LHCb-中国组研究进展

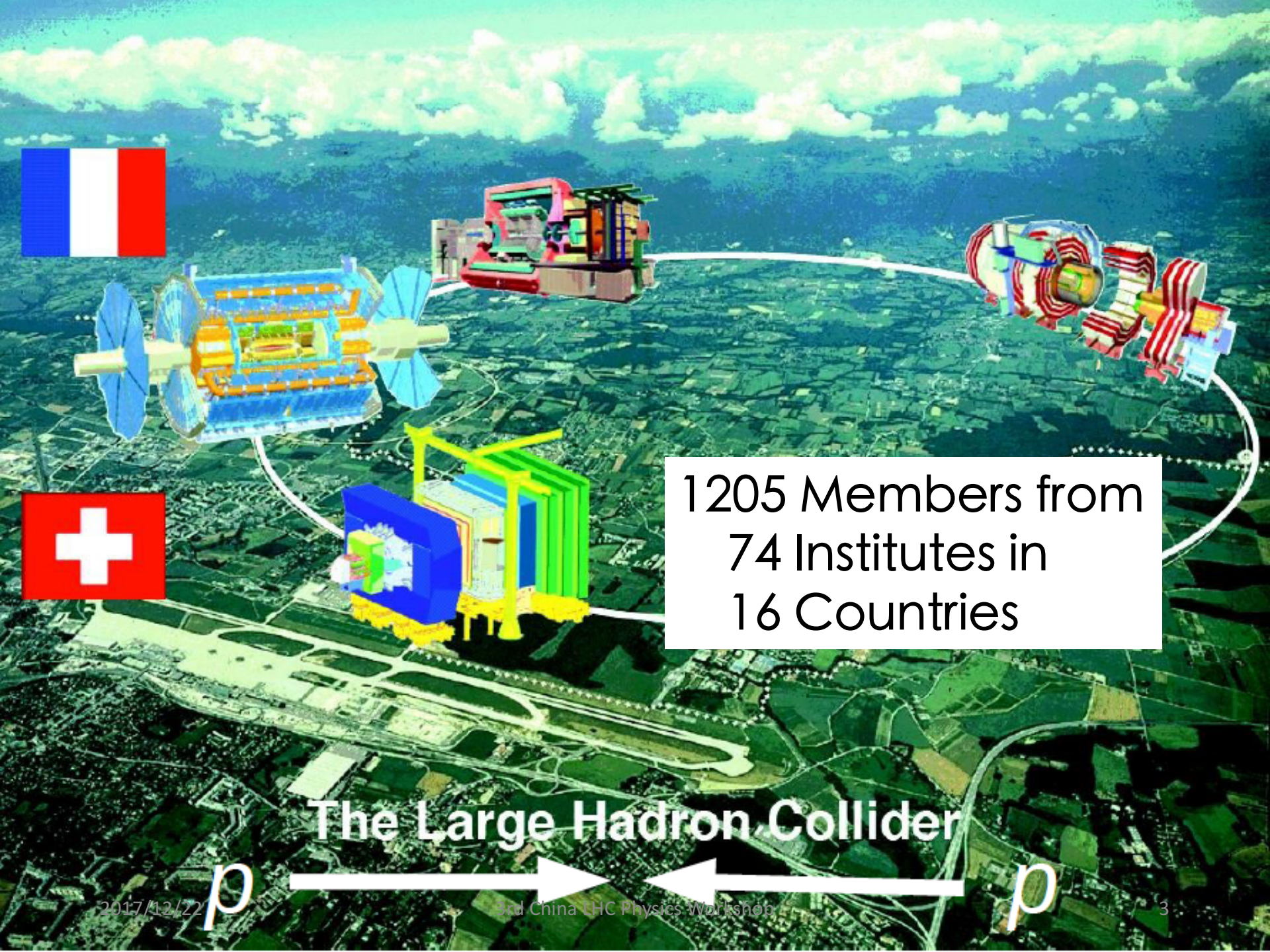
高原宁 （清华大学）
代表LHCb-中国组

第三届中国LHC物理工作会议
南京大学，2017.12.22-24

中国科学院大学
University of Chinese Academy of Sciences

报告内容

- **LHCb 实验进展**
- **2017 中国组物理工作和总结**
- 服务和探测器升级
- 总结和展望

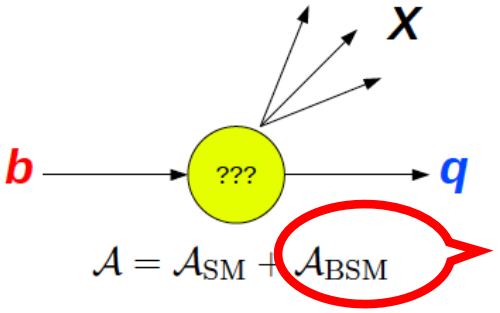

1205 Members from
74 Institutes in
16 Countries
The Large Hadron Collider
p
p

LHC的科学目标

- **LHC 实验 = ALICE + ATLAS, CMS + LHCb + ..**

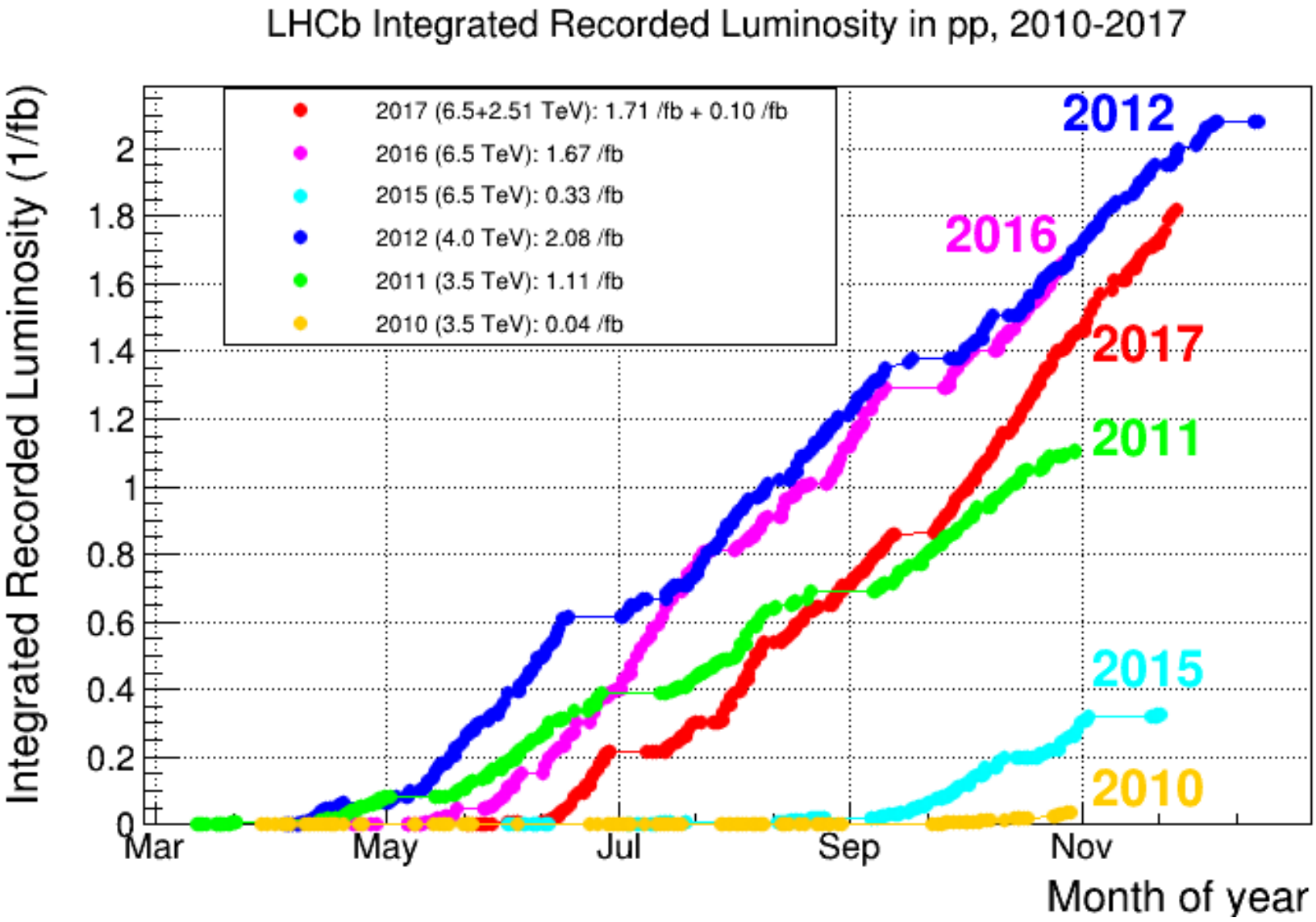
  - **ALICE** 高能核物理前沿
  - **ATLAS, CMS** 粒子物理高能量前沿
  - **LHCb** 粒子物理高精度前沿

- **LHCb的主要科学目标是寻找超出标准模型的新物理**



间接发现新物理

+ QCD, Electroweak, Hadron spectroscopy …


LHCb Integrated Recorded Luminosity in pp, 2010-2017
Integrated Recorded Luminosity (1/fb)
Month of year
Mar
May
Jul
Sep
Nov
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2017 (6.5+2.51 TeV): 1.71 /fb + 0.10 /fb
2016 (6.5 TeV): 1.67 /fb
2015 (6.5 TeV): 0.33 /fb
2012 (4.0 TeV): 2.08 /fb
2011 (3.5 TeV): 1.11 /fb
2010 (3.5 TeV): 0.04 /fb
2012
2016
2017
2011
2015
2010

LHCb-中国组成员（2017）

- 清华大学 (member 2000-)
  - 高原宁，杨振伟，张黎明，朱相雷，龚光华，曾鸣
  - 博士后 2，博士生 11，硕士生 3
- 华中师范大学 (associate member 2013 -)
  - 谢跃红，尹航，张东亮
  - 博士后 3， 博士生 3，硕士生 7
- 中国科学院大学 (associate member 2015-)
  - 郑阳恒，吕晓睿，何吉波，钱文斌
  - 博士后 5， 博士生 4，硕士生 2
- 武汉大学 (associate member 2016-)
  - 孙亮，蔡浩，王继科
  - 博士生 2

2017物理结果总结:
- 重味强子产生机制研究

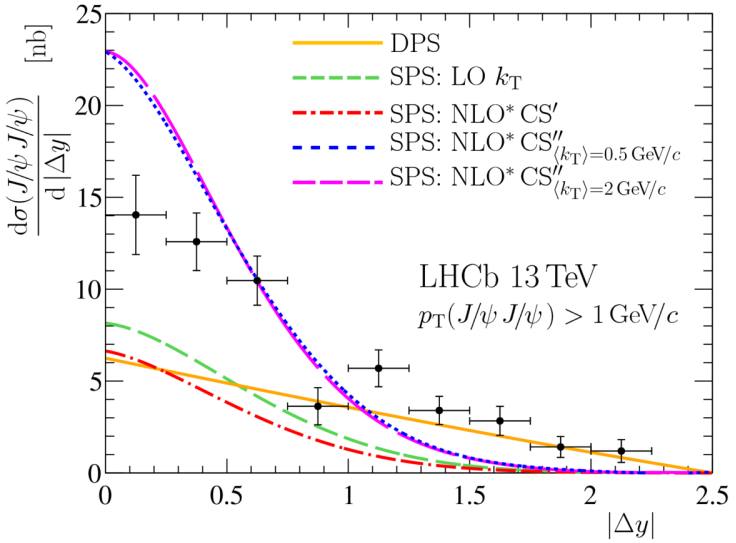
1. Measurement of the J/ψ pair production cross-section in pp collisions at $\sqrt{s} = 13$ TeV, JHEP 06 (2017) 043.
2. Study of prompt D^0 meson production in *pPb* collisions at $\sqrt{s_{NN}} = 5$ TeV, JHEP 10 (2017) 090.

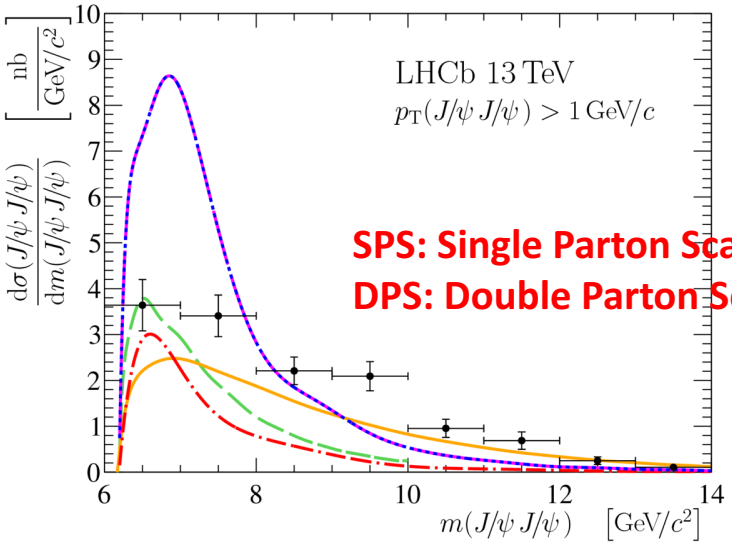
- Prompt Λ_c production in pPb collisions at $\sqrt{s_{NN}} = 5.02$ TeV, LHCb-CONF-2017-005 (conference note)

3. Measurement of the $\boldsymbol{B}^{\pm}$ production cross-section in pp collisions at $\sqrt{\boldsymbol{s}}$= 7 and 13 TeV, JHEP 12 (2017) 026.

$pp \to J/\psi + J/\psi + X$

LHCb, JHEP 06 (2017) 043



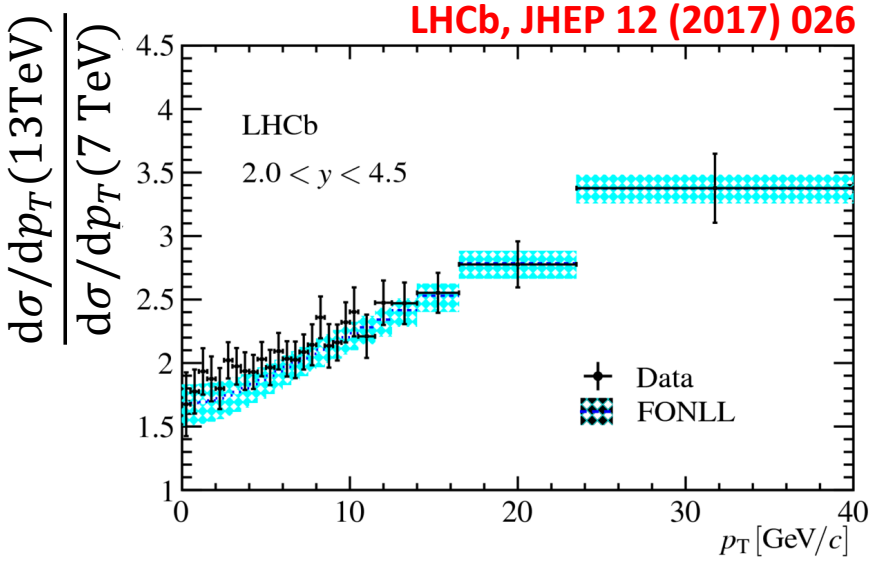


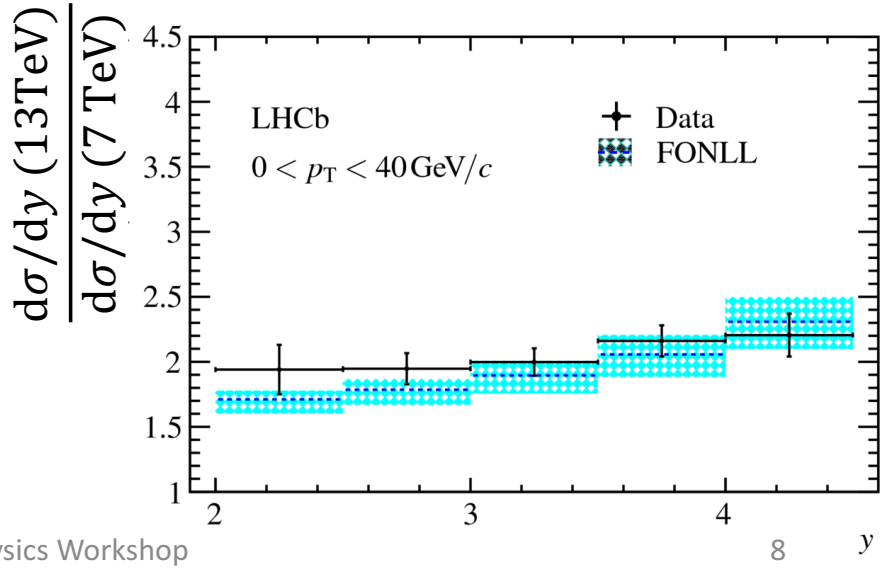
SPS: Single Parton Scattering
DPS: Double Parton Scattering

$pp \to B^+ + X, B^+ \to J/\psi\pi^+$

LHCb, JHEP 12 (2017) 026

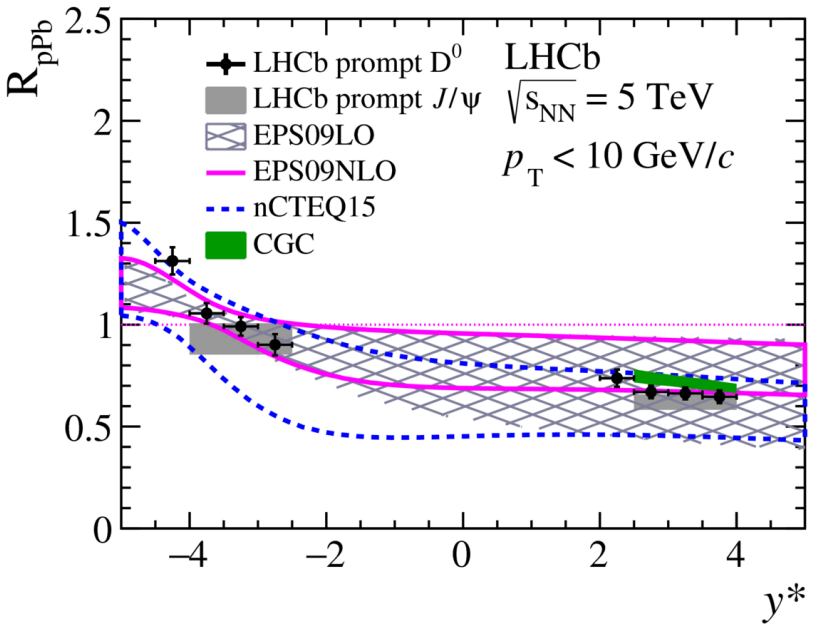
LHCb 第400篇论文！



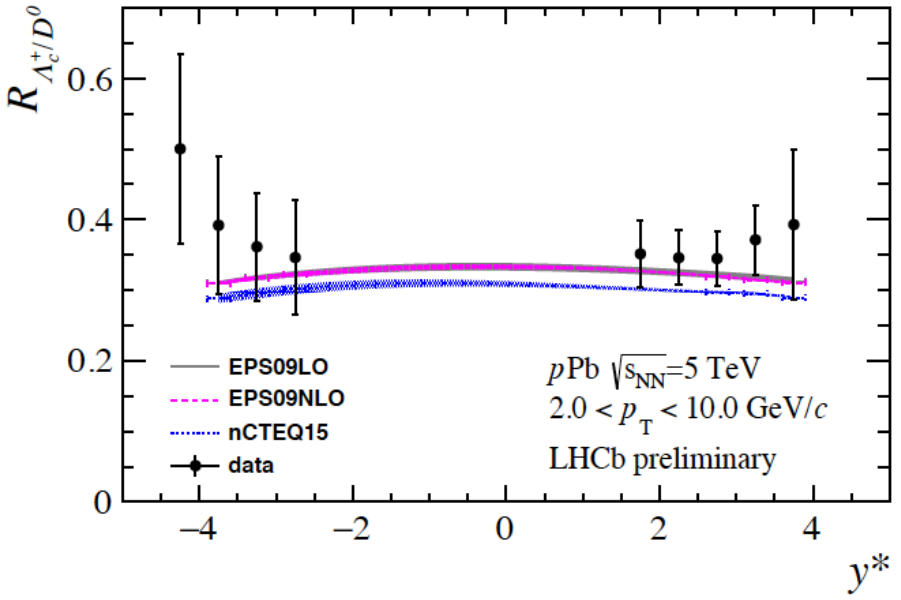


$pPb \rightarrow D^0, \Lambda_c^+$

LHCb, JHEP 10 (2017) 090



LHCb-CONF-2017-005

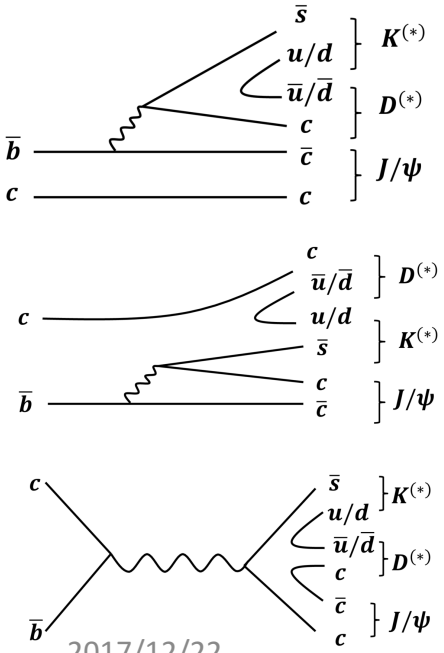


Nuclear Modification Factor:

$$R_{p\mathrm{Pb}}(p_\mathrm{T}, y^*) \equiv \frac{1}{A} \frac{\mathrm{d}^2\sigma_{p\mathrm{Pb}}(p_\mathrm{T}, y^*)/\mathrm{d}p_\mathrm{T}\mathrm{d}y^*}{\mathrm{d}^2\sigma_{pp}(p_\mathrm{T}, y^*)/\mathrm{d}p_\mathrm{T}\mathrm{d}y^*}$$

2017研究结果总结:
- B_c 介子性质研究

4. Observation of $B_c^+ \to J/\psi D^{(*)} K^{(*)}$ decays, Phys. Rev. D95 (2017) 032005.
5. Search for excited B_c^+ states, arXiv:1712.04094



$$\frac{\mathcal{B}(B_c^+ \to J/\psi D^0 K^+)}{\mathcal{B}(B_c^+ \to J/\psi \pi^+)} = 0.432 \pm 0.136 \pm 0.028,$$

$$\frac{\mathcal{B}(B_c^+ \to J/\psi D^{*0} K^+)}{\mathcal{B}(B_c^+ \to J/\psi D^0 K^+)} = 5.1 \pm 1.8 \pm 0.4,$$

$$\frac{\mathcal{B}(B_c^+ \to J/\psi D^{*+} K^{*0})}{\mathcal{B}(B_c^+ \to J/\psi D^0 K^+)} = 2.10 \pm 1.08 \pm 0.34,$$

$$\frac{\mathcal{B}(B_c^+ \to J/\psi D^+ K^{*0})}{\mathcal{B}(B_c^+ \to J/\psi D^0 K^+)} = 0.63 \pm 0.39 \pm 0.08,$$

First Observation

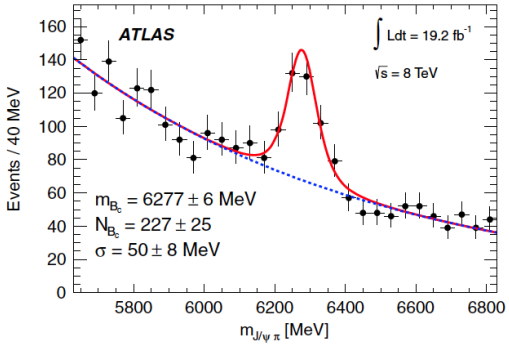
$B_c^{(*)}(2S) \to B_c^{(*)}\pi^+\pi^-$

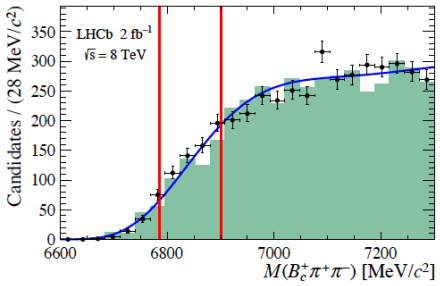
LHCb, arXiv:1712.04094

ATLAS, PRL 113 (2014) 212004

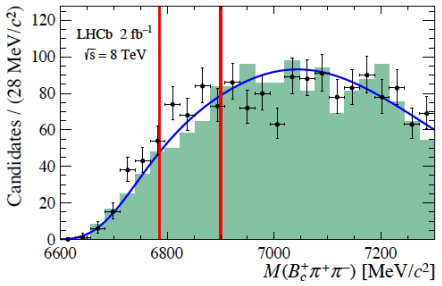
Data	Signal events
7 TeV	100 ± 23
8 TeV	227 ± 25

$N_{B_c}^{\mathrm{ATLAS}}$

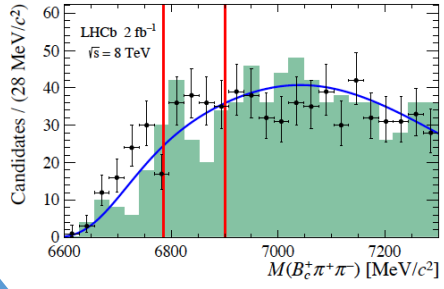




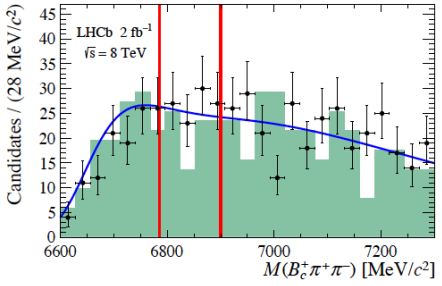
(a) MLP category: (0.02,0.2)



(b) MLP category: [0.2,0.4]



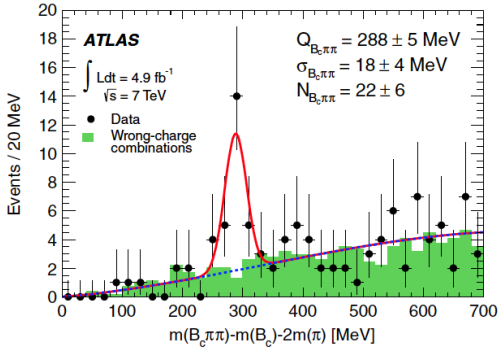
(c) MLP category: [0.4,0.6)

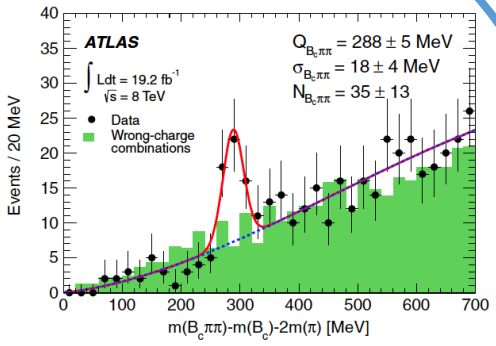


(d) MLP category: [0.6,1.0]

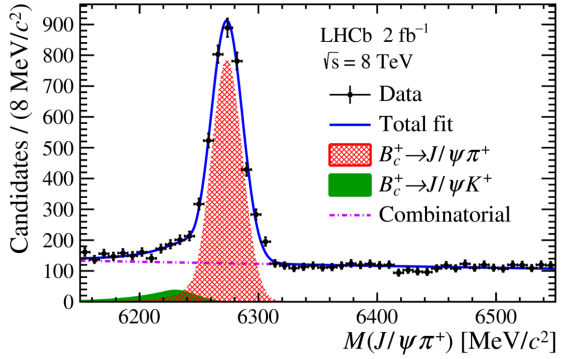
$m_{B_c(2S)} = 6842 \pm 4 \pm 5$ MeV

5.2σ





$N_{B_c}^{\mathrm{LHCb\ 8TeV}} = 3325 \pm 73$



$$\mathcal{R} = \frac{\sigma_{B_c^{(*)}(2S)^+}}{\sigma_{B_c^+}} \cdot \mathcal{B}(B_c^{(*)}(2S)^+ \to B_c^{(*)+}\pi^+\pi^-)$$
$$= \frac{N_{B_c^{(*)}(2S)^+}}{N_{B_c^+}} \cdot \frac{\varepsilon_{B_c^+}}{\varepsilon_{B_c^{(*)}(2S)^+}},$$

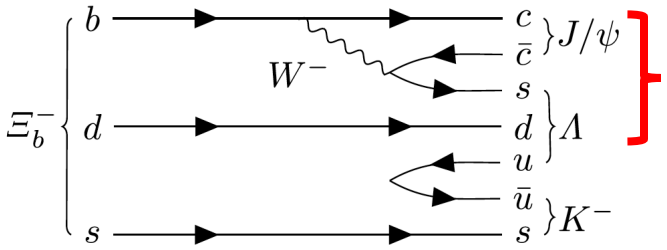
	$\sqrt{s} = 7\,\text{TeV}$	$\sqrt{s} = 8\,\text{TeV}$
ATLAS	$(0.22 \pm 0.08\,(\text{stat}))/\varepsilon_7$	$(0.15 \pm 0.06\,(\text{stat}))/\varepsilon_8$
LHCb	–	$< [0.04, 0.09]$

$\varepsilon_7, \varepsilon_8$: relative efficiencies of reconstructing $B_c^{(*)}(2S)^+$ wrt B_c^+

- **ATLAS did not publish $\varepsilon_7, \varepsilon_8$**
- **ATLAS/LHCb only compatible if $\varepsilon_7, \varepsilon_8$ are large**

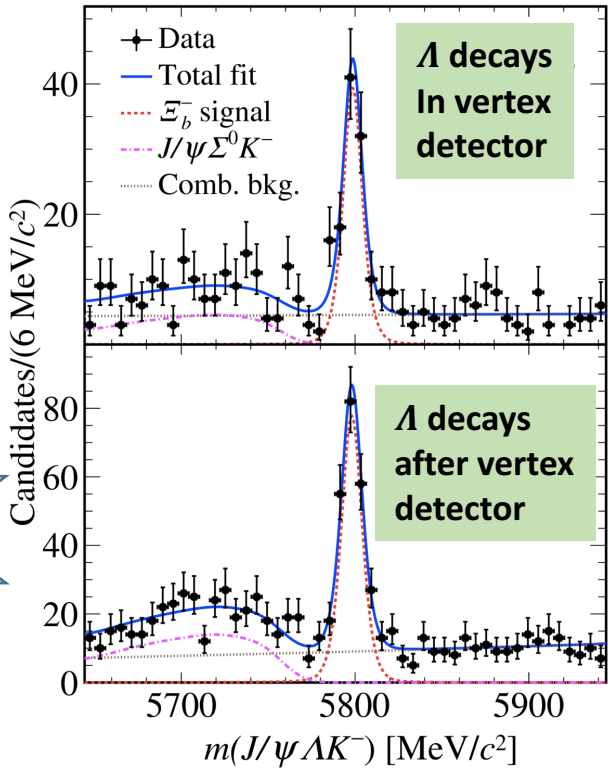
2017研究结果总结:
- 五夸克态相关研究

6. Observation of the $\Xi_b^- \to J/\psi \Lambda^0 K^-$ decay, Phys.Lett.B772 (2017) 265.



s-quark五夸克态？ not yet …

Wu et al., PRL 105 (2010) 232001
Chen et al., PRC 93 (2016) 065203



~ 300 candidates in RUN1
Amplitude analysis with RUN2

First Observation

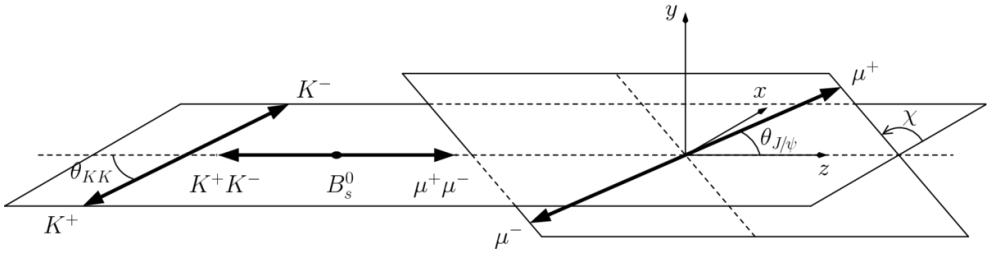
$$\frac{f_{\Xi_b^-}}{f_{\Lambda_b^0}} \frac{\mathcal{B}(\Xi_b^- \to J/\psi \Lambda K^-)}{\mathcal{B}(\Lambda_b^0 \to J/\psi \Lambda)} = (4.19 \pm 0.29 \pm 0.15) \times 10^{-2}$$

2017研究结果总结:
- CP 破坏研究

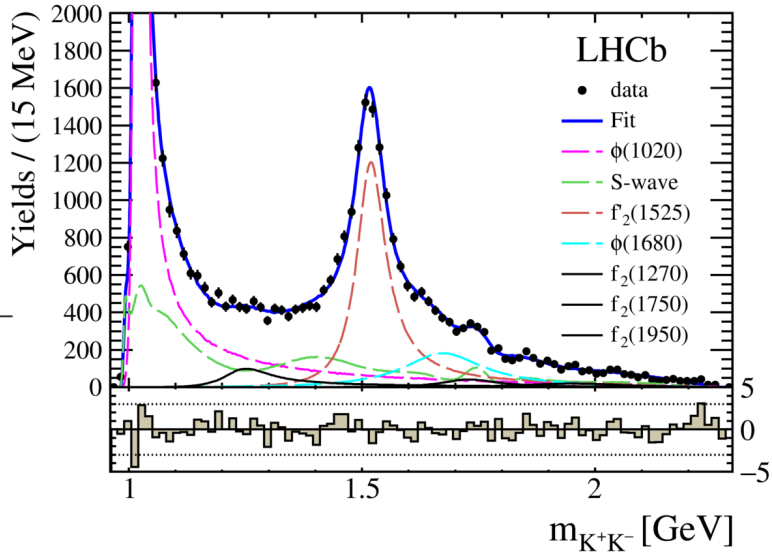
7. Resonances and CP violation in B_s^0 and $\bar{B}_s^0 \to J/\psi K^+K^-$ decays in the mass region above the $\phi(1020)$, JHEP 08 (2017) 037.
8. Observation of the decay $B_s \to \phi\pi^+\pi^-$ and evidence for $B_d \to \phi\pi^+\pi^-$, Phys. Rev. D95 (2017) 012006
9. Measurement of the ratio of branching fractions and difference in CP asymmetries of the decays $B^+ \to J/\psi\pi^+$ and $B^+ \to J/\psi K^+$, JHEP03 (2017) 036.

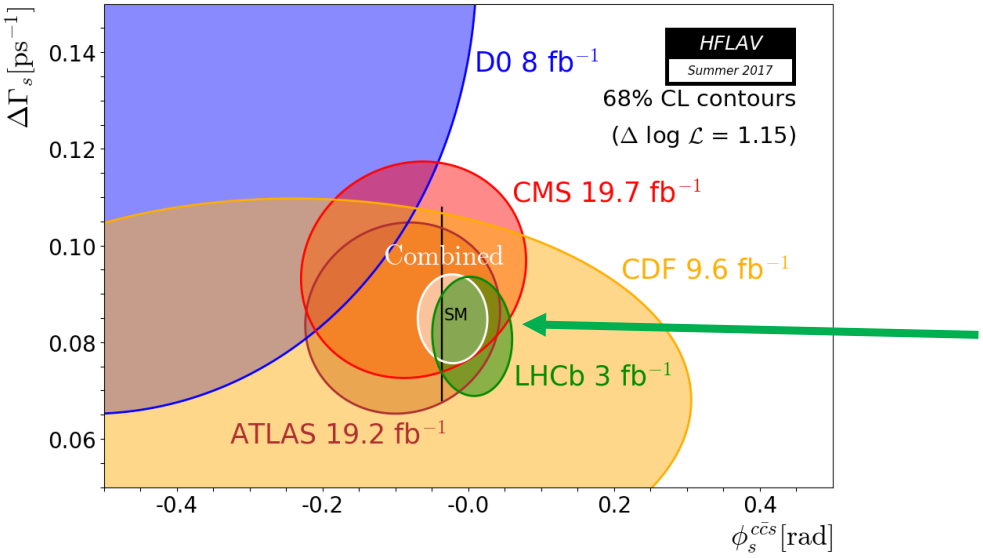
$B_s \to J/\psi K^+K^-, \quad m_{K^+K^-} > m_\phi$

LHCb, JHEP 08 (2017) 037



Component	Fit fraction (%)	Transversity fraction (%) 0	∥	⊥
$\phi(1020)$	$70.5 \pm 0.6 \pm 1.2$	50.9 ± 0.4	23.1 ± 0.5	26.0 ± 0.6
$f_2(1270)$	$1.6 \pm 0.3 \pm 0.2$	76.9 ± 5.5	6.0 ± 4.2	17.1 ± 5.0
$f_2'(1525)$	$10.7 \pm 0.7 \pm 0.9$	46.8 ± 1.9	33.8 ± 2.3	19.4 ± 2.3
$\phi(1680)$	$4.0 \pm 0.3 \pm 0.3$	44.0 ± 3.9	32.7 ± 3.6	23.3 ± 3.6
$f_2(1750)$	$0.59^{+0.23}_{-0.16} \pm 0.21$	58.2 ± 13.9	31.7 ± 12.4	$10.1^{+16.8}_{-6.1}$
$f_2(1950)$	$0.44^{+0.15}_{-0.10} \pm 0.14$	$2.2^{+6.7}_{-1.5}$	38.3 ± 13.8	59.5 ± 14.2
S-wave	$10.69 \pm 0.12 \pm 0.57$	100	0	0





Parameter	Value
Γ_s [ps^{-1}]	$0.650 \pm 0.006 \pm 0.004$
$\Delta\Gamma_s$ [ps^{-1}]	$0.066 \pm 0.018 \pm 0.010$
ϕ_s [mrad]	$119 \pm 107 \pm 34$
$\lvert\lambda\rvert$	$0.994 \pm 0.018 \pm 0.006$

LHCb combined (RUNI)

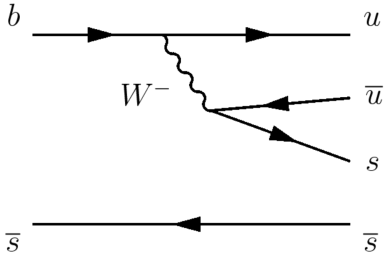
$B_s \to J/\psi K^+K^- \ (m_{K^+K^-} > m_\phi)$
$\to J/\psi\phi$
$\to J/\psi\pi^+\pi^-$
$\to D_s^+D_s^-$

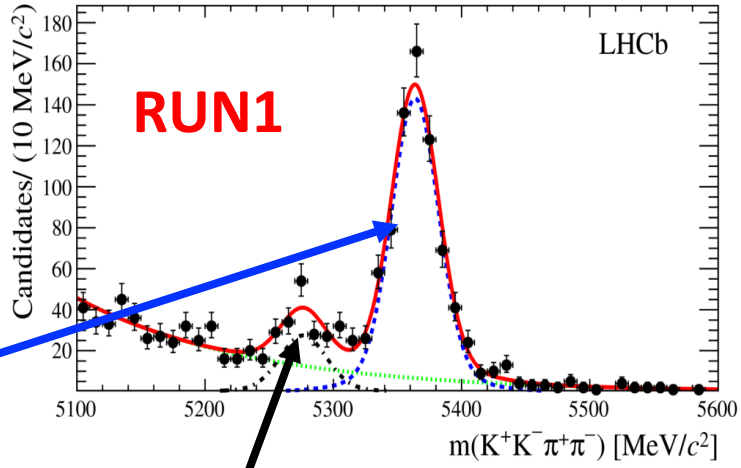
$B_{s,d} \to \phi\pi^+\pi^-$

LHCb, PRD 95 (2017) 012006

First Observation

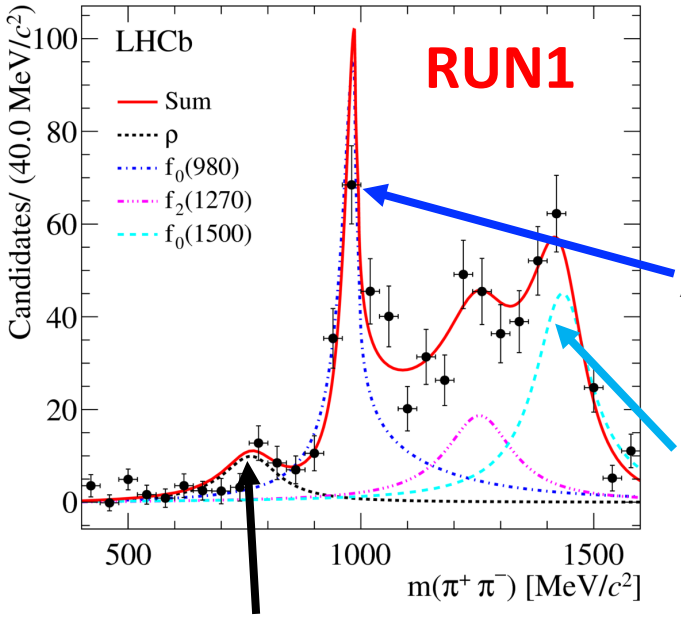
$B_s \to \phi\rho^0$

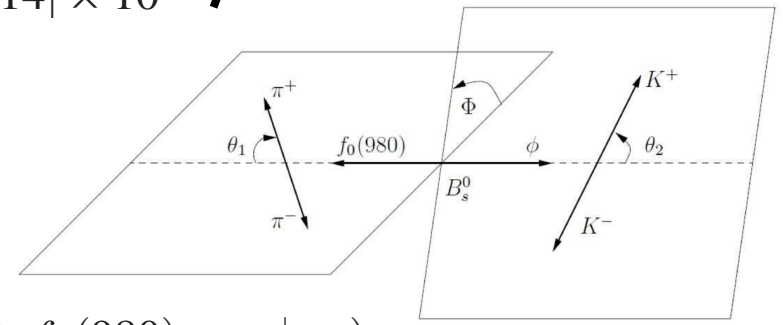




$$\mathcal{B}(B_s^0 \to \phi\pi^+\pi^-) = [3.48 \pm 0.23 \pm 0.17 \pm 0.35] \times 10^{-6}$$

$$\mathcal{B}(B^0 \to \phi\pi^+\pi^-) = [1.82 \pm 0.25 \pm 0.41 \pm 0.14] \times 10^{-7}$$





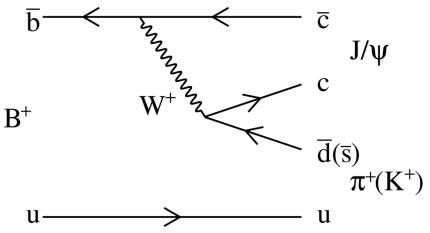
$$\mathcal{B}(B_s^0 \to \phi f_0(980), f_0(980) \to \pi^+\pi^-) = [1.12 \pm 0.16^{+0.09}_{-0.08} \pm 0.11] \times 10^{-6}$$

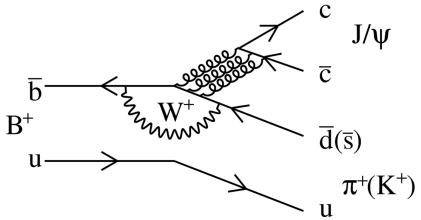
$$\mathcal{B}(B_s^0 \to \phi f_2(1270), f_2(1270) \to \pi^+\pi^-) = [0.61 \pm 0.13^{+0.12}_{-0.05} \pm 0.06] \times 10^{-6}.$$

$$\mathcal{B}(B_s^0 \to \phi\rho^0) = [2.7 \pm 0.7 \pm 0.2 \pm 0.2] \times 10^{-7}$$

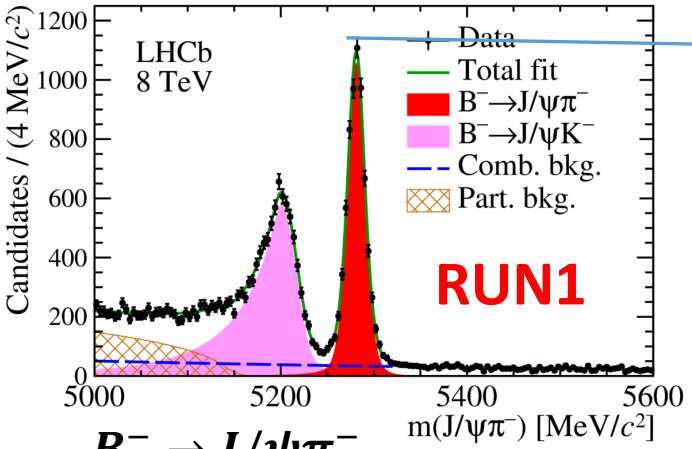
$B^+ \to J/\psi\pi^+, J/\psi K^+$

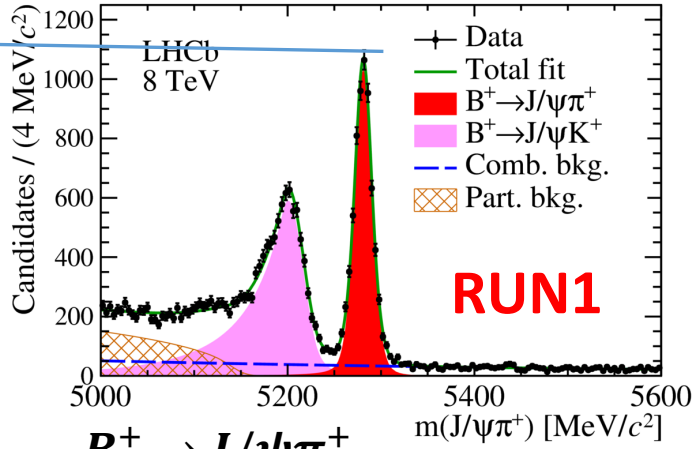
LHCb, JHEP 03 (2017) 036





$$\frac{\mathcal{B}(B^+ \to J/\psi\pi^+)}{\mathcal{B}(B^+ \to J/\psi K^+)} = (3.83 \pm 0.03 \pm 0.03) \times 10^{-2}$$





$$\mathcal{A}^{CP}(B^+ \to J/\psi\pi^+) - \mathcal{A}^{CP}(B^+ \to J/\psi K^+) = (1.82 \pm 0.86 \pm 0.14) \times 10^{-2}$$

input

$$\mathcal{A}^{CP}(B^+ \to J/\psi K^+) = (0.09 \pm 0.27 \pm 0.07) \times 10^{-2}$$

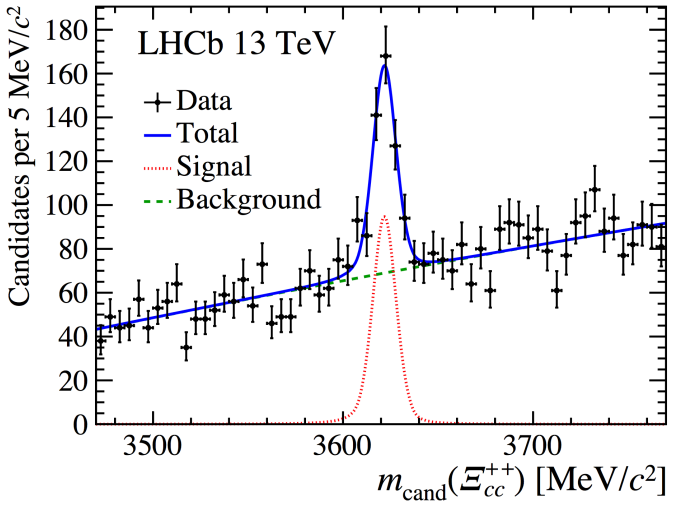
LHCb PRD 95 (2017) 052005

$$\mathcal{A}^{CP}(B^+ \to J/\psi\pi^+) = (1.91 \pm 0.89 \pm 0.16) \times 10^{-2}$$

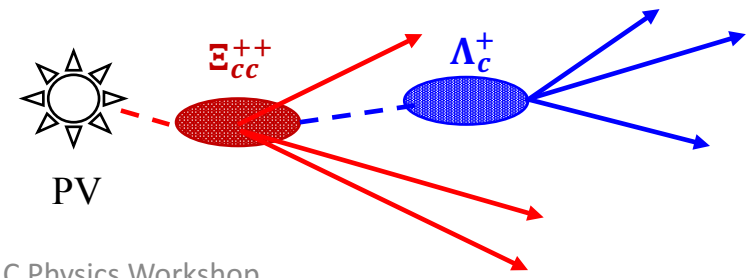
2017研究结果总结:
- Ξ_{cc}^{++}的实验发现

10. Observation of the doubly charmed baryon Ξ_{cc}^{++}, Phys. Rev. Lett. 119 (2017) 112001.

- *PRL* 编辑推荐（Editor's Suggestion)
- *Physics* 专题报道（Viewpoint）



$\Xi_{cc}^{++} \to K^-\pi^+\pi^+\Lambda_c^+(\to pK^-\pi^+)$

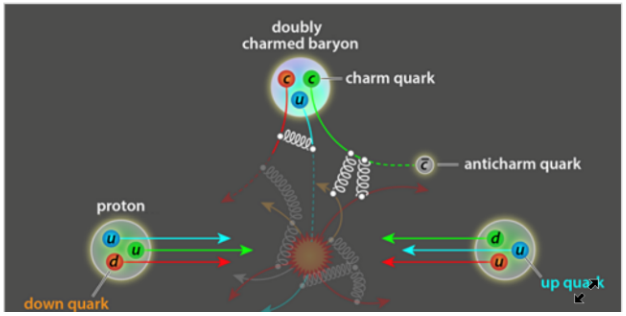


Viewpoint: A Doubly Charming Particle

Raúl A. Briceño, Department of Physics, Old Dominion University, Norfolk, VA 23529, USA and Thomas Jefferson National Accelerator Facility, Newport News, VA 23606, USA

September 11, 2017 • *Physics* 10, 100

High-precision experiments at CERN find a new baryon containing two charm quarks.



nature.com > research highlights

nature.com

PARTICLE PHYSICS · 11 September 2017

New particle has twice the charm

The LHCb experiment is charmed to announce observation of a new particle with two heavy quarks | Media and Press Relatio

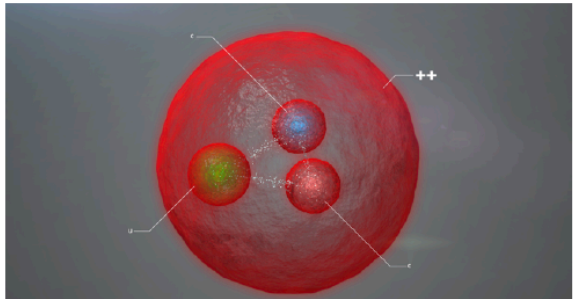
CERN Accelerating science

Media and Press Relations

News | Media visits | Events | Photos & Videos | Other resources | Contact us

The LHCb experiment is charmed to announce observation of a new particle with two heavy quarks

06 Jul 2017



CCTV 央视网 com 新闻 国内 | 国际 | 图片 | 视频

我国科学家牵头首次发现新型重子“双粲重子”

科技频道 来源：科技日报 2017年07月07日 09:22 A- A+ 我要分享

原标题：我国科学家牵头发现新型重子

科技日报北京7月6日电 （记者操秀英）北京时间7月6日，欧洲核子研究中心大型强子对撞机（LHC）上的实验组宣布首次发现双粲重子。该发现由中国科学家主导。国际合作组已将研究论文提交至《物理评论快报》。

LHCb中国组负责人，清华大学高原宁教授介绍道，按照夸克模型的分类，重子由三个夸克组成，熟知的质子和中子是最常见的重子。自然界中存在六种不同夸克：u, d, s, c, b, t。前三种较轻，后三种较重。理论预期存在很多种具有不同组分的重子。此前发现的重子最多含有一个重夸克，但此次发现的重子含有两个重夸克。这次发现的重子含有两个c夸克（粲夸克）和一个u夸克（上夸克），带两个单位电荷。

SCIENCE

Demystifying Science: What is Xicc++ ?

JULY 09, 2017 04:02 IST
UPDATED: JULY 09, 2017 00:42 IST

SHARE ARTICLE PRINT A | A A

MORE-IN

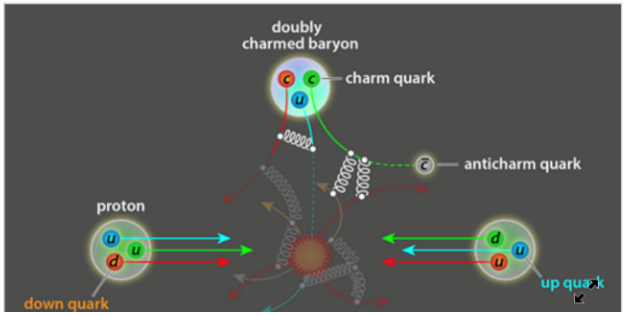
It's a new kind of quark, or a subatomic particle, that is a

Viewpoint: A Doubly Charming Particle

Raúl A. Briceño, Department of Physics, Old Dominion University, Norfolk, VA 23529, USA and Thomas Jefferson National Accelerator Facility, Newport News, VA 23606, USA

September 11, 2017 • *Physics* 10, 100

High-precision experiments at CERN find a new baryon containing two charm quarks.



PARTICLE PHYSICS · 11 September 2017

New particle has twice the charm

The LHCb experiment is charmed to announce observation of a new particle with two heavy quarks | Media and Press Relatio

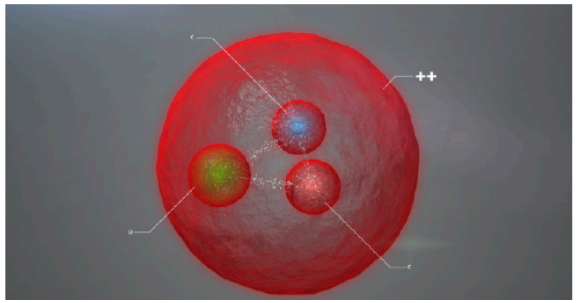
CERN Accelerating science

Media and Press Relations

News | Media visits | Events | Photos & Videos | Other resources | Contact us

The LHCb experiment is charmed to announce observation of a new particle with two heavy quarks

06 Jul 2017



CCTV 央视网 com 新闻 国内 | 国际 | 图片 | 视频

我国科学家牵头首次发现新型重子“双粲重子”

科技频道 来源：科技日报 2017年07月07日 09:22 A- A+ 我要分享

原标题：我国科学家牵头发现新型重子

科技日报北京7月6日电 （记者操秀英）北京时间7月6日，欧洲核子研究中心大型强子对撞机（LHC）上的实验组宣布首次发现双粲重子。该发现由中国科学家主导。国际合作组已将研究论文提交至《物理评论快报》。

LHCb中国组负
克组成，熟知的质
三种较轻，后三种
一个重夸克，但此
和一个u夸克（上夸

SCIENCE

Demystifying Science: What is Xicc++ ?

09, 2017 04:02 IST
09, 2017 00:42 IST

e, that is a

据CERN新闻办公室统计，全球科技和大众媒体的报道数量创造了大型强子对撞机运行以来的新纪录。

LHCb国际合作负责人的公开评价

- **LHCb 发言人 Giovanni Passaleva**

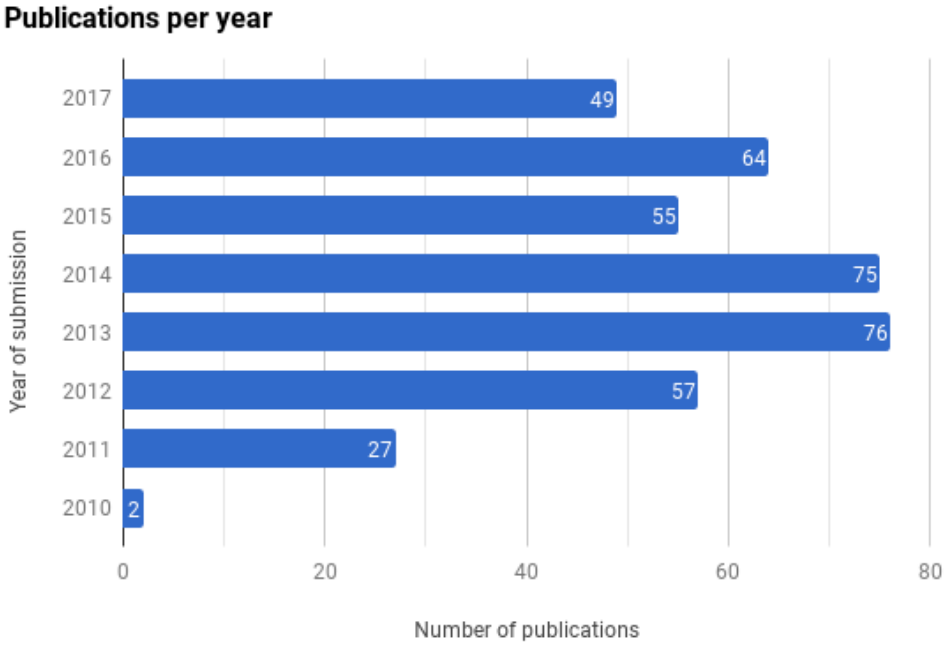
The LHCb Chinese scientists played a crucial role in the observation of the new particle. They are being rewarded for a long standing and highly recognized experimental effort. LHCb的中国科学家对该粒子(Ξ_{cc}^{++})的发现做出了关键性贡献。这是他们在实验上长期不懈努力的成果。

A group of Chinese theorists provided also fundamental inputs to drive the analysis to the right direction and gave key suggestions to achieve this result. 中国的理论家也提供了重要帮助，他们的关键建议引导该分析在正确的方向上取得了突破。

- **LHCb 物理协调人 Vincenzo Vagnoni**

Our Chinese colleagues have been very active in the LHCb physics analysis. They ever played a leading role in the discovery of pentaquark states in 2015 and this time in the discovery of Ξ_{cc}^{++}. I am looking forward to their continuous efforts on this exciting topic in the future. 中国同事在LHCb实验上的物理研究非常活跃。2015年他们主导了五夸克态的发现，这一次又主导了双粲重子Ξ_{cc}^{++}的发现。我对他们在这一激动人心的领域中的持续努力充满期待。

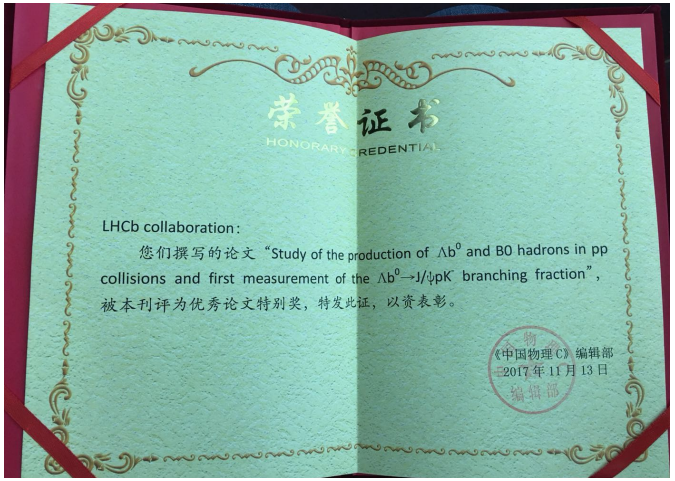
发表论文情况总结



LHCb : 49

LHCb-China : 10

- 3 production
- 2 B_c
- 1 pentaquark
- 3 CP
- 1 Ξ_{cc}^{++}



测量$\Lambda_b^0 \to J/\psi p K^-$衰变的绝对分支比

得到五夸克态级联分支比

$$\mathcal{B}\left(\Lambda_b^0 \to P_c^+ K^-\right) \times \mathcal{B}\left(P_c^+ \to J/\psi p\right)$$

Chin.Phys.C40 (2016) 01

《中国物理 C》2016年度最佳论文奖

国际会议报告

1. 杨振伟, Heavy flavour production and spectroscopy, 5th Annual Large Hadron Collider Physics Conference (LHCP2017) , Shanghai, 15-20 May, 2017
   （ATLAS/CMS/LHCb/ALICE-各有一个大会报告）

2. 高原宁，Latest results in hadron spectroscopy from LHCb,
   28th International Symposium on Lepton Photon Interactions at High Energies (Lepton Photon 2017), Guangzhou, 7-12 August, 2017
   （CMS/LHCb-中国组各有一个大会邀请报告）

+ 25 口头报告 + 2 poster

国际会议报告（1）

3. 尹航，Heavy flavor hadron spectroscopy, Workshop on heavy flavor production in high energy collisions, Berkeley, October 30, 2017
4. 尹航， EW production at LHCb, 21st Particle & Nuclei International Conference, Beijing, September 1-5, 2017
5. 尹航, Tracking and vertexing reconstruction at LHCb from run-2, 5th Annual Conference on Large Hadron Collider Physics, Shanghai, May 15-20, 2017
6. Biplab Dey, Overview on pentaquarks, 15th International Conference on Flavour Physics and CP violation, June 5-9, 2017
7. 俞洁晟，Study of B_c decays at LHCb, 12th International Workshop on Heavy Quarkonium, Beijing, November 6-20, 2017
8. 俞洁晟, LHCb results on hadron spectroscopy, 5th Annual Conference on Large Hadron Collider Physics, Shanghai, May 15-20, 2017
9. 徐梦琳, Single boson production at LHCb, 5th Annual Conference on Large Hadron Collider Physics, Shanghai, May 15-20, 2017

国际会议报告（2）

10. 王梦臻, Decays of baryons with heavy quark at LHCb, 12th International Workshop on Heavy Quarkonium, Beijing，6-10 November, 2017
11. 安刘攀, Measurement of the J/ψ pair production cross-section in pp collisions at $\sqrt{s}$ =13 TeV, 12th International Workshop on Heavy Quarkonium，Beijing，6-10 November, 2017
12. 安刘攀, Central exclusive production of J/ψ and $\psi(2S)$ mesons in pp collisions at $\sqrt{s}$ =13 TeV，12th International Workshop on Heavy Quarkonium，Beijing，6-10 November, 2017
13. 孙佳音, Quarkonium results in p-Pb and Pb-Pb, 12th International Workshop on Heavy Quarkonium，Beijing，6-10 November, 2017
14. Adam Davis, Real-time alignment and reconstruction in Run 2 and its performance at the LHCb experiment, 26th International Workshop on Vertex Detectors，Las Caldas, Spain, 10-15 September, 2017

国际会议报告（3）

15. 许傲，Heavy flavour spectroscopy at LHCb, 21st Particles and Nuclei International Conference (PANIC 2017), Beijing, 1-5 September, 2017
16. 孙佳音, Heavy ion physics at LHCb, 21st Particles and Nuclei International Conference (PANIC 2017), Beijing, 1-5 September, 2017
17. 张黎明, Pentaquark candidates in the LHCb data, 6th International Conference on New Frontiers in Physics (ICNFP 2017), Kolymbari, 17-29 August, 2017
18. 张黎明，Pentaquark & tetraquark states at LHCb, Meeting of the APS Division of Particles and Fields (DPF 2017), Batavia, US, 31 July – 4 August, 2017
19. 孙佳音，Production cross-sections and nuclear modification factor for charmed baryons and mesons in pPb collisions at 5 TeV with the LHCb detector, 17th International Conference on Strangeness in Quark Matter (SQM 2017), Utrecht, Netherlands, 10-15 July, 2017

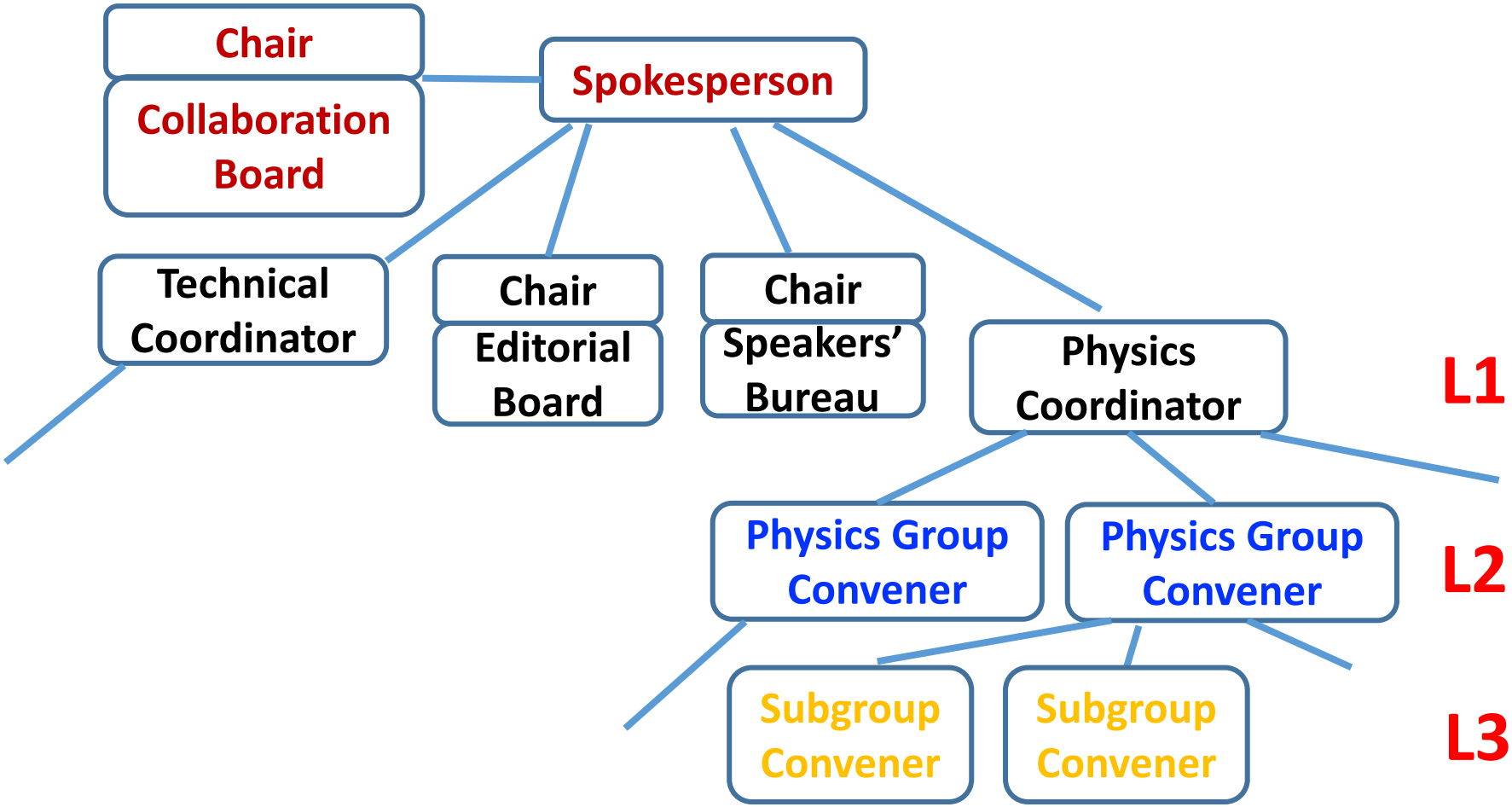
国际会议报告（4）

20. 刘雪淞，Heavy flavour production and spectroscopy at LHCb, 29th Rencontres de Blois International Conference (Blois 2017), Blois, France, 28 May -2 June, 2017
21. 安刘攀，DPS measurement in double J/psi production at 13 TeV, 2nd Italian Workshop on Hadron Physics and Non Perturbative QCD, Pollenzo, 22-26 May, 2017
22. 安刘攀，Measurements of particle production, soft-QCD, and double parton scattering at LHCb, 5th Annual Large Hadron Collider Physics Conference, Shanghai, 15-20 May, 2017
23. 刘雪淞, Mixing and CP violation results in b-hadron decays at LHCb, 5th Annual Large Hadron Collider Physics Conference (LHCP2017) , Shanghai, 15-20 May, 2017

国际会议报告（5）

24. Adam Davis, Measurements of charm mixing and CP violation using $D^0 \to K^{\pm}\pi^{\mp}$ decays, （Poster）5th Annual Large Hadron Collider Physics Conference (LHCP2017) , Shanghai, 15-20 May, 2017
25. 王梦臻, Measurements of the CP violating phase ϕ_s at LHCb, （Poster）5th Annual Large Hadron Collider Physics Conference ,Shanghai, 15-20 May, 2017
26. Daniel Vieira, Observation of the charmed baryon, 12th International Workshop on Heavy Quarkonium，Beijing，6-10 November, 2017
27. Daniel Vieira, Results on charmed baryon from LHCb, 12th International Workshop on Heavy Quarkonium，Beijing，6-10 November, 2017
28. 秦佳佳，Study of J/ψ production in Jets, 12th International Workshop on Heavy Quarkonium，Beijing，6-10 November, 2017
29. 秦佳佳，New results on Jets, heavy flavor & quarkonium with LHCb, 5th Annual Large Hadron Collider Physics Conference (LHCP2017) , Shanghai, 15-20 May, 2017

LHCb组织结构


Chair
Collaboration Board
Spokesperson
Technical Coordinator
Chair
Editorial Board
Chair
Speakers' Bureau
Physics Coordinator
L1
Physics Group Convener
Physics Group Convener
L2
Subgroup Convener
Subgroup Convener
L3

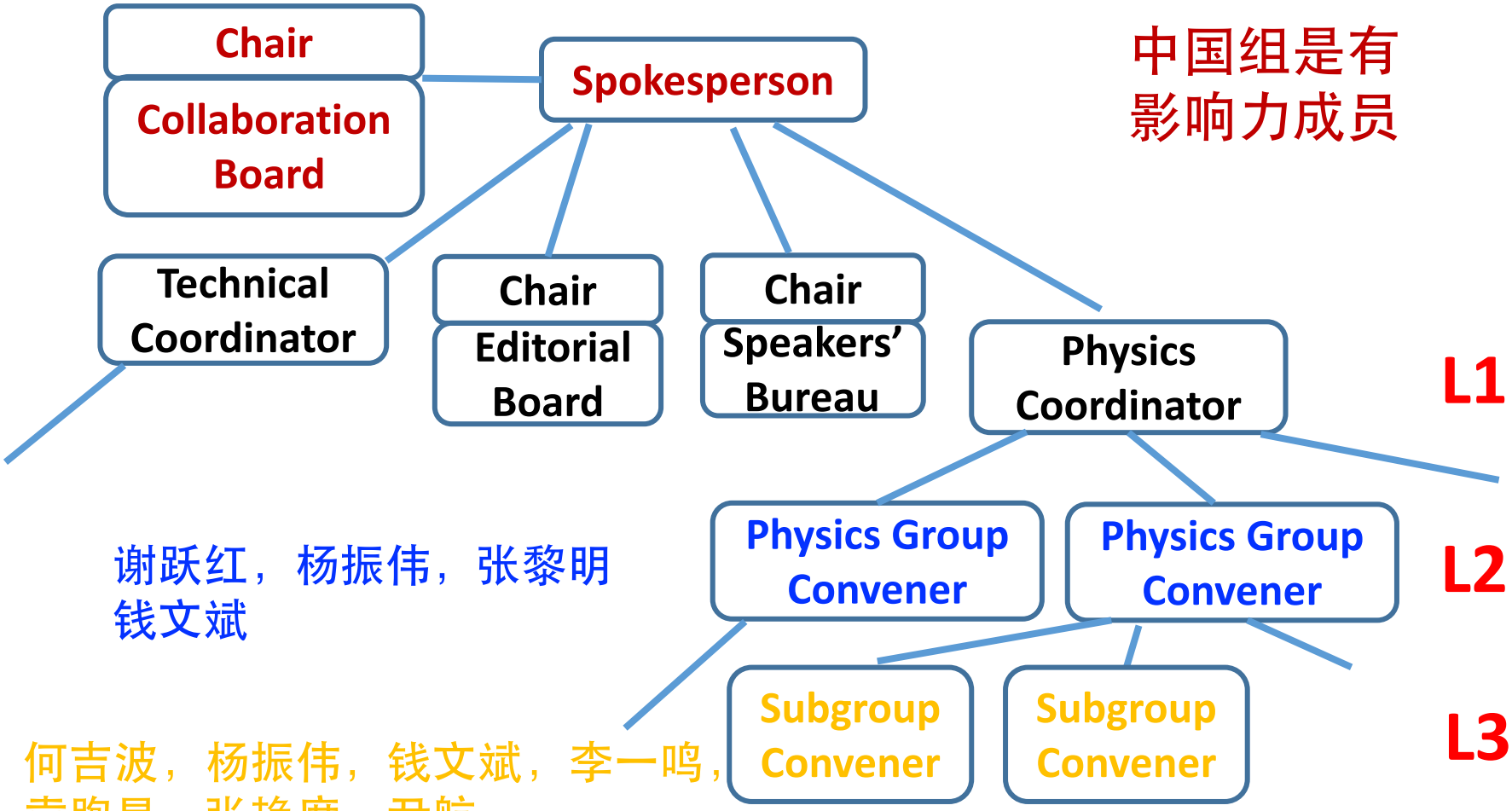
中国组成员担任领导工作情况

- **Physics Group Convener (L2)**
  - 谢跃红 (2013-2015)
  - 杨振伟 (2014-2016)
  - 张黎明 (2015-2017)
  - 钱文斌 (2018-)

    (LHCb-清华组毕业的学生钱文斌、张艳席入选)

- 杨振伟入选 **Speaker's Bureau**

LHCb组织结构


Chair
Collaboration Board
Spokesperson
中国组是有影响力成员
Technical Coordinator
Chair
Editorial Board
Chair
Speakers' Bureau
Physics Coordinator
L1
谢跃红，杨振伟，张黎明
钱文斌
Physics Group Convener
Physics Group Convener
L2
何吉波，杨振伟，钱文斌，李一鸣，
袁煦昊，张艳席，尹航…
Subgroup Convener
Subgroup Convener
L3

高影响力的因素

- 高水平研究成果
- 中国组内协调、支持
- 整体实力提高

中国组成员
中国组单位

- 承担与物理成果相匹配的责任（升级、服务工作、…）
- 经费支持
- 主管部门支持（MoU，RRB…）

主管部门
中国组成员
中国组单位

2017年经费申请

- 国家重点研发计划“大科学装置前沿研究”专项
  - 大型强子对撞机LHCb实验的物理研究

项目编号: 2017YFA0402100
执行期限: 2017.07-2022.06
负责人: 谢跃红
总经费: 752万元

- 国家自然科学基金国际合作项目2016年已结题
  希望能得到持续支持…

服务工作 + 探测器升级

- **Core Software**
  - 孙亮（武汉大学教师）
  - Maciej Szymanski （国科大博士后, 100%）

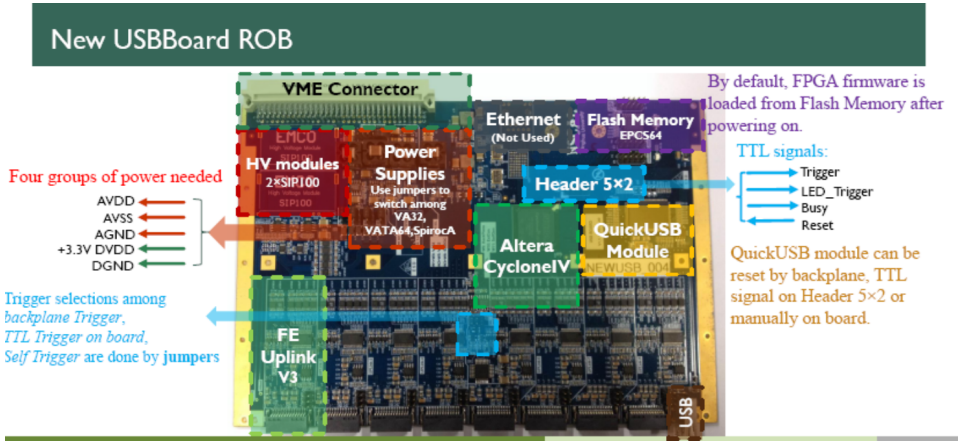
- **探测器升级 – SciFi Tracker**
  - 曾鸣、龚光华（清华大学教师）
  - Adam Davis （清华大学博士后，50%）
  - Biplab Dey （华中师大博士后，50%）
  - 研究生多人

SciFi模块与芯片性能研究与测试电子学系统

SciFi光纤模块性能测试电子学，用于实验室测试和束流实验

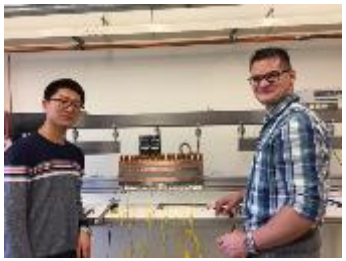
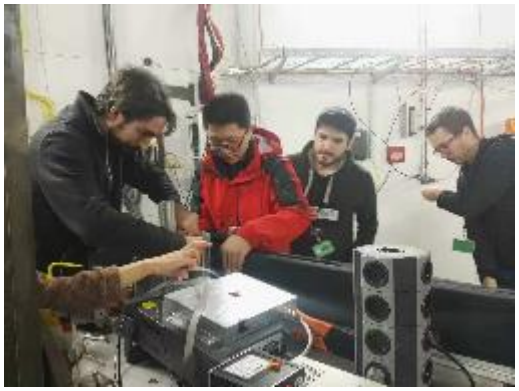
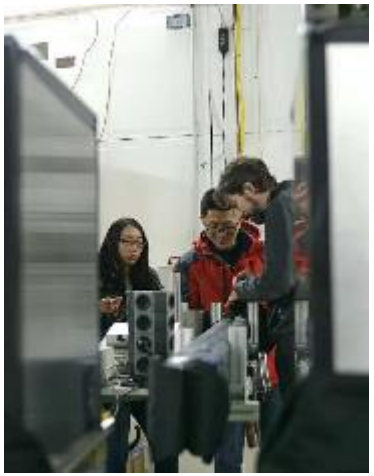
已为合作组提供20套系统

Single-board Setup in HD

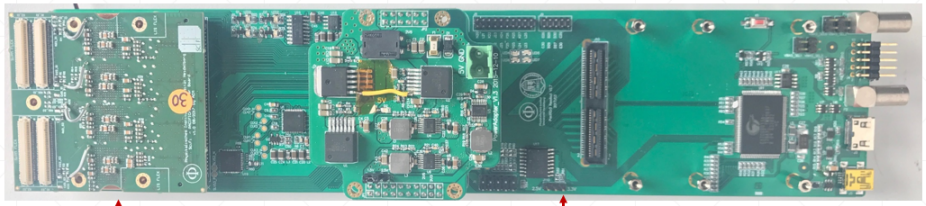


SciFi模块与芯片性能研究与测试电子学系统

- 参加SciFi探测器测试
- 束流实验及性能研究

Verification with PACIFIC5

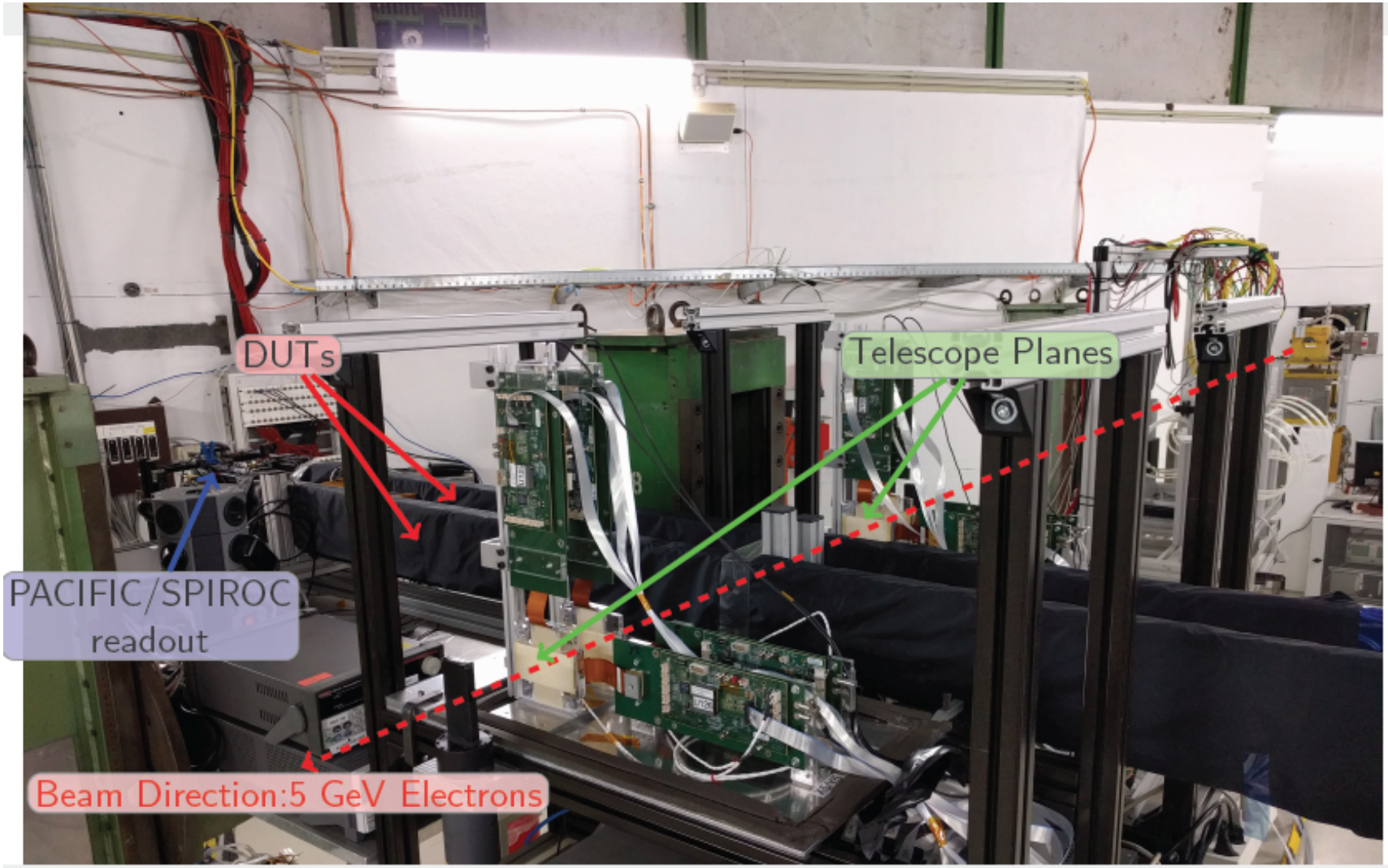


128 PACIFIC5 ASICs have been tested
by using PACIFICROB

LHCb SciFi束流测试与寻迹准直研究

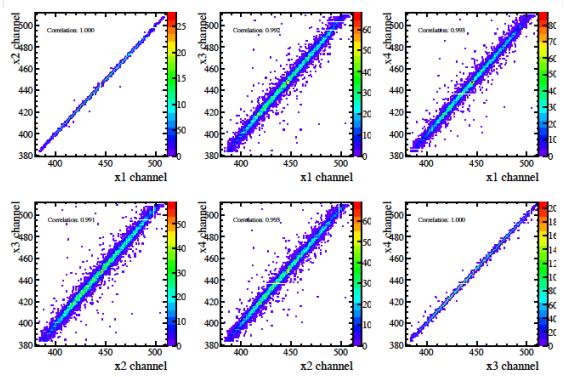
- 博士后Adam Davis和博士生王梦臻、安刘攀等为束流测试和模拟搭建了软件框架，比较分析束流测试与模拟结果
  - 处理PACIFIC和SPIROC两种不同读出数据，前者用于最终升级
  - 撰写了可独立用于SciFi寻迹准直的软件包
  - 用于LHCb软件框架下的模拟软件包仍在测试中
- Adam Davis与王梦臻参加了2017年8月在DESY的束流测试
  - 采集数据、调试软件
- 正在持续投入人力于SciFi探测器的寻迹准直
  - 华中师范博士后Biplab Dey近期加入准直工作
  - 预计明年会增加1-2名博士生

LHCb SciFi束流测试与寻迹准直研究

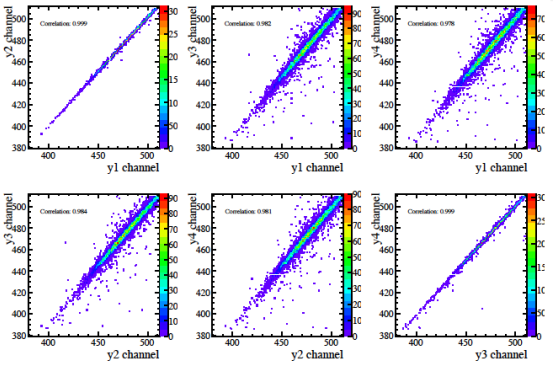


LHCb SciFi束流测试与寻迹准直研究

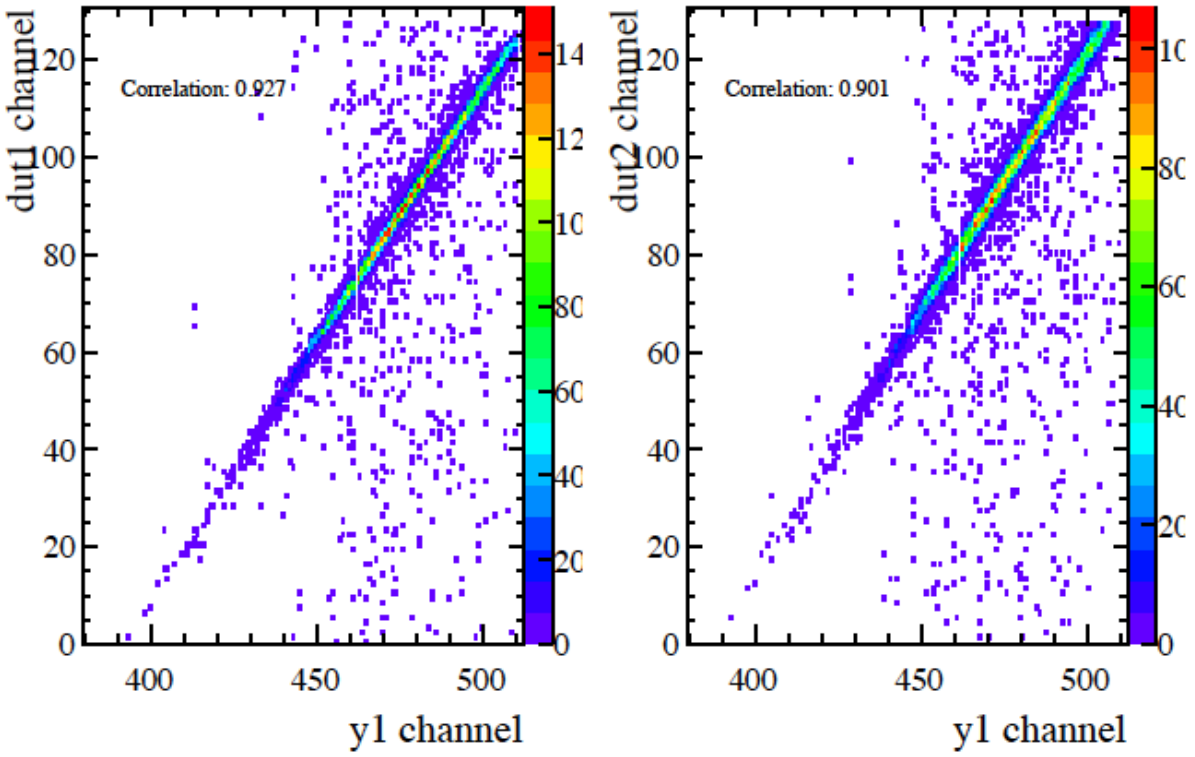
利用搭建的软件框架对束流测试数据的分析



Y通道的关联



X通道的关联



待测探测器(DUT)与Y通道的关联

LHCb-中国组学术组织

- LHCb-中国组是一个整体
  - 人力 + 研究资源
  - 共同组会，联合指导学生
- 各大学组发展态势良好，提高了LHCb-中国组的影响力，也促进了所在高校的学科建设
- 小课题组也可以做出大贡献！

欢迎加入LHCb

2017年总结

- 物理研究继续取得好成绩
  - 优势课题高产出（production, B_c）
  - 在 CP破坏研究上得到重要结果（ϕ_s,..）
  - 发现Ξ_{cc}^{++}
- 在国际合作中的影响力继续得到提高
  - 钱文斌新当选课题负责人
  - 杨振伟入选Speaker's Bureau
- 探测器升级任务进展顺利
- 经费申请取得重大突破，但缺口依然很大…

2018年重点工作

- 基于RUN2数据的物理研究
- 保证在Upgrade I 后物理研究的竞争力
  - 研讨科学问题
  - 布局有特色的研究课题
- 积极参加后续升级工作，争取主动
  - 研究物理潜力 (已经开展量能器研究)
  - 参加前沿技术研发

Phase 1b/II

LS2: Major changes, Upgrade I Installation

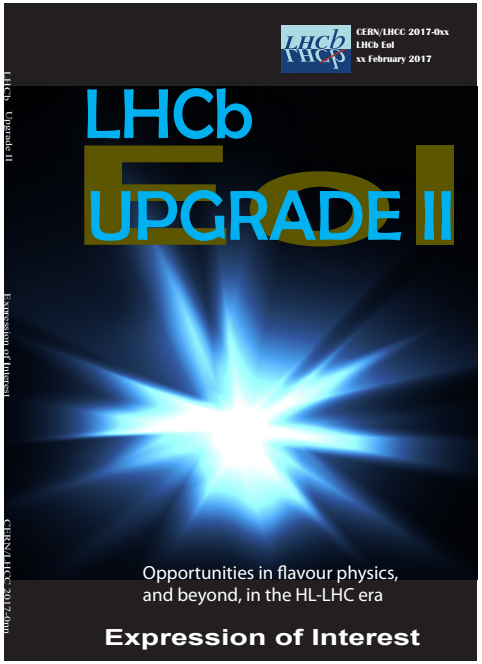
- Run 3 (2021-2023)
  - LHCb Upgrade I
  - L=2x10^{33} cm^{-2} s^{-1}, ~5 fb^{-1}/yr

LS3: Consolidation, Upgrade 1b Installation

- Run 4 (2026-2029)
  - LHCb Upgrade Ib
  - L=2x10^{33} cm^{-2} s^{-1}, ~5 fb^{-1}/yr Total Int. L ~ 50fb^{-1}

LS4: Major Changes, Upgrade II Installation

- Run 5/6 (2031-)
  - LHCb Upgrade II Total Int L ~ 300fb^{-1}
  - L=1-2x10^{34} cm^{-2} s^{-1}, ~50 fb^{-1}/yr



LHCb talks at this workshop

- Plenary

✓ Sat 8:55 郑阳恒 (UCAS) *Highlights of rare decays and lepton universality*

✓ Sat 9:20 尹航 (CCNU) *CP violation in B decays*

✓ Sat 9:45 何吉波 (UCAS) *Results of hadron production and spectroscopy*

- Parallel- Heavy Flavor and Heavy Ion

✓ Fri 13:50 徐梦琳 (CCNU) *Observation of Xicc++ at LHCb*

✓ Fri 14:10 安刘攀 (Tsinghua) *Search for excited Bc states at LHCb*

✓ Fri 14:30 王梦臻 (Tsinghua) *Studies of pentaquarks at LHCb*

✓ Fri 15:50 胡文华 (CCNU) *B+ production at LHCb*

✓ Fri 16:10 Miroslav Saur (UCAS) *CP Violation in the charm sector*

✓ Fri 17:10 曾鸣 (Tsinghua) *Recent development of a large SciFi tracker*

✓ Sat 16:10 孙佳音 (Tsinghua) *Heavy flavor results in pPb and PbPb collisions*

Backup Slides