



# Empowered by Hitoshi

*Hitoshi Fest*  
*December 19, 2024*  
Naohito SAITO



Tsukuba Campus



Tokai Campus



**IPNS**  
Institute of  
Particle and  
Nuclear Studies

**IMSS**  
Institute of  
Materials  
Structure Science

**QUP**  
International Center  
for Quantum Field  
Measurement Systems  
for Studies of Particle  
and Universe

**ACCL**  
Accelerator  
Laboratory

**ARL**  
Applied Research  
Laboratory

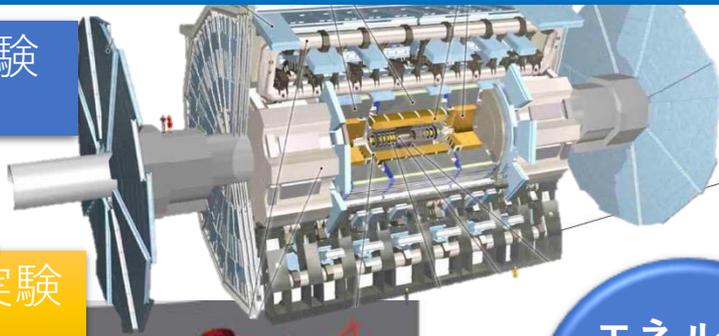
**J-PARC**  
Japan Proton  
Accelerator  
Research  
Complex

Tsukuba Campus

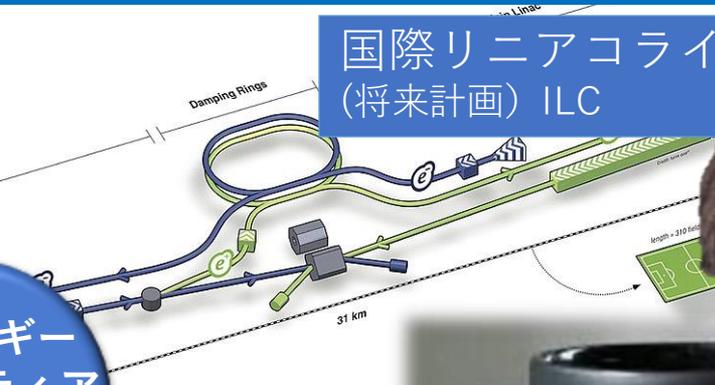


Tokai Campus

ATLAS実験  
(CERN)

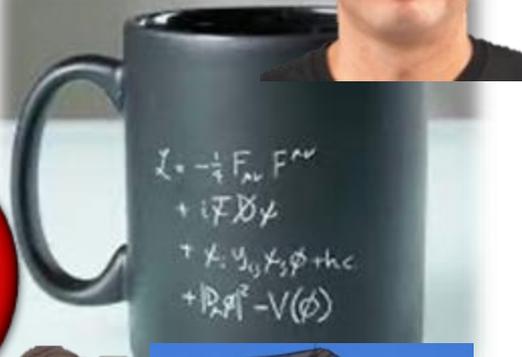


国際リニアコライダー計画  
(将来計画) ILC



エネルギー  
フロンティア  
Energy  
Frontier

理論物理  
Theoretical  
Physics

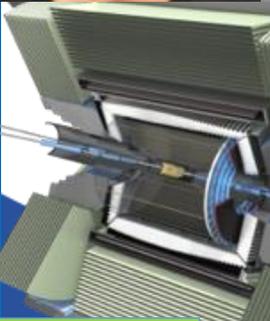


KOTO実験  
(J-PARC)

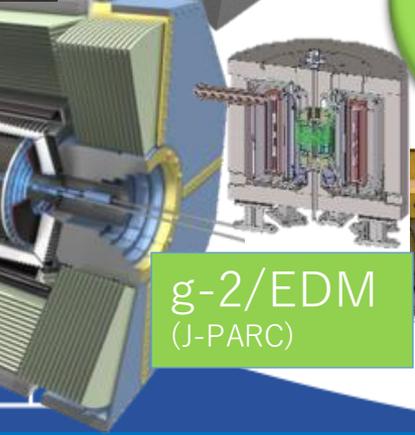


COMET実験  
(J-PARC)

フレーバー  
物理  
Flavor  
Physics



Belle-II  
(KEKB)



g-2/EDM  
(J-PARC)

宇宙  
素粒子物理  
Astro-Particle  
Physics

POLARBEAR  
(Chile)



UCN  
(TRIUMF)



T2K and Hyper-K  
(J-PARC & Kamioka)

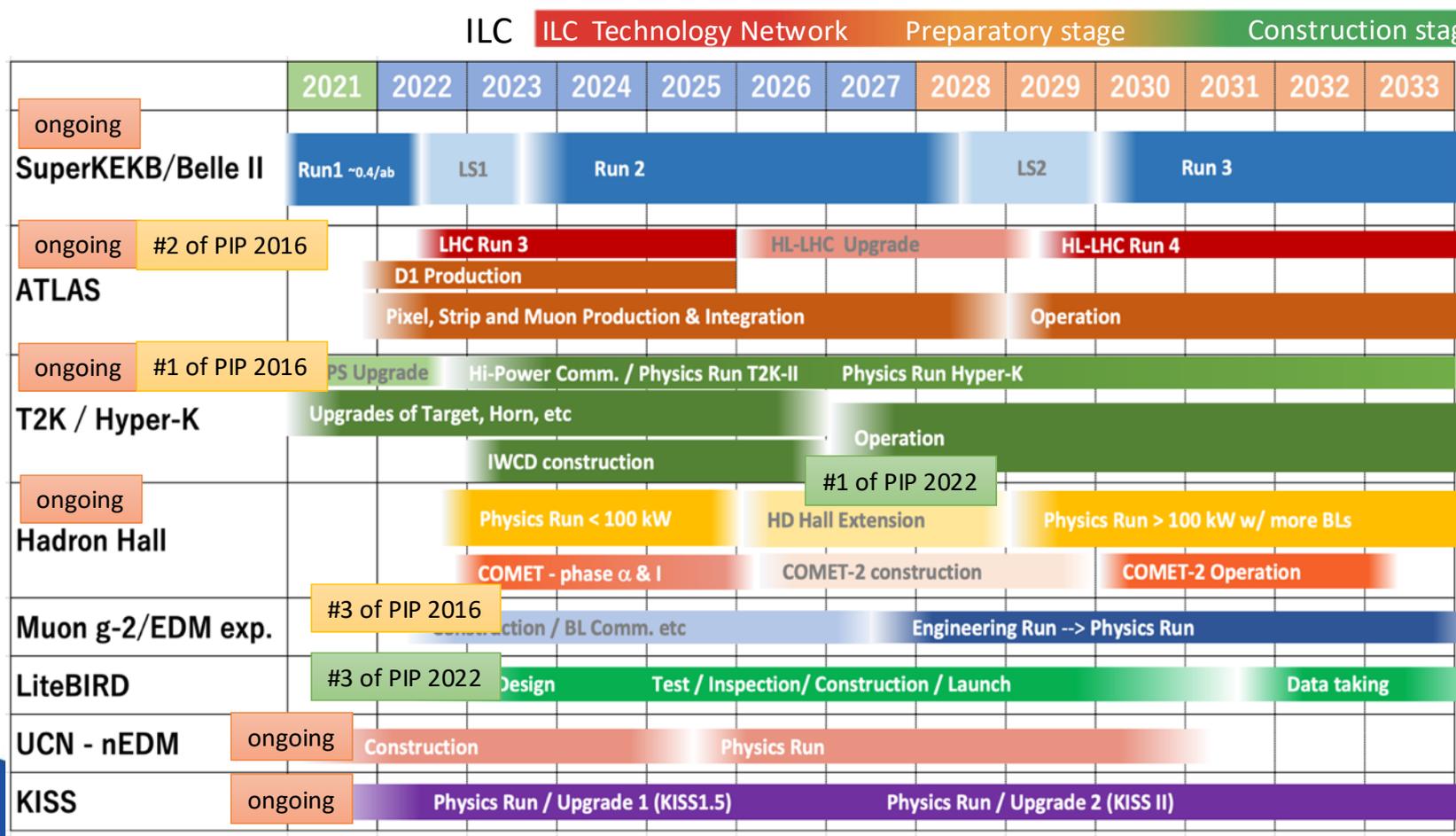


# The Timeline + Under Revision!

- Aggressive version of intended schedule by IPNS.
- PIP = Project Implementation Plan

- PIP2016
1. Hyper-K /J-PARC upgrades
  2. HL-LHC
  3. muon g-2/EDM
  4. HEF extension

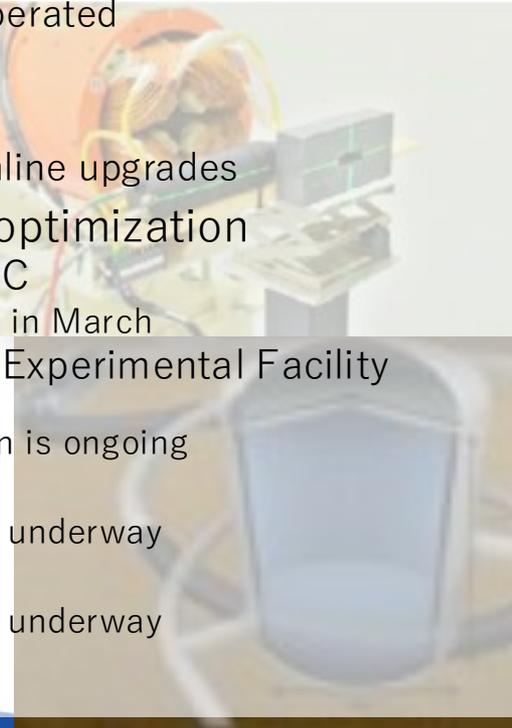
- PIP2022
1. HEF extension
  2. HL-LHC++
  3. LiteBIRD
  4. Muon Microscope



Will start future plan

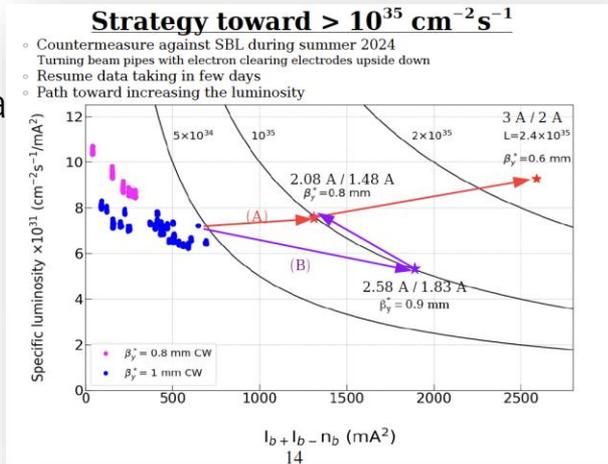
# IPNS Projects Current Status

- Belle II
  - Just started the beamtime after “summer” maintenance.
  - Physics Analyses are ongoing
- J-PARC MR Beam > 800 kW
  - Beamtime, Aging and New Initiatives
- LHC Run3 : done for this years’ pp run.
  - Detectors and Magnets are being prepared towards HL-LHC
- ITDC
  - Test beamline is being operated
  - R&D platforms are active
- Hyper-K construction
  - IWCD construction/Beamline upgrades
- PIP 2022 realization and optimization
  - Muon g-2/EDM@J-PARC
    - Annual review is held in March
  - Optimization of Hadron Experimental Facility Extension (HEF-ex)
    - Core group discussion is ongoing
  - COMET Review
    - Post-review action is underway
  - LiteBIRD Review
    - Post-review action is underway

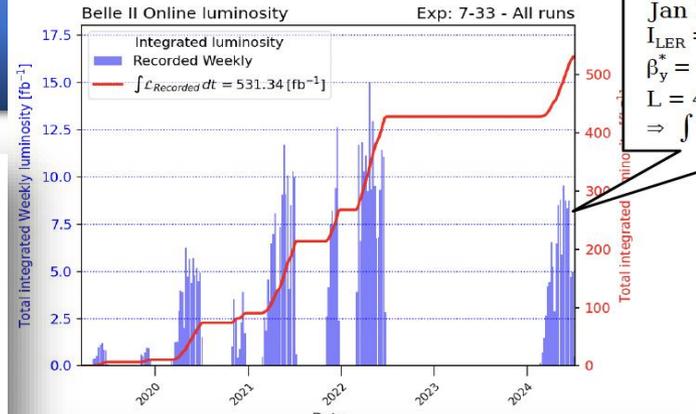


# NO Beam, NO Life!

- SuperKEKB
  - We are working very hard to improve the luminosity...
- J-PARC
  - Will resume in mid-January. >800 kW for FX and >70kW for SX is expected.
- We are very sorry for the sudden schedule change due to the MLF problems, and thank you very much for accommodating the change of part of the Nov-Dec. MR/FX beam-time to Mar.



## Situation in 2024a/b...



Jan 2  
 $I_{\text{LER}} =$   
 $\beta_y^* = 0$   
 $L = 4$   
 $\Rightarrow \int I$

## Search for $B \rightarrow K^* \tau \tau$ decays [PRELIMINARY]

Combinations of 4 categories:  $\Gamma^{\Gamma}, 1\alpha, \alpha\alpha, \rho X$

BDT trained using missing energy, extra cluster energy in EM calorimeter,  $M(K^* \tau), q^2, \dots$

BDT output  $\eta$  (BDT) is used to extract signal yield with a simultaneous fit to 4 categories

**Validation**

- total efficiency and peaking  $B^0 \bar{B}^0: B \rightarrow J/\psi K^* \tau$  sample, replace  $J/\psi K^* \tau$  with  $K^* \tau \tau$  (14% uncertainty)
- Non-peaking BB: sample with  $B_{\text{sig}}$  and  $B_{\text{tag}}$  having same flavor
- $q\bar{q}$  background is scaled by off-resonance data

**Belle II ( $364 \text{ fb}^{-1}$ ) BF ( $B \rightarrow K^* \tau \tau$ )  $< 1.8 \times 10^{-3}$  @ 90% C.L.**

**The most stringent limit among the results for  $b \rightarrow s \tau \tau$  transition**

Twice better with only half sample wrt Belle I  
 B-tagged  $B^0 \bar{B}^0$  sample,  $\tau$  classifier...



### Beam Destinations of Accel. Run 92

24/11/28 09:31:38 Ver. 2.15 (Jan.2024)

LI MacroPulse, MLF 50 us, MR 300 us, 61.8 mA

MR Beam Cycle and Mode: MR-BeamOn, MR-B(BeamRun), Acc-mode

Shot 86004, LI 1360 ms, MR 1360 ms, 515.9 kW, 24/11/28 09:31:38 beam to NU

MLF Beam Information: MLF-Off, 0 kW

Power Trend (1 hour) <MLF IMW/MR IMW>

LI: LI BD 90deg, LI BD 100deg, LI BD 30deg, LI BD 0deg, LI MEBT1, LI LEBT

RCS: 3NBTD AC, 3NBTD DC, RCS H0 Dmp

MR: MR ExtApt, MR InjDmp

MLF: MLF TGT

NU: NU(N TGT)

HD: HDG TGT

TS max 100 mA

# Muon Acceleration@J-PARC

- Muon beam was cooled and accelerated with RF for the first time!
- It will contribute to
  - Ultra-precision measurement of  $g-2/EDM$  at J-PARC.
  - Muon Collider in a future.
- Muon tomography for scanning a large construction, e.g. pyramid

Acceleration of positive muons by a radio-frequency cavity

S. Arimoto,<sup>1</sup> K. Futatsukawa,<sup>2</sup> H. Hara,<sup>3</sup> K. Hayasaka,<sup>4</sup> Y. Ibaraki,<sup>5</sup> T. Ichikawa,<sup>6</sup> T. Iijima,<sup>5,6</sup> H. Iinuma,<sup>7</sup> Y. Ikeda,<sup>2</sup> Y. Imai,<sup>3,8</sup> K. Inami,<sup>3,8</sup> K. Ishida,<sup>2</sup> S. Kamal,<sup>8</sup> S. Kamioka,<sup>2,9</sup> N. Kawamura,<sup>2</sup> M. Kimura,<sup>2</sup> A. Koda,<sup>2</sup> S. Koji,<sup>3</sup> K. Kojima,<sup>9,10</sup> A. Kondo,<sup>3</sup> Y. Kondo,<sup>9</sup> M. Kuzuba,<sup>7</sup> R. Matsushita,<sup>1</sup> T. Mibe,<sup>3</sup> Y. Miyamoto,<sup>3</sup> J. G. Nakamura,<sup>2</sup> Y. Nakazawa,<sup>7,11</sup> S. Ogawa,<sup>10,11</sup> Y. Okazaki,<sup>2</sup> M. Otani,<sup>2</sup> S. Oyama,<sup>1</sup> N. Saito,<sup>2</sup> H. Sato,<sup>7</sup> T. Sato,<sup>1</sup> Y. Sato,<sup>4</sup> K. Shimomura,<sup>2</sup> Z. Shioya,<sup>11</sup> P. Strasser,<sup>2</sup> S. Sugiyama,<sup>3</sup> K. Suiji,<sup>9,11</sup> K. Suzuki,<sup>2</sup> Y. Takeuchi,<sup>11,12</sup> M. Tanida,<sup>11</sup> J. Tojo,<sup>11,10</sup> K. Ueda,<sup>3</sup> S. Uetake,<sup>2</sup> X. H. Xie,<sup>12,13</sup> M. Yamada,<sup>11</sup> S. Yamamoto,<sup>2</sup> T. Yamazaki,<sup>2</sup> K. Yamura,<sup>4</sup> M. Yoshida,<sup>2</sup> T. Yoshioka,<sup>10,11</sup> and M. Yotsuzuka<sup>14</sup>

<sup>1</sup> Graduate School of Science, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan  
<sup>2</sup> High Energy Accelerator Research Organization, Ibaraki 319-1106, Japan  
<sup>3</sup> Research Institute for Interdisciplinary Science, Okayama University, Okayama 700-8530, Japan  
<sup>4</sup> Institute of Science and Technology, Niigata University, Niigata 950-2181, Japan  
<sup>5</sup> Graduate School of Science, Nagoya University, Nagoya, Aichi 464-8602, Japan  
<sup>6</sup> Kobayashi-Maskawa Institute for the Origin of Particles and the Universe, Nagoya University, Nagoya, Aichi 464-8602, Japan  
<sup>7</sup> Graduate School of Science and Engineering, Ibaraki University, Mito, Ibaraki 310-8512, Japan  
<sup>8</sup> Laboratory for Advanced Spectroscopy and Imaging Research (LASIR), Department of Chemistry, University of British Columbia, Vancouver, BC, V6T 1Z1, Canada  
<sup>9</sup> Japan Atomic Energy Agency (JAEA), Tokai, Naka, Ibaraki 319-1195, Japan  
<sup>10</sup> Research Center of Advanced Particle Physics, Kyushu University, Fukuoka, Fukuoka 819-0395, Japan

h] 15 Oct 2024

**nature**

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NEWS | 24 October 2024

planes were  $0.85 \pm 1$ , respectively. The  $1 \times 10^9$  (horizontal) the way to realize material science, and

## Physicists tame fundamental muon particles into highly controlled beam for first time

The milestone is an important step towards building smaller, cheaper particle colliders.

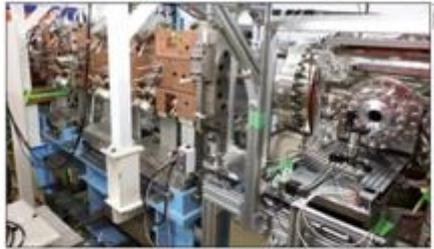


# CERN COURIER

July/August 2024, cerncourier.com Reporting on international high-energy physics

## ACCELERATOR PHYSICS Muons cooled and accelerated in Japan

In a world first, a research group working at the J-PARC laboratory in Tokai, Japan, has cooled and accelerated a beam of antimatter muons ( $\mu^+$ ). Though muon cooling was first demonstrated by the Muon Ionisation Cooling Experiment in the UK in 2020 (CERN Courier March/April 2020 p7), this is the first time that the short-lived cousins of the electron have been accelerated after cooling – an essential step for applications in particle physics.



**World first** The experimental set up for muon cooling and acceleration at J-PARC. A beam of antimatter muons enters the apparatus from the right.

The cooling method is ingenious – and completely different to ionisation cooling, where muons are focused in absorbers

to reduce their transverse momentum. Instead,  $\mu^+$  are slowed to 0.002% of the speed of light in a thin silica-aerogel target, capturing atomic electrons to form muonium, an atom-like compound of an antimatter muon and an electron. Experimenters then ionise the muonium using a laser to create a near monochromatic beam that is reaccelerated in radiofrequency (RF) cavities. The work builds on the acceleration of negative muonium ions – an antimatter muon bonded to two electrons – which the team demonstrated in 2017 (CERN Courier July/August 2018 p8). Though the analysis is still to be finalised, with results due to be published soon, the cooling and acceleration effect is unmistakable. In accelerator physics, cooling is traditionally quantified by a reduction in beam emittance – an

# Summer Challenge Since 2007

## Summer School for Undergrads



- More than 1,500 graduates over 18 years!
- Hot 9 days of Lectures and Lab Course at KEK
- Hitoshi served as Distinguished Lecturer many times!



# Spring School for High Energy Physics

April, 2016



Just arrived  
directly from the airport!



Tomoto-san



# Public Lecture at Neutrino 2012 in Kyoto



Nakaya-san

# Public Lecture at the 10<sup>th</sup> Anniversary of J-PARC

September, 2019





# 宇宙物質生命

市民公開講座

場所：つくば国際会議場 3階中ホール 300

参加無料

J-PARC (大強度陽子加速器施設) は、基礎物理から産業応用まで幅広い分野で最先端研究が行われています。2009年のJ-PARC全施設の利用運転開始から10周年を記念して、市民公開講座を開催いたします。対象は中・高校生以上ですが、どなたでもご参加いただけます。

## 9.23

祝

の起源を求めて

第一部		モデレーター	
<p>10時~</p>  <p>齊藤 直人 J-PARC センター / 東京大学大学院理学系研究科</p>	<p>11時~</p>  <p>村山 斉 東京大学 Kavli IPMU / カリフォルニア大学バークレー校</p>		
第二部			
<p>13時30分~</p>  <p>加藤 晃一 自然科学研究機構 生命創成研究センター</p>	<p>14時30分~</p>  <p>岸本 浩通 株式会社 エヌエムエー 分析センター</p>	<p>15時30分~</p>  <p>榎田 隆章 東京大学宇宙線研究所</p>	 <p>横山 広美 東京大学 Kavli IPMU</p>

お問い合わせ [j-parc2019\\_secretariat@j-parc.jp](mailto:j-parc2019_secretariat@j-parc.jp)



文部科学省 EXPO'70 FUND 東海村

# The 30<sup>th</sup> Anniversary of US-Japan Cooperation for High Energy Physics



# Inauguration of Next-Generation Neutrino Science Organization

October 1, 2017



祝 東京大学次世代ニュートリノ科学連携研究機構発足式

Shiozawa-san



# Belle II

Quest for the origin of CPV and beyond

Hitoshi in front of Belle II

shooting for NHK TV program

“COSMIC FRONT”



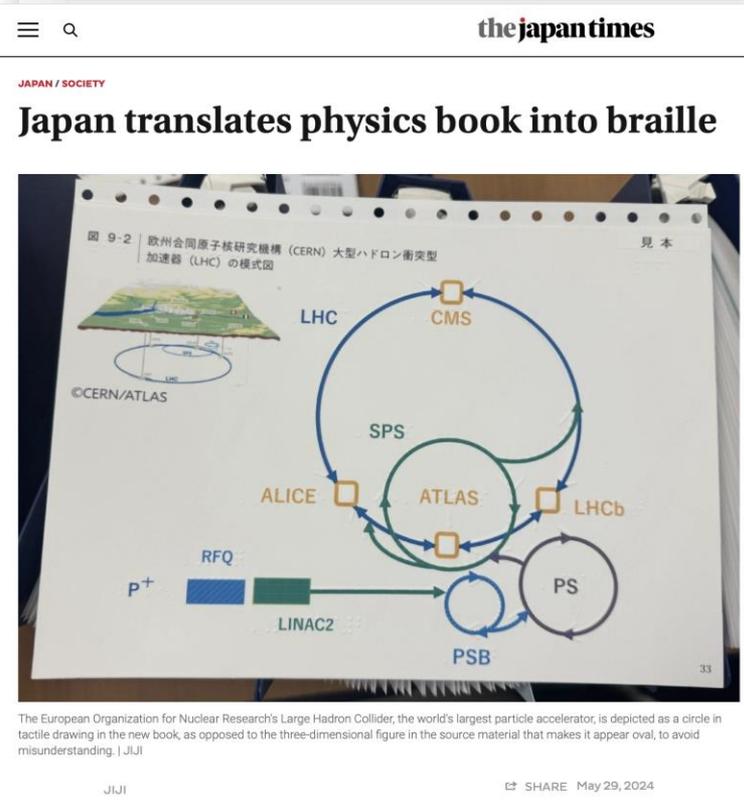
# 点字本プロジェクト「宇宙と物質の起源」

## Braille Book Project "Origin of Matter and Universe"

筑波技術大学 x 素核研で、多くの人に基礎科学のエッセンスを！

### 点字本「宇宙と物質の起源」の制作について

「私たちはなぜ存在」根源的な問いをみんなで



点字本「宇宙と物質の起源」収録の触図（左）と確認をしている様子（右）



Also on **audible**

# CERNCOURIER

# Happy 60<sup>th</sup> Anniversary!

- Just finished the first round of Japanese/Chinese Calendar based on Yin-Yang
  - This is the year of **Dragon** and **Big Tree**
    - Among big or small 5 elements
    - Among 12 Japanese zodiac

甲辰



Happy Second Round!

# 60<sup>th</sup> Anniversary!

- Discovery of CPV in Kaon Decays
  - Cronin and Fitch received Nobel Prize in 1980
- Discovery of Cosmic Microwave Background
  - Penzias and Wilson received Nobel Prize in 1978
- Discovery of Quark Model
  - Gell-Mann received Nobel Prize in 1959
- Theoretical Discovery of Higgs boson
  - Englert, Higgs received Nobel Prize in 2013



James Watson  
Cronin  
Prize share: 1/2



Val Logsdon Fitch  
Prize share: 1/2



Arno Allan Penzias  
Prize share: 1/4



Robert Woodrow  
Wilson  
Prize share: 1/4



Murray Gell-Mann  
Prize share: 1/1

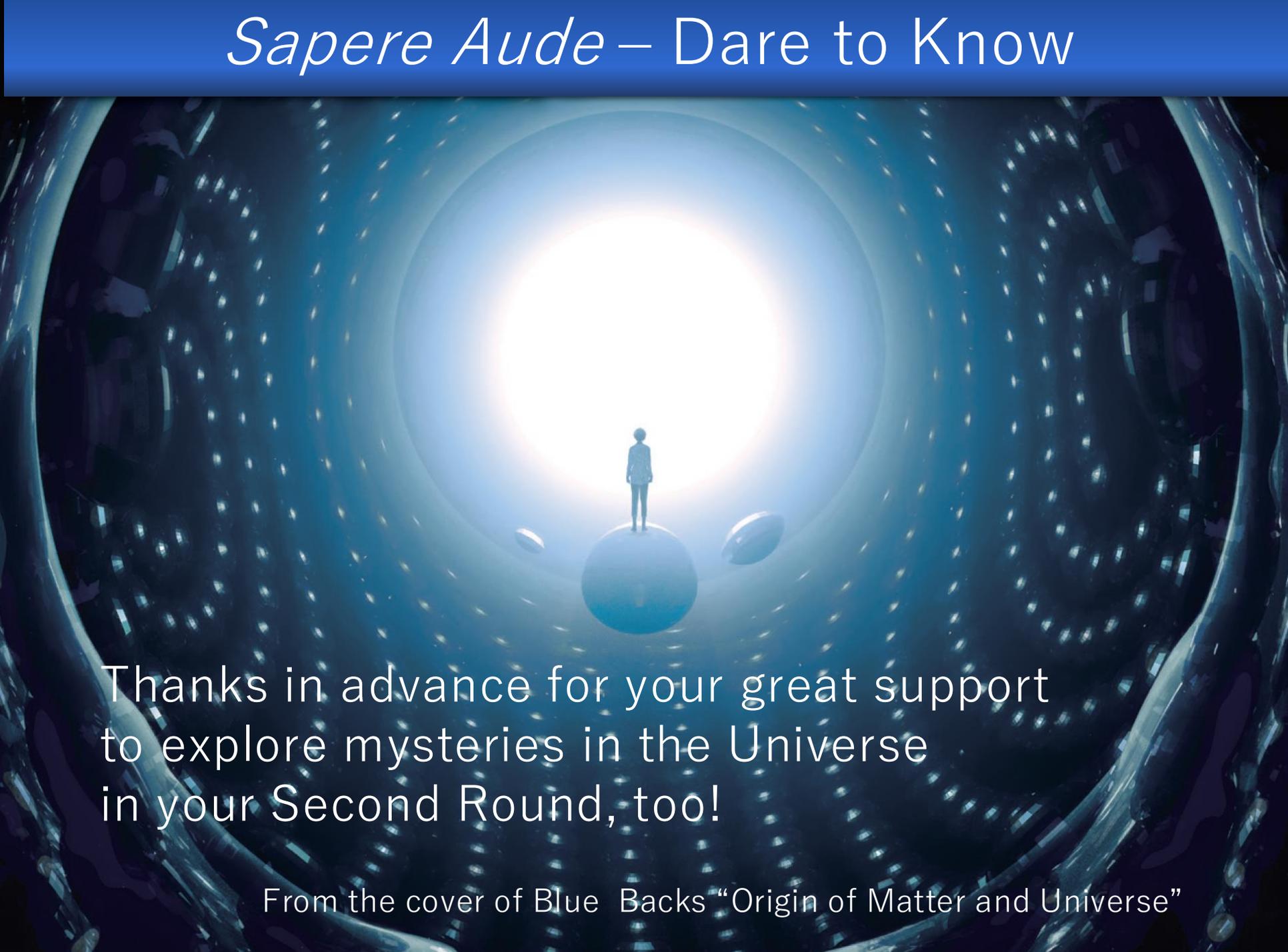


Photo: A. Mahmoud  
François Englert  
Prize share: 1/2



Photo: A. Mahmoud  
Peter W. Higgs  
Prize share: 1/2

# *Sapere Aude* – Dare to Know

A surreal, blue-toned image depicting a person standing on a globe. The scene is set within a vast, circular tunnel or well that recedes into the distance. The walls of the tunnel are lined with numerous small, glowing points of light, creating a starry effect. At the far end of the tunnel, a bright, glowing orb, possibly representing the sun or a distant star, illuminates the scene. The overall atmosphere is one of cosmic exploration and discovery.

Thanks in advance for your great support  
to explore mysteries in the Universe  
in your Second Round, too!

From the cover of Blue Backs “Origin of Matter and Universe”

# Let's Share More Excitements!

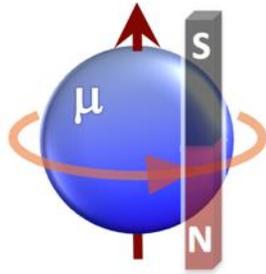


# J-PARC muon $g-2$ /EDM experiment

$g-2$

Anomalous magnetic moment

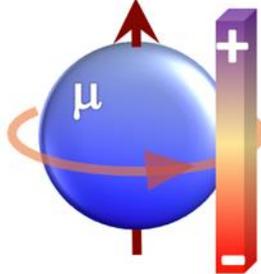
450 ppb



EDM

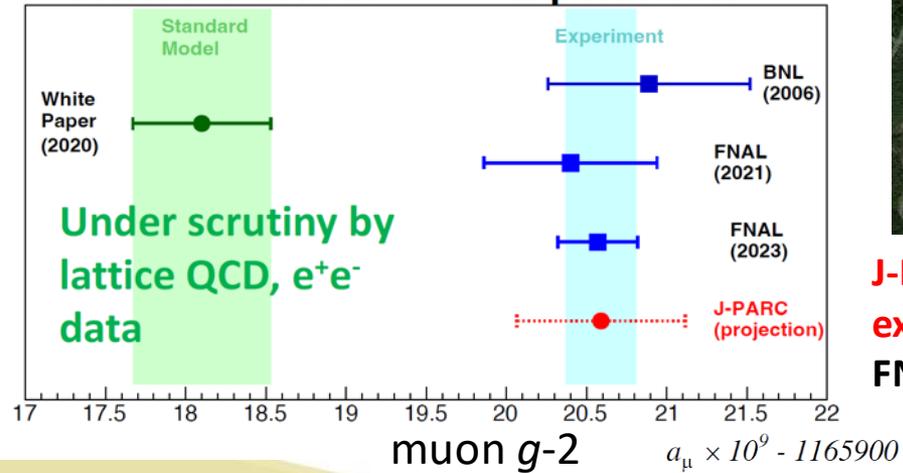
Electric Dipole Moment

1.5 E-19 ecm



Standard Model

Experiments

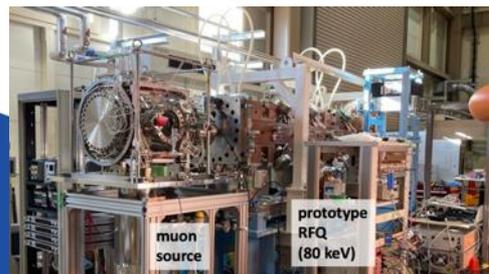
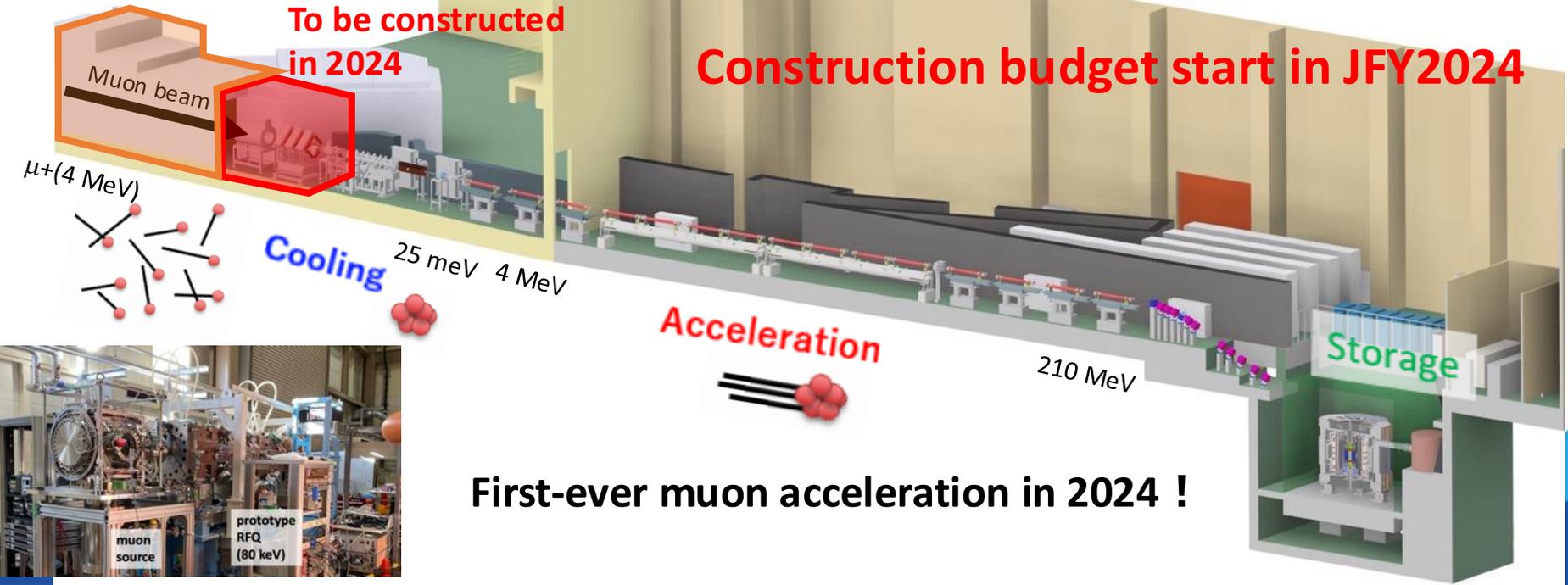


**J-PARC is the only experiment to check FNAL/BNL results.**

Constructed

To be constructed in 2024

Construction budget start in JFY2024



**First-ever muon acceleration in 2024 !**