Core University Seminar

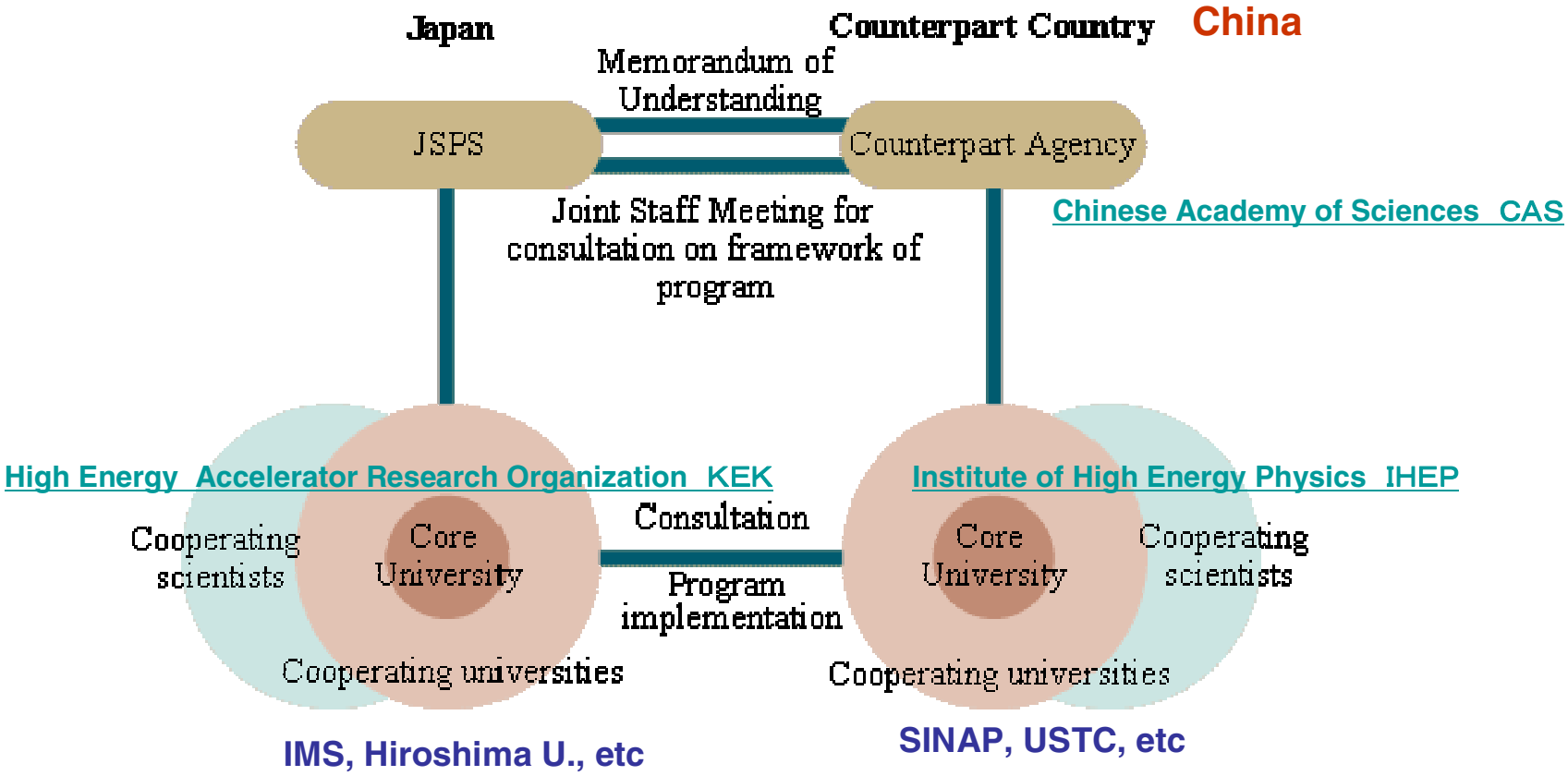
Single-bunch operation, the generation of ultra-short light pulses at storage rings and their applications

Feb.28-Mar.1, 2005

Tsukuba

Core University Program

JSPS (Japan Society for the Promotion of Science)



Core University Program

Countries & Counterpart Agencies

China, Chinese Academy of Sciences CAS

Fields

Accelerator Sciences

Core University in Japan

High Energy Accelerator Research Organization

KEK

Core Universities in Counterpart Countries

Institute of High Energy Physics

IHEP

Core University Program

Accelerator Sciences

- **Cooperative Universities:**
- **Tohoku University • Graduate School of science / Institute of Multidisciplinary Research for Advanced Material, Ibaraki University • Faculty of Engineering, University of Tokyo • School of Science / International Center for Elementary Particle Physics / Institute for Solid State Physics, Tokyo University of Agriculture and Technology • Faculty of Technology, Inst. Molecular Science, Hiroshima Univ. etc**

- **Cooperative Universities:**
- **Shanghai Synchrotron Radiation Facility. Institute of Theoretical Physics, Beijing University, Tsinghua University, University of Science and Technology of China, Shandong University, Zhejiang University, China Center Advanced Science and Technology, Suranaree University, Pohan University of Science and Technology**

Single-bunch impurity

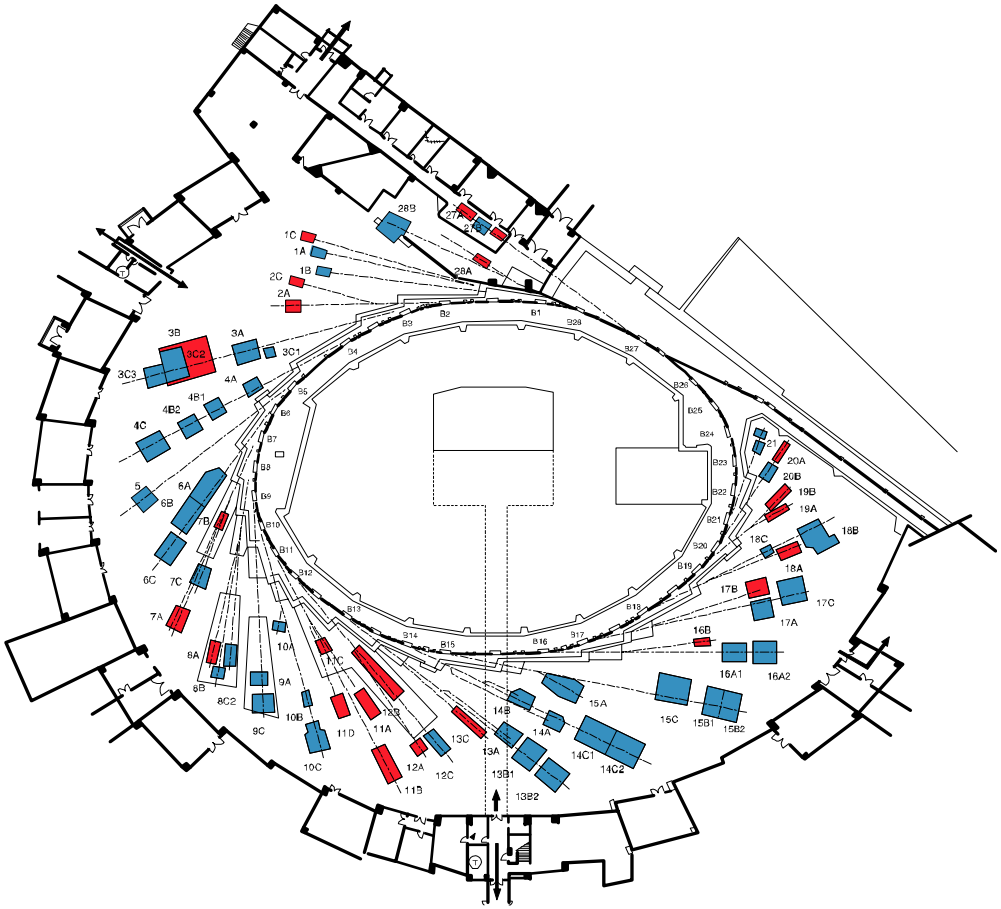
Impurity:

number of electrons in undesirable bunches/
number of electrons in main bunch

～20 years ago
Dr. Reich (CERN) told me….
Required impurity
<10E-7,10E-8
Impurity at UVSOR(750MeV ring at IMS)
～10E-3

Parameters of storage ring		
	PF	**PF-AR**
Energy	2.5/3.0 GeV	6.5/5.0 GeV
Circumference	186.6 m	384 m
Initial current	450 mA	60 mA
Emittance	36 nm rad	294 nm rad
Beam size	0.7 - 2.0 mm (H) 0.04 - 0.13 mm (V)	2.3 - 2.9 mm (H) 0.29 - 0.46 mm(V)
Beam lifetime	50 - 70 hrs	14 - 20 hrs
Insertion device	7	4 (+1)
Stations	62	9

PF-2.5 GeV Ring



C=186.6 m

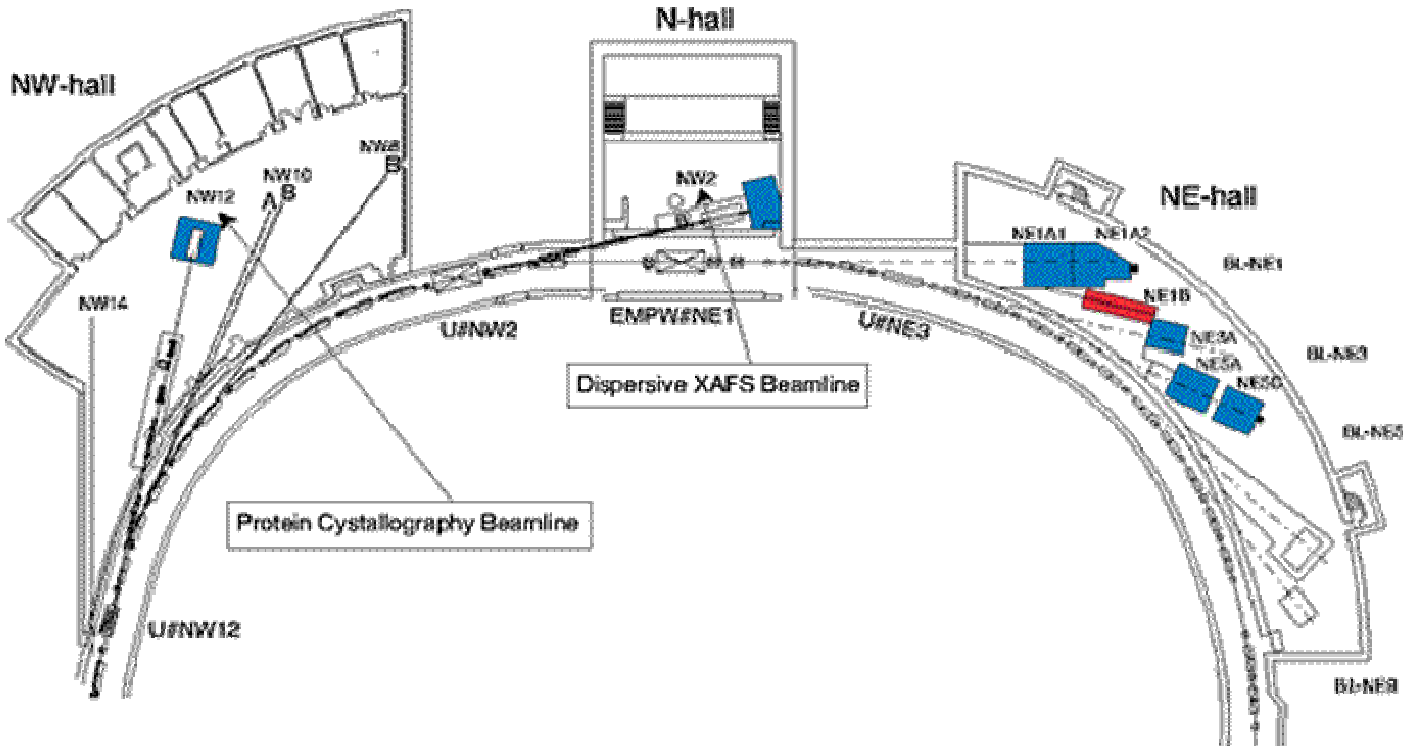
I = 450 mA
70 mA (Single-Bunch)
e = 36 nmrad
t = ~ 60 hrs

Single-bunch
2-3 weeks/year

PF-AR

6.5 GeV, C=384m, 60 mA in Single-Bunch

100% single-bunch machine



Importance of Single-Bunch Operation

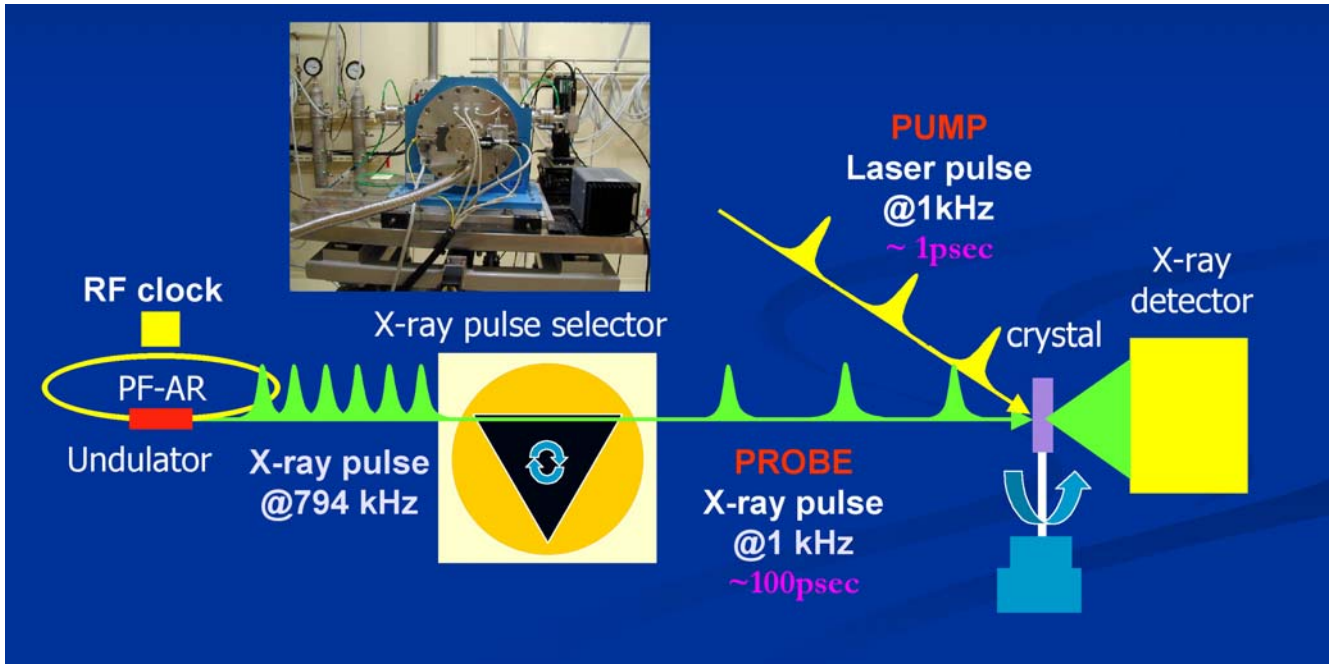
Single-bunch operation is important not only for SR experiments but also for "Machine Physics"

Some parameters are affected in Multi-bunch condition

- Ion trapping effect
- Multi-bunch instabilities

NW14; Undulator Beamline for Non-Equilibrium Dynamics

A new ERATO project “Non-Equilibrium Dynamics” led by Prof. Shinya Koshihara of Tokyo Institute of Technology has started in collaboration with the PF since November, 2003. A new beamline NW14 is now under construction to observe “Molecular Movie” in sub-nanosecond timescale of light-induced phase transition in strongly correlated materials by utilizing the single-bunch operation of the PF-AR.



Natural Bunch length

PF	10 mm	33 ps
PF-AR	19 mm	63 ps

Requirement (light pulses)

<1 ps, 0.1 ps?

Storage of short bunch

low α operation

before all things

We must solve
“difficulty in storing a short bunch in a ring”.

Generation of ultra-short light pulses

using

- short pulse laser
  Dr.Zolotorev
- crab cavity
  Dr. Nakazato
  Dr.Sakanaka

Mission of JST (Japan Science and Technology Agency)

JST's mission is to promote science and technology in Japan by conducting a broad range of activities, including the following:

*** Promotion of consistent research and development from basic research to commercialization with particular emphasis on the creation of new technological seeds**

*** Upgrading the infrastructure for the promotion of science and technology, including dissemination of scientific and technological information**

科学技術振興機構

Exploratory Research for Advanced Technology - ERATO

Basics: In 1981 JST initiated an innovative research effort called Exploratory Research for Advanced Technology - ERATO - for fostering the creation of advanced science and technology while stimulating future interdisciplinary scientific activities and searching for better systems by which to do basic research. Within the ERATO program JST acts as a Producer in selecting innovative, scientifically versed, key individuals - Directors - who are responsible for setting up exciting motifs and selecting young, talented, international Performers. The atmosphere of this adventure would be like a "science fishing club."