

# Discussion for hypernuclear experiment with Pb target

Franco, Guido, **Toshi**

October 4, 2021

20:00—21:00 JST

# Summary table (yield and resolution)

D0	e' ( $\theta$ 、 $\Omega$ 、dp)	K <sup>+</sup> ( $\theta_{\gamma K}$ 、 $\Omega$ 、 $f_K$ )	$\Gamma$ (/10 <sup>-5</sup> )	$\Delta E_{\Lambda}$ FWHM (/ MeV)	Yield per hour <sup>12</sup> C, 0.1 g/cm <sup>2</sup> , 100 nb/sr, 30 $\mu$ A
SPL	HES (5°、7 msr、17.5%)	HKS (7°、8 msr、0.3)	5.7	0.4 + opt.	32
PCS	HES (6°、5 msr、17.5%)	HKS (0°、7 msr、0.25)	2.8		12
PCS	SHMS (6°、1.5 msr、40%)	HKS (0°、7 msr、0.25)	1.9	0.9 + opt.	8
-	SHMS (6°、2.0 msr、40%)	PCS+HKS (0°、7 msr、0.25)			10

e: 2.344 GeV, e': 0.844 GeV/c, K+: 1.2 GeV/c  
Efficiency = 0.7

# Yield per day (Hall C) @ $20 \mu A$

Areal density of target =  $100 \text{ mg/cm}^2$

Configuration	$\Delta E_{\Lambda}$ (# of events needed for $\Delta B_{\Lambda}^{\text{stat.}} = 20 \text{ keV}$ )	${}^3\text{He} \rightarrow {}^3_{\Lambda}\text{H}$ 5 nb/sr	${}^{12}\text{C} \rightarrow {}^{12}_{\Lambda}\text{B}$ 100 nb/sr	${}^{40}\text{Ca} \rightarrow {}^{40}_{\Lambda}\text{K}$ 50 nb/sr	${}^{208}\text{Pb} \rightarrow {}^{208}_{\Lambda}\text{Tl}$ 20 nb/sr
SPL+(HES+HKS)	<b>0.5</b> <b>(113)</b>	51.8 (2.2 day)	518	78.8 (1.4 days)	5.95 (19 days)
PCS+(HES+HKS)		18.6 (6.1 days)	186	27.9 (4.1 days)	2.13 (53 days)
SHMS+(PCS+HKS)	<b>1.0</b> <b>(451)</b>	12.6 (36 days)	126	18.9 (24 days)	1.45 (311 days)

Efficiency = 0.7  
Gas reduc. = 0.5

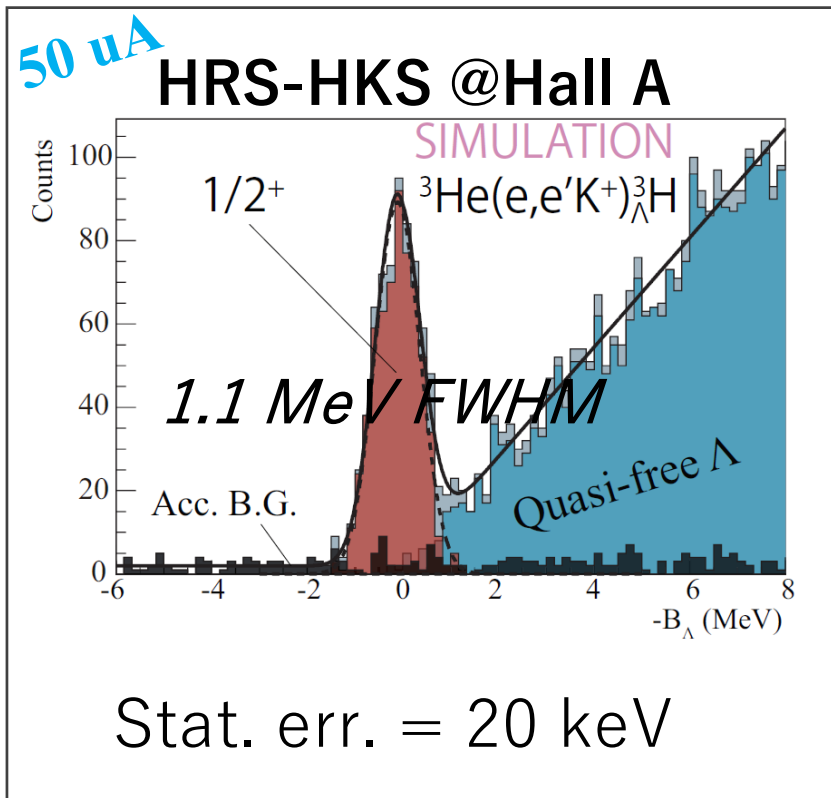
In case of  $\Delta B_{\Lambda}^{\text{stat.}} = 50 \text{ keV}$ :  
0.5 MeV FWHM  $\rightarrow$  18 counts  
1.0 MeV FWHM  $\rightarrow$  72 counts

*Not only yield and resolution, but also S/N needs to be studied*  
 $\leftarrow$  *S/N would be reasonable if the HKS-vacuum extension is modified*

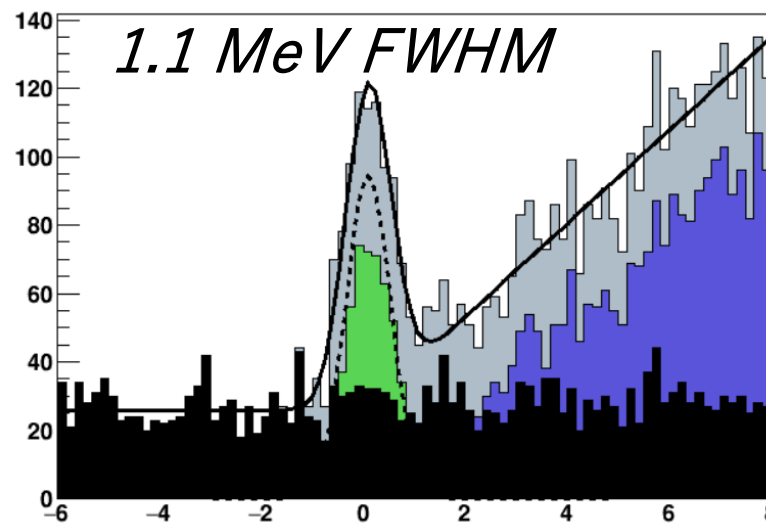
# Signal to noise ratio in the case of Hall C

- ✓ HES-HKS; w/o e+e- background in HKS
- ✓ (HES rate = 2.5 MHz @8uA,  $^{52}\text{Cr}$  → ) HES rate @20uA →
  - 2.2 MHz ( $^3\text{He}$ , 190+162 mg/cm $^2$ ) → coin = 1.5 kHz
  - 3.6 MHz ( $^{40}\text{Ca}$ , 100 mg/cm $^2$ ) → coin = 1.3 kHz
  - 55.7 MHz ( $^{208}\text{Pb}$ , 100 mg/cm $^2$ ) → coin = **18.4 kHz**

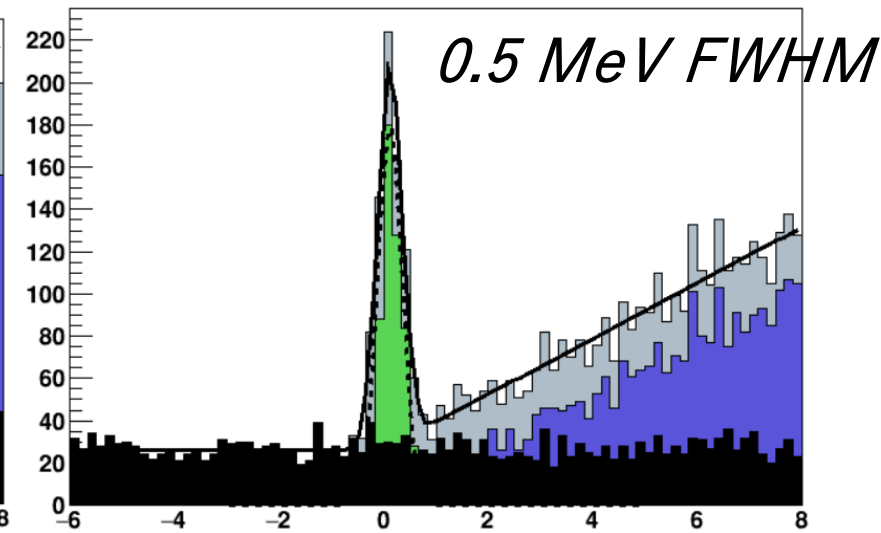
One of solutions:  
➤ 1/3 of beam intensity  
➤ 3 times longer beamtime



### S/N: HES-HKS @Hall C, 20 uA



Stat. err. < 30 keV



Stat. err. < 20 keV

Toshiyuki Gogami <goga.don25@gmail.com>

# Pb-208, Ca-40 and Ca-48

Toshiyuki Gogami <gogami.toshiyuki.4a@kyoto-u.ac.jp> Thu, Sep 30, 2021 at 9:56 AM

To: Franco Garibaldi <franco.garibaldi7@gmail.com>, Guido Maria Urciuoli <guido.maria.Urciuoli@roma1.infn.it>

Hi Franco,

I scaled to estimate the number of estimated events for the lead target from the  $A = 3$  estimation as follows:

Thickness 100./165. \*

Cross section 80./5. \*

The mass number 3./209 \*

Beam intensity 25./50. \*

No gas density reduction for Pb 1./0.5 \*

Yield per day for 3H\_L 60. \*

The number of days for Pb 20.

-->  $100./165. * 80./5. * 3./209 * 25./50. * 1./0.5 * 60. * 20. = 167 \text{ counts for 480 hours on Pb}$

I took the cross section from your proposal:

[https://www.jlab.org/exp\\_prog/proposals/20/PR12-20-013\\_Proposal.pdf](https://www.jlab.org/exp_prog/proposals/20/PR12-20-013_Proposal.pdf)

which is 80 nb/sr for the ground state.

The yield is more or less consistent with the proposal value (145 counts for 480 hours).

If the cross section and the beam current are changed to 22 nb/sr and 20 uA,

the number of events becomes **36 counts for 480-hour beam on Pb.**

Regards,

Toshi

[Quoted text

# Pb-208, Ca-40 and Ca-48

Toshiyuki Gogami <gogami.toshiyuki.4a@kyoto-u.ac.jp>

Thu, Sep 30, 2021 at 7:45 PM

To: Franco Garibaldi <franco.garibaldi7@gmail.com>

Cc: Toshiyuki Gogami <gogami.toshiyuki.4a@kyoto-u.ac.jp>, Guido Maria Urciuoli <guido.maria.Urciuoli@roma1.infn.it>

Hi Franco,

The same way applied and the yield for 48K\_L is expected as follows:

$100./165. * 50./5. * 3./48. * 20./50. * 1./0.5 * 60. * 278./24. = 210$  counts for 278 hours on 48Ca.

The ground-state cross section predicted by Umeya and Motoba recently is about 50 (could be >70 if the excited doublet state is included), and used for this calculation.

Regards,  
Toshi