

Data-Driven Modeling of the Cosmogenic ^9Li Background in the JUNO Experiment

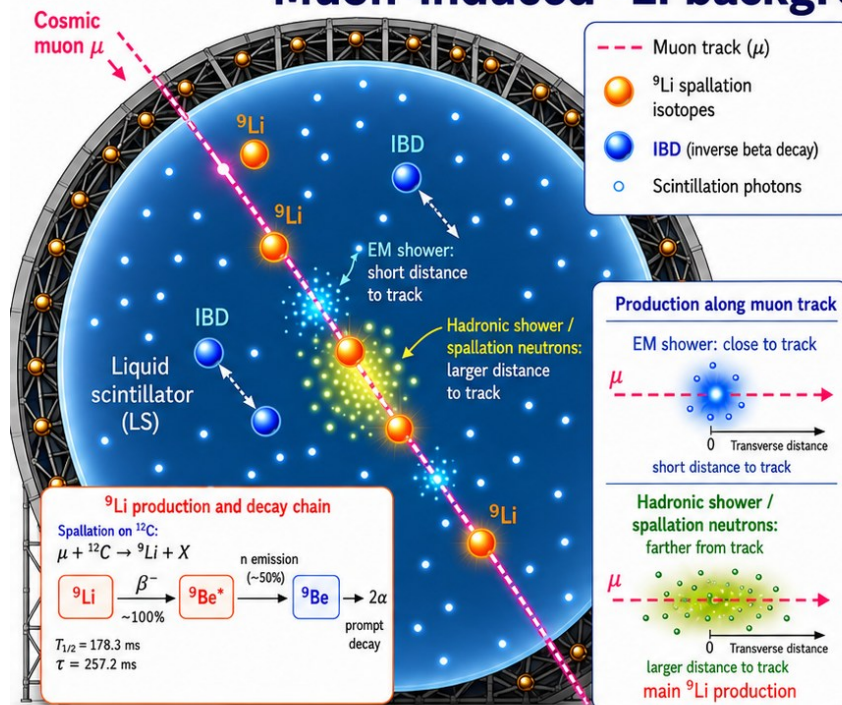
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The 12th Annual Meeting of HEP Branch of CPS

17 July 2026 | Guangzhou, China

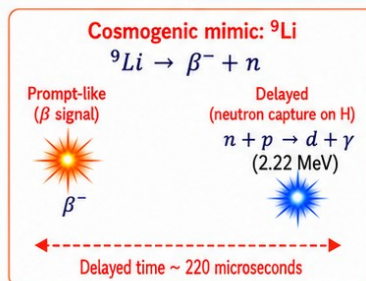
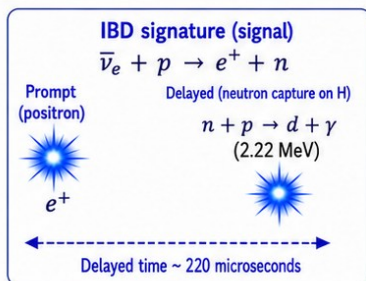
Muon-induced ^9Li background in JUNO



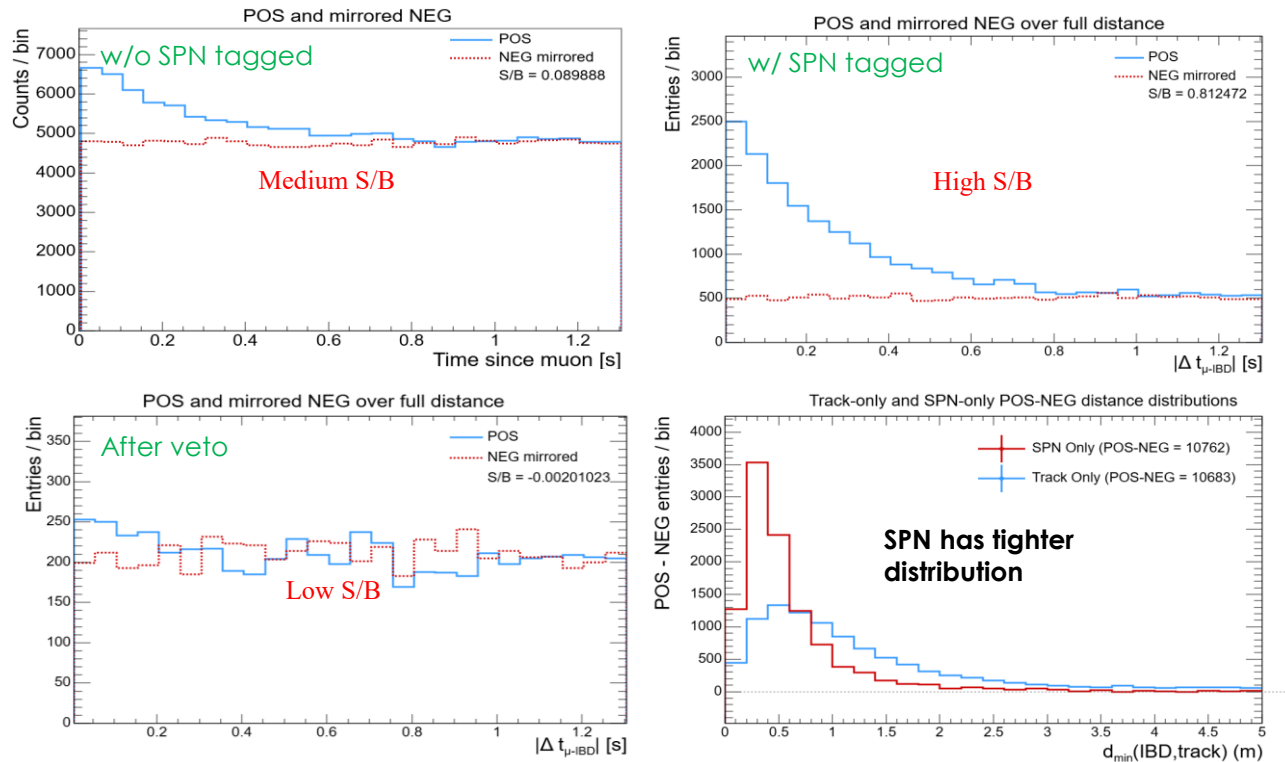
Background rates (cpd)		
Backgrounds (cpd)	Pre-fit	Best fit
^9Li	4.3 ± 1.4	3.9 ± 0.6
Geoneutrinos	1.2 ± 0.5	1.4 ± 0.4
World reactors	0.88 ± 0.09	0.88 ± 0.09
$^{214}\text{Bi}-^{214}\text{Po}$	0.18 ± 0.10	0.20 ± 0.10
$^{13}\text{C}(\alpha, n)^{16}\text{O}$	0.04 ± 0.02	0.04 ± 0.02
Fast neutrons	0.02 ± 0.02	0.02 ± 0.02
Double neutrons	0.05 ± 0.05	0.07 ± 0.05
Atmospheric neutrinos	0.08 ± 0.04	0.07 ± 0.04
Accidentals ($\times 10^{-2}$)	4.9 ± 0.3	4.9 ± 0.3
Total	6.80 ± 1.49	6.63 ± 0.74

Nature 654, 343–348 (2026)

- ❑ Dominant correlated background in IBD
- ❑ Mimics IBD and long life time, can't be simply removed by subtraction
- ❑ Accurate estimation is essential for JUNO Oscillation precision



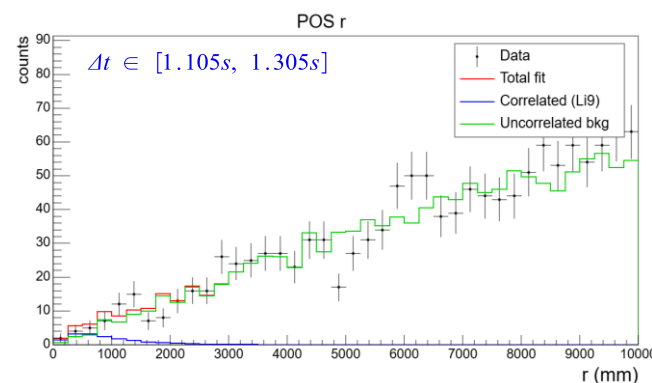
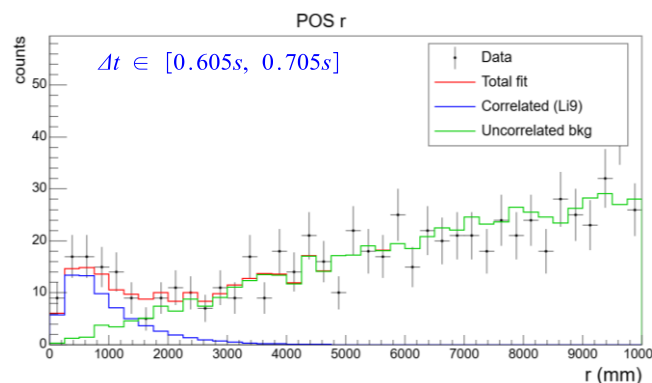
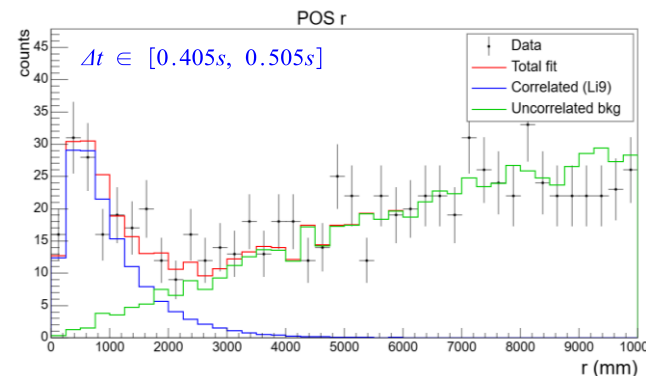
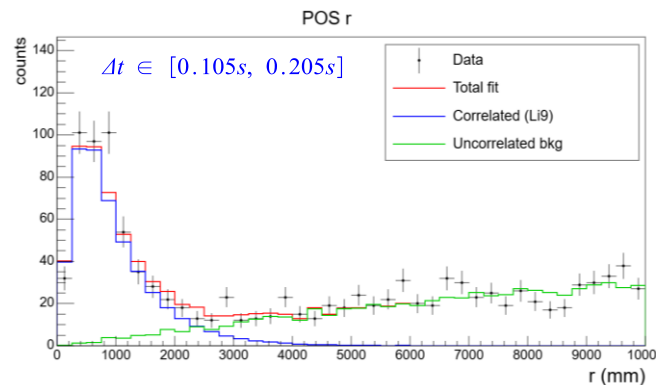
Challenges



□ Challenge

- ❖ low S/B before veto leads to large statistical uncertainty
- ❖ Accurate prediction of the residual ${}^9\text{Li}$ after veto is challenging
- ❖ Aggressive muon vetoes reduce background at the cost of IBD live time

Solutions

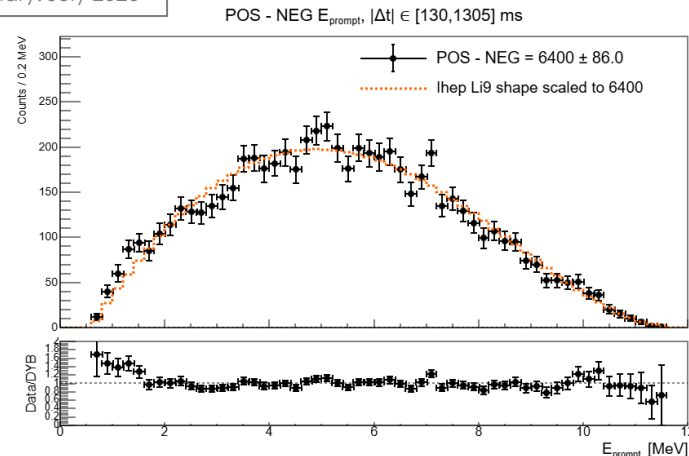
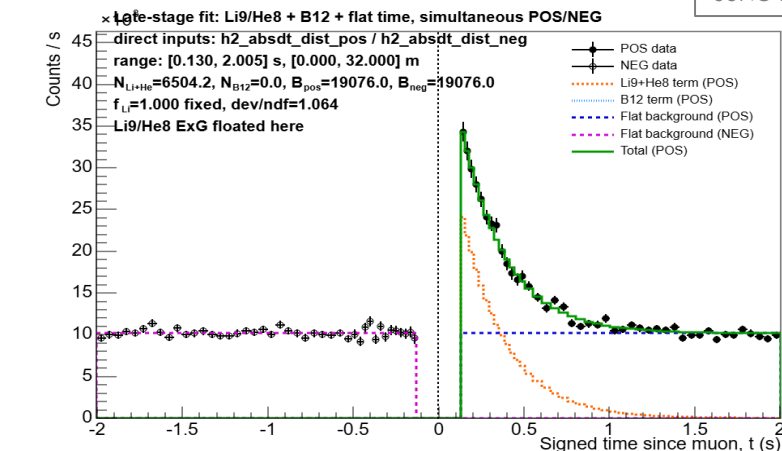


□ Our Idea

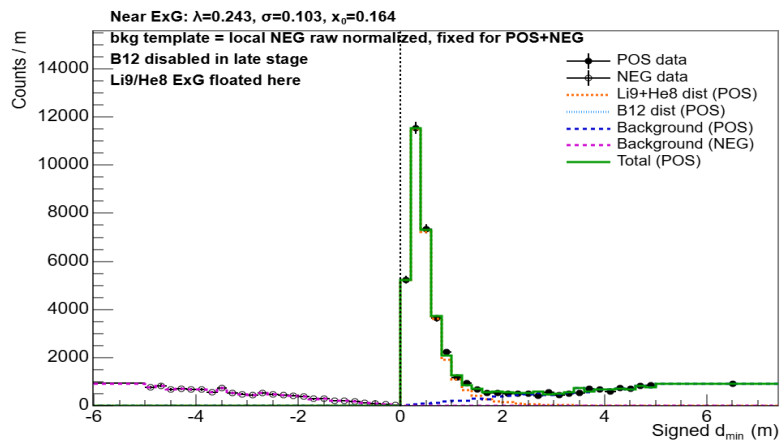
1. Separate muon into 3 categories
 - ❖ Promote S/B and live days
 - ❖ Enable a data-driven veto strategy
2. Apply a 2D likelihood fitting
 - ❖ Accurate estimation of Li^9 rate
 - ❖ Provide a method to predict residual Li^9

Results

JUNO Preliminary, July 2026



Prompt energy spectrum matches well with DYB



Selection Criteria	^9Li Rate Estimation (day^{-1})
Preliminary	54.4 ± 0.8 (stat)
After SPN veto	4.0 ± 0.3 (stat) ± 0.2 (sys)
After SPN + Muon veto	1.7 ± 0.3 (stat) ± 0.2 (sys)

❖ Finally, our method suppresses the ^9Li rate from ~ 54.0 cpd to 1.7 cpd, while losing $\sim 6\%$ of IBD efficiency

❖ If you are interested in the fitting model, welcome to visit my poster