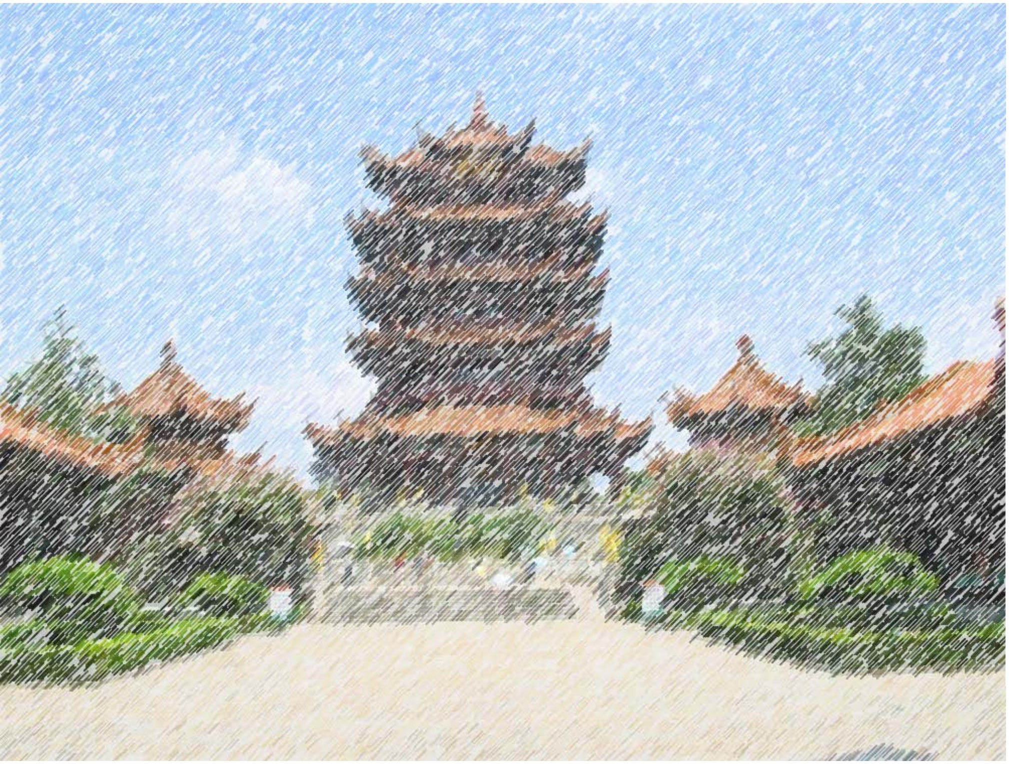
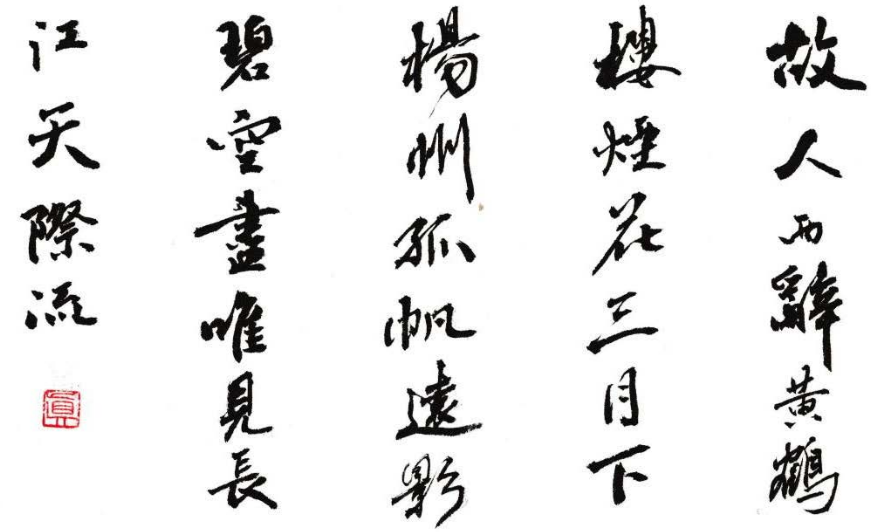




This Chinese poem by 李白 (701 – 762), describing the Yellow Crane Tower （黄鶴楼） here at Wuhan, is learned at every high school in Japan, so that many Japanese people know this place. Thank you for giving me a chance to come this famous place, and discuss hadron physics.

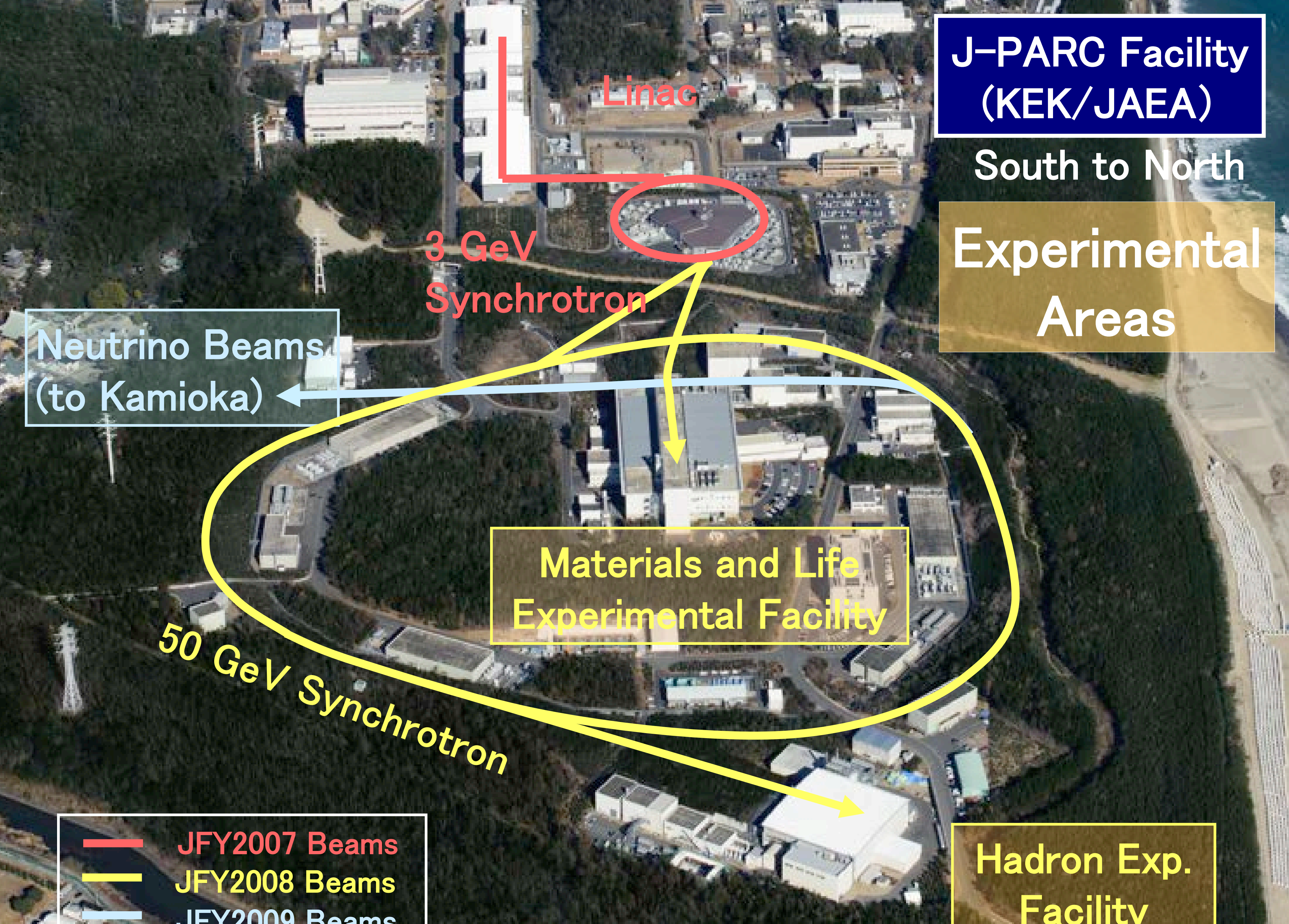
HADRON PHYSICS AT J-PARC

August 8, 2016

Shin’ya Sawada
澤田 真也
KEK (High Energy Accelerator Research Organization)

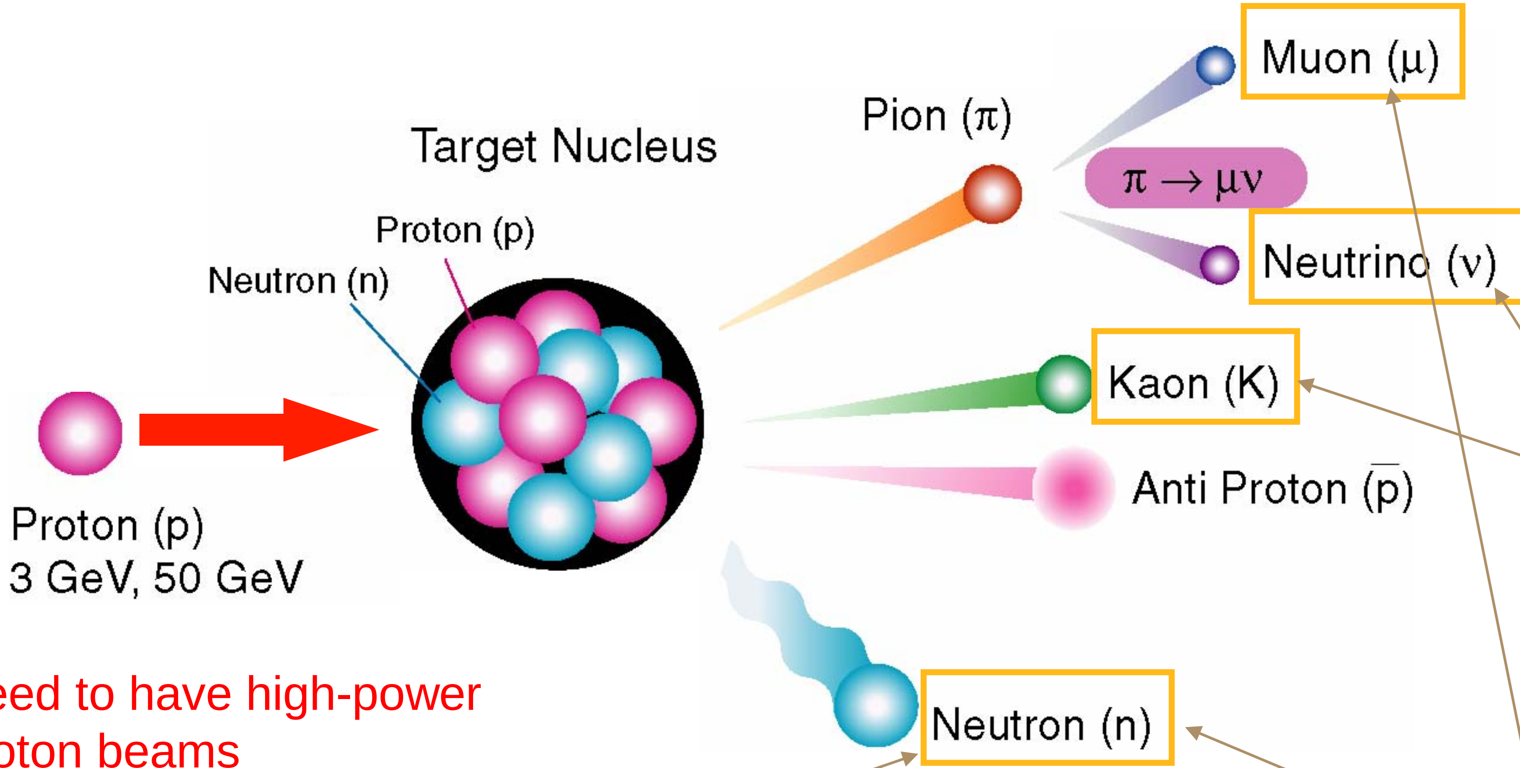
Contents

- J-PARC and Hadron Experimental Facility (Hadron Hall)
- Hadron physics overview and fruits so far obtained
- High-momentum beam line
- Extension
- Summary



Bird's eye photo in January of 2016

Goals at J-PARC

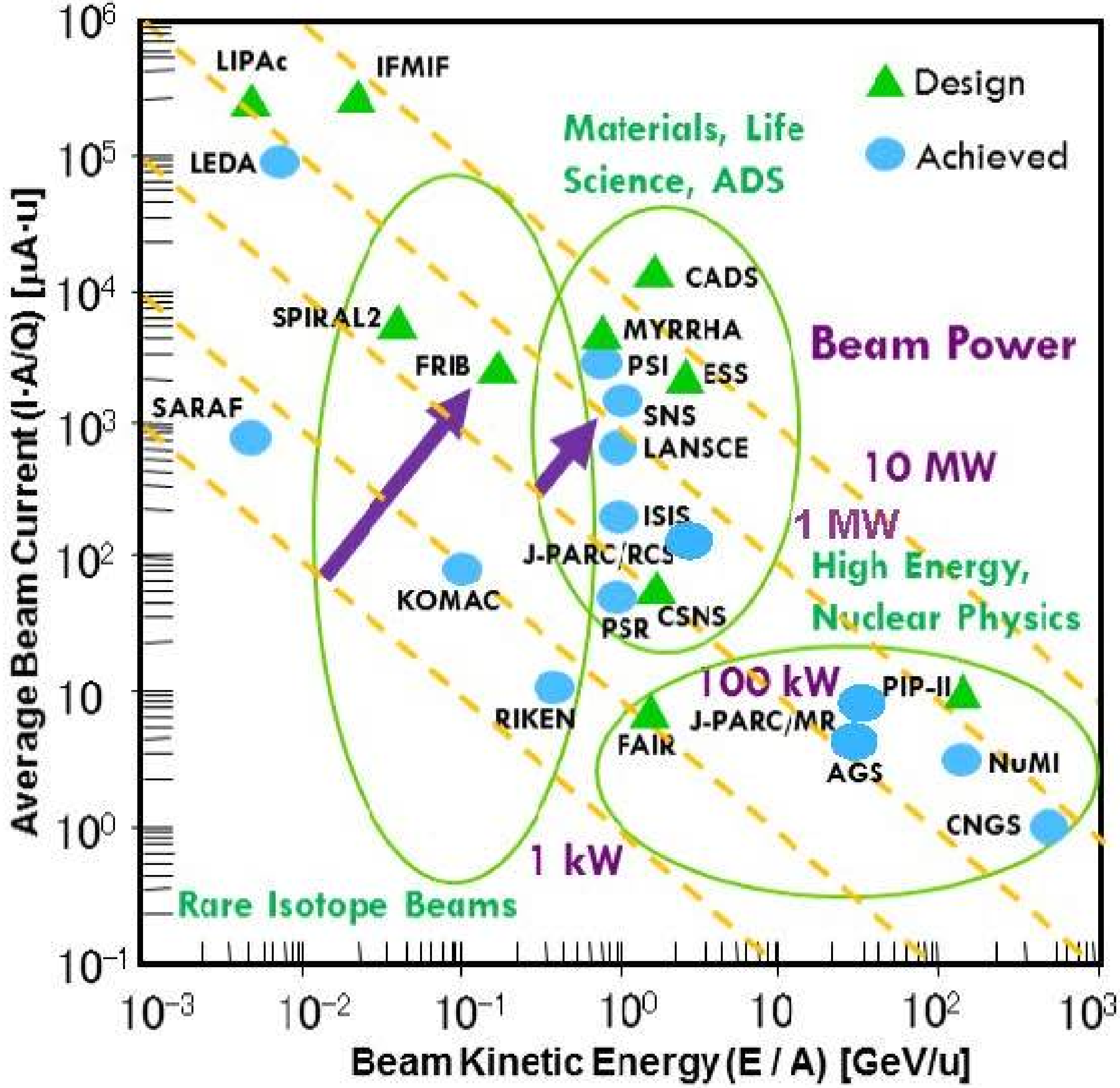


Need to have high-power proton beams

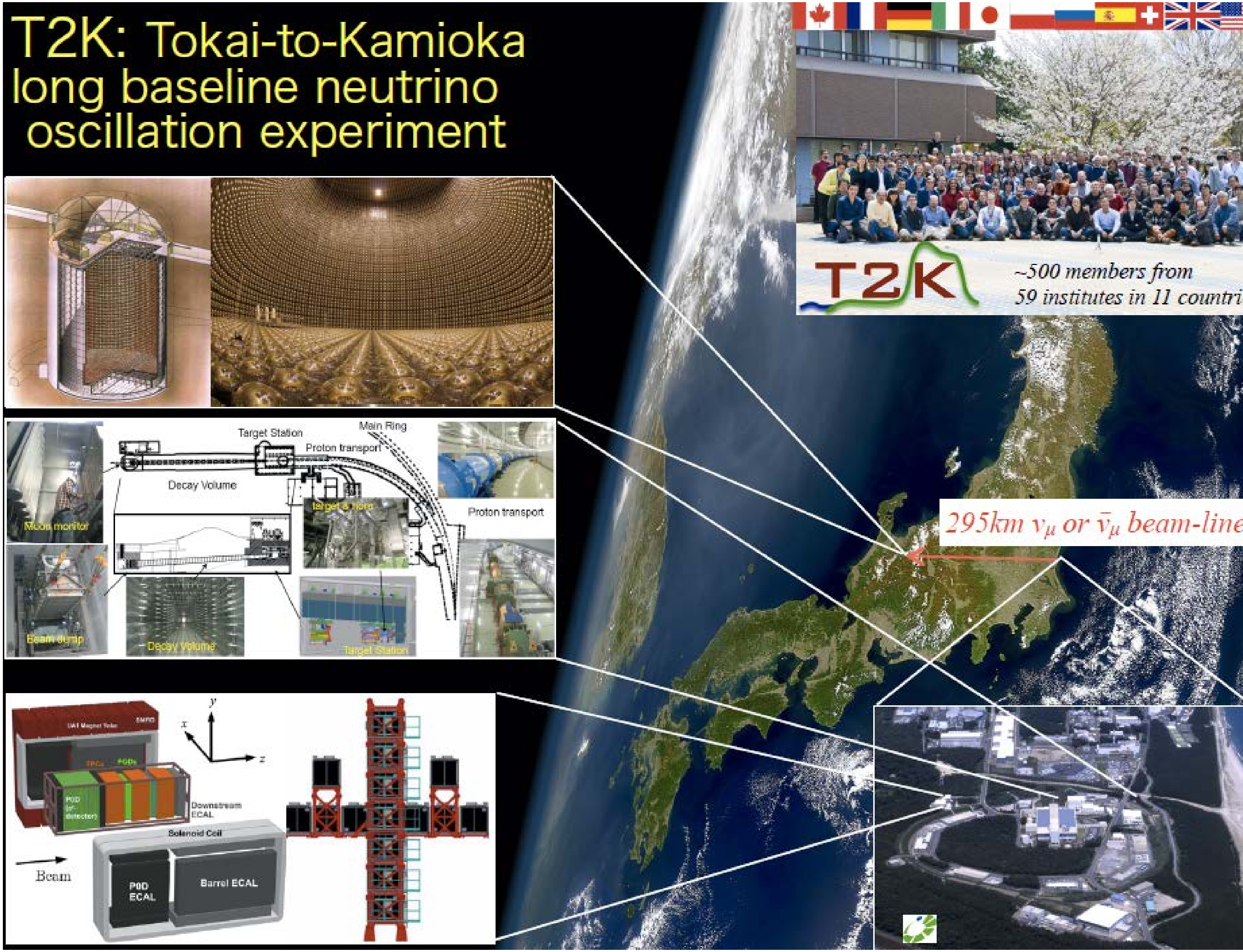
→ MW-class proton accelerator
(current frontier is about 0.1 MW)

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

Hadron accelerators in the world



Jie Wei / Y. Yamazaki


T2K: Tokai-to-Kamioka
long baseline neutrino
oscillation experiment
T2K
~500 members from
59 institutes in 11 countrie
Target Station
Main Ring
Proton transport
Decay Volume
Muon monitor
target & horn
Proton transport
Beam dump
Decay Volume
Target Station
295km ν_μ or $\bar{\nu}_\mu$ beam-line!
y
x
z
Downstream
ECAL
Solenoid Coil
Beam
P0D
ECAL
Barrel ECAL

Neutrino Oscillation is one of the most hot topic.

The Nobel Prize in Physics 2015
Takaaki Kajita, Arthur B. McDonald

Share this: 1.7K

The Nobel Prize in Physics 2015

Photo: A. Mahmoud
Takaaki Kajita
Prize share: 1/2

Photo: A. Mahmoud
Arthur B. McDonald
Prize share: 1/2

The Nobel Prize in Physics 2015 was awarded jointly to Takaaki Kajita and Arthur B. McDonald *"for the discovery of neutrino oscillations, which shows that neutrinos have mass"*

Neutrino oscillation is the phenomena beyond the standard model of the particle physics.

FUNDAMENTAL PHYSICS BREAKTHROUGH PRIZE
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COMMITTEE PRIZES LAUREATES RULES

LAUREATES

Breakthrough Prize | Special Breakthrough Prize | New Horizons Prize | Physics Frontiers Prize

2016 | 2015 | 2014 | 2013 | 2012

- Kam-Biu Luk and the Daya Bay Collaboration
- Yifang Wang and the Daya Bay Collaboration
- Koichiro Nishikawa and the K2K and T2K Collaboration
- Atsuto Suzuki and the KamLAND Collaboration
- Arthur B. McDonald and the SNO Collaboration
- Takaaki Kajita and the Super K Collaboration
- Yoichiro Suzuki and the Super K Collaboration

BREAKTHROUGH INITIATIVES | BREAKTHROUGH JUNIOR CHALLENGE
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SUBSCRIBE

https://breakthroughprize.org/Laureates/1/L155

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BOARD TROPHY EVENTS NOMINATIONS NEWS CONTACTS Search
COMMITTEE PRIZES LAUREATES RULES

LAUREATES

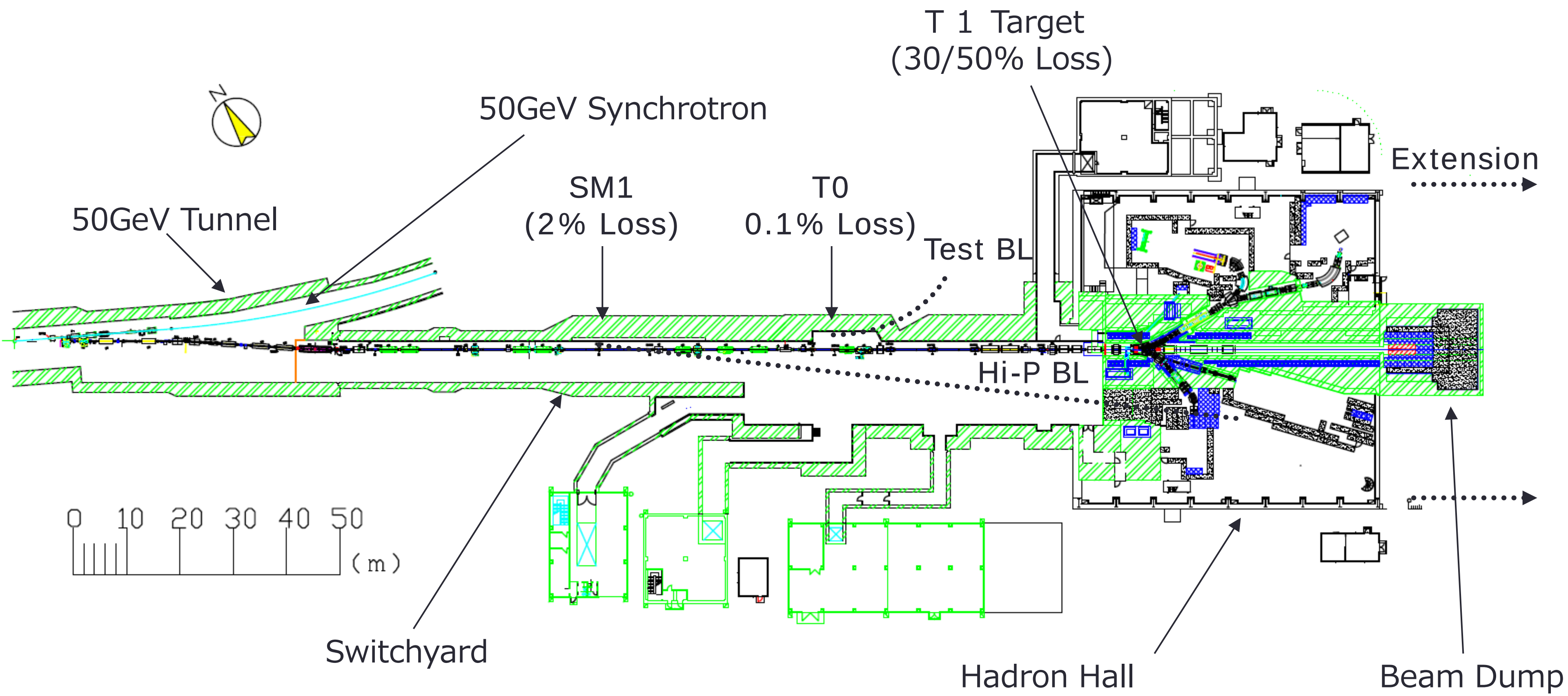
Koichiro Nishikawa and the K2K and T2K Collaboration

Affiliation when awarded Breakthrough Prize: KEK: High Energy Accelerator Research Organization

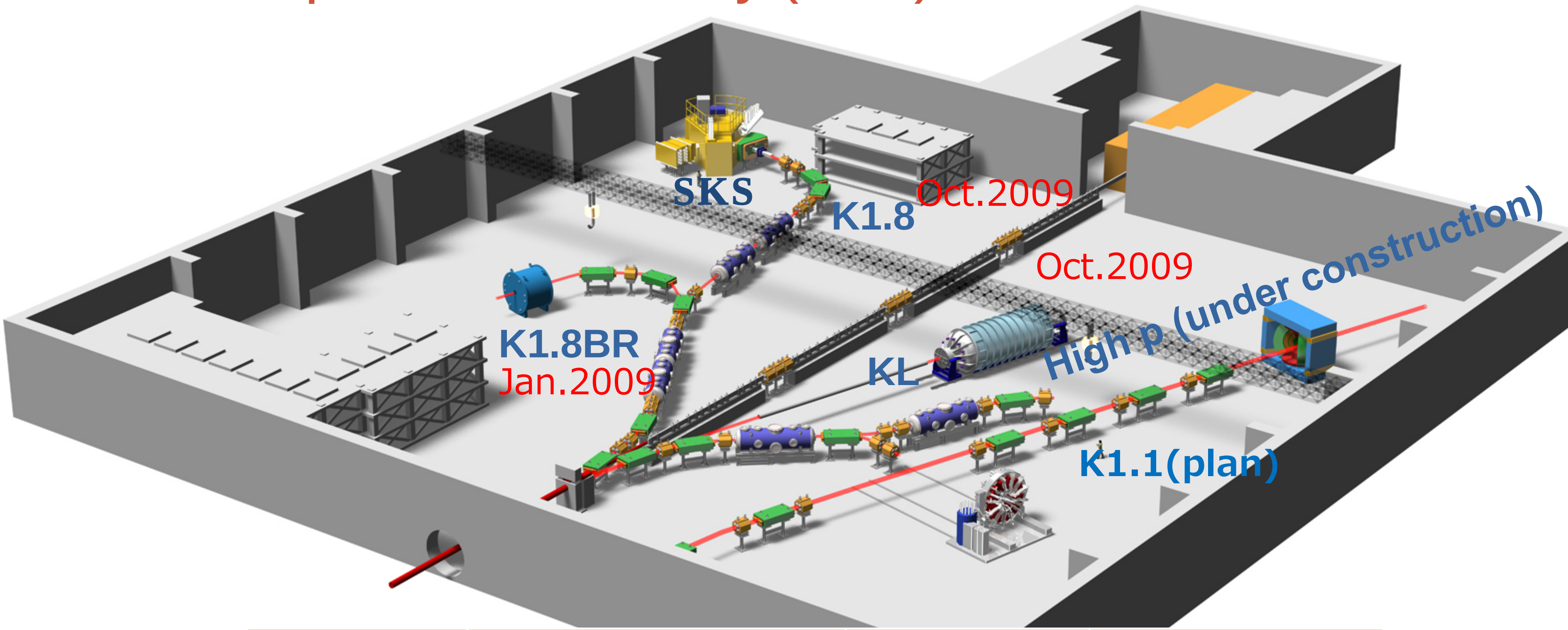
Citation: For the fundamental discovery and exploration of neutrino oscillations, revealing a new frontier beyond, and possibly far beyond, the standard model of particle physics.

Acceptance Remarks: I thank my K2K and T2K collaborators for their exceptional work and dedication to the experiments. I thank the pioneering Japanese high-energy physicists for their hard efforts to realize a high-energy proton accelerator in 1979, and the KEK accelerator group for their innovative efforts to improve it two decades later. The successful operation of the new J-PARC accelerator was made possible by the innovations and dedication of my colleagues at J-PARC. I thank the late Yoji Totsuka, who made every possible effort to support both K2K and T2K from their very beginnings, as spokesperson of Super Kamiokande and later as director general of KEK. I thank Hirotaka Sugawara. He made determinations at all critical phases of the K2K and T2K as Director General of KEK. K2K confirmed the muon neutrino disappearance observed in atmospheric neutrino observation by Kamiokande. In addition, it showed the disappearance rate has energy dependence as expected in neutrino oscillation assumption. T2K observed neutrino oscillation, where both initial and final flavor were identified. The oscillation amplitude and mass parameters are consistent with the standard "three generations scheme." Using neutrino oscillation as a tool, further studies may solve the long-standing mystery of the three generations, and/or require correction of the standard view. I hope further studies and innovations by my young colleagues will lead to a big step forward in coming years. Last but not least, I would like to thank my wife and family for their patience.

Hadron Experimental Facility (Current Layout)

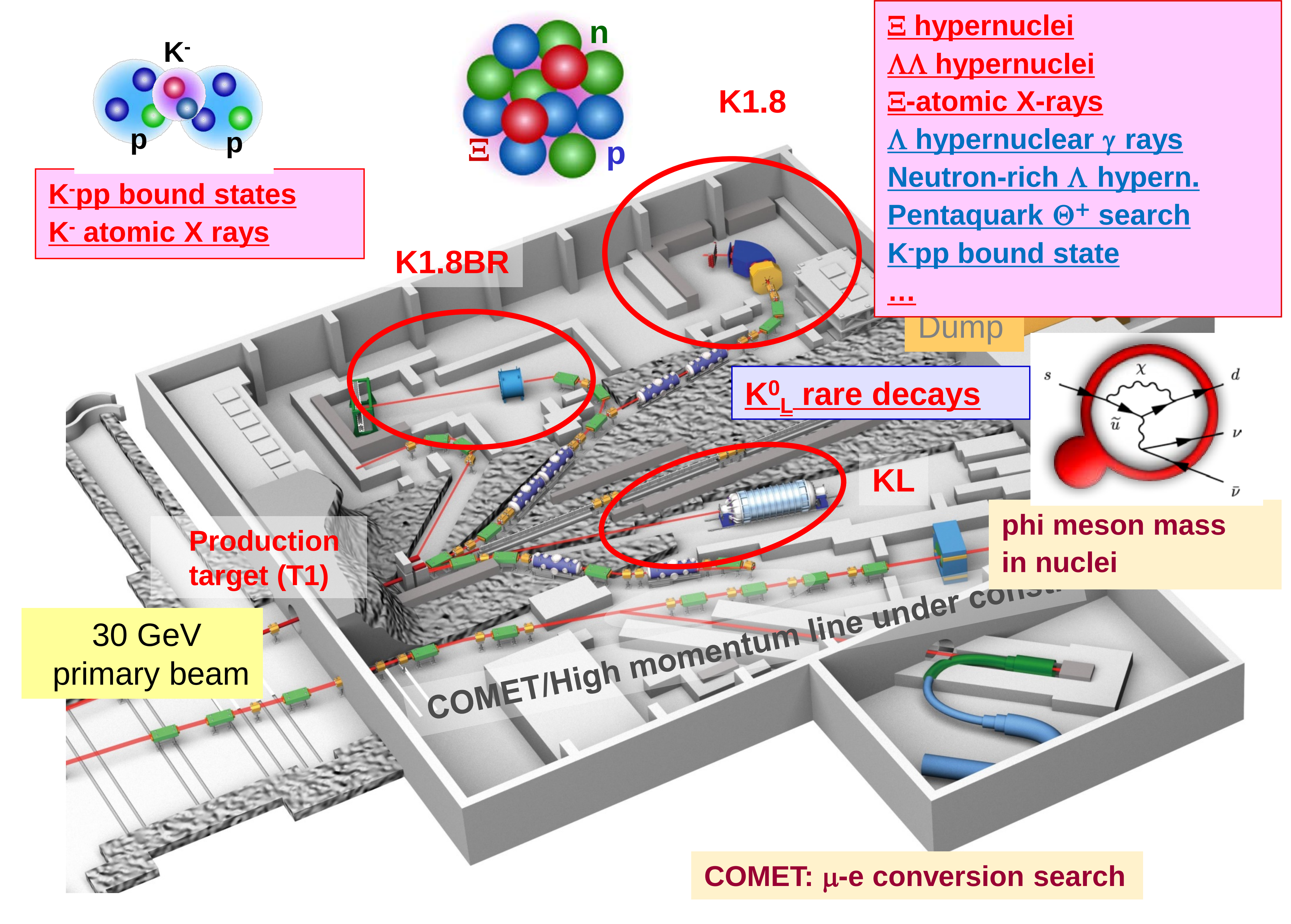


Hadron Experimental Facility (HEF)



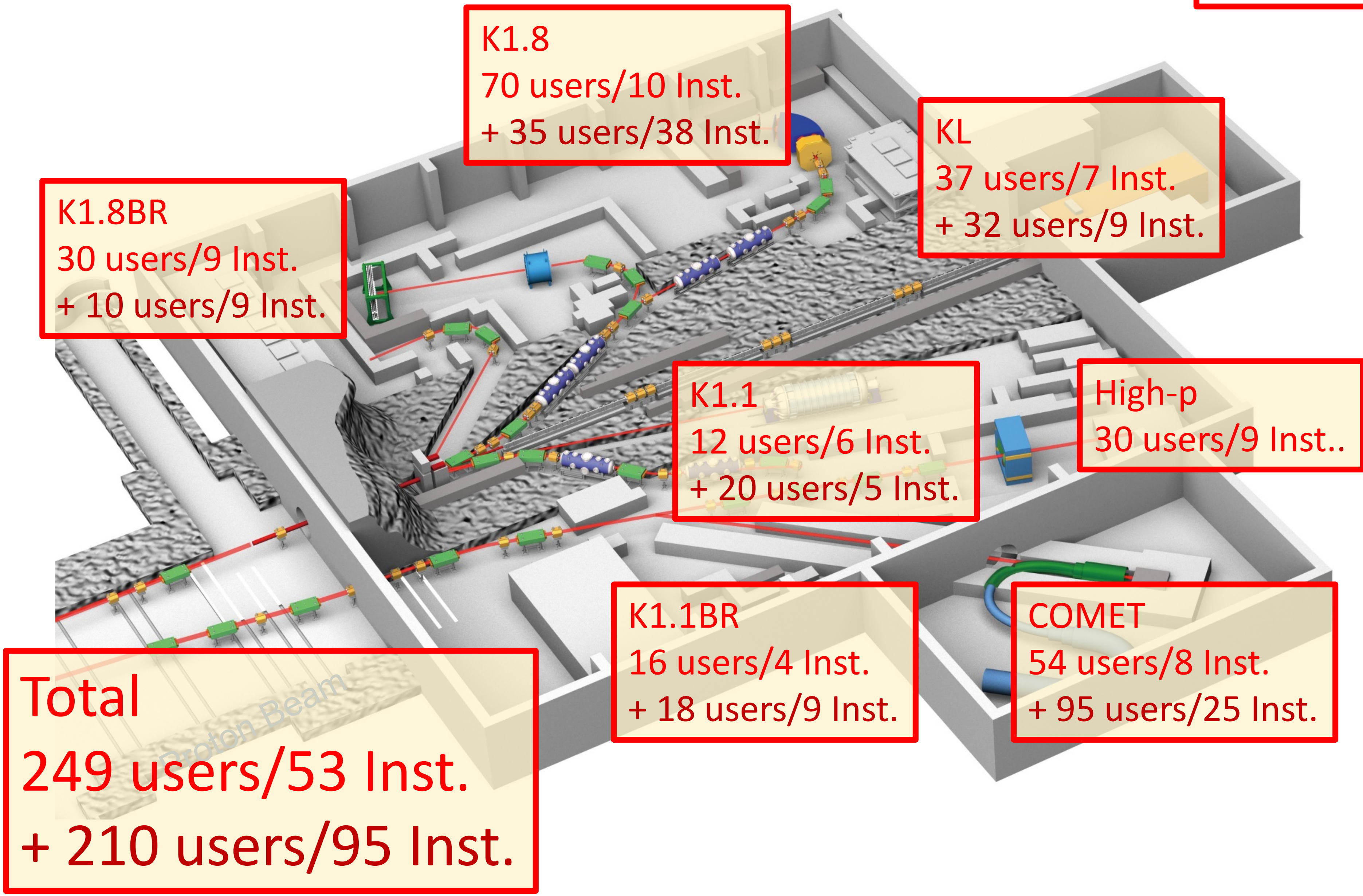
Beam Lines	Secondary particles	Max. Mom.	Max. Intensity
K1.8	π, K, p (2 separators)	< 2.0 GeV/*c*	~10^6 /spill for K^-
K1.8BR	π, K, p (1 separator)	< 1.1 GeV/*c*	~10^5 /spill for K^-
KL	Neutral Kaon	~ 2.1 GeV/*c*	~10^7 /spill

Intense Kaon Beam in the momentum range of ~ 1 GeV/c

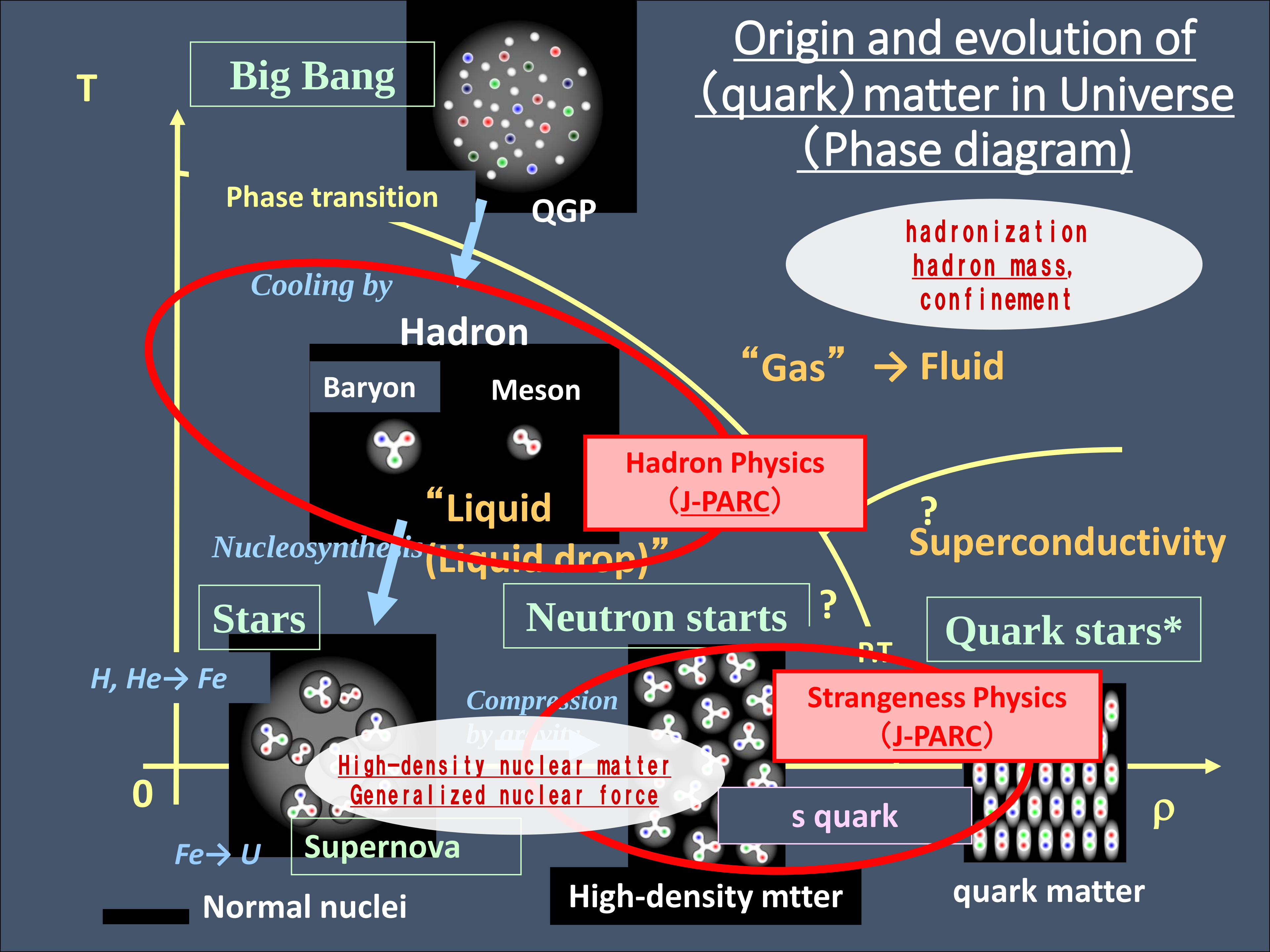

K-
p
p
K-pp bound states
K- atomic X rays
n
Ξ
p
K1.8
Ξ hypernuclei
ΛΛ hypernuclei
Ξ-atomic X-rays
Λ hypernuclear γ rays
Neutron-rich Λ hypern.
Pentaquark Θ+ search
K-pp bound state
...
K1.8BR
Dump
K0L rare decays
s
χ
d
ũ
ν
ν̄
KL
Production target (T1)
phi meson mass in nuclei
30 GeV primary beam
COMET/High momentum line under const.
COMET: μ-e conversion search

Number of Users/Institutions (as of 2015)

domestic
abroad



Contents


Origin and evolution of
(quark) matter in Universe
(Phase diagram)
T
Big Bang
QGP
Phase transition
Cooling by
Hadron
Baryon
Meson
"Liquid
(Liquid drop)"
Nucleosynthesis
hadronization
hadron mass,
confinement
"Gas" → Fluid
Hadron Physics
(J-PARC)
?
Superconductivity
Stars
Neutron starts
?
Quark stars*
H, He→ Fe
Compression
by gravity
Strangeness Physics
(J-PARC)
High-density nuclear matter
Generalized nuclear force
0
s quark
ρ
Fe→ U
Supernova
Normal nuclei
High-density mtter
quark matter

Nuclear Physics：

Study of quantum many-body systems bound by the strong interaction

S.N.Nakamura

Nuclear Physics：

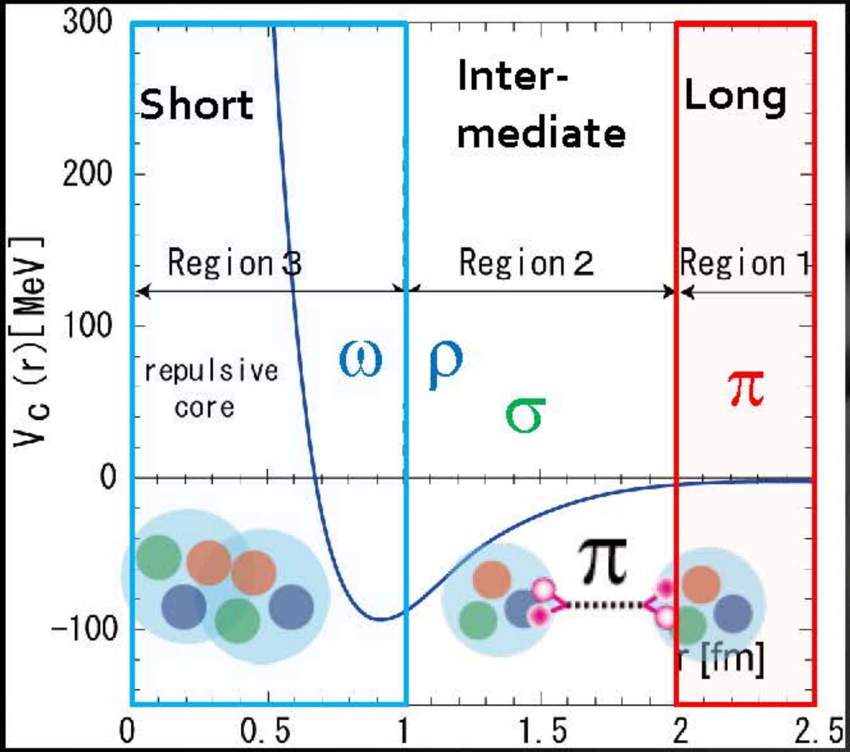
Study of quantum many-body systems bound by the strong interaction

Nuclear Saturation

Supernova Explosion

Neutron Stars

Short Distance
High Energy



Evolution of Stars

Nucleosynthesis
Abundance of elements

Long Distance
Low Energy

Quark color magnetic

Heavier meson / multi π exchange

Yukawa Potential
one π exchange

Baryonic Force

QCD → ← Realistic Nuclear Forces Models

S.N.Nakamura

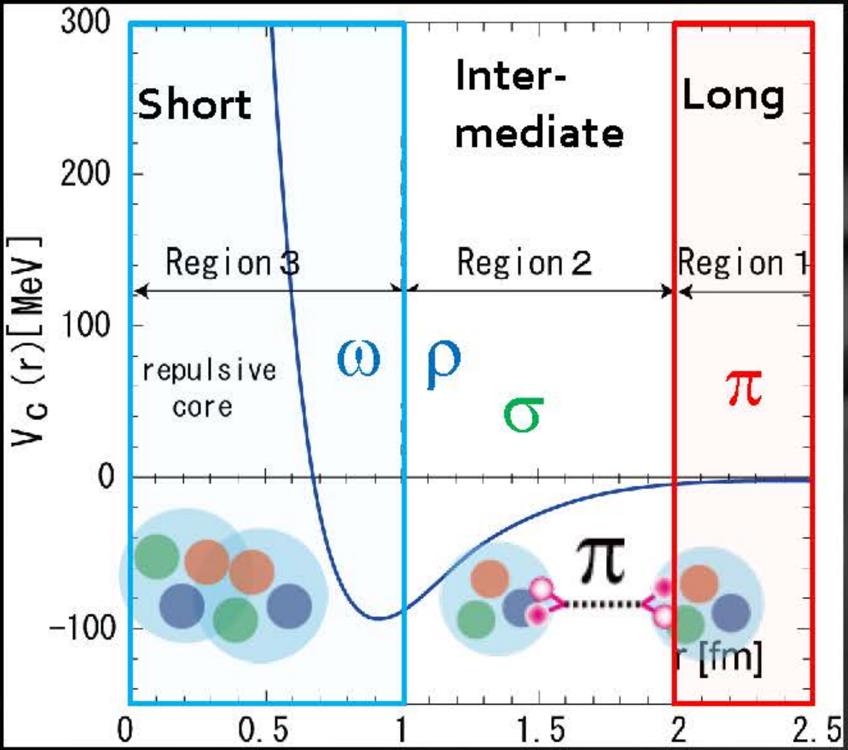
Nuclear Physics：

Study of quantum many-body systems bound by the strong interaction

Quark DoF

Hadron Spectroscopy

Short Distance
High Energy



Nucleon DoF

u, d sector:
NN scattering Exps.

u, d , **S** sector:
Spectroscopy of
Hypernuclei

Long Distance
Low Energy

Quark color magnetic

Heavier meson /
multi π exchange

Yukawa Potential
one π exchange

Baryonic Force

QCD

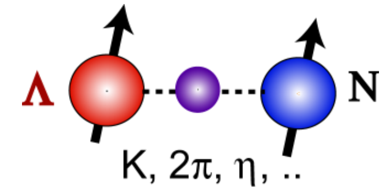
Realistic Nuclear Forces Models

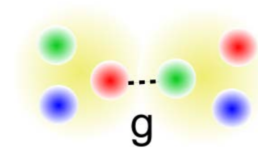
S.N.Nakamura

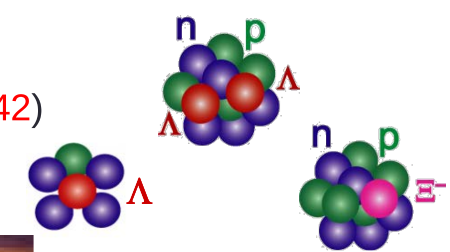
Nuclear/Hadron Physics at HEF

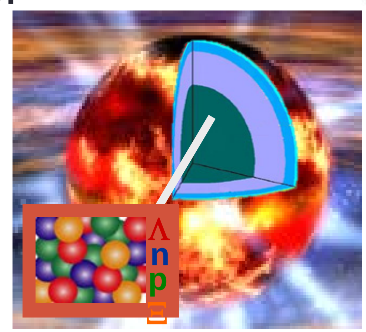
- Unified understanding of baryon-baryon forces
  - Meson exchange picture / quark pictures
  - Origins of short-range nuclear forces
  - Test lattice QCD calculations
    - Structure of various hypernuclei
      - γ-ray spectroscopy(E13), double-strangeness system(E03/E05/E07/E42)
    - YN scattering experiments (E40)
- YN, YY, K^{bar}N interactions in nuclear matter
  - High density matter in neutron stars
  - Baryon properties in nuclei
    - Structure of various hypernuclei (E10)
    - Kaonic nuclear bound states (E15/E17/E27/E31)
    - Hyperon properties in nuclei
- Hadrons in vacuum and medium
  - Exotic hadrons (E19)
  - In-medium property of hadrons
    → Chiral Symmetry Breaking (CSB)
    - meson-mass spectroscopy (E16)
  - Charmed baryon spectroscopy (E50)

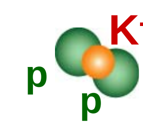
Blue: performed or on-going
Red: plan

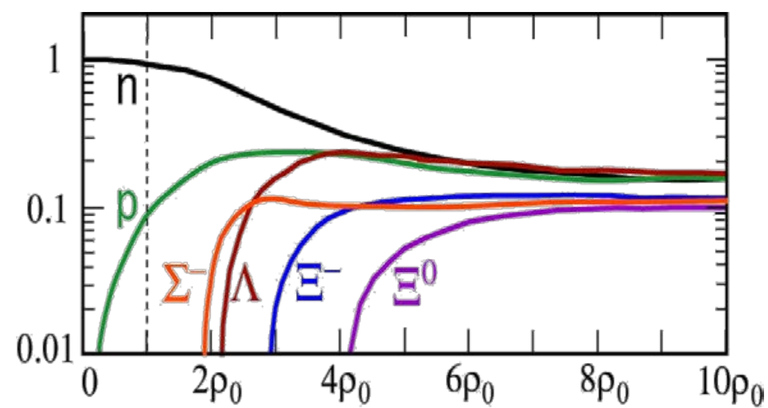












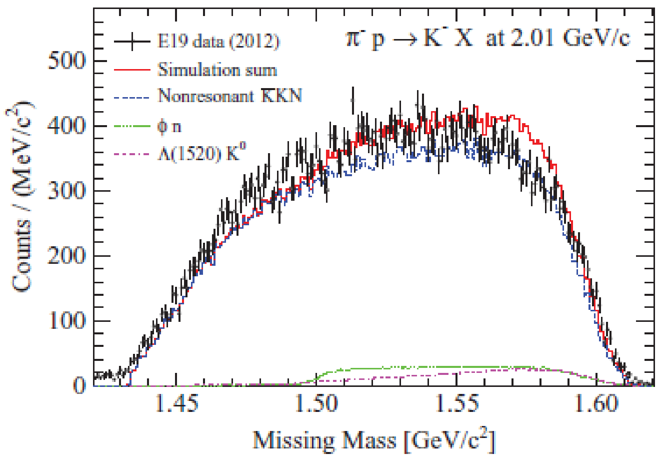
Results (1)

- E19:Search for Θ^+ by π^-+p→K^-X

2010, Jan.2012

  - No peak was observed
  - U.L. of cross section : 0.28μb/sr
  - U.L. of Θ^+ width: 0.36 (1.9) MeV for ½ $^+$ (½$^-$)

PRL **109**, 132002(2012)
PRC **90**, 035205(2014)



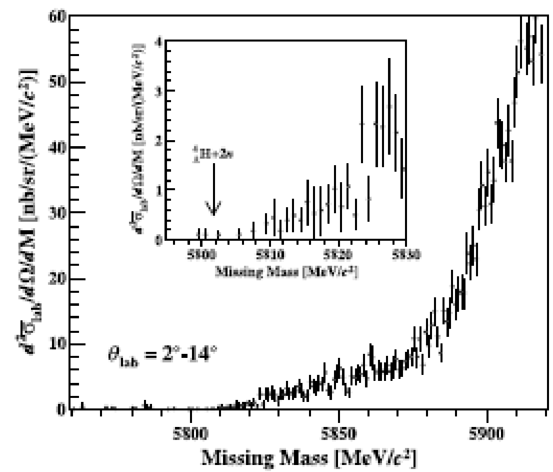
Dec.2012-Jan.201

- E10:Neutron-rich $^6{}_\Lambda$H via the ^{6}Li(π^-,K^+)
  - No peak was observed
  - U.L. of cross section :1.2nb/sr

⇔ Observation of 3 candidates

by FINUDA (PRL **108**,04251(2012))

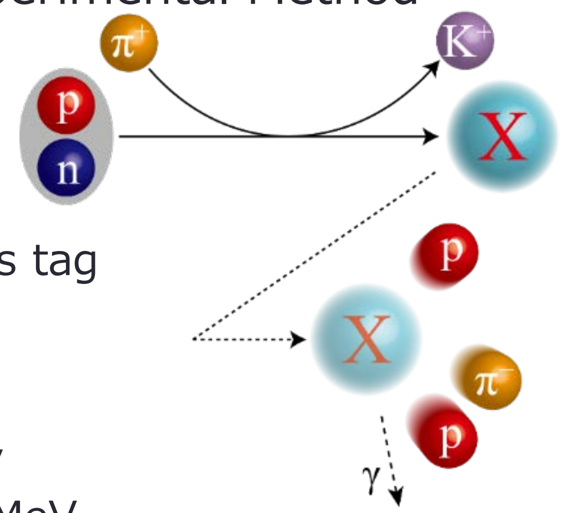
PLB **729**, 39 (2014)



Results (2)

- E27: Search for K^-pp bound states by the $d(\pi^+,K^+)$ at P_π=1.7GeV/c

Experimental Method



Jun. 2012

Missing mass spectrum is obtained with two protons tag

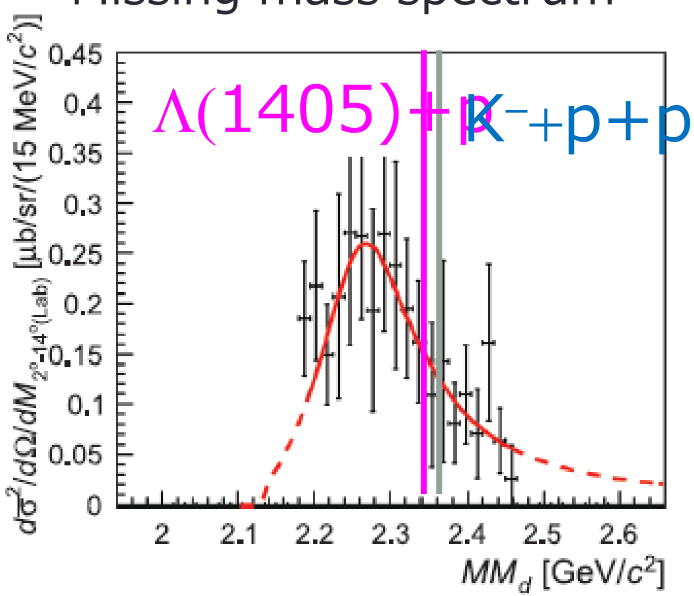
Observation of "K^-pp"-like structure

PTEP **2015**, 021D01 (2015)

Binding Energy 95^{+18}_{-17} (stat.) $^{+30}_{-21}$ (syst.) MeV

Width 162^{+87}_{-45} (stat.) $^{+66}_{-78}$ (syst.) MeV

Missing mass spectrum



A positive signature of K^-pp bound state was obtained. Comparison with other experiments and theoretical studies are necessary and important to establish K^-pp bound state.

Analysis of inclusive spectrum was also published.

PTEP **2014**, 101D03(2014)

- ΣN-ΛN cusp
- Shift of Y* bump

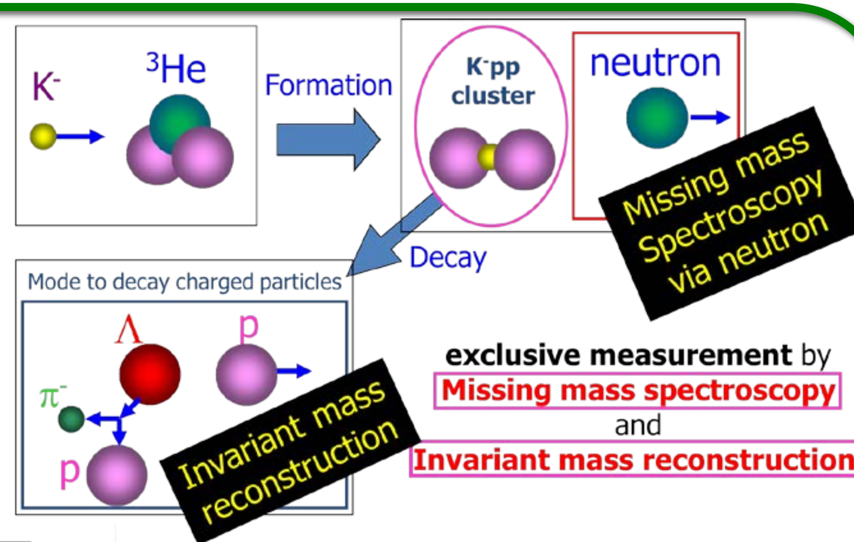
Results (3)

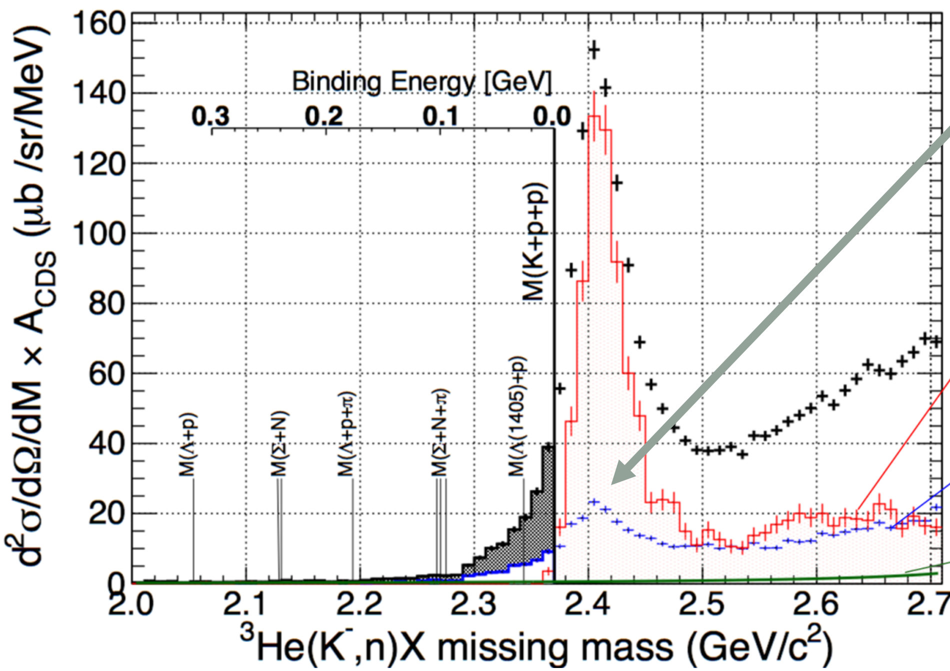
- E15: Search for $K^{-}pp$ bound states by the $^{3}He(K^{-},n)X \rightarrow \Lambda p$

1st- stage RUN with 1% of the proposal

arXiv:1408.5637 [nucl-ex] May 2013

PTEP (2015) 061D01
PTEP (2016) 051D01





Significant enhancements were observed in a bound-region

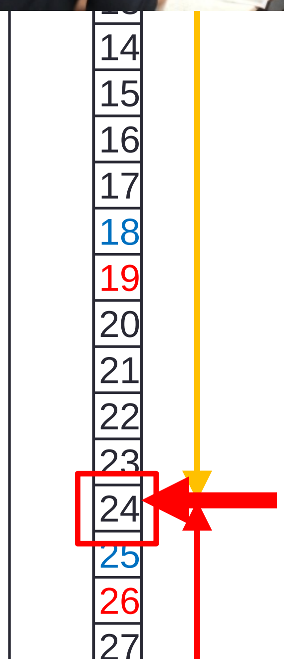
"semi"-inclusive
~10MeV/c^2 resolution

K^0_s-tagged x 8

Contribution of $\Sigma \rightarrow n\pi$
(No other contribution in a bound-region due to kinematical limitations)

Accidental

Restart of Hadron Beam Operation



User operation restarted with the proton beam power of 24kW!

(Almost 2 years after the accident)

朝日新聞　２０１５年４月２５日　朝刊　２８ページ　茨城全県

J－PARC

実験施設が再開

放射能漏れから2年

東海村にある加速器実験施設「J－PARC」で24日、放射性物質の漏出事故＝キーワード＝を起こしたハドロン実験施設の運転が約2年ぶりに再開された。

「標的温度、異常なし」

午前11時すぎ、陽子ビームを標的に当てる作業を開始。運転管理室では職員が標的の温度や放射能濃度のモニター画面を確認した。

この日から、国内外の大学や研究機関の三つの実験が始まった。他に約10の実験が控えているという。

運転管理室で標的の温度などを確認する職員ら＝東海村のJ－PARC

J－PARCは、日本原子力研究開発機構と高エネルギー加速器研究機構が共同で運営。ハドロン実験施設は2009年に完成した。陽子ビームの出力が高く、世界最高性能の施設とされる。標的となる金などの原子核と衝突させて粒子を作り出し、物質の起源や宇宙の成り立ちを探究している。事故前の12年度は利用期間中、常時約100人が利用した。

事故で八つの実験が中断や延期を余儀なくされた。事故当時、チームの責任者として実験に取り組んでいた大阪大の山中卓教授（高エネルギー物理学）は「2年は長かったが、安全対策や住民への説明を丁寧にした結果。ようやく研究を進められるのでホッとしている」と話す。

J－PARC側は、約19億円をかけて安全対策を講じた。異常な量のビームが出る原因となった電源基板に劣化対策を施し、放射性物質が外に漏れないよう排気ファンを撤去。異常時の行動基準もマニュアルに盛り込んだ。こうした再発防止策を踏まえ、県や村は先月、運転再開を了承した。

事故以降、一市民の立場でJ－PARCの動向をブログで発信してきた常総市の行政書士古性隆さん(50)は、ウェブサイトでの会議資料の掲載など情報公開が進んだことに一定の評価をしつつ、釘を刺す。「研究者と住民との安全認識の差はだいぶ縮まった。ただ、施設全体の災害対策でまだ不安な点がある。今後も住民目線で監視したい」

J－PARCの斉藤直人センター長は「安全確保を最優先に施設を運営する。最先端の研究成果を生み出し、社会に貢献していきたい」と話している。

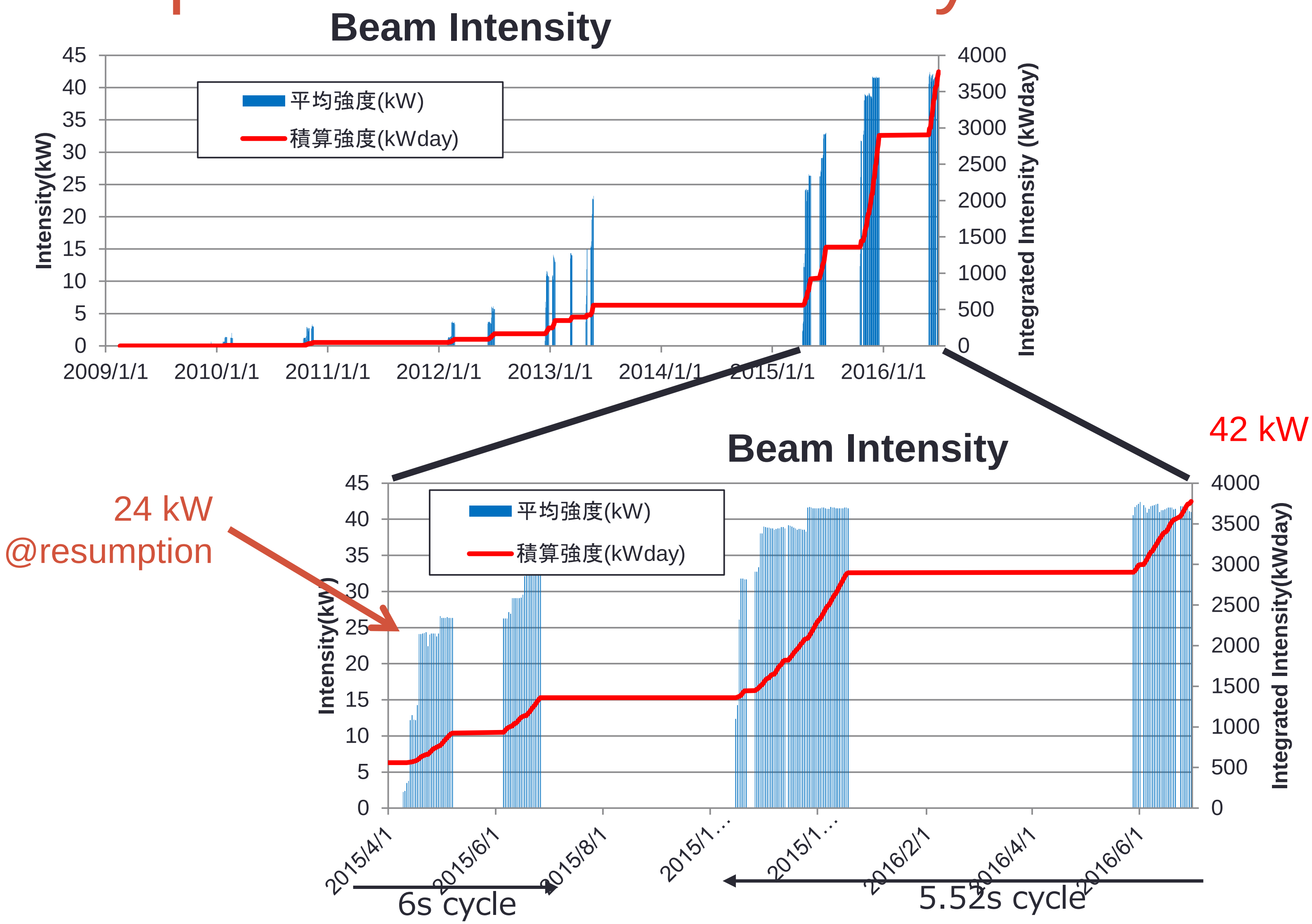
（酒本友紀子）

放射性物質の漏出事故

2013年5月、陽子ビームを標的の金に当てて粒子を発生させる実験中に起きた。機器劣化による誤作動で設定値を大きく超えるビームが当たり、金の中の放射性物質が蒸発。研究者ら34人が被曝（ひばく）し、排気ファンを回したことで放射性物質が屋外に漏れた。警報が出た後も4時間以上実験を続け、自治体への報告が1日半遅れたことが批判を浴びた。

事故は国際原子力事象評価尺度で、1995年の高速増殖炉もんじゅ（福井県）のナトリウム漏れ事故と同じ「レベル1」とされた。

Development of Beam Intensity



Accumulated beam time and intensity for HD

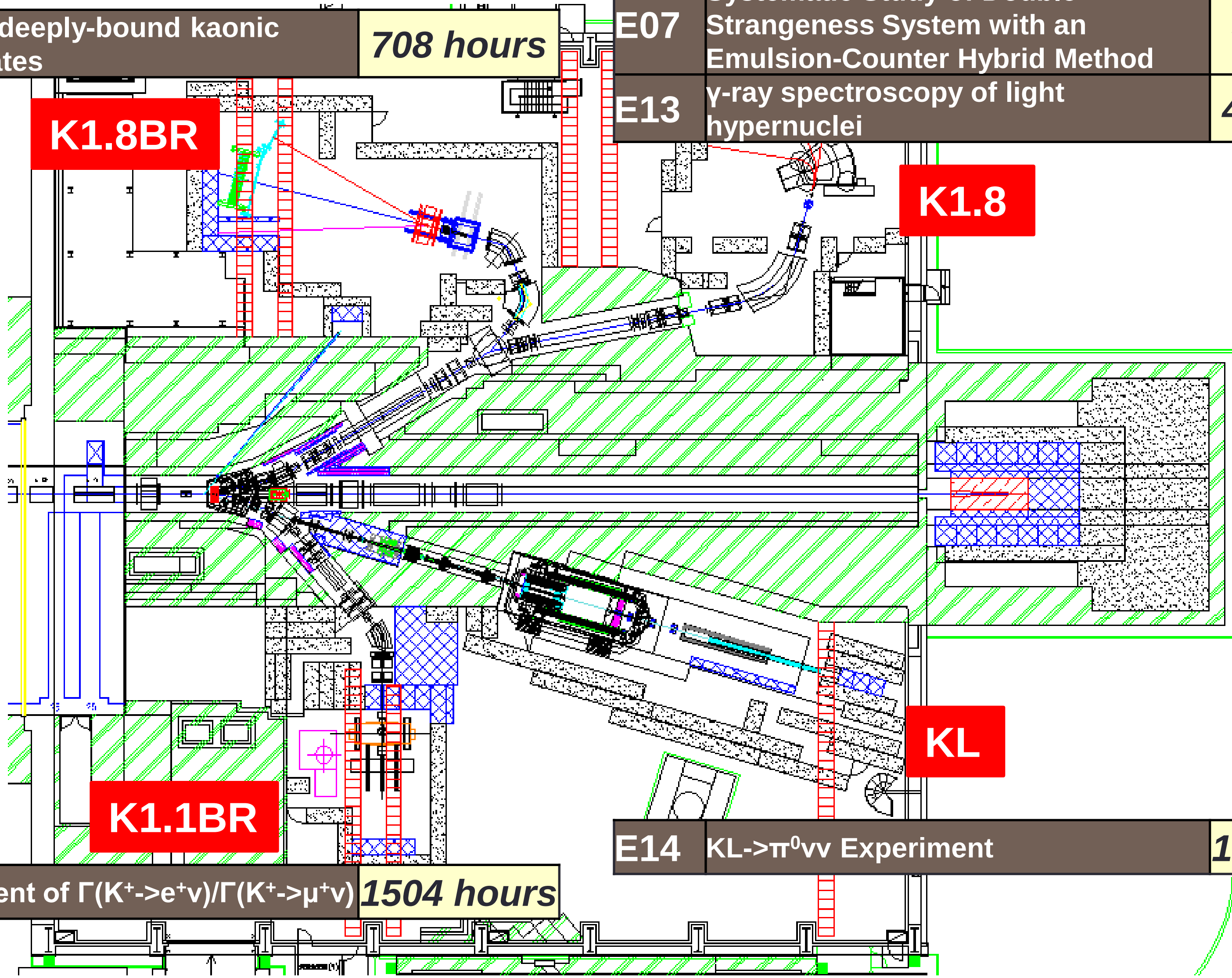
Feb, 2009 - May, 2013: 1.26x10^6 spills, 560 kW*days ←Before May, 2013

Apr, 2015 - Dec, 2015: 1.05x10^6 spills, 2338 kW*days ←During 2015

May, 2016 - Jun, 2016: 0.33x10^6 spills, 875 kW*days ←May – June, 2016

Beam time used by experiments in 2015

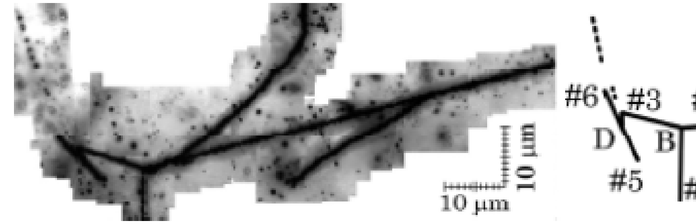
E05	Spectroscopic Study of Ξ- Hypernucleus	*319 hours*
E07	Systematic Study of Double Strangeness System with an Emulsion-Counter Hybrid Method	*42 hours*
E13	γ-ray spectroscopy of light hypernuclei	*435 hours*
E15	search for deeply-bound kaonic nuclear states	*708 hours*
E14	KL->$\pi^0\nu\nu$ Experiment	*1509 hours*
E36	Measurement of $\Gamma(K^+\text{->}e^+\nu)/\Gamma(K^+\text{->}\mu^+\nu)$	*1504 hours*

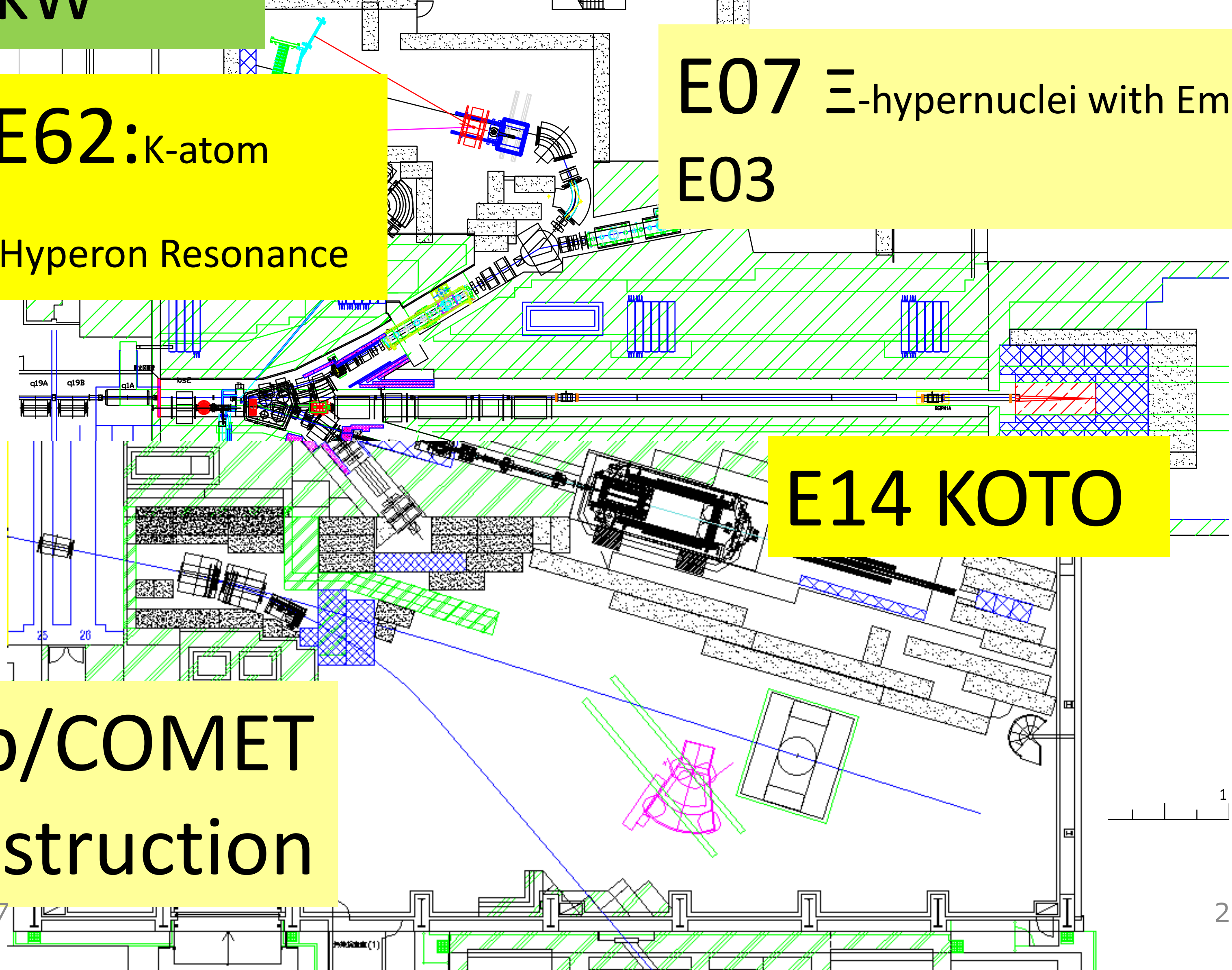


JFY2016
~50kW

E57/E62: K-atom
E31: Hyperon Resonance

E07 Ξ-hypernuclei with Emulsion
E03

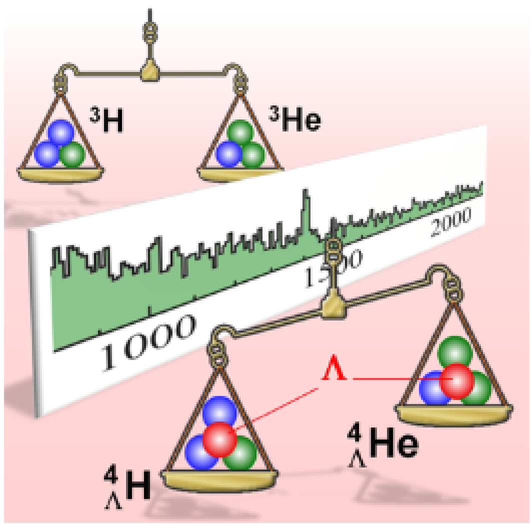




E14 KOTO

Hi-p/COMET
construction

PHYSICAL REVIEW LETTERS
moving physics forward



EDITORS' SUGGESTION

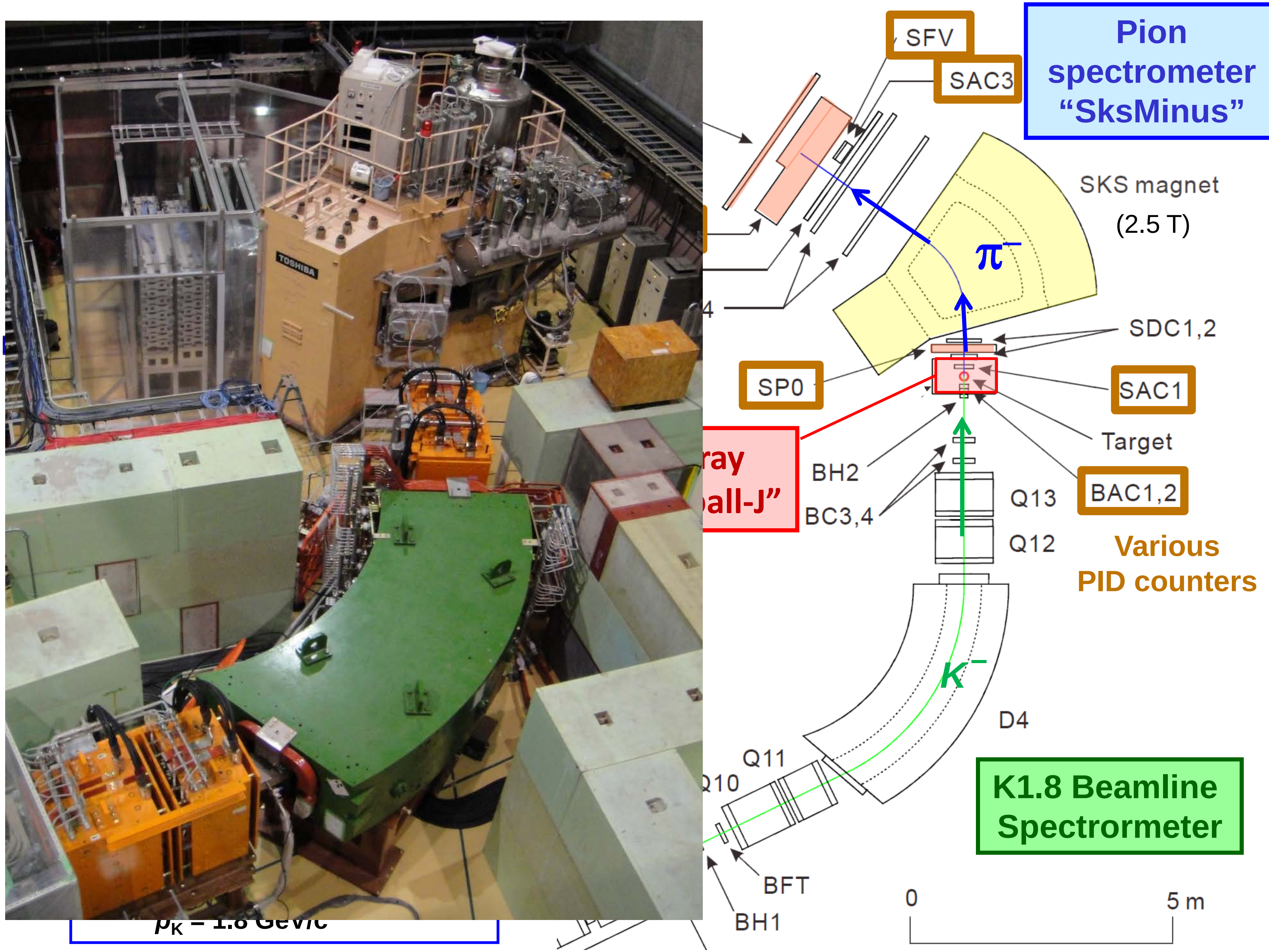
Observation of Spin-Dependent Charge Symmetry Breaking in ΛN Interaction: Gamma-Ray Spectroscopy of $^4_\Lambda\mathrm{He}$

The energy spacing of the spin-doublet states in the $^4_\Lambda$He hypernucleus indicate a large spin dependent charge symmetry breaking in the ΛN interaction.

T. O. Yamamoto *et al.* (J-PARC E13 Collaboration)

Phys. Rev. Lett. **115**, 222501 (2015)

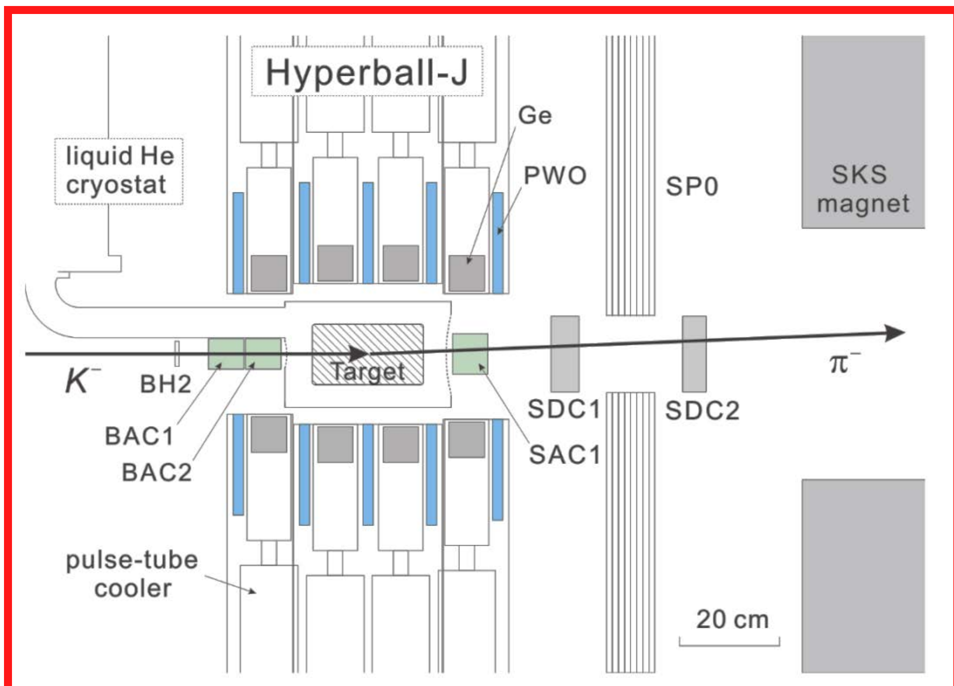
Press-released from Tohoku U., KEK, JAEA, J-PARC

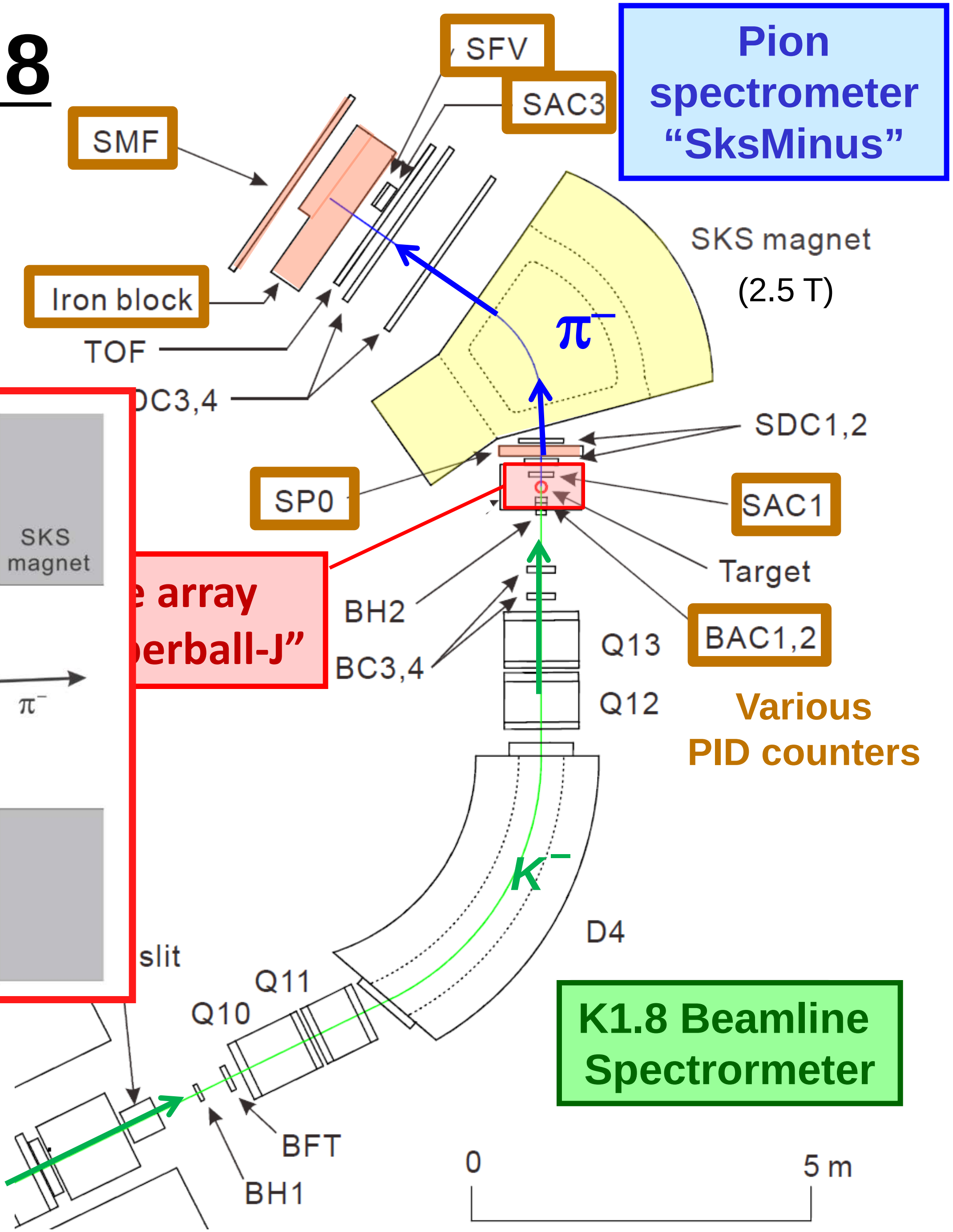


SFV
SAC3
Pion spectrometer "SksMinus"
SKS magnet
(2.5 T)
π^-
SDC1,2
SP0
SAC1
Target
BH2
BC3,4
BAC1,2
Q13
Q12
Various PID counters
K^-
D4
Q11
Q10
K1.8 Beamline Spectrormeter
BFT
BH1
0
5 m
TOSHIBA

E13 setup at K1.8

$$^{A}Z\,(K^{-},\pi^{-})\,^{A}_{\Lambda}Z^{*}$$
$$\rightarrow {}^{A}_{\Lambda}Z + \gamma$$





$^{4}_{\Lambda}He$: liq.He target (2.5 g/cm^2)

p_K = 1.5 GeV/c

$^{19}_{\Lambda}F$: HF -> CF_4 target (20 g/cm^2)

p_K = 1.8 GeV/c

Hyperball-J

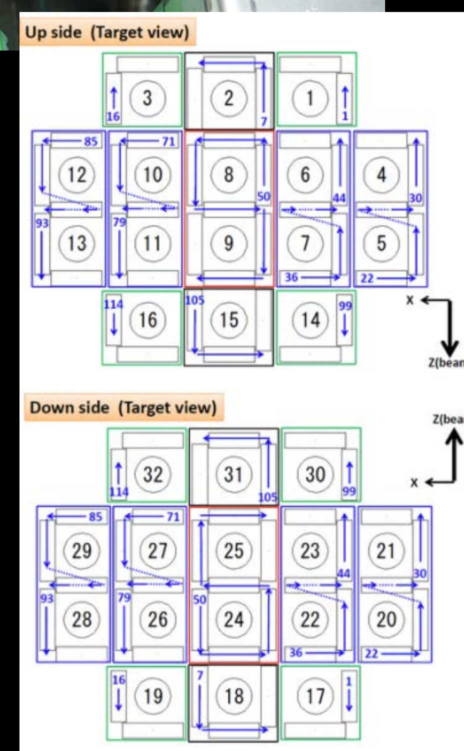
A newly developed Ge array for hypernuclei

Ge cooled down to ~70K
by a pulse-tube refrigerator
(c.f. 92K w/LN_2) to suppress
radiation damage

Fast background suppressor
made of PWO

ΔE= 3.1(1) keV at 1.33 MeV

Eff. = 5.4% @1 MeV
with 28 Ge(re=60%)



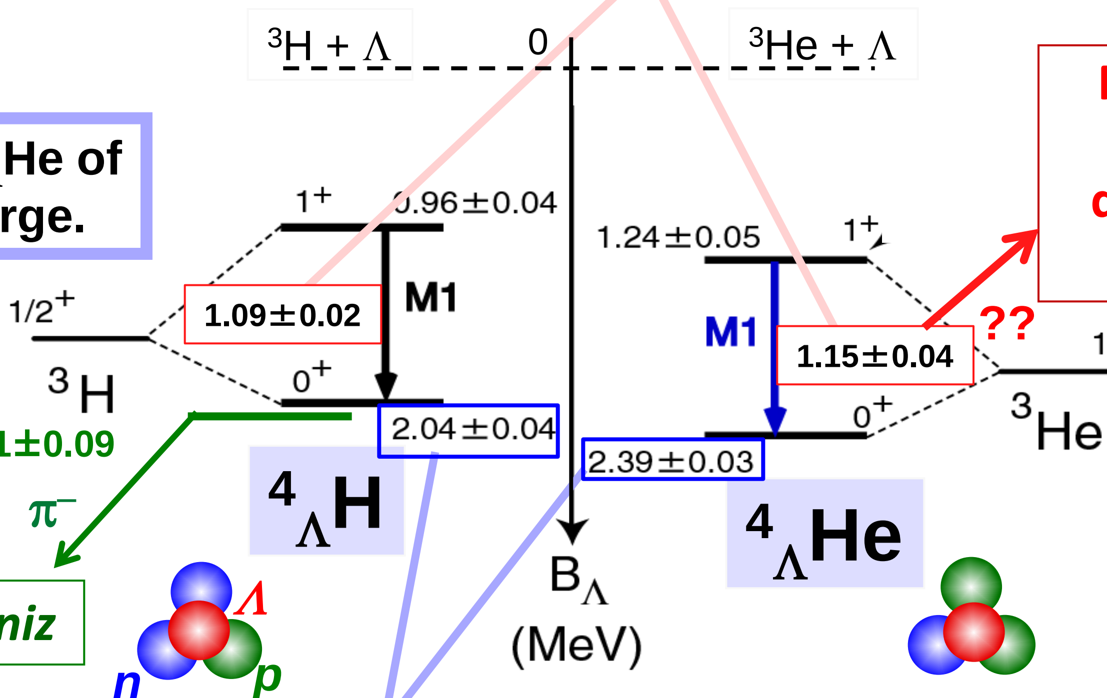
Charge Symmetry Breaking puzzle in hypernuclei

^{3}H / ^{3}He binding energy difference due to strong int.
~60 keV

B_Λ diff. in $^4_\Lambda$H / $^4_\Lambda$He of 350 keV is too large.

Old NaI data

Bedjidian et al.
PLB 62 (1976) 467
PLB 83 (1979) 252



Measure with Ge detectors => E13

??

2.12±0.01±0.09

π⁻

Measured at Maniz

A. Esser et al., PRL 114 (2015) 12501

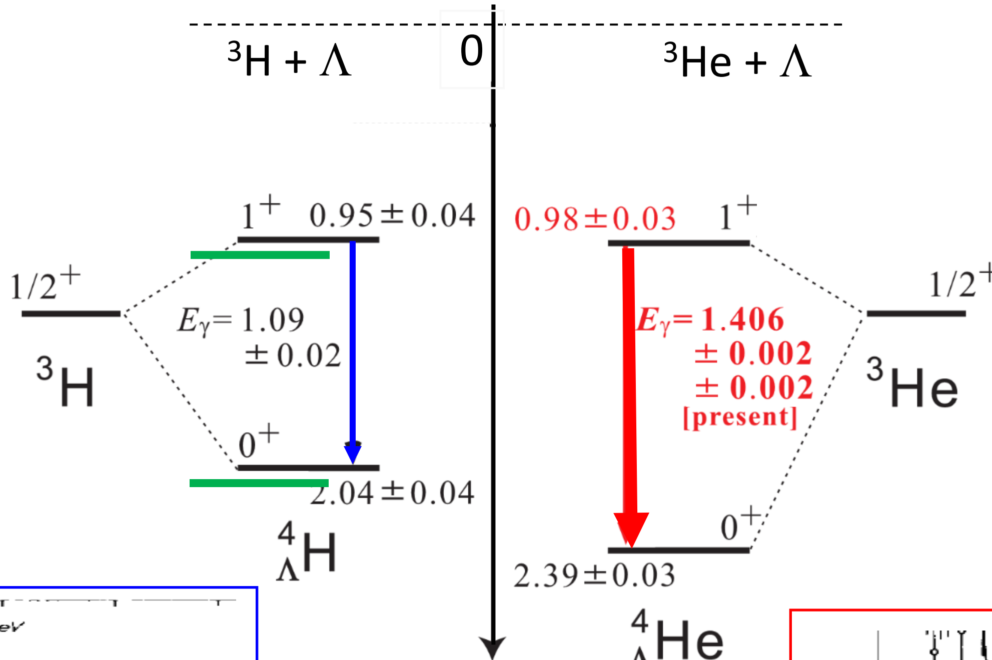
Old emulsion data — *no systematic errors given*

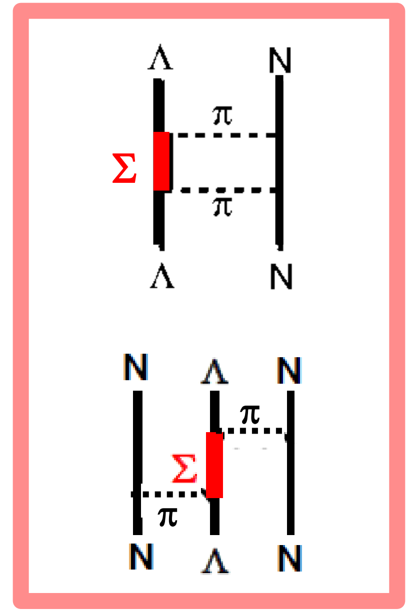
M. Juric et al. NPB 52 (1973) 1

4-body exact calc's with Λ–Σ mixing using Nijmegen BB interaction models failed
=> Long standing puzzle

Experimental confirmation of CSB is necessary

Results



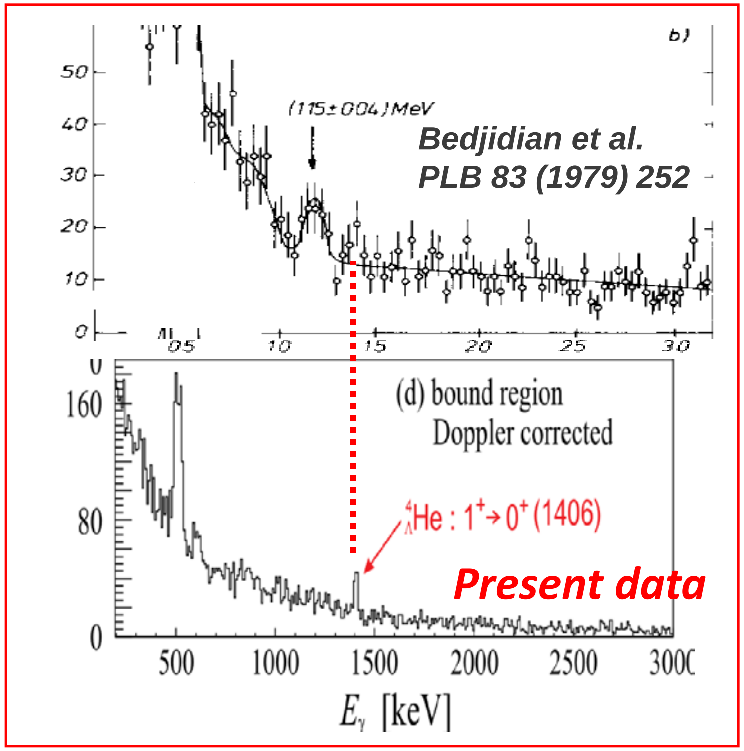


=> Existence of a large CSB effect confirmed only by γ-ray data

Combining with emulsion data,	**$\Delta B_\Lambda(1^+)$: 0.03±0.05 MeV** **$\Delta B_\Lambda(0^+)$: 0.35±0.05 MeV**

=> Large spin dependence in CSB found

=> CSB is sensitive to Σ mixing.
ΛN–ΣN coupling force in the existing BB int models should be modified.



Observation of Spin-Dependent Charge Symmetry Breaking in ΛN Interaction: Gamma-Ray Spectroscopy of $^{4}_{\Lambda}$He

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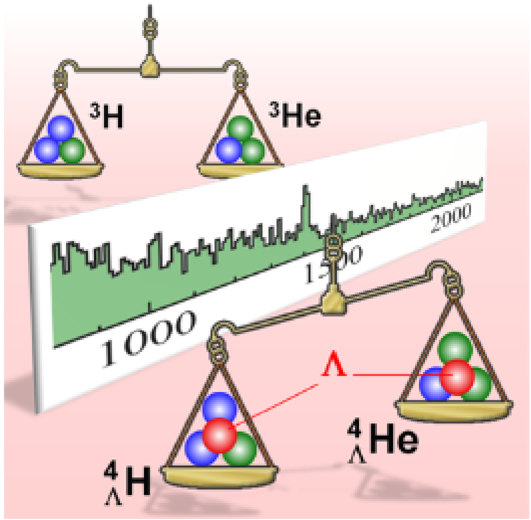
The energy spacing between the spin-doublet bound state of $^{4}_{\Lambda}\mathrm{He}(1^+, 0^+)$ was determined to be $1406 \pm 2 \pm 2$ keV, by measuring γ rays for the $1^+ \to 0^+$ transition with a high efficiency germanium detector array in coincidence with the $^{4}\mathrm{He}(K^-, \pi^-)^{4}_{\Lambda}\mathrm{He}$ reaction at J-PARC. In comparison to the corresponding energy spacing in the mirror hypernucleus $^{4}_{\Lambda}$H, the present result clearly indicates the existence of charge symmetry breaking (CSB) in ΛN interaction. By combining the energy spacings with the known ground-state binding energies, it is also found that the CSB effect is large in the 0^+ ground state but is vanishingly small in the 1^+ excited state, demonstrating that the ΛN CSB interaction has spin dependence.

DOI: 10.1103/PhysRevLett.115.222501 PACS numbers: 21.80.+a, 13.75.Ev, 23.20.Lv, 25.80.Nv

PHYSICAL REVIEW LETTERS
moving physics forward



EDITORS' SUGGESTION

Observation of Spin-Dependent Charge Symmetry Breaking in ΛN Interaction: Gamma-Ray Spectroscopy of $^4_\Lambda$He

The energy spacing of the spin-doublet states in the $^4_\Lambda$He hypernucleus indicate a large spin dependent charge symmetry breaking in the ΛN interaction.

T. O. Yamamoto *et al.* (J-PARC E13 Collaboration)

Phys. Rev. Lett. **115**, 222501 (2015)

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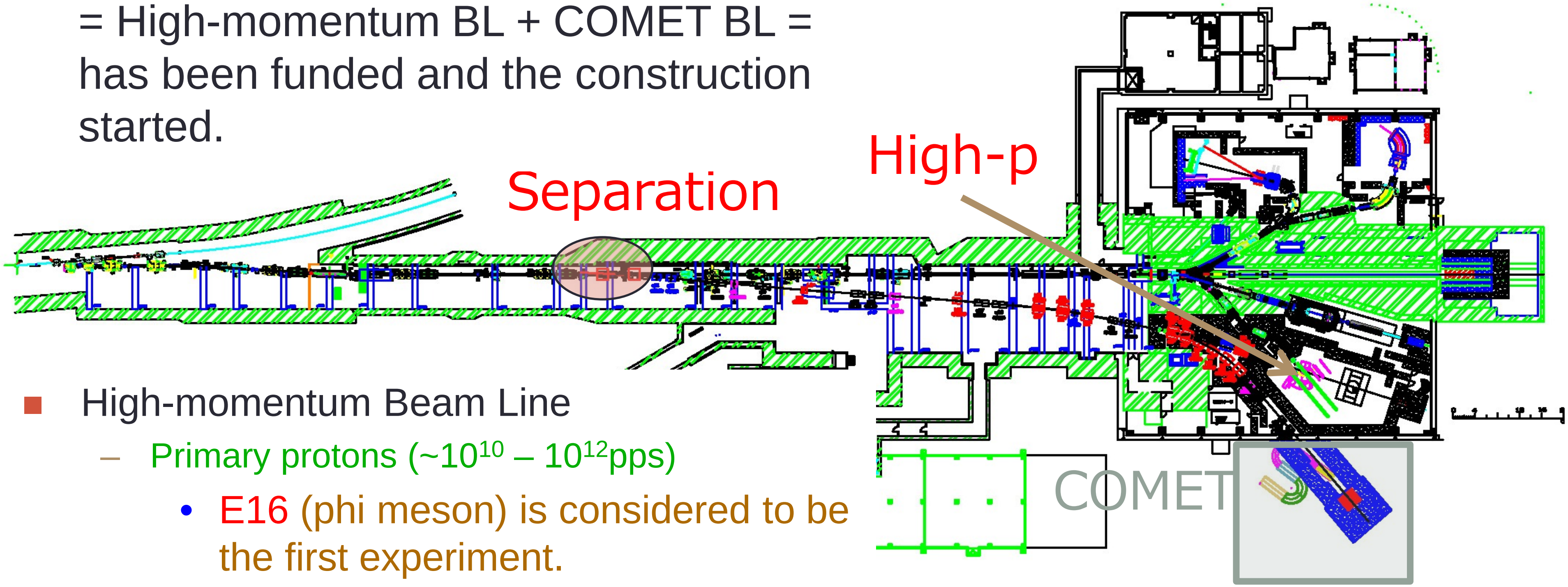
Contents

- J-PARC and Hadron Experimental Facility (Hadron Hall)
- Hadron physics overview and fruits so far obtained
- High-momentum beam line
- Extension
- Summary

New Primary Proton Beam Line

- New primary Proton Beam Line
  = High-momentum BL + COMET BL =
  has been funded and the construction started.

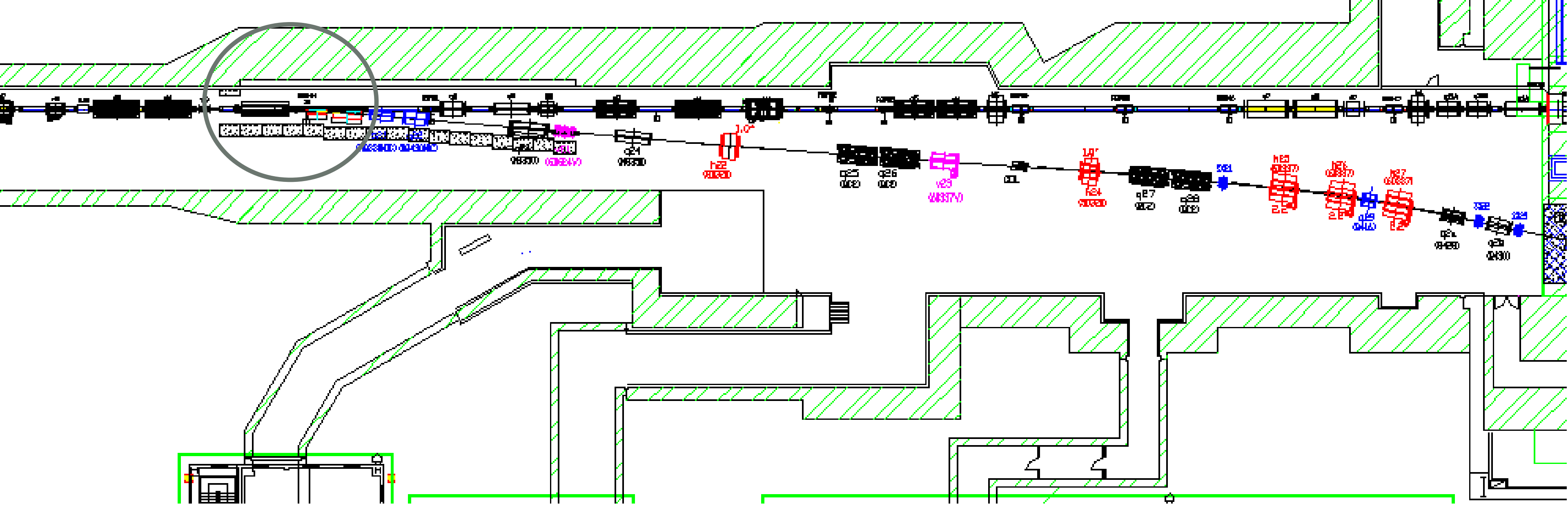


- High-momentum Beam Line
  - Primary protons (~10^{10} – 10^{12}pps)
    - E16 (phi meson) is considered to be the first experiment.
  - Unseparated secondary particles (pi, …)
    - High-resolution secondary beam by adding several quadrupole and sextupole magnets.

- COMET
  - Search for μ to e conversion
  - 8 GeV, 50 kW protons
  - Branch from the high-momentum BL
  - Annex building is being built at the south side.

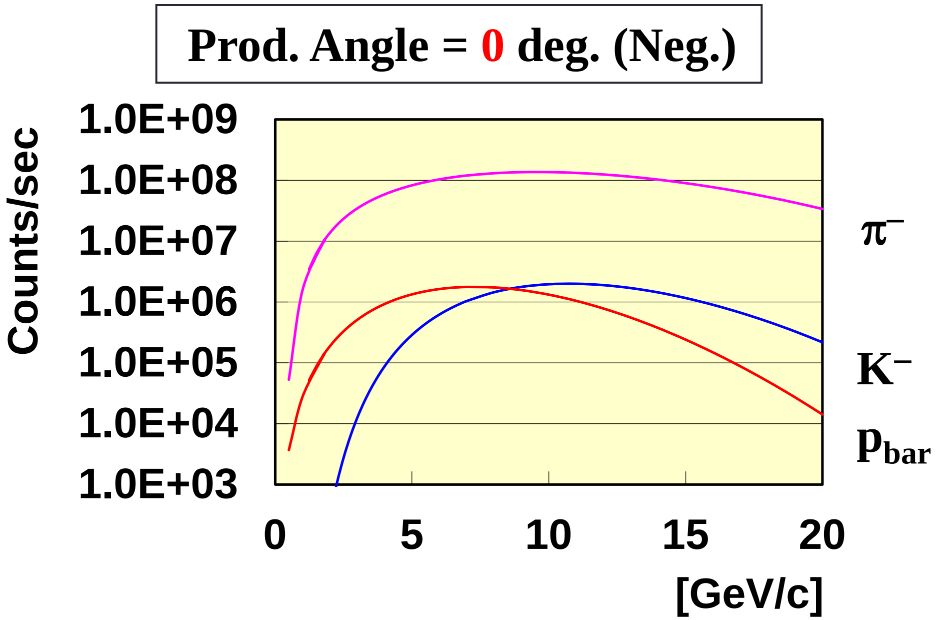
Secondary beams

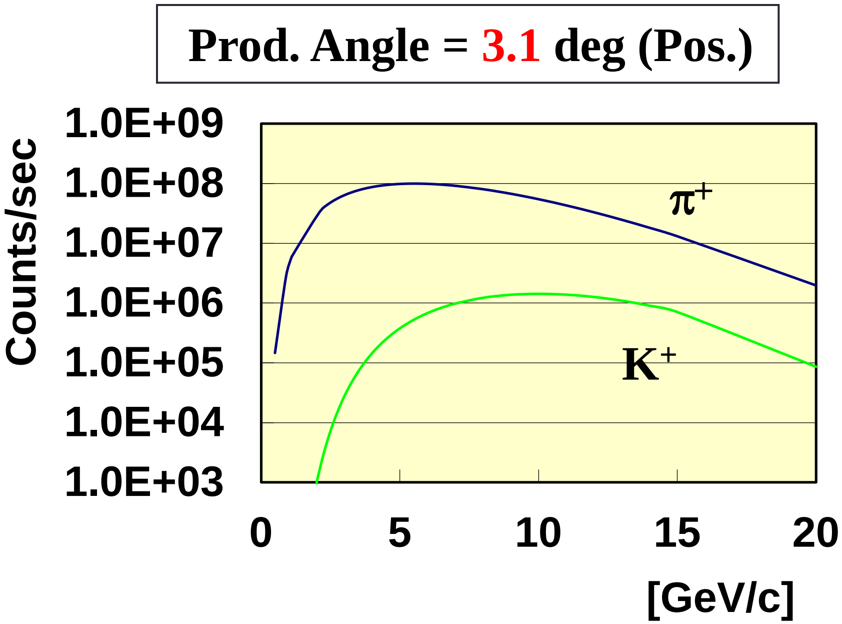
Thin production target!



Unseparated Secondary Beam

Noumi

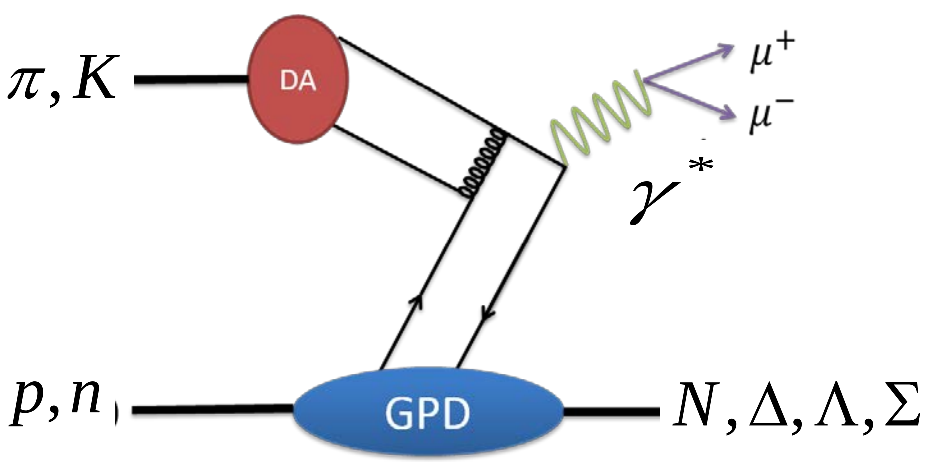




* Sanford-Wang:15 kW Loss on Pt, Acceptance :1.5 msr%, 133.2 m

"GPD" and "Transition GPD"

- $\pi^- \mathrm{p} \rightarrow \gamma^* n$
- $\pi^- \mathrm{p} \rightarrow \gamma^* \Delta^0$
- $\pi^- \mathrm{n} \rightarrow \gamma^* \Delta^-$
- $\pi^+ \mathrm{n} \rightarrow \gamma^* \mathrm{p}$
- $\pi^+ \mathrm{p} \rightarrow \gamma^* \Delta^{++}$
- $\pi^+ \mathrm{n} \rightarrow \gamma^* \Delta^+$
- $K^- \mathrm{p} \rightarrow \gamma^* \Lambda$
- $K^- \mathrm{p} \rightarrow \gamma^* \Lambda(1405)$
- $K^- \mathrm{p} \rightarrow \gamma^* \Lambda(1520)$
- $K^- \mathrm{n} \rightarrow \gamma^* \Sigma^-$



GPD with pion beams at J-PARC

PHYSICAL REVIEW D **93**, 114034 (2016)

Accessing proton generalized parton distributions and pion distribution amplitudes with the exclusive pion-induced Drell-Yan process at J-PARC

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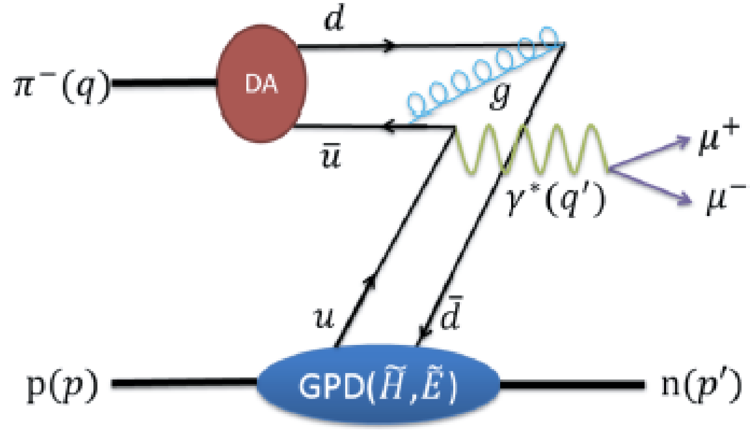


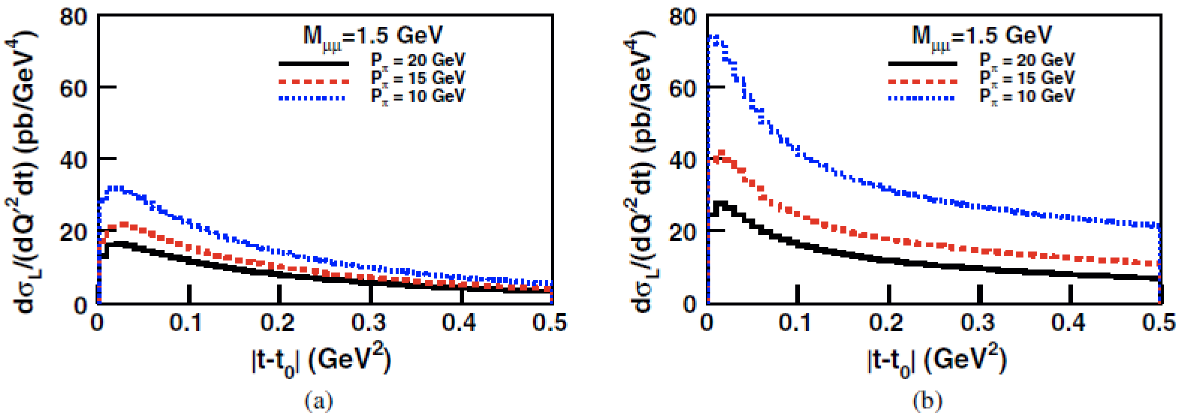
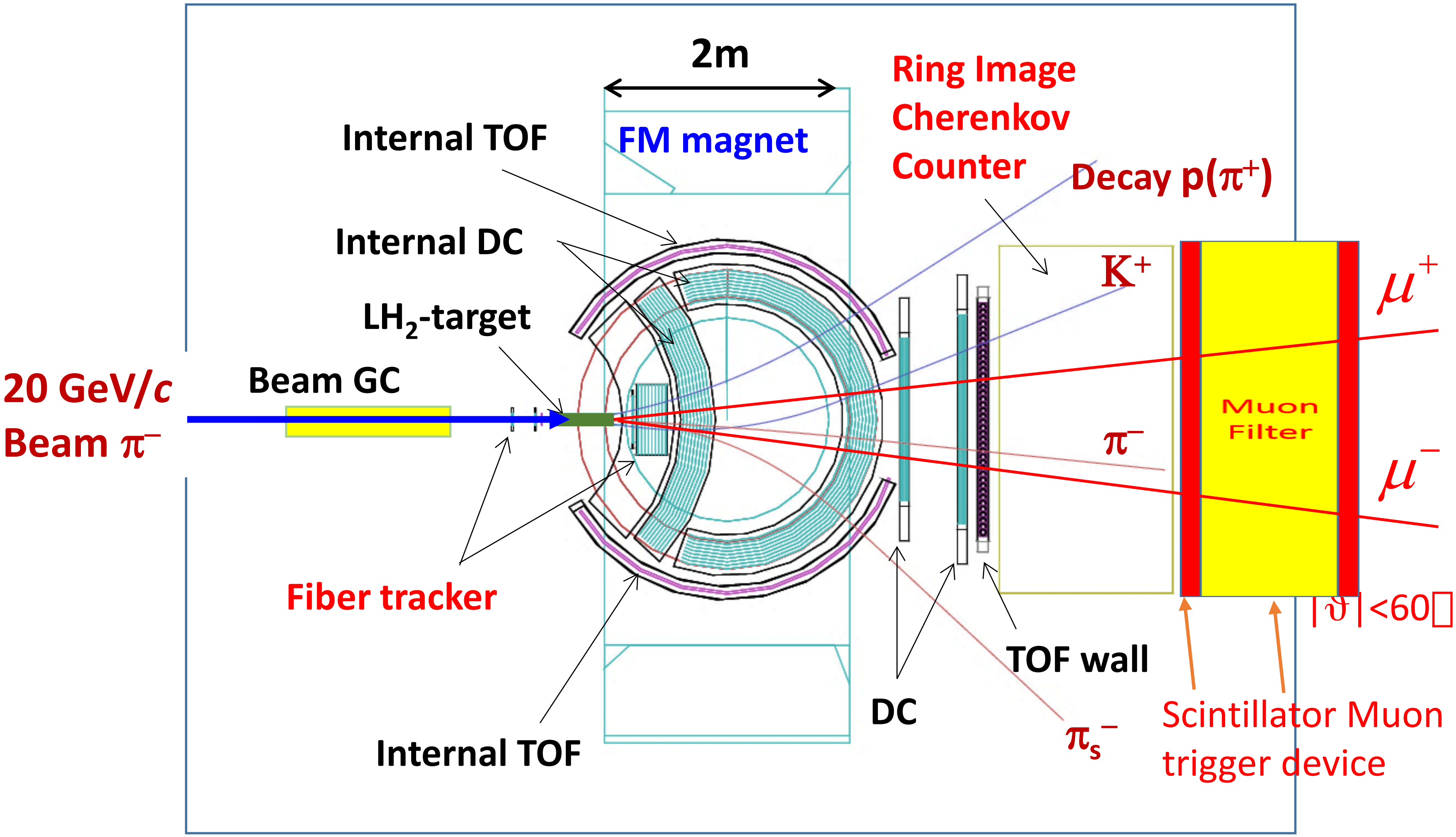


FIG. 10. Differential cross sections of exclusive Drell-Yan events, Eq. (20), as a function of $|t - t_0|$ at $M_{\mu^+\mu^-} = 1.5$ GeV for $P_\pi = 10$, 15, and 20 GeV with the input GPDs: (a) BMP2001 and (b) GK2013.

J-PARC E50 Spectrometer + MuID



Acceptance: ~ 60% for D^*, ~80% for decay π^+
Resolution: $\Delta p/p$~0.2% at ~5 GeV/c （Rigidity：~2.1 Tm)

GPD with pion beams at J-PARC

Experimental conditions:
4g/cm2 H2 target, 1.83/1.58/1.00E7 p-/spill (for 10/15/20 GeV beam), 50-day beam time.

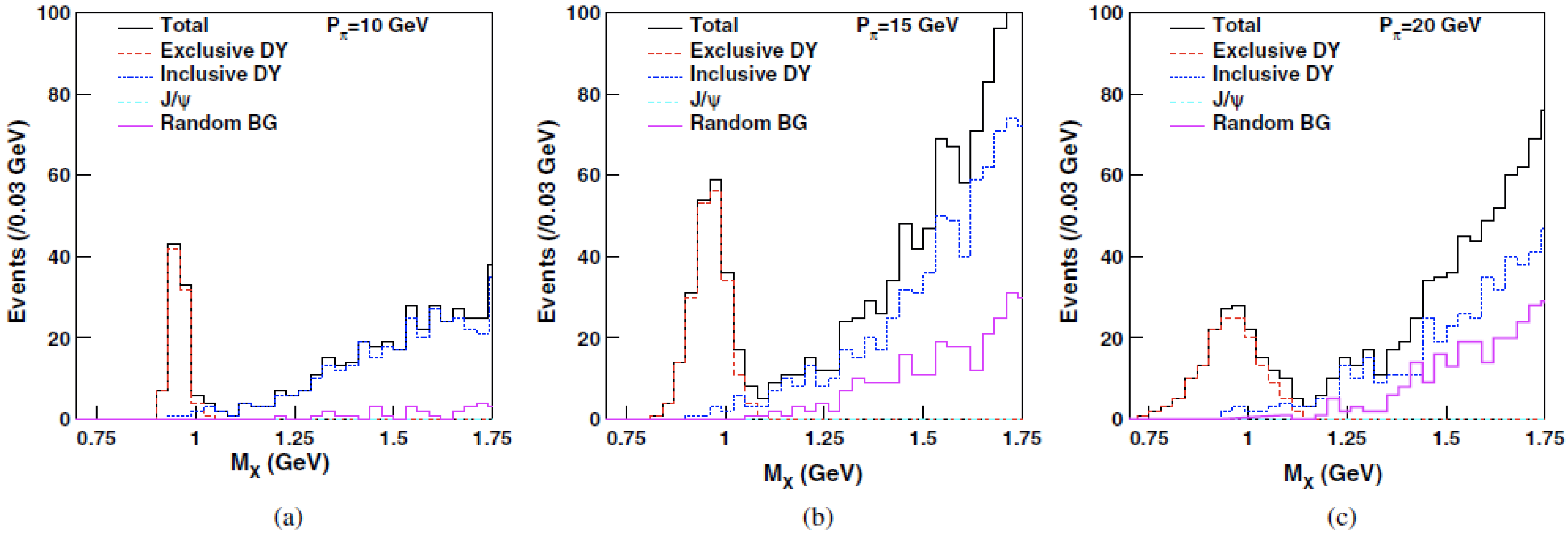


FIG. 14. The Monte Carlo simulated missing-mass M_X spectra of the $\mu^+\mu^-$ events with $M_{\mu^+\mu^-} > 1.5$ GeV and $|t - t_0| < 0.5$ GeV^2 for $P_\pi = 10$ (a), 15 (b), and 20 (c) GeV. Lines with different colors denote the contributions from various sources. The GK2013 GPDs is used for the evaluation of exclusive Drell-Yan process.

GPD with pion beams at J-PARC

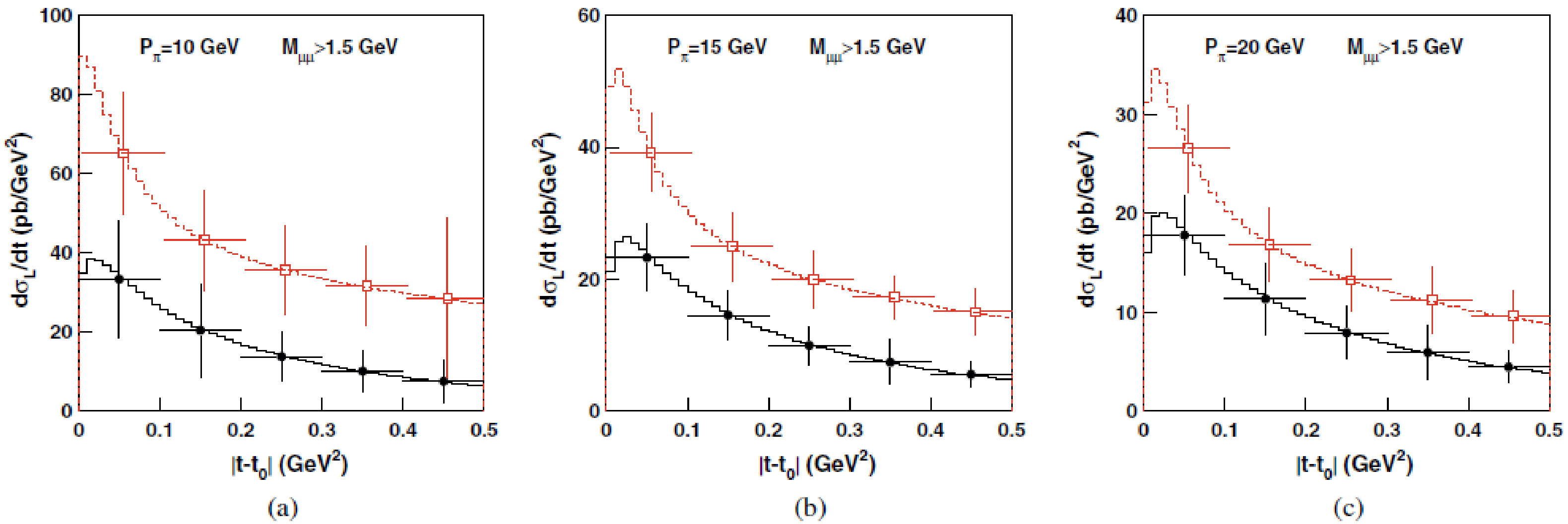


FIG. 15. The expected statistical errors of the exclusive Drell-Yan measurement for two GPDs inputs, BMP2001 (black) and GK2013 (red), as a function of $|t - t_0|$ in the dimuon mass region of $M_{\mu^+\mu^-} > 1.5$ GeV for 10 (a), 15 (b), and 20 (c) GeV beam momentum.

GPD with pion beams at J-PARC

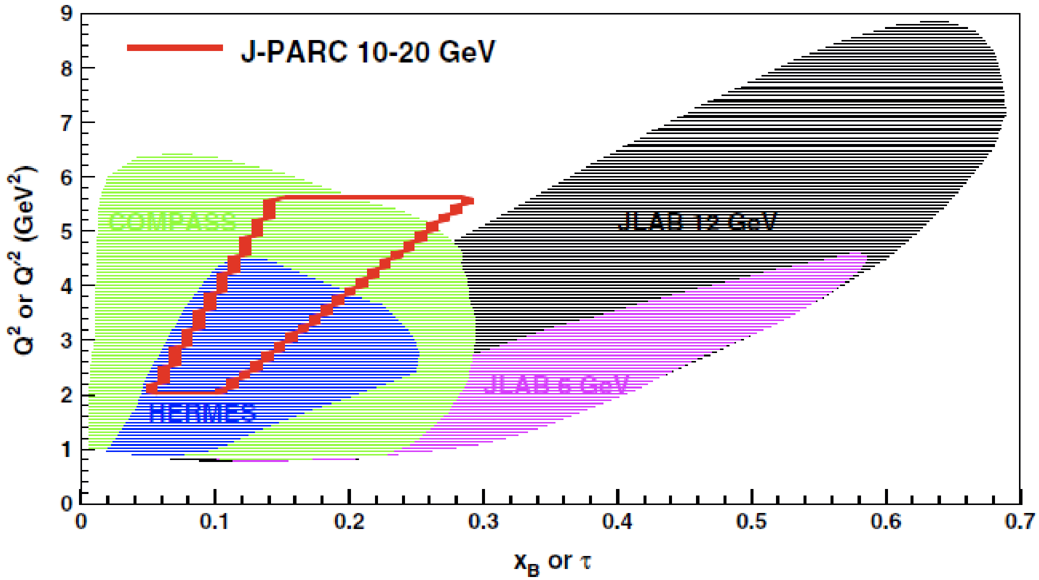


FIG. 16. The kinematic regions of GPDs explored by the experiments at JLab, HERMES and COMPASS and J-PARC (exclusive Drell-Yan). The region is either $[Q^2, x_B]$ for spacelike processes or $[Q'^2, \tau]$ for timelike ones.

Letter of Intent to J-PARC being prepared.

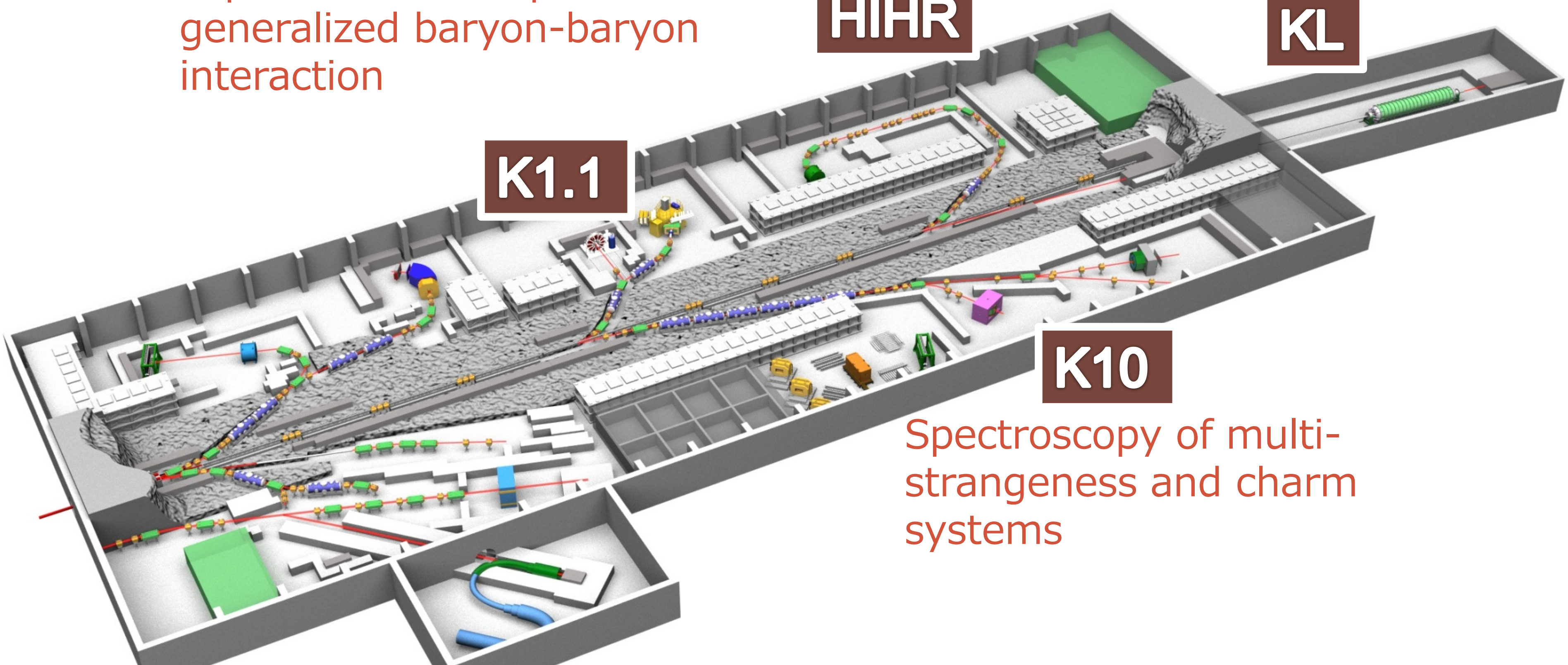
Contents

Hadron Hall Extension

- Extend the Hadron Hall for ~105m.
- Construct 2 production targets with beam lines.

From discovery to measurement of K0 rar decay

Single strangeness experiments to explore generalized baryon-baryon interaction



Spectroscopy of multi-strangeness and charm systems

Hadron Hall Extension

- Hadron Hall extension has been proposed to the Science Council of Japan for their recommendation as a next big project, and selected as one of the 27 important big projects.
- A review committee at MEXT selected the J-PARC future project including the Hadron Hall extension as one of the 11 major projects on its roadmap.
- The Institute of Particle and Nuclear Studies, KEK has made the discussion for future projects (ILC, neutrino, and Hadron extension) at the research program committee, and they have concluded that the Hadron extension should be promoted, as well as other projects.
- At the discussion of the KEK Project Implementation Plan, the Hadron Hall Extension was assigned a priority to realize.

Summary

- The beam operation at the Hadron Facility restarted from April, 2015.
- The beam power at the restart was 24kW, and then improved gradually to 42kW. The Hadron Experimental Facility is now in the era of K-induced experiments.
- The high-momentum beam line is under construction, and will be available in a few years, for hadron phsics experiments.
- An experiment to measure nucleon GPDs with pion beams is being planned.
- The extension of the Hadron Hall has been proposed, and got a good message from initial reviews.

April 28, 2015