December 4, 2009
Lecture at Berze Secondary Grammar School

J-PARC Accelerator Facility in Japan

- Sciences toward Materials, Life and Fundamental Sciences -

Shoji Nagamiya

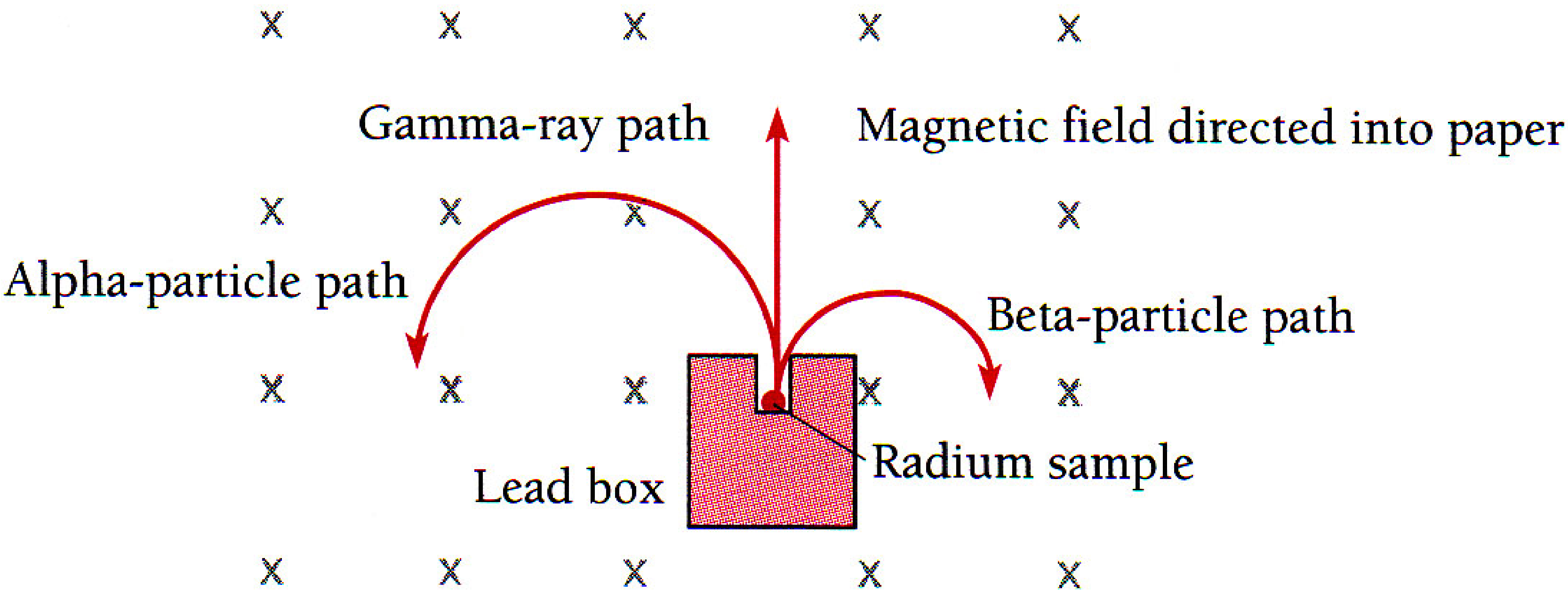
Director, J-PARC Center

Radiation and Accelerator

Radiation

Hot Topic in the Early 20th

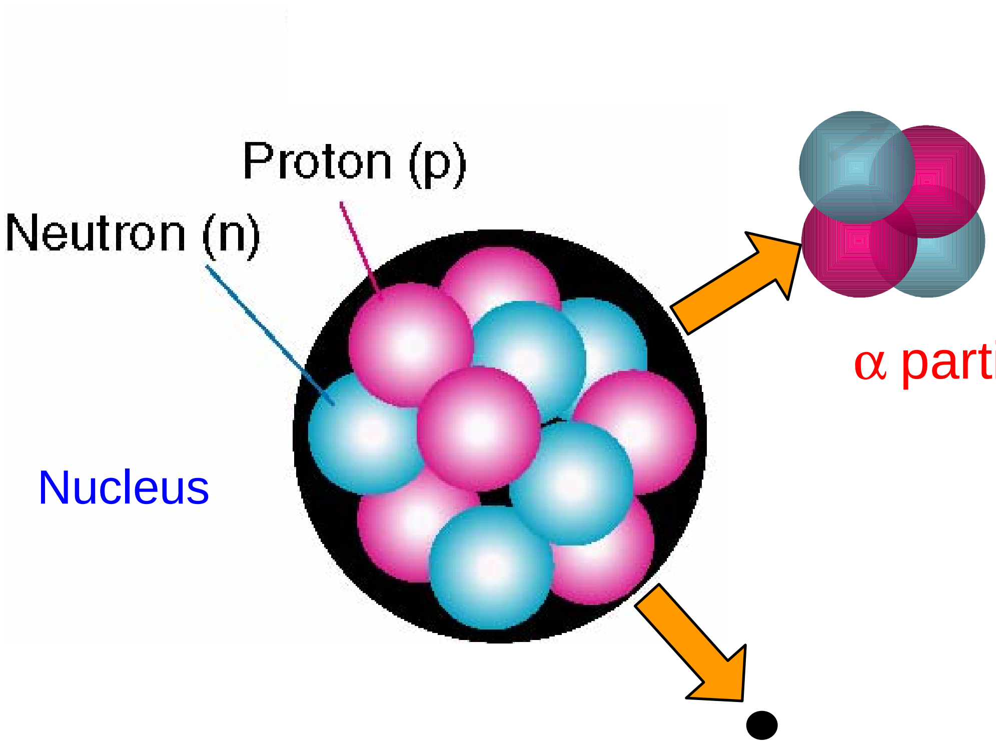
γ **Ray**: Moving straight in the magnetic field



α **Ray**: Bending left in the magnetic field

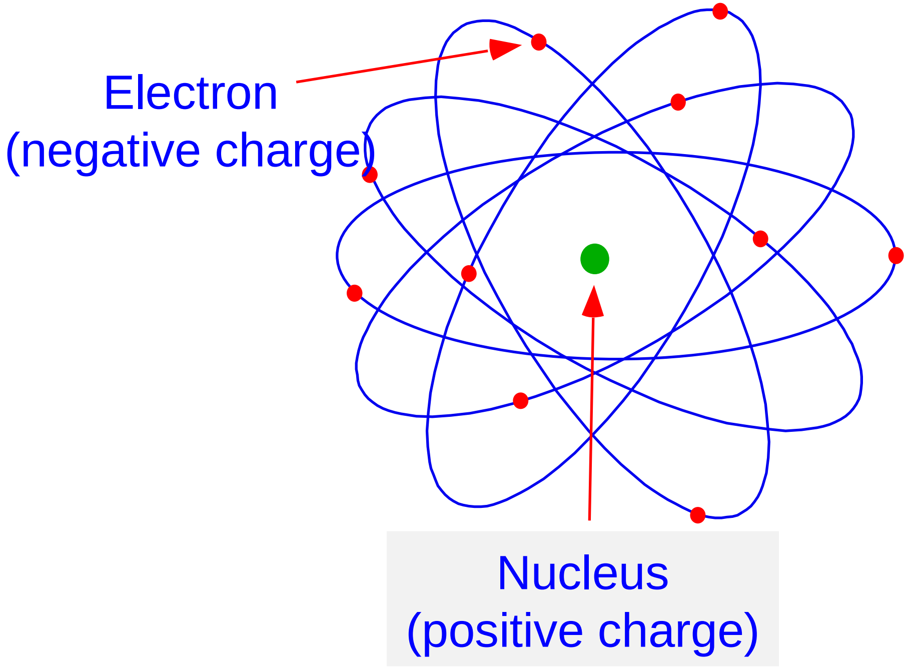
β **Ray**: Bending right in the magnetic field

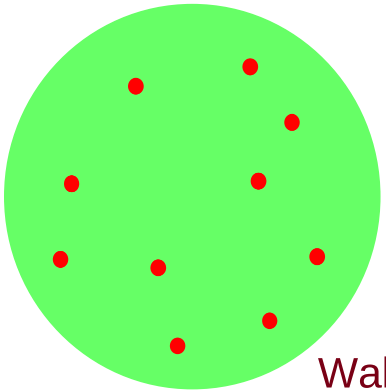
Origin of Radiation



Excited nucleus decays
into the ground state
by the emission of γ rays.

What is Atom?





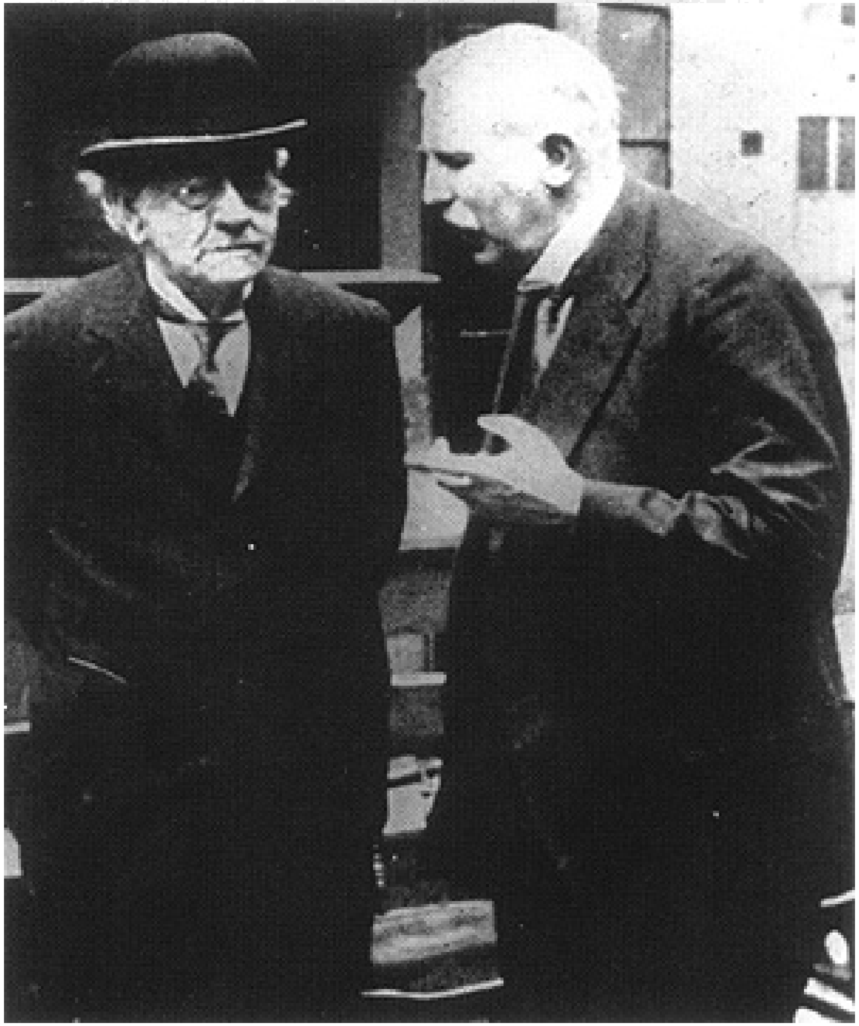
Walter Melon
Model for Atom

Unstable by classical theory | Stable by classical theory

Rutherford | Thomson

Discovered the nucleus | Discovered electron

Rutherford and Thomson



Proposed walter melon
model for atoms

Thomson Rutherford

Radiation and Rutherford

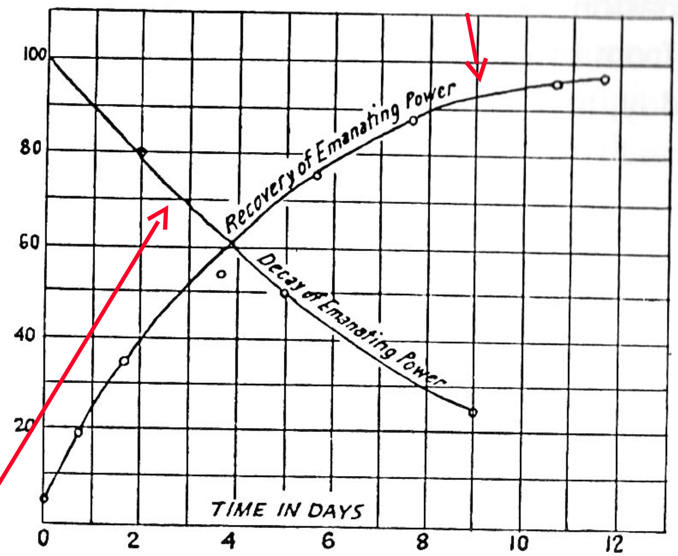
Strength of radiation is proportional to the number of the sample

$$dN/dt \propto N$$

↓

$$N = N_0 \exp(-\alpha t)$$

Yield for the daughter nucleus



Yield for the parent nucleus

FIGURE 3. Growth and decay curve.

FIGURE 4. Rutherford's coat-of-arms.

Rutherford received Nobel Prize in Chemistry by the discovery of this decay curve (and not by the discovery of the nucleus) .

Rutherford and New Zealand

Mother of Rutherford was the first woman teacher
in elementary school in New Zealand.

Device to Create Radiation Artificially (1932)

J. D. Cockcroft (1897-1967)
E. Walton (1903-1995)

1932 First Accelerator
1951 Nobel Prize

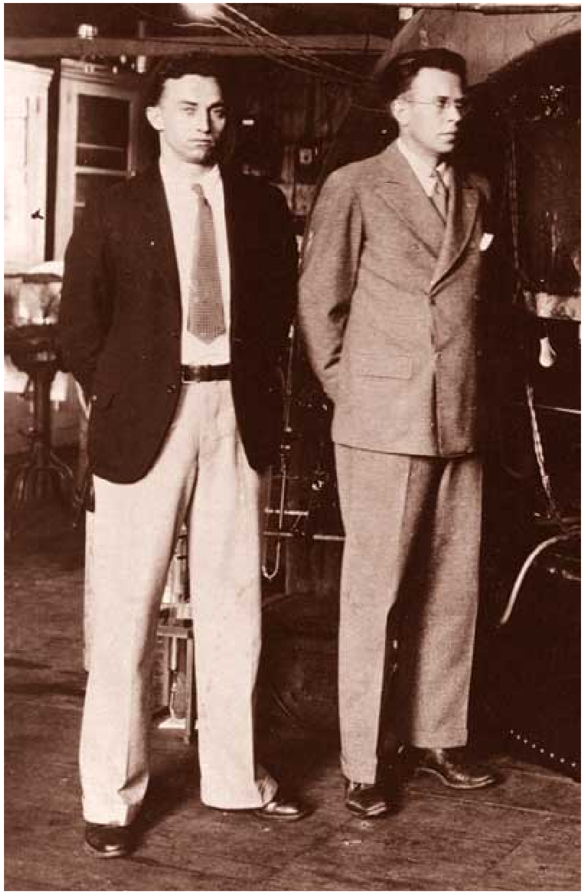
Accelerate particle and bombard the nucleus

Production of new nuclide

Radiation from a new nuclide
Artificially created radiation

Actual Cockcroft -Walton accelerator
(from London Science Musiam)

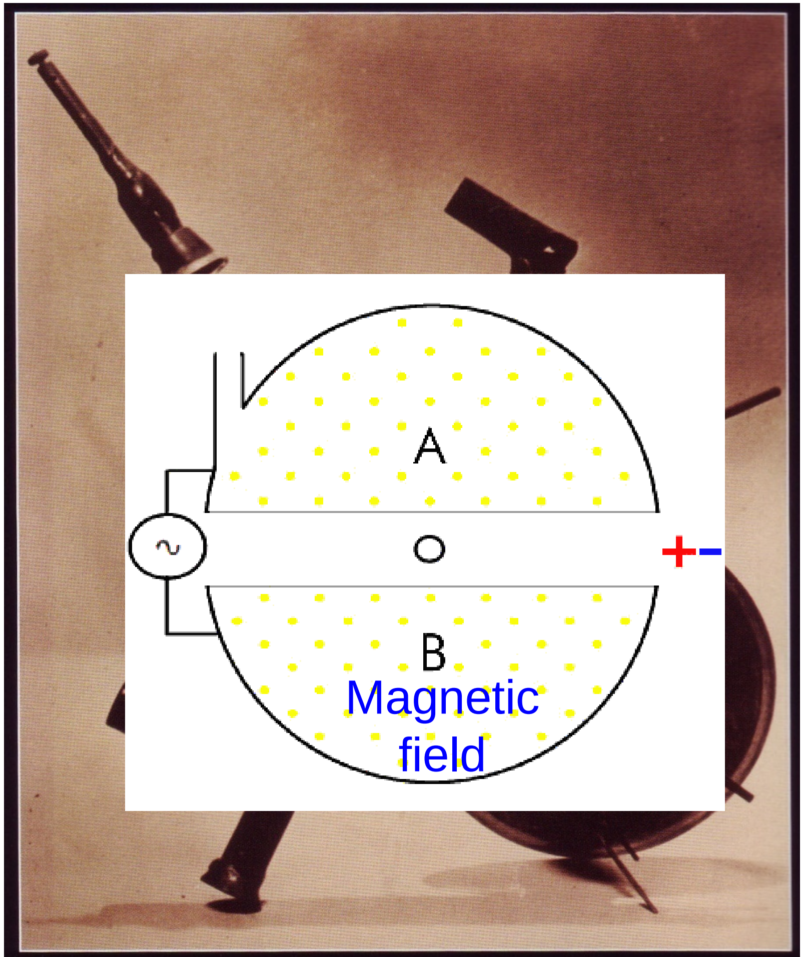
Discovery of Cyclotron (1930)



E. O. Lawrence (1901-1958) right
M. S. Livingston (1905-1986) left

Student of Lawrence

1931 □□ First Cyclotron
1939 □□ Nobel Prize to Lawrence



ローレンスの大学院生だったM. S. リビングストンが博士論文研究のために1931年に試作したサイクロトロンの分解写真。「D」の直径が手のひらサイズの約11センチ。二つの「D」の間にかける最大電圧が1000ボルト，磁場の強さが0.52テスラ（地球の磁場の約5000倍）。プラスの電気を帯びさせた水素分子を1万3000電子ボルトまで加速した。

Usage of Cyclotron in 1030's

Ernest O. Lawrence (1901-1958)
1928 ▯ From Yale to Berkeley
1930 ▯ Construction of Cyclotron
1939 ▯▯ Nobel Prize

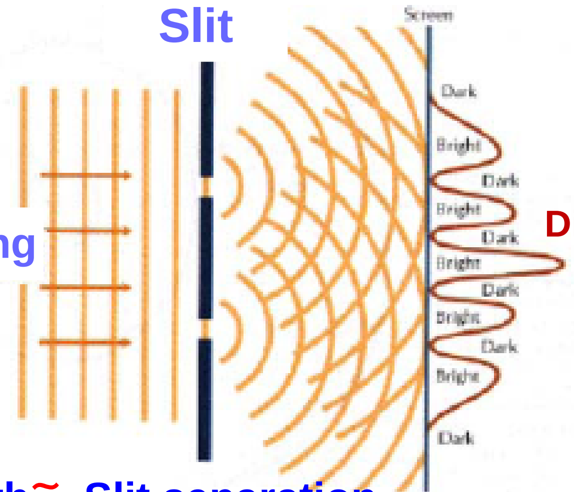
John H. Lawrence (1903-1991)
1936 ▯ From Yale to Berkeley
Pioneer for Radiation Therapy
(Neutron therapy, usage of isotopes ▯
1983 ▯ E. Fermi Prize

Why Accelerator?

Wave and Particle (Two Predictions and Experiment)

Slit

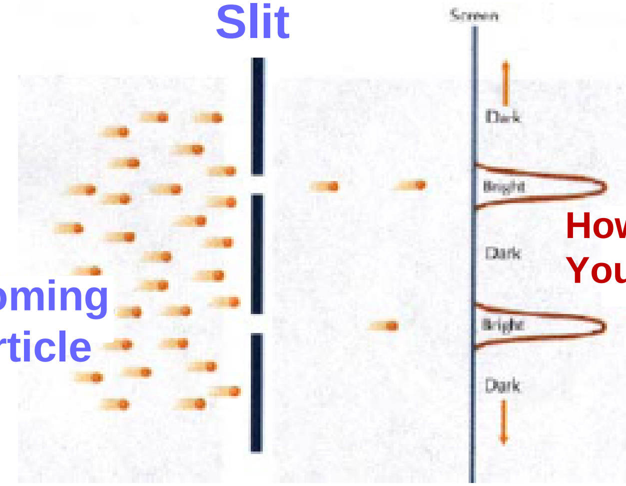
Incoming
Wave



Diffraction
Pattern

Slit

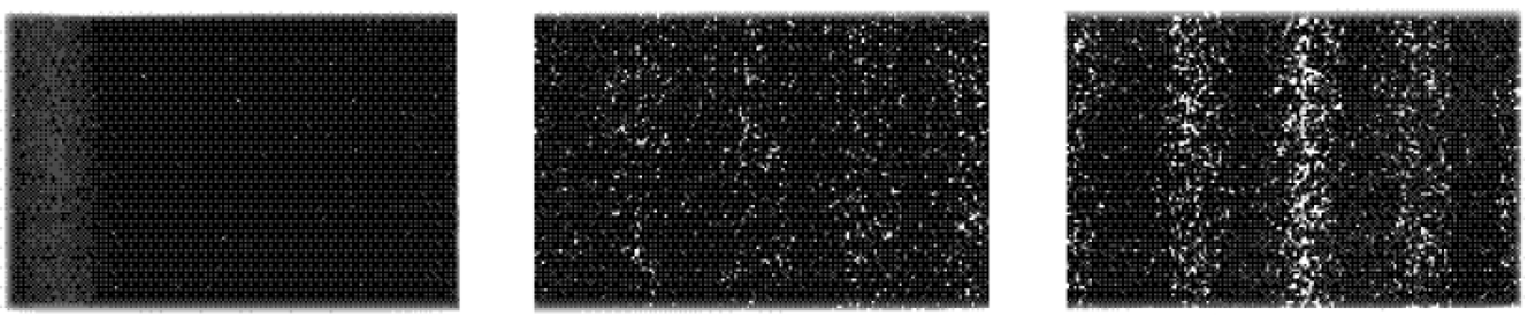
Incoming
Particle



How do
You think ?

Wavelenfth~ Slit separation
Diffraction is observed !

Measurement for Electrons



100 electrons 3,000 electrons 70,000 electrons

Particle is Wave
Wave is particle

Fundamental rule in Quantum Theory

(Particle) Energy and (Wave) Length

Louis de Broglie
(1892-1987)

Planck Constant

$$\lambda = \frac{h}{p}$$

Wavelength ↔ Momentum

Wave ↔ Particle

Referee: A. Einstein

1924: PhD Thesis

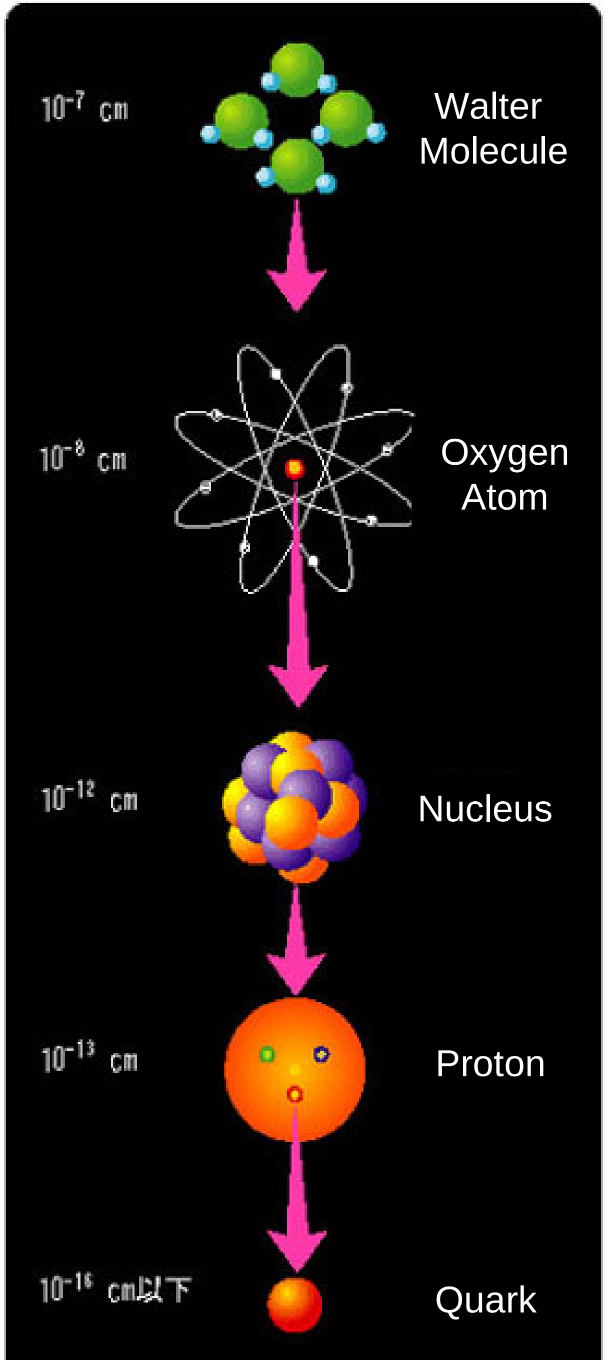
(1927: Davidson-Germer Electron Scattering Exp

1929: Nobel Prize

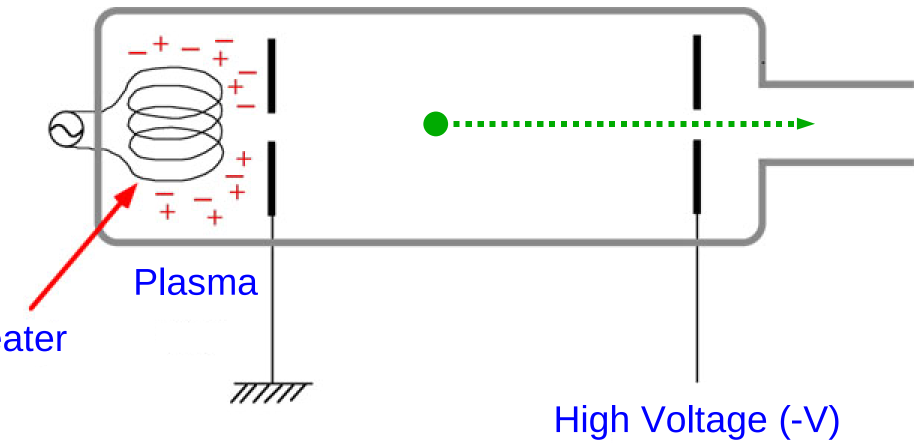
Higher the Energy → Higher the Momentum
→ Shorter the Wavelength → Microscopic object

Accelerator

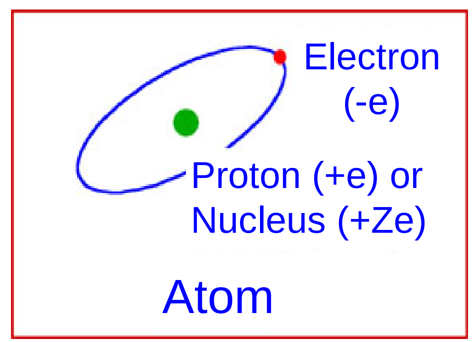
To study micro object



10 keV



100 MeV

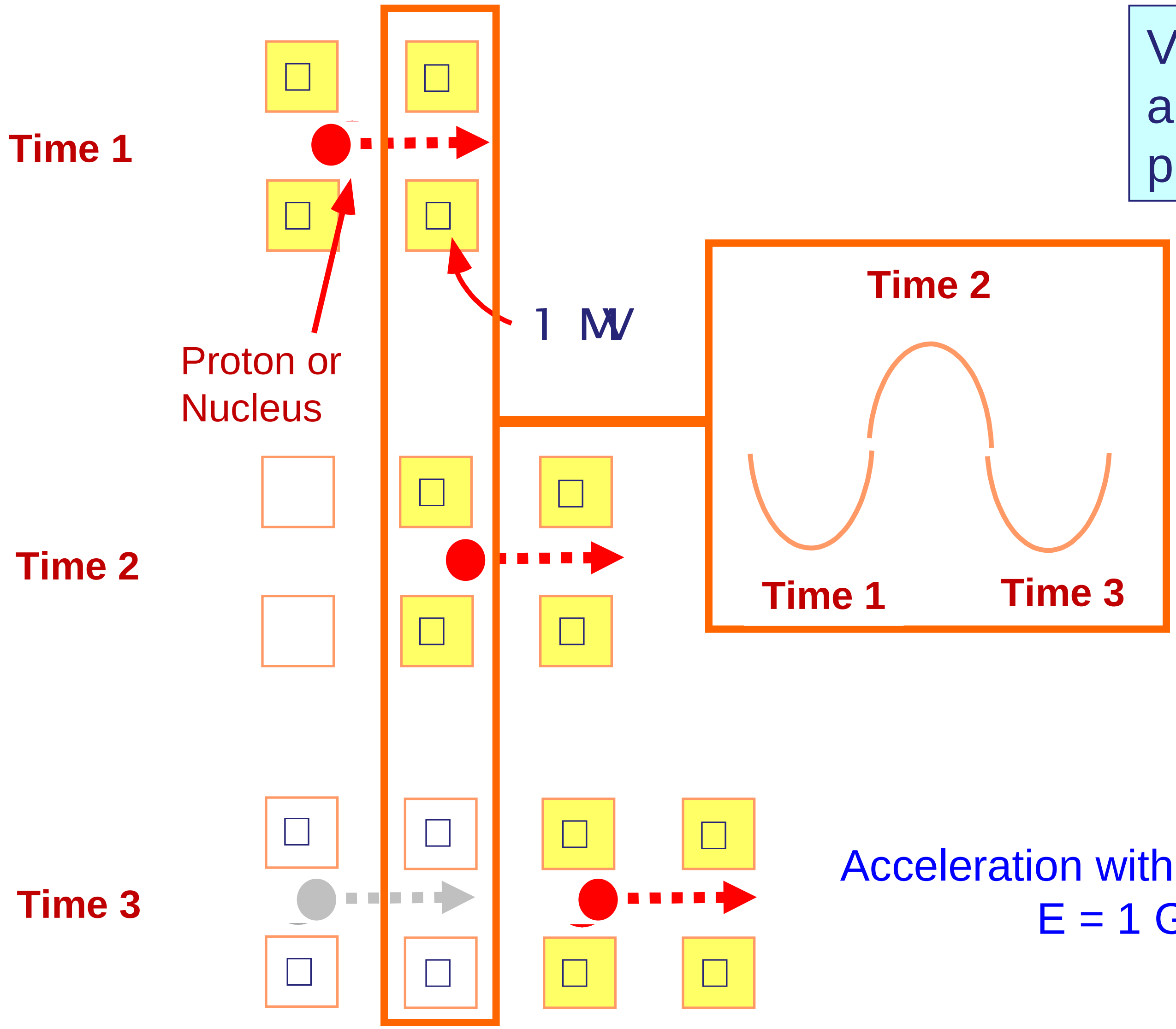


1 GeV

> 100 GeV

eV: Electron Volt (energy with 1 Volt)
k = 1,000, M = 1,000,000
G = 1,000,000,000

Linear Accelerator (Linac)

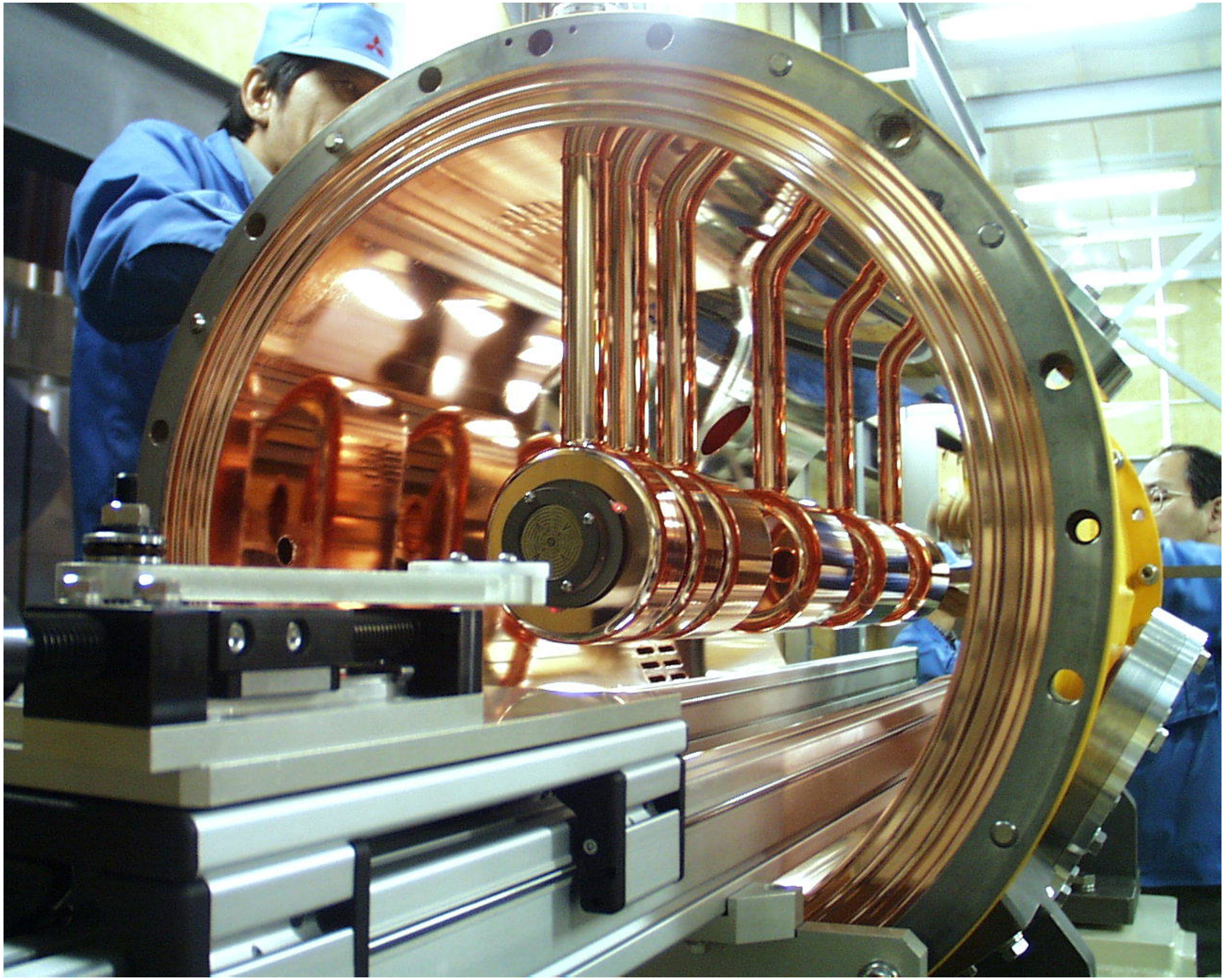


Voltage is changed according to the position of protons

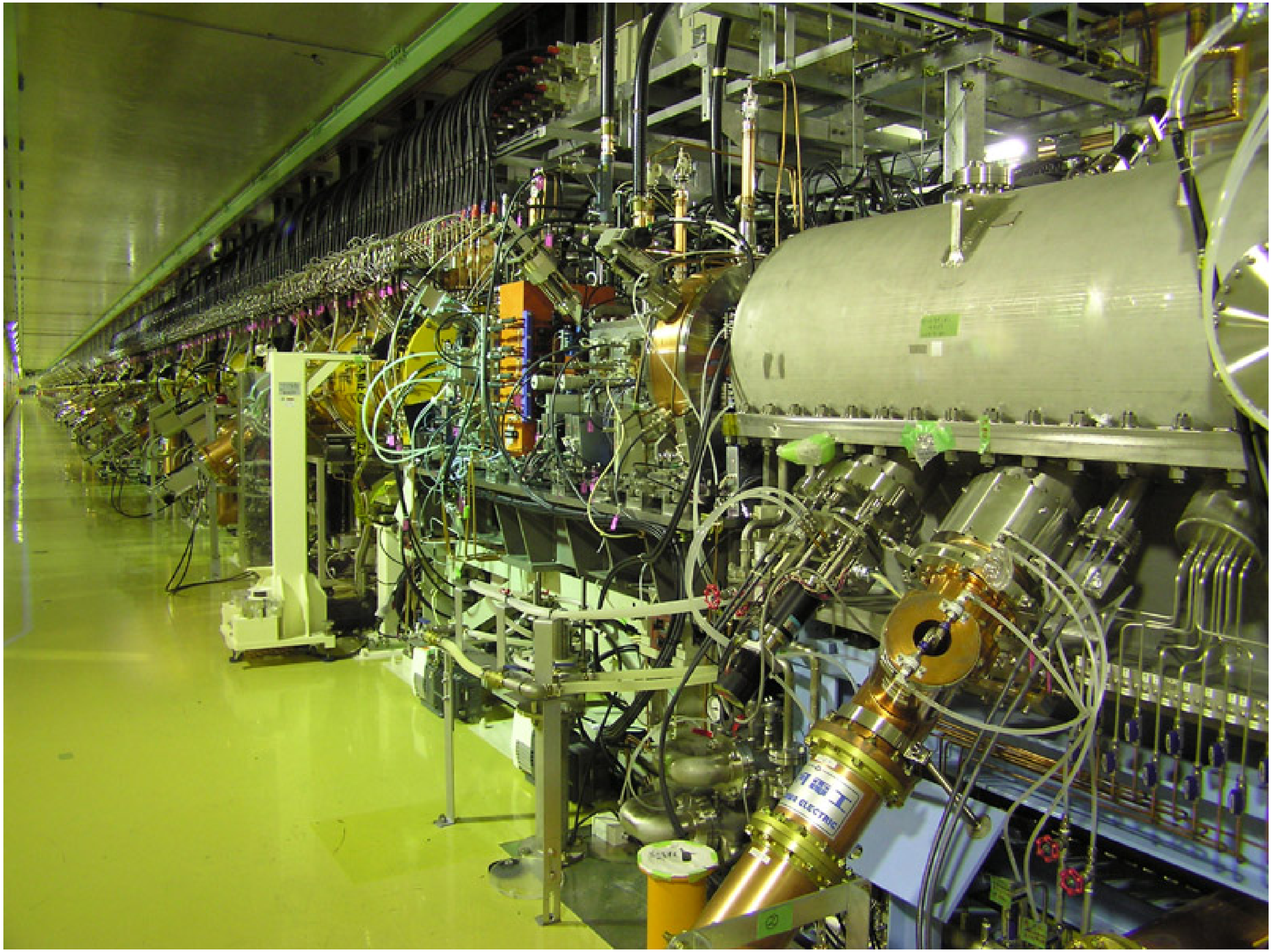
Alternating field at each electrode

Acceleration with 1,000 stages
E = 1 GeV

Inside of Linac for J-PARC



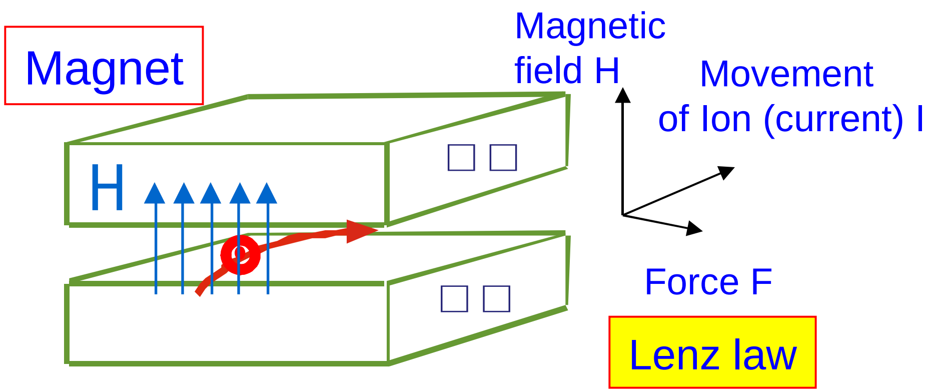
Entire Linac for J-PARC



Synchrotron

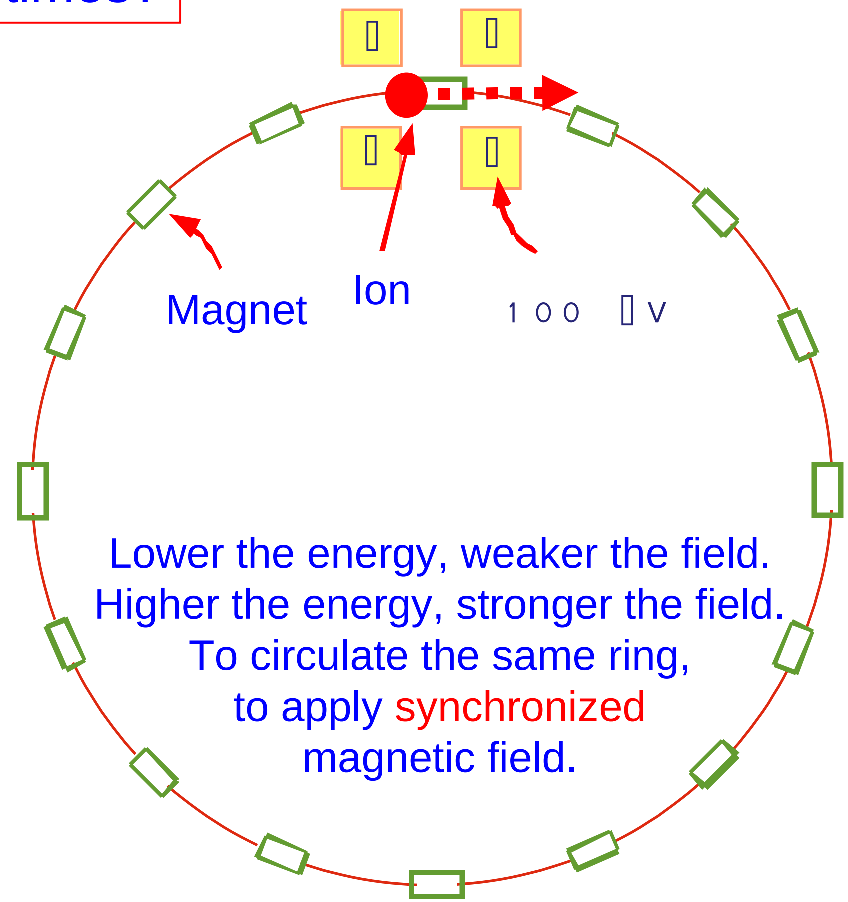
Longer length for higher energy acceleration

Can we use one electrode many times?



Moving ion is bent by the magnetic field.
Higher the energy, less bent

Apply rf field to coherently accelerate particles



Lower the energy, weaker the field.
Higher the energy, stronger the field.
To circulate the same ring,
to apply synchronized
magnetic field.

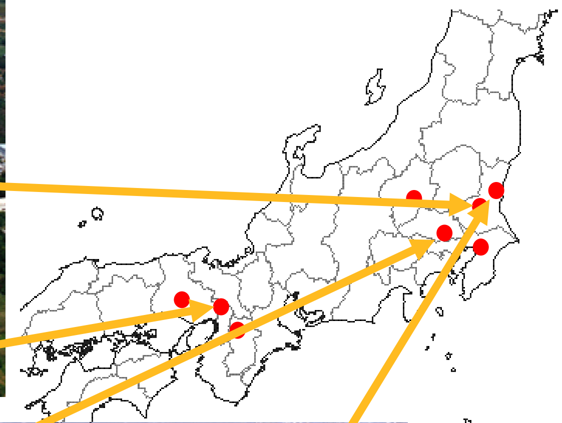
One turn acceleration is
100 kV → 100, 000 turns
E = 10 GeV

50 GeV Synchrotron for J-PARC

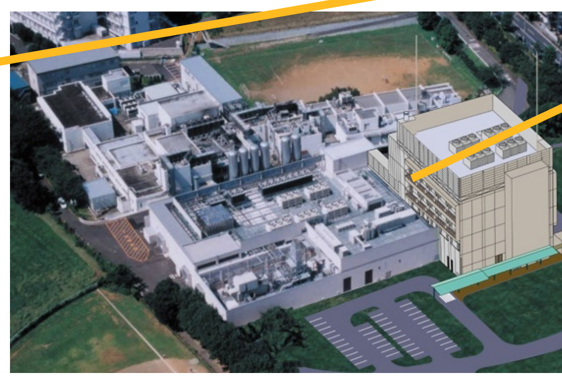
Accelerators in Japan (Particles & Nuclei)

B-Factory

Electron-Positron Collider



- **CP Violation**
- **New Particles**



J-PARC 50 GeV

Kaon Beam Neutrinos

RCNP Ring Cyclotron

Proton Beam

RI Beam Factory

RI Beam

- **Precise Measurements on Nuclear Structure**

- **Nuclei far from the Stability Line**
- **Nuclear Synthesis**

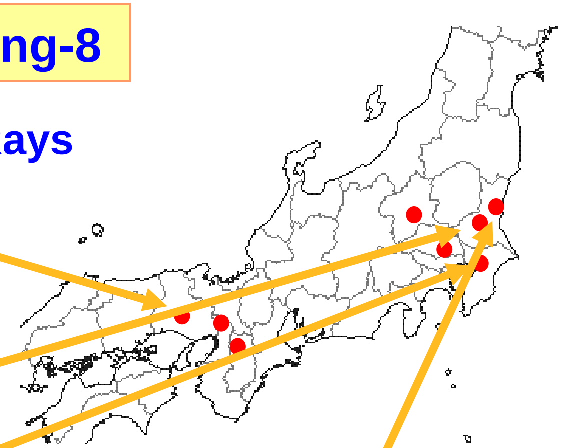
- **Kaonic Nuclei, Hyper nuclei, Rare Decays**
- **Neutrino Mass + Mixing**

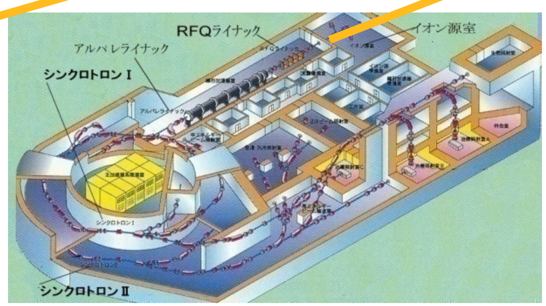
Accelerators in Japan (Applications)

- Nano sciences
- Materials structure
- Biology
- Laser Compton Gamma Rays
- Industrial usage
- etc., etc.

SPring-8

X-Rays





J-PARC 3 GeV

Neutrons Muons

KEK PF **X-Rays**

- Largest until the completion of SPring-8. Still working.

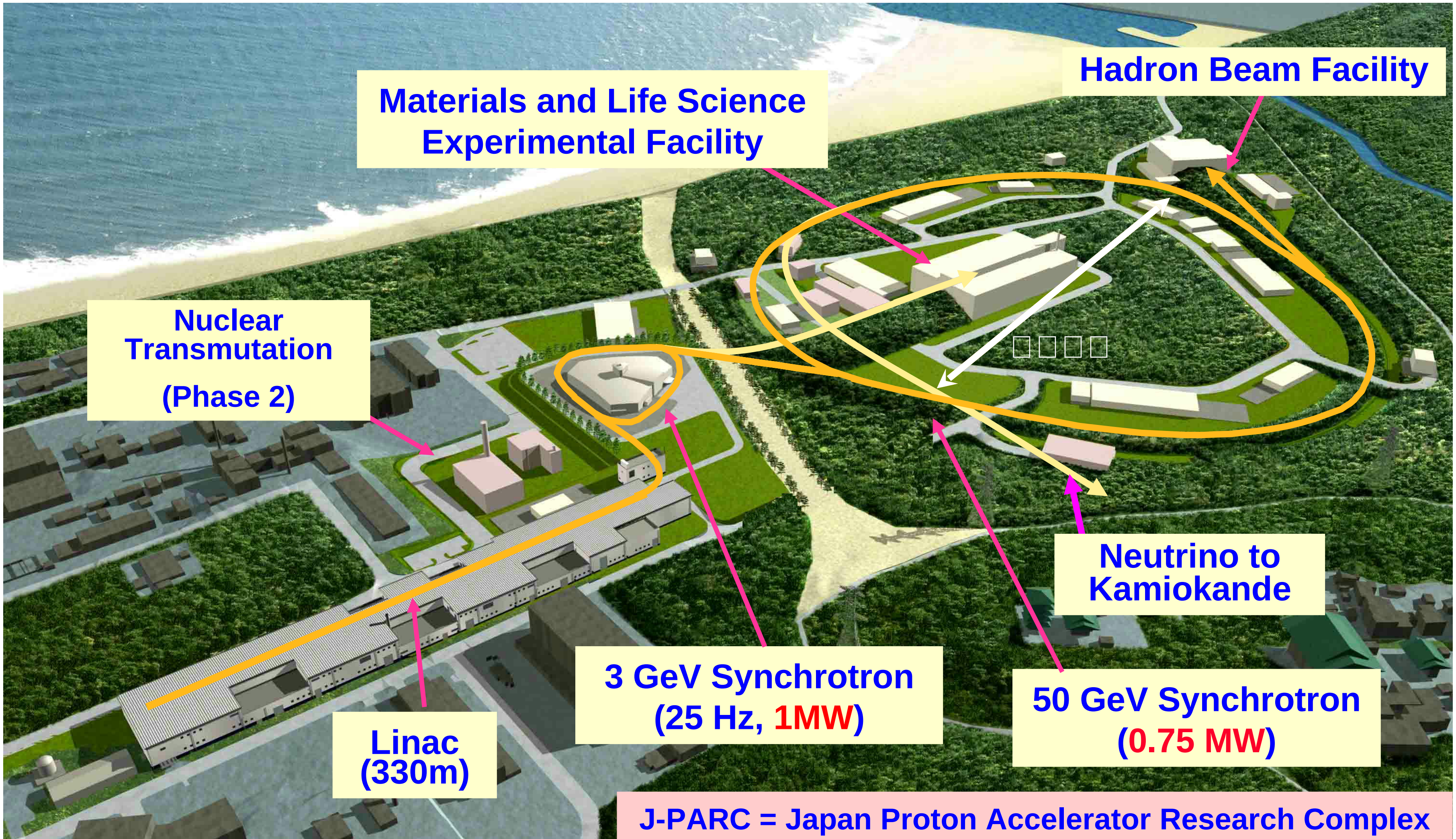
HIMAC **Heavy Ions**

- Cancer therapy
- Biology, etc.

- Magnetism
- Biology
- Hydrogen in matter
- Industrial usage, etc.

J-PARC Facility

J-PARC Facility



Joint Project between KEK and JAEA

Start of the Joint Project

- □□□□□□International Review
- □□□□□□ □□□□□□□□□□□[Domestic Review for 10 months]
- □□□□12 □ Approval of the Project
  - □□□□□□Formation of the Project Team

□□□□□□□□

JAEA KEK

□□□□□□□□□□□□□□

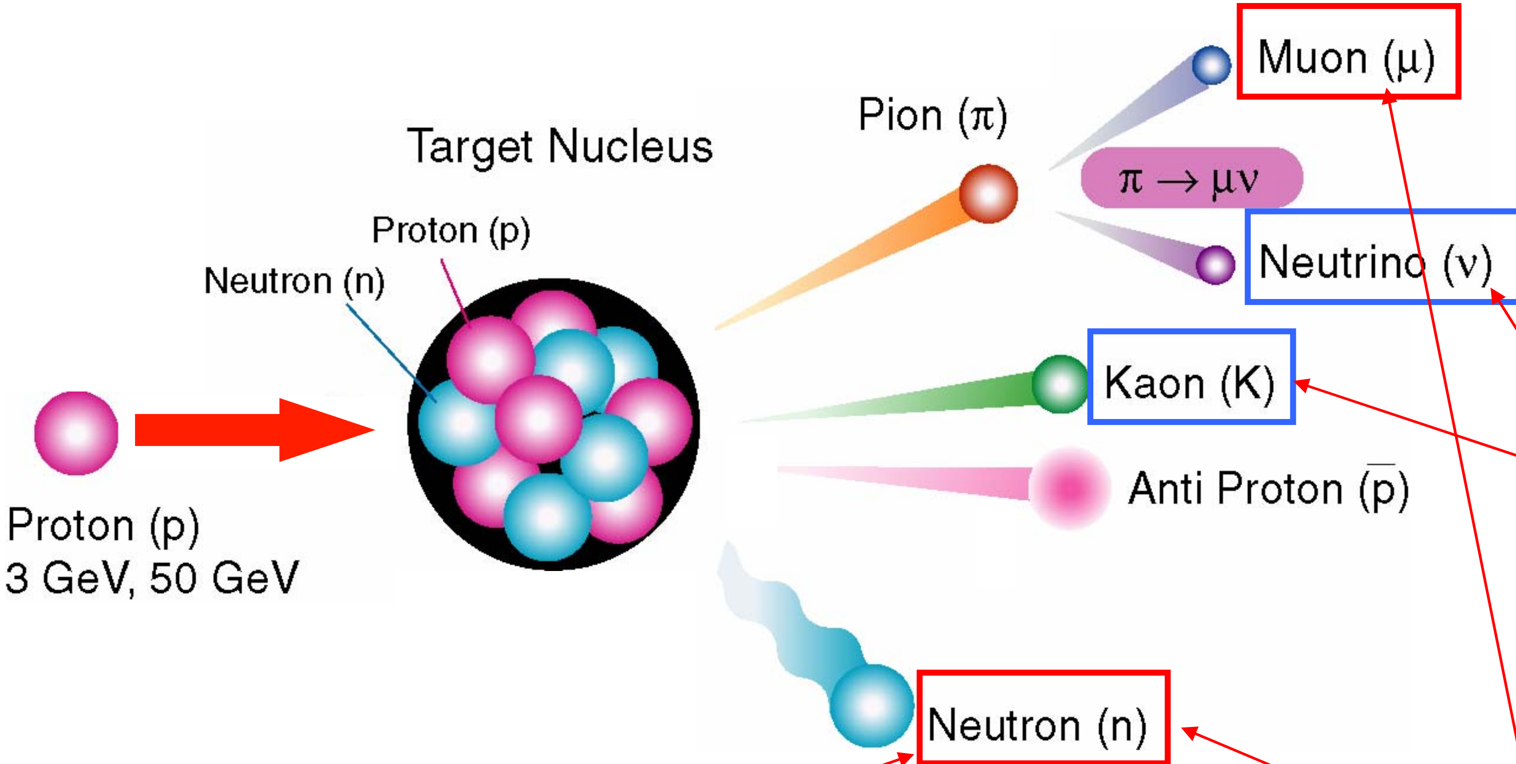
- □□□□□□

Ground Breaking Ceremony

Major Event During the Past One Year

- **2008 2** — **Beam power of 5 kW/pulse (130 kW equiv.), 50 kW extracted at 3 GeV**
- **3**
- **4**
- **5** — **Injection, RF capture and extraction with 3 GeV beams at MR (5/22)**
  Production of Neutrons (5/30)
- **6**
- **7**
- **8** — **Open House (8/10)**
- **9** — **Beam power of 12 kW/pulse (300 kW equiv.), 210 kW extracted at 3 GeV**
  Production of Muons (9/26)
- **10**
- **11**
- **12** — **Acceleration of Beams to 30 GeV at the 50 GeV MR (12/23)**
  Neutrons + Muons: Beam Usage for General Users (12/23)
- **1** — **Extraction of the 30 GeV beams to the Hadron Experimental Hall (1/27)**
- **2009 2** — **Production of Kaons (Feb.)**
- **3**
- **4** — **Production of Neutrinos (4/23)**

Goals at J-PARC



Need to have high-power proton beams

→ MW-class proton accelerator
(current frontier is about 0.1 MW)

Materials & Life Sciences at 3 GeV
Nuclear & Particle Physics at 50 GeV
R&D toward Transmutation at 0.6 GeV

Number of Beam Particles

Beam Flux at the Full Power Proton Beams

	# of particles per one proton	# of particles per second	Typical number of particles at one beamline*)
Neutron	80	10^{17}	10^{8}
Muon	10^{-4}	10^{11}	10^{7}
Kaon	10^{-4}	10^{10}	10^{6}
Neutrino	6	10^{15}	3×10^{7}

*) Number listed here is at Super Kamiokande.

J-PARC Open House

Last year, about 2,600 people came!

We had the open house this year On August 1 with Tokai JAEA Campus

We had 4,600 people this year Among them the tour of J-PARC were 3,700 (+ staff members of 600 □

Inauguration Ceremony (1)

Okazaki (JAEA), Nagamiya (J-PARC Center）, Suzuki (KEK)

Minister Shionoya

Shionoya (MEXT), Kanazawa (SCJ), Imai (Economical Society), Arima Hashimoto (Governor)

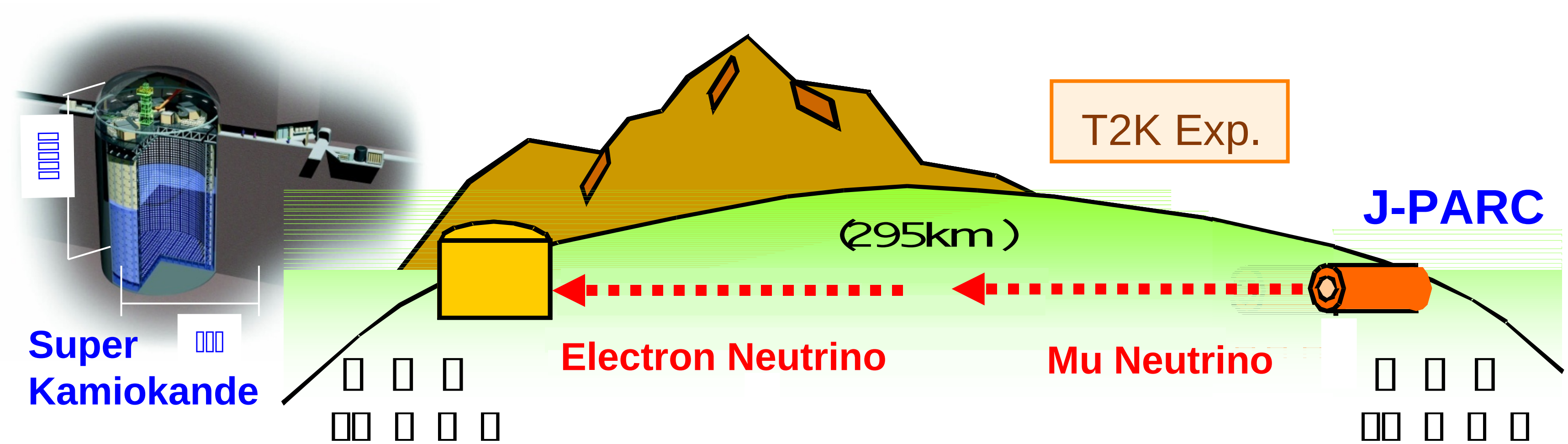
Inauguration Ceremony (2)

Koshiba Kobayashi

Important Guests from Abroad

Neutrino Facility

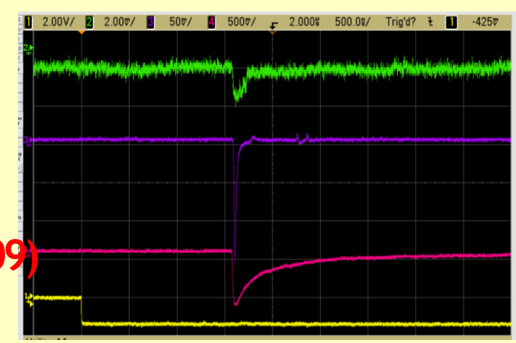
Neutrino Oscillation (T2K) Experiment



350 Non-Japanese Members
60 Japaneses

First measurements of mixing angles
between 1st and 3rd neutrinos

Signal of
neutrino
production
(April 23. 2009)



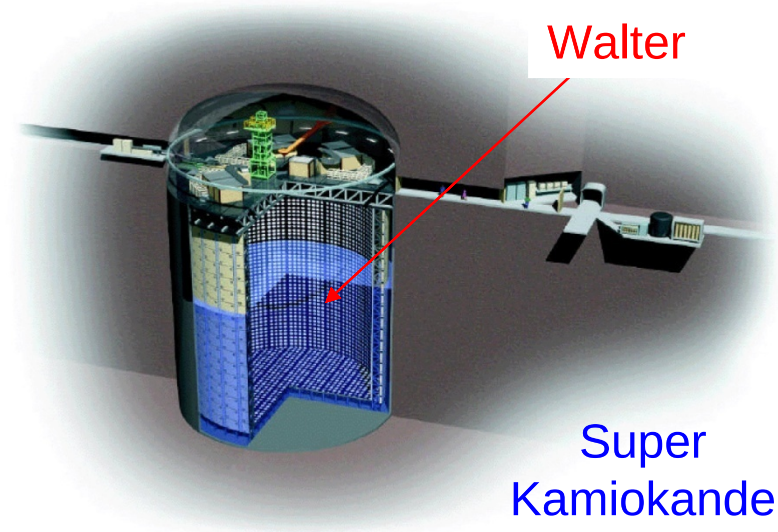
Detection of Neutrino

μ neutrino

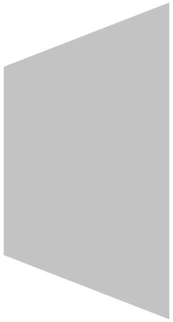
μ-particle
(with charge)

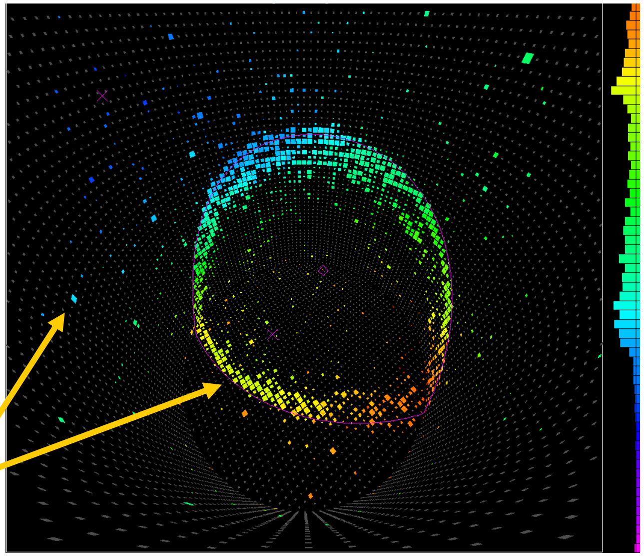
Nucleus

vacuum



Super
Kamiokande

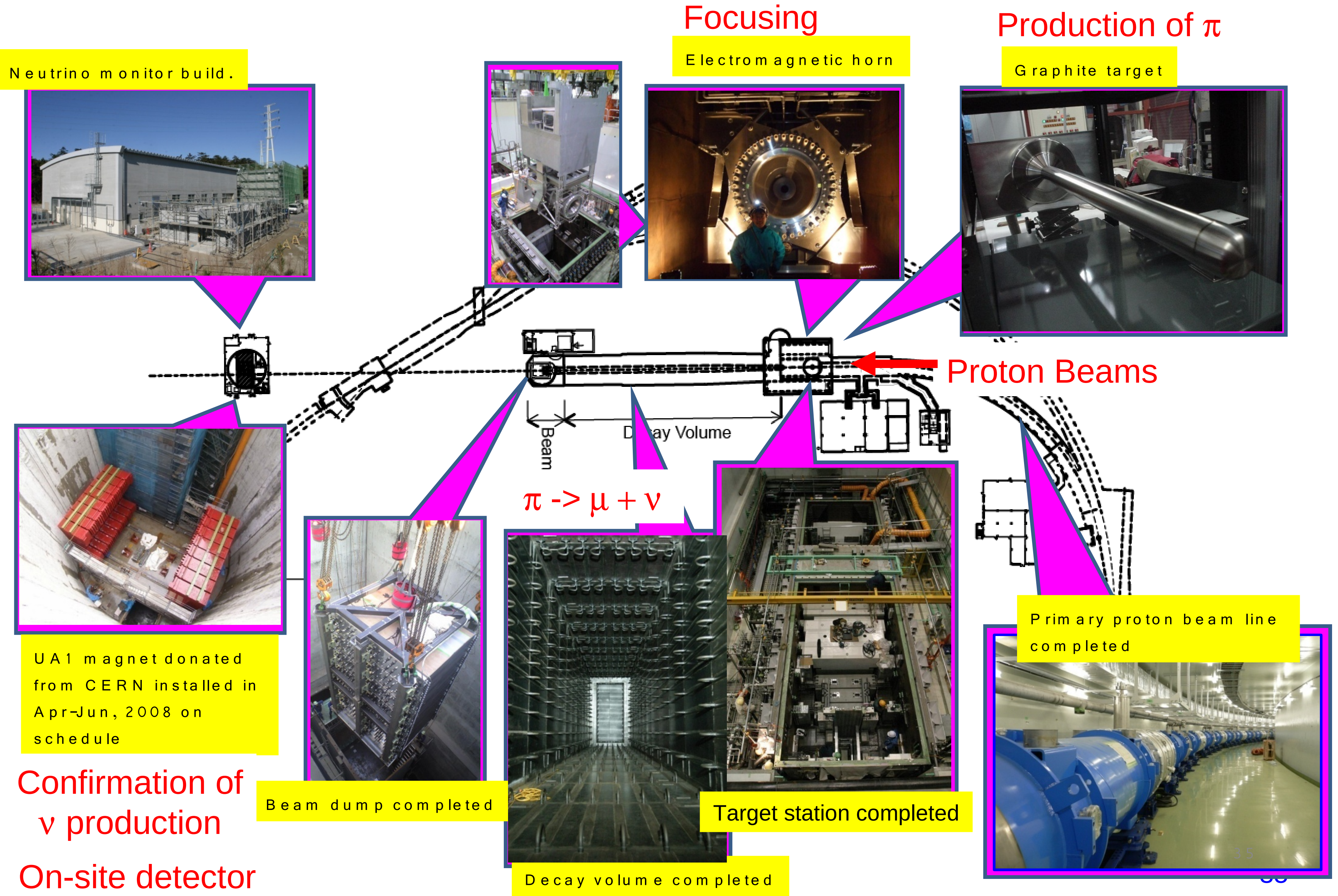




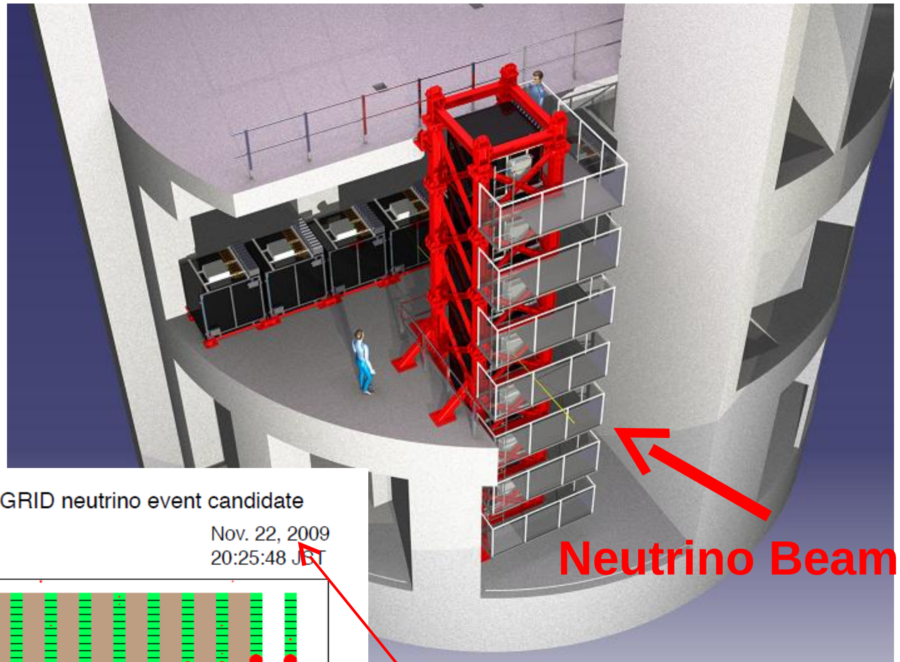
Cerenkov light

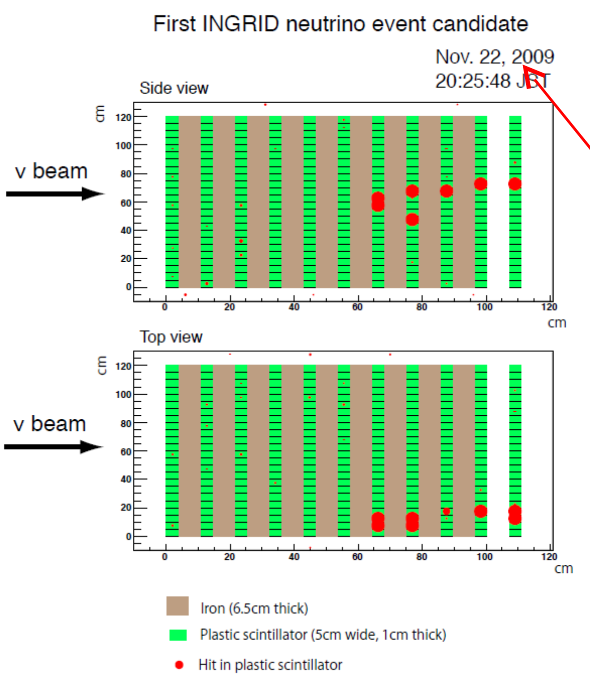
Photon count

Neutrino beamline



Neutrino Detection with On-Site Detector

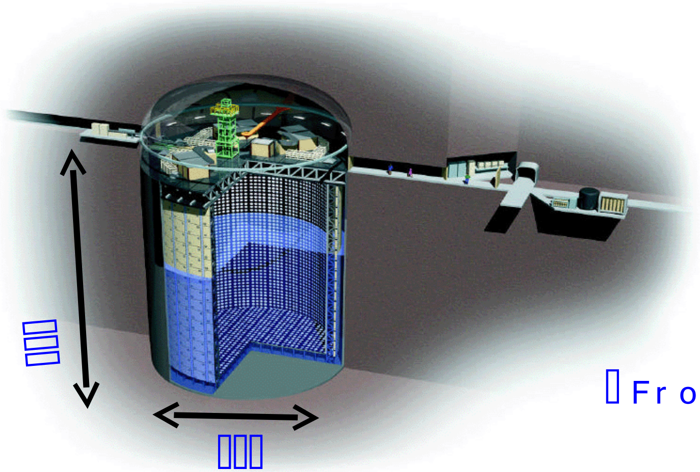




On November 22
it was succeeded to
detect a neutrino

How Many Neutrinos Can You Detect?

50,000 ton walter, over 10,000 phototubes



Super Kamiokande

3x107/s (30 million/s)

A few x 108/day

Neutrinos are penetrating

Through the detector

Detected are only

10-20/day

Neutrino beam

From Tokai to Kamioka:

about 1 ms)

From top of on-site detector

On-site detector

(photo:: under

construction)

About 1015 /s

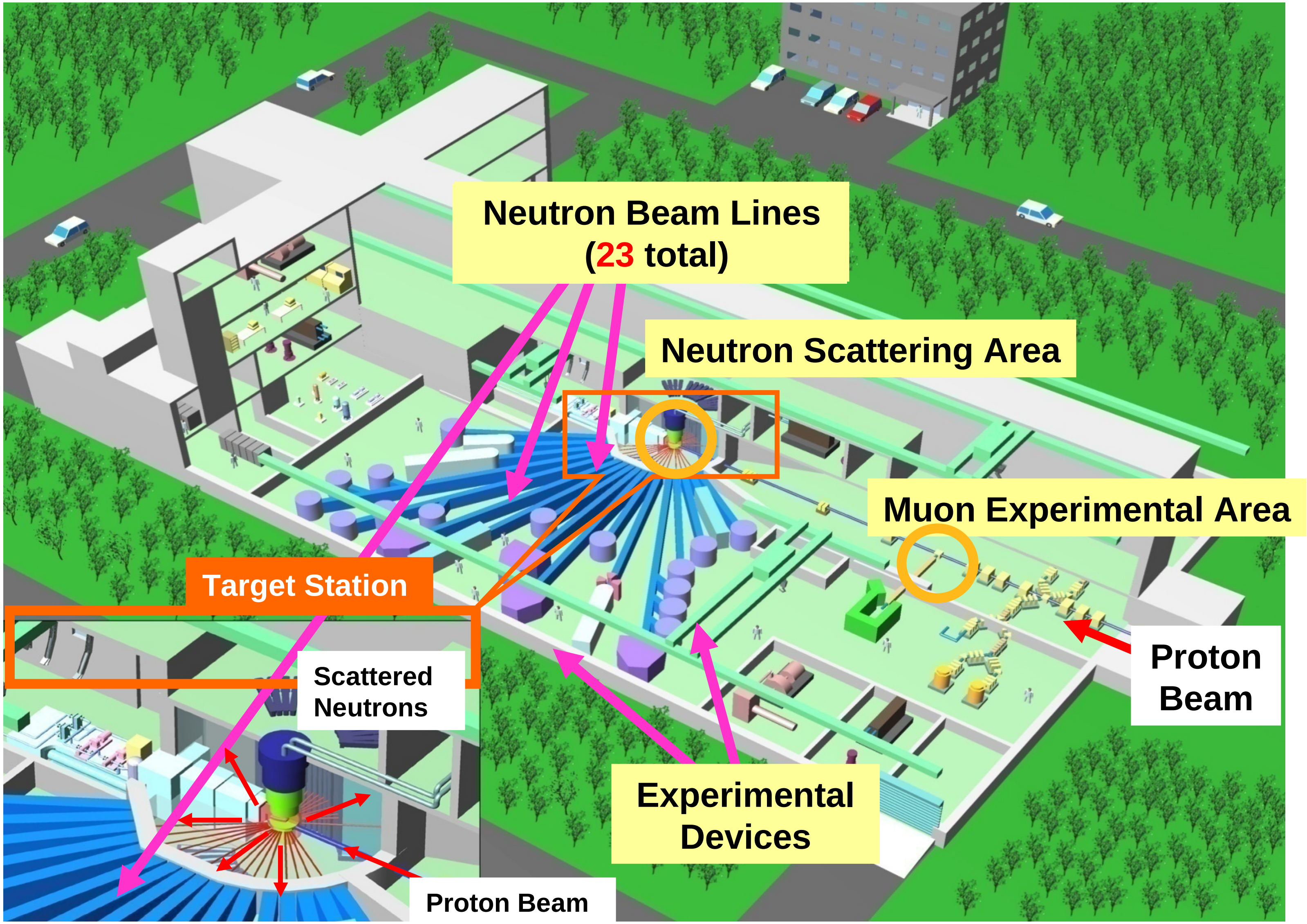
neutrionos are

procduced from

J-PARC

Neutron Facility

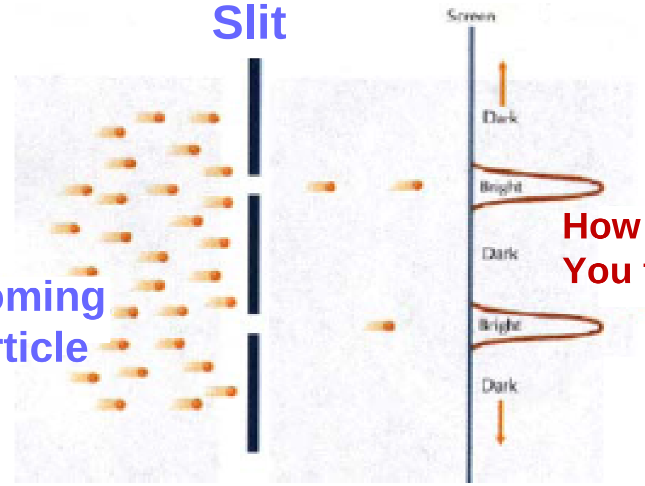
Materials & Life Experimental Facility



Diffraction Pattern for Neutrons

Slit

Incoming Particle



How do You think ?

Neutron carries wave nature !

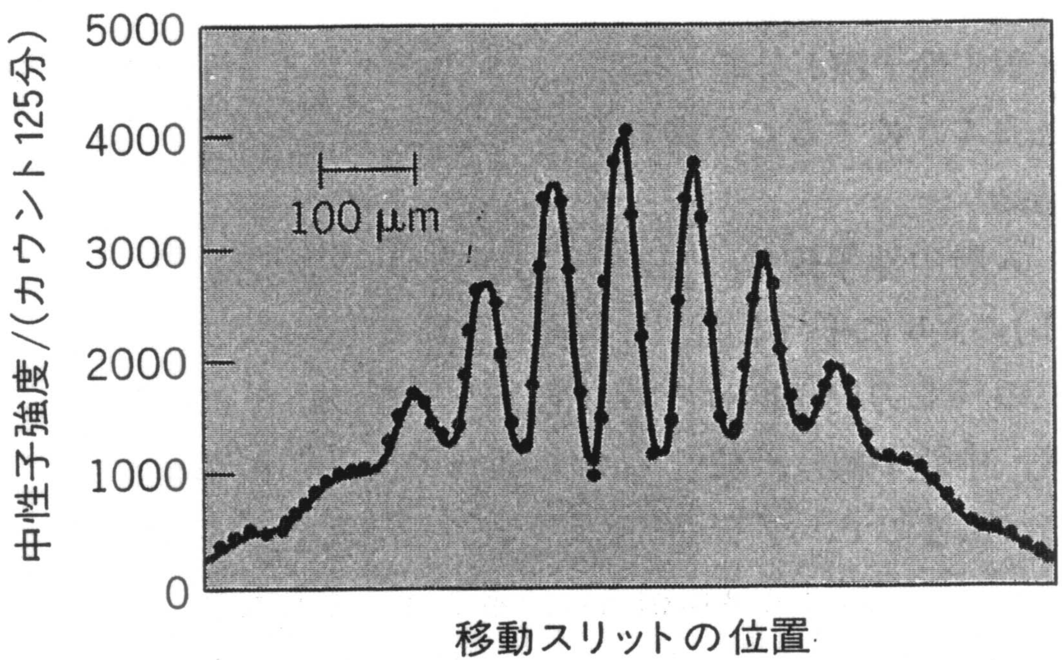
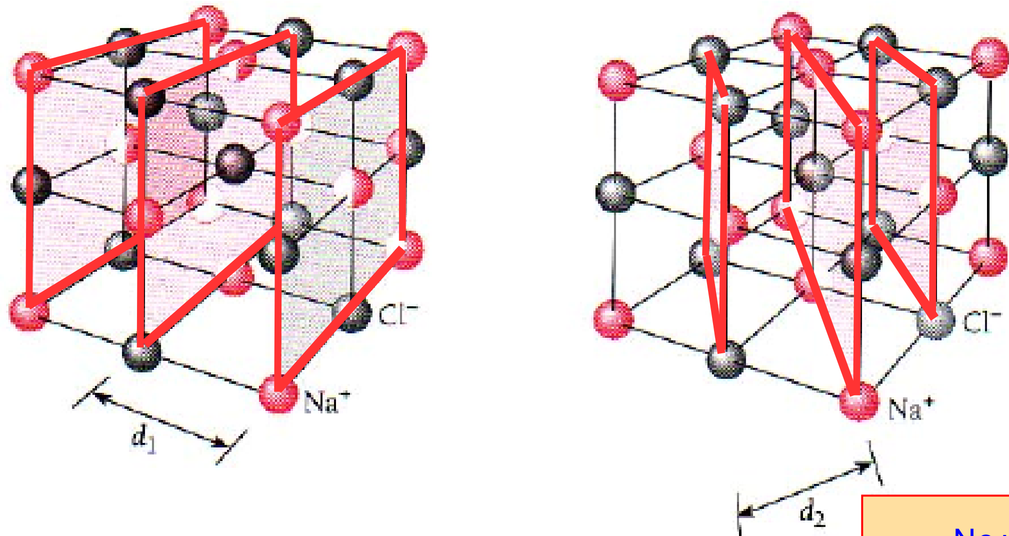


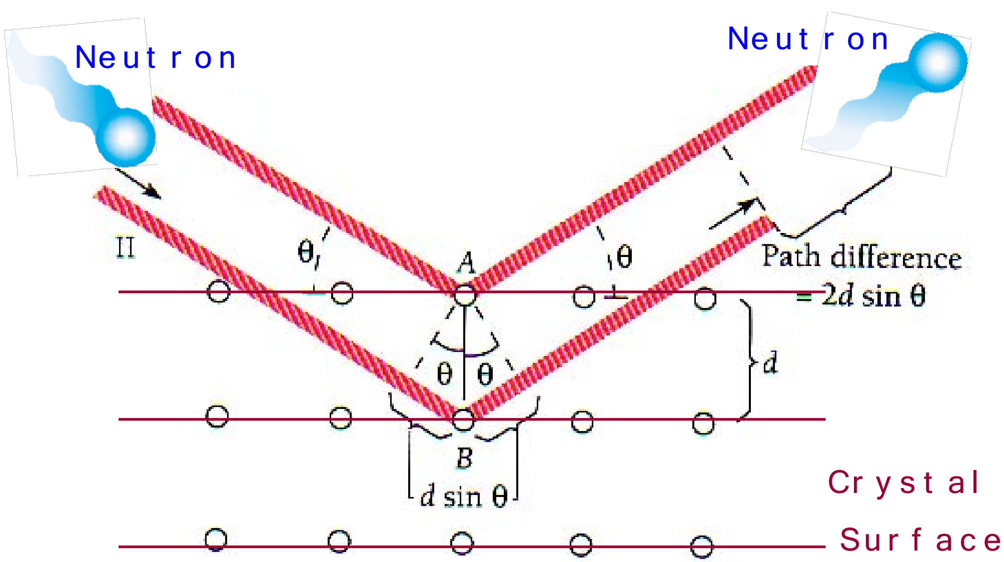
図1 コリメートした中性子線を二重スリット系を通して生じさせた
回折パターン．実線はスカラー回折理論の予測である．（A. Zeilinger

Neutron Scattering

Crystal Surface



Neutron is particle and wave



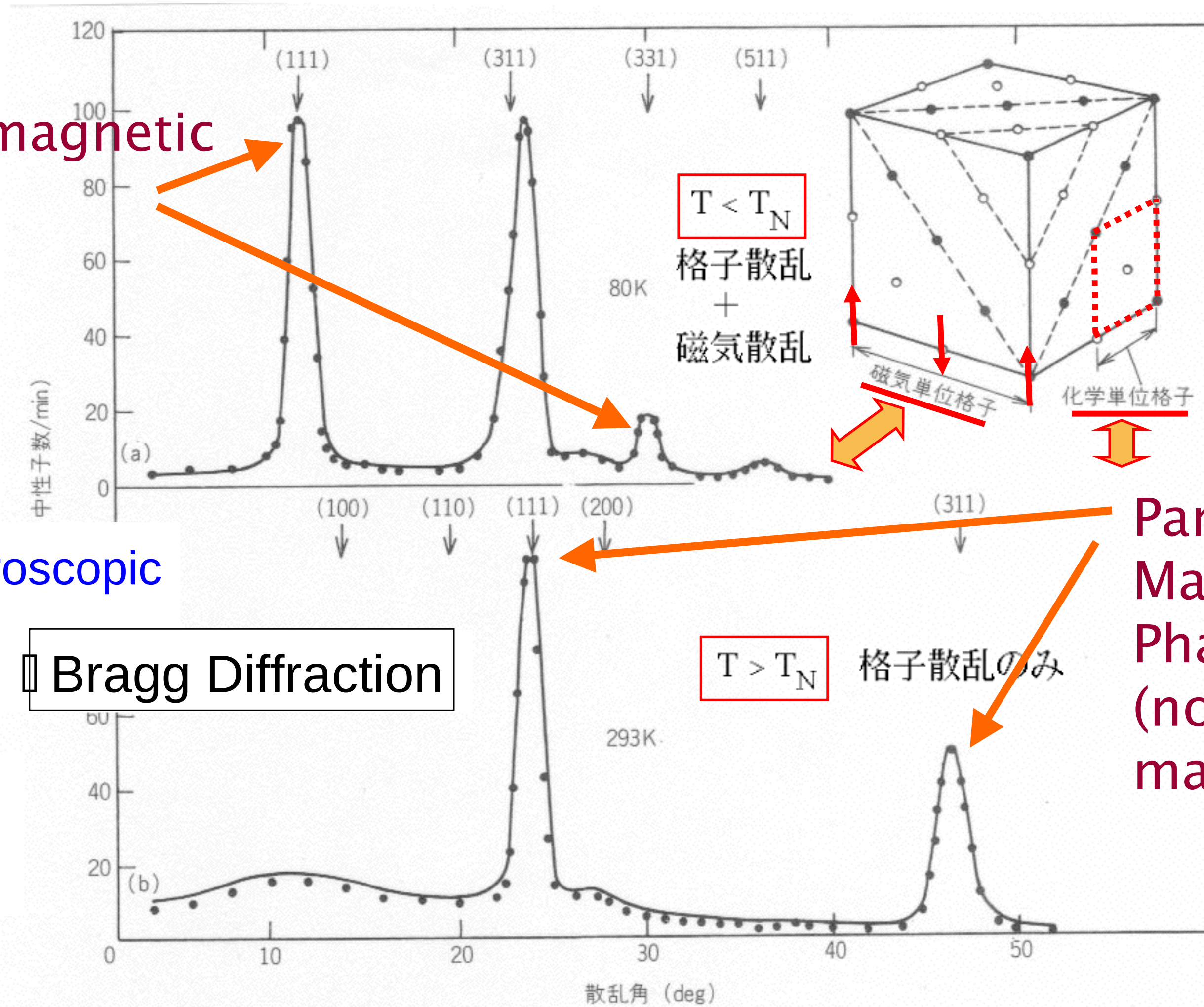
If the path difference is n-times the wavelength, then, wave is ehnanced

Neutron will be reflected to a specific angle

Research on Magnetism !

Neutron Diffraction

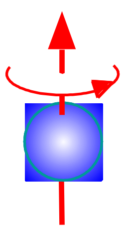
Antiferromagnetic Phase



Para Magnetic Phase (no magnetism)

- Neutron is a microscopic magnet

- Bragg Diffraction



Neutron

Spin ½

Charge 0

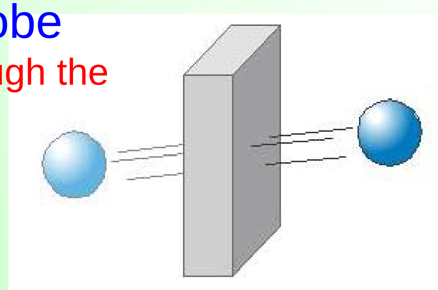
図 3　多結晶一酸化マンガン MnO の中性子回折パターン．温度は，(a)122 K の反強磁性秩序転移温度以下，(b)転移温度以上．293 K では核による反射だけが鋭いピークとして観測される．これに対して，80 K では図に示した反強磁性構造によって生ずる反射が加わっている．○で示した原子の磁気モーメントと●で示した原子の磁気モーメントはそれぞれ同種のものでは平行に，異種のものでは互いに反平行に整列しており，向きは(111)面に平行である．


1st Experimental Hall (East Hall)
Beam
4SEASONS
NNRI
NOBORU
HRC
NOP
S-HRPD
iBIX

Nature of Neutron & Neutron Scattering

Penetration Probe

→ Penetrate through the matter



Wave Nature

→ Determination of the structure

→ Sensitive to hydrogen atom

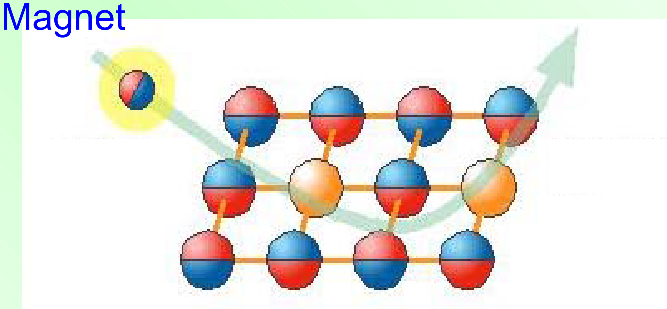
Diffraction Pattern

Incoming Wave

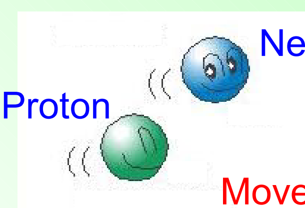
Probing Magnetic Structure

Neutron -Microscopic Magnet

Magnetic Scattering



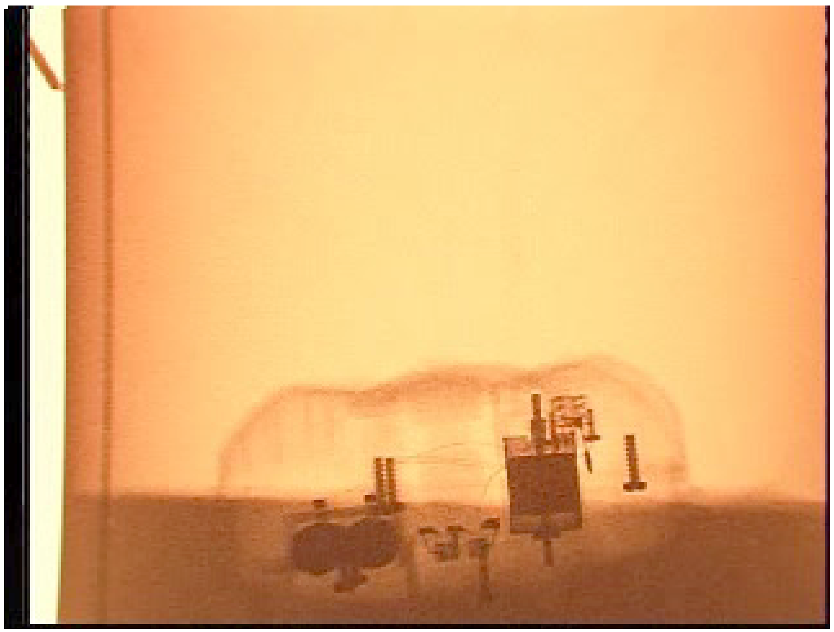
Sensitive to the Movement of Atoms

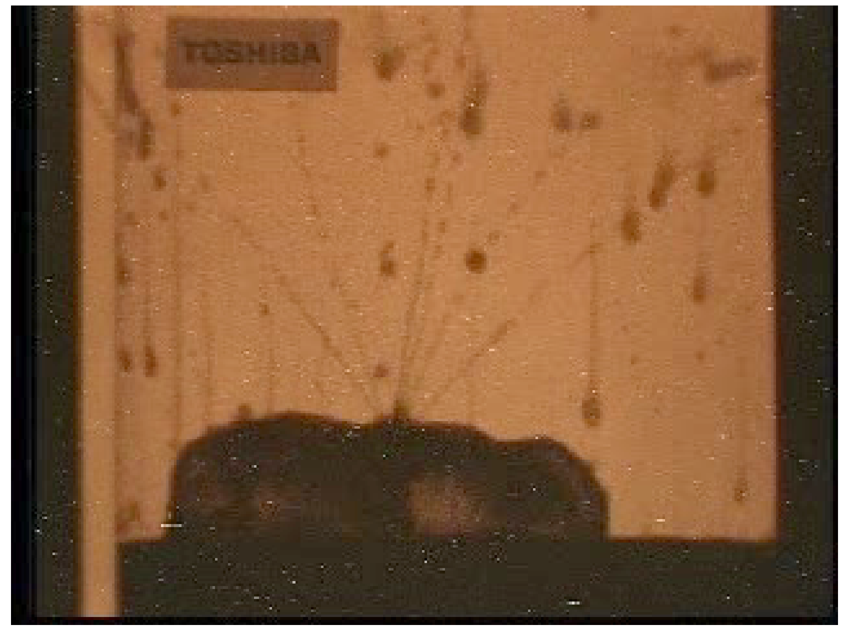


Movement can be detected

Neutron Beams as a Probe of Hydrogen [illegible]

[illegible] Rays	Neutrons
[illegible]１／５００	[illegible]１／５００



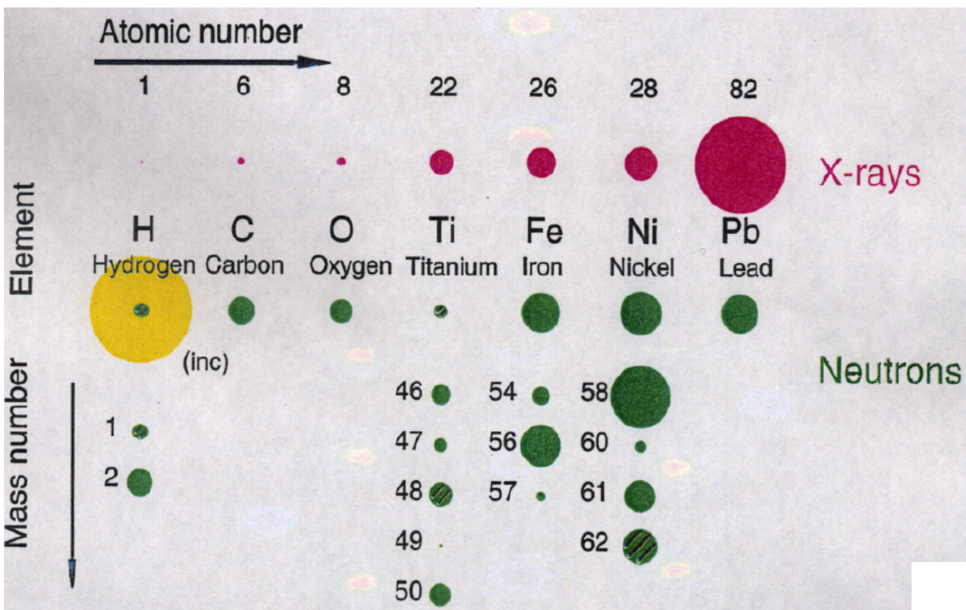


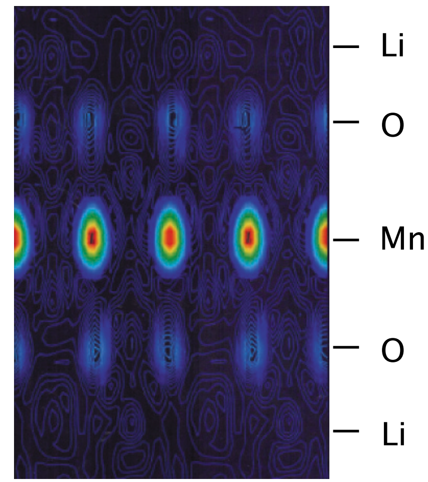
[illegible]

[illegible] X [illegible]

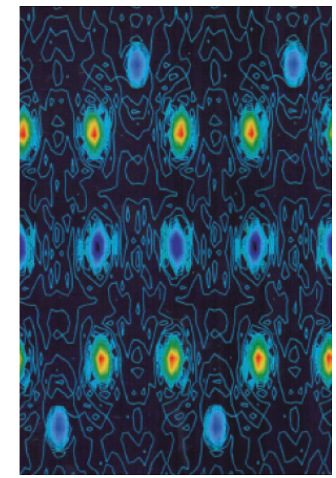
Example of Neutron Scattering

Li battery





X-Ray Measurement



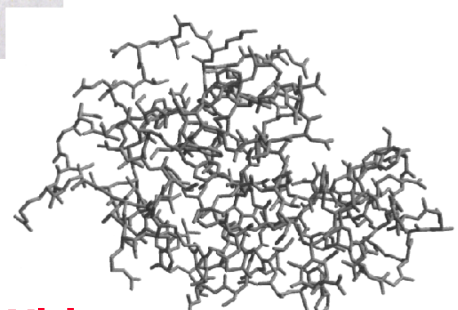
Neutron Measurement

X-rays interact with electrons.

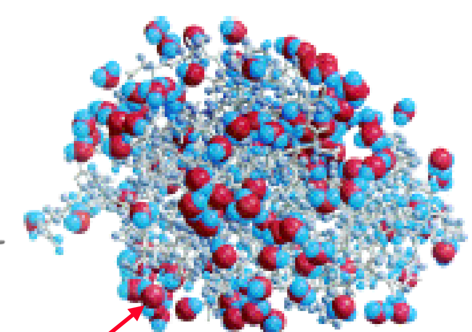
→ X-rays see high-Z atoms.

Neutrons interact with nuclei.

→ Neutrons see low-Z atoms.



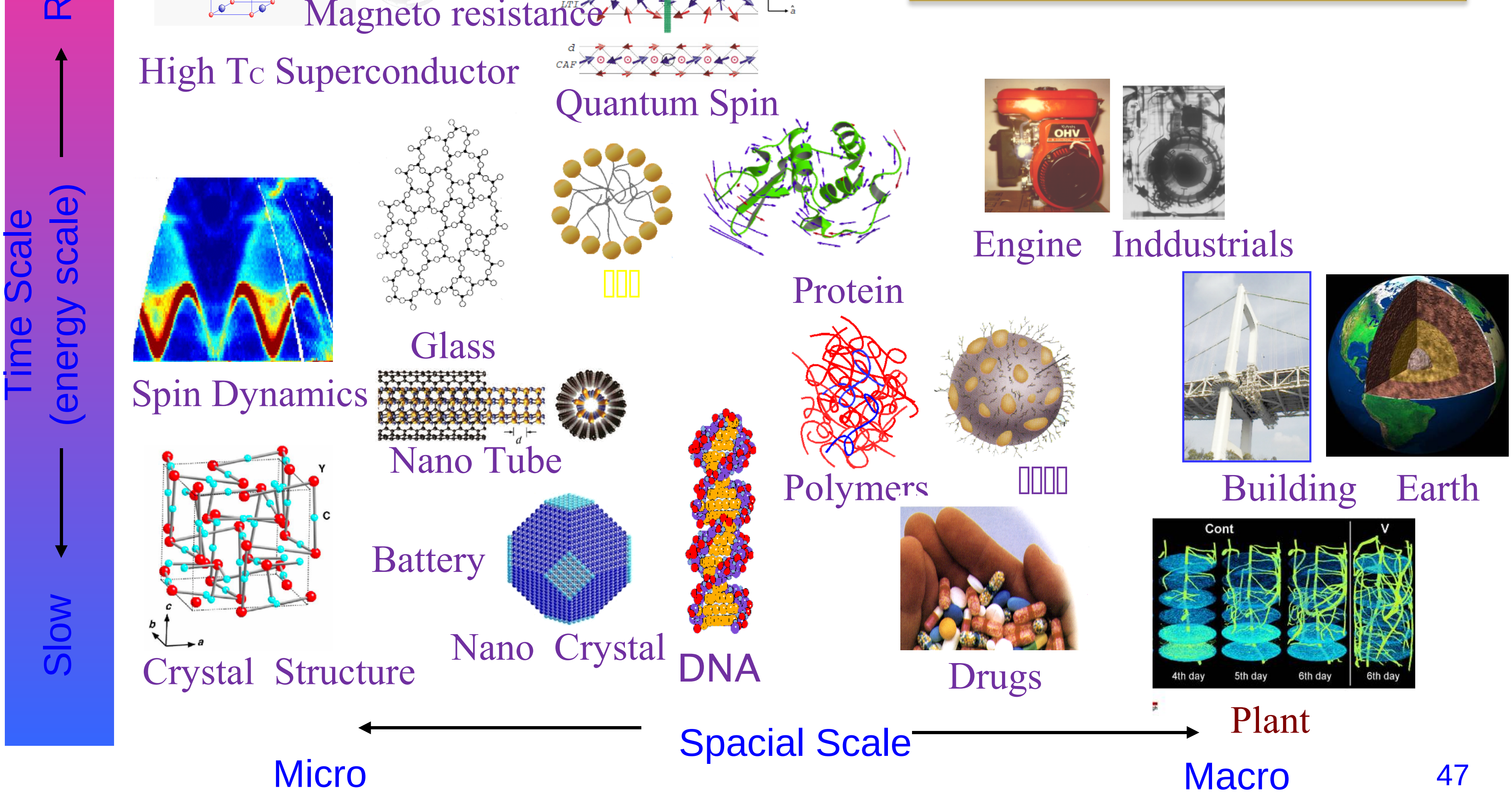
Hen Egg-White Lysozyme



H_2O

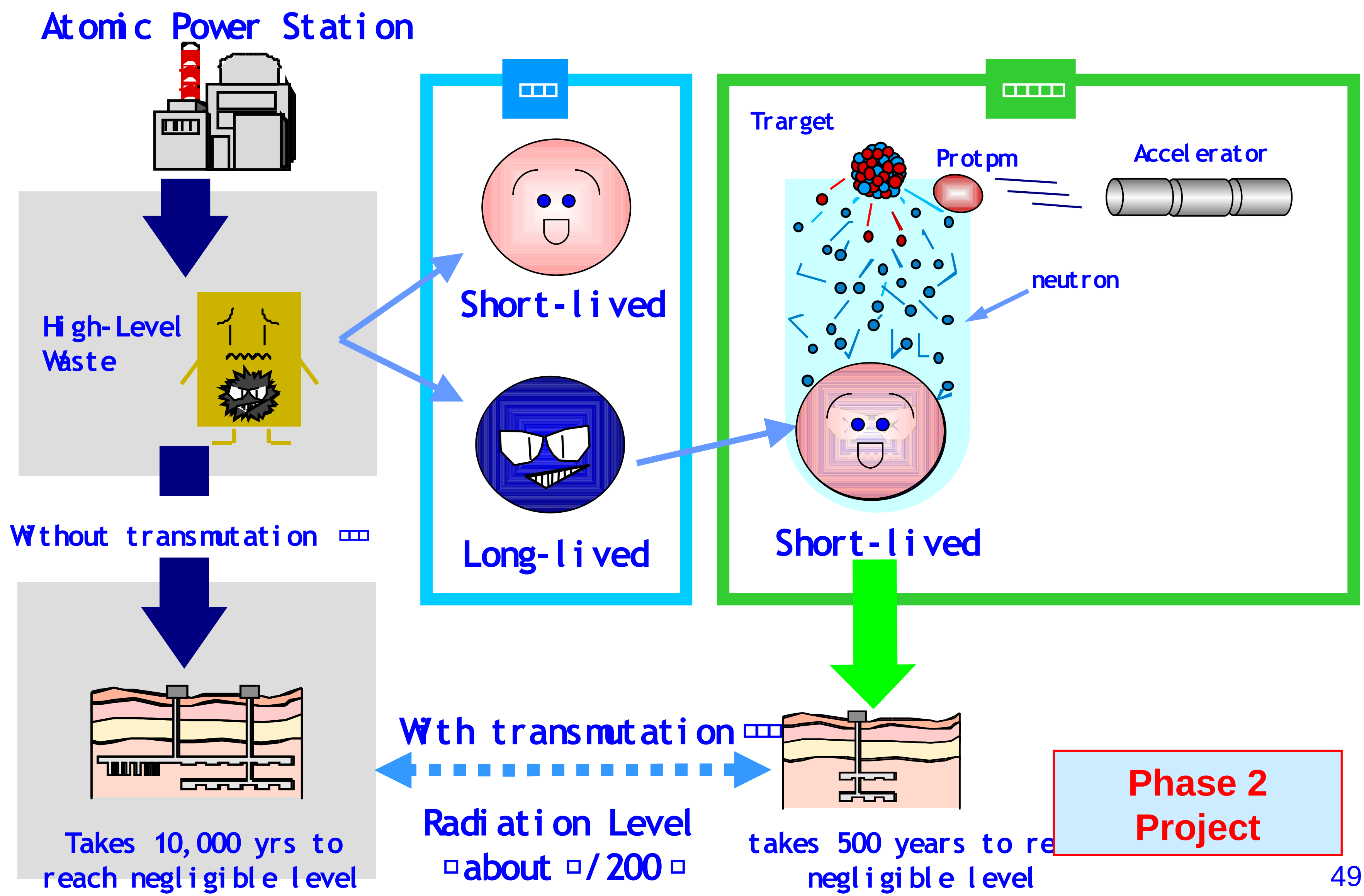
Broad Application of Neutrons

Wide areas in time and space
Atomic size □ Human size
Fento second □ year



Transmutation

Accelerator-Driven Transmutation



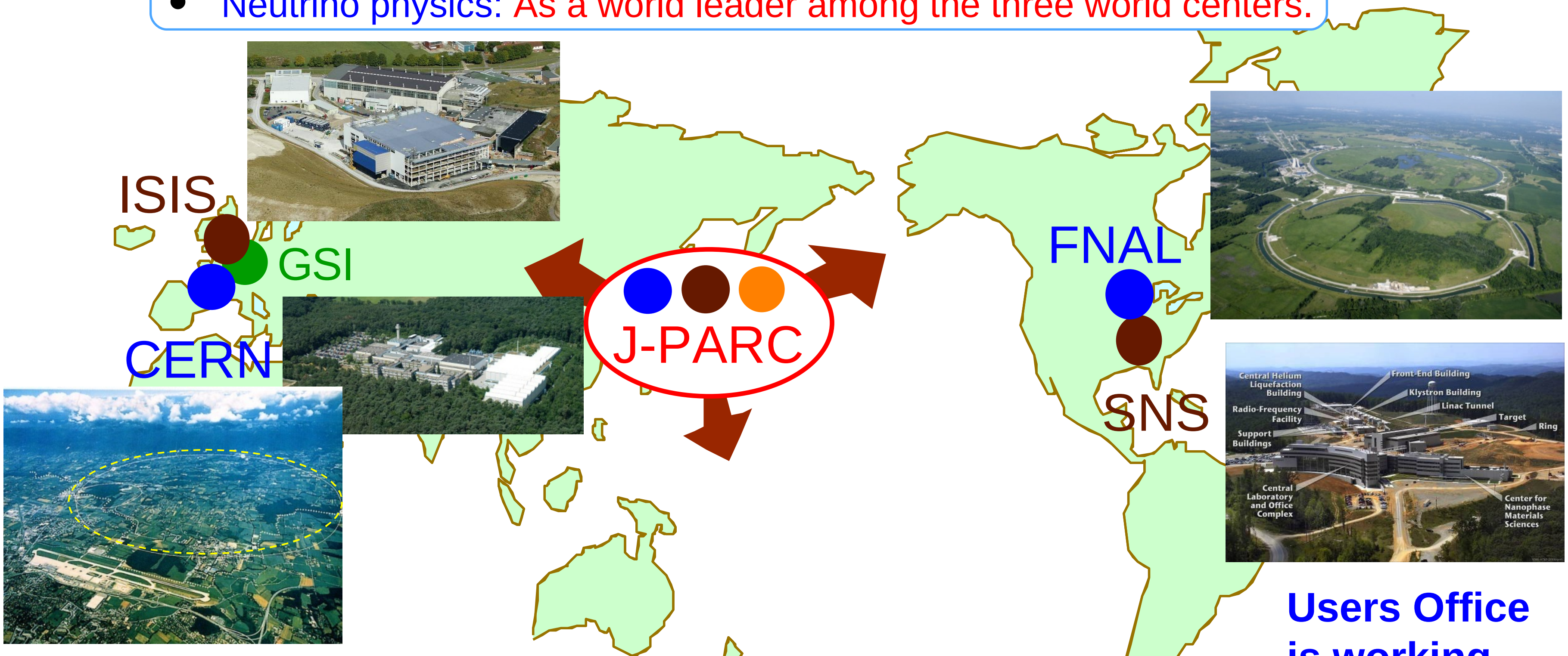
Facility Image of TEF 1st Phase

- TEF-P can include subcritical and critical experiments for both ADS and FBR.
- Beam dump is necessary to introduce a proton beam into TEF-P. The beam dump can be utilized for various experiments concerning radiation engineering.
- **By combining these facilities, wide range of experimental study for nuclear science and engineering can be conducted.**

Current status of facility site

World Center

- Materials and Life: One of three world centers, in particular, in Asia.
- Hadron physics A unique kaon factory in the world.
- Neutrino physics: As a world leader among the three world centers.



Center in neutrino

Center in neutrons

Hadron (Kaons)

Hadron (antiprotons)

Users Office is working very hard on this issue !

ISIS SNS
CERN FNAL GSI

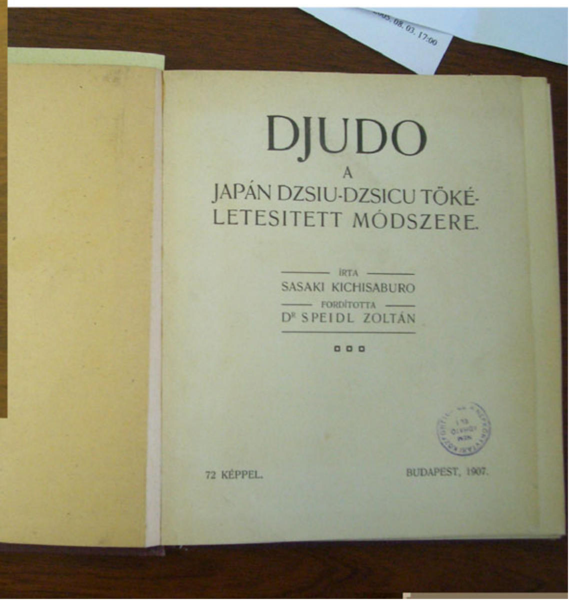
Summary

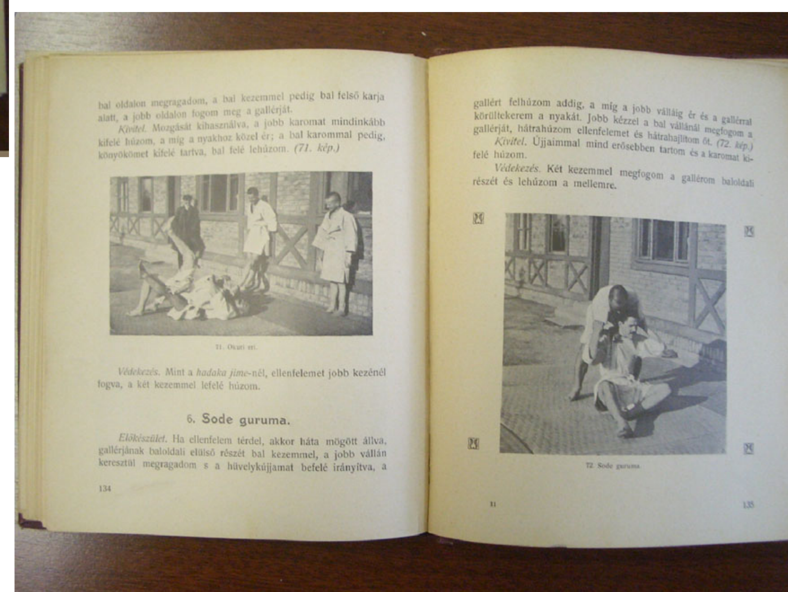
- Unique Accelerator Project □ Multi-purpose facility
  - World class proton facility → Variety of secondary beams   Multipurpose
  - Broad fields in Science (materials and Life, Nuclear and Particle, Nuclear Industrial, etc.) → Interdisciplinary facility
  - Big facility with small users (over 1000 user groups)
- Open the Facility to International Scientific Communities and Domestic Industries
  - Internationalization is still not sufficient. Need to improve this aspect.
  - Open to industries in the area of neutron sciences.
- Future Issues: Production of Top-Level Scientific Results
  - Production of world leading results.
  - Operation of the facility as the “User Facility”.
  - International facility. Open to any countries in the world.
  - Easier access by the industries.
  - Operational funds for KEK and JAEA

    JAEA adopted a new scheme controlled by the Government (but protected)

    Still some work is needed for KEK”s portion of the operational fund.

When the Book Was Discovered (2007)





Persons who Helped Me (2007)

Prof. ZIMÁNYI József and
Mrs. ZIMÁNYI Magdolna

Prof. CSÖRGŐ Tamás (left),
Mr. OZSVÁR András (middle)
and myself (right)

Mr. MOLDOVÁN István

Gift Given to me in 2007


DIPLOMA

"Tiszteletbeli Mester"
Övfokozatot adományozom

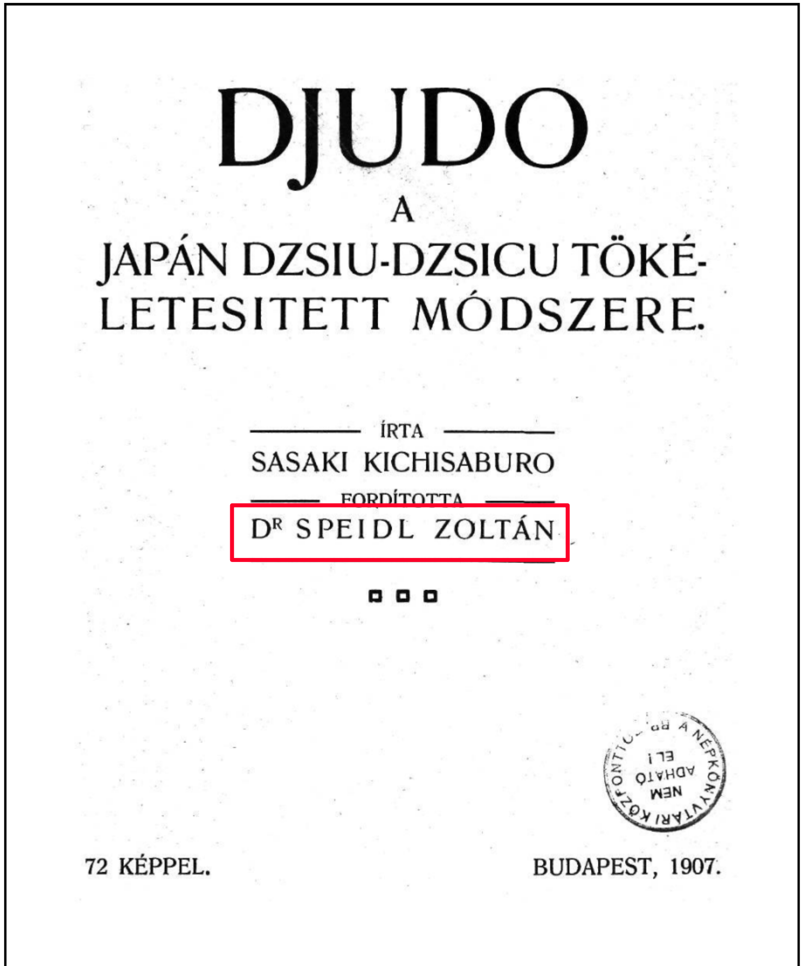
Sodzsi Nagamija
Úrnak a
Sasaki Kichisaburo Mester unokájának
Az Óbudai Judo Club.

Ozsvár András elnök,
mesteredző, 5. dan

Budapest, 2005. augusztus 05.
Magyarország

Certificate of Honorary Master (left) given to me and the black belt. (top).

Book in 1907


DJUDO

A

JAPÁN DZSIU-DZSICU TÖKÉ-
LETESITETT MÓDSZERE.

ÍRTA

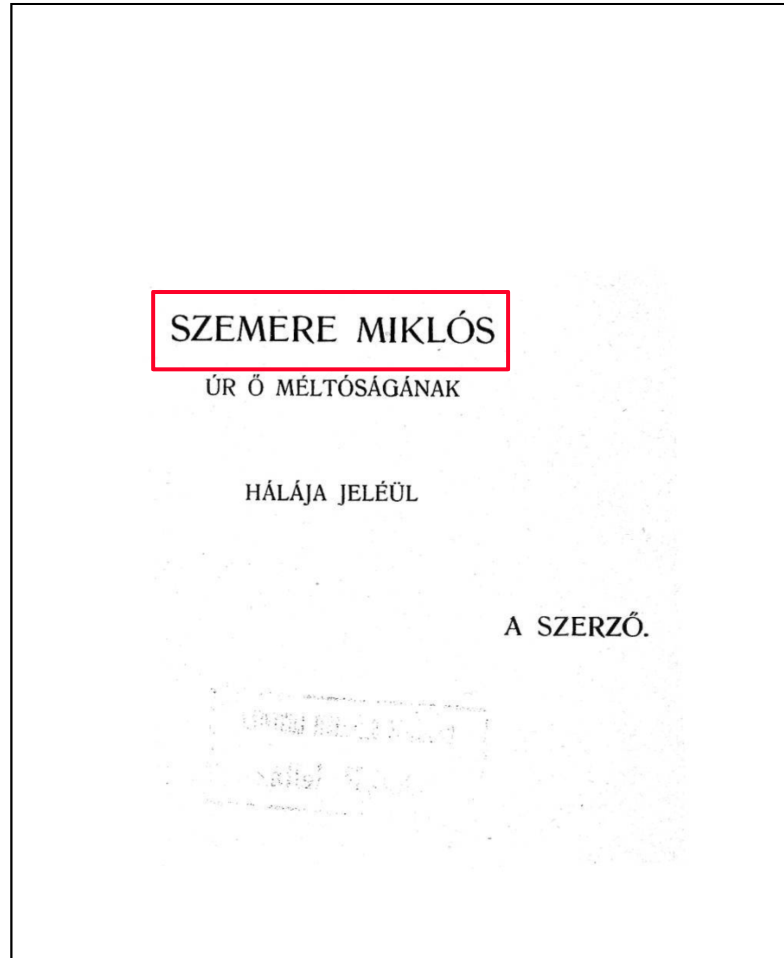
SASAKI KICHISABURO

FORDÍTOTTA

DR SPEIDL ZOLTÁN

72 KÉPPEL.

BUDAPEST, 1907.


SZEMERE MIKLÓS

ÚR Ő MÉLTÓSÁGÁNAK

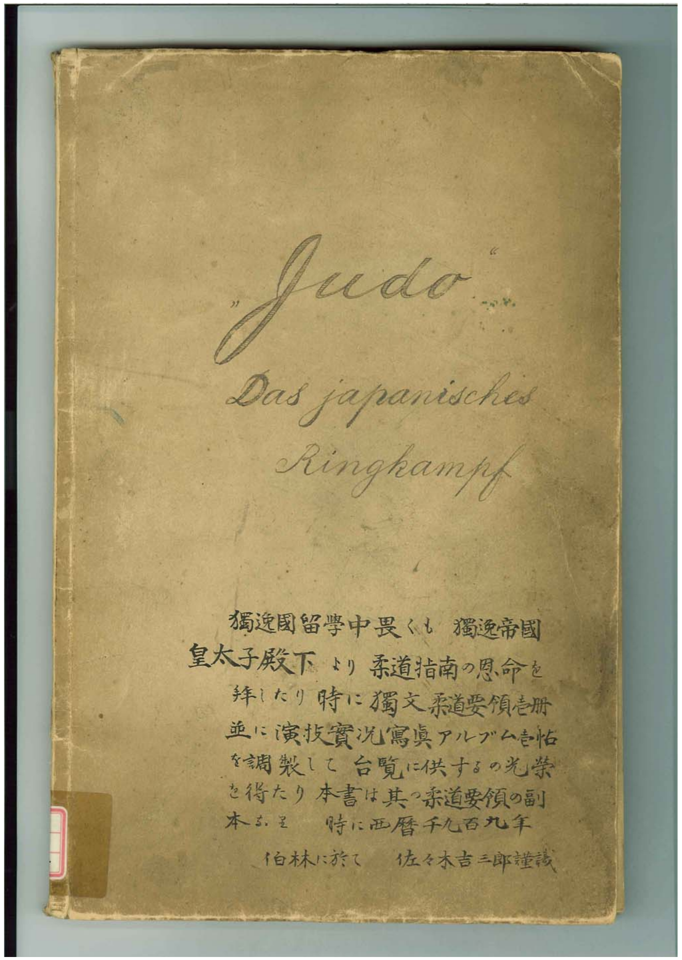
HÁLÁJA JELÉÜL

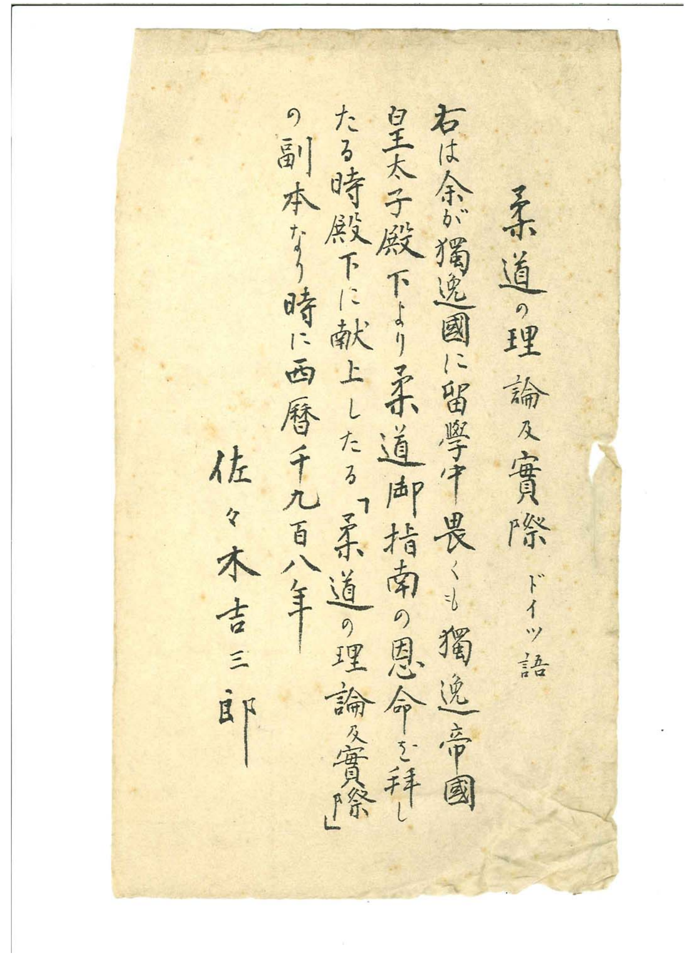
A SZERZŐ.

Photo in Budapest in 1906

This photo was taken on July 14th of 1906, the birthday of his second daughter named Tokuko.

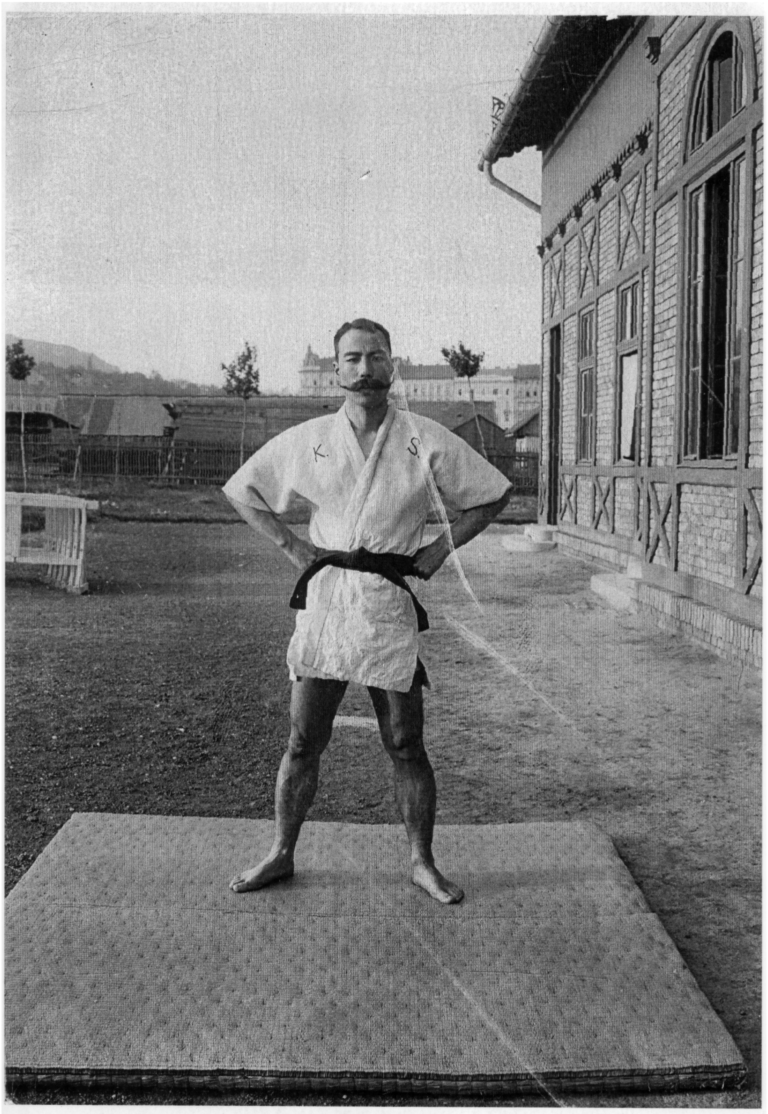
Evidence to teach Judo to German Prince

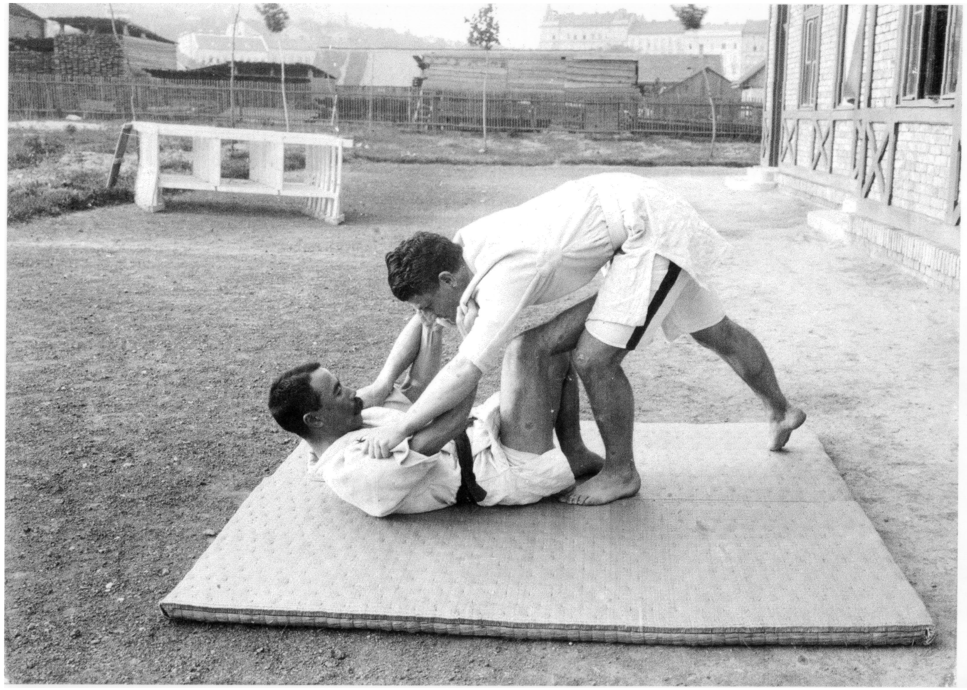




German translation discovered at Kodo-Kan Library with a hand-written cover page (left) and a sheet of paper inserted in the book (right). These show the evidenced that this book is dedicated to German Prince

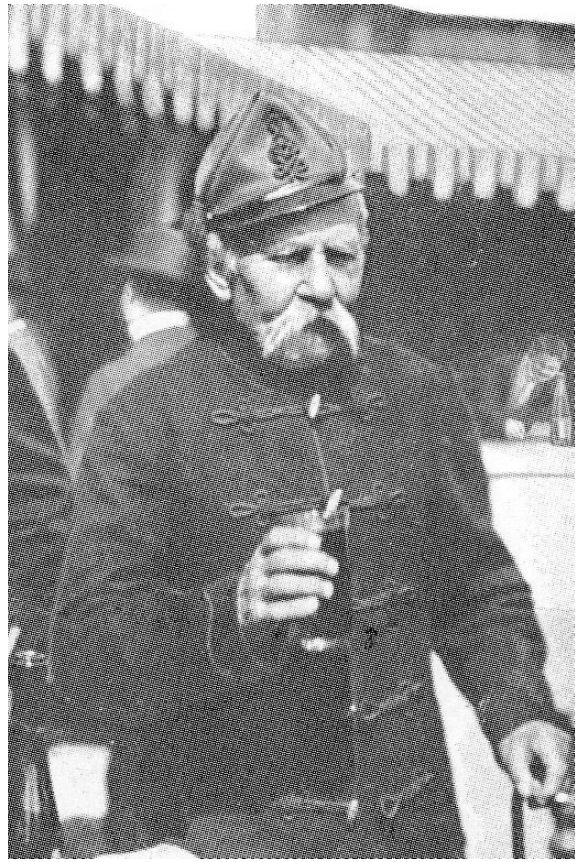
Photos Discovered in Hungarian Sports Museum





SASAKI Kichisaburo playing with
Mr. NEIDENBACH Emil (1884-1957).

Mr. Szemere and his recent family



Ms. MAGYAR Fruzsina
A family member of
Mr. SZEMERE Miklós.

Mr. SZEMERE Miklós (1856-1919)

Newspaper and Magazine in 1906

Budapesti Hírlap
(Budapest News)
Monday, 23 April 1906, p. 11

SPORT.

* **Dsiu-dsitsu.** *Sasaki Kihisaburo,* a tokiói egyetem neveléstan professzora, a napokban elkezdi a Budapesti Egyetemi Atletikai Klub lágymányosi klub-házában a dsiu-dsitsu tanitását. A mester a gyakorlati oktatás megkezdése előtt megjelölte a tanitás alatt követendő irányt és kijelenti a téves hiresztelésekkel szemben, hogy a japán birkózás tanulása kellő felügyelet mellett *egyáltalán nem veszedelmes.* A dsiu-dsitsunak a hatása nemcsak oly irányban nyilvánul, mint például az atletikáé, vagy a tornáé, hanem a szellemi erőt és munkaképességet is nagy mértékben fokozza. Nem a nyers erőt fejleszti, hanem az ügyességet, bátorságot és szivósságot. Növeli az önbizalmát a gyengének az erősebbel szemben. Japánországban a gyermekek 14 éves korukban kezdik el a dsiu-dsitsu tanulását és tanulmányaikkal párhuzamban a legfelsőbb kiképzésökig folytatják. Mielőtt a tanuló ifjuság szellemi munkához fogna, naponként reggel 4-től 7 óráig orvosi felügyelet mellett edzi magát a dsiu-dsitsu gyakorlásával, mely alól fölmentést még annyian sem kapnak, mint nálunk a tornázás alól. A most Budapesten megkezdődő tanfolyam első Európában s ennek köszönhető az a nagy érdeklődés, a mely iránta mutatkozik. Eddig 460 résztvevő jelentkezett s a Budapesti Egyetemi Atletikai Klub elnökségének nagy gondot ad a 60 embernek a kiválasztása, a kik a tanfolyamban részt vehetnek. A tanitás naponként négy órát vesz igénybe, délután 4 órától este 8-ig tart. Egy-egy tiz emberből álló csoport 30 percig birkózik. Jelentkezni még csütörtökig lehet délelőtt 10 és fél 11 óra között a B. E. A. K. tudományegyetemi hivatalos helyiségében. Tegnap érkeztek meg Tokióból Sasaki mesternek tengeri füből és rizsszárból szőtt szőnyegei, melyek arra alkalmasak, hogy fedetlen lábbal mozoghassanak rajta. Megemlitjük itt, hogy a dsiu-dsitsu birkózásnál cipő vagy harisnya használata nem szokásos.

NEMZETI SPORT

IV. évfolyam. Budapest, 1906. május 20. 20. szám.

VIVÁSSAL ÉS MINDEN EGYÉB SPORTTAL FOGLALKOZÓ HETILAP

MEGJELENIK MINDEN VASÁRNAP.

A MAGYAR ATHLETIKAI SZÖVETSÉG, A MAGYAR LABDARUGÓK SZÖVETSÉGE, A MAGYAR ATHLETIKAI CLUB, A FŐVÁROSI VIVÓ CLUB, A BUDAPESTI POSTA- ÉS TÁVIRDATISZTVISELŐK SPORTEGYESÜLETE, A FERENCVÁROSI TORNA CLUB, A MŰEGYETEMI ATHLETIKAI ÉS FOOTBALL CLUB ÉS A „BALATON“ USZÓK EGYESÜLETE HIVATALOS LAPJA.

ALAPITOTTA: FODOR KÁROLY, MŰEGYETEMI VIVÓMESTER.

KÉPEK A DSIU-DSITSU TANFOLYAMRÓL.

Tartalom

OLYMPIA. *Athéni levelek. Az athéni versenyek tanulságai. Olympiai támadások.* ◦ VIVÁS. ◦ ATLETIKA. *Versenyek. Hirek.* ◦ TORNA. ◦ FOOTBALL. *A német bajnokságok. Mérkőzések. Hirek. Ifjusági labdarugás.* ◦ VEGYES. ◦ LÓSPORT. ◦ HIVATALOS.

ELŐFIZETÉSI ÁRA: EGÉSZ ÉVRE 12 KORONA, FÉLÉVRE 6 K., NEGYEDÉVRE 3 K., EGYES SZÁM ÁRA 20 FILLÉR.

Laptulajdonosok: Fodor Károly és Leopold Gyula.

Szerkesztőség: IV., Koronaherceg-utca 3. sz. TELEFON 996.

Kiadóhivatal: VII., Erzsébet-körut 41. sz. TELEFON 12–06.

Sasaki Kichisaburo Cup in 2007 (1)

Judo team from Japan (in front of Sasaki Dojo)

Competition among boys and girls in the afternoon

Sasaki Kichisaburo Cup in 2007 (2)

Important Sports persons. From left to right, TÓTH László (President of Hungarian Judo Association), VIZER Marius (President of International Judo Federation), SCHMITT Pál (Chair of Hungarian Olympic Committee; he received gold medals twice for fencing), myself and OZSVÁR András

Sasaki Kichisaburo Cup in 2007 (3)

Sasaki Kichisaburo Cup

Mr. SPEIDL Zoltán (2nd from the left) who is a nephew of Mr. SPEIDL Zoltán (1880- 1917)

Mr. NÉMETH Sándor who took a responsibility for music in Sasaki Cup. He composed Judo anthem for the Sasaki cup. He is a professional wrestler.

Sasaki Kichisaburo Cup in 2007 (4)

Athletic Club for Budapest Univ., where Kichisaburo-san taught Judo.

A lot of suveniors on the occasion of Sasaki Cup.

Sasaki Kichisaburo in Berlin in 1908

SASAKI Kichisaburo (right) with his guest,
and the owners mother and daughter.

House in Tokyo for Sasaki Family

House that he built when hearing the visit of German Prince. In the middle is SASAKI Kichisaburo.

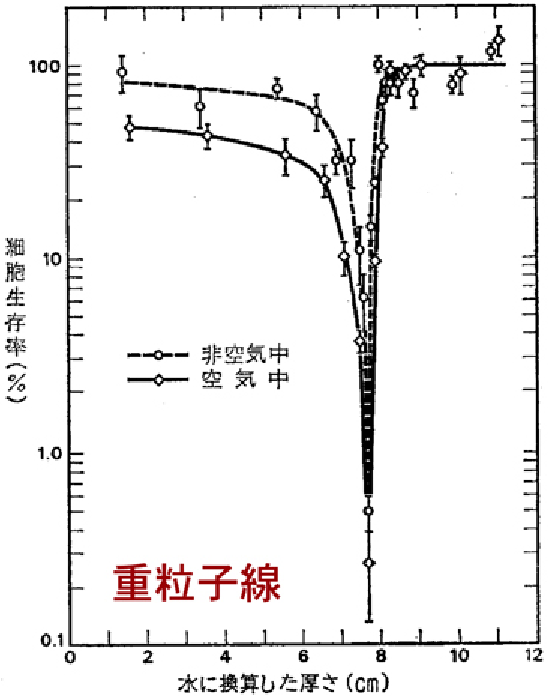
Sasaki Family

Sasaki Family (the infant in the middle is my mother).

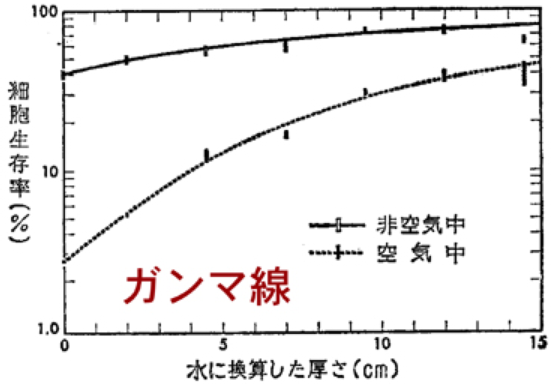
Sasaki Kichisaburo from My Album

SASAKI Kichisaburo from my album. This photo was used in my trip report in 2005, so that I saw this picture in many places in Hungary. The year when the photo was taken is unknown

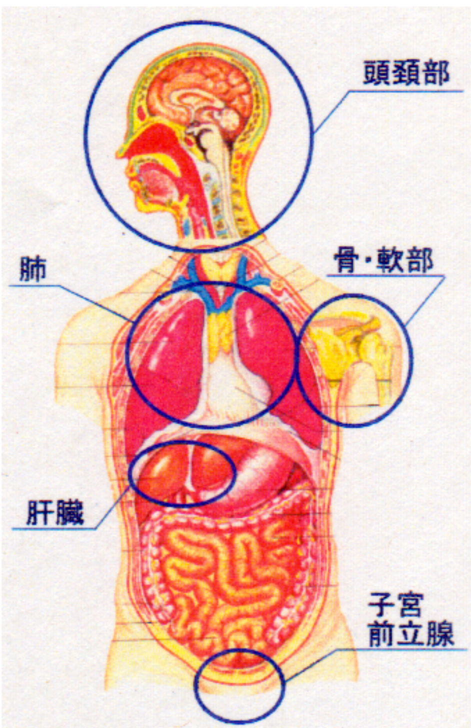
□□□□□□ (□□□□□□□□)



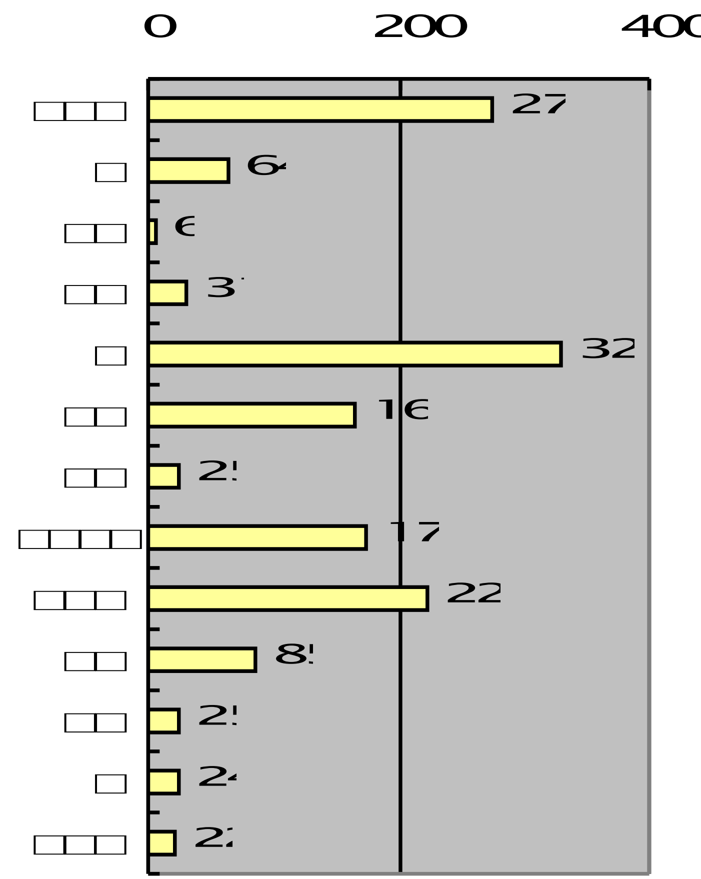
100
10
1.0
0.1
細胞生存率(%)
非空気中
空気中
重粒子線
0 2 4 6 8 10 12
水に換算した厚さ(cm)



100
10
1.0
細胞生存率(%)
非空気中
空気中
ガンマ線
0 5 10 15
水に換算した厚さ(cm)



頭頸部
骨・軟部
肺
肝臓
子宮
前立腺



0
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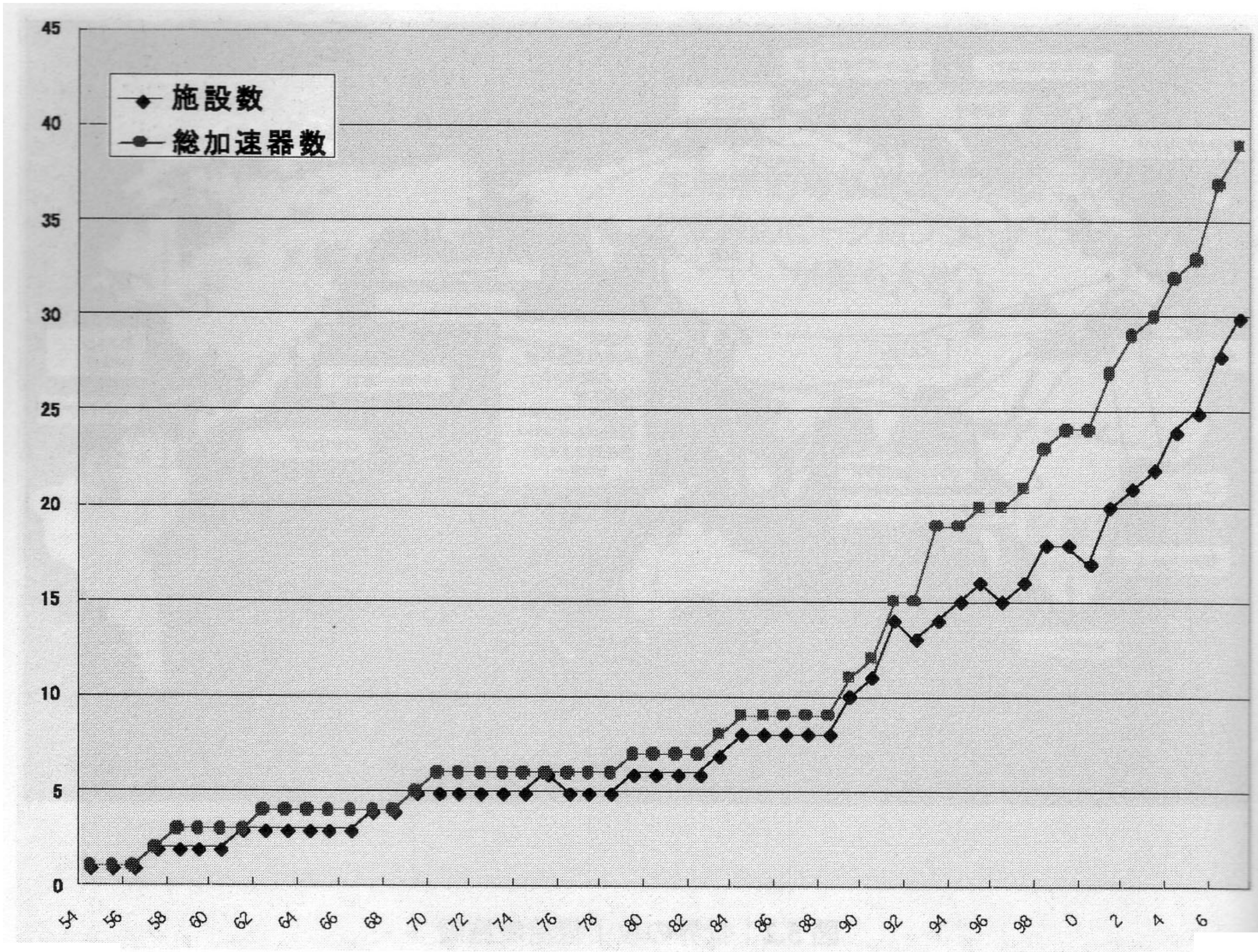
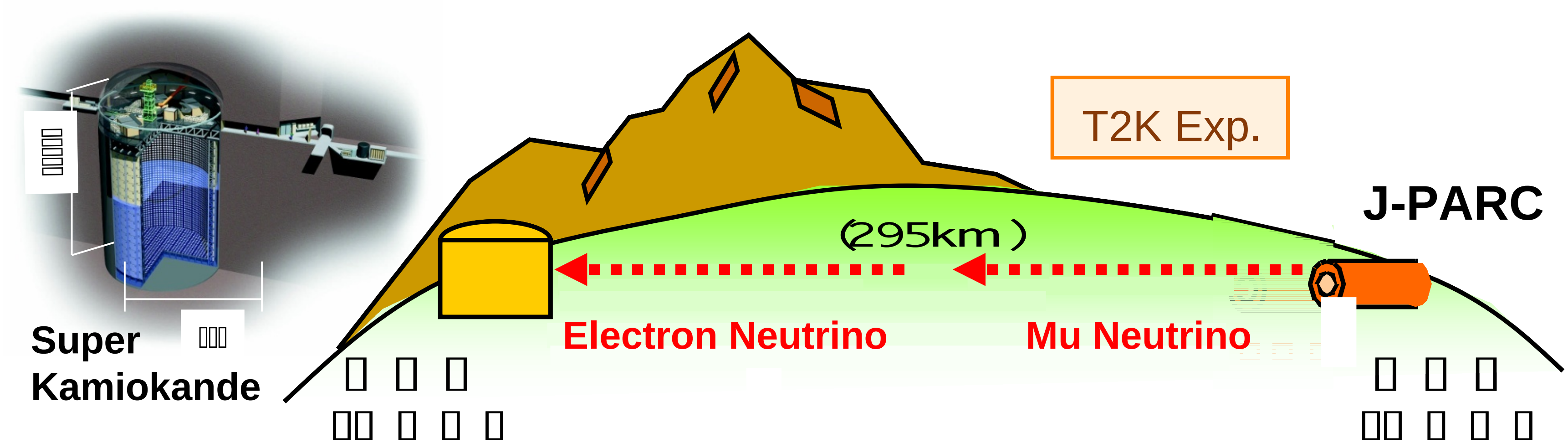


1954 2008

図 5.3：世界の荷電粒子線治療施設数

Neutrino Oscillation (T2K) Experiment



100 times sensitivity as compared with K2K

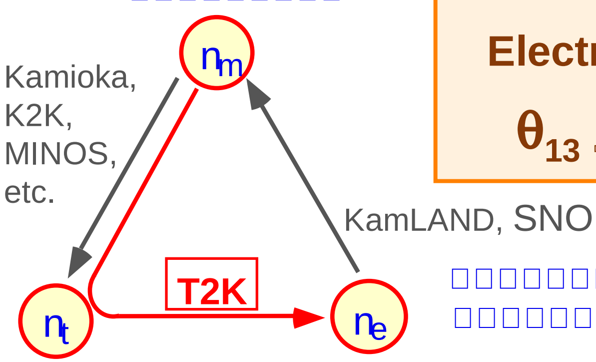
For example

100 neutrinos ← 150 neutrinos

Disappearance of neutrinos ↔ Finite Mass

Electron neutrinos ← Mu neutrinos

θ_{13} ↔ Mixing between the 1st and 3rd generation



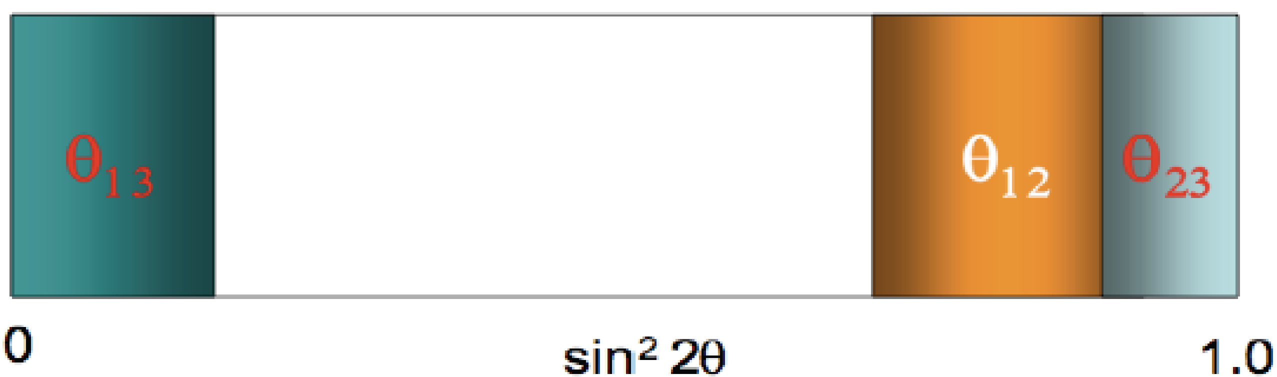
CP violation experiment later by increasing intensity

Competition with DiyaBay, FNAL, etc.

Neutrino Mixing Angle CL 90%

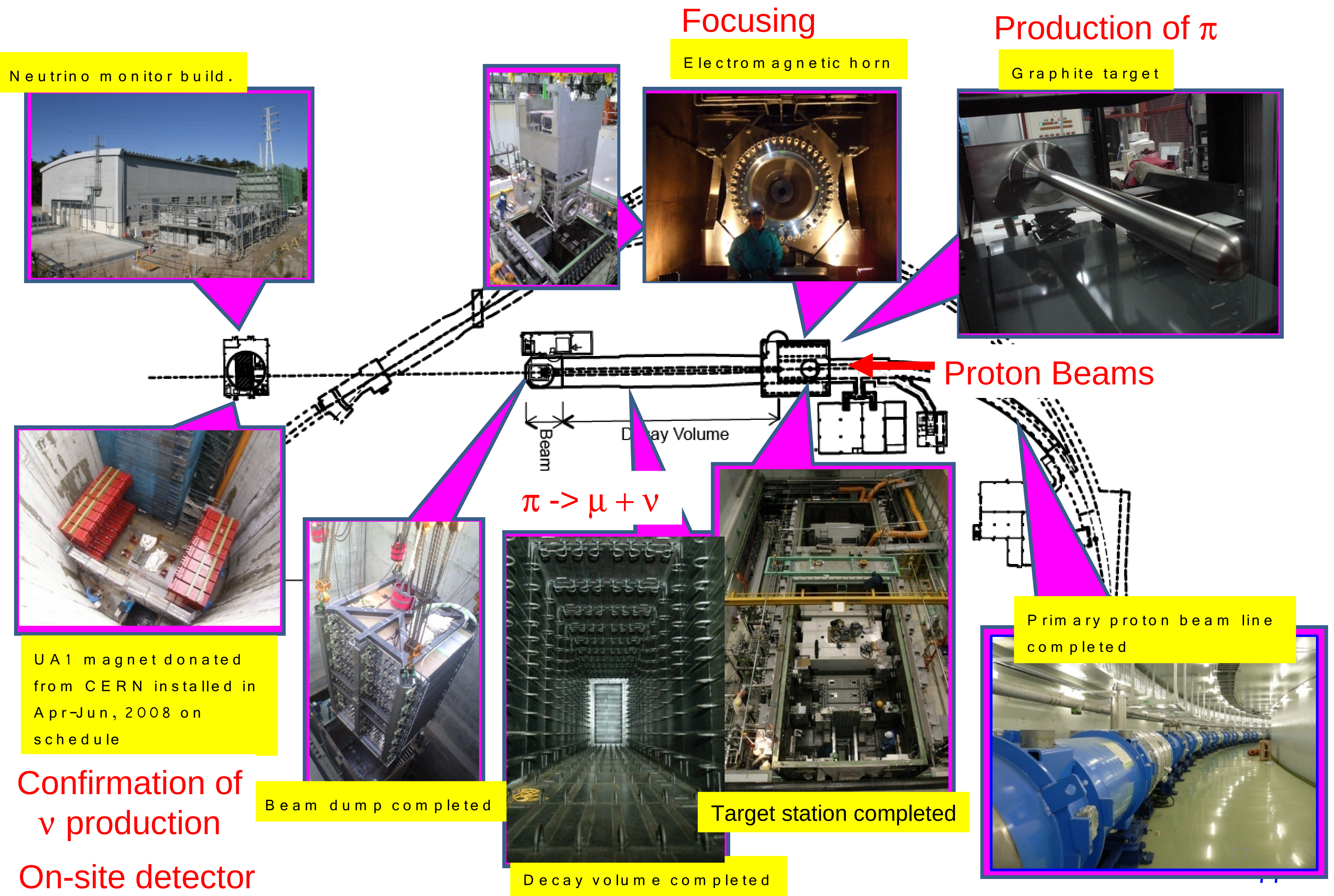
$$U=\begin{pmatrix} U_{e1} & U_{e2} & U_{e3} \\ U_{\mu 1} & U_{\mu 2} & U_{\mu 3} \\ U_{\tau 1} & U_{\tau 2} & U_{\tau 3} \end{pmatrix}=\begin{pmatrix} 1 & 0 & 0 \\ 0 & c_{23} & s_{23} \\ 0 & -s_{23} & c_{23} \end{pmatrix}\begin{pmatrix} c_{13} & 0 & s_{13}e^{-i\delta} \\ 0 & 1 & 0 \\ -s_{13}e^{i\delta} & 0 & c_{13} \end{pmatrix}\begin{pmatrix} c_{12} & s_{12} & 0 \\ -s_{12} & c_{12} & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$\sin^2 2\theta_{13}<0.16$ $0.68<\sin^2 2\theta_{12}<0.94$ $\sin^2 2\theta_{23}>0.87$



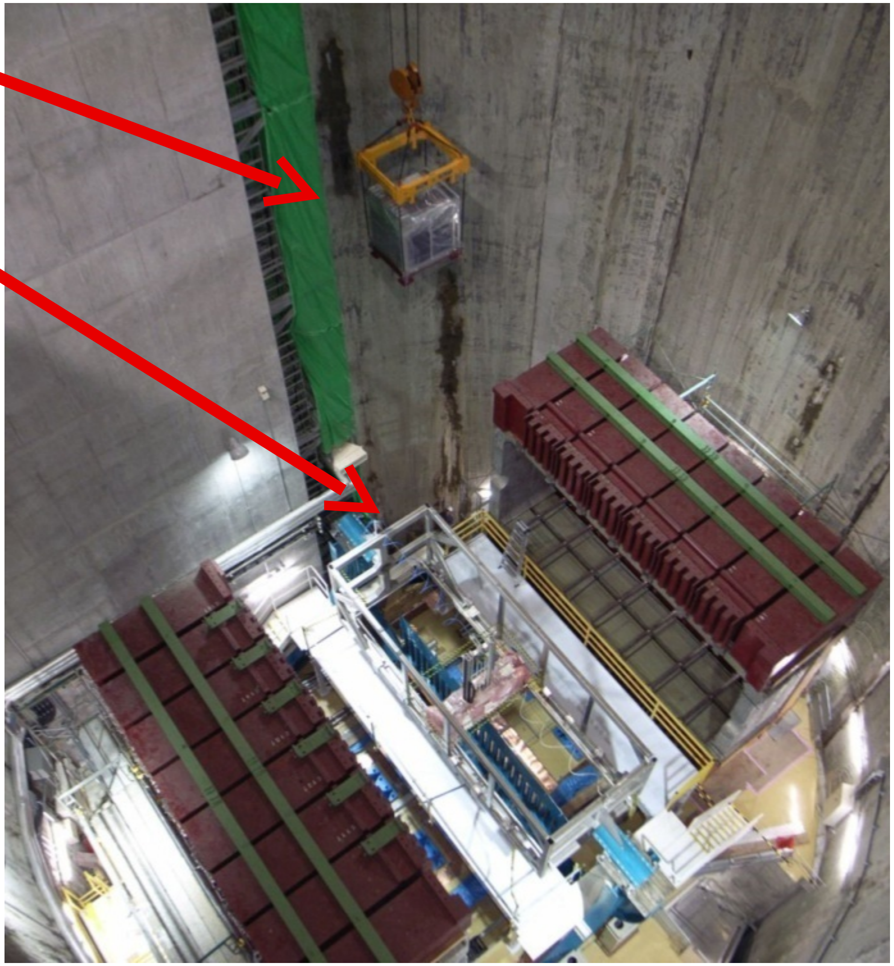
- $\Delta(\sin^2 2\theta_{23}) = 0.01$, $\sin^2 2\theta_{13}$ down to 0.008
- **severe competition around 2009-2011**

Neutrino beamline

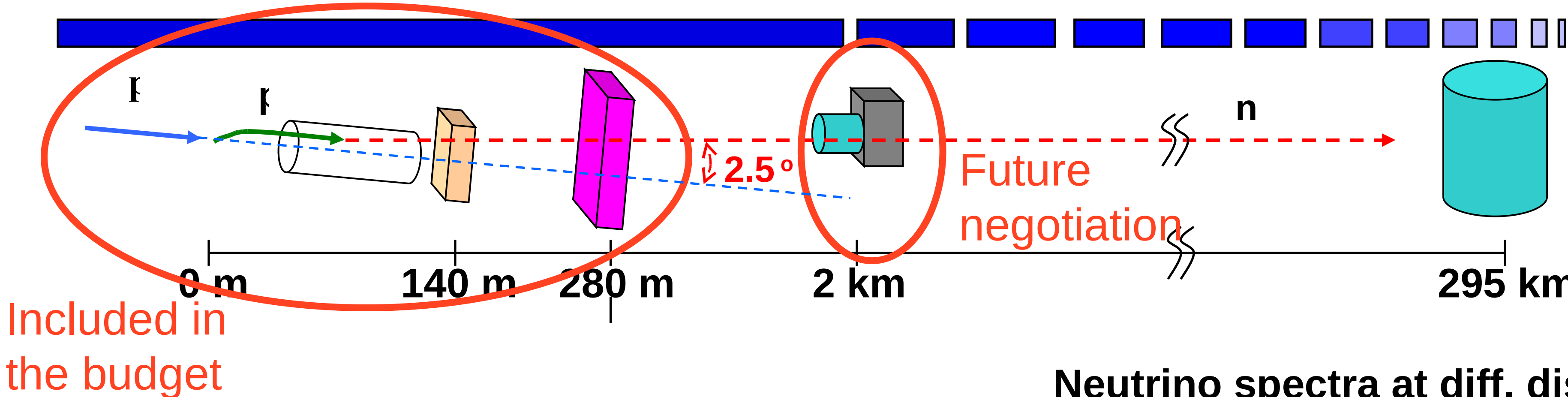


T2K near detectors

- Significant progress since last PAC meeting
  - On-axis INGRID modules being installed and operated
  - Off-axis detector basket installed
  - Preparing to excite magnet in mid-August
    - installing power, cooling, control systems

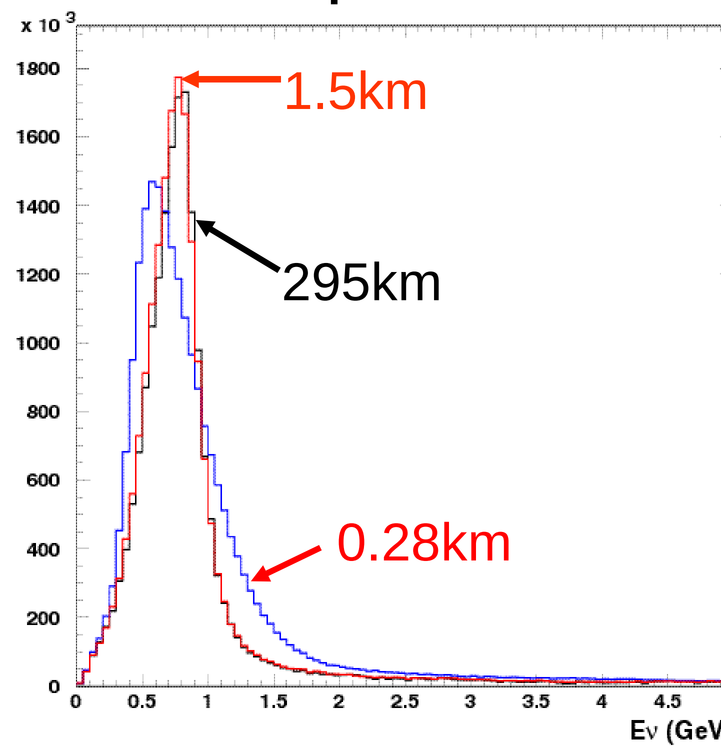


Layout for Neutrino Experiment

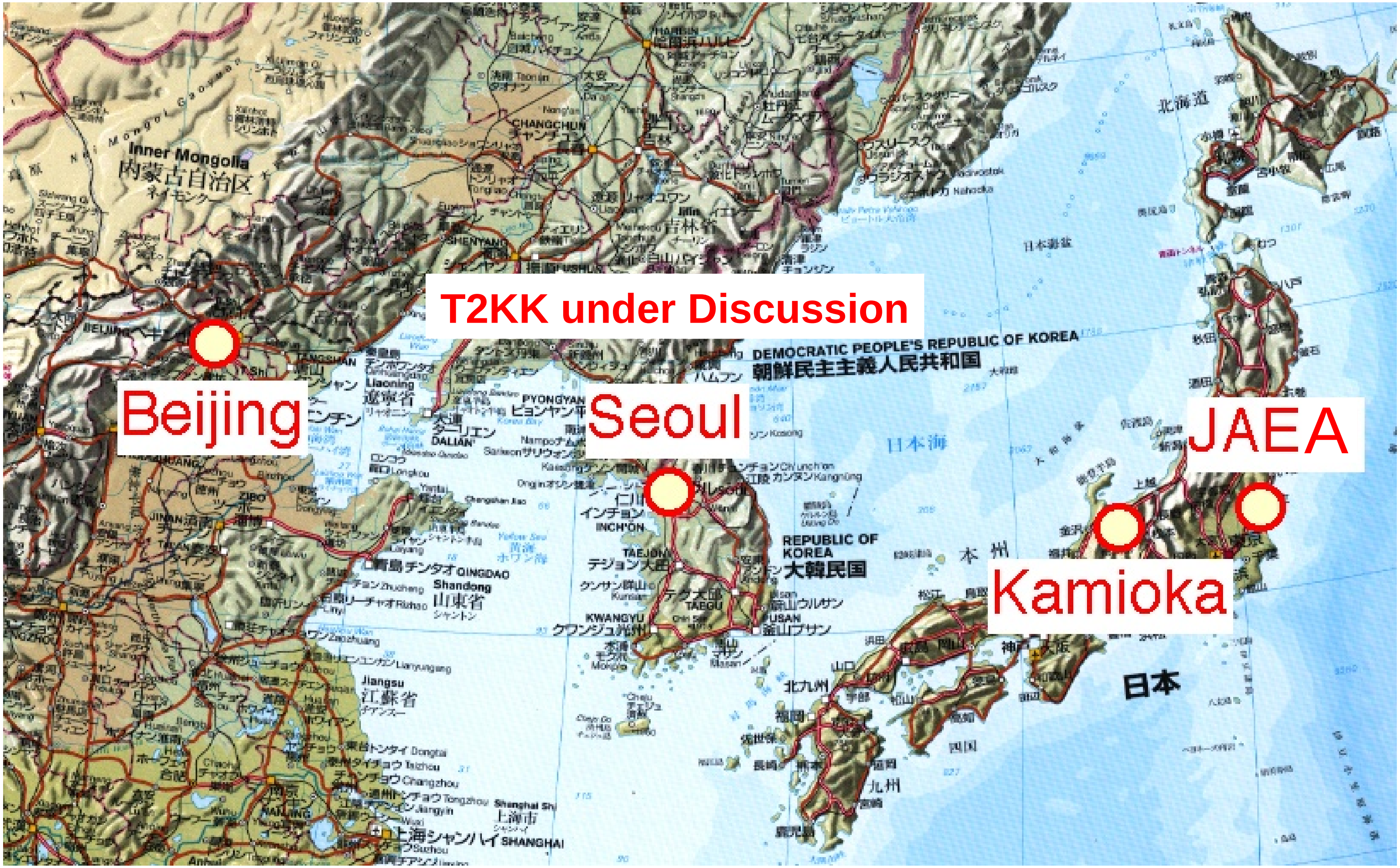


- **Muon monitors @ ~140m**
  - **spill-by-spill monitoring of p-beam direction/intensity**
- **First Front detector @280m**
  - **0 degree definition**
  - **High stat. neutrino inter. studies**
- **Second Front Detector @ ~2km**
  - **Ultimate systematics**
  - Now fixing the site
- **Far detector @ 295km**
  - **Super-Kamiokande (50kt)**

Neutrino spectra at diff. dist



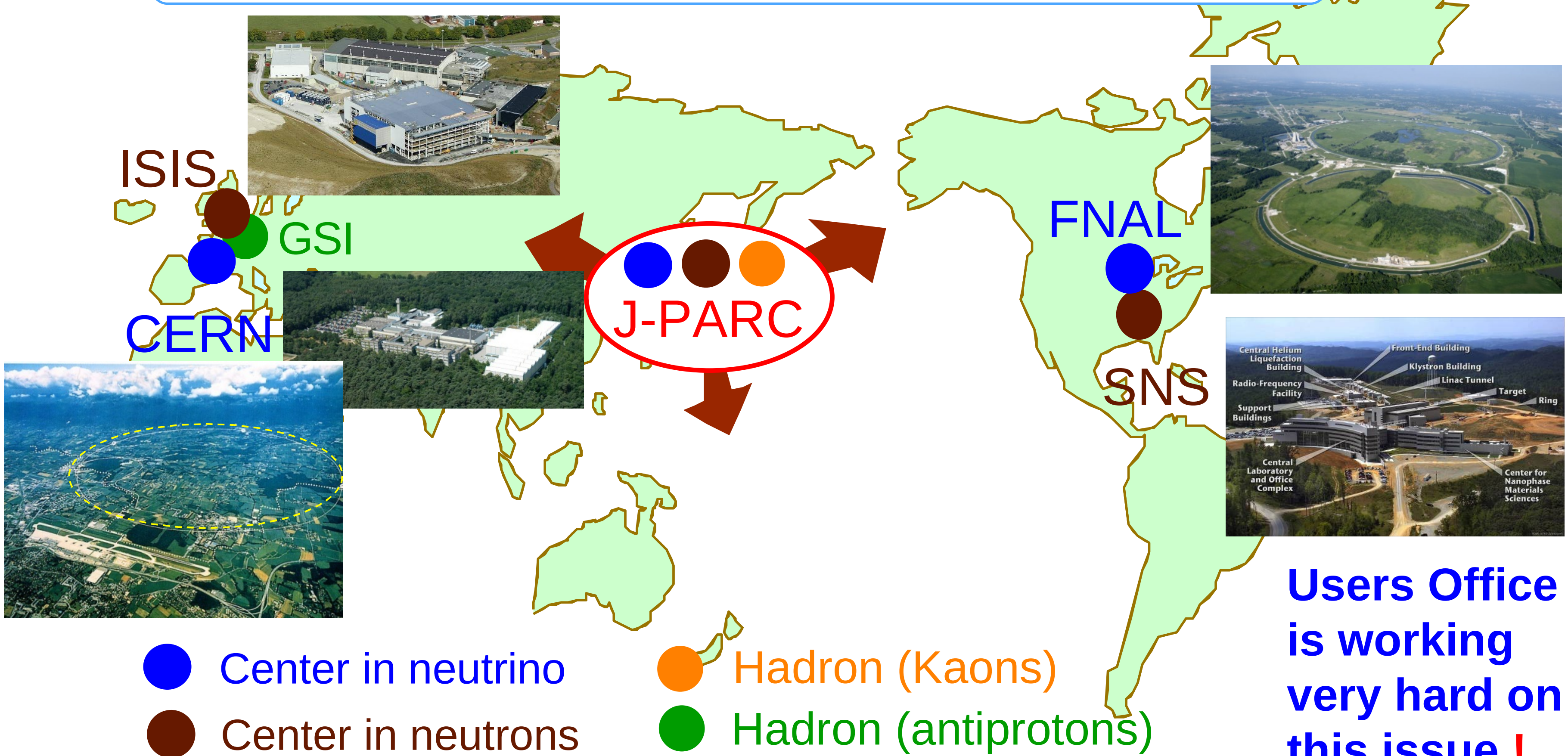
Asian Map



T2KK under Discussion
Beijing
Seoul
Kamioka
JAEA
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA
朝鮮民主主義人民共和国
REPUBLIC OF KOREA
大韓民国
日本

World Center

- Materials and Life: One of three world centers, in particular, in Asia.
- Hadron physics A unique kaon factory in the world.
- Neutrino physics: As a world leader among the three world centers.



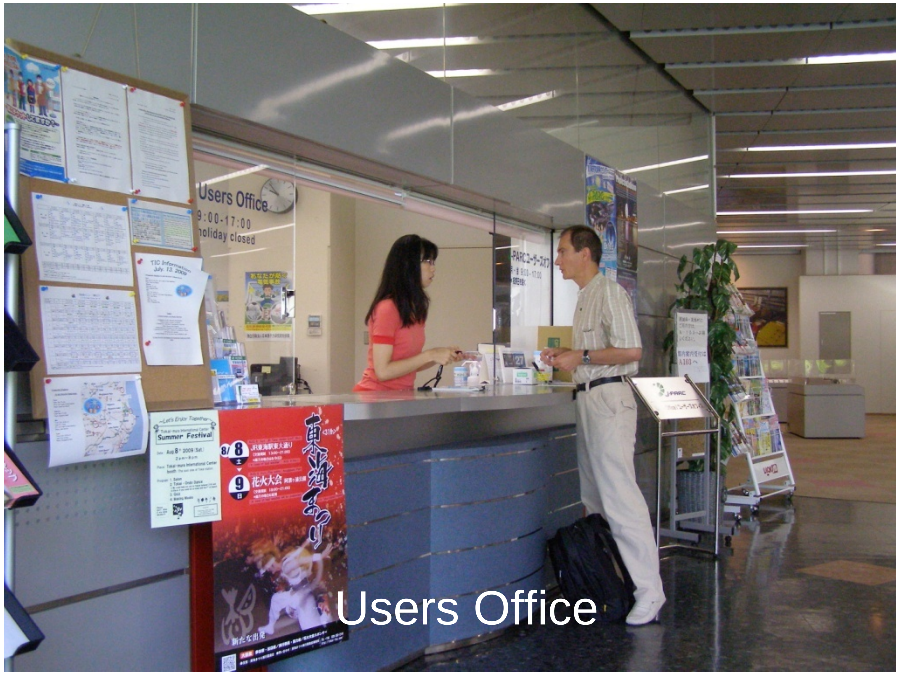
Users Office is working very hard on this issue !

ISIS □□□□□□□□□□□□□□□□□□□ SNS □□□□□□□□□□□□□□□□□□□□□

CERN □□□□□□□□□□□□□□□□ FNAL □□□□□□□□□□□□□□ GSI □□□□□□□□□□□□

Ibaraki Quantum Beam Research Center

1st Floor Users Office, etc.
2nd Floor Meeting Rooms
3-4 Floors Offices for Users



Users Office

Users Office

At the Window

- □Issue of ID Card
- □Portal Site
- □Renting Office Materials

Users Office
□Can be used in English□

Daily Consultation

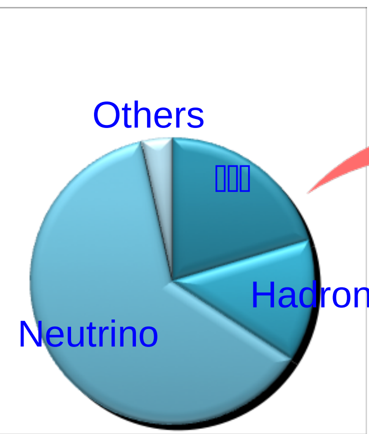
- □Research Topics
- □Technical Details

MLF Research scientists

Experimental Programs

- □Application for Proposals
- □Handling research highlights

Program Adv. Comm.



□□ Total□10,165□
□□ Non-Japanese: 4,195□

Half a year for
2008.12□2009.6

Office Support

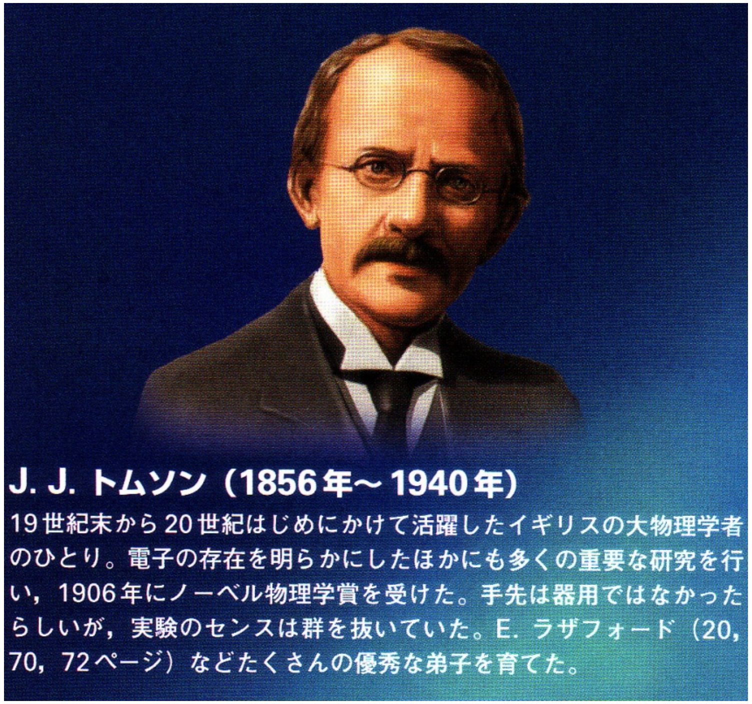
- □Radiation and general Safety education
- □Office for Users

Life Support

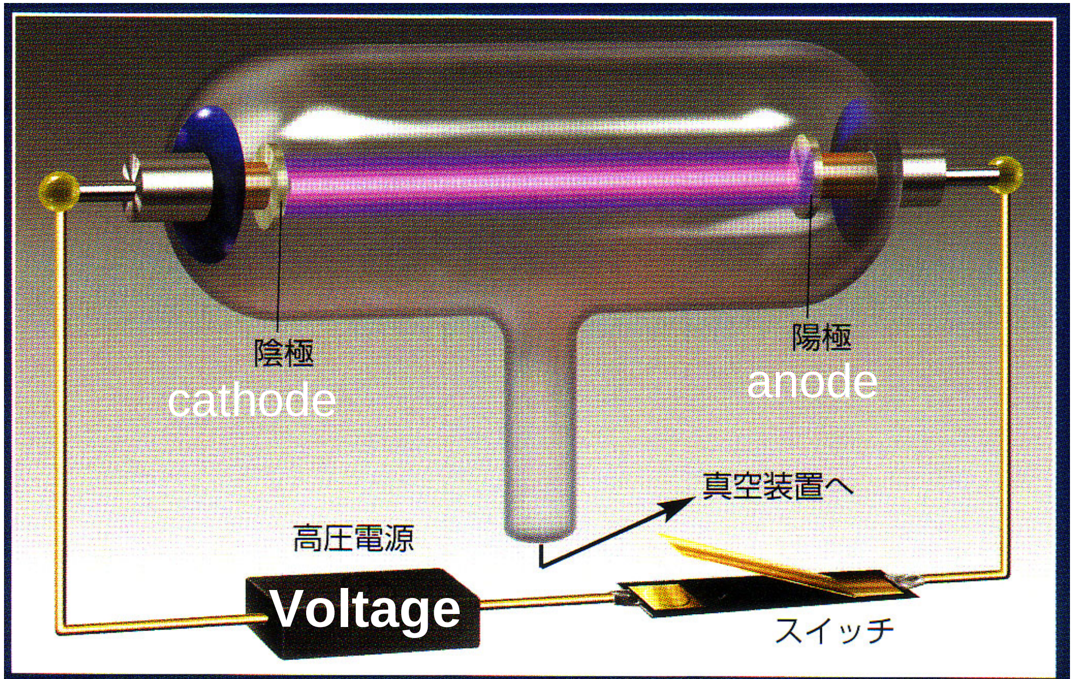
- □Arrangement of Lodging
- □Rental Car
- □Map, local transportation, etc.

A handful people are handling all jobs for users!

Discovery of Electron (1897)



J. J. Thomson (1856-1940)
1897: Discovery of Electron

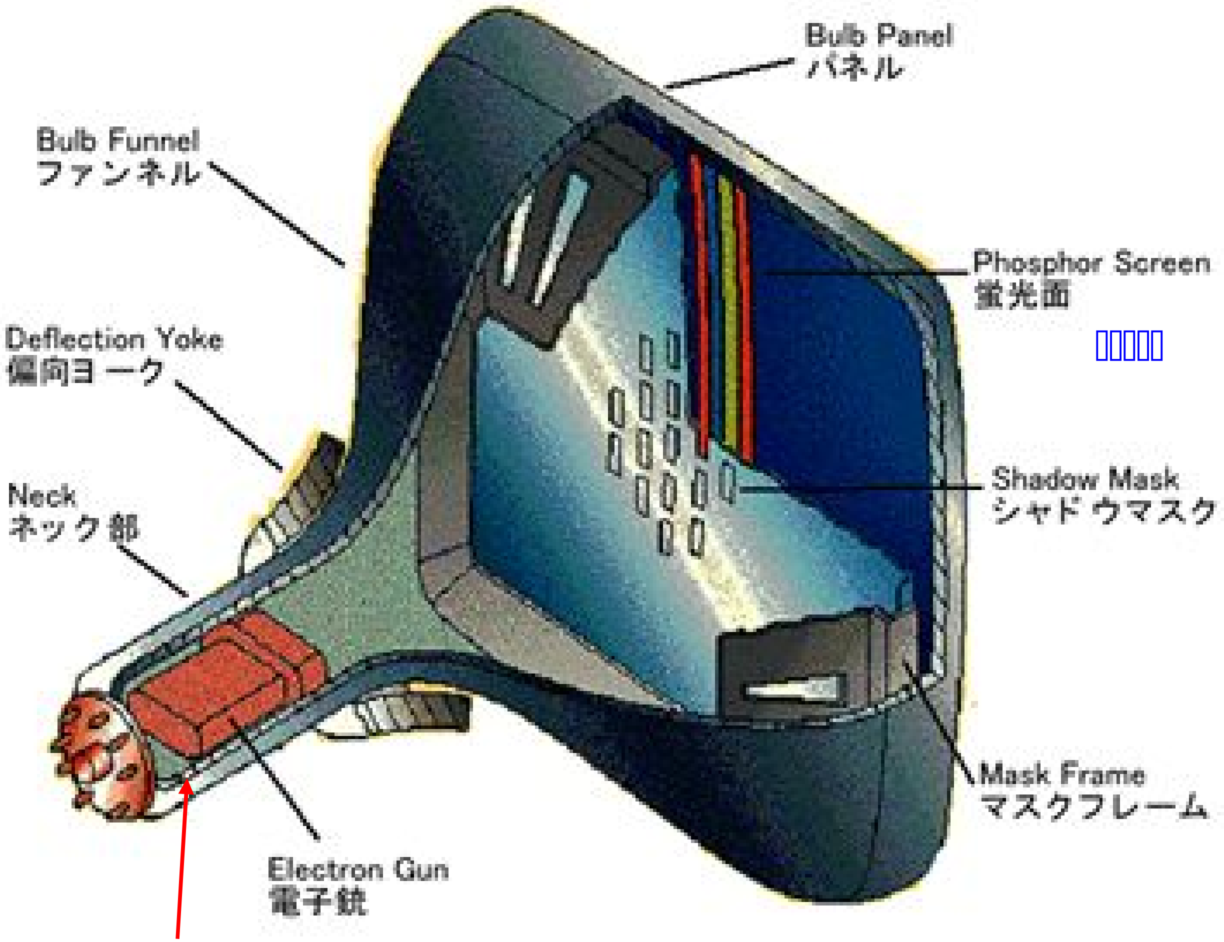


ガイスラー管

内部の真空度を高めたガイスラー管（図参照）の両電極間に電圧をかけたときに発する淡い光は，気圧のちがいのほか管内の位置によっても変化する。この変化は，管内の圧力を大ざっぱに知る目的で今も利用されている。管内の気体分子に電子がぶつかり，そのエネルギーで光ることがのちにわかった。固定標的に加速粒子をぶつけて反応を調べていた1960年代までの粒子加速器の原型といえる。

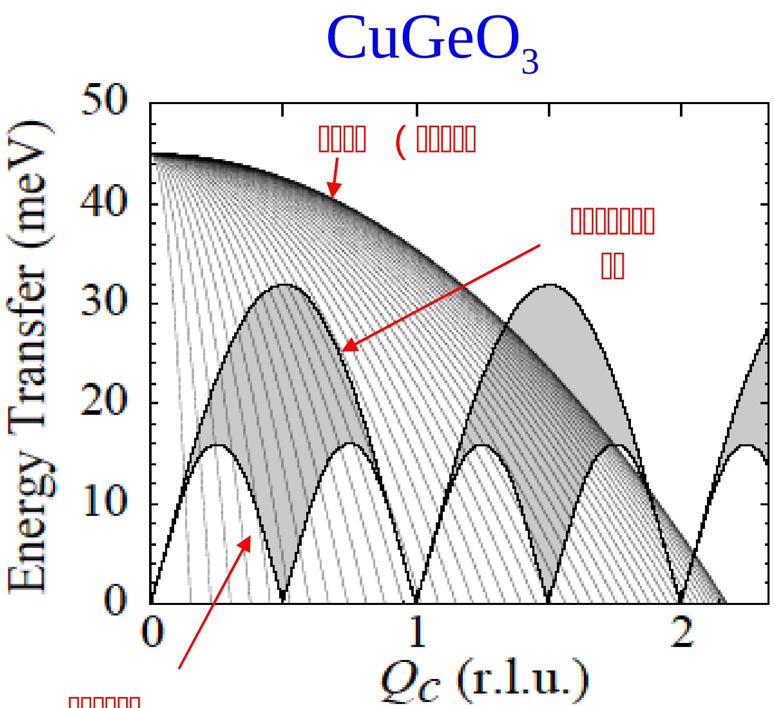
First Accelerator

Broun Tube and Electron Accelerator

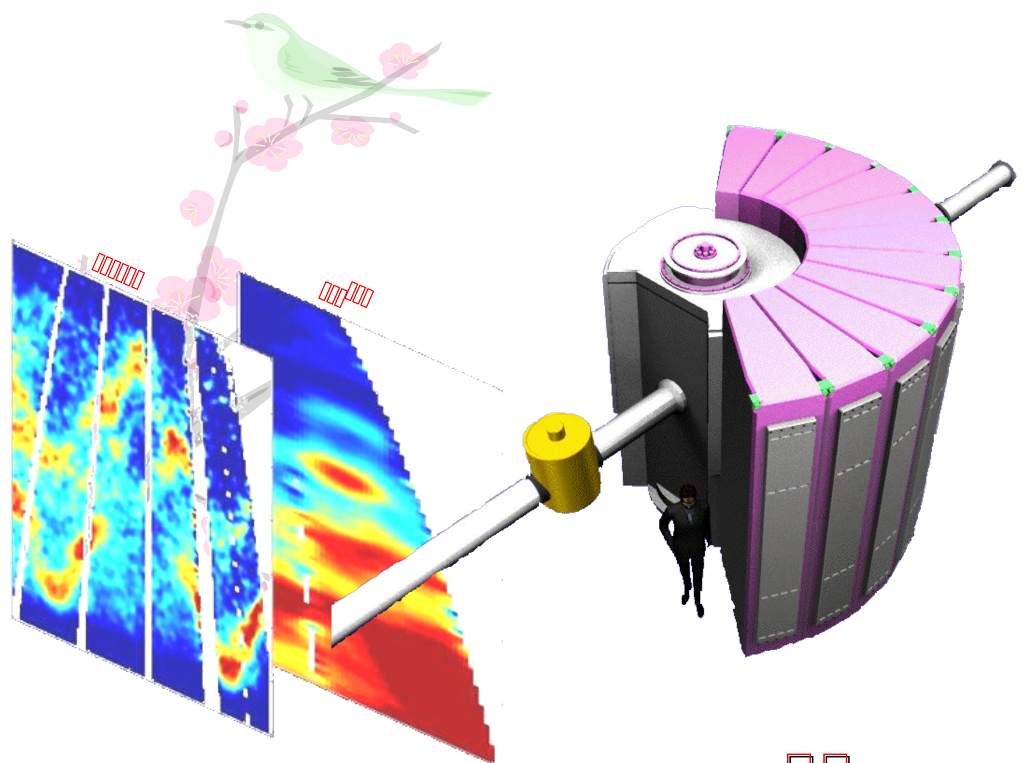


Electron Accelerator

From Toshiba Home Page



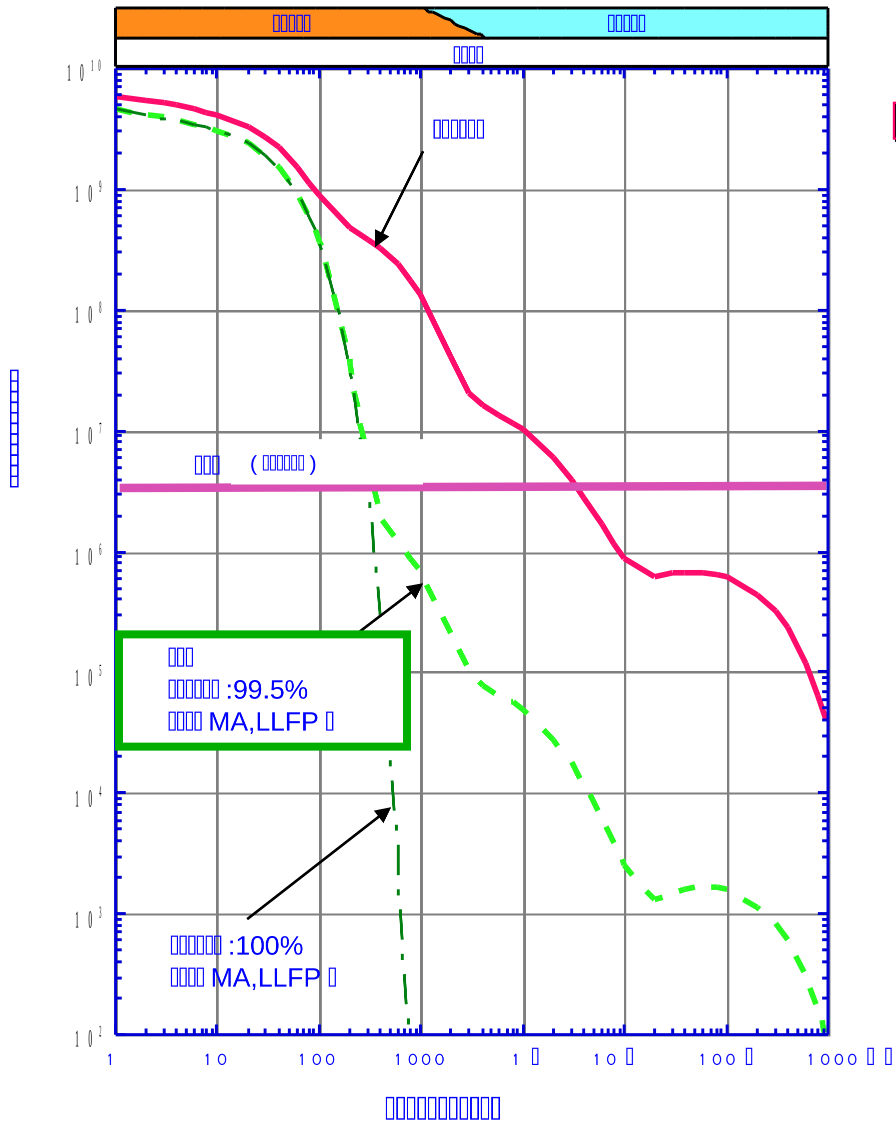
ISIS
J-PARC



J. Phys. Soc. Japan
Editor's Choice

[illegible]

[illegible]



[illegible] 99.5 [illegible]

500 [illegible]

MA : [illegible] (Np, Am, Cm)

LLFP : [illegible] (Tc-99, I-129)