

E73 status report

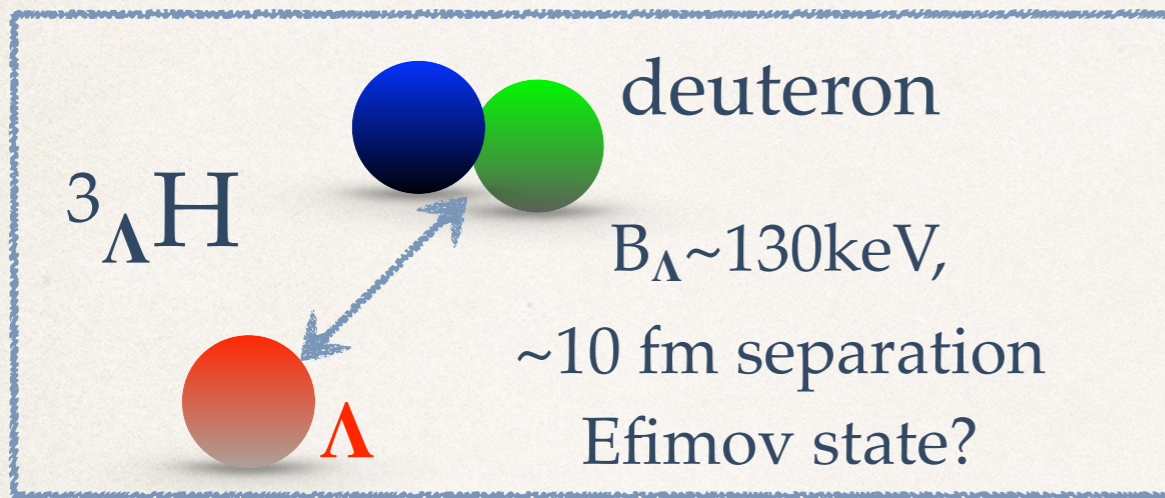
toward Stage-2 approval

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Motivation of E73 experiment



Up to a few years ago, we believe:
 $\tau \approx 263 \text{ ps}$ ($B_{\Lambda} = 130 \pm 50 \text{ keV}$);
 However, heavy ion experiments
 suggest $\tau \approx 180 \text{ ps} \dots$

Collaboration	Experimental method	${}^3_{\Lambda}\text{H}$ lifetime [ps]	Release date
STAR	Au collider	$142^{+24}_{-21}(\text{stat.}) \pm 29(\text{syst.})$	2018
ALICE	Pb collider	$181^{+54}_{-39}(\text{stat.}) \pm 33(\text{syst.})$	2016
HypHI	fixed target	$183^{+42}_{-32}(\text{stat.}) \pm 37(\text{syst.})$	2013

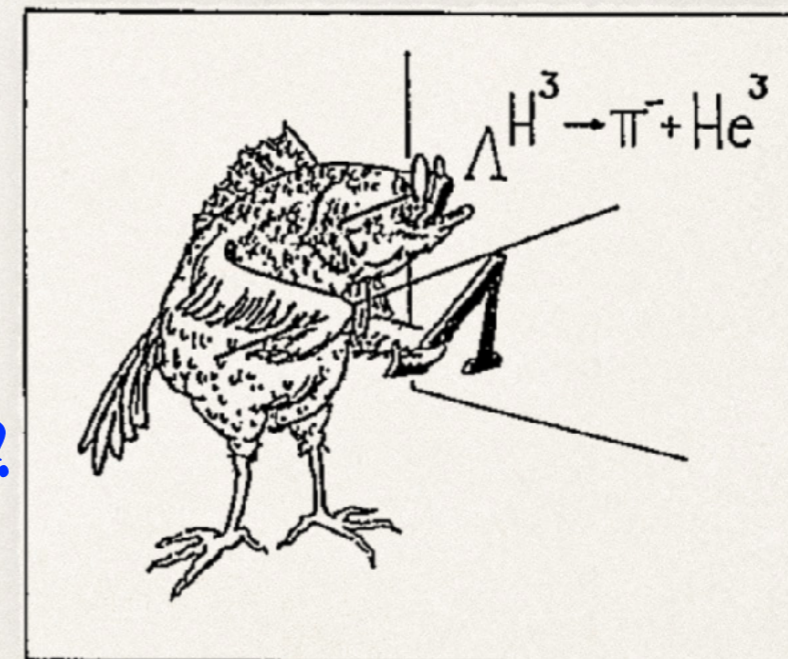
ALICE 2019:

$$\tau = 240^{+40}_{-31} \pm 18 \text{ ps}$$

STAR 2021:

$$\tau = 232.1 \pm 29.2 \pm 36.7 \text{ ps}$$

*Is the Hypertriton
lifetime puzzle solved?*



Neither fish nor fowl?

${}^3\text{He}(\text{K}^-, \pi^0){}_\Lambda^3\text{H}$ vs heavy ion production

Experiment	J-PARC E73	BNL STAR
Production method	${}^3\text{He}(\text{K}^-, \pi^0){}_\Lambda^3\text{H}$	Au+Au
Microscopic process	Strangeness exchange	Thermal model; Coalescence model
PID	pi- momentum	Invariant mass; ${}^4_\Lambda\text{He}$ mixture?
Quantum number	spin=1/2 dominant	1/2 and 3/2 mixture?
Lifetime derivation	Time of flight	Decay length

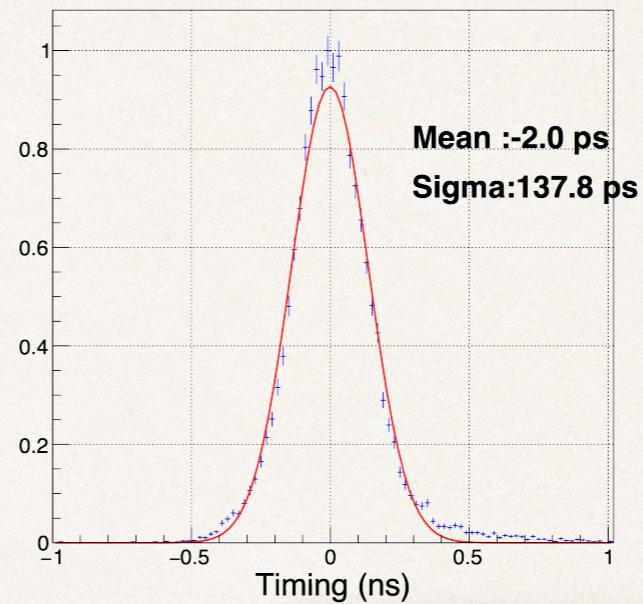
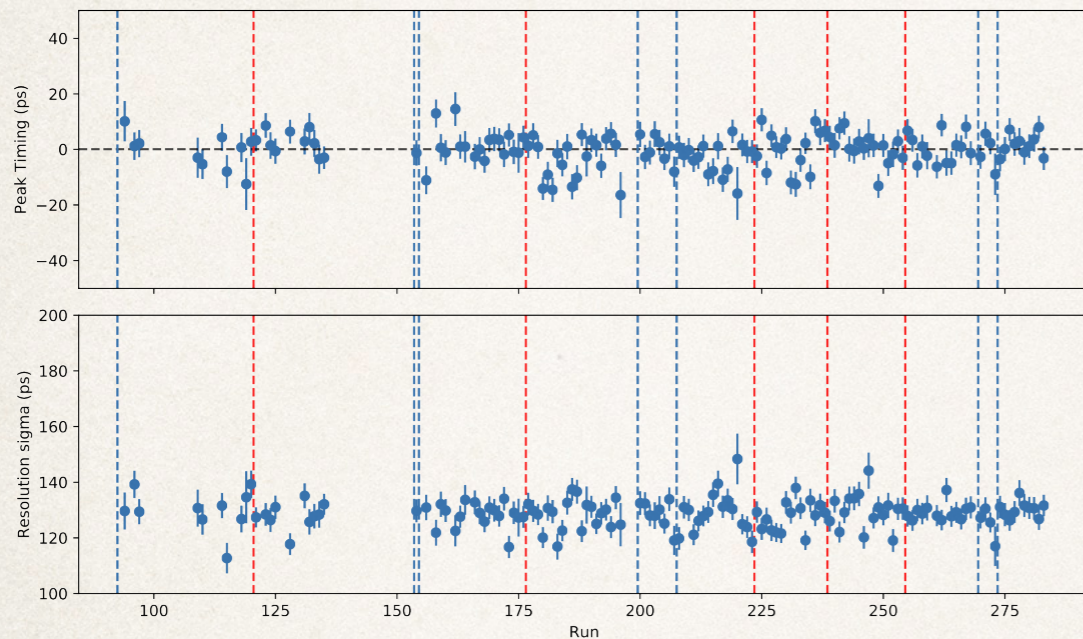
J-PARC E73 staging & status

Staging:	Phase-0 (June, 2020)	Phase-1 (May, 2021)	Phase-2
Task:	Background study with ${}^4\text{He}(K^-, \pi^0){}^4_{\Lambda}\text{H}$	First measurement for ${}^3\text{He}(K^-, \pi^0){}^3_{\Lambda}\text{H}$ reaction	Direct lifetime measurement for ${}^3_{\Lambda}\text{H}$
Output:	Established a new method as: $(K^-, \pi^0) +$ decay spectrum	Production cross section study for ${}^3_{\Lambda}\text{H}$ @ 1 GeV / c	Pin down Hypertriton lifetime puzzle
Status:	${}^4_{\Lambda}\text{H}$ lifetime publication under preparation	Fully ready for beam time from now on	Depends on Phase-1 results

Covered in this talk

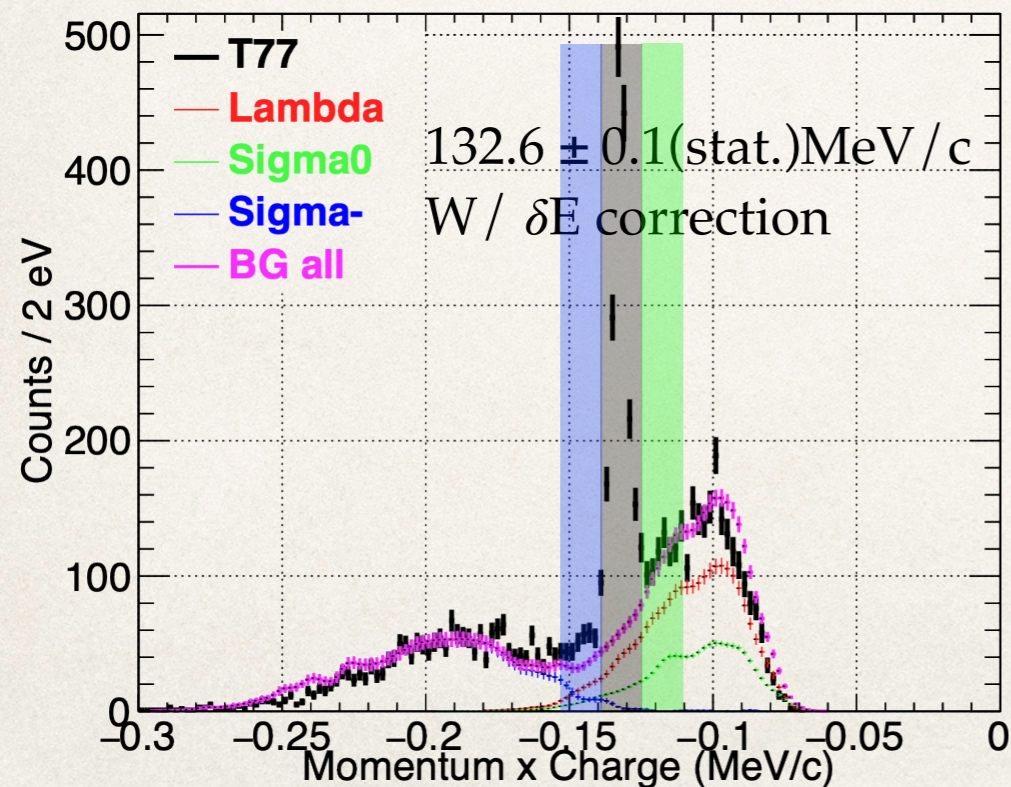
To be approved

E73 Phase-0: ${}^4_\Lambda\text{H}$ lifetime results

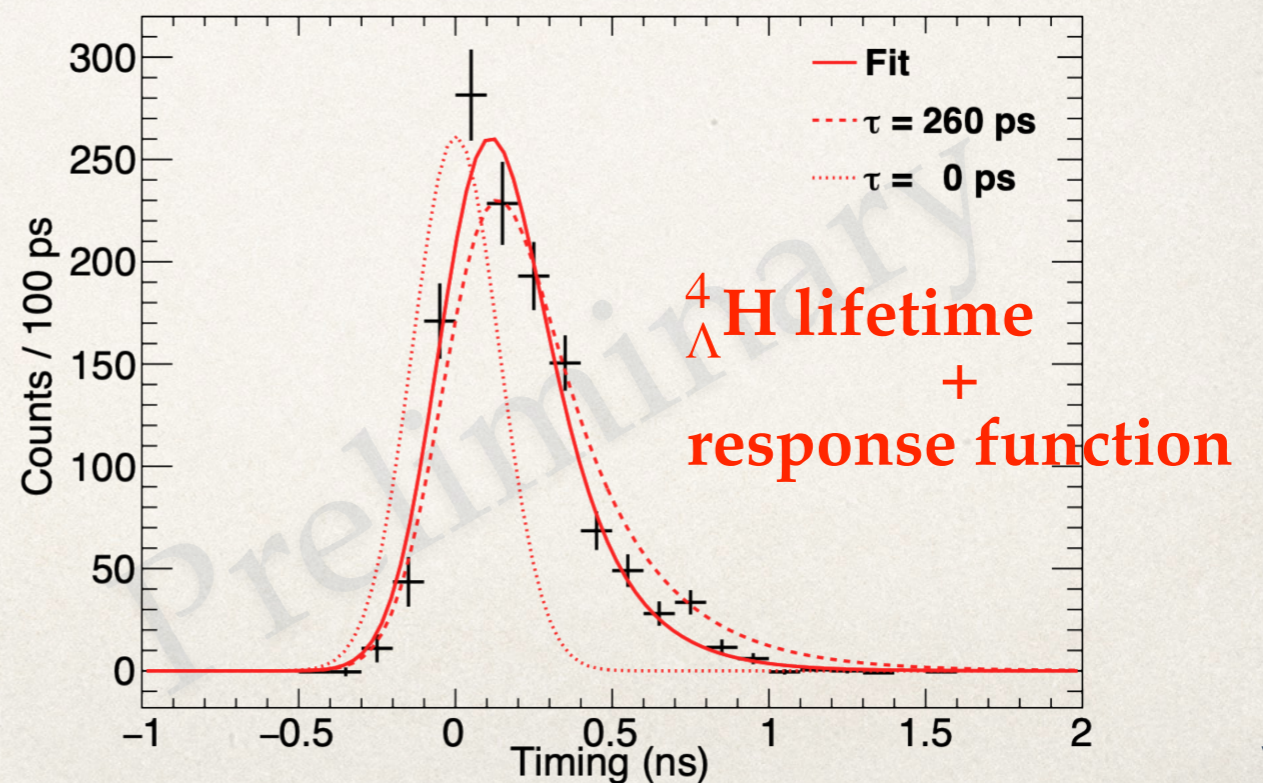


Stability and time response function from prompt hadronic events

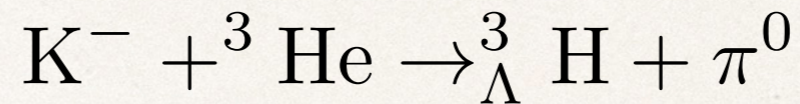
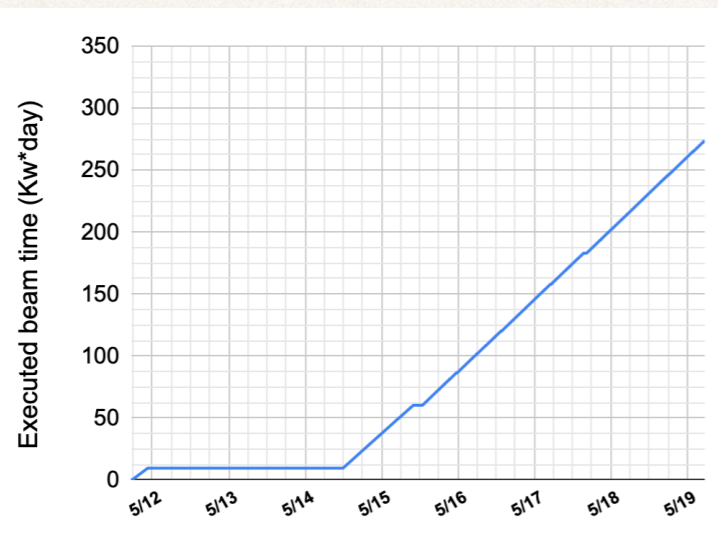
Background subtraction



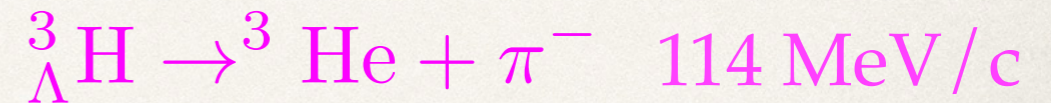
$$\tau = 180 \pm 7 \text{ ps (stat. only)}$$



E73 Phase-1: ${}^3_{\Lambda}\text{H}$ production cross section



↓ slows down inside ${}^3\text{He}$ target and decays at rest

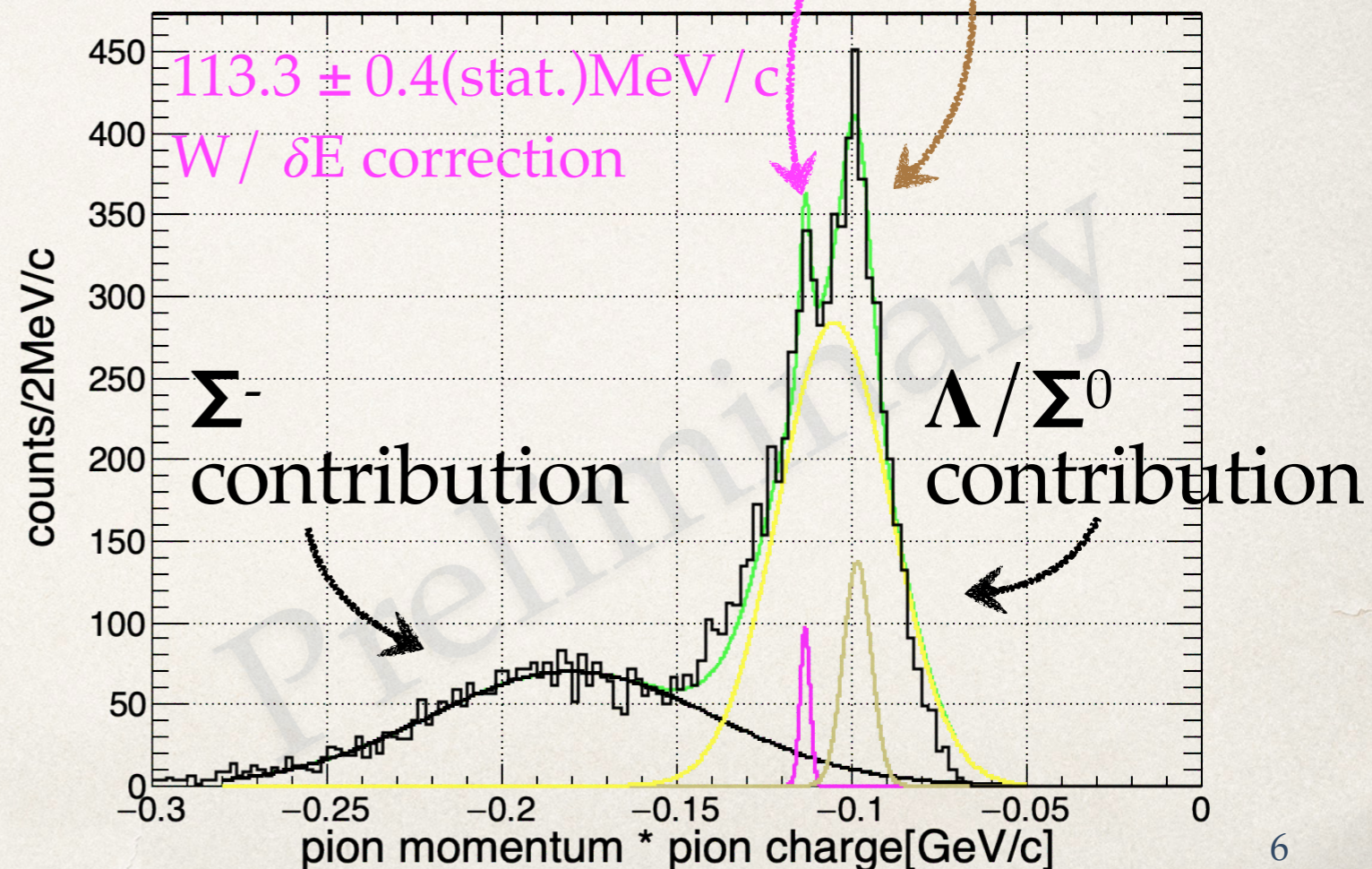


Completed in May, 2021

Stable beam condition: 97.5% up time
(350kW*Day request, 273kW*Day executed)

Thanks for the J-PARC staffs!

- ❖ ${}^3_{\Lambda}\text{H}$ production cross section;
- ❖ Both 2-body & 3-body decay from ${}^3_{\Lambda}\text{H}$ has been observed;



Summary

- ❖ Based on previous results, E73 is ready for the Stage-2 approval
 - ❖ Phase-0 (June, 2020): preliminary results for ${}^4_{\Lambda}\text{H}$ lifetime has been obtained to demonstrate the feasibility of our approach
 - ❖ Phase-1 (May, 2021): ${}^3_{\Lambda}\text{H}$ production cross section has been measured as a reference for Stage-2 beam time request
- ❖ *Feasibility and security have been confirmed by Phase-0 & Phase-1 results --> waive of FIFC report and directly apply for Stage-2 approval?*
- ❖ E73 Stage-2 beam time: 25days@80kW beam time for ~1k 2-body decay events (scaled with Phase-1 data)