

Future Visions of KEK

Interim report of the KEK future vision
committee

December, 2005

1

- **In July 2005, the KEK Director formed a committee in order to informally discuss and assess the various future plans of KEK.**
- **The committee held a series of meetings to study future plans up to year 2020 to make an interim report by the end of 2005.**
- **The interim report was issued based on the discussions done so far, though the future visions on the areas such as common infrastructure, public relations and evaluations are still to be considered.**
- **The report is expected to give information useful for the processes of preparation of the next mid-term plans of KEK.**
- **The report neither aims at modification of any current mid-term plans nor binds the judgments by the next KEK management.**
- **The report is assembled based on the existing knowledge as well as various boundary conditions, and therefore, any future changes in prerequisites may alter the visions presented here.**

2

Basic KEK Policies

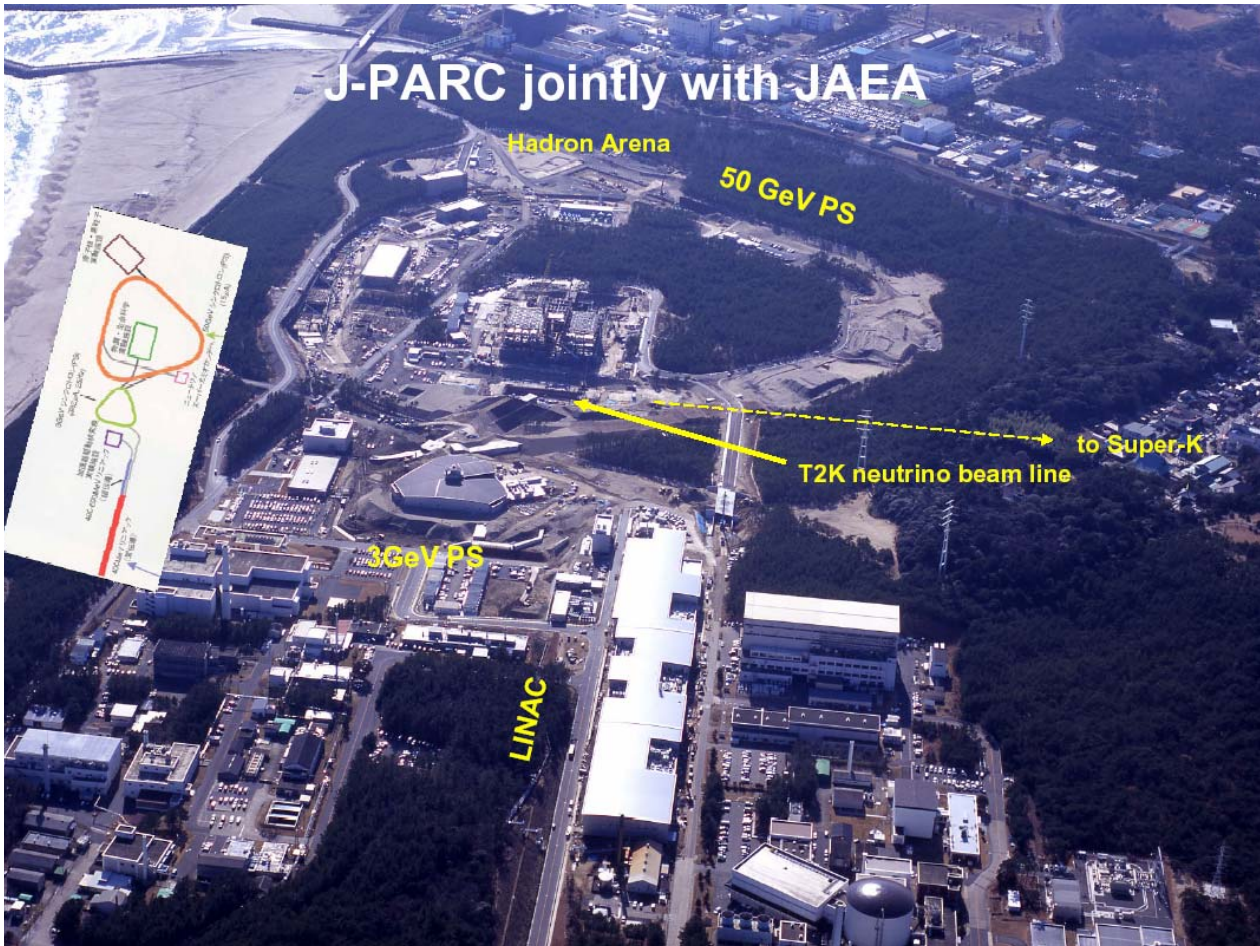
- KEK pushes on forward with both the particle/nuclear physics and the materials structure science under the united efforts.
- KEK promotes the inter-university research.
- While optimizing the scale of the inter-university research, KEK promotes research by the KEK staffs.

3

Current Status of KEK

- Research of the CP violations in the rare decays of B mesons by KEKB and Belle experiment.
 - Current goal is to achieve the integrated luminosity of 1 at^{-1} .
- 12 GeV PS has been shut down in December 2005 and its 500 MeV booster will be shut down on 22 March 2006.
- The inter-university research activities are quite active at the synchrotron light sources, PF (2.5 GeV storage ring) and PF-AR (6.5 GeV single-bunch storage ring). It is the time to consider the upgrades of both facilities.
- The inter-university research using KENS (spallation neutron facility) and MSL (muon facility) are successfully finishing and their transitions to J-PARC are underway.
- Construction of J-PARC and its commissioning in 2008.
 - Securing the construction budget.
 - Establishing the management structure.
 - Optimization of the operation expenditure and its acquisition.
 - Approval of experiments.
- Positive engagements in the ILC project.

4



Strategy in Materials Structure Science (1)

- KEK aims at appropriate scale in its inter-university research and puts more emphasis on research and outputs by the KEK staffs.
- KEK pushes forward with wide research areas including the top-priority fields (life science, communications, environments, nano-materials) listed in the Japan's Science and Technology Base Plan, by strengthening
 - research using J-PARC neutron beams from 2008.
 - research using J-PARC muon beams from 2008.

Strategy in Materials Structure Science (2)

- KEK plans to construct ERL (Energy Recovery LINAC) for research with synchrotron radiation:
 - Operation of current PF and PF-AR till the ERL completion.
 - Need to justify technical feasibility of the ERL using a ERL prototype machine.
 - Construction and test of the prototype to be done in 2006-2009.
 - R&D's to seek possible collaborations with Cornell University, J-Lab and JAEA.
 - Pursue as an international and/or Asian project.
 - Optimization for the construction cost.
 - The construction budget will be requested in 2010 or 2011 to be included in the 4th Japan's Science and Technology Base Plan.

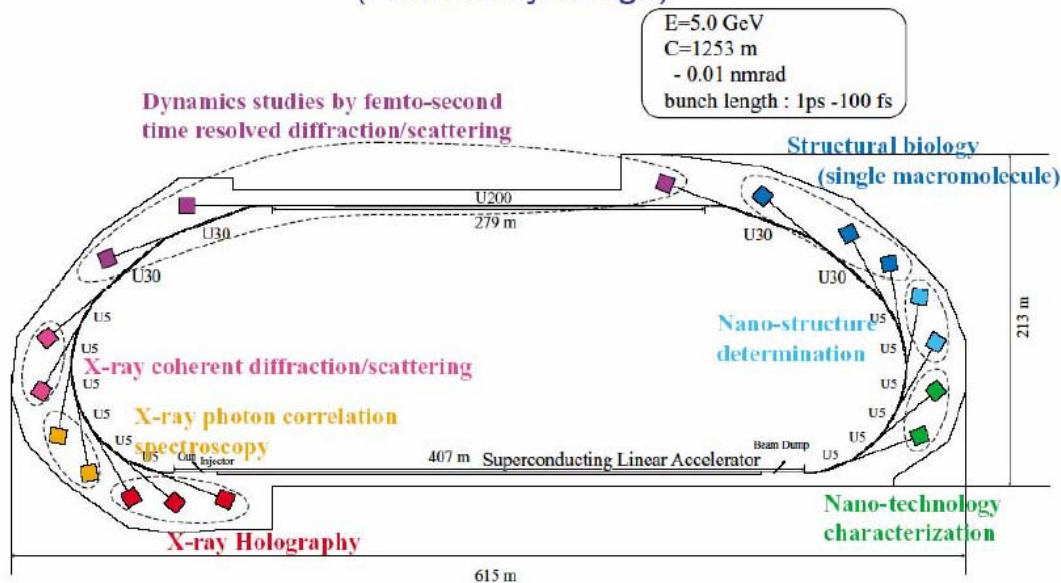
7

Table: Major Parameters of ERL

| | | |
|-----------------------|--------------------|------------------------------|
| Beam energy | 2.5 ~ 5 | GeV |
| Injection energy | 10 | MeV |
| Circumference | 1253 | m |
| Maximum current | 100 | mA |
| Normalized emittance | 0.1 | $\mu\text{m}\cdot\text{rad}$ |
| Energy spread (rms) | 5×10^{-5} | |
| Bunch length (rms) | 1~0.1 | ps |
| Radio frequency | 1.3 | GHz |
| Acceleration gradient | 10~20 | MV/m |

8

PF ERL(Energy Recovery Linac) (Preliminary design)

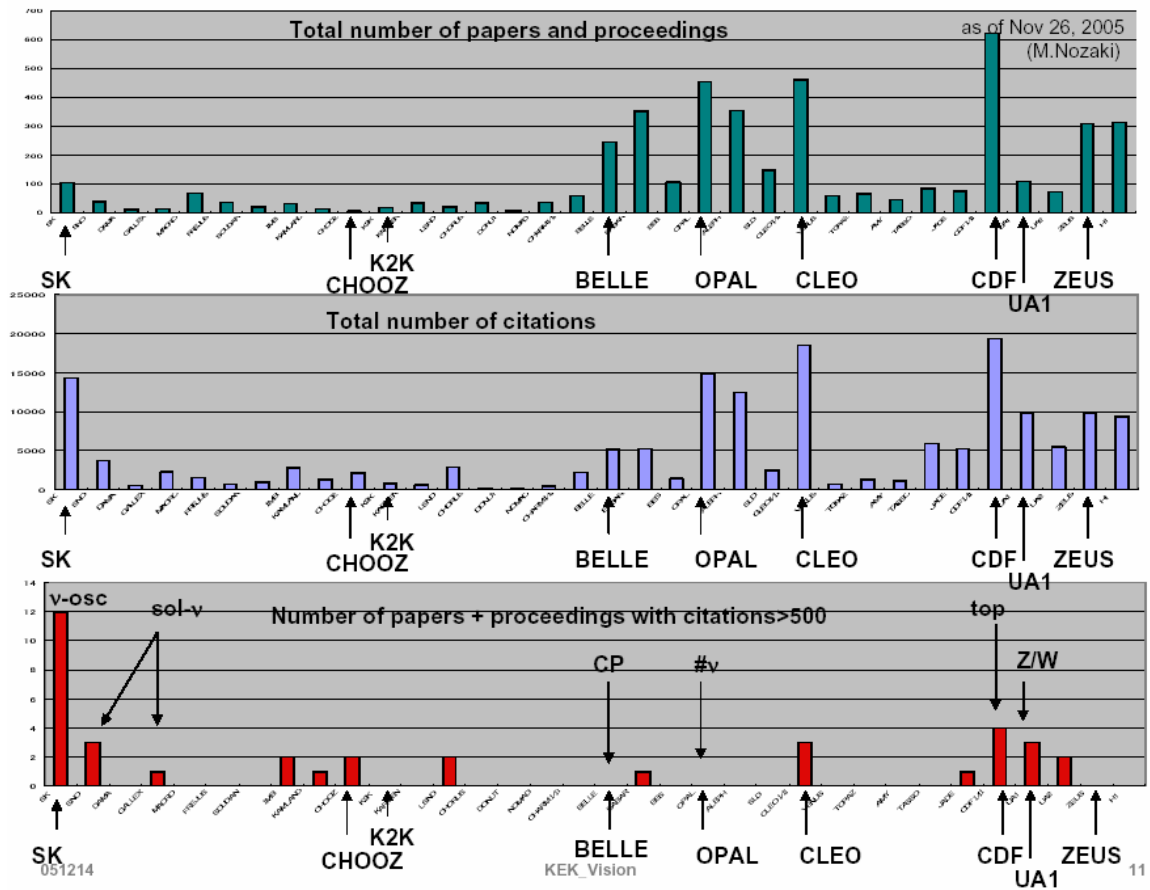


9

Strategy of Particle and Nuclear Physics

- Select the most important domains in particle and nuclear physics and aim at the leadership in the world.
- Research in Neutrino Physics at J-PARC
 - The most important target is the start of the T2K experiment in April 2009.
 - The second stage plans (Hyper-Kamiokande and 4 MW upgrade of the J-PARC 50 GeV PS) to be considered after the experimental results on θ_{13} becomes clear.
- Research on strangeness and strange baryons in nuclei and/or on rare decays of kaons at J-PARC starting from 2008.

10



Hyper-Kamiokande

Super-Kamiokande
Run 999999 Event 294
0520-11-06-000-04-10
Owner: 2004 data, 4110 pb
Detector: 8000, 2.00 (10-11-00)
Trigger ID: 0403
@ 0411-04-10-00
PC: read - 400.0 (RM)/072

Charge (pe)

- >45.0
- 43.1-45.0
- 41.4-43.0
- 39.7-41.3
- 38.0-39.6
- 36.3-37.9
- 34.6-36.2
- 32.9-34.5
- 31.2-32.8
- 29.5-31.1
- 27.8-29.4
- 26.1-27.7
- 24.4-26.0
- 22.7-24.3
- 21.0-22.6
- 19.3-20.9
- 17.6-19.2
- 15.9-17.5
- 14.2-15.8
- 12.5-14.1
- 10.8-12.4
- 9.1-10.7
- 7.4-9.0
- 5.7-7.3

Times (ns)

Outer Detector
Inner Detector
Access Drift
Photo-Detectors
Plat form
Opaque Sheet
Liner
Water Purification System

SECTION

Access Drift
Plat form
Liner
Outer Detector
Inner Detector

Height: 54m
Diameter: 43m
Width: 48m
Compartment Length: 50m
Total Length: 250m (5 Compartments)

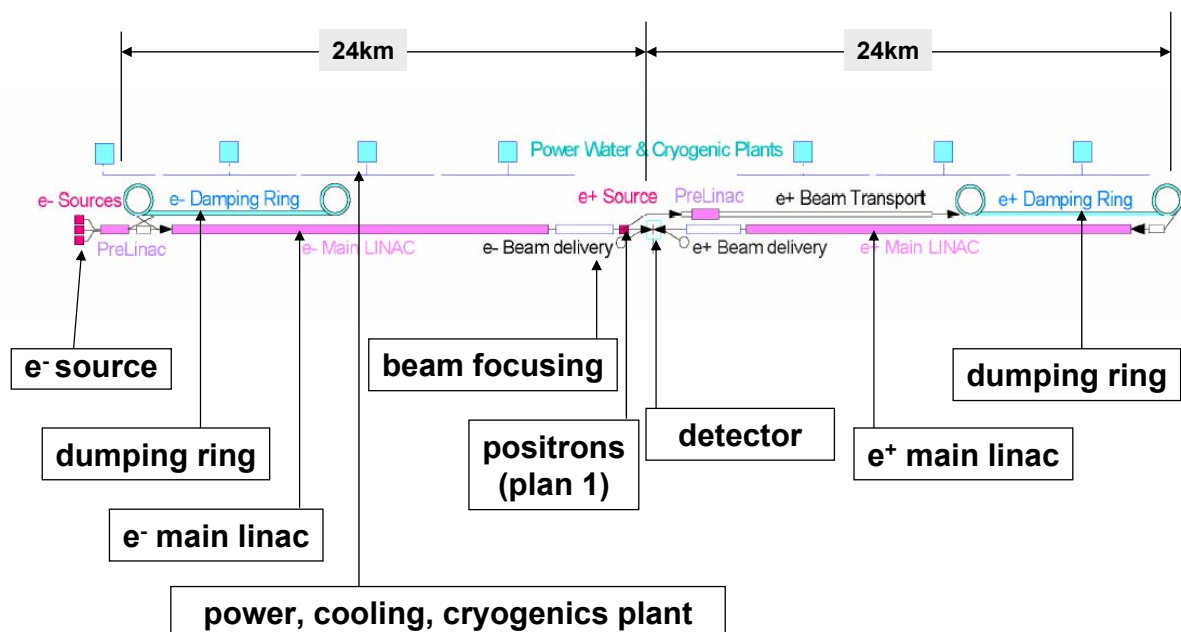
1 Mton water Cherenkov detector

Research on Energy Frontier Physics (Higgs/SUSY particles): **scenario-V1**

- Confirming the discoveries of Higgs and/or SUSY particles at LHC, ILC performs detailed research on these particles.
 - It will be the most important contribution to the future particle physics.
 - KEK actively participates in the ILC design and the R&D's as one of the major accelerator facilities in the world.
 - KEK takes a leadership in the global ILC works.
- In 2007 or 2008, KEK makes a decision whether the ILC will be built as scheduled in close coordination with ICFA and with Fermilab.
- Confirming the presence of new particles such as SUSY, and after ILC, the Super-B factory be constructed as early as possible to do high precision measurements of rare B decays to study the contributions of these new particles to the CKM matrix elements.

13

ILC : e^+e^- Linear Collider



14



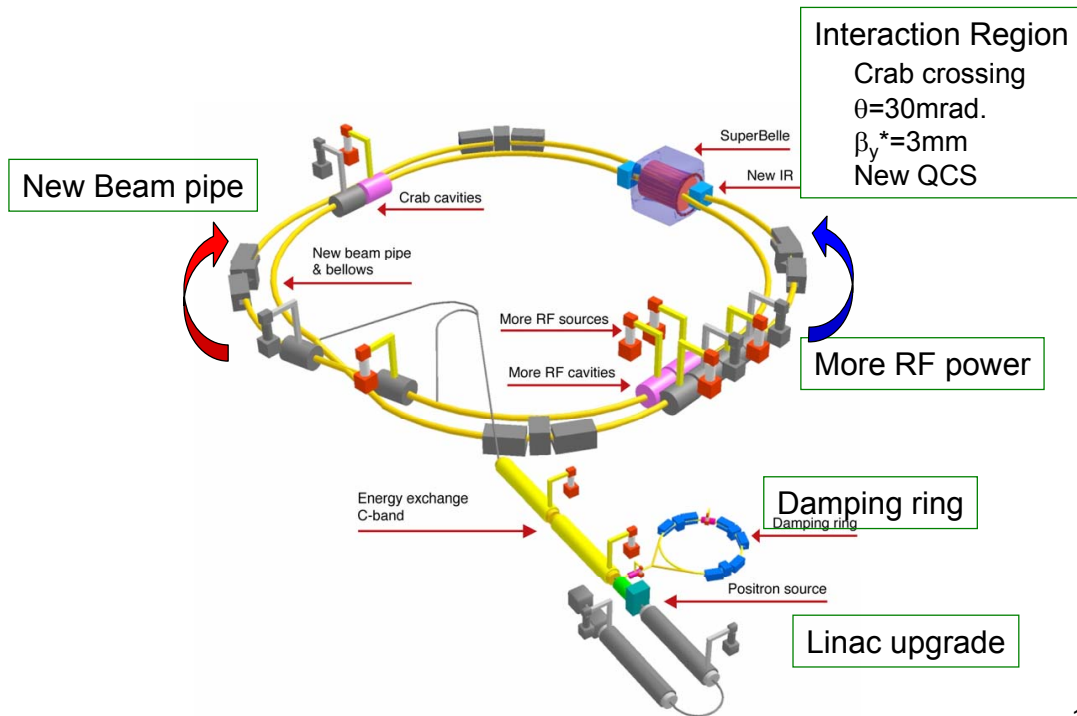
- beam energy
 - 1st phase: 250 GeV
 - 2nd phase: 500 GeV
 - e-, e+ beams
 - 5 pulses /sec
 - 2820 bunches / pulse, bunch separation = 295nsec
 - 1 bunch = 2×10^{10} e-, e+ / bunch
 - beam size at IP : 5nm x 550nm x 300 μ m ($E_b=250$ GeV)
- (as of Sep 2005)

Illustrated by
SHIGEMI NUMAZAWA
/ ATLAS BANK

Research on Energy Frontier Physics (Higgs/SUSY particles): **scenario-V2**

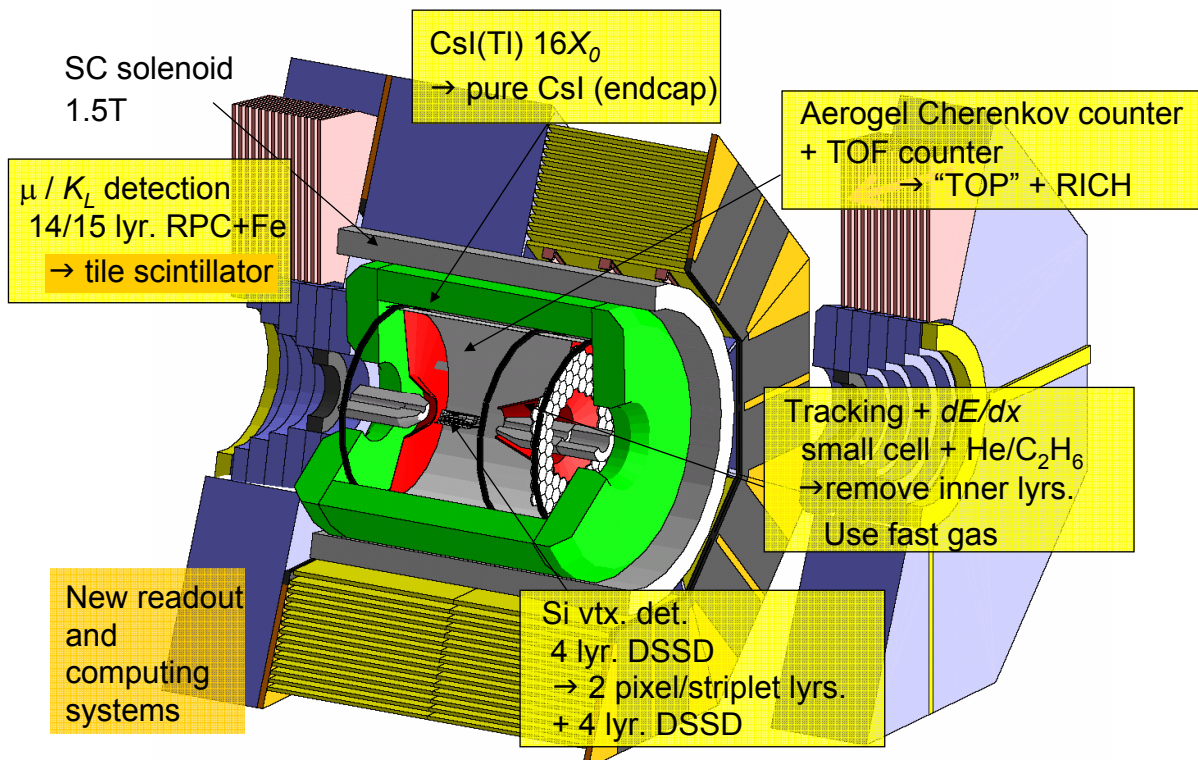
- **Confirming the discoveries of Higgs and/or SUSY particles at LHC, ILC performs detailed research on these particles.**
 - It will be the most important contribution to the future particles physics.
 - KEK actively participates in the ILC design and the R&D's as one of the major accelerator facilities in the world.
 - KEK takes a leadership in the global ILC works.
- **If the ILC construction be to be delayed for several years, the Super-B factory will be built internationally to do high precision measurements of rare B decays to study the contributions of possible new particles to the CKM matrix elements.**
 - In 2007 or 2008, KEK makes a decision whether the ILC will be built as scheduled or delayed in close coordination with ICFA and with Fermilab.
 - The Super-B factory should start its international collaboration using the ILC collaboration as a model.
 - The decision on the Super-B construction to be done at the ICFA level.

Super-KEKB



17

Belle upgrade



Astro-particle Physics

- **Along with challenges in accelerators for the energy as well as luminosity frontiers, KEK starts seeking substantial research in astroparticle physics:**
 - Study the importance of particle astrophysics,
 - Which part of astrophysics should KEK involve?
 - How to collaborate with Institute for Cosmic Ray Research of Univ. of Tokyo and the KamLAND group of Tohoku Univ. etc.?
 - Possibilities on research using artificial satellites.

19

Factors to be considered -1

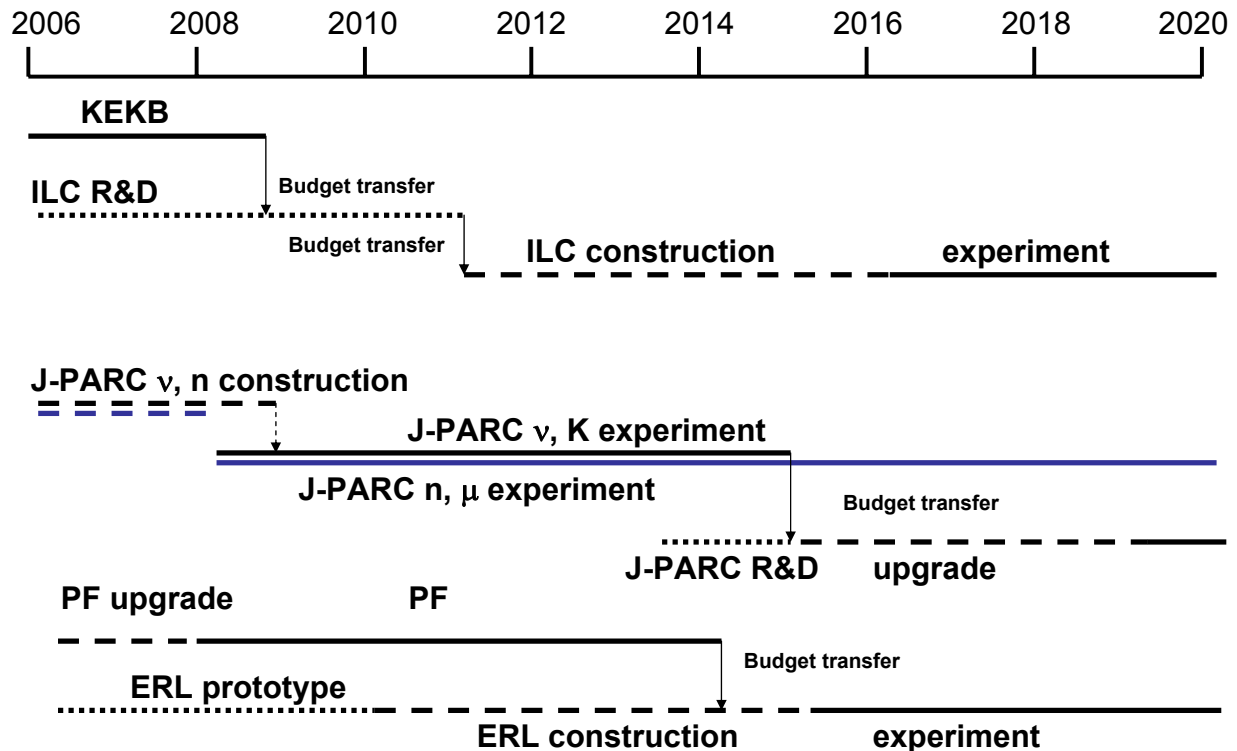
- **KEK staffs:**
 - How to cope with aging of staffs
 - Promoting activities by young generation
- **Budget:**
 - Increasing budget efficiency (aiming at reduction of 5% per 5 years in general management cost).
 - Large suppression of the frame of Facility Maintenance Budget.
 - Strengthen the segment management (decrease of freedom)
 - Manpower: need selection and concentration.
 - Pressure of 5% decrease in total personnel expenses planned by the Japanese Council on Economic and Fiscal Policy.
 - Increase of works in J-PARC. How to cope with increase of personnel expenses (J-PARC, allowance, bear etc).
- **How to cope with policy changes in use of Large Facilities?**
- **Maintain or reform the system of Inter-University Research Institute Corporation.**

20

Factors to be considered -2

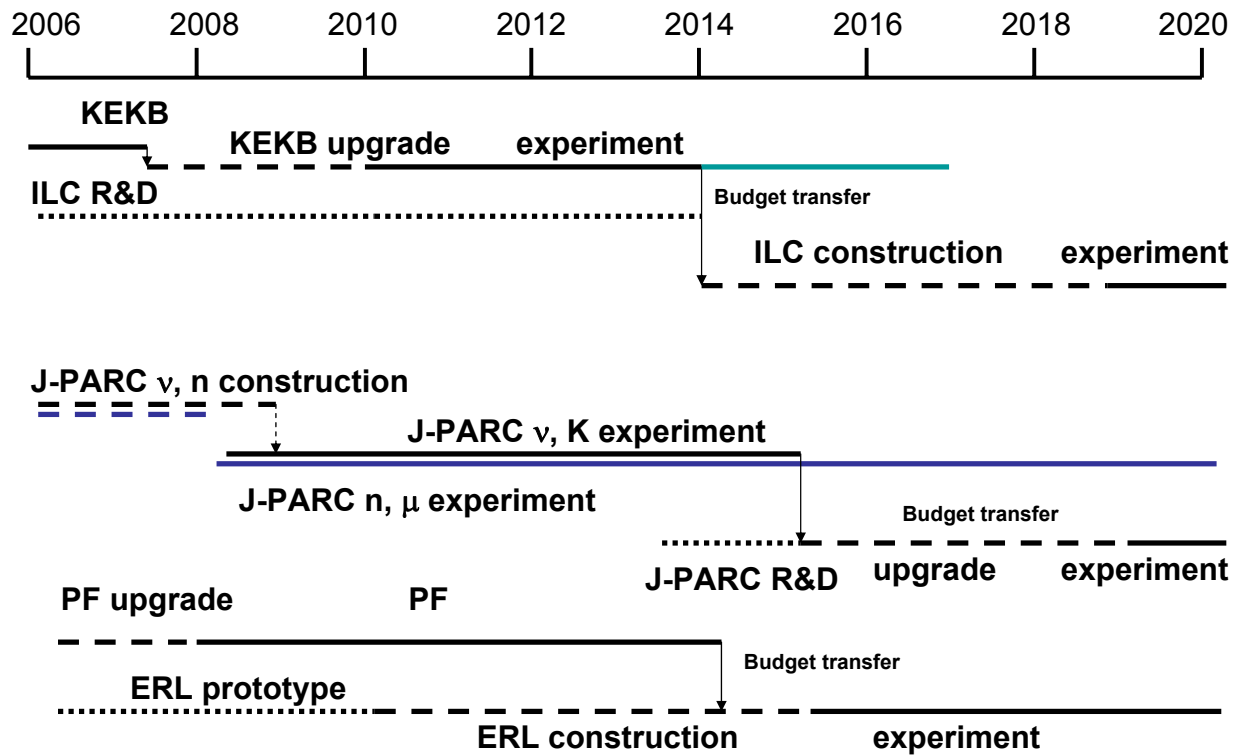
- Maintenance cost of J-PARC:
 - Suppress the cost and secure the budget.
- ERL:
 - Put the ERL as a base technology project in the Japan's 4-th Science and Technology Basic Plan.
- Super-B:
 - Effort to make the Super-B as an international project (KEK contribution to be within the current budget framework).
- ILC:
 - Start a formal discussion with the Government when the RDR including the cost estimate is issued in the end of 2006.
 - Budget request in 2007, Secure the R&D budget from JFY 2008 (possibly including prototype facility if necessary).
 - How to position the ILC project the Japan's 4-th Science and Technology Basic Plan?
 - Aim at construction budget from 2011.

21



Scenario Version 1

22



Scenario Version 2