第八届全国重味物理与量子色动力学研讨会

Determining baryon static properties in a boostrap way

Fanrong Xu

Jinan University

in collaboration with
Hsiang-nan Li & Shuge Zeng

2603.15989

April 27, 2026， ChongQing

OUTLINE

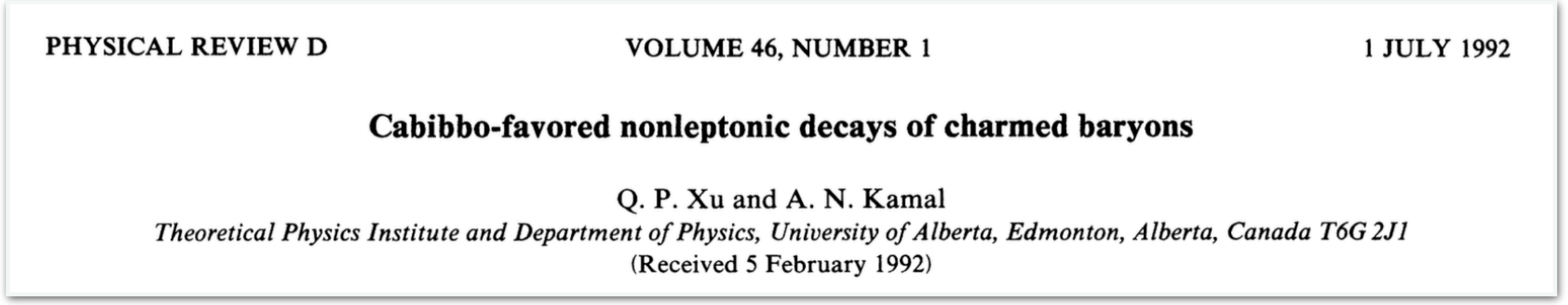
- Introduction
- Inverse matrix method: ρ revised
- Baryon masses and pole residue
- Summary

Introduction

CHARMING CHALLENGE

A story in $\Lambda_c^+ \to \Xi^0 K^+$

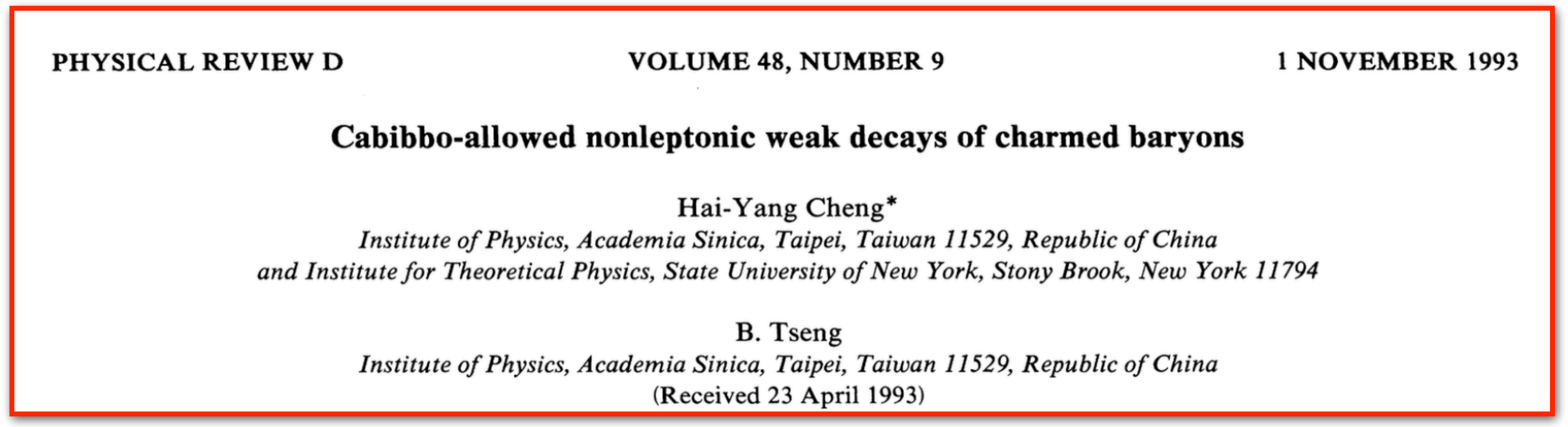
1. Theory in 1990s: small BF & zero α, due to smallness of S-wave amplitude



PHYSICAL REVIEW D VOLUME 46, NUMBER 1 1 JULY 1992

Cabibbo-favored nonleptonic decays of charmed baryons

Q. P. Xu and A. N. Kamal
Theoretical Physics Institute and Department of Physics, University of Alberta, Edmonton, Alberta, Canada T6G 2J1
(Received 5 February 1992)



PHYSICAL REVIEW D VOLUME 48, NUMBER 9 1 NOVEMBER 1993

Cabibbo-allowed nonleptonic weak decays of charmed baryons

Hai-Yang Cheng*
Institute of Physics, Academia Sinica, Taipei, Taiwan 11529, Republic of China
and Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11794

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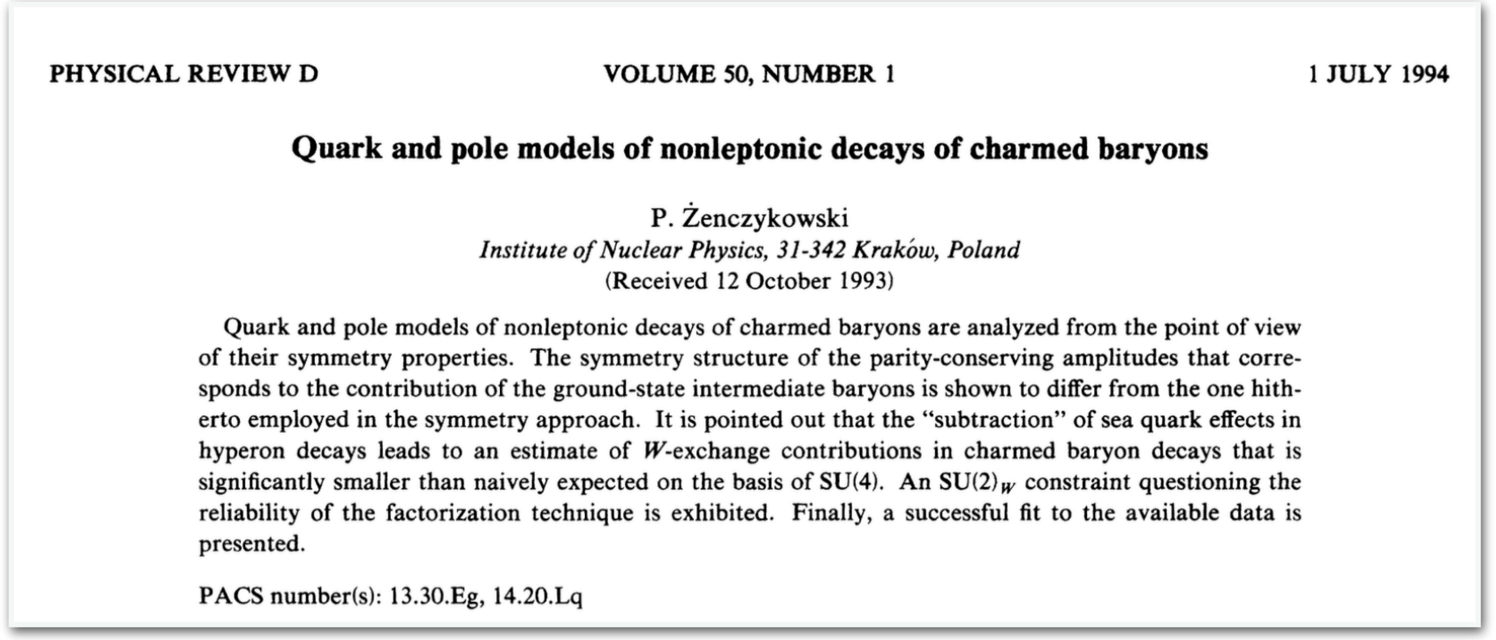
(Received 23 April 1993)



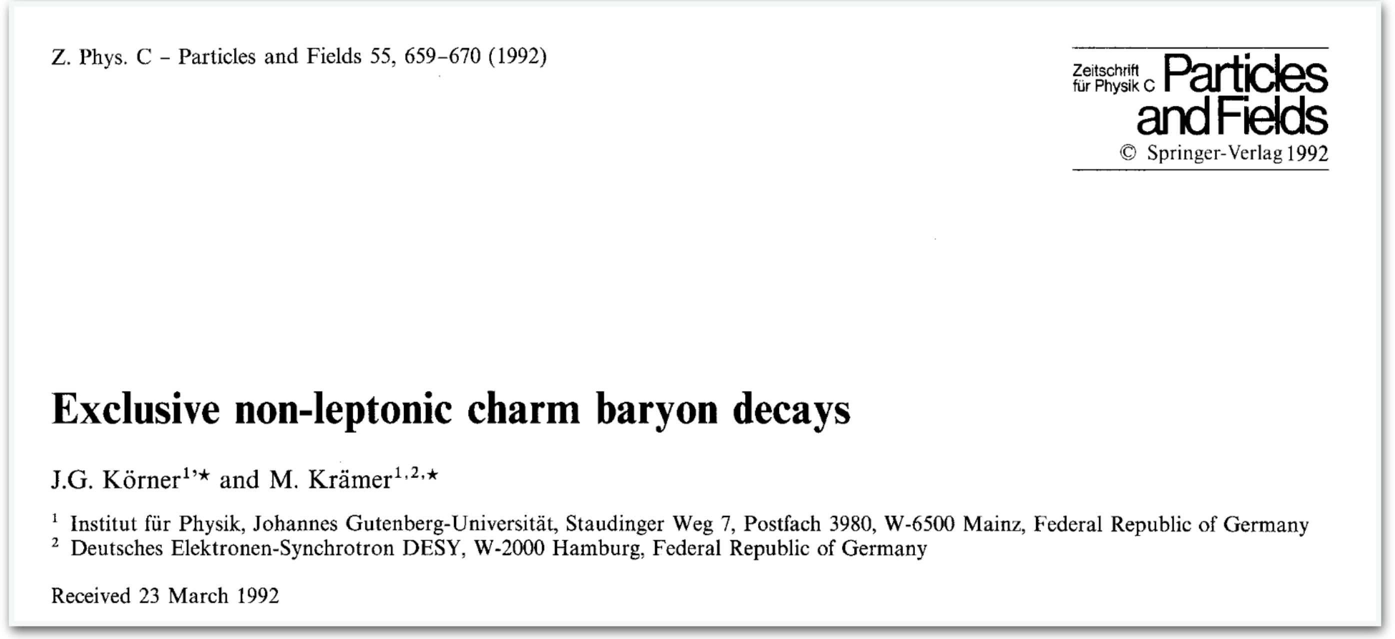
PHYSICAL REVIEW D VOLUME 50, NUMBER 1 1 JULY 1994

Quark and pole models of nonleptonic decays of charmed baryons

P. Żenczykowski
Institute of Nuclear Physics, 31-342 Kraków, Poland
(Received 12 October 1993)

Quark and pole models of nonleptonic decays of charmed baryons are analyzed from the point of view of their symmetry properties. The symmetry structure of the parity-conserving amplitudes that corresponds to the contribution of the ground-state intermediate baryons is shown to differ from the one hitherto employed in the symmetry approach. It is pointed out that the "subtraction" of sea quark effects in hyperon decays leads to an estimate of W-exchange contributions in charmed baryon decays that is significantly smaller than naively expected on the basis of SU(4). An $SU(2)_W$ constraint questioning the reliability of the factorization technique is exhibited. Finally, a successful fit to the available data is presented.

PACS number(s): 13.30.Eg, 14.20.Lq



Z. Phys. C – Particles and Fields 55, 659–670 (1992)

Zeitschrift für Physik C Particles and Fields
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Exclusive non-leptonic charm baryon decays

J.G. Körner[1,*] and M. Krämer[1,2,*]

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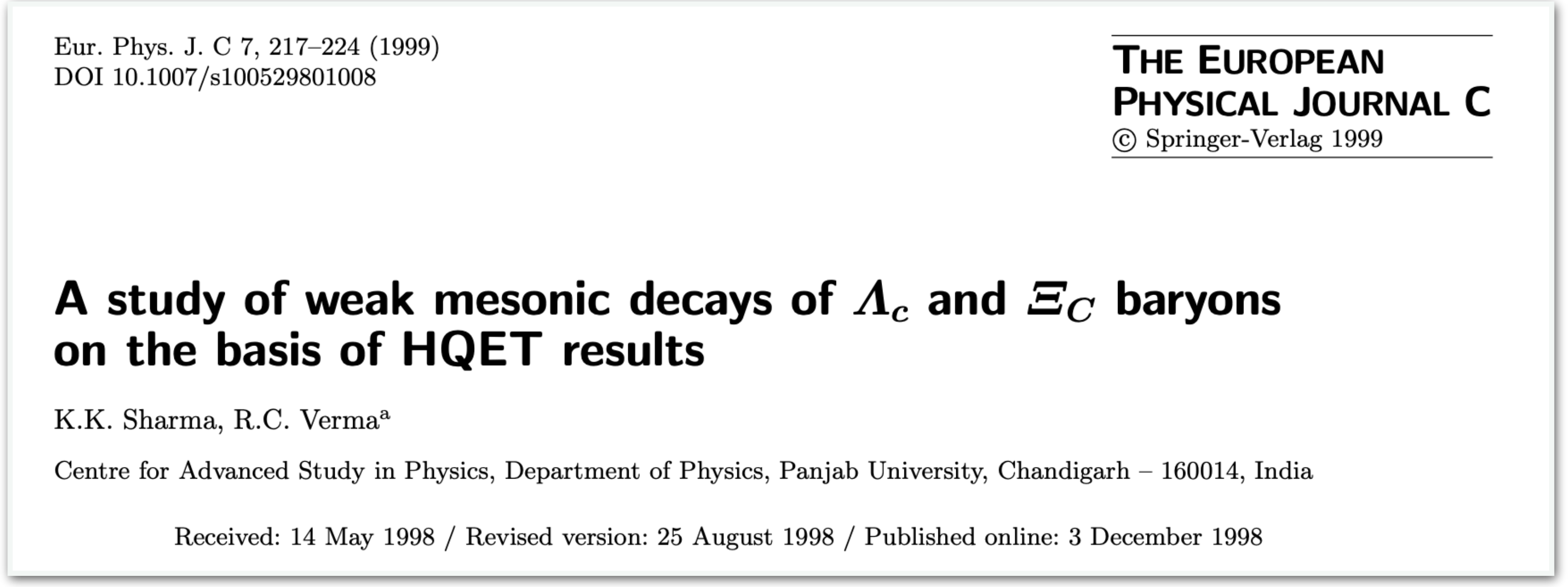
Received 23 March 1992



Eur. Phys. J. C 7, 217–224 (1999)
DOI 10.1007/s100529801008

THE EUROPEAN PHYSICAL JOURNAL C
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A study of weak mesonic decays of Λ_c and Ξ_C baryons on the basis of HQET results

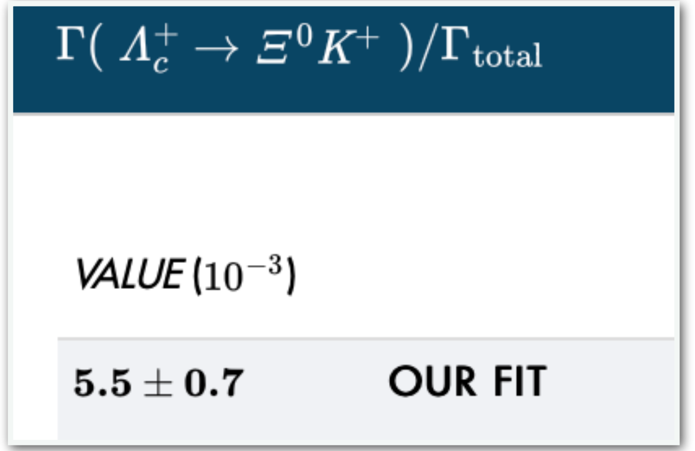
K.K. Sharma, R.C. Verma[a]

Centre for Advanced Study in Physics, Department of Physics, Panjab University, Chandigarh – 160014, India

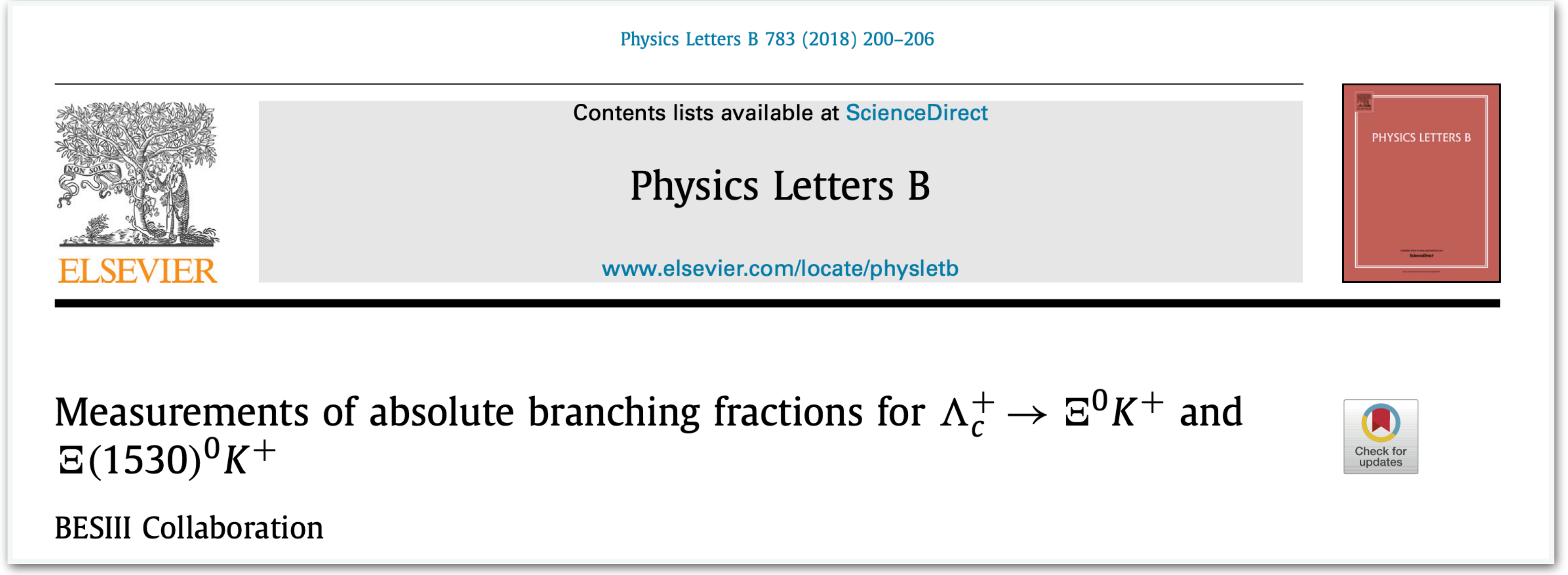
Received: 14 May 1998 / Revised version: 25 August 1998 / Published online: 3 December 1998

2. BF was measured, not that small

PDG



$\Gamma(\Lambda_c^+ \to \Xi^0 K^+)/\Gamma_{\text{total}}$	
VALUE (10^{-3})	
5.5 ± 0.7	**OUR FIT**



Physics Letters B 783 (2018) 200–206

Contents lists available at ScienceDirect

Physics Letters B

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ELSEVIER

Measurements of absolute branching fractions for $\Lambda_c^+ \to \Xi^0 K^+$ and $\Xi(1530)^0 K^+$

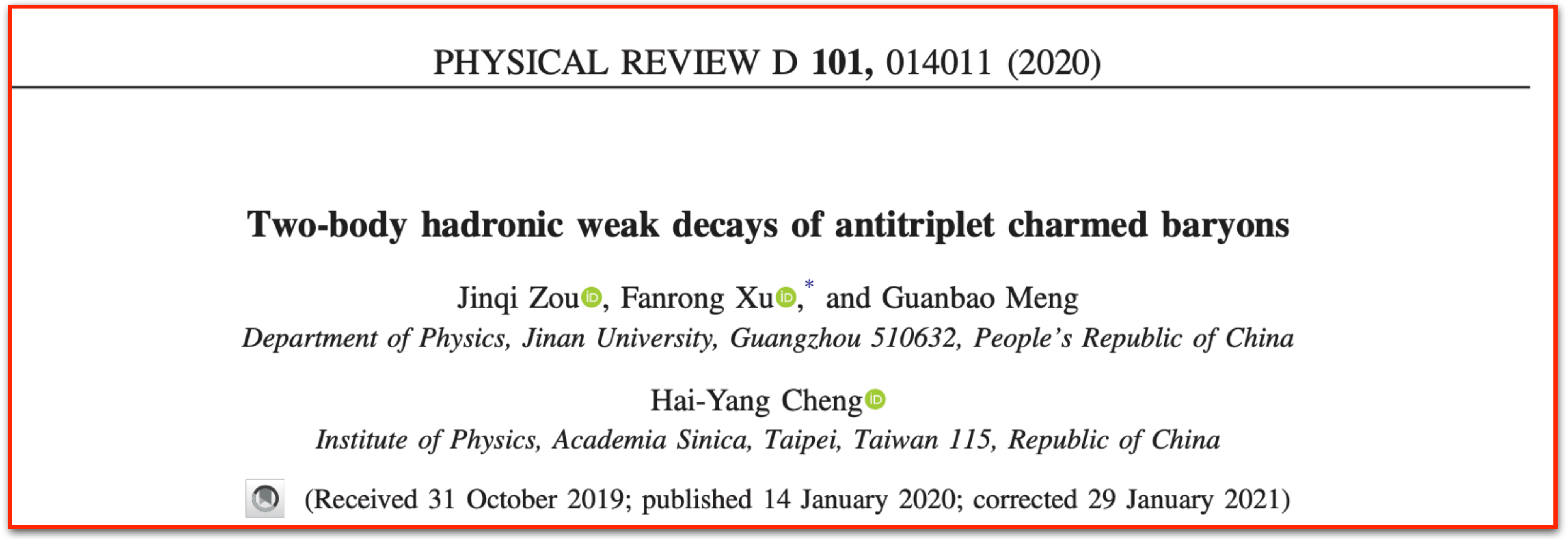
BESIII Collaboration

CHARMING CHALLENGE

A story in $\Lambda_c^+ \to \Xi^0 K^+$

3. large BF can be explained, α is predicted to be unity

dynamic calculation



PHYSICAL REVIEW D **101,** 014011 (2020)

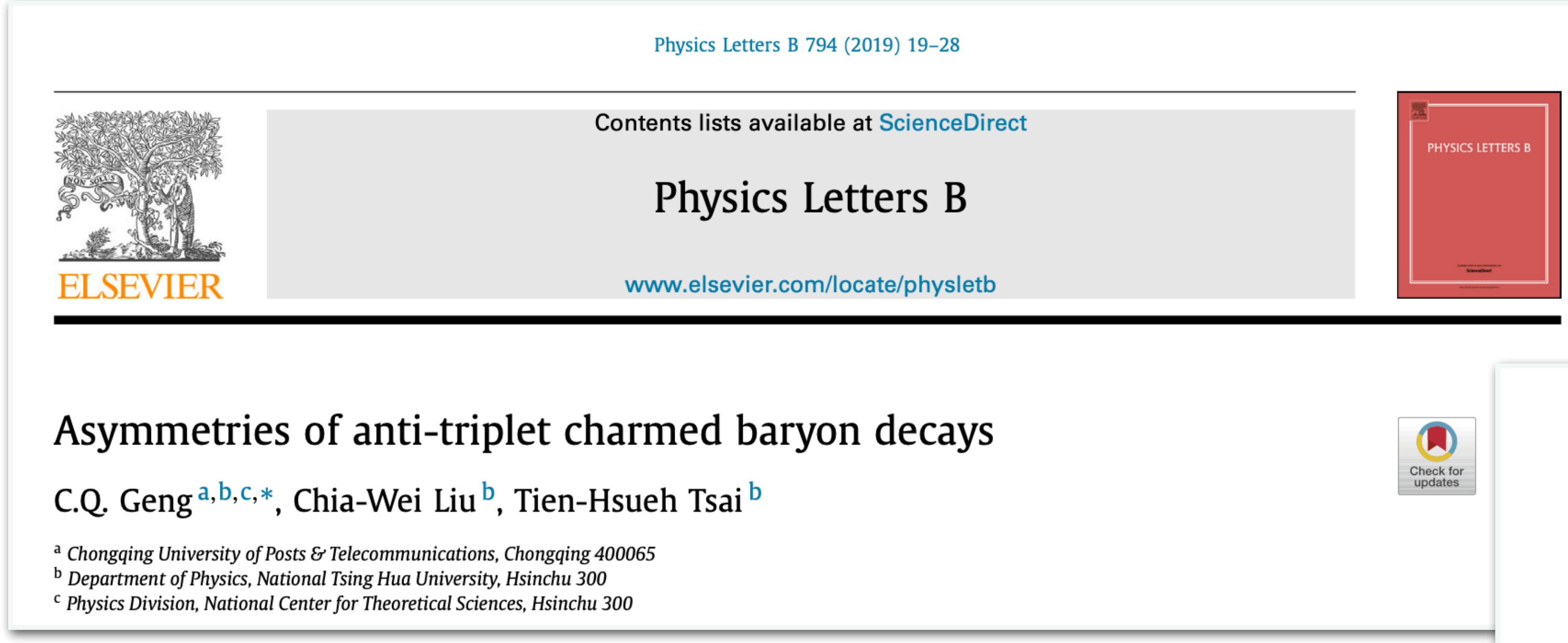
Two-body hadronic weak decays of antitriplet charmed baryons

Jinqi Zou, Fanrong Xu,* and Guanbao Meng
Department of Physics, Jinan University, Guangzhou 510632, People's Republic of China

Hai-Yang Cheng
Institute of Physics, Academia Sinica, Taipei, Taiwan 115, Republic of China

(Received 31 October 2019; published 14 January 2020; corrected 29 January 2021)

fit



Physics Letters B 794 (2019) 19–28

Contents lists available at ScienceDirect

Physics Letters B

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ELSEVIER

Asymmetries of anti-triplet charmed baryon decays

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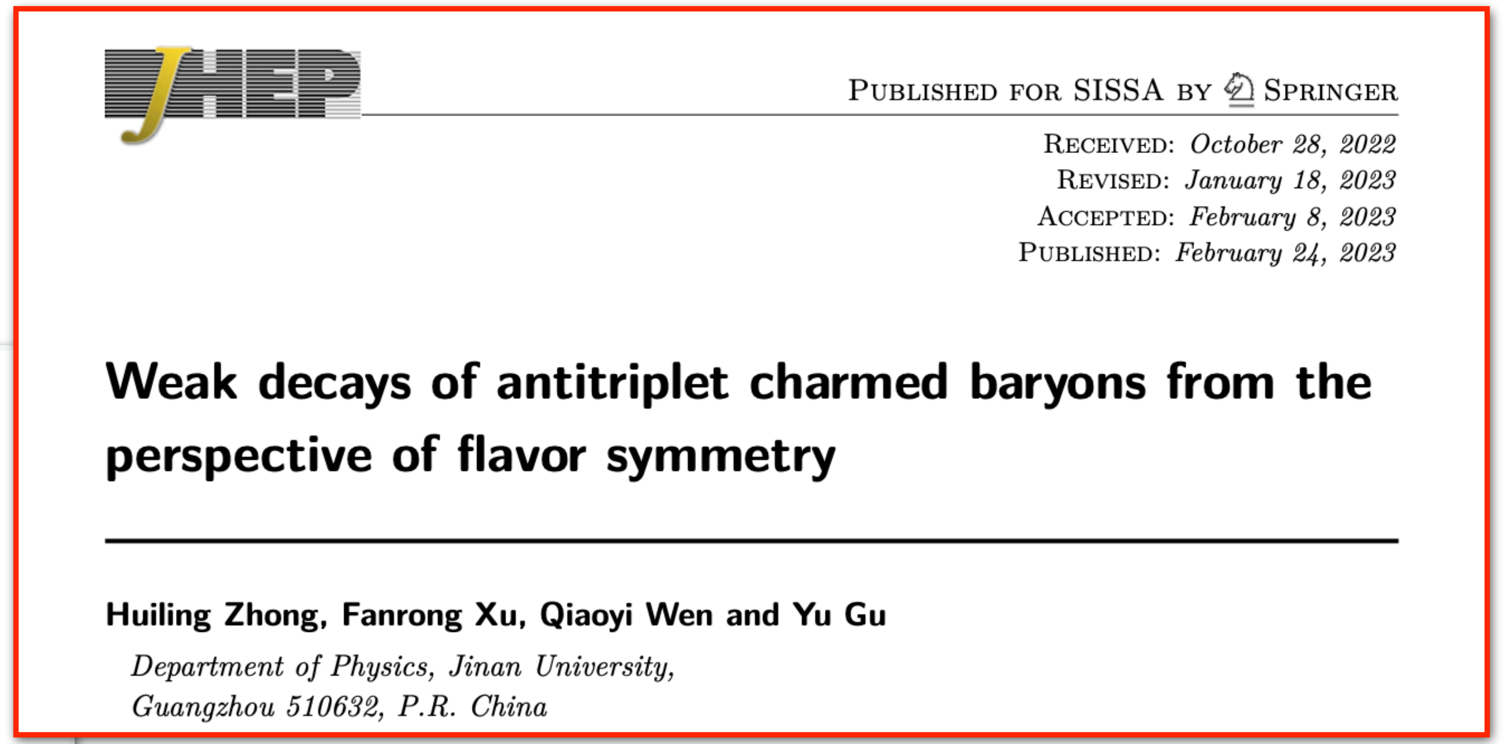
A global analysis of charmless two body hadronic decays for anti-triplet charmed baryons

Fei Huang,[a] Zhi-Peng Xing[b,1] and Xiao-Gang He[a,b,c]



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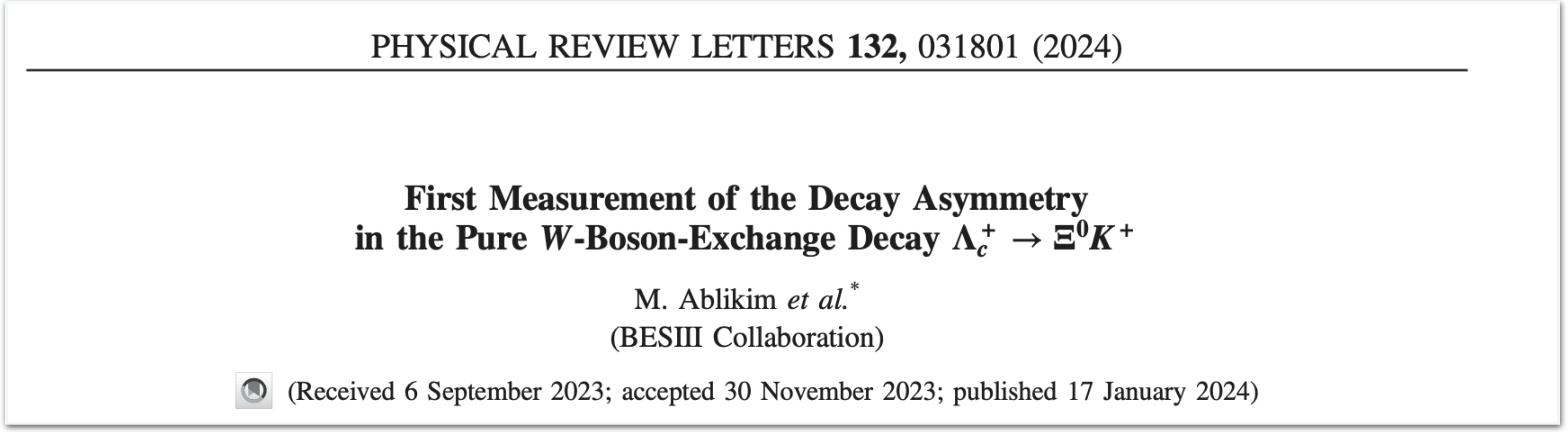
Weak decays of antitriplet charmed baryons from the perspective of flavor symmetry

Huiling Zhong, Fanrong Xu, Qiaoyi Wen and Yu Gu
Department of Physics, Jinan University,
Guangzhou 510632, P.R. China

CHARMING CHALLENGE

A story in $\Lambda_c^+ \to \Xi^0 K^+$

4. α is measured to be small



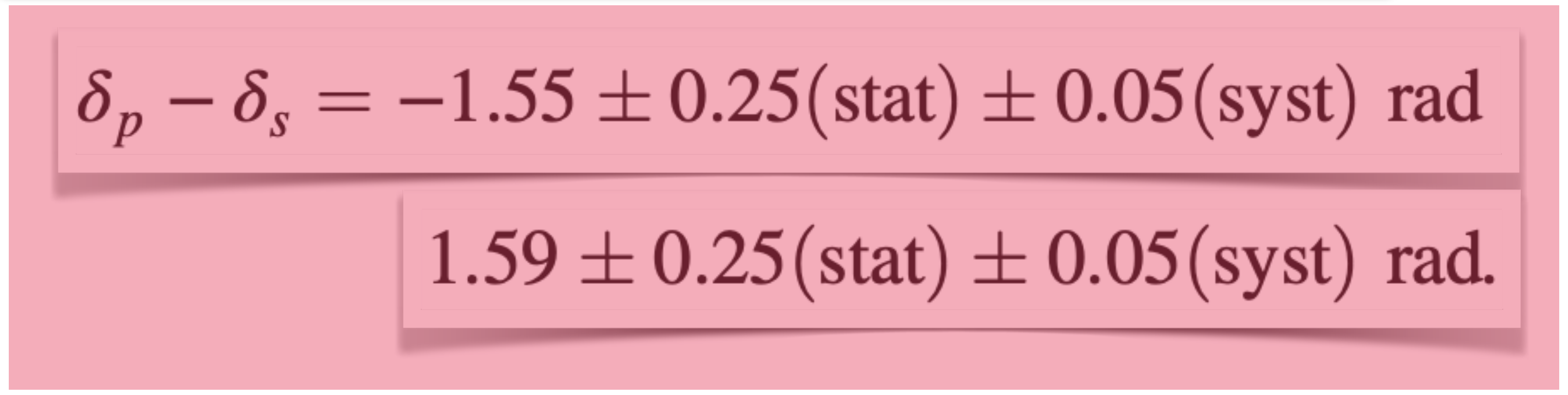
PHYSICAL REVIEW LETTERS **132,** 031801 (2024)

First Measurement of the Decay Asymmetry in the Pure W-Boson-Exchange Decay $\Lambda_c^+ \to \Xi^0 K^+$

M. Ablikim *et al.*[*]
(BESIII Collaboration)

(Received 6 September 2023; accepted 30 November 2023; published 17 January 2024)

$$\alpha_{\Xi^0 K^+} = 0.01 \pm 0.16(\text{stat}) \pm 0.03(\text{syst})$$

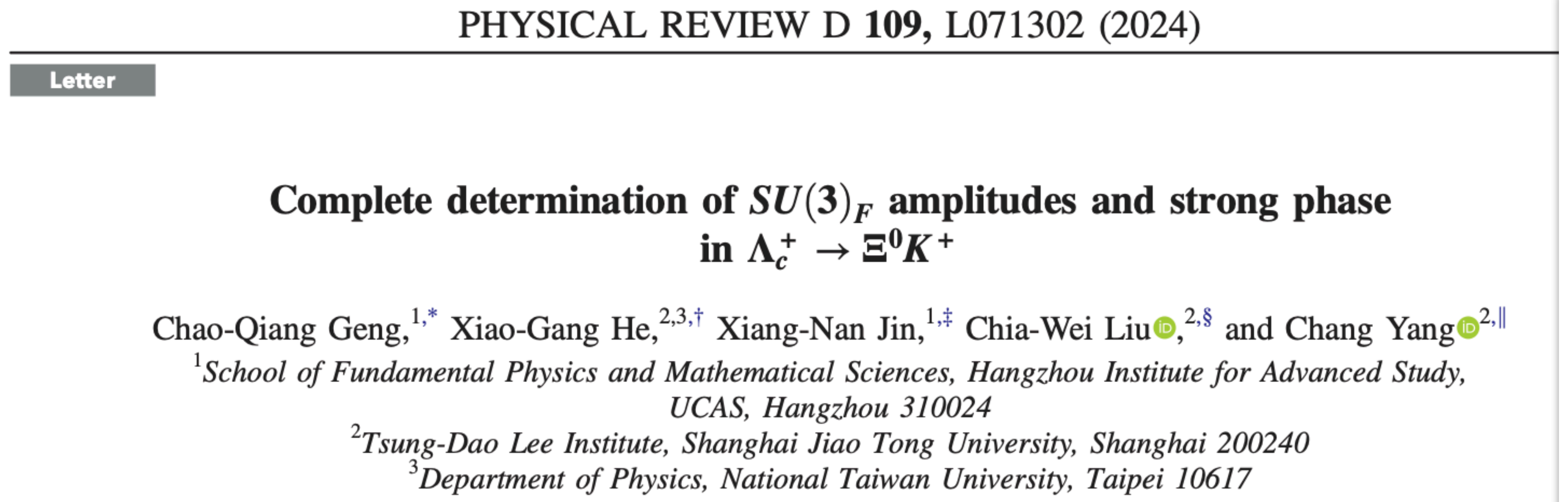


$$\delta_p - \delta_s = -1.55 \pm 0.25(\text{stat}) \pm 0.05(\text{syst})\ \text{rad}$$

$$1.59 \pm 0.25(\text{stat}) \pm 0.05(\text{syst})\ \text{rad}.$$

The CP phase plays a critical role!

5. small α can be accommodated in IRA and TDA

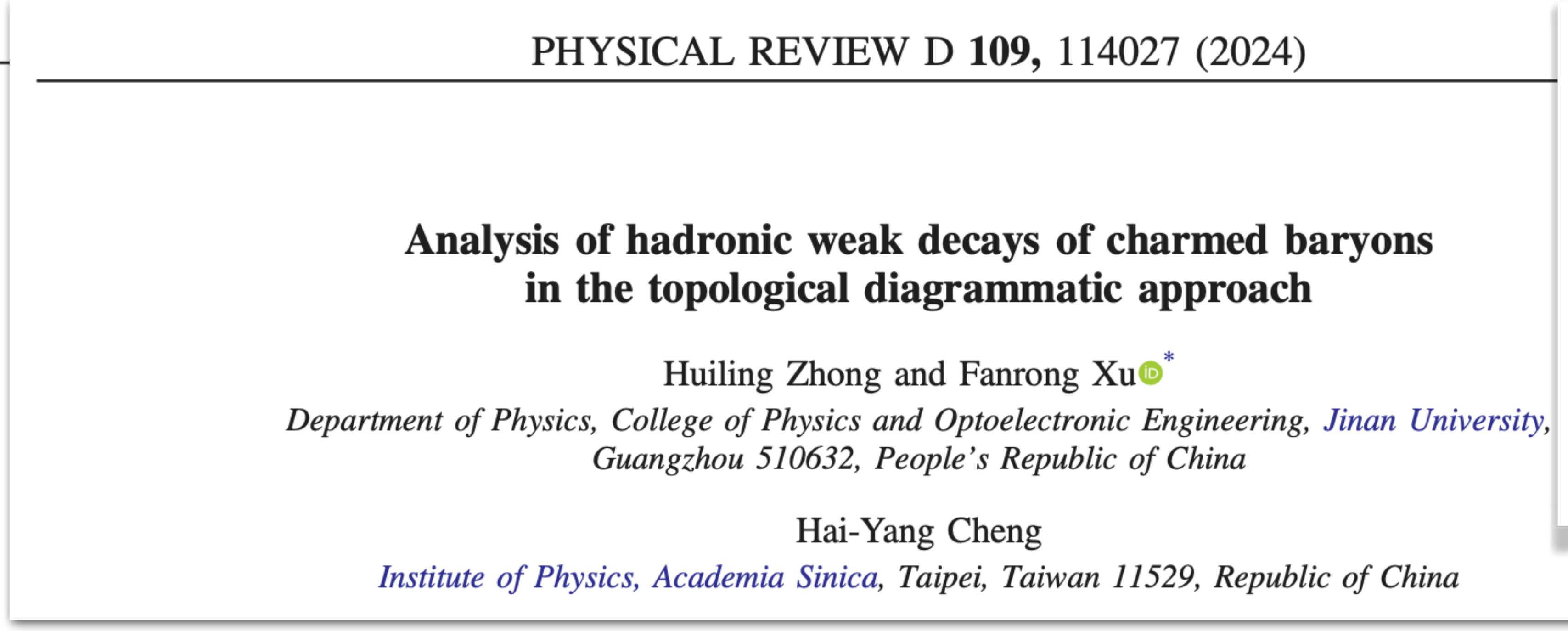


PHYSICAL REVIEW D **109,** L071302 (2024)

Letter

Complete determination of $SU(3)_F$ amplitudes and strong phase in $\Lambda_c^+ \to \Xi^0 K^+$

Chao-Qiang Geng,[1,*] Xiao-Gang He,[2,3,†] Xiang-Nan Jin,[1,‡] Chia-Wei Liu,[2,§] and Chang Yang[2,∥]
[1]*School of Fundamental Physics and Mathematical Sciences, Hangzhou Institute for Advanced Study, UCAS, Hangzhou 310024*
[2]*Tsung-Dao Lee Institute, Shanghai Jiao Tong University, Shanghai 200240*
[3]*Department of Physics, National Taiwan University, Taipei 10617*

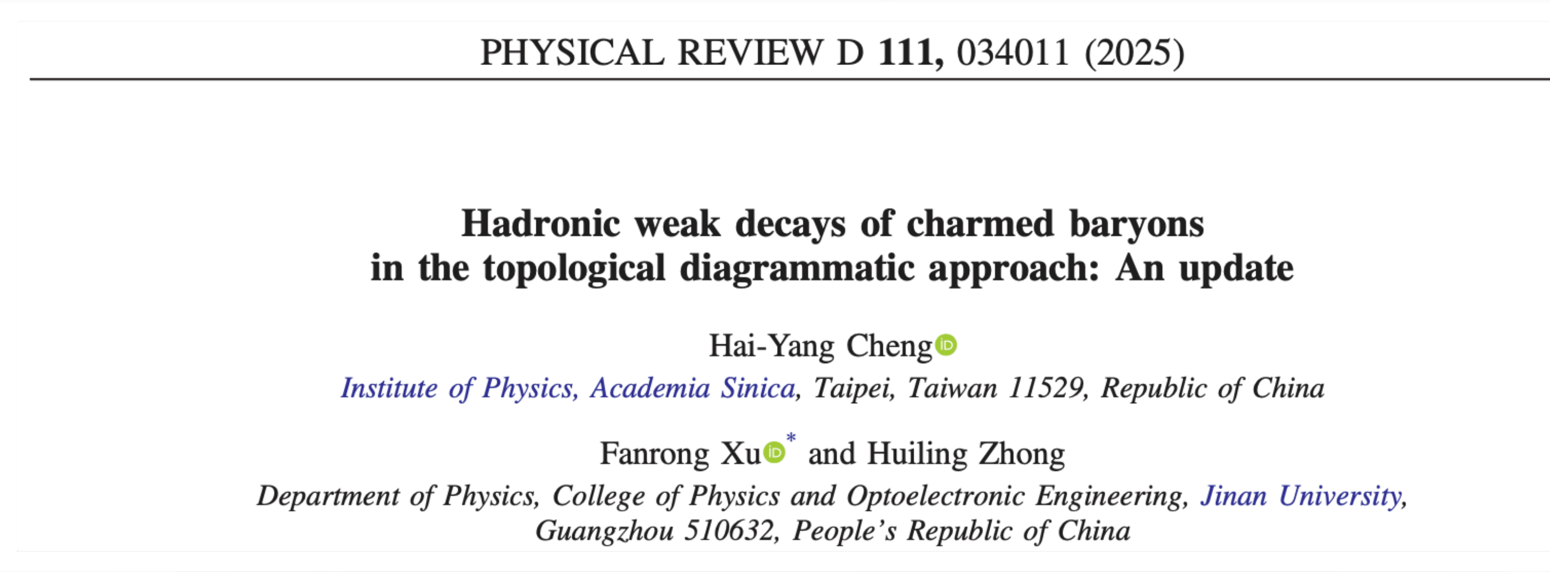


PHYSICAL REVIEW D **109,** 114027 (2024)

Analysis of hadronic weak decays of charmed baryons in the topological diagrammatic approach

Huiling Zhong and Fanrong Xu[*]
Department of Physics, College of Physics and Optoelectronic Engineering, Jinan University, Guangzhou 510632, People's Republic of China

Hai-Yang Cheng
Institute of Physics, Academia Sinica, Taipei, Taiwan 11529, Republic of China



PHYSICAL REVIEW D **111,** 034011 (2025)

Hadronic weak decays of charmed baryons in the topological diagrammatic approach: An update

Hai-Yang Cheng
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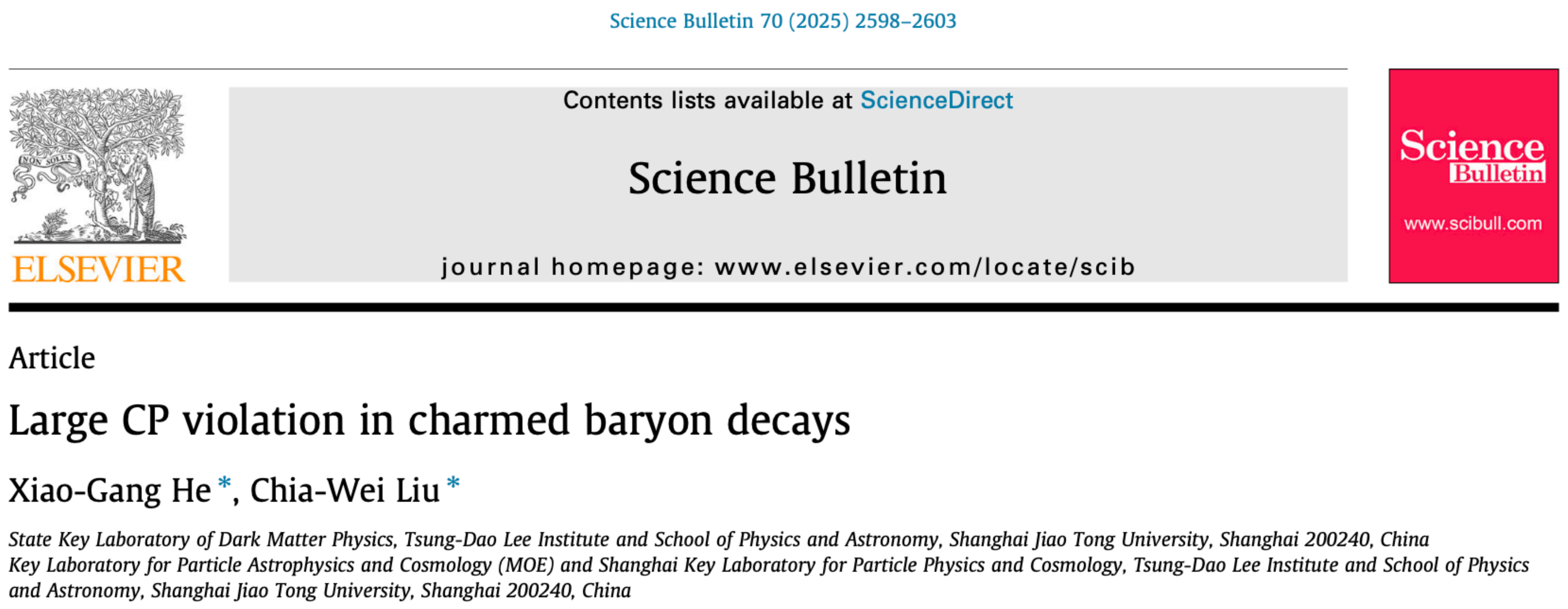
Fanrong Xu[*] and Huiling Zhong
Department of Physics, College of Physics and Optoelectronic Engineering, Jinan University, Guangzhou 510632, People's Republic of China

CHARMING CHALLENGE

A story in $\Lambda_c^+ \to \Xi^0 K^+$

6. The desired CPV in charmed baryon decay has been predicted


Science Bulletin 70 (2025) 2598–2603

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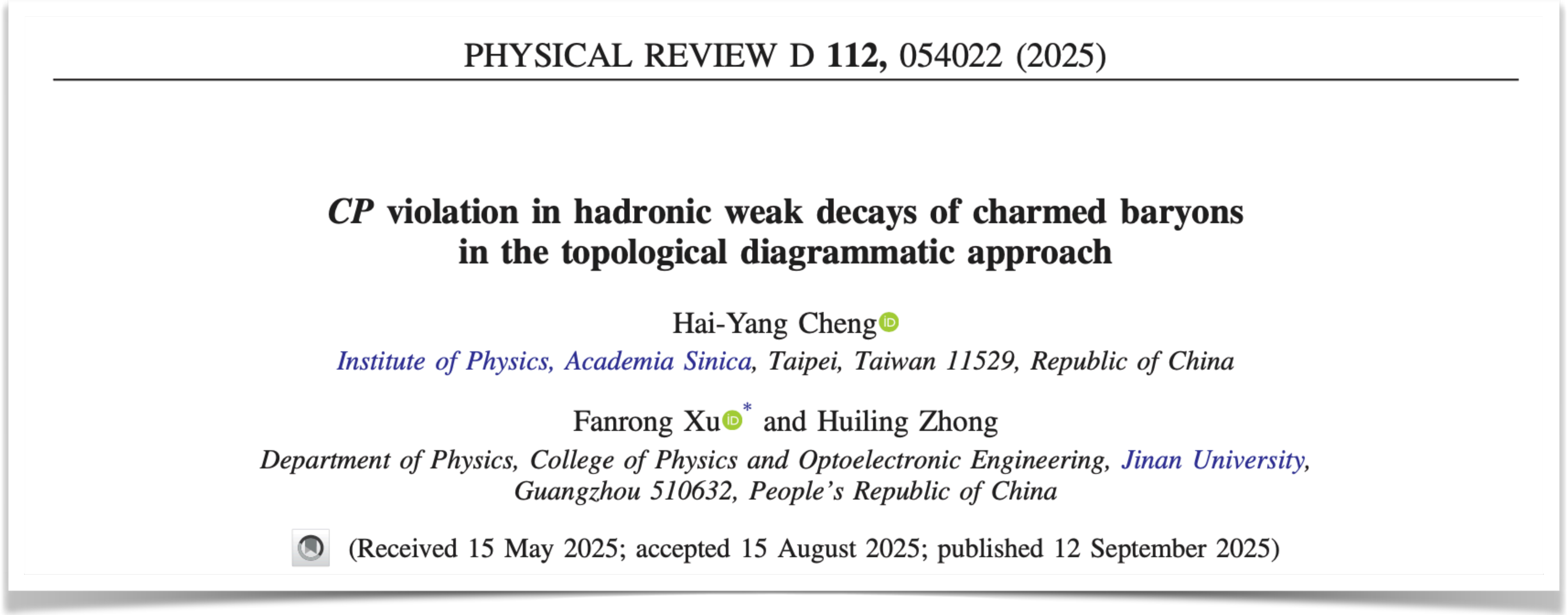
Article

Large CP violation in charmed baryon decays

Xiao-Gang He[*], Chia-Wei Liu[*]

State Key Laboratory of Dark Matter Physics, Tsung-Dao Lee Institute and School of Physics and Astronomy, Shanghai Jiao Tong University, Shanghai 200240, China
Key Laboratory for Particle Astrophysics and Cosmology (MOE) and Shanghai Key Laboratory for Particle Physics and Cosmology, Tsung-Dao Lee Institute and School of Physics and Astronomy, Shanghai Jiao Tong University, Shanghai 200240, China


PHYSICAL REVIEW D **112,** 054022 (2025)

***CP* violation in hadronic weak decays of charmed baryons in the topological diagrammatic approach**

Hai-Yang Cheng
Institute of Physics, Academia Sinica, Taipei, Taiwan 11529, Republic of China

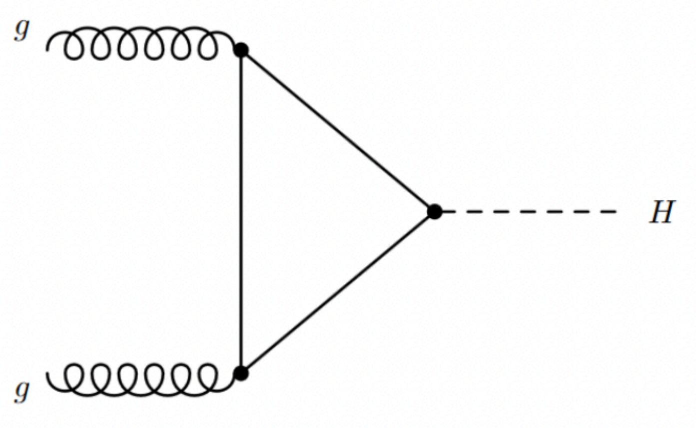
Fanrong Xu[*] and Huiling Zhong
Department of Physics, College of Physics and Optoelectronic Engineering, Jinan University, Guangzhou 510632, People's Republic of China

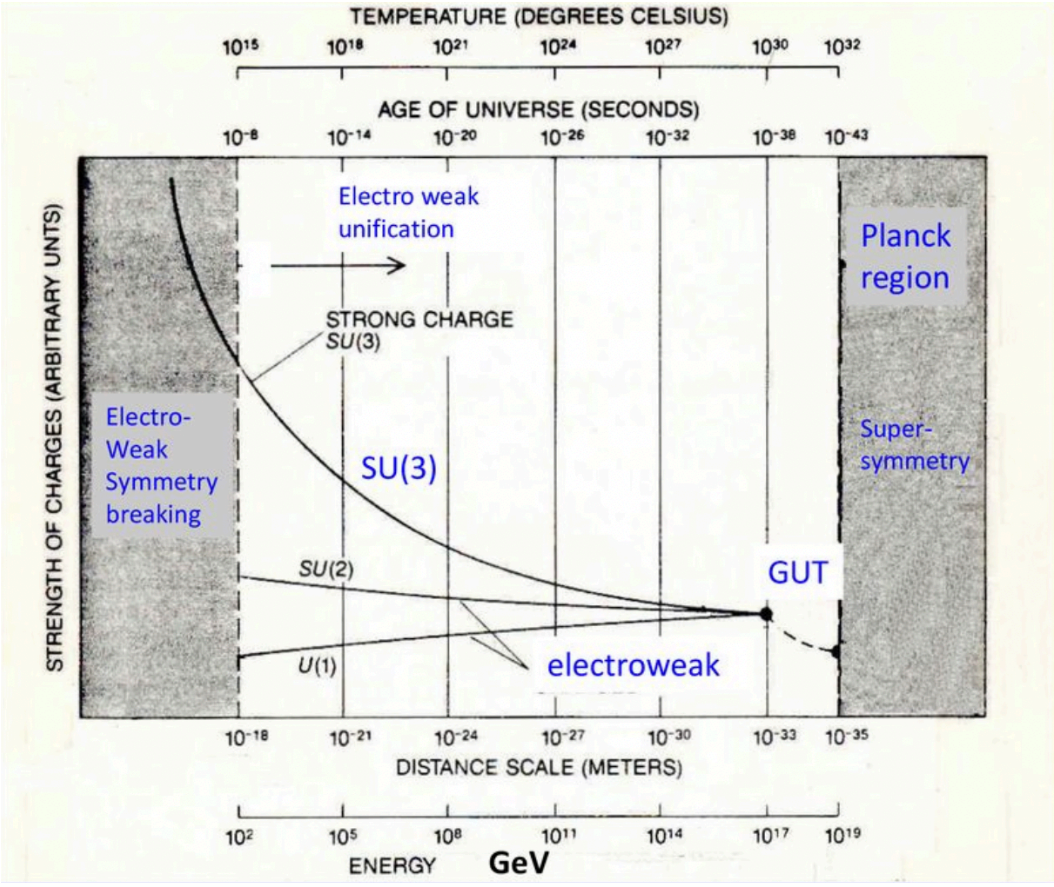
(Received 15 May 2025; accepted 15 August 2025; published 12 September 2025)

7-1. To be discovered in STCF?

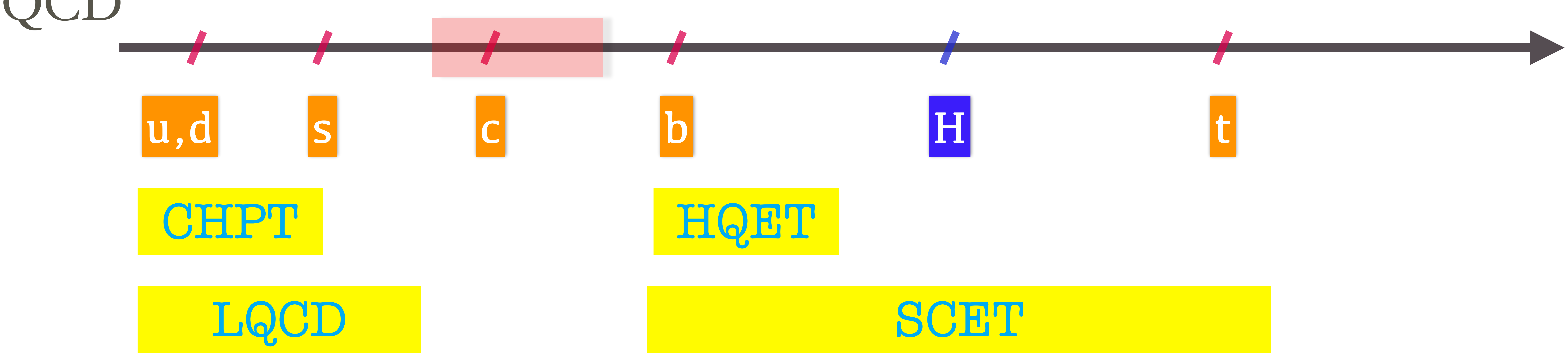
7-2. What is the origin of CPV?

CHARMING CHALLENGE





?


QCD

u,d

s

c

b

H

t

CHPT

HQET

LQCD

SCET

INVERSE PROBLEM METHOD

D meson mixing as an inverse problem #33

Hsiang-Nan Li (Taiwan, Inst. Phys.), Hiroyuki Umeeda (Taiwan, Inst. Phys.), Fanrong Xu (Jinan U.), Fu-Sheng Yu (Lanzhou U.) (Jan 13, 2020)

Published in: *Phys.Lett.B* 810 (2020) 135802 • e-Print: 2001.04079 [hep-ph]

Vacuum polarization contribution to muon $g-2$ as an inverse problem

Hsiang-nan Li (Taiwan, Inst. Phys.), Hiroyuki Umeeda (Taiwan, Inst. Phys.) (Apr 14, 2020)

Published in: *Phys.Rev.D* 102 (2020) 9, 094003 • e-Print: 2004.06451 [hep-ph]

QCD sum rules with spectral densities solved in inverse problems

Hsiang-nan Li (Taiwan, Inst. Phys.), Hiroyuki Umeeda (Taiwan, Inst. Phys.) (Jun 30, 2020)

Published in: *Phys.Rev.D* 102 (2020) 114014 • e-Print: 2006.16593 [hep-ph]

Dispersive analysis of glueball masses

Hsiang-nan Li (Taiwan, Inst. Phys.) (Sep 10, 2021)

Published in: *Phys.Rev.D* 104 (2021) 11, 114017 • e-Print: 2109.04956 [hep-ph]

Dispersive derivation of the pion distribution amplitude

Hsiang-nan Li (Taiwan, Inst. Phys.) (May 13, 2022)

Published in: *Phys.Rev.D* 106 (2022) 3, 034015 • e-Print: 2205.06746 [hep-ph]

Dispersive analysis of neutral meson mixing

Hsiang-nan Li (Taiwan, Inst. Phys.) (Aug 31, 2022)

Published in: *Phys.Rev.D* 107 (2023) 5, 054023 • e-Print: 2208.14798 [hep-ph]

Dispersive constraints on fermion masses

Hsiang-nan Li (Taiwan, Inst. Phys.) (Feb 3, 2023)

Published in: *Phys.Rev.D* 107 (2023) 9, 094007 • e-Print: 2302.01761 [hep-ph]

Dispersive determination of electroweak-scale masses

Hsiang-nan Li (Taiwan, Inst. Phys.) (Apr 12, 2023)

Published in: *Phys.Rev.D* 108 (2023) 5, 054020 • e-Print: 2304.05921 [hep-ph]

Dispersive determination of neutrino mass ordering

Hsiang-nan Li (Taiwan, Inst. Phys.) (Jun 6, 2023)

Published in: *Nucl.Phys.B* 1018 (2025) 116978 • e-Print: 2306.03463 [hep-ph]

Dispersive determination of fourth generation quark masses

Hsiang-nan Li (Taiwan, Inst. Phys.) (Sep 27, 2023)

Published in: *Phys.Rev.D* 109 (2024) 11, 115024 • e-Print: 2309.15602 [hep-ph]

Dispersive determination of the fourth generation lepton masses

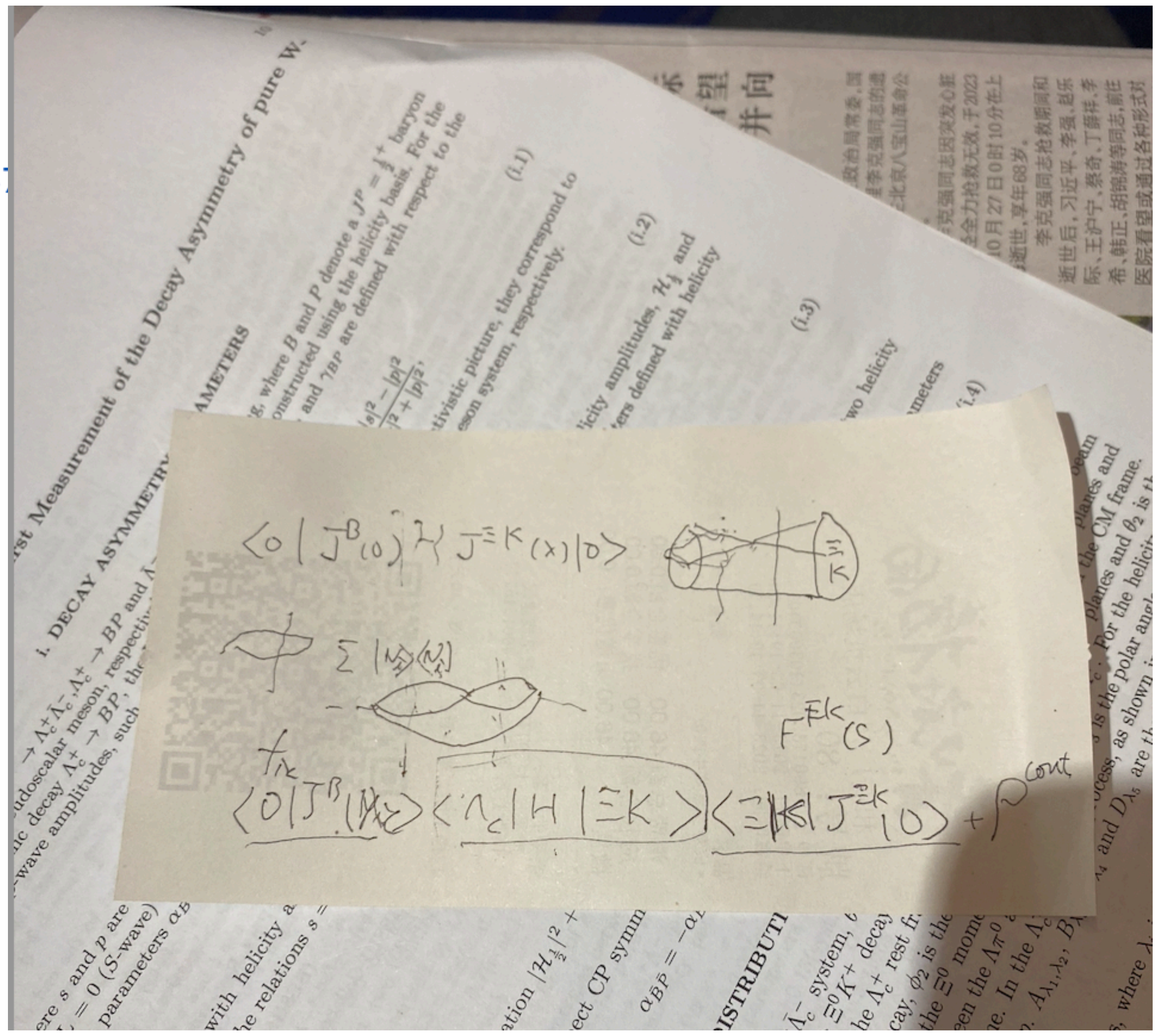
Hsiang-nan Li (Taiwan, Inst. Phys.) (Jul 10, 2024)

Published in: *J.Phys.G* 52 (2025) 2, 025001 • e-Print: 2407.07813 [hep-ph]

Dispersive Analysis of Excited Glueball States

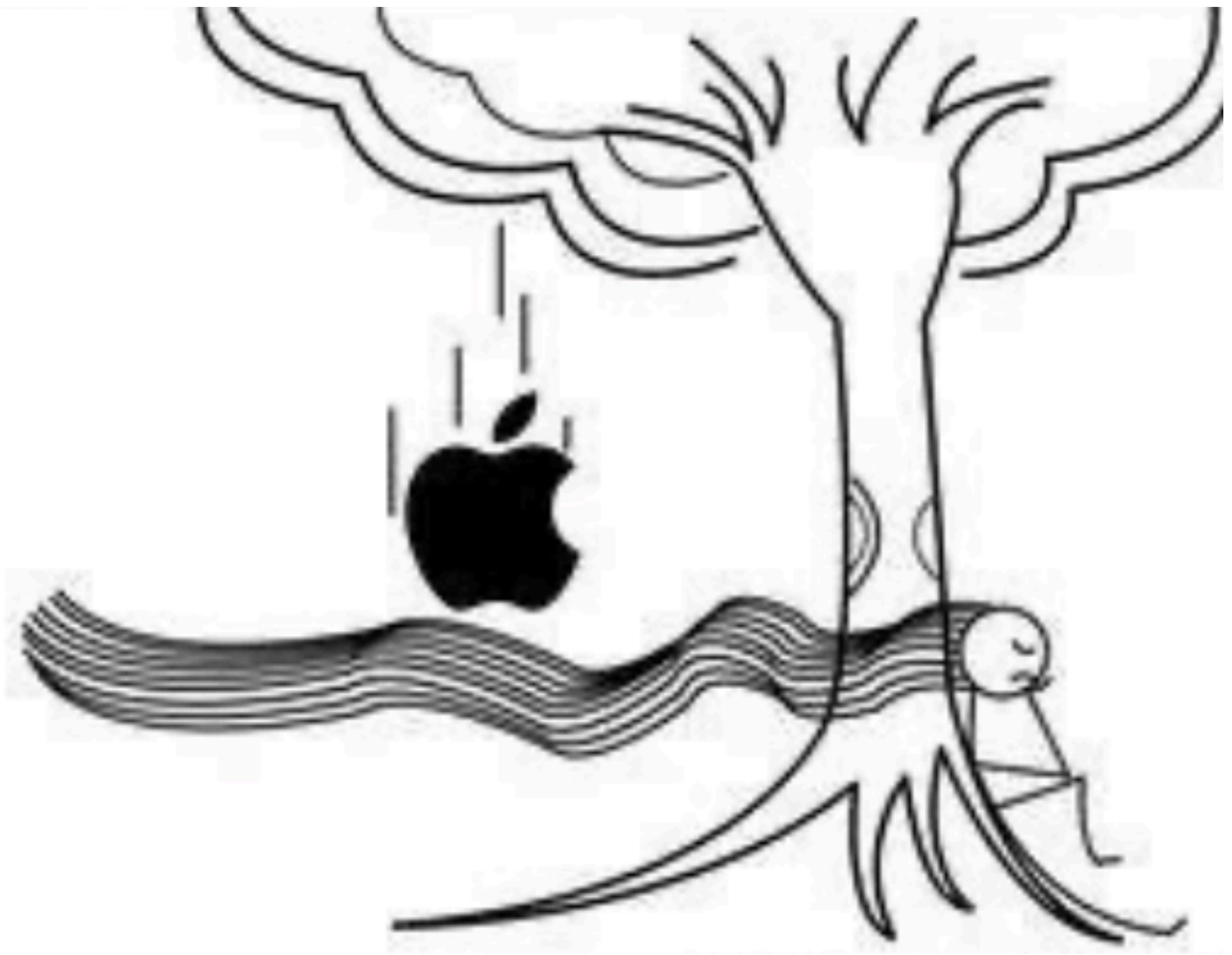
Hsiang-nan Li (Taiwan, Inst. Phys.) (Aug 13, 2024)

Published in: *Chin.Phys.Lett.* 41 (2024) 10, 101101 • e-Print: 2408.06



On the way to a workshop, with Hsiang-nan Li, 2023

FIRST STEP: MASS



$$\mathcal{L}_{\text{mass}} = -m\bar{\psi}\psi$$

$$m_f = \frac{yv}{\sqrt{2}}$$

SSB mass

$$m_H^2 = \frac{\int_0^{s_0} ds\, s\, \rho(s) e^{-s/M^2}}{\int_0^{s_0} ds\, \rho(s) e^{-s/M^2}}$$

QCDSR mass

$$m^{\text{eff}}(t) = \ln \frac{C_2(t)}{C_2(t+1)}$$

LQCD mass

Inverse Matrix Method: ρ mass revised

VECTOR MESON: QCDSR

2PT correlation

$$\Pi^{\mu\nu}(q^2) = \int d^4x e^{iq\cdot x}\langle 0|T\left[J^{\dagger\mu}(x)J^\nu(0)\right]|0\rangle$$

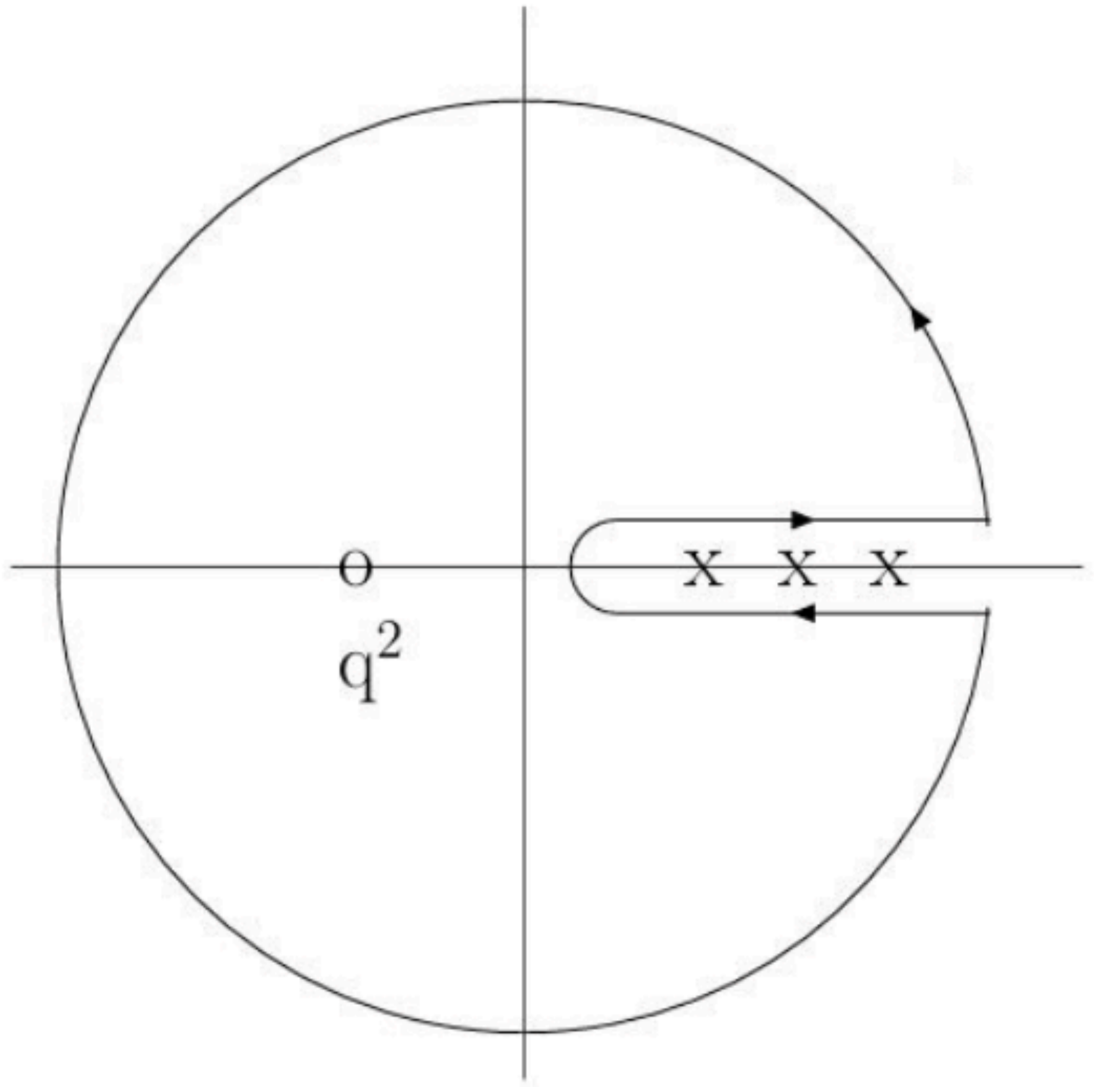
$$J^\mu = \frac{1}{\sqrt{2}}(\bar{u}\gamma^\mu u - \bar{d}\gamma^\mu d)$$

$$= (q^\mu q^\nu - q^2 g^{\mu\nu})\Pi(q^2)$$

Analyticity I

$$\Pi^{\text{mes}}(q^2) = \frac{1}{2\pi i}\oint ds \frac{\Pi(s)}{s-q^2};$$

$$\Pi^{\text{mes}}(q^2) = \frac{1}{\pi}\int_0^R ds \frac{\text{Im}\Pi(s)}{s-q^2} + \frac{1}{2\pi i}\int_{s_L} ds \frac{\Pi^{\text{pert}}(s)}{s-q^2};$$



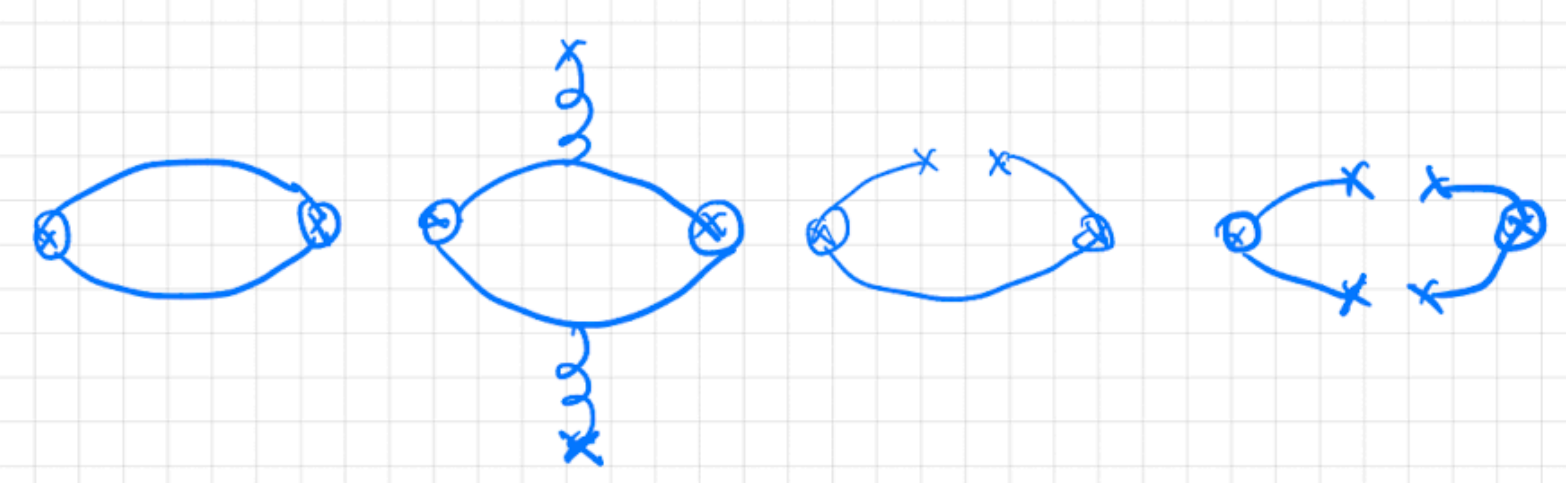
$$\int_0^R ds \frac{\rho(s)}{s-q^2}$$

$$\rho(s) = \frac{1}{\pi}\text{Im}\Pi(s)$$

VECTOR MESON: QCDSR

OPE

$$\Pi^{\mathrm{OPE}}(q^2) = \Pi^{\mathrm{pert}}(q^2) + \frac{1}{12\pi}\frac{\langle \alpha_s G^2\rangle}{(q^2)^2} + \frac{2\langle m_q \bar{q}q\rangle}{(q^2)^2} + \frac{224}{81}\frac{\kappa\alpha_s\langle\bar{q}q\rangle^2}{(q^2)^3}$$



Analyticity II

$$\Pi^{\mathrm{pert}}(q^2) = \frac{1}{4\pi^2}\left(1+\frac{\alpha_s}{\pi}\right)\ln\frac{\mu^2}{-q^2}$$

$$= \frac{1}{\pi}\int_0^R ds\frac{\mathrm{Im}\Pi^{\mathrm{pert}}(s)}{s-q^2} + \frac{1}{2\pi i}\int_{s_L} ds\frac{\Pi^{\mathrm{pert}}(s)}{s-q^2}$$

VECTOR MESON: QCDSR

Duality

$$\Pi^{\mathrm{mes}}(q^2) = \Pi^{\mathrm{OPE}}(q^2)$$

$$\int_0^R ds \frac{\rho(s)}{s-q^2} = \frac{1}{\pi}\int_0^R ds \frac{\mathrm{Im}\Pi^{\mathrm{pert}}(s)}{s-q^2} + \frac{1}{12\pi}\frac{\langle \alpha_s G^2\rangle}{(q^2)^2} + \frac{2\langle m_q \bar{q}q\rangle}{(q^2)^2} + \frac{224}{81}\frac{\kappa\alpha_s\langle\bar{q}q\rangle^2}{(q^2)^3}$$

$$\Delta\rho(s,\Lambda) = \rho(s) - \frac{1}{\pi}\mathrm{Im}\Pi^{\mathrm{pert}}(s)[1-\exp(-s/\Lambda)]$$

$$x = q^2/\Lambda$$

$$y = s/\Lambda$$

$$\int_0^\infty dy \frac{\Delta\rho(y)}{x-y} = \int_0^\infty dy \frac{\frac{1}{4\pi^2}(1+\alpha_s/\pi)e^{-y}}{x-y} - \frac{1}{12\pi}\frac{\langle\alpha_s G^2\rangle}{x^2\Lambda^2} - \frac{2\langle m_q\bar{q}q\rangle}{x^2\Lambda^2} - \frac{224}{81}\frac{\kappa\alpha_s\langle\bar{q}q\rangle^2}{x^3\Lambda^3}$$

$$\omega(x) = \sum_{n=1}^{N}\frac{b_n}{x^n}$$

VECTOR MESON: INVERSE MATRIX METHOD

Fredholm integral equation

$$\int_0^\infty dy \frac{\Delta\rho(y)}{x-y} = \omega(x)$$

$$\frac{1}{x-y} = \sum_{m=1}^{N} \frac{y^{m-1}}{x^m}, \qquad \omega(x) = \sum_{n=1}^{N} \frac{b_n}{x^n}$$

$$\Delta\rho(y) = \sum_{n=1}^{N} a_n y^\alpha e^{-y} L_{n-1}^{(\alpha)}(y)$$

$$M_{nm} = \int_0^\infty dy y^{m-1+\alpha} e^{-y} L_{n-1}^{(\alpha)}(y)$$

$$\boxed{Ma = b}$$

→

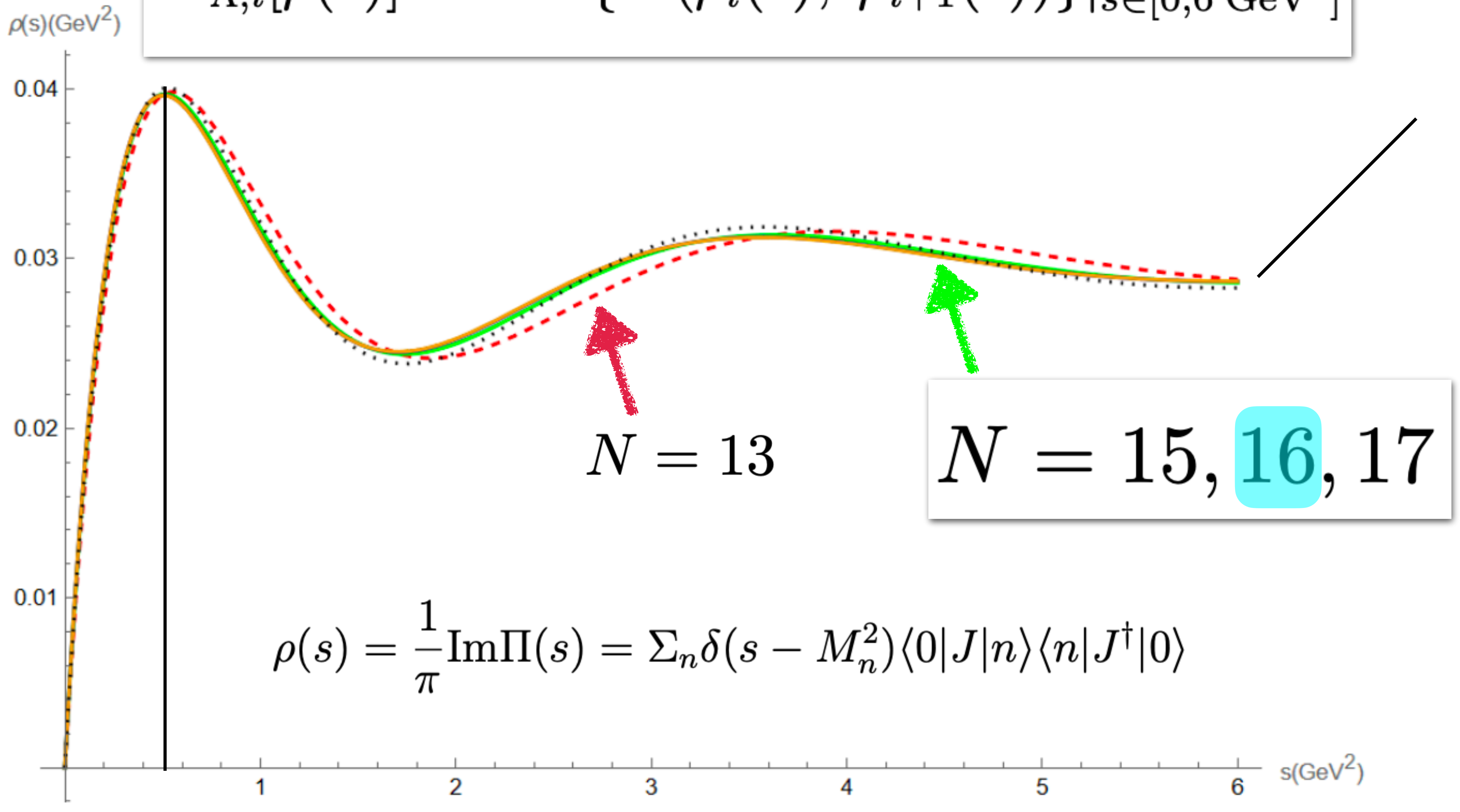
$$\boxed{a = M^{-1} b}$$

ill-posedness discussed in
Xiong-Wei-Yu, 2211.13753

- Key issue: optimal choice of N

VECTOR MESON: INVERSE MATRIX METHOD

- positivity for spectral density
- Frechet distance to search the proper N



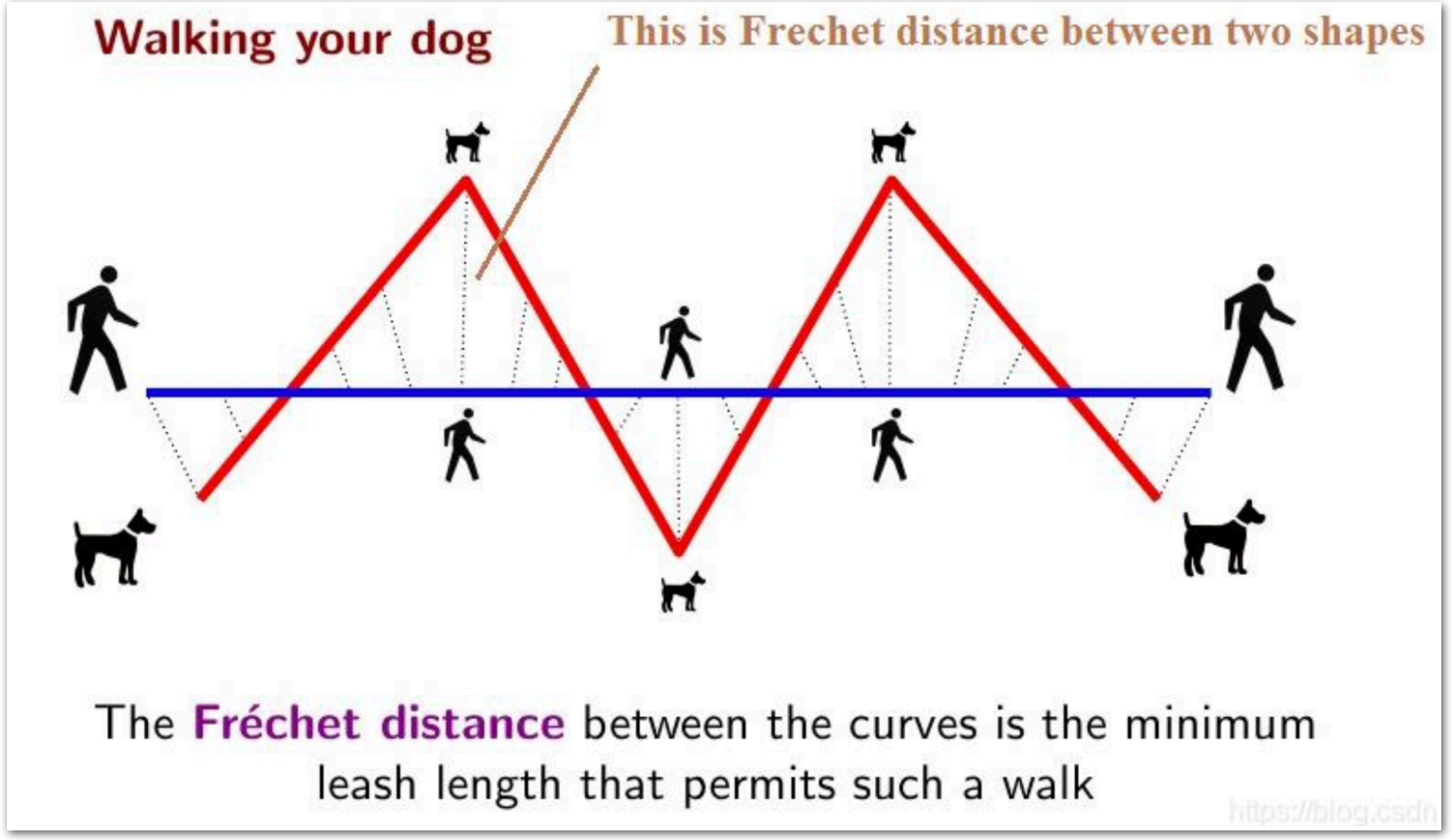
$$F_{\Lambda,i}[\rho(s)] = \max\{\mathrm{D}\left(\rho_i(s),\ \rho_{i+1}(s)\right)\}|_{s\in[0,6\ \mathrm{GeV}^2]}$$

$N = 13$

$N = 15, 16, 17$

$$\rho(s) = \frac{1}{\pi}\mathrm{Im}\Pi(s) = \Sigma_n \delta(s - M_n^2)\langle 0|J|n\rangle\langle n|J^\dagger|0\rangle$$

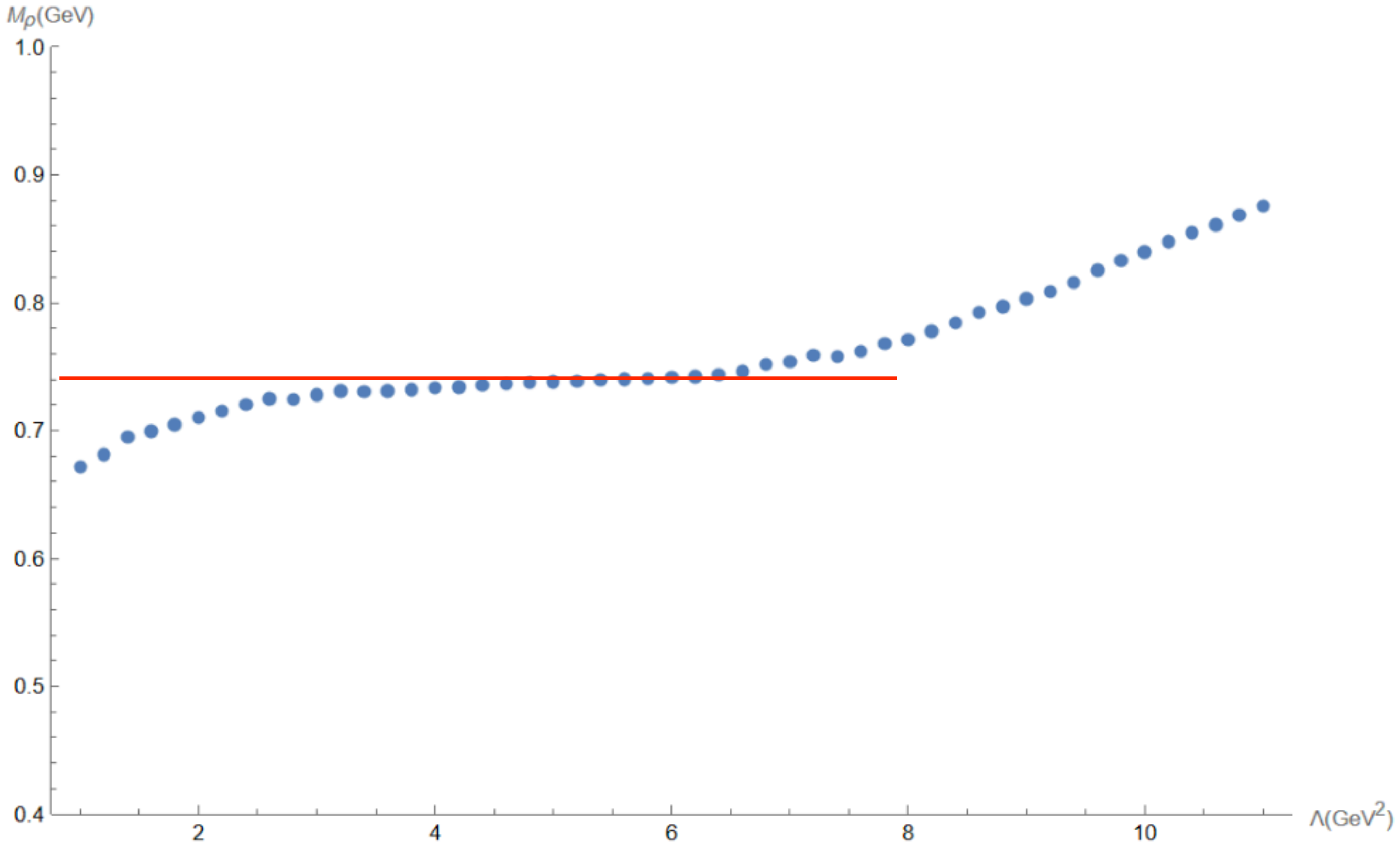
$\Lambda = 2\ \mathrm{GeV}^2$



The **Fréchet distance** between the curves is the minimum leash length that permits such a walk

VECTOR MESON: INVERSE MATRIX METHOD

- The stability with Λ



$$\langle \alpha_s G^2 \rangle = 0.028 \text{ GeV}^4, \quad \langle m_q \bar{q} q \rangle = 0.007 \times (-0.215)^3 \text{ GeV}^4,$$
$$\alpha_s \langle \bar{q} q \rangle^2 = 6.64 \times 10^{-5} \text{ GeV}^6 \quad \alpha_s = 0.5, \quad \kappa = 2,$$

$$\boxed{M_\rho = (0.737 \pm 0.004) \text{ GeV}}$$

$$f_\rho^2 \approx \int_0^a ds \Delta\rho(s, \Lambda)$$

$$\boxed{f_\rho \approx 0.218 \text{ GeV}}$$

Baryon Mass

QCDSR

2PT correlation

$$\eta(x) = \epsilon^{abc}[u^{aT}(x)C\gamma^{\mu}u^{b}(x)]\gamma_5\gamma_\mu d^c(x)$$

$$\Pi(k) = i\int d^4x e^{ik\cdot x}\langle 0|T[\eta(x)\bar{\eta}(0)]|0\rangle = A(k^2)\not{k} + B(k^2)$$

Hadron

$$\Pi^{\mathrm{Had}}(k) = \lambda_+^2\frac{\not{k}+m_+}{m_+^2-k^2} + \lambda_-^2\frac{\not{k}-m_-}{m_-^2-k^2} + \dots$$

positive parity:

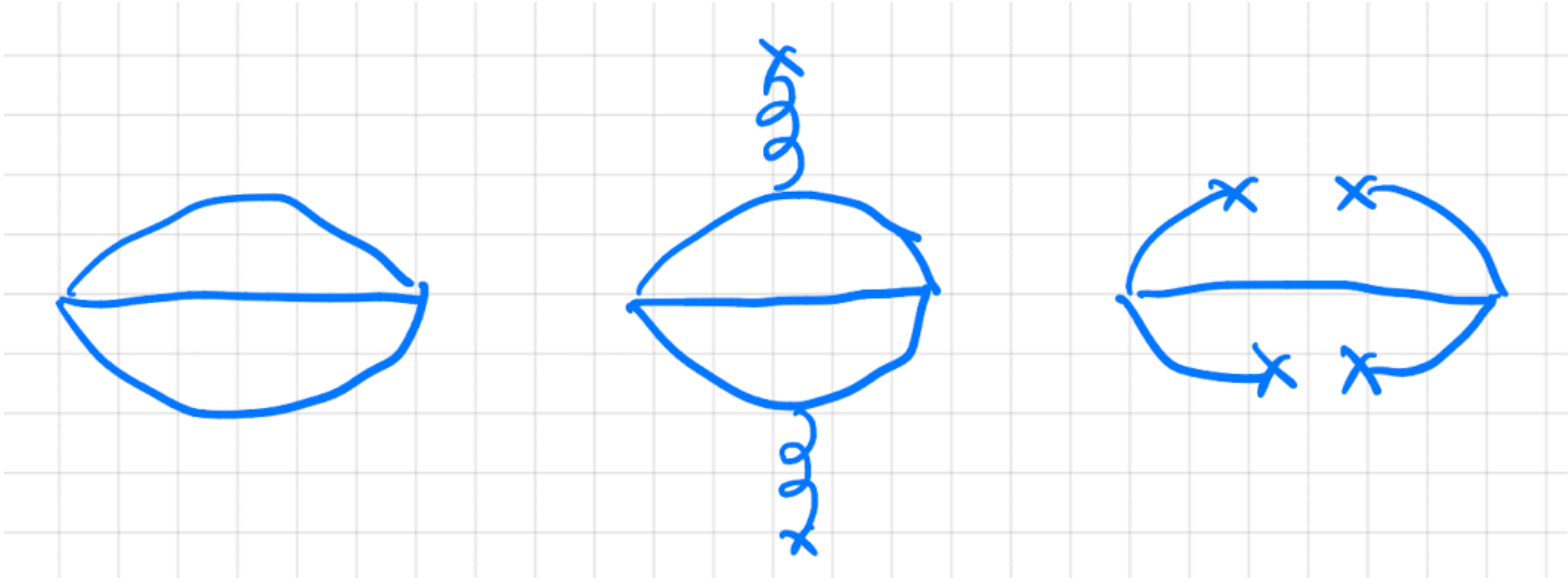
$$A(k^2) = \frac{\lambda_P^2}{M_P^2-k^2}, \quad B(k^2) = \frac{\lambda_P^2 M_P}{M_P^2-k^2}$$

OPE IN QCDSR

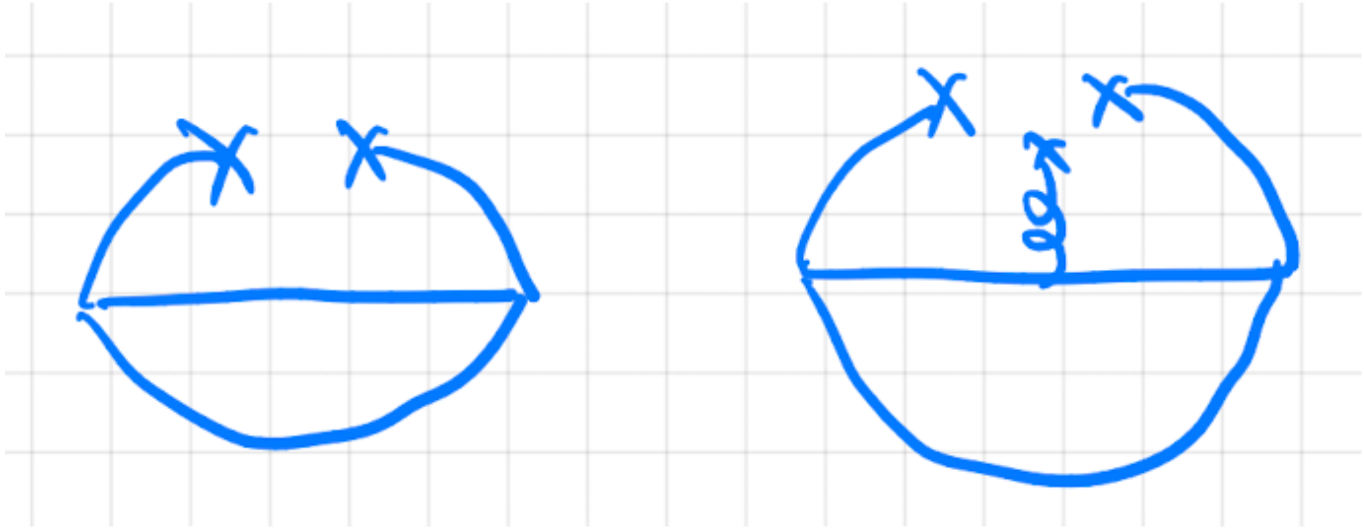
B. L. Ioffe, Nucl. Phys. B **188**, 317-341 (1981)

OPE

$$\Pi_A(k^2) = \frac{k^4}{64\pi^4} \ln\left(\frac{-k^2}{\mu^2}\right) + \frac{\langle \alpha_s G^2 \rangle}{32\pi^3} \ln\left(\frac{-k^2}{\mu^2}\right) - \frac{2}{3k^2}\kappa\langle \bar{q}q \rangle^2$$



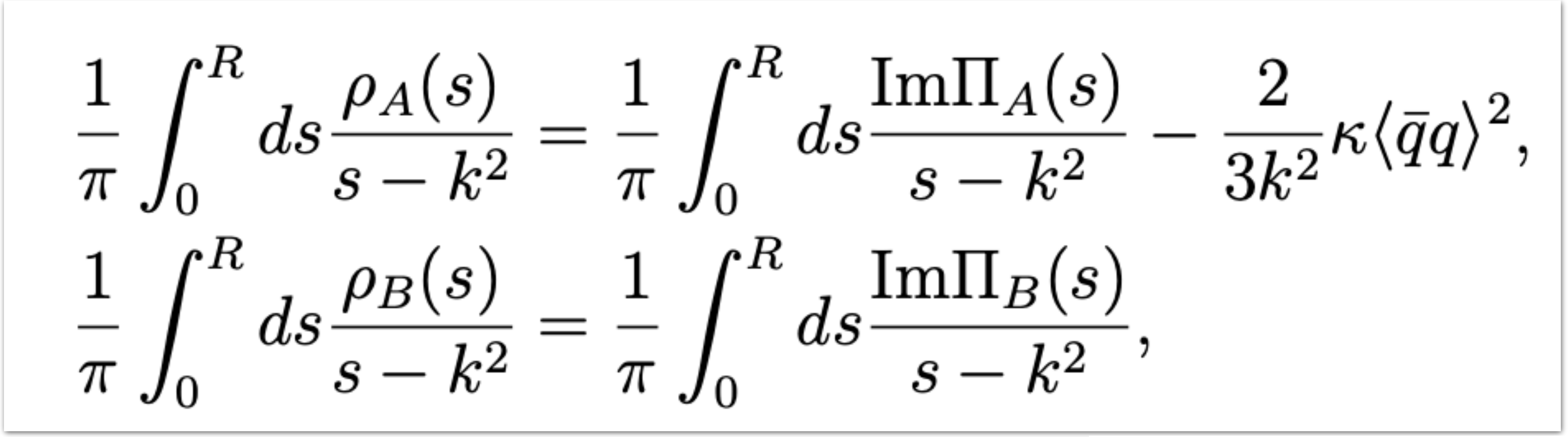
$$\Pi_B(k^2) = -\left(\frac{k^2}{4\pi^2}\langle \bar{q}q \rangle + \frac{1}{8\pi^2}\langle \bar{q}g\sigma \cdot Gq \rangle\right) \ln\left(\frac{-k^2}{\mu^2}\right)$$



ANALYTICITY

Analyticity

$$A(k^2) = \frac{1}{2\pi i}\oint ds \frac{A(s)}{s-k^2}, \quad B(k^2) = \frac{1}{2\pi i}\oint ds \frac{B(s)}{s-k^2},$$



$$\frac{1}{\pi}\int_0^R ds \frac{\rho_A(s)}{s-k^2} = \frac{1}{\pi}\int_0^R ds \frac{\mathrm{Im}\Pi_A(s)}{s-k^2} - \frac{2}{3k^2}\kappa\langle\bar{q}q\rangle^2,$$

$$\frac{1}{\pi}\int_0^R ds \frac{\rho_B(s)}{s-k^2} = \frac{1}{\pi}\int_0^R ds \frac{\mathrm{Im}\Pi_B(s)}{s-k^2},$$

$$\rho_A(s) = \tfrac{1}{\pi}\mathrm{Im}A(s),\ \rho_B(s) = \tfrac{1}{\pi}\mathrm{Im}B(s)$$

$$\mathrm{Im}\Pi_A(s) = \pi\left(\frac{s^2}{64\pi^4} + \frac{\langle\alpha_s G^2\rangle}{32\pi^3}\right),$$

$$\mathrm{Im}\Pi_B(s) = -\pi\left(\frac{s}{4\pi^2}\langle\bar{q}q\rangle + \frac{1}{8\pi^2}\langle\bar{q}g\sigma\cdot Gq\rangle\right)$$

BARYON OCTET: SPECTRAL DENSITY

$$\Delta\rho_A(s,\Lambda) = \rho_A(s) - \frac{s^2}{64\pi^4}[1-\exp(-s/\Lambda)] - \frac{\langle\alpha_s G^2\rangle}{32\pi^3}[1-\exp(-s^\alpha/\Lambda^\alpha)],$$

$$\Delta\rho_B(s,\Lambda) = \rho_B(s) + \frac{s}{4\pi^2}\langle\bar{q}q\rangle[1-\exp(-[s/\Lambda]^{\alpha-1})] + \frac{1}{8\pi^2}\langle\bar{q}g\sigma\cdot Gq\rangle[1-\exp(-s^\alpha/\Lambda^\alpha)],$$

$$x = k^2/\Lambda$$
$$y = s/\Lambda$$

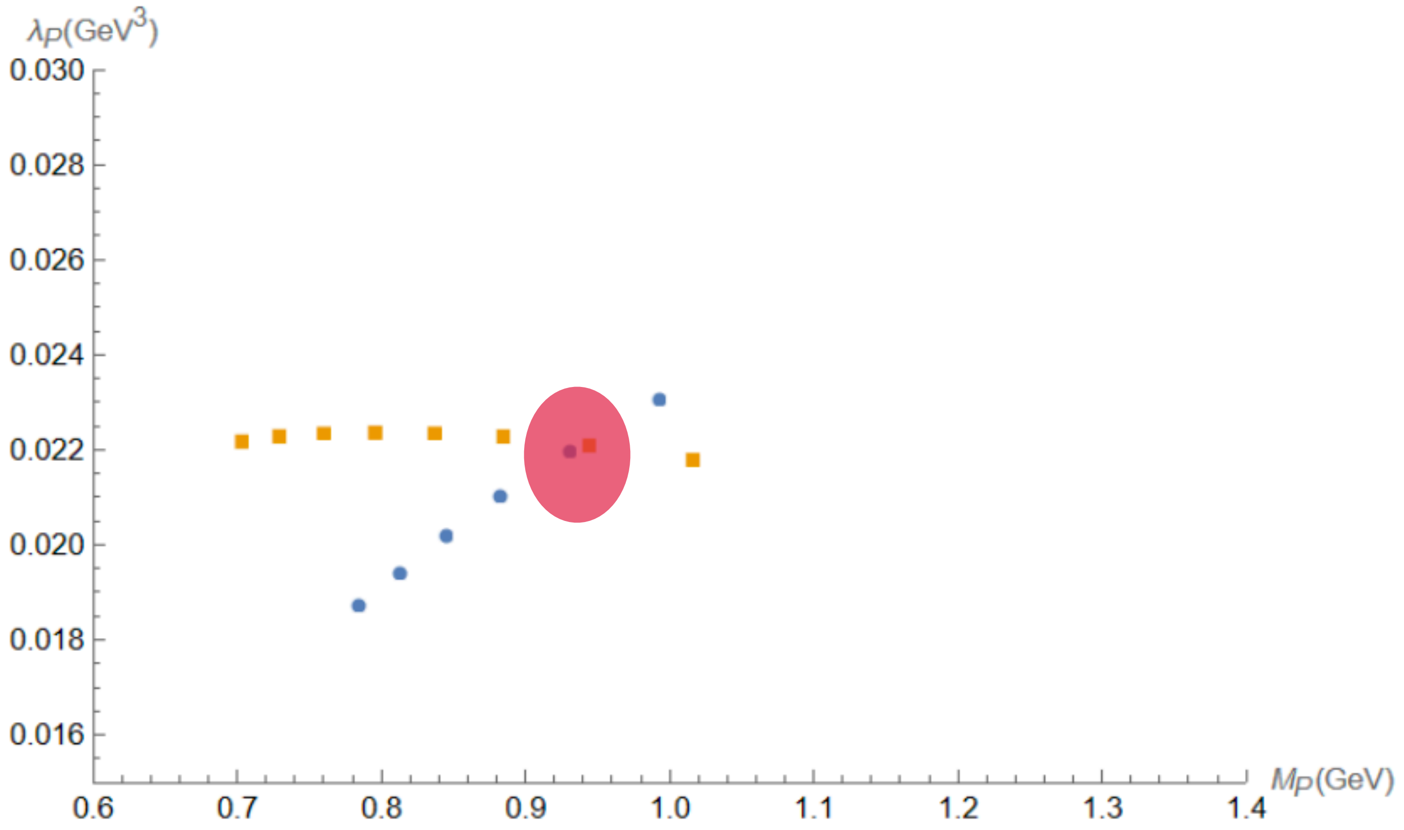
$$\int_0^\infty dy\frac{\Delta\rho_A(y)}{x-y} = \frac{1}{64\pi^4}\int_0^\infty dy\frac{y^2e^{-y}}{x-y} + \frac{\langle\alpha_s G^2\rangle}{32\pi^3\Lambda^2}\int_0^\infty dy\frac{e^{-y^2}}{x-y} + \frac{2}{3x\Lambda^3}\kappa\langle\bar{q}q\rangle^2,$$

$$\int_0^\infty dy\frac{\Delta\rho_B(y)}{x-y} = -\frac{\langle\bar{q}q\rangle}{4\pi^2\Lambda^{3/2}}\int_0^\infty dy\frac{ye^{-y}}{x-y} - \frac{\langle\bar{q}g\sigma\cdot Gq\rangle}{8\pi^2\Lambda^{5/2}}\int_0^\infty dy\frac{e^{-y^2}}{x-y}$$

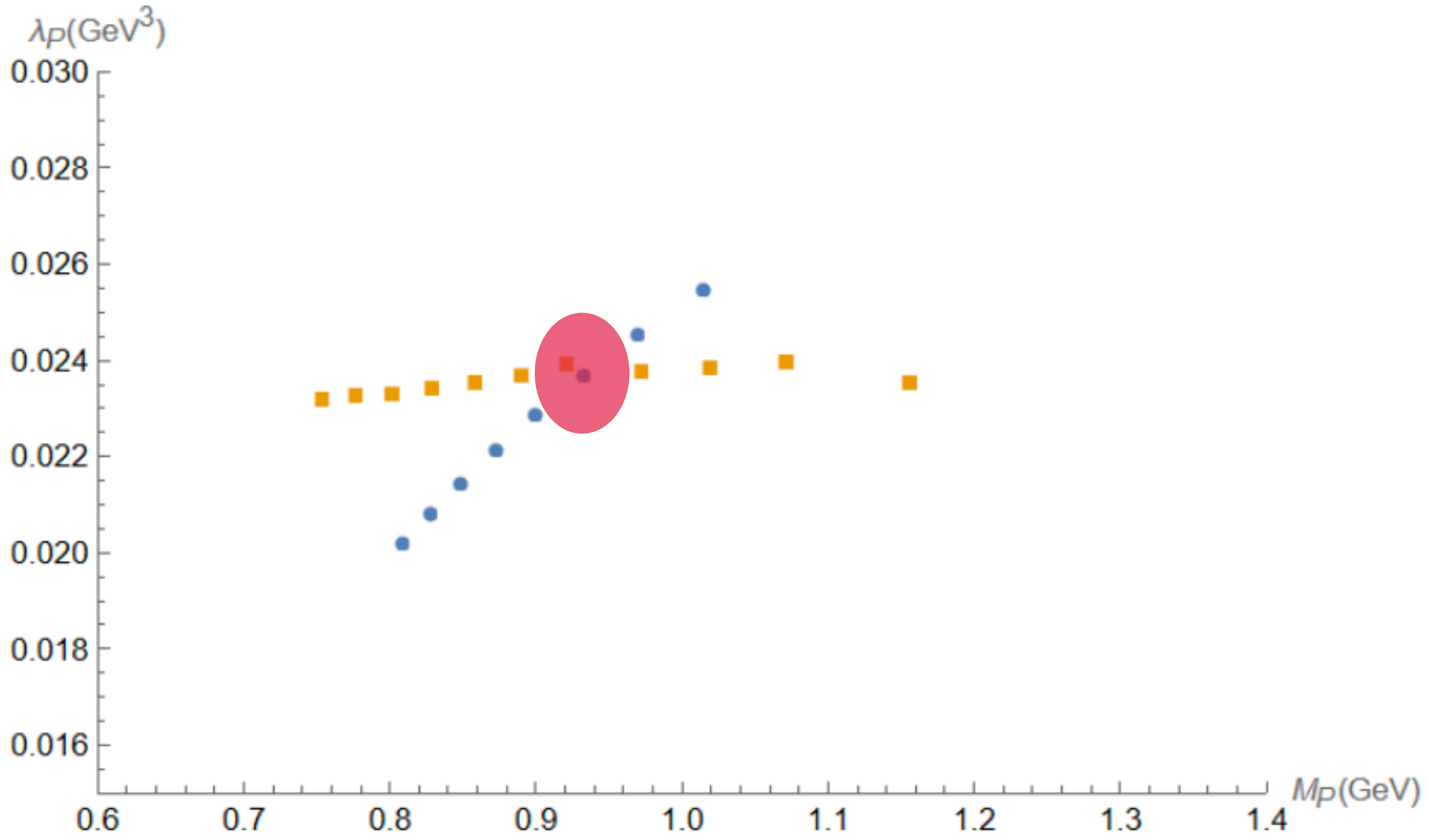
$$\boxed{Ma = b}$$

NUMERICAL ANALYSIS

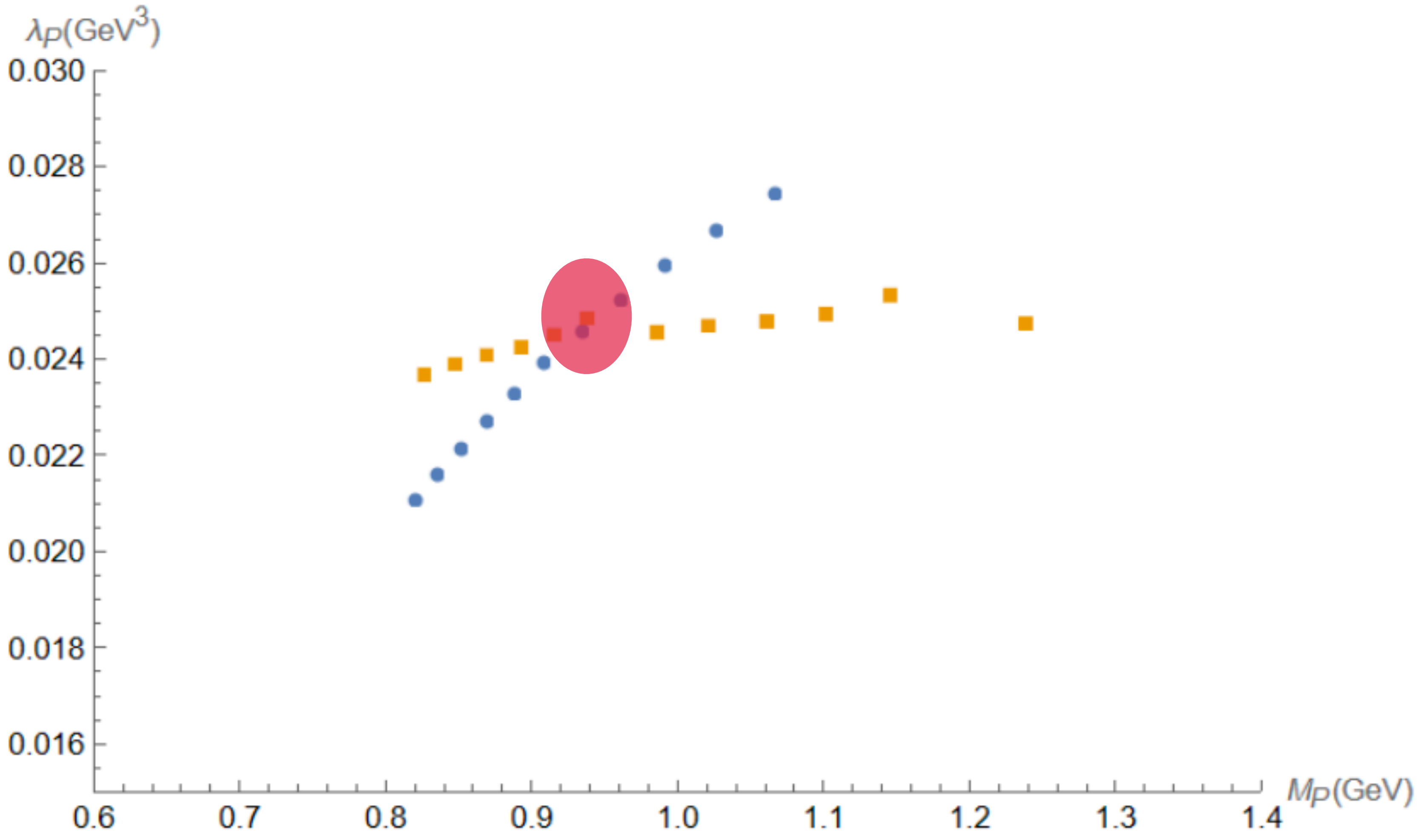
- Difficulty: no stable N;
- strategy: combine $\lambda_p - M_p$ relation for each N in 2 SRs



$\Lambda = 2$ GeV^2



3 GeV^2



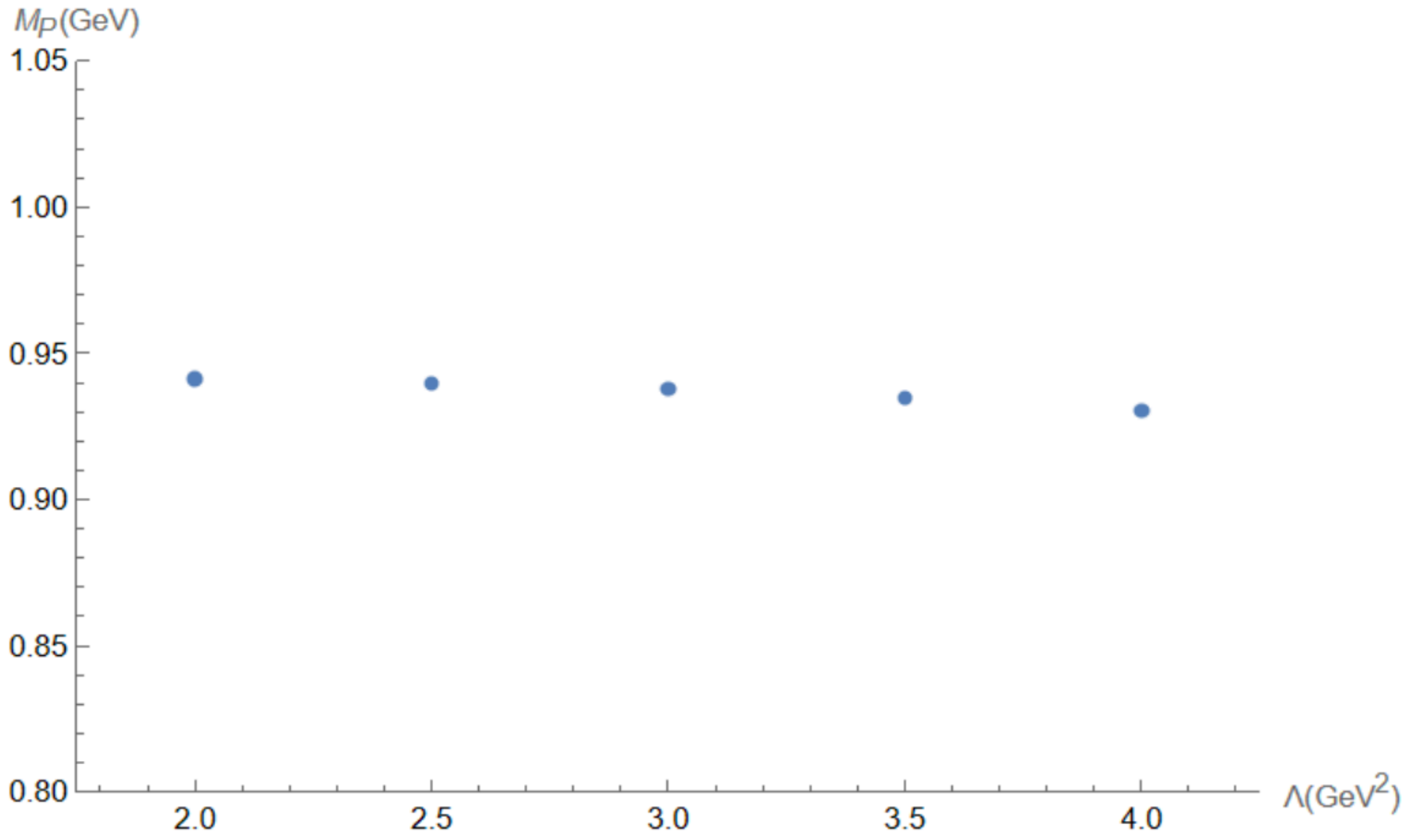
4 GeV^2

$$\boxed{M_P = (0.936 \pm 0.005)\ \mathrm{GeV}}$$

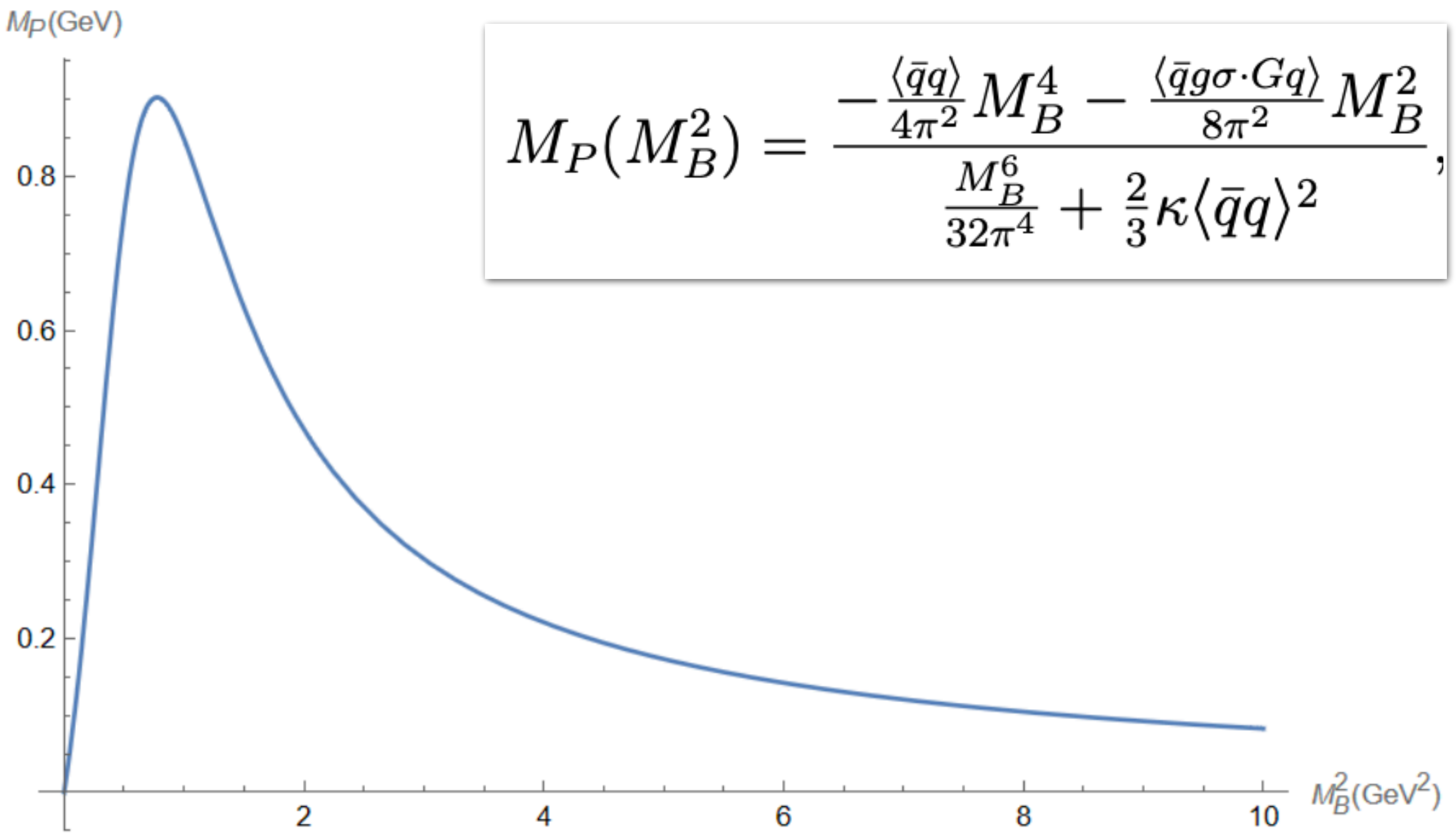
$$\boxed{\lambda_P = (0.0232 \pm 0.0013)\mathrm{GeV}^3}$$

STABILITY AND COMPARISON

- Dependences of mass on Λ



- Dependences of mass on Borel mass in QCDSR



$$M_P(M_B^2) = \frac{-\frac{\langle\bar{q}q\rangle}{4\pi^2}M_B^4 - \frac{\langle\bar{q}g\sigma\cdot Gq\rangle}{8\pi^2}M_B^2}{\frac{M_B^6}{32\pi^4} + \frac{2}{3}\kappa\langle\bar{q}q\rangle^2},$$

SUMMARY

- We have successfully generate static parameters for baryon system in the dispersion approach.

- In addition to vector meson, we can also predict decuplet parameters

$$M_\Delta = (1.238 \pm 0.018)\ \mathrm{GeV}, \quad \lambda_\Delta = (0.019 \pm 0.002)\ \mathrm{GeV}^3$$

- For all the three hadrons, universal condensates are adopted.
- Heavy baryon static properties are ongoing.
- In the Inverse Problem Method, to study parameters such as CPV sources are promising.