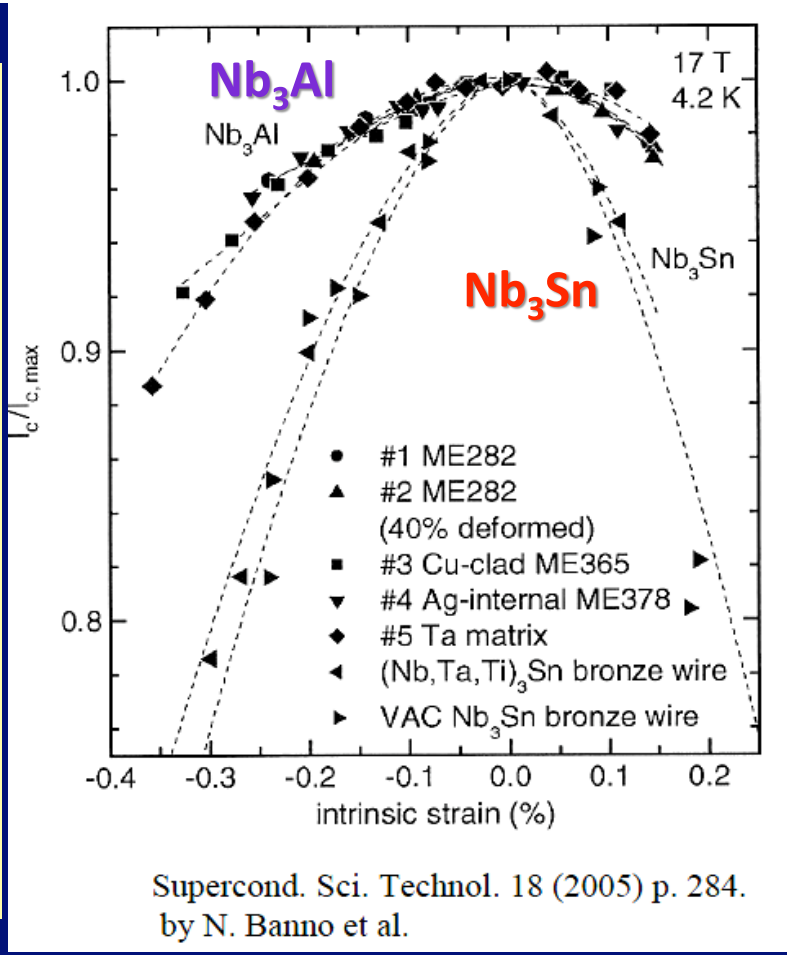




LHC Upgrade

IRQ Development
Required for Luminosity Upgrade

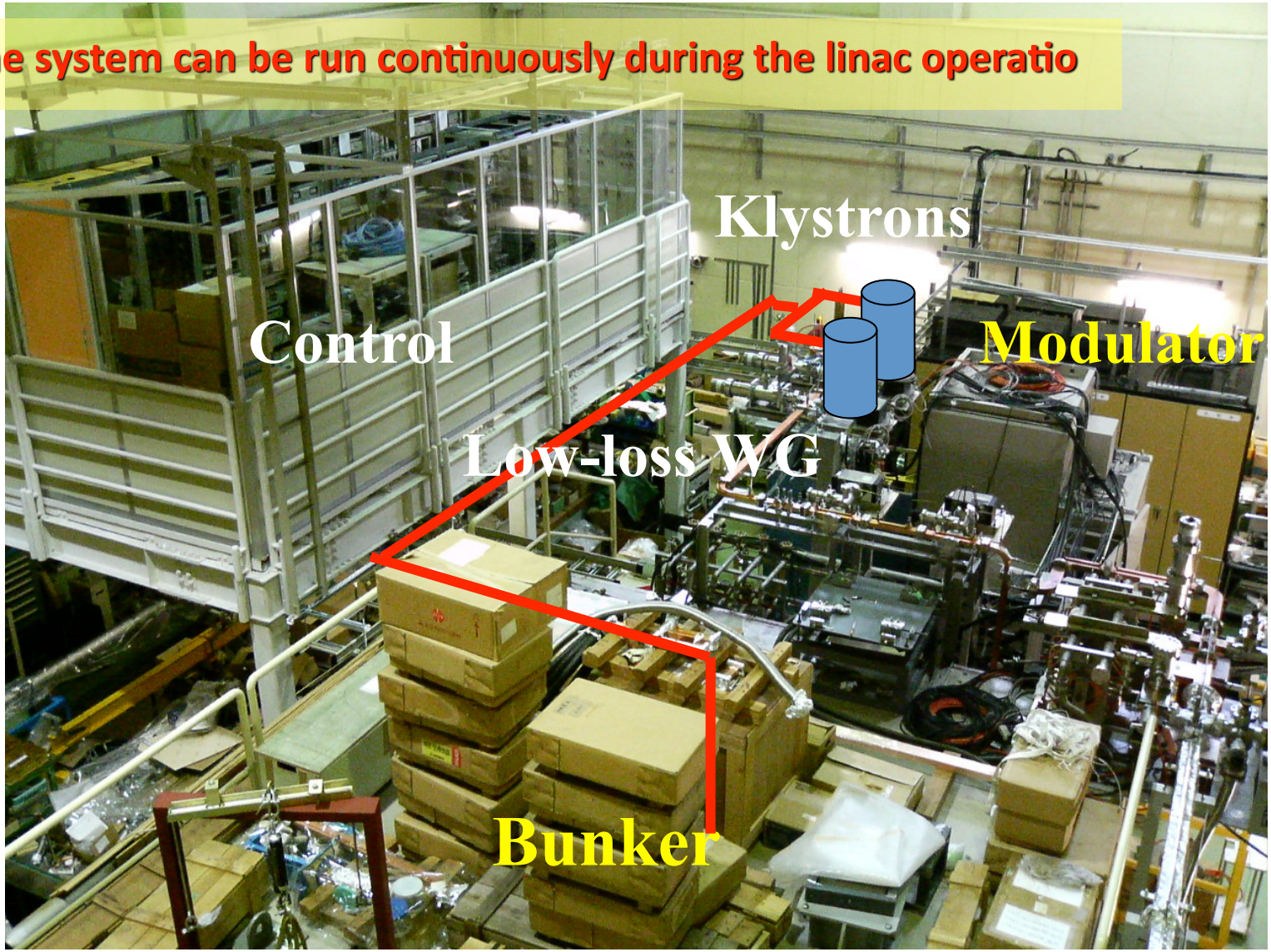
Parameters	LHC start	--> Upgrade
Field gradient	215 T/m	--> 250 T/m
Coil inner radius	35 mm	--> 50 mm
Yoke outer radius	235 mm	
Magnetic length	6.37 m	
Peak field in coil	8.63 T	--> ~15 T
Current	7149 A	
Superc. load-line ratio	80 %	
Inductance	87.9 mH	
Stored energy	2.24 MJ	
Mag. force/pole (octant)		
Fx	1.19 MN/m	
Fy	-1.37 MN/m	



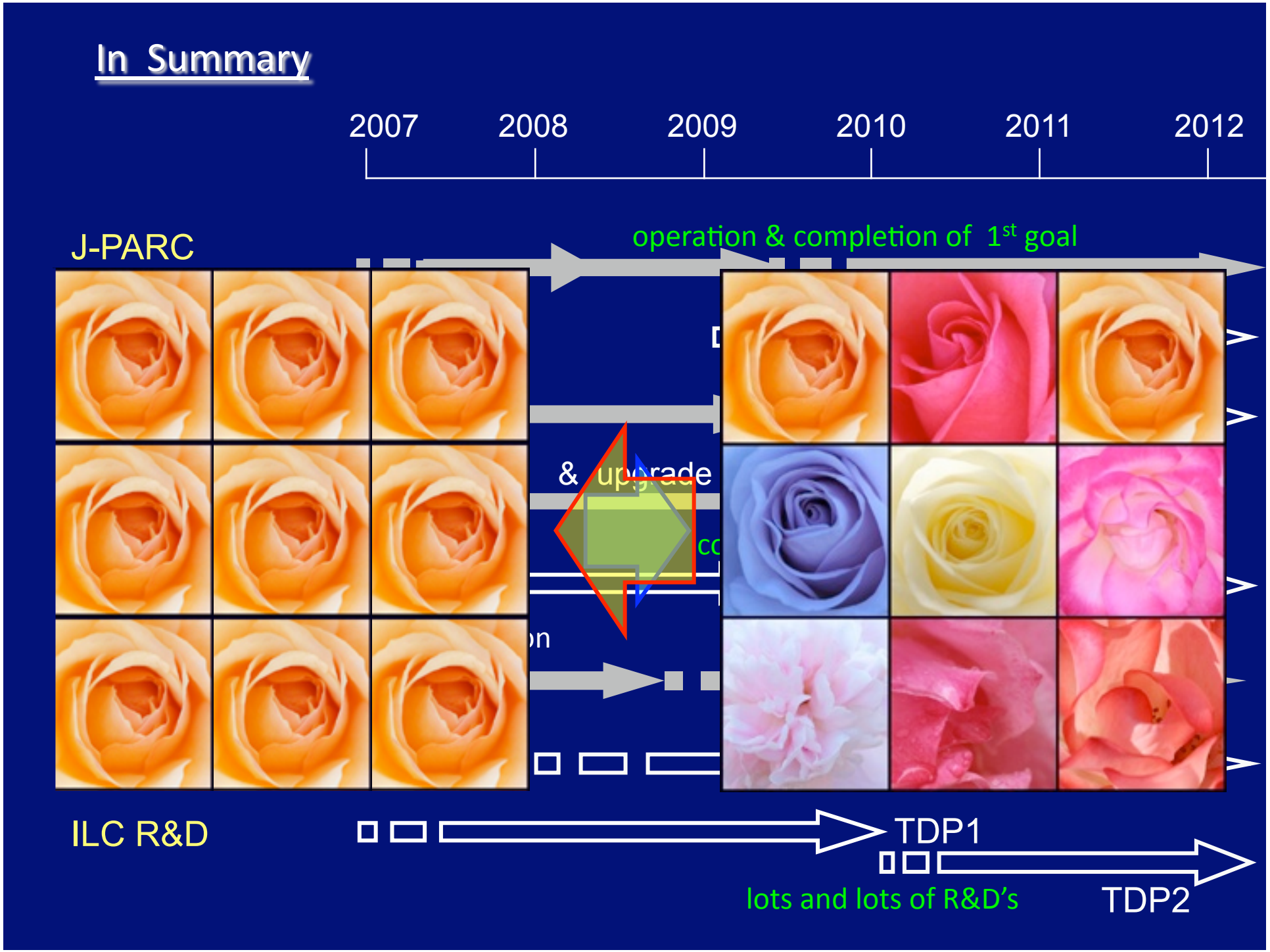
Supercond. Sci. Technol. 18 (2005) p. 284.
by N. Banno et al.

KEK Testing Programs toward X-band CLIC

- The system can be run continuously during the linac operatio



In Summary


2007
2008
2009
2010
2011
2012
J-PARC
operation & completion of 1st goal
& upgrade
ILC R&D
TDP1
lots and lots of R&D's
TDP2