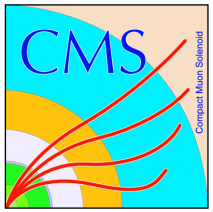
CMS中国组2018年研究进展

李强　北京大学
谨代表CMS中国组

2018年12月20日



中国科学院高能物理研究所
Institute of High Energy Physics
Chinese Academy of Sciences

参与CMS人数

单位	职工人数	博士后人数	学生人数	总人数	Authors
高能所	14	6	14	34	17
北大	5	2	15	22	8
北航	2		5	7	3
清华	1		1	2	1
中山大学	1		3	4	
总数	23	8	38	69	29

CMS文章签名人数占CMS总签名人数1.5%

2018高能所做出重要贡献的28个分析

序号	物理道	文章 / PAS号	高能所的贡献
1	矢量夸克T' (T'->tZ)	CMS-PAS-B2G-17-007，PLB 781 (2018) 574	高能所Aniello分析负责人，独立完成所有分析及所有审核报告
2	Lμ−Lτ 规范玻色子寻找in Z→4μ	CMS-PAS-EXO-18-008，arXiv:1808.03684	高能所Ahmad为分析负责人，预审核报告
3	Underlying Event in ttbar events	CMS-PAS-TOP-17-015, arXiv:1807.02810	高能所Efe为分析负责人，预审核报告
4	双光子末态寻找低质量共振态	CMS-PAS-HIG-17-013，arXiv:1811.08459	高能所陶军全承担了大部分的研究内容，做了预审核报告报告及审核报告等
5	产生子模型调节	CMS-PAS-GEN-17-001，to be submitted	高能所Efe为分析负责人，审核报告
6	ttH多轻子末态2015+2016数据	CMS-PAS-HIG-17-018，JHEP 08 (2018) 066, PRL 120 (2018) 231801	高能所Francesco给予预审核报告。事例选择，同步，本底研究，多变量分析

序号	物理道	文章 / PAS号	高能所的贡献
7	希格斯衰变到四轻子的性质测量2017数据	CMS-PAS-HIG-18-001	负责缪子效率及其误差确定，独立分析框架检验
8	希格斯衰变到两光子的性质测量2016数据	CMS-PAS-HIG-16-040，CMS-PAS-HIG-17-015，CMS-PAS-HIG-18-018 arXiv:1804.02716, arXiv:1807.03825,	陶军全负责光子识别，光子能量线性检验，文章编辑之一
9	ttH bb末态分析2015+2016数据	CMS-PAS-HIG-17-026, arXiv:1804.03682	提出B-jetness方案，提高了识别效率
10	通过bb寻找超对称希格斯粒子	CMS-PAS-HIG-16-018 JHEP 1808 (2018) 113	陈晔负责触发方案
11	X->HH or VH 共振态寻找	CMS-PAS-B2G-17-006 arXiv:1808.01365	Aniello对事例选择、boost tau重建误差应用等贡献
12	ZZ末态大质量共振态寻找	CMS-PAS-HIG-17-012 JHEP 06 (2018) 127	参与2l2j及4l末态分析

高能所博士后Francesco Romeo担任CMS Exotica物理组之下的Jets+X 组召集人，负责16个分析

2018 高校做出重要贡献的11个分析

序号	物理道	文章 / PAS号	高校的贡献
1	WW/WZ 共振态寻找	CMS-PAS-B2G-16-029 JHEP 05 (2018) 088	北大组黄璜担当分析负责人， 预审核报告
2	B->$K^+\mu^+\mu^-$ FCNC测量	CMS-PAS-BPH-15-001 Accepted by PRD	北大王大勇分析负责人，预审核报告，北大陈耿审核报告
3	$B\rightarrow K^*\mu^+\mu^-$	CMS-PAS-BPH-15-008 Phys. Lett. B 781 (2018) 517	北大李林蔚预审核报告
4	Z+Jets	CMS-PAS-SMP-15-010 CMS-PAS-SMP-16-015 EPJC 78 (2018) 965	北大王群审核报告
5	Z'→ll 2016	CMS-PAS-EXO-16-047 JHEP06(2018)120	北航方文兴审核报告。北航负责电子效率测量，Drell-Yan本底测量，误差分析等
6	Z'→ll 2017	CMS-PAS-EXO-18-006	北航高旭阳审核报告

序号	物理道	文章 / PAS号	高校的贡献
7	RunII VBS Zγ	CMS-PAS-SMP-18-007	北大组卢梦担当分析负责人
8	LFV Z'→eμ	CMS-PAS-EXO-16-058 JHEP04(2018)073	北航负责电子鉴别及其效率
9	Heavy Higgs→ZZ	CMS-PAS-HIG-17-012 JHEP 06 (2018)127	北航袁丽为H→ZZ→2l2v负责人
10	Top 奇异耦合	CMS-PAS-TOP-17-020	北航负责触发效率测量，本底估计等
11	ttH多轻子末态 2015+2016数据	CMS-PAS-HIG-17-018, JHEP 08 (2018) 066, PRL 120 (2018) 231801	北大李晶负责MEM，有效压低本底

发表有高能所贡献的CMS文章29篇

1. Search for a standard model-like Higgs boson in the mass range between 70 and 110 GeV in the diphoton final state in proton-proton collisions at $\sqrt{s}=$ 8 and 13 TeV, Submitted to PLB, arXiv:1811.08459
2. Observation of ttH production, Phys. Rev. Lett. 120, 231801, arXiv:1804.02610
3. Evidence for associated production of a Higgs boson with a top quark pair in final states with electrons, muons, and hadronically decaying tau leptons at s√= 13 TeV, JHE P 08 (2018) 066, arXiv:1803.05485
4. Search for ttH production in the Hbbbar decay channel with leptonic ttbar decays in proton-proton collisions at s√= 13 TeV, Submitted to JHEP, arXiv:1804.03682
5. Search for beyond the standard model Higgs bosons decaying into a bbbar pair in pp collisions at √s=13 TeV, JHEP 1808 (2018) 113, arXiv:1805.12191
6. Measurements of Higgs boson properties in the diphoton decay channel in proton-proton collisions at √s = 13TeV, accepted by JHEP, arxiv:1804.02716
7. Identification of heavy-flavour jets with the CMS detector in pp collisions at 13 TeV, JINST 13 (2018) P05011, arXiv:1712.07158
8. Search for single production of a vector-like T quark decaying to a Z boson and a top quark in proton-proton collisions at sqrt(s) = 13 TeV, Phys. Lett. B 781 (2018) 574, arXiv:1708.01062
9. Search for heavy resonances decaying into two Higgs bosons or into a Higgs boson and a W or Z boson in proton-proton collisions at 13 TeV, submitted to JHEP, arXiv:1808.01365
10. Performance of reconstruction and identification of τleptons decaying to hadrons andντin pp collisions at 13 TeV, JINST 13 (2018) P10005, arXiv:1809.02816
11. Search for an Lμ−Lτ gauge boson using Z→4μ events in proton-proton collisions at s√= 13 TeV, Submitted to PLB, arXiv:1808.03684
12. Search for a new scalar resonance decaying to a pair of Z bosons in proton-proton collisions at s√= 13 TeV, JHEP 06 (2018) 127, arXiv:1804.01939
13. Study of the underlying event in top quark pair production in pp collisions at 13 TeV, Submitted to EPJC, arXiv:1807.02810

高能所博士后Francesco担任CMS Exotica物理组下的Jets+X 组召集人，负责16个分析

14. Search for narrow and broad dijet resonances in proton-proton collisions at sqrt(s)= 13 TeV and constraints on dark matter mediators and other new particles, JHEP 08 (2018) 130, arXiv:1806.00843
15. Search for narrow resonances in the b-tagged dijet mass spectrum in proton-proton collisions at sqrt(s)= 8 TeV, Phys. Rev. Lett. 120, 201801 (2018), arXiv:1802.06149
16. Search for new physics in dijet angular distributions using proton-proton collisions at sqrt(s)= 13 TeV and constraints on dark matter and other models, Eur. Phys. J. C 78 (2018) 789 , arXiv:1803.08030
17. Search for low mass vector resonances decaying into quark-antiquark pairs in proton-proton collisions at sqrt(s) = 13 TeV, JHEP 01 (2018) 097, arXiv:1710.00159
18. Search for low-mass resonances decaying into bottom quark-antiquark pairs in proton-proton collisions at sqrt(s)= 13 TeV, arXiv:1810.11822
19. Search for pair-produced resonances decaying to quark pairs in proton-proton collisions at sqrt(s) = 13 TeV, arXiv:1808.03124
20. Search for pair-produced 3-jet resonances in proton-proton collisions at sqrt(s)=13 TeV, arXiv:1810.10092
21. Search for pair-produced resonances each decaying into at least four quarks in proton-proton collisions at sqrt(s) = 13 TeV, Phys. Rev. Lett. 121, 141802 (2018), arXiv:1806.01058
22. Search for black holes and sphalerons in high-multiplicity final states in proton-proton collisions at sqrt(s) = 13 TeV, JHEP 11 (2018) 042, arXiv:1805.06013
23. Search for heavy neutral leptons in events with three charged leptons in proton-proton collisions at sqrt(s) = 13 TeV, Phys. Rev. Lett. 120, 221801 (2018), arXiv:1802.02965
24. Search for a heavy right-handed W boson and a heavy neutrino in events with two same-flavor leptons and two jets at sqrt(s) = 13 TeV, JHEP 05 (2018) 148, arXiv:1803.11116
25. Search for pair production of first-generation scalar leptoquarks at sqrt(s) = 13 TeV, arXiv:1811.01197
26. Search for pair production of second-generation leptoquarks at sqrt(s) = 13 TeV, arXiv:1808.05082
27. Search for heavy Majorana neutrinos in same-sign dilepton channels in proton-proton collisions at sqrt(s) = 13 TeV, arXiv:1806.10905
28. Search for a heavy composite Majorana neutrino in the final state with two leptons and two quarks at sqrt(s) = 13 TeV, Phys. Lett. B 775 (2017) 315, arXiv:1706.08578
29. Search for heavy neutrinos and third-generation leptoquarks in hadronic states of two tau leptons and two jets in proton-proton collisions at sqrt(s) = 13 TeV, arXiv:1811.00806

发表有高校重要贡献的CMS期刊文章8篇

1. Search for a heavy resonance decaying to a pair of vector bosons in the lepton plus merged jet final state at sqrt(s)= 13 TeV, JHEP 05 (2018) 088.
2. Angular analysis of the decay B+ -> K+mu+mu− in proton-proton collisions at sqrt(s)= 8 TeV, accepted by PRD, CMS-PAS-BPH-15-001.
3. Measurement of angular parameters from the decay B0 -> K∗0mu+mu− in proton-proton collisions at sqrt(s)= 8 TeV, Phys. Lett. B 781 (2018) 517.
4. Search for high-mass resonances in dilepton final states in proton-proton collisions at sqrt(s)=13 TeV,JHEP06(2018)120.
5. Search for lepton-flavour violating decays of heavy resonances and quantum black holes to emu final states in proton-proton collisions at sqrt(s) = 13 TeV, JHEP04(2018)073 .
6. Search for a new scalar resonance decaying to a pair of Z bosons in proton-proton collisions at sqrt(s) = 13 TeV, JHEP 06 (2018)127.
7. Measurement of differential cross sections for Z boson production in association with jets in proton-proton collisions at sqrt(s)= 13 TeV, EPJC 78 (2018) 965.
8. Observation of ttH production, Phys. Rev. Lett. 120, 231801, arXiv:1804.02610

中国组代表CMS在国际会议报告Plenary12个

1. Junquan Tao , “Measurements of the 125 GeV Higgs boson at CMS ”, QCD 18, 2-6 July 2018 , France
2. Junquan Tao , “Overview of CMS FCPPL collaborations”, FCPPL workshop 2018 , 21-25 May 2018, France
3. Huaqiao Zhang , “CMS upgrades ”, FCPPL workshop 2018, 21-25 May 2018 , France
4. Aniello Spiezia , “State and Prospects of BSM Searches at the LHC”, Third Alpine LHC Physics Summit, 15-20 Apr 2018, Obergurgl, Austria
5. Efe Yazgan , “Overview of underlying event measurements for DY in CMS”, LHCEW, 22-25 May 2018 , France
6. Francesco Romeo, “Search for leptoquarks with large couplings to third generation quarks with CMS”, CERN LPCC EP-LHC Seminar Series, 29 May 2018, Geneva (Switzerland) , 29-May-18 , Geneva, Switzerland
7. Joshuha Thomas-wilsker , “CMS ttH”, Higgs Hunting 2018, 23-25 Jul 2018, Paris, France
8. Efe Yazgan , “Pythia Tunes in CMS”, LHC-EW WG: Jets and EW bosons , 20-Jun ,Switzerland
9. Linwei Li, “Rare B decays”, BEACH 2018, 17-Jun 2018, Portugal;
10. Dayong Wang, “b->s ll results”, BEAUTY2018 , 6-May 2018, Italy;
11. Qiang Li, “Recent results from the LHC and future plans”, BARAM2018, 21-Mar 2018, Jeju, Korea;
12. Huang Huang, “Search for dijet and diboson resonance”, Moriond/EWK, 10-Mar 2018, Italy.

中国组代表CMS在国际会议报告Parallel 12个

1. Aniello Spiezia , B2G Spring workshop , single T'->tZ(ll) , 22-24 May 2018 , Hamburg, Germany;
2. Aniello Spiezia, “LQ3: top b tau nu”, CMS Exotica Workshop 2018 , 1-3 Nov 2018 , Greece;
3. Ahmad, “Zprime/Dark Photons (3L/4L)”, CMS Exotica Workshop 2018 , 1-3 Nov 2018 , Greece;
4. Hongbo Liao, “Top quark properties in ATLAS and CMS”, Blois2018, 3-8 Jun 2018 , Blois, France;
5. Feng Wang, “Detector performance studies for the CMS High Granularity Calorimeter”, ALCW2018, 28 May-1 Jun 2018, Fukuoka, Japan;
6. Huaqiao Zhang, “Status of CMS HGCal ”, CEPC 2018, 12-14 Nov 2018, IHEP, Beijing (China);
7. Junquan Tao, “Searches for light Higgs bosons at CMS”, HC 2018, 26-30 Nov 2018, Tokyo Japan;
8. Efe Yazgan, PEGCW-2018, 26-27 Nov 2018, CERN, Geneva, Switzerland;
9. Xudong Lyu, “VVV cascade decays”, CMS B2G Workshop 2018, 22-24 May 2018, Germany;
10. Geng Chen, “Angular analyses at CMS”, 4-Jul 2018, ICHEP2018, Korea;
11. Andrew Levin, “Multiboson production at CMS”, DIS2018, 16-Apr 2018, Japan;
12. Wenxing Fang, “Search for high mass resonances in the dileptonic channel”, BPS2018, 11-Apr 2018, Belgium.

中国组代表CMS在国际会议报告Poster 5个

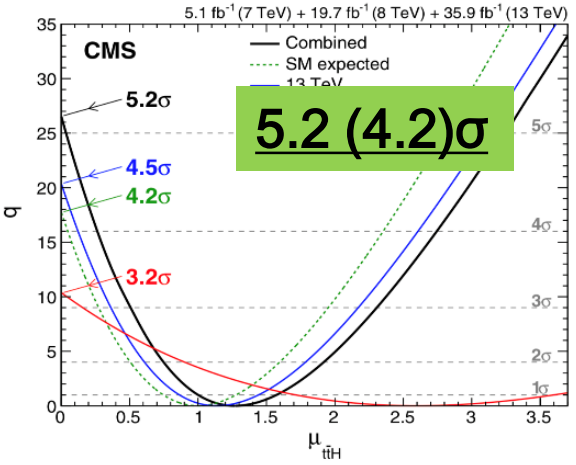
1. Joshuha Thomas-wilsker , ICHEP2018 , Performance Measurements of B-tagging Algorithms in CMS , 4-11 Jul 2018 , Seoul, Korea;
2. Zhen-An LIU, Data analysis to evaluate the CPPF system in CMS trigger phase-I upgrade, IEEE/NPSS Real Time Conference 2018, Williamsburg/USA, May 2018;
3. Huang Huang, “Search for heavy resonances decaying the Semileptonic WW channel”, Posters@LHCC, 18 Feb 2018;
4. Linwei Li, “Angular analysis of the decay B0→K*0μμ”, Posters@LHCC, 18 Feb 2018;
5. Xuyang Gao, "Search for high-mass resonances in the di-electron channel using the data collected by CMS in 2017". BPS2018, April 2018.

Highlight

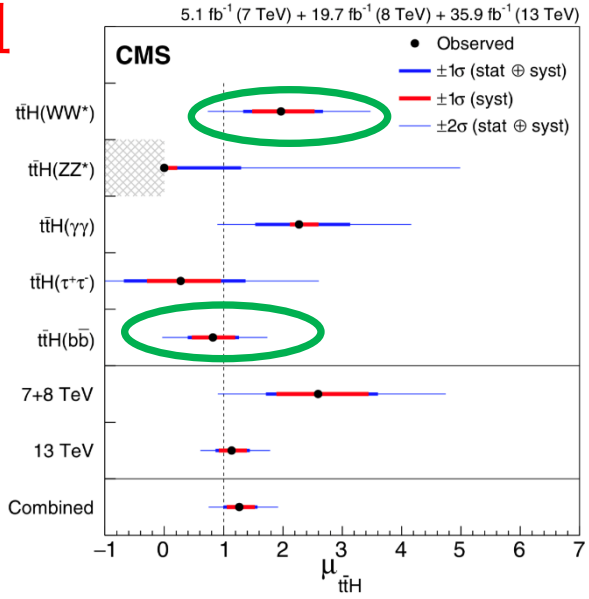
CMS实验发现ttH物理过程
高能所CMS组作出关键贡献

PRL 120, 231801 2018
JHEP 08 (2018) 066
arXiv:1804.03682

- 2018年6月4日，PRL以编辑推荐的方式发表了CMS合作组首次以5.2倍标准差发现ttH物理过程的文章。此项发现直接证明了希格斯粒子和顶夸克存在一种全新的汤川相互作用，对理解费米子的质量起源有着里程碑式的意义。



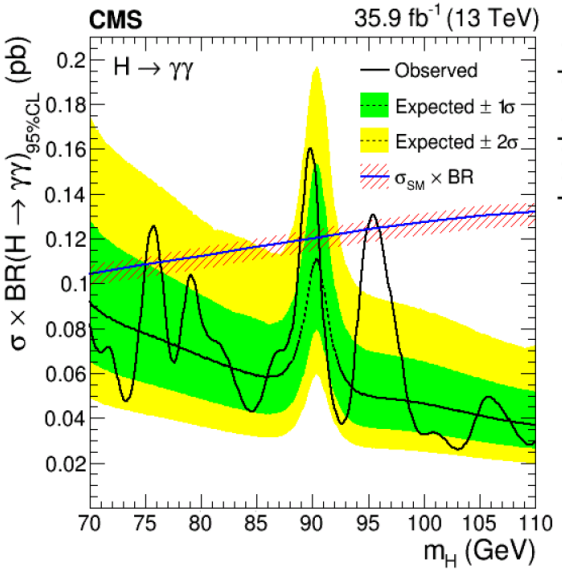
- 高能所CMS组在该项研究中最灵敏的ttHWW末态作出了关键性贡献并做合作组预审核报告，这些关键性贡献包括轻子孤立化方案，希格斯喷注识别方案，和希格斯质量重建方案。也是文章HWW部分的执笔人。(张华桥，Francesco，李秉桓)

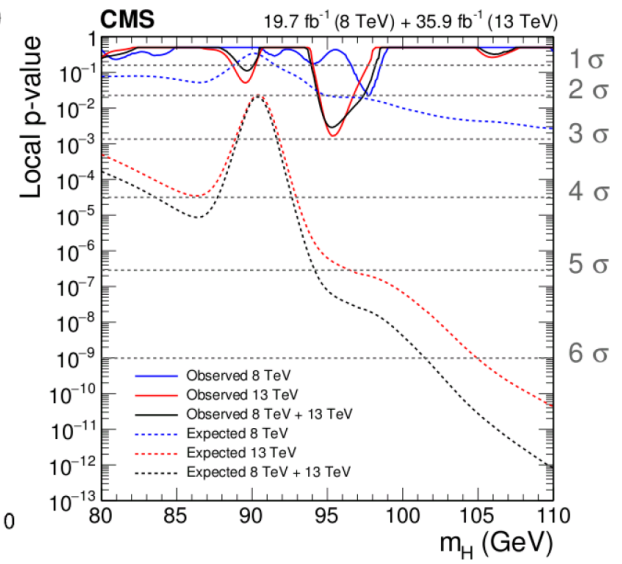


- 高能所组在ttHbb末态改进了事例中b喷注的识别，做出了重要贡献。（Aniello，Francesco，Joshuha，廖红波，张华桥）

寻找低质量额外希格斯h→γγ

- 高能所组利用13TeV 2016年的数据，开展低质量区间[70,110] GeV双光子末态的共振态的寻找
- 高能所组承担了大部分的研究内容，主导了2016年的数据分析
  - 陶军全做了该分析的全部重要报告，包括期望结果的预审核报告、数据结果的unblinding报告以及最终审核报告等
- 文章已提交PLB
  arXiv:1811.08459



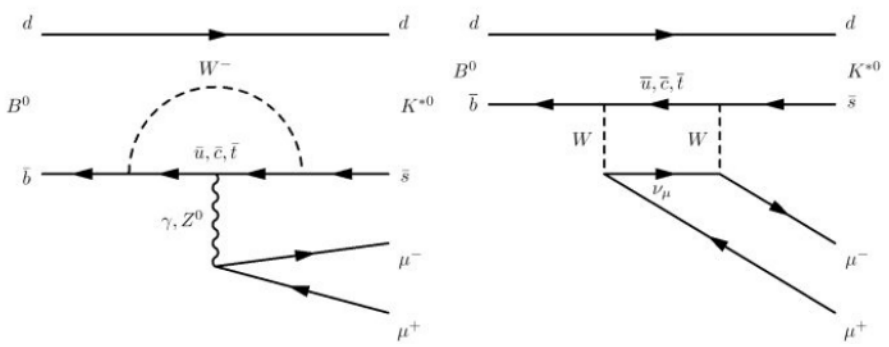


Run1+Run2联合测量得到的截面乘以衰变分支比相对于理论预言的比值的上限（左图）和信号显著性（右图）

2016年13TeV最大测量显著性为95.3GeV的2.9σ； 与2012年结果结合，最大观测显著性(右图中黑色实线)为95.3GeV处的2.8σ

对b → sμ⁺ μ⁻ 的测量和角度分析

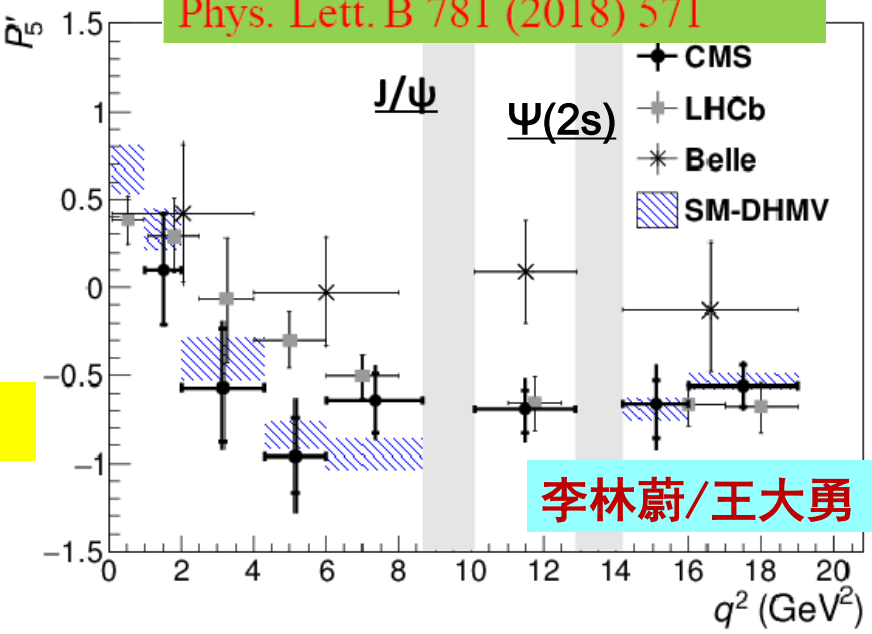
味道改变中性流过程对新物理极敏感



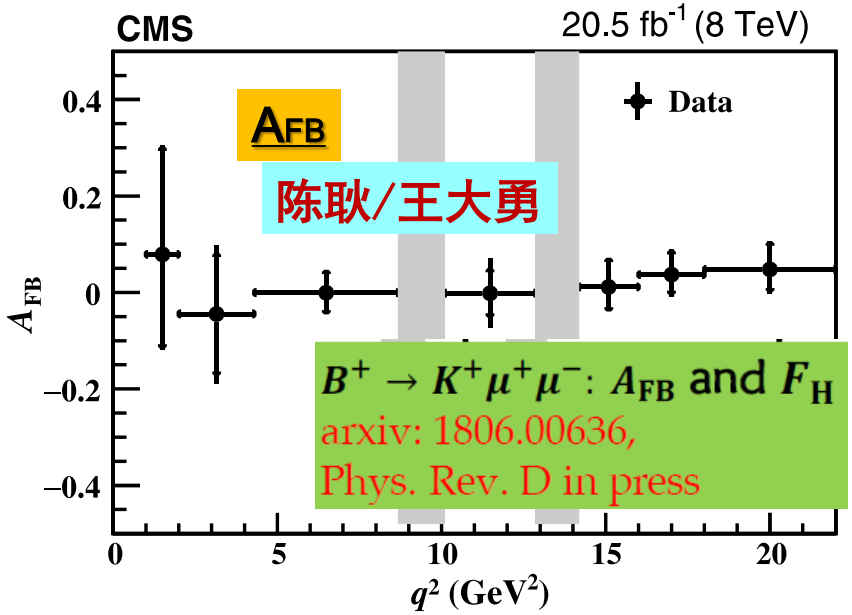
“B 介子反常”=> 多种新物理模型

$B^0 \to K^{*0}\,\mu^+\mu^-$: P_1 and P_5'

Phys. Lett. B 781 (2018) 571



李林蔚/王大勇



陈耿/王大勇

$B^+ \to K^+\mu^+\mu^-$: A_{FB} and F_H

arxiv: 1806.00636,

Phys. Rev. D in press

北大组在重要国际会议上的相关报告:

ICHEP2016 （口头报告）

LHCP2017 (1口头报告，1墙报）

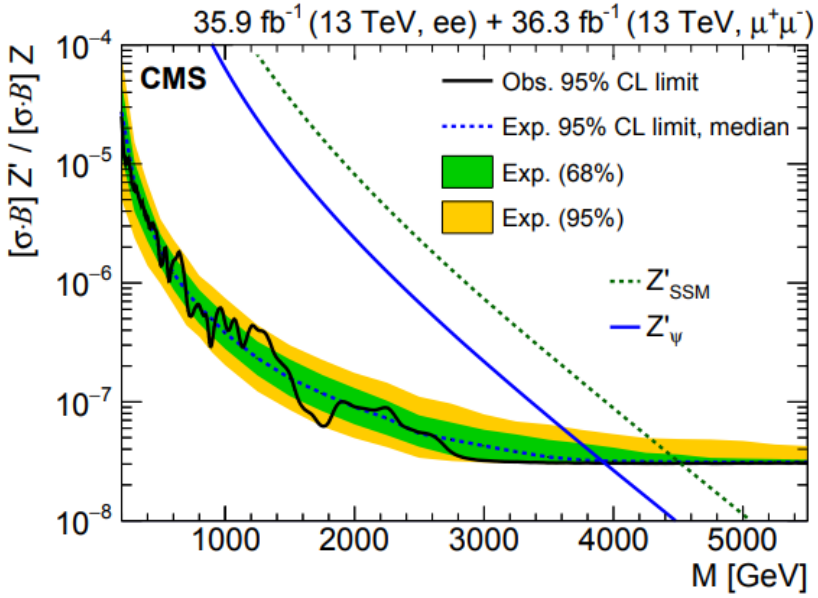
BEAUTY2018 （口头报告）

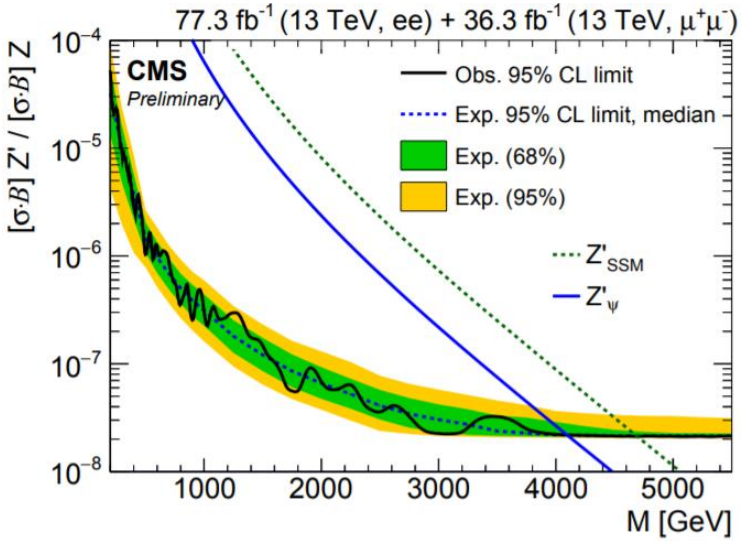
BEACH2018 （口头报告）

ICHEP2018 （口头报告）

Z’ 粒子的寻找

双轻子末态：寻找Z’粒子的黄金道。北航组成员方文兴，高旭阳自2015年加入CMS合作组即积极参与该分析，并作出主导性贡献：



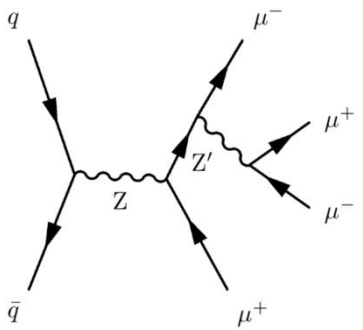


ee channel (2016 data + 2017 data) and μμ channel (2016 data):

2016年数据分析结果发表在
JHEP06（2018）120
北航CMS组给予审核报告

2017年数据分析结果发表在
CMS-EXO-18-006
北航CMS组给予审核报告
该结果是CMS合作组在Moriond2018会议公开的少数几个2017年数据分析结果之一

$L\mu$-$L\tau$ Z' 粒子寻找



- 寻找仅与缪子耦合的U'(1)规范玻色子：Z'新粒子
- 可提供对以下现象的解释：
  - LHCb实验Lepton Flavor Universality Violation异常
  - muon g-2 反常超出
  - 尚未直接探测到暗物质
- 高能所是分析联系及编辑人，并给了预审核报告
  - LHCP2018会议文集EXO-18-008，正式文章已提交EPJC,arXiv:1807.02810
- CMS新物理寻找中最先正式发表利用78/fb数据进行分析的物理结果

CERN Courier December 2018

News

CERNCOURIER

LHC EXPERIMENTS

CMS weighs in on flavour anomalies

Recent results from the LHCb and other experiments appear to challenge the assumption of lepton-flavour universality. To explore further, the CMS collaboration has recently conducted a new search probing one of the theories that attempts to explain these flavour "anomalies". Using 77.3 fb^{-1} of proton–proton collision data recorded in 2016 and 2017 at a centre-of-mass energy of 13 TeV, the CMS analysis is the first dedicated search for a neutral gauge boson with specific properties that couples only to leptons of the second and third family.

Although the Standard Model (SM) has been successful in describing current experimental results, it is generally believed to be incomplete. It cannot, for example, explain dark matter or the observed asymmetry between matter and antimatter in the universe. There are also several smaller differences between the experiment and the SM prediction that have been building up over the last few years. One set of intriguing anomalies has been reported by LHCb and other dedicated B-physics experiments, indicating a possible lepton-flavour universality violation in B-meson decays (*CERN Courier* April 2018 p23). Another is the long-standing tension in the measurement of the anomalous magnetic moment of the muon, for which an updated measurement is eagerly awaited (*CERN Courier* September 2018 p9).

One extension to the SM that has been proposed to explain these anomalies is an enlarged SM gauge group with an additional U(1) symmetry. Spontaneous breaking of this symmetry leads to the prediction of a new massive gauge boson, Z′. To keep the extended gauge symmetry free from quantum anomalies, only certain generation-dependent couplings are allowed. The model investigated by CMS promotes the difference in lepton numbers between the second and third generation to a local gauge symmetry, and until now has only been constrained slightly by experiment. Since the predicted Z′ boson only couples to second- and third-generation leptons, the only way to produce it at the LHC is as final-state radiation off one of these leptons. The ideal source of muons for the purposes of this search is the decay of the SM Z boson to two muons, which can be measured with excellent mass resolution (~1%) in CMS. If a Z′ boson exists, it will be radiated by one of the muons and decay subsequently to another pair of muons, leading to a final state with four muons.

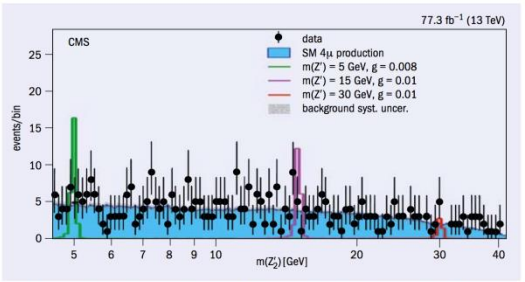


Fig. 1. The distribution of the opposite-sign muon pair with the lowest reconstructed invariant mass, m(Z_2'), for data (points), SM background (solid histogram) and a few examples of a potential Z′ signal (open, superimposed histograms).

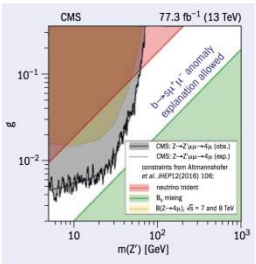


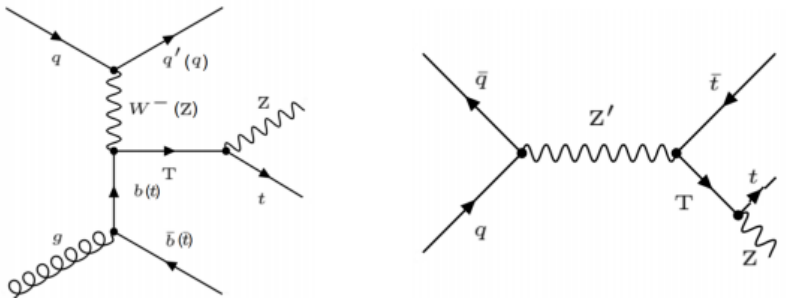
Fig. 2. The expected and observed limits at 95% confidence level on the gauge-coupling strength g as a function of the Z′ mass, and comparison with other experimental constraints. For comparison, the electroweak couplings g_{EW} and g'_{EW} are 0.6 and 0.3, respectively.

Such a final state is also produced by a rare SM Z-boson decay to four muons mediated by an off-shell photon. The first observation of this rare decay of the SM Z boson in proton–proton collisions was reported by CMS in 2012. In order to reduce this background, the search exploits the resonant character of the new gauge boson's di-muon decay. Events are selected that contain at least four muons with an invariant mass near the SM Z-boson mass. Di-muon candidates are then formed from muon pairs of opposite sign and a peak in their invariant mass distribution is sought, which would indicate the presence of a Z′ particle.

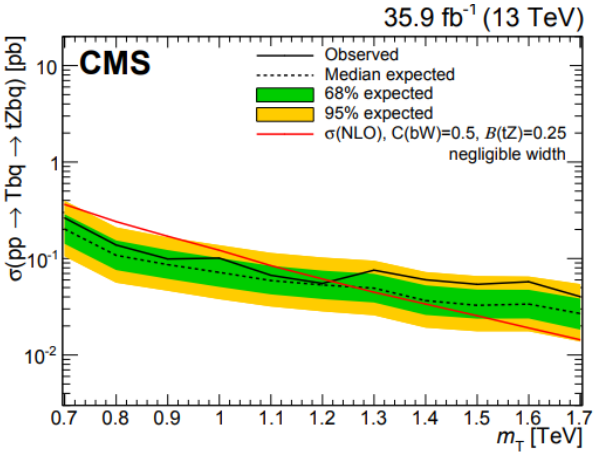
The event yields are found to be consistent with the SM predictions (figure 1). Upper limits of the order of 10^{-8}–10^{-7} are set on the branching fraction of a Z boson decaying to two muons and a Z′, with the latter also decaying into two muons, as a function of the Z′ mass. This can be interpreted as a limit on the Z′ particle's coupling strength to muons, and provides the first dedicated limits on these Z′ models at the LHC. Compared to other experiments and to indirect limits from the LHC obtained at lower centre-of-mass energies during Run 1, this search excludes a significant portion of parameter space favoured by the B-physics anomalies (figure 2). The analysis demonstrates the power and flexibility of the CMS experiment to adapt to and test new incoming physics models, which in turn react to previous experimental results, showing that experiments and theory go hand-in-hand.

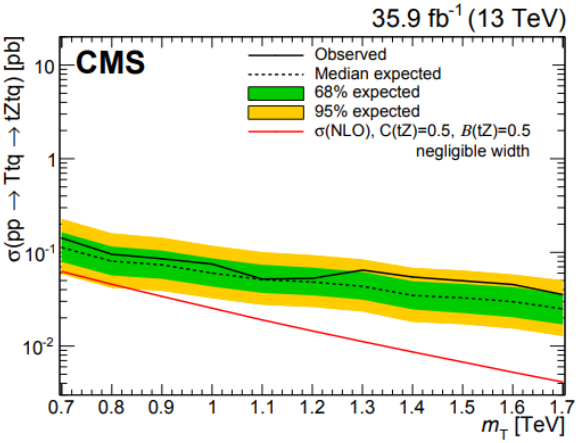
● **Further reading**
W Altmannshofer *et al.* 2016 *J. High Energy Phys.* **1612** 106.
CMS Collaboration 2018 arXiv:1808.03684.
CMS Collaboration 2012 *J. High Energy Phys.* **1212** 034.

寻找类矢量夸克 T'->tZ



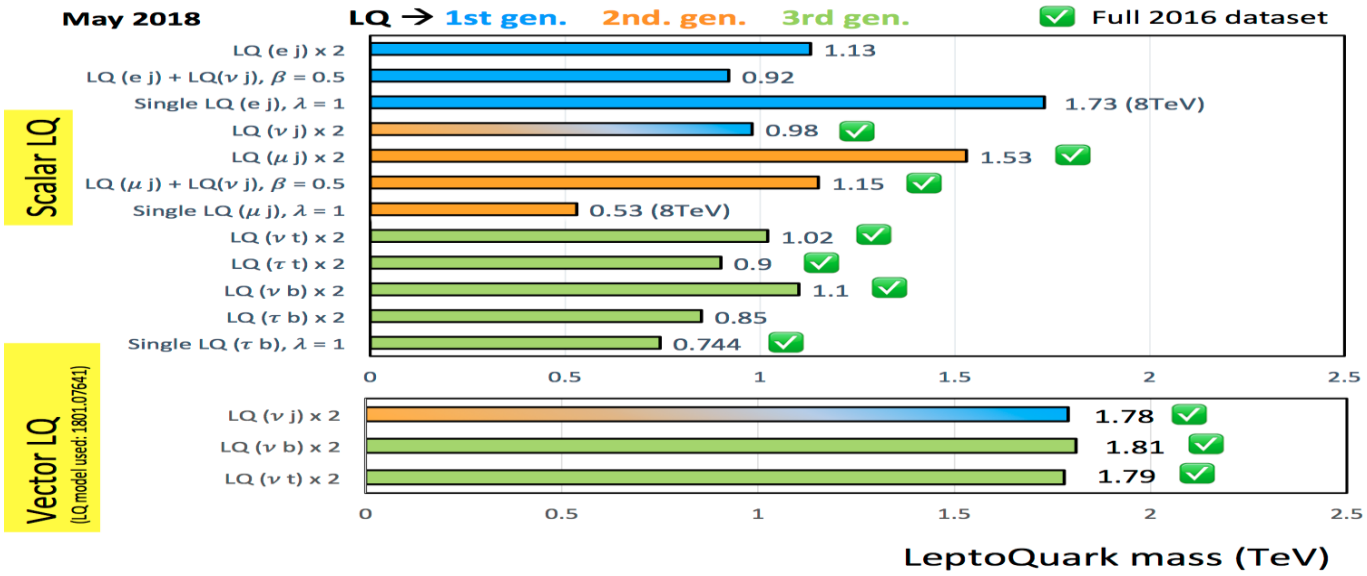
- ✓ 很多新物理模型，如复合希格斯模型等，同时预言了类矢量夸克的存在。
- ✓ 高能所独立完整地完成基于2016年13TeV数据的分析：在双轻子以及喷注末态中寻找单个产生的类矢量顶夸克
  - ✓担任分析联系人：
    Aniello Spiezia
  - ✓PAS和分析文档的编辑人:
    Aniello Spiezia, 廖红波;
  - ✓给予预审核和审核报告:
    Aniello Spiezia；
- ✓ 发表CMS-PAS-B2G-17-007及PLB 781(2018)574-600



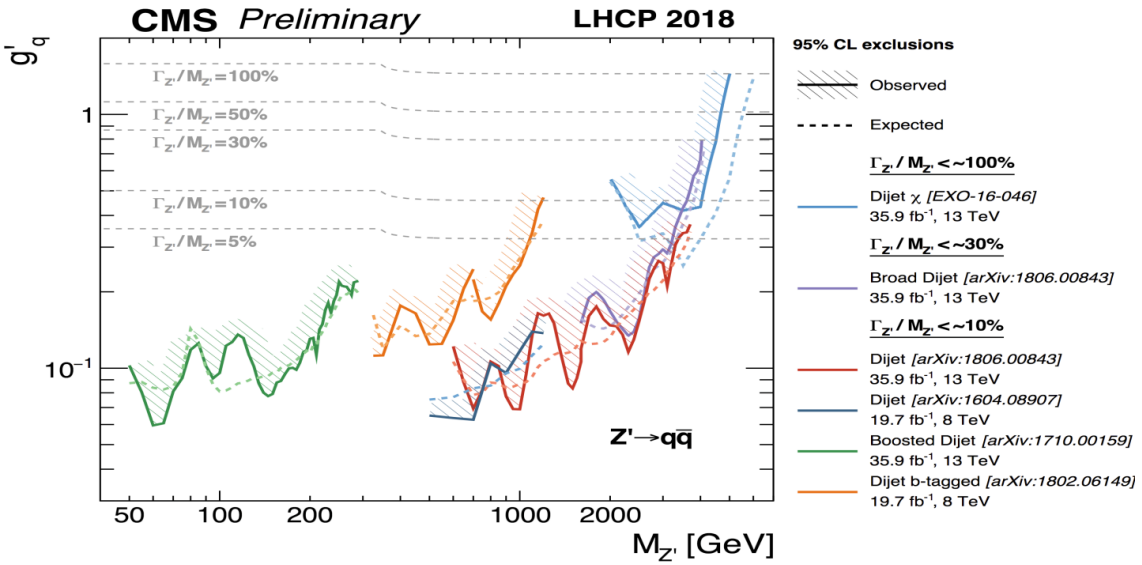


Jet+X末态新物理寻找Summary

高能所Francesco Romeo担任CMS Exotica物理组之下的Jets+X 组召集人

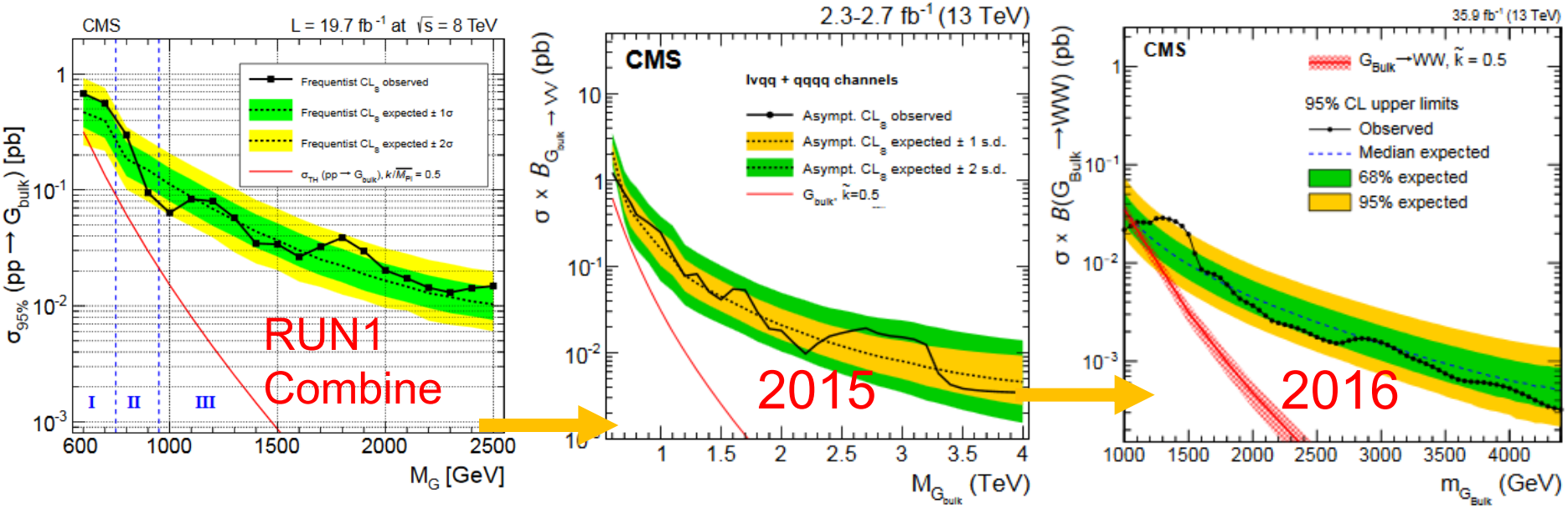


Dijet search summary plot



WW半轻道寻找共振态

北大组参与推动了CMS的Jet Substructure技术。对WW共振态进行重点寻找。博士生黄璜代表CMS组在2018年Moriond EWK会议上给予大会报告(Young Scientist Forum)。



JHEP 03 (2017) 162； Phys. Lett. B 774 (2017) 533； JHEP 05 (2018) 088

从左往右，可以看到我们的工作一方面使得对引力子的质量探寻范围扩展到了4.5TeV。此外，相关限制也大大增强。比如2TeV引力子产生截面（不包含G->WW分支比）的95%置信度上限被加强到约10fb。

任CMS实验二/三级管理职位任职统计表

物理分组（二级）	人员	管理级别	所属三级物理分组	下属人员数量	服务期限	平级管理人员数（共）
产生子组	Efe Yazgan	二级	-	50-60	2017.9-2019.9	2
产生子组	李强	二级	-	50-60	2018.9-2020.9	2
超2代物理分析组 B2G	Aniello Spiezia	三级	MC联络人	5-10	2017.3-2018.6	3
EXOTIC	Francesco	三级	Jets+X	20-30	2017.9-	2
LHC实验Higgs物理工作组	陈明水	三级	Higgs Properties	10-20	2016.1-2018.12	4
B2G	Aniello Spiezia	三级	Very Heavy Fermion	5-10	2018.7-	2
物理性能以及数据集 PPD	Ahmad Muhammad	三级	Validation	10-15	2017.12-	2-3
B-Tagging组	Joshuha Thomas-Wilsker	三级	Commissioning	10-20	2018.02-	2
希格斯物理组	陈晔	三级	触发组联络人	10-15	2016.09-2018.09	2
标准模型分析组	卢梦	三级	MC联络人	5-10	2017.4-	3

高能所担任CMS Analysis Review Committee 22人次

1. Efe TOP-16-016: “Search for standard model four-top-quark production at 13 TeV”
2. Efe FTR-16-006: “Prospects for Standard Model measurements the HL-LHC”
3. Efe SMP-16-018: “Measurement of electroweak production of two jets in association with a Z boson in proton-proton collisions at √s = 13 TeV”
4. Efe TOP-15-001: “Measurement of the top quark mass using single top quark events in proton-proton collisions at √s = 8 TeV”
5. Zhang huaqiao B2G-16-017 Search for W0 boson resonances decaying into a top quark and a bottom quark in the leptonic final state using data collected at p s = 13 TeV
6. Zhang Huaqiao B2G-16-016 Searches for W’ bosons decaying to a top quark and a bottom quark in proton-proton collisions at 13 TeV
7. Francesco EXO-16-006: Search for W’ decaying to tau lepton and neutrino in proton-proton collisions at √s=13 TeV
8. Francesco EXO-16-023: Search for third-generation scalar leptoquarks and heavy right-handed neutrinos in final states with two tau leptons and two jets in proton-proton collisions at √s = 13 TeV
9. Francesco EXO-16-045: Search for heavy neutrinos and W bosons with right handed couplings in proton-proton collisions at √s = 13 TeV
10. Francesco EXO-17-011: Search for a heavy right-handed W boson and heavy neutrino in the final state with two charged leptons and two jets at √s = 13 TeV
11. Francesco EXO-17-008: Search for high-mass resonances in tau+MET final state
12. Bian Jianguo BPH-16-001‘Observation of the Z0->llJ/ψ(+X) Decay Channel‘
13. Chen Ye HIG-17-008, Searches for H(bbar)H(2gamma) at sqrt(s)=13TeV with full 2016 dataset
14. Chen Mingshui CMS-EXO-16-046, Search for new physics with dijet angular distributions (dijet chi analysis).
15. Bian Jianguo BPH-14-008, 'Observation of Upsilon(1S) pair production in proton-proton collisions at sqrt(s) = 8 TeV', JHEP.
16. Zhang Huaqiao，B2G-15-004，Search for W'->tb in the semileptonic final state at sqrt(s)=13 TeV
17. Zhang Huaqiao，B2G-16-009，Search for Wprime->tb in the all-hadronic final state at sqrt(s)=13 TeV with the 2015 dataset
18. Francesco, SUS-18-001, LQ reinterpretation of MT2 (2016)
19. Efe, SMP-17-011, EW W+jets with 2016 13 TeV data
20. Efe, SMP-18-004, WW cross section
21. Efe, FTR-18-031, Projections of sensitivities for tttt production at HL-LHC and HE-LHC
22. Hongbo Liao, B2G-18-005, Search for Pair Production of Vector-Like T Quarks in the Fully Hadronic Channel

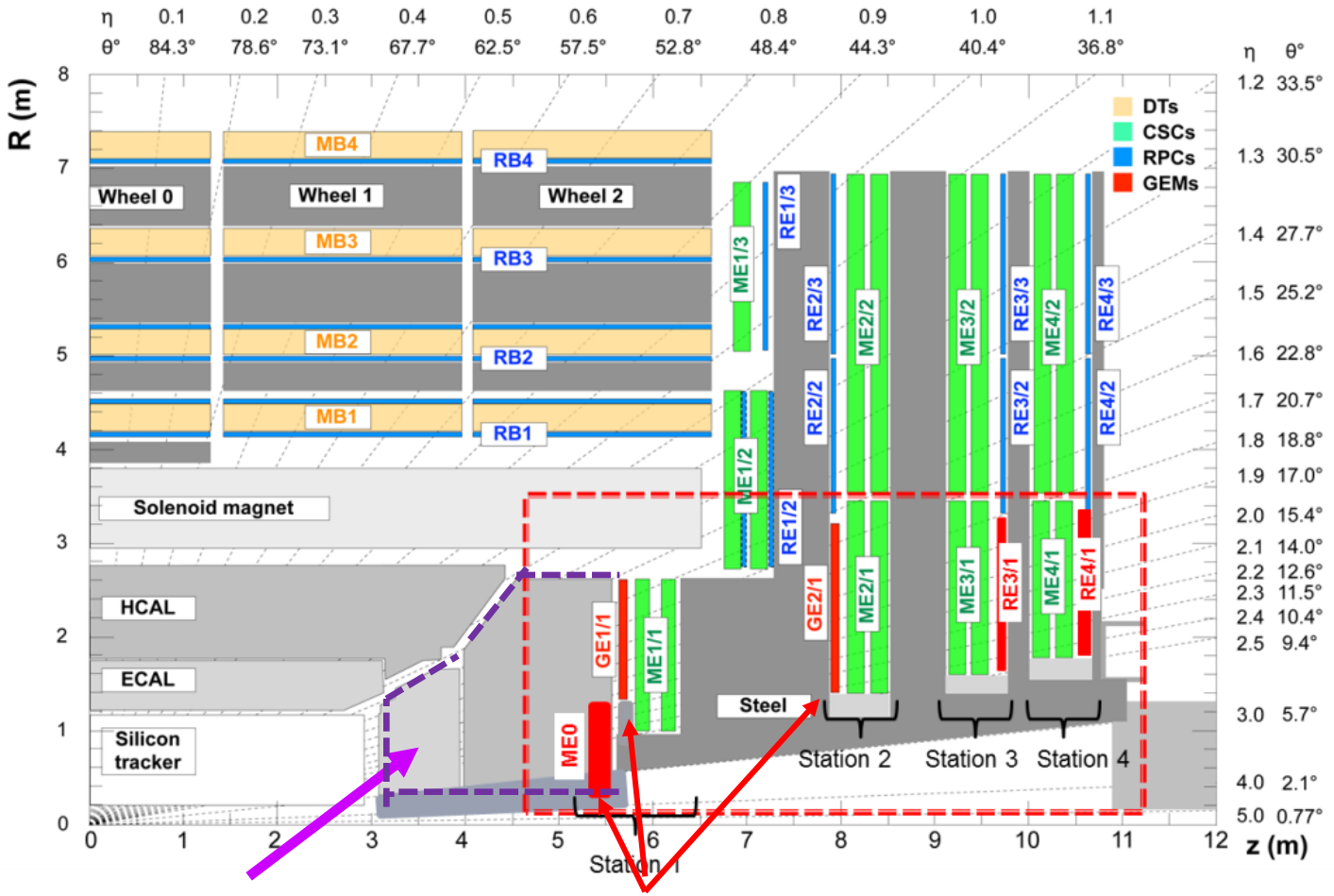
北大担任CMS Analysis Review Committee 5人次

1. Qiang Li, SMP-14-008, Prospects for the study of vector boson scattering in same sign WW and WZ interactions at the HL-LHC with the upgraded CMS detector
2. Qiang Li, HIG-16-042, Higgs to WW with 13TeV with full 2016 dataset
3. Qiang Li, HIG-17-033, High mass H -> WW with 2016 dataset
4. Dayong Wang, HIG-16-035, A search for BSM light bosons decaying into muon pairs with 13TeV data
5. Dayong Wang, HIN-18-003, Drell-Yan differential cross section measurements in pPb at 8.16 TeV in the muon channel

ARC对文章质量的提升起重要作用。多人次担任ARC说明我们在CMS的作用和影响有了提升

此外，高能所卞建国2018年获选担任
Thesis Award Committee Member

中国组拟承担CMS phase II 升级任务



端部量能器升级

高能所

端盖μ触发探测器升级

北京大学, GEM

缪子backend

电子学及触发 高能所

CMS 触发 进展

中国设计制造的CPPF系统

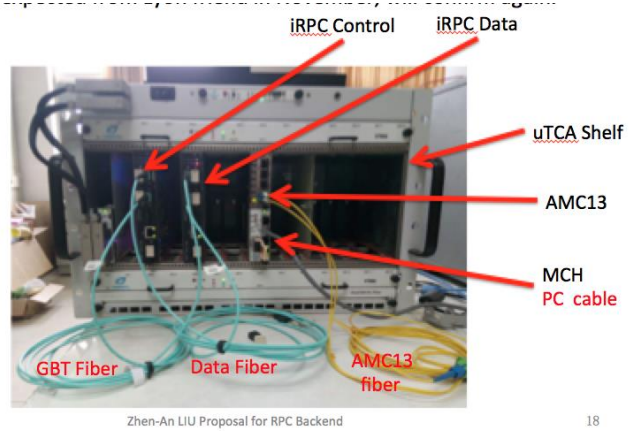
(1) CMS中国组研制建造了CMS L1触发系统缪子触发的第一层触发CPPF系统，2017年5月起正式取数运行。2018年负责多项重要任务，包括运行维护、软件开发等等：程立波、Ahmad、张思颖、曹鹏程、寇含君、唐光毅、陈明水、赵京周、刘振安。

(3) 缪子系统整体RPC后端系统的设计与建造

- CMS要求所有设计基于ATCA标准
- 高能所第一版ATCA样机已经完成设计与测试，并在CMS进行报告

进展

- 高能所方案已经在CMS合作中获得考虑
- 任务基本落实，双方负责人进行了任务沟通
- 正在落实造价与贡献
- 有望中方整体负责

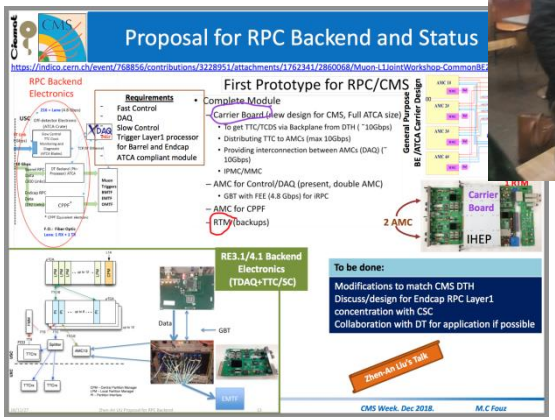


Zhen-An LIU Proposal for RPC Backend 18

(2)中方负责iRPC触发与后端读出的设计与建造（又一中方主导、具有显示度的工作），

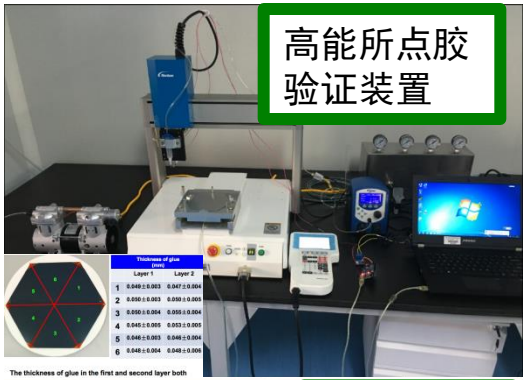
包括：layer1 触发、快控制（DTCS)、DAQ

- 在北京建立了开发与测试系统，并设计了原理样机
- 计划：2019年联调、2020小批量量产、配合探测器2020-2011年两次安装



高粒度量能器项目(HGC)进展

- CMS 确定HGC为CMS端盖量能器唯一正式方案（2015）
- 明确了高能所在CMS合作组中HGC项目任务
  - 硅传感器R&D，实验束和模拟研究，生产中心等
- 对华芯片禁运问题基本解决 (建立生产中心可行)
- 在高能所自主建造HGC模块组装系统，研究可行性
  - 160平米HGCal专用洁净间
- 多次到美国UCSB参与HGC模型样机的模块生产
- 11次参与HGC束流测试的准备，值班，数据分析
  - 主导HGC束流测试中MIP信号的分析 （TDR+JINST文章）
  - 计划2019年之后到高能所做实验束测试
- 科技部重点研发+高能所创新支持实验室(后续缺口大)



China-IHEP_Beijing in CMS-HGCAL Phase 2 Upgrades Project

Dear Huaqiao,

CMS has undertaken to upgrade its endcap calorimetry for Phase 2 of the LHC. The Project comprises around 50 Institutes from over 15 countries. The HGCAL project shall be submitting a Technical Design Report (TDR) in November 2017 to the LHCC, the scientific peer review committee of CERN.

The HGCAL Project would like to see the following contributions from the China-IHEP_Beijing Group (with an initial CORE contribution of 1.2 MCHF):

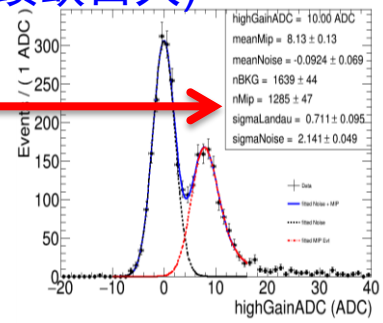
- Pro-rata (Si+Scint cost/total cost) Contribution to Active Elements
- Contribute to sensor R&D, qualification and testing
- Contribute to fe chips testing
- Contribute to testing of on-detector electronics boards (PCBs)
- Host a silicon module assembly centre
- Contribute to EC_ECAL and EC_Hadronic assembly and test
- Contribute to 2nd cassette assembly centre at CERN (collective responsibility)
- Contribute to the installation and cabling/services in UXC
- Contribute to simulation and performance studies
- Contribute to test beam activities

Please check that the list conforms to our mutual understanding.

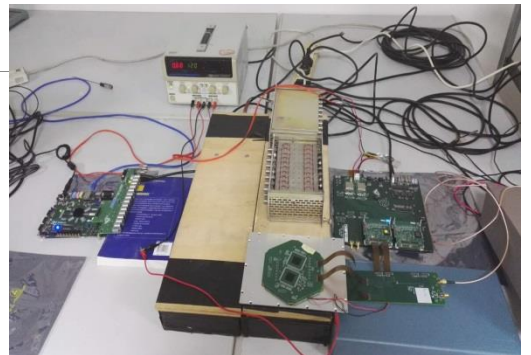
Yours sincerely,

任务书

首个MIP信号



在高能所运行的HGC
Cosmic-束流测试系统



CERN European Organization for Nuclear Research
Organisation européenne pour la recherche nucléaire

CERN-LHCC-2017-xxx
CMS-TDR-17-007
ISBN 978-92-9083-459-5
dd mmm 2017

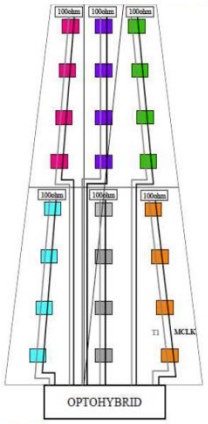
CMS

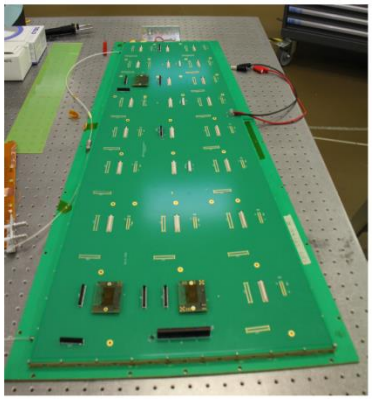
HGC TDR

CMS端盖μ子GEM探测器升级进展

第一站内圈GE1/1 前端电子学板GEB在中国的生产测试

- GE1/1（2017-2019）中GEB由北大组负责在中国深圳鑫诺捷公司的生产测试
- 开发了测试设备，2016年4月至今分别生产了五批共82套GEB并运到CERN，同时在CERN参加GE1/1探测器整体组装测试。

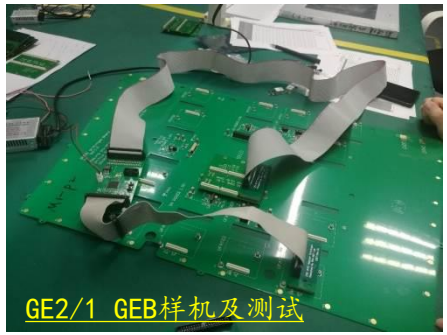




深圳鑫诺捷公司生产的GE1/1 GEB板及测试

第二站内圈GE2/1 GEB的设计研发

- 北大组负责GE2/1（2019-2022年）GEB的设计研发，共分成八块不同尺寸8层GEB板（M1-M8）。
- 至2018年12月完成了M1-M3设计，M1已生产出5块样机并成功进行了测试，M2样机目前正在生产。



GE2/1、ME0探测器生产基地之一作准备

- 改建实验室、洁净室，升级探测器生产质控设备
- 研制小尺寸探测器样机，设立组装测试流程及质控指标

在洁净室组装探测器样机

小结

- CMS中国组工作努力，尽管没有突破标准模型，仍然在希格斯性质测量、新粒子寻找、标准模型检验三方面取得一批很好的成果（如ttH的发现），发表了有我方贡献的CMS文章36篇 。
- 队伍稳中前进：在2018年，10余位 2/3级召集人；8位分析负责人。 欢迎更多单位加入CMS组！
- Phase-2 R&D多项工作，目前进展良好。由于phase-1的升级任务已经完成，建议基金委尽快启动phase-2升级项目，以便赶上CMS的步伐。

感谢基金委、科技部、科学院和兄弟单位长期大力支持！

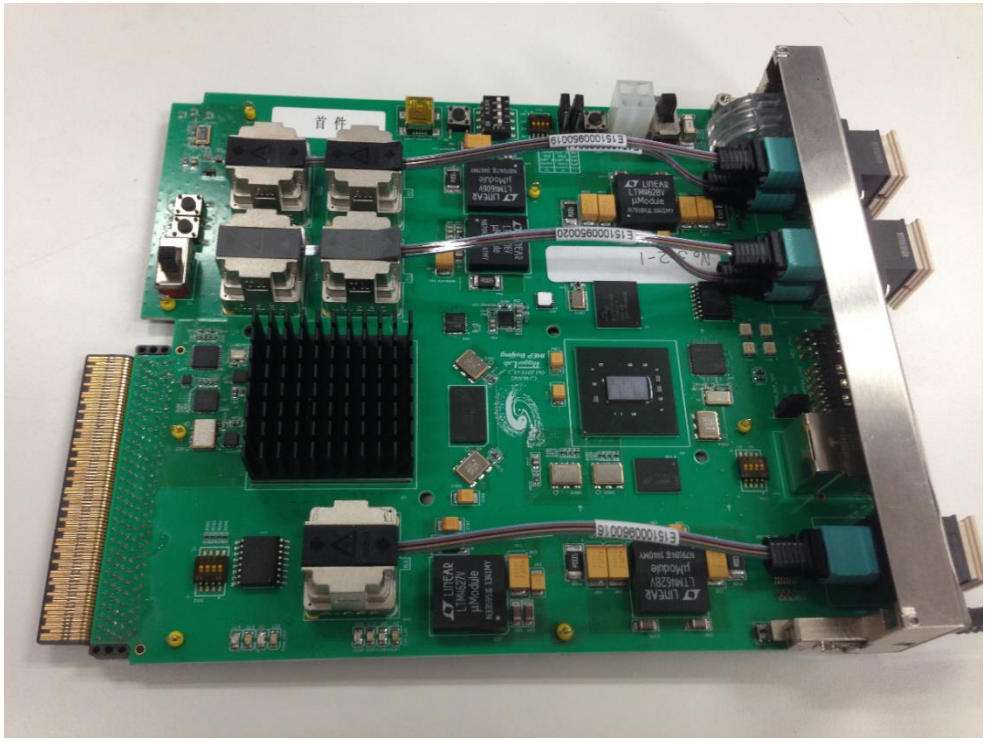
请大家指正！

高能所完成CMS Phase-1 L1触发CPPF系统研制

CPPF（Concentration，Pre-Processing and Fan-out）

世界上同类产品中传输速率与处理速度最快的系统

- 10Gb每秒*12路*3座=360Gb每秒的同步处理输出能力



CMS中国组完成phase-1升级任务

- 参加端盖缪子触发探测器RPC第4站的建造

  2008—2015，基金委专项经费支持

  得到承认的贡献 500kCHF

- 参加端盖缪子探测器CSC第4站的建造

  2010—2015，基金委支持

  得到承认的贡献 300kCHF

- 承担L1触发CPPF系统的建造

  2013—2017，基金委支持

  得到承认的贡献 326kCHF

一共1126kCHF，占整个CMS phase-1的 1.6%