Study of antineutron and hyperon interact with nuclei at J/ψ factory

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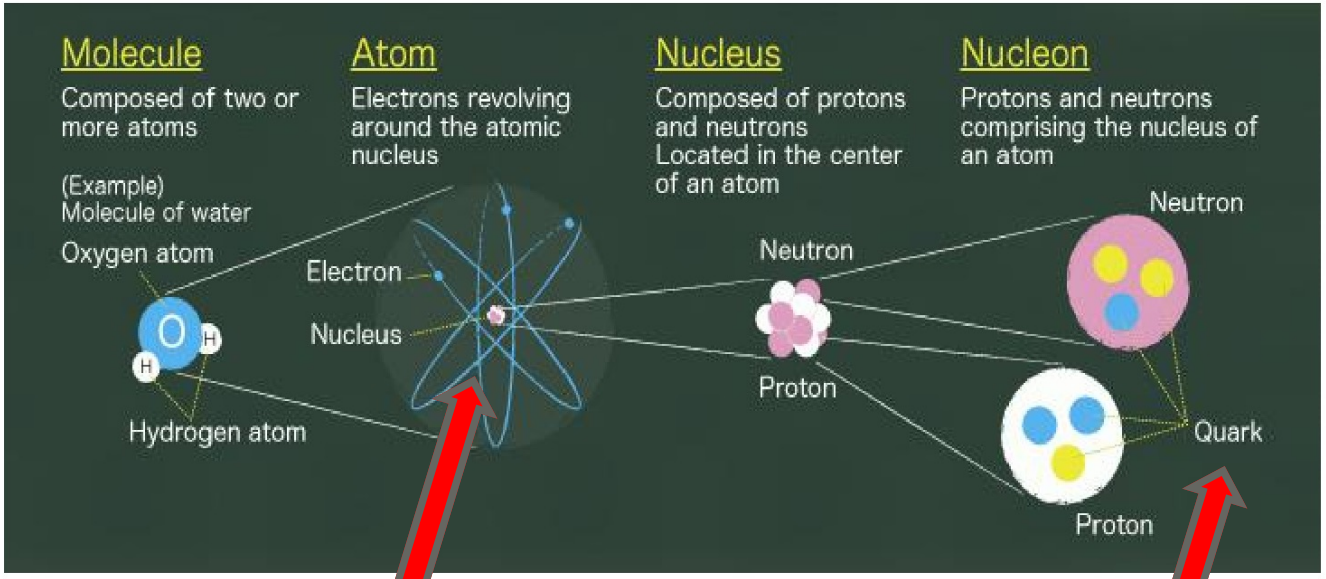
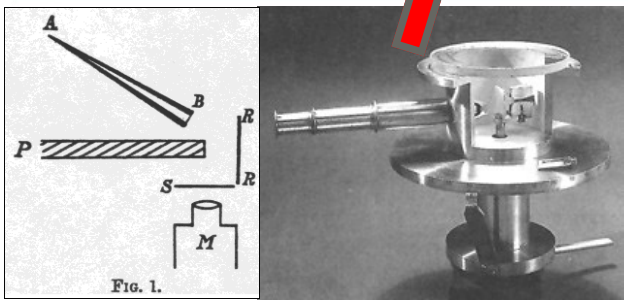
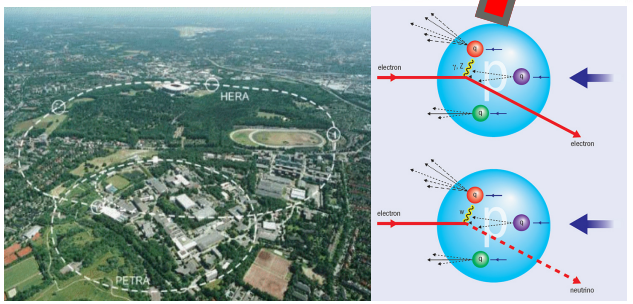
第八届全国重味物理与量子色动力学研讨会-重庆

Scattering experiments shed light on matter structure





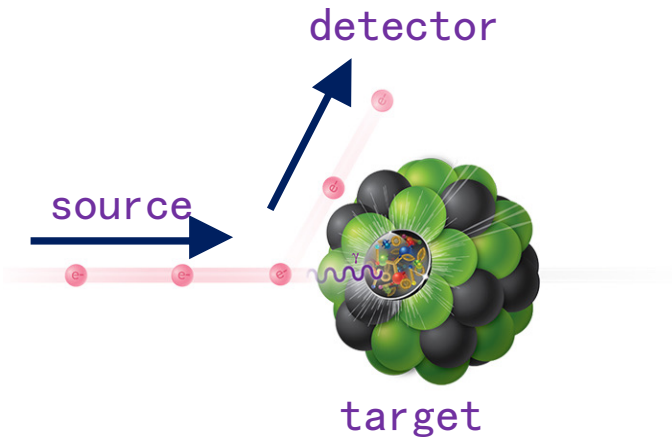


Rutherford experiment → **Nucleus**

Electon-nucleon DIS → **Quark**

Particle sources

Three elements of scattering experiment : particle source, target, and detector



High quality particle source : long lifetime、easy to produce and control、low background、high intensity、good resolution……

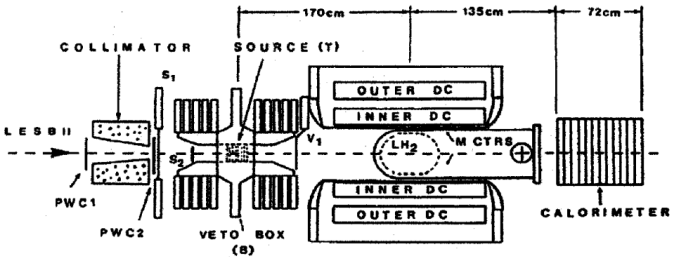
- **charged : electron/positron , muon , pion , kaon , proton , heavy ion**
- **neutral : photon , neutron , neutrino**

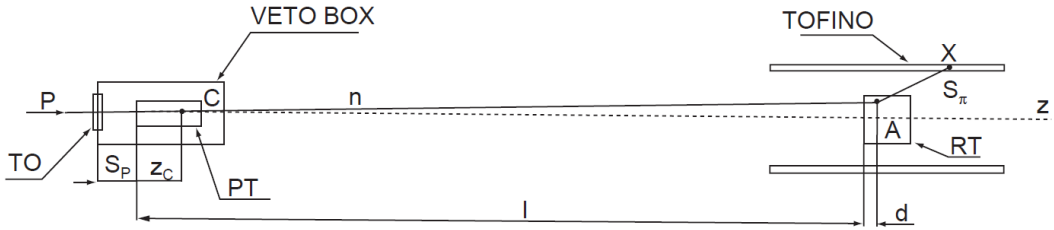
For more details: D.C. Faircloth, Particle Sources, 2103.13231 (Proceedings of the CERN–Accelerator–School: Introduction to Accelerator Physics)

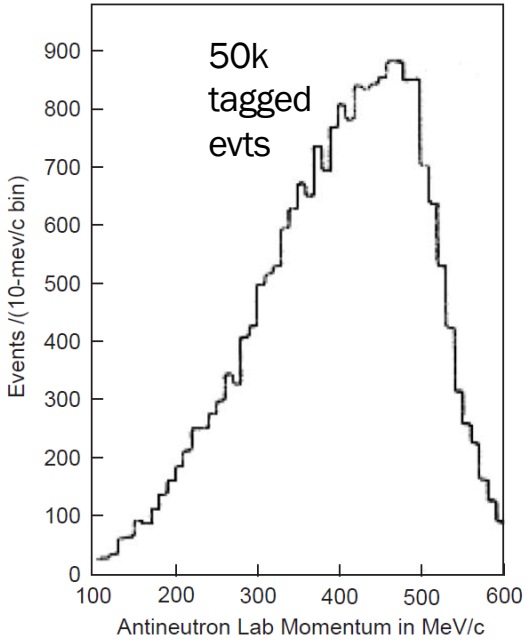
Beams of other neutral particles, such as antineutrons, K^0 and $\bar{K}^0$, long-lived hyperons (Λ, $\Sigma^{\pm}$, $\Xi^{0/-}$) and their antiparticles ($\bar{\Lambda}$, $\bar{\Sigma}^{\pm}$, $\bar{\Xi}^{0/+}$) have great physics potential, but they are typically much more difficult to produce and control.

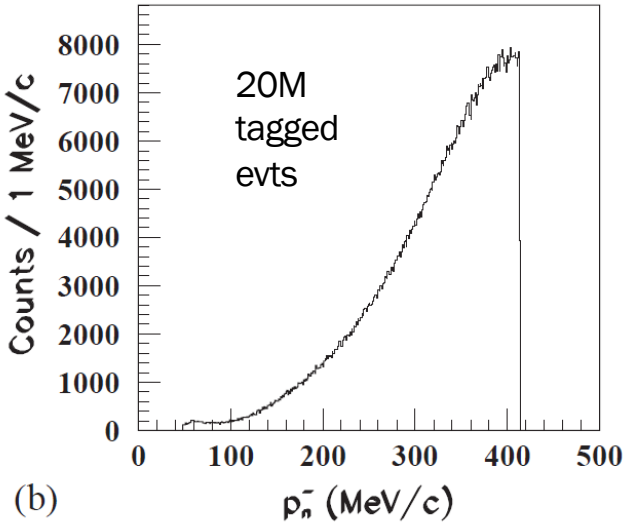
Antineutron in history

- $\bar{p}p \rightarrow \bar{n}n$ @ E-767@BNL & OBELIX@CERN









Limited statistics

36 $\bar{n}$ per 10^6 $\bar{p}$

[2×10^7 collected in 5 years]

Limited momentum range

Uncertainty in flux~7%

$\sigma p_{\bar{n}}$ = 3% @ 50 MeV/c

= 5% @ 400 MeV/c

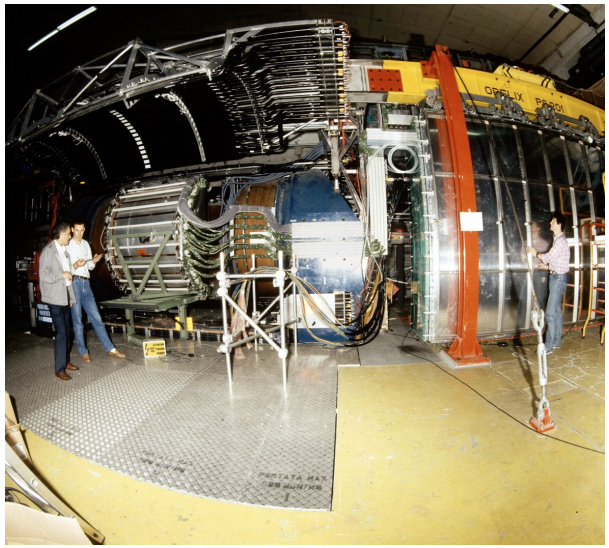
Antineutron in history

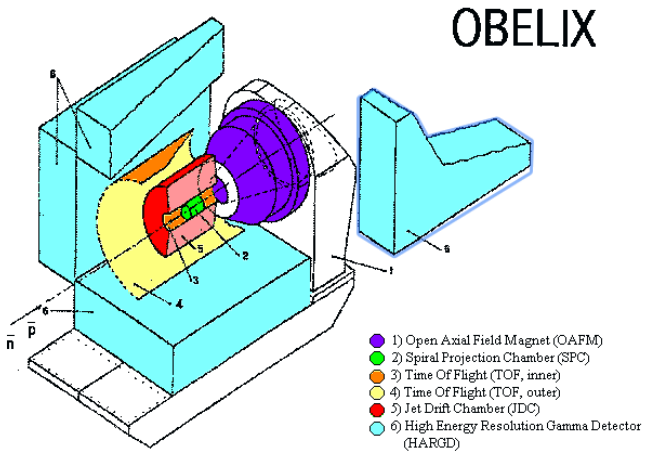
Anti-neutron is neutral

Hard to control and select

VS

No coulomb interaction, easy to get the physics amplitute



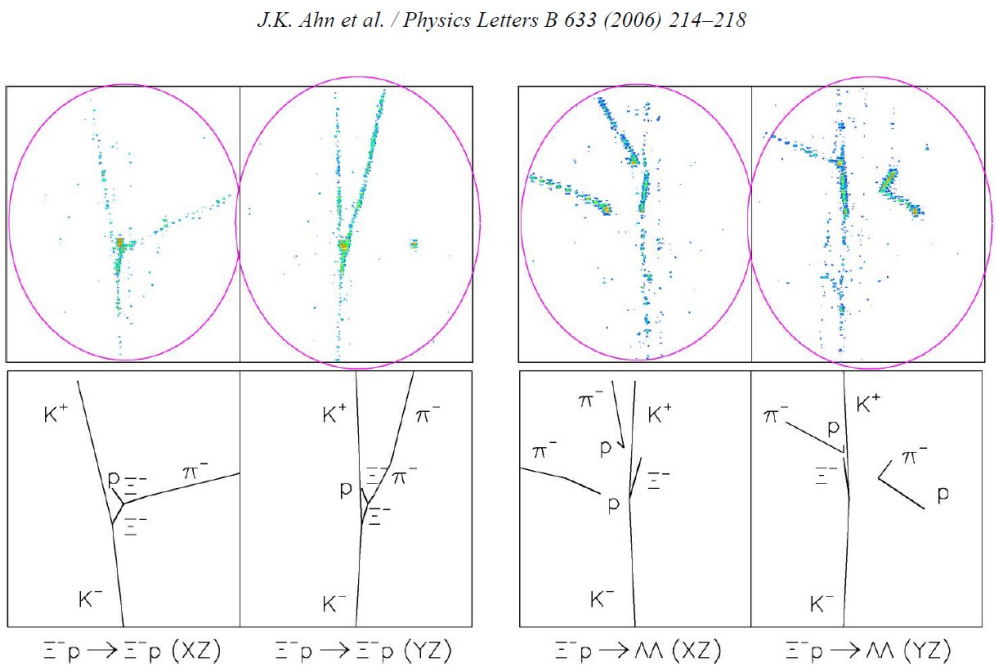


OBLIX experiment at CERN : $p\bar{p} \rightarrow n\bar{n}$

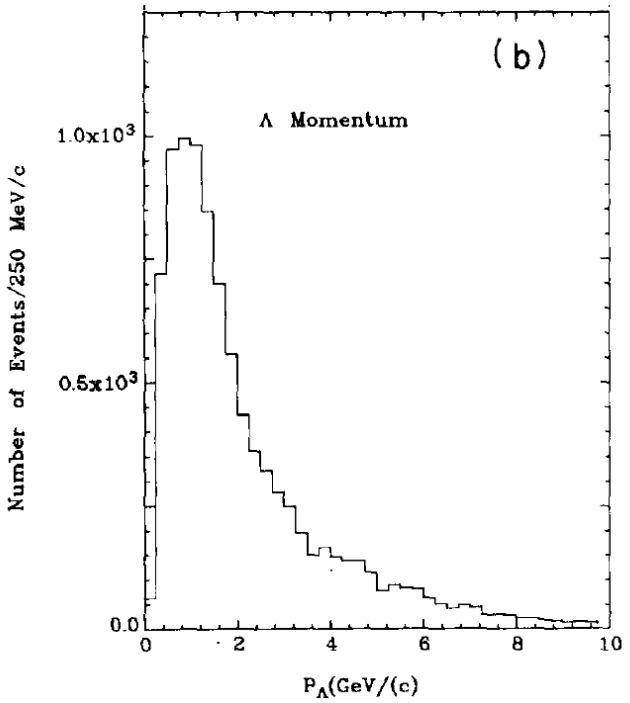
About 40 publications [Physics Report 383, 213-297]

Sources of Λ & other hyperons

- Bubble chamber experiments with hyperons from K^-+target
- Emulsion experiments with K^-+target → K^++X, K^++K^++X, …
- A few to about 10^4 events (typical O(100) tagged events)
- No anti-hyperon sources!

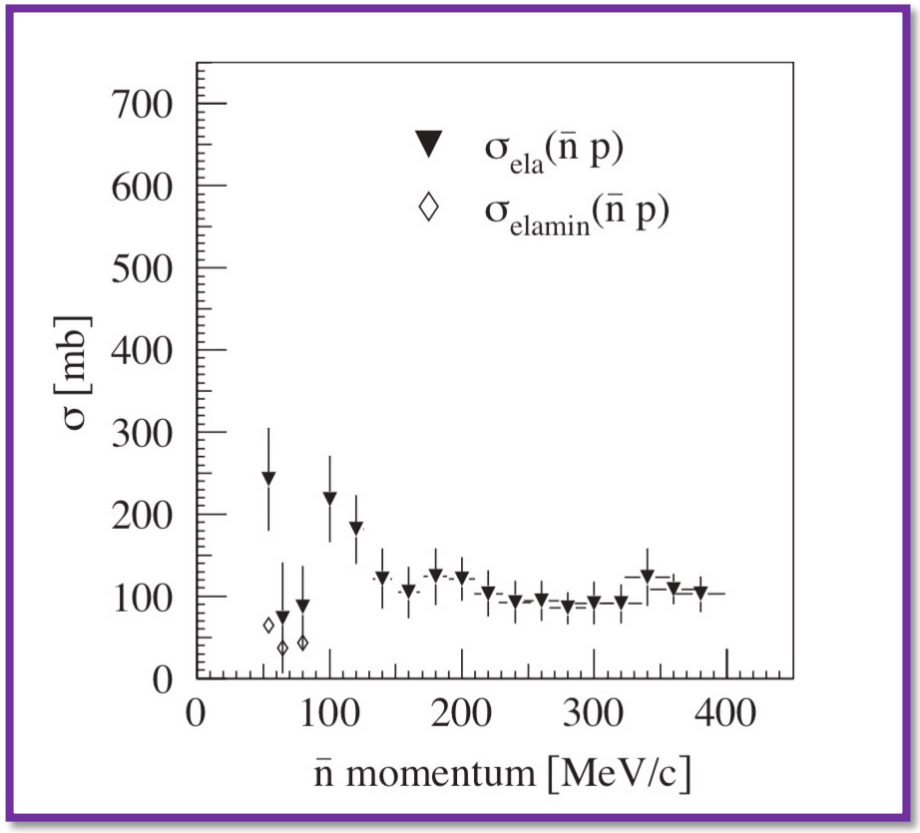


KEK, K^- + SCIFI → Ξ^- X

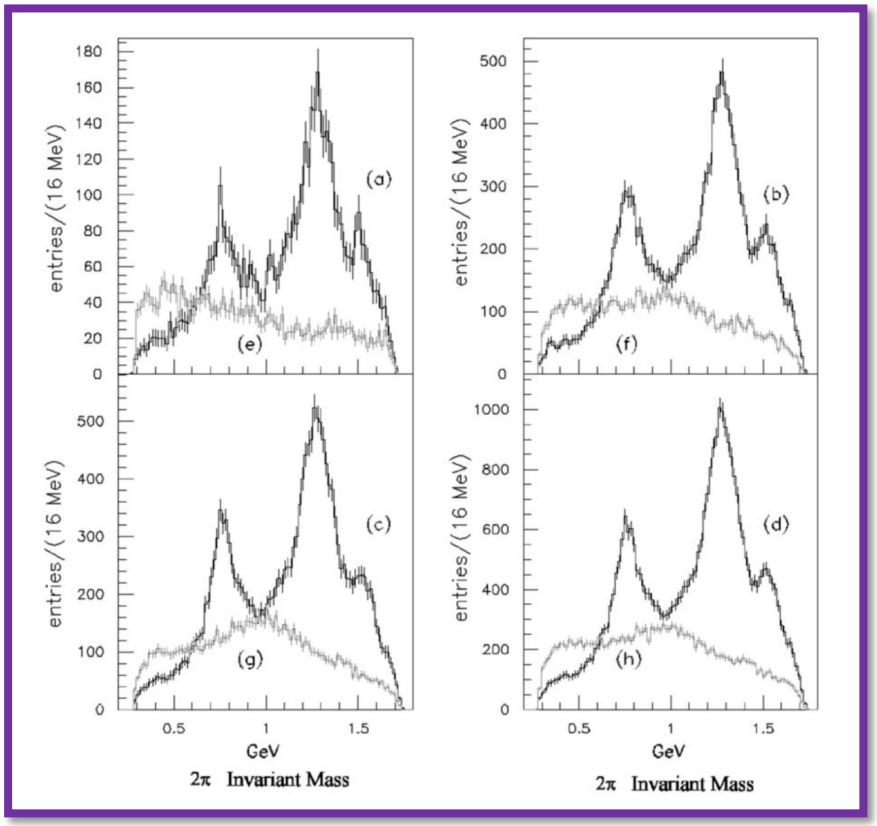


SLAC HBC, Nuclear Physics B125 (1977) 29-51

Many unsolved problems

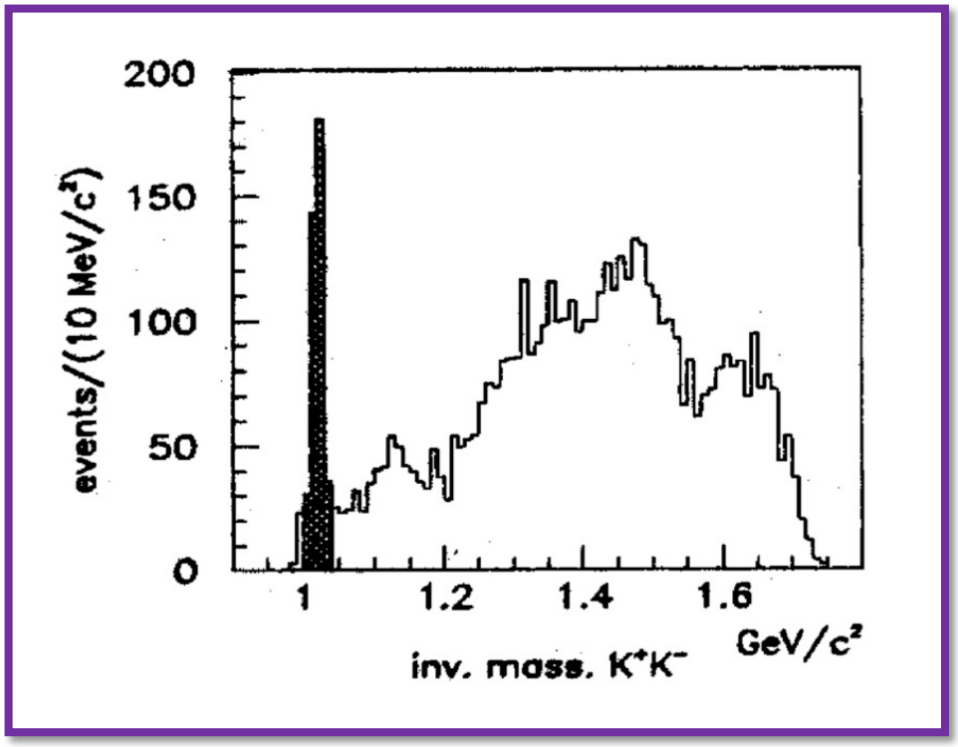


Dip on the cross section:
Initial-Final State Interaction?

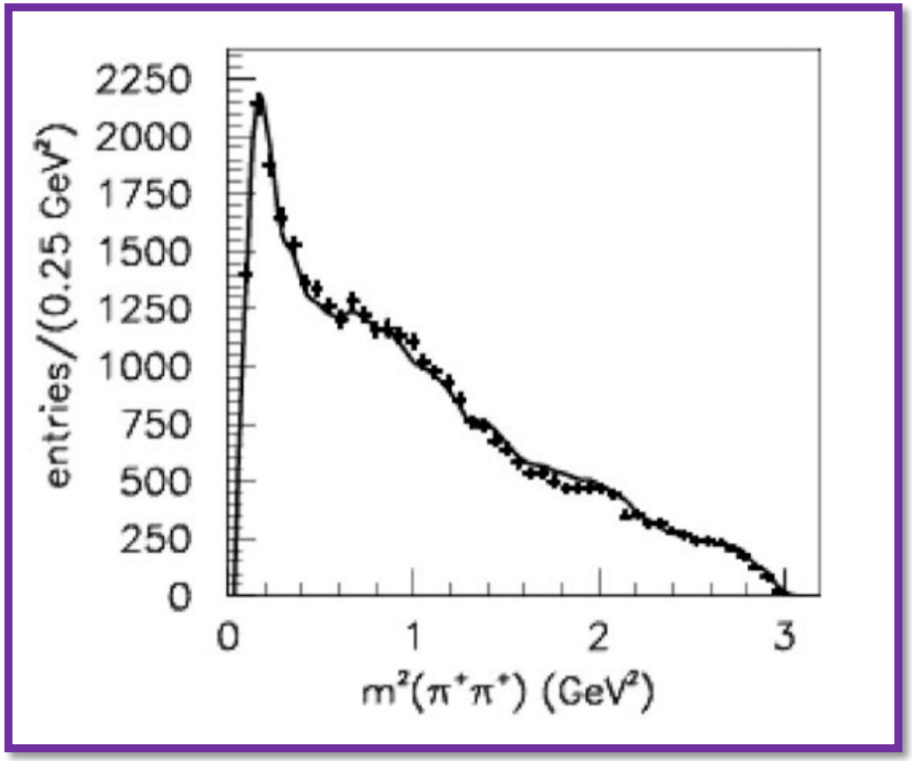


$f_0(1500)$: glue ball?

Many unsolved problems



Large Kaon pair production: OZI Violation?

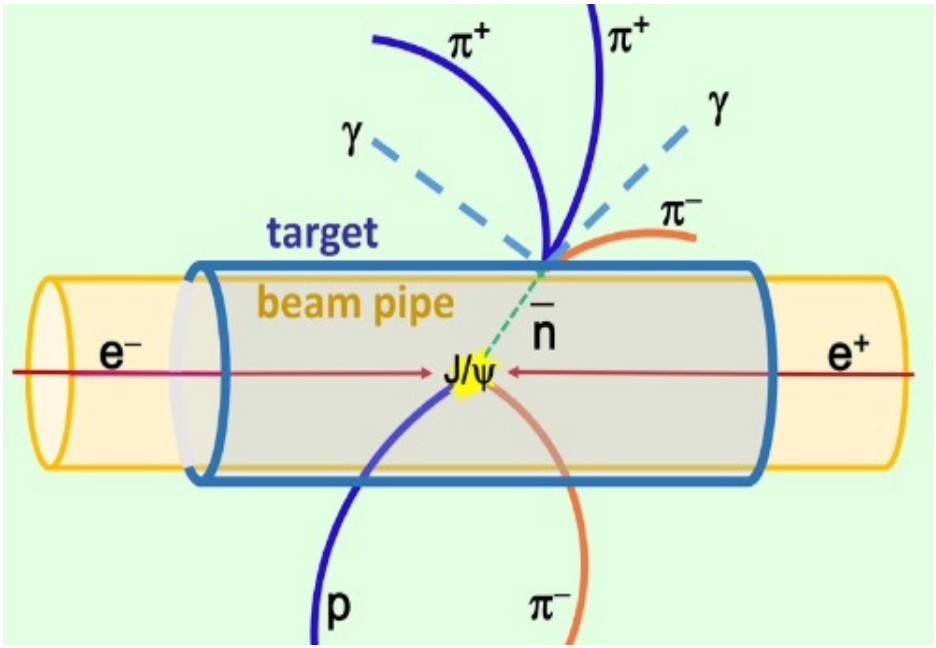


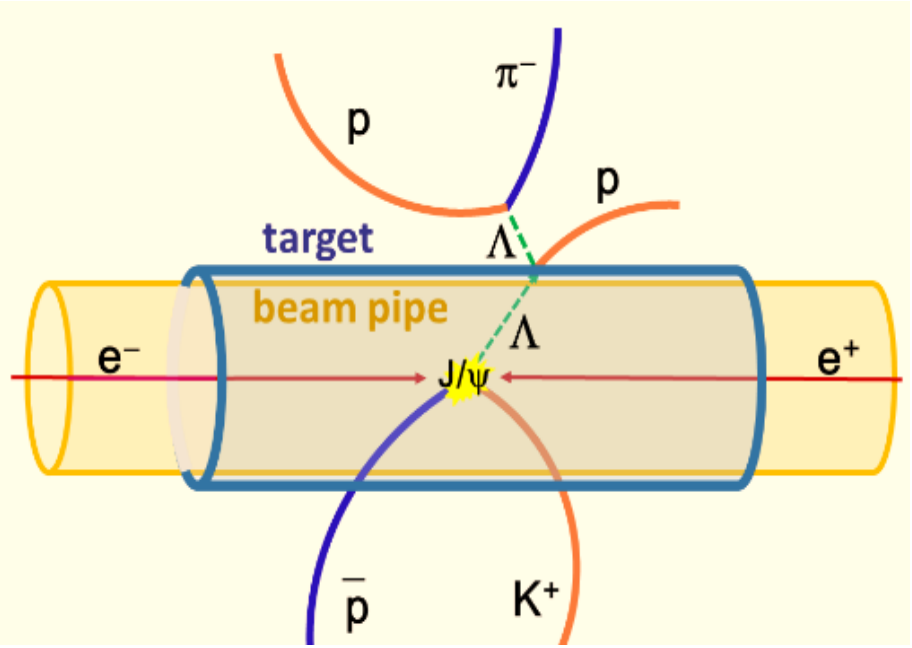
Paticle with Isospin=2?

How could we obtain antineutron/hyperson sources with better resolution, wider momentum range and lower cost?

The idea

Do fixed target experiments @ a super J/ψ factory





Why J/ψ decays: huge cross section of e^+e^-→J/ψ

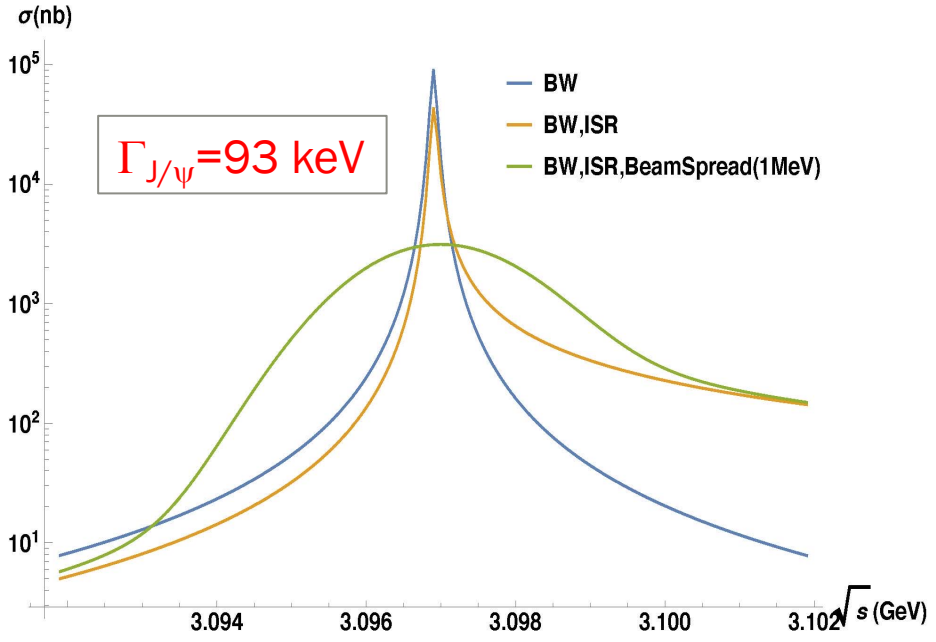
$$\sigma_{Born}(s) = \frac{12\pi\Gamma_{ee}\Gamma_f}{(s-M^2)^2+\Gamma_t^2 M^2}$$

$$\sigma_{r.c.}(s) = \int_0^{x_m} dx F(x,s)\frac{\sigma_{Born}(s(1-x))}{|1-\Pi(s(1-x))|^2}$$

$$\sigma_{exp}(W) = \int_0^{\infty} dW' \sigma_{r.c.}(W') G(W',W)$$

$$G(W,W') = \frac{1}{\sqrt{2\pi}\Delta} e^{-\frac{(W-W')^2}{2\Delta^2}}$$

Formulas from PLB 557 (2003) 192
Numbers & plot from Yuping Guo



at J/ψ peak	Born	ISR	Δ=1 MeV
σ (nb)	9.1×10^4	4.4×10^4	3,100

$\mathcal{L}$ = 0.5 $nb^{-1}s^{-1}$ @ BEPCII

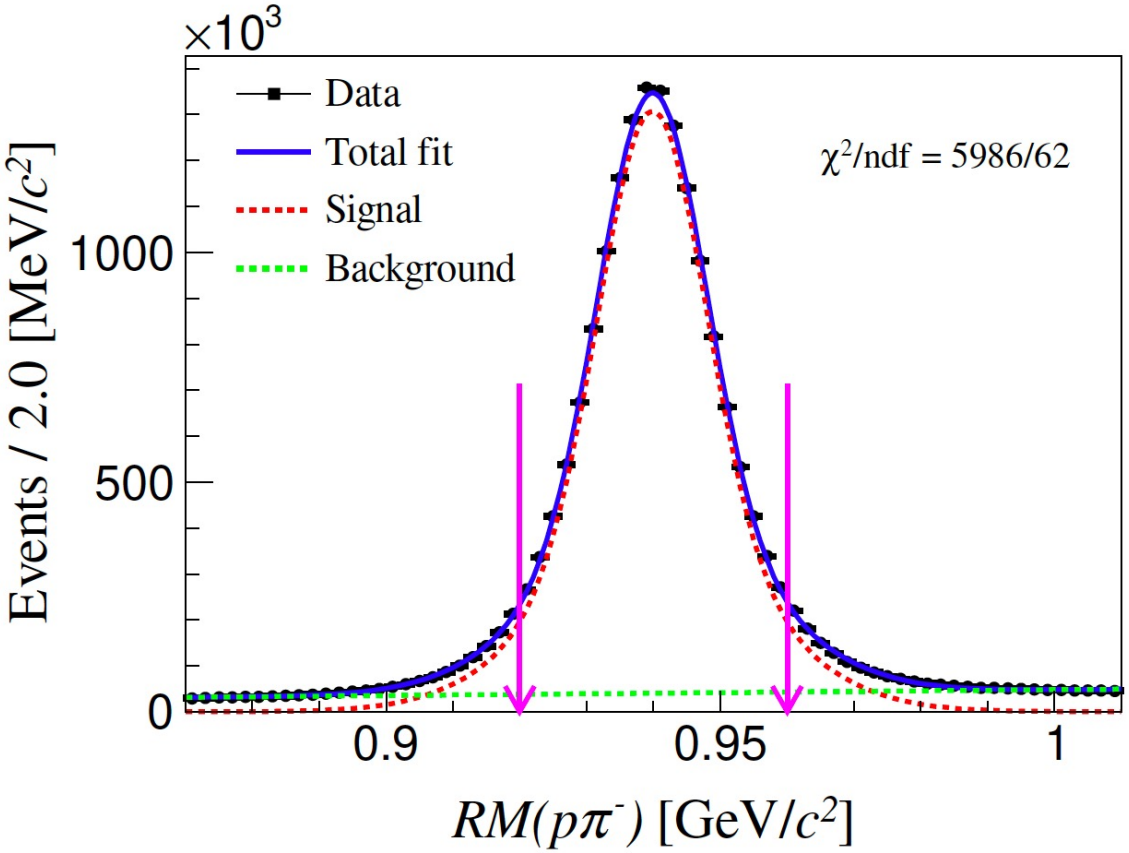
Hyperons and anti-hyperons at BESIII experiment

Baryon	$c\tau$ (cm)	decay mode	$\mathcal{B}$ ($\times 10^{-3}$)	$p_{\max}$ (MeV/c)	$n_{\rm BP}^{B}$ ($\times 10^{5}$)
$\bar{n}$	2.6×10^{13}	$J/\psi \to p\pi^-\bar{n}$	2.12	1174	80
Λ	7.89	$J/\psi \to \bar{\Lambda}\Lambda$	1.89	1074	26
		$J/\psi \to \bar{p}K^+\Lambda$	0.87	876	9
Σ^+	2.40	$J/\psi \to \bar{\Sigma}^-\Sigma^+$	1.50	992	4
		$J/\psi \to \bar{\Lambda}\pi^-\Sigma^+$	0.83	950	1
Σ^-	4.43	$J/\psi \to \bar{\Lambda}\pi^+\Sigma^-$	—	945	—
Ξ^0	8.71	$J/\psi \to \bar{\Xi}^0\Xi^0$	1.17	818	7
		$J/\psi \to \bar{\Xi}^+\pi^-\Xi^0$	—	685	—
Ξ^-	4.91	$J/\psi \to \bar{\Xi}^+\Xi^-$	0.97	807	3
		$J/\psi \to \bar{\Xi}^0\pi^+\Xi^-$	—	686	—
Ω^-	2.46	$\psi(2S) \to \bar{\Omega}^+\Omega^-$	0.05	774	0.05
		$\psi(2S) \to \bar{\Xi}^0K^+\Omega^-$	—	606	—

The Ω hyperons are produced from 3 billion ψ(2S) event sample.
All these particles can also be produced in decays of other charmonia.

arXiv 2511.21462, submitted to PRL

$\bar{n}p \to 2\pi^+\pi^-(\pi^0)$

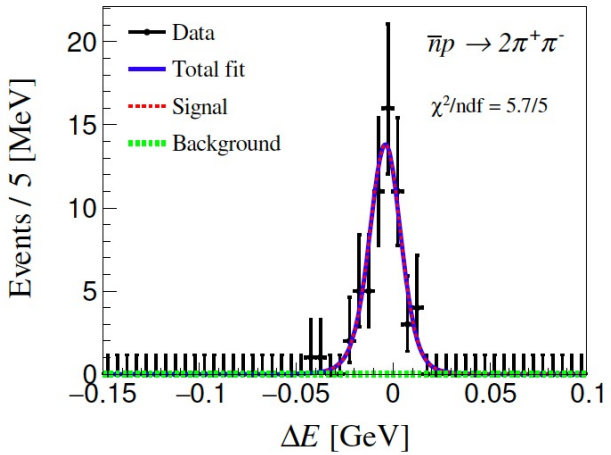


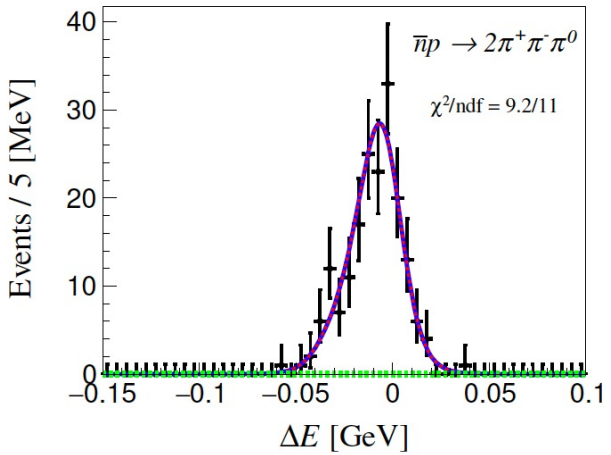
10B J/ψ at BESIII

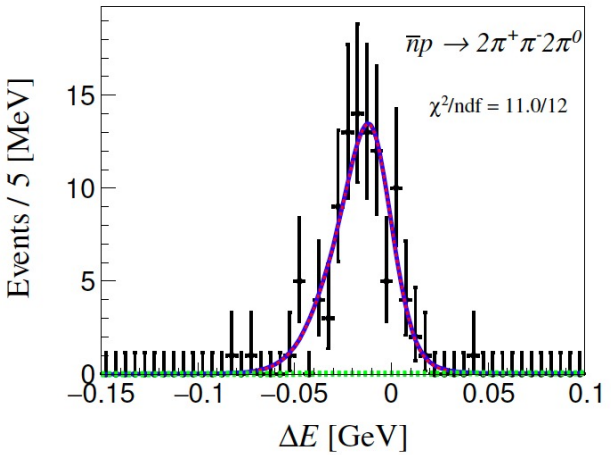
Huge number of antiproton from $e^+e^- \to J/\psi \to p\pi^-\bar{n}$ by tagging $p\pi$.

arXiv 2511.21462, submitted to PRL

$\bar{n}p \to 2\pi^+\pi^-(\pi^0)$



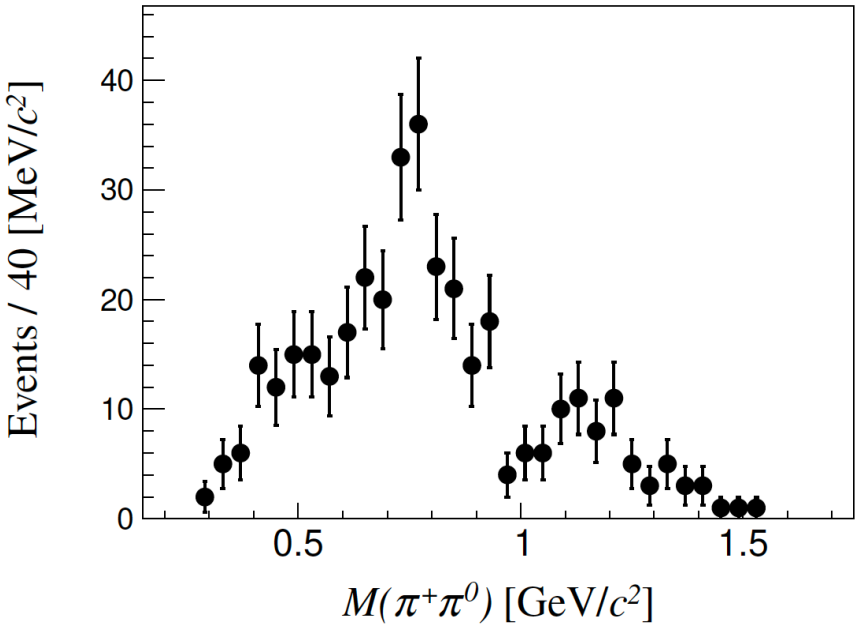


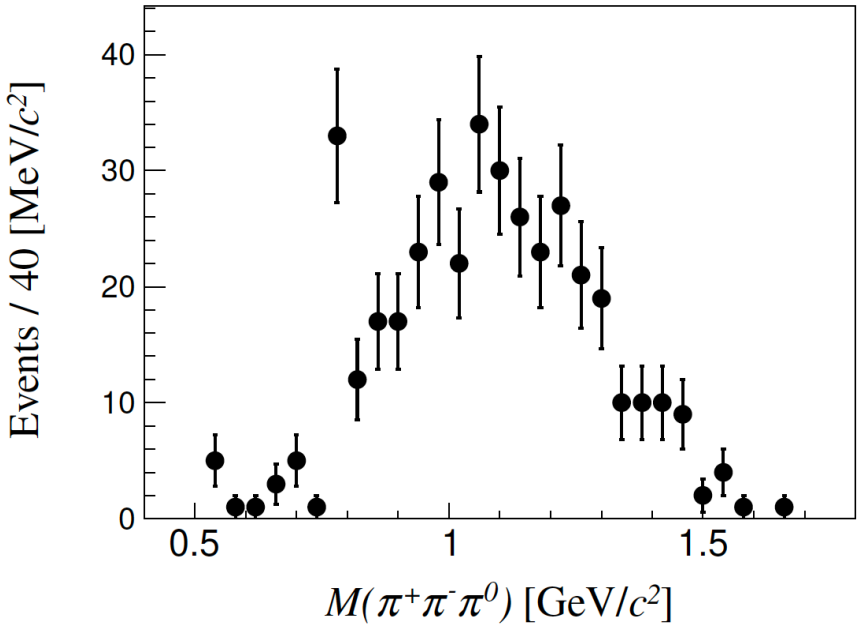


Energy difference between the final states and the initial states is used to subtract the signal.

arXiv 2511.21462, submitted to PRL

$\bar{n}p \rightarrow 2\pi^+\pi^-(\pi^0)$

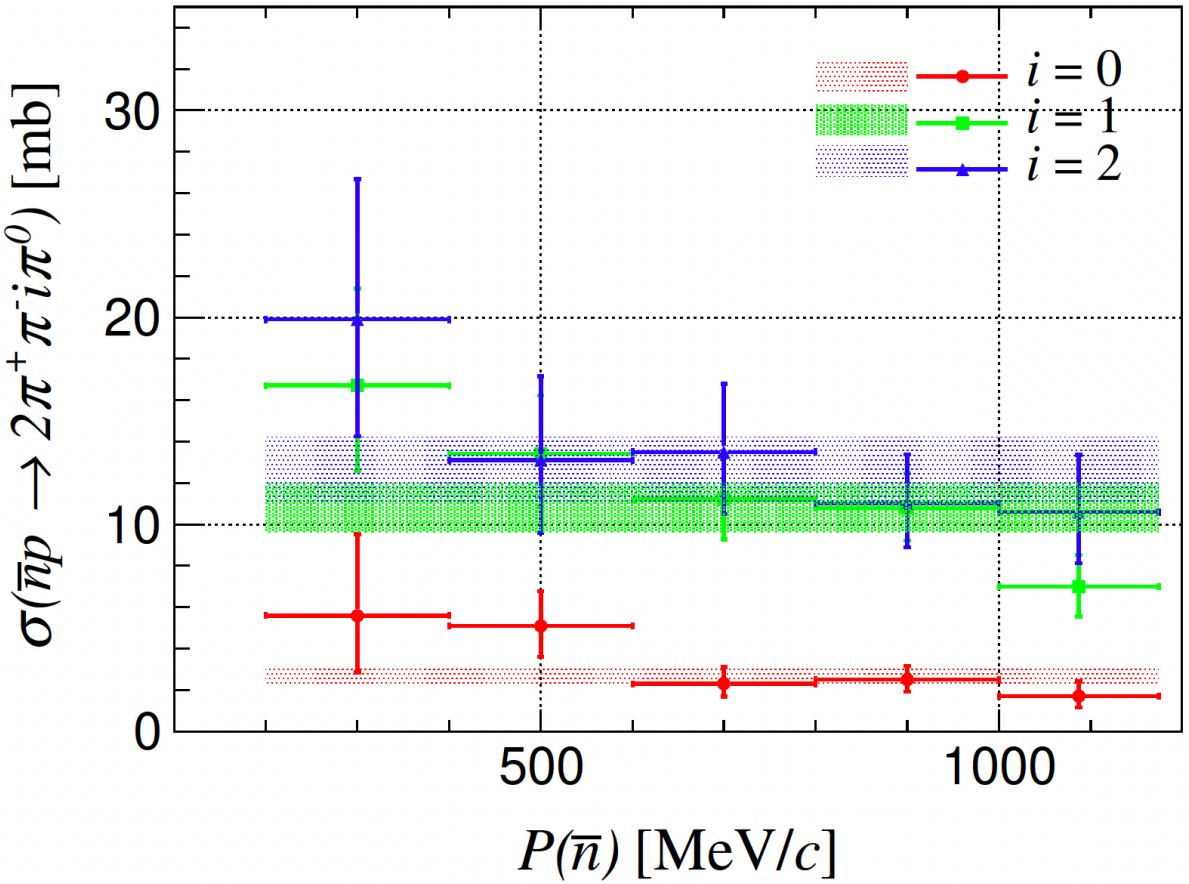




Clear ρ and ω are observed in the intermediate states.

arXiv 2511.21462, submitted to PRL

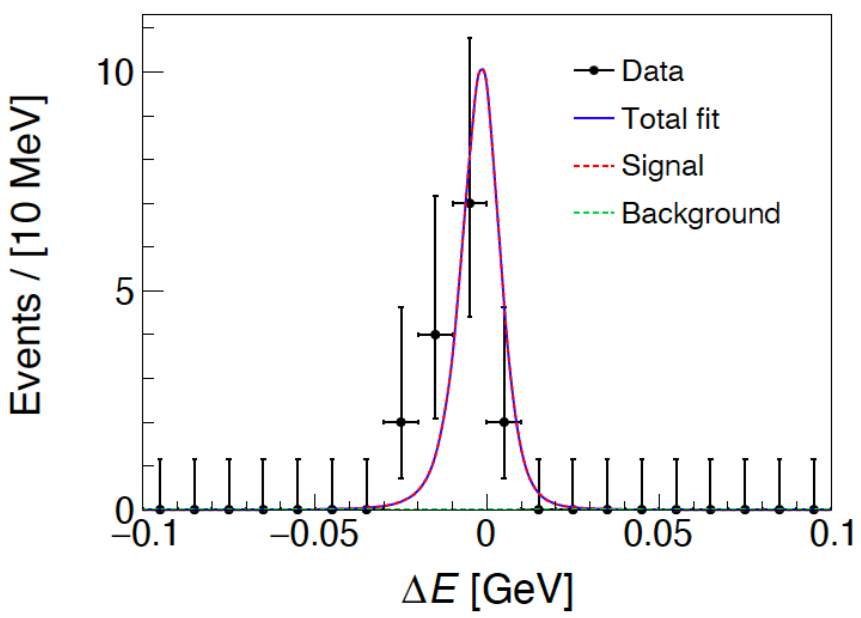
$\bar{n}p \to 2\pi^+\pi^-(\pi^0)$

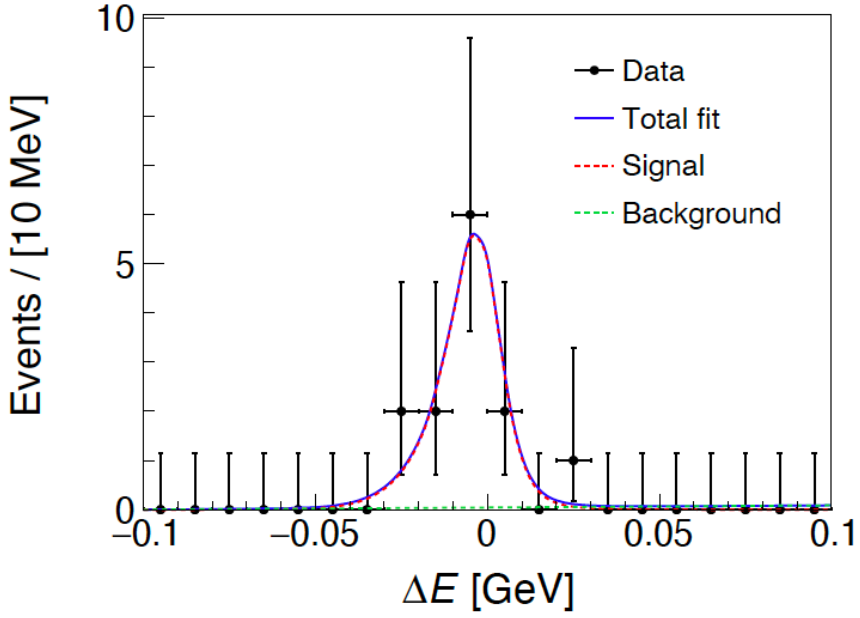


Cross sections are measured as function of anti-neutron momentum, and the part above 800 MeV is measured for first time.

arXiv 2603.24272, submitted to PRL

$\bar{n}p \to K^+K^-\pi^-(\pi^0)$





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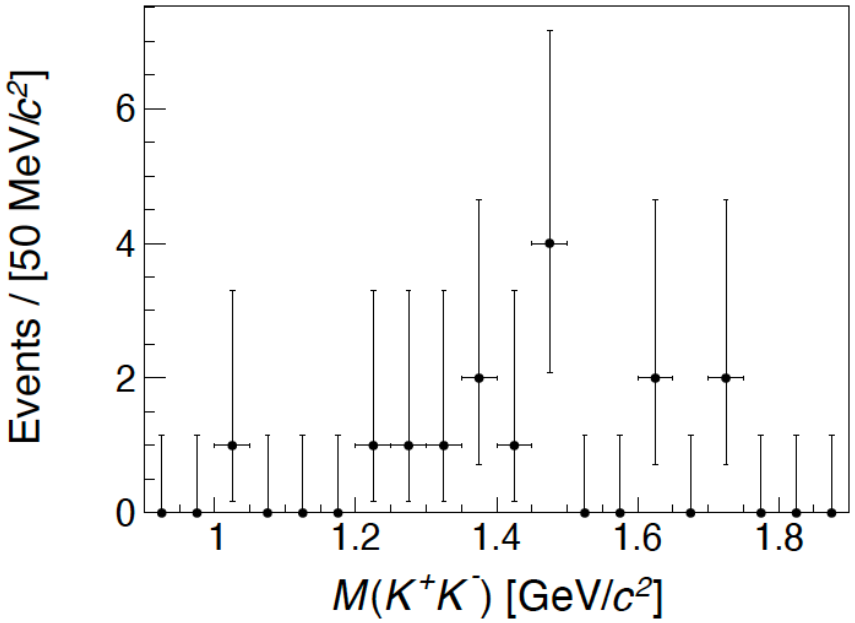
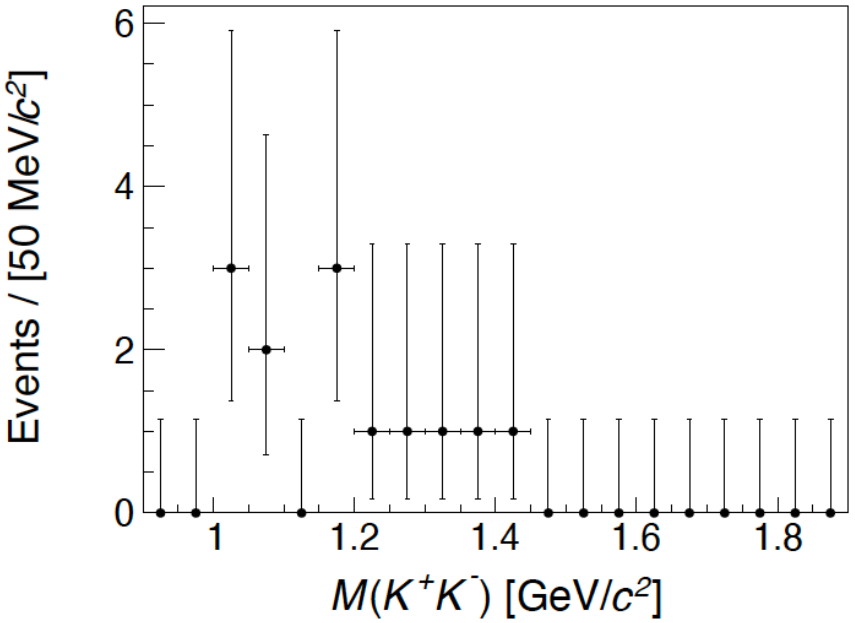




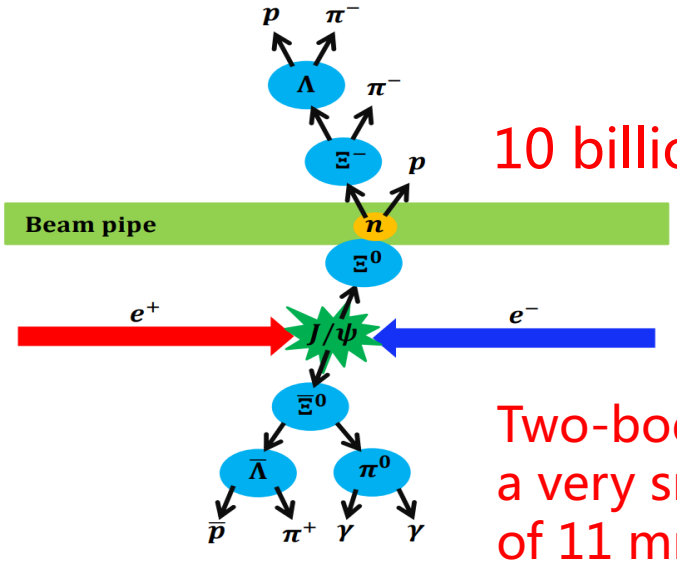
Due to limited statistics, it is difficult to extract the contributions of intermediate states.

$\Xi^0 n \to \Xi^- p$

PRL 130, 251902 (2023)

Reaction chain :

$J/\psi \to \Xi^0\bar{\Xi}^0$, $\bar{\Xi}^0 \to \bar{\Lambda}\pi^0$, $\bar{\Lambda} \to \bar{p}\pi^+$, $\pi^0 \to \gamma\gamma$,
$\Xi^0 n \to \Xi^- p$, $\Xi^- \to \Lambda\pi^-$, $\Lambda \to p\pi^-$.



10 billion J/ψ data

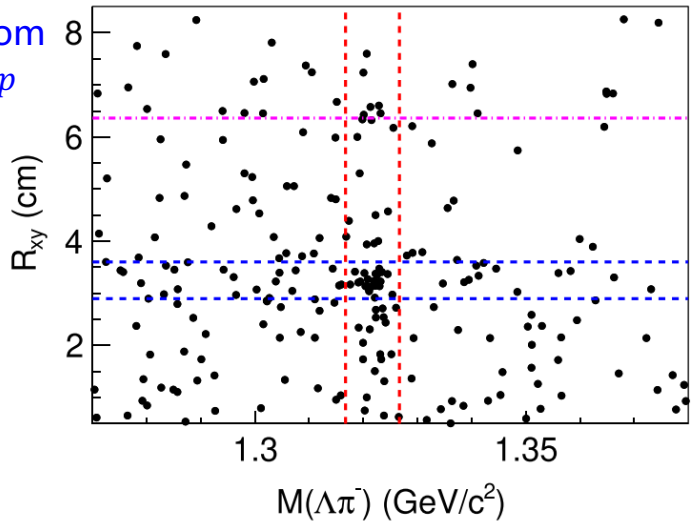
Two-body decay, $P_{\Xi^0} \approx 0.818\ \mathrm{GeV}/c$, a very small horizontal crossing angle of 11 mrad for e^+ and e^- beams.

Analysis method :

Using $\bar{\Xi}^0$ to tag the event and requiring the recoiling mass in Ξ^0 region. Then reconstructing Ξ^- and p in the signal side.

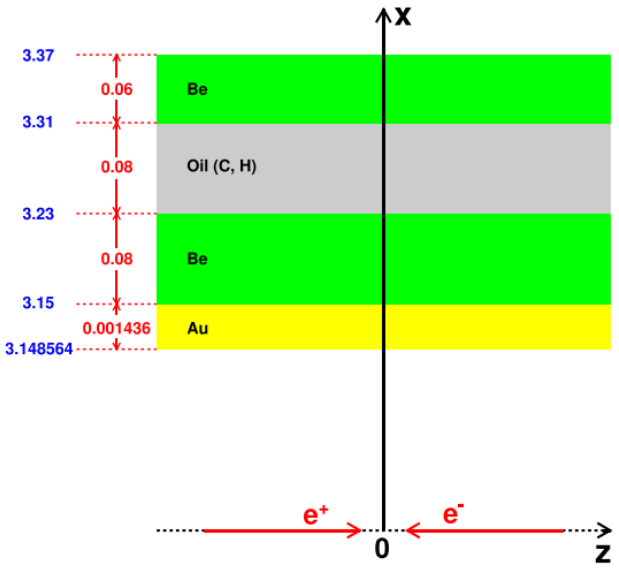
$\Xi^0 n \to \Xi^- p$

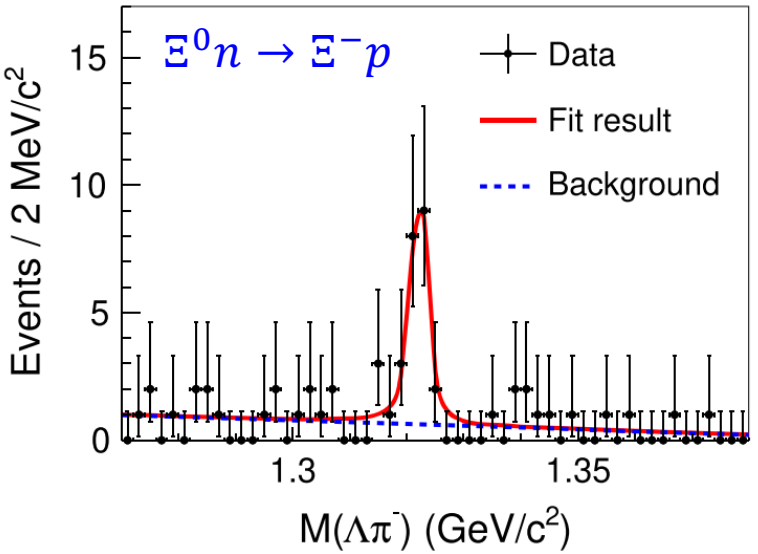
R_{xy} is distance from reconstructed $\Xi^- p$ vertex to z axis



Inner wall of MDC

Beam pipe





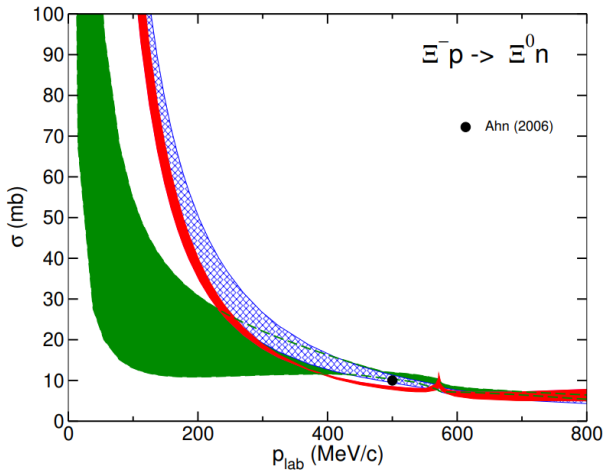
$N = 22.9 \pm 5.5$

$S = 7.1\sigma$

$\Xi^0 n \to \Xi^- p$

The measured cross section of the reaction process $\Xi^0 + {}^9\mathrm{Be} \to \Xi^- + p + {}^8\mathrm{Be}$ is $\sigma(\Xi^0 + {}^9\mathrm{Be} \to \Xi^- + p + {}^8\mathrm{Be}) = (22.1 \pm 5.3_{\mathrm{stat}} \pm 4.5_{\mathrm{sys}})$ mb at $P_{\Xi^0} \approx 0.818$ GeV/c.

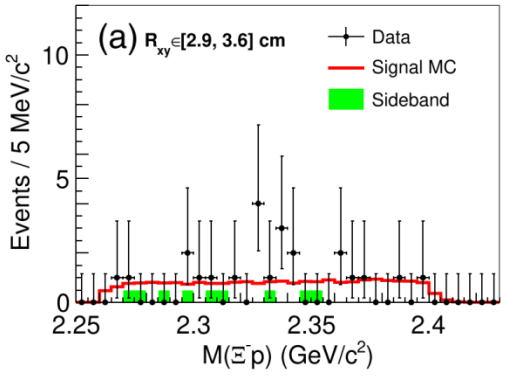
If we take the effective number of reaction neutrons in ${}^9\mathrm{Be}$ nucleus as 3, the cross section of $\Xi^0 n \to \Xi^- p$ for single neutron is determined to be $\sigma(\Xi^0 n \to \Xi^- p) = (7.4 \pm 1.8_{\mathrm{stat}} \pm 1.5_{\mathrm{sys}})$ mb, consistent with theoretical predictions.

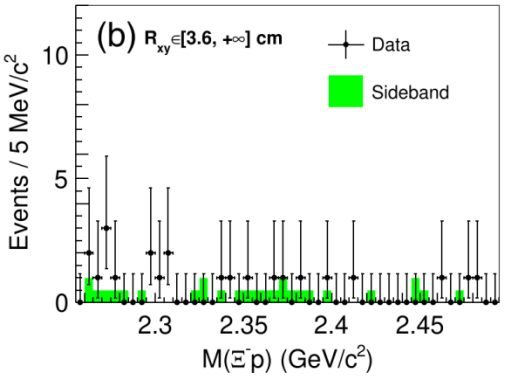


LO : H. Polinder, J.H., U.-G. Meißner, PLB 653 (2007) 29

NLO16: J.H., U.-G. Meißner, S. Petschauer, NPA 954 (2016) 273

NLO19: J.H., U.-G. Meißner, EPJA 55 (2019) 23

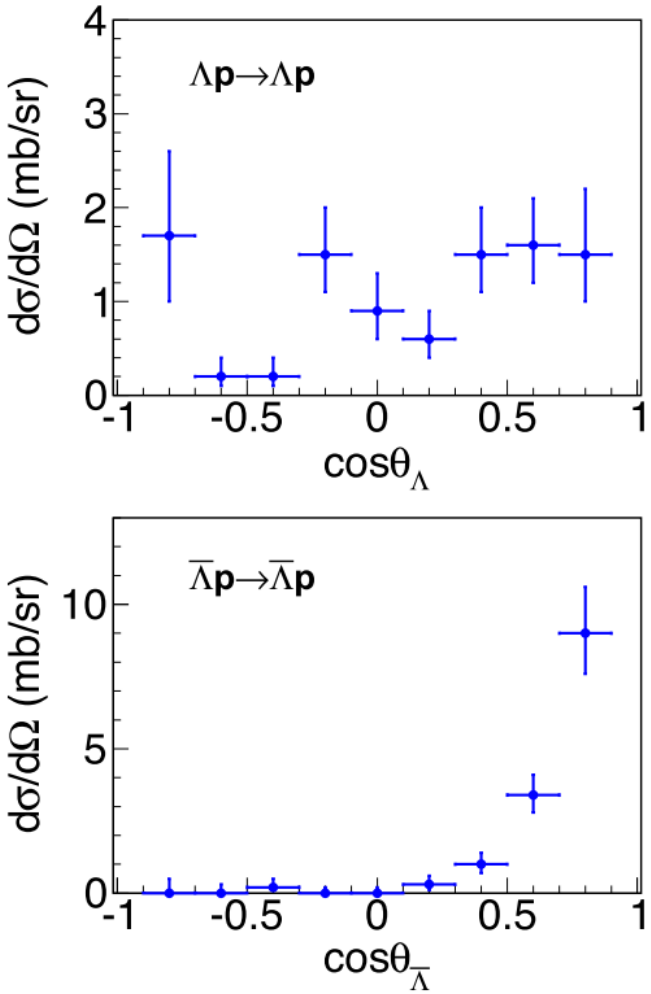




No significant H-dibaryon signals are seen

This work is the first study of hyperon-nucleon interaction in electron-positron collisions, and opens up a new direction for such research.

$\Lambda p \to \Lambda p$ and $\bar{\Lambda} p \to \bar{\Lambda} p$



First measurement of antihyperon-nucleon reaction

PRL 132, 231902 (2024)

$\cos\theta_{\Lambda/\bar{\Lambda}}$	N_i^{sig}	ϵ_i (%)	$(d\sigma/d\Omega)$ (mb/sr)
$[-0.9,-0.7]$	$(5.0^{+2.6}_{-1.9}, 0.0^{+1.1}_{-0.0})$	(6.94,4.93)	$(1.7^{+0.9}_{-0.7}, 0.0^{+0.5}_{-0.0})$
$(-0.7,-0.5]$	$(1.0^{+1.4}_{-0.7}, 0.0^{+1.1}_{-0.0})$	(14.13,10.44)	$(0.2^{+0.2}_{-0.1}, 0.0^{+0.3}_{-0.0})$
$(-0.5,-0.3]$	$(1.0^{+1.4}_{-0.7}, 1.0^{+1.4}_{-0.7})$	(17.32,13.27)	$(0.2^{+0.2}_{-0.1}, 0.2^{+0.3}_{-0.1})$
$(-0.3,-0.1]$	$(11.0^{+3.7}_{-3.0}, 0.0^{+1.1}_{-0.0})$	(17.74,14.66)	$(1.5^{+0.5}_{-0.4}, 0.0^{+0.2}_{-0.0})$
$(-0.1, 0.1]$	$(6.9^{+3.0}_{-2.3}, 0.0^{+1.1}_{-0.0})$	(19.11,15.79)	$(0.9^{+0.4}_{-0.3}, 0.0^{+0.2}_{-0.0})$
$(0.1, 0.3]$	$(5.0^{+2.6}_{-1.9}, 2.0^{+1.8}_{-1.1})$	(19.53,16.82)	$(0.6^{+0.3}_{-0.2}, 0.3^{+0.3}_{-0.2})$
$(0.3, 0.5]$	$(12.0^{+3.8}_{-3.1}, 7.0^{+3.0}_{-2.3})$	(19.21,17.68)	$(1.5^{+0.5}_{-0.4}, 1.0^{+0.4}_{-0.3})$
$(0.5, 0.7]$	$(13.0^{+3.9}_{-3.3}, 25.0^{+5.3}_{-4.7})$	(19.71,17.60)	$(1.6^{+0.5}_{-0.4}, 3.4^{+0.7}_{-0.6})$
$(0.7, 0.9]$	$(6.0^{+2.8}_{-2.1}, 37.0^{+6.4}_{-5.8})$	(9.80,9.93)	$(1.5^{+0.7}_{-0.5}, 9.0^{+1.6}_{-1.4})$

Cross sections in $-0.9 \leq \cos\theta_{\Lambda/\bar{\Lambda}} \leq 0.9$ are measured to be

$\sigma(\Lambda p \to \Lambda p) = (12.2 \pm 1.6_{\mathrm{stat}} \pm 1.1_{\mathrm{sys}})$ mb and

$\sigma(\bar{\Lambda} p \to \bar{\Lambda} p) = (17.5 \pm 2.1_{\mathrm{stat}} \pm 1.6_{\mathrm{stat}})$ mb

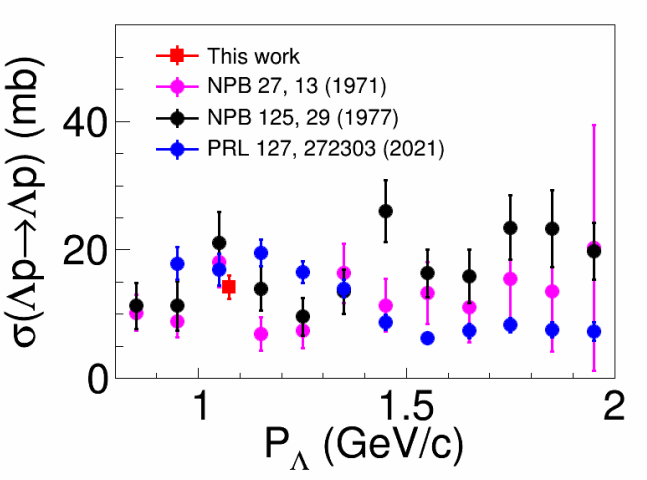
Total cross sections are determined to be

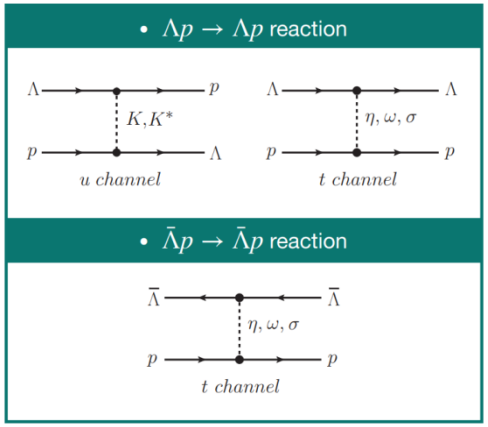
$\sigma_t(\Lambda p \to \Lambda p) = (14.2 \pm 1.8_{\mathrm{stat}} \pm 1.3_{\mathrm{sys}})$ mb and

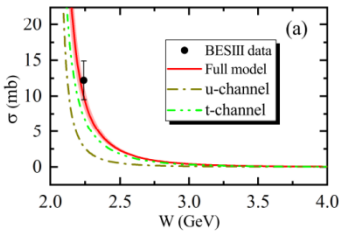
$\sigma_t(\bar{\Lambda} p \to \bar{\Lambda} p) = (27.4 \pm 3.2_{\mathrm{stat}} \pm 2.5_{\mathrm{sys}})$ mb

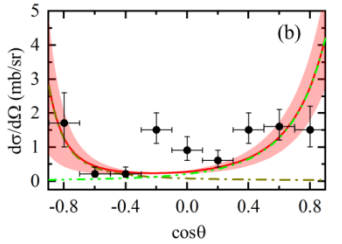
$\Lambda p \to \Lambda p$ and $\bar{\Lambda} p \to \bar{\Lambda} p$

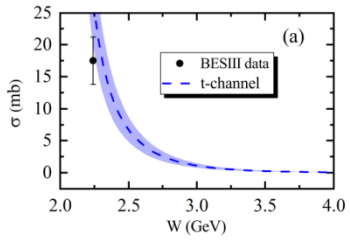
PLB 862, 139321 (2025)

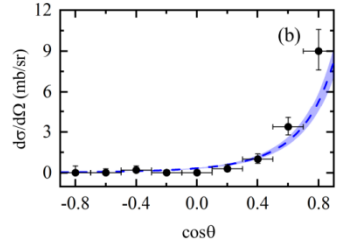












EPJA 60, 119 (2024)

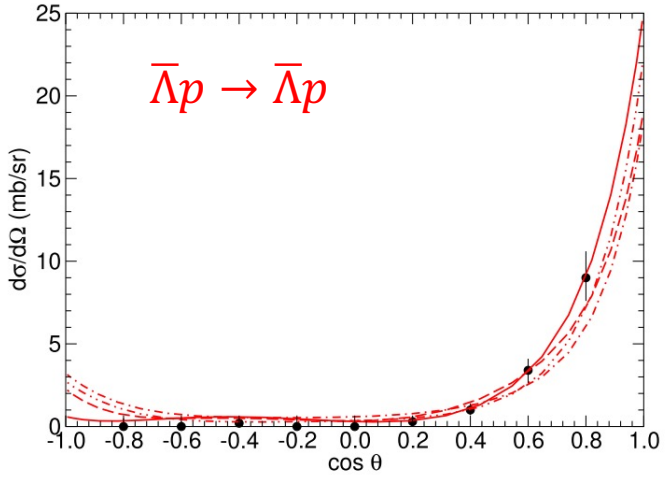
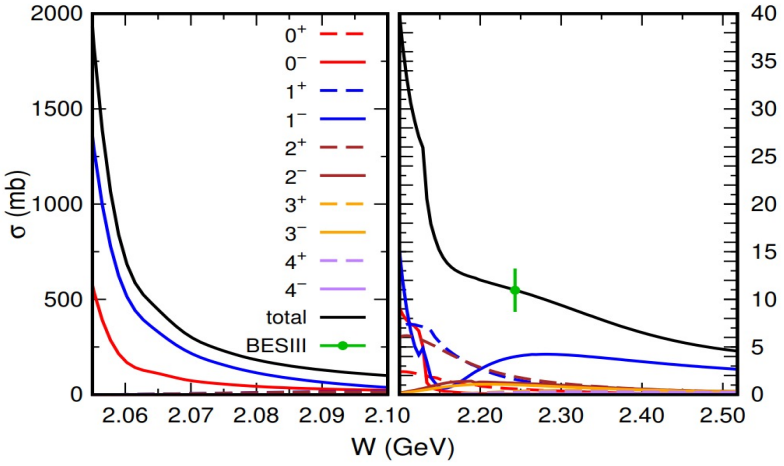


Fig. 1 Differential cross section for $p\bar{\Lambda}$ scattering at $p_{lab} = 1.074 \pm 0.017$ GeV [59]. The curves are predictions by the $\Lambda\bar{\Lambda}$ interactions I-IV, see Ref. [35], at 1.05 GeV/c

PLB 871, 140004 (2025)



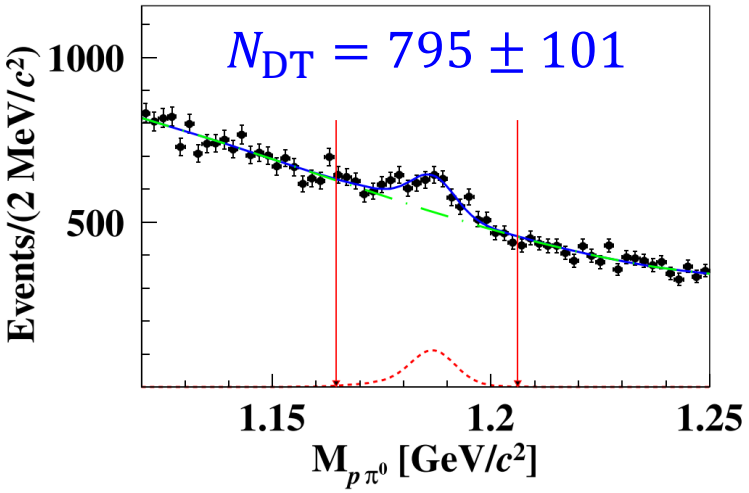
Study of $\Lambda p \to \Sigma^+ n$

PRC 109, L052201 (2024)

Reaction chain :

$J/\psi \to \Lambda\bar{\Lambda}$, $\bar{\Lambda} \to \bar{p}\pi^+$, $\Lambda + N(\text{nucleus}) \to \Sigma^+ + X(\text{anything})$, $\Sigma^+ \to p\pi^0$, $\pi^0 \to \gamma\gamma$.

$\Lambda p \to \Sigma^+ n$



Parameter	Value
$N_{\rm DT}$	795 ± 101
$\epsilon_{\rm sig}$	24.32%
$\mathcal{L}_\Lambda$	$(17.00 \pm 0.01) \times 10^{28}\ \text{cm}^{-2}$
$\mathcal{B}(\Sigma^+ \to p\pi^0)$	$(51.57 \pm 0.30)\%$

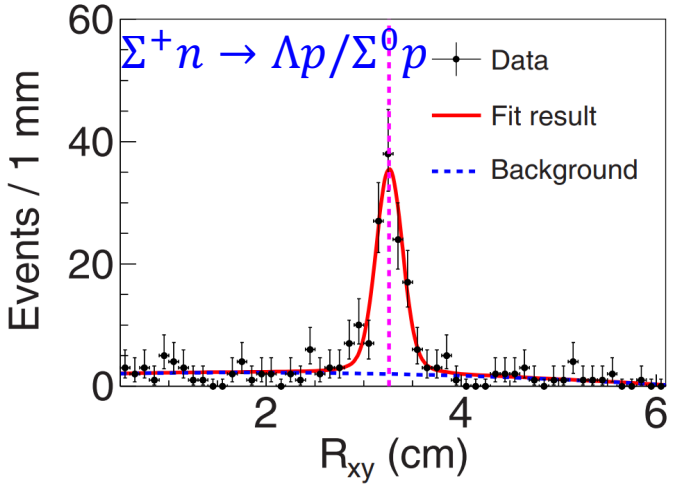
The measured cross section of the reaction process $\Lambda + {}^9\text{Be} \to \Sigma^+ + X$ is $\sigma(\Lambda + {}^9\text{Be} \to \Sigma^+ + X) = (37.3 \pm 4.7_{\rm stat} \pm 3.5_{\rm sys})$ mb at $P_\Lambda \approx 1.074$ GeV/c. This work represents the first attempt to investigate Λ-nucleus interaction at an e^+e^- collider.

$\Sigma^+ n \to \Lambda p$ and $\Sigma^+ n \to \Sigma^0 p$

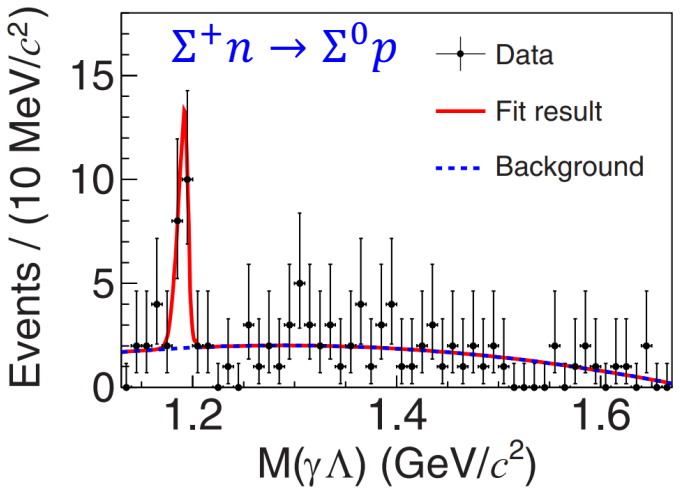
PRC 113, L032201 (2026)

Reaction chain :

$J/\psi \to \Sigma^+ \bar{\Sigma}^-, \bar{\Sigma}^- \to \bar{p}\pi^0, \pi^0 \to \gamma\gamma,$
$\Sigma^+ n \to \Lambda p/\Sigma^0 p, \Sigma^0 \to \gamma\Lambda, \Lambda \to p\pi^-.$



$N_\Lambda = 77.6 \pm 20.8$
$\varepsilon_\Lambda = 14.44\%$



$N_{\Sigma^0} = 14.1 \pm 4.6$
$\varepsilon_{\Sigma^0} = 3.98\%$

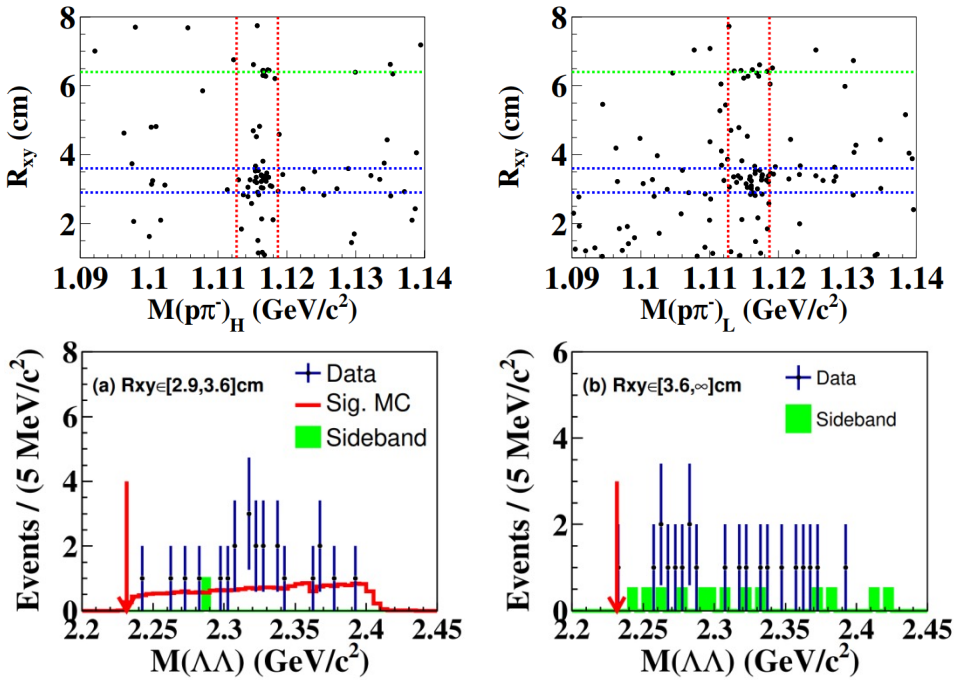
The measured cross sections of the two reactions $\Sigma^+ + {}^9\mathrm{Be} \to \Lambda + p + X$ and $\Sigma^+ + {}^9\mathrm{Be} \to \Sigma^0 + p + X$ are $\sigma(\Sigma^+ + {}^9\mathrm{Be} \to \Lambda + p + X) = (45.2 \pm 12.1_{\mathrm{stat}} \pm 7.2_{\mathrm{sys}})$ mb and $\sigma(\Sigma^+ + {}^9\mathrm{Be} \to \Sigma^0 + p + X) = (29.8 \pm 9.7_{\mathrm{stat}} \pm 6.9_{\mathrm{sys}})$ mb at $P_{\Sigma^+} \approx 0.992$ GeV/c.

$\Xi^0 n \to \Lambda\Lambda X$

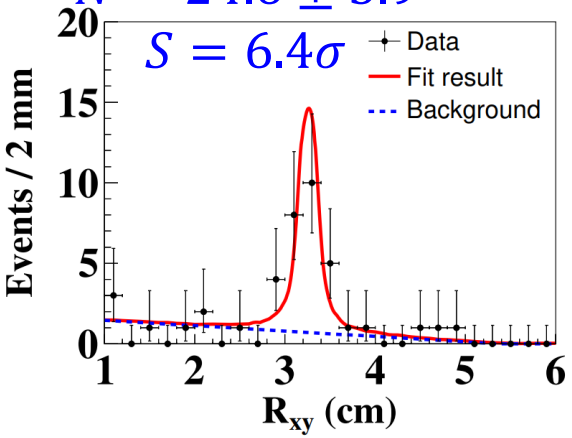
Reaction chain :

arXiv: 2512.04701

$J/\psi \to \Xi^0\bar{\Xi}^0,\ \bar{\Xi}^0 \to \bar{\Lambda}\pi^0,\ \bar{\Lambda} \to \bar{p}\pi^+,\ \pi^0 \to \gamma\gamma,$
$\Xi^0 n \to \Lambda\Lambda X,\ \Lambda \to p\pi^-.$



$N = 24.6 \pm 5.9$



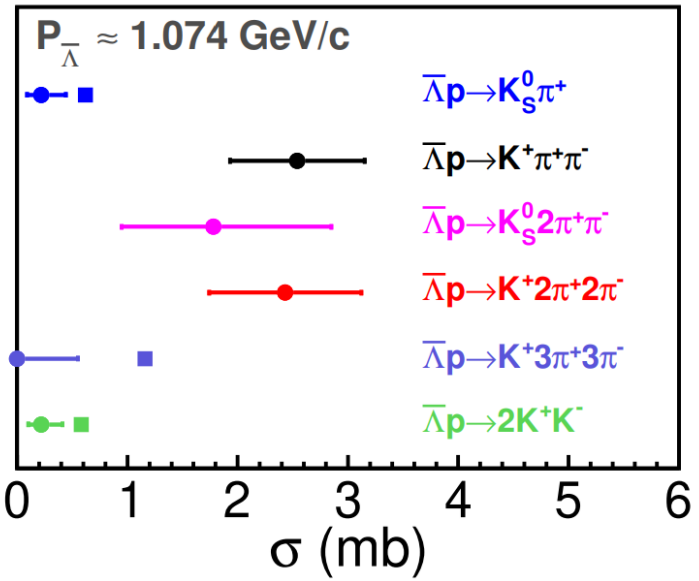
No significant H-dibaryon signals are seen

The measured cross section of the reaction $\Xi^0 + {}^9\mathrm{Be} \to \Lambda + \Lambda + X$ is $\sigma(\Xi^0 + {}^9\mathrm{Be} \to \Lambda + \Lambda + X) = (43.6 \pm 10.5_{\mathrm{stat}} \pm 11.1_{\mathrm{sys}})$ mb at $P_{\Xi^0} \approx 0.818$ GeV/c.
The reaction $\Xi^0 n \to \Lambda\Lambda X$ is mainly composed of the reaction $\Xi^0 n \to \Lambda\Lambda$ and $\Xi^0 n \to \Lambda\Sigma^0 \to \Lambda\Lambda\gamma$.

$\bar{\Lambda}p \to$ light mesons

arXiv: 2602.04276

$P_{\bar{\Lambda}} \approx 1.074$ GeV/c		$0.5 \leq P_{\bar{n}} \leq 0.8$ GeV/c	
$\bar{\Lambda}p \to$	σ (mb)	$\bar{n}p \to$	σ (mb)
$K_S^0\pi^+$	$0.22^{+0.22}_{-0.13} \pm 0.02 (< 0.62)$	$\pi^+\pi^0$	0.16 ± 0.05
$K^+\pi^+\pi^-$	$2.54 \pm 0.56 \pm 0.23$	$2\pi^+\pi^-$	1.16 ± 0.10
$K_S^0 2\pi^+\pi^-$	$1.78^{+1.05}_{-0.81} \pm 0.20$	$2\pi^+\pi^-\pi^0$	10.15 ± 0.51
$K^+2\pi^+2\pi^-$	$2.43 \pm 0.63 \pm 0.27$	$3\pi^+2\pi^-$	2.41 ± 0.18
$K^+3\pi^+3\pi^-$	$0.00^{+0.55}_{-0.00} \pm 0.00 (< 1.16)$	$3\pi^+2\pi^-\pi^0$	4.86 ± 0.31
$2K^+K^-$	$0.22^{+0.19}_{-0.12} \pm 0.02 (< 0.58)$	$4\pi^+3\pi^-$	0.31 ± 0.08
		$4\pi^+3\pi^-\pi^0$	0.05 ± 0.02



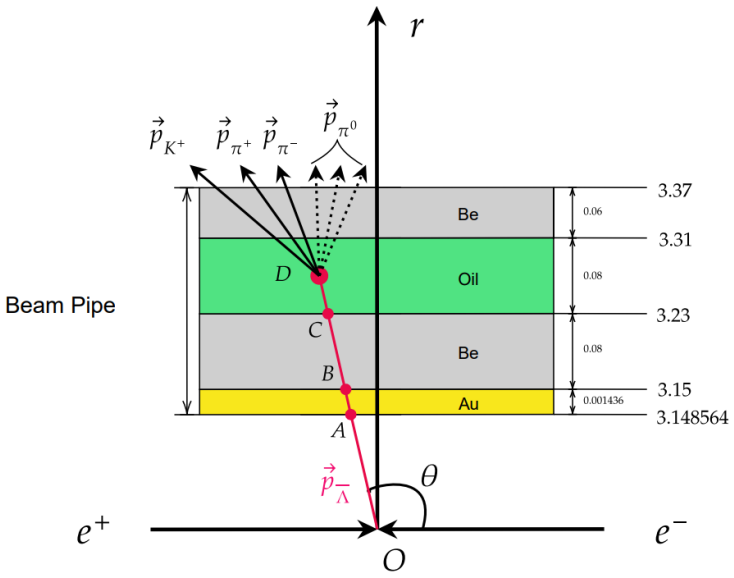
A similar behavior is found for the reactions $\bar{\Lambda}p \to KN\pi$ and $\bar{n}p \to \pi N\pi$ $(N \geq 1)$, the results are useful to understand antibaryon-baryon interaction in a unified perspective.

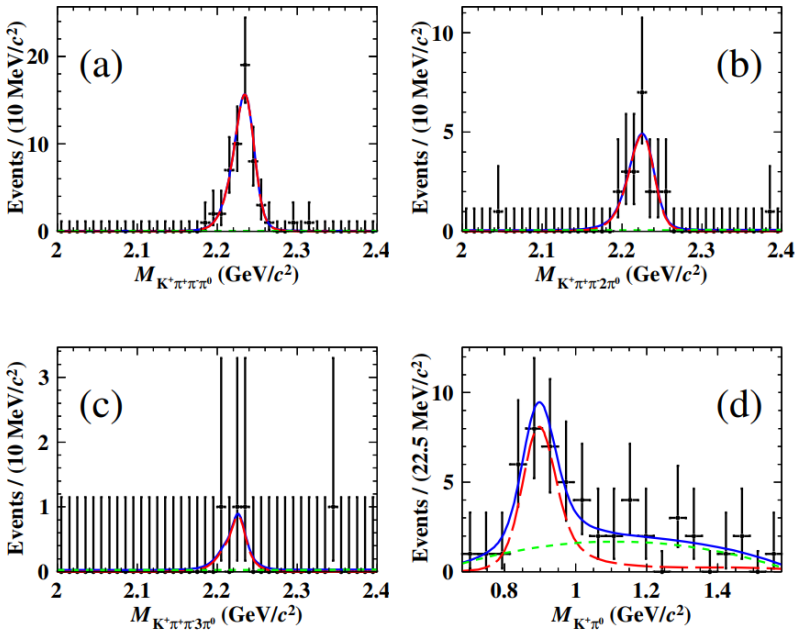
$\bar{\Lambda}p \to K^+\pi^+\pi^-(k)\pi^0$

arXiv: 2602.01282

Reaction chain :

$J/\psi \to \Lambda\bar{\Lambda}, \Lambda \to p\pi^-, \bar{\Lambda}p \to K^+\pi^+\pi^-(k)\pi^0.$

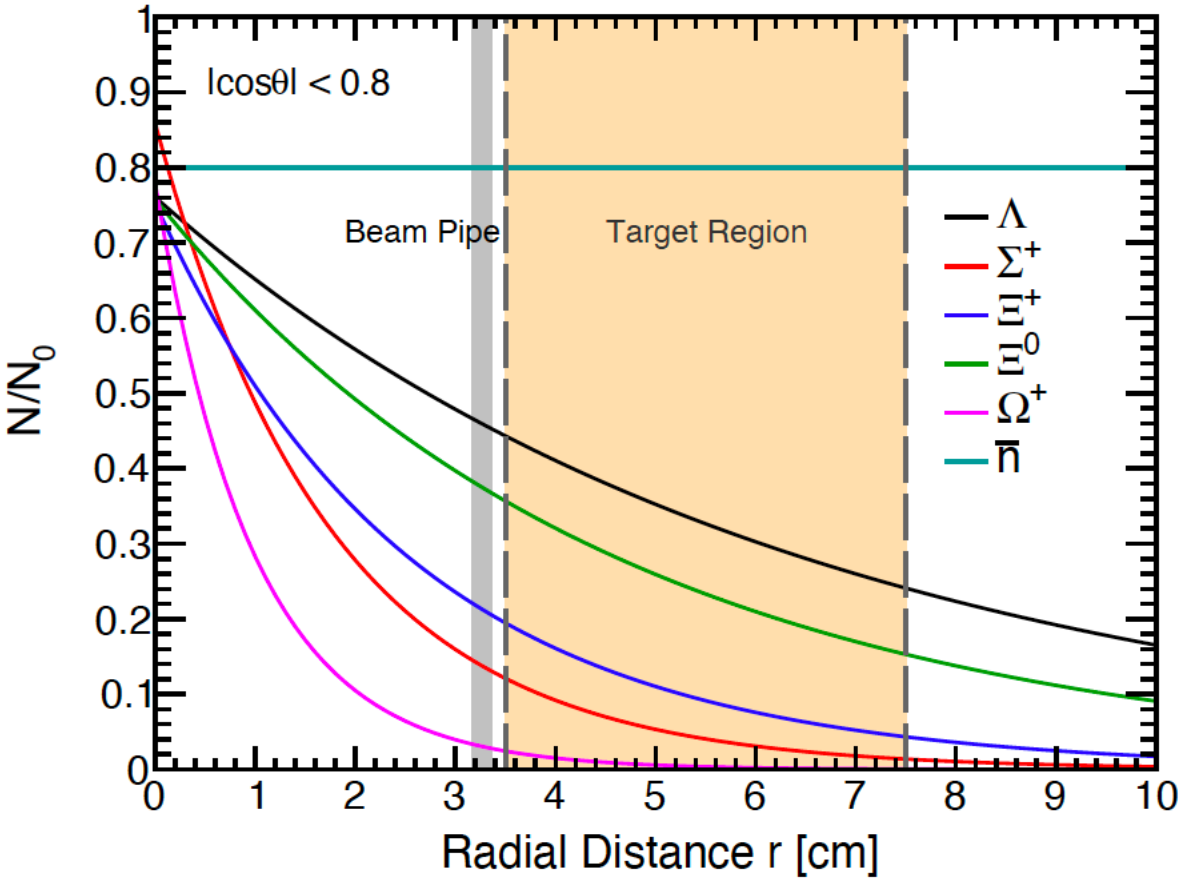




Channel	Cross section (upper limit)	Sig
$\bar{\Lambda}p \to K^+\pi^+\pi^-\pi^0$	$8.5^{+1.2}_{-1.1} \pm 0.4$	12.9σ
$\bar{\Lambda}p \to K^+\pi^+\pi^-2\pi^0$	$7.9^{+1.9}_{-1.7} \pm 0.4$	6.9σ
$\bar{\Lambda}p \to K^+\pi^+\pi^-3\pi^0$	$3.1^{+2.2}_{-1.5} \pm 0.2$ (< 7.2)	2.1σ
$\bar{\Lambda}p \to K^*(892)^+\pi^+\pi^-$	$12.5^{+3.8}_{-3.4} \pm 1.2$	3.2σ

arXiv 2603.16075, submitted to PRD

Precision Y N and $\bar{n}$N measurements with an LH2/LD2 target in the BESIII detector



How to increase the statistics? 1. More target material

arXiv 2603.16075, submitted to PRD

Precision Y N and $\bar{n}$N measurements with an LH2/LD2 target in the BESIII detector

Process	$N_{\rm obs}$ (BP)	σ (mb)	$N_{\rm obs}$ (LH_2/LD_2)
$\Lambda + p_f \to \Lambda + p$	60.9 ± 7.8	$12.2 \pm 1.6 \pm 1.1$	$\sim 2{,}400$
$\bar{\Lambda} + p_f \to \bar{\Lambda} + p$	72.0 ± 8.5	$27.4 \pm 3.2 \pm 2.5$	$\sim 2{,}800$
$\Lambda + p \to \Sigma^+ + X$	795 ± 101	$19.3 \pm 2.4 \pm 1.8$	$\sim 3{,}900$
$\Sigma^+ + n \to \Lambda p$	77.6 ± 20.8	$45.2 \pm 12.1 \pm 7.2$	~ 200
$\Sigma^+ + n \to \Sigma^0 p$	48.6 ± 15.9	$29.8 \pm 9.7 \pm 6.9$	~ 120
$\Xi^0 + n \to \Xi^- + p$	22.9 ± 5.5	$22.1 \pm 5.3 \pm 4.5$	~ 110
$\bar{n} + p_f \to 2\pi^+\pi^-$	59.0 ± 7.7	$2.7 \pm 0.3 \pm 0.3$	$\sim 3{,}200$
$\bar{n} + p_f \to 2\pi^+\pi^-\pi^0$	182.0 ± 13.5	$10.8 \pm 0.8 \pm 0.9$	$\sim 10{,}000$
$\bar{n} + p_f \to 2\pi^+\pi^-2\pi^0$	97.7 ± 10.0	$12.6 \pm 1.3 \pm 1.0$	$\sim 5{,}400$

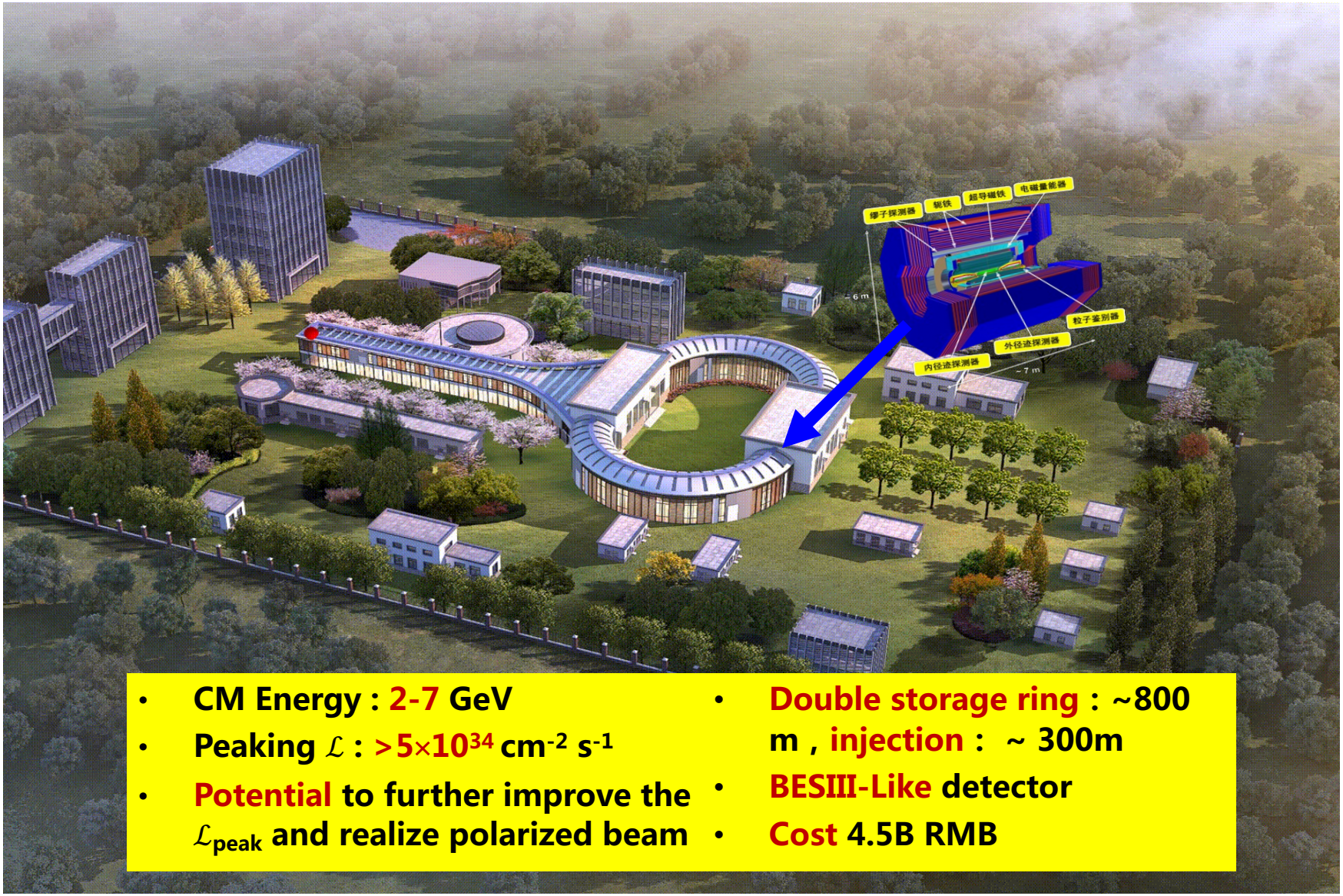
How to increase the statistics? 1. More target material

A super J/ψ factory with 10^{12} J/ψ events per year

- Design luminosity = O(100) × $\mathscr{L}$@BESIII ~ 10^{35} $cm^{-2}s^{-1}$
  - ✓ Existing proposals: STCF (China), SCTF (Novosibirsk)
- Detector improvements vs. BESIII: tracking, PID, γ detection
- (1-3)×10^{12} J/ψ events/year = 100 × BESIII sample
- Further improvements to expand range of physics topics
  - ✓ Reduce the diameter of the beam pipe
  - ✓ Interchangeable custom targets inside the detector
  - ✓ Subdetector for specific final states, e.g. deuteron, triton, …

How to increase the statistics? 2. Higher beam luminosity

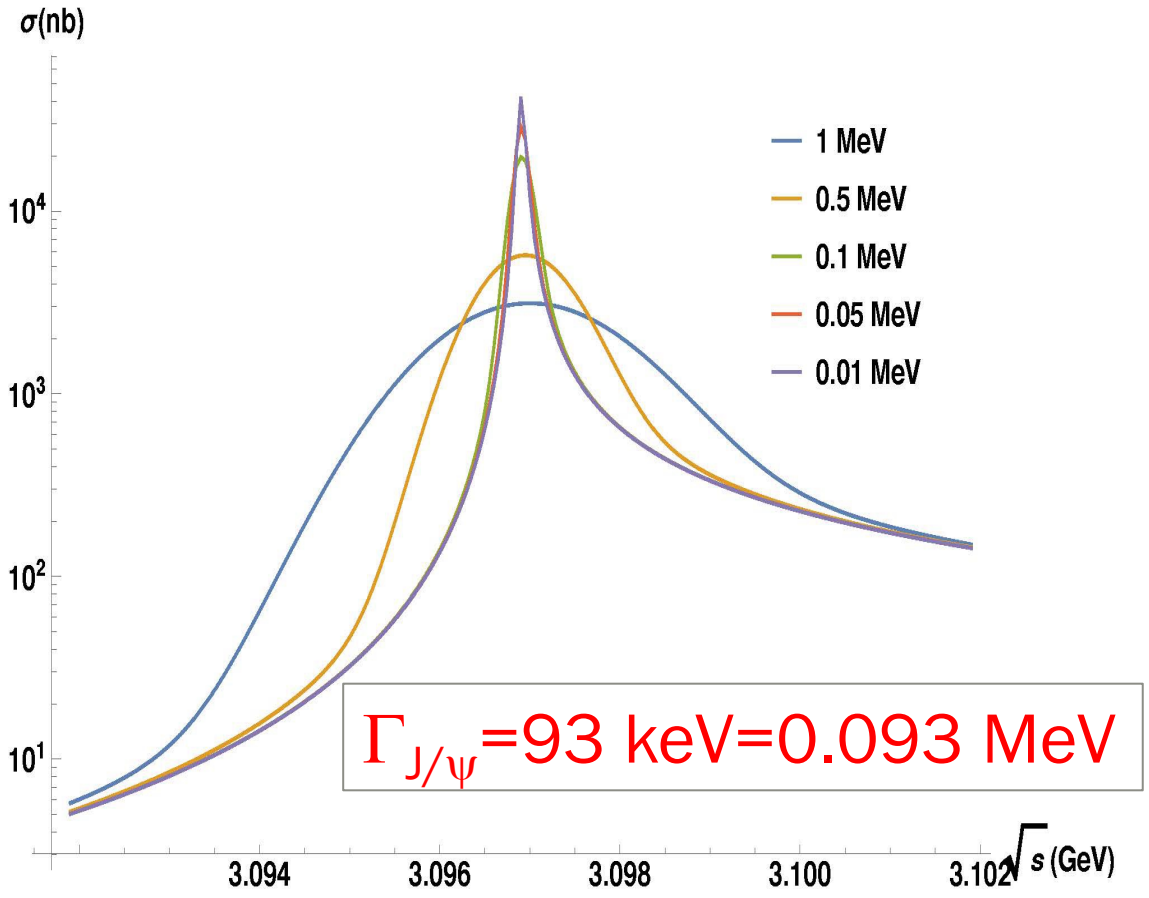
STCF in China



- CM Energy : 2-7 GeV
- Peaking $\mathcal{L}$: $>5\times10^{34}$ cm^{-2} s^{-1}
- Potential to further improve the $\mathcal{L}_{peak}$ and realize polarized beam
- Double storage ring : ~800 m , injection : ~ 300m
- BESIII-Like detector
- Cost 4.5B RMB

STCF workshop, Guangzhou, 2022

A hyper J/ψ factory with 10^{13} J/ψ events?



Two ways of improving J/ψ production rate:

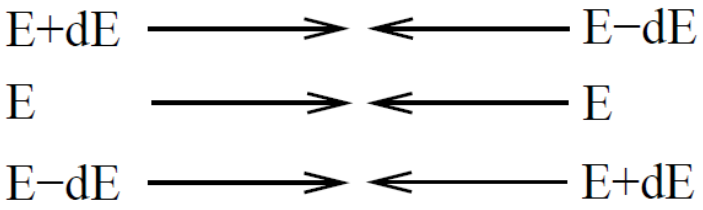
1. Increase luminosity
2. Reduce energy spread

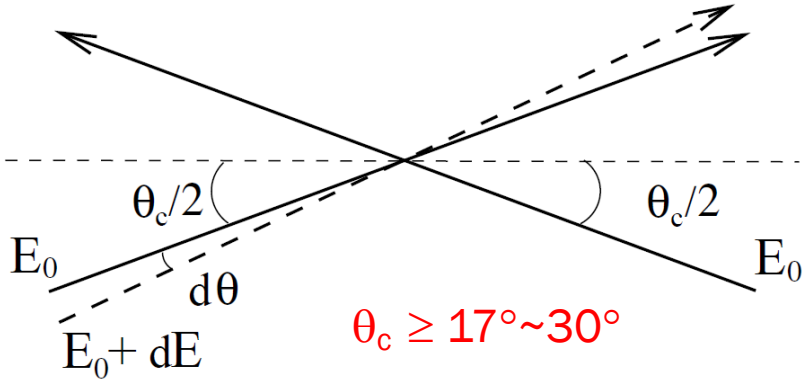
Energy spread (MeV)	Cross section (nb)
1	3,100
0.5	5,700
0.1	20,000
0.05	29,000
0.01	42,000

Numbers & plot from Yuping Guo

A new scheme of monochromatization?

V. I. Telnov, 2008.13668v3
Monochromatization of e^+e^- colliders with a large crossing angle





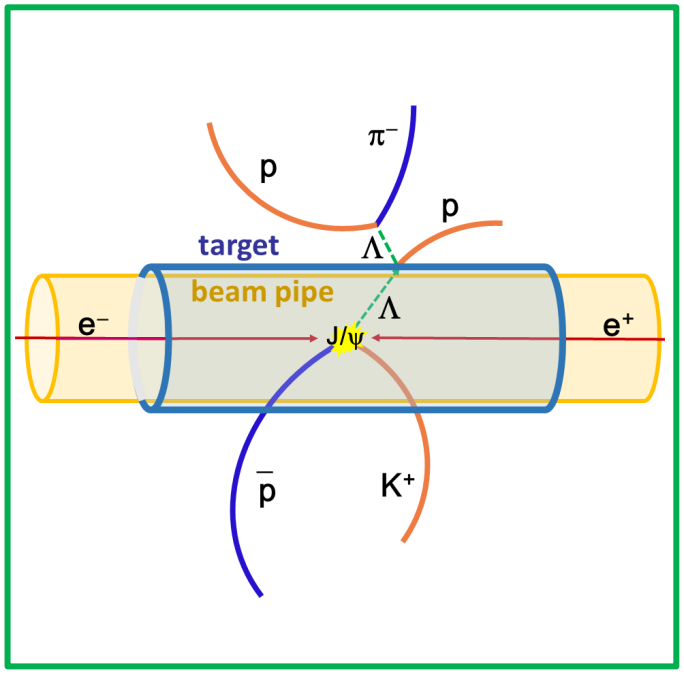
Existing monochromatization scheme for head-on collisions will reduce luminosity significantly

New scheme: Provide the beams with an angular dispersion such that a beam particle arrives to the IP with a horizontal angle that depends on its energy.

$$\sigma_W/W \sim (3\text{–}5) \times 10^{-6}$$

σW=10-15 keV @ J/ψ peak
and J/ψ is moving!

Summary: Do fixed target experiments @ a super J/ψ factory



- Super (or hyper) J/ψ factory
  - *e^+e^- annihilation @ 3.097 GeV; O($10^{12\text{-}13}$) J/ψ events/year*
  - *State of the art detector*
  - *Variety of custom removable targets*
  - *Smaller beam pipe*
- High quality sources of long lived (anti-)hyperons and $\bar{n}$ for many different kinds of experiments
- Same software, similar systematic effects
- No need to share beam time
- No need for additional resources, additional infrastructure, minimal further investments
- A variety of physics topics

Thanks very much!