第八届重味物理与量子色动力学研讨会

Summary

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第八届全国重味物理与量子色动力学研讨会，2026/04/27，重庆

非常成功的大会：参会人数、会议主题、报告人数

感谢会议主办方和承办方：重庆大学、重庆科技大学、南开大学、中国科学院高能物理研究所、南京师范大学、重庆物理学会

感谢会议组委会：郑绪昌、吴兴刚、张家伟、王玉明、吕才典、肖振军

感谢地方组委会：边立功、崔博言、秦思学、孙冠豪、王俊璋、吴兴刚、张家伟、张生辉、郑绪昌

2

会议主题：

- 重味物理与 QCD：精确检验粒子物理标准模型、间接寻找超出标准模型的新物理的重要场所，有助于理解宇宙正反物质不对称性，理解量子色动力学基本理论、揭示强子内部结构、……

- 广泛的主题：强子谱、强子结构、CP 破坏、重味强子的产生和衰变、重夸克偶素物理、核子自旋和部分子结构、圈图计算新方法及其应用、对各种过程的高阶微扰和高阶幂次修正、新物理、…

- 实验进展：LHCb 、Belle (II)、BESIII 、CMS、ATLAS、STCF、EIC、……

- 理论进展：基于QCD 的各种方法，如Lattice QCD、HQET 、QCDF 、pQCD 、NRQCD、ChPT 、….

- 深刻印象：理论与实验合作更为紧密、实验测量精度和理论计算精度越来越高、青年学者越来越多加入

3

实验： LHCb、BESIII、Belle (II)、CMS、ATLAS ……

Outline of the talk

- Introduction
- Precise measurement of the CKM angle γ with a novel approach
- CP violation studies in $B^+ \to K^+\pi^+\pi^-$ decays
- Prospects and conclusion

Disclaimer: results are selected based on personal taste

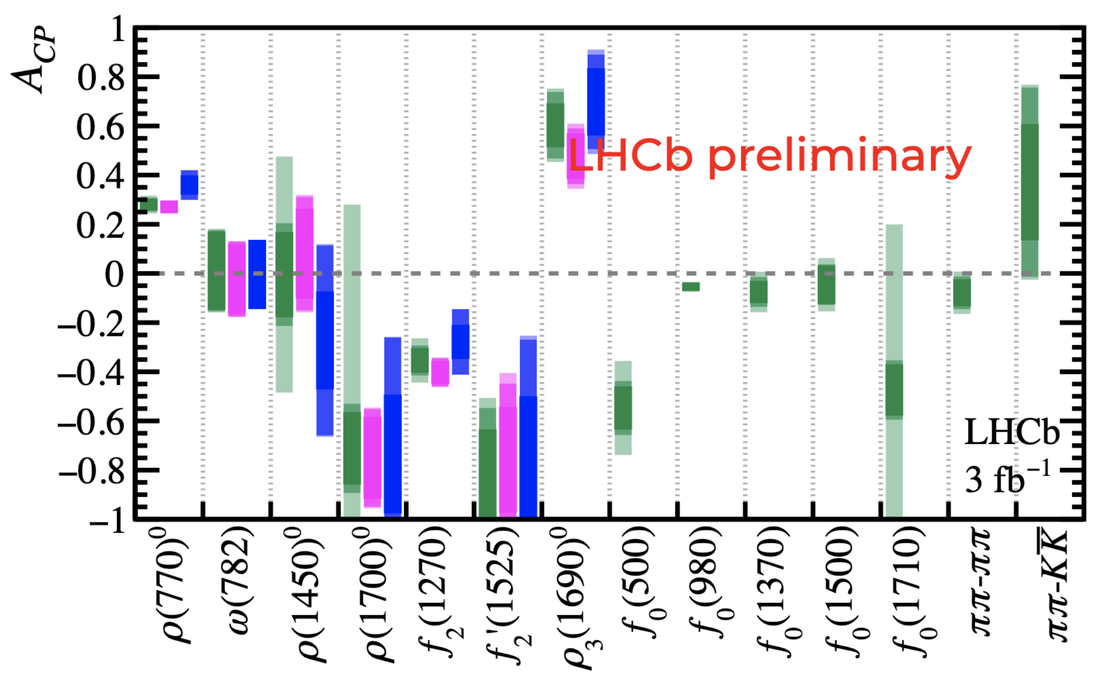
2026/04/25 UCAS, Wenbin Qian 2

- Three different approaches to build the $\pi\pi$ S-wave model LHCb-PAPER-2025-067
- *CP* violation LHCb-PAPER-2025-069
    - Good agreement of *CPV* between S-waves obtained from different approaches
    - Observe *CP* violation in $B^+ \to \rho(770)^0 K^+$ and $B^+ \to f_2(1270) K^+$ decays , while evidence for *CP* violation in $B^+ \to \rho_3(1690)^0 K^+$ decay and low-mass S-wave-dominated region of $\pi^+\pi^-$ for the first time
    - Observe *CP* violation in $B^+ \to (S\text{–}P)K^+$ interference and find evidence of the same in $B^+ \to (S\text{–}D)K^+$ interference for the first time
- Implications for hadronic modelling (strong interaction physics) LHCb-PAPER-2025-068
    - Measured branching fraction of $B^+ \to K_0^*(1430)^0\pi^+$ now favours QCDf, resolving longstanding puzzle
    - Improved $K\pi$ S-wave model also means $f_X(1300)$ is no longer needed: standard $f_0(1370)$, $f_0(1500)$, tensor components and their interference describe the data well
    - Ten new intermediate processes are observed for the first time

Joint measurement between LHCb and BESIII

$$\gamma = (71.3 \pm 5.0)^\circ ,$$
$$r_B^{DK} = 0.0949^{+0.0086}_{-0.0085} , \quad r_B^{D\pi} = 0.0064^{+0.0021}_{-0.0019} ,$$
$$\delta_B^{DK} = (121.6^{+5.6}_{-5.9})^\circ , \quad \delta_B^{D\pi} = (311^{+17}_{-20})^\circ .$$

most precise single measurement to date on γ



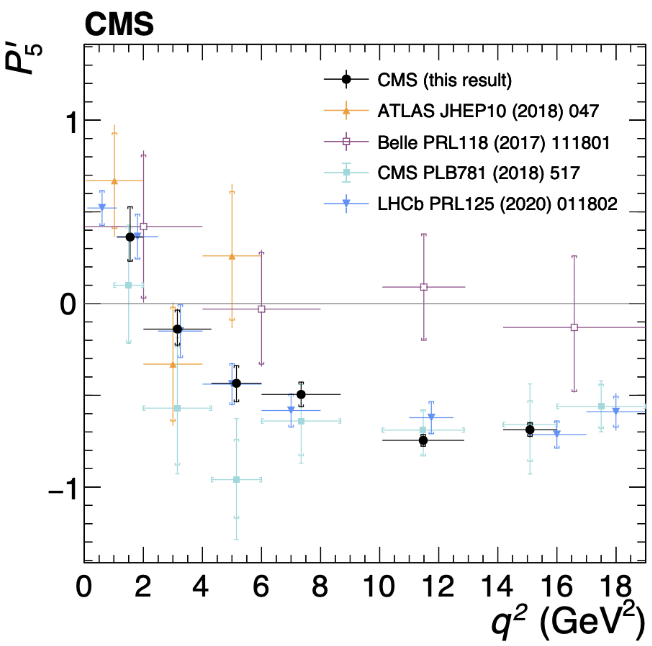
detailed amplitude analysis 4

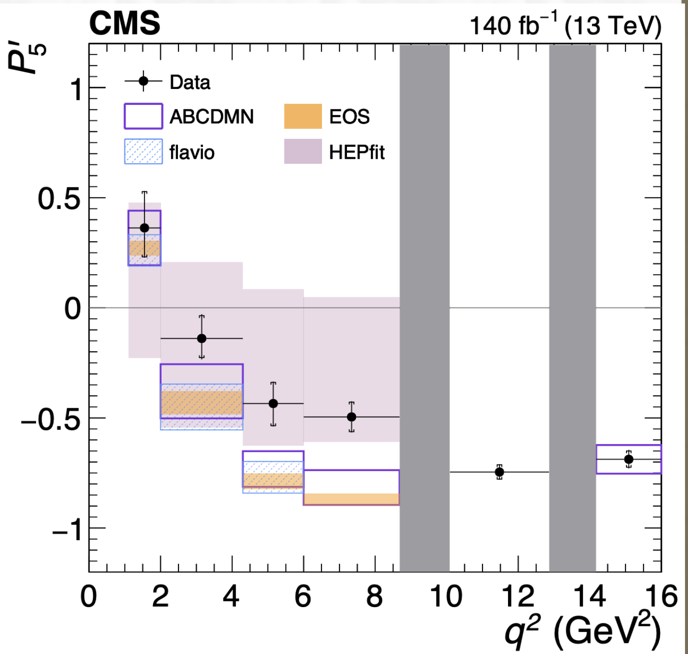
实验：LHCb、BESIII、Belle (II)、CMS、ATLAS ……

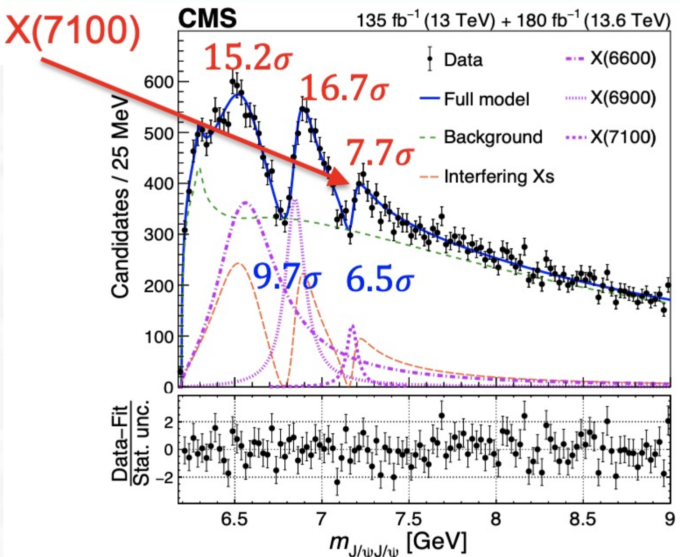
Recent CMS BPH results

- Production & properties
  - Y(nS) cross section measurements at 13.6 TeV (submitted to JHEP)
  - Full angular analysis of $B^0 \to K^{*0}\mu\mu$ (PLB)
  - Differential $\mathcal{B}$ measurement and angular analysis of $B^0_s \to \phi\mu\mu$
- Search for new rare decays
  - Observation of $\eta \to \mu^+\mu^-e^+e^-$
  - Search for B^0_s (B^0) $\to 4\mu$
  - Search for $\tau \to 3\mu$
- Spectroscopy
  - Observation of X(6600) and X(7100) in $J/\psi\, J/\psi \to 4\mu$
  - Observation of X(6900) $\to J/\psi\, \psi(2S) \to 4\mu$ (submitted to Sci. Adv.)
  - J^{PC} measurement of the tetraquark family X(6600),X(6900),X(7100) (Nature)

Zhen Hu





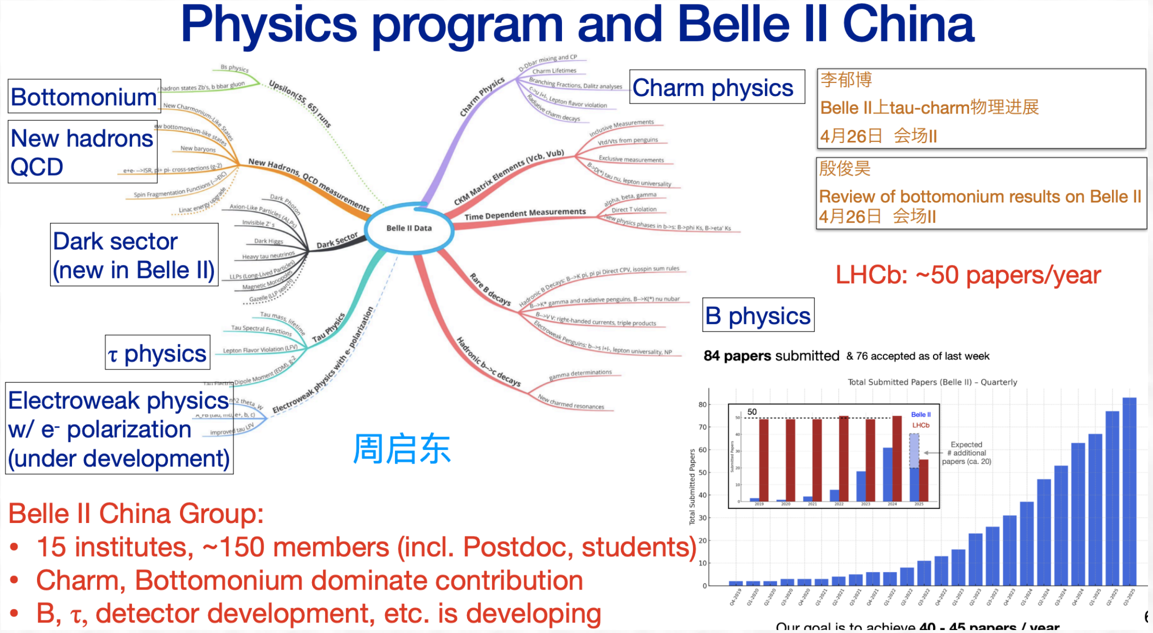


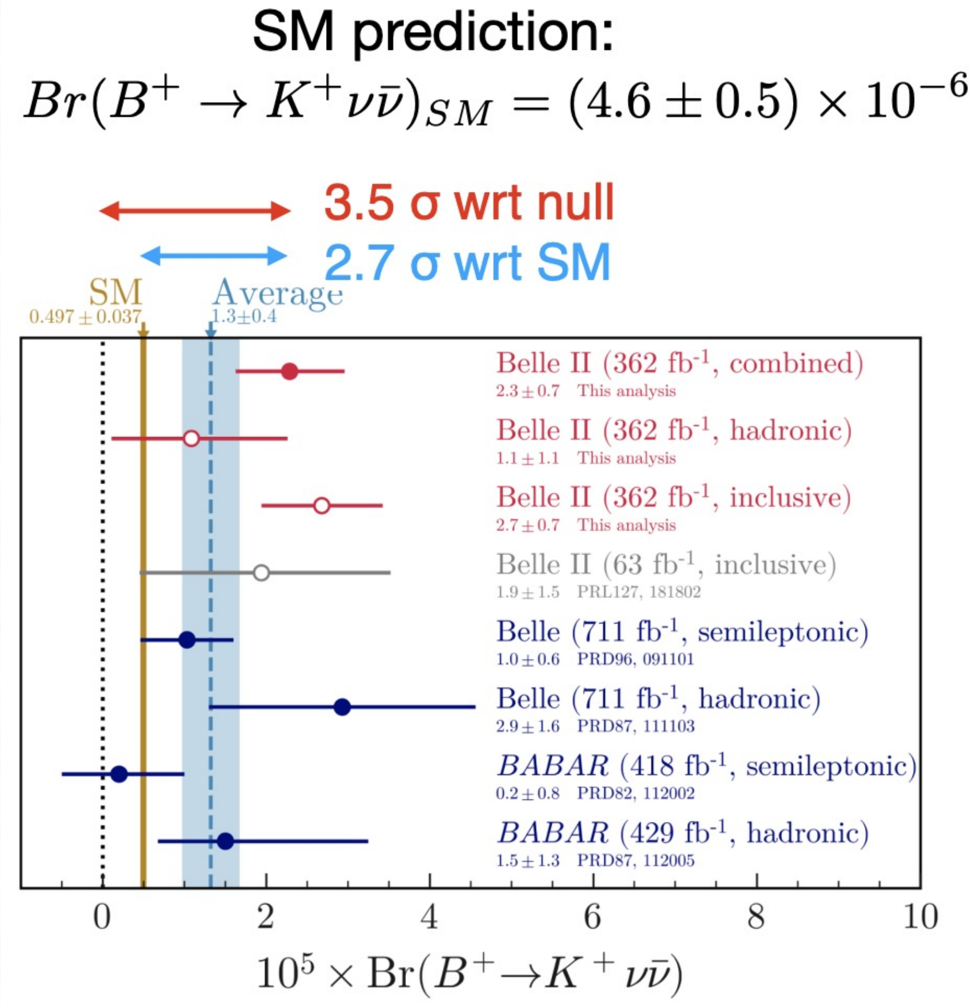
most precise measurements of the angular observables

valuable contribution to our understanding of the $b \to sll$

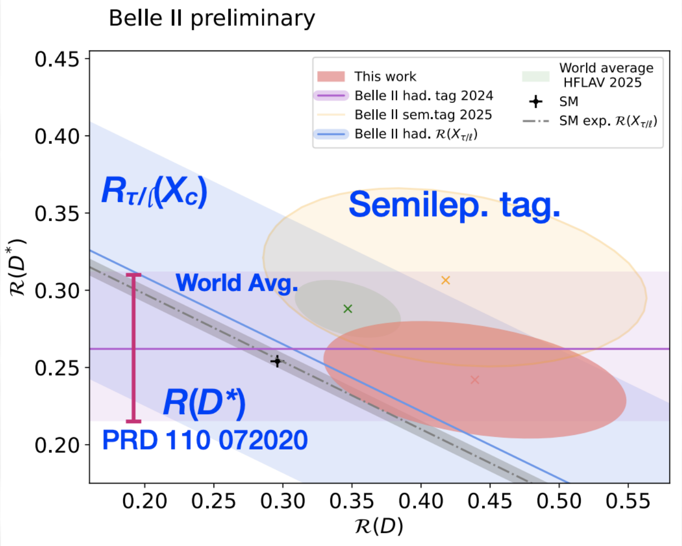
CMS paints a full picture of fully-charm tetraquarks

实验：LHCb、BESIII、Belle (II)、CMS、ATLAS ……





- ✓ three R(D(*)) measurements
- ✓ performed the first R(Xc) measurement



other $b \to s\nu\bar{\nu}$ decays in preparation (stay tuned)

6

实验： LHCb、BESIII、Belle (II)、CMS、ATLAS ……

Study on the Charmed Baryons in the BESIII Experiment

Pei-Rong Li（李培荣）

Lanzhou University

Λ_c^+ decay asymmetry studies

P.-R. Li, X.-R. Lyu, Y. Zheng, Chin. Phys. C 50, 022

Mode	α	Experiment	Mode	α	Experiment
Nucleon-involved			$\Lambda_c^+\to\Lambda(1600)\pi^+$	0.2±0.5	LHCb(2023)[91]
$\Lambda_c^+\to pK_S^0$	−0.75±0.10	LHCb(2024)[160]	$\Lambda_c^+\to\Lambda(1670)\pi^+$	0.82±0.08	LHCb(2023)[91]
	$-0.92^{+0.14}_{-0.09}$	BESIII(2025)[159]		0.21±0.43	BESIII(2025)[153]
$\Lambda_c^+\to p\bar{K}_0^*(700)^0$	−0.1±0.7	LHCb(2023)[91]	$\Lambda_c^+\to\Lambda(1690)\pi^+$	0.958±0.034	LHCb(2023)[91]
$\Lambda_c^+\to p\bar{K}^*(892)^0$	0.87±0.03	LHCb(2023)[91]	$\Lambda_c^+\to\Lambda(2000)\pi^+$	−0.57±0.19	LHCb(2023)[91]
$\Lambda_c^+\to p\bar{K}_0^*(1430)^0$	0.34±0.14	LHCb(2023)[91]	**Σ-involved**		
$\Lambda_c^+\to\Delta(1232)^{++}K^-$	0.55±0.04	LHCb(2023)[91]	$\Lambda_c^+\to\Sigma^+\pi^0$	−0.48±0.03	Belle(2023)[103]
$\Lambda_c^+\to\Delta(1600)^{++}K^-$	−0.50±0.18	LHCb(2023)[91]		−0.59±0.05	BESIII(2025)[159]
$\Lambda_c^+\to\Delta(1700)^{++}K^-$	0.22±0.08	LHCb(2023)[91]	$\Lambda_c^+\to\Sigma^+\eta$	−0.99±0.06	Belle(2023)[103]
Λ-involved			$\Lambda_c^+\to\Sigma^+\eta'$	−0.46±0.07	Belle(2023)[103]
$\Lambda_c^+\to\Lambda\pi^+$	−0.785±0.007	LHCb(2024)[160]	$\Lambda_c^+\to\Sigma^0\pi^+$	−0.46±0.02	Belle(2023)[137]
	−0.755±0.006	Belle(2023)[137]		−0.50±0.08	BESIII(2025)[159]
	−0.790±0.033	BESIII(2025)[159]	$\Lambda_c^+\to\Sigma(1385)^+\pi^0$	−0.917±0.089	BESIII(2022)[98]
$\Lambda_c^+\to\Lambda K^+$	−0.59±0.05	Belle(2023)[137]	$\Lambda_c^+\to\Sigma(1385)^+\eta$	−0.61±0.16	BESIII(2025)[153]
	−0.52±0.05	LHCb(2024)[160]	$\Lambda_c^+\to\Sigma(1385)^0\pi^+$	−0.79±0.11	BESIII(2022)[98]
$\Lambda_c^+\to\Lambda\rho(770)^+$	−0.763±0.070	BESIII(2022)[98]	$\Lambda_c^+\to\Sigma^0K^+$	−0.54±0.20	Belle(2023)[137]
$\Lambda_c^+\to\Lambda a(980)^+$	$-0.91^{+0.20}_{-0.12}$	BESIII(2025)[153]	**Ξ-involved**		
$\Lambda_c^+\to\Lambda(1405)\pi^+$	0.58±0.28	LHCb(2023)[91]	$\Lambda_c^+\to\Xi^0K^+$	0.01±0.16	BESIII(2024)[161]
$\Lambda_c^+\to\Lambda(1520)\pi^+$	0.93±0.09	LHCb(2023)[91]			
Mode	β	Experiment	Mode	γ	Experiment
$\Lambda_c^+\to\Lambda\pi^+$	0.378±0.015	LHCb(2024)[160]	$\Lambda_c^+\to\Lambda\pi^+$	0.491±0.012	LHCb(2024)[160]
	$0.37^{+0.17}_{-0.25}$	BESIII(2025)[159]		$0.64^{+0.10}_{-0.20}$	BESIII(2025)[159]
$\Lambda_c^+\to\Sigma^0\pi^+$	$0.70^{+0.14}_{-0.48}$	BESIII(2025)[159]	$\Lambda_c^+\to\Sigma^0\pi^+$	$-0.50^{+0.59}_{-0.30}$	BESIII(2025)[159]
$\Lambda_c^+\to\Sigma^+\pi^0$	$0.76^{+0.05}_{-0.24}$	BESIII(2025)[159]	$\Lambda_c^+\to\Sigma^+\pi^0$	$-0.26^{+0.48}_{-0.38}$	BESIII(2025)[159]
$\Lambda_c^+\to\Xi^0K^+$	−0.64±0.70	BESIII(2024)[161]	$\Lambda_c^+\to\Xi^0K^+$	−0.77±0.59	BESIII(2024)[161]
$\Lambda_c^+\to\Lambda K^+$	0.33±0.08	LHCb(2024)[160]	$\Lambda_c^+\to\Lambda K^+$	−0.799±0.041	LHCb(2024)[160]

Λ_c^+ BF studies

P.-R. Li, X.-R. Lyu, Y. Zheng, Chin. Phys. C 50, 022002 (2026)

Λ_c^+ Mode	BF($\times10^{-3}$)	Experiment	Λ_c^+ Mode	BF($\times10^{-3}$)	Experiment
$\Lambda_c^+\to\Lambda e^+\nu_e$	23.7±5.1(37%)†	ARGUS(1991)[24]	$\Lambda_c^+\to pK^-e^+\nu_e$	0.88±0.18(20%)	BESIII(2022)[29]
	26.8±5.1(19%)†	CELO(1994)[25]	$\Lambda_c^+\to\Lambda(1405)e^+\nu_e$, $\Lambda(1405)\to pK^-$	0.42±0.19(45%)	BESIII(2022)[29]
	36.3±4.3(12%)	BESIII(2015)[30]			
	35.6±1.3(3.6%)	BESIII(2022)[31]	$\Lambda_c^+\to\Lambda(1520)e^+\nu_e$	1.0±0.5(50%)	BESIII(2022)[29]
$\Lambda_c^+\to\Lambda\mu^+\nu_\mu$	34.9±5.3(15%)	BESIII(2017)[32]	$\Lambda_c^+\to pK_S^0\pi^-e^+\nu_e$	<0.33	BESIII(2023)[33]
	34.8±1.7(4.9%)	BESIII(2023)[34]	$\Lambda_c^+\to\Lambda\pi^+\pi^-e^+\nu_e$	<0.39	BESIII(2023)[33]
$\Lambda_c^+\to e^+X$	39.5±3.5(8.9%)	BESIII(2018)[35]	$\Lambda_c^+\to ne^+\nu_e$	3.57±0.37 (10%)	BESIII(2025)[36]
	40.6±1.3(3.2%)	BESIII(2023)[37]			
Ξ_c Mode	BF($\times10^{-3}$)	Experiment	Ξ_c Mode	BF($\times10^{-3}$)	Experiment
$\Xi_c^0\to\Xi^-e^+\nu_e$	13.7±7.7(56%)†	ARGUS(1993)[26]	$\Xi_c^0\to\Xi^-\mu^+\nu_\mu$	10.1±2.1(21%)†	Belle(2021)[38]
	$44.3^{+16.6}_{-17.8}$(40%)†	CLEO(1995)[27]	$\Xi_c^+\to\Xi^0e^+\nu_e$	67±39(58%)†	CLEO(1995)[27]
	19.7±5.3(27%)†	ALICE(2021)[39]			
	10.4±2.1(20%)†	Belle(2021)[38]			
Ω_c^0 Mode	Ratio	Experiment	Ω_c^0 Mode	Ratio	Experiment
$\Omega_c^0\to\Omega^0e^+\nu_e$	2.4±1.1(47%)	CLEO(2002)[28]	$\Omega_c^0\to\Omega^0\mu^+\nu_\mu$	1.94±0.21(11%)	Belle(2022)[40]
	1.98±0.15(7.7%)	Belle(2022)[40]			

Table 3. The determined BFs for the CS decays of the Λ_c^+ (in units of 10^{-3}). Upper limits are set at 90% confidence level.

Mode	BF	Experiment	Mode	BF	Experiment
Nucleon-involved					
$\Lambda_c^+\to n\pi^+$	0.66±0.13	BESIII(2022)[126]	$\Lambda_c^+\to nK^+\pi^0$	<0.71	BESIII(2024)[107]
$\Lambda_c^+\to p\pi^0$	<0.27	BESIII(2017)[117]	$\Lambda_c^+\to n\pi^+\pi^0$	0.64±0.09	BESIII(2023)[129]
	<0.08	Belle(2021)[109]	$\Lambda_c^+\to nK_S^0K^+$	$0.39^{+0.17}_{-0.14}$	BESIII(2024)[91]
	$0.16^{+0.07}_{-0.06}$	BESIII(2024)[118]	$\Lambda_c^+\to n\pi^+\pi^+\pi^-$	0.45±0.08	BESIII(2023)[129]
	0.18±0.04	BESIII(2025)[119]	$\Lambda_c^+\to p\pi^+\pi^-$	3.91±0.40	BESIII(2016)[127]
$\Lambda_c^+\to p\eta$	1.24±0.30	BESIII(2017)[117]		4.72±0.28	LHCb(2018)[138]
	1.42±0.12	Belle(2021)[109]	$\Lambda_c^+\to pK^+K^-$	1.08±0.07	LHCb(2018)[138]
	1.57±0.12	BESIII(2023)[120]	$\Lambda_c^+\to p(K^+K^-)_{\text{non-}\phi}$	0.55±0.14	BESIII(2016)[127]
	1.63±0.33	BESIII(2024)[118]	$\Lambda_c^+\to pK_S^0K_S^0$	0.24±0.02	Belle(2023)[146]
	1.67±0.80	LHCb(2024)[121]	$\Lambda_c^+\to p\phi\pi^0$	<0.15	Belle(2017)[147]
$\Lambda_c^+\to p\eta'$	$0.56^{+0.23}_{-0.21}$	BESIII(2022)[123]	$\Lambda_c^+\to(pK^+K^-\pi^0)_{NR}$	<0.06	Belle(2017)[147]
	0.47±0.10	Belle(2022)[122]	$\Lambda_c^+\to pK^+\pi^-$	0.16±0.02	Belle(2016)[137]
$\Lambda_c^+\to p\rho$	1.52±0.44	LHCb(2024)[121]		0.10±0.01	LHCb(2018)[138]
$\Lambda_c^+\to p\omega$	0.94±0.39	LHCb(2018)[124]			
	0.83±0.11	Belle(2021)[125]			
	1.11±0.21	BESIII(2023)[120]			
	0.98±0.31	LHCb(2024)[121]			
$\Lambda_c^+\to p\phi$	1.06±0.22	BESIII(2016)[127]			
Λ-involved					
$\Lambda_c^+\to\Lambda K^+$	0.62±0.06	BESIII(2022)[131]	$\Lambda_c^+\to\Lambda K^+\pi^0$	<2.0	BESIII(2024)[107]
	0.66±0.04	Belle(2023)[132]		1.49±0.29	BESIII(2024)[135]
$\Lambda_c^+\to\Lambda K^{*+}$	2.40±0.59($\theta_0=0°$)	BESIII(2025)[134]	$\Lambda_c^+\to\Lambda K_S^0\pi^+$	1.73±0.29	BESIII(2025)[134]
	5.21±0.75($\theta_0=109°$)	BESIII(2025)[134]	$\Lambda_c^+\to\Lambda K^+\pi^+\pi^-$	0.41±0.15	BESIII(2024)[135]
	1.29±0.44($\theta_0=221°$)	BESIII(2025)[134]			
Σ-involved					
$\Lambda_c^+\to\Sigma^0K^+$	0.47±0.10	BESIII(2022)[133]	$\Lambda_c^+\to\Sigma^+K^+\pi^-$	2.00±0.28	BESIII(2023)[150]
	0.36±0.03	Belle(2023)[132]	$\Lambda_c^+\to\Sigma^+K^+\pi^-\pi^0$	<0.01	BESIII(2023)[150]
$\Lambda_c^+\to\Sigma^+K_S^0$	0.48±0.14	BESIII(2022)[133]	$\Lambda_c^+\to\Sigma^0K^+\pi^0$	<1.8	BESIII(2024)[107]
				<0.50	BESIII(2024)[151]
			$\Lambda_c^+\to\Sigma^0K^+\pi^+\pi^-$	<0.65	BESIII(2024)[151]
			$\Lambda_c^+\to\Sigma^-K^+\pi^+$	0.38±0.12	BESIII(2024)[136]

Table 2. Measurements of the BFs for the CF decays of the Λ_c^+ (in units of %).

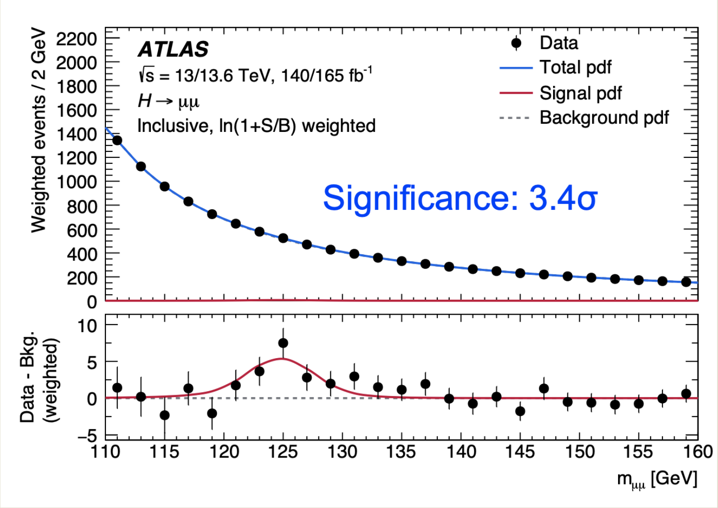
Mode	BF	Experiment	Mode	BF	Experiment
Nucleon-involved					
$\Lambda_c^+\to pK_S^0$	1.52±0.09	BESIII(2016)[80]	$\Lambda_c^+\to nK_S^0\pi^+$	1.82±0.25	BESIII(2017)[90]
$\Lambda_c^+\to pK_L^0$	1.67±0.07	BESIII(2024)[89]		1.86±0.09	BESIII(2024)[91]
$\Lambda_c^+\to p\bar{K}_0^*(700)^0\to pK^-\pi^+$	0.19±0.06	LHCb(2023)[86]	$\Lambda_c^+\to nK_S^0\pi^+\pi^0$	0.85±0.13	BESIII(2024)[92]
$\Lambda_c^+\to p\bar{K}_0^*(892)^0\to pK^-\pi^+$	1.38±0.08	LHCb(2023)[86]	$\Lambda_c^+\to nK^-\pi^+\pi^+$	1.90±0.12	BESIII(2023)[129]
$\Lambda_c^+\to p\bar{K}_0^*(1430)^0\to pK^-\pi^+$	0.92±0.18	LHCb(2023)[86]	$\Lambda_c^+\to pK_S^0\pi^0$	1.87±0.14	BESIII(2016)[80]
$\Lambda_c^+\to\Delta(1232)^{++}K^-\to p\pi^+K^-$	1.78±0.05	LHCb(2023)[86]		2.12±0.11	Belle(II)(2025)[144]
$\Lambda_c^+\to\Delta(1600)^{++}K^-\to p\pi^+K^-$	0.28±0.10	LHCb(2023)[86]	$\Lambda_c^+\to pK_L^0\pi^0$	2.02±0.14	BESIII(2024)[89]
$\Lambda_c^+\to\Delta(1700)^{++}K^-\to p\pi^+K^-$	0.24±0.06	LHCb(2023)[86]	$\Lambda_c^+\to pK_S^0\eta$	0.41±0.09	BESIII(2021)[145]
				0.44±0.03	Belle(2023)[146]
			$\Lambda_c^+\to pK_S^0\pi^+\pi^-$	1.53±0.14	BESIII(2016)[80]
			$\Lambda_c^+\to pK_L^0\pi^+\pi^-$	1.69±0.11	BESIII(2024)[89]
			$\Lambda_c^+\to pK^-\pi^+$	$6.84^{+0.32}_{-0.36}$	Belle(2014)[81]
				5.84±0.35	BESIII(2016)[80]
			$\Lambda_c^+\to pK^-\pi^+\pi^0$	4.53±0.38	BESIII(2016)[80]
				4.42±0.21	Belle(2017)[147]
Λ-involved					
$\Lambda_c^+\to\Lambda\pi^+$	1.24±0.08	BESIII(2016)[80]	$\Lambda_c^+\to\Lambda\pi^+\pi^0$	7.01±0.42	BESIII(2016)[80]
	1.31±0.09	BESIII(2023)[126]	$\Lambda_c^+\to\Lambda\pi^+\eta$	1.84±0.26	BESIII(2019)[94]
$\Lambda_c^+\to\Lambda\rho(770)^+$	4.06±0.52	BESIII(2022)[93]		1.84±0.13	Belle(2021)[95]
$\Lambda_c^+\to\Lambda a_0(980)^+$	1.23±0.21	BESIII(2025)[94]		1.94±0.13	BESIII(2025)[148]
$\Lambda_c^+\to\Lambda(1405)\pi^+\to pK^-\pi^+$	0.48±0.19	LHCb(2023)[86]	$\Lambda_c^+\to\Lambda\pi^+\pi^-\pi^+$	3.81±0.30	BESIII(2016)[80]
$\Lambda_c^+\to\Lambda(1520)\pi^+\to pK^-\pi^+$	0.12±0.02	LHCb(2023)[86]	$\Lambda_c^+\to\Lambda K_S^0K^+$	0.30±0.03	BESIII(2025)[134]
$\Lambda_c^+\to\Lambda(1600)\pi^+\to pK^-\pi^+$	0.32±0.12	LHCb(2023)[86]		0.31±0.05	BESIII(2025)[108]
$\Lambda_c^+\to\Lambda(1670)\pi^+\to pK^-\pi^+$	0.07±0.02	LHCb(2023)[86]			
$\Lambda_c^+\to\Lambda(1670)\pi^+\to\Lambda\eta\pi^+$	0.27±0.06	Belle(2021)[95]			
	0.27±0.06	BESIII(2025)[148]			
$\Lambda_c^+\to\Lambda(1690)\pi^+\to pK^-\pi^+$	0.07±0.02	LHCb(2023)[86]			
$\Lambda_c^+\to\Lambda(2000)\pi^+\to pK^-\pi^+$	0.60±0.07	LHCb(2023)[86]			
Σ-involved					
$\Lambda_c^+\to\Sigma^+\pi^0$	1.18±0.10	BESIII(2016)[80]	$\Lambda_c^+\to\Sigma^+\pi^+\pi^-$	4.25±0.31	BESIII(2016)[80]
$\Lambda_c^+\to\Sigma^+\eta$	0.41±0.20	BESIII(2018)[96]		4.57±0.28	Belle(2018)[149]
	0.31±0.05	Belle(2023)[98]	$\Lambda_c^+\to\Sigma^+\pi^0\pi^0$	1.57±0.15	Belle(2018)[149]
	0.38±0.06	BESIII(2025)[97]	$\Lambda_c^+\to\Sigma^0\pi^+\pi^0$	3.65±0.30	Belle(2018)[149]
$\Lambda_c^+\to\Sigma^+\eta'$	1.34±0.56	BESIII(2018)[96]	$\Lambda_c^+\to\Sigma^0\pi^+\eta$	0.76±0.08	Belle(2021)[95]
	0.42±0.09	Belle(2023)[98]	$\Lambda_c^+\to\Sigma^-\pi^+\pi^+$	1.81±0.19	BESIII(2017)[105]
	0.57±0.18	BESIII(2025)[97]	$\Lambda_c^+\to\Sigma^-\pi^+\pi^+\pi^0$	2.11±0.36	BESIII(2017)[105]
$\Lambda_c^+\to\Sigma^+\omega$	1.56±0.21	BESIII(2016)[80]	$\Lambda_c^+\to\Sigma^+K^+K^-$	0.38±0.05	BESIII(2023)[150]
$\Lambda_c^+\to\Sigma^+\phi$	0.41±0.09	BESIII(2023)[150]	$\Lambda_c^+\to\Sigma^+K^+K^-_{\text{non-}\phi}$	0.20±0.04	BESIII(2023)[150]
$\Lambda_c^+\to\Sigma^0\pi^+$	1.27±0.09	BESIII(2016)[80]	$\Lambda_c^+\to\Sigma^0K_S^0K^+$	0.08±0.03	BESIII(2025)[108]
	1.22±0.11	BESIII(2023)[126]			
$\Lambda_c^+\to\Sigma(1385)^+\pi^0$	0.59±0.08	BESIII(2022)[93]			
$\Lambda_c^+\to\Sigma(1385)^+\eta$	0.91±0.20	BESIII(2019)[94]			
	1.21±0.12	Belle(2021)[95]			
	0.68±0.08	BESIII(2025)[148]			
$\Lambda_c^+\to\Sigma(1385)^0\pi^+$	0.65±0.10	BESIII(2022)[93]			
Ξ-involved					
$\Lambda_c^+\to\Xi^0K^+$	0.59±0.09	BESIII(2018)[106]	$\Lambda_c^+\to\Xi^0K^+\pi^0$	0.78±0.17	BESIII(2024)[107]
$\Lambda_c^+\to\Xi(1530)^0K^+$	0.50±0.10	BESIII(2018)[106]	$\Lambda_c^+\to\Xi^0K_S^0\pi^+$	0.37±0.06	BESIII(2025)[108]
	0.60±0.11	BESIII(2024)[107]			

opportunity in charmed baryons, and plan to take data up to 5.6GeV to cover all ground-state charmed baryons

7

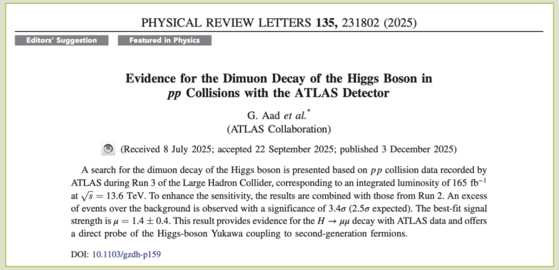
实验：LHCb、BESIII、Belle (II)、CMS、ATLAS ……

Evidence of Higgs to dimuon decay from ATLAS



arXiv:2507.03595 Phys. Rev. Lett. **135**, 231802 (2025)

李海峰



PHYSICAL REVIEW LETTERS **135**, 231802 (2025)

Editors' Suggestion Featured in Physics

Evidence for the Dimuon Decay of the Higgs Boson in *pp* Collisions with the ATLAS Detector

G. Aad *et al.**
(ATLAS Collaboration)

(Received 8 July 2025; accepted 22 September 2025; published 3 December 2025)

A search for the dimuon decay of the Higgs boson is presented based on pp collision data recorded by ATLAS during Run 3 of the Large Hadron Collider, corresponding to an integrated luminosity of 165 fb^{-1} at $\sqrt{s} = 13.6$ TeV. To enhance the sensitivity, the results are combined with those from Run 2. An excess of events over the background is observed with a significance of 3.4σ (2.5σ expected). The best-fit signal strength is $\mu = 1.4 \pm 0.4$. This result provides evidence for the $H \to \mu\mu$ decay with ATLAS data and offers a direct probe of the Higgs-boson Yukawa coupling to second-generation fermions.

DOI: 10.1103/gzdh-p159

Gavin Salam（英国牛津大学教授）

- H→μμ将首次证明第二代费米子的质量来自于汤川耦合

Toponium from ATLAS

- An excess of events is observed over the NNLO perturbative QCD prediction, with 8σ observed (6σ expected) near the $t\bar{t}$ production threshold by ATLAS with LHC Run 2 data. [arXiv:2601.11780, Accepted by Reports on Progress in Physics (IF 20.9)], [ATLAS Physics Briefing], [CERN Press Release]
- This excess is consistent with **color-singlet, S-wave, quasi-bound $t\bar{t}$ states** predicted by NRQCD with cross-section of 9.3 ± 1.3 pb
- CMS 2L results (Rep. Prog. Phys. 88 (2025) 087801) and also 1L CMS PAS TOP-25-002
- Observation of toponium opens a new field to study NRQCD with top quarks

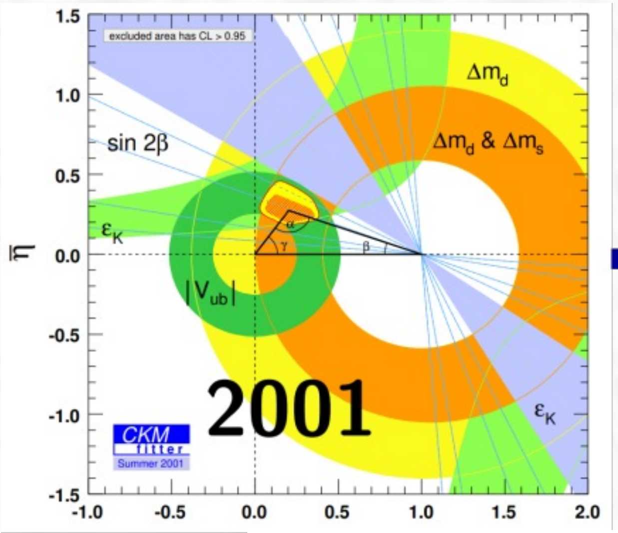
"as we now realize, the top quark is simply too short-lived to form bound states - apparently there are no top baryons and mesons." -- Section 1.9, David Griffiths, Introduction to Elementary Particle Physics, Second Edition

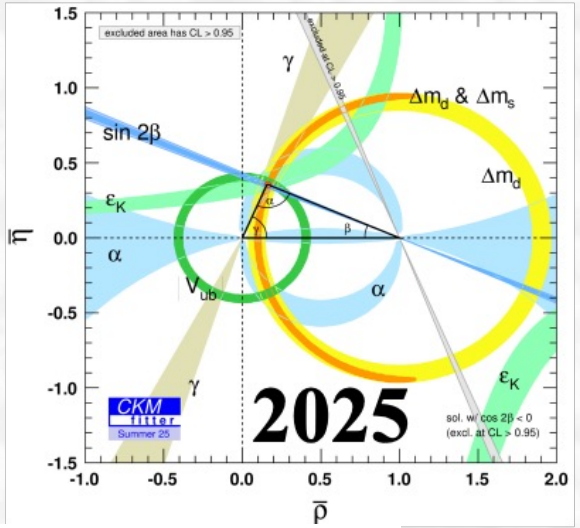
"The top quark is too short-lived to form observable hadron states and its mass is again inferred indirectly, from observations on the decay products of $t\bar{t}$ pairs, as we shall see." -- Section 3.1, B.R. Martin and G. Shaw, Particle Physics, Fourth Edition

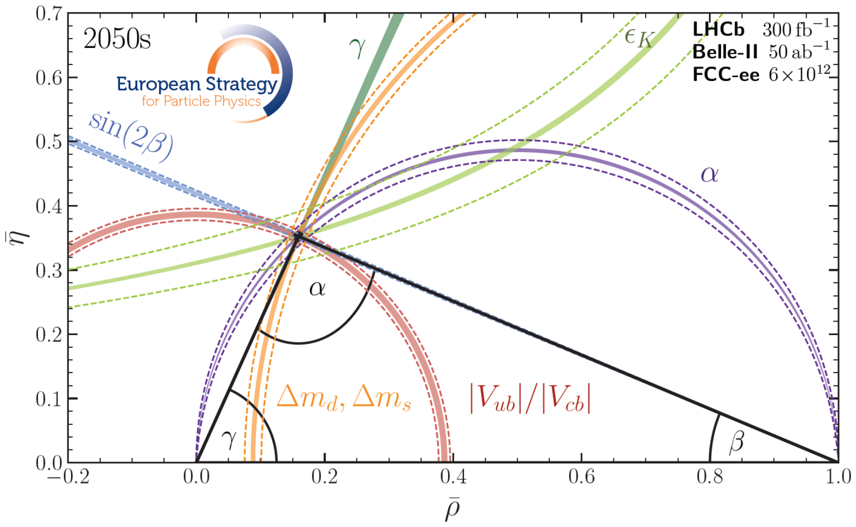
8

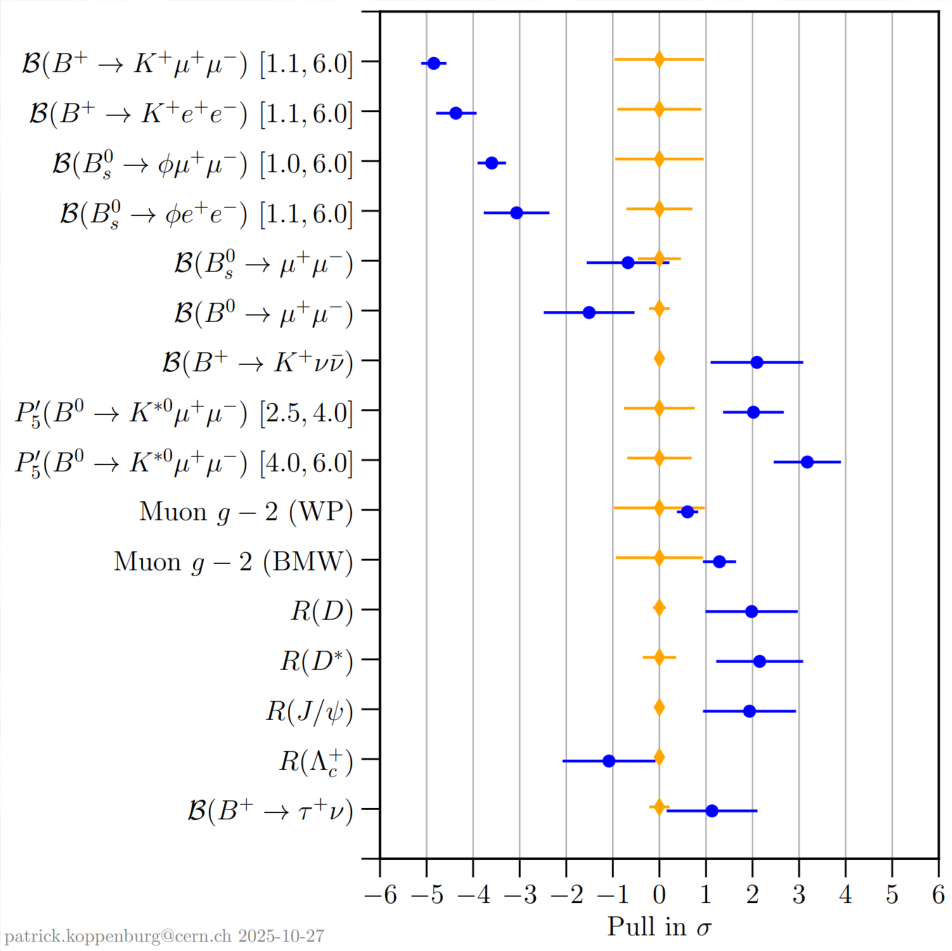
精确味物理时代：精确检验SM + 寻找新物理

BESIII、LHCb、Belle-II、CMS、ATLAS… + 格点QCD + 理论研究进展





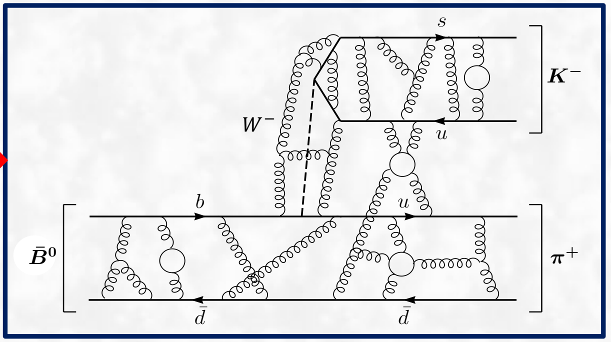




https://www.nikhef.nl/~pkoppenb/anomalies.html

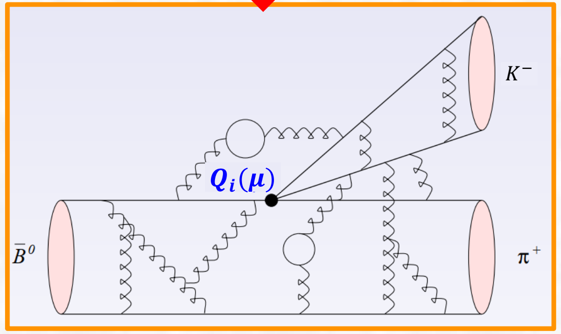
Example: how to test SM and probe NP?

$\bar{B}^0 \to \pi^+ K^-$



EW interaction scale	$\gg$	ext. mom'a in B rest frame	$\gg$	QCD-bound state effects
$m_W \sim 80$ GeV $m_Z \sim 91$ GeV	$\gg$	$m_b \sim 5$ GeV	$\gg$	$\Lambda_{\rm QCD} \sim 1$ GeV

$$\mathcal{H}_{\rm eff} = -\frac{4G_F}{\sqrt{2}} \sum_{p=u,c} V^*_{pD} V_{pb} \left(C_1 Q_1^p + C_2 Q_2^p + \sum_{i=3}^{10} C_i Q_i + C_{7\gamma} Q_{7\gamma} + C_{8g} Q_{8g} \right)$$



electroweak parameters

WCs due to NP

non-perp. parameters

$$\mathcal{A}(\bar{B}^0 \to \pi^+ K^-) = \frac{G_F}{\sqrt{2}} \sum_{ij} V_{\rm CKM} \left(\mathcal{C}_i^{\rm SM} + \mathcal{C}_i^{\rm NP}\right) \left[F_j^{B\to\pi}(m_K^2) \int_0^1 du\, T_{ij}^{\rm I}(u) \Phi_K(u) + (\pi \leftrightarrow K) + \int_0^1 d\xi\, du\, dv\, T_i^{\rm II}(\xi, u, v) \Phi_B(\xi) \Phi_\pi(v) \Phi_K(u) \right]$$

related to exp. Br & CPV

WCs from SM, also perp. calculable

perp. calculable in QCD & QED

圈图计算新方法及其应用

Symbolic Reduction of Multi-loop Feynman Integrals via Generating Functions

April 25-27, 2026, Chongqing

Bo Feng

April 24, 2026

New Strucutes in Feynman Integrals

Xing Wang (王 星)

The Chinese University of Hong Kong, Shenzhen

Based on 2506.09124 (PRL accepted), 2507.23594 (JHEP), 2511.15381 with ε-collaboration, and 2603.18576, 2605.xxxxx, with Yefan Wang and Jian Wang

Recent developments and applications of NeatIBP

A package for IBP reduction of Feynman integrals

吴子昊

- ✔ First bootstrap computation of 2loop 6point QCD amplitudes

ACCEPTED PAPER

Bootstrapping Six-Gluon QCD Amplitudes

Sérgio Carrôlo and Dmitry Chicherin and Johannes Henn and Qinglin Yang and Yang Zhang

Phys. Rev. Lett. - **Accepted** 20 March, 2026

DOI: https://doi.org/10.1103/k237-8ccq

Carrôlo, Chicherin, Henn, Yang, YZ

arXiv:2510.20565, Phys. Rev. Lett. accepted

arXiv:2602.02783

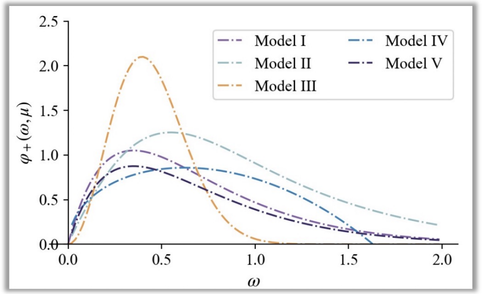
- ✔ analytic computation of all 2loop 6point planar massless integrals

- ➢ 王建雄、王健、陈龙斌、桑文龙、张海斌、陶伟、杨通智、张鸿飞、王烨凡、梁泽锐，黎哲、 Hongyang Han 、施博轩、 Chengtai Tan 、…….

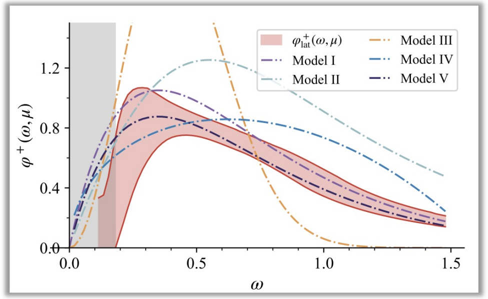
格点QCD：衰变常数、形状因子、LCDAs

Toward the First-Principle Calculation of Heavy Meson LCDAs

Before 2025



LQCD result, 2025



- Only models
- LQCD, but still preliminary

LPC, Phys.Rev.D 111 (2025), L111503; PRD111 (2025), 034503

Qi-An Zhang *Precision HQET LCDAs from Lattice QCD for Tightening B Decay Uncertainties* 7

Inverse and inverse-logarithmic moments

μ	Reference (Method)	λ_B (GeV)	$\sigma_B^{(1)}$	
1 GeV	This work	0.347(21)	1.723(69)	
	Ref. [18] (LQCD)	0.376(63)	1.66(13)	PRD111 (2025), 034503
	Ref. [29] (Experiment)	> 0.24	–	PRD98 (2018), 112016
	Ref. [15] (QCD sum rule)	$0.343^{+0.064}_{-0.079}$	1.4(4)	PRD101 (2020), 074035
	Ref. [6] (QCD sum rule)	0.46(11)	1.4(4)	PRD69 (2004), 034014
	Ref. [30] (QCD sum rule)	0.383(153)	–	JHEP10 (2020), 043
	Ref. [14] (OPE)	0.48(11)	1.6(2)	PRD72 (2005), 094028
	Ref. [5] (Asymptotic behavior)	0.35(15)	–	PRD55 (1997), 272290
	Ref. [31] (Global Fit)	0.338(68)	–	PLB848 (2024), 138345

Summary & Outlook

Light meson

Light baryon

Nucleon GPD...

Lattice scheme results → Renormalization → A well-defined scheme → LaMET Matching → Light cone results Λ

(Calculating the LaMET matching kernel under self scheme) Done!

Ensembles	a (fm)	m_π (MeV)
C24P29	0.1052	292.3
C32P23	0.1052	227.9
C48P14	0.1052	136.4
F32P30	0.0775	300.4
F32P21	0.0775	210.3
G36P29	0.0689	297.2
H48P32	0.0520	316.6

New (C32P23), New (G36P29)

Ratio scheme

Self renormalization New

Hybrid scheme New

LPC, PRD 111, 034510 (2025)

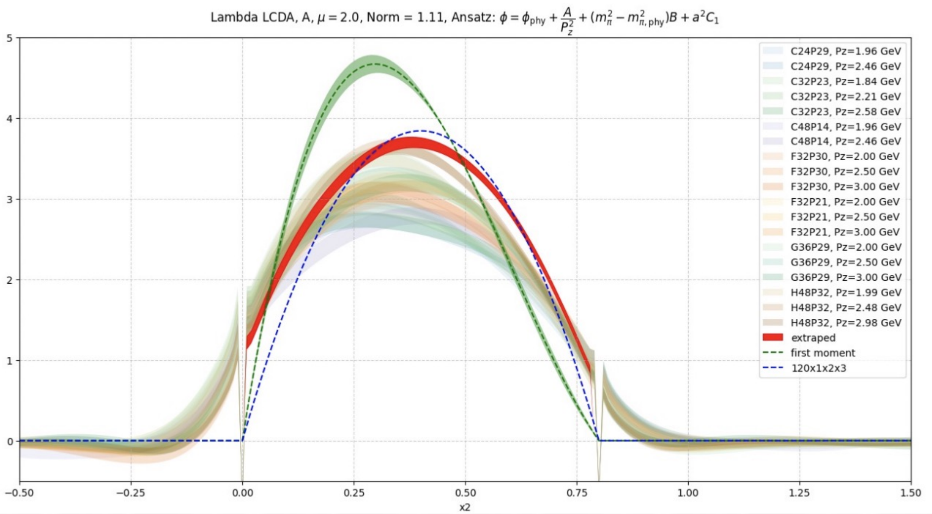
LPC, PRD 112, 114515 (2025)

Few weeks ...

Proton

华俊

A Term:



很多有趣、重要的结果：https://indico.ihep.ac.cn/event/28363/contributions/

14:00-14:20	BFKL dynamics on the celestial sphere	朱华星(PKU)
14:20-14:40	核子自旋结构研究近期进展	周剑(SDU)
14:40-15:00	An unexpected possible extraction of α_s using EEC in the post-confinement region	刘晓辉(BNU)
15:00-15:20	New Bootstrap Method for Perturbative QCD	张扬(USTC)
15:20-15:40	Precision calculations for SIDIS and determination of light hadron FFs	高俊(SJTU)
15:40-16:00	Vtb from tW production	王健(SDU)

16:30-16:50	Covariant Amplitudes for Hadron Form Factors and Parton Correlators	于江浩(ITP)
16:50-17:10	Global analysis of transverse momentum dependent parton distributions	刘天博(SDU)
17:10-17:30	New Perspectives on Precision Nucleon Tomography	邵鼎煜(FDU)
17:30-17:50	Transverse momentum resummation for fully charm tetraquark production at hadron colliders	朱瑞林(NJNU)
17:50-18:10	Ds1 的 Ds π π 衰变和 Tcsbar 粒子的耦合道解释	吴佳俊(UCAS)
18:10-18:30	BESIII 和 LHCb 上重味奇特强子态研究进展	吕晓睿(UCAS)

14:00-14:20	How can Femtoscopy help decipher the nature of exotic hadrons?	耿立升(BUAA)
14:20-14:40	Axions in Chiral Effective Field Theory	刘佳(PKU)
14:40-15:00	Implications of the latest JUNO's measurement	丁桂军(USTC)
15:00-15:20	Structure of heavy mesons on the light front	赵行波(IMP)
15:20-15:40	Bottom quark effects in Higgs boson pair production at the LHC	刘涛(IHEP)
15:40-16:00	Triple Differential Heavy-to-light Semi-leptonic Heavy-quark Decays at N3LO in QCD	陈龙(SDU)

16:20-16:40	Two quark or tetraquark nature of the light scalar mesons produced in heavy meson decays?	郑海扬(AS)
16:40-17:00	Studying K_1 mesons in semileptonic D decays	孙亮(WHU)
17:00-17:20	Precision frontier of pQCD with NNLOJET	陈暄(SDU)
17:20-17:40	Energy correlators resolving proton spin	李海涛(SDU)
17:40-18:00	Heavy quarkonium production in heavy ion collisions	唐泽波(USTC)
18:00-18:20	Exclusive B-Meson Decays Beyond the Leading Power	沈月龙(OUC)

未来可期：

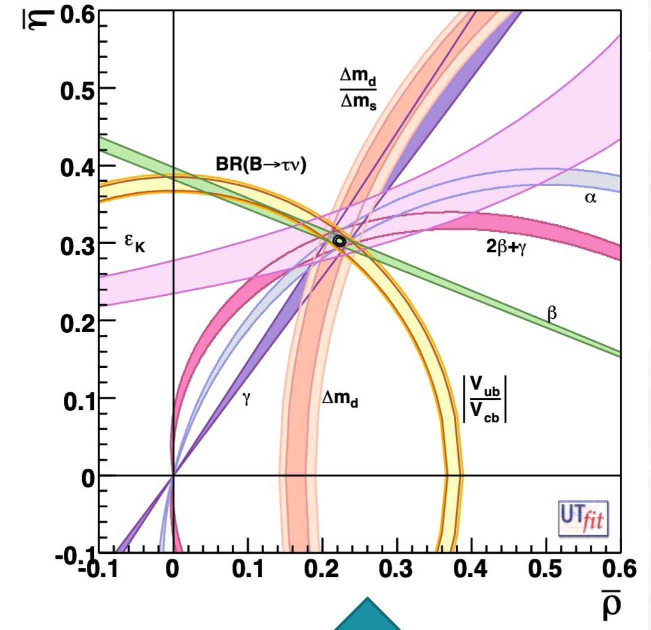
Projections for early 2040s

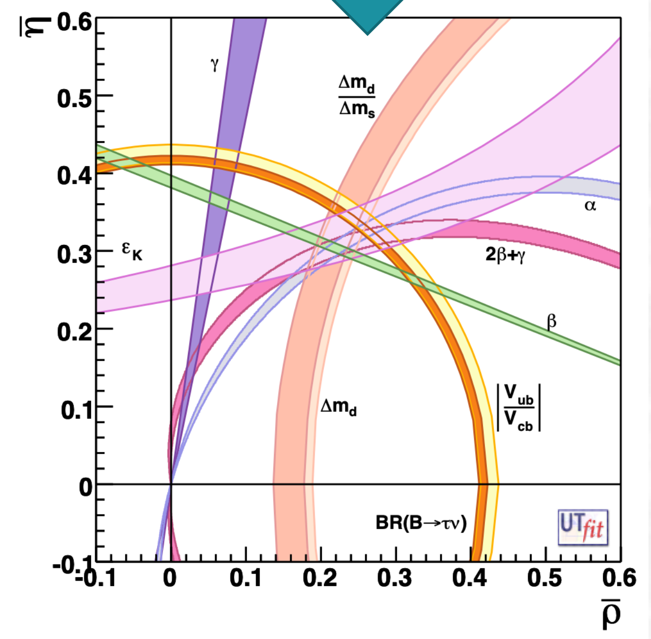
2503.24346, ESPP

Experiment Assumed data sample	ATLAS 3000 fb^{-1}	CMS 3000 fb^{-1}	LHCb 300 fb^{-1}	Belle II 50 ab^{-1}
Semileptonic B decays				
$\lvert V_{ub}\rvert$	—	—	1%	1.2%
$\lvert V_{cb}\rvert$	—	—	—	1.0%
$R(D)$, $R(D^*)$	—	—	3.3%, 3.0%	1.4%, 1.0%
Leptonic B decays				
$\mathcal{B}(B_s^0 \to \mu^+\mu^-)$ [10^{-9}]	(0.33 – 0.40)	0.22	0.16	—
$\mathcal{B}(B^0 \to \mu^+\mu^-)$ [10^{-10}]	(0.32 – 0.48)	0.12	0.12	—
$\mathcal{B}(B^+ \to \tau^+\nu_\tau)$	—	—	—	6%
$\mathcal{B}(B^+ \to \mu^+\nu_\mu)$	—	—	—	5%
Flavour-changing neutral current $b \to s\ell\ell$ decays				
$P_5'(B^0 \to K^{*0}\mu^+\mu^-)$ [10^{-3}]	(47 – 82)	23	12	
$\mathcal{B}(B^{+,0} \to K^{+,*0}\nu\bar{\nu})$	—	—	—	8%, 23%
$\mathcal{B}(B^{+,0} \to K^{+,*0}\tau^+\tau^-)$ [10^{-4}]	—	—	—	< 0.9, < 1.5
Flavour-changing neutral current $b \to s\gamma$ decays				
$\mathcal{B}(B \to X_s\gamma; E_\gamma > 1.6\,\mathrm{GeV})$	—	—	—	(4.7 – 8.8)%
Lepton flavour violation in τ decays				
$\mathcal{B}(\tau^+ \to \mu^+\gamma)$ [10^{-8}]	—	—	—	< 0.7
$\mathcal{B}(\tau^+ \to \mu^+\mu^+\mu^-)$ [10^{-8}]	$< (0.13 – 0.64)$	< 0.39	< 0.26	$< (0.02 – 0.17)$

$\mathcal{O}(5)$ improvement

$\mathcal{O}(10)$ improvement





第九届重味物理与量子色动力学将在武汉召开，期待更多、更好的成果

地点：东湖宾馆，湖北省国宾馆，有“湖北中南海”之称，毛泽东主席48 次下榻地；时间：待定

1. 全景与建筑（国宾风范）




2. 园林湖景（一步一景）




华师粒子物理团队成员：徐梦琳（LHCb 实验） + 徐凌霄 （理论）

欢迎大家明年来武汉参会和指导工作！

我们将全力做好各项准备工作，服务好大家！

谢谢！