Hypernuclear Physics Program at J-PARC Hadron Facility

Elba XI Workshop

2010 June 25

T.Takahashi (KEK/J-PARC)

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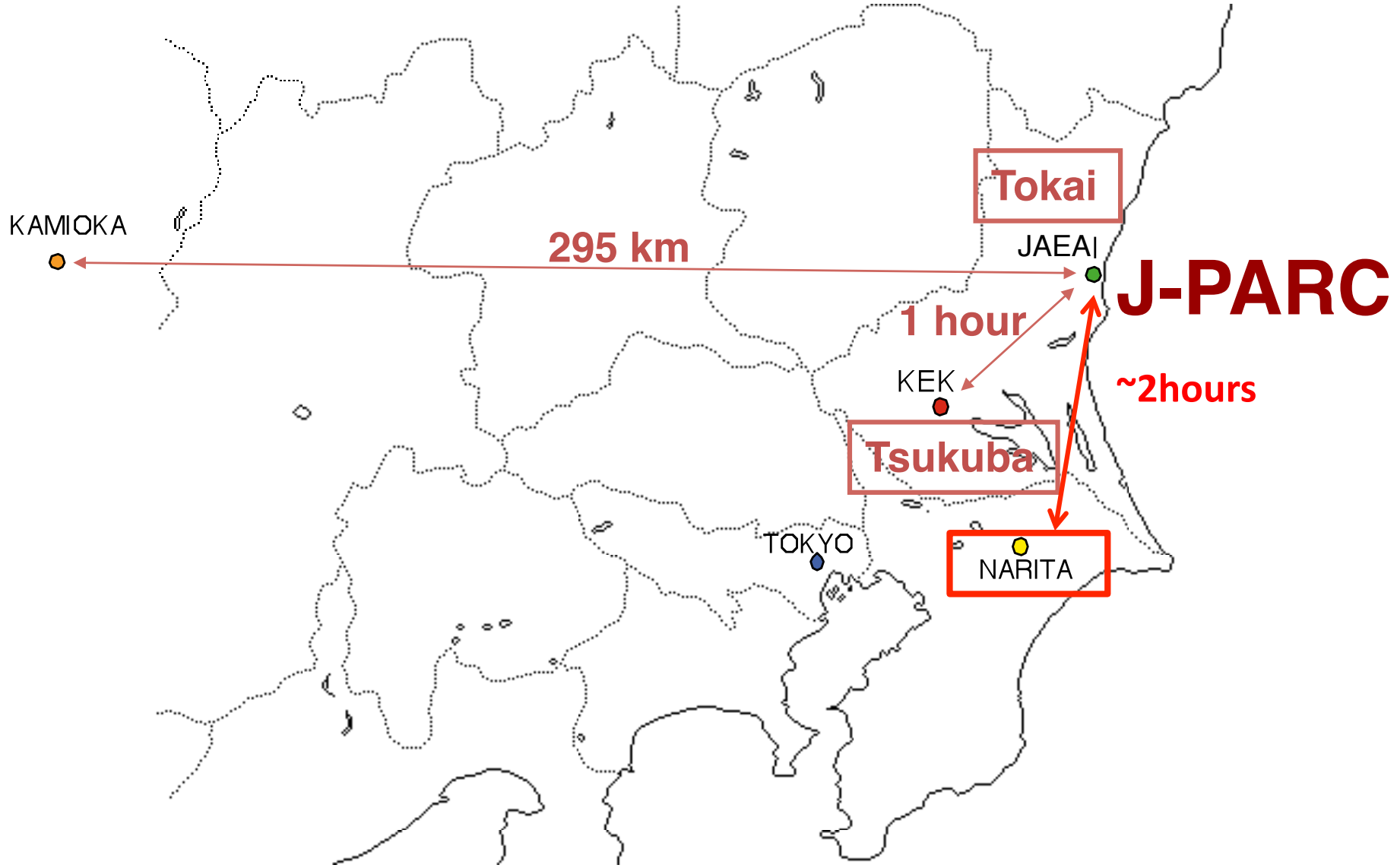
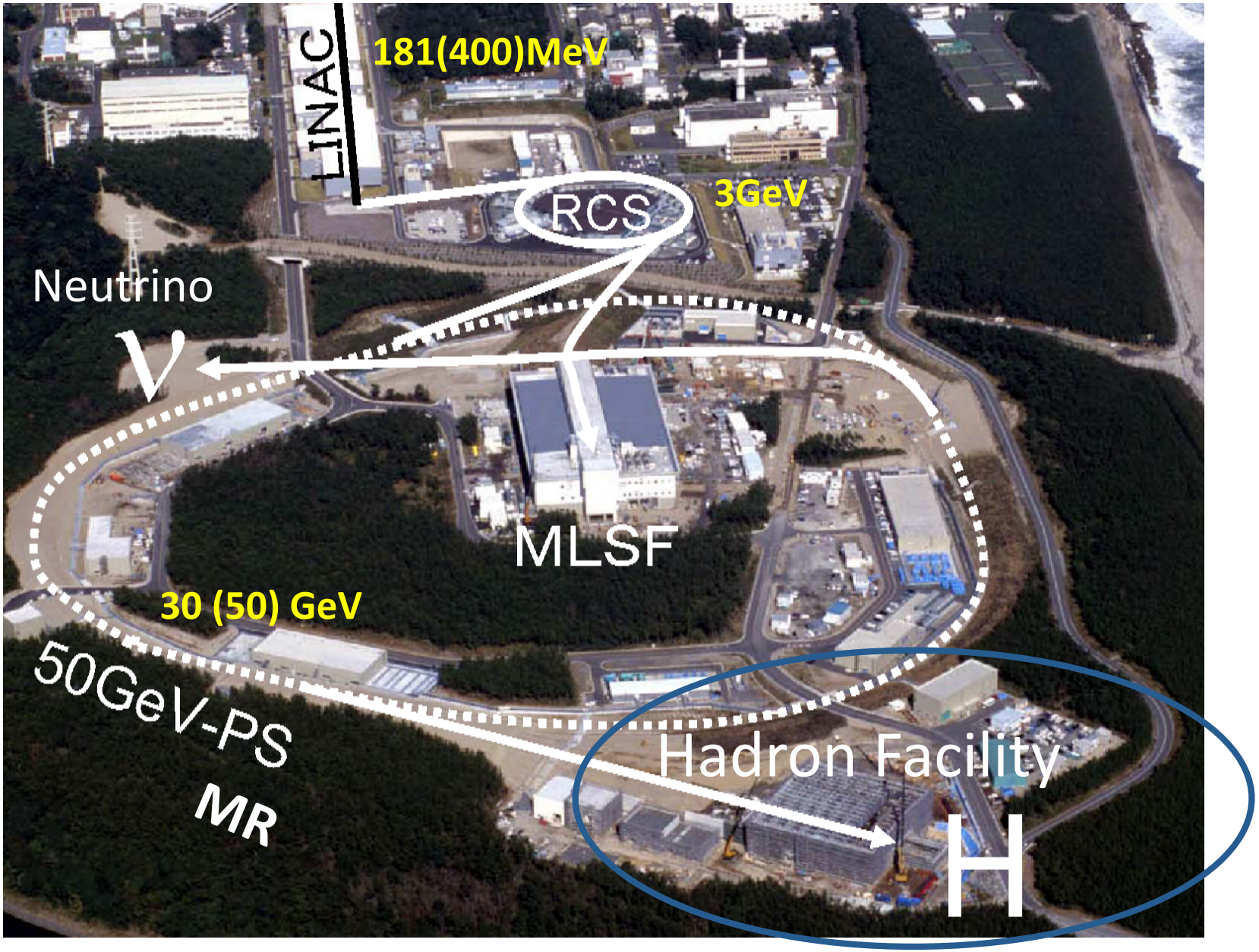
- Overview of J-PARC & Hadron Facility
  - Milestones of Activities at Hadron Facility
- Summary of Proposals
- Experiments
  - S=−2 Experiments
  - S=−1 Experiments
- Summary

Overview of J-PARC & Hadron Facility

Location of J-PARC at Tokai



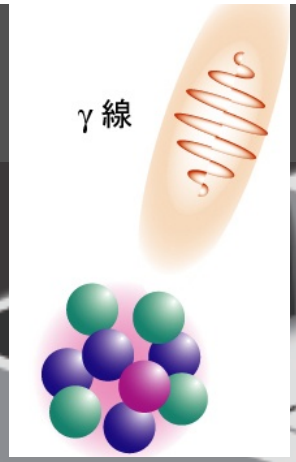
Japan Proton Accelerator Research Complex



Nuclear & Hadron Physics at Hadron Hall

Hypernuclear Physics

γ-ray spectroscopy



multi-strangeness hypernuclei

double-Λ

Pentaquark Θ+

K1.8

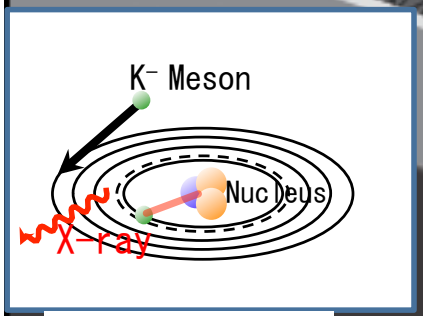
K1.8BR

KL

High-P

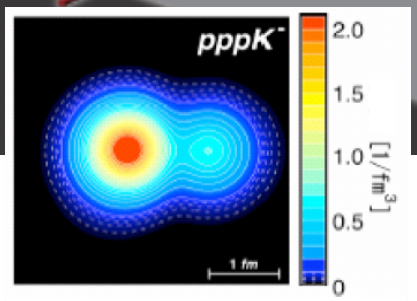
K1.1

K1.1BR

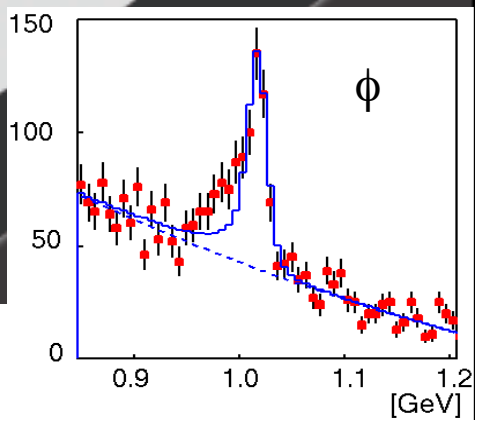


kaonic atom

K̄ N Interaction



kaonic nuclei

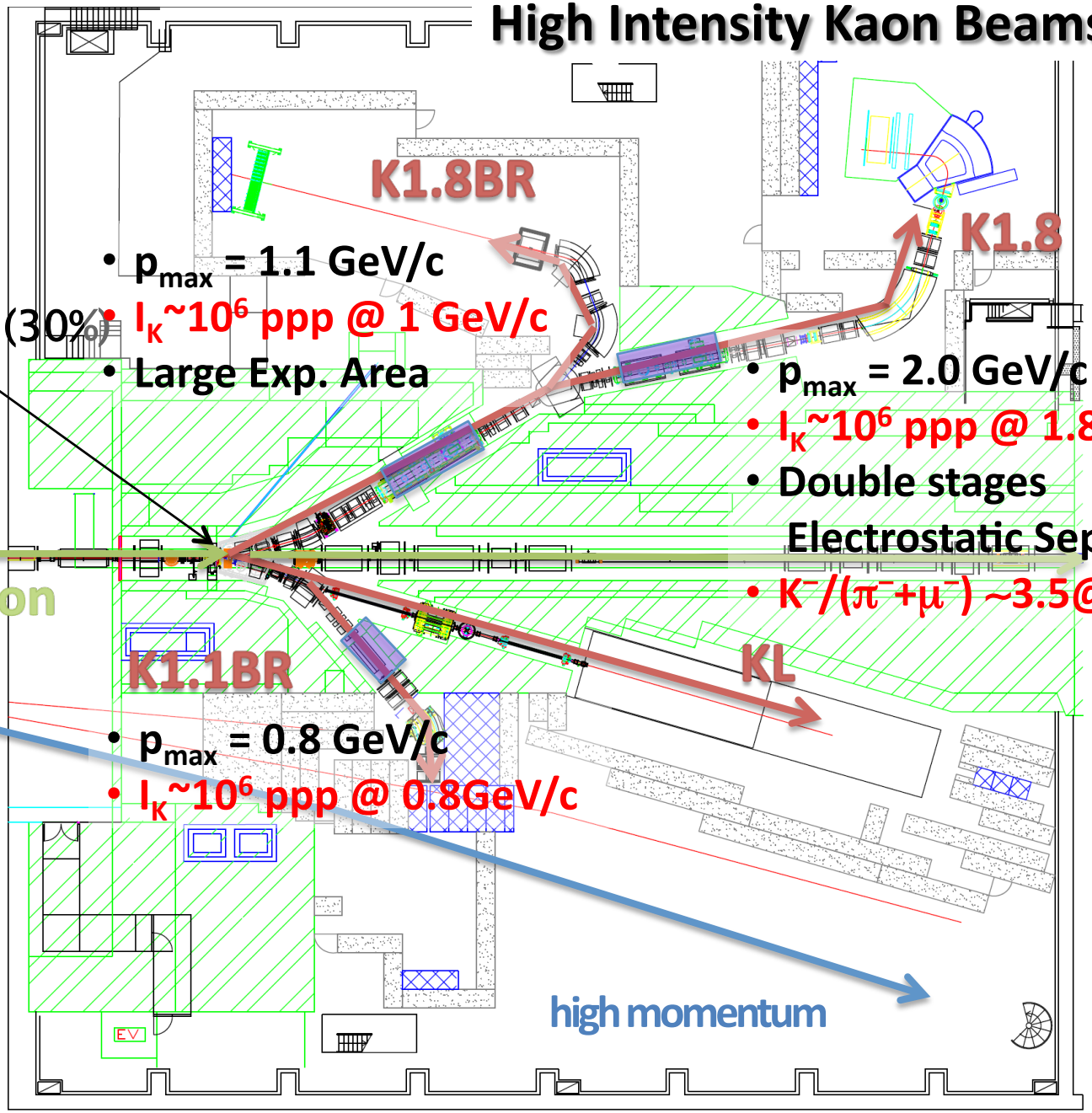


Exotic Hadrons

Origin of Hadron Mass

Hadron Hall & Beamlines

High Intensity Kaon Beams



Milestones

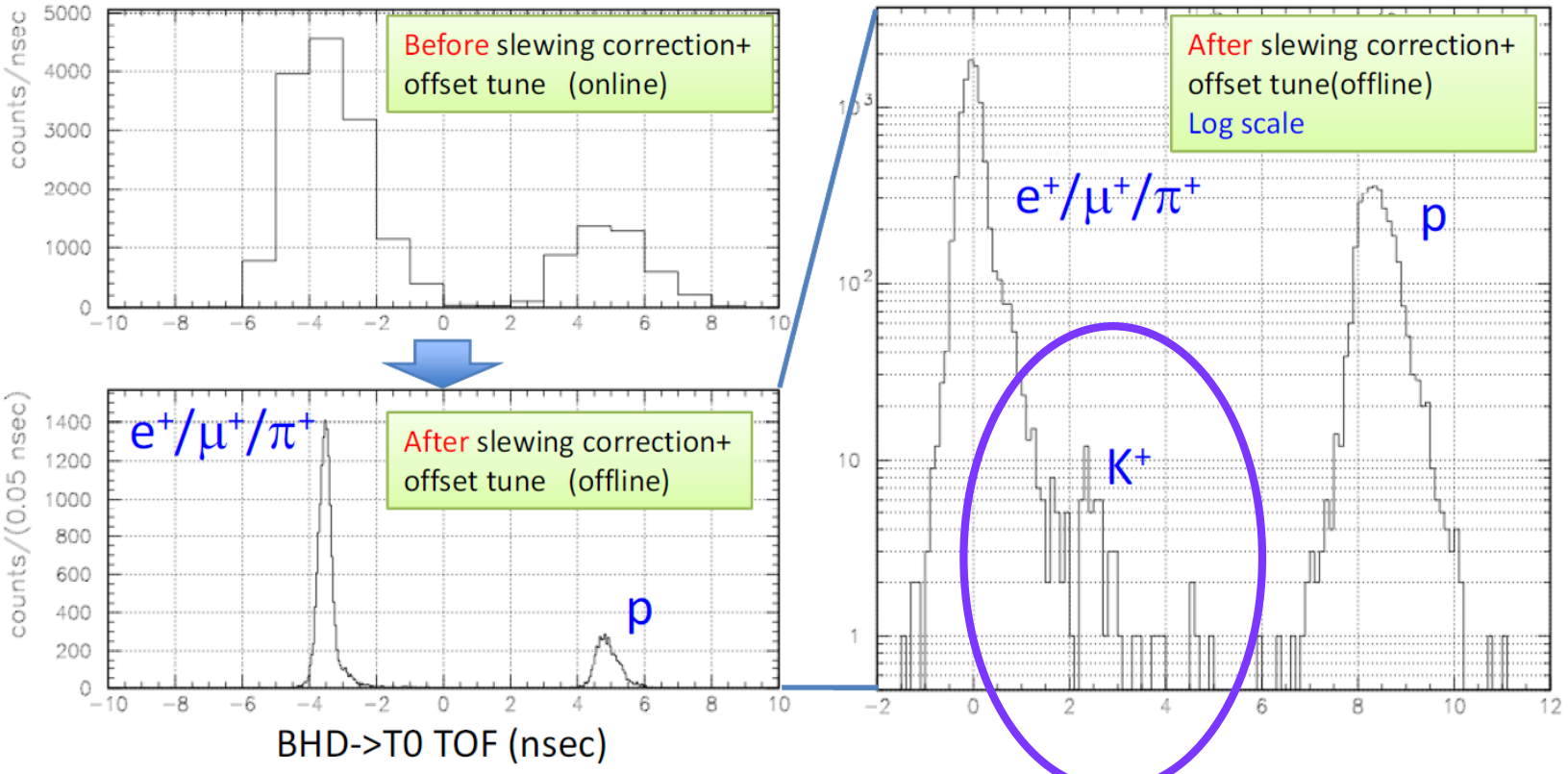
- 2007 Jan.24 Acc. to 181MeV at LINAC
- 2007 Oct.31 Acc. to 3GeV at RCS
- 2008 May.22 Injection to MR
- 2008 Dec.23 Acc. to 30GeV at MR
- 2009 Jan.27 Extraction to Hadron Hall
- 2009 Feb.12 The first beam to K1.8BR
  — Mar. (Kaon identification)
- 2009 Oct.22 The first beam to K1.8/KL
  — 2010 Feb. (Kaon id./confirm SKS resol.)
  (K1.1BR constriction)
- 2010 Oct.? — Experiments start.
  E19@K1.8/E17@K1.8

The


祝 ハドロンビームライン
ビーム取り出し・輸送成功
平成 21 年 1 月 27 日 19時35分

1 (q01in)
3 (v04in)
4 (V06in)
7 (q1Aout)
8 (T1in)

Kaon Identification@K1.8BR 2009 Feb.
Beam TOF w/o Separators @1.1GeV/c



π-KのTOF差~ 2.4 nsec (計算値 2.3 nsec @1.1 GeV/c)

$e^+ + \mu^+ + \pi^+ : K^+$ ~ 9000:40 ($\pi^+ : K^+$の計算値~540:1 @1.0GeV/c)

=> BHD->T0のTOFスペクトル上にK^+を同定

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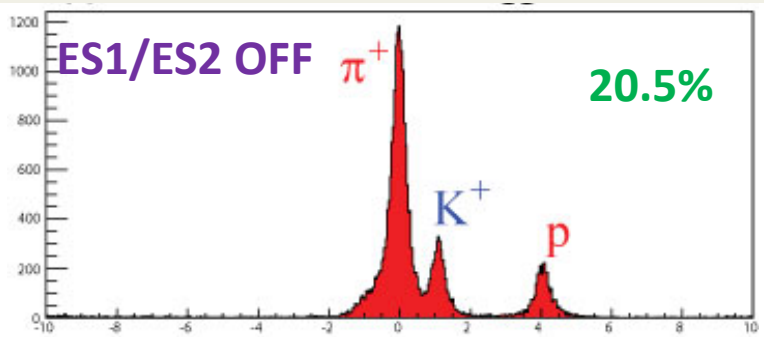
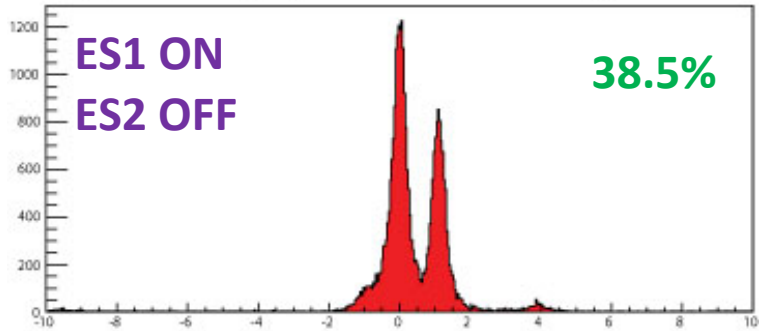
K1.8 Beamline Tuning
2009 Oct. – 2010 Feb.

@1.8GeV/c

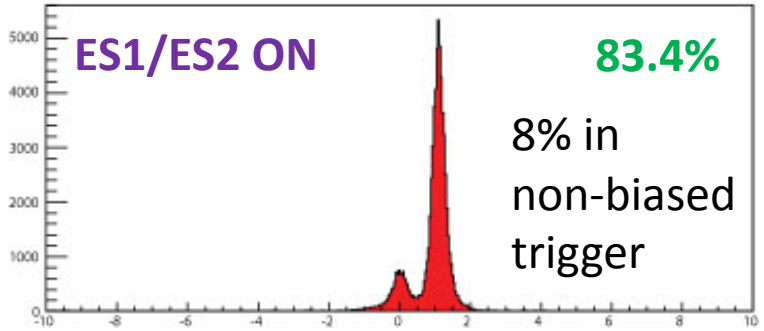
TOF of beam particle in "K" trigger

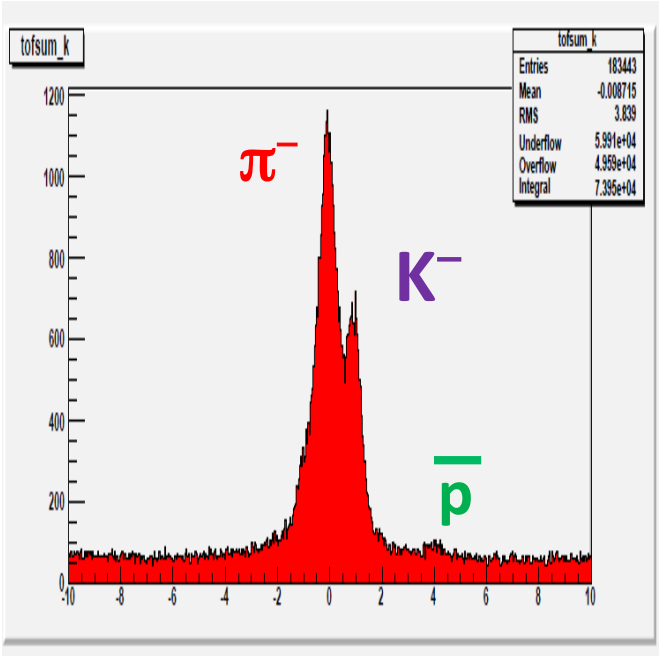


(b) ES1 on (K) / ES2 off / "K" trigger



(c) ES1 on (K) / ES2 on (K) / "K" trigger



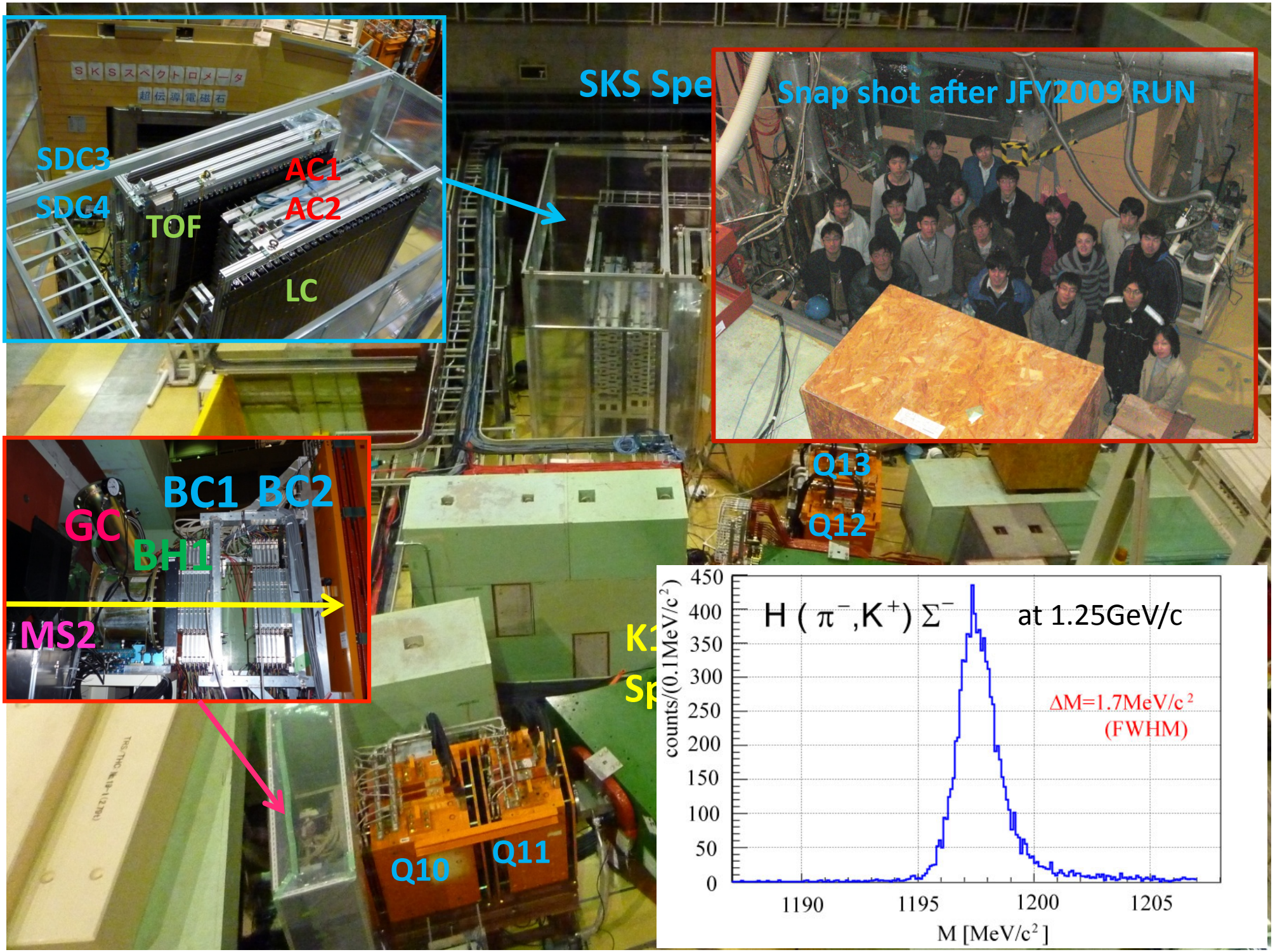


K^- : 7k/2.5E+12 ppp

K^+ : 40k/2.5E+12 ppp

consistent with design values

*still rough tuning
K/π will be much more improved


SDC3
SDC4
TOF
AC1
AC2
LC
SKS Spe
Snap shot after JFY2009 RUN
Q13
Q12
BC1 BC2
GC
BH1
MS2
Q10
Q11
H (π⁻,K⁺) Σ⁻
at 1.25GeV/c
ΔM=1.7MeV/c²
(FWHM)
counts/(0.1MeV/c²)
M [MeV/c²]
450
400
350
300
250
200
150
100
50
0
1190
1195
1200
1205

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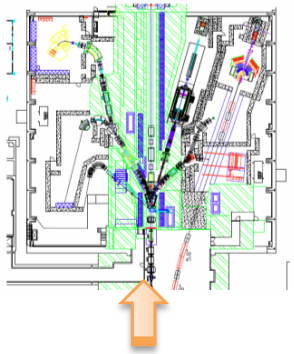
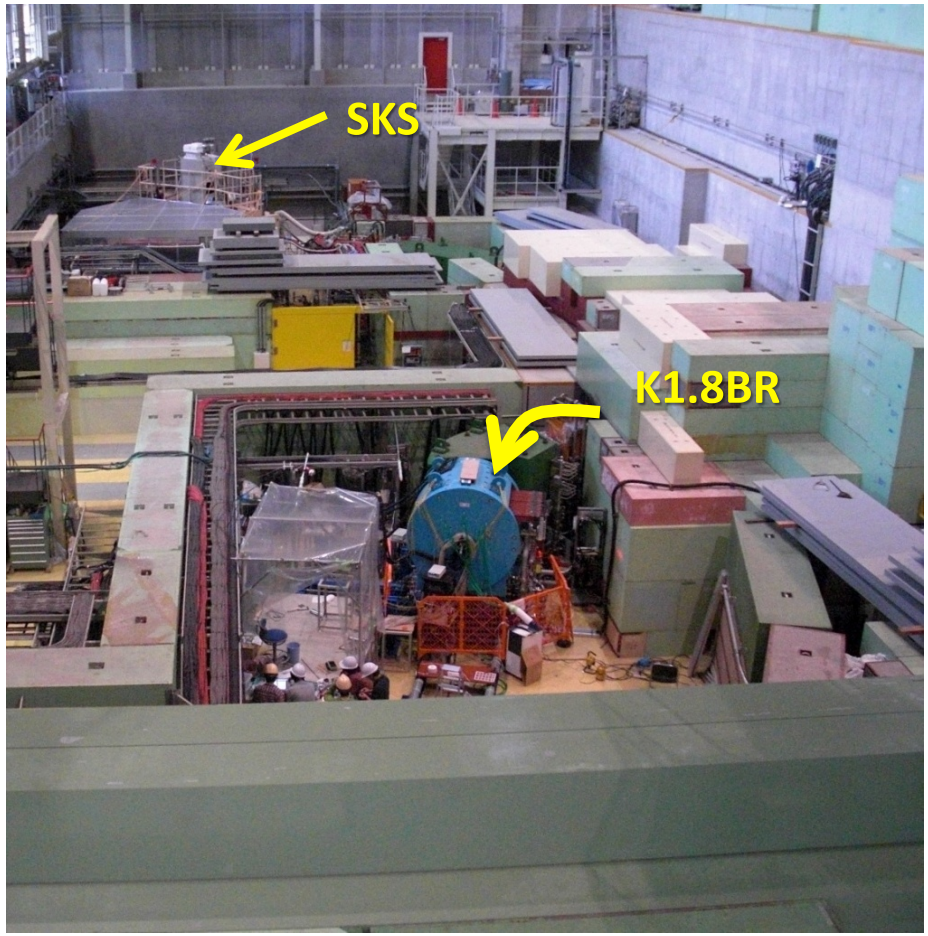
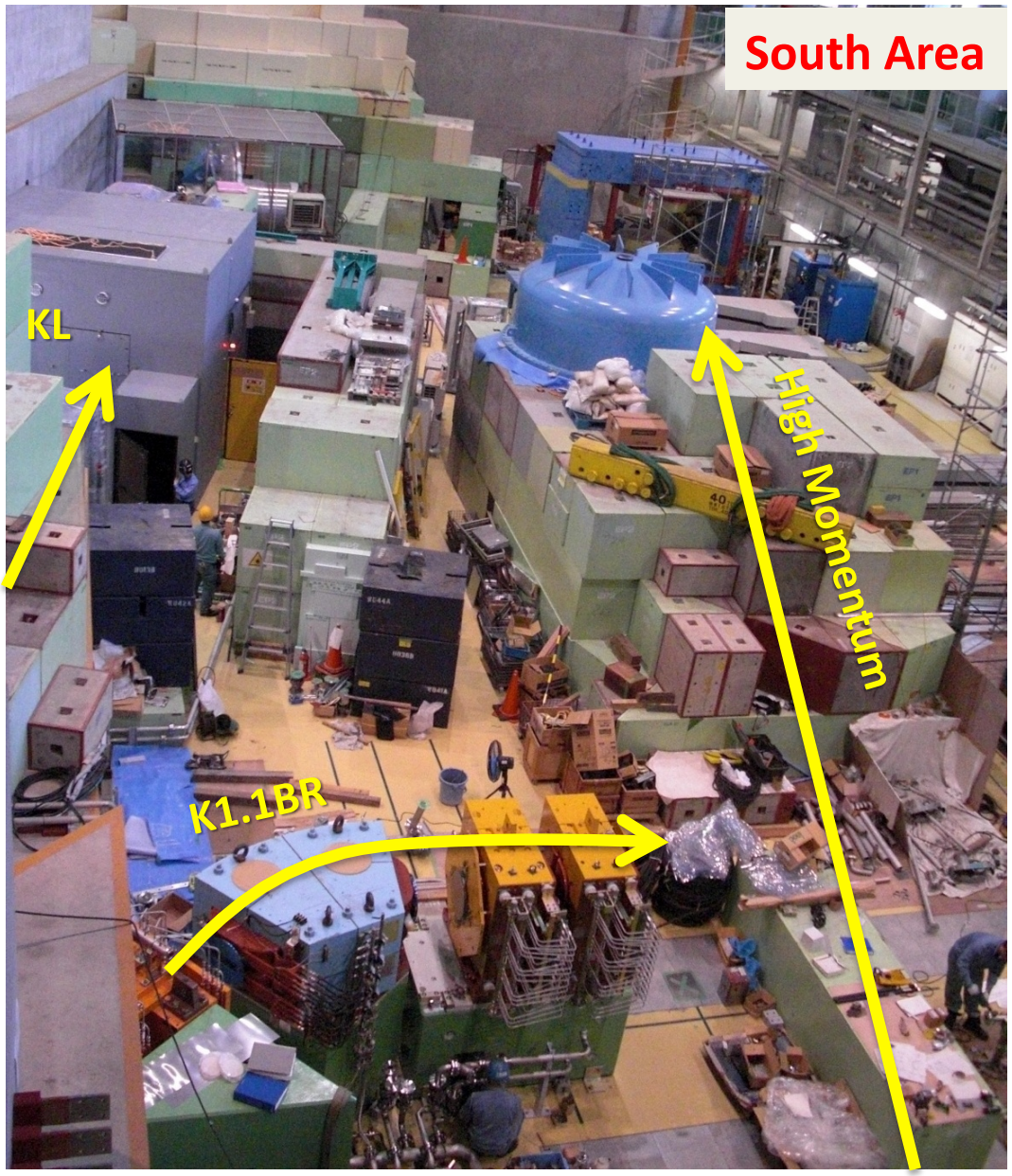
Hadron Hall Now
– K1.1BR Construction in Progress –



North Area





Proposals & Experiments

Nuclear & Particle Physics
(Approved) Proposals at J-PARC

—— J-PARC PAC Approval summary after the 9th meeting ——

Proposals

E03	K. Tanida	Kyoto U	Measurement of X rays from Ξ^- Atom	Stage 2			K1.8
P04	J. C. Peng; S. Sawada	U. of Illinois at Urbana-Champaign; KEK	Measurement of High-Mass Dimuon Production at the 50-GeV Proton Synchrotron	Deferred			Primary
E05	T. Nagae	Kyoto U	Spectroscopic Study of Ξ-Hypernucleus, $^{12}_{\Xi}$Be, via the ^{12}C(K$^-$, K$^+$) Reaction	Stage 2	Day1	1	K1.8
E06	J. Imazato	KEK	Measurement of T-violating Transverse Muon Polarization in $K^+ \to \pi^0 \mu^+ \nu$ Decays	Stage 1			K1.1BR
E07	K. Imai, K. Nakazawa, H. Tamura	Kyoto U., Gifu U., Tohoku U.	Systematic Study of Double Strangeness System with an Emulsion-counter Hybrid Method	Stage 2			K1.8
E08	A. Krutenkova	ITEP	Pion double charge exchange on oxygen at J-PARC	Stage 1			K1.8
E10	A. Sakaguchi, T. Fukuda	Osaka U	Production of Neutron-Rich Lambda-Hypernuclei with the Double Charge-Exchange Reaction (Revised from Initial P10)	Stage 2			K1.8
E11	T. Kobayashi	KEK	Tokai-to-Kamioka (T2K) Long Baseline Neutrino Oscillation Experimental Proposal	Stage 2			neutrino
E13	T. Tamura	Tohoku U.	Gamma-ray spectroscopy of light hypernuclei	Stage 2	Day1	2	K1.8
E14	T. Yamanaka	Osaka University	Proposal for $K_L \to \pi^0 \nu\nu$-bar Experiment at J-PARC	Stage 2			KO
E15	M. Iwasaki, T. Nagae	RIKEN, Kyoto	A Search for deeply-bound kaonic nuclear states by in-flight 3He(K-, n) reaction	Stage 2	Day1		K1.8BR
E16	S. Yokkaichi	RIKEN	Electron pair spectrometer at the J-PARC 50-GeV PS to explore the chiral symmetry in QCD	Stage 1			High p
E17	R. Hayano, H. Outa	U. Tokyo, RIKEN	Precision spectroscopy of Kaonic ^{3}He 3d->2p X-rays	Stage 2	Day1		K1.8BR
E18	H. Bhang, H. Outa, H. Park	SNU, RIKEN, KRISS	Coincidence Measurement of the Weak Decay of $^{12}_{\Lambda}$C and the three-body weak interaction process	Stage 1			K1.8
E19	M. Naruki	KEK	High-resolution Search for Θ^+ Pentaquark in $\pi^- p \to K^- X$ Reactions	Stage 2	Day1		K1.8

—— J-PARC PAC Approval summary after the 9th meeting ——

Proposals

E21	Y. Kuno	Osaka U	An Experimental Search for $\mu^- - e^-$ Conversion at a Sensitivity of 10^{-16} with a Slow-Extracted Bunched Beam	Stage 1			New beamline
E22	S. Ajimura, A. Sakaguchi	Osaka U	Exclusive Study on the Lambda-N Weak Interaction in A=4 Lambda-Hypernuclei (Revised from Initial P10)	Stage 1			K1.8
T25	S. Mihara	KEK	Extinction Measurement of J-PARC Proton Beam at K1.8BR	test experiment			K1.8BR
P26	K. Ozawa	U. Tokyo	Direct measurements of omega mass modifcation in A(pi$^-$,n)omega reaction and omega -> pi0 gamma decays	Deferred			K1.8
E27	T. Nagae	Kyoto U	Search for a nuclear Kbar bound state K$^-$pp in the d(π^+, K$^+$) reaction	Stage 1			K1.8
P28	H. Fujioka	Kyoto U	Study of isospin dependence of kaon-nucleus interaction by in-flight 3He(K-,n/p) reactions	approved as a part of E15			K1.8BR
P29	H. Ohnisi	RIKEN	Study of in medium mass modification for phi meson using phi meson bound state in nucleus	Deferred			K1.1
E31	H. Noumi	Osaka U	Spectroscopic study of hyperon resonances below KN threshold via the (K$^-$,n) reaction on Deuteron	Stage 1			K1.8
T32	A. Rubbia	ETH, Zurich	Towards a Long Baseline Neutrino and Nucleon Decay Experiment with a next-generation 100 kton Liquid Argon TPC detector at Okinoshima and an intensity upgraded J-PARC Neutrino beam	Test Experiment			K1.1BR
P33	H. M. SHIMIZU	KEK	Measurement of Neutron Electric Dipole Moment	Deferred			Linac
P34	N. Saito, M. Iwasaki	KEK, RIKEN	An Experimental Proposal on a New Measurement of the Muon Anomalous Magnetic Moment g-2 and Electric Dipole Moment at J-PARC	Deferred			MFL
P35	T. KAJITA	ICRR, Tokyo	A test experiment to measure sub-GeV flux in the on-axis direction at the J-PARC neutrino beam	to be Decided by E11 and Lab			

=== Status ===

Stage-2 Approval	**10**
Stage-1 Approval	**8**
Approval as Test Exp.	**2**
Approval	**2**
Deferred	**5**
	27

=== Beamlines ===

- **K1.8 12**
- **K1.8BR 5**
- **KL 1**
- **K1.1BR 2**
- **High-P 2**
- **New B.L. 1**
- **Others 4**

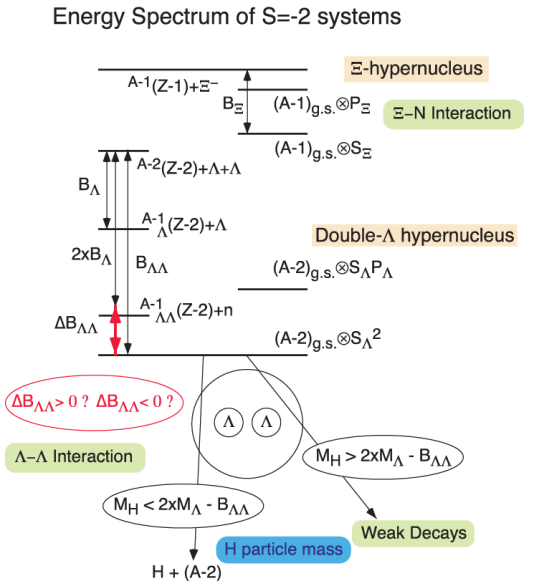
Approved Proposals – Category –

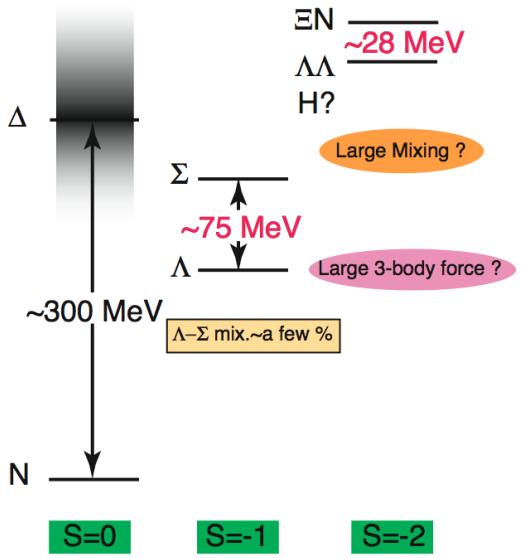
- Hypernuclear Physics 7
  - S=−2 system 3 (E03/E05/E07)
  - S=−1 system 4 (E10/E13/E18/E22)
- Hadron Physics 9
  - Kbar-N interaction 5 (E15/E17/E27/P28/E31)
  - In-medium mass modification 3 (E16/P26/P29)
  - Exotic Hadrons (Θ^+) 1 (E19)
- Nuclear Physics 2
  - Drell-Yang (P04), PionDCX(E08)
- Particle Physics 9

Motivation to Study S=−2 System

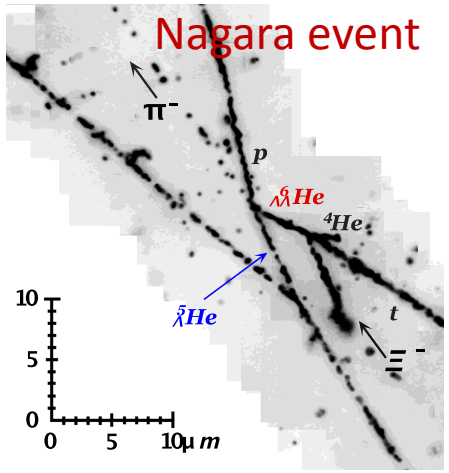
- ***H* dibaryon, ΛΛ hypernuclei, Ξ hypernuclei**
- **Baryon-Baryon Interaction**

- New interaction based on $SU_f(3)$ classification
  - ΛΛ-ΞN-ΣΣ channel
- Strong ΞN-ΛΛ mixing
  - 28MeV <−> ~80MeV for S=−1
- Existence of strange hadronic matter with Ξ
  - in core of Neutron-Star
  - Ξ Potential in Nucleus



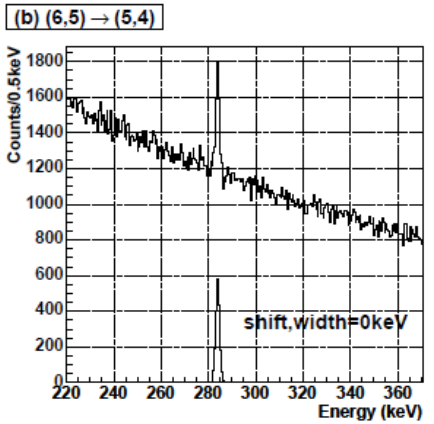


Experiments for S=−2 Studies



- E07: Systematic study of Double Strangeness System with an Emulsion-Counter Hybrid Method
  - Upgrade of the previous experiment, E307, with new technique
  - ~10^4 Ξ^- stop events / ~100 double-hypernuclei
    - more information on $\Lambda\Lambda$ interaction
  - X-ray measurement with Hyperball-J
    - Ξ^- A interaction
- E03: Measurement of X-ray from Ξ^- Atom
  - Ξ potential at surface region <−> Ξ-Hypernuclei
  - Fe X-ray with Hyperball-J & Ξ^- Prod. tag by KURAMA
- E05: Spectroscopy of $^{12}_{\Xi}$Be

Simulation



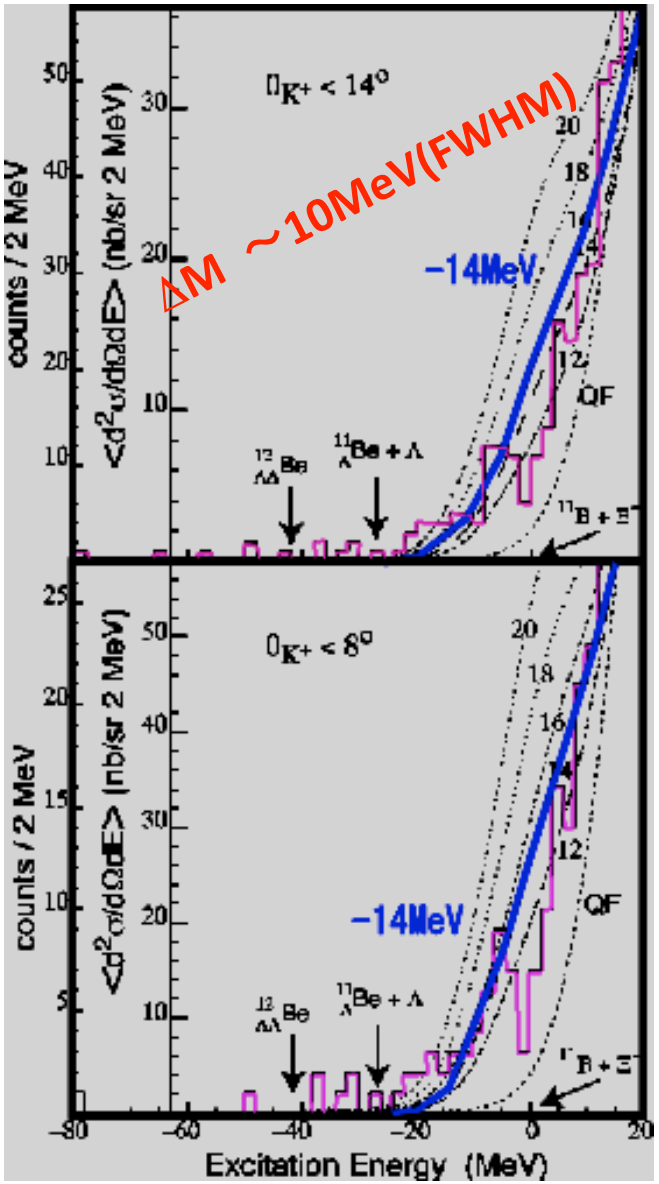
E05: Spectroscopy of $^{12}_{\Xi}$Be via the ^{12}C(K^-,K^+) Reaction

- The first observation of Ξ hypernuclear state(s) with good resolution & statistics.
  −> improve the previous exp.

➢ Ξ potential inside nucleus.
  −14 MeV ? from the previous exp.

➢ ΞN interaction
  attractive or repulsive ?
  imaginary part ? <−> width of state

BNL-AGS E885
P.Khaustov et al,
PRC61(2000)0546



E05: Spectroscopy of $^{12}_{\Xi}$Be via the ^{12}C(K^-,K^+) Reaction – cont' –

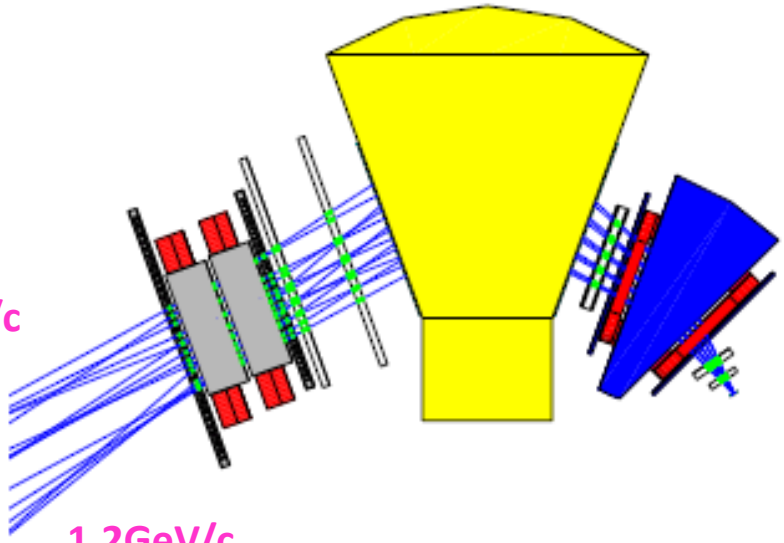
K^- beam with 1.8GeV/c @ K1.8 beamline

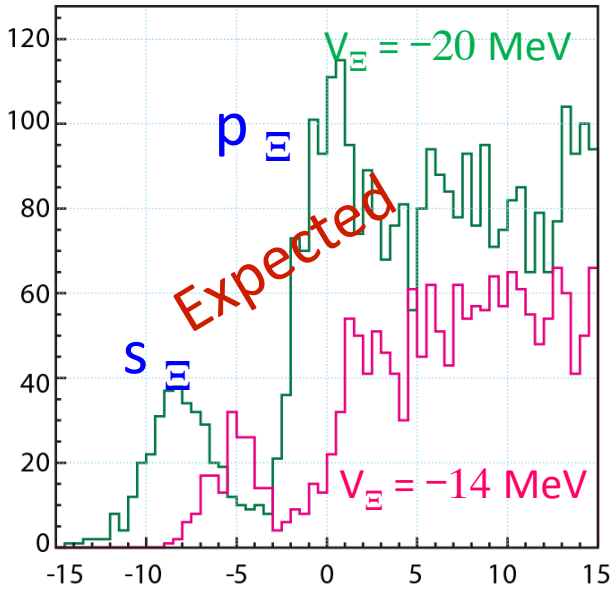
- 1.4×10^6 /spill , $K^-/(\pi^-+\mu^-) = 3.5$
  @ 30GeV – 2×10^{14} protons (9μA)
- $\Delta p/p = 3.3\times10^{-4}$ (FWHM) (K1.8BS)

SksPlus Spectrometer for K^+

- ~30msr
- 1.2 – 1.5GeV/c

SksPlus Spectrometer





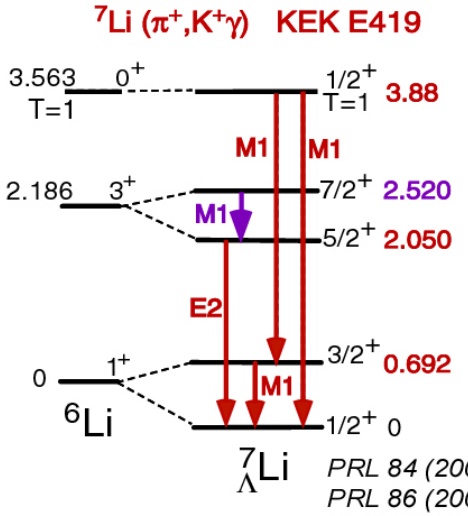
Expected spectrum with
3g/cm² target,
1month data-taking
Resolution of 3MeV (FHWM)

Experiments for S=−1/+1

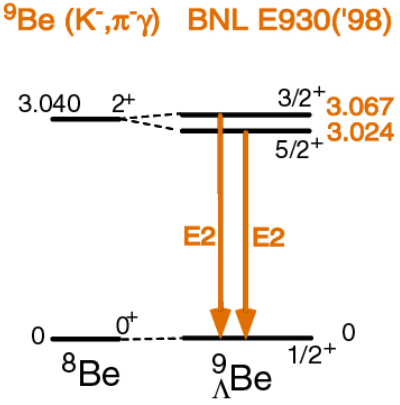
- E13
- E10
- E19

Hypernuclear γ-ray data since 1998

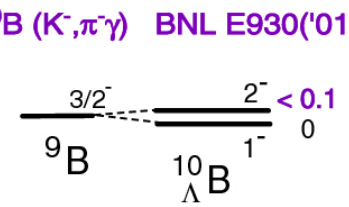
- $(\pi^+,K^+\gamma)$ at KEK-PS
- $(K^-,\pi^-\gamma)$ at BNL-AGS
  using
- Ge array "Hyperball"
- NaI array ($^{13}_{\Lambda}$C)



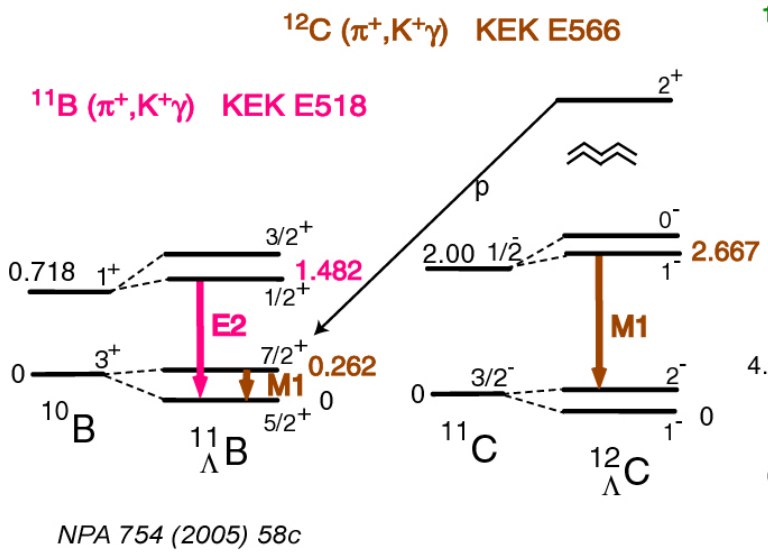
PRL 84 (2000) 5963
PRL 86 (2001) 1982
PLB 579 (2004) 258
PRC 73 (2006) 012501



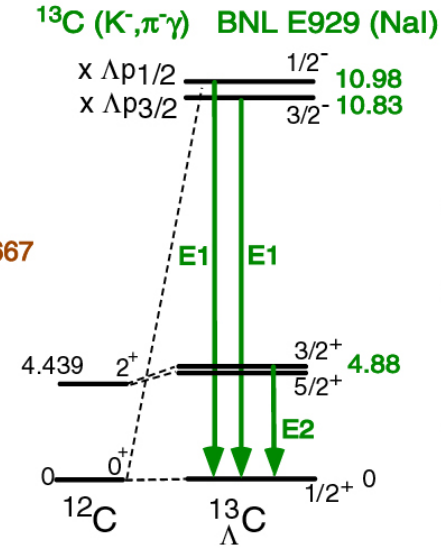
PRL 88 (2002) 082501
NPA 754 (2005) 58c



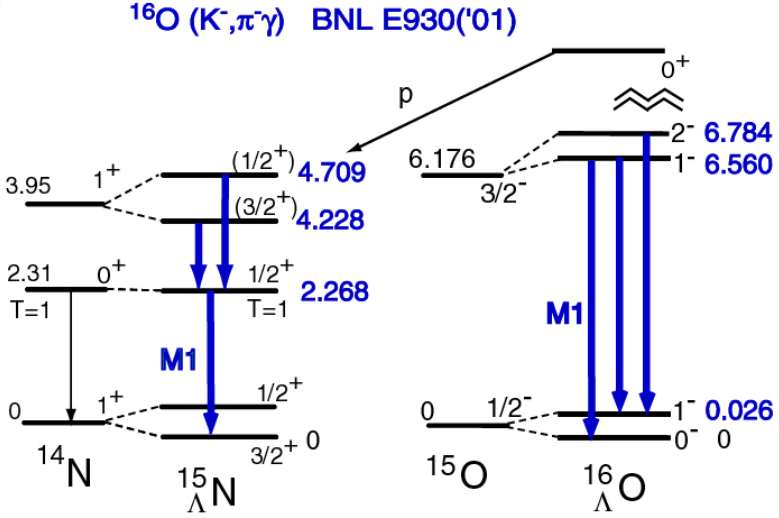
NPA 754 (2005) 58c



NPA 754 (2005) 58c



PRL 86 (2001) 4255
PRC 65 (2002) 034607



PRL 93 (2004) 232501

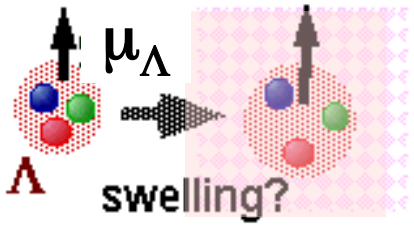
E13: γ-ray Spectroscopy of Light Λ Hypernuclei

$(K^-,\pi^-\gamma)$ at 1.5GeV/c with SksMinus + Hyperball-J

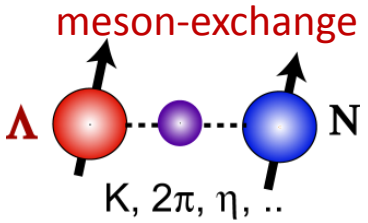
- μ_Λ in a nucleus from B(M1)
  - in-medium modification of hadron properties
  - lifetime by Doppler Shift Attenuation Method

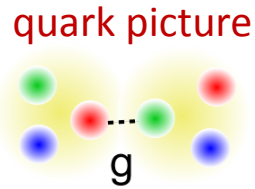
  $^7_\Lambda$Li

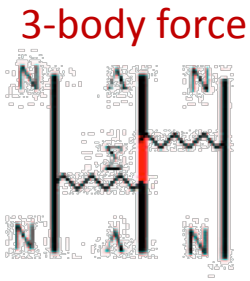
^{6}Li $^7_\Lambda$Li g_c



- Further study of ΛN interaction
  - spin-dependent ΛN force
  - 3-body force via ΛN-ΣN coupling
  - Charge Symmetry Breaking
  - Radial dependence from sd-shell hypernucleus





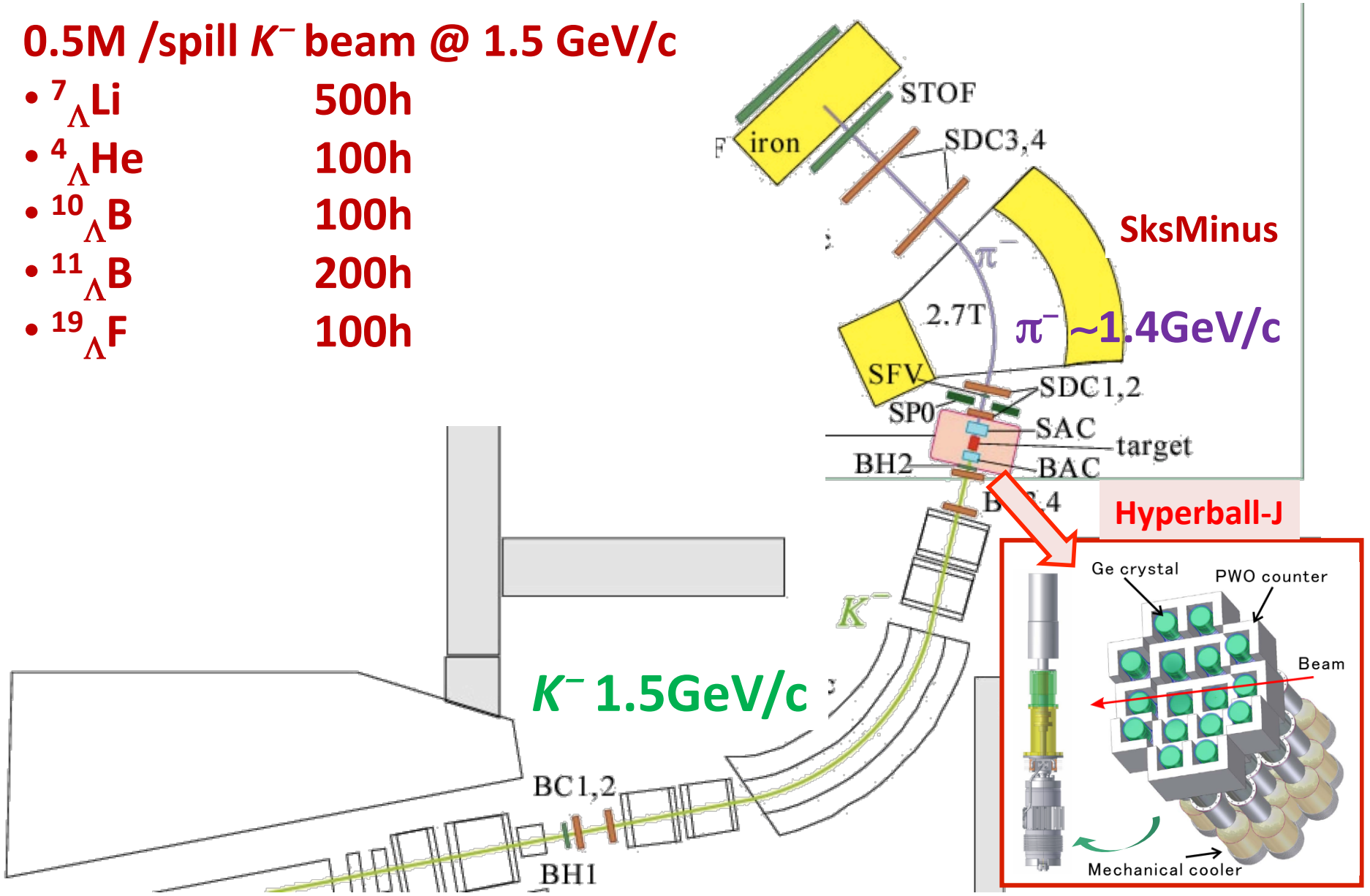


$^4_\Lambda$He, $^{10}_\Lambda$B, $^{11}_\Lambda$B, $^{19}_\Lambda$F

E13: γ-ray Spectroscopy of Light Λ Hypernuclei – cont' –

0.5M /spill K^- beam @ 1.5 GeV/c

- $^{7}_{\Lambda}$Li 500h
- $^{4}_{\Lambda}$He 100h
- $^{10}_{\Lambda}$B 100h
- $^{11}_{\Lambda}$B 200h
- $^{19}_{\Lambda}$F 100h

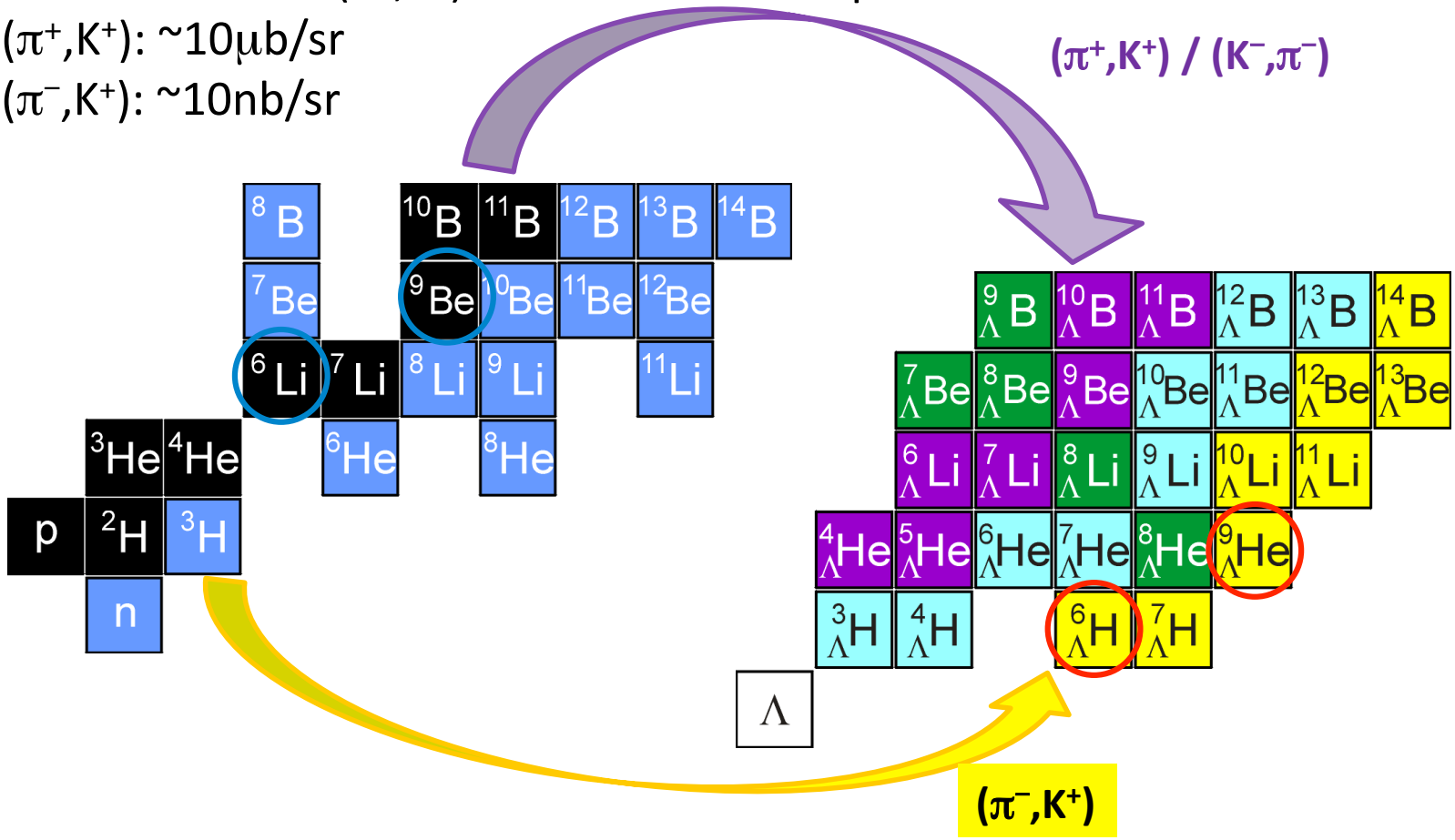


E10: Neutron-rich Λ hypernuclei via the DCX (π^-,K^+) Reactions

- Using high-intensity pion beam (~10^7/spill) at J-PARC, the production via DCX (π^-,K^+) reaction becomes possible.

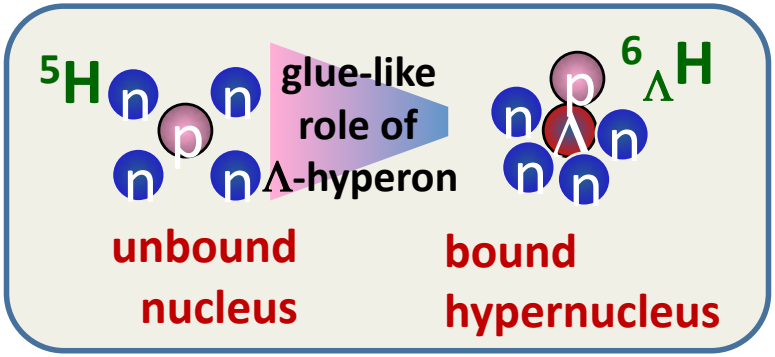
  (π^+,K^+): ~10μb/sr

  (π^-,K^+): ~10nb/sr

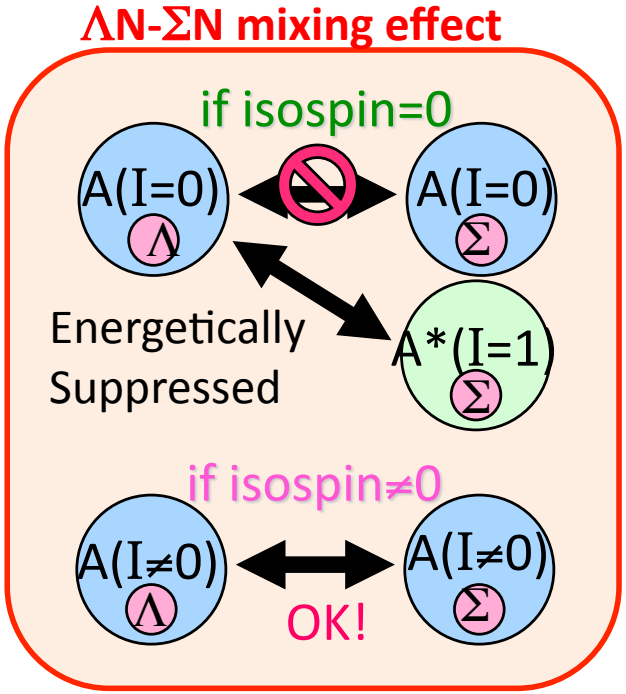


E10: Neutron-rich Λ hypernuclei via the DCX (π^-,K^+) Reactions – cont' –

- Change of the structure due to glue-like role of Λ
  - — Neutron halo to normal by adding a Λ
- ΛN interaction in N-rich environment
  - — Λ in the core of Neutron-Star
  - — ΛN-ΣN mixing



~1.2GeV/c π^- beam + SKS (2.2T)
Expected resolution 2MeV (FWHM)
10^7 /spill (2sec ext./6sec duration)
-> 3 weeks /target



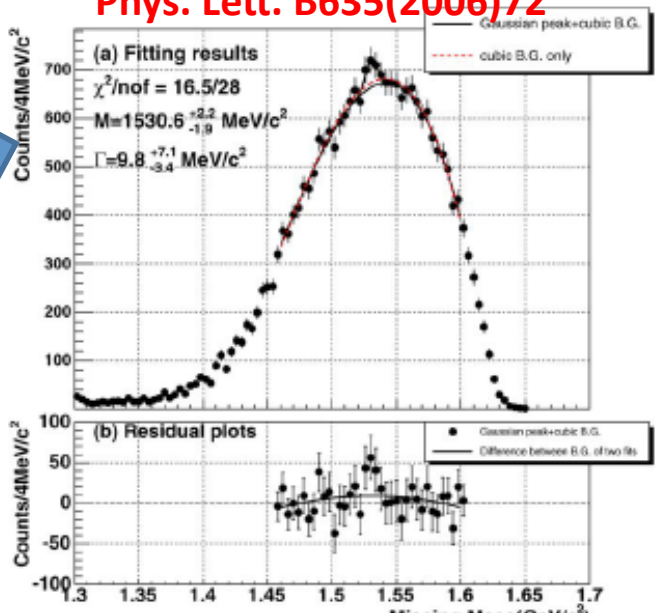
E19: Θ^+ Search in $\pi^-p \to K^-X$ Reaction

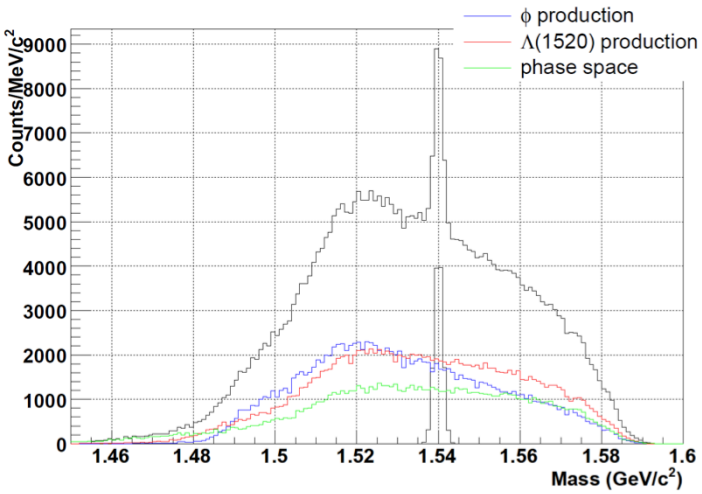
Production RUN from Oct. 2010

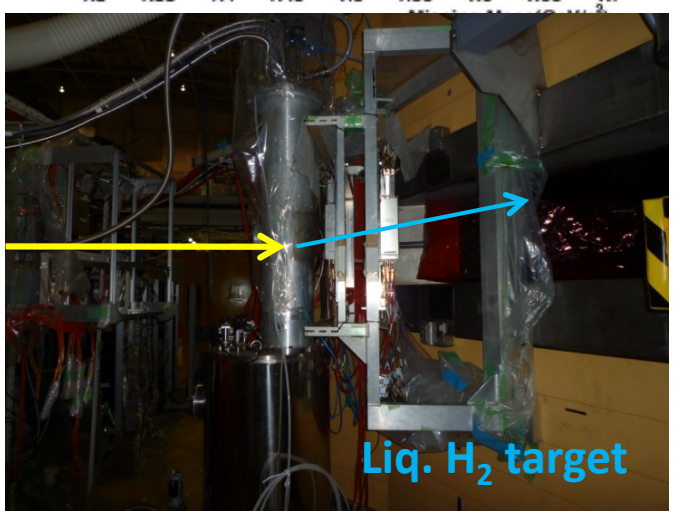
- Search for Pentaquark in hadronic reaction
  $\pi^- + p \rightarrow K^- + X$ at 1.87, 1.92 and 1.97 GeV/c
- Previous (π^-, K^-) spectrum shows a hint of 2.6σ.
- Measurement with much improved detectors etc.
  - ~2MeV (FWHM) by SKS
  - No Q.F. background using Liq.H_2 target

10 days RUN at 1.92GeV/c with 0.5M/spill to confirm E522 with 10σ sensitivity

E522 with CH_2 target
K.Miwa et al,
Phys. Lett. B635(2006)72







Summary

- Hadron facility at J-PARC has started the beam operation.
  - K1.8BR from Feb. 2009
  - K1.8/KL from Oct. 2009
- Commissioning of SKS spectrometer at K1.8 was also done.
  - 1.7 MeV(FWHM) resolution for $H(\pi^-,K^+)\Sigma^-$ at 1.25GeV/c.
- There are a lot of experimental programs concerning to hypernuclear and/or strangeness nuclear physics.
  - Study of S=−2 system
- Beam operation will start again in Oct. 2010.
  - New beamline K1.1BR
  - Physics RUN starts
    - E19 at K1.8
    - (E17 at K1.8BR)

backup

The status of Slow eXtraction

- Beam power (Original Goal 30GeV-270kW)
  - 5kW Max. from Rad. Permission at present
  - 1-2 kW realized in Feb. 2010
    - from beam loss at electrostatic & magnetic septa, etc...
  - 3-4 kW stable operation in Oct. 2010 RUN
  - (70kW operation of FX for T2K)
- Time structure
  - ~10% “Dufy Factcor” in Feb. 2010 RUN
  - < 30% D.F. w/o replacing P.S within 3 years

K1.8 Beamline

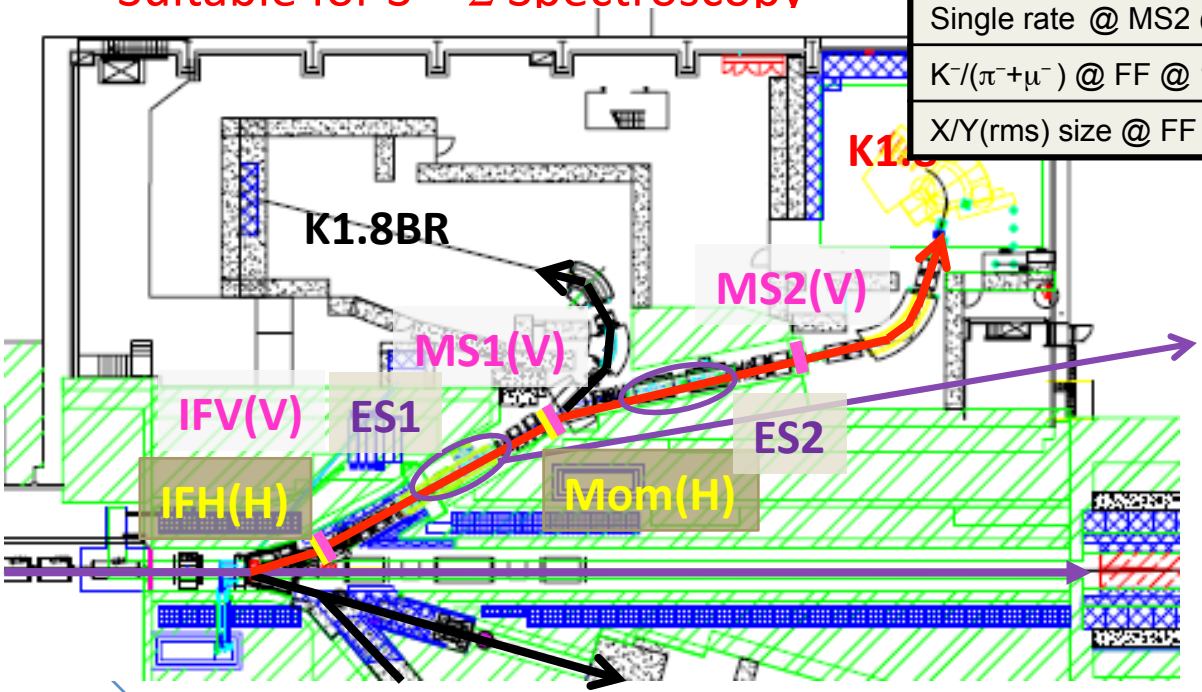
270kW

P_{max} = 2.0 GeV/c
Double stages of E.S. Separators
High-resolution beam spectrometer

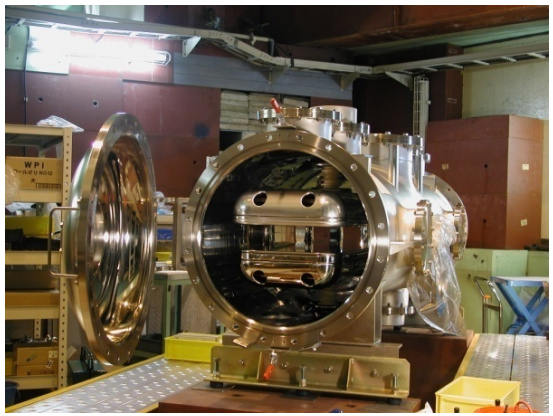
$\Delta p/p$ (BS)=3.3x10^{-4}(FWHM)

Suitable for S=−2 Spectroscopy

Primary proton beam (protons/spill)	30 GeV-9μA 2.0E+14
Length (m)	45.853
Acceptance (msr.%)	1.4
$K^-(\pi)$ intensity (ppp) @1.8 GeV/c	1.4E+06
@1.5 GeV/c	0.54E+06
@1.1 GeV/c	0.08E+06
Electrostatic separators	750kV/10cm, 6m×2
Single rate @ MS2 @ 1.8 GeV/c	＞8E+06
$K^-/(\pi^-+\mu^-)$ @ FF @ 1.8 GeV/c	3.5
X/Y(rms) size @ FF (mm)	19.8/3.2



Electro-static Separator (new)



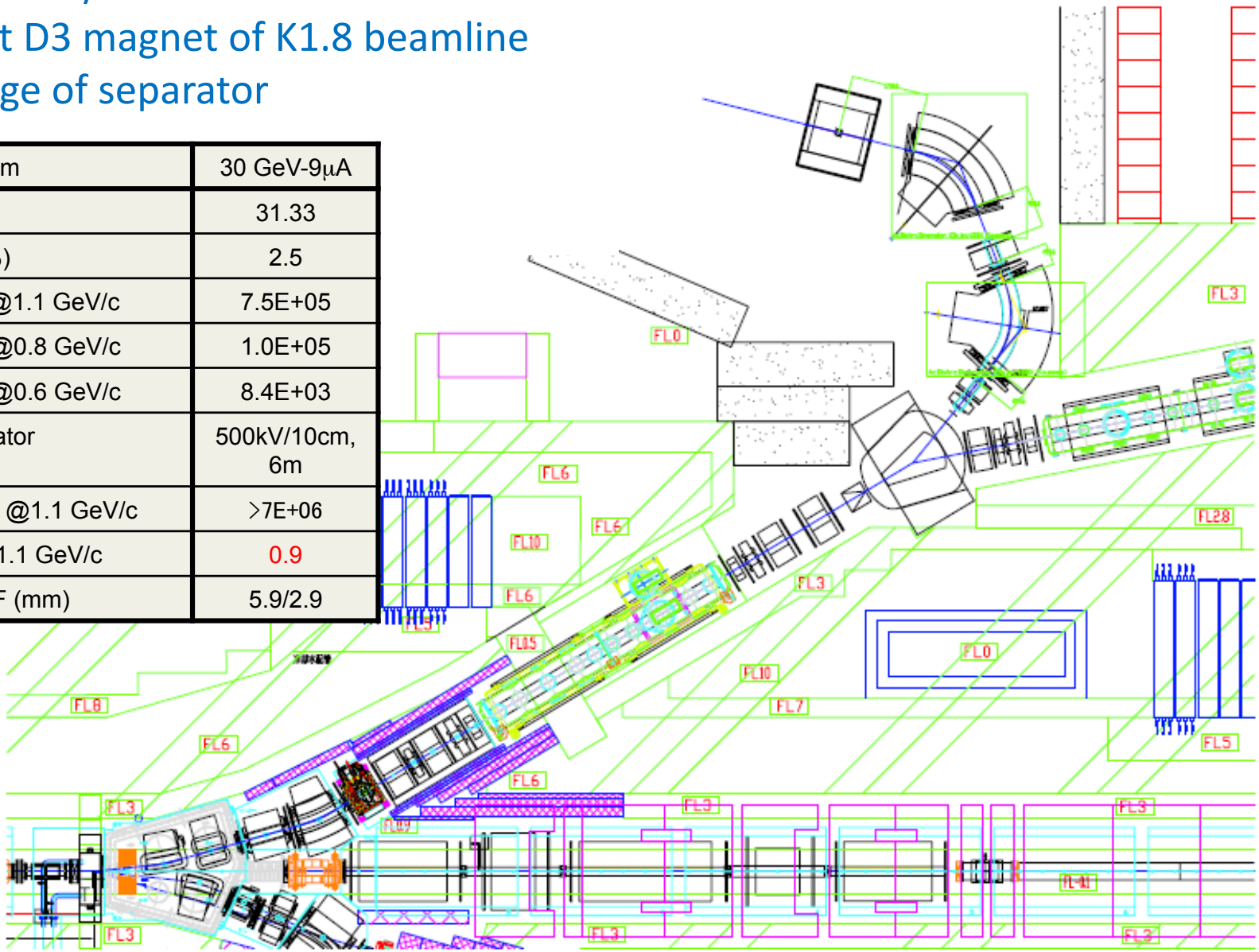
K1.8BR Beamline

P_{max} = 1.1 GeV/c

Splitted at D3 magnet of K1.8 beamline

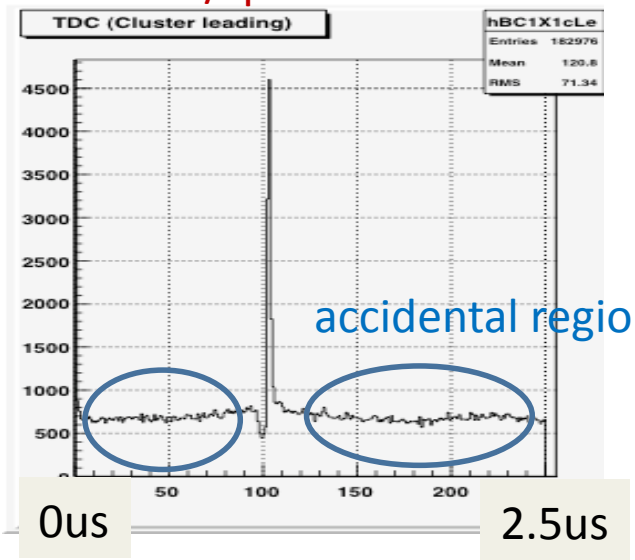
Single stage of separator

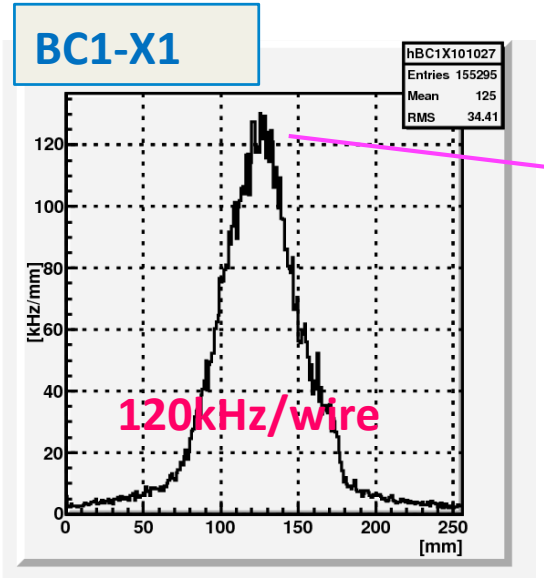
Primary proton beam	30 GeV-9μA
Length (m)	31.33
Acceptance (msr.%)	2.5
K^- intensity (ppp) @1.1 GeV/c	7.5E+05
@0.8 GeV/c	1.0E+05
@0.6 GeV/c	8.4E+03
Electrostatic separator	500kV/10cm, 6m
Single rate@D3out @1.1 GeV/c	>7E+06
$K^-/(\pi^-+\mu^-)$ @ FF@1.1 GeV/c	0.9
X/Y(rms) size @ FF (mm)	5.9/2.9

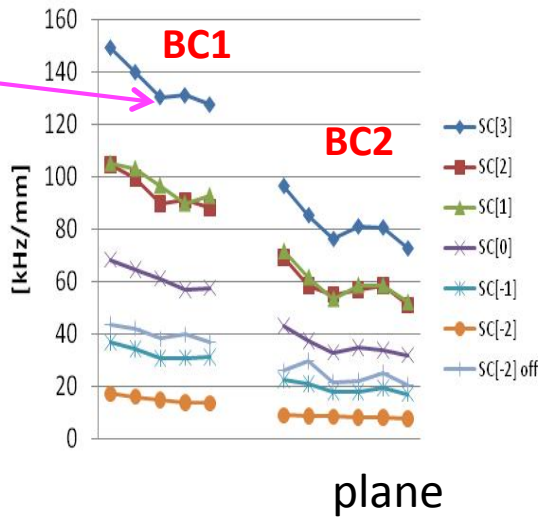


Instantaneous Intensity from MWPC Time Spectra

657k π^+/spill







Integration over all wires
−> 8MHz

From BH1 Scaler & Duty-Factor
1.82M/1.5sec/0.05 = 24MHz
From pion Scaler & Duty-Factor
0.66M/1.5sec/0.05 = 8.8MHz

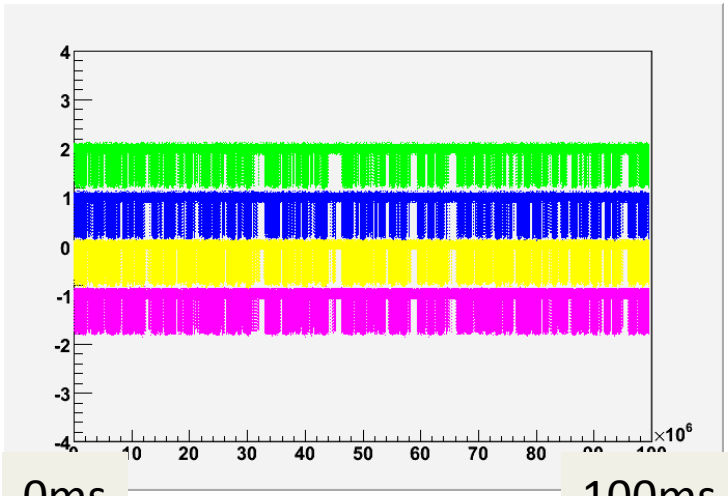
Track analysis efficiency 60 - 80% .

Our expected value at Proposal
200kHz/wire
10MHz in total

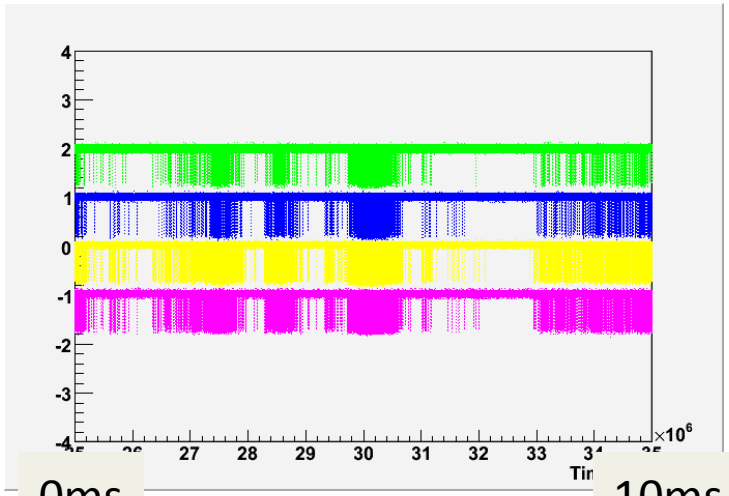
Acceptable beam intensity is limited by the time structure for pion beam.

Improved Time Structure
– But not sufficient yet –

Feb. 2010
EQ/RQ ON
Coil short



0ms 100ms

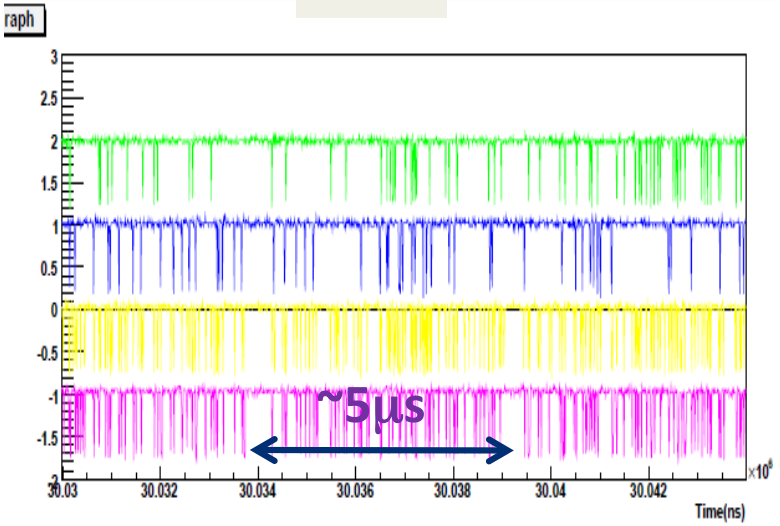


0ms 10ms

50Hz ripple was almost suppressed.

Duty factor ~10%

Acceptable beam intensity
300k/spill (Jan.)
-> 750k/spill (Feb.)

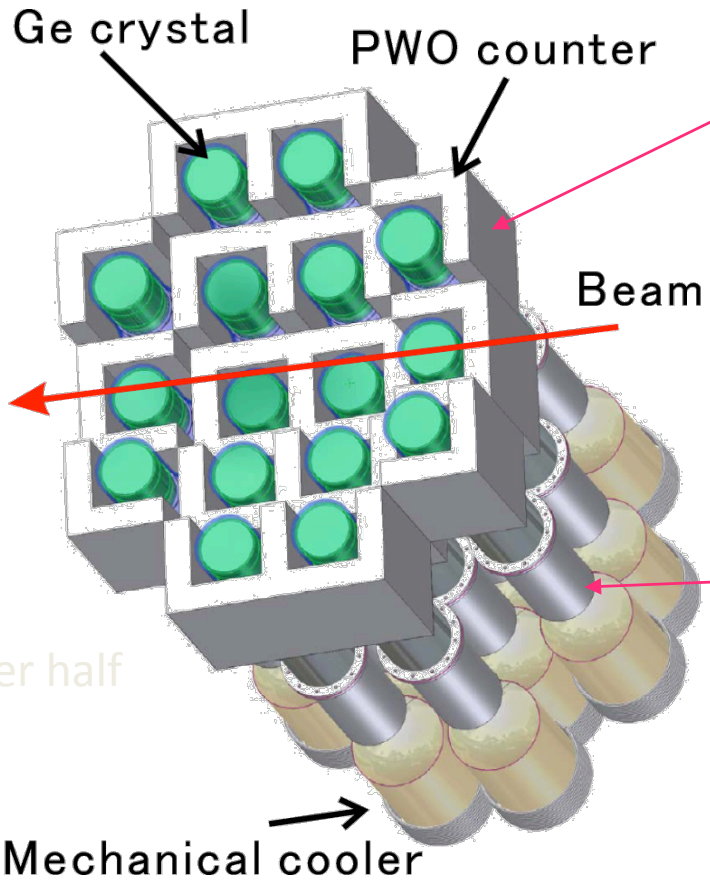


0μs 14μs

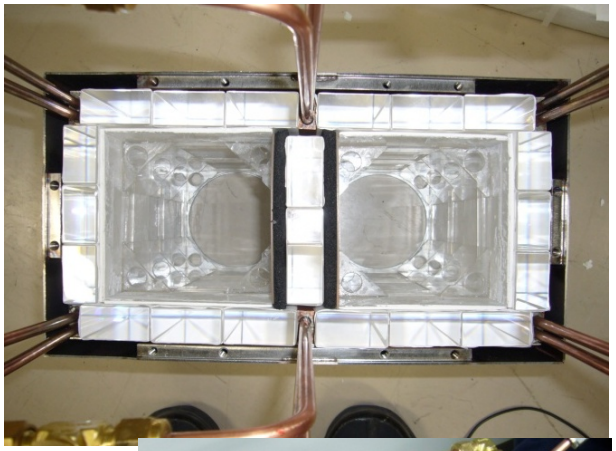
Hyperball-J (E13, E07)

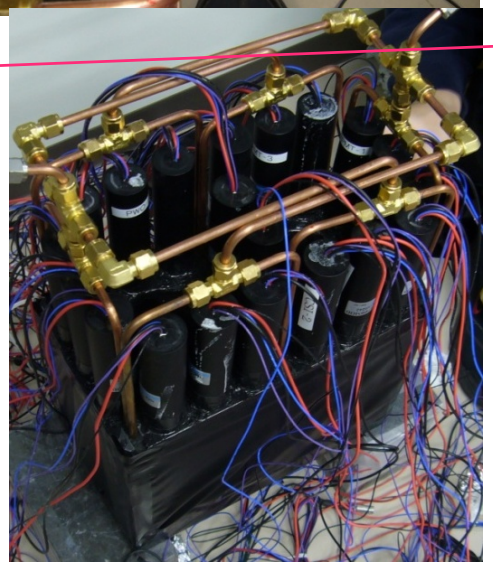
- Mechanical cooling
  -- Lower temp. for less radiation damage
  -- Save space for flexible setup

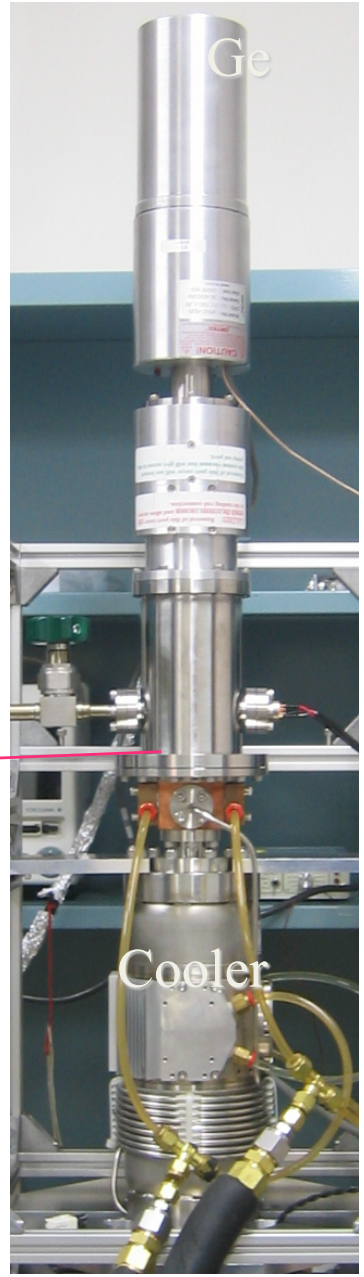
- **Ge (r.e.~60%) x ~32 → eff. ~6% at 1 MeV**
  (x ~3 of Hyperball)



- PWO background suppression counters replaced from BGO for higher rate

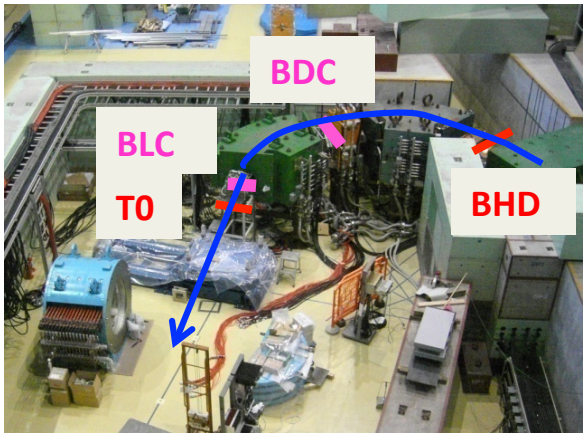




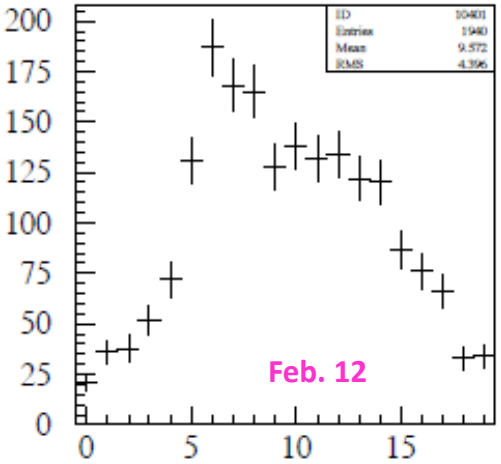


- Waveform readout for future
  -> Rate limit ~2x10^7 /s (x5 of Hyperball)

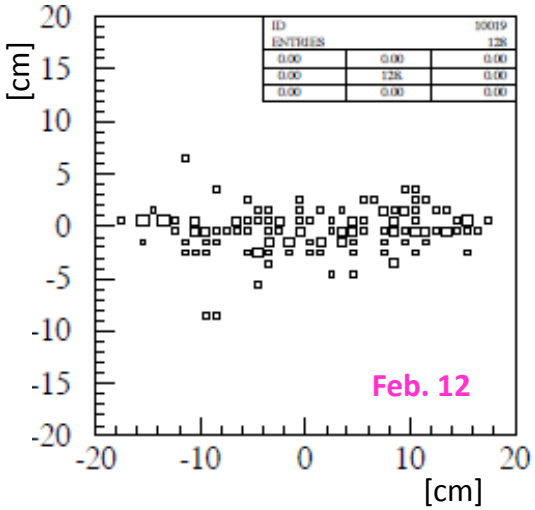
The first beam at K1.8BR



BHD hit pattern

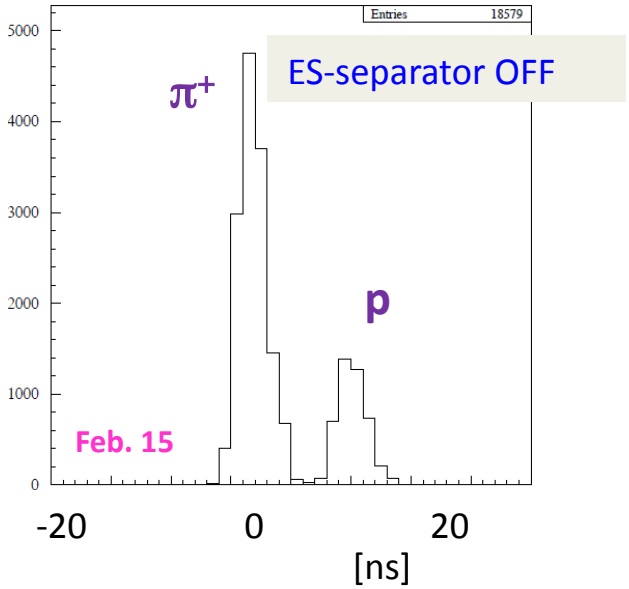


X-Y profile at BDC



2cm/seg.

BHD-T0 time difference



1.1GeV/c setting (no optimization)

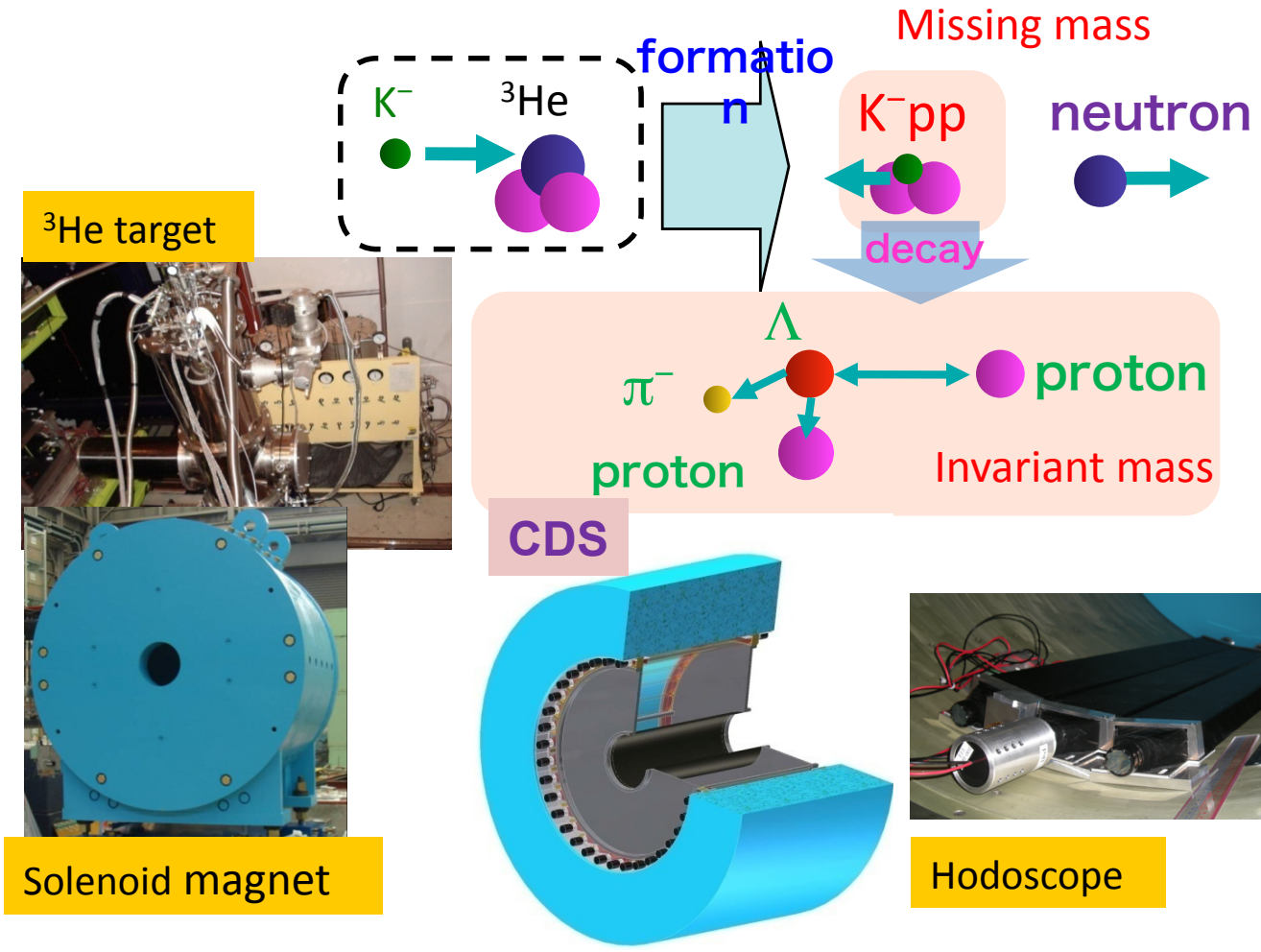
More studies etc ... are necessary...

- Optics of the beamline
- Intensity (primary/secondary)
- Time structure
- .....

E15: Search for kaonic nuclei via ^{3}He(K^-,n)

~1GeV/c

Study K^-pp system (the lightest system)
Observation of both "formation" and "decay"

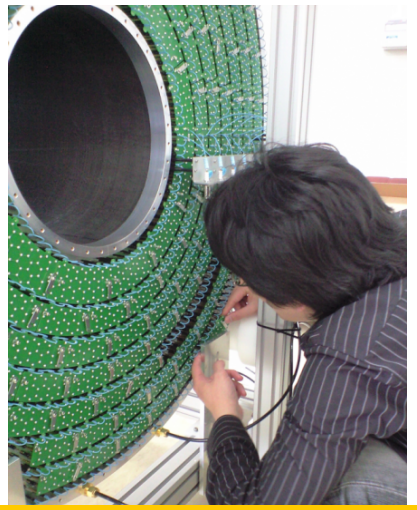


³He target

Solenoid magnet

Hodoscope

Neutron counter



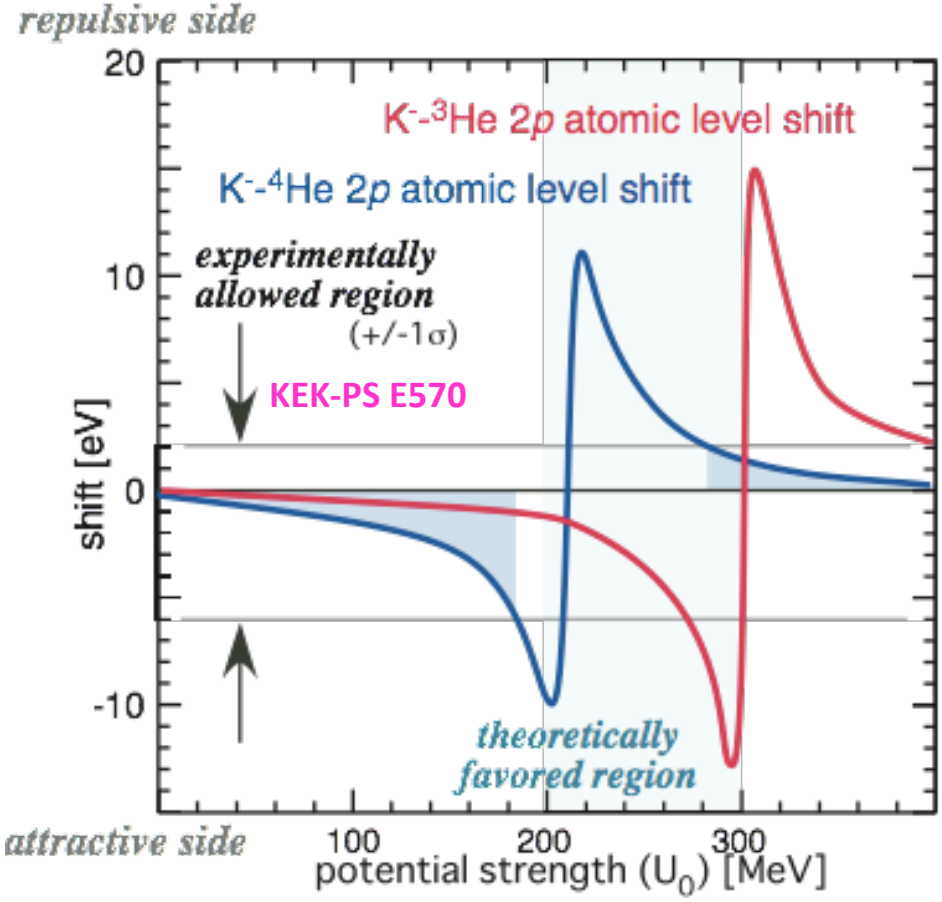
Cylindrical Drift Chamber

E17: Kaonic helium-3 X-ray spectroscopy

~0.8GeV/c K^- beam

Measure *level shift & width* of
K^- ^{3}He atom 3d −> 2p X-rays

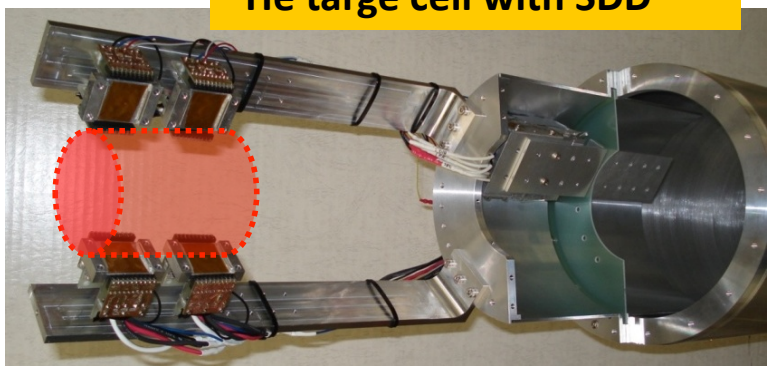
Calculated 2p level shift by Akaishi (Coupled Channel)



- **Similar setup with E15**
  - Silicon Drift Detector
  - w/o Neutron Detector
  - CDS w/o Mag. Field
- Needs 35 days DAQ with 1/10 designed intensity
  - Requests ~24kW

The first exp. for physics results

^{3}He targe cell with SDD



Hypernuclear γ-ray data since 1998

(π^+,$K^+\gamma$) at KEK-PS

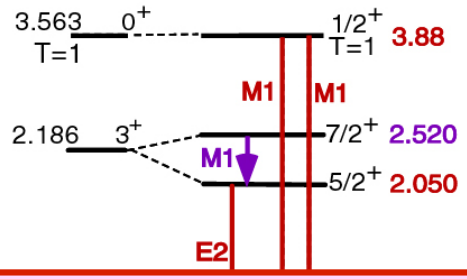
(K^-, $\pi^-\gamma$) at BNL-AGS

using

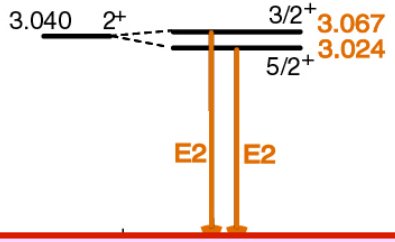
Ge array "Hyperba

NaI array ($^{13}_{\Lambda}$C)

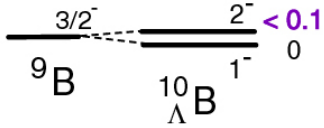
^{7}Li (π^+,$K^+\gamma$) KEK E419



^{9}Be (K^-,$\pi^-\gamma$) BNL E930('98)



^{10}B (K^-,$\pi^-\gamma$) BNL E930('01)



Extend the 3D nuclear chart

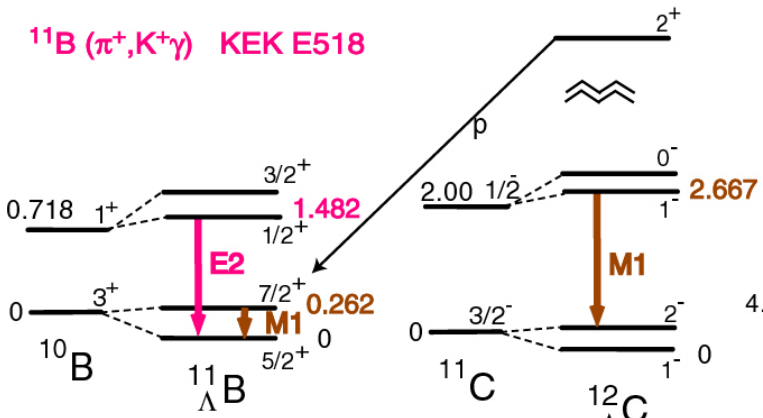
much efficiently using intense K^- beam

-> "Table of Hyper-Isotopes"

NPA 754 (2005) 58c

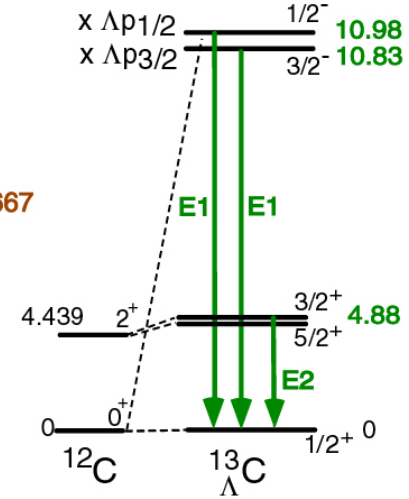
^{11}B (π^+,$K^+\gamma$) KEK E518

^{12}C (π^+,$K^+\gamma$) KEK E566



NPA 754 (2005) 58c

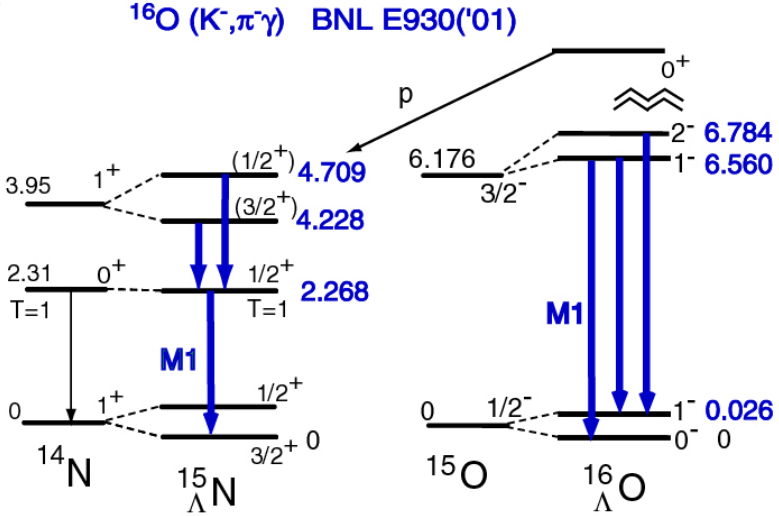
^{13}C (K^-,$\pi^-\gamma$) BNL E929 (NaI)



PRL 86 (2001) 4255

PRC 65 (2002) 034607

^{16}O (K^-,$\pi^-\gamma$) BNL E930('01)



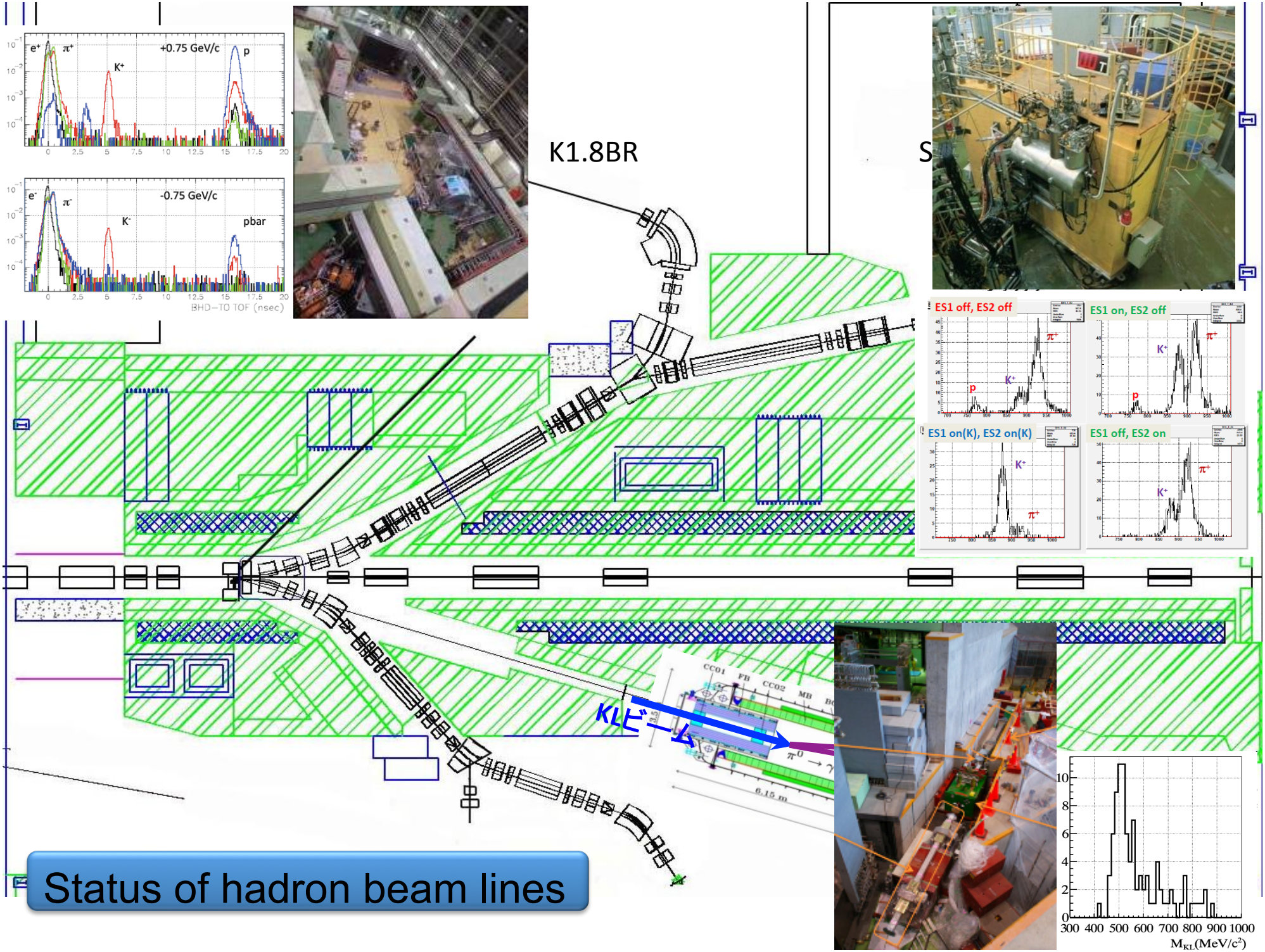
PRL 93 (2004) 232501

U_Ξ and Partial Wave Contributions in Nuclear Matter

(MeV)

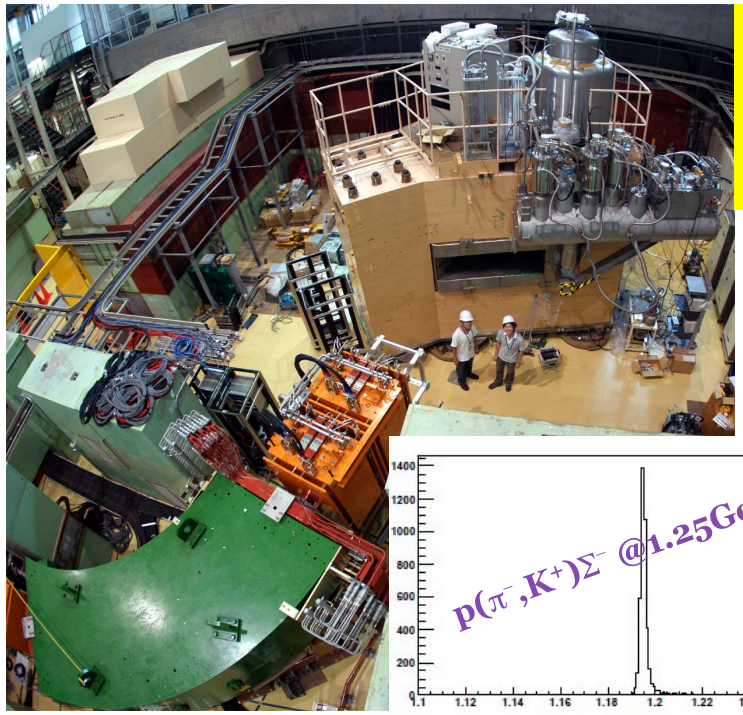
Model	T	$^1S_0$	$^3S_1$	$^1P_1$	$^3P_0$	$^3P_1$	$^3P_2$	U_Ξ	Γ_Ξ
NHC-D	0	−2.6	0.1	−2.1	−0.2	−0.7	−1.9		
	1	−3.2	−2.3	−3.0	−0.0	−3.1	−6.3	−25.2	0.9
Ehime	0	−0.9	−0.5	−1.0	0.3	−2.4	−0.7		
	1	−1.3	−8.6	−0.8	−0.4	−1.7	−4.2	−22.3	0.5
ESC04d*	0	6.3	−18.4	1.2	1.5	−1.3	−1.9		
	1	7.2	−1.7	−0.8	−0.5	−1.2	−2.8	−12.1	12.7

- OBE (NHC-D, Ehime)
  - odd-state attraction
  - strong A-dependence of V_Ξ
- ESC04d*
  - strong attraction of $^3S_1$ (T=0)



Status of hadron beam lines

Beam Lines & Experiments Ready at Hadron Hall



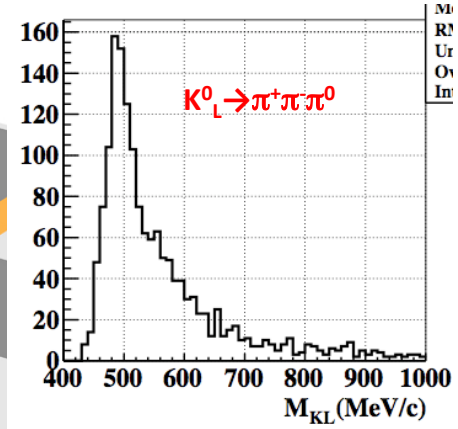
High Resolution Spectroscopy

KL Rare Decay

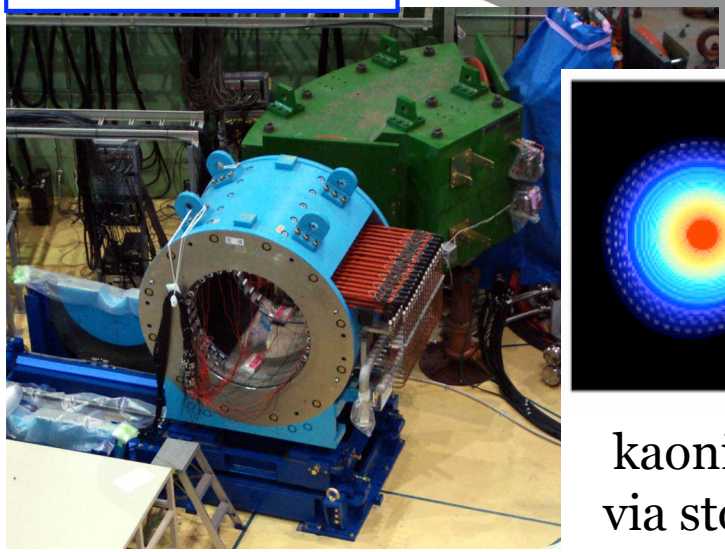
$K^0_L \rightarrow \pi^0 \nu \nu$

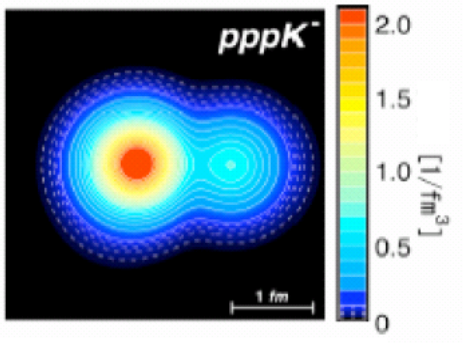
Θ⁺ via p(π⁻, K⁻) reaction

Pentaquark Θ⁺

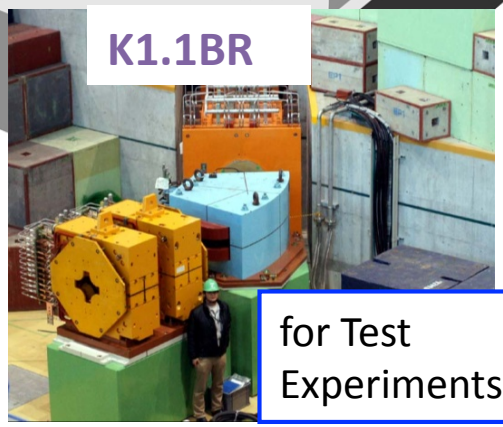


Strangeness Nuclear Matter





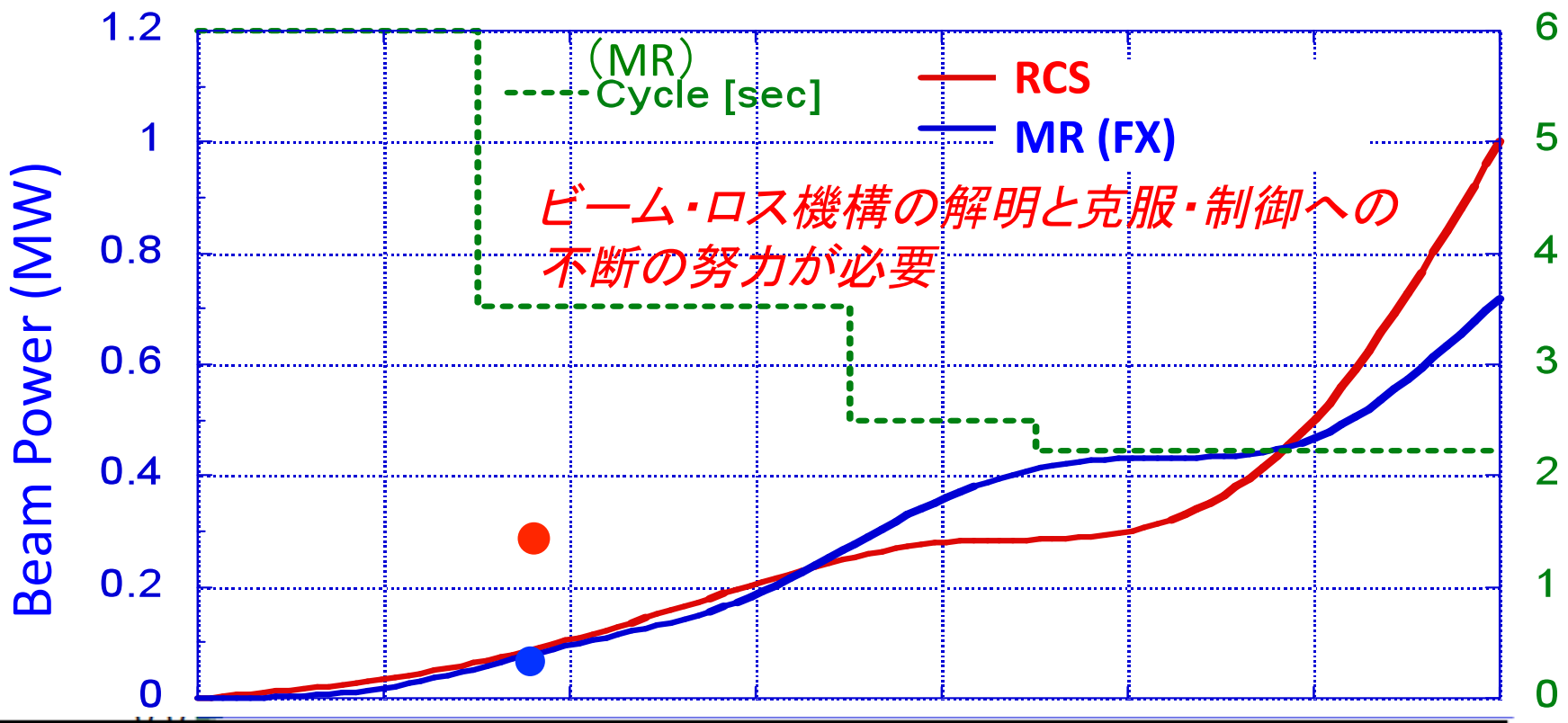
kaonic nuclei via stopped K⁻



for Test Experiments

FM Magnet is ready!

RCS の設計： 400 MeV入射で1 MW ----> 181 MeV入射なら 300 kW
300 kW 超を目指した不断の努力は不可欠



西暦		JFY2008	JFY2009	JFY2010	JFY2011	JFY2012	JFY2013	JFY2014
平成		H20	H21	H22	H23	H24	H25	H26
Linac	Linac400 MeV増強	Manufacturing			製作	システム組立て 電気動作確認	ビーム コミッショニング	運転
	50mA対応前段部 (イオン源、RFQな			製作		システム調整	ビーム コミッショニング	運転
RCS	400 MeV, Inj.			製作・試験運転			ビーム コミッショニング	運転
	補正系(トリムQなど)		スタディ・設計		製作・据付・ビーム運転対応			
	加速空洞12号機			製作・据付			ビーム運転対応	