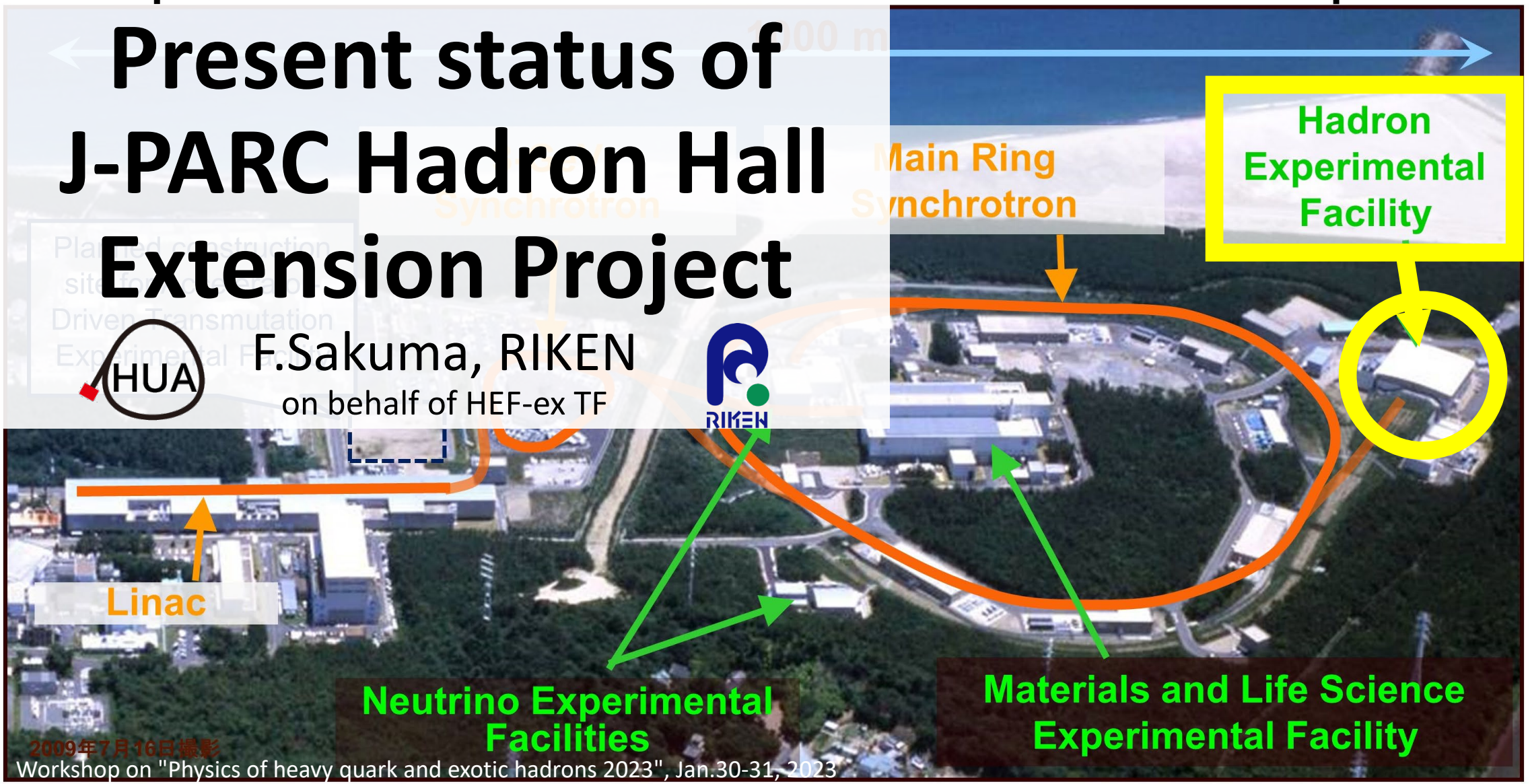
J-PARC

Japan Proton Accelerator Research Complex

Present status of J-PARC Hadron Hall Extension Project

F.Sakuma, RIKEN
on behalf of HEF-ex TF

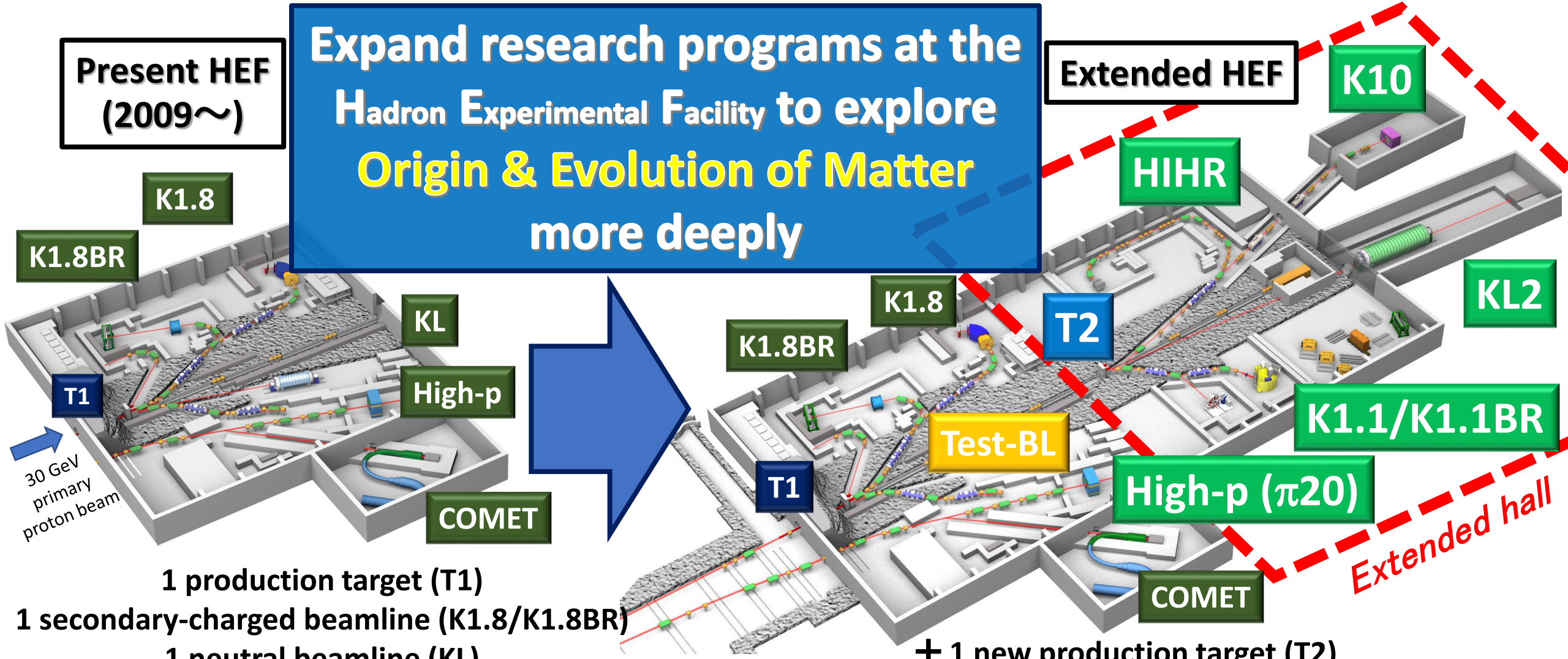


Hadron Experimental Facility eXtension (HEF-ex) Project

Present HEF (2009～)

Expand research programs at the Hadron Experimental Facility to explore Origin & Evolution of Matter more deeply

Extended HEF



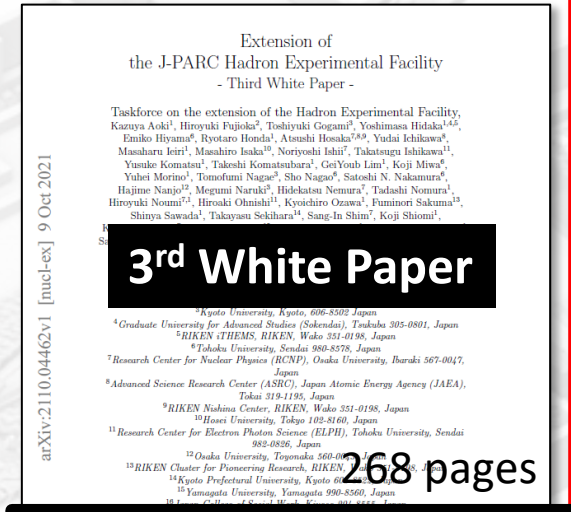
1 production target (T1)
1 secondary-charged beamline (K1.8/K1.8BR)
1 neutral beamline (KL)
1 primary beamline (High-p)
1 muon beamline (COMET)

＋1 new production target (T2)
＋4 new beamlines (HIHR, K1.1/K1.1BR, KL2, K10)
＋ 2 updated beamlines (High-p (π20), Test-BL)

The Plan Refined with Communities

Communities and facility staff have been working together on the project

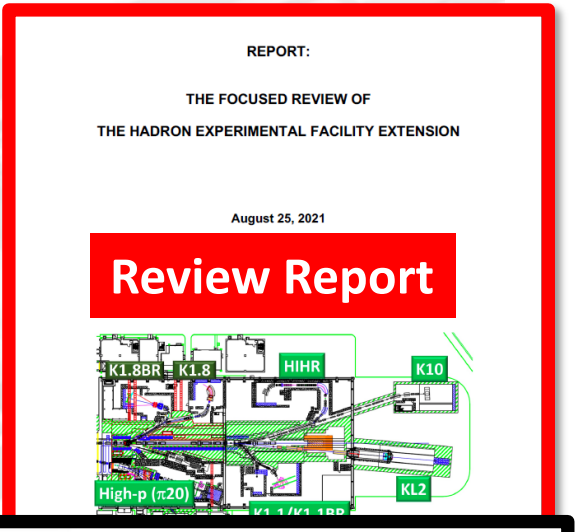
- A task force was formed under **H**adron hall **U**sers' **A**ssociation (HUA) aiming at early realization of the extension project in 2020
- Multiple **domestic and international workshops** were organized in 2021-22
  - **worldwide support** for the project
  - 3 new proposals to the J-PARC PAC
  - 3rd white paper (arXiv:2110.04462)
- **International review** in Aug. 2021
  - formed under the J-PARC PAC: chaired by Prof. T.Hatsuda (RIKEN)
  - **a high evaluation** for the project


Extension of
the J-PARC Hadron Experimental Facility
- Third White Paper -

arXiv:2110.04462v1 [nucl-ex] 9 Oct 2021

3rd White Paper

268 pages


REPORT:

THE FOCUSED REVIEW OF

THE HADRON EXPERIMENTAL FACILITY EXTENSION

August 25, 2021

Review Report

Worldwide support for the project

156 physicists have supported the project

(as of the end of 2021)

We have also received supporting letters from physicists in

experiment：26 institutions / theory：41 institutions

Top-Priority Project @ KEK-PIP2022

March 2022

- Through **KEK-SAC2022** (Scientific Advisory Committee), the project was selected as **the top-priority project** to be budgeted in the KEK's mid-term plan (FY2022-26) at **KEK-PIP2022** (Project Implementation Plan)

The project will start in full swing soon!

KEK Project Implementation Plan 2022

June 24, 2022

High Energy Accelerator Research Organization (KEK)

8. Projects to Be Prioritized for New Budget Requests

Category II: Projects to make new budget requests according to priority

Of the new research programs proposed in the process of formulating KEK-PIP2022, the following four are given high priority, and appropriate efforts will be made to receive new budgetary measures in this order.

II-1. Extension of the J-PARC Hadron Experimental Facility

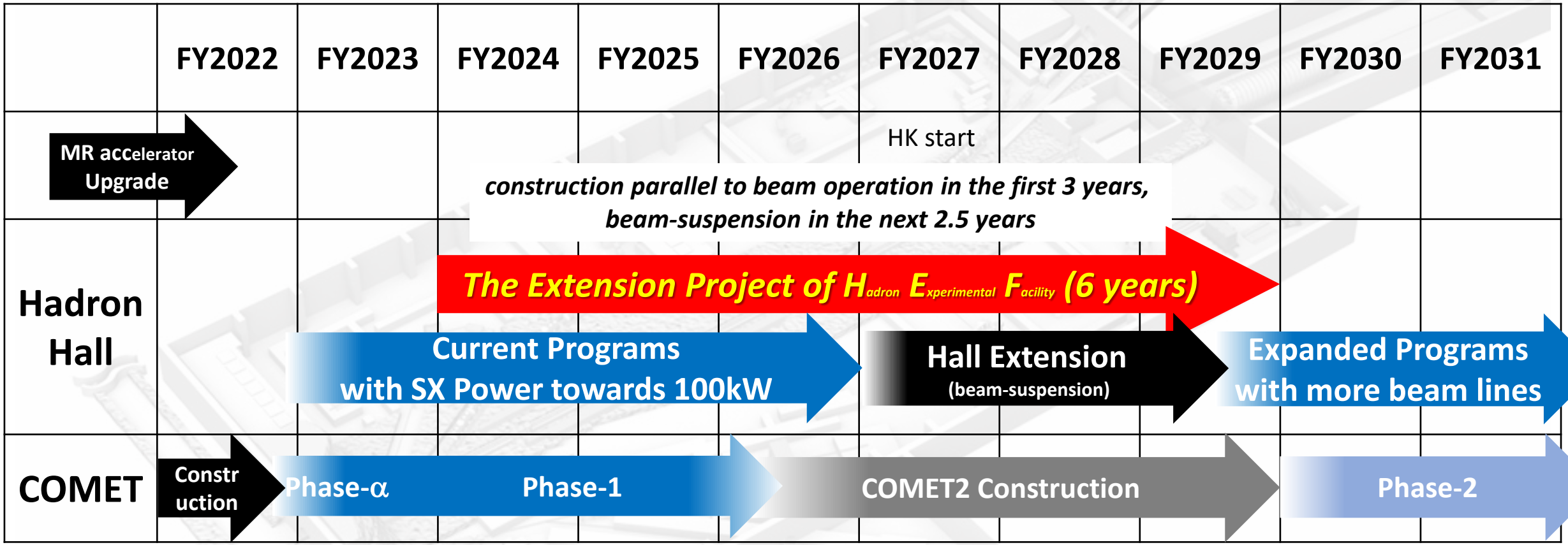
II-2. Strengthening the Cooperation with CERN in Projects Including HL-LHC

II-3. LiteBIRD

II-4. Transmission Muon Microscope

https://www.kek.jp/wp-content/uploads/2022/07/KEK-PIP2022.pdf

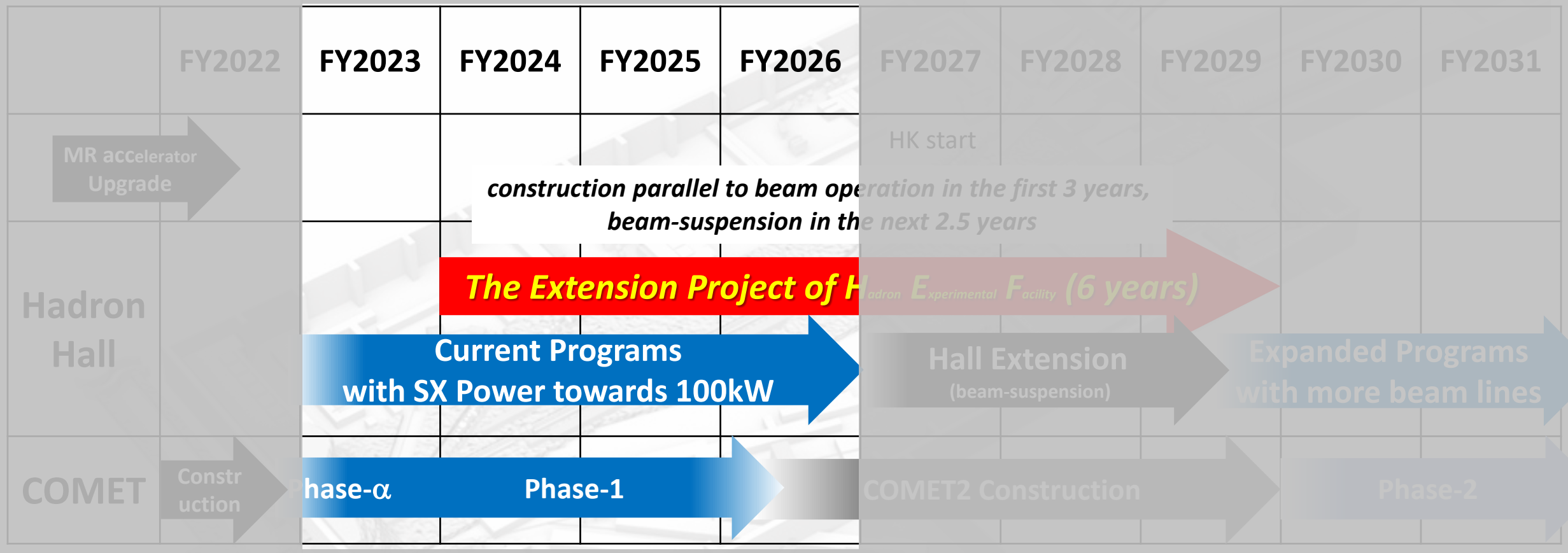
Timeline of the Project



We will start the project in FY2024

→ We are working on getting the timeline consistent with current programs

Timeline of the Project



We will start the project in FY2024

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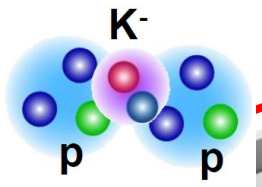
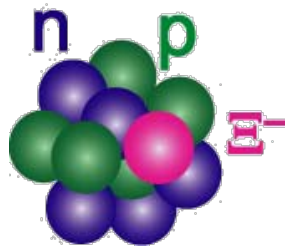
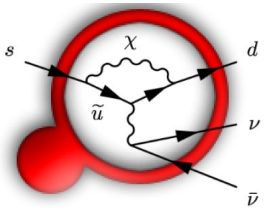
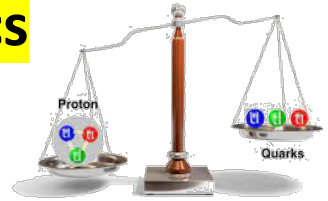
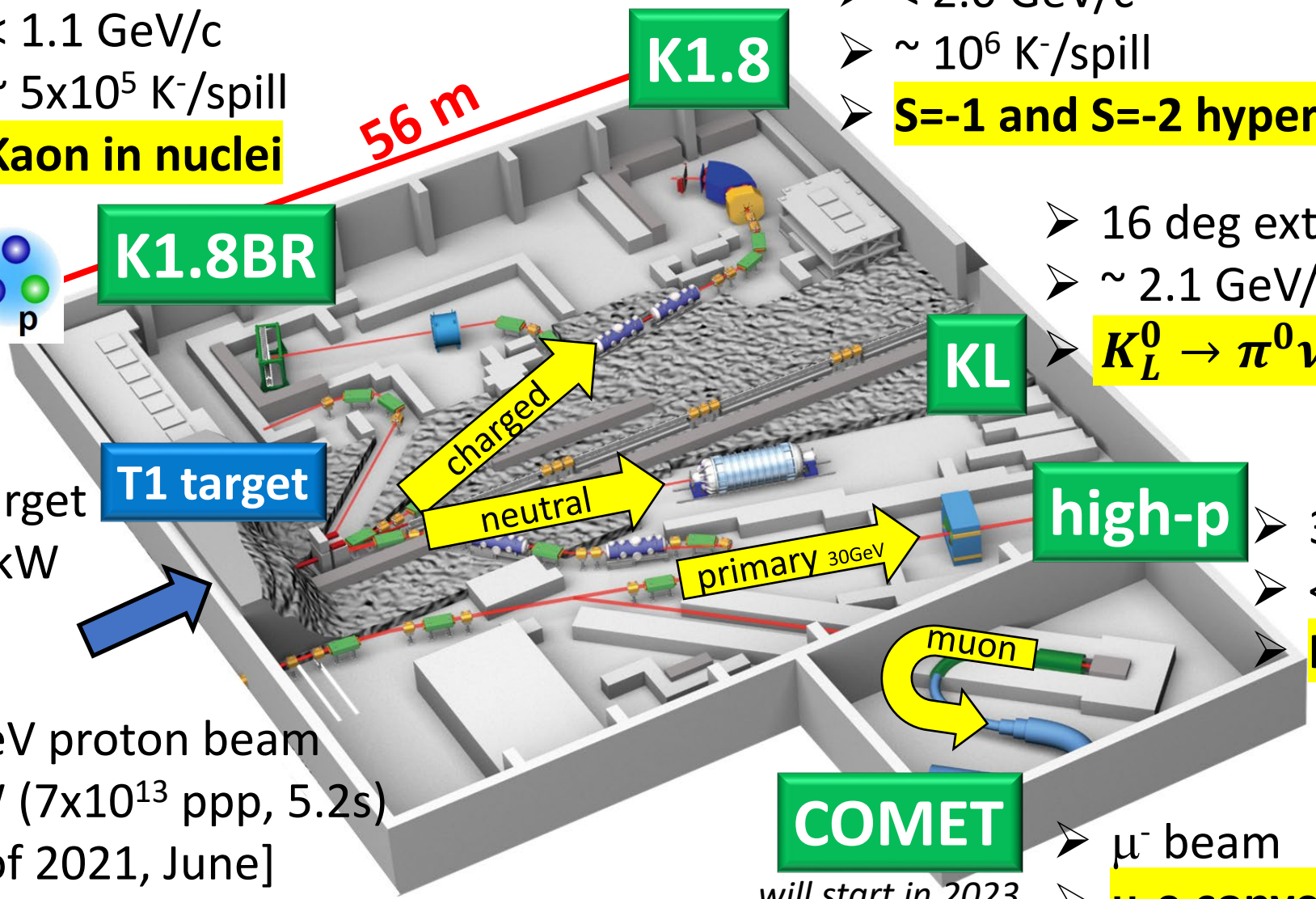
Present Hadron Experimental Facility (HEF)











- < 1.1 GeV/c
- ~ 5x10^5 K$^-$/spill
- **Kaon in nuclei**

- < 2.0 GeV/c
- ~ 10^6 K$^-$/spill
- **S=-1 and S=-2 hypernuclei**

- 16 deg extraction
- ~ 2.1 GeV/c ~ 10^7 K^0_L/spill
- **$K_L^0 \to \pi^0 \nu \bar{\nu}$**

- Au Target
- < 95 kW

launched in 2020

- 30 GeV proton ~ 10^{10}
- < 31 GeV/c unsepa. π ~ 10^7
- **Hadron physics**

- 30 GeV proton beam
- 65kW (7x10^{13} ppp, 5.2s)
  [as of 2021, June]

will start in 2023

- μ^- beam
- **μ-e conversion**

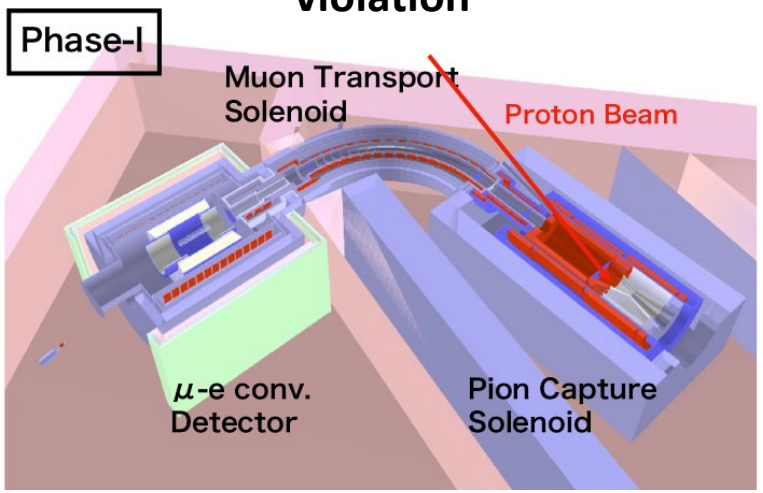
Research directions at the Hadron Experimental Facility

Flavor Physics

$K_L^0 \to \pi^0 \nu\bar{\nu}$ search @ KOTO &

Search for μ→e conversion @ COMET (2023~)

→ **Search for charged lepton flavor violation**



Further research

$K_L^0 \to \pi^0 \nu\bar{\nu}$ search with further sensitivity

→ **Explore beyond the SM sensitivity**

Hadron Physics

Measurement of spectral modification of ϕ meson in nuclei (2020~)

→ **Attack mass-generation mechanism of hadrons**

Further research

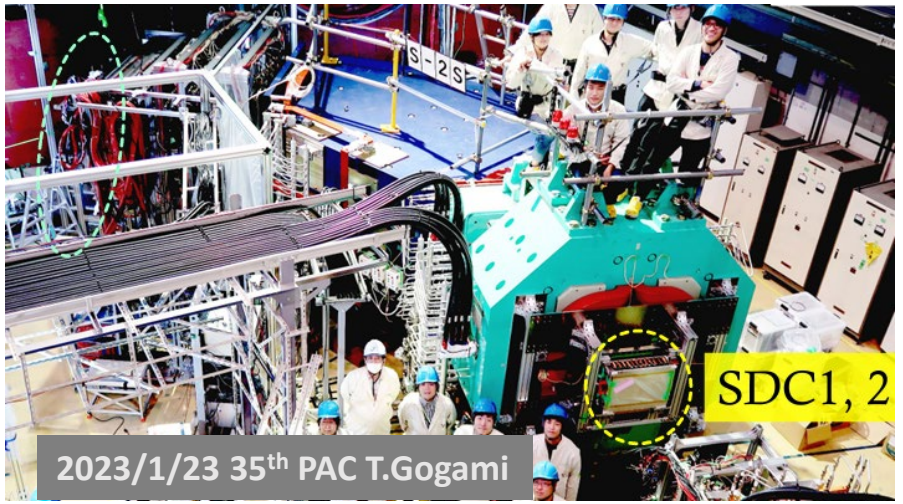
Charmed and muti-strange baryon spectroscopies

→ **Establish diquark in baryon**

Strangeness Nuclear Physics

High-resolution spectroscopic study of S=−2 Ξ-hypernuclei (2023~)

→ **Provide accurate and systematic information on ΞN, ΛΛ interactions**

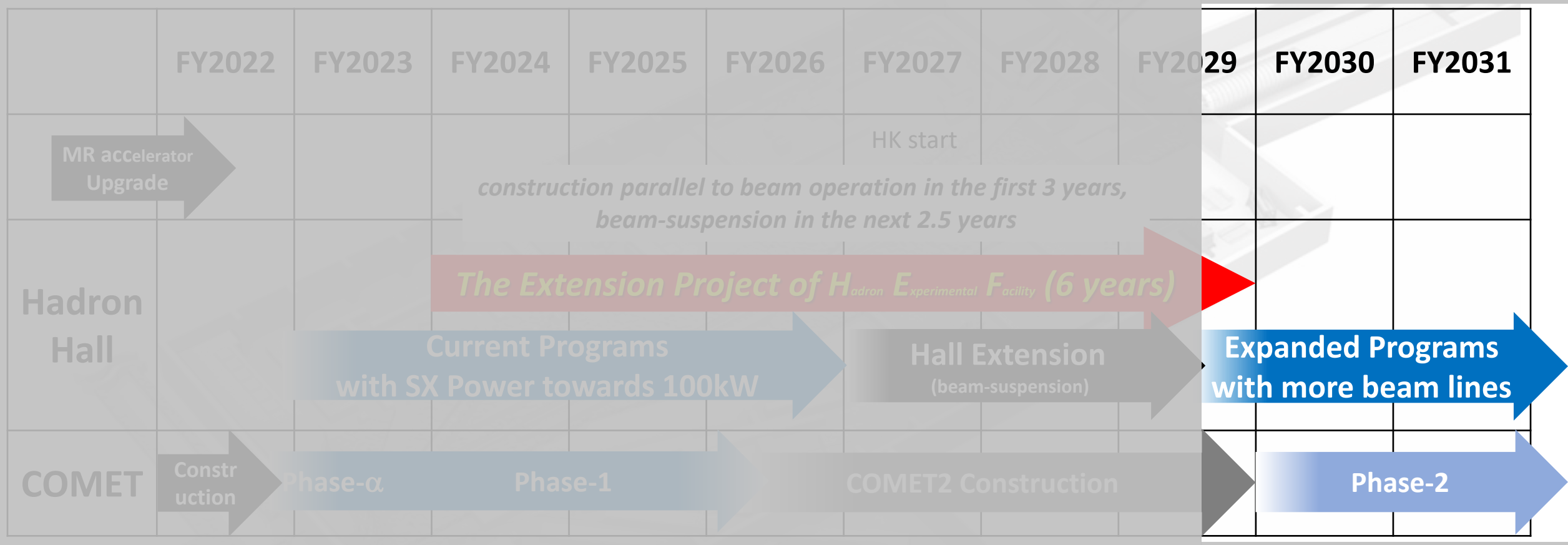


Further research

Ultra-precise spectroscopy of S=−1 hypernuclei with cutting-edge spectrometer

→ **Extract density dependence of ΛN int.**

Timeline of the Project



We will start the project in FY2024

→ We are working on getting the timeline consistent with current programs

Expanded Research Programs

at the Extended Facility

Extract density dependent ΛN interaction

HIHR **Ultra-high-resolution Λ hypernuclei spectroscopy**
- intense dispersion matched π beam

K1.1 **Systematic ΛN scattering measurement**
- intense polarized Λ beam

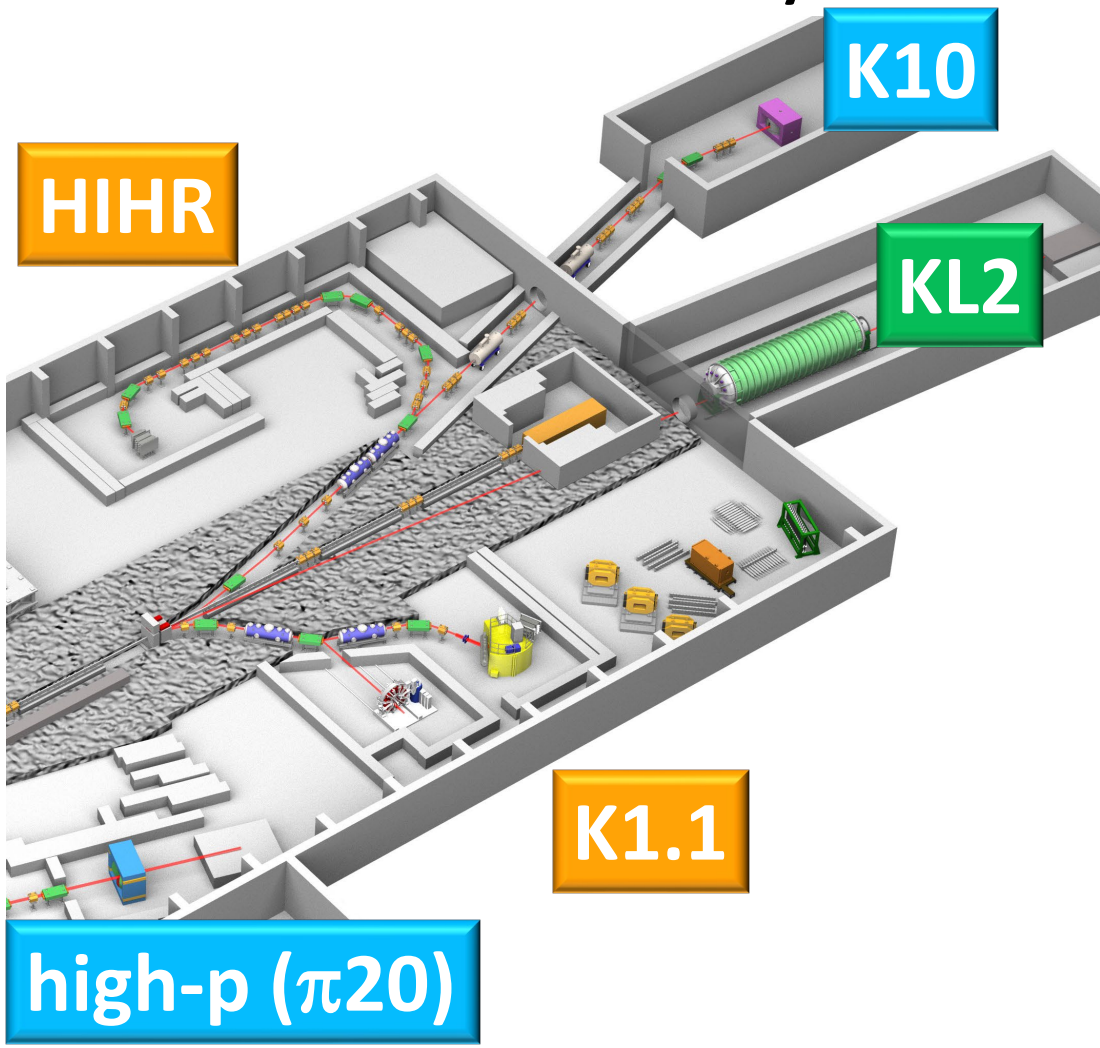
Investigate diquarks in baryons

high-p (π20) **High-resolution charm baryon spectroscopy**
- intense high-momentum π beam

K10 **High-resolution multi-strange baryon spectroscopy**
- intense high-momentum separated K beam

Search for new physics beyond the SM

KL2 **Highest-sensitive $K_L^0 \to \pi^0 \nu\bar{\nu}$ measurement**
- intense neutral K beam



Summary of the Extension Project of the J-PARC Hadron Experimental Facility

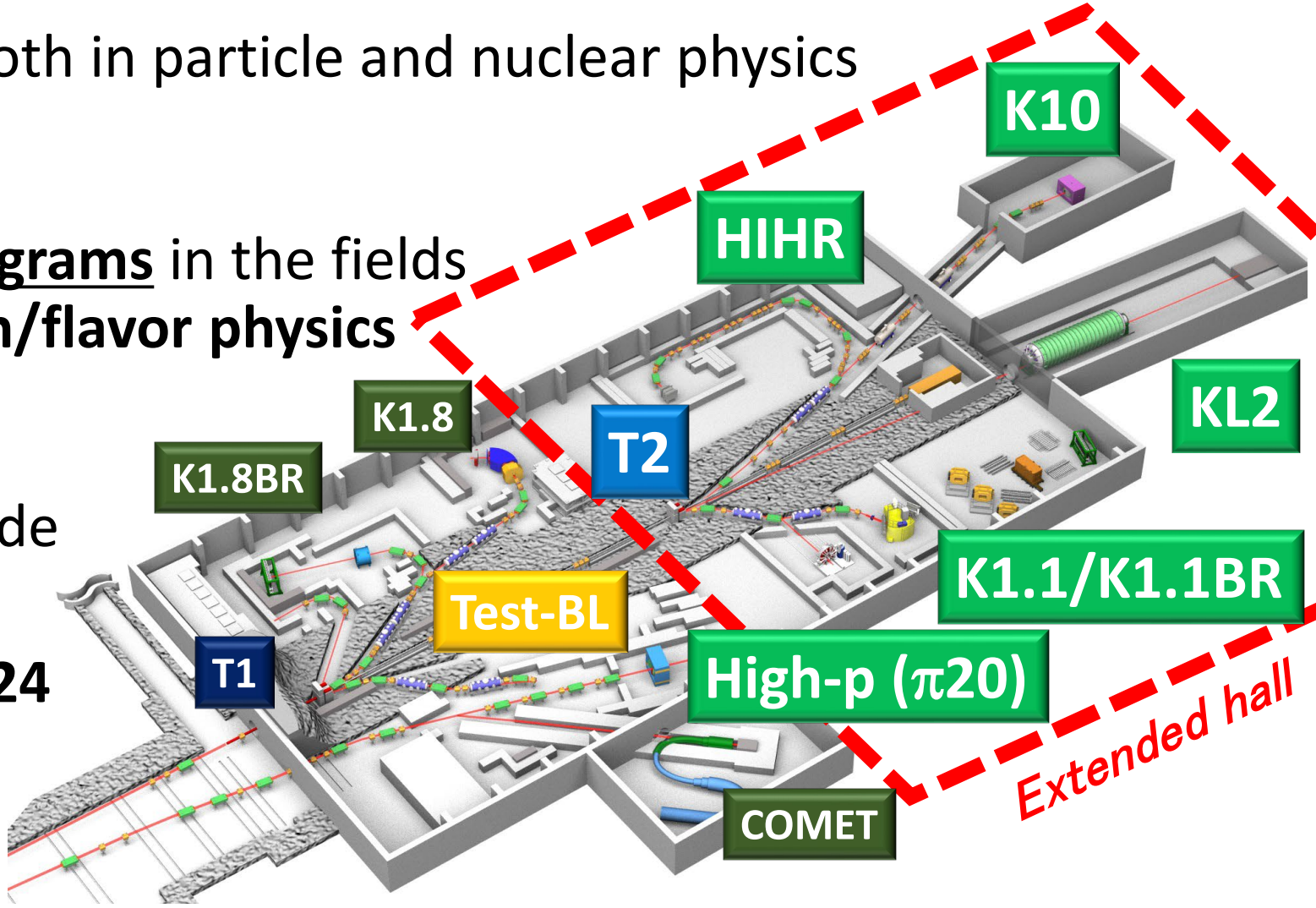
- **Unique research programs** both in particle and nuclear physics at high-intensity frontier

- **World's leading research programs** in the fields of **strangeness-nuclear/hadron/flavor physics**

- **Top-priority project at KEK-PIP2022** / Progress in facility-side preparation

→ The project will start in **FY2024**

Stay tuned!



Thank you for your attention!

https://www.rcnp.osaka-u.ac.jp/~jparchua/en/hefextension.html

International WS on the Extension Project for the J-PARC Hadron Experimental Facility (1st J-PARC HEF-ex WS), 7-9 July 2021, online

2nd International WS on the Extension Project for the J-PARC Hadron Experimental Facility (2nd J-PARC HEF-ex WS), Feb.16-18 2022, online

We are looking forward to seeing you at the 3rd J-PARC HEF-ex WS on Mar. 14-17, 2023 (hybrid style)
https://kds.kek.jp/event/44086/