Jlab Hypernuclear Collaboration Meeting

22 July 2022

Introduction

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Current problems of Λ hypernuclei

New method to study nuclear shape $^{27}_{\Lambda}\mathrm{Mg}$

Hypertriton Puzzle

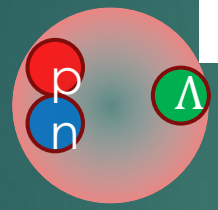
MAMI

JLab E12-19-002

Shallow bound
Short lifetime

J-PARC

ELPH

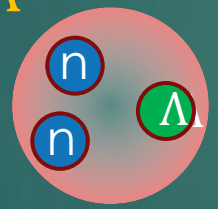


$^{3}_{\Lambda}n$ Puzzle

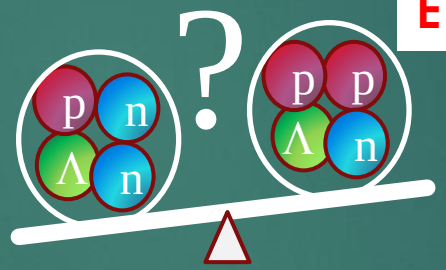
GSI

Bound?
Resonance?
Not Exist?

JLab E12-17-003



CSB of Λ Hypernuclei



JLab E12-15-008 E12-20-013

Hyperon Puzzle

Why massive NS exists?

Recent astronomical observations

$A=3$

10^{-15} m

$A\sim10^{57}$

10^{4} m

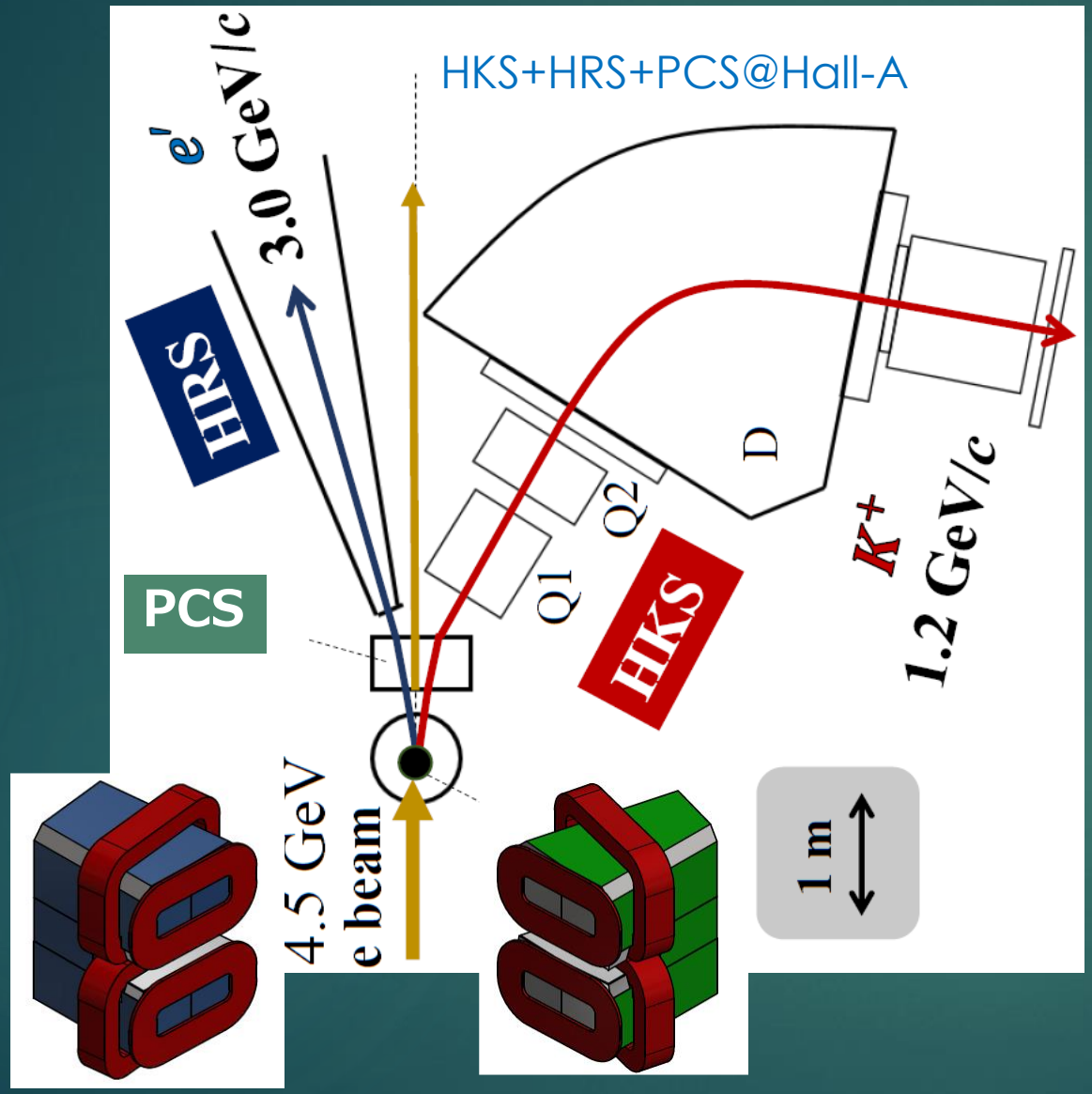
J-PARC HIHR

Isotopically enriched targets

110 mg, Φ1.27cm, 0.5mm thick (79 mg/cm^2)
^{40}Ca (99.96%) and ^{48}Ca (95.99%) targets at JLab.

	Li	C	Ca	Pb
Melting Point ($^\circ C$)	181	3642	**842**	323
Heat Cond. (W/(m*K))	85	120	**201**	35

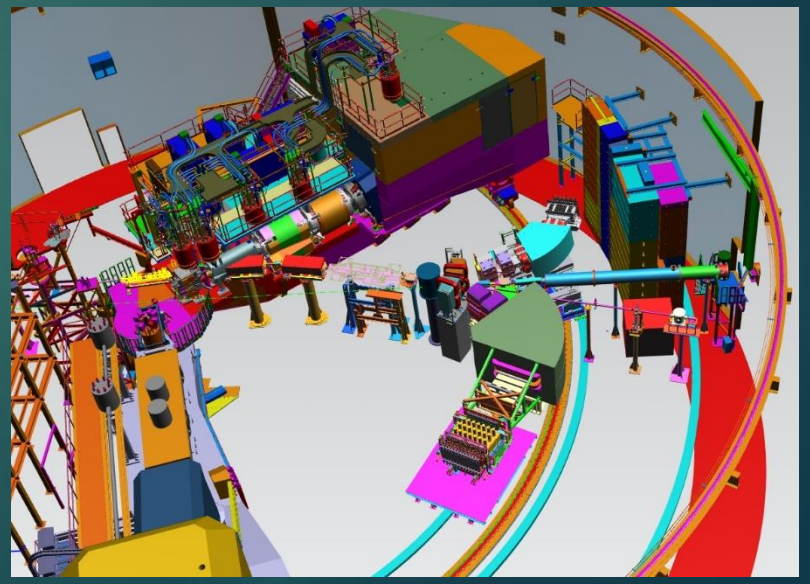
HKS + HES + PCS in Hall-A



2020/3/13 @ TOKIN (SENDAI)

New Pair Charge Sep. Mag.

HKS+HES+PCS@Hall-C



Originally Requested Beamtime in Hall A

	Beam Current (μA)	Target Thick (mg/cm²)	Beam Time (h) For 200ev.
${}^{40}_{\Lambda}K$	50	50	230
${}^{48}_{\Lambda}K$	50	50	278
${}^{208}_{\Lambda}Tl$	25	100	480
Calib.			147
Total			655+480
${}^{3}_{\Lambda}\mathrm{H}$	50	165	240
${}^{4}_{\Lambda}\mathrm{H}$	50	228	48
Calib.			60
Total			655+480+348

28 PAC days
20

14.5

Due to long queue at Hall-A, we decided to move to Hall-C.

Hall-A vs Hall-C

	Hall-A	Hall-C	Comments
e' Spectrometer	HRS	HES (V) or SHMS	HES needs mod. to vertical
K Spectrometer	HKS	HKS (H or V)	1.2 GeV/c
Beam Energy	4.23 GeV	2.34 GeV	
Resolution	○	◎ (HES) △ (SHMS)	
Yield	◎	○ (Vertical)	
S/N	◎	×	

To be discussed today

In order to arrange ERR at earliest possible occasion, what we should prepare?

Quick Monte-Carlo study shows the experiments in Hall-C is possible, but to overcome deteriorated S/N, we should reduce beam current.

How can we modify HES (or HKS) to be vertical bending spectrometer?
Detailed engineer design is necessary.

Design of target systems (cryogenic targets and solid targets)

Selection of calibration targets and radiation budget in experimental hall

Necessary PS and Water for magnets

Magnet	Power Supply	Water	Power Supply
HRS(L)	Standard equipment	-	-
HKS Q1	875A / 160V	0.57 MPa, 49.6 L/min	HKS Q
HKS Q2	450A / 54V	0.38 MPa, 17.3 L/min	HKS Q
HKS Dipole	1140A / 165V	Gap side: 0.32 MPa, 66.3 L/min Yoke side: 0.35 MPa, 68.8 L/min	HKS D
PCS (e') Main Coil Corr. Coil	1700A / 110V ※1 1000A / 100V ※2	0.16 MPa, 100 L/min ※3 0.16 MPa, 100 L/min ※3	SBS HES D
PCS (K) Main Coil Corr. Coil	1700A / 110V ※1 1000A / 100V ※2	0.16 MPa, 100 L/min ※3 0.16 MPa, 100 L/min ※3	SBS HES D

※1 Main Coils of PCS(e') and PCS(K) are series connection. Requirement of the voltage is double. Power supply for SBS (2250A / 290V) is a candidate.

※2 Correction Coils of PCS(e') and PCS(K) are series connection. Requirement of the voltage is double. Power supply for HES D (stored in ESB, 1100A / 250V) is a candidate.

※3 To be updated.

0.38 MPa, 220 L/min & 0.16 MPa, 400 L/min water is necessary in total ??

S Nagao (2020)

Detailed Simulation				
HKS, HES or SHMS	Modification to V bend Stands			
	Detector Commissioning	Check for V. Option	DC, WC	
	Vacuum systems			
Target	Holder, Ladder Cryo. Target Design Collimator, SS Viewer			
Radiation Budget				
DAQ				
PCS	Stand design Vacuum PS, Cooling Water			