Particle and Nuclear Physics Facilities
A summary of ‘approved experiments’

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KEK

June 5, 2008

Two stage aapproval

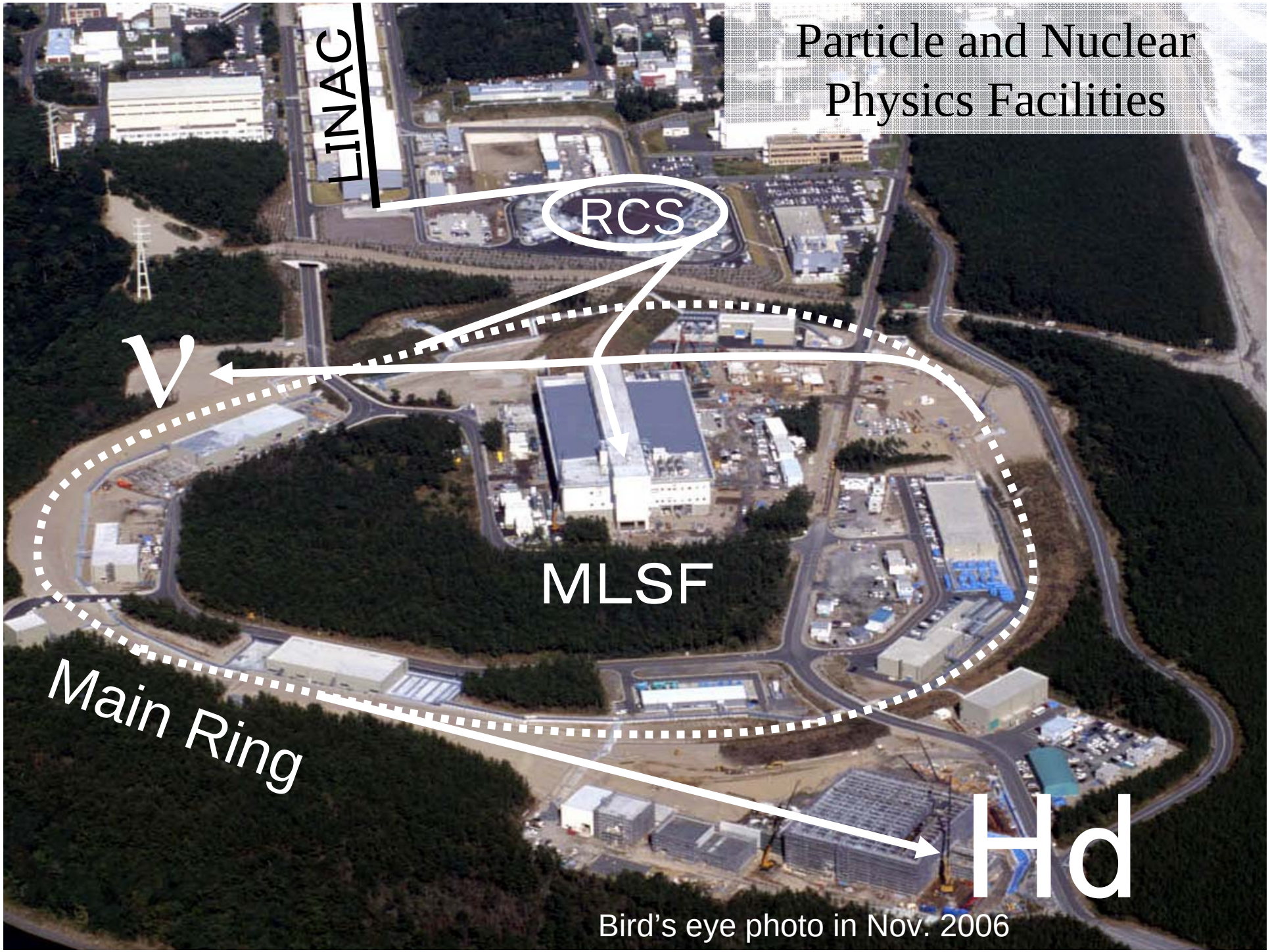
- The stage-1 approval

  This will be given by the IPNS director based on the recommendation of the PAC, if the scientific merit of the proposal is of a high value and the experimental principle is reasonable. This approval helps the proponents to negotiate with funding agencies.

- The stage-2 approval

  After the stage-1 approval, the PAC judges the feasibility of the experiment and gives a recommendation for the stage-2 approval to the IPNS director. The feasibility judgment must be based on the technical feasibility, the fairness of cost estimate, financial feasibility and the man power allocation.

- As a general rule, KEK is responsible for the construction and maintenance of facilities
- Financial resources for each experimental equipments must be secured by each experimental group
- If necessary, the IPNS director can ask the *FIFC* (Facility Impact and Funding Committee) to evaluate the various aspects of the feasibility.
- Accessing this information, PAC recommend the IPNS director the stage-2 approval to be given.
- The IPNS director make decision. If it is positive, the approval is notified through the J-PARC center to the experimental group.


Particle and Nuclear Physics Facilities
LINAC
RCS
ν
MLSF
Main Ring
Hd
Bird's eye photo in Nov. 2006

Fast extraction facility and Slow extraction facility

Machine time must be allocated between two types of operational modes,

- Fast Extracted Beam one neutrino experiment

- Slow Extracted Beam many proposed experiments

Priority 1> Day-1 > Stage-2 > Stage-1 approval

J-PARC PAC Approval Summary for 5th PAC

	(Co-)Spokespersons	Affiliation(*)	Title of the experiment	PAC recommendations 1st	2nd	3rd	4th	Slow line priority Day1 ?	Priority
P01	V.Sumachev	Petersburg Nuclear Physics Institute	Proposal on measurements of the spin rotation parameters A and R at the J-PARC in the resonance region of π-N elastic scattering	Rejected					
P02	P.Aslanyan	JINR	Study of Exotic Multiquark States with Λ-Hyperons and K^0_S Meson Systems at JPARC	LoI					
E03	K.Tanida	Kyoto U	Measurement of X rays from Ξ- Atom	Stage 1	->	->	Stage 2		
P04	J.C.Peng; S.Sawada	U.of Illinois, KEK	Measurement of High-Mass Dimuon Production at the 50-GeV Proton Synchrotron	Deferred	->	->	->		
E05	T.Nagae	KEK	Spectroscopic Study of Ξ-Hypernucleus, $^{12}_{\Xi}$Be, via the ^{12}C(K⁻, K⁺) Reaction	Stage 2	->	->	->	Day1	1
E06	J.Imazato	KEK	Measurement of T-violating Transverse Muon Polarization in $K^+ \to \pi^0 \mu^+ \nu$ Decays	Stage 1	->	->	->		
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 1	Stage 2	->	->		
L08	A.Krutenkova	ITEP	Pion double charge exchange on oxygen at J-PARC	(no presentation)	Stage 1	->	->		
P09	T.Nakano	RCNP, Osaka U	Study of Exotic Hadrons with S=+1 and Rare Decay $K^+ \to \pi^+ \nu \bar{\nu}$ with Low-momentum Kaon Beam at J-PARC	LoI					
E10	A.Sakaguchi	Osaka U	Study on Λ-Hypernuclei with the Charge-Exchange Reactions	Deferred	Stage 1	Stage 2	->		
E11	K.Nishikawa	KEK	Tokai-to-Kamioka (T2K) Long Baseline Neutrino Oscillation Experimental Proposal	Stage 2	->	->	->		
P12	S.Choi	Seoul National U.	Study of Parton Distribution Function of Mesons via Drell-Yan Process at J-PARC at High-p beamline	LoI					
E13	T.Tamura	Tohoku U.	Gamma-ray spectroscopy of light hypernuclei	Stage 2	->	->	->	Day1	2
E14	T.Yamanaka	Osaka U.	Proposal for $K_L \to \pi^0 \nu \bar{\nu}$ Experiment at J-PARC	Stage 1	->	Stage 2	->		
E15	M.Iwasaki, T.Nagae	RIKEN, KEK	A Search for deeply-bound kaonic nuclear states by in-flight 3He(K⁻, n) reaction	Stage 1	Stage 2	->	->	Day1	
E16	S.Yokkaichi	RIKEN	Electron pair spectrometer at the J-PARC 50-GeV PS to explore the chiral symmetry in QCD	Deferred	Stage 1	->	->		
E17	R.Hayano, H.Outa	U. Tokyo, RIKEN	Precision spectroscopy of Kaonic ^{3}He 3d->2p X-rays	Stage 1	Stage 2	->	->	Day1	
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	Deferred	Stage 1	->	->		
E19	M.Naruki	RIKEN	High-resolution Search for Θ⁺ Pentaquark in $\pi^- p \to K^- X$ Reactions	Stage1	Stage 2	->	->	Day1	
P20	Y.Kuno	Osaka U	An Experimental Search for $\mu^- \to e^-$ Conversion at Sensitivity of 10^{-18} with a High Intense Muon Source, PRISM	LoI					
P21	Y.Kuno	Osaka U	An Experimental Search for Lepton Flavor Violating $\mu^- \to e^-$ Conversion at Sensitivity of 10^{-18} with a Slow-Extracted Bunched Proton Beam		LoI	LoI	Deferred		
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	->	->		
P23	A.D. Krisch	U. of MICHIGAN	Analyzing power A_n and A_{nn} in 30-50 GeV very-high-P_t^2 proton-proton elastic scattering				Deferred		
P24	Y. Goto, H. Sato	RIKEN, KEK	Polarized Proton Acceleration at J-PARC				No decision		

(*) : Affiliation of the spokespersons

:Stage2 approval
:Stage2 PAC recommendation
:Stage1 approval
:Deferred
:Rejected
:LoI
: Experiment at the fast extraction beam

Machine time allocation between two types of operational modes

- Fast Extracted Beam E11
- Slow Extracted Beam

Stage-1 > Sage-2 > Day-1 > Priority

Approval Summary for Experiments at Hadron Hall

Experiments at Hadron Hall

	(Co-)Spokespersons	Affiliation(*)	Title of the experiment	Status	Slow line priority: Day1?	Slow line priority: Priority	Beam line	Beam	Intensity [/spill]	Net Run Time: in proposal	Net Run Time: [hours]
E03	K.Tanida	Kyoto U	Measurement of X rays from Ξ⁻ Atom	Stage 2			K1.8	K-	1.4×10^{6}	100 shifts	800
E05	T.Nagae	KEK	Spectroscopic Study of Ξ-Hypernucleus, $^{12}_{\Xi}$Be, via the ^{12}C(K⁻, K⁺) Reaction	Stage 2	Day1	1	K1.8	K-	1.4×10^{6}	4 weeks	672
E06	J.Imazato	KEK	Measurement of T-violating Transverse Muon Polarization in $K^+ \to \pi^0 \mu^+ \nu$ Decays	Stage 1			K1.1BR	K+	3×10^{6}	1.3×10^{7} sec	3611
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	K-	3×10^{5}	600 hours	600
E08	A.Krutenkova	ITEP	Pion double charge exchange on oxygen at J-PARC	Stage 1			K1.8	π±	5×10^{6}	13 days	312
E10	A.Sakaguchi	Osaka U	Study on Λ-Hypernuclei with the Charge-Exchange Reactions	Stage 2			K1.8	π-	1×10^{7}	3(9Be)+3(6Li) weeks	1008
E13	T.Tamura	Tohoku U.	Gamma-ray spectroscopy of light hypernuclei	Stage 2	Day1	2	K1.8	K-	5×10^{5}	1000 hours	1000
E14	T.Yamanaka	Osaka U.	Proposal for $K_L \to \pi^0 \nu \bar{\nu}$ Experiment at J-PARC	Stage 2			KL	KL0		3×10^{7}sec (Step1)	8333
E15	M.Iwasaki, T.Nagae	RIKEN, KEK	A Search for deeply-bound kaonic nuclear states by in-flight 3He(K⁻, n) reaction	Stage 2	Day1		K1.8BR	K-	1.4×10^{6}	5.5 weeks	924
E16	S.Yokkaichi	RIKEN	Electron pair spectrometer at the J-PARC 50-GeV PS to explore the chiral symmetry in QCD	Stage 1			High Pt	p	1×10^{10}	100 shifts	800
E17	R.Hayano, H.Outa	U. Tokyo, RIKEN	Precision spectroscopy of Kaonic ^{3}He 3d->2p X-rays	Stage 2	Day1		K1.8BR	K-	8×10^{5}	35 days (@10% of full)	840
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	π+	1×10^{7}	72 shifts	576
E19	M.Naruki	RIKEN	High-resolution Search for Θ⁺ Pentaquark In $\pi^- p \to K^- X$ Reactions	Stage 2	Day1		K1.8	π-	4×10^{6}	160 hours	160
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	π+	1×10^{7}	4 weeks	672

(*) : Affiliation of the spokespersons

:Stage2 approval
:Stage2 PAC recommendation
:Stage1 approval

Total	20308
Stage2	13537
Stage1	14304

Stage-2 13537hours

'Net Run Time' Summary for Experiments at Hadron Hall

- Stage 2

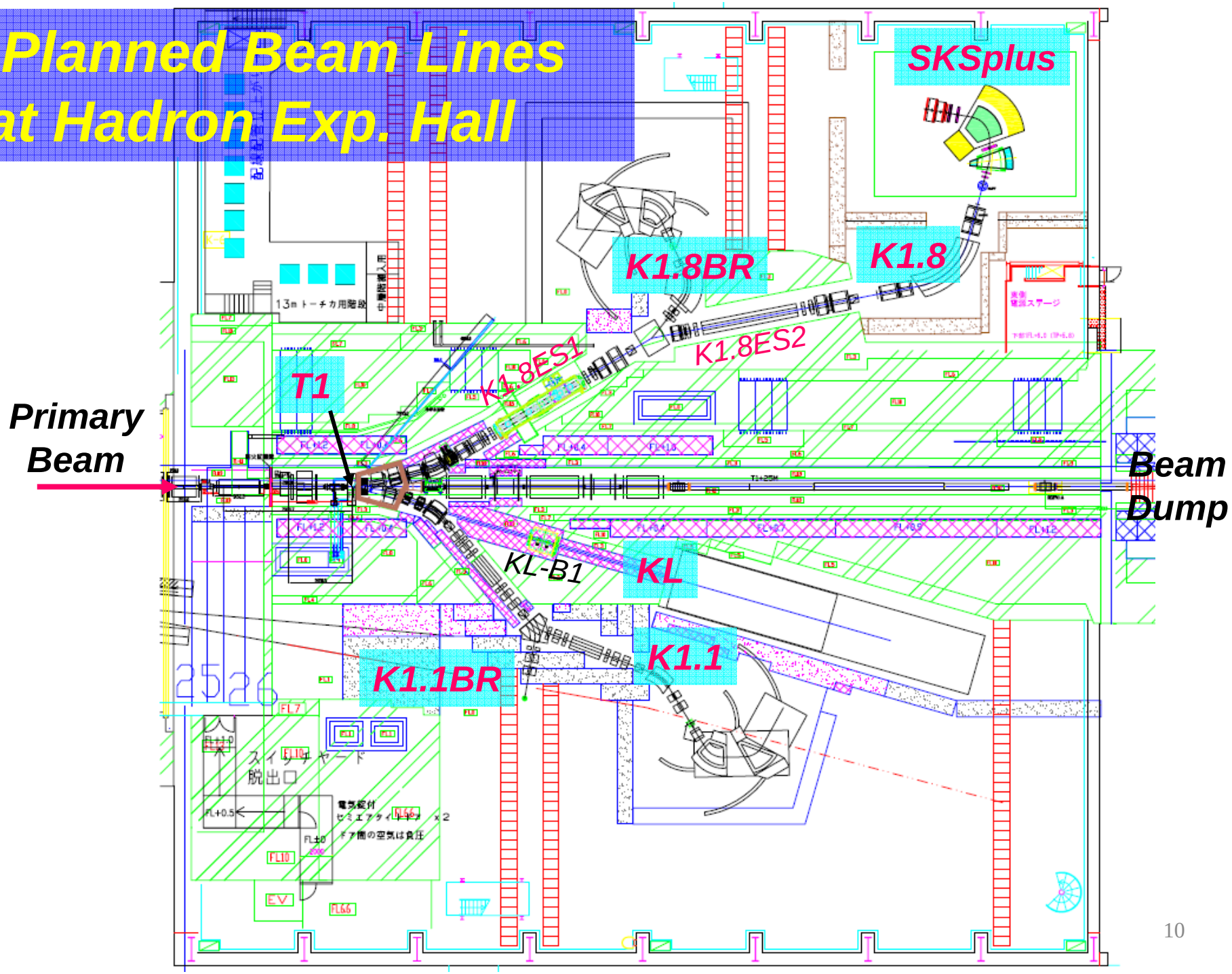
Beam line	Stage2	
	[hours]	[hours]/2000
K1.8 & K1.8BR	5204	2.6
KL	8333	4.2

- Stage 2 & Stage 1

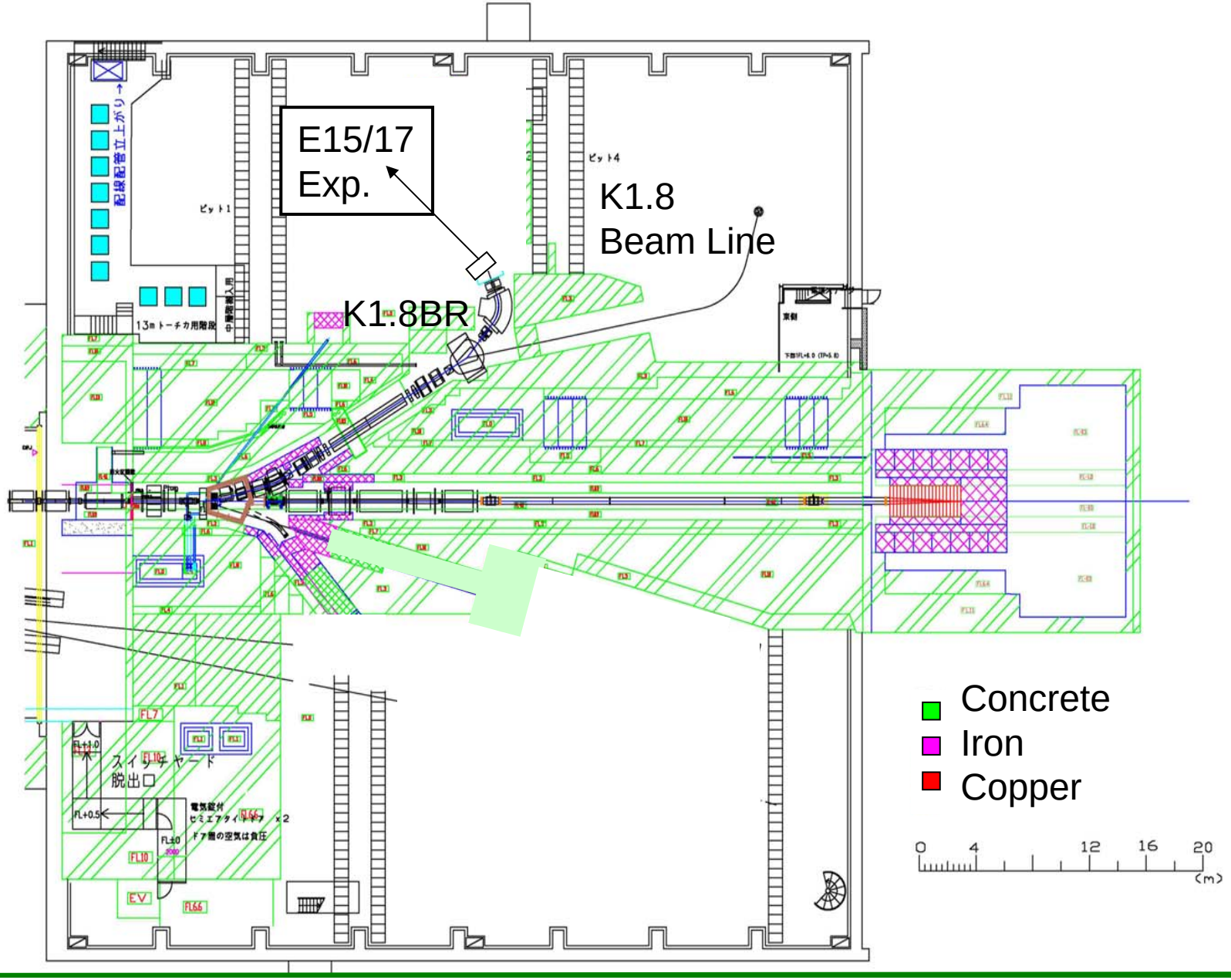
Beam line	Stage2&1	
	[hours]	[hours]/2000
K1.8 & K1.8BR	7564	3.8
KL	8333	4.2
K1.1BR	3611	1.8
High Pt	800	0.4

Beam line construction plan

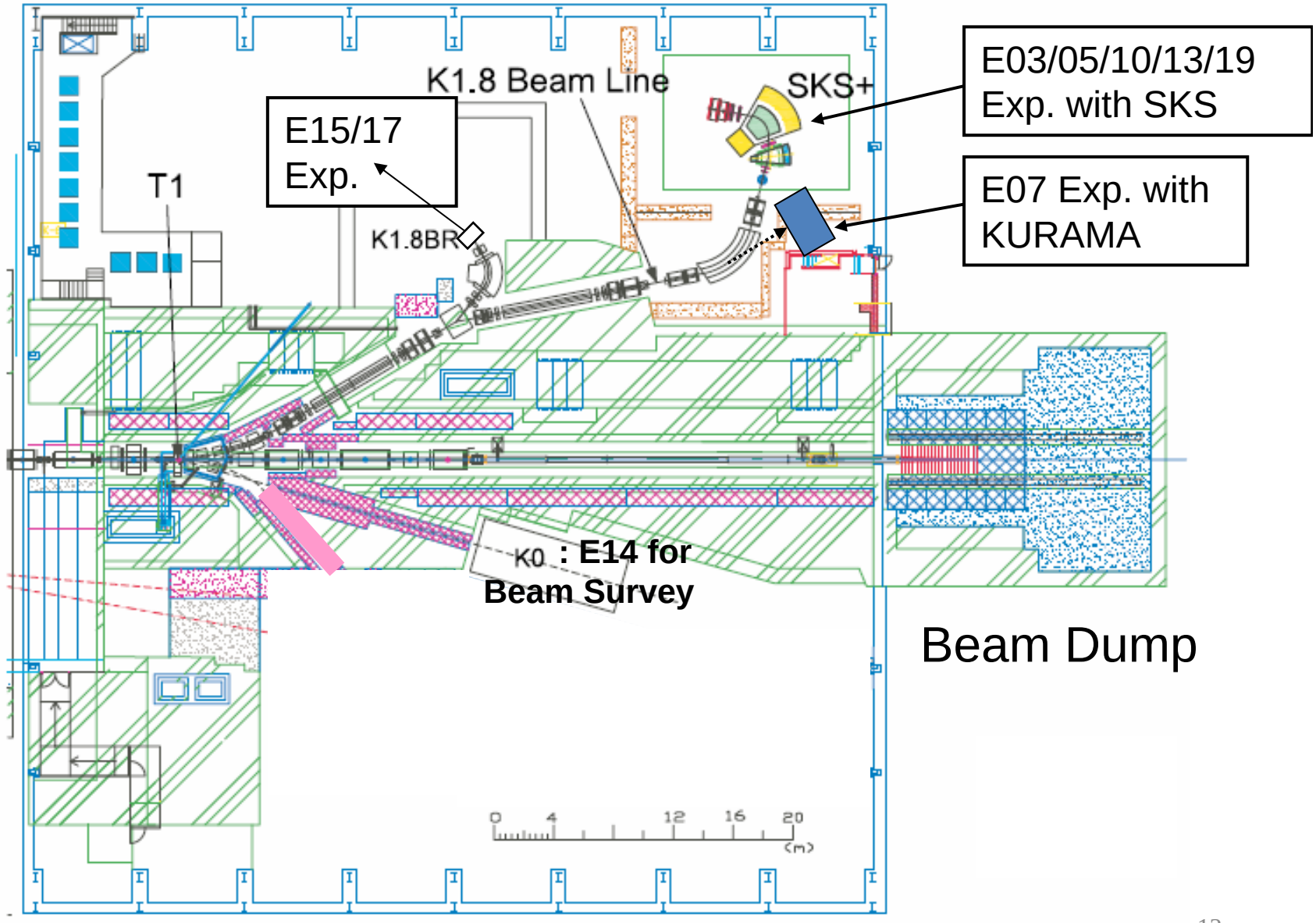
Planned Beam Lines at Hadron Exp. Hall



Hadron Hall, at the end of 2008

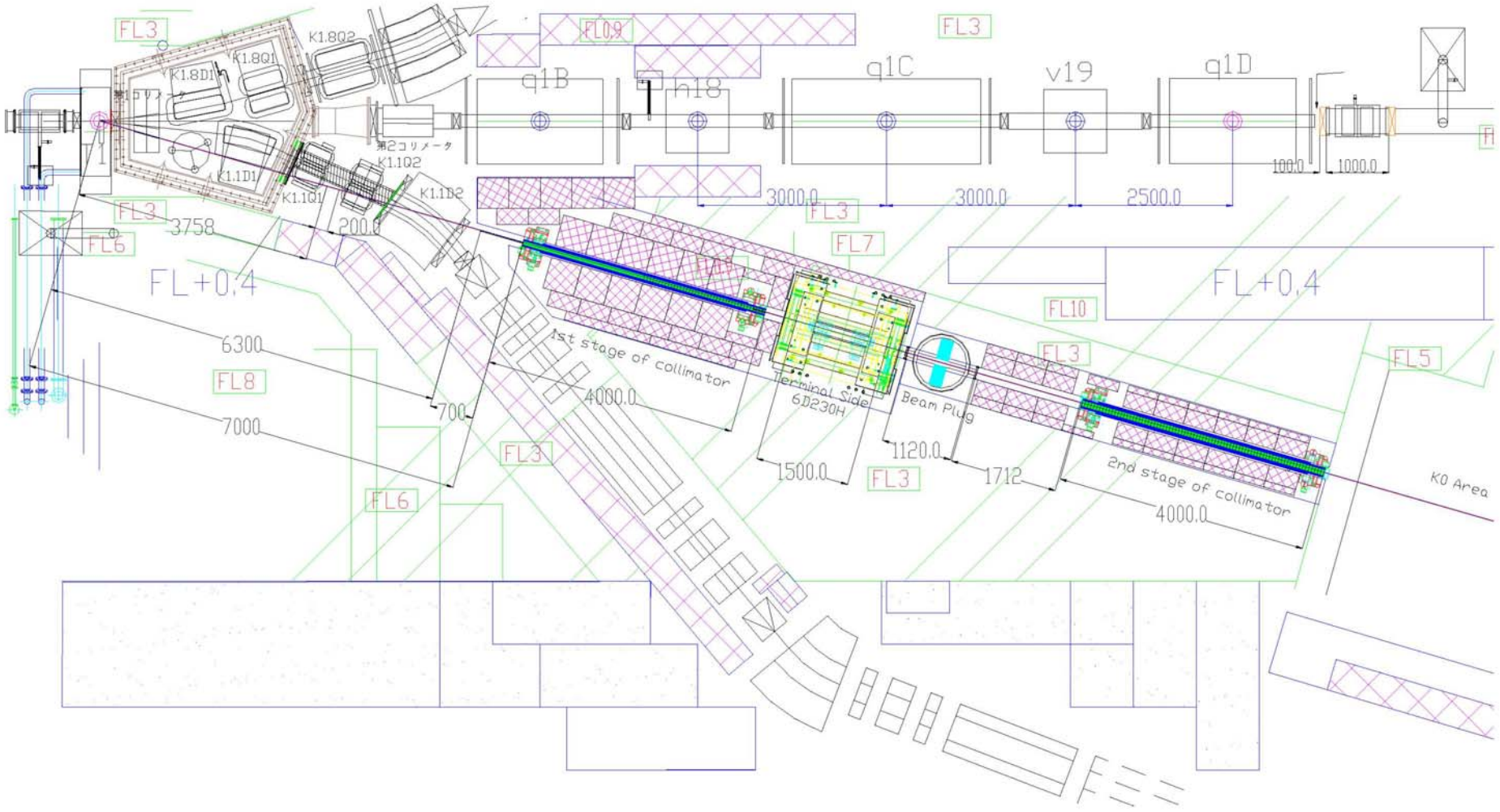


Hadron Hall, at the end of 2009

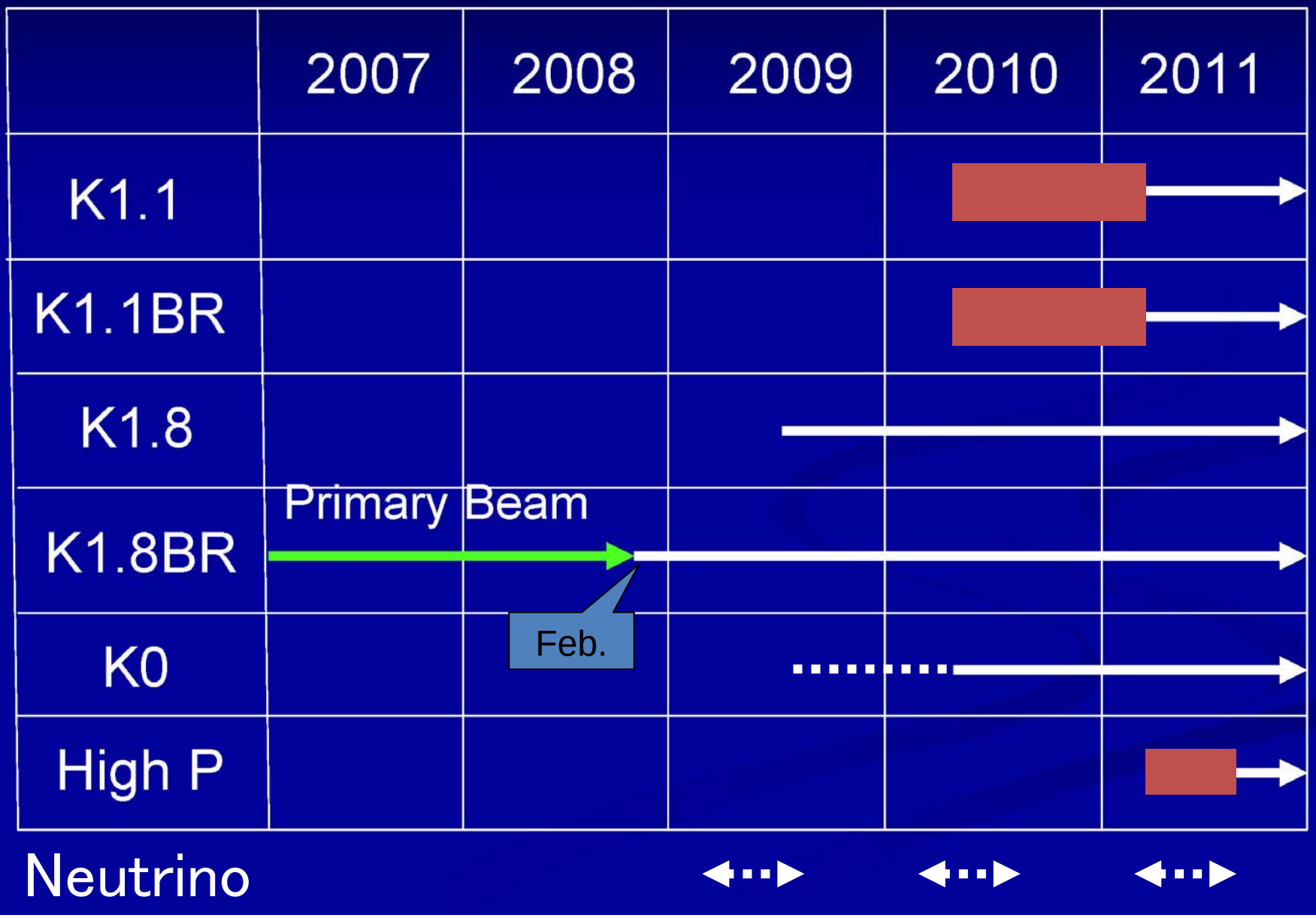


KL Beam Line

Overall view (top view)

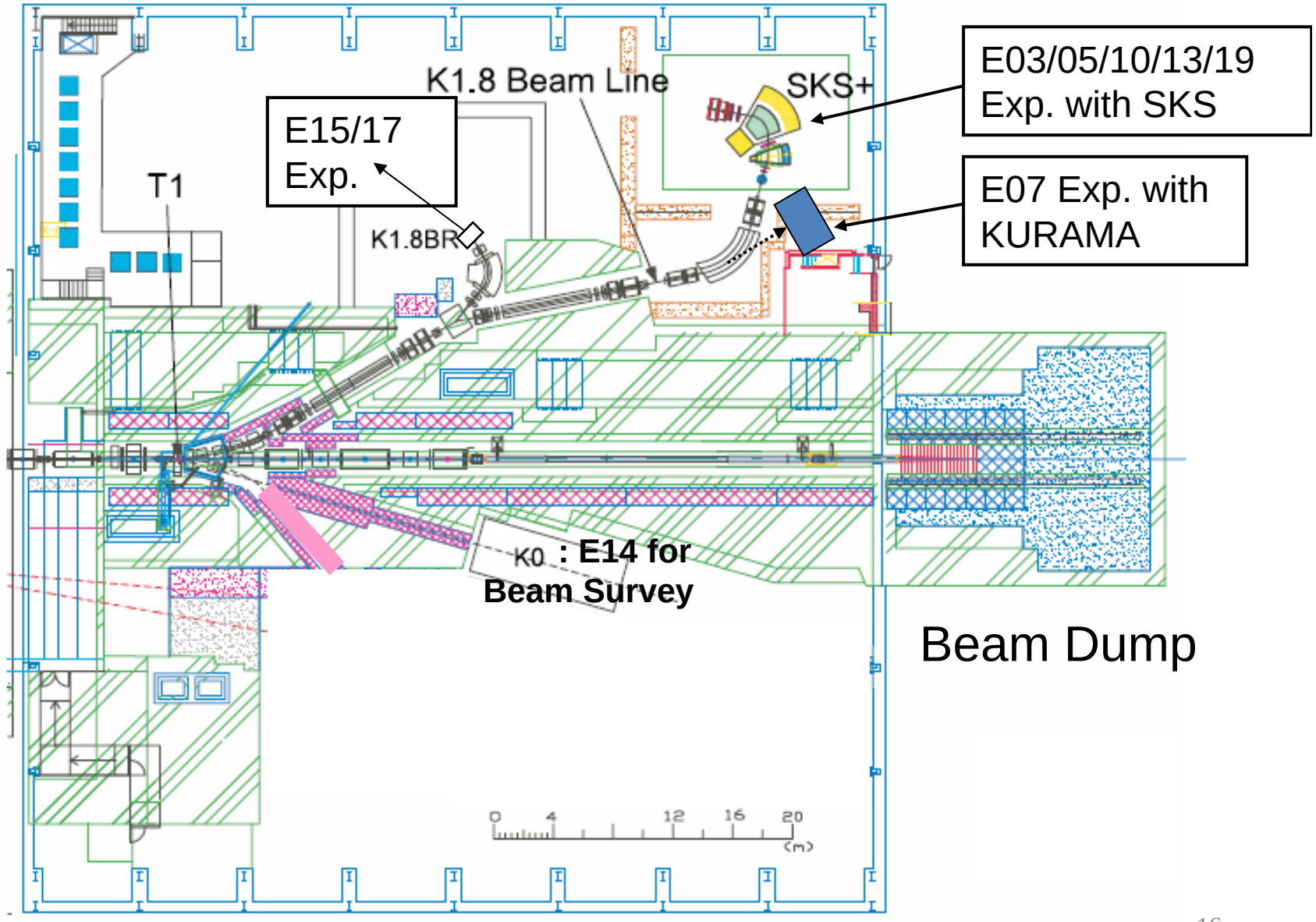


A possible Schedule of Beam Delivery



SKS Magnet Status

Hadron Hall, at the end of 2009



SKS Magnet @ J-PARC

- Modification of cooling system
  - 300W refrigerator –> 3.5W GM-JT cooler x 3
    - keep Liq-He
  - Normal current lead –> Hi-TC C.L. with GM cooler
- Magnet position of each experiment
  determined by K1.8 users group
  - SKS0 E10/E19/E18/E22 same as PS-K6
  - SksMinus E17/(E08)
  - SksPlus E05/E08
  - no use E07/E03
    (KURAMA)

Change in cooling method:

- (Old) 300W He refrigerator (Cold Box, Compressor, He transfer line, LN2 storage)

↓

(New) Three or four 4K GM-JT cryocooler on the yoke and these compressors located outside the Hadron-hall.

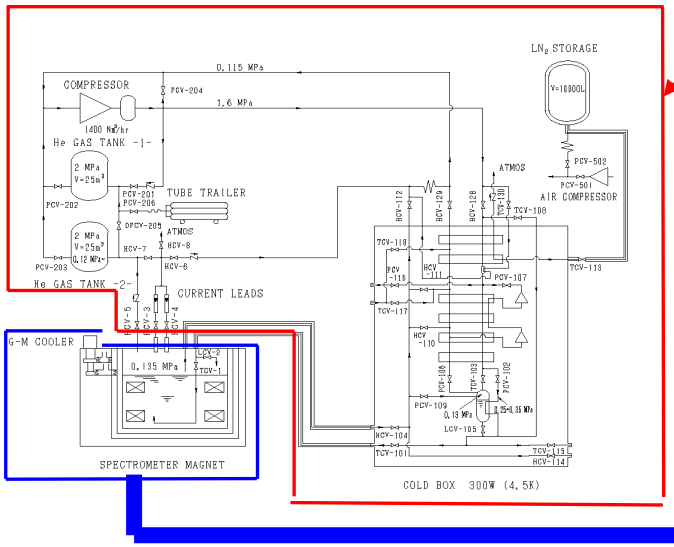
- (Old) Cu current leads → (New) HTC current leads + new GM cryocooler

to suppress the heat load.

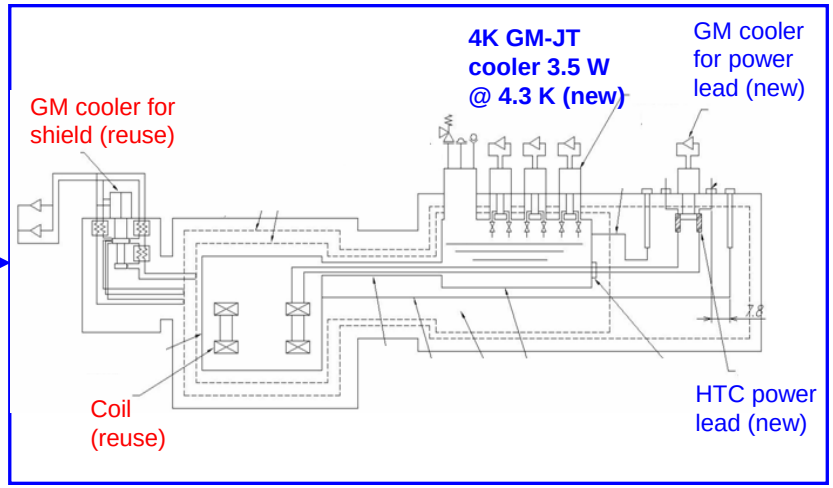
- During precooling the magnet from room temperature to LHe temperature, LHe will be poured directly to cool down the magnet temperature.

Before reconstruction

Not to be used

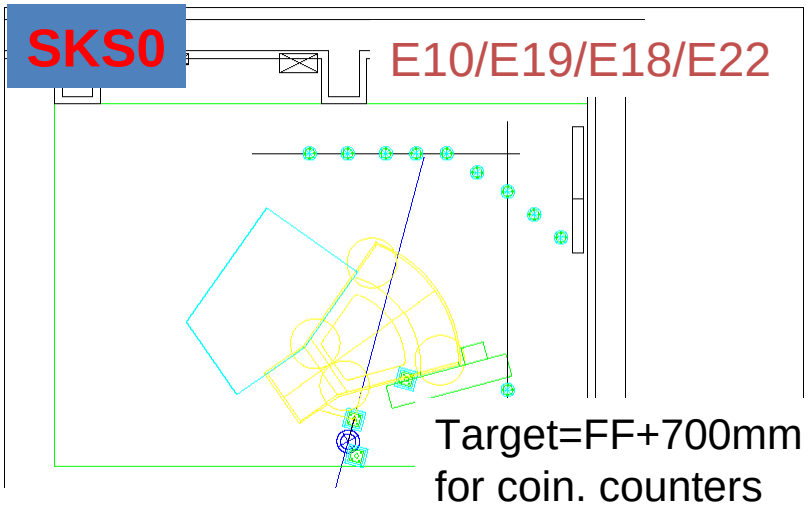


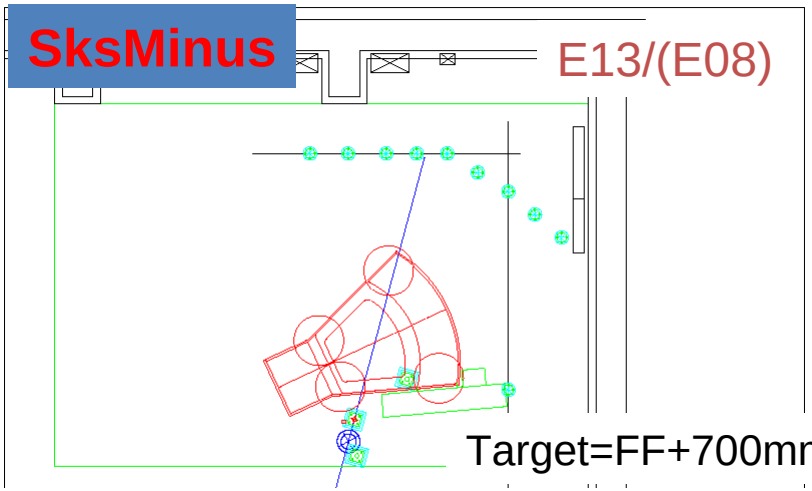
After reconstruction

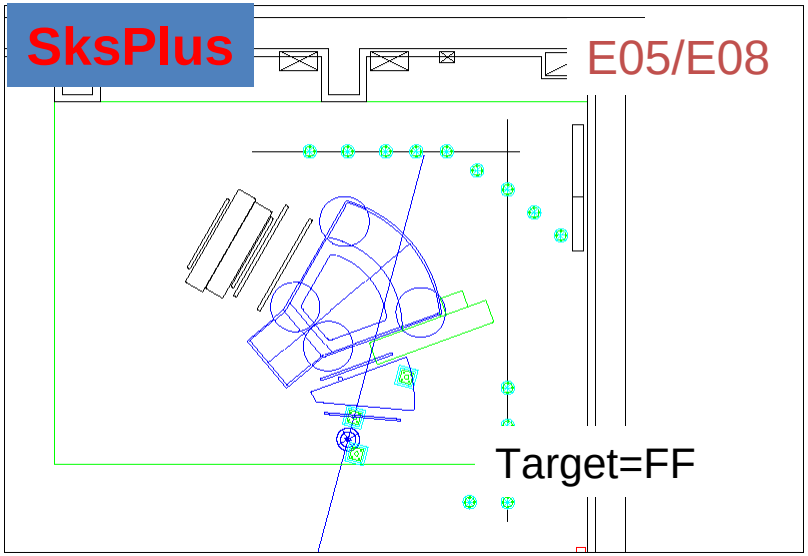


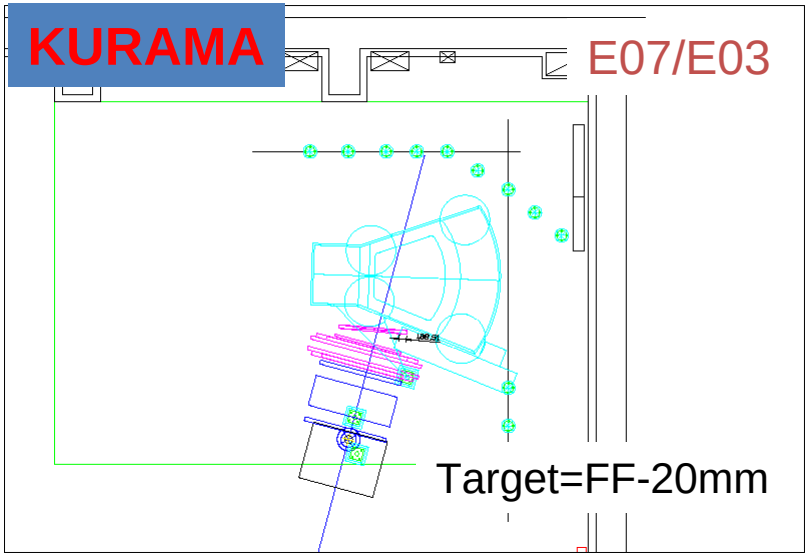
SKS Magnet position for each setup

moved by the combination of rotations









Some attachments should be fabricated ! (budget is not allocated yet.)

Magnet disassemble in Jan. 2008 and a new cooling system

- 2/3 of magnet yoke was disassembled in Jan. 2008 and the coil vessel was shipped to the factory (Toshiba) for the modification of the cooling system.
- 3 GM-JT coolers and other coolers are ready and will be shipped to Toshiba soon.
- The modification of cooling system and cooling test will be finished by the end of Sep. 2008.
- Allocation of the crane and space at Hadron Hall is very difficult before Dec. 2008.
- Assemble and cooling/excitation tests may be delayed from the original schedule.

The cooler vessel was cut away at the factory.

Schedule

- Jun. 2008 Pivot anchor construction at K1.8 area
- Oct. Transfer disassembled yoke (2/3 of all) to J-PARC
- Nov. Disassemble of the remaining part at Tsukuba
- Dec.?Construction of control hat will be finished !?
- Jan. 2009 - Transfer all items to J-PARC

  Assemble of the magnet yoke and coil
- Feb(Mar.)- Apr.

  Connection of

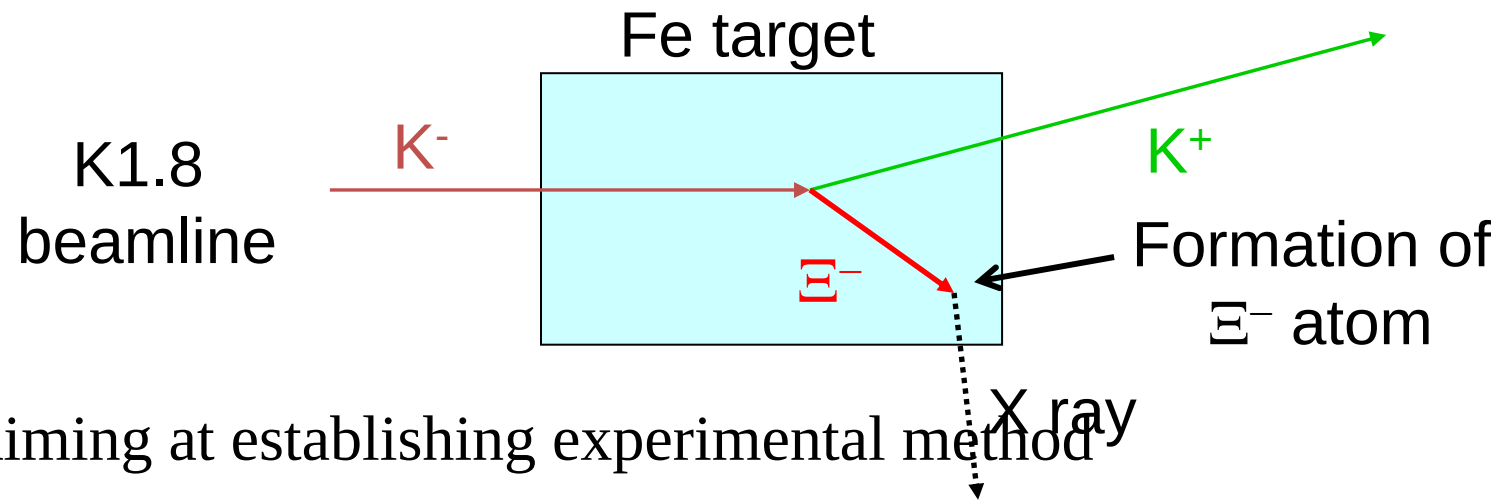
  power lines/cooling-water/compressors/monitor lines
- May Cooling and excitation tests
- Jun. ? – Counter installation

One page summary of stage-2 approved experiments at Hadron Facility
E3, 5, 7, 10, 13, 19

E15/17(K d.b.s), E06(TREK), E11(T2K), E14(KL)
will have presentation at this PAC

E03 – Measurement of X rays from Ξ^- atom

- World first data to give direct information on the Ξ-A optical potential
  - X-ray energy shift (width) → real (imaginary) part

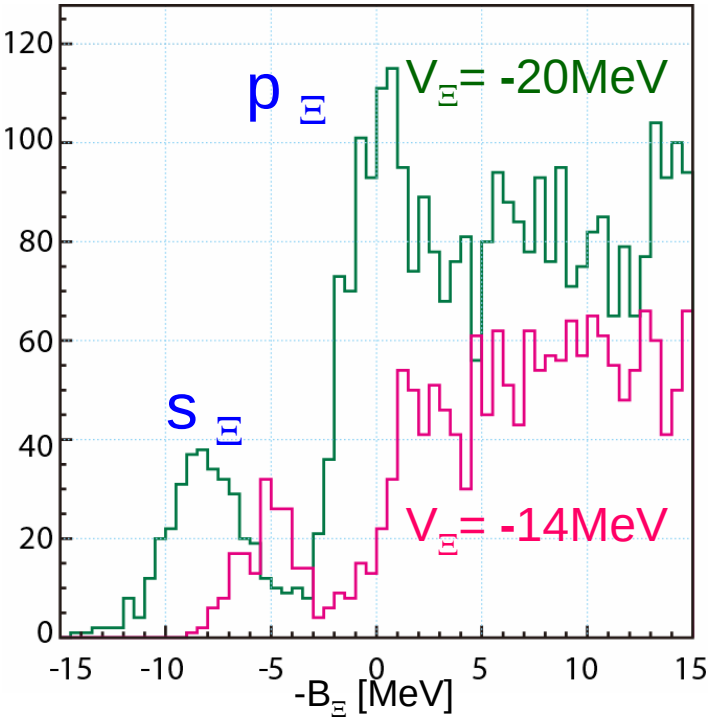


- Aiming at establishing experimental method
- $\delta E_X \sim 0.05$ keV (ΔE_X up to a few keV)
  - Capability demonstrated

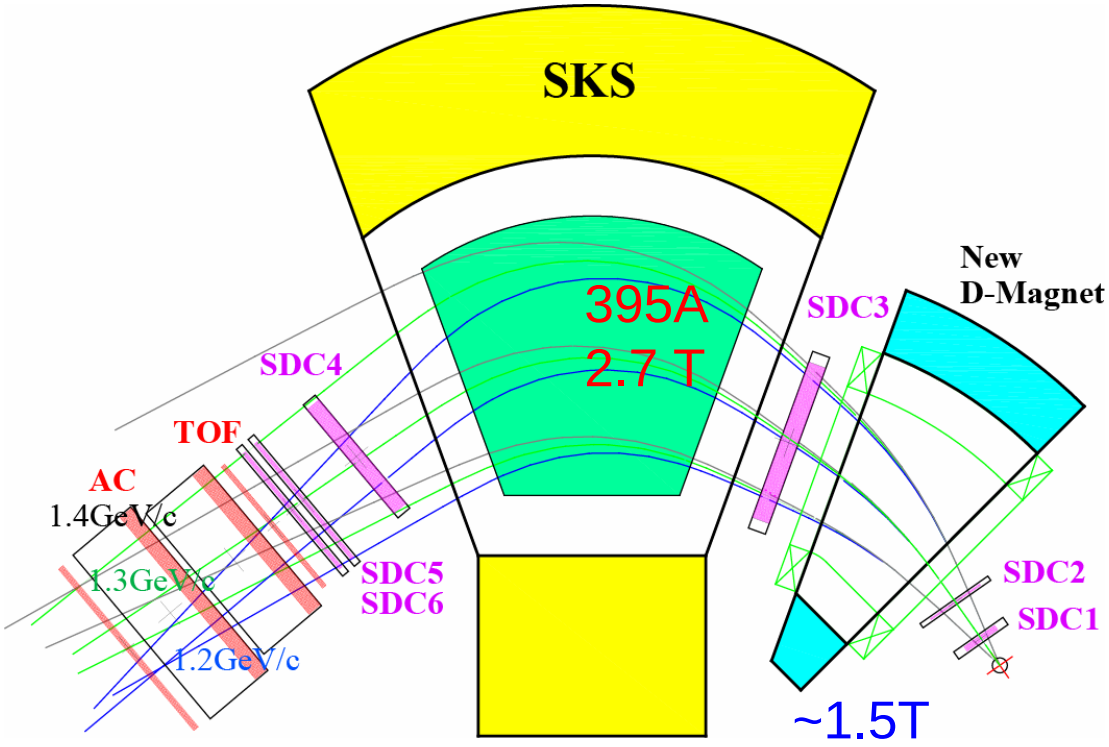
E05: Spectroscopic Study of Ξ-Hypernucleus, $^{12}_{\Xi}$Be, via the ^{12}C(K^-,K^+) Reaction

Spokesperson: T. Nagae (Kyoto)

- Discovery of Ξ-hypernuclei
  - Measurement of Ξ-nucleus potential depth and width of $^{12}_{\Xi}$Be
- Beam: K^- @ 1.8 GeV/c, 1.4x10^6/spill
  - CH_2 ~2 g/cm^2 (2 weeks)
  - ^{12}C 5.4 g/cm^2 (4 weeks)
- Setup: K1.8 & SKS+

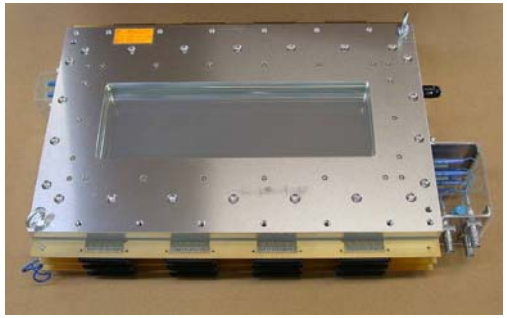


SKS+ Spectrometer Construction



SKS disassembled in Feb. 2008,
and will be back in 2009

- 30 msr
- $\Delta p/p=0.17\%$



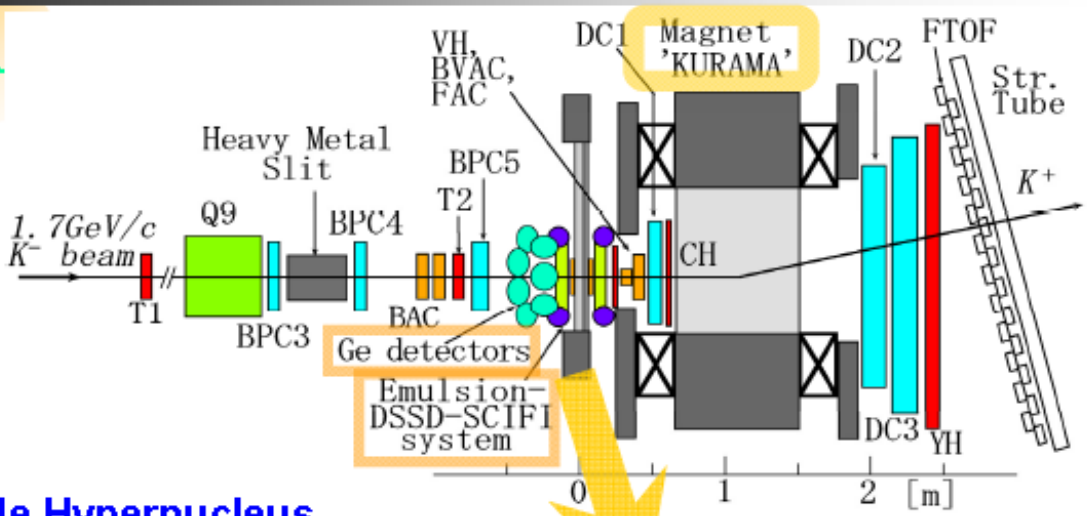
New tracking chambers and
Front-end Electronics in preparation

A new D magnet

E07 experiment

Jun.03,2008

Systematic Study of Double Strangeness System with an Emulsion-Counter Hybrid Method



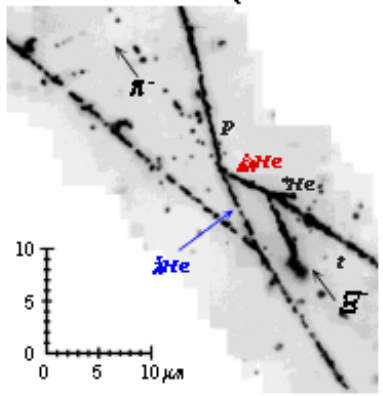
 # Beam : K^- (1.7GeV/c),
3×10^5 K^-/spill with $K^-/\pi^- > 6$
at K1.8 line (~20% of 9μA)

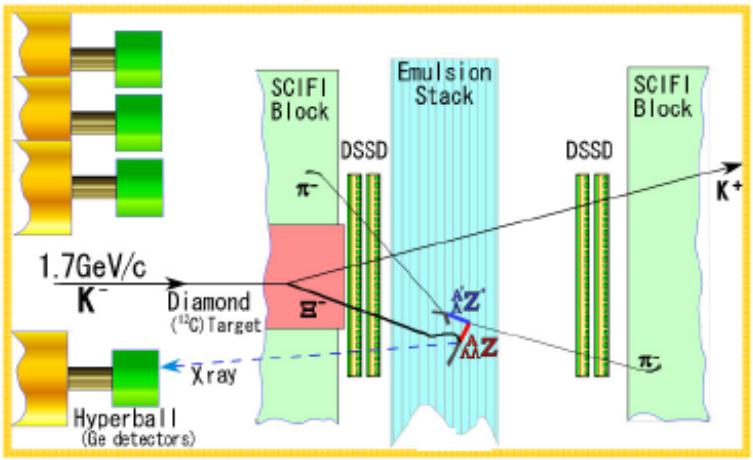
 # Spectrometer : KURAMA

 # Trigger : (K^-, K^+)
=> 10^4 Ξ^- stop events in nuclear emulsion.

(1) Double Hypernucleus in Emuslion

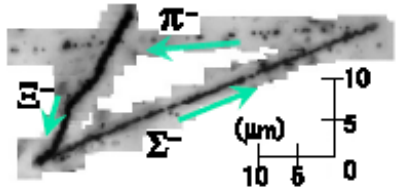
NAGARA event (KEK-E373)





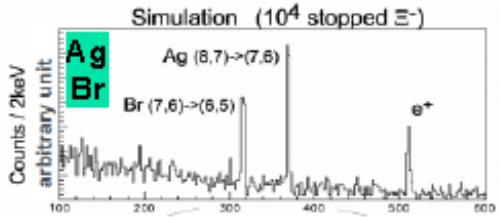
~100 events (expected)
=> Nuclear chart with $S = -2$
=> A-dependence of Λ-Λ int.

(2) Ξ-N mixing state. decay of S=-2 systems



=> study ΞN -> X -> ΣN

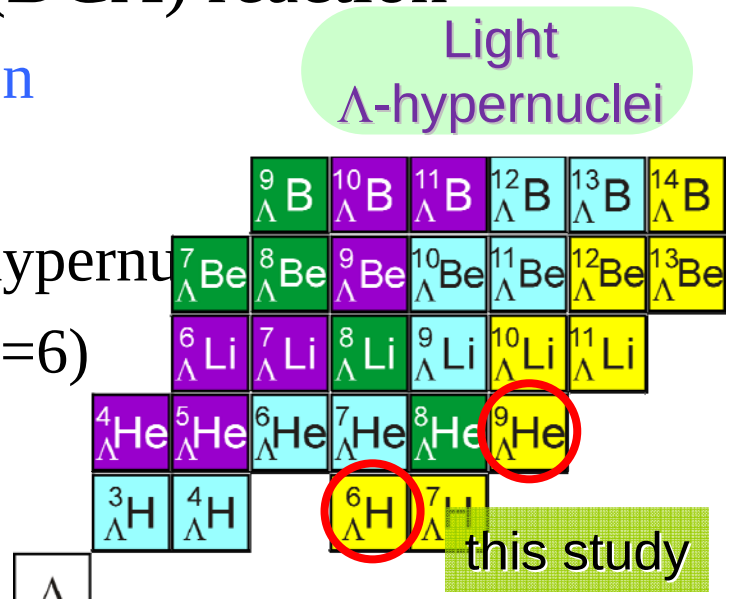
(3) X-ray from Ξ-atom with Hyperball



=> precisely measurement of Ξ-Nucleus int.

J-PARC / E10

- Subject: Produce neutron-rich and exotic hypernuclei by the double charge-exchange (DCX) reaction
  - DCX reaction: the (π^-,K^+) reaction
    - use high-intensity pion beams
  - Produce neutron-rich and exotic hypernu
    - ${}^{6}_{\Lambda}$H (Z=1, N=4), ${}^{9}_{\Lambda}$He (Z=2, N=6)
    - large N/Z ratio
    - core nuclei have neutron-hallo
  - Λ-N interaction in n-rich environment
    - explore ΛN-ΣN mixing effect

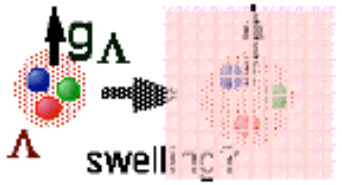


- Preparation status
  - Standard K1.8 beam line and SKS spectrometer
    - collaboration with J-PARC/E05, E13, E19, E22, etc.
  - Tracking chambers for high-intensity pion beams

E13 (Tamura et al.)
Gamma-ray spectroscopy of light Λ hypernuclei

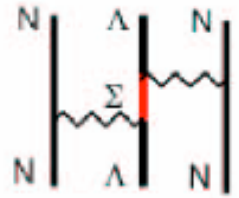
(K^-,π) reaction (p_K=1.5 GeV/c) at K1.8 line
using SKS + Hyperball-J (developed for higher counting rate)

- **g_Λ in a nucleus from spin-flip B(M1)**
  $^7_\Lambda$Li Doppler shift attenuation method
  Accuracy ~5%



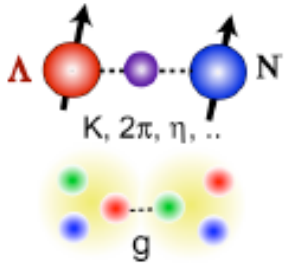
reduction of mass ?
-> enhancement of μ ?

- **Further Study of ΛN interaction**
  - **Consistency of ΛN spin-dependent force strengths**
  - **ΛN-ΣN coupling and three body force**
  - **Charge symmetry breaking (Λn≠Λp?)**
  - **Radial dependence (Interaction range)**



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

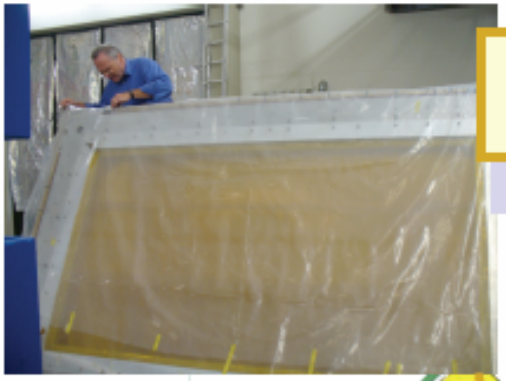
1000 hours with full beam (0.5M K^-/spill)



Toward unified
understanding
of BB interactions

E13 Status

Ready by the fall, 2009



SDC3, 4:
Large drift chambers from BNL and Freiburg

Shipped and repaired.

PWO background suppression counter

R&D finished.
Under mass production

SksMinus

SP0: Lead-plastic counters for π^0 rejection

Design finished.
prototype tested.

Liq. He target

Under design

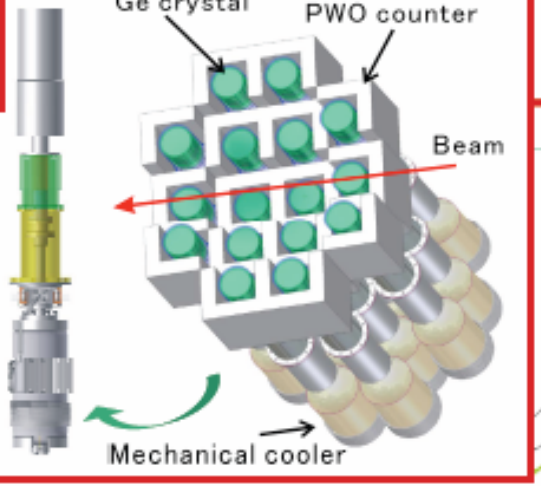
Hyperball-J
Under construction with Kakenhi grant

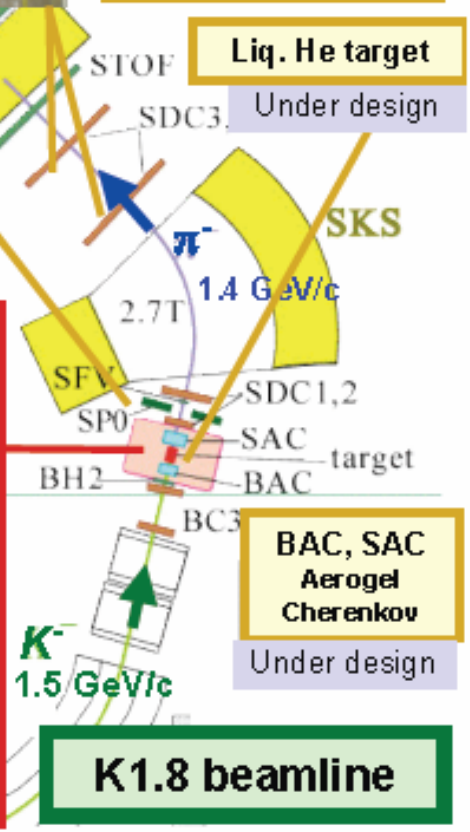
Support Frame

Under fabrication

Mechanically-cooled low temp. **Ge detector**

R&D finished.
Under mass production





BAC, SAC
Aerogel Cherenkov

Under design

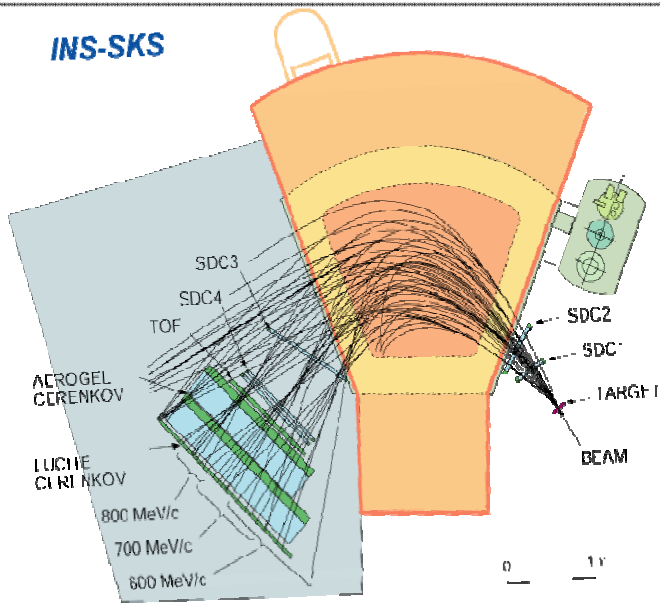
K1.8 beamline

J-PARC E19 experiment
Search for Θ^+ Pentaquark in $\pi^- p \rightarrow K^- X$ reactions

Goal

✓confirm Θ^+ existence with high-statistics & high mass resolution.

✓study production mechanism : $\pi^- p \rightarrow K^- \Theta^+$



Experimental Method

✓K1.8 beam line + SKS

✓2GeV/c $\pi^- + p \rightarrow K^- + \Theta^+$

✓target : liquid H_2

✓ K- identification with SKS

statistics: 62σ

sensitivity :

75nb/sr

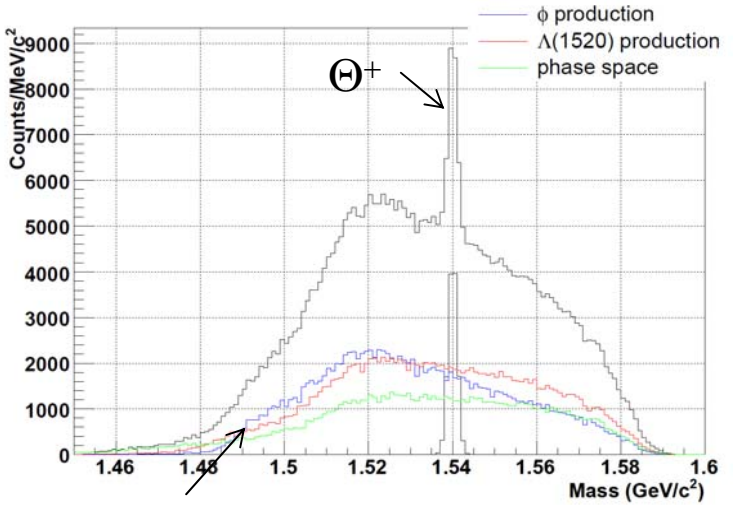
if $\Gamma <$ 2 MeV

Current Status

✓Spectrometer : co-developing w/ SKS users. Except MWPC, reuse existing magnet & counters.

✓Target : reuse E559's, prepare to transport from KEK to J-PARC.

Expected Missing Mass Spectrum



main background(ϕ · Λ · phase space)

Some of the stage-1 approved experiments

E08:Pion double charge exchange on oxygen at J-PARC

A.P.Krutenkova (ITEP) et al.
ITEP, KEK, Tohoku, Valencia

Motivation:

Reaction mechanism for high energy pion DCX.

Sequential Single Charge eXchange (SSCX)

➡ rapid drop at T_π=0.5-1.3GeV

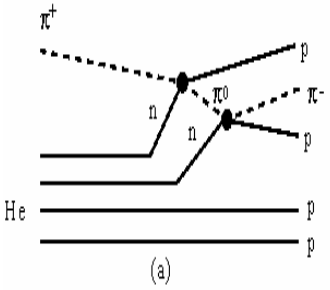
and/or other new mechanisms ?

One Pion Exchange (OPE)

Inelastic Glauber Rescattering (IR)

(two pions in intermediate state)

SSCX



Measurement:

Pilot step : (π^-,π^+) inclusive reaction on ^{16}O (H_2O)

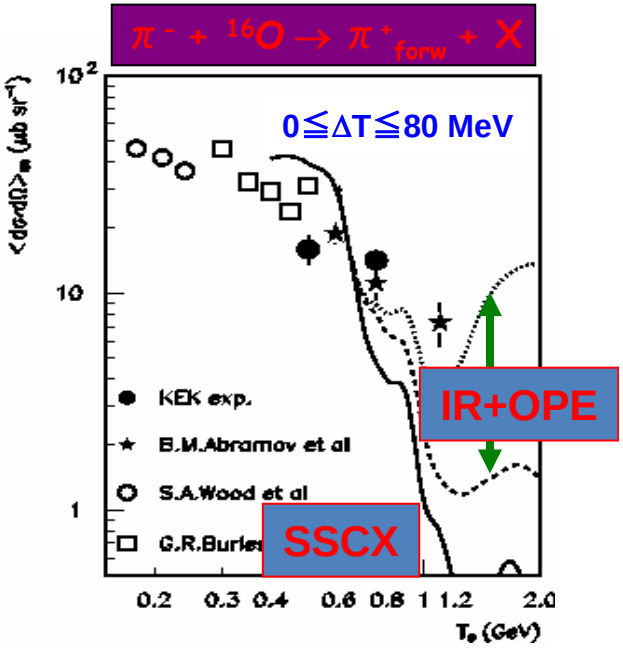
at T_π=1.1, 1.25, 1.5 GeV (1.25 - 1.65GeV/c)

with SksPlus (E05) or SksMinus (E13)

(1-1.6 GeV/c)

Final step: $^{18}O(\pi^+,\pi^-)^{18}Ne_{g.s}$ at T_π=1.1GeV

with SksPlus



should be prepared ...

- e^-/e^+ counter (Aerogel or L.G.?) for e^-/e^+ supression from π^0.
- ^{18}O target

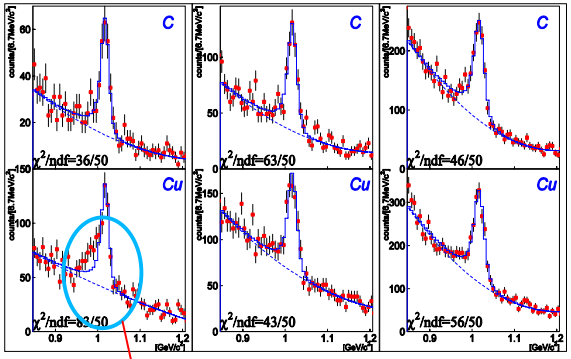
but not yet founded...

E16: *spokesperson: S. Yokkaichi (RIKEN)*

Electron pair spectrometer at J-PARC 50-GeV PS to explore the chiral symmetry in QCD

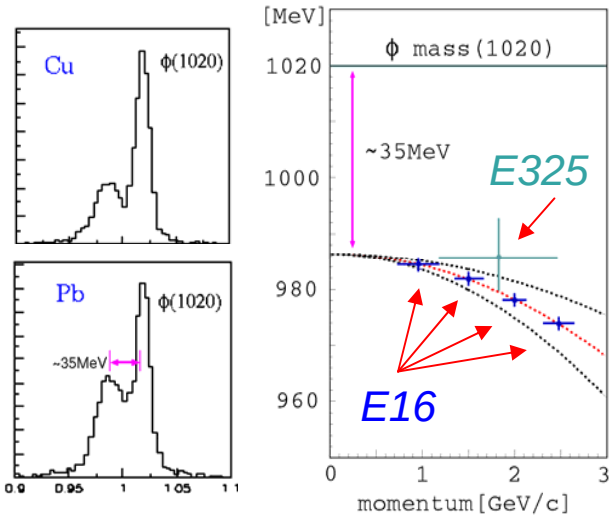
- Measure the vector-meson mass modification in nuclear matter with the e^+e^- invariant mass spectrum
- "High-momentum beam line" & New spectrometer
- 30 or 50 GeV primary proton beam (10^{10}/spill) / 5 weeks of physics run to collect ~10^5 $\phi \rightarrow e^+e^-$ for each target

Precedence exp. (KEK-PS E325)



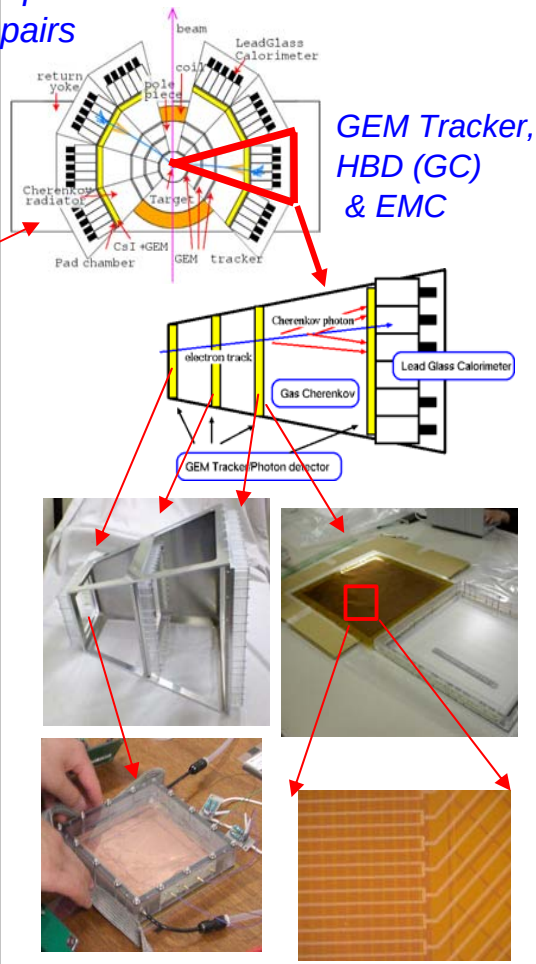
ϕ–mass is modified in large nuclei for slowly moving mesons ... consistent with the prediction based on the QCD sum rule

Proposed exp. E16



Nuclear size dependence & *Momentum dependence* of mass modification

Spectrometer to measure e^+e^- pairs



GEM Tracker, HBD (GC) & EMC

- Prototype detector is under construction w/ grant-in-aid ($160K)
- Applying another grant-in-aid($6M) for the spectrometer

J-PARC

Measurement of nonmesonic weak decay branch of $^{4}_{\Lambda}$He, $\Gamma(\Lambda n \to nn)$ and $\Gamma(\Lambda p \to np)$

- Subjects: Properties of ΛN weak interaction
  - spin/isospin structure
  - parity information

  } Determination of partial decay amplitudes

  - $\Delta I=1/2$ rule in B-B int. (need meas. of both $^{4}_{\Lambda}$H & $^{4}_{\Lambda}$He)
- Preparation status
  - beamline & spectrometer: collaboration with E05,E10,E13,….
    tracking chambers for intense pion beam (E10/E22) – R&D
  - decay counter system (E18/E22)
    scintillator array for neutron (E18/E22)
    – reuse KEK-PS's, ordered for the rest