Planning of the experiments in K1.8 beamline

7th J-PARC PAC Meeting

March 6 2009

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Approved Experiments
— K1.8 beamline —

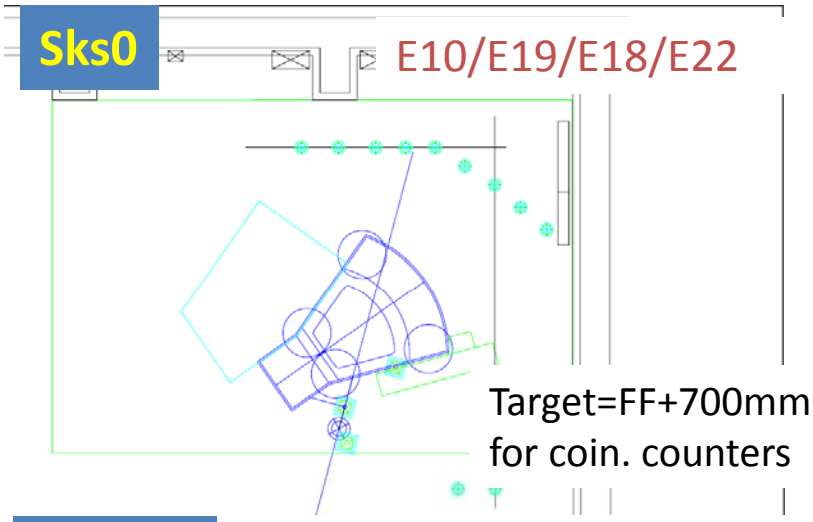
Stage-2: 5 2 Day-1 experiments
Stage-1: 4

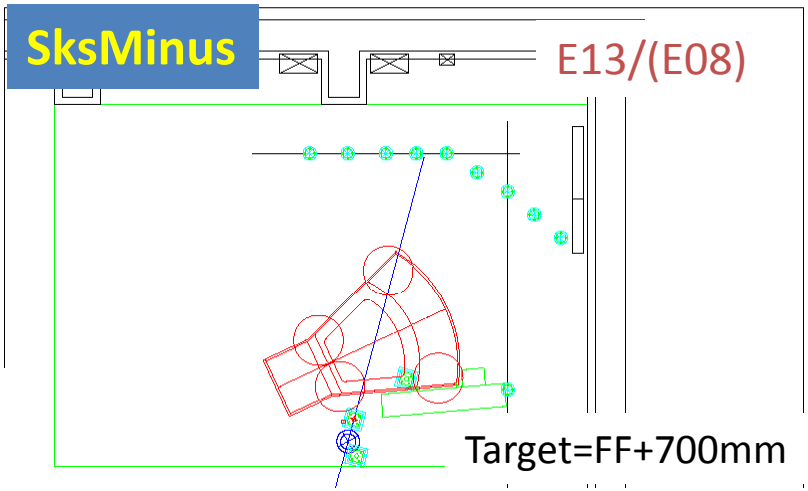
K^- beam: 4
π beam: 5

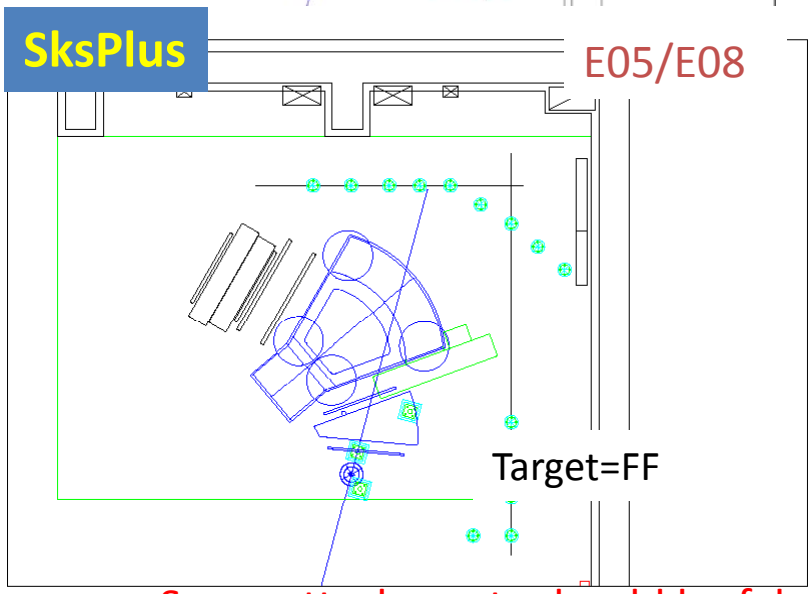
	Spokesperson	Title	Status	Beam	
E19	M.Naruki Sks0	High-resolution search for Θ^+ pentaquark in $\pi^-p \to K^-X$ reactions	Stage-2	π^- (~2.0)	160 hours
E10	A.Sakaguchi Sks0	Study on Λ-hypernuclei with the charge-exchange reactions	Stage-2	π^- (1.2)	6 weeks
E13	H.Tamura	Gamma-ray spectroscopy of light hypernuclei SksMinus+HyperBall	Stage-2 Day-1	K^- (1.5)	1000 hours
E07	K.Imai, K.Nakazawa, H.Tamura	Systematic study of double strangeness system with an emulsion-counter hybrid method KURAMA+HyperBall	Stage-2	K^- (1.7)	(150+600) hours
E05	T.Nagae	Spectroscopic study of Ξ-hypernucleus, $^{12}_{\Xi}$Be, via the ^{12}C(K^-,K^+) reaction SksPlus	Stage-2 Day-1	K^- (1.8)	(2+4) weeks
E03	K.Tanida	Measurement of X rays from Ξ^- atom KURAMA+HyperBall	Stage-1	K^- (1.8)	(20+100) shifts
E08	A.Krutenkova	Pion double charge exchange on oxygen SksPlus	Stage-1	π^+ (1.1-2.13)	(3+10) days
E18	H.Bhang, H.Outa, H.Park Sks0+ ...	Coincidence measurement of the weak decay of 12LC and the three-body weak interaction process	Stage-1	π^+ (1.05)	(28+72) shifts
E22	S.Ajimura, A.Sakaguchi Sks0+ ...	Exclusive study on the Lambda-N weak interaction in A=4 Lambda-hypernuclei	Stage-1	π^+ (1.1)	4 weeks

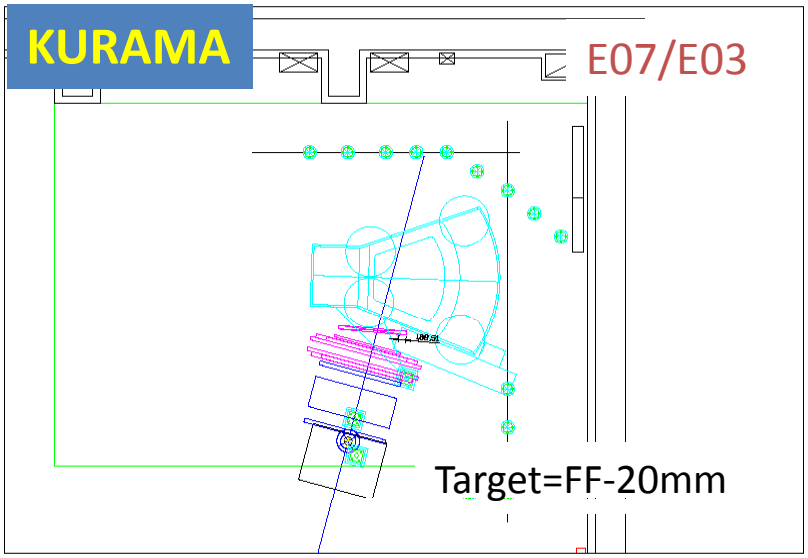
SKS Magnet position for each setup

moved by the combination of rotations









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

Status of SKS magnet
– Assembly at J-PARC –

Transportation of SKS magnet with the modification of cooling system was finished.

- Deassembly of the yoke at Tsukuba (Jan.–Feb 2008)


- Assembly at J-PARC (Jan.–Feb. 2009)

- Modification of cooling system & cooling test at the factory (Apr.–Dec. 2008)

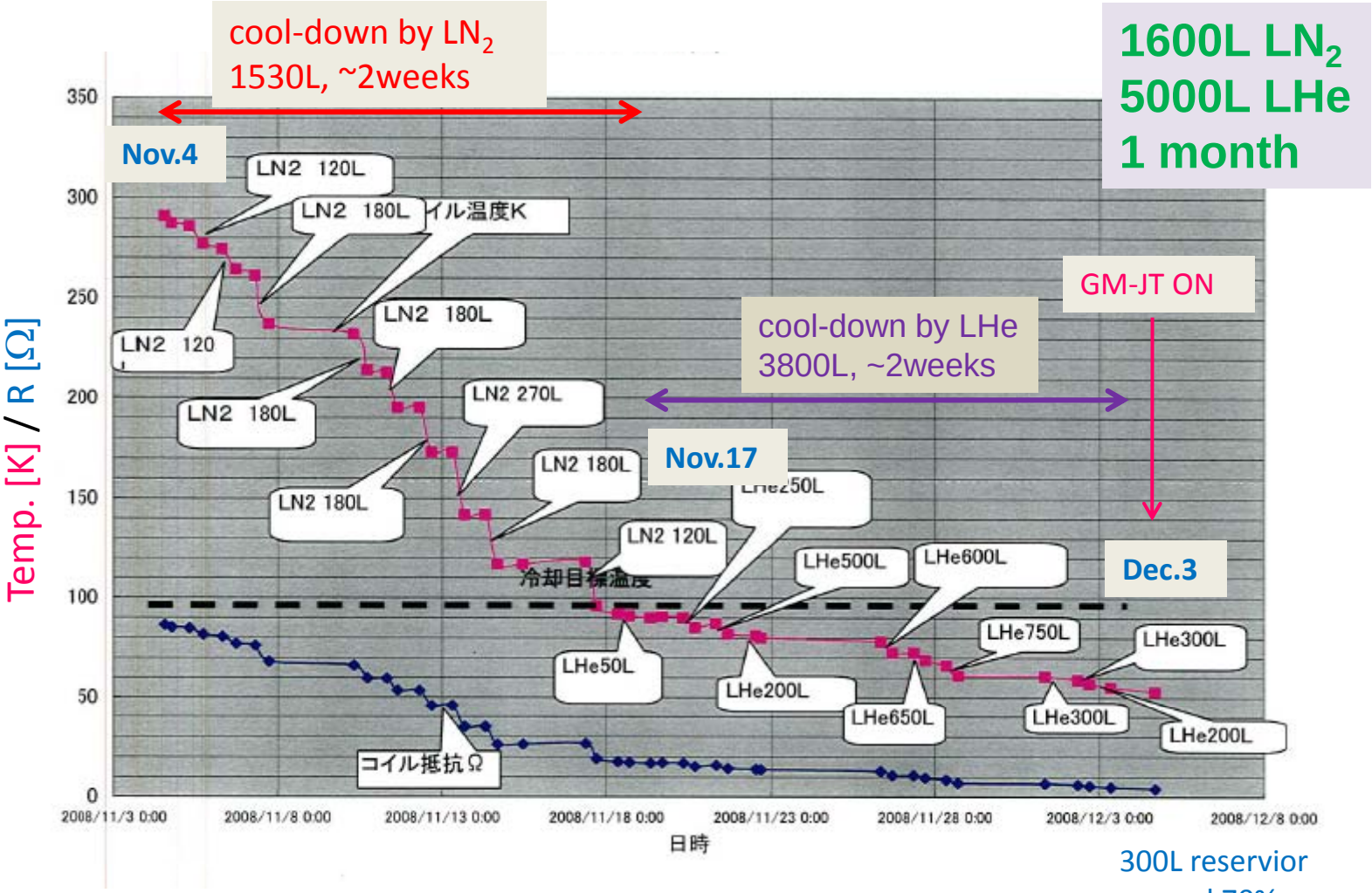
- Setup compressors for cryo-coolers, magnet power supply, monitor system. (March 2009 –)
- Cool-down & excitation test (May /June 2009 –)

Ready by summer 2009

- Detector installation (Aug.– ?)

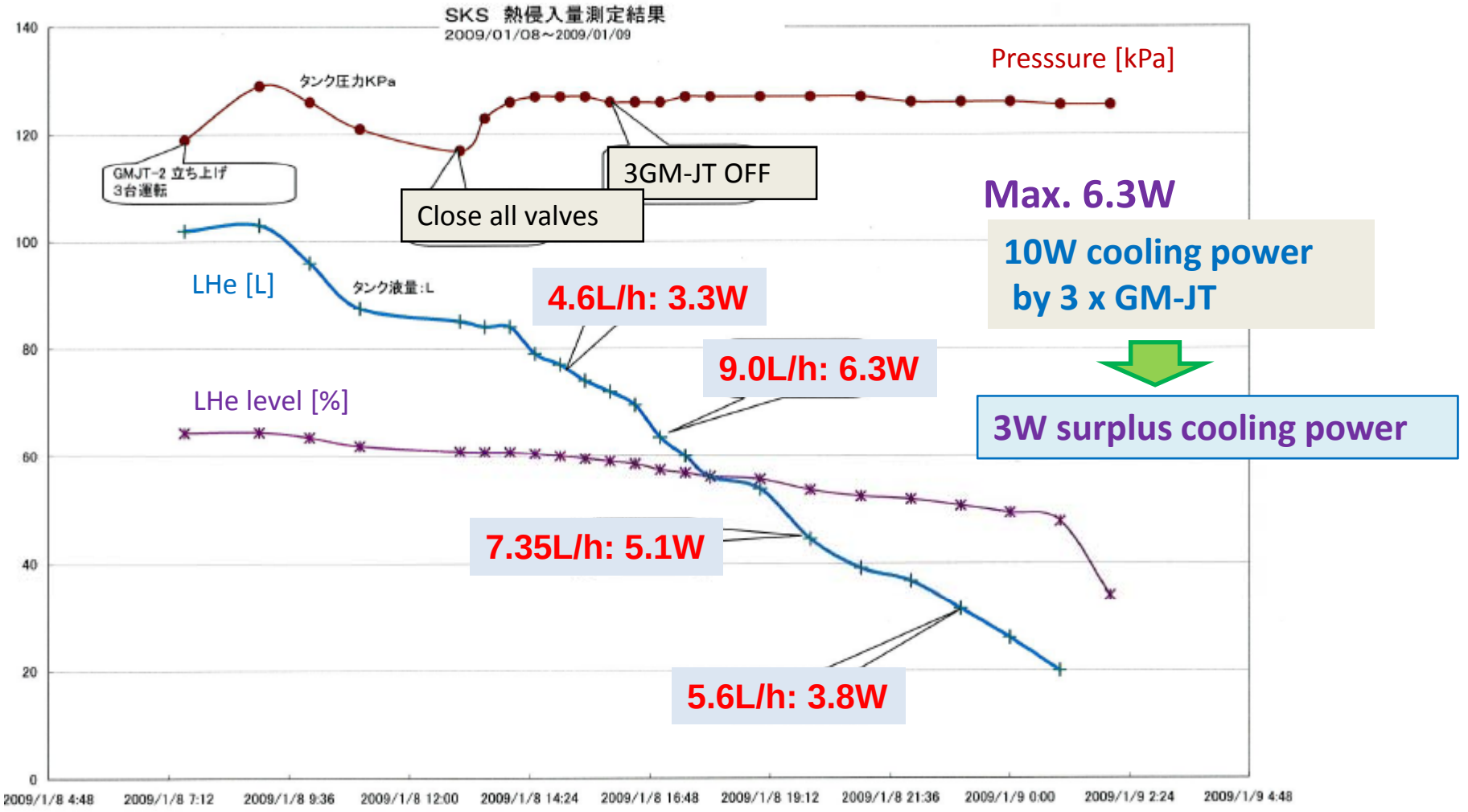
Cool-down Test at Toshiba

Nov.-Dec., 2008



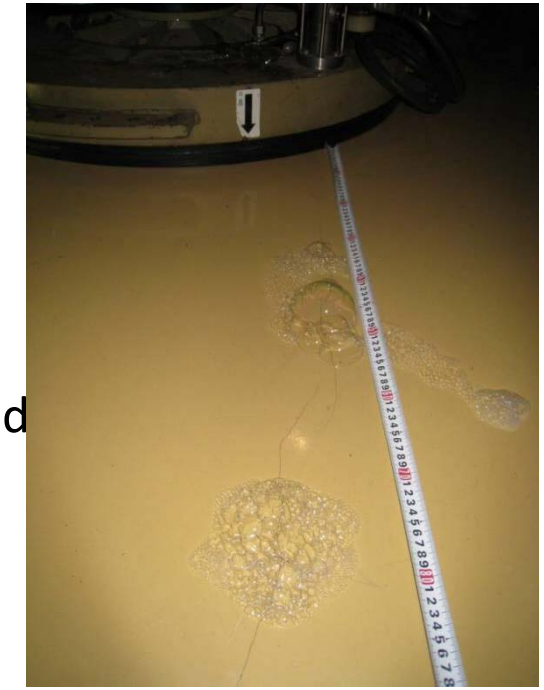
300L reservior
normal 70%

Measurement of Incoming Heat



Some (minor) problems of SKS

- Earth fault of the coil at the most inner layer
  - Skip 1/6 blook of the coil 2108 turns –> 1778 turns
  - 2.7 T –> 2.48 T @ 400A
  - Change of the magnetic field.
    - Use of the calculated map
    - Need enough calibration data on $^{12}C(\pi^+,K^+)^{12}_{\Lambda}C$
- One of the air floating device (Fluidt module) was not good
  - On the crack on floor -> Air leaks along the crack.
    - Repiar the floor (March)
  - Non-uniform deformation of the rubber.
    - It is better to replace it to the spare one.
- The module will be re-intalled when it is neccesary.
  - Attachment tools for the rotation will be made in JFY2009 or later.
    - The magnet is positioned as Sks0 setup now. E10/E19/E18/E22



Run plan

- Basic studies and tuning of K1.8 beamline
  based on the studies of K1.8BR (upstream)
  - K^-(1.8GeV/c) optics : comparison with design
  - π(2.0, 1.2GeV/c) optimazation for the experiments
- Comissioning of SKS spectrometer
  - Measurement of $^{12}C(\pi^+,K^+)^{12}_{\Lambda}C$ @ 1.05GeV/c
    check resolution & efficiencies
    calibration of the field distribution, optics, etc.

  1 week data-taking & 1 month? analysis
- E19 ($\pi^-p \rightarrow K^- X$ @ 1.87, 1.92, 1.97 GeV/c)
  Liq H_2 target
  10^7 Hz with ~1s length 4s repetition 160hours
- E10 ((π^-,K^+)@1.2GeV/c on ^{6}Li & ^{9}Be)
  5MHz with 3s length ~6s repetition 3+3 weeks

How much intensity we can expect?

- $4x10^{11}$ ppp for 1 bunch in MR (**0.3kW** by 6s repetition)
  - ~$5x10^5$ pions in secondary beamline with Ni target
- Intenisity increase by **1.8kW or 9kW(equivalent)**
  - 6 bunches' operation x 6
  - Ni disk –> Pt target x1.7 [30%loss –> 50%]
    (x2~3) [A dep.]

  ~10^{13} ppp(MR equivalent) –> $1.2x10^7$ pions/spill
- Max. acceptable intensity is limited by detectors.
  - $5x10^6$ Hz
- 0.5s extraction length, 6s repetition (Case.A)
  - $2.4x10^7$ Hz too high, enough Acc. intensity
- 2s extraction length, 6s repetition (Case.B)
  - $6x10^6$ Hz desirable for us

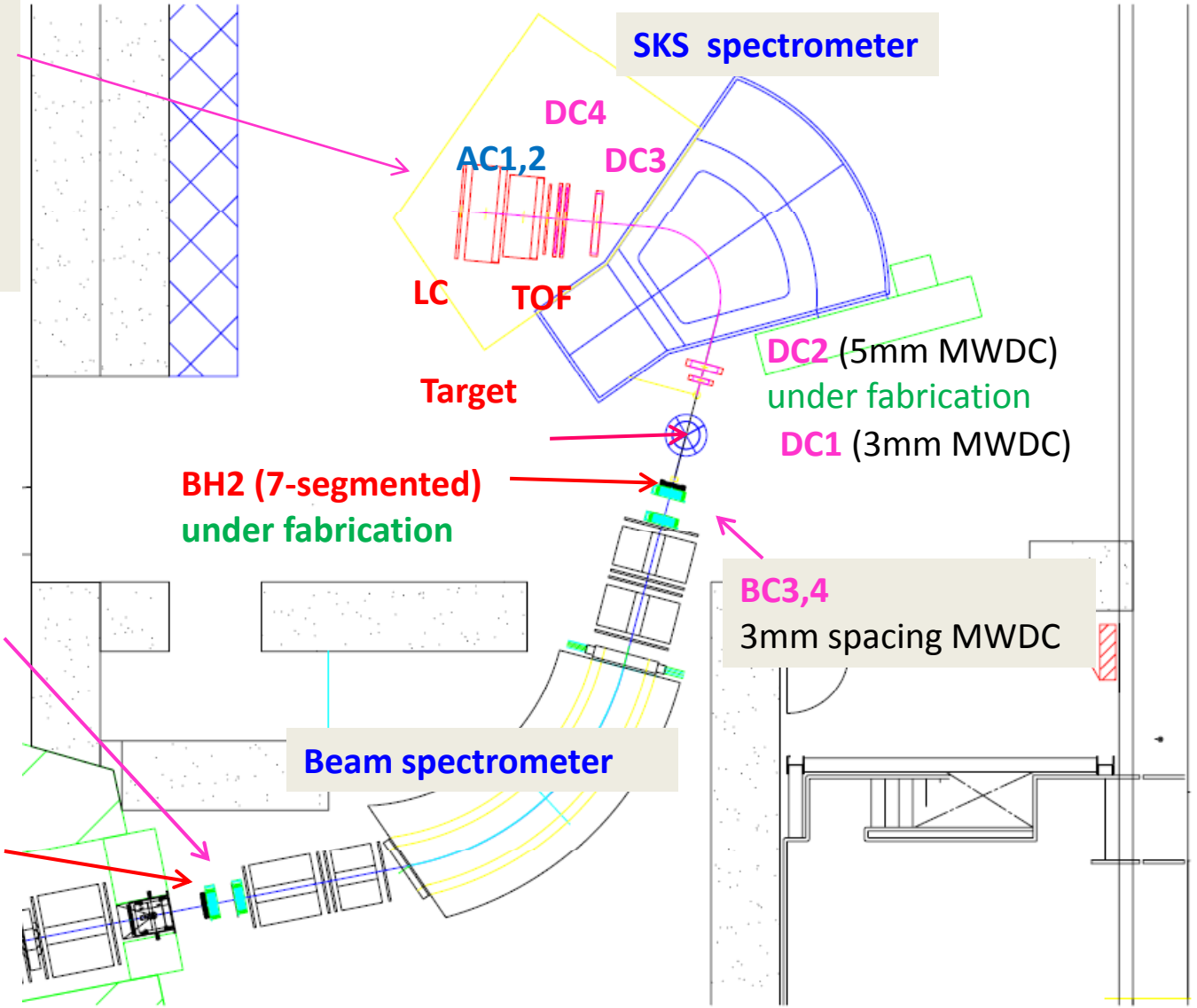
Time estimates (w/o commissioning)

E19	Original	Case A		Case B	
			factor		factor
Intensity [Hz]	10^7	$5x10^6$		$5x10^6$	
Ext. Length [s]	1	0.5		2.0	
Inten. [/spill]	10^7	$2.5x10^6$	1/4	10^7	1
Repetition [s]	4	6	2/3	6	2/3
Time	1 week	6 weeks		1.5 weeks	

E10	Original	Case A		Case B	
			factor		factor
Intensity [Hz]	$5x10^6$	$5x10^6$		$5x10^6$	
Ext. Length [s]	3	0.5		2.0	
Inten. [/spill]	$1.5x10^7$	$2.5x10^6$	1/6	10^7	2/3
Repetition [s]	6	6	1	6	1
Time [/target]	3weeks	18weeks		4.5weeks	

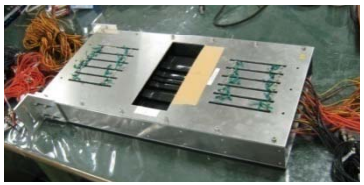
Detetor preparation status
– Setup for Sks0 –

Downstream counters
DC3,DC4
TOF wall
Aerogel Cherenkov
Lucite Cherenkov
Existing counters



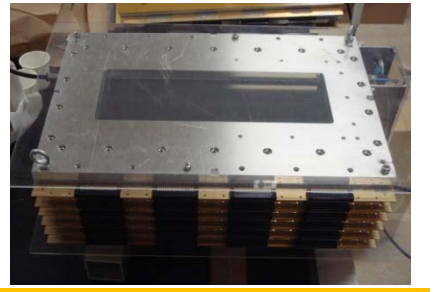
BC1,2
1mm spacing MWPC

BH1(11-segmented)



Detector preparation status
– MWPC & Readout –

MWPC
- 1mm spacing
- 3mm gap
- 256ch./plane
- 6 planes x 2
- x-u-v-x-u-v



Noise shields plates under preparation

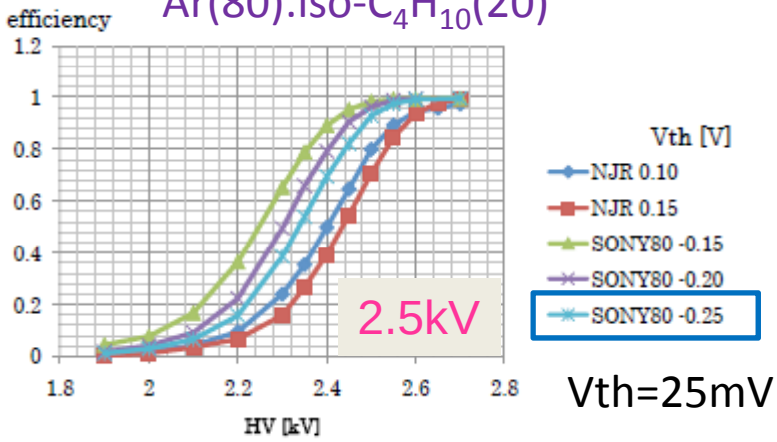
MWPC Encoder
- FINNESE card on COPPER System
- 100MHz sampling
- 128(256) depth

FPGA firmware updates are neccessary to match DAQ scheme.

ASD
- SONY(16ns)
- SONY(80ns)
- NJR

No difference between SONY 16ns and 80ns

Ar(80):iso-C_4H_{10}(20)



Vth=25mV

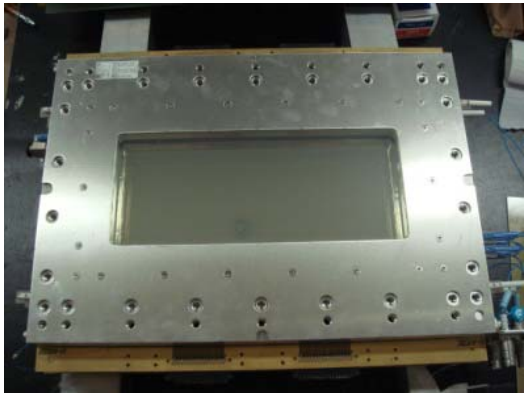
32ch. ASD board

ASD board for MWPC/MWPC are ready.

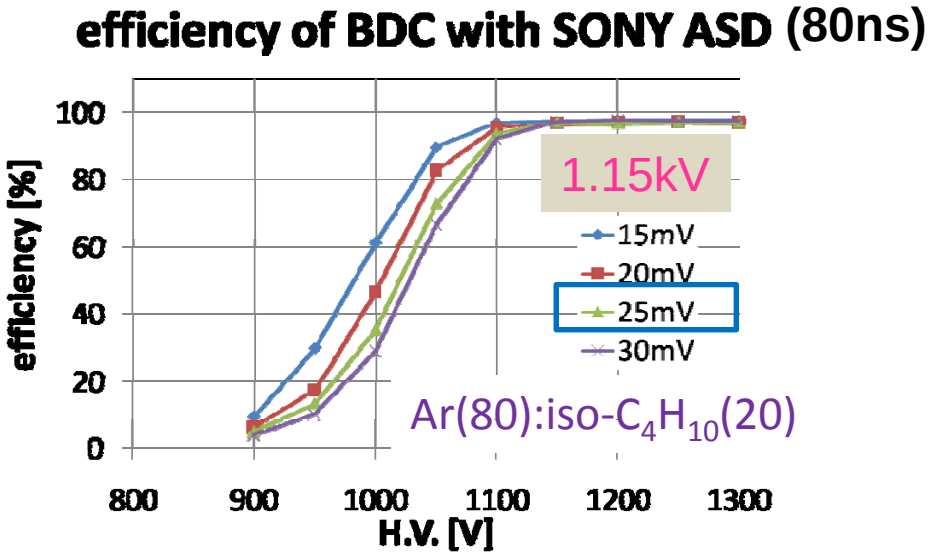
Detector preparation status
– MWDC –

BC3,4 and DC1

- 1.5mm anode-potential pitch
- 2mm wire-cathode gap
- 96ch./plane
- 6(x-x'-u-u'-v-v') for BC3,4
- 4(u-u'-v-v') for DC1



Mass-fabrication will be finished soon.



DC2 same as previously used DC

- 2.5mm anode-potential pitch
- 2.4mm wire-cathode gap
- 80ch./plane
- 6(x-x'-u-u'-v-v') planes

under fabrication

Summary

- SKS magnet will be ready by summer.
  - at Sks0 position
- Each detector will be ready to install by summer.
- Run plan
  - Study of the beamline and tuning
  - Data-taking for SKS calibration etc. $^{12}C(\pi^+,K^+)^{12}_{\Lambda}C$ @1.05GeV/c
  - E19 $H(\pi^-,K^-)X$ at 1.87, 1.92, 1.97 GeV/c
  - E10 $^{6}Li/^{9}Be(\pi^-,K^+)$ at 1.2 GeV/c
- Our experiments using pion beams can be performed with even 10kW beam power and output meaningful results.

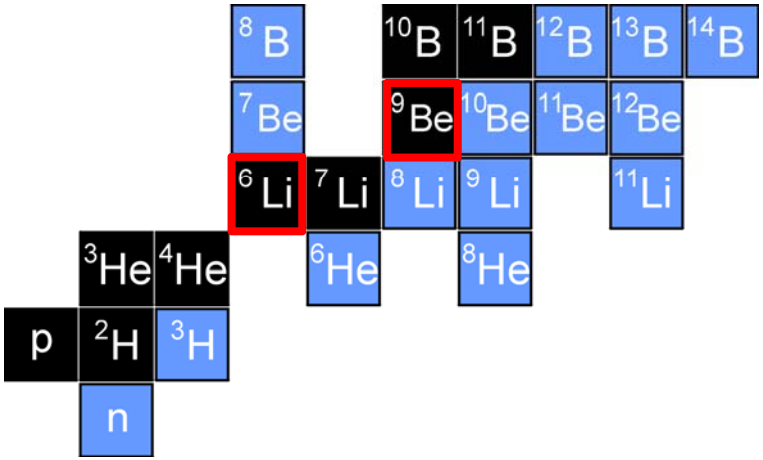
  However long extraction length of ~2 sec. is desirable.

backup

E10: Study on neutron-rich Λ hypernuclei

Produce N-rich Λ hypernuclei by DCX (π^-,K^+) reaction ~1.2GeV/c

Ordinary nuclei (target)

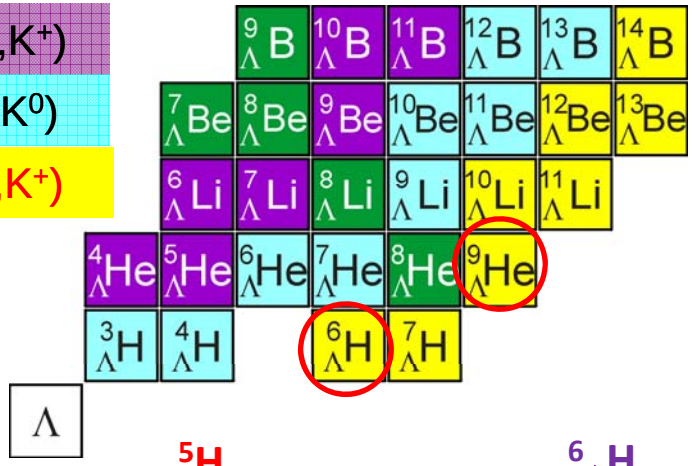


NCX: (K^-,π^-), (π^+,K^+)

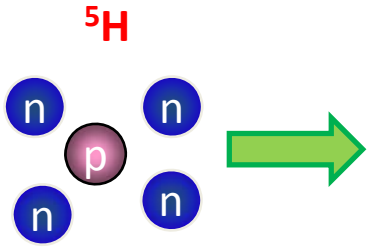
SCX: (K^-,π^0), (π^-,K^0)

DCX: (K^-,π^+), (π^-,K^+)

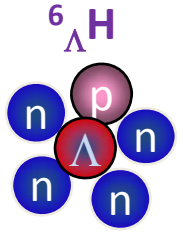
Λ hypernuclei



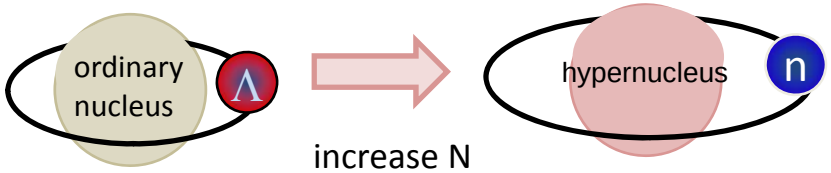
- **Glue-like role of Λ**
  - unbound (^{5}H) –> bound ($^6_\Lambda$H)
- **Change of the structure**
  - ordinary nucleus core + Λ
    –> hypernuclues + n halo
- **ΛN interaction in the n-rich environment**
  - core of neutron star
  - ΛN –> ΣN coupling effect



unbound

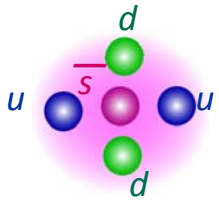


bound



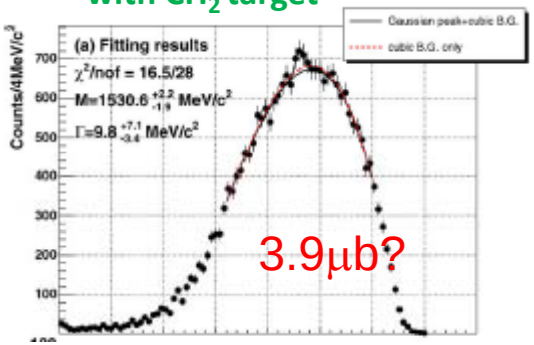
E19: Search for pentaquark, Θ^+, by $\pi^- p \rightarrow K^- X$ reaction ~2GeV/c

- Exotic five quark state $(qqqq\bar{q})$
  c.f. meson$(q\bar{q})$, baryon(qqq)



- Existence/No existence is not established yet.
  - Positive results at low energy
    LEPS, etc
  - Negative results at high energy
  - Acceptance is different . LEPS .vs. CLAS

KEK-PS E522
with CH_2 target

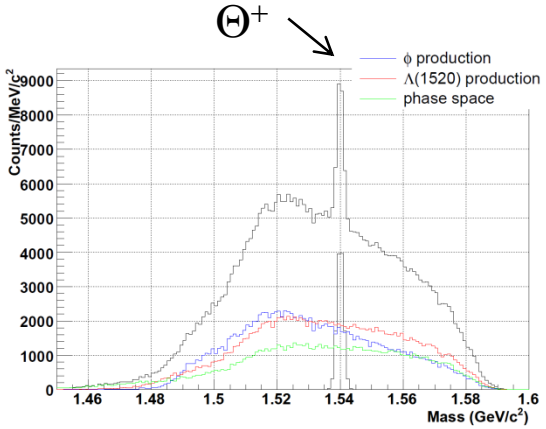


PLB635(2006)72

- Very narrow width. Why ?

Search for Θ^+ by hadronic reaction,
$\pi^- p \rightarrow K^- \Theta^+$ channel with Liq. H_2
high resolution of ~2MeV
high statistics of 62σ

Expected spectrum



1 week data-taking with 10^7/spill beam
based on KEK-E522 result