STRATEGY MEETING (JLAB HYPERNUCLEAR EXPERIMENT)

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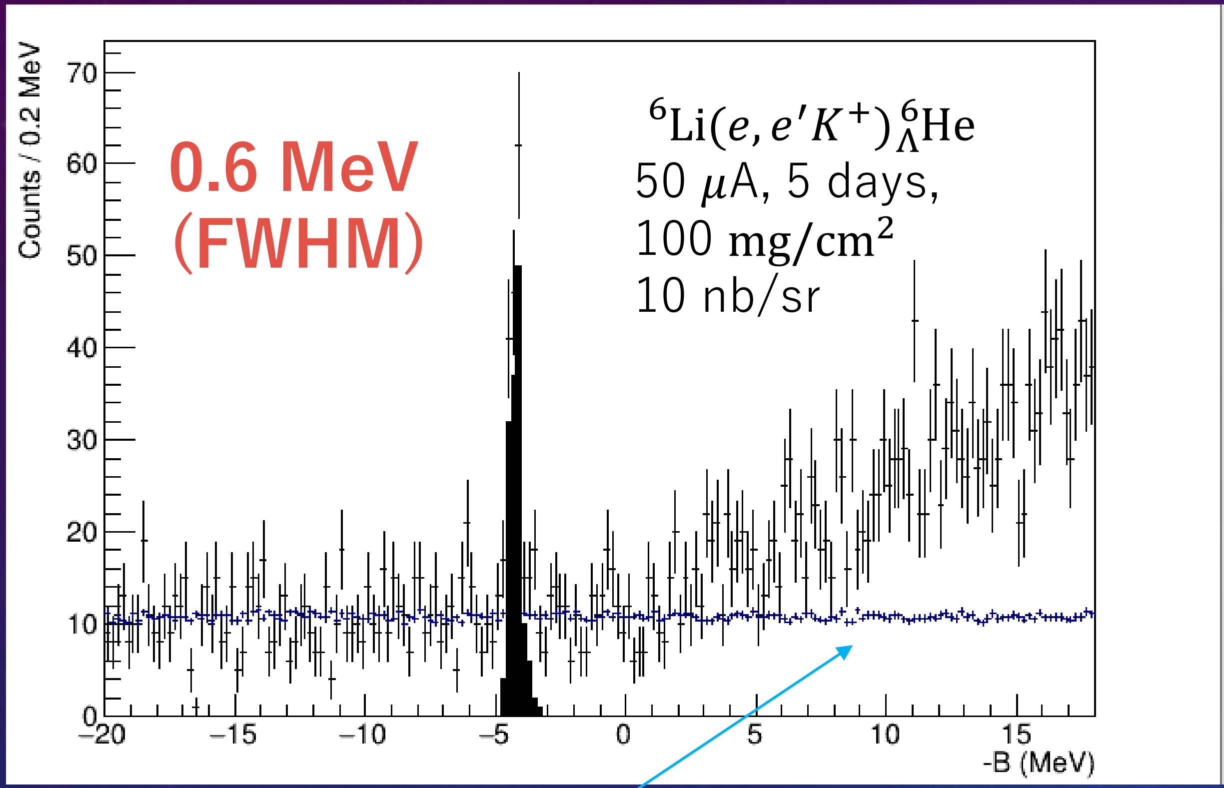
Update (50 μA, 100 mg/cm^2)

- □ $^{6}_{\Lambda}\mathrm{He}$
- □ $^{9}_{\Lambda}\mathrm{Li}$
- □ $^{11}_{\Lambda}\mathrm{Be}$

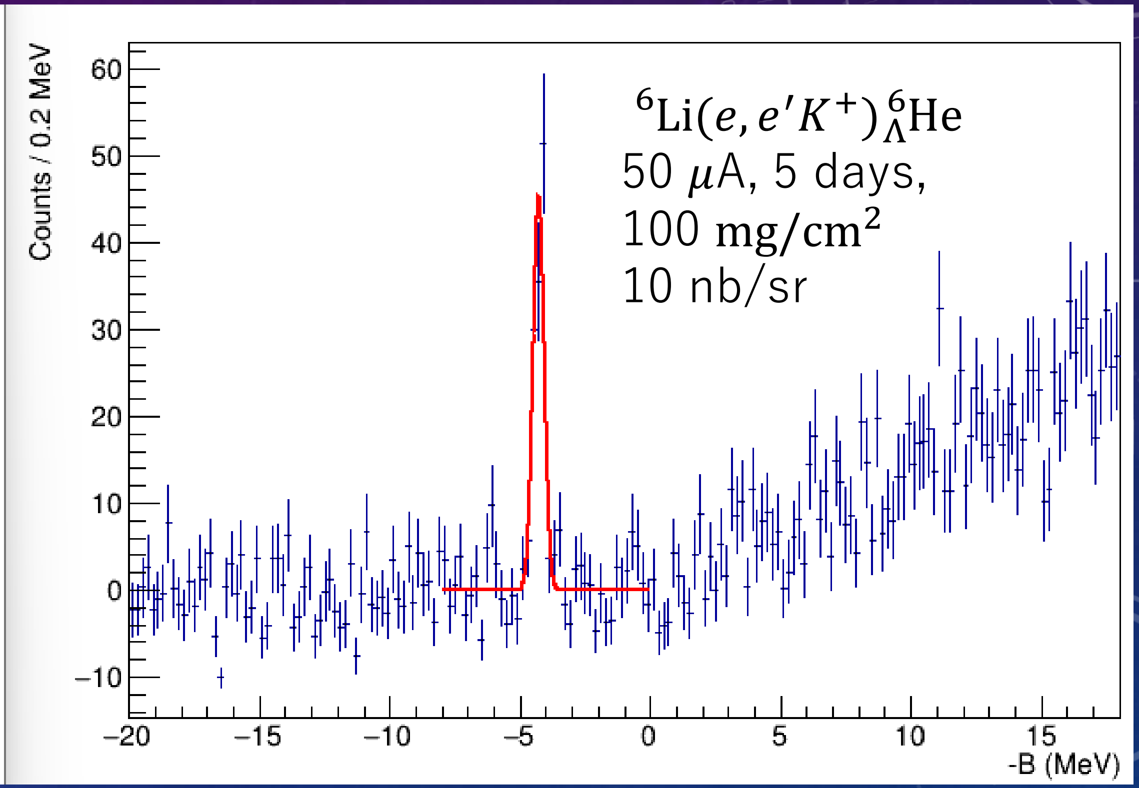
} 4 + 8 + 2 = **14 PAC days**

⇨ To complete CSB data set in p-shell

Expected spectrum for the $^{6}\mathrm{Li}(e,e'K^{+})^{6}_{\Lambda}\mathrm{He}$ reaction

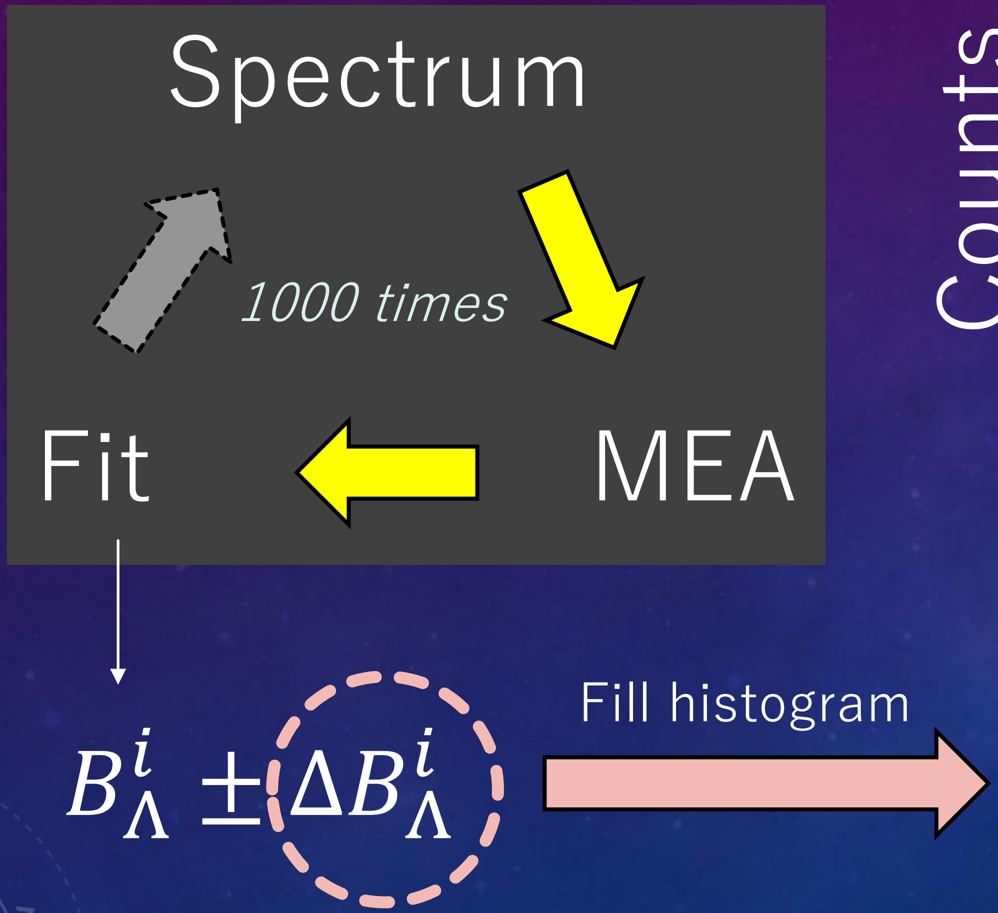


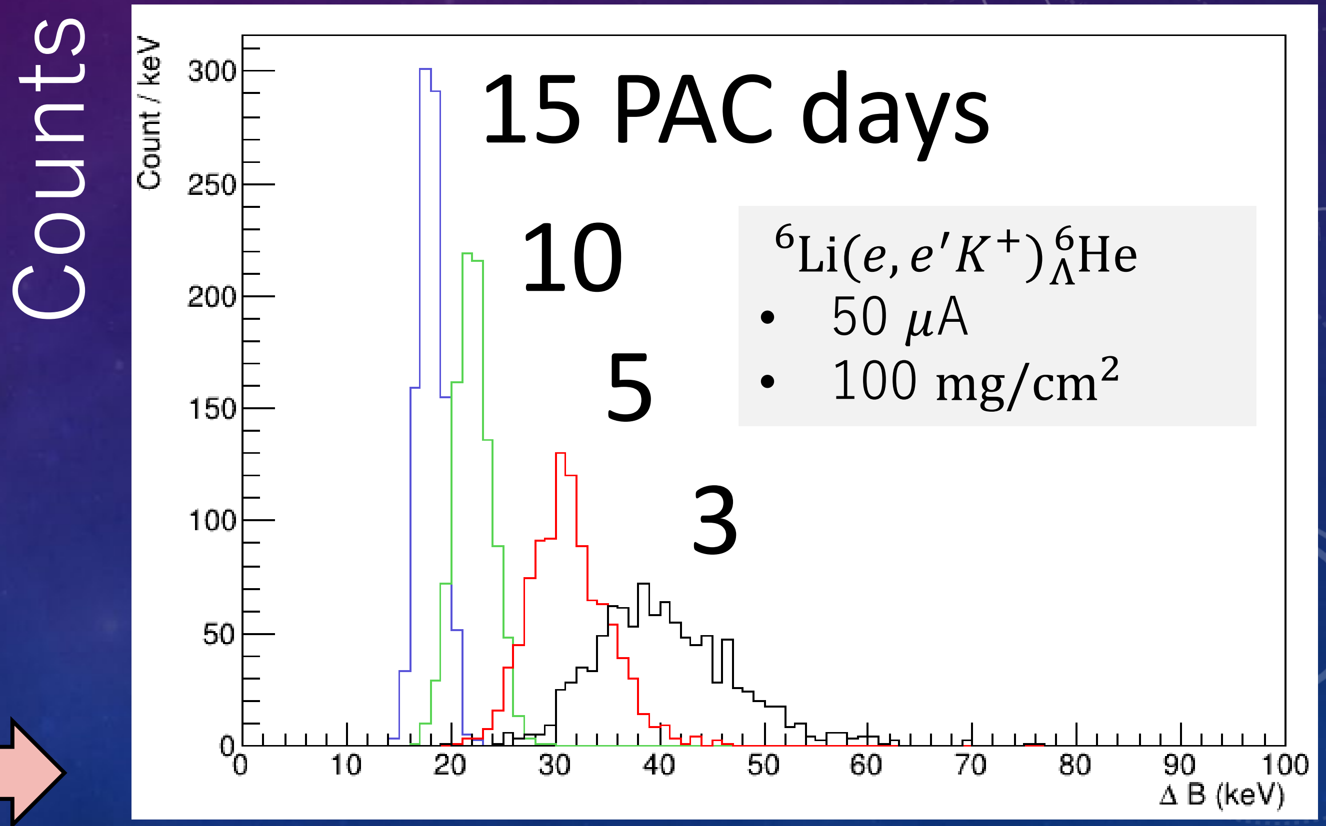
BG shape from Mixed Event Analysis (MEA)



Spectrum after MEA BG was subtracted
→ Fitting

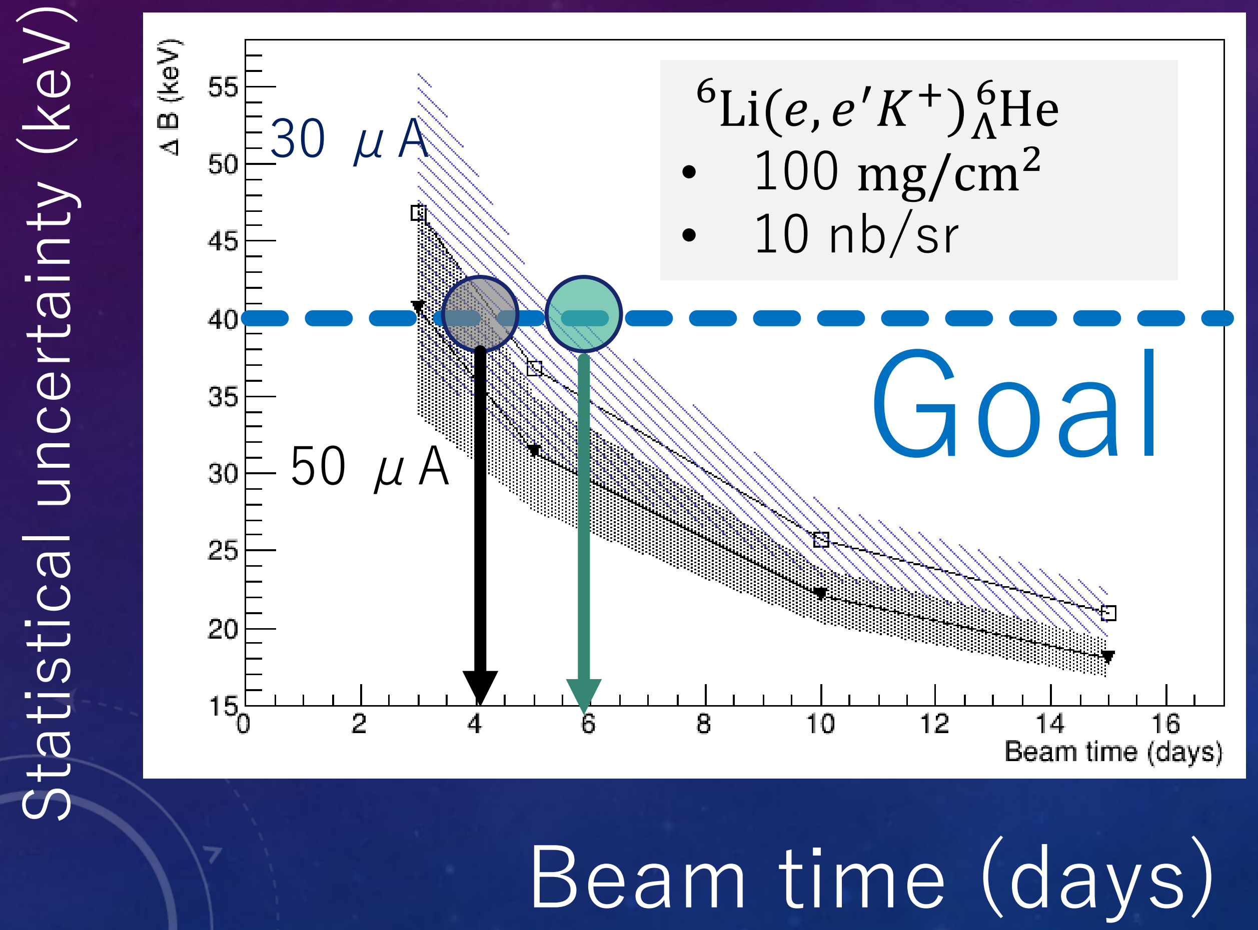
Statistical error simulation : ${}^{6}\mathrm{Li}(e,e'K^{+}){}^{6}_{\Lambda}\mathrm{He}$





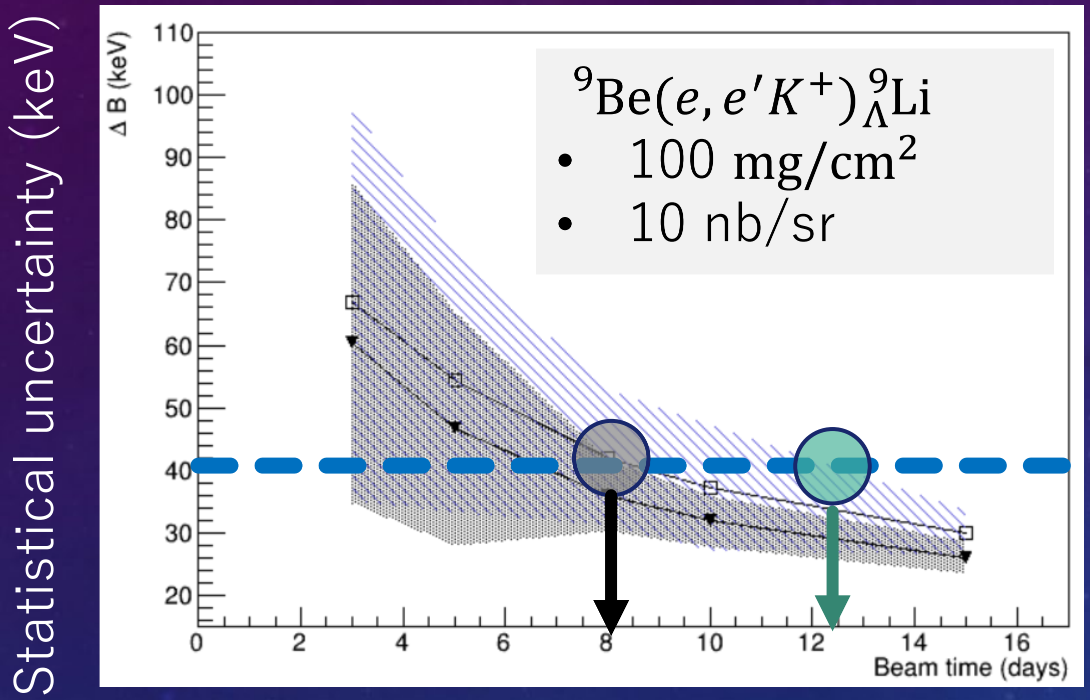
ΔB_{Λ} Statistical uncertainty (keV)

Necessary beam time to achieve the goal: $^{6}\mathrm{Li}(e,e'K^{+})^{6}_{\Lambda}\mathrm{He}$

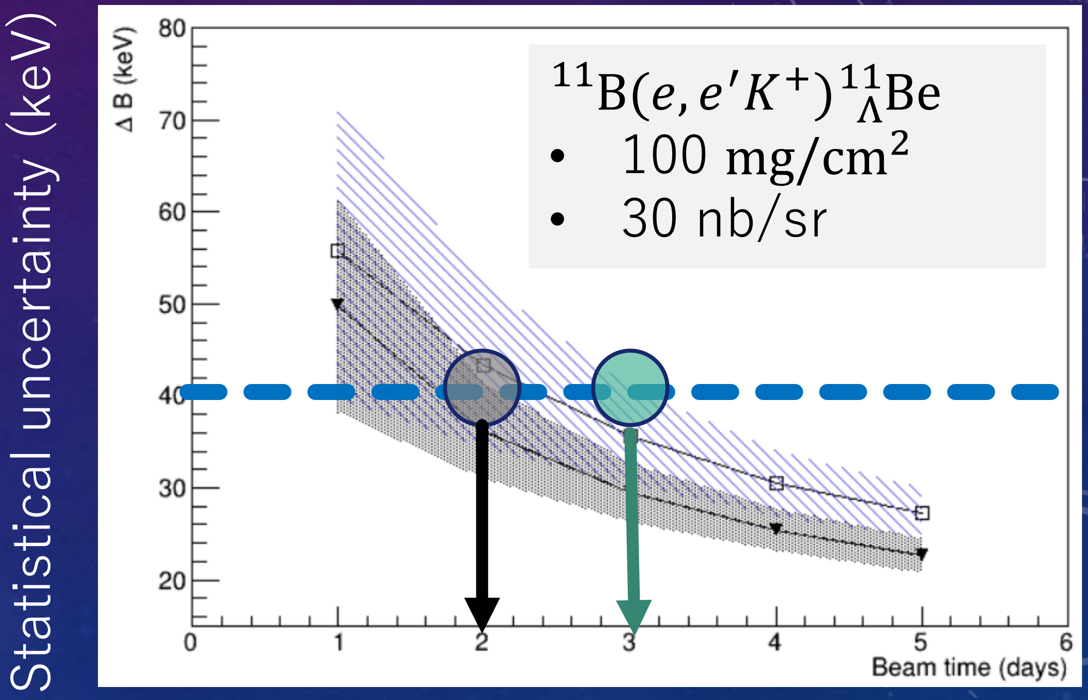


Goal = 40 keV of statistical error
→4 days with 50 uA
→6 days with 30 uA

Necessary beam time to achieve the goal: $^{9}\mathrm{Be}(e,e'K^{+})^{9}_{\Lambda}\mathrm{Li}$ and $^{11}\mathrm{B}(e,e'K^{+})^{11}_{\Lambda}\mathrm{Be}$

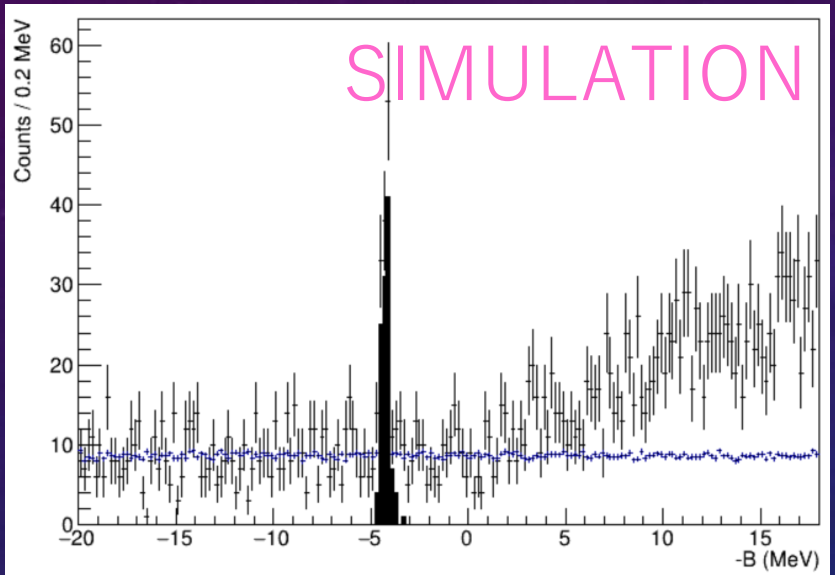


→8 days with 50 uA
→12.5 days with 30 uA

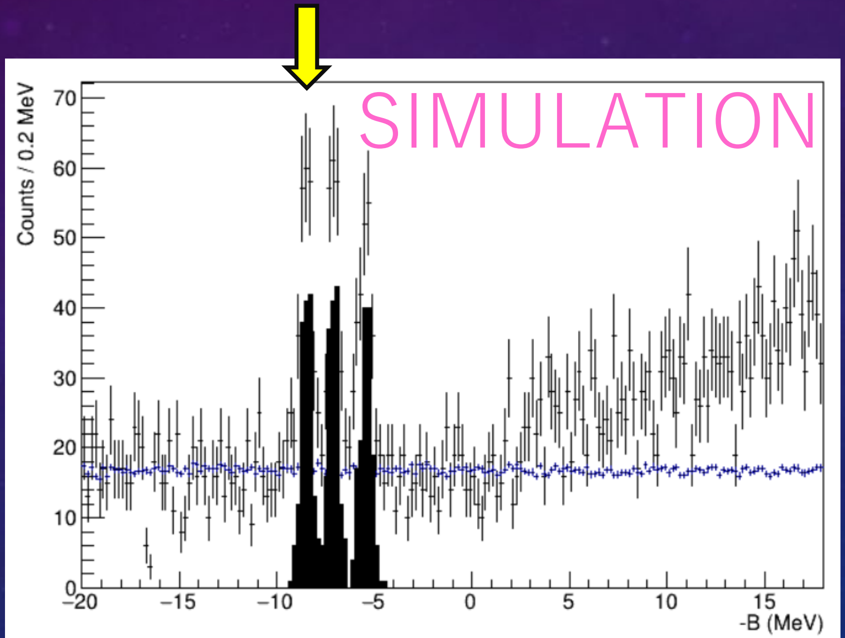


→2 days with 50 uA
→3 days with 30 uA

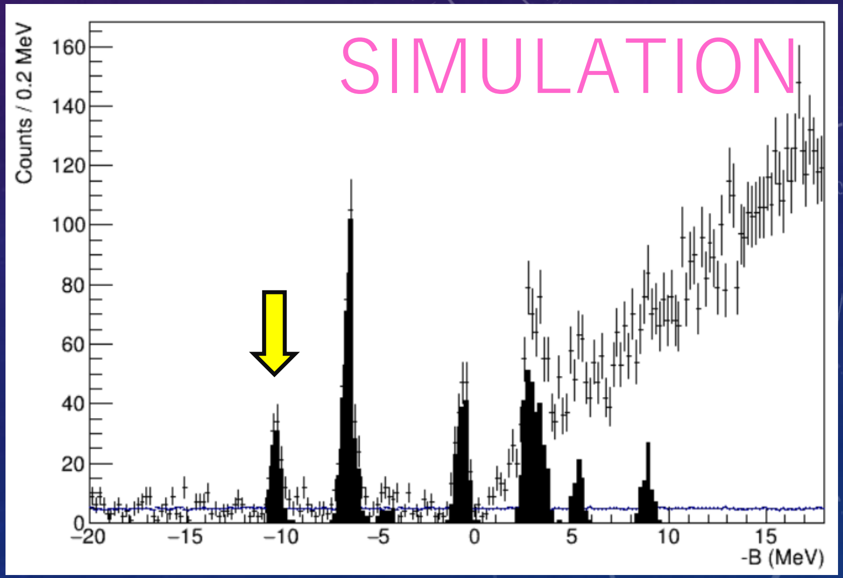
Expected spectra (50 μA, 100 mg/cm^2) for the goal $\Delta B_{\Lambda}^{\text{stat.}} \simeq 40$ keV



$^{6}\text{Li}(e,e'K^{+})^{6}_{\Lambda}\text{He}$
- 10 nb/sr
- **4 days**



$^{9}\text{Be}(e,e'K^{+})^{9}_{\Lambda}\text{Li}$
- 10 nb/sr
- **8 days**



$^{11}\text{B}(e,e'K^{+})^{11}_{\Lambda}\text{Be}$
- 30 nb/sr
- **2 days**

Accidental coincidence rate

Beam current (/μA)	Target [/(mg/cm^2)]		Rate (/kHz)				
			HES	HKS			Coincidence btw
			e'	K^+	π^+	p	HES and HKS
50	^{6}Li	100	140	0.27	22	28	1.9
	^{9}Be		160	0.26	21	27	2.2
	^{10}B		200	0.25	21	26	1.8
30	^{6}Li	100	86	0.16	13	17	0.4
	^{9}Be		96	0.15	13	16	0.6
	^{10}B		120	0.15	12	16	0.5

K^+: 200 ns
e': 30 ns

Cherenkov counters may not be needed for trigger

Summary (50 μA, 100 mg/cm^2)

- ☐ ${}^{6}_{\Lambda}\mathrm{He}$
- ☐ ${}^{9}_{\Lambda}\mathrm{Li}$
- ☐ ${}^{11}_{\Lambda}\mathrm{Be}$

} $4 + 8 + 2 =$ **14 PAC days**

➡ To complete CSB data set in p-shell

Documentation will be started

BACKUP

DATA TO INVESTIGATE ΛN CSB

Shell	Hypernuclei		
s	${}^{4}_{\Lambda}\mathrm{H}\ (0^+)$		${}^{4}_{\Lambda}\mathrm{He}\ (0^+)$
	${}^{4}_{\Lambda}\mathrm{H}\ (1^+)$		${}^{4}_{\Lambda}\mathrm{He}\ (1^+)$
p	${}^{6}_{\Lambda}\mathrm{He}\ (\alpha + \mathbf{n} + \mathbf{\Lambda})$		${}^{6}_{\Lambda}\mathrm{Li}\ (\alpha + \mathbf{p} + \mathbf{\Lambda})$
	${}^{7}_{\Lambda}\mathrm{He}\ (\alpha + \mathbf{n} + \boldsymbol{n} + \boldsymbol{\Lambda})$	${}^{7}_{\Lambda}\mathrm{Li}^*\ (\alpha + \mathbf{n} + \mathbf{p} + \mathbf{\Lambda})$	${}^{7}_{\Lambda}\mathrm{Be}\ (\alpha + \mathbf{p} + \mathbf{p} + \mathbf{\Lambda})$
	${}^{8}_{\Lambda}\mathrm{Li}\ (\alpha + d + \mathbf{n} + \mathbf{\Lambda})$		${}^{8}_{\Lambda}\mathrm{Be}\ (\alpha + d + \mathbf{p} + \mathbf{\Lambda})$
	${}^{9}_{\Lambda}\mathrm{Li}\ (\alpha + \mathrm{d} + \mathbf{n} + \mathbf{n} + \boldsymbol{\Lambda})$	${}^{9}_{\Lambda}\mathrm{Be}\ (\alpha + \mathrm{d} + \mathbf{n} + \boldsymbol{p} + \boldsymbol{\Lambda})$	${}^{9}_{\Lambda}\mathrm{B}\ (\alpha + \mathrm{d} + \mathbf{p} + \mathbf{p} + \boldsymbol{\Lambda})$
	${}^{10}_{\Lambda}\mathrm{Be}\ (\alpha + \alpha + \mathbf{n} + \mathbf{\Lambda})$		${}^{10}_{\Lambda}\mathrm{B}\ (\alpha + \alpha + \mathbf{p} + \mathbf{\Lambda})$
	${}^{11}_{\Lambda}\mathrm{Be}\ (\alpha + \alpha + \mathbf{n} + \mathbf{n} + \mathbf{\Lambda})$	${}^{11}_{\Lambda}\mathrm{B}\ (\alpha + \alpha + \mathbf{p} + \mathbf{n} + \mathbf{\Lambda})$	${}^{11}_{\Lambda}\mathrm{C}\ (\alpha + \alpha + p + \mathbf{p} + \mathbf{\Lambda})$
	${}^{12}_{\Lambda}\mathrm{B}\ (\alpha + \alpha + d + \mathbf{n} + \mathbf{\Lambda})$		${}^{12}_{\Lambda}\mathrm{C}\ (\alpha + \alpha + d + \mathbf{p} + \mathbf{\Lambda})$

DATA TO INVESTIGATE Λ CSB

Shell	Hypernuclei		
s	Emulsion / MAMI		Emulsion
s	Emulsion + γ		Emulsion + γ
p	Not accurate		No data
p	JLab	Emulsion + γ	Emulsion
p	Emulsion		Emulsion
p	Not accurate	Emulsion	Not accurate
p	JLab		Not accurate
p	No data	Emulsion	No data
p	JLab		Shift Problem

CSB study

DATA TO INVESTIGATE ΛN CSB

Shell	Hypernuclei		
s	Emulsion / MAMI		Emulsion
	JLab E12-19-002		Emulsion + γ
p	JLab (New)		No data
	JLab	Emulsion + γ	Emulsion
	Emulsion		Emulsion
	JLab (New)	Emulsion	Not accurate
	JLab		Not accurate
	JLab (New)	Emulsion	No data
	JLab		Shift Problem

CSB study

DATA TO INVESTIGATE ΛN CSB

Shell	Hypernuclei		
s	Emulsion / MAMI		Emulsion
	JLab E12-19-002		Emulsion + γ
p	JLab (New)		J-PARC (plan)
	JLab	Emulsion + γ	Emulsion
	Emulsion		Emulsion
	JLab (New)	Emulsion	Not accurate
	JLab		J-PARC E94
	JLab (New)	J-PARC (plan)	No data
	JLab		J-PARC E94

CSB study

TABLE IV. Contributions to CSB in the $A = 7$ and 8 isospin multiplets, based on the YN potentials NLO13(500) and NLO19(500) (including 3N forces and SRG-induced YNN interactions). The results are for the original potentials (without CSB force) and for the scenario CSB1, see text. Results by Gal [37] and by Hiyama *et al.* [13] are included for the ease of comparison. All energies are in keV. The estimated uncertainties for $A = 7$ and 8 systems are 30 and 50 keV, respectively.

		ΔT	ΔV_{NN}	ΔV_{YN}			ΔB_Λ
				$^1S_0$	$^3S_1$	Total	
	NLO13	7	−24	−1	0	0	−17
	NLO13-CSB	8	−24	−49	26	−24	−40
	NLO19	6	−40	−1	0	0	−34
$^7_\Lambda$Be - $^7_\Lambda$Li*	NLO19-CSB	6	−41	−43	42	9	−35
	Hiyama [13]		−70			200	150
	Gal [37]	3	−70			50	−17
	Experiment [6]						−100 ± 90
	NLO13	8	−13	0	0	0	−5
	NLO13-CSB	7	−14	−49	26	−24	−31
	NLO19	5	−22	−43	42	0	−17
$^7_\Lambda$Li* - $^7_\Lambda$He	NLO19-CSB	5	−21	−38	37	−1	−16
	Hiyama [13]		−80			200	130
	Gal [38]	2	−80			50	−28
	Experiment [6]						−20 ± 230[a] −50 ± 190
	NLO13	12	8	−2	0	−4	16
	NLO13-CSB	12	7	100	56	159	178
	NLO19	7	−11	−1	0	−2	−6
$^8_\Lambda$Be - $^8_\Lambda$Li	NLO19-CSB	6	−11	62	79	147	143
	Hiyama [13]		40				160
	Gal [37]	11	−81			119	49
	Experiment [4]						40 ± 60

[a]The difference between $B_\Lambda(^7_\Lambda\text{Li}^*)$ and $B_\Lambda(^7_\Lambda\text{He})$ is −20 ± 230 keV for the FINUDA and JLab results, but −50 ± 190 keV when the revised SKS and JLab results are used [6].

NCSM

Cluster + Phenom. CSB

Shell model + eff. ΛΣ coup.

Hoai Le et al., Phys. Rev. C 107, 024002 (2023)

https://doi.org/10.1103/PhysRevC.107.024002

https://docs.google.com/spreadsheets/d/18GEnIWgMTDtWNbbDInGvp9WjeGrG-XeFp1jVcL0nBys/edit#gid=2056335386

	Inputs								Results									
	Beam		Target		e'	K	Efficienciy											
Title	Setting	Current (μA)	Name	t (mg /cm2)	Spectrometer	Spectrometer	Efficienciy	day	e' rate (Hz)	pi rate (Hz)	K rate (Hz)	p rate (Hz)	K trig rate (Hz)	Coin rate (Hz)	Hyper Yield	BG Height (Counts/ 0.3MeV)	S/N (3sigma)	Significance (3sigma)
1.33252242	1-pass	20	Pb208	100	PCS+HES(H) 8deg	PCS+HKS(H)	Setting 1	60.00	900,000	5,500	66	6,900	920	59	290	151.1	0.4	9.0
	1-pass	20	Pb208	100	PCS+HES(H) 10deg	PCS+HKS(H)	Setting 1	60.00	370,000	5,500	66	6,900	920	24	180	62.2	0.6	8.2
	1-pass	20	Pb208	100	PCS+HES(H) 12deg	PCS+HKS(H)	Setting 1	60.00	180,000	5,500	66	6,900	920	12	120	30.2	0.8	7.4
	1-pass	50	Li6	100	PCS+HES(H) 8deg	PCS+HKS(H)	Setting 1	3.00	140,000	22,000	270	28,000	3,800	39	85	9.7	1.7	7.3
	1-pass	50	Be9	100	PCS+HES(H) 8deg	PCS+HKS(H)	Setting 1	10.00	160,000	21,000	260	27,000	3,600	41	31	31.5	0.9	8.2
	1-pass	50	B11	100	PCS+HES(H) 8deg	PCS+HKS(H)	Setting 1	2.00	200,000	21,000	250	26,000	3,500	49	93	7.2	0.8	3.7
	1-pass	30	Li6	100	PCS+HES(H) 8deg	PCS+HKS(H)	Setting 1	5.00	86,000	13,000	160	17,000	2,300	14	85	5.8	2.8	7.9
	1-pass	30	Be9	100	PCS+HES(H) 8deg	PCS+HKS(H)	Setting 1	16.67	96,000	13,000	150	16,000	2,100	15	31	18.9	1.5	9.2
	1-pass	30	B11	100	PCS+HES(H) 8deg	PCS+HKS(H)	Setting 1	3.33	120,000	12,000	150	16,000	2,100	18	93	4.3	1.4	4.2
																0.0		