

Thank you very much for excellent Hospitality.



KEK Branch Office

We thank TRIUMF Management
for our partnership



Rei Ito-san stays the office
He takes care of partnership
between Canada and Japan

Insight through Accelerators.





KEK UPDATE

for HK / Muon/ Neutron/ KISS & New Proposals (SuperKEKB/ QUP / ILCTN)

1. J-PARC

There are two Rings

RCS 3GeV

MR 30GeV

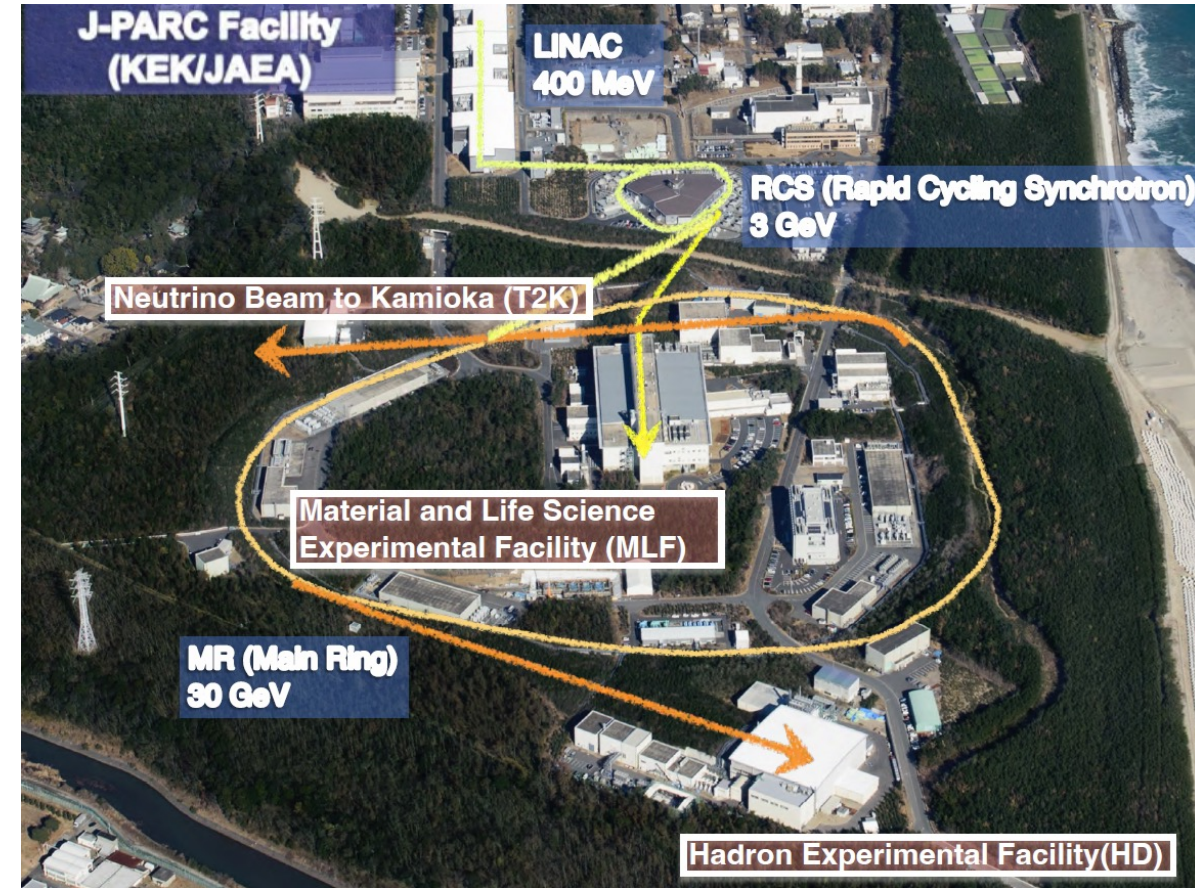
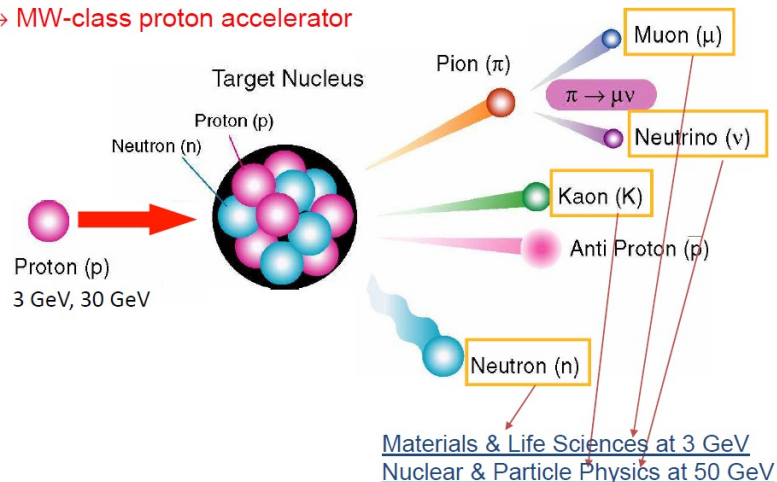
There are three facilities: MLF, T2K, HD

MLF: Material / Life Science

Facility (muon/neutron) muon acc.

RCS (MLF)
power achieved to 1MW

→ MW-class proton accelerator

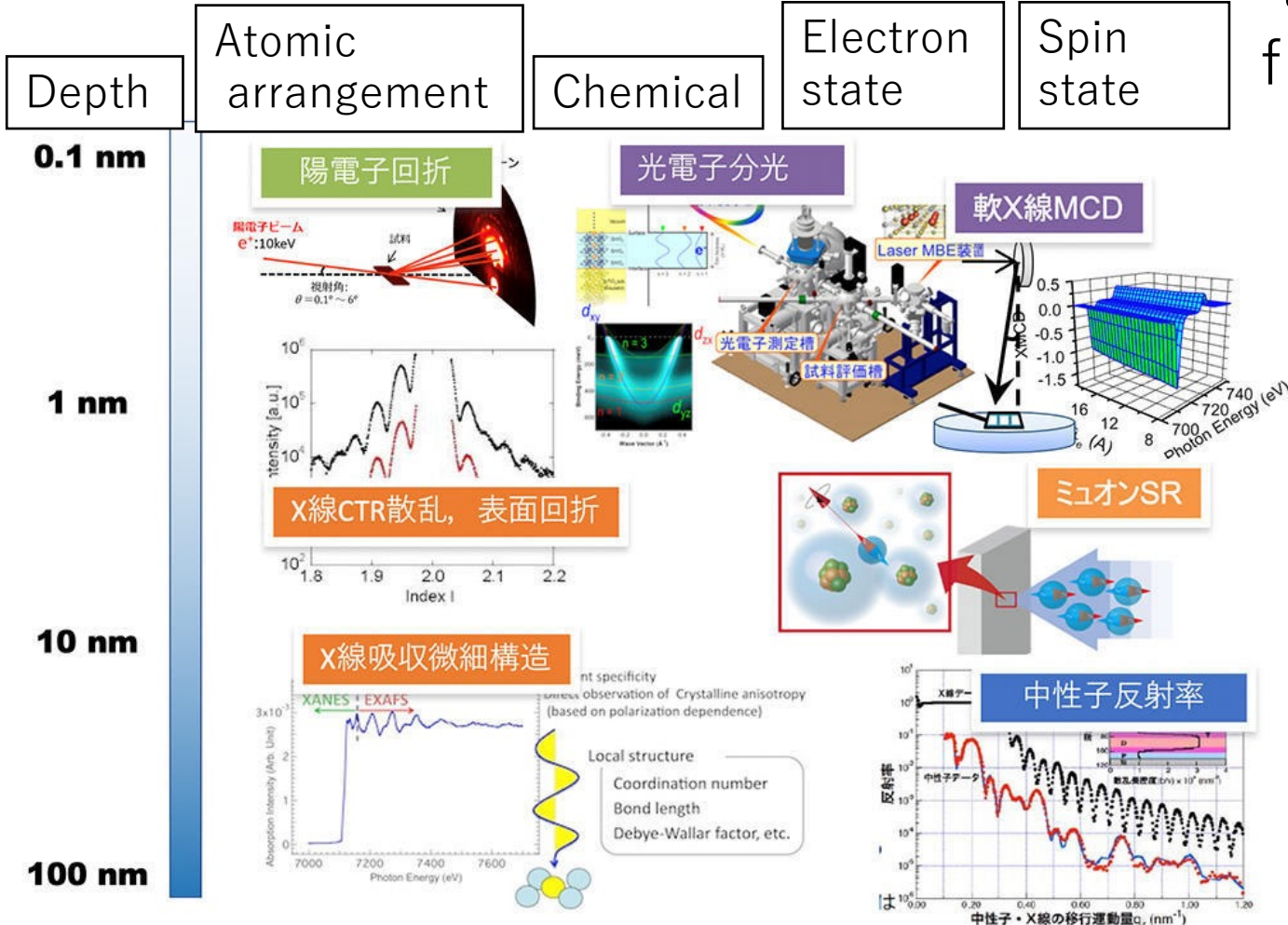


Various particle beams are used:

We have many synergies with muon/neutron.

AI for Material Science with Multi-beam

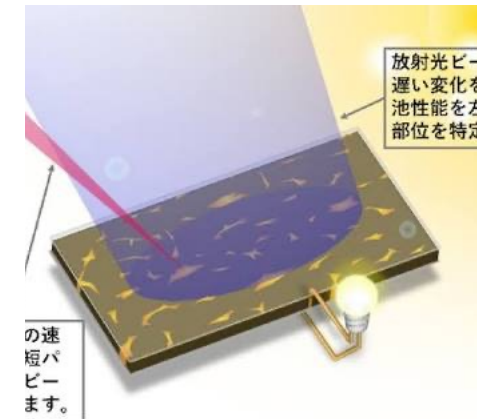
We have
5 quantum beams
to understand material
functions and states



- Slow Positron (Surface)
- Soft X
- Hard X
- **Muon (Spin)** → K
- **Neutron (nuclear)**



->
Kojima-san



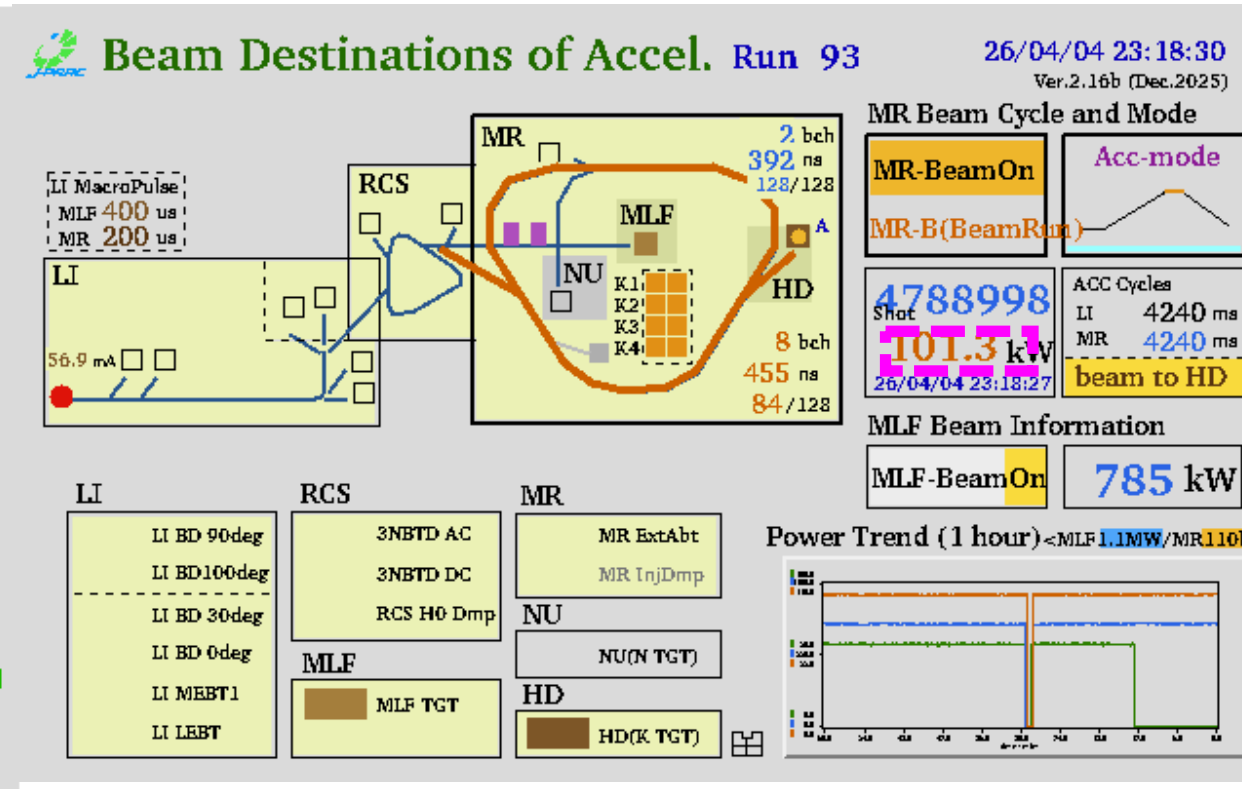
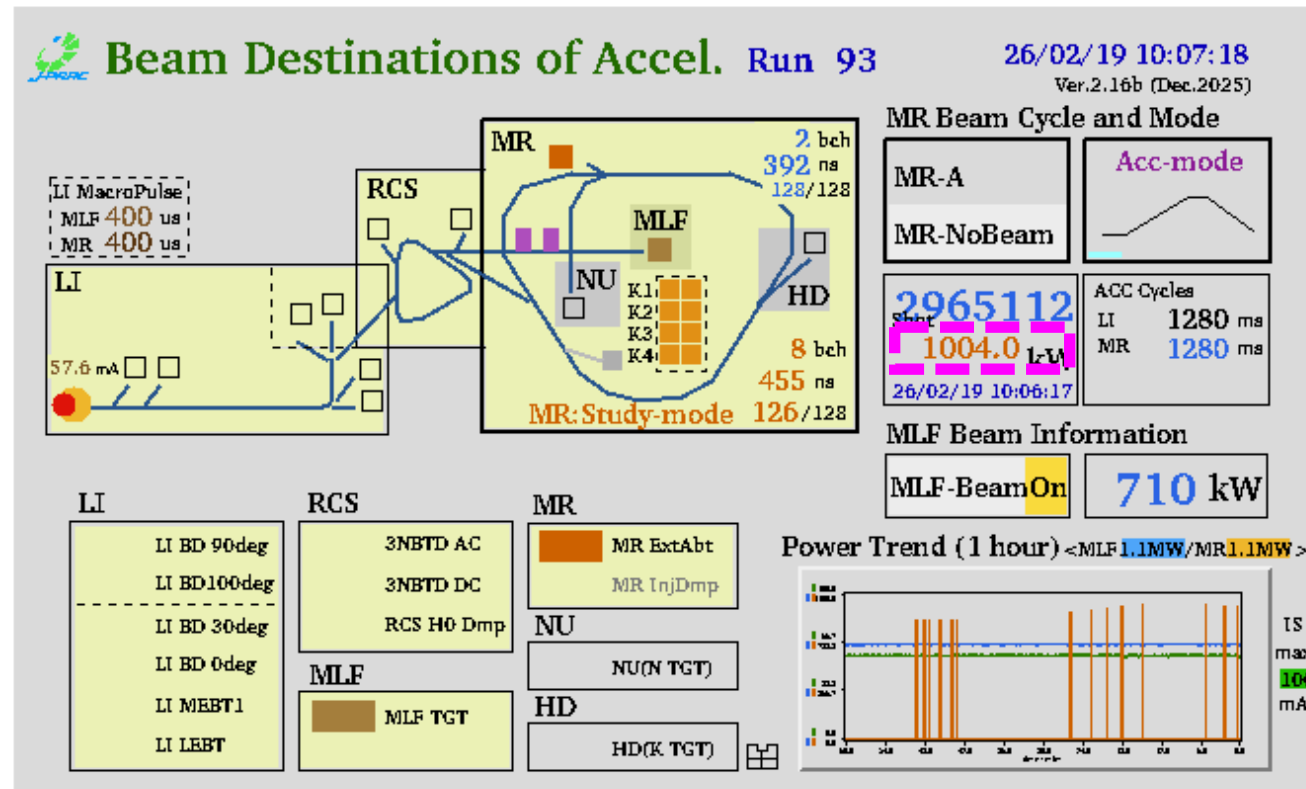
BL11
SoftX + HardX

The other
Multibeam are
realized
@ AI

Start with Material Science
input from various beam studies

19th Feb. J-PARC MR Achieved **1MW**
(highest power / pulse)

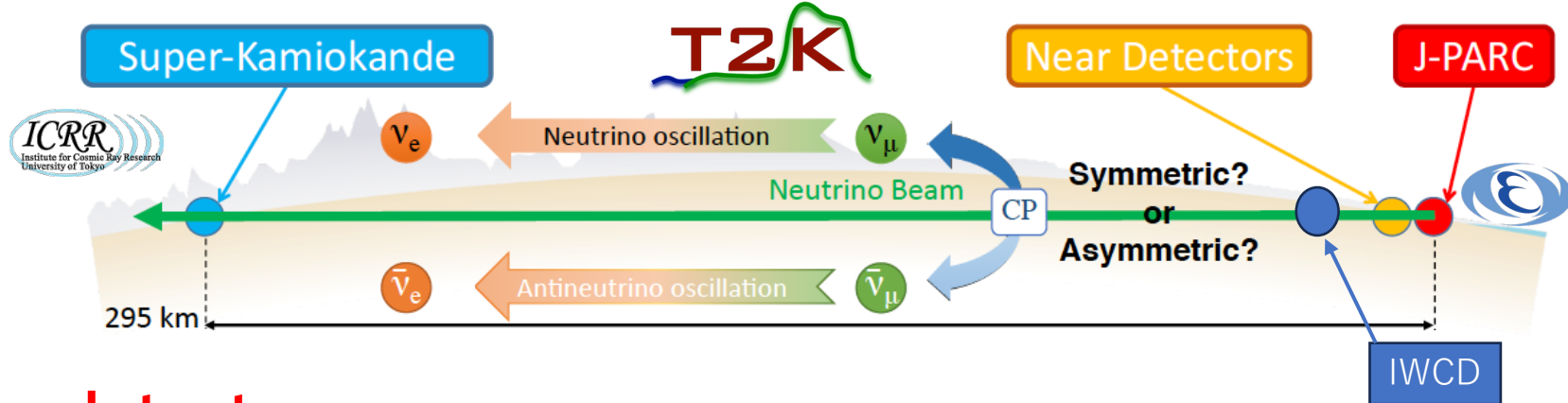
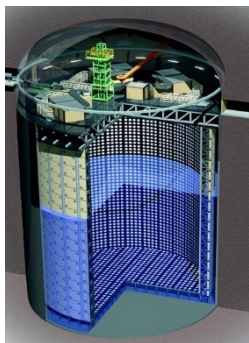
4th Apr. MR Slow extraction Achieved **101kW**
(World highest power)



- We continue T2K Program until the end of May 2027
(Many thanks for contributions to T2K)
- We start commissioning for HK (1.3MW operation) from June 2027.



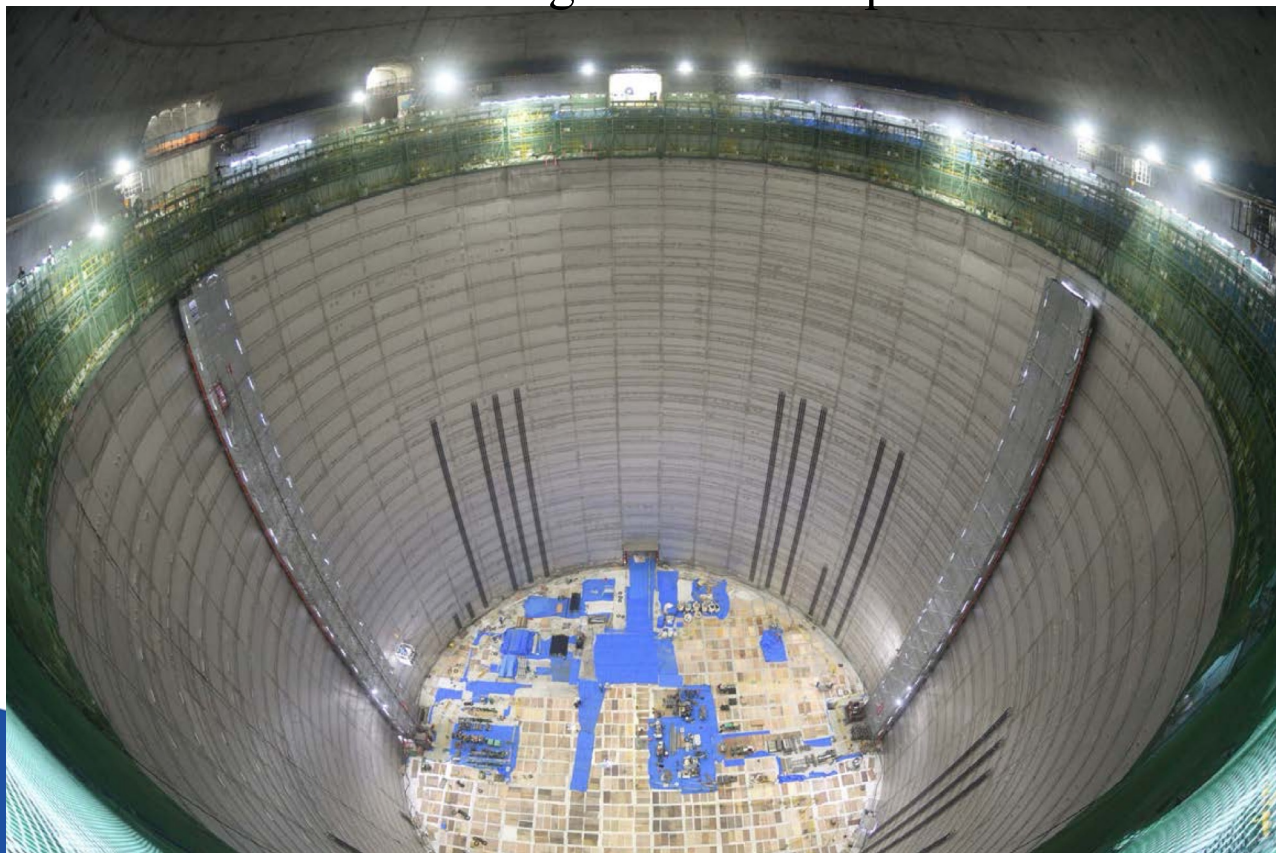
Smooth Transition
is crucial



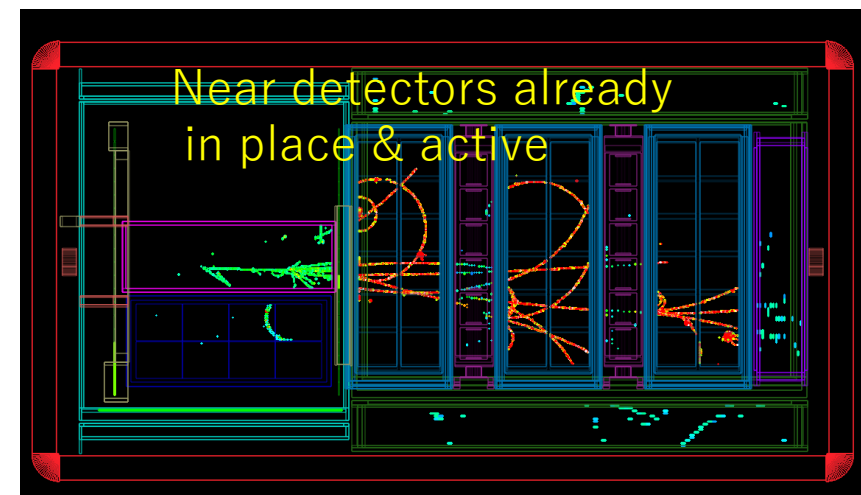
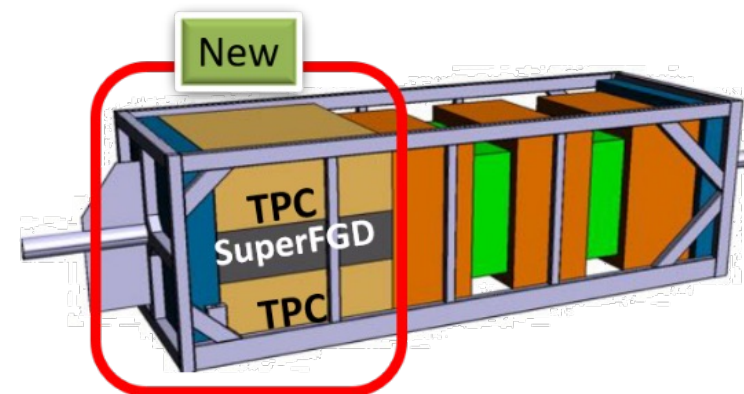
Unique program
We have 3 layer
of detectors

HK Far detector

The tank lining work is completed



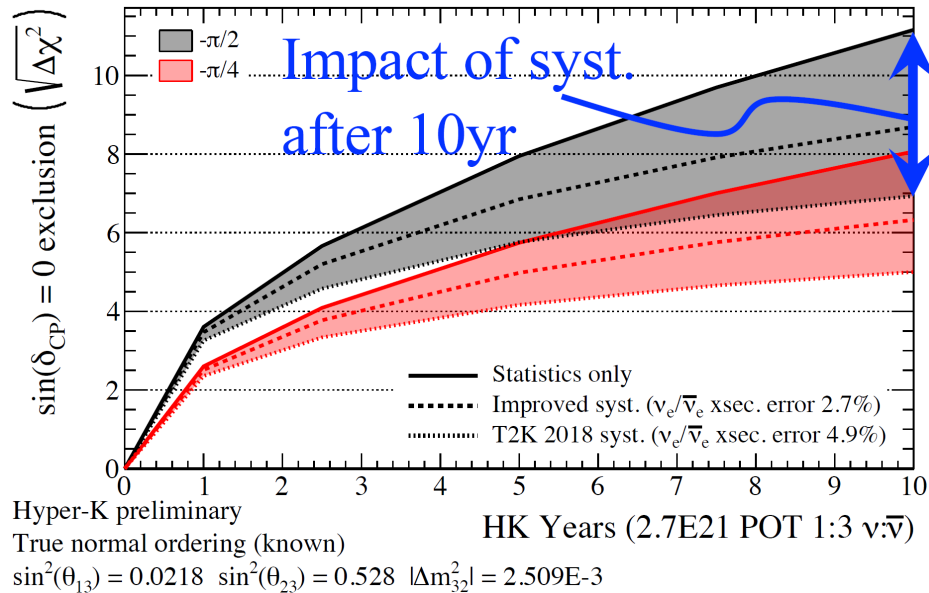
Near Detectors are Ready





IWCD key detector for discovery of CP violation

δ_{CP} Projected sensitivity to CPV



IWCD key detector for discovery of CP violation
We can reduce systematic error on water-neutrino Interaction significantly.

$\delta_{CP} = -\pi/2$ (3 years -> 2 years run for 5σ)
 $\delta_{CP} = -\pi/4$ (10 years -> 5 years run for 5σ)

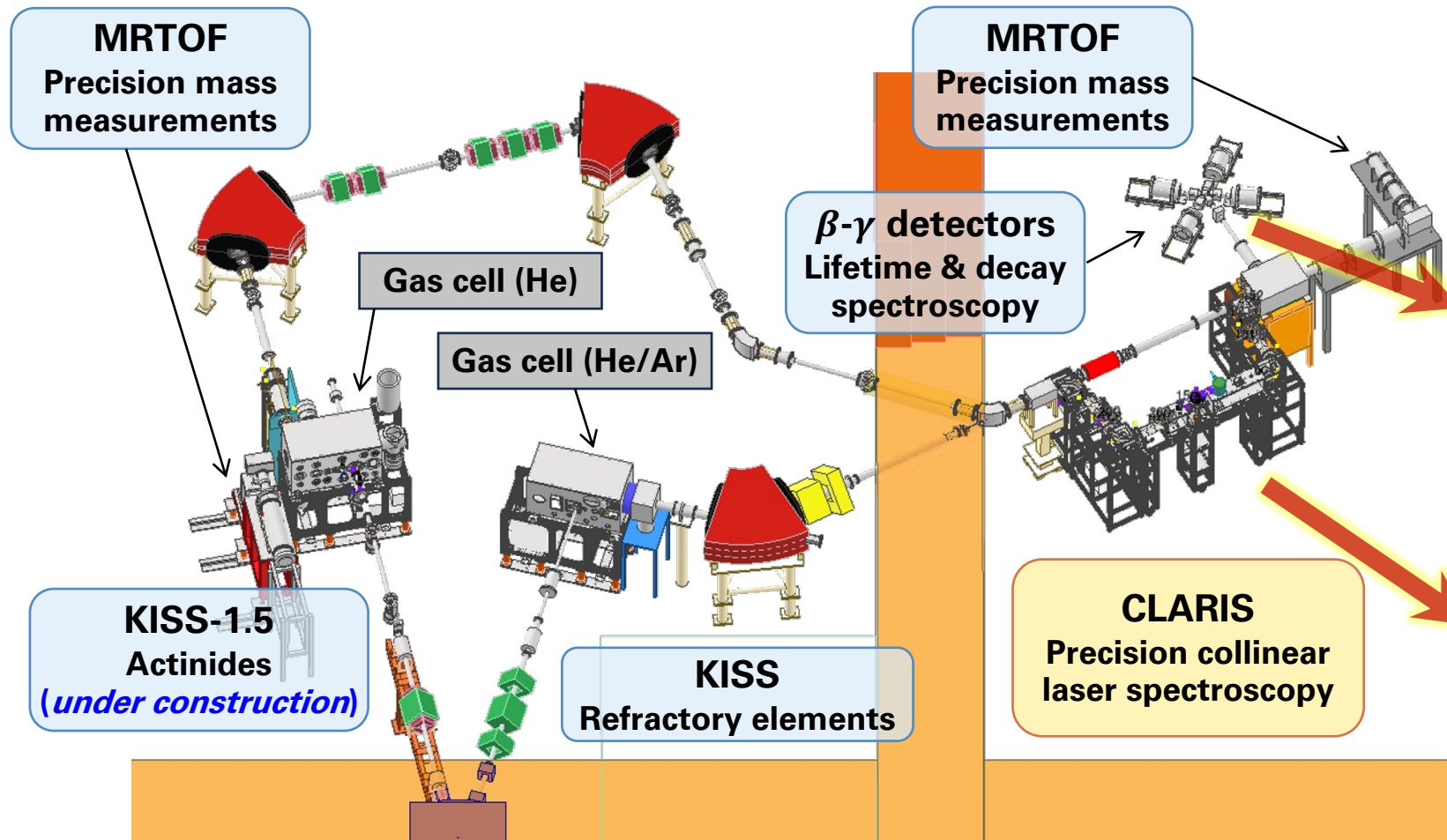
About half of Caisson are ready now.
Civil will be ready in the next summer.

**Schedule is very tight:
but keep schedule start in
2028 JFY**

2. KISS/KISS-1.5/CLARIS and Collaboration with TRIUMF

Many Japanese use ISAC

Toward unexplored neutron-rich nuclei and r-process nucleosynthesis



Nuclear data to be obtained

- ◆ Mass
- ◆ Lifetime
- ◆ Decay schemes
- ◆ Charge radii
- ◆ Electromagnetic moments
- ◆ Nuclear deformation
- ◆ Fission

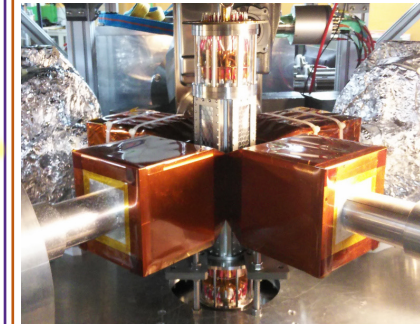
⋮

- Understanding r-process nucleosynthesis
- Origin of heavy elements
- Heavy-nucleus structure

KEK-TRIUMF Collaboration

β - γ spectroscopy

β - γ detectors



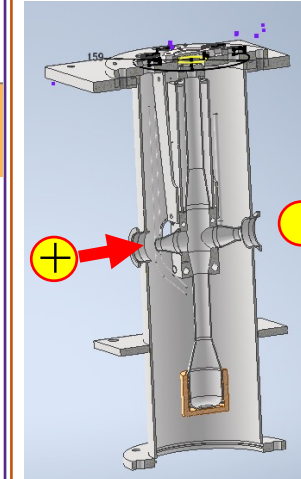
GRIFFIN DAQ system



GRIFFIN DAQ system introduced for KISS β - γ spectroscopy in 2020.

CLARIS

Neutralization (charge-exchange) cell



Ongoing joint development with TRIUMF

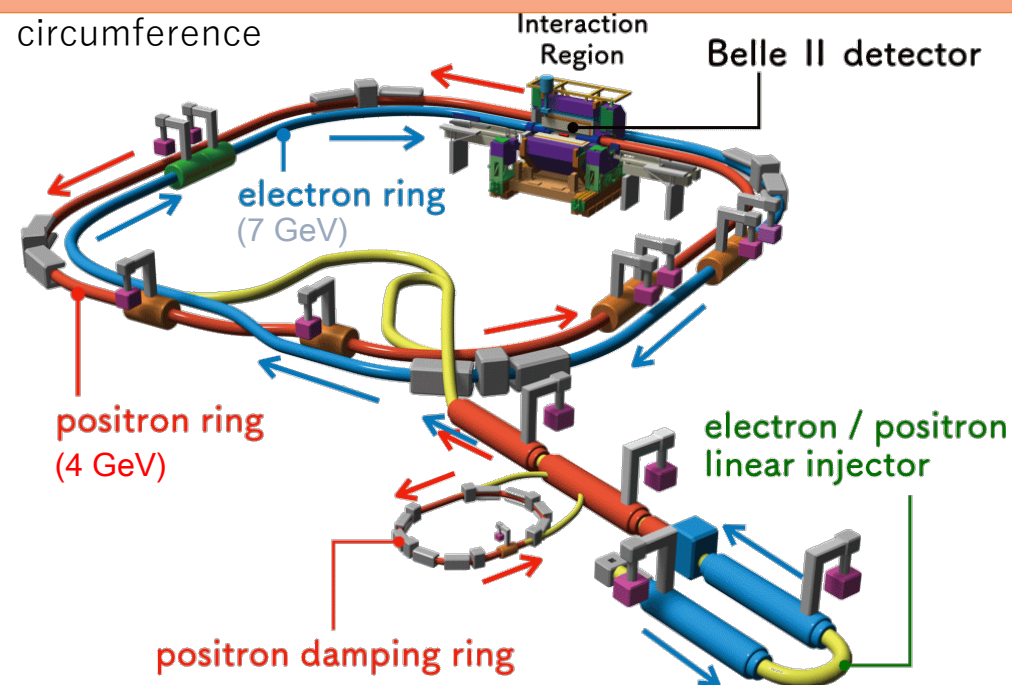
- ◆ Atomic collision with Rb vapor
- ◆ Commissioning soon

3.SuperKEKB / Belle II

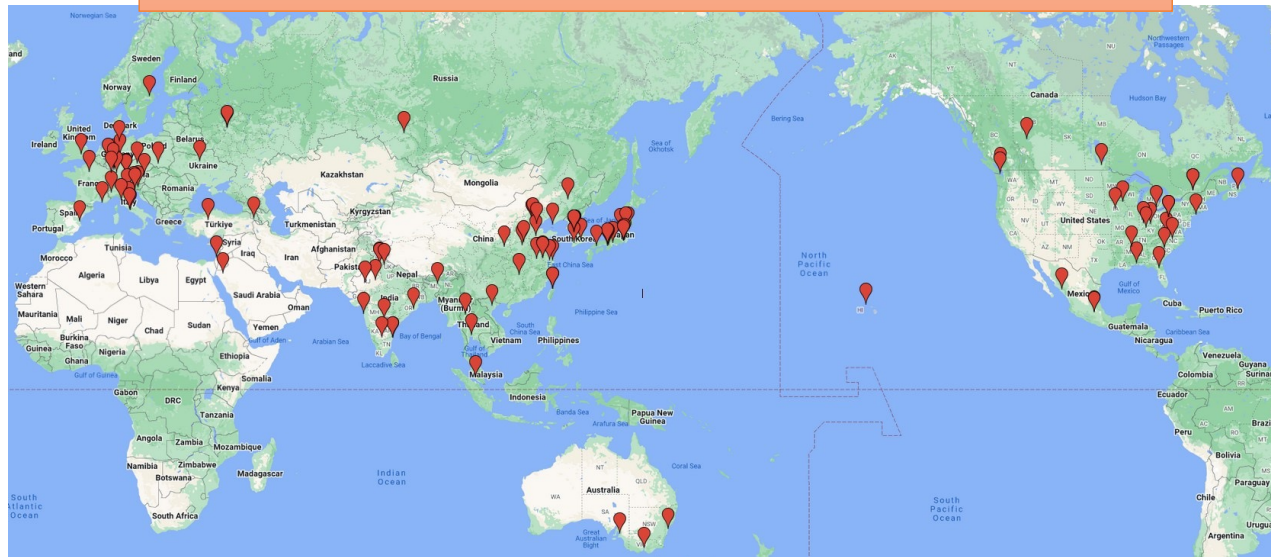
circumference

Interaction
Region

Belle II detector



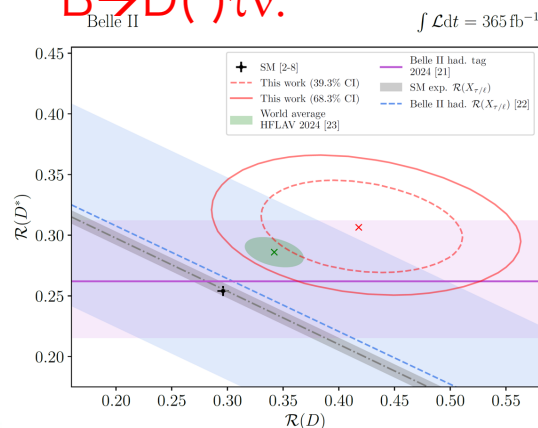
The world-highest Luminosity updated **Now**
 $5.3 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ (June. 2026)



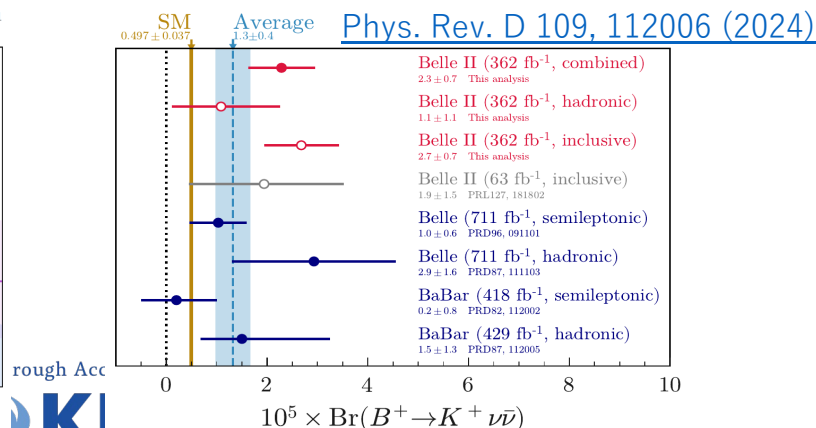
Belle II Collaboration:
>1200 members from 28 countries/regions

Many Interesting Topics,
 we can cover!!!

$B \rightarrow D^{(*)} \tau \nu$



$B \rightarrow K \nu \nu$



New Hadronic
 States
 for QCD
 (with AI)
 New era opens

Large contributions with 7 institutes

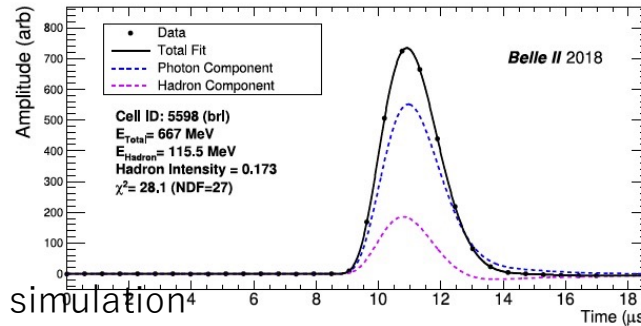
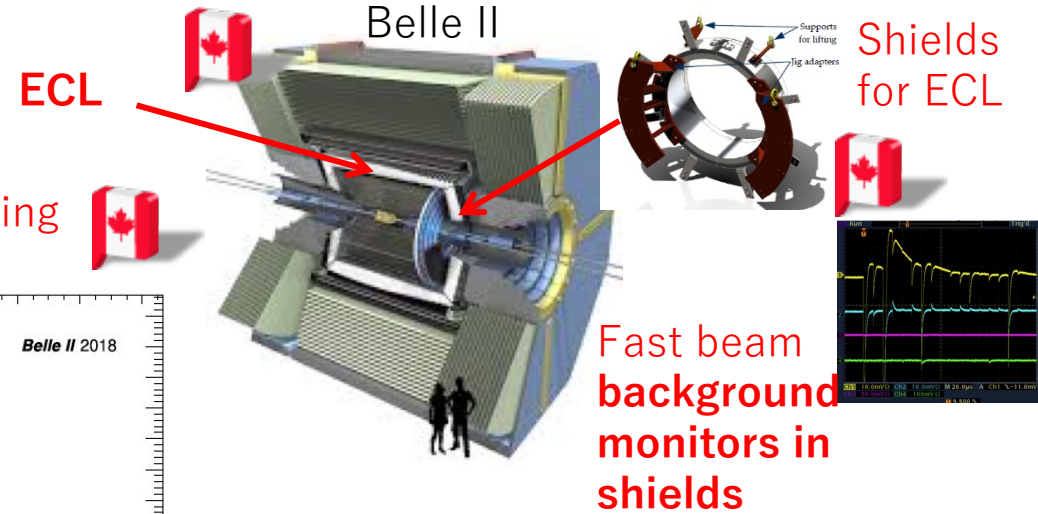
Canadian Groups contribute to Belle-II Detector/Physics

- Electromagnetic Calorimeter (ECL)
- Trigger Development:
- Background monitors:
 - ▶ In SuperKEKB tunnel and imbedded in ECL shield to understand beam backgrounds
- Belle II computing:
 - ▶ High Level Trigger hardware
 - ▶ Cloud computing personnel & facilities for data simulation and data analysis

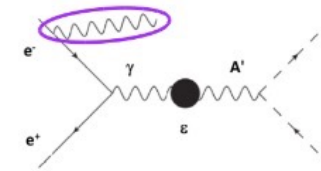
Big contribution

Thanks and we need more collaboration

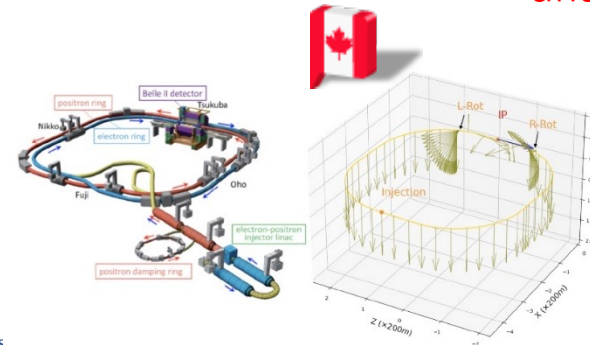
Canada has proposed the introduction of a polarized electron beam to SuperKEKB to enable precise measurements of electroweak physics through the "Chiral Belle" initiative.



Trigger for dark sector searches

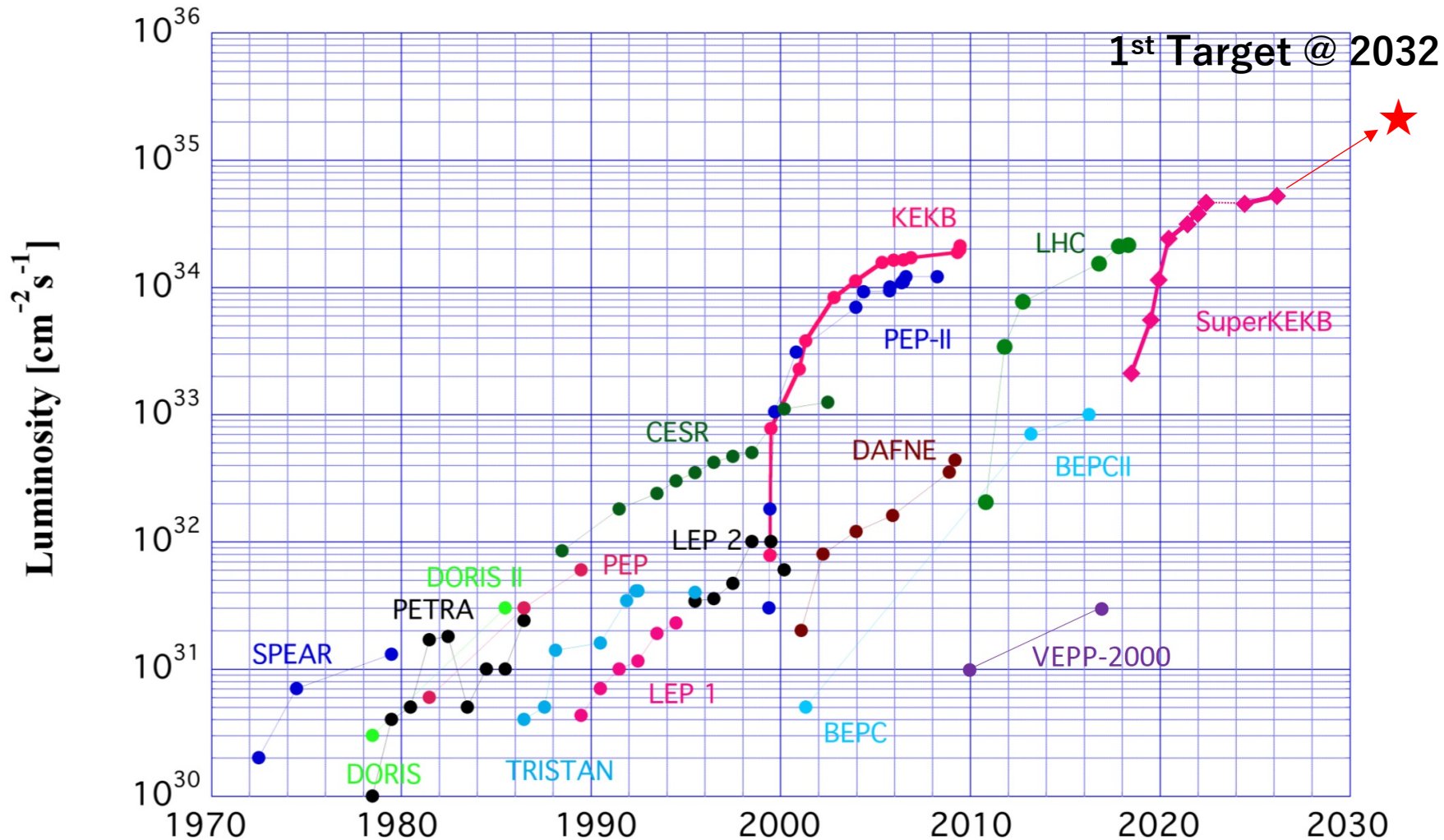


Victoria cloud **computing** provides ~15% of data analysis & MC production



R&D on Spin Rotators: enables new research frontier with polarized e-beams

Luminosity frontier



KEK and CERN start collaboration for SuperKEKB and FCCee.

SuperKEKB & FCCee have many synergies.

- High beam currents
- Nano Beam
- High Power Sources
- Beam dynamics

4. Quantum Center (QUP) in KEK starts

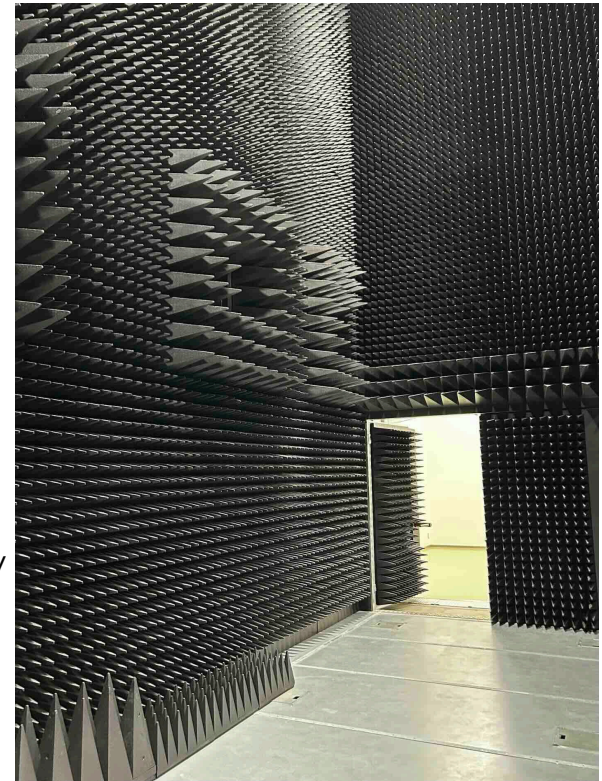


Director
Toshi Azuma
(AMO/muonic atom expert)

New Building / Experimental Hall

Kamioka Branch

Low Noise/
Low BG
are crucial



anechoic chamber



Quantum Center play key role in all KEK

TOYOTA CENTRAL R&D LABS



Application
Sensor
Q-Connection

academic-
industrial
Collab. office

Q-Sensor
Basic Science



Quantum
Material
using
multibeam

Mat.Lab



PP Lab



Accl. /WorkshopLabs.



KEK's Core Technologies
Quantum Beams,
Detector R&D, Cryogenics,
Superconducting Cavities,
Electronics

International Collaboration



ASPIRE



Study Q Material
(Various Quantum
beams prove spin/state
of atom, electron, nuclear)

Branch: Berkeley, JAXA, TCRDL

Sensor for Basic Science
Gravity
Q-Connection
Dark Matter detection

Insight through Accelerators.

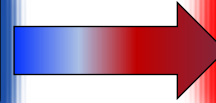


1) Quantum Eyes Opening the Weak-Coupling Frontier

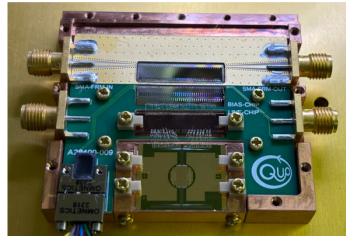
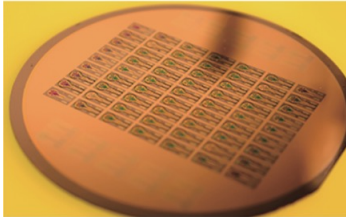
Integrating Quantum Sensing for Precision Measurements



Traditional High-Energy Frontier
(Accelerators)



New Weak-Coupling Frontier
(Quantum Eyes)



Pillar 1
Fundamental Forces
& Hidden Sectors

- TES for QED Test with Muonic Atoms

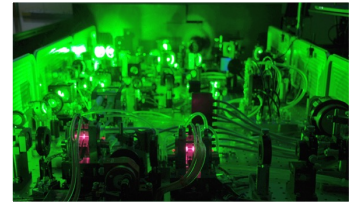
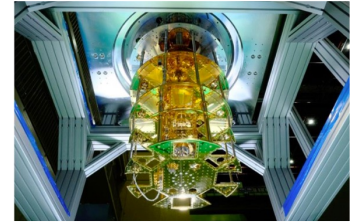
Pillar 2
Light Dark Matter

- Superconducting Qubits
- Kamioka TES
- NV Center Diamond

Pillar 3
Gravity

- Superconducting RF Cavities for GW
- Atomic Fountain for Antimatter Gravity

->
Fujiwara-san



Technology Advancement Platform — Superconducting Detectors | Semiconductor Detectors | CryoCMOS | D

Strategic Driver within KEK | Quantum Research Hub | Global Network (Berkeley • JAXA • Industry)

2) $Q \sim 3 \times 10^9$ Achieved for Bosonic Qubit

1.3GHz RF cavity for ILC

5.5GHz Cavity

Physical Review Applied
Editor's Suggestion

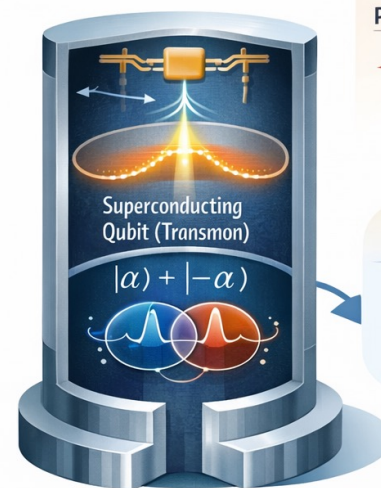
arXiv:2510.01819v2

New stable baking method developed
Q value is world-record (By Factor 2 FNAL)

Bosonic Qubit:

Error Correction and Quantum Operations

Bosonic Qubit in a Cavity



Error Correction

Photon Loss



-1 Photon

Photon Gain



+1 Photon

Phase Error



Phase Flip

Detect & Correct Errors

Encoded Qubit State

$$|\bar{0}\rangle = \frac{(|\alpha\rangle + |-\alpha\rangle)}{\sqrt{2}}$$

Quantum Operations



Logical Gates

$\bar{X}, \bar{Z}, \bar{H}$, etc.

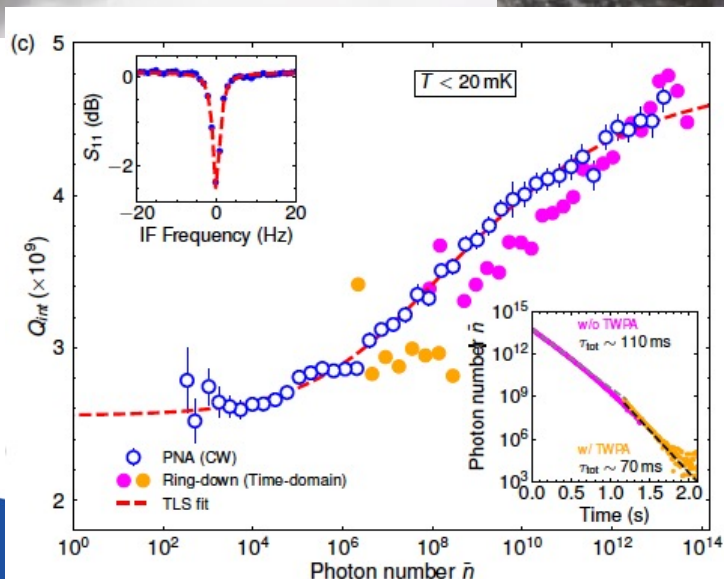
Entangling Operations



Bell State $|\psi\rangle =$

$$|\bar{00}\rangle + |\bar{11}\rangle / \sqrt{2}$$

Robust Quantum Information Processing

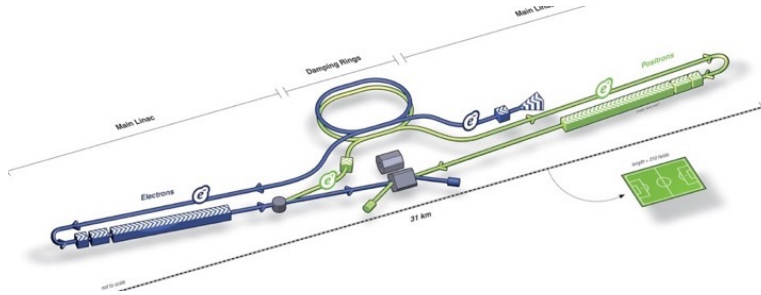


Insight through Ac



5. Three (Two?) Higgs Factories are proposed now

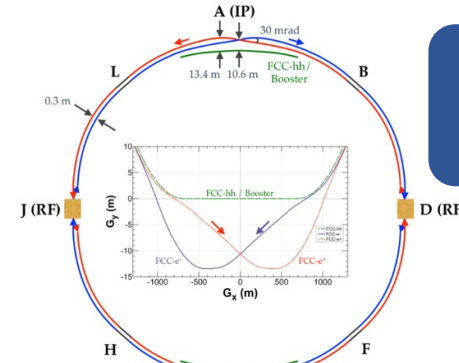
Power Consumption:120MW



ILC

E_{CM} extendable:
LC vision includes all technologies:
SC, HELEN, CCC, CLIC, Plasma

Energy Recovery Technology could lead to significantly reduced power consumption and much higher luminosity ($e^+ e^-$ reuse). Principle of energy recovery has been demonstrated by cERL:

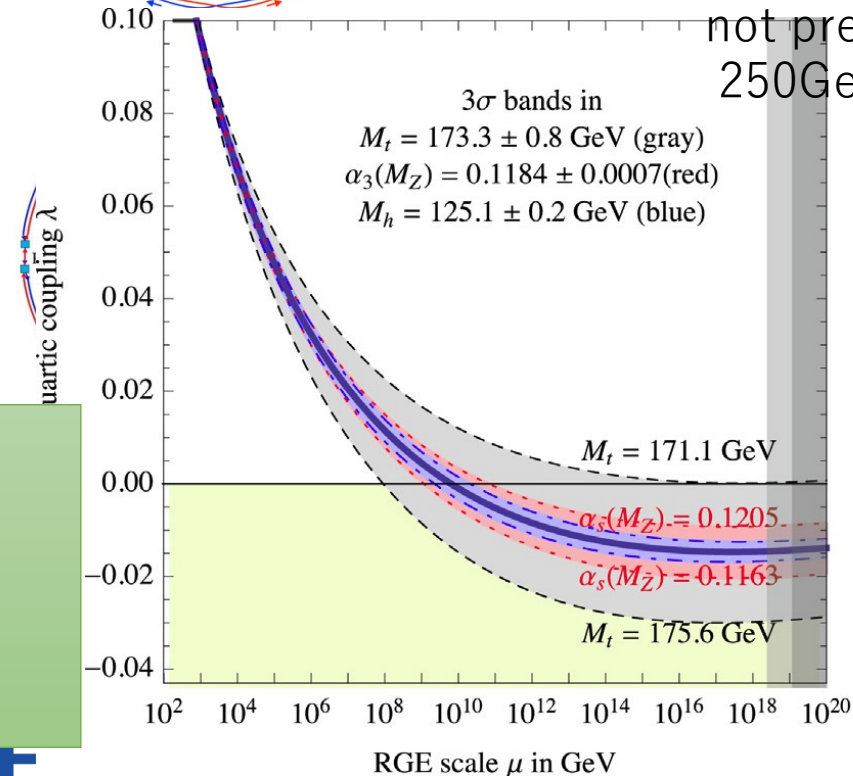


FCC-ee
(CERN)

16BSF

Power consumption
:300MW

Next Target is
EWSB / Self coupling
not precision @
250GeV



Extension of ILC Technology Network (ITN)

ITN is the global collaboration program.

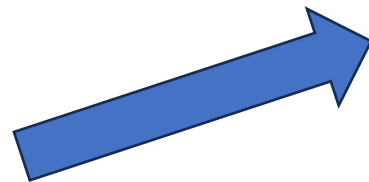


Current Activities based on
“ILC250 specific” work-package

e-, e+
Sources

Nano-
Beam

SRF



We are discussing with CERN / European Labs.
Let's join R&D for New technology

KEK/IDT/JHEP would like to extend not only for
“narrow sense” ILC but also the other R&D for
cutting edge technologies for Future collider;

**HG-SC Cavity, High Q cavity,
Energy Recover, Nano-beam, Powerful
sources.
Additionally
AI operation, Robotics for construction...**

Physics for Higgs Potential/ EW SB

Sakai-san will report
Younger Canadian (with EPECR) contributes

Insight through Accelerators.



Young career development program.

Mutual exchange under KEK-TRIUMF Exchange Program
for Early Career Researchers (EPECR) since 2018

派遣年度	2018	2019	2020	2021	2022	2023	2024	2025	2026	合計
日→加	1/1	1/1	0/0	0/0	1/1	2/2	2/2	1/1	2/3	10名
加→日	0/0	3/6	0/0	0/0	1/1	3/7	2/2	2/3	2/5	13名

We have good/long history
of our collaboration

Now the situation of the world is not good for Science,
Our Collaboration can help us. We have the same ideology.

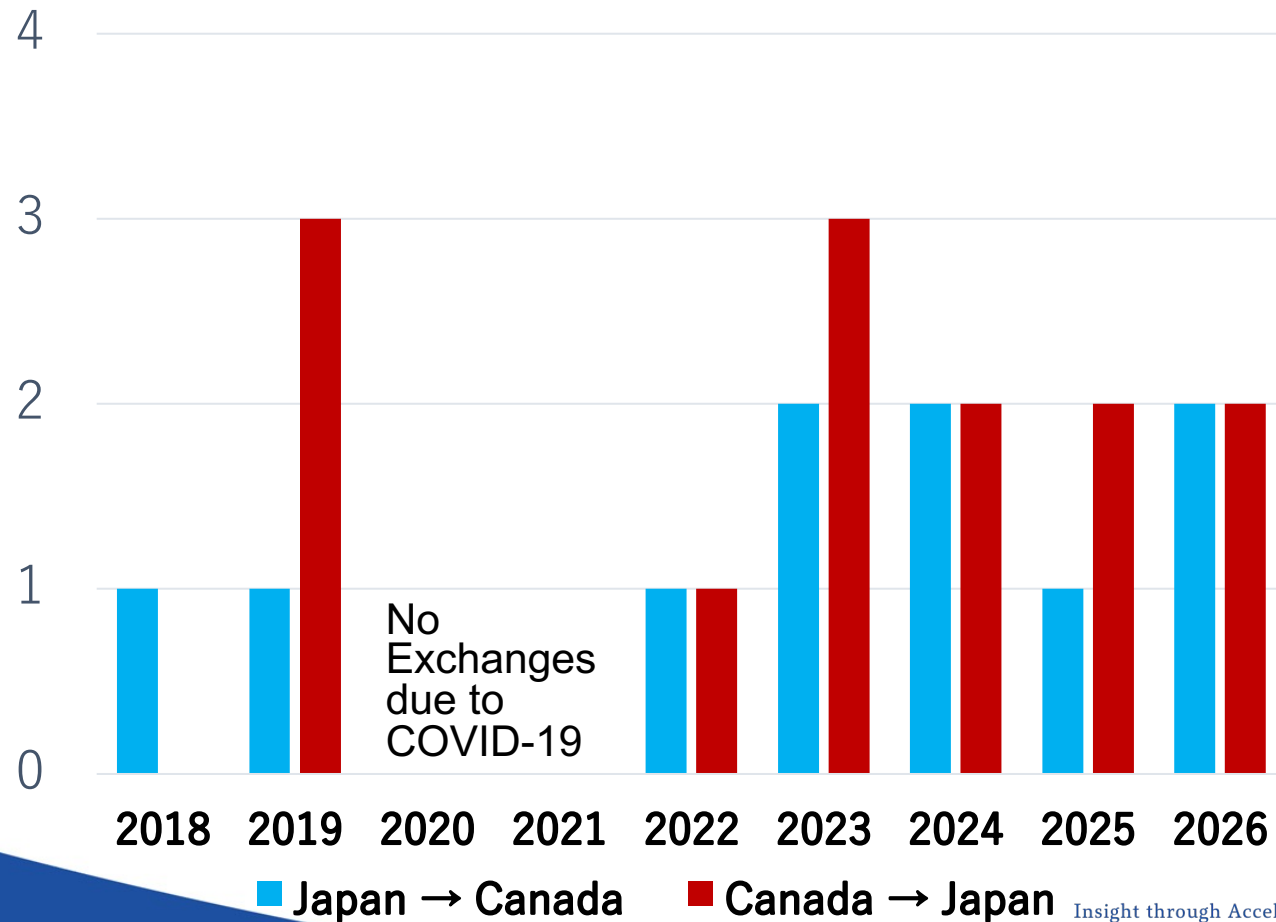
We keep current collaboration and have chance to extend new topics!

TUESDAY, SEPTEMBER 29	
9:00	Tour ARIEL and E-Linac focused (maybe Cyclotron Vault if ambitious)
11:30	Strategic Session Content TBD
12:30	Lunch
13:30	EPECR Talks (4 talks - 15 + 5 mins each) Content TBD
14:50	Closing
15:00	Break

Exchange Program for Early Career Researchers (EPECR)

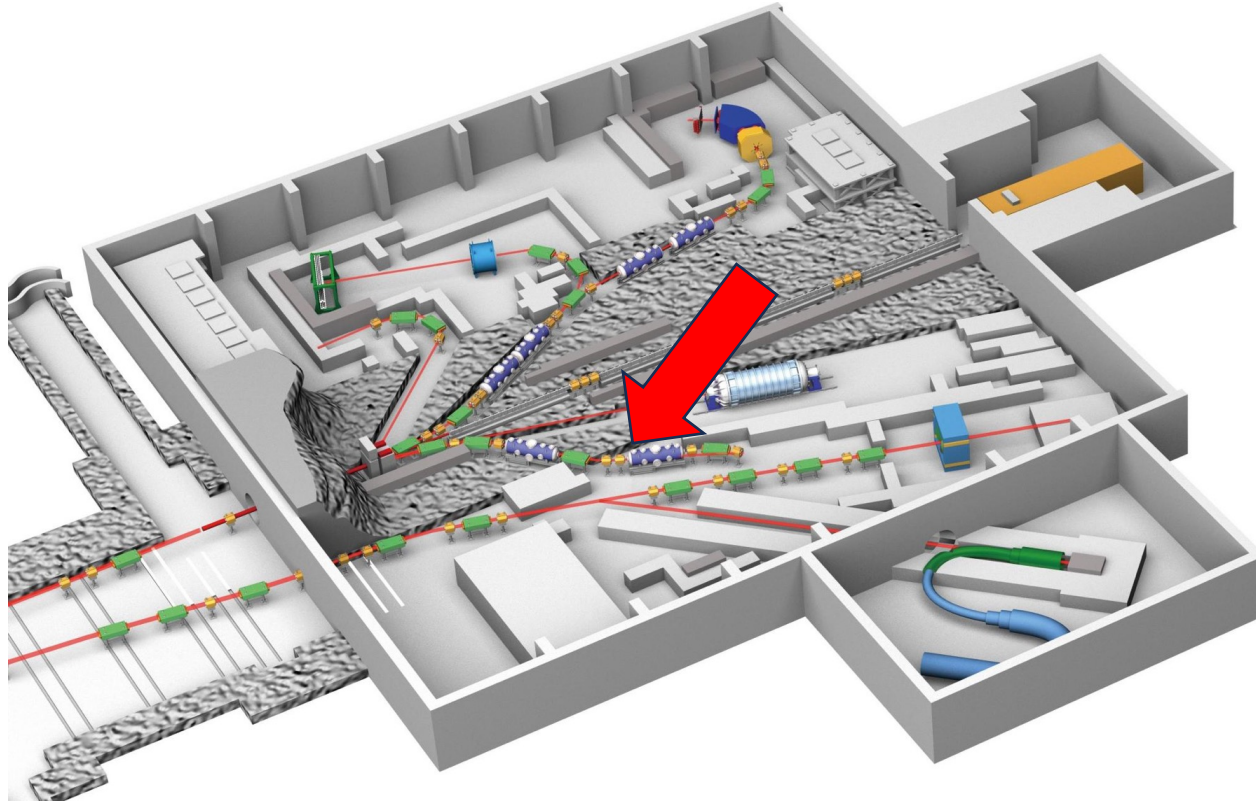
Eligible: **Postdocs & Graduate students** | Duration: **14 – 90 days**

Number of Exchanges by Year



Fields by Year

Year	Japan → Canada	Canada → Japan
2018	ACCL (1)	—
2019	TUCAN (1)	TUCAN (1), Neutrino (1), g-2 (1)
2022	TUCAN (1)	TUCAN (1)
2023	TUCAN (1), Material Science (1)	TUCAN (1), Material Science (1), ACCL (1)
2024	TUCAN (1), Material Science (1)	TUCAN (1), SKEKB (1)
2025	Material Science (1)	Material Science (1), ACCL (1)
2026	TUCAN (1), Neutrino (1)	TUCAN (1), ACCL (1)



Project Title:
 "Development of a Proton Beamline for Single-Event
 Evaluation
 Capable of Easily Switching Between Different Energy
 Levels and Particle Types"

Start ~2030 JFY

年度	2026	2027	2028	2029	2030
ビームライン					
機器設計・製造	←→				
機器設置・試験			←→		
実験室					
放射線遮へい設計・製造	←→				
放射線遮へい設置・エリア構築			←→		
モニター設計・製造		←→			
モニター設置・試験				←→	
実験装置設計・製造	←→				
実験装置設置・試験				←→	

▲ ステージゲート評価?

▲ 試験開始

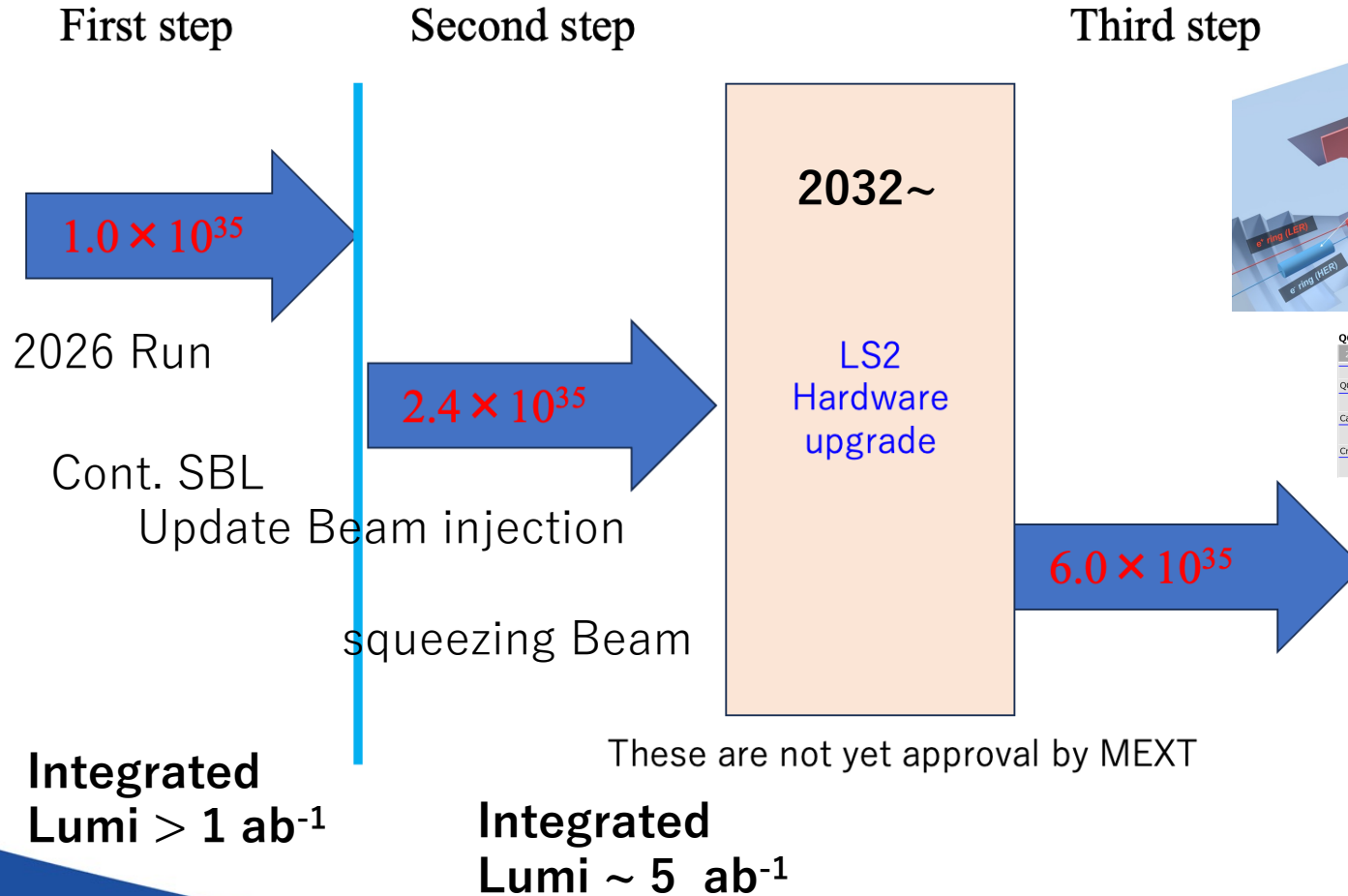
Beam Line for Beam test
 Beam Line for Kaon Physics...

Plan of SuperKEKB

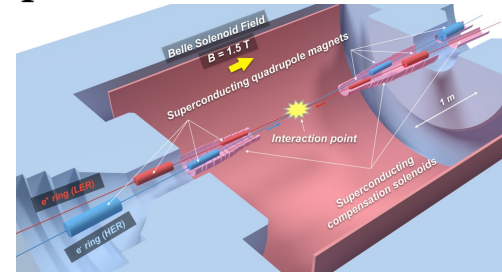
- 1) The Nb₃Sn technology for QCS magnet
- 2) Design IR region

Three steps

are considered.



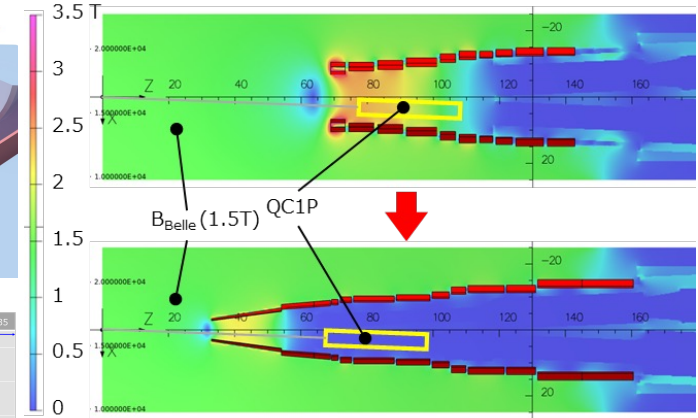
Third step



QCS upgrade schedule

The timeline chart displays the following milestones:

- QC1P Nb₂N R&D**: Starts in 2025, continues through 2028.
- Cancel solenoid design**: Occurs around 2027-2028.
- Cryostat design**: Occurs around 2029-2030.
- FWD side**: Includes **Proto -type** (around 2028) and **BWD side** (starting around 2030).
- Fabrication**: Occurs between 2030 and 2032.
- Installation**: Occurs between 2032 and 2034.
- LS2**: A red dot indicating a specific milestone or start point around 2032.
- Run2**: Labeled at the top around 2028.
- Run3**: Labeled at the top around 2034.



3) Accelerator AI operation



(semi hard
FPGA)