Hyperon Physics at BESIII

WIN2023

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on behalf of BESIII collaboration

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Outline

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CP violation in hyperon decays

PART.01

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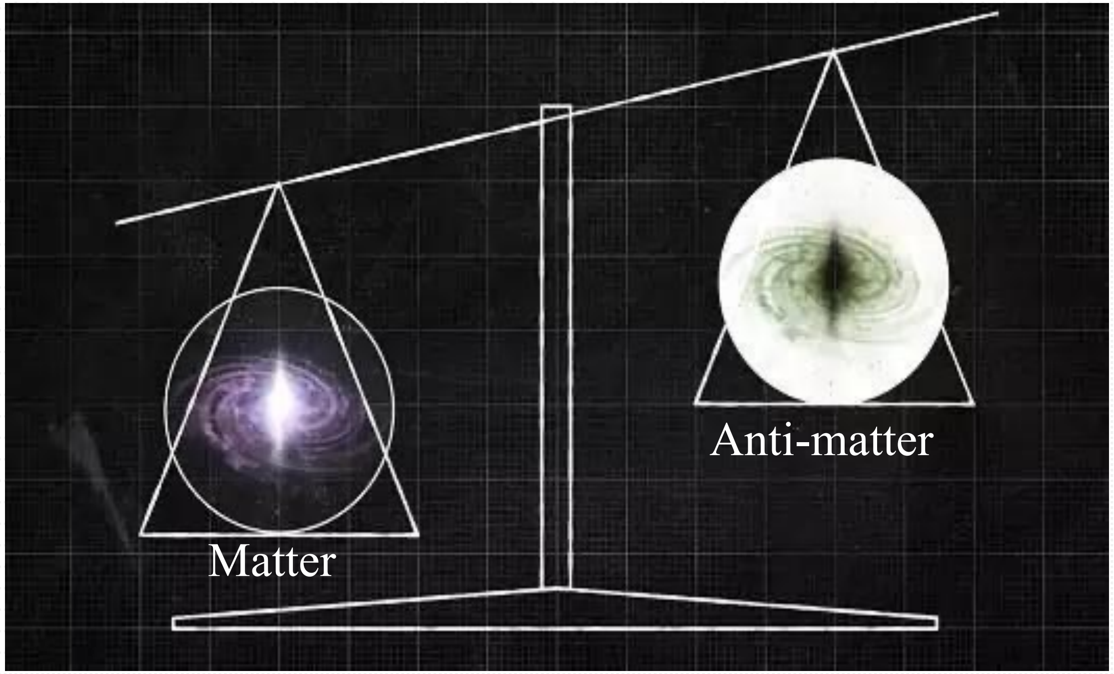
Mystery of matter-antimatter asymmetry



- According to the Big Bang theory:
  - Matter and anti-matter have the same amount
- The observed universe is matter dominant:

$$(n_B - n_{\bar{B}})/n_\gamma \sim 10^{-10}$$

New Journal of Physics 14 (2012) 095012

- Sakharov three conditions require:
  1. Baryon number violation
  2. C and CP violation
  3. Thermal non-equilibrium

Pisma Zh. Eksp. Teor. Fiz., 1967, 5: 32-35

CP violation (CPV)

$$V_{CKM} = \begin{pmatrix} c_{12}c_{13} & s_{12}c_{13} & s_{13}e^{-i\delta_{13}} \\ -s_{12}c_{23} - c_{12}s_{23}s_{13}e^{i\delta_{13}} & c_{12}c_{23} - s_{12}s_{23}s_{13}e^{i\delta_{13}} & s_{23}c_{13} \\ s_{12}c_{23} - c_{12}s_{23}s_{13}e^{i\delta_{13}} & -c_{12}s_{23} - s_{12}c_{23}s_{13}e^{i\delta_{13}} & c_{23}c \end{pmatrix}$$

$$\delta_{13} \rightarrow V_{CKM}^{*} \neq V_{CKM} \rightarrow CPV!$$

Chien-Shiung Wu

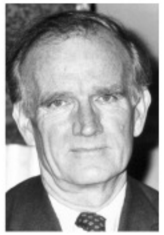
C.N. Yang   T.D. Lee

1. CPV has been founded at K, B, D meson systems, but not enough to explain matter dominant Universe;

2. No CPV is observed in baryon sector!

P violation	K meson CPV	B meson CPV	D meson CPV	Baryon ?
1957	1964	2001	2019	

James Watson Cronin



Val Logsdon Fitch

[1] Phys. Rev. 104 (1956) 254-258
[2] Phys. Rev. 105 (1957) 1413-1414
[3] Phys. Rev. Lett., 1964, 13: 138-140
[4] Phys. Rev. Lett., 2001, 87: 091801
[5] Phys. Rev. Lett., 2001, 87: 091802
[6] Phys. Rev. Lett., **122**, 211803 (2019)

Hyperon non-leptonic weak decay

The amplitude of spin-1/2 hyperon B_i decay to a spin-1/2 baryon B_f and π:

$$\boldsymbol{\mathcal{A}} \sim S\sigma_0 + P\boldsymbol{\sigma}\cdot\hat{\boldsymbol{n}}$$

The decay parameters are defined as:

$$\alpha_Y = \frac{2\,\mathrm{Re}\,(S^*P)}{|S|^2+|P|^2}, \quad \beta_Y = \frac{2\,\mathrm{Im}\,(S^*P)}{|S|^2+|P|^2}, \quad \gamma_Y = \frac{|S|^2-|P|^2}{|S|^2+|P|^2}$$

Two complex amplitudes:

$$S = \Sigma^i S_i e^{i(\xi_i^S+\delta_i^S)}, \qquad P = \Sigma^i P_i e^{i(\xi_i^P+\delta_i^P)}$$

Under CP transformation:

$$\bar{S} = -\Sigma^i S_i e^{i(-\xi_i^S+\delta_i^S)}, \qquad \bar{P} = \Sigma^i P_i e^{i(-\xi_i^P+\delta_i^P)}$$

If CP conserved: $S \xrightarrow{CP} -S$, $P \xrightarrow{CP} P$ ⟹ $\alpha_Y \xrightarrow{CP} -\alpha_Y$, $\beta_Y \xrightarrow{CP} -\beta_Y$


General Partial Wave Analysis of the Decay of a Hyperon of Spin $\frac{1}{2}$

T. D. Lee* and C. N. Yang
Institute for Advanced Study, Princeton, New Jersey

(Received October 22, 1957)
Phys. Rev. 108, 1645 (1957)

$$\alpha_Y^2 + \beta_Y^2 + \gamma_Y^2 = 1$$

$$\beta_Y = (1-\alpha_Y^2)^{\frac{1}{2}} sin\phi_Y \;,\; \gamma_Y = (1-\alpha_Y^2)^{\frac{1}{2}} cos\phi_Y$$

Hyperon *CPV* observables

Phys. Rev. Lett. **55**, 162 (1985)
Phys. Rev. D **34**, 833 (1986)
Phys. Rev. D **105**, 116022 (2022)
arXiv:2209.04377

$$A_{CP} = \frac{\alpha + \bar{\alpha}}{\alpha - \bar{\alpha}} \approx -\tan(\delta_P - \delta_S)\tan(\xi_P - \xi_S)$$

If the strong phase difference $\delta_P - \delta_S$ is close to 0, A_{CP} will be suppressed, however, B_{CP} and $\Delta\phi_{CP}$ won't suffer from this problem.

$$B_{CP} = \frac{\beta + \bar{\beta}}{\alpha - \bar{\alpha}} \approx \tan(\xi_P - \xi_S)$$

$$\Delta\phi_{CP} = \frac{\phi + \bar{\phi}}{2} \approx \frac{\alpha}{\sqrt{1-\alpha^2}}\cos\phi\tan(\xi_P - \xi_S)$$

B_{CP} and $\Delta\phi_{CP}$ can be directly determined, if the polarization of the daughter baryon B_f can be measured.
This is a big advantage of $\Xi^{0(-)}$ hyperon compared to Λ or $\Sigma^{\pm}$ hyperon.

Recent results from BESIII

PART.02

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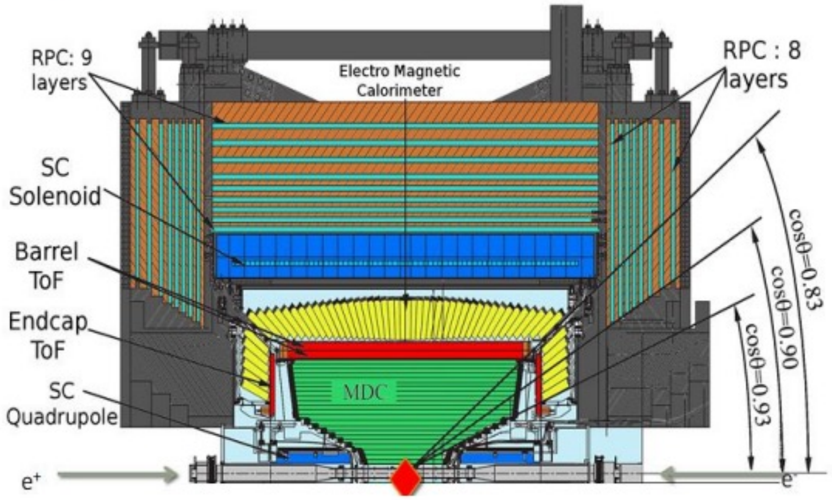
Study hyperons at BESIII

Electromagnetic Calorimeter
CsI(Tl): L=28 cm
Barrel σ_E=2.5%
Endcap σ_E=5.0%

Muon Counter
RPC
Barrel: 9 layers
Endcap: 8 layers
$\sigma_{spatial}$=1.48 cm

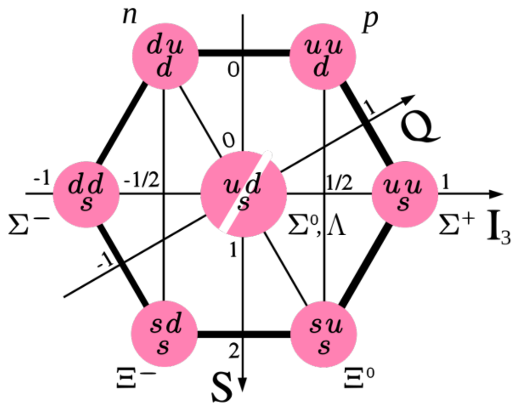


Main Drift Chamber
Small cell, 43 layer
σ_{xy}=130 μm
dE/dx~6%
σ_p/p= 0.5% at 1 GeV

Time Of Flight
Plastic scintillator
σ_T(barrel)=80 ps
σ_T(endcap)=110 ps
(update to 65 ps with MRPC)

With 10 billion J/ψ and 2.7 billion $\psi(3686)$ collected at BESIII.

$\sim 10^7$ entangled hyperon pairs can be studied.

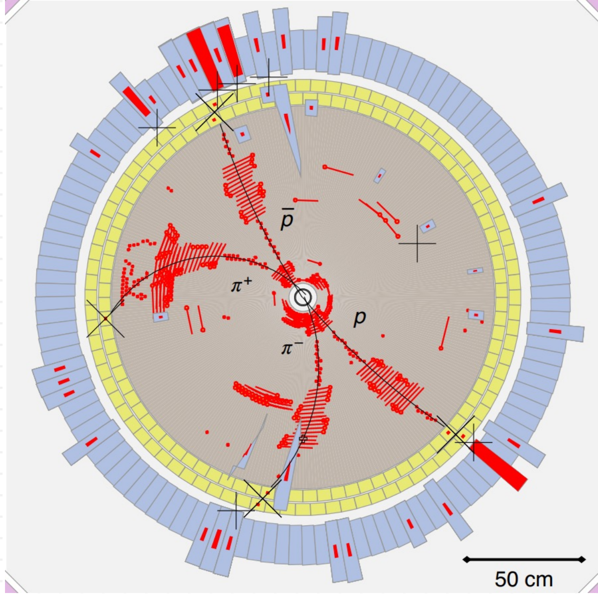


$+\ \Omega^-(sss)$ spin-$\frac{3}{2}$

Front. Phys. 12(5), 121301 (2017)

Decay mode	$B(\times 10^{-3})$	$N_B(\times 10^6)$
$J/\psi \to \Lambda\bar{\Lambda}$	1.89 ± 0.09	$\sim$18.9
$J/\psi \to \Sigma^0\bar{\Sigma}^0$	1.172 ± 0.032	$\sim$11.7
$J/\psi \to \Sigma^+\bar{\Sigma}^-$	1.07 ± 0.04	$\sim$10.7
$J/\psi \to \Xi^0\bar{\Xi}^0$	1.17 ± 0.04	$\sim$11.7
$J/\psi \to \Xi^-\bar{\Xi}^+$	0.97 ± 0.08	$\sim$9.7
$\psi(2S) \to \Omega^-\bar{\Omega}^+$	0.057 ± 0.003	$\sim$0.17

$e^+e^- \to J/\psi \to \Lambda\bar{\Lambda}, \Lambda \to p\pi^-, \ \bar{\Lambda} \to \bar{p}\pi^+$



- Joint amplitude:

$$M = \frac{ie^2}{q^2} j_\mu \bar{u}(p_1)\left(F_1\gamma_\mu + \frac{F_2}{2m} p_\nu \sigma^{\nu\mu}\gamma_5\right) v(p_2)$$

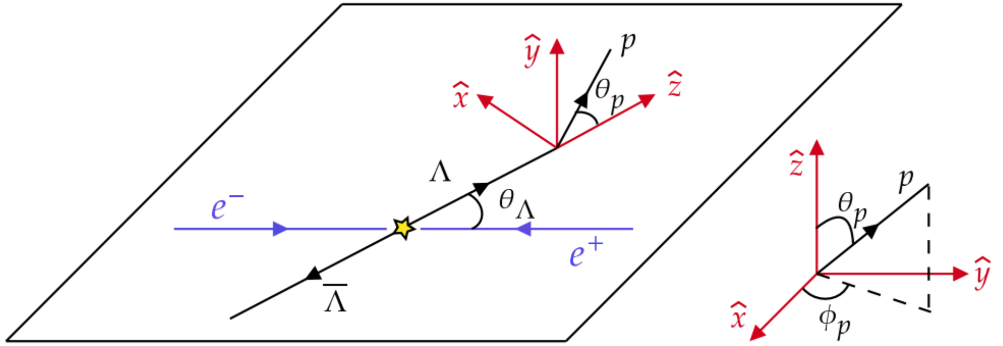
- Differential cross section:

$$d\sigma \sim 1 + \alpha_\psi \cos^2\theta_\Lambda + (\alpha_\psi + \cos^2\theta_\Lambda) s_\Lambda^z s_{\bar{\Lambda}}^z + \sin^2\theta_\Lambda s_\Lambda^x s_{\bar{\Lambda}}^x - \alpha_\psi \sin^2\theta_\Lambda s_\Lambda^y s_{\bar{\Lambda}}^y + \sqrt{1-\alpha_\psi^2}\cos\Delta\Phi \sin\theta_\Lambda \cos\theta_\Lambda (s_\Lambda^x s_{\bar{\Lambda}}^z + s_\Lambda^z s_{\bar{\Lambda}}^x) + \sqrt{1-\alpha_\psi^2}\sin\Delta\Phi \sin\theta_\Lambda \cos\theta_\Lambda (s_\Lambda^y + s_{\bar{\Lambda}}^y)$$

SPIN CORRELATIONS

POLARIZATIONS

- The spin vector of Λ is denoted by $\boldsymbol{s_\Lambda}$
- Only $< s^y >$ could be non-zero, if $\sin\Delta\Phi \neq 0$



Nuovo Cim. A 109, 241 (1996)
Phys. Rev.185 D 75, 074026 (2007)
Nucl. Phys. A190 771, 169 (2006)
Phys. Lett. B 772, 16(2017)

$e^+e^- \to J/\psi \to \Lambda\bar{\Lambda}, \Lambda \to p\pi^-, \bar{\Lambda} \to \bar{p}\pi^+$

Two works of this channel from BESIII:

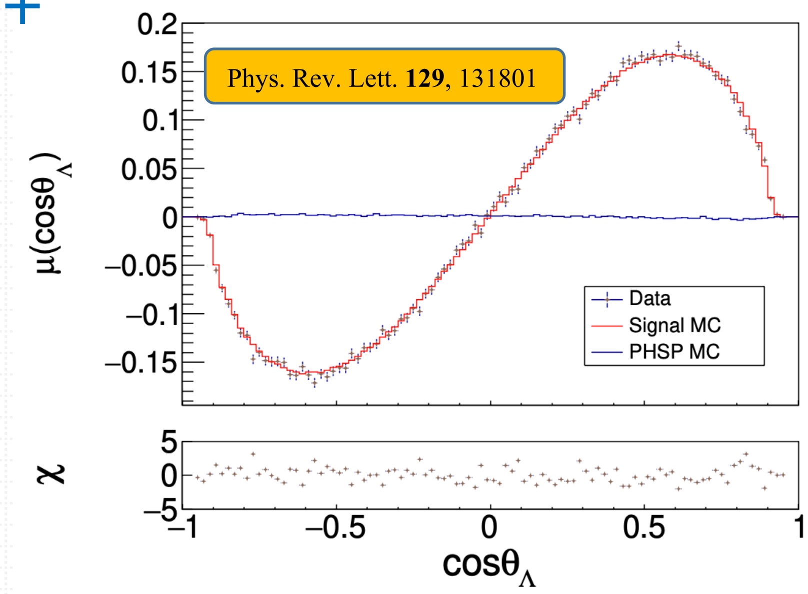
[1] 1.3 billion: Nature Phys.15(2019)631

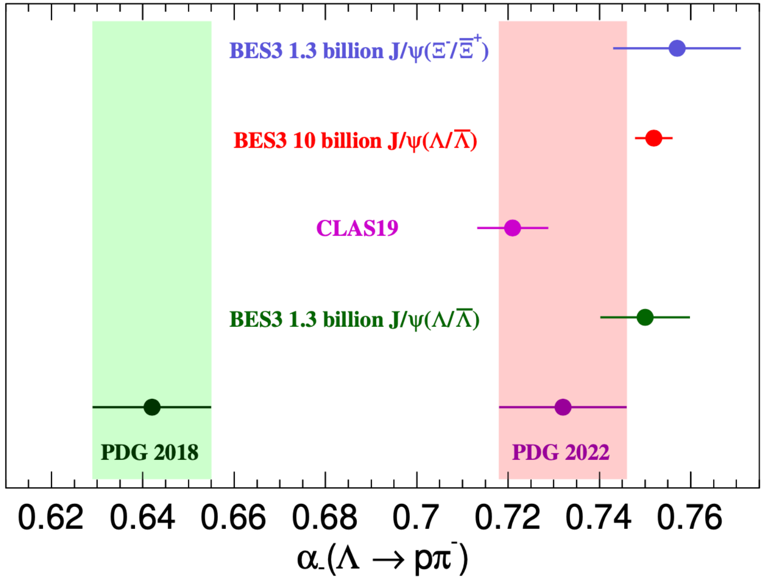
[2] 10 billion: Phys. Rev. Lett. 129 (2022) 13, 131801

Par.	BESIII 10 billion [2]	BESIII 1.3 billion [1]
$\alpha_{J/\psi}$	$0.4748 \pm 0.0022 \pm 0.0031$	$0.461 \pm 0.006 \pm 0.007$
$\Delta\Phi$	$0.7521 \pm 0.0042 \pm 0.0066$	$0.740 \pm 0.010 \pm 0.009$
α_-	$0.7519 \pm 0.0036 \pm 0.0024$	$0.750 \pm 0.009 \pm 0.004$
α_+	$-0.7559 \pm 0.0036 \pm 0.0030$	$-0.758 \pm 0.010 \pm 0.007$
A_{CP}	$-0.0025 \pm 0.0046 \pm 0.0012$	$0.006 \pm 0.012 \pm 0.007$
α_{avg}	$0.7542 \pm 0.0010 \pm 0.0024$	-

- Most precise values for Λ decay parameter
- Most precise *CP* test in the hyperon sector:

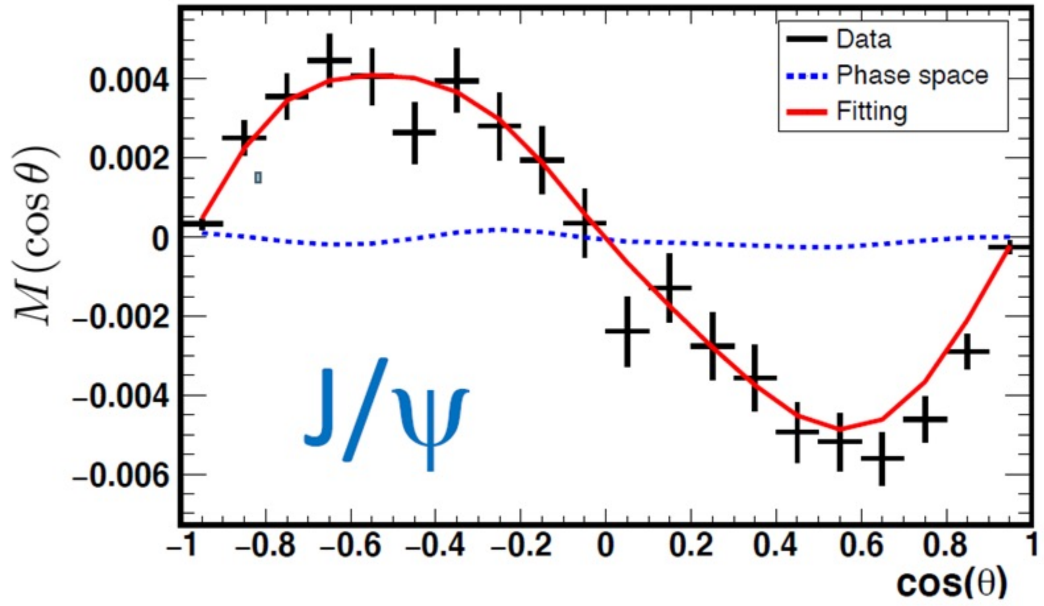
$$A_{CP} = \frac{\alpha + \bar{\alpha}}{\alpha - \bar{\alpha}} = -0.0025 \pm 0.0046 \pm 0.0011$$

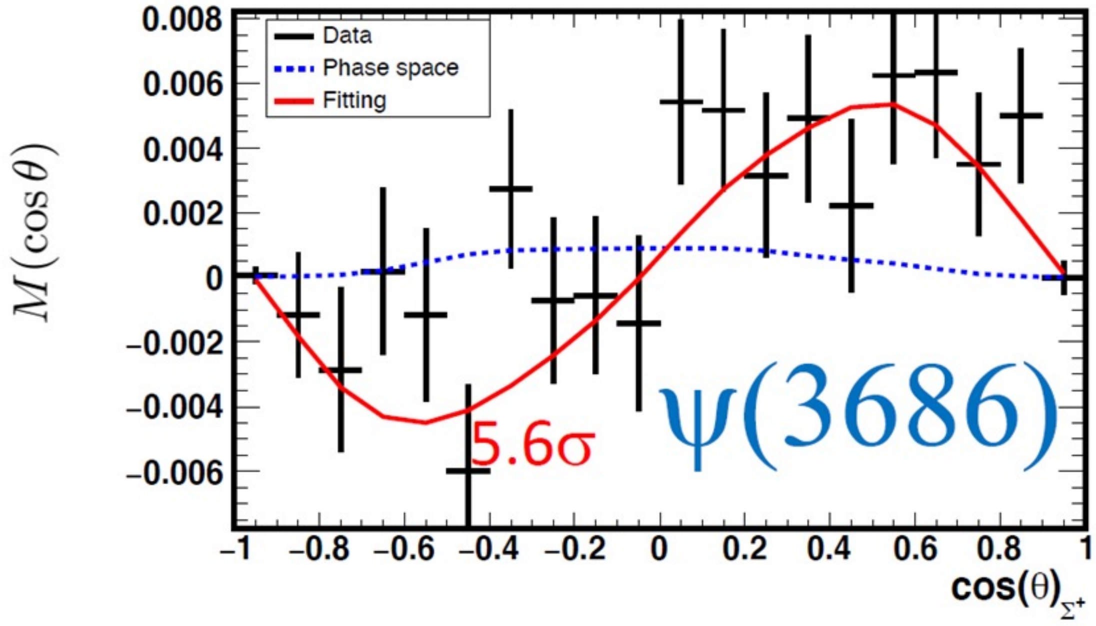




$e^+e^- \to J/\psi$ and $\psi(3686) \to \Sigma^+\bar{\Sigma}^-, \Sigma^+ \to p\pi^0, \bar{\Sigma}^- \to \bar{p}\pi^0$

Phys. Rev. Lett. **125**, 052004 (2020)





Parameter	Measured value
$\alpha_{J/\psi}$	$-0.508 \pm 0.006 \pm 0.004$
$\Delta\Phi_{J/\psi}$	$-0.270 \pm 0.012 \pm 0.009$
$\alpha_{\psi'}$	$0.682 \pm 0.03 \pm 0.011$
$\Delta\Phi_{\psi'}$	$0.379 \pm 0.07 \pm 0.014$
α_0	$-0.998 \pm 0.037 \pm 0.009$
$\bar{\alpha}_0$	$0.990 \pm 0.037 \pm 0.011$

- First CP test in Σ^+ weak decay with 1.3 billion J/ψ and 0.45 billion $\psi(3686)$ data:

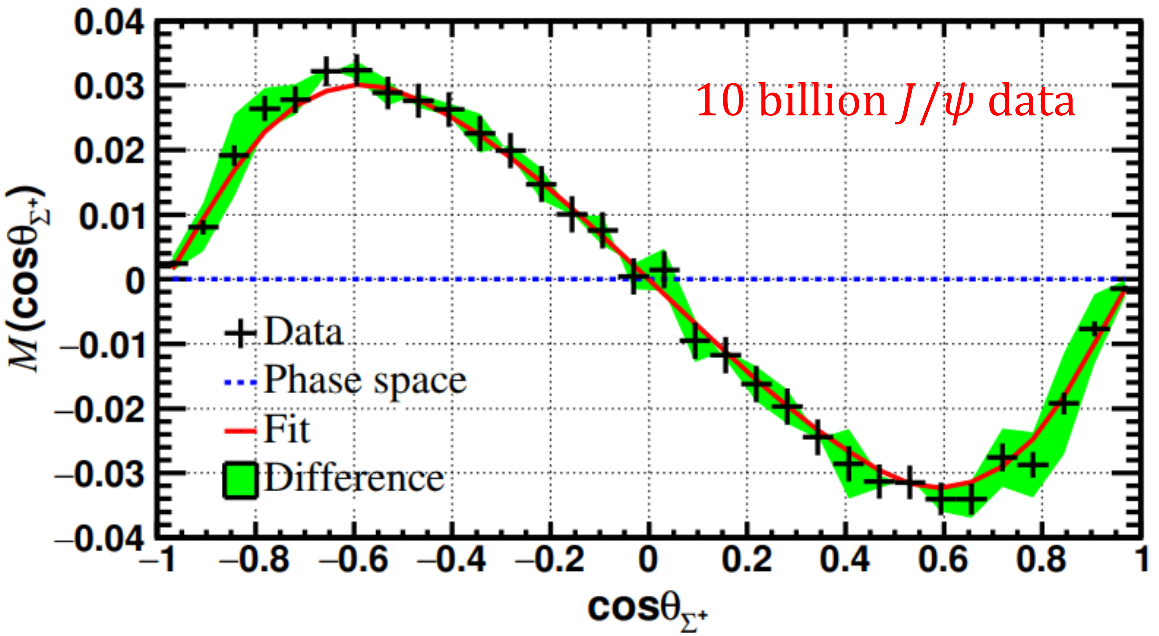
$$A_{CP} = \frac{\alpha + \bar{\alpha}}{\alpha - \bar{\alpha}} = -0.004 \pm 0.037 \pm 0.010$$

- The results with 10 billion J/ψ and 2.7 billion $\psi(3686)$ are undergoing.

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

arxiv: 2304.14655

[1] Phys. Rev. Lett. **125**, 052004(2020)
[2] Phys. Rev. D **21**, 2501 (1980)



parameters	This work	Previous result
$\alpha_{J/\psi}$	$-0.5156 \pm 0.0030 \pm 0.0061$	$-0.508 \pm 0.006 \pm 0.004$ [1]
$\Delta\Phi_{J/\psi}$(rad)	$-0.2772 \pm 0.0044 \pm 0.0041$	$-0.270 \pm 0.012 \pm 0.009$ [1]
$\alpha_+(n\pi^+)$	$-0.0481 \pm 0.0031 \pm 0.0019$	0.068 ± 0.013 (PDG)
$\bar{\alpha}_-(\bar{n}\pi^-)$	$0.0565 \pm 0.0047 \pm 0.0022$	-
α_+/α_0	$-0.0490 \pm 0.0032 \pm 0.0021$	-0.069 ± 0.021 [2]
$\bar{\alpha}_-/\bar{\alpha}_0$	$-0.0571 \pm 0.0053 \pm 0.0032$	-
A_{CP}	$-0.080 \pm 0.052 \pm 0.028$	-
$< \alpha_+ >$	$-0.0506 \pm 0.0026 \pm 0.0019$	-

- First measurement of the decay parameter $\bar{\alpha}_-$ of $\bar{\Sigma}^- \to \bar{n}\pi^-$
- **First time to probe CP violation in the final neutron state for all hyperon decays**

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

$$\mathcal{W}(\vec{\omega},\vec{\zeta}) = \sum_{\mu,\nu=0}^{3} C_{\mu\nu} \sum_{\mu'=0}^{3}\sum_{\nu'=0}^{3} a^{\Xi}_{\mu\mu'} a^{\bar{\Xi}}_{\nu\nu'} a^{\Lambda}_{\mu'0} a^{\bar{\Lambda}}_{\nu'0}$$

Developed by two different methods

Feynman diagram:
Phys. Lett. B **772**, 16 (2017)

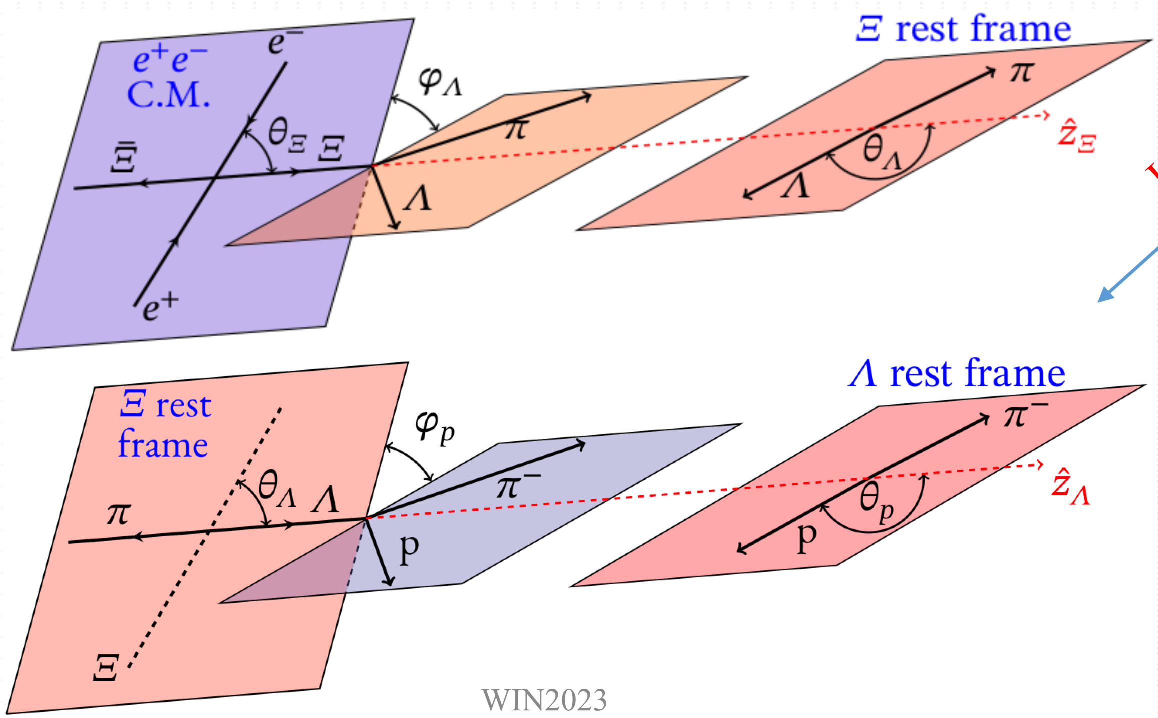
Exactly the same!

Helicity frame:
Phys. Rev. D **99**, 056008 (2019)

$\vec{\omega} = (\alpha_{J/\psi}, \Delta\phi, \alpha_\Xi, \bar{\alpha}_\Xi, \phi_\Xi, \bar{\phi}_\Xi, \alpha_\Lambda, \bar{\alpha}_\Lambda);$

$\vec{\zeta} = (\theta_\Xi, \theta_\Lambda, \theta_{\bar{\Lambda}}, \varphi_\Lambda, \varphi_{\bar{\Lambda}}, \theta_p, \theta_{\bar{p}}, \varphi_p, \varphi_{\bar{p}});$

Helicity angles

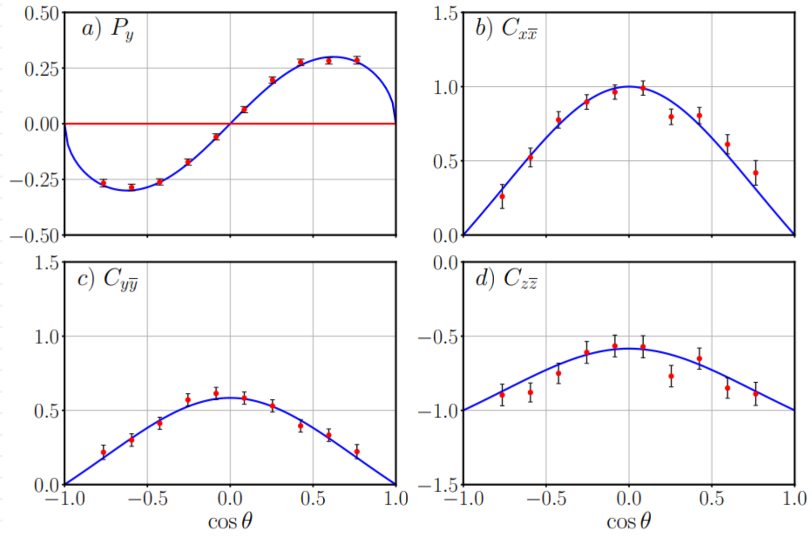


The weak phase and strong phase differences can be directly measured through these decays!

$e^+e^- \to J/\psi \to \Xi^-\bar{\Xi}^+, \Xi^- \to \Lambda(\to p\pi^-)\pi^- + \bar{\Lambda}(\to \bar{p}\pi^+)\pi^+.$

1.3 billion J/ψ

Parameter	Nature **606** (2022) 64-69	Previous result
α_ψ	$0.586\pm0.012\pm0.010$	$0.58\pm0.04\pm0.08$
$\Delta\Phi$	$1.213\pm0.046\pm0.016$ rad	–
α_Ξ	$-0.376\pm0.007\pm0.003$	-0.401 ± 0.010
ϕ_Ξ	$0.011\pm0.019\pm0.009$ rad	$-0.042 \pm 0.011 \pm 0.011$
$\bar{\alpha}_\Xi$	$0.371\pm0.007\pm0.002$	–
$\bar{\phi}_\Xi$	$-0.021\pm0.019\pm0.007$ rad	–
α_Λ	$0.757\pm0.011\pm0.008$	$0.750\pm0.009\pm0.004$
$\bar{\alpha}_\Lambda$	$-0.763\pm0.011\pm0.007$	$-0.758\pm0.010\pm0.007$
$\xi_P-\xi_S$	$(1.2\pm3.4\pm0.8)\times10^{-2}$ rad	–
$\delta_P-\delta_S$	$(-4.0\pm3.3\pm1.7)\times10^{-2}$ rad	$(10.2\pm3.9)\times10^{-2}$ rad
A^Ξ_{CP}	$(6\pm13\pm6)\times10^{-3}$	–
$\Delta\phi^\Xi_{CP}$	$(-5\pm14\pm3)\times10^{-3}$ rad	–
A^Λ_{CP}	$(-4\pm12\pm9)\times10^{-3}$	$(-6\pm12\pm7)\times10^{-3}$
$\langle\phi_\Xi\rangle$	$0.016\pm0.014\pm0.007$ rad	



The precision of our analysis (73K events) is comparable with the measurement from HyperCP (144M events), which means that the accuracy of a single event is more than 1000 times higher than HyperCP!

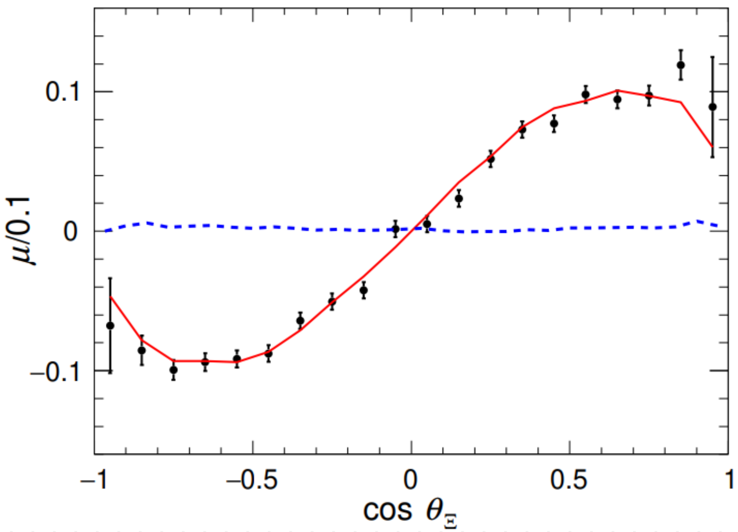
First measurement of weak phase difference in Ξ decay.

Three CP tests.

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

10 billion J/ψ

Parameter	arXiv:2305.09218	Previous result
$\alpha_{J/\psi}$	$0.514 \pm 0.006 \pm 0.015$	0.66 ± 0.06 [34]
$\Delta\Phi$(rad)	$1.168 \pm 0.019 \pm 0.018$	-
α_{Ξ}	$-0.3750 \pm 0.0034 \pm 0.0016$	-0.358 ± 0.044 [18]
$\bar{\alpha}_{\Xi}$	$0.3790 \pm 0.0034 \pm 0.0021$	0.363 ± 0.043 [18]
ϕ_{Ξ}(rad)	$0.0051 \pm 0.0096 \pm 0.0018$	0.03 ± 0.12 [18]
$\bar{\phi}_{\Xi}$(rad)	$-0.0053 \pm 0.0097 \pm 0.0019$	-0.19 ± 0.13 [18]
α_{Λ}	$0.7551 \pm 0.0052 \pm 0.0023$	0.7519 ± 0.0043 [13]
$\bar{\alpha}_{\Lambda}$	$-0.7448 \pm 0.0052 \pm 0.0017$	-0.7559 ± 0.0047 [13]
$\xi_P - \xi_S$(rad)	$(0.0 \pm 1.7 \pm 0.2) \times 10^{-2}$	-
$\delta_P - \delta_S$(rad)	$(-1.3 \pm 1.7 \pm 0.4) \times 10^{-2}$	-
A_{CP}^{Ξ}	$(-5.4 \pm 6.5 \pm 3.1) \times 10^{-3}$	$(-0.7 \pm 8.5) \times 10^{-2}$ [18]
$\Delta\phi_{CP}^{\Xi}$(rad)	$(-0.1 \pm 6.9 \pm 0.9) \times 10^{-3}$	$(-7.9 \pm 8.3) \times 10^{-2}$ [18]
A_{CP}^{Λ}	$(6.9 \pm 5.8 \pm 1.8) \times 10^{-3}$	$(-2.5 \pm 4.8) \times 10^{-3}$ [13]
$\langle\alpha_{\Xi}\rangle$	$-0.3770 \pm 0.0024 \pm 0.0014$	-
$\langle\phi_{\Xi}\rangle$(rad)	$0.0052 \pm 0.0069 \pm 0.0016$	-
$\langle\alpha_{\Lambda}\rangle$	$0.7499 \pm 0.0029 \pm 0.0013$	0.7542 ± 0.0026 [13]



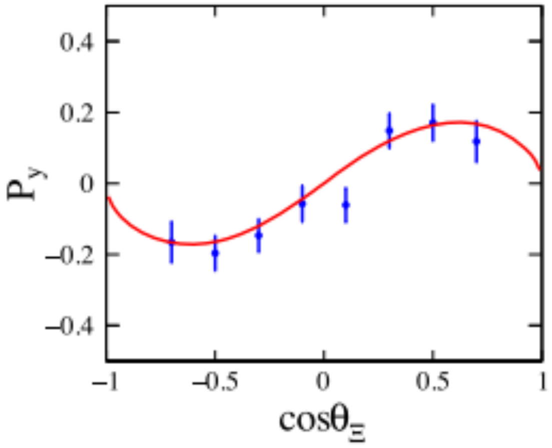
Precisions are improved in more than one order!

First measurement of weak phase difference in Ξ^0 decay and most precise result in any weakly decaying baryon!

Three CP tests.

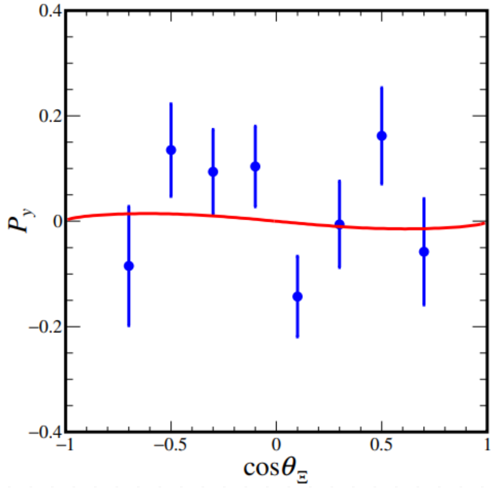
$\Xi^{-(0)}\bar{\Xi}^{+(0)}$ pairs from $\psi(3686)$ decay

Ξ^-



Parameter	Phys. Rev. D **106**, L091101 (2022)
α_ψ	$0.693 \pm 0.048 \pm 0.049$
$\Delta\Phi$ (rad)	$0.667 \pm 0.111 \pm 0.058$
α_{Ξ^-}	$-0.344 \pm 0.025 \pm 0.007$
$\alpha_{\bar{\Xi}^+}$	$0.355 \pm 0.025 \pm 0.002$
ϕ_{Ξ^-} (rad)	$0.023 \pm 0.074 \pm 0.003$
$\phi_{\bar{\Xi}^+}$ (rad)	$-0.123 \pm 0.073 \pm 0.004$
$\delta_p - \delta_s$ ($\times 10^{-1}$ rad)	$-2.0 \pm 1.3 \pm 0.1$
$A_{CP,\Xi}$ ($\times 10^{-2}$)	$-1.5 \pm 5.1 \pm 1.0$
$\Delta\phi_{CP}$ ($\times 10^{-2}$ rad)	$-5.0 \pm 5.2 \pm 0.3$

Ξ^0

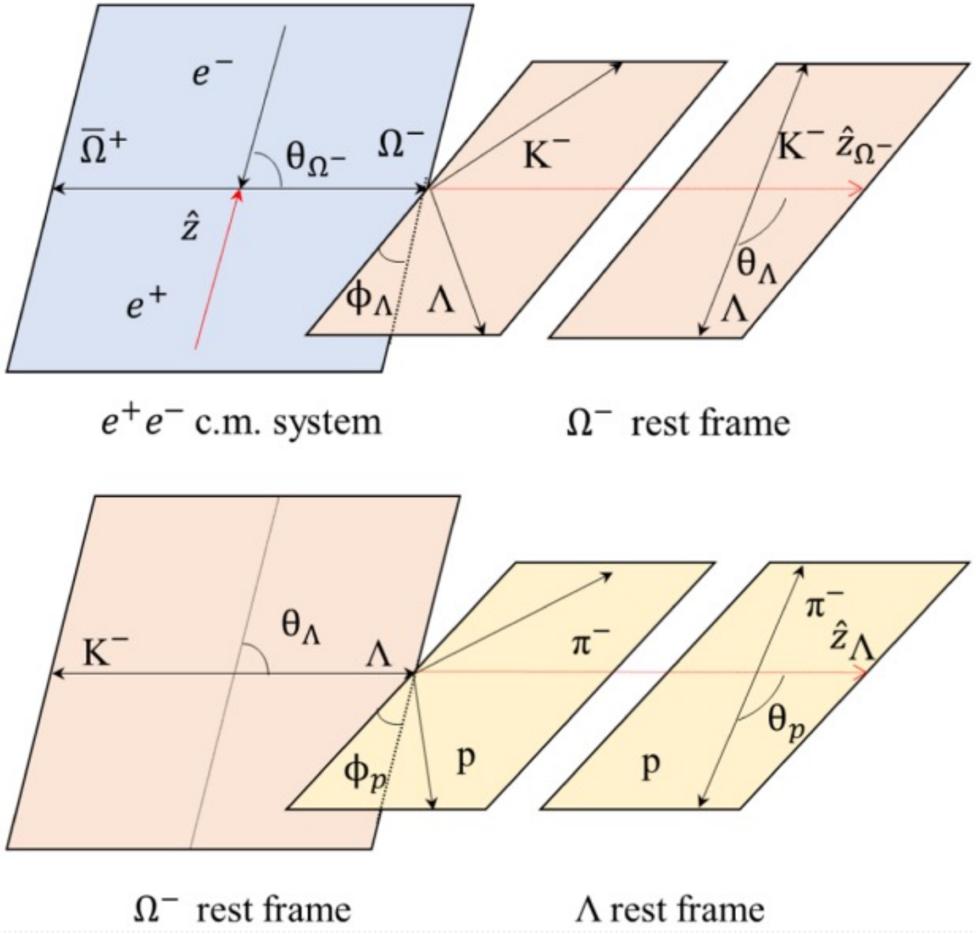


No polarization!

Param.	arXiv:2302.09767
$\alpha_{\psi(3686)}$	$0.665 \pm 0.086 \pm 0.081$
$\Delta\Phi$	$-0.050 \pm 0.150 \pm 0.020$
α_{Ξ^0}	$-0.358 \pm 0.042 \pm 0.013$
ϕ_{Ξ^0}	$0.027 \pm 0.117 \pm 0.011$
$\alpha_{\bar{\Xi}^0}$	$0.363 \pm 0.042 \pm 0.013$
$\phi_{\bar{\Xi}^0}$	$-0.185 \pm 0.116 \pm 0.017$
A_{CP}^{Ξ}	$-0.007 \pm 0.082 \pm 0.025$
$\Delta\phi_{CP}^{\Xi}$	$-0.079 \pm 0.082 \pm 0.010$

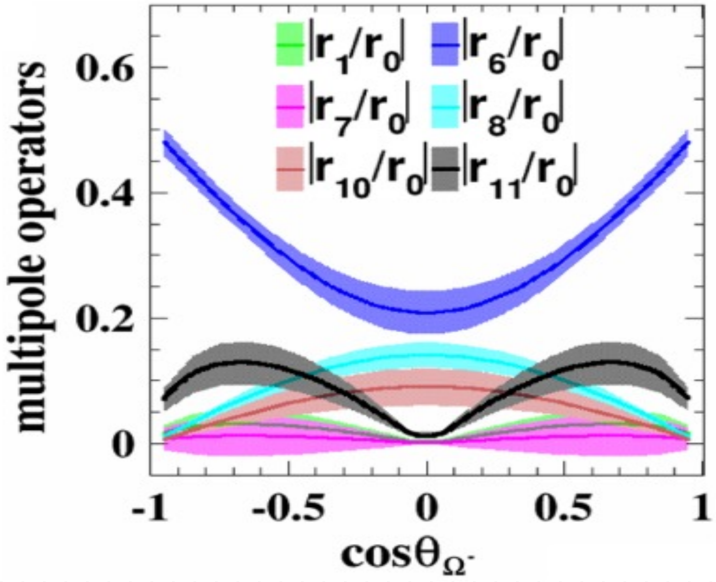
Accepted by PRD(L)

$e^+e^- \to \psi(3686) \to \Omega^-\bar{\Omega}^+, \Omega^- \to \Lambda(\to p\pi^-)K^-, \bar{\Omega}^+ \to$ anthing +c.c.



Phys. Rev. Lett. **126** (2021) 9, 092002

First model-independent determination of the spin of Ω^-!

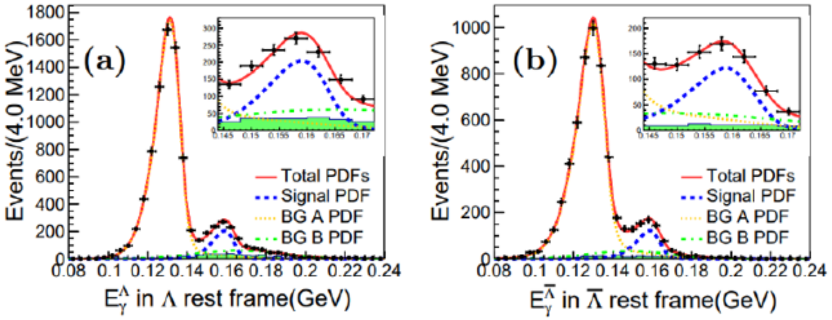


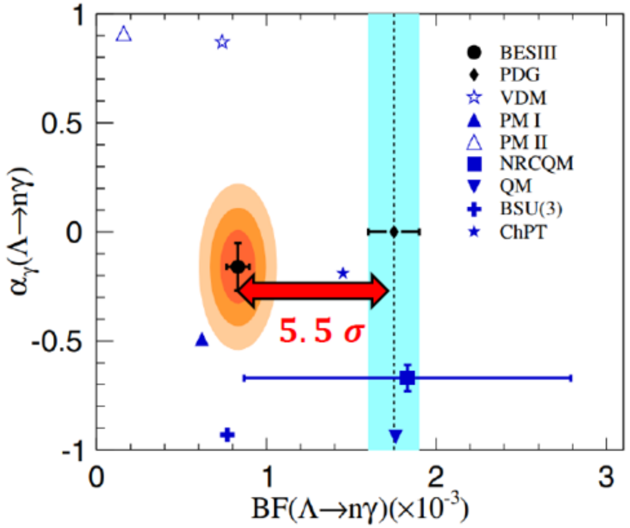
Not only observe vector polarization(r1), but also quadrupole (r6, r7, r8) and octupole (r10, r11) polarizations

Study on hyperon rare decays

$\Lambda \to n\gamma$

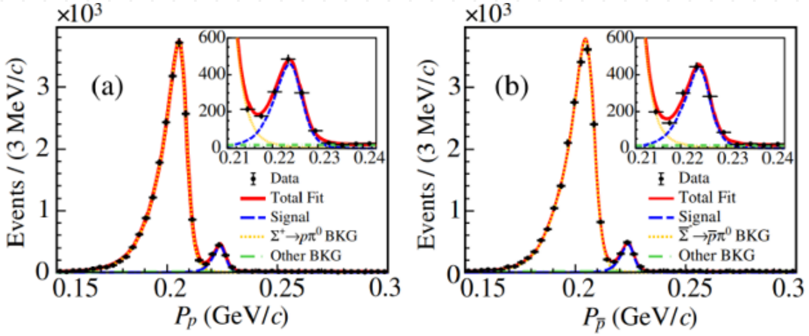
Phys. Rev. Lett. **129**, 212002 (2022)

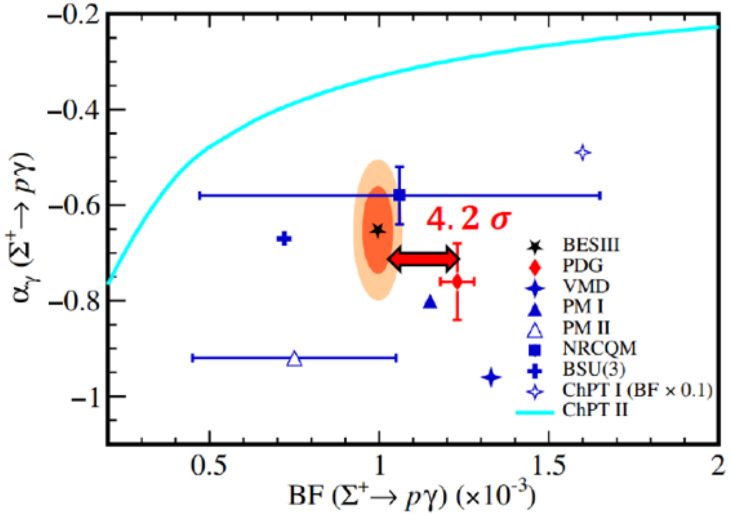




$\Sigma^+ \to p\gamma$

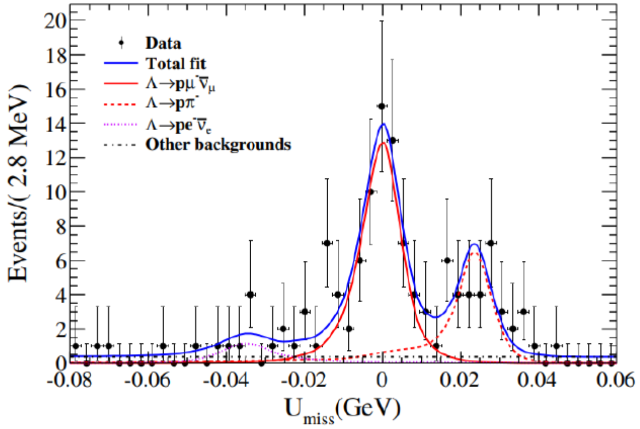
Phys. Rev. Lett. **130**, 211901(2023)





$\Lambda \to p\mu^-\bar{\nu}_\mu$

Phys. Rev. Lett. 127 (2021) 12, 121802



$$B(\Lambda \to p\mu^-\bar{\nu}_\mu) = (1.48 \pm 0.21 \pm 0.08) \times 10^{-4}$$

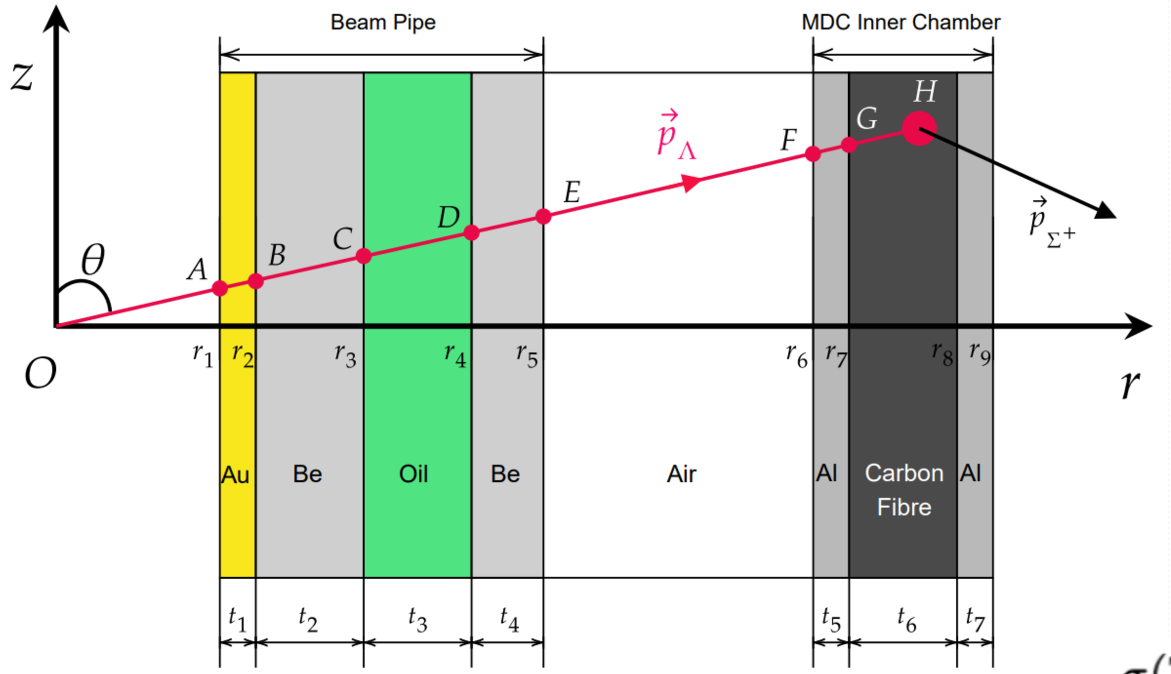
$$R^{\mu e} \equiv \frac{\Gamma(\Lambda\to p\mu^-\bar{\nu}_\mu)}{\Gamma(\Lambda\to pe^-\bar{\nu}_e)} = 0.178 \pm 0.028$$

consistent with SM prediction: 0.153 ± 0.008

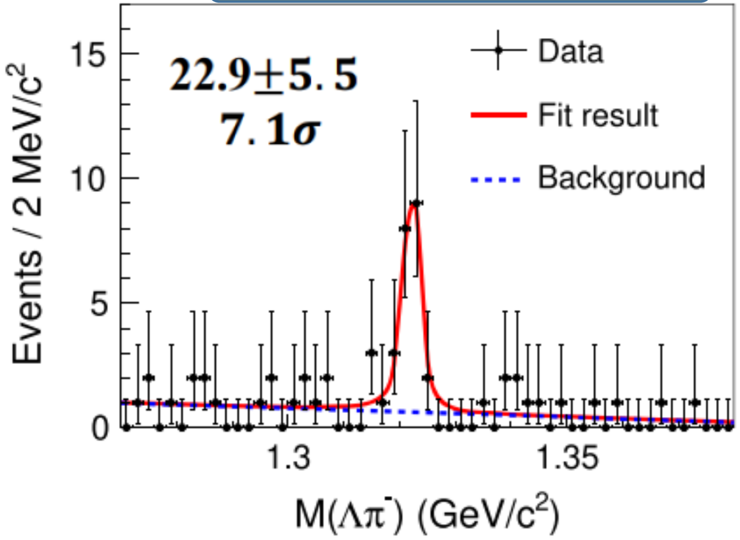
$$A_{CP} \equiv \frac{B(\Lambda\to p\mu^-\bar{\nu}_\mu) - B(\bar{\Lambda}\to\bar{p}\mu^+\nu_\mu)}{B(\Lambda\to p\mu^-\bar{\nu}_\mu) + B(\bar{\Lambda}\to\bar{p}\mu^+\nu_\mu)} = 0.02 \pm 0.14 \pm 0.02$$

Study of hyperon-nucleus interaction

PRL 127,012003 (2021)
arxiv: 2209.12601



Phys. Rev. Lett. **130**, 251902 (2023)



$\Xi^0 n \to \Xi^- p$ is observed for the first time.

When Ξ^0 momentum is 0.818 GeV/c

$$\sigma(\Xi^0 n \to \Xi^- p) = (7.4 \pm 1.8_{\mathrm{stat}} \pm 1.5_{\mathrm{sys}})\ \mathrm{mb}$$

$$\sigma(\Xi^0 + {}^9\mathrm{Be} \to \Xi^- + p + {}^8\mathrm{Be}) = (22.1 \pm 5.3_{\mathrm{stat}} \pm 4.5_{\mathrm{sys}})\ \mathrm{mb}$$

The first study of hyperon–nucleon interaction in electron–positron collisions!
More results are on the way.

Summary and Outlooks

PART.03

WIN2023

Summary and Outlooks

- Hyperons are important probes to study QCD and CP symmetry.
- BESIII has made fruitful achievements in the studies of hyperon decays!
- More interesting studies of hyperon will come soon!

Thank you!